How to Identify and Measure Pipe Fittings & Pipe

Before making a connection you'll need to know the thread type and the pipe size or thread size. The thread types must be compatible, and the sizes must be the same in order for two components to mate properly.

Pipe Size and Thread Size

Pipe size is not an actual measured size, but rather an industry designation. People sometimes refer to pipe size as IPS or nominal size. Thread types that are measured by pipe size include NPT, BSP, and NPSM threads. Unthreaded fittings are also measured by pipe size.

Thread size is the actual measured diameter of the threads and the threads per inch (TPI) or thread pitch. Thread types that are measured by thread size include UN/UNF (SAE) and metric threads.

Thread Style

Tapered thread types include NPT, NPTF, and BSPT.

Straight thread types include BSPP, UN/UNF (SAE), NPSM, NPSL, NPSC, and metric straight threads. Male threads typically have an O-ring or gasket to make a seal.

Tapered Straight

Thread Compatibility

Use this thread compatibility chart to see which threads will mate together. Metric threads, UN/UNF (SAE) threads, GHT (Garden Hose) threads, and NH/NST (National Hose/National Standard) threads are not compatible with any other thread types.

	Thread Type (M = male; F = female)		NPT M	NPT F	NPTF M	NPTF F	BSPT M	BSPT F	JIS Taper M	JIS Taper F	BSPP M	BSPP F	JIS Straight M	JIS Straight F	NPSM M	NPSM F	NPSL M	NPSL F	NPSC M	NPSC F	NPSH M	NPSH F
Tapered Threads	**NPT**—National Pipe Taper (Also known as MPT and FPT threads)	M		✓		✓										✓		✓		✓		✓
		F	✓		✓																	
	NPTF—National Pipe Taper Fuel (Also known as Dryseal threads)	M		✓		✓										✓						✓
		F	✓		✓																	
	BSPT—British Standard Pipe Taper (Also known as R threads and 55 Whitworth)	M						✓		✓		✓										
		F					✓		✓													
	JIS Taper—Japanese Industrial Standard (Also known as PT threads)	M						✓		✓												
		F					✓		✓													
Straight Threads	**BSPP**—British Standard Pipe Parallel (Also known as G threads and 55 Whitworth)	M										✓		✓								
		F					✓				✓		✓									
	JIS Straight—Japanese Industrial Standard (Also known as PF threads)	M										✓		✓								
		F									✓		✓									
	NPSM—National Pipe Straight Mechanical	M														✓						✓
		F	✓		✓										✓							
	NPSL—National Pipe Straight Locknut	M																				
		F	✓																			
	NPSC—National Pipe Straight Coupling	M																				
		F	✓																			
	NPSH—National Pipe Straight Hose	M																				✓
		F	✓		✓										✓						✓	

Measuring Gauges and Kits

Accurately determine the size of your fittings and pipe with one of these kits. For more gauges, see pages 2324-2326.

Pipe Thread and Thread Pitch Identifiers

In addition to measuring male and female threads in NPT and BSPT pipe sizes 1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, and 2, use the two included gauges for measuring thread pitch.

5887T1 ..... $8.13

Thread Identifier Sets

Set includes calipers, four gauges, and an instruction book to identify male and female NPT, BSPT, BSPP, and metric threads.

7863K1 ..... $57.04

Pipe Size Measuring Kits

Kits contain 304 stainless steel 90° male x female elbows so you can determine the size of a fitting or pipe without measuring.

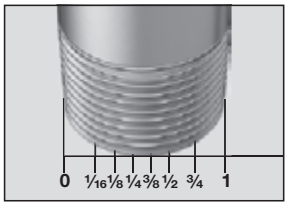
No. of Pieces	Pipe Size	NPT Kits		BSPT Kits	
6	1/8, 1/4, 3/8, 1/2, 3/4, 1	7843K5	$22.33	7843K7	$24.14
9	1/8, 1/4, 3/8, 1/2, 3/4, 1, 1 1/4, 1 1/2, 2	7843K6	64.17	7843K8	69.31

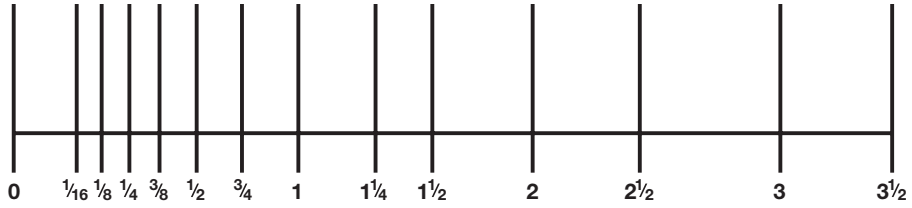
How to Measure Pipe Size for NPT or BSP Threads

Align your pipe or fitting with the "0" line as shown below. The line on the opposite edge gives the pipe size.

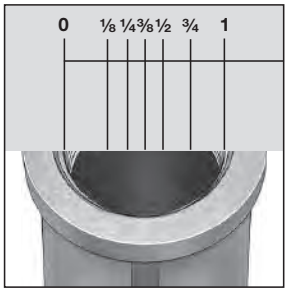
ⓘ To measure larger pipe and fittings up to pipe size 8, go to mcmaster.com and search for **4464KAC**.

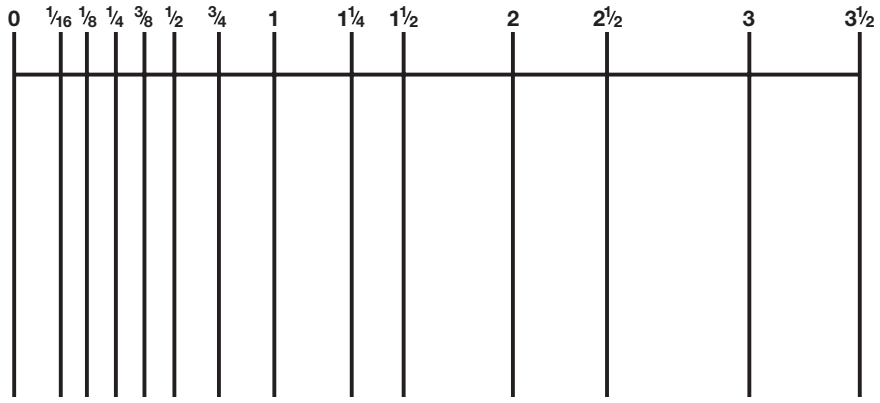
Measuring OD of Male Threads





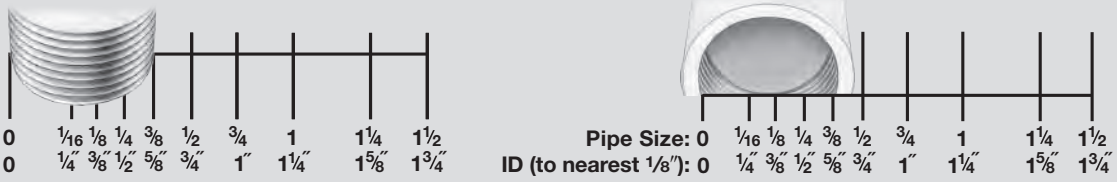
Measuring ID of Female Threads





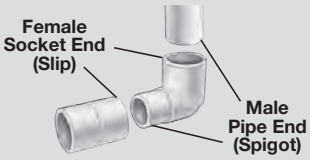
How to Measure Threaded Pipe and Fittings—*Example shows pipe size 3/8.*

Pipe size is an industry designation, not the actual size. Place your pipe or fitting on the scale to determine the pipe size. You can also measure the outside diameter (OD) of your pipe or inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.



To measure larger pipe sizes, go to mcmaster.com and search for **4464KAC**. For information about fittings and pipe, see pgs. 2-3.

About Plastic Pipe Fittings and Pipe



Unthreaded pipe fittings generally come with either a female socket end (slip) or a male pipe end (spigot) connection.

Both primer and cement (sold on page 3558) are required to connect unthreaded plastic pipe fittings to pipe. After applying the primer and cement, slide the pipe end into the socket end.

Plastic pipe fittings are not rated for pressure; however, you can use the pressure rating for the plastic pipe as a reference.

Applications	Fittings	Pages
Cold Drinking Water	Standard-Wall White PVC	112-114
	Thick-Wall Dark Gray PVC	118-119, 122-123
Cold and Hot Drinking Water	Thick-Wall Light Gray CPVC	126-129
Water Drainage	Drain, Waste, and Vent Standard-Wall White PVC	115-116
Gasoline	High-Strength White Nylon	125
Chemicals	Thick-Wall Black Polypropylene	130
	Chemical-Resistant Thick-Wall Red PVDF	132
	Corrosion-Resistant Thick-Wall White PFA	132-133
High Temperatures	High-Temperature Thick-Wall White PTFE	133
Outdoor Use	UV-Resistant Standard-Wall PVC	111

Warning: Never use plastic pipe fittings and pipe with compressed air or gas.

UV-Resistant Standard-Wall PVC Pipe Fittings and Pipe

Pipe Fittings:
- Meet NSF/ANSI 61 Standard for use with drinking (potable) water
- Maximum Temperature: 140° F

Pipe:
- Use with water; does not meet NSF/ANSI Standard 61
- Maximum Temperature: 140° F

Go ahead and use these Schedule 40 pipe fittings and pipe outdoors—the PVC has an additive that protects it from the damaging effects of ultraviolet light. PVC is rigid and corrosion resistant; it is the most popular choice for low-pressure plumbing applications.

Fittings meet ASTM D2466.

Pipe meets ASTM D1784.

Connections: Fittings are unthreaded socket end (female), unthreaded pipe end (male), or threaded (NPT); pipe is unthreaded. Connect unthreaded fittings to pipe using a PVC primer and cement (see series 74605A on page 3558).

Unthreaded Socket End (Female)—Beige

Pipe Size	90° Elbows		45° Elbows		Tees		Couplings	
1/2	4738T11	$2.27	4738T21	$3.16	4738T31	$2.84	4738T41	$2.36
3/4	4738T12	2.84	4738T22	4.11	4738T32	3.35	4738T42	3.16
1	4738T13	4.74	4738T23	4.94	4738T33	6.64	4738T43	4.74
1 1/2	4738T14	10.25	4738T24	9.65	4738T34	13.14	4738T44	7.28
2	4738T15	14.22	4738T25	13.77	4738T35	17.40	4738T45	11.06

Male to Unthreaded Socket End (Female)—Beige

Reducing Bushings, Pipe End (A) x Socket End (B)

Pipe Size (A)	Pipe Size (B)		
3/4	1/2	4738T51	$2.50
1	3/4	4738T53	3.60
1 1/2	1	4738T55	6.18
2	1	4738T56	7.60
2	1 1/2	4738T57	7.60

Adapters, Threaded x Socket End

Pipe Size		
3/4	4738T82	$2.50
1	4738T83	3.16
1 1/2	4738T84	5.37
2	4738T85	8.70

Unthreaded Pipe—Black

Pipe Size	Max. psi @ 72° F	5 ft.		10 ft.	
1/2	300	5065K32	$18.93	5065K35	$35.72
3/4	240	5065K33	25.37	5065K36	47.87
1	220	5065K34	37.68	5065K37	71.09
1 1/2	170	5065K38	60.90	5065K41	114.92
2	140	5065K39	82.19	5065K42	147.31

Cut-to-Angle Standard-Wall White PVC Unthreaded Pipe Elbows

- Use with water
- Maximum Temperature: 140° F
- Pipe: Use unthreaded Schedule 40 standard-wall white PVC (see page 114)

These two-piece elbows can be cut to any angle you need, so you'll always have the right one on hand. They have molded cutting guides at 22 1/2°, 33 3/4°, 45°, 56 1/4°, 67 1/2°, 78 3/4°, and 90° angles; they also come with a template for custom angles. After cutting, bond the removable socket end to the cut piece with a PVC primer and cement (see series 74605A on page 3558). Elbows are PVC, which is strong and corrosion resistant. They meet ASTM D2466.

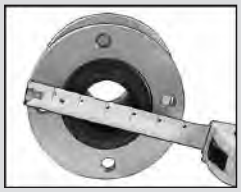
Connections: Socket end (female).

Pipe Size		
1 1/2	4747T11	$5.35
2	4747T12	6.71
3	4747T13	18.88
4	4747T14	24.69

About Expansion Joints

Reduce stress, vibration, and noise in piping systems by providing a point of flexibility to absorb movement.

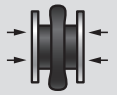
How to Measure Your Expansion Joint: If you are replacing an existing expansion joint in your piping system and do not know the pipe size you need, there are two methods for determining size.



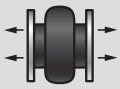
First, look for an etched stamp on the edge of the flange that indicates pipe size. If etching is unreadable, use the second method—measure the outside diameter of the flange and match it to the Flange OD specification in the table. Each pipe size has a standard flange OD. The example shows a 6″ flange OD, which corresponds to a pipe size 2.

If you do not have a flange on your existing joint, measure the outside diameter of your pipe and match it to the For Pipe OD specification listed in the tables.

Expansion Joint Movement: Expansion joints are rated for three types of movement; however, they can only move one way at a time. For example, if the expansion joint has moved to an offset position, it must go back to its original position before it can compress or expand.



Compress is when the distance between the connections is shortened.



Expand is when the distance between the connections is lengthened

Offset is the distance when connections are moved off center.

Expansion Joints with Easy-Align Flanged Ends

Standard

High Vibration

General Purpose Neoprene:
- Use with water, grain alcohol, non-abrasive slurry
- Temperature Range: –10° to 225°F
- Maximum Pressure: 225 psi @ 72°F
- Vacuum: 26″ Hg @ 72°F

High-Temperature EPDM:
- Use with water, alcohol
- Temperature Range: –20° to 250°F
- Maximum Pressure: 225 psi @ 72°F
- Vacuum: 26″ Hg @ 72°F

The flanged ends on these expansion joints rotate for easy bolt hole alignment during installation. The flanges are made of zinc-plated steel; they'll mate with a same-size flat-surface Class 150 flange without the need for a gasket. All have a flexible neoprene or EPDM body that's nylon-reinforced for added strength.

Standard joints have a single-bulb design, which is the most popular.

High-vibration joints have a double-bulb design, which handles more vibration and movement than standard joints.

Flange OD	Pipe Size	O'all Lg.	Maximum Movement: Compress	Expand	Offset	No. of Bolt Holes	General Purpose Neoprene with Threaded Bolt Holes: Bolt Hole Size			General Purpose Neoprene with Unthreaded Bolt Holes: Bolt Hole Size			High-Temperature EPDM with Unthreaded Bolt Holes: Bolt Hole Size		
Standard															
5″	1½	6″	½″	⅜″	½″	4	½″-13	9175K32	$56.00	⅝″	9175K13	$46.88	⅝″	9175K52	$56.00
6″	2	6″	½″	⅜″	½″	4	⅝″-11	9175K33	56.00	¾″	9175K14	55.94	¾″	9175K53	56.00
7″	2½	6″	½″	⅜″	½″	4	⅝″-11	9175K34	74.00	¾″	9175K15	72.54	¾″	9175K54	74.00
7½″	3	6″	½″	⅜″	½″	4	⅝″-11	9175K35	82.00	¾″	9175K16	89.38	¾″	9175K55	82.00
9″	4	6″	¾″	½″	½″	8	⅝″-11	9175K36	102.00	¾″	9175K17	109.58	¾″	9175K56	102.00
10″	5	6″	¾″	½″	½″	8	¾″-10	9175K37	118.00	⅞″	9175K18	142.40	⅞″	9175K57	118.00
11″	6	6″	¾″	½″	½″	8	¾″-10	9175K38	156.00	⅞″	9175K19	180.00	⅞″	9175K58	156.00
13½″	8	6″	¾″	½″	½″	8	¾″-10	9175K39	224.00	⅞″	9175K23	265.73	⅞″	9175K59	224.00
16″	10	8″	1″	⅝″	¾″	12	⅞″-9	9175K21	292.45	1″	9175K24	359.50	1″	9175K61	310.00
19″	12	8″	1″	⅝″	¾″	12	⅞″-9	9175K22	358.93	1″	9175K25	516.10	1″	9175K62	402.75
High Vibration															
5″	1½	7″	2″	1 3⁄16″	1¾″	4	½″-13	6819K61	68.75	⅝″	6819K26	72.45	⅝″	6819K81	68.75
6″	2	7″	2″	1 3⁄16″	1¾″	4	⅝″-11	6819K62	77.08	¾″	6819K27	96.58	¾″	6819K82	77.08
7″	2½	7″	2″	1 3⁄16″	1¾″	4	⅝″-11	6819K63	95.83	¾″	6819K28	104.87	¾″	6819K83	95.83
7½″	3	7″	2″	1 3⁄16″	1¾″	4	⅝″-11	6819K64	110.42	¾″	6819K29	131.97	¾″	6819K84	110.42
9″	4	9″	2″	1⅜″	1 9⁄16″	8	⅝″-11	6819K65	150.00	¾″	6819K31	167.50	¾″	6819K85	150.00
10″	5	9″	2″	1⅜″	1 9⁄16″	8	¾″-10	6819K66	177.08	⅞″	6819K52	231.84	⅞″	6819K86	177.08
11″	6	9″	2″	1⅜″	1 9⁄16″	8	¾″-10	6819K67	245.83	⅞″	6819K53	283.82	⅞″	6819K87	245.83
13½″	8	13″	2⅜″	1⅜″	1⅜″	8	¾″-10	6819K68	347.92	⅞″	6819K54	369.24	⅞″	6819K88	347.92
16″	10	13″	2⅜″	1⅜″	1⅜″	12	⅞″-9	6819K69	426.92	1″	6819K55	476.79	1″	6819K89	426.92
19″	12	13″	2⅜″	1⅜″	1⅜″	12	⅞″-9	6819K71	566.67	1″	6819K56	623.67	1″	6819K91	566.67

Expansion Joints with Sealing Flanged Ends

Grease-Resistant Neoprene w/Buna-N Liner:
- Use with grease, water, ethylene glycol, hydraulic fluid
- Temp. Range: –65° to 225°F
- Max. Pressure: 210 psi @72°F
- Vacuum: 30″ Hg @ 72°F

General Purpose Neoprene:
- Use with water, grain alcohol, non-abrasive slurry
- Temp. Range: –20° to 225°F
- Max. Pressure: 190 psi @ 72°F
- Vacuum: 26″ Hg @ 72°F

Easy-Flex EPDM:
- Use with water, alcohol
- Temp. Range: –20° to 250°F
- Max. Pressure: 225 psi @ 72°F
- Vacuum: 24″ Hg @ 72°F

You'll get a tighter seal than with other expansion joints because the flanges on these are molded into the body for a wide sealing surface. Each flange is supported by a zinc-plated steel split-ring backup plate. Flanges will mate with a same-size Class 150 flange. The joint bodies have a single-bulb design.

Grease-resistant neoprene with Buna-N liner and **general purpose neoprene** joints are for use on metal pipe systems. The body is reinforced with cord for added strength.

Easy-flex EPDM joints are specially designed for use on plastic pipe systems. They have a softer construction that takes less force to move than joints for metal pipe systems.

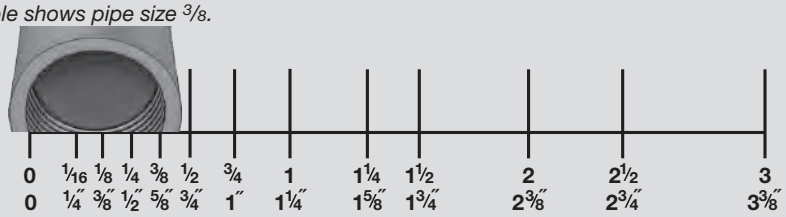
Flange OD	Pipe Size	O'all Lg.	Unthreaded Bolt Holes: No.	Size	Maximum Movement: Compress	Expand	Offset	Grease-Resistant Neoprene/Buna-N		General Purpose Neoprene		Easy-Flex EPDM	
5″	1½	6″	4	⅝″	1¼″	⅝″	9⁄16″					4528K41	$242.31
6″	2	6″	4	¾″	1¼″	⅝″	9⁄16″	4528K52	$165.38	4528K82	$253.85	4528K42	253.85
7″	2½	6″	4	¾″	1¼″	⅝″	9⁄16″	4528K53	201.92	4528K83	263.46	4528K43	263.46
7½″	3	6″	4	¾″	1¼″	⅝″	9⁄16″	4528K54	232.69	4528K84	265.38	4528K44	265.38
9″	4	6″	8	¾″	1¼″	⅝″	9⁄16″	4528K55	299.97	4528K85	321.15	4528K45	321.15
10″	5	6″	8	⅞″	1¼″	⅝″	9⁄16″	4528K56	338.46	4528K86	388.46		
11″	6	6″	8	⅞″	1¼″	⅝″	9⁄16″	4528K57	409.62	4528K87	421.15	4528K46	415.38
13½″	8	6″	8	⅞″	1¼″	⅝″	9⁄16″	4528K58	492.73	4528K88	536.84	4528K47	494.74

Through-Wall Fittings

For technical drawings and 3-D models, go to mcmaster.com.

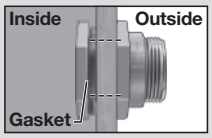
How to Measure Female Threaded Fittings—*Example shows pipe size 3/8.*

Pipe size is an industry designation, not the actual size. Place your female threaded fitting on the scale to determine the pipe size. You can also measure the inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.



Pipe Size:	0	1/16	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
ID (to nearest 1/8″):	0	1/4″	3/8″	1/2″	5/8″	3/4″	1″	1 1/4″	1 5/8″	1 3/4″	2 3/8″	2 3/4″	3 3/8″

To measure larger pipe sizes, go to mcmaster.com and search for **4464KAC**. For information about fittings and pipe, see pgs. 2-3.



About Through-Wall Fittings

Through-wall fittings, also known as bulkhead fittings, allow you to make inlets and outlets in walls, tanks, and panels for faucets, pipes, and spigots. To install in a tank, first depressurize and drain the tank. Cut a hole, then slide the fitting into the hole from the inside of the tank, and tighten the nut from the outside. If the fitting has a gasket, it should be on the inside of the tank.

Through-Wall Fittings

PVC

Cold Water PVC:
- Temp. Range: 40° to 140° F

Hot Water CPVC:
- Temp. Range: 40° to 180° F

Chemical-Resistant Polypropylene:
- Use with hydrochloric and phosphoric acid
- Temp. Range: 40° to 180° F

Oil-Resistant Polyethylene:
- Use with water, ethylene glycol, hydraulic oil
- Temp. Range: –20° to 140° F

High-Temperature PTFE:
- Use with oil, gasoline, diesel
- Temp. Range: –75° to 400° F

Corrosion-Resistant Type 316 Stainless Steel:
- Use with water (not rated for steam)
- Temp. Range: –20° to 300° F

Mount these fittings through a hole in your wall, tank, or panel to serve as an inlet or outlet for faucets, pipes, and spigots. They're for use on curved and flat surfaces. Each comes with an EPDM gasket, except the PTFE fittings have an FEP-encapsulated silicone O-ring. They are vacuum rated to 29″ Hg @ 72° F, except polyethylene and Type 316 stainless steel are not rated for vacuum.

Connections: NPT threaded or unthreaded socket end (female).

Pipe Size	Wall Requirements: Hole Size	Wall Requirements: Max. Thick.	Lg.	Max. psi @ 72° F		
NPT Threaded Female on Both Ends						
Cold Water PVC—Dark gray						
1/2	1 3/8″	1 1/16″	2 3/4″	150	36895K161	$19.74
1/2	1 3/8″	2 1/16″	3 3/4″	150	36895K121	19.26
3/4	1 5/8″	1 1/16″	2 7/8″	150	36895K162	21.66
3/4	1 5/8″	2 1/16″	3 7/8″	150	36895K122	21.08
1	1 7/8″	1 1/16″	2 7/8″	150	36895K163	23.46
1	1 7/8″	2 1/16″	3 7/8″	150	36895K123	23.04
1 1/4	2 5/8″	2″	4″	150	36895K124	31.14
1 1/2	2 5/8″	1″	3″	150	36895K164	33.90
1 1/2	2 5/8″	2″	4″	150	36895K125	33.08
2	3 1/4″	1″	3 1/4″	150	36895K165	45.12
2	3 1/4″	2″	4 1/4″	150	36895K126	44.02
3	4 1/2″	2 1/8″	4 5/8″	150	36895K127	76.94
4	5 3/4″	2 7/16″	5 3/4″	150	36895K128	131.78
6	8 1/16″	3 1/4″	8″	150	36895K129	286.02
Hot Water CPVC—Light gray						
1/2	1 3/8″	2 1/16″	3 3/4″	150	36895K151	26.06
3/4	1 5/8″	2 1/16″	3 7/8″	150	36895K152	30.42
1	1 7/8″	2 1/16″	3 7/8″	150	36895K153	33.54
1 1/2	2 5/8″	2″	4″	150	36895K155	51.42
2	3 1/4″	2″	4 1/4″	150	36895K156	64.22
Chemical-Resistant Polypropylene—Semi-clear white						
1/2	1 3/8″	2 1/16″	3 3/4″	150	36895K141	25.12
3/4	1 5/8″	2 1/16″	3 7/8″	150	36895K142	30.58
1	1 7/8″	2 1/16″	3 7/8″	150	36895K143	39.70
1 1/4	2 5/8″	2″	4″	150	36895K144	50.34
1 1/2	2 5/8″	2″	4″	150	36895K145	50.34
2	3 1/4″	2″	4 1/4″	150	36895K146	78.38
3	4 1/2″	2 1/8″	4 5/8″	150	36895K147	139.27
4	5 3/4″	2 7/16″	5 3/4″	150	36895K148	262.42
Oil-Resistant Polyethylene—Black						
3/4	1 11/16″	7/16″	1 5/8″	150	3736K2	13.77
1	2 5/8″	9/16″	1 3/4″	150	3736K3	19.60
1 1/4	2 5/8″	9/16″	1 3/4″	150	3736K5	19.60
1 1/2	2 5/8″	9/16″	1 3/4″	150	3736K4	19.60
2	3 1/4″	9/16″	1 7/8″	150	3736K6	31.50

Pipe Size	Wall Requirements: Hole Size	Wall Requirements: Max. Thick.	Lg.	Max. psi @ 72° F		
NPT Threaded Female on Both Ends (Cont.)						
High-Temperature PTFE—White						
1/2	1 1/2″	5/8″	2 1/8″	60	1282K44	$240.98
3/4	1 13/16″	3/4″	2 1/2″	50	1282K45	278.32
1	2 1/16″	3/4″	2 1/2″	35	1282K46	353.09
2	3 1/8″	7/8″	2 7/8″	30	1282K48	503.20
Corrosion-Resistant Type 316 Stainless Steel						
3/8	1″	5/16″	1 5/16″	150	6696K58	93.57
1/2	1 3/8″	1/2″	1 9/16″	150	6696K59	124.03
3/4	1 5/8″	3/4″	1 13/16″	150	6696K61	145.26
1	2 1/4″	1 3/8″	2 7/8″	150	6696K62	176.87
1 1/4	2 1/4″	1 3/8″	2 3/8″	150	6696K63	176.87
1 1/2	3″	1 3/8″	2 5/8″	150	6696K64	222.15
2	3″	1 3/8″	2 5/8″	150	6696K65	222.15
2	3 1/4″	1 3/4″	3 1/8″	150	6696K66	234.47
3	4 3/8″	1 11/16″	2 13/16″	150	6696K67	359.26
Unthreaded Socket End Female to NPT Threaded Female						
Cold Water PVC—Dark gray						
1/2	1 3/8″	2 1/16″	3 3/4″	150	36895K111	14.74
3/4	1 5/8″	2 1/16″	3 7/8″	150	36895K112	16.54
1	1 7/8″	2 1/16″	3 7/8″	150	36895K113	19.12
1 1/4	2 5/8″	2″	4″	150	36895K114	23.94
1 1/2	2 5/8″	2″	4″	150	36895K115	23.94
2	3 1/4″	2″	4 1/4″	150	36895K116	35.76
3	4 1/2″	2 1/8″	4 5/8″	150	36895K117	65.82
4	5 3/4″	2 7/16″	5 3/4″	150	36895K118	117.53
6	8 1/16″	3 1/4″	8″	150	36895K119	286.02
Hot Water CPVC—Light gray						
1/2	1 3/8″	2 1/16″	3 3/4″	150	36895K831	19.94
3/4	1 5/8″	2 1/16″	3 7/8″	150	36895K832	23.72
1	1 7/8″	2 1/16″	3 7/8″	150	36895K833	27.28
1 1/4	2 5/8″	2″	4″	150	36895K838	38.16
1 1/2	2 5/8″	2″	4″	150	36895K834	37.22
2	3 1/4″	2″	4 1/4″	150	36895K835	52.72
3	4 1/2″	2 1/8″	4 5/8″	150	36895K836	90.92
4	5 3/4″	2 7/16″	5 3/4″	150	36895K837	138.91
6	8 1/16″	3 1/4″	8″	150	36895K839	396.05

Swivel Through-Wall Fittings

- Use with water and ethylene glycol
- Temperature Range: 40° to 140° F

Fittings swivel to compensate for misaligned and angled connections. Mount them through a hole in your wall, tank, or panel to serve as an inlet or outlet. Use them on curved and flat surfaces. They adjust from the outside of the tank, so there is no need to drain your tank to make adjustments. Fittings are PVC and come with a PTFE seal and an EPDM gasket. They are vacuum rated to 29″ Hg @ 72° F.

Connections: NPT threaded.

Pipe Size	Wall Requirements: Hole Size	Wall Requirements: Max. Thick.	Lg.	Max. psi @ 72° F		
3/4	3 1/4″	7/8″	2 9/16″	75	3766K21	$142.13
1	3 1/4″	1 1/2″	2 9/16″	75	3766K12	147.34
1 1/2	4 1/2″	1 1/16″	2 1/2″	75	3766K23	216.04
2	4 1/2″	1 1/8″	2 1/2″	75	3766K14	223.42
3	5 3/4″	1 11/16″	3 1/4″	75	3766K15	345.74

Rotating Joints

How to Measure Male Pipe Size Threads—*Example shows pipe size 3/8.*

Pipe size is an industry designation, not the actual size. Place the male threads of your joint on the scale to determine the pipe size. You can also measure the outside diameter (OD) of the male threads, then select the pipe size on the scale that corresponds to your measurement.

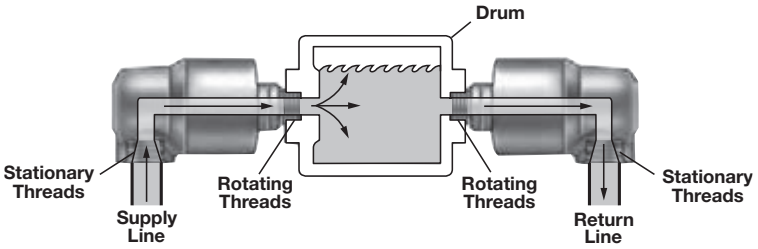
Pipe Size:	0	1/16	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3
OD (to nearest 1/8″):	0	1/4″	3/8″	1/2″	5/8″	3/4″	1″	1 1/4″	1 5/8″	1 3/4″	2 3/8″	2 3/4″	3 3/8″

To measure larger pipe sizes, go to mcmaster.com and search for **4464KAC**. For information about selecting pipe size, see pages 2-3.

About Rotating Joints

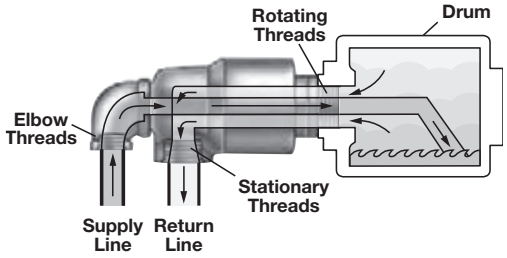
Rotating joints transfer hot and cold materials from your supply line to a continuously revolving drum, roller, or other rotating equipment.

One-Way Flow



Use one-way joints in pairs; one joint serves as a supply line, while the other serves as a return line.

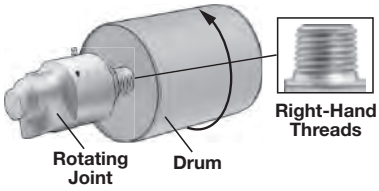
Two-Way Flow



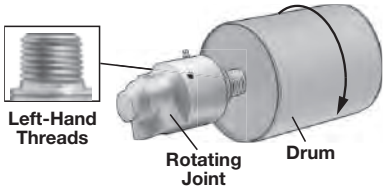
Use two-way joints when you need the supply line and return line to be on the same side of the drum.

For Counterclockwise Rotating Drums

If your drum rotates counterclockwise as you face the connecting end, you should select a rotating joint with right-hand threads.



For Clockwise Rotating Drums



If your drum rotates clockwise as you face the connecting end, you should select a rotating joint with left-hand threads.

One-Way Flow Rotating Joints

General Purpose Iron and High-Speed Brass

General Purpose Iron:
- Use with water, oil, steam
- Temperature Range: –20° to 375°F
- Maximum Pressure: Water: 250 psi @ 72°F; Oil: 100 psi @ 72°F; Steam: 150 psi @ 365°F

High-Speed Brass:
- Use with water, oil, intermittent steam (up to 20% of operating time)
- Max. Temperature: 250°F
- Maximum Pressure: Water: 750 psi @ 72°F; Oil: 100 psi @ 72°F; Steam: 15 psi @ 250°F

Corrosion-Resistant 300 Series Stainless Steel:
- Use with water, air, oil, steam
- Temperature Range: Water: –40° to 300°F; Oil: –40° to 395°F; Steam: up to 350°F
- Maximum Pressure: Water: 750 psi @ 72°F; Air: 300 psi @ 72°F; Oil: 100 psi @ 72°F; Steam: 120 psi @ 350°F
- Vacuum: 25″ Hg @ 72°F

Corrosion-Resistant 300 Series Stainless Steel

Use these joints in pairs—one joint serves as the supply line while the other serves as the return. All have right-hand rotating threads for drums and rollers that rotate counterclockwise. They have one or two precision ball bearings, a seal, and a stainless steel rotating shaft, except the general purpose iron joints have a steel rotating shaft.

Connections: NPT, except 5/8″-18 threads are UNF straight threads.

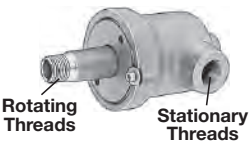
Also Available: Rotating joints with left-hand rotating threads for drums and rollers that rotate clockwise. Please ask for 5275K2 and specify the corresponding joint part number below.

Threads, Pipe Size: Rotating	Threads, Pipe Size: Stationary	Max. rpm	Body Dia.	Lg.		
General Purpose Iron						
1/4	1/4	700	1 3/4″	4 3/8″	5278K51	$229.09
3/8	3/8	700	1 3/4″	4 3/8″	5278K52	187.27
1/2	1/2	700	2 3/8″	5″	5278K53	214.55
3/4	3/4	700	2 1/2″	5 1/2″	5278K54	262.42
1	1	700	3″	6 1/8″	5278K55	298.18
1 1/4	1 1/4	700	3 3/4″	9 1/16″	5278K66	465.45
1 1/2	1 1/2	700	4 1/8″	9 11/16″	5278K67	550.91
2	2	700	5 7/8″	11 3/4″	5278K68	829.31
High-Speed Brass						
3/8	3/8	1,500	1 3/4″	3 15/16″	5275K412	158.56
1/2	1/2	1,500	2 1/4″	4 13/16″	5275K422	183.08
1/2	3/4	1,500	2 7/8″	5 9/16″	5275K432	220.67

★ Maximum speed is 550 rpm for air.

Threads, Pipe Size: Rotating	Threads, Pipe Size: Stationary	Max. rpm	Body Dia.	Lg.		
High-Speed Brass (Cont.)						
5/8″-18	3/8	3,500	1 3/4″	3 15/16″	5275K612	$159.17
3/4	3/4	1,500	2 7/8″	5 9/16″	5275K442	220.67
1	1	1,500	3 1/4″	6 13/16″	5275K452	302.40
1 1/4	1 1/2	1,500	4 1/4″	8 1/2″	5275K462	514.90
1 1/2	1 1/2	1,500	4 1/4″	8 1/2″	5275K472	514.90
Corrosion-Resistant 300 Series Stainless Steel						
3/8	3/8	1,000★	1 9/16″	4″	9177K512	236.54
1/2	1/2	1,000★	2 1/16″	4 3/4″	9177K522	236.54
3/4	3/4	1,000★	2 5/16″	5 1/4″	9177K532	271.43
1	1	1,000★	3 1/8″	6 3/16″	9177K542	358.93
1 1/4	1 1/4	1,000★	3 1/2″	7 1/2″	9177K552	511.32
1 1/2	1 1/2	1,000★	4″	8 3/8″	9177K562	673.68
2	2	1,000★	4 3/8″	9 1/2″	9177K572	937.50

High-Temperature One-Way Flow Rotating Joints



- Use with oil, steam
- Temperature Range: Oil: –20° to 600°F; Steam: Up to 450°F
- Maximum Pressure: Oil: 100 psi @ 72°F; Steam: 175 psi @ 377°F

These iron joints are built to handle hot oil or steam. They have right-hand rotating threads for drums and rollers that rotate counterclockwise. They're painted with a high-temperature gold enamel and include a bearing, seal, and nickel-plated steel rotating shaft.

Connections: NPT.

Threads, Pipe Size: Rotating	Threads, Pipe Size: Stationary	Max. rpm	Body Dia.	Lg.	For Oil		For Steam	
1	1	600	4 1/2″	7 1/8″	9189K142	$381.82	9189K442	$292.73

About Plastic and Rubber Tubing

Clarity—An indicator of how easy it is to see what's flowing inside of your tubing.

Clear—You can see through the tubing.

Semi-Clear—You can see there's something in the tubing, but the view is limited.

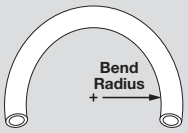
Opaque—You cannot see what's in the tubing.

Flexibility—A general indicator of how bendable tubing is, this characteristic takes many factors into account, including bend radius, wall hardness, material, and diameter. Tubing can have a hard wall and still be flexible.

Very Flexible—Bends easily.

Flexible—Good for gradual bends.

Rigid—Does not bend.



Bend Radius—A specific indicator of how bendable tubing is, bend radius is the point to which you can bend tubing without damaging it. It is measured from the center of the bend to the edge of the tubing. The smaller the measurement, the better the bend.

Material Sample Packs—Contain 3″ long pieces of tubing for each of the materials listed.

Polyurethane, PVC, Polypropylene, Polyethylene, and EVA	3077K1	$3.75
Nylon, PTFE, PVDF, and PEEK	3077K2	11.19
Latex, Silicone, Buna-N, Viton® Fluoroelastomer, Neoprene, Gum, and Blended Rubber	3077K3	7.66

Hardness—Hardness indicates the firmness of tubing. It is measured on a Durometer A, Durometer D, or Rockwell R scale. The higher the number, the harder the tubing.

We've assembled a **tubing hardness sample pack** that includes nine pieces of 3″ long tubing, each labeled with its hardness; Durometer 35A, 40A, 55A, 65A, 74A, 85A, 43D-55D, 65D, and Rockwell R120.

3077K5 ..... $11.97

Tubing Application Guide

	Soft Tubing  • Use with barbed fittings. • Durometer is 30-74A. Page	Firm Tubing  • Use with barbed, compression, and push-to-connect fittings. • Durometer is 75-95A or 22-44D. Page	Hard Tubing  • Use with compression and push-to-connect fittings. • Hardness is Durometer 96-110A, Durometer 45-81D, or Rockwell R50-130. Page
Best Clarity	Masterkleer PVC Clear 147	Abrasion-Resistant PVC/Polyurethane Clear 162	FEP Clear 173 Crack-Resistant PFA Clear 175
Most Flexible	High-Flex White PVC 154 Super-Soft Latex Rubber 155	Choose-a-Color PVC 162	Flexible Nylon 169
General Purpose (Air and Water)	Masterkleer PVC Clear 147 Super-Soft Latex Rubber 155	Choose-a-Color PVC 162	Choose-a-Color Flexible Nylon 168
Drinking Water	———	High-Pressure Versilon Polyurethane Clear Tubing for Drinking Water 164	Polyethylene for Drinking Water 167
Food and Beverage	Tygon PVC Clear 148 High-Temperature White Silicone Rubber 157	Abrasion-Resistant PVC/Polyurethane Clear 162 Large-Diameter Thin-Wall Polyurethane Clear 165	Hard PVC Clear 171 Flexible White PVDF 175
Sanitary (Dairy)	PVC Clear 147	Large-Diameter Thin-Wall Polyurethane Clear 165	Flexible White PVDF 175
High Purity	Cleaned and Bagged High-Purity White Silicone Rubber 158	———	High-Purity Hard PFA Clear 174
Chemical Resistance	Laboratory Tygon PVC Clear 151 Ultra-Chemical-Resistant Versilon PVC Clear 152	Low-Temperature Tygon Clear 152 High-Temperature Viton® Fluoroelastomer 162	Extreme-Temperature PTFE and Teflon® PTFE 172 White Teflon® FEP 173
Fuel and Lubricant	Clear Yellow PVC 151 Yellow Tygon PVC 151	———	Nylon Clear for Fuels 169
High Temperature	High-Temperature Silicone Rubber 156	High-Temperature Viton® Fluoroelastomer 162	Extreme-Temperature PTFE and Teflon® PTFE 172
High Pressure	High-Pressure PVC 149 High-Pressure White Silicone Rubber 157	High-Pressure White EVA 167	Flexible High-Pressure White Nylon 169
High Vacuum	Vacuum-Rated PVC Clear for Food, Beverage, and Dairy 150 Durable Beige Rubber Vacuum-Rated for Food and Beverage 161	Abrasion-Resistant/Self-Retracting Choose-a-Color Polyurethane 163	High-Pressure/Vacuum Polyethylene for Chemicals 170
Abrasion Resistance	Abrasion-Resistant Gum Rubber 155	Abrasion-Resistant Black Neoprene Rubber 162	Abrasion-Resistant White ETFE 171
UV Resistance	UV-Resistant Black Versilon PVC 153	Low-Temperature White EVA 167	Choose-a-Color FEP 173 High-Strength White PVDF 175
For Metering Pumps	High-Flex Tygon PVC Clear 154 High-Purity White Silicone Rubber for Metering Pumps 158	———	———

About Metal Tubing

While metal tubing is often called pipe, tubing is actually lighter than pipe and easier to work with. It can, in most cases, be bent into shape without the need for elbows or other fittings. Tubing is also thinner than pipe, so it cannot be threaded; connect tubing to pumps, valves, and other components with tube fittings.

Construction

Welded—With a weld bead on the inside, use this tubing when your application does not require a smooth interior. For some tubing, the weld bead is smoothed (also known as drawn), which reduces the chance of particle buildup and makes it an economical alternative to seamless tubing.

Seamless—Formed from a cylinder, this tubing has no weld, so it is smooth on the inside for unrestricted flow. It is stronger than welded tubing and can be flared without splitting.

Wall Thickness

Each tubing OD comes in a variety of wall-thickness choices. As the walls get thicker, the amount of pressure the tubing can withstand increases and the amount of flow decreases. The illustrations below show how the wall thickness affects the ID of the tubing.

1/4″ OD Tubing (Actual OD)

0.02″ 0.035″ 0.049″ 0.065″ 0.083″

1/2″ OD Tubing (Actual OD)

0.02″ 0.035″ 0.049″ 0.065″ 0.083″

Tubing Application Guide

		Pages
General Purpose (Air and Water)	Smooth-Bore Seamless Stainless Steel Welded Stainless Steel	176-177 178-179
Drinking Water	Copper for Drinking Water	185
Salt Water	Titanium Ultra-Corrosion-Resistant Aluminum	184 187
Food, Beverage, and Dairy	High-Polish Stainless Steel for Food, Beverage, and Dairy	179
High Purity	High-Polish Stainless Steel	179
Chemicals	Super-Corrosion-Resistant Nickel Acid-Resistant Nickel	184 184
Gasoline, Diesel Fuel, and Fuel Oil	Aluminum	188
Natural and LP Gases	Copper with Coated Exterior for Natural and LP Gas	186
High Temperatures	Smooth-Bore Seamless Stainless Steel High-Temperature Nickel	176-177 184
Compact Spaces	Miniature Stainless Steel	182-183

Stainless Steel Tubing

For technical drawings and 3-D models, go to mcmaster.com. CAD

Smooth-Bore Seamless Stainless Steel Tubing CAD

- Temperature Range:
  304 Stainless Steel: -425° to 1500°F
  316 Stainless Steel: -325° to 1500°F
- Bend with a tube bender
- Use with compression fittings (see pages 209-215), flared fittings (see pages 218-221), and butt-weld fittings (see pages 260-261)

Seamless construction with no weld bead gives this tubing a smooth interior for unrestricted flow. It is stronger than welded tubing and can be flared without splitting. Use with water, air, natural gas, and oil. Tubing meets ASTM A213 and A269. It has a Rockwell hardness of B90 and a soft temper. OD tolerance is ±0.006″ for tubing ODs 7/16″ and smaller; ±0.01″ for 1/2″ to 1 3/8″; and ±0.03″ for 1 1/2″ and larger, unless noted. Tubing can be sterilized with chemicals.

304 stainless steel has very good corrosion resistance.
316 stainless steel offers excellent corrosion resistance.

Short Straight Lengths

OD	Wall	ID	Max. psi @ 72°F	304 Stainless Steel	2″	4″	6″	8″
1/4″	0.035″	0.18″	4,300	89895K411	$3.50	$4.00	$4.50	$5.00
1/4″	0.049″	0.152″	6,100	89895K421	5.28	6.03	6.79	7.54
3/8″	0.035″	0.305″	2,900	89895K431	4.16	4.75	5.35	5.94
3/8″	0.049″	0.277″	4,100	89895K451	6.00	6.86	7.71	8.57
3/8″	0.065″	0.245″	5,400	89895K461	6.96	7.96	8.96	9.95
1/2″	0.035″	0.43″	2,300	89895K471	5.58	6.38	7.17	7.97
1/2″	0.049″	0.402″	3,200	89895K481	7.26	8.30	9.33	10.37
1/2″	0.065″	0.37″	4,300	89895K491	7.82	8.94	10.05	11.17

Straight Lengths

OD	Wall	ID	Max. psi @ 72°F	304 Stainless Steel	1 ft.	3 ft.	6 ft.	316 Stainless Steel	1 ft.	3 ft.	6 ft.
1/16″	0.02″	0.022″	6,400	89895K611	$9.94	$28.70	$55.20	89785K911	$13.11	$29.67	$69.00
1/16″	0.028″	0.006″	8,900	89895K612	7.84	21.86	41.25	89785K912	12.99	37.51	72.14
3/32″	0.02″	0.054″	4,200	89895K613	11.88	34.32	66.00	89785K913	17.10	47.70	90.00
1/8″	0.02″	0.085″	4,900	89895K711	11.87	19.89	34.90	89785K811	14.96	28.36	51.57
1/8″	0.028″	0.069″	7,100	89895K712	12.48	20.92	36.70	89785K812	13.42	33.31	49.72
1/8″	0.035″	0.055″	8,500	89895K713	10.86	19.69	33.94	89785K813	9.29	22.66	37.14
1/8″	0.049″	0.027″	12,000	89895K714	13.72	24.79	44.27	89785K814	12.77	35.62	67.20
5/32″	0.035″	0.086″	4,400	89895K614	14.25	39.75	75.00	89785K914	14.57	40.65	76.69
5/32″	0.049″	0.058″	6,200	89895K615	10.26	29.64	57.00	89785K915	22.80	61.56	114.00
3/16″	0.02″	0.148″	3,300	89895K715	9.80	19.25	33.78	89785K815	12.60	30.92	57.26
3/16″	0.028″	0.132″	4,700	89895K716	9.58	17.61	30.89	89785K816	8.42	21.04	38.25
3/16″	0.035″	0.118″	5,700	89895K717	10.36	20.02	34.52	89785K817	10.83	26.61	45.11
3/16″	0.049″	0.09″	8,000	89895K718	12.54	22.34	39.20	89785K818	13.53	40.60	71.23
7/32″	0.035″	0.148″	3,200	89895K616	23.78	68.71	132.13	89785K916	25.97	75.03	144.29
1/4″	0.01″	0.23″	1,200	89895K719	12.22	20.49	35.95	89785K819	14.95	41.71	78.69
1/4″	0.016″	0.218″	1,200	89895K721	8.28	22.08	39.42	89785K896	13.33	37.45	63.48

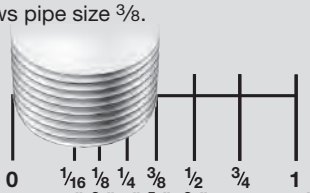
(Continued on following page)

About Tube Fittings

Fitting Style	Advantages	Recommended Tubing	Pressure	Pages
Barbed 	Slide into tubing and secure with a clamp. The large contact area provides a secure grip.	Soft plastic and rubber	Low	190-200
Compression 	A sleeve bites and forms around the outside of rigid tubing as you tighten the nut.	Hard plastic and metal	Medium to high	201-210
Yor-Lok 	Similar to compression fittings, but has two sleeves for more gripping power at higher pressures.	Metal	High	212-217
Flared 	The nose of the fitting mates with tubing that has a flared end. Secure with a nut for the tightest metal-to-metal seal we offer.	Metal	High	218-224
Push-to-Connect 	The tubing slides into the fitting, and an internal gripping ring holds it in place.	Plastic and soft metal	Low	225-249
Quick Disconnect 	Choose these fittings if you frequently connect and disconnect your line.	Plastic	Low	250-254

How to Measure Threaded Pipe Size—Example shows pipe size 3/8.

Pipe size is an industry designation, not the actual size. Place your pipe or fitting on the scale to determine the pipe size. You can also measure the outside diameter (OD) of your pipe or inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.



Durable Nylon Extra-Grip Barbed Tube Fittings CAD

- Maximum Pressure: 75 psi @ 72° F
- Temperature Range: 32° to 167° F
- Tubing: Use with soft and firm (Shore A45-A80) PVC and polyurethane, unless noted

Ensure a tight, secure connection with these fittings. They have multiple barbs, which provide additional contact between the fitting and the tubing for extra gripping power except straight female pipe adapters for 3/16" tube ID have a single barb. Use with water and air. Fittings are made of nylon for excellent impact and abrasion resistance.

Inline tees are also known as branch tees.

Connections: Barbed or NPT threads, unless otherwise stated.

Tube-to-Threaded Pipe Adapters—Semi-Clear White

Straights, Male Pipe

For Tube ID	Pipe Size	Pkg. Qty.		Pkg.
3/16"	1/4	10	5372K121	$4.15
1/4"	1/8	10	5372K111	4.50
1/4"	1/4	10	5372K112	4.67
1/4"	3/8	10	5372K113	4.86
1/4"	1/2	10	5372K114	5.20
1/4"	3/4	10	5372K122	6.55
3/8"	1/8	10	5372K116	3.75
3/8"	1/4	10	5372K117	4.74
3/8"	3/8	10	5372K118	4.93
3/8"	1/2	10	5372K119	5.25
3/8"	3/4	10	5372K154	5.54
3/8"	1	10	5372K156	8.66
1/2"	1/8	10	5372K115	4.93
1/2"	1/4	10	5372K123	4.94
1/2"	3/8	10	5372K124	4.98
1/2"	1/2	10	5372K125	4.54
1/2"	3/4	10	5372K126	6.01
1/2"	1	10	5372K157	8.41
5/8"	1/4	10	5372K146	8.84
5/8"	3/8	10	5372K148	5.06
5/8"	1/2	10	5372K128	4.75
5/8"	3/4	10	5372K155	7.57
3/4"	1/4	10	5372K129	8.62
3/4"	3/8	10	5372K149	5.91
3/4"	1/2	10	5372K132	5.57
3/4"	3/4	10	5372K133	6.53
3/4"	1	10	5372K136	8.08
1"	1/2	10	5372K143	8.86
1"	3/4	10	5372K134	7.87
1"	1	10	5372K135	8.70
1 1/4"	3/4	5	5372K147	8.30
1 1/4"	1	5	5372K141	9.09
1 1/4"	1 1/4	5	5372K142	9.51
1 1/2"	1 1/4	5	5372K151	9.74
1 1/2"	1 1/2	5	5372K152	9.12
2"	2	5	5372K161	12.98

90° Elbows, Male Pipe

For Tube ID	Pipe Size	Pkg. Qty.		Pkg.
1/4"	1/8	10	5372K311	$5.91
1/4"	1/4	10	5372K312	5.70
1/4"	3/8	10	5372K313	6.04
1/4"	1/2	10	5372K167	9.53
1/4"	3/4	5	5372K137	8.37
5/16"	1/4	10	5372K165	7.46
5/16"	3/8	10	5372K166	8.13
3/8"	1/8	10	5372K316	7.61
3/8"	1/4	10	5372K317	5.80
3/8"	3/8	10	5372K318	7.04
3/8"	1/2	10	5372K323	7.35
3/8"	3/4	10	5372K138	9.02
3/8"	1	10	5372K139	10.45
1/2"	1/4	10	5372K314	6.24
1/2"	3/8	10	5372K324	7.04
1/2"	1/2	10	5372K325	7.46
1/2"	3/4	10	5372K326	8.70
1/2"	1	10	5372K476	10.31
5/8"	1/4	10	5372K127	8.41
5/8"	3/8	10	5372K131	7.84
5/8"	1/2	10	5372K328	9.01
5/8"	3/4	10	5372K332	9.21
5/8"	1	10	5372K144	11.16
3/4"	1/2	10	5372K329	8.77
3/4"	3/4	10	5372K333	7.48
3/4"	1	10	5372K485	11.48
3/4"	1 1/4	1	5372K168	3.09
13/16"	1/2	10	5372K171	9.54
1"	3/4	10	5372K334	9.89
1"	1	10	5372K335	11.69
1"	1 1/4	5	5372K336	10.04
1"	1 1/2	2	5372K189	5.51
1 1/4"	1	5	5372K169	9.19
1 1/4"	1 1/4	5	5372K145	11.88
1 1/2"	1 1/2	5	5372K338	13.50
2"	2	2	5372K339	7.00

90° Elbows, Female Pipe

For Tube ID	Pipe Size	Pkg. Qty.		Pkg.
1/2"	1/2	10	5372K341	$11.07
1/2"	3/4	10	5372K342	10.65
3/4"	3/4	10	5372K343	12.76

Inline Tees, Male Pipe

For Tube ID	Pipe Size	Pkg. Qty.		Pkg.
3/16"	1/8	10	5372K631	$7.32
3/16"	1/4	10	5372K632	7.34
1/4"	1/8	10	5372K633	7.20
1/4"	1/4	10	5372K634	7.37
1/4"	3/8	10	5372K635	7.54
3/8"	1/4	10	5372K636	7.72
3/8"	3/8	10	5372K637	7.91
3/8"	3/4	5	5372K412	6.93
3/8"	1	5	5372K414	7.53
1/2"	3/8	10	5372K638	8.08
1/2"	1/2	10	5372K639	6.16
1/2"	3/4	5	5372K413	7.38
1/2"	1	5	5372K415	7.83
3/4"	1/2	5	5372K411	7.53
3/4"	3/4	10	5372K641	10.70
3/4"	1	5	5372K416	8.57

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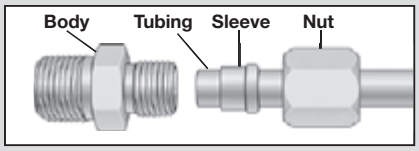
About Compression Tube Fittings



Compression fittings form a tight seal around the outside of hard plastic and soft metal tubing, without the need for flaring or soldering. Most compression fittings consist of a body and nut, as well as a sleeve (ferrule) or gripping ring. To install, insert the tubing into the body and tighten the nut.

Application	Fitting	Page
Air	Polypropylene	201
Air and Water	Brass	204-205
Food and Beverage	Sanitary PVDF	203
Fuel and Oil	Vibration-Resistant Brass	207
Chemicals	Chemical-Resistant PFA	202
High Temperature	Type 316 Stainless Steel	209
High Pressure	Extreme-Pressure Type 316 SS	210

Polypropylene Compression Tube Fittings for Air

- Maximum Pressure: 220 psi @ 70° F
- Temperature Range: –30° to 215° F
- Tubing: Use with firm and hard polypropylene, polyethylene, and nylon

A built-in sleeve (ferrule) means you won't have to disassemble these fittings to install them. Fittings are white and also include a nut. Sterilize with ethylene oxide and steam (autoclaving).

Inline tees are also known as branch tees. **Tube supports** (sold separately) are recommended for polypropylene, polyethylene, and nylon tubing with a hardness of Shore A70 or less.

Connections: Compression or NPT threads.

Tube-to-Threaded Pipe Adapters





For Tube OD	Pipe Size	Pkg. Qty.	Straights, Male Pipe	Pkg.	Straights, Female Pipe	Pkg.	90° Elbows, Male Pipe	Pkg.	90° Elbows, Female Pipe	Pkg.	Inline Tees, Male Pipe	Pkg.
6 mm	1/8	2	5016K381	$4.63								
6 mm	1/4	2	5016K382	4.95			5016K385	$6.79				
1/4"	1/8	5	5016K411	4.21	5016K911	$5.37	5016K611	6.11	5016K125	$7.68	5016K811	$8.74
1/4"	1/4	5	5016K422	4.53	5016K922	5.63	5016K622	6.16	5016K135	7.79	5016K822	10.37
1/4"	3/8	5	5016K423	4.63			5016K681	7.21				
5/16"	1/4	5	5016K477	4.68	5016K977	5.84	5016K677	6.63	5016K145	8.58	5016K877	11.16
3/8"	1/4	5	5016K488	5.42	5016K988	6.63	5016K688	7.68	5016K156	9.32	5016K889	12.05
3/8"	3/8	5	5016K444	5.95	5016K944	6.84	5016K644	7.95	5016K165	10.42	5016K844	12.42
3/8"	1/2	5	5016K446	7.00	5016K949	7.79						
10 mm	1/8	2	5016K383	5.90								
10 mm	1/4	2	5016K384	6.00			5016K386	8.42				
1/2"	1/4	5	5016K491	8.95			5016K112	8.53				
1/2"	3/8	5	5016K499	7.26	5016K991	7.95	5016K699	9.21	5016K175	12.21	5016K899 ★	3.14
1/2"	1/2	5	5016K466	7.68	5016K966	8.42	5016K666	9.26	5016K185	13.95	5016K866 ★	3.19
5/8"	3/8	5	5016K455	8.37			5016K655	10.84				
5/8"	1/2	2	5016K456	3.39	5016K933	5.22	5016K656	4.46	5016K195	7.14	5016K855	7.31
3/4"	1/2	1	5016K457	2.79							5016K856	5.29
3/4"	3/4	1	5016K458	2.91							5016K857	5.38

★ Package quantity is 1.

Tube-to-Tube Connectors



For Tube OD	Pkg. Qty.	Straights	Pkg.	90° Elbows	Pkg.	Tees	Pkg.
1/4"	5	5016K522	$6.74	5016K111	$8.58	5016K722	$11.26
5/16"	5	5016K577	7.00	5016K122	9.05	5016K777	11.79
3/8"	5	5016K544	9.05	5016K133	11.37	5016K744	14.95
1/2"	2	5016K566	4.65	5016K144	5.58	5016K766	7.16
5/8"	1	5016K555	2.69	5016K155	4.66	5016K755	3.91
3/4"	1	5016K588	4.34	5016K205	6.86	5016K788	6.67

Replacement Parts and Accessories


For Tube OD	Pkg. Qty.	Nuts	Pkg.	Tube Supports: For Tube ID	Tube Supports	Pkg.
1/4"	10	5016K222	$5.05	3/16"	5016K322	$1.37
5/16"	10	5016K277	5.26	3/16"	5016K377	1.58
3/8"	10	5016K244	6.42	1/4"	5016K344	1.79
1/2"	10	5016K266	7.89	3/8"	5016K366	2.32
5/8"	10	5016K233	8.74			
3/4"	5	5016K234	8.21			

Moisture-Resistant Acetal Compression Tube Fittings

Good for humid environments, these fittings are made of acetal, which won't absorb moisture. Maximum pressure is 220 psi @ 70° F. Temperature range is –40° to 200° F. Use with firm and hard polypropylene, polyethylene, and nylon tubing.

For pricing, specifications such as pipe size, and a list of common applications, go to mcmaster.com and search for the part number below.

To Order Please specify tube OD, pipe size, and male or female pipe (where applicable).

Available Shapes	For Tube ODs	
Tube-to-Threaded Pipe Adapters		
Straights (Male Pipe; Female Pipe)	1/4", 5/16", 3/8", 1/2", 5/8", 3/4"	5694T511
90° Elbows (Male Pipe; Female Pipe)	1/4", 5/16", 3/8", 1/2", 5/8"	5694T512
Inline Tees (Male Pipe)	1/4", 5/16", 3/8", 1/2", 5/8", 3/4"	5694T513
Tube-to-Tube Connectors		
Straights	1/4", 5/16", 3/8", 1/2", 5/8", 3/4"	5694T514
90° Elbows	1/4", 5/16", 3/8", 1/2", 5/8", 3/4"	5694T515
Tees	1/4", 5/16", 3/8", 1/2", 5/8", 3/4"	5694T516
Replacement Parts and Accessories		
Nuts	1/4", 5/16", 3/8", 1/2", 5/8", 3/4"	5694T517
Tube Supports	1/4", 5/16", 3/8", 1/2"	5694T518

Yor-Lok Tube Fittings

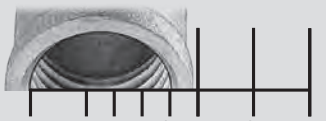
For technical drawings and 3-D models, go to mcmaster.com.

For information about selecting pipe size, see pages 2-3.

How to Measure Threaded Pipe Size—Example shows pipe size 3/8.

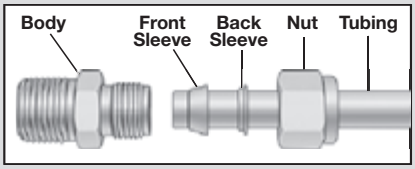
Pipe size is an industry designation, not the actual size. Place your pipe or fitting on the scale to determine the pipe size. You can also measure the outside diameter (OD) of your pipe or inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.

Pipe Size:	0	1/16	1/8	1/4	3/8	1/2	3/4	1
OD (to nearest 1/8"):	0	1/4"	3/8"	1/2"	5/8"	3/4"	1"	1 1/4"



Pipe Size:	0	1/16	1/8	1/4	3/8	1/2	3/4	1
ID (to nearest 1/8"):	0	1/4"	3/8"	1/2"	5/8"	3/4"	1"	1 1/4"

About Yor-Lok Tube Fittings



Also known as instrumentation fittings, Yor-Lok fittings are designed to handle higher pressures than other types of compression fittings. Use them with metal tubing. They come with a body, nut, and front and back sleeves (double ferrules); two sleeves provide extra gripping power and ensure a leak-free, gas-tight seal. To install, insert your tubing into the body until the tubing bottoms out, then finger-tighten the nut. Continue tightening the nut using a wrench. For 1/16", 1/8", and 3/16" fittings, a 3/4 wrench turn is all you need; all other sizes need a 1 1/4 wrench turn.

Type 316 Stainless Steel Yor-Lok Tube Fittings

- Maximum Pressure: See chart at right, unless otherwise stated
- Temperature Range: –425° to 1200° F
- Tubing: Use with welded and seamless Types 304, 304L, 316, and 316L stainless steel that meets ASTM A213, A249, or A269

When you need excellent corrosion resistance choose these fittings. They have front and back sleeves (double ferrules) that form a leak-resistant seal. Use with air, water, steam, oil, natural gas, gasoline, and hydraulic fluid. Fittings are made of forged or bar stock Type 316 stainless steel and include a nut. They are compatible with Swagelok®, Parker A-Lok, and Let-Lok fittings. Sterilize with steam (autoclaving).

Cleaned and Bagged Fittings—Individually bagged to prevent moisture and dirt from contaminating the inside.

Tube-to-Flange Pipe Adapters—Maximum pressure @ 72°F is 275 psi.

Inline tees are also known as branch tees, and **right angle tees** are also known as run tees. **Through-wall straights** are also known as bulkhead couplings and require a hole through the wall that is 1/4" larger than the tube OD. **Flange end straights** connect with ANSI Class 150 flanges. **Sanitary straights** are also known as tri-clamps. Max. pressure @ 72°F is 2,200 psi for 1/2" and 3/4" flange OD and 1,500 psi for 1" and 1 1/2" flange OD.

Tube stems insert into the end of your tube fitting. **Tube stems with sleeve** allow you to connect two fittings closely together by replacing the sleeves in one fitting.

Connections: Compression or NPT threads, unless noted.

For Tube OD	Tube Wall Thick.	Max. psi @ 72°F
1/16"	0.020"	9,100
1/8"	0.035"	6,100
3/16"	0.035"	5,600
1/4"	0.035"	4,100
5/16"	0.035"	3,200
3/8"	0.035"	2,600
1/2"	0.035"	2,100
5/8"	0.049"	2,300
3/4"	0.049"	2,100
1"	0.065"	1,900

Tube-to-Threaded Pipe Adapters






For Tube OD	Pipe Size	Straights, Male Pipe		Straights, Female Pipe		90° Elbows, Male Pipe		90° Elbows, Female Pipe		45° Elbows, Male Pipe		Inline Tees, Female Pipe	
Standard													
1/16"	1/16	5182K834	$17.64	5182K181	$21.48	5182K839	$38.36						
1/16"	1/8	5182K435	16.55	5182K182	22.91	5182K441	30.55						
1/8"	1/16	5182K411	10.91			5182K931	37.64						
1/8"	1/8	5182K804	10.18	5182K491	13.27	5182K817	18.55	5182K183	$25.26			5182K452	$42.18
1/8"	1/4	5182K405	11.27	5182K492	15.45	5182K418	19.82	5182K172	30.12			5182K481	42.98
3/16"	1/8	5182K806	11.09	5182K793	12.73	5182K819	18.73						
3/16"	1/4	5182K912	11.82	5182K942	23.27	5182K932	23.45						
1/4"	1/8	5182K807	8.91	5182K794	12.73	5182K821	16.36	5182K205	22.91	5182K357	$28.55	5182K353	38.67
1/4"	1/4	5182K111	9.27	5182K251	15.45	5182K142	17.64	5182K206	26.36	5182K358	29.27	5182K319	44.55
1/4"	3/8	5182K112	12.36	5182K253	19.82	5182K143	26.18	5182K207	38.73			5182K363	67.22
1/4"	1/2	5182K113	16.55	5182K256	21.64	5182K144	29.82	5182K208	44.00			5182K174	78.71
5/16"	1/8	5182K808	10.91	5182K795	17.82	5182K822	20.00	5182K198	29.99				
5/16"	1/4	5182K809	12.73	5182K796	18.18	5182K823	20.18	5182K199	32.90				
3/8"	1/8	5182K811	11.82	5182K797	16.91	5182K824	23.09	5182K209	25.82	5182K359	37.27		
3/8"	1/4	5182K119	12.55	5182K266	15.82	5182K156	21.82	5182K211	26.73	5182K403	34.36	5182K323	46.00
3/8"	3/8	5182K125	14.36	5182K267	21.09	5182K157	26.36	5182K212	30.37			5182K785	52.96
3/8"	1/2	5182K126	17.09	5182K268	28.18	5182K158	33.64	5182K213	45.28			5182K373	79.56
3/8"	3/4	5182K913	23.27	5182K943	40.18	5182K933	54.18						
1/2"	1/4	5182K129	18.00	5182K269	22.36	5182K159	32.00	5182K214	34.73			5182K383	72.18
1/2"	3/8	5182K133	19.45	5182K275	22.91	5182K164	31.64	5182K215	37.08	5182K361	63.45	5182K324	66.00
1/2"	1/2	5182K135	21.27	5182K276	29.45	5182K166	38.55	5182K216	49.26			5182K333	74.36
1/2"	3/4	5182K812	28.00	5182K798	37.64	5182K825	58.00						
5/8"	3/8	5182K813	23.64	5182K799	41.64	5182K826	45.82	5182K223	52.35				
5/8"	1/2	5182K814	24.91	5182K801	34.18	5182K827	45.64	5182K225	56.00			5182K786	97.64
5/8"	3/4	5182K914	31.27	5182K944	43.58	5182K934	57.09						
3/4"	1/2	5182K815	32.55	5182K802	41.82	5182K828	49.64	5182K217	63.45			5182K175	100.65
3/4"	3/4	5182K816	33.09	5182K803	42.36	5182K829	48.00	5182K218	100.00	5182K404	139.57	5182K787	107.85
3/4"	1	5182K836	53.45	5182K176	93.31	5182K177	93.23	5182K173	71.80				
1"	3/4	5182K837	62.91	5182K831	75.82	5182K842	98.18	5182K219	112.92			5182K844	137.66
1"	1	5182K838	57.64	5182K832	90.36	5182K843	96.55	5182K221	125.86			5182K845	144.04
Cleaned and Bagged													
1/8"	1/8	5943K277	15.82	5943K282	19.81	5943K286	26.00	5943K316	36.00			5943K291	57.64
1/8"	1/4	5943K278	16.91	5943K283	22.00	5943K287	25.45	5943K317	46.18				
1/4"	1/8	5943K279	14.00	5943K284	18.54	5943K288	22.18	5943K318	33.82	5943K321	32.91	5943K292	50.91
1/4"	1/4	5943K111	14.36	5943K251	20.91	5943K142	22.36	5943K206	32.00	5943K322	33.64	5943K185	51.64
3/8"	1/4	5943K281	17.64	5943K285	21.82	5943K289	28.36	5943K319	38.90	5943K323	37.63	5943K293	58.18
3/8"	3/8	5943K125	18.36	5943K267	24.73	5943K157	40.00	5943K212	33.64	5943K324	48.92		
1/2"	1/2	5943K135	26.18	5943K276	33.45	5943K166	44.36	5943K216	56.73			5943K193	79.27

(Continued on following page)

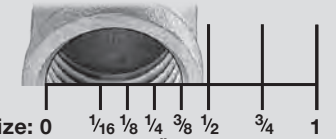
Flared Tube Fittings

For technical drawings and 3-D models, go to mcmaster.com.

For information about selecting pipe size, see pages 2-3.

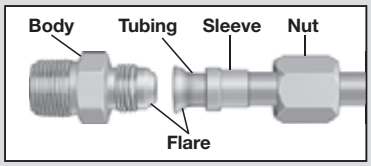
How to Measure Threaded Pipe Size—Example shows pipe size 3/8.

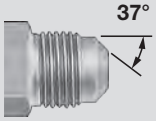
Pipe size is an industry designation, not the actual size. Place your pipe or fitting on the scale to determine the pipe size. You can also measure the outside diameter (OD) of your pipe or inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.



About Flared Tube Fittings

Flared tube fittings provide a tight seal on metal tubing that has been flared with a flaring tool. A complete fitting consists of a body, nut, and sleeve (ferrule). To install, slide the nut and sleeve onto the tubing, flare the end of the tubing, then tighten the nut onto the body and sleeve.





Flared tube fittings come with a 37° flare or a 45° flare.

37° Flare—The most popular style of flare, these fittings are often used in hydraulic applications. They withstand higher pressure than 45° flared fittings.

45° Flare—Commonly used in refrigeration applications, these fittings are made of brass and are for lower-pressure applications than 37° flared fittings.

Gauge for 37° and 45° Flared Tube Fittings—Use this pocket-size gauge to determine the angle of your flared fitting.

50715K2 ..... $11.28

Precision AN Stainless Steel 37° Flared Tube Fittings

- Maximum Pressure: 3,000 psi @ 72° F
- Temperature Range: –320° to 1200° F, except Type 316 Stainless Steel with PTFE Seal are –320° to 500° F
- Tubing: Use with flareable stainless steel

Tighter tolerances set these fittings apart from other 37° flared fittings. The tube end/nut threads are 3A and 3B threads, which adhere to higher tolerances than all other tube end/nut threads. Use with water, air, oil, and hydraulic fluid. Fittings are made to exact AS (formerly AN) specifications and meet SAE AS4841 and ASTM A380, unless noted. They are made of forged or bar stock stainless steel. The nuts and sleeves are sold separately.

Type 304 offers good corrosion resistance, and **Type 316** provides excellent corrosion resistance. **Inline tees** are also known as branch tees, and **through-wall fittings** are also known as bulkhead couplings. **Tube end reducers** require two nuts for assembly.

Threaded Connections: Tube end/nut threads are UNJF straight threads, except 1 1/16"-12 and 1 5/16"-12 are UNJ straight threads. Pipe ends have ANPT threads, which are compatible with NPT threads.

For Tube OD	Tube End/Nut Thread
1/8"	5/16"-24
1/4"	7/16"-20
3/8"	9/16"-18
1/2"	3/4"-16
3/4"	1 1/16"-12
1"	1 5/16"-12

Tube-to-Threaded Pipe Adapters



For Tube OD	Pipe Size	Straights, Male Pipe Type 304		Straights, Male Pipe Type 316		90° Elbows, Male Pipe Type 304		90° Elbows, Male Pipe Type 316		Inline Tees, Male Pipe Type 304		Inline Tees, Male Pipe Type 316	
1/8"	1/8	5482K11	$20.00	5482K117	$22.81	5482K208	$40.00	5482K218	$45.60	5482K228	$62.54	5482K237	$92.73
1/4"	1/8	5482K111	9.76	5482K119	11.30	5482K209	21.60	5482K219	24.68	5482K229	24.70	5482K238	28.00
1/4"	1/4	5482K12	10.86	5482K118	13.00	5482K211	26.30	5482K221	29.17	5482K231	40.00	5482K239	50.40
1/4"	1/2	5482K112	18.46	5482K121	25.33	____	____	____	____	____	____	____	____
3/8"	1/4	5482K113	10.32	5482K123	12.00	5482K212	22.00	5482K222	25.33	5482K232	40.00	5482K241	49.09
3/8"	3/8	5482K15	13.60	5482K122	15.64	5482K213	26.80	5482K223	33.48	____	____	____	____
1/2"	3/8	5482K114	14.00	5482K124	17.54	5482K214	29.40	5482K224	36.84	5482K233	42.00	5482K242	50.91
1/2"	1/2	5482K18	17.60	5482K125	20.60	5482K215	57.00	5482K225	66.00	5482K234	100.75	5482K243	117.27
3/4"	3/4	5482K21	24.70	5482K126	28.12	5482K216	63.46	5482K226	70.00	5482K235	72.73	5482K244	87.55
1"	1	5482K116	41.70	5482K127	49.60	5482K217	96.36	5482K227	106.45	5482K236	133.33	5482K245	145.45

Tube-to-Tube Connectors



For Tube OD	Straights Type 304		Straights Type 316		Required Hole Size	Through-Wall Straights Type 304		Through-Wall Straights Type 316		90° Elbows Type 304		90° Elbows Type 316	
1/8"	5482K31	$17.22	5482K129	$28.75	5/16"	5482K259	$45.00	5482K266	$70.91	5482K24	$45.80	5482K147	$56.25
1/4"	5482K32	11.02	5482K131	12.70	7/16"	5482K261	20.40	5482K267	23.62	5482K25	21.44	5482K148	26.40
3/8"	5482K33	11.90	5482K132	14.30	9/16"	5482K262	24.80	5482K268	27.20	5482K26	24.40	5482K149	30.70
1/2"	5482K34	17.38	5482K133	20.50	3/4"	5482K263	35.70	5482K269	42.20	5482K27	33.96	5482K151	37.60
3/4"	5482K35	38.06	5482K134	47.17	1 1/16"	5482K264	74.50	5482K271	82.45	5482K28	62.38	5482K152	69.09
1"	5482K128	59.60	5482K135	69.24	1 5/16"	5482K265	93.18	5482K272	118.09	5482K146	87.27	5482K153	110.00



For Tube OD	Through-Wall 90° Elbows Required Hole Size	Type 304		Through-Wall 90° Elbows Type 316		Tees Type 304		Tees Type 316		Crosses Type 304		Crosses Type 316	
1/8"	____	____	____	____	____	5482K51	$64.22	5482K171	$70.60	5482K246	$73.22	5482K253	$153.83
1/4"	7/16"	5482K273	$34.26	5482K278	$38.80	5482K52	27.50	5482K172	31.90	5482K247	32.60	5482K254	45.33
3/8"	9/16"	5482K274	39.22	5482K279	43.20	5482K53	28.30	5482K173	35.20	5482K248	40.16	5482K255	51.25
1/2"	3/4"	5482K275	48.87	5482K281	54.10	5482K54	42.74	5482K174	56.33	5482K249	57.80	5482K256	78.83
3/4"	1 1/16"	5482K276	81.18	5482K282	99.72	5482K55	80.00	5482K175	101.82	5482K251	121.82	5482K257	150.00
1"	1 5/16"	5482K277	102.36	5482K283	127.27	5482K169	116.73	5482K176	158.33	5482K252	212.51	5482K258	250.49

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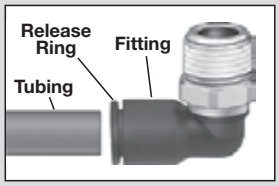
About Push-to-Connect Tube Fittings



Also known as instant fittings, these fittings provide a quick and easy way to connect and disconnect plastic and soft metal tubing. To install, insert the tubing into the fitting until it stops. An internal gripping ring and O-ring hold the fitting secure and form a tight seal around the outside of the tubing. To disconnect, push on the release ring and pull the tubing out of the fitting.

Applications

Push-to-Connect Tube Fittings for Air

- Maximum Pressure: 290 psi @ 70° F, unless noted
- Temperature Range: –4° to 175° F, unless noted
- Tubing: Use with firm (Shore A95) polyurethane, firm (Shore D44) polyethylene, and hard (Shore D62) nylon

The most popular choice for air applications, these fittings are lightweight, yet offer excellent strength. They have a black, glass-filled nylon body, unless noted, and a black release ring. The threads are nickel-plated brass, unless noted. Tapered male threads (NPT and BSPT) have a PTFE thread sealant, and straight male threads (UNF and metric) have an O-ring. Vacuum rating is 28″ Hg @ 70° F. Fittings meet ISO 14743.

Easy-access 90° elbows are also known as banjo-style elbows; they have a hex head for easy adjustment in tight spaces.

Threaded Connections: NPT threads, except 10-32 are UNF straight threads and M7 are metric straight threads.

Tube-to-Threaded Pipe Adapters






For Tube OD	Pipe Size	Straights, Male Pipe ★		Straights, Female Pipe ★		Swivel 90° Elbows, Male Pipe		Swivel Long 90° Elbows, Male Pipe		Swivel 90° Elbows, Female Pipe		Swivel 45° Elbows, Male Pipe	
1/8″	10-32	5779K241	$2.71	5779K441	$14.69	5779K281	$5.17	5779K222	$8.23	5779K447	$13.60	5779K331	$6.78
1/8″	1/16	5779K242	4.08			5779K282	7.03					5779K401	12.25
1/8″	1/8	5779K102	2.96	5779K123	4.58	5779K143	3.33	5779K148	6.78	5779K631	6.40	5779K332	4.18
1/8″	1/4	5779K243	4.51	5779K251	6.22	5779K283	5.02	5779K149	6.98	5779K462	11.25	5779K402	9.13
5/32″	10-32	5779K244	2.71	5779K442	12.33	5779K284	4.66	5779K223	8.35	5779K448	12.49	5779K403	11.15
5/32″	1/8	5779K104	2.41	5779K125	5.62	5779K146	2.81	5779K165	8.40	5779K632	5.40	5779K404	7.58
5/32″	1/4	5779K105	4.67	5779K126	7.15	5779K147	5.86	5779K166	11.18	5779K633	7.92	5779K468	9.90
3/16″	1/8	5779K245 ■	4.06	5779K252 ■	6.80	5779K285	6.95			5779K463	8.57	5779K405	9.40
3/16″	1/4			5779K248 ■	18.85								
1/4″	10-32	5779K246	3.52	5779K443	16.20	5779K286	5.85	5779K224	8.20	5779K449	12.11	5779K406	10.96
1/4″	M7							5779K225	7.06				
1/4″	1/8	5779K108	3.08	5779K129	4.38	5779K151	3.12	5779K167	6.47	5779K634	4.05	5779K333	3.87
1/4″	1/4	5779K109	3.08	5779K131	5.67	5779K152	3.42	5779K169	6.76	5779K635	6.00	5779K334	4.91
1/4″	3/8	5779K111	4.00	5779K488	12.53	5779K153	4.58	5779K173	8.40	5779K451	14.75	5779K446	16.13
5/16″	1/8	5779K112	5.35	5779K132	8.20	5779K154	6.50	5779K188	10.88	5779K636	8.68	5779K407	7.78
5/16″	1/4	5779K113	5.35	5779K133	7.78	5779K155	6.50	5779K189	11.71	5779K637	8.68	5779K408	8.93
5/16″	3/8	5779K114	6.11			5779K156	6.82					5779K409	12.68
3/8″	1/8	5779K115	5.83	5779K134	7.45	5779K157	5.42	5779K218	9.72	5779K452	14.45	5779K411	12.05
3/8″	1/4	5779K116	4.38	5779K135	8.60	5779K158	4.80	5779K219	9.55	5779K638	7.58	5779K335	5.83
3/8″	3/8	5779K117	5.30	5779K136	9.12	5779K159	5.33	5779K221	11.88	5779K453	16.00	5779K336	6.06
3/8″	1/2	5779K118	7.55	5779K444	13.13	5779K161	8.13			5779K454	18.76	5779K461	12.67
1/2″	1/4	5779K119	7.40	5779K445	16.82	5779K162	6.08			5779K455	17.13		
1/2″	3/8	5779K121	7.55	5779K137	10.50	5779K163	7.73			5779K639	11.38		
1/2″	1/2	5779K122	7.88	5779K139	11.62	5779K164	8.65			5779K456	21.36		

★ Body is nickel-plated brass. ■ The body and threads are plain brass.

Easy-Access 90° Elbows, Male Pipe

For Tube OD	Pipe Size			For Tube OD	Pipe Size		
1/8″	10-32	5779K657	$6.47	1/4″	1/4	5779K653	$14.50
5/32″	10-32	5779K658	6.03	1/4″	3/8	5779K654	17.85
5/32″	1/8	5779K651	16.27	5/16″	1/8	5779K457	20.38
3/16″	1/8	5779K464	17.95	5/16″	1/4	5779K458	45.78
1/4″	10-32	5779K659	9.38	3/8″	1/4	5779K655	21.60
1/4″	1/8	5779K652	14.85	3/8″	3/8	5779K656	17.98

Easy-Access Double 90° Elbows, Male Pipe

For Tube OD	Pipe Size		
5/32″	10-32	5779K249	$9.93
5/32″	1/8	5779K253	12.63
1/4″	1/8	5779K254	15.66
1/4″	1/4	5779K255	27.52
3/8″	1/4	5779K256	29.85
3/8″	3/8	5779K257	23.35

(Continued on following page)

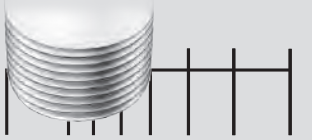
Quick-Disconnect Tube Couplings

For technical drawings and 3-D models, go to mcmaster.com.

For information about selecting pipe size, see pages 2-3.

How to Measure Threaded Pipe Size—Example shows pipe size 3/8.

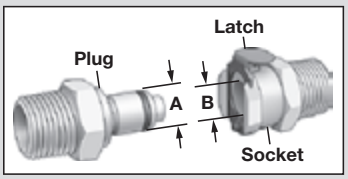
Pipe size is an industry designation, not the actual size. Place your pipe or fitting on the scale to determine the pipe size. You can also measure the outside diameter (OD) of your pipe or inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.



Pipe Size: 0	1/16	1/8	1/4	3/8	1/2	3/4	1
OD (to nearest 1/8″): 0	1/4″	3/8″	1/2″	5/8″	3/4″	1″	1 1/4″

Pipe Size: 0	1/16	1/8	1/4	3/8	1/2	3/4	1
ID (to nearest 1/8″): 0	1/4″	3/8″	1/2″	5/8″	3/4″	1″	1 1/4″

About Quick-Disconnect Tube Couplings



A complete quick-disconnect coupling consists of a plug and a socket with the same coupling size. To connect, insert the plug into the socket. This connection also permits 360° swiveling, so your tubing won't twist and kink. To disconnect, press the latch and remove the plug. All couplings have an O-ring.

Coupling size is the accepted industry designation, not the actual measured size. You can determine the actual dimension of the plug and socket by measuring the OD of the plug (A) and the ID of the socket (B).

Air and Water Quick-Disconnect Tube Couplings

- Maximum Pressure: 100 psi @ 70° F
- Temperature Range: –40° to 180° F
- Tubing: Compression Couplings: Use with firm and hard (Shore A82-D60) polyethylene and nylon Barbed Couplings: Use with soft and firm (Shore A68-A80) polyurethane

Because they're made of moisture-resistant acetal, these couplings are commonly used for air and water applications. Couplings are white. The sockets have a Type 316 stainless steel latch, except the food and beverage sockets have an acetal latch. Sterilize with chemicals. Vacuum rating is 24″ Hg @ 70° F.

Plugs and sockets **with shut-off** have a valve that stops the flow when the coupling is separated. **Through-wall** couplings are also known as bulkhead couplings.

Miniature Couplings—Are twist-lock style. The sockets do not have a latch.

Food and Beverage Couplings—Materials are NSF/ANSI 169 listed.

Threaded Couplings—Have NPT threads.

Compression Couplings—Insert your tubing into the plug or socket and tighten the nut to form a seal.

Barbed Couplings—Insert the barbed end into your tubing and secure with a clamp (see pages 330-336). The couplings for 1/16″ tube ID have a collar that limits the size of the tubing to a maximum 1/8″ OD.

Note: For a complete coupling, order a set or a plug and a socket with the same coupling size.

Plug and Socket Sets—With Shut-Off on Both Ends

Male Pipe on Both Ends

Pipe Size		
1/8	5012K111	$19.46
1/4	5012K112	19.72
3/8	5012K113	19.72

Compression on Both Ends

For Tube OD		
1/4″	5012K122	$24.24
3/8″	5012K123	24.49

Barbed on Both Ends

For Tube ID		
1/8″	5012K114	$19.18
1/4″	5012K115	18.30
3/8″	5012K116	18.30

Male Pipe Plug × Barbed Socket

Pipe Size	For Tube ID		
1/8	1/8″	5012K117	$19.57
1/4	1/4″	5012K118	19.27
3/8	3/8″	5012K119	19.27

Compression Plug × Male Pipe Socket

For Tube OD	Pipe Size		
1/4″	1/8	5012K124	$19.30
1/4″	1/4	5012K125	21.09
3/8″	3/8	5012K126	21.09

Standard Plugs

Pipe Size	*Threaded, Male Pipe* With Shut-Off		*Threaded, Male Pipe* Open Flow	
1/8 Coupling Size (A=5/16″)				
1/8	5012K46	$9.95	5012K27	$3.06
1/4	5012K47	10.07	5012K28	3.06
1/4 Coupling Size (A=7/16″)				
1/4	5012K87	9.79	5012K73	2.97
3/8	5012K88	9.79	5012K74	1.95

For Tube OD	*Compression* With Shut-Off		*Compression* Open Flow		*Through-Wall, Compression* With Shut-Off		*Through-Wall, Compression* Open Flow	
1/8 Coupling Size (A=5/16″)								
5/32″	5012K222	$17.36	5012K221	$5.36				
1/4″	5012K41	9.75	5012K22	5.14	5012K482	$17.09	5012K481	$10.57
3/8″	5012K42	12.26	5012K23	6.69				
1/4 Coupling Size (A=7/16″)								
1/4″	5012K692	11.84	5012K691	5.60	5012K492	13.36	5012K491	10.29
3/8″	5012K84	11.84	5012K69	5.60	5012K496	16.44	5012K495	10.45

For Tube ID	*Barbed* With Shut-Off		*Barbed* Open Flow		*Through-Wall, Barbed* With Shut-Off		*Through-Wall, Barbed* Open Flow	
1/8 Coupling Size (A=5/16″)								
1/16″	5012K43	$10.03	5012K24	$2.54	5012K52	$16.14	5012K51	$9.42
1/8″	5012K44	8.94	5012K25	1.59	5012K54	13.83	5012K53	7.78
3/16″	5012K252	9.29	5012K251	1.86	5012K56	14.53	5012K55	7.19
1/4″	5012K45	8.94	5012K26	1.94	5012K58	14.17	5012K57	7.92
1/4 Coupling Size (A=7/16″)								
1/4″	5012K85	7.34	5012K71	1.48	5012K94	14.01	5012K93	6.27
5/16″	5012K712	7.34	5012K711	1.78	5012K96	14.91	5012K95	8.40
3/8″	5012K86	7.34	5012K72	1.48	5012K98	14.71	5012K97	7.94

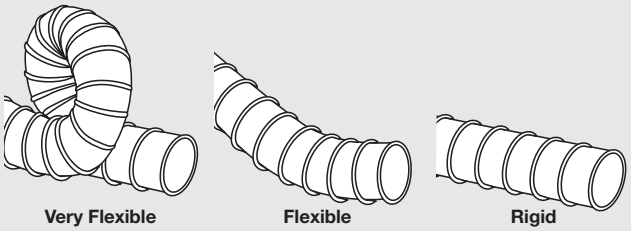
(Continued on following page)

Duct Hose

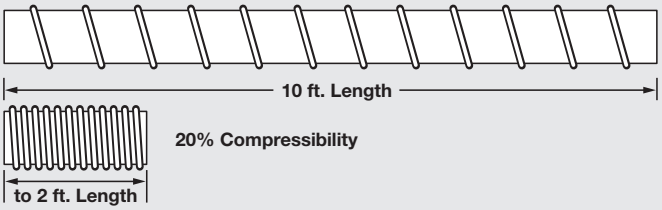
About Duct Hose

Duct hose is designed for use in blowing and venting applications. While it is typically used to exhaust air and fumes, some types of duct hose can carry materials such as dust, chips, shavings, and liquids.

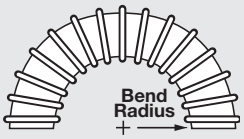
Flexibility—Flexibility takes into account several factors, including bend radius, material, and hose diameter. We've rated the flexibility for each hose in general terms:



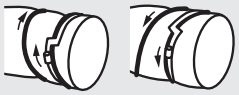
Compressibility—Compressibility is listed as a percentage. The lower the percentage, the more compressible the hose. For example, if a 10-ft. hose compresses to 20%, the hose compresses to 2 ft. Hose lengths given are the extended length, unless otherwise stated.



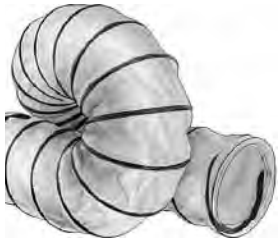
Bend Radius—An indicator of how much you can bend a hose without damaging it, bend radius is measured from the center of the bend to the inside edge of the hose. The smaller the measurement, the more flexible the hose.



Spiral Direction—The direction of the hose spiral determines whether you need a right-hand clamp or a left-hand clamp. When looking at the end of the hose, a right-hand spiral will twist away from you clockwise; a left-hand spiral will twist away from you counterclockwise.



Blo-N-Vent Duct Hose for Air



Hose with Wear Strip and Embedded Wire Ends

- Very flexible
- Temperature Range: –65° to 250° F
- Color: Yellow; wear strip is black
- Clamps: Use worm-drive clamps (see pages 330-334)

Our most versatile duct hose for blowing and venting air, this 0.013″ thick neoprene-coated polyester hose is lightweight and very flexible. It has a right-hand metal spiral, a ribbed interior, and can be used outdoors. Hose with a 4″ to 5″ ID compresses to 20% of its length; 6″ to 24″ ID compresses to 10%. Meets UL 94V0 for flame retardance. Not rated for vacuum. Maximum continuous length is 25 feet.

Hose with Wear Strip—The wear strip protects against damage caused by dragging. *Hose with embedded wire ends* has a wire rope sewn into each end that lets you connect lengths of hose without a duct hose connector or clamp. Squeeze the end on one hose and slip it into the opening of another.

				Hose			*Hose with Wear Strip*					
				With Unfinished Ends			With Unfinished Ends			With Embedded Wire Ends		
ID	OD	Bend Radius	Max. psi @ 72° F		Per Ft. 1-24	Per Ft. 25-Up		Per Ft. 1-24	Per Ft. 25-Up	10 ft.	25 ft.	Other Lengths, ft.
4″	4 5/16″	3″	5.4	5265K14	$7.43	$5.78	5265K41	$8.63	$6.71	5265K61	$89.90	$183.64	1 to 50
5″	5 3/8″	3 1/2″	4	5265K15	8.66	6.73	5265K42	10.54	8.20	5265K62	84.58	185.20	1 to 50
6″	6 3/8″	3 1/2″	3	5265K16	9.63	7.49	5265K43	11.20	8.71	5265K63	116.37	237.83	1 to 50
8″	8 7/16″	5″	3	5265K18	10.63	8.27	5265K45	12.37	9.62	5265K64	128.73	263.26	1 to 50
10″	10 1/2″	6 1/2″	2.5	5265K21	12.17	9.47	5265K47	14.66	11.40	5265K65	152.43	312.22	1 to 50
12″	12 1/2″	7 1/2″	2	5265K23	14.91	11.60	5265K49	17.86	13.89	5265K66	184.80	356.02	1 to 50
14″	14 1/2″	8 1/2″	1.7	5265K25	18.37	14.29	5265K51	20.40	15.87	5265K67	212.23	431.39	1 to 50
16″	16 1/2″	9 1/2″	1.5	5265K27	20.03	15.58	5265K53	23.91	18.60	5265K68	248.90	496.20	1 to 50
18″	18 1/2″	10 1/2″	1.3	5265K29	24.11	18.76	5265K55	28.34	22.04	5265K69	294.75	600.00	1 to 50
20″	20 1/2″	12″	1.1	5265K31	26.40	20.53	5265K56	31.03	24.13	5265K72	324.39	647.28	1 to 50
24″	24 9/16″	13″	1	5265K32	32.63	25.38	5265K57	38.83	30.20	5265K74	403.95	806.04	1 to 50

Insulated Blo-N-Vent Duct Hose with Wear Strip for Air

- Very flexible
- Temperature Range: –40° to 250° F
- Color: Yellow with a black wear strip
- Clamps: Use worm-drive and quick-release clamps (see pages 330-334)

A layer of fiberglass insulation helps maintain the temperature inside the hose. Use for heating and cooling applications in outdoor environments. Insulation is 1″ thick and has an R value of 4. Hose has a wear strip that protects against damage caused by dragging. The ends are cuffed for easy attachment to duct hose connectors. Hose is made from 0.008″ thick neoprene-coated polyester with a right-hand metal spiral and a ribbed interior. Hose with a 4″ to 5″ ID compresses to 35% of its length; 6″ to 24″ ID compresses to 20%. The liner meets UL 94V0 for flame retardance.

ID	OD	Bend Radius	Vacuum @ 72° F	Max. psi @ 72° F		10 ft.	25 ft.
4″	5 7/16″	3″	8″ Hg	8.2	1210N11	$197.82	$494.55
5″	6 3/8″	3 1/2″	7.2″ Hg	4.5	1210N12	299.09	747.73
6″	8 7/16″	4″	6.4″ Hg	4	1210N13	308.73	771.82
8″	9 1/2″	5″	6.1″ Hg	3.5	1210N14	324.36	810.91
10″	11 9/16″	6″	3.1″ Hg	2.8	1210N15	363.45	908.64
12″	13 1/2″	7 1/2″	1.8″ Hg	2.3	1210N16	436.73	1,091.82
14″	16 9/16″	8 1/2″	1.2″ Hg	2	1210N17	508.91	1,272.27
16″	17 1/2″	10″	0.7″ Hg	1.7	1210N18	581.64	1,454.09
18″	19 1/2″	11″	0.5″ Hg	1.6	1210N19	676.00	1,690.00
20″	21 9/16″	12″	0.4″ Hg	1.4	1210N21	800.91	2,002.27
24″	26 9/16″	14″	Not Rated	0.9	1210N22	965.27	2,413.18

How to Measure Threaded Pipe Size—Example shows pipe size 3/8.

Pipe size is an industry designation, not the actual size. Place your pipe or fitting on the scale to determine the pipe size. You can also measure the outside diameter (OD) of your pipe or inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.

Pipe Size:	0	1/16	1/8	1/4	3/8	1/2	3/4	1
OD (to nearest 1/8"):	0	1/4"	3/8"	1/2"	5/8"	3/4"	1"	1 1/4"

Pipe Size:	0	1/16	1/8	1/4	3/8	1/2	3/4	1
ID (to nearest 1/8"):	0	1/4"	3/8"	1/2"	5/8"	3/4"	1"	1 1/4"

About Hose

Hose generally has two layers of material and is reinforced for extra strength. It can be used in higher pressure applications than tubing.

All of our hose lists bend radius, which is an indicator of flexibility. This is the most you can bend a hose without damaging it or shortening its life. Bend radius is measured from the center of the bend to the inside edge of the hose. The smaller the measurement, the more flexible the hose.

Air Hose

For information about pipe size and threads, see pages 2-3.

Air Hose

- Temperature Range: –40° to 200°F
- Hose: EPDM rubber
- Color: Black or red

Hose is made of EPDM rubber, which is the most common material for air applications. It has a smooth interior and is reinforced with yarn. Hose can be used outdoors.

Hose

To attach your own fittings to the hose, you'll need a barbed hose fitting (see pages 342-346) and a clamp (see pages 330-341).

Maximum continuous length is 100 ft.

Hose ID	Hose OD	Bend Radius	Max psi @ 72°F	Black	Red	Per Ft. 1-99	Per Ft. 100-Up
3/16"	7/16"	1 3/16"	250	5304K42	5405K18	$0.71	$0.59
1/4"	1/2"	1 1/2"	200	5304K14	5405K2	.79	.67
1/4"	1/2"	1 1/2"	300	5304K16	5405K3	1.21	1.00
5/16"	5/8"	2"	300	5304K19	5405K4	1.20	.99
3/8"	11/16"	2 1/4"	200	5304K22	5405K5	.90	.82
3/8"	11/16"	2 1/4"	300	5304K24	5405K6	1.46	1.20
1/2"	13/16"	3"	200	5304K26	5405K7	1.40	1.17
1/2"	7/8"	3"	300	5304K28	5405K8	1.59	1.34
5/8"	15/16"	3 3/4"	200	5304K96	5405K9	1.96	1.63

Hose ID	Hose OD	Bend Radius	Max psi @ 72°F	Black	Red	Per Ft. 1-99	Per Ft. 100-Up
5/8"	1"	3 3/4"	300	5304K31	5405K11	$2.09	$1.73
3/4"	1 3/16"	4 1/2"	200	5304K65	5405K12	2.10	1.73
3/4"	1 3/16"	4 1/2"	300	5304K44	5405K13	2.29	1.87
1"	1 3/8"	7"	200	5304K66	5405K14	2.99	2.75
1"	1 3/8"	7"	300	1593N91	5405K15	3.20	2.65
1 1/4"	1 3/4"	8 3/4"	200	5304K46	5405K16	5.85	4.72
1 1/2"	2"	10 1/2"	200	5304K47	5405K17	6.81	5.45
2"	2 9/16"	14"	200	1593N69	1593N68	7.00	5.85

Hose with Male Threaded Fittings

Fittings are brass. Those with pipe sizes of 1/8 to 1 have NPTF (Dryseal) threads; those with pipe sizes of 1 1/4 to 2 have NPT threads. Both NPTF and NPT threads are compatible with NPSM (National Pipe Straight Mechanical) threads.

To Order: Please specify black or red hose.

Pipe Size	Hose OD	Bend Radius	Max. psi @ 72°F		1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	10 ft.	15 ft.	25 ft.	50 ft.	75 ft.	100 ft.	Other Lg., ft.
1/8	1/2"	1 1/2"	200	1593N45	$5.63	$6.35	$7.07	$7.78	$8.48	$12.04	$15.58	$22.72	$40.50	$58.28	$76.11	1 to 500
1/4	1/2"	1 1/2"	200	1593N1	13.23	14.00	14.77	15.50	16.24	20.09	23.87	31.51	50.53	69.57	76.46	1 to 500
1/4	1/2"	1 1/2"	300	1593N4	13.60	14.74	15.88	17.02	18.17	23.91	29.63	41.06	69.69	95.99	107.02	1 to 500
3/8 x 1/4	11/16"	2 1/4"	200	1593N38	12.92	14.92	15.67	16.34	16.94	21.67	25.82	33.51	56.24	78.48	90.69	1 to 500
3/8	11/16"	2 1/4"	200	1593N7	14.35	15.24	16.13	17.02	17.91	22.33	26.75	35.59	57.68	79.79	93.29	1 to 500
3/8	11/16"	2 1/4"	300	1593N11	14.90	16.26	17.68	19.04	20.39	27.30	34.19	48.02	82.49	117.00	126.86	1 to 500
1/2 x 3/8	13/16"	3"	200	1593N42	20.65	21.56	23.19	24.63	26.04	33.71	40.00	53.86	89.35	122.71	134.70	1 to 500
1/2	13/16"	3"	200	1593N14	21.93	23.22	24.58	25.91	27.24	33.95	40.62	53.97	87.36	120.77	131.90	1 to 500
1/2	7/8"	3"	300	1593N17	22.08	23.59	25.06	26.60	28.08	35.60	43.09	58.15	95.71	133.29	147.12	1 to 500
3/4	13/16"	4 1/2"	200	1593N21	22.02	24.04	26.03	28.04	30.03	40.06	50.05	70.07	120.11	170.16	185.45	1 to 500
3/4	13/16"	4 1/2"	300	1593N24	22.18	24.32	26.47	28.61	30.76	41.52	52.26	73.76	127.49	181.19	195.25	1 to 500
1	1 3/8"	7"	200	1593N27	48.93	51.78	54.62	57.49	60.33	74.62	88.89	117.46	188.86	260.30	309.09	1 to 500
1	1 3/8"	7"	300	1593N31	49.11	52.19	55.26	58.31	61.36	76.65	91.95	122.56	199.05	275.50	298.94	1 to 500
1 1/4	1 3/4"	8 3/4"	200	1593N34	89.46	95.02	100.66	106.11	111.67	139.44	167.20	222.75	361.60	500.45	532.10	1 to 500
1 1/2	2"	10 1/2"	200	1593N36	88.32	94.78	101.25	107.69	114.16	146.45	178.72	243.27	404.70	566.15	602.27	1 to 500
2	2 1/2"	14"	200	1593N47	168.91	176.93	184.98	193.02	201.05	241.22	281.38	356.15	562.58	763.42	964.27	1 to 500

(Continued on following page)

Fire-Fighting Hose

For information about pipe size and threads, see pages 2-3.

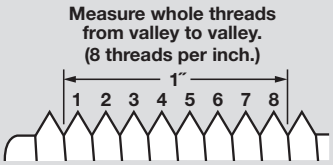
About Fire-Fighting Hose Threads and Fittings

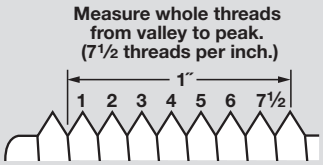
There are two main types of fire-fighting hose threads: **NH** (National Hose), which is also known as NST (National Standard Thread), and **NPSH** (National Pipe Straight Hose).

If you don't know the type or size of your threads, measure the ID or OD of your fitting and count the threads per inch.

How to Choose Fire-Fighting Hose Threads

Fitting ID Female	Fitting OD Male	Threads per Inch	NH/NST Threads	NPSH Threads
1″	1″	14		3/4″ NPSH
1 1/8″	1 1/4″	11 1/2		1″ NPSH
1 1/4″	1 3/8″	8	1″ NH/NST	
1 3/4″	1 7/8″	11 1/2		1 1/2″ NPSH
1 7/8″	2″	9	1 1/2″ NH/NST	
2 5/8″	2 7/8″	8		2 1/2″ NPSH
3″	3 1/16″	7 1/2	2 1/2″ NH/NST	
3 1/2″	3 5/8″	6	3″ NH/NST	

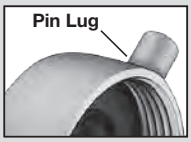


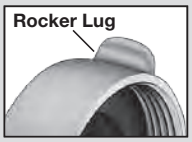


Once you determine which threads you have, use the chart below to see which threads will mate with them.

Thread Type	Compatibility
NH/NST	Work with other NH/NST threads.
NPSH	Male threads work with female NPSH threads. Female threads work with male NPSH, NPT, NPTF, and NPSM threads.

Next, select from two styles of fire-fighting hose fittings: pin lug and rocker lug. Both lug styles provide a quick connection to hydrants and washdown equipment. Tighten with a hook-style spanner wrench (see Hydrant Wrenches on page 2820).





Note: Some of our fire-fighting hose adapters on page 309 have NPT threads. NPT is the accepted industry designation for pipe, not an actual size.

Fire-Fighting Hose

Hose meets NFPA (National Fire Protection Association) standards. It has a smooth interior and is suitable for outdoor use. Hose has one male threaded fitting and one easy-install female threaded fitting that swivels 360° until tightened. *Brass fittings* are more durable than aluminum fittings. *Aluminum fittings* are lighter than brass fittings.

Lightweight Hose—Also known as pin-rack hose, this hose can be folded to fit in a rack. Hose is polyurethane with a polyester cover. It is FM approved. Temperature range is -40° to 180° F.

Choose-a-Color Abrasion-Resistant Hose—Differentiate your hose by color. The abrasion-resistant polyester cover on this hose comes in red, white, or yellow. Hose is EPDM rubber. It is UL listed and FM approved. Temperature range is -40° to 150° F.

Abrasion-Resistant Hose—Lightweight yet tough, this hose is EPDM rubber with an abrasion-resistant polyester cover. It is UL listed and FM approved, unless noted. Temperature range is -40° to 150° F.

Extra-Tough Hose—Two heavy duty polyester covers protect this hose. Hose is EPDM rubber. It is UL listed and FM approved, unless noted. Temperature range is -40° to 150° F.

Hose ID	Max. psi @ 72° F	Thread Size	Length, ft.	*Brass Pin-Lug Fittings* NH/NST	NPSH		*Brass Rocker-Lug Fittings* NH/NST	NPSH		*Aluminum Rocker-Lug Fittings* NH/NST	NPSH	
Lightweight—White												
1 1/2″	225	1 1/2″	50	6549T151	6549T152	$103.00	6549T153★	6549T154★	$93.50	6549T721	6549T722	$95.50
1 1/2″	225	1 1/2″	75	6549T161	6549T162	132.50	6549T163★	6549T164★	123.00	6549T731	6549T732	125.00
1 1/2″	225	1 1/2″	100	6549T172	6549T171	162.00	6549T173★	6549T174★	152.00	6549T741	6549T742	154.50
2 1/2″	225	2 1/2″	50	6549T541	6549T542	331.55	6549T543	6549T544	331.55			
2 1/2″	225	2 1/2″	75	6549T662	6549T661	459.58	6549T664	6549T663	459.58			
2 1/2″	225	2 1/2″	100	6549T581	6549T582	466.05	6549T583	6549T584	466.05			
Choose-a-Color Abrasion-Resistant—To Order: Please specify red, white, or yellow.												
1 1/2″	225	1 1/2″	50	6446T113	6446T114	207.80	6446T115	6446T116	207.80	6446T143	6446T144	154.87
1 1/2″	225	1 1/2″	75	6446T123	6446T124	237.95	6446T125	6446T126	237.95	6446T145	6446T146	185.02
1 1/2″	225	1 1/2″	100	6446T133	6446T134	275.71	6446T135	6446T136	275.71	6446T147	6446T148	247.00
Abrasion Resistant—White												
1″	270	1″	50							6446T681■	6446T682■	126.65
1″	270	1″	100							6446T691■	6446T692■	196.91
2 1/2″	225	2 1/2″	50	6446T21	6446T24	340.11	6446T46	6446T49	340.11			
2 1/2″	225	2 1/2″	75	6446T22	6446T25	407.51	6446T47	6446T51	407.51			
2 1/2″	225	2 1/2″	100	6446T23	6446T26	489.65	6446T48	6446T52	489.65			
Extra Tough—White												
1 1/2″	270	1 1/2″	50	6555T21	6555T24	275.47	6555T27	6555T31	275.47	6555T112■	6555T111■	195.78
1 1/2″	270	1 1/2″	100	6555T23	6555T26	441.56	6555T29	6555T33	441.56	6555T132■	6555T131■	351.56
2 1/2″	270	2 1/2″	50	6555T45	6555T48	431.89	6555T52	6555T55	454.11	6555T122■	6555T121■	286.20
2 1/2″	270	2 1/2″	100	6555T47	6555T51	646.49	6555T54	6555T57	646.49	6555T142■	6555T141■	504.85

★Has combination pin/rocker-lug fittings. ■Not UL listed or FM approved.

Racks and Reels for Fire-Fighting Hose

Rack (Hose Not Included)

Reel

A pivoting mounting bracket allows racks and reels to swing as the hose is released to prevent kinking. Material is steel. Color is red. Fasteners are not included.

Racks are for use with foldable lightweight fire-fighting hose (also known as pin-rack hose). The mounting bracket has four 1/2″ dia. mounting holes. **Reels** allow quick winding and unwinding of hose; the mounting bracket has four 3/8″ dia. mounting holes. **Covers** are red vinyl-coated nylon and have "Fire Hose Keep Clear" printed on them.

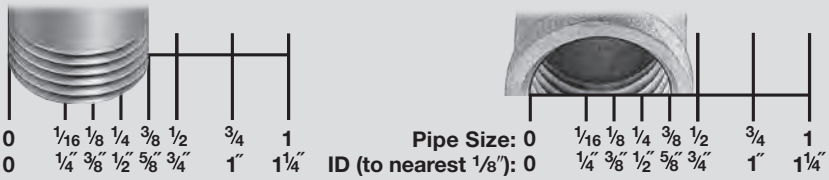
For Hose ID	*Hose Capacity* Light-weight	Abrasion Resistant	Extra Tough	*Racks/Reels* Wd.	Ht.	Extended Dp.	Racks and Reels		Covers	
Rack										
1 1/2″	150 ft.	Not Rated	Not Rated	6″	1 1/2″	20″	6465T13	$145.07	6465T21	$39.52
Reels										
1 1/2″ to 1 3/4″	150 ft.	75 ft.	50 ft.	6 1/4″	18″	23 1/2″	6464T11	164.29	6464T21	29.40
1 1/2″ to 1 3/4″	200 ft.	100 ft.	75 ft.	6 1/4″	24″	29″	6464T12	197.62	6464T22	35.02
2″ to 2 1/2″	200 ft.	100 ft.	75 ft.	8 1/2″	24″	29″	6464T13	285.71	6464T23	37.50

Air & Steam Hose

For information about pipe size and threads, see pages 2-3

How to Measure Threaded Pipe Size—Example shows pipe size of 3/8.

Pipe size is an industry designation, not the actual size. Place your pipe or fitting on the scale to determine the pipe size. You can also measure the outside diameter (OD) of your pipe or inside diameter (ID) of your fitting, then select the pipe size on the scale that corresponds to your measurement.



About Pressure Reductions for Extreme-Temperature Air and Steam Hose

We list the maximum pressure rating (max. psi) for constant flow at room temperature. If your application requires higher temperatures or different flow conditions you will need to adjust the maximum pressure rating of your hose.

1. To calculate the maximum pressure rating, first account for temperature. As the temperature increases, the amount of pressure a hose can withstand decreases. Multiply the max. psi listed for your hose by the factors below.

Temperature	Multiply Max. psi by
≤ 200° F	No change
201° to 400° F	0.93
401° to 800° F	0.74
801° to 1200° F	0.30

2. Adjust the pressure rating again based on your flow conditions. Round the final digit down to the nearest whole number.

Flow Conditions	Divide Max. psi by
Constant (no variations in pressure)	No change
Pulsating (periodic variations in pressure)	2
Shock (sharp spikes in pressure)	6

For example, if the max. psi listed is 3,000, and you are using the hose at 400° F under pulsating conditions, your calculation would be (3,000 × 0.93) ÷ 2 = 1,395 max. psi.

Extreme-Temperature Air and Steam Hose

- Use with air, steam, and mineral oil
- Temperature Range: -325° to 1200° F

Braided stainless steel construction gives this hose flexibility and makes it tough enough to handle extreme temperatures, as well as vibration. Vacuum rating is 29" Hg @ 72° F. Hose has a ribbed interior. Suitable for outdoor use.

Corrosion Resistant—Hose is 321 stainless steel with 304 stainless steel braid and fittings.

Chemical Resistant—Hose is 316 stainless steel with a 304 stainless steel braid and 316 stainless steel fittings. It offers a wider range of chemical compatibility than corrosion-resistant hose. Use with chemicals such as phosphoric acid (25%), sodium hydroxide (10%), and isopropyl alcohol.

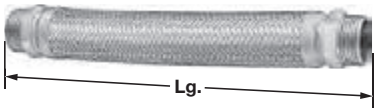
High-Pressure Corrosion Resistant—Hose is 321 stainless steel with a 321 stainless steel braid and 304 stainless steel fittings. It is double-braided to withstand higher pressures.

Extra-flexible hose allows for misalignment and is easy to bend.

ⓘ For information about chemical compatibility, go to mcmaster.com and search for the part number.

Hose with Male Threaded Fittings

Fittings have NPT threads.



Pipe Size	Max. psi @ 72° F	Hose OD	Flexible Bend Radius		12"	18"	24"	36"	Other Lengths	Extra Flexible Bend Radius		12"	18"	24"	36"	Other Lengths
Corrosion Resistant																
1/4	1,800	1/2"	4 1/2"	5680K61	$32.24	$34.78	$37.33	$42.40	7"-120"	3 11/16"	54875K31	$41.88	$50.16	$58.44	$75.00	7"-120"
3/8	1,550	3/4"	5"	5680K12	34.41	37.83	41.25	48.09	7"-120"	4"	54875K13	47.26	55.78	64.30	81.34	7"-120"
1/2	1,180	7/8"	5 1/2"	5680K13	36.96	40.68	44.40	51.84	7"-120"	4 3/8"	54875K15	52.53	60.45	68.37	84.21	7"-120"
3/4	890	1 1/4"	8"	5680K64	44.67	49.46	54.23	63.79	9"-120"	6 3/8"	54875K17	61.03	71.23	81.43	101.83	9"-120"
1	710	1 1/2"	9"	5680K15	52.17	58.23	64.29	76.41	9"-120"	7 1/16"	54875K19	74.03	85.91	97.79	121.55	9"-120"
1 1/4	640	1 7/8"	10"	5680K16	74.02	81.76	89.50	104.98	9"-120"	7 7/8"	54875K21	73.94	89.06	104.18	134.42	9"-120"
1 1/2	530	2 1/4"	11"	5680K17	84.19	93.07	101.95	119.71	10"-120"	8 11/16"	54875K23	82.54	100.60	118.66	154.78	10"-120"
2	440	2 3/4"	13"	5680K68	104.47	116.27	128.08	151.62	11"-120"	10 5/16"	54875K25	101.09	121.91	142.73	184.37	11"-120"
2 1/2	410	3 1/2"	16"	5680K19	164.09	181.19	198.29	232.49	12"-120"	12 7/8"	54875K51	150.52	181.40	198.60	256.32	12"-120"
3	340	4"	18"	5680K2	195.47	213.41	231.35	267.23	12"-120"	14 1/2"	54875K53	185.77	221.38	240.11	305.34	12"-120"
4	290	5 1/8"	22"	5680K3	271.93	303.49	335.05	398.17	12"-120"	17 1/2"	54875K55	252.58	291.14	316.40	380.27	12"-120"
Chemical Resistant																
1/4	1,800	1/2"	4 1/2"	5793K61	36.16	38.74	41.32	46.48	7"-120"	3 11/16"	5301T41	45.74	52.87	59.98	74.18	7"-120"
3/8	1,550	3/4"	5"	5793K12	40.94	44.60	48.26	55.58	7"-120"	4"	5301T42	51.56	59.32	67.07	82.56	7"-120"
1/2	1,180	7/8"	5 1/2"	5793K13	49.19	53.75	58.31	67.43	7"-120"	4 3/8"	5301T43	58.50	66.24	73.98	89.46	7"-120"
3/4	890	1 1/4"	8"	5793K64	57.75	63.63	69.51	81.27	9"-120"	6 3/8"	5301T44	68.04	76.95	85.84	103.62	9"-120"
1	710	1 1/2"	9"	5793K15	78.06	85.50	92.94	107.82	9"-120"	7 1/16"	5301T45	82.27	93.05	103.84	125.39	9"-120"
1 1/4	640	1 7/8"	10"	5793K16	83.00	91.94	100.88	118.76	9"-120"	7 7/8"	5301T46	82.89	98.46	114.01	145.05	9"-120"
1 1/2	530	2 1/4"	11"	5793K17	94.37	104.69	115.01	135.65	10"-120"	8 11/16"	5301T47	93.77	110.80	127.80	161.74	10"-120"
2	440	2 3/4"	13"	5793K68	142.26	154.74	167.22	192.18	11"-120"	10 5/16"	5301T48	111.89	131.79	151.65	191.34	11"-120"
2 1/2	410	3 1/2"	16"	5793K19	181.59	200.79	219.99	258.39	12"-120"	12 7/8"	5301T73	186.52	207.16	227.80	269.08	12"-120"
3	340	4"	18"	5793K2	216.34	236.44	256.54	296.74	12"-120"	14 1/2"	5301T75	235.18	257.50	279.82	324.46	12"-120"
4	290	5 1/8"	22"	5793K3	301.46	335.12	368.78	436.10	12"-120"	17 1/2"	5301T77	296.64	324.78	352.93	409.22	12"-120"
High-Pressure Corrosion Resistant																
3/4	3,600	1 3/8"	10"	5615K11	83.70	111.02	138.32	192.90	9"-120"							
1	3,000	1 3/4"	11"	5615K21	100.80	135.97	171.09	241.34	9"-120"							
1 1/4	2,600	2"	12 1/2"	5615K31	129.22	171.23	213.21	297.16	9"-120"							
1 1/2	2,200	2 3/8"	13"	5615K41	140.56	185.57	230.52	320.47	10"-120"							
2	1,650	2 7/8"	14"	5615K51	203.92	265.12	326.32	444.52	12"-120"							
2 1/2	1,050	3 5/8"	16"	5615K52	—	367.40	437.40	577.38	14"-120"							
3	900	4"	20"	5615K53	—	429.48	504.08	653.30	14"-120"							
4	850	5 1/8"	26"	5615K54	—	585.20	701.56	926.13	14"-120"							

(Continued on following page)

About Measuring Hose and Tube Clamps

The best way to measure the clamp size you need is to measure the outside diameter of your hose with the fitting installed. Some clamps accommodate a range of sizes, so be sure the size you need falls in the middle of that range.

Note: It is your responsibility to test and monitor clamps to ensure they are appropriate for your application.

General Purpose Worm-Drive Clamps for Firm Hose and Tube

So easy to install, it's no wonder these are the most frequently used style of hose clamps. Clamps are reusable. The banding is 0.023″ thick. Temperature range is -50° to 250°F. Clamps meet SAE J1508. Clamps are for firm plastic and rubber hose and tube. Do not exceed the maximum torque or clamps may be damaged.

5/16″ band width clamps tighten with a wrench, slotted screwdriver, or 1/4″ external hex nutdriver. Maximum torque is 10 in.-lbs. for clamps with *zinc-plated steel* and *410 stainless steel screws* and 7.5 in.-lbs. for clamps with *305 stainless steel* and *316 stainless steel screws*.

1/2″ band width clamps tighten with a wrench, slotted screwdriver, or 5/16″ external hex nutdriver. Maximum torque is 30 in.-lbs., except clamps with *zinc-plated steel screws* have a maximum torque of 25 in.-lbs.

9/16″ band width clamps tighten with a wrench, slotted screwdriver, or 5/16″ external hex nutdriver. Maximum torque is 30 in.-lbs., except clamps with *zinc-plated steel screws* have a maximum torque of 25 in.-lbs.

301 Stainless Steel Clamps—Have a 301 stainless steel housing and band for very good corrosion resistance. The *zinc-plated screws* have fair corrosion resistance. The *410 stainless steel screws* offer good corrosion resistance. The *305 stainless steel screws* have very good corrosion resistance.

316 Stainless Steel Clamps with 316 Stainless Steel Screw—Have excellent corrosion resistance.

Note: When choosing a clamp, measure the outside diameter of your hose or tube with the fitting installed.

Clamp ID Range		SAE	301 SS with Zinc-Plated Steel Screw			301 SS with 410 SS Screw			301 SS with 305 SS Screw			316 SS with 316 SS Screw		
Inch	mm	No.	Pkg. Qty.		Pkg.	Pkg. Qty.		Pkg.	Pkg. Qty.		Pkg.	Pkg. Qty.		Pkg.
5/16″ Band Width														
7/32″-5/8″★	5.6-16	4	10	5388K14	$6.26	10	5321K14	$7.68	10	54195K14	$8.65	10	5011T141	$11.22
7/16″-25/32″★	11-20	6	10	5388K16	6.26	10	5321K16	7.68	10	54195K16	8.65	10	5011T161	11.22
1/2″-29/32″	13-23	8	10	5388K17	6.87	10	5321K17	8.05	10	54195K17	9.63	10	5011T171	12.50
9/16″-1 1/16″	14-27	10	10	5388K18	6.87	10	5321K18	8.05	10	54195K18	9.63	10	5011T181	12.50
1 1/16″-1 1/4″	17-32	12	10	5388K22	7.85	10	5321K22	9.01	10	54195K22	11.47	10	5011T221	14.90
15/16″-1 1/2″	24-38	16	10	5388K24	7.85	10	5321K24	9.01	10	54195K24	11.47	10	5011T241	14.90
1 3/16″-1 3/4″	30-44	20	10	5388K26	8.85	10	5321K26	10.04	10	54195K26	11.65	10	5011T261	15.12
1 7/16″-2″	37-51	24	10	5388K28	8.89	10	5321K28	10.04	10	54195K28	11.65	10	5011T281	15.12
1 11/16″-2 1/4″	43-57	28	10	5388K32	9.89	10	5321K32	11.09	10	54195K32	11.91	10	5011T321	15.46
1 15/16″-2 1/2″	49-64	32	10	5388K34	9.89	10	5321K34	11.09	10	54195K34	11.91	10	5011T341	15.46
1/2″ Band Width														
7/16″-25/32″★	11-20	6	10	5415K11	7.05	10	5416K11	10.18	10	54155K11	11.87	10	5011T11	15.40
1/2″-29/32″★	13-23	8	10	5415K32	7.05	10	5416K32	10.18	10	54155K32	11.87	10	5011T32	15.40
9/16″-1 1/16″★	14-27	10	10	5415K33	7.05	10	5416K33	10.18	10	54155K33	11.87	10	5011T33	15.40
1 1/16″-1 1/4″★	17-32	12	10	5415K14	7.18	10	5416K14	10.36	10	54155K14	11.87	10	5011T14	15.40
1 3/16″-1 1/2″★	21-38	16	10	5415K15	7.18	10	5416K15	10.36	10	54155K15	11.87	10	5011T15	15.40
1 3/16″-1 3/4″	21-44	20	10	5415K16	7.30	10	5416K16	10.53	10	54155K16	12.22	5	5011T16	7.93
1 1/16″-2″★	27-51	24	10	5415K17	7.30	10	5416K17	10.53	10	54155K17	12.22	5	5011T17	7.93
1 5/16″-2 1/4″	33-57	28	10	5415K18	7.45	10	5416K18	10.69	10	54155K18	12.39	5	5011T18	8.04
1 9/16″-2 1/2″	40-64	32	10	5415K19	7.45	10	5416K19	10.69	10	54155K19	12.39	5	5011T19	8.04
1 13/16″-2 3/4″★	46-70	36	10	5415K21	7.75	10	5416K21	11.15	10	54155K21	12.91	5	5011T21	8.39
1 7/8″-5″	48-127	72	10	5415K34	12.40	5	5416K34	8.86	5	54155K34	9.66	5	5011T34	11.18
2 1/16″-3″★	52-76	40	10	5415K22	9.60	10	5416K22	12.81	10	54155K22	14.44	5	5011T22	9.37
2 5/16″-3 1/4″	59-83	44	10	5415K23	10.56	10	5416K23	14.88	5	54155K23	8.74	5	5011T23	10.79
2 1/2″-5 1/2″	64-140	80	10	5415K35	14.24	5	5416K35	9.14	5	54155K35	9.96	5	5011T35	13.06
2 9/16″-3 1/2″	65-89	48	10	5415K24	10.56	10	5416K24	14.88	5	54155K24	8.74	5	5011T24	10.79
2 13/16″-3 3/4″	71-95	52	10	5415K25	11.39	5	5416K25	8.19	5	54155K25	9.12	5	5011T25	11.28
3 1/16″-4″	78-102	56	10	5415K41	11.39	5	5416K41	8.19	5	54155K41	9.12	5	5011T41	11.28
3 1/8″-6″	79-152	88	10	5415K36	14.60	5	5416K36	9.67	5	54155K36	9.79	5	5011T36	14.62
3 5/16″-4 1/4″	84-108	60	10	5415K42	11.79	5	5416K42	8.44	5	54155K42	8.97	5	5011T42	12.06
3 9/16″-4 1/2″	91-114	64	10	5415K26	11.79	5	5416K26	8.44	5	54155K26	8.97	5	5011T26	11.27
3 5/8″-6 1/2″	92-165	96	10	5415K37	14.87	5	5416K37	9.92	5	54155K37	9.72	5	5011T37	14.99
4 1/8″-7″	105-178	104	10	5415K38	15.05	5	5416K38	10.02	5	54155K38	9.81	5	5011T38	15.11
9/16″ Band Width														
7/16″-25/32″	11-20	6	10	5415K51	9.11	10	5416K45	11.34	10	54155K51	13.16	5	5011T51	9.25
1/2″-29/32″	13-23	8	10	5415K75	9.11	10	5416K53	11.34	10	54155K75	12.20	—	—	—
9/16″-1 1/16″	14-27	10	10	5415K76	9.11	10	5416K54	11.34	10	54155K76	12.20	—	—	—
1 1/16″-1 1/4″	17-32	12	10	5415K54	9.30	10	5416K46	11.65	10	54155K54	13.16	5	5011T54	9.25
1 3/16″-1 1/2″	21-38	16	10	5415K77	9.31	10	5416K55	11.65	10	54155K77	12.56	—	—	—
1 3/16″-1 3/4″	21-44	20	10	5415K78	9.31	10	5416K56	11.81	10	54155K78	12.56	—	—	—
1 1/16″-2″	27-51	24	10	5415K57	9.45	10	5416K47	11.81	10	54155K57	13.55	5	5011T57	9.53
1 5/16″-2 1/4″	33-57	28	10	5415K79	9.77	10	5416K57	11.96	10	54155K79	12.86	—	—	—
1 9/16″-2 1/2″	40-64	32	10	5415K81	9.77	10	5416K58	11.96	10	54155K81	12.86	—	—	—
1 13/16″-2 3/4″	46-70	36	10	5415K61	10.03	10	5416K48	12.44	10	54155K61	14.34	5	5011T61	10.07
2 1/16″-3″	52-76	40	10	5415K82	12.48	10	5416K59	15.19	10	54155K82	16.00	—	—	—
2 9/16″-3 1/2″	65-89	48	10	5415K64	13.67	5	5416K49	8.65	5	54155K64	9.69	5	5011T64	12.95
3 5/16″-4 1/4″	84-108	60	10	5415K67	15.24	5	5416K51	9.22	5	54155K67	9.86	5	5011T67	13.98
3 9/16″-4 1/2″	91-114	64	10	5415K86	15.02	5	5416K64	9.22	10	54155K86	18.55	—	—	—
3 5/8″-6 1/2″	92-165	96	5	5415K87	9.13	5	5416K65	11.53	5	54155K87	11.84	—	—	—
4 1/8″-7″	105-178	104	5	5415K74	9.65	5	5416K52	11.72	5	54155K74	11.88	2	5011T74	7.25
5 5/8″-8 1/2″	143-216	128	5	5415K39	10.55	5	5416K39	10.59	5	54155K39	11.48	1	5011T39	4.46
7 1/8″-10″	181-254	152	5	5415K43	9.88	5	5416K43	9.84	5	54155K43	10.50	2	5011T43	9.63
9 3/8″-12 1/4″	238-311	188	5	5415K44	9.80	5	5416K44	9.86	5	54155K44	10.49	2	5011T44	9.77

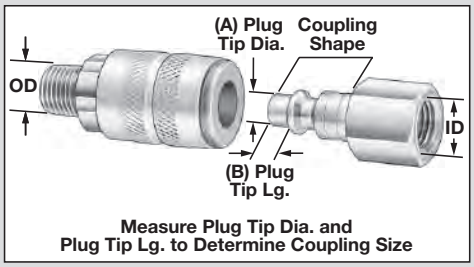
Assortments

Clamps come packed in a metal box with individual compartments for each clamp size. Each assortment includes a total of 100 clamps—10 of each size shown above with a ★. You'll also get two external hex nutdrivers (1/4″ and 5/16″ sizes).

Clamps with Zinc-Plated Steel Screw Assortment	5419K17	$99.37
Clamps with 410 Stainless Steel Screw Assortment	5419K19	129.10
Clamps with 305 Stainless Steel Screw Assortment	5419K21	147.92
Clamps with 316 Stainless Steel Screw Assortment	5419K22	182.93

Quick-Disconnect Hose Couplings

How to Order Quick-Disconnect Hose Couplings



Measure Plug Tip Dia. and Plug Tip Lg. to Determine Coupling Size

1. Determine the coupling shape. To make a connection, you'll need a plug and a socket with the same shape; however, the coupling's shape is determined by the plug's end. Compare your plug's end to the illustrations below.

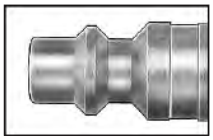
2. Determine the coupling size. Coupling size is an industry designation, not the actual measured size. To determine coupling size, measure the "A" and "B" dimensions as shown at left, and match the measurements to those found in the individual presentations for your specific coupling shape.

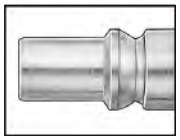
3. For threaded connections, determine the pipe size. Pipe size is an accepted industry designation, not the actual measured size. To determine pipe size, first use a ruler to measure the outside diameter (OD) or inside diameter (ID), as shown at left. Then, round up the measurement to the closest OD or ID listed in the chart and select the corresponding pipe size. For example, if the OD or ID measures 1 3/16", the next highest OD is 1 3/8" and the corresponding pipe size is 1.

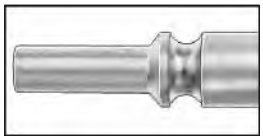
Threaded OD or ID	3/8"	1/2"	5/8"	3/4"	1"	1 3/8"	1 5/8"
Pipe Size	1/8	1/4	3/8	1/2	3/4	1	1 1/4

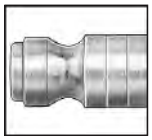
Quick-Disconnect Hose Coupling Shape Selection Chart

While many of the quick-disconnect couplings are named after their original manufacturer, they're now made by most coupling manufacturers.


Industrial (Most Popular) Pages 354-357


ARO Page 358


Lincoln Page 358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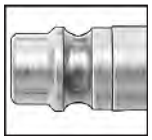
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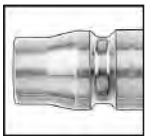
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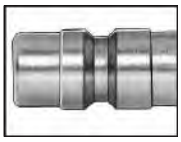
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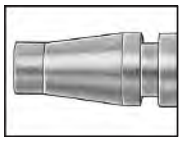
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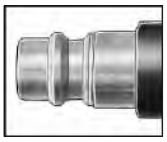
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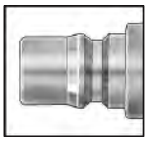
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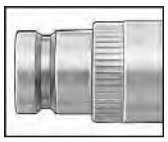
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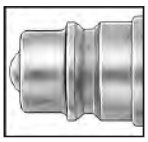
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High Pressure Thread Lock Page 366

For a comparison chart that shows actual-size illustrations for all of the quick-disconnect hose couplings we offer, go to mcmaster.com and search for **6534KAC**.

Industrial-Shape Size-Identification Kits

Kits contain industrial-shape plugs in four coupling sizes (1/4, 3/8, 1/2, and 3/4), so you can determine the size of your couplings without the need for measuring.

The plugs in this kit are steel and the size is clearly labeled on each plug.

5597K12 ..... $11.37

Industrial-Shape Hose Coupling Sets with Threaded Ends for Air

- Maximum Pressure @ 72° F: 300 psi
- Temperature Range: -40° to 250° F
- Hose: Use flexible PVC and rubber


Set includes one plug and one socket. Plug shown has male pipe connection; socket has female pipe connection.

Sets include an industrial-shape zinc-plated steel plug, and a brass socket with a zinc-plated steel sleeve. They are also known as industrial interchange couplings. The couplings are single-shut-off style, so there is a valve in the socket but not the plug. The valve stops the flow when the coupling is separated. They meet the dimensional requirements of Fed Spec. A-A-59439. Not rated for vacuum. NPTF (Dryseal) threads are compatible with NPT threads.

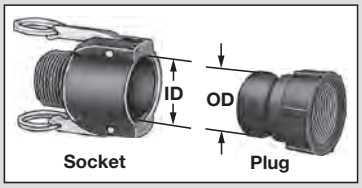
Plugs are also known as nipples. They meet ISO 6150/B and ANSI T3.20.14.

Sockets are sleeve-lock style. To connect, slide back the sleeve on the socket, insert the plug, and release the sleeve. To disconnect, slide back the sleeve and pull out the plug. They have a Buna-N rubber seal.




Pipe Size, NPTF	Male Pipe Plug × Male Pipe Socket	Female Pipe Plug × Female Pipe Socket	Male Pipe Plug × Female Pipe Socket	Female Pipe Plug × Male Pipe Socket
Coupling Size: 1/4				
1/4	5602K11 ..... $7.70	5602K14 ..... $8.09	5602K12 ..... $7.77	5602K13 ..... $8.04

How to Order Cam-and-Groove Hose Couplings



1. **Determine the coupling size.** Coupling size is an industry designation, not the actual measured size. To determine coupling size, measure the inside diameter (ID) of the socket or outside diameter (OD) of the plug, as shown at left. Match the actual size to the coupling size listed in the chart below. For example, if the actual size measures 3 5/8", the coupling size is 3.

Actual ID or OD	15/16"	1 1/4"	1 7/16"	1 13/16"	2 1/8"	2 1/2"	3"	3 5/8"	4 3/4"	5 3/4"	6 15/16"
Coupling Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6

2. **Determine the pipe size.** Pipe size is also an industry designation, not the actual measured size. To determine pipe size, first use a ruler to measure the outside diameter (OD), as shown at left. Then, round up the measurement to the closest OD listed in the chart and select the corresponding pipe size. For example, if the OD measures 1 3/16", the next highest OD is 1 3/8" and the corresponding pipe size is 1.

Threaded OD	3/4"	1"	1 3/8"	1 5/8"	1 7/8"	2 3/8"	2 7/8"	3 1/2"	4 1/2"	5 5/8"	6 5/8"
Pipe Size	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4	5	6

Metal Cam-and-Groove Hose Couplings

- Maximum Pressure: See below
- Temperature Range: -65° to 250° F
- Hose: Use polyethylene, polyurethane, PVC, and rubber

Metal cam-and-groove couplings are stronger and more durable than the plastic versions. They provide quick access to medium- and large-diameter hose lines. All couplings meet Fed. Spec. A-A-59326. They're compatible with PT Coupling, Dixon, Andrews, and Ever-Tite cam-and-groove couplings.

Sockets must be used with a plug of the same coupling size; see pages 371-373 for plugs. To connect, insert the plug into the socket and press the levers down. The levers fit snugly into the groove on the plug's body and force the plug down against the gasket to form a tight seal. To disconnect, lift both levers and pull out the plug.

Material	Features	Applications
Aluminum	Good abrasion resistance. Fair corrosion and chemical resistance. Lightweight.	Use with diesel fuel, ethylene glycol, gasoline, hydraulic fluid, and petroleum.
Anodized Aluminum	Lightweight with good abrasion and corrosion resistance.	Use with water.
Brass	Good corrosion resistance. Fair abrasion resistance.	Use with water.
316 Stainless Steel	Excellent abrasion, corrosion, and chemical resistance.	Use with citric acid, diesel fuel, ethylene glycol, gasoline, hydraulic fluid, and petroleum.

Sockets with Threaded Male Pipe Connection

Also known as B-couplers, these sockets have a Buna-N rubber seal and zinc-plated steel pull rings, except 316 stainless steel sockets have 304 stainless steel pull rings. Sockets **with locking levers** prevent accidental disconnection.


With Nonlocking Levers

Coupling Size	Pipe Size, NPT	Max. psi @ 72° F	Aluminum with Brass Levers		Aluminum with 316 Stainless Steel Levers		Anodized Aluminum with 316 Stainless Steel Levers		Brass with Brass Levers		316 Stainless Steel with 316 Stainless Steel Levers	
With Nonlocking Levers												
1/2	1/2	250	51415K108	$13.34	2005T91	$13.88			52155K108	$24.02	53015K108	$44.24
3/4	3/4	250	51415K11	14.13	2005T11	18.20	2084T11	$18.74	52155K11	30.10	53015K11	47.31
1	1	250	51415K12	15.68	2005T12	16.93	2084T12	18.75	52155K12	34.58	53015K12	52.64
1 1/4	1 1/4	250	51415K13	20.07	2005T13	21.69	2084T13	26.60	52155K13	46.88	53015K13	60.84
1 1/2	1	250	95805K22	46.99	2005T131	47.01	2084T131	58.74	52155K131	104.26		
1 1/2	1 1/2	250	51415K14	19.43	2005T14	20.99	2084T14	29.47	52155K14	54.76	53015K14	67.81
2	1 1/2	250	95805K23	50.74	2005T132	51.24	2084T132	60.85	52155K161	125.05	6795K132	170.95
2	2	250	51415K15	21.92	2005T15	23.66	2084T15	34.26	52155K15	58.98	53015K15	76.47
2 1/2	2 1/2	200	51415K16	30.48	2005T16	32.91	2084T16	45.99	52155K16	73.06	53015K16	124.48
3	2	200	95805K63	49.26	2005T133	64.83	2084T133	78.70	52155K171	144.21	6795K63	287.07
3	3	200	51415K17	37.54	2005T17	40.54	2084T17	54.36	52155K17	115.32	53015K17	144.36
4	3	150	95805K62	81.54	2005T134	95.00	2084T134	118.75	52155K181	231.18		
4	4	150	51415K18	57.85	2005T18	62.47	2084T18	84.72	52155K18	157.08	53015K18	205.60
5	5	75	51415K109	95.10	2005T1	102.71			52155K109	277.20	53015K109	284.86
6	6	75	51415K19	134.29	2005T19	145.03	2084T19	188.46	52155K19	337.04	53015K19	351.59
With Locking Levers												
1	1	250	51415K432	29.23	2005T92	31.57	2084T92	56.83	52155K432	61.52	53015K132	74.98
1 1/4	1 1/4	250	51415K433	43.89	2005T93	39.45	2084T93	41.70	52155K433	88.03	53015K133	89.15
1 1/2	1 1/2	250	51415K434	41.31	2005T94	44.61	2084T94	44.18	52155K434	88.88	53015K134	95.52
2	2	250	51415K435	43.09	2005T95	46.53	2084T95	69.34	52155K435	99.32	53015K135	110.09
2 1/2	2 1/2	200	51415K436	54.30	2005T96	58.64	2084T96	59.18	52155K436	115.71	53015K136	147.99
3	3	200	51415K437	65.43	2005T97	70.66	2084T97	87.02	52155K437	158.88	53015K137	193.72
4	4	150	51415K438	84.94	2005T98	91.73	2084T98	117.35	52155K438	213.88	53015K138	251.42
5	5	75	51415K439	123.30	2005T99	133.16			52155K439	318.27	53015K139	337.32

(Continued on following page)

Warning: *It is important to relieve all pressure before disconnecting the couplings. Do not use cam-and-groove couplings with compressed air or gas.*

Drum Pumps

About Drum Pumps

Drum pumps dispense and transfer liquid from drums, pails, and other containers. To select the pump that's best suited for your application, consider the amount of liquid you need to move. Hand-operated drum pumps are best for small quantities of liquid. Electric and air-powered drum pumps can quickly empty a container. If you choose an air-powered pump, install an air line filter/lubricator to ensure efficiency and reduce wear on the pump. For filter/lubricators, see page 1055.

Chemical Compatibility—Our pumps are organized by the liquids they are most commonly used with. Metal drum pumps are generally used with coolants, lubricating oils, and fuels. Many plastic drum pumps are compatible with water as well as a wide range of chemicals, so they are often used with acidic and alkaline solutions. For information about the compatibility of specific liquids, go to mcmaster.com and search by pump part number for common compatible chemicals and a list of wetted parts.

Viscosity—Also known as liquid thickness, viscosity is measured in centipoise (cp). Your liquid's thickness depends on temperature—liquids get thicker as temperature drops. For proper pump performance, select a pump that's rated for a higher viscosity than your liquid; a pump not strong enough to move your liquid is prone to wear and failure.

Viscosity of Common Liquids at Room Temperature

	Viscosity, cp		Viscosity, cp
Water	1 to 5	SAE 40 Oil	250 to 500
Antifreeze	15	Honey	2,000 to 3,000
SAE 30 Oil	150 to 200	Molasses	5,000 to 10,000

Pumping Flammable Liquids—When using a pump approved for flammable liquids, always bond and ground your application for static control. For more information about bonding and grounding, see Sections 1910.106 and 1910.107 of the Federal OSHA Code. For bonding and grounding equipment, see pages 1008-1009.

Metal Drum Pumps for Coolants and Lubricating Oils

The metal housing provides durability for tough pumping jobs. Pumps come with a 2 NPT drum connector. **Standard** pumps have a steel housing and a removable spout. The spout can be replaced with a garden hose. **Corrosion-resistant** pumps have a Type 316 stainless steel housing.

ⓘ For common compatible chemicals and a list of wetted parts, go to mcmaster.com and search by part number.

Flow Rate, oz./Stroke	Container Size, gal.	Temperature Range, °F	Max. Viscosity, cp	*Intake Tube* Lg.	*Intake Tube* OD	Discharge Style		
Standard								
16	15-55	50° to 100°	316	37″	1½″	Spout	9912K28	$30.88
22	15-55	32° to 140°	200	35″	1½″	Spout	2520K22	32.12
Corrosion Resistant								
8	5-15	Max. 140°	300	22½″	½″	Spout	9912K31	136.72
16	15-55	Max. 140°	300	39½″	1⅛″	Spout	9912K32	145.50
Optional 5-Gallon Pail Adapter for 9912K31 (Adapts 2 NPT Connector to 1¾ NPT)							9912K21	17.23

Metal Drum Pumps for Flammable Liquids

Pump Class I and II flammable and combustible liquids such as fuels, cleaning solvents, and lacquer thinners with these FM-approved pumps. They have an internal flame arrester and bonding and grounding wires. Housing is steel, and pumps have a telescoping intake tube. Temperature range is not rated.

Pump for 5-gallon containers has a clamped connector (fits Rieke Flex Spout) and four threaded screw cap adapters: 1¾″, 2⅛″, 2¼″, and 2⅞″. Pump for 15- to 55-gallon containers has a 2 NPT drum connector.

ⓘ For common compatible chemicals and a list of wetted parts, go to mcmaster.com and search by part number.

Flow Rate, oz./Stroke	Container Size, gal.	Max. Viscosity, cp	*Intake Tube* Lg.	*Intake Tube* OD	Discharge Style		
4	5	650	16″-38″	1⅛″	Spout	4259K23	$243.20
8	15-55	650	16″-38″	9⁄16″	Spout	4259K43	243.80

Easy-Stroke Metal Drum Pumps

A lever handle allows you to dispense liquid with less effort than standard hand pumps. All pumps come with a 2 NPT drum connector.

For Lubricating Oils—These pumps have a removable spout that can be replaced with a garden hose. Pumps have a steel housing and a telescoping intake tube.

For High-Viscosity Motor Oils—Rated for liquids up to 4,000 centipoise, this pump is often used with very thick motor oils. A 1″ ID discharge tube can be attached to the spout with a clamp. Pump has a zinc alloy housing and a telescoping intake tube.

For Fuels—Designed for use with diesel fuel, gasoline, kerosene, and mineral spirits, these pumps have a lever handle that delivers fluid on both the forward and backward strokes to quickly move drum contents. Lock the handle with a padlock (not included); maximum shackle diameter is ¼″. Flow is reversible. Pumps have an aluminum housing and are UL listed. *Pump with hose and metering nozzle* records flow rate up to 99.9 gallons per delivery (resettable) and totals up to 99,999.9 gallons (nonresettable).

ⓘ For common compatible chemicals and a list of wetted parts, go to mcmaster.com and search by part number.

Flow Rate, oz./Stroke	Container Size, gal.	Temperature Range, °F	Max. Viscosity, cp	*Intake Tube* Lg.	*Intake Tube* OD	Discharge Style		
For Lubricating Oils								
10	15-55	60° to 100°	319	18″-34″	1¾″	Spout	4266K11	$39.69
10	15-55	60° to 100°	319	18″-34″	1¾″	Nondrip Spout	4266K12	45.66
For High-Viscosity Motor Oils								
18	15-55	Max. 140°	4,000	18″-35″	1½″	Spout	8246K15	77.15
For Fuels								
26	15-55	–15° to 150°	319	20″-35″	1″	Spout	9906K11	188.48
26	15-55	–15° to 150°	319	20″-35″	1″	8-ft. Hose & Nozzle	9906K12	197.40
26	15-55	–15° to 150°	319	20″-35″	1″	8-ft. Hose & Metering Nozzle	9906K33	448.60

About Pump Performance

Choosing the best pump for your application depends primarily on:

- How high you're pumping your liquid
- How much your liquid slows down as it flows through your pipe

These two factors create your total feet of head—the amount of pressure working against your pump.

A pump's flow rate in gallons per minute (gpm) at a given pressure in feet of head is known as **max. flow @ feet of head**. As pressure increases, flow decreases. When the liquid reaches a height where the pressure is greater than the pump's power, flow stops entirely. This point is called **max. ft. of head**. Pumps generally operate most efficiently at around 80% of the max. ft. of head.

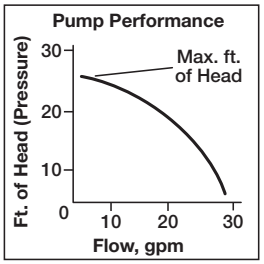
How to Calculate Max. Flow @ Feet of Head

To select a pump, you must know how much vertical pipe you have and the flow resistance of your system.

In small applications without much pipe, flow resistance is generally low, so the actual number of feet of vertical pipe is usually a good estimate of the feet of head you need. You can also add a few feet to account for the minimal flow resistance.

For large applications, you need to know your pipe size, flow rate, and the total length of pipe in your system. Find your pipe size in the chart below, and read across to the flow resistance value that corresponds with your flow rate. Then add the flow resistance value to your number of vertical feet of pipe for the feet of head required.

Example Pump Performance Curve



The curve shows how the flow rate changes for this pump as pressure increases. It pumps approximately:

- 25 gpm @ 10 ft. of head
- 15 gpm @ 20 ft. of head
- 0 gpm @ 25 ft. of head

This pump operates most efficiently at 20 ft. of head, or 80% of the max. ft. of head (25 ft. of head).

Flow Resistance Values for 100 Feet of PVC Pipe

Pipe Size	Flow Rate, gpm 5	10	15	20	25
¾	5.66	20.40	43.30	73.50	—
1	1.75	6.31	13.50	22.80	34.60
1¼	0.46	1.67	3.53	6.00	9.06
1½	0.22	0.79	1.67	2.83	4.26
2	—	0.23	0.49	0.84	1.27

For 50 feet of PVC pipe, split these values in half; for 200 feet, double the values. Metal pipe has about twice as much flow resistance as PVC, so double these values for 100 feet of metal pipe. Fittings and valves can also add up to 3% additional resistance.

Pumping Flammable Liquids—When using a pump approved for flammable liquids, always bond and ground your application for static control. For more information about bonding and grounding, see Sections 1910.106 and 1910.107 of the Federal OSHA Code. For bonding and grounding equipment, see pages 1008-1009.

About Sump, Water-Removal, Condensate, and Submersible Pumps

Sump pumps drain accumulated water from a sump pit. Be sure to choose the right capacity pump for your application. A pump that doesn't have enough flow won't be able to keep up with water flowing into your sump pit. But a pump that is too powerful and has too high a flow rate will start and stop too fast. Both situations can cause premature pump failure.

Water-removal pumps move water out of flooded open areas. Generally, they are not used with a sump pit.

Condensate pumps typically have a tank in which condensate accumulates from HVAC or refrigeration systems.

Submersible pumps are compact and have low horsepower motors. They're often used to circulate liquids in small tanks and baths.

When selecting a pump, choose from several activation options:

Plug-In Activation—Pumps do not have a switch. Plug in to turn on.

Separate Float-Switch Activation—The piggyback float switch has a separate cord and is not wired to the pump, so you can replace it without replacing the whole pump.

Integrated Float-Switch Activation—The float switch is part of the pump, which provides a smaller footprint than a separate float switch.

Pressure-Switch Activation—The pressure switch design has no external moving parts to catch on sump walls.

Piggyback Switch

Sump Pumps for Water

Sump Pumps for Water

Integrated Float-Switch Activation

Separate Float-Switch Activation

Pressure-Switch Activation

Remove accumulated water from sump pits, loading docks, and cooling towers. Pumps have a continuous duty, single-phase motor with thermal overload protection and a cord with plug. A minimum open area of 18″ Dia. × 24″ Dp. is required for operation. Use with debris-free water. Submerge pumps while in use and do not run dry. Intake is screened and discharge has a 1½ NPT female connection, except discharge for light duty pump has a 1¼ NPT female connection. Temperature range is 33° to 120° F. All pumps are CSA certified.

Light duty pump has a zinc housing.

Heavy duty pumps have a cast iron housing that stands up to demanding environments.

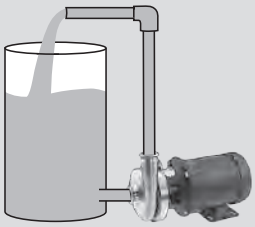
Extended-life heavy duty pump has a rugged bronze housing for a long service life.

Max. Flow, gpm @ 5 ft. of Head	@10 ft. of Head	@15 ft. of Head	Max. ft. of Head	Switch Level Turns On	Turns Off	hp	Volts AC @ 60 Hz	Amps	Ht.	Wd.	Dp.	Cord Lg., ft.		
Light Duty Pump														
Integrated Float-Switch Activation														
35	30	20	25	10″	5″	¼	120	8.5	11″	9″	6″	10	9989K41	$187.29
Heavy Duty Pumps														
Plug-In Activation														
46	29	13	18	—	—	⅓	120	9	8″	10″	8″	10	9989K54	145.22
46	29	13	18	—	—	⅓	120	9	8″	10″	8″	25	9989K31	173.92
54	42	26	22.9	—	—	⅖	120	10	6″	10″	9″	10	9989K56	250.12
54	42	26	22.9	—	—	⅖	120	10	6″	10″	9″	25	9989K32	265.53
Separate Float-Switch Activation														
46	29	13	18	11″	5″	⅓	120	9	8″	10″	8″	10	9989K45	198.21
Integrated Float-Switch Activation														
67	57	52	36	11″	5″	½	120	6.5	12″	11″	9″	10	9989K61	296.49
67	57	52	36	11″	5″	½	120	6.5	12″	11″	9″	20	9989K62	316.45
Pressure-Switch Activation														
46	29	13	18	10″	4″	⅓	120	9	6″	10″	9″	10	9989K53	152.04
54	42	26	22.9	10″	4″	⅖	120	10	6″	10″	9″	10	9989K33	267.83
54	42	26	22.9	10″	4″	⅖	120	10	6″	10″	9″	25	9989K34	288.19
Extended-Life Heavy Duty Pump														
Pressure-Switch Activation														
54	42	26	22.9	10″	4″	⅖	120	10	6″	10″	9″	10	9989K55	372.91
Switch Repair Kit for Pumps with Pressure-Switch Activation													9989K71	19.58

About Process Pumps

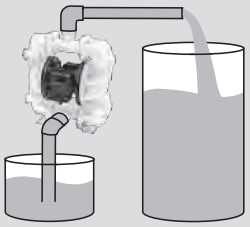
Circulation Pumps—Also known as centrifugal pumps, these send a high flow of liquid through a pipeline or a closed circuit. They are the most common process pump. See pages 402-408.

- Frequently used for heating and cooling and tank filling and emptying
- For use with thin liquids, such as water and coolants
- Some pumps are self-priming for installation above your liquid source
- Do not run dry; this can damage the pump and cause failure



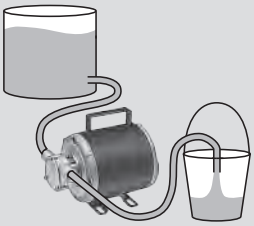
Air-Powered Transfer Pumps—Also known as air-operated diaphragm pumps, these operate on compressed air for pumping liquid in harsh and hazardous environments. See pages 409-412.

- Common applications include chemical handling, waste removal, and transporting coatings and slurries
- Excellent for caustic chemicals and thick liquids with solids
- All are self-priming for installation above your liquid source
- Can run dry



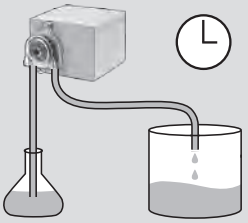
Dispensing Pumps—Also known as positive displacement pumps, these maintain a fixed flow rate. They have the widest variety of styles to support many applications. See pages 413-416.

- Suitable for engine lubrication, water delivery, and point-of-use transfer
- Can move thick liquids, such as hydraulic oil and motor oil
- Some pumps are self-priming for installation above your liquid source
- Do not run dry; this can damage the pump and cause failure



Metering Pumps—Also known as peristaltic and diaphragm metering pumps, these inject a minute amount of liquid within a specified time frame. See pages 416-418.

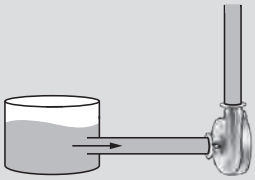
- Often used for applications such as water treatment, pH control, and chemical processing
- Designed for use with harsh chemicals as well as thin and thick liquids
- All are self-priming for installation above your liquid source
- Can run dry



When to Choose a Self-Priming Pump—To begin pumping, your pump must be primed by filling the pump chamber with liquid. Your system's setup determines whether you need a self-priming pump.

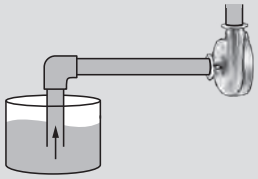
Not a Self-Priming Setup

When your liquid source is above or at the same level as the pump, liquid flows into the pump chamber by gravity. All pumps will work in this setup.



Self-Priming Setup

When your liquid source is below the pump, only a self-priming pump will create a vacuum that can draw liquid upward to fill the pump chamber.



For more information about pump performance, see page 392. For information about liquid viscosity, see page 384.

Circulation Pumps

Circulation Pumps for Water

Standard and High Flow

Heavy Duty Self-Priming

Move water in boiler feed systems, cooling towers, and heat exchangers. These pumps have a bronze housing. Do not run dry. Temperature range is 40° to 180° F. Connections are NPT female.

All pumps have a continuous-duty motor. *Single-phase motors* have thermal overload protection and screw terminals for electrical connection, except standard pumps have spade terminals for electrical connection. *Three-phase motors* have wire leads for electrical connection.

Standard and **high-flow pumps** are not self-priming or for use with solids. *Standard pumps* have a stainless steel impeller. Maximum viscosity is 1 centipoise. *High-flow pumps* have a more powerful motor than standard pumps for twice the flow rate. Impeller is bronze. Maximum viscosity is 20 centipoise.

Heavy duty self-priming pumps are self-priming up to 6 feet and provide protection in dusty and dirty environments. All have a Type 316 stainless steel impeller that can handle solids up to 3⁄8″ dia. Maximum viscosity is 20 centipoise.

ⓘ For common compatible chemicals and a list of wetted parts, go to mcmaster.com and search by part number.

Max. Flow, gpm								*Pipe Size*						
@ 10 ft. of Head	@ 20 ft. of Head	@ 40 ft. of Head	@ 60 ft. of Head	Max. ft. of Head	hp	Volts AC @ 60 Hz (phase)	Amps	Intake	Discharge	Ht.	Wd.	Dp.		
Standard—With Open Dripproof (ODP) Motor														
20	17	11	—	56	1⁄3	120/240 (1)	6.8/3.4	3⁄8	3⁄8	7 3⁄4″	5 3⁄8″	11 7⁄8″	8249K49	$486.00
35	31	18	—	57	1⁄3	120/240 (1)	6.8/3.4	3⁄4	1⁄2	7 3⁄4″	5 3⁄8″	11 7⁄8″	8249K53	490.91
55	36	—	—	35	1⁄3	120/240 (1)	6.8/3.4	1 1⁄4	1	7 3⁄4″	6 3⁄8″	11 7⁄8″	8249K55	509.79
High Flow—With Open Dripproof (ODP) Motor														
55	45	10	—	42	1⁄2	120/208-240 (1)	11.1/6.5-5.5	1 1⁄4	1	6 7⁄8″	5 5⁄8″	12 3⁄8″	8249K81	485.54
72	63	41	—	55	3⁄4	120/208-240 (1)	13/7.2-6.5	1 1⁄4	1	6 7⁄8″	5 5⁄8″	12 7⁄8″	8249K82	516.01
72	63	41	—	55	3⁄4	208-240/460 (3)	2.4-2.3/1.2	1 1⁄4	1	6 7⁄8″	5 5⁄8″	12 7⁄8″	8249K85	527.03
108	98	71	—	58	1	120/208-240 (1)	12.4/6.8-6.2	1 1⁄2	1 1⁄4	6 7⁄8″	5 5⁄8″	13 3⁄4″	8249K83	558.00
115	104	81	40	67	1 1⁄2	120/208-240 (1)	17/9.3-8.5	1 1⁄2	1 1⁄4	6 7⁄8″	5 5⁄8″	15″	8249K84	671.21
115	104	81	40	67	1 1⁄2	208-240/460 (3)	4.5-4.2/2.1	1 1⁄2	1 1⁄4	6 7⁄8″	5 5⁄8″	15″	8249K86	681.81
Heavy Duty Self-Priming—With Totally Enclosed Fan-Cooled (TEFC) Motor														
61	52	24	—	52	3⁄4	120/208-240 (1)	9.8/5.4-4.9	1 1⁄2	1 1⁄2	9 1⁄2″	6 3⁄8″	15 1⁄8″	8249K87	972.70
61	52	24	—	52	3⁄4	208-240/460 (3)	2.5-2.3/1.2	1 1⁄2	1 1⁄2	9 1⁄2″	6 3⁄8″	14 1⁄2″	8249K88	920.17
91	79	48	—	52	1 1⁄2	120/208-240 (1)	16.6/9-8.3	1 1⁄2	1 1⁄2	9 1⁄2″	6 3⁄8″	16 5⁄8″	8249K89	1,043.00
91	79	48	—	52	1 1⁄2	208-240/460 (3)	4.6-4.2/2.1	1 1⁄2	1 1⁄2	9 1⁄2″	6 3⁄8″	15 5⁄8″	8249K91	948.84
123	113	82	26	63	2	208-240/460 (3)	5.9-5.4/2.7	1 1⁄2	1 1⁄2	9 1⁄2″	6 3⁄8″	15 5⁄8″	8249K92	970.39

Vacuum Pumps

About Vacuum Pumps

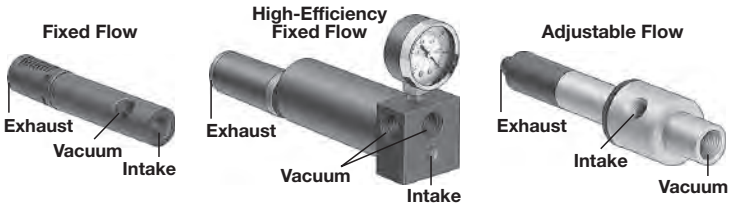
When selecting a vacuum pump, consider your application. For medium-vacuum operations, such as air extraction, leak testing, and lifting, grabbing, and moving small parts, choose an **air-operated vacuum pump**. Choose an **electric vacuum pump** for demanding applications that require a powerful vacuum and continuous flow, such as filtration systems, drying chambers, distillation, and refrigeration service.

Additional factors, such as the vacuum strength your application requires and how quickly you want to form a vacuum, can also help you to select a vacuum pump that will meet your needs.

Vacuum Strength—Vacuum is measured in inches of mercury (Hg) up to 29.9″ Hg. Above 29.9″ Hg, it's measured in microns of Hg. When vacuum is measured in inches of Hg, higher values indicate a stronger vacuum. But when vacuum is measured in microns of Hg, lower values indicate a stronger vacuum.

Free Air—Measured in cubic feet per minute, free air is the initial pull required to create a vacuum. Determine how long a pump will take to form a vacuum by dividing your tank's capacity (measured in cubic feet) by the pump's free air requirement. The larger the tank, the longer it will take to form a vacuum. Tube and fitting ID will also affect flow.

Maintenance-Free Air-Operated Vacuum Pumps



Also known as venturi pumps, these compressed-air-powered pumps are commonly used in vacuum packaging, pick-and-place operations, and end-of-arm robotic tooling. They have no seals or moving parts that can wear down or overheat, and they don't require lubrication, so there's no downtime for maintenance. The compact body allows inline installation close to your vacuum point. Pumps have a muffler. Connections are NPT female.

High-efficiency fixed-flow pumps have a multistage design to generate high vacuum flow with less air consumption than other air-operated vacuum pumps. They include a 2″ vacuum gauge.

Adjustable-flow pumps have a rotating diffuser to alter flow rate.

Max. Vacuum, Inches of Hg	Free Air, cfm	Operating Pressure, psi	Air Consumption, cfm	dB	Temp. Range, °F	*Pipe Size* Intake	Vacuum	Exhaust	Lg.	Dia.		
Fixed Flow—Aluminum Housing												
26	0.95	75	1.6	65	32° to 125°	1/8	1/8	1/8	5 3/8″	2″	41605K13	$74.27
27	2.2	75	3.5	65	32° to 125°	1/8	1/4	1/4	7 3/8″	1 3/4″	41605K14	77.75
27	4	75	6.4	65	32° to 125°	1/8	3/8	3/8	8 1/4″	1 3/4″	41605K15	99.22
28	0.5	80	0.8	64	–100° to 400°	1/8	1/8	1/4	4 1/4″	3/4″	9997K15	73.25
28	1.2	80	1.8	64	–100° to 400°	1/8	1/8	1/4	4 1/4″	3/4″	9997K16	80.75
28	2	80	2.8	64	–100° to 400°	1/8	1/8	1/4	4 1/4″	3/4″	9997K17	88.25
28	3.2	80	4.8	64	–100° to 400°	1/8	1/8	1/4	4 1/4″	3/4″	9997K18	95.50
28	5.4	80	7.8	70	–100° to 400°	1/4	3/8	3/8	5 7/8″	1″	9997K25	142.25
28	9	80	12.5	76	–100° to 400°	1/4	3/8	3/8	8 7/8″	1 1/4″	9997K26	188.50
28	20	80	22	72	–100° to 400°	3/8	3/8	3/8	9 7/8″	1 1/4″	9997K27	247.75
28	28	80	28	76	–100° to 400°	1/2	1/2	1/2	10 7/8″	1 1/4″	9997K29	367.75
High-Efficiency Fixed Flow—Acetal Housing												
26	17	68	7	65	32° to 125°	1/8	1/2	3/8	10 1/4″	3″	41605K45	325.10
27	6.8	68	2.7	65	32° to 125°	1/8	1/2	1/4	8 1/4″	3″	41605K33	250.27
27	12	68	4.9	65	32° to 125°	1/8	1/2	3/8	8 3/4″	3″	41605K34	290.80
Adjustable Flow—Aluminum Housing												
0-25	2	80	1.3	70	–100° to 400°	1/8	1/4	1/4	5 5/8″	1 1/4″	13445K87	125.75
0-25	3.2	80	2.4	74	–100° to 400°	1/8	1/4	1/4	5 5/8″	1 1/4″	13445K81	139.00
0-25	6	80	4.7	78	–100° to 400°	1/8	1/4	1/4	5 5/8″	1 1/4″	13445K82	153.50
0-25	10	80	8.3	84	–100° to 400°	1/8	1/4	1/4	6 1/4″	1 1/4″	13445K83	191.25
0-25	30	80	17	88	–100° to 400°	3/8	1/2	1/2	10 7/8″	1 3/4″	13445K84	210.75
0-25	60	80	28	82	–100° to 400°	3/8	1/2	3/4	13″	2″	13445K85	295.25
0-25	120	80	44	98	–100° to 400°	1/2	3/4	1	13 7/8″	2 1/4″	13445K86	358.50

Oil-Free Electric Vacuum Pumps

Since these pumps don't require lubrication and run entirely on electricity, there's no risk of oil contamination. They have a continuous-duty, single-phase motor with thermal overload protection and a 6-ft. cord with plug. Temperature range is 32° to 104° F.

Base Mount—Often used for air and gas sampling, controlling compressed air flow, and vacuum filtration, this pump can also be used in pressure applications up to 18 psi. Housing is polyester and diaphragm is fluorocarbon elastomer. Pump comes with barbed hose adapters that fit 3/8″ ID tubing. **Repair kit** includes a replacement diaphragm.

Portable—This pump weighs only 16 pounds and has a handle, so it's convenient for on-site sampling, atomizing, and vacuum filtration. It's also for use in pressure applications up to 60 psi. Housing is aluminum and diaphragm is EPDM/Nomex. Pump comes with an on/off switch. Connections are barbed and fit 3/8″ ID tubing. **Repair kit** includes seals, a filter cartridge, and replacement valve components.

Max. Vacuum, Inches of Hg	Free Air, cfm	dB	hp	Volts AC @ 60 Hz (phase)	Amps	Lg.	Wd.	Ht.	Pumps		Repair Kits	
Base Mount												
20	0.6	72	1/45	120 (1)	1.2	7 1/4″	4″	5 1/2″	41675K61	$437.50	41675K65	$92.17
Portable												
25.5	1.1	65	1/8	120 (1)	4.2	7 3/4″	5 7/8″	11″	4176K11	542.35	4176K21	39.42

Oil-Free Electric Vacuum Pumps with Tank

Generate a vacuum on demand with this pump that comes mounted on a 10-gal. ASME code vacuum tank for quick startup. It's often used in vacuum-forming applications such as product packaging. Pump includes a vacuum gauge, a three-position switch, and a shutoff valve. It needs no lubrication, so oil won't contaminate your process.

Motor is continuous duty, single phase with thermal overload protection, and it has a 6-ft. cord with plug. Housing is aluminum. Temperature range is 41° to 104° F. Pump has a barbed inlet connection that fits 3/8″ ID tubing and a 3/8 NPT female discharge connection with a muffler.

Max. Vacuum, Inches of Hg	Free Air, cfm	dB	hp	Volts AC @ 60 Hz (phase)	Amps	Lg.	Wd.	Ht.		
26	7.1	58	1/3	120 (1)	4	30″	12 3/8″	24 1/2″	6419K31	$2,377.14

About Noise, Filtration, and Flow Ratings

Consider noise, filtration, and flow ratings when selecting mufflers, breather vents, and filters.

***Noise*—**Measured in decibels (dB), the rating indicates how much a product reduces exhaust noise from your tool or equipment. OSHA recommends hearing protection for exposure to 80 dB and greater. Some common noise levels include an air-powered riveter @ 125 dB, air-powered drill @ 120 dB, and an impact wrench @ 103 dB.

***Filtration*—**Products trap particles to clean the air exhausting to the environment or going into your process and equipment. The size of particles is measured in microns; the lower the number of microns, the smaller the particles that are removed from the air. For examples of common particle sizes, see page 440.

***Flow*—**Measured in standard cubic feet per minute (scfm), this rating is the maximum air flow a product can withstand.

Mufflers

A **B** **C** **D**

Our most popular mufflers, use these with air-powered tools, valves, and cylinders to reduce noise and filter exhaust air. All have a porous bronze body.

Styles A&D have hex wrench flats. Mufflers reduce noise by 15-20 dB. They trap particles down to 40 microns, except mufflers with 1¼-2 pipe size, which trap particles down to 90 microns. Use with air and inert gas. Fitting is plated steel. Max. temp. is 300°F.

Style B are high temperature; max. temp. is 500°F. They have a slotted head for installation with a screwdriver. Mufflers reduce noise by 10-20 dB and trap particles down to 100 microns. Use with air and inert gas. Fitting is porous bronze.

Style C are knurled for an easy grip. Mufflers reduce noise by 13-21 dB and trap particles down to 100 microns. Use with air. Fitting is plated bronze. Max. temp. is 302°F.

	Pipe Size	Max. scfm @ 100 psi	Max. psi	Ht.	Hex Size/Dia.		
With UNF Male Connection							
A	10-32	6	300	11/16"	5/16"	**4450K31**	$1.97
With NPT Male Connection							
A	1/16	26	175	13/16"	3/8"	**4450K15**	2.44
A	1/8	11	300	1 1/8"	7/16"	**4450K1**	2.07
A	1/4	21	300	1 3/8"	9/16"	**4450K2**	2.43
A	3/8	23	300	1 1/2"	11/16"	**4450K3**	3.21
A	1/2	57	300	1 7/8"	7/8"	**4450K4**	4.33
A	3/4	112	300	2 1/4"	1 1/16"	**4450K5**	6.57
A	1	154	300	2 7/8"	1 5/16"	**4450K6**	10.17
A	1 1/4	154	300	3 1/4"	1 11/16"	**4450K8**	19.00
A	1 1/2	162	300	3 11/16"	2"	**4450K9**	25.26
A	2	2,190	175	4 3/4"	2 3/8"	**4450K16**	60.80
B	1/8	26	170	1"	7/16"	**8158T31**	2.59
B	1/4	35	170	1 5/16"	9/16"	**8158T32**	3.21
B	3/8	82	170	1 9/16"	11/16"	**8158T33**	4.28
B	1/2	130	170	2 1/16"	15/16"	**8158T34**	8.68
B	3/4	215	170	2 7/8"	1 1/8"	**8158T35**	12.40
B	1	305	170	3 3/8"	1 3/8"	**8158T36**	24.68
C	1/8	18	145	13/16"	7/16"	**4450K17**	3.47
C	1/8	28	145	1 1/2"	1/2"	**4450K18**	5.21
With NPS Female Connection							
D	1/8	53	175	1 1/4"	9/16"	**4450K91**	$2.71
D	1/4	70	175	1 7/16"	11/16"	**4450K92**	3.50
D	3/8	175	175	1 7/8"	7/8"	**4450K93**	5.86
D	1/2	263	175	2 1/8"	1 1/16"	**4450K94**	10.57
With BSPT Male Connection							
A	1/8	53	175	7/8"	7/16"	**9836K21**	2.06
A	1/4	70	175	1 5/16"	9/16"	**9836K22**	2.61
A	3/8	175	175	1 1/2"	11/16"	**9836K23**	3.37
A	1/2	263	175	2"	7/8"	**9836K24**	5.64
A	3/4	438	175	2 5/16"	1 1/16"	**9836K25**	10.18
A	1	613	175	3"	1 5/16"	**9836K26**	14.78
A	1 1/4	700	175	3 3/8"	1 5/8"	**9836K27**	23.58
A	1 1/2	1,314	175	4"	2"	**9836K28**	34.03
A	2	2,190	175	4 11/16"	2 3/8"	**9836K29**	53.50
C	1/8	18	145	13/16"	7/16"	**9836K31**	3.47
C	1/8	28	145	1 5/16"	1/2"	**9836K32**	5.21
With Metric Male Connection							
C	M3	3	145	3/8"	1/4"	**4450K21**	1.67
C	M5	10	145	5/8"	5/16"	**4450K22**	3.04

Corrosion-Resistant Mufflers

E&G

F

All-stainless construction stands up to harsh environments—body is porous Type 316 stainless steel. Use with air and inert gas.

High-temperature mufflers withstand temperatures up to 400°F. They reduce noise by 15-20 dB and trap particles down to 50 microns. Fitting is Type 304 stainless steel. Max. pressure is 175 psi.

Extreme-temperature mufflers withstand temperatures up to 1000°F. They trap particles down to 100 microns. Fitting is Type 316 stainless steel. Max. pressure is 150 psi. *Style F* reduce noise by 10-20 dB, except 4402K61 and 4402K62 reduce noise by 13-29 dB. *Style G* reduce noise by 13-29 dB.

Pipe Size	Max. scfm @ 100 psi	Ht.	Hex Size/Dia.		
High-Temperature Mufflers					
(E) With NPT Male Connection					
1/8	53	7/8"	7/16"	**4402K51**	$9.04
1/4	70	1 1/4"	9/16"	**4402K52**	9.36
3/8	175	1 5/8"	11/16"	**4402K53**	11.33
1/2	263	2"	7/8"	**4402K54**	15.45
3/4	438	2 1/4"	1 1/16"	**4402K55**	48.90
1	613	3 9/16"	1 5/16"	**4402K56**	68.99
Extreme-Temperature Mufflers					
(F) With NPT Male Connection					
1/8	40	1 1/4"	3/8"	**8360T11**	27.82
1/4	53	1 5/8"	5/8"	**8360T12**	38.31
1/2	200	2 1/8"	7/8"	**8360T14**	47.07
3/4	340	2 1/4"	1 1/16"	**8360T15**	48.84
1	470	2 7/16"	1 7/16"	**8360T16**	71.16
(G) With BSPT Male Connection					
1/8	19	1 1/2"	7/16"	**4402K63**	60.15
1/4	36	2 1/16"	11/16"	**4402K64**	66.83
3/8	65	2 1/16"	11/16"	**4402K65**	66.83
1/2	90	2 5/16"	7/8"	**4402K66**	83.25
(F) With Metric Male Connection					
M3	3	3/8"	1/4"	**4402K61**	34.65
M5	6	11/16"	5/16"	**4402K62**	37.80

Sure-Seal Miniature Mufflers

H

J&K

A rubber O-ring above the threads ensures a tight seal. Mufflers reduce noise by 17-22 dB and trap particles down to 40 microns. Use with air and inert gas. Connection is UNF male.

Styles H&J have a porous bronze body with a brass fitting. O-ring is Buna-N. Max. pressure is 125 psi. Max. temp. is 200°F.

Style K has a porous Type 316 stainless steel body with a Type 303 stainless steel fitting. O-ring is fluoroelastomer. Max. pressure is 300 psi. Max. temp. is 300°F.

Thread Size	Max. scfm @ 100 psi	Ht.	Hex Size		
Bronze Mufflers					
H	10-32	5	5/8"	1/4"	**8226T11**	$8.67
J	10-32	5	1 1/16"	5/16"	**8226T13**	7.51
Type 316 Stainless Steel Muffler					
K	10-32	5	1 1/16"	5/16"	**8226T16**	21.67

Flow-Control Mufflers

Adjust the speed of air-powered tools and cylinders—turn the screw to change air flow and tighten the nut to secure. Mufflers reduce noise by 17-20 dB and trap particles down to 40 microns. Use with air and inert gas. Body is porous bronze and fitting is brass. Max. pressure is 300 psi. Max. temp. is 300°F. Connections are NPT male.

Pipe Size	Max. scfm @ 100 psi	Ht.	Hex Size		
1/8	20	1 5/16"	1/2"	**9834K31**	$4.74
1/8	30	1 9/16"	9/16"	**9834K41**	5.29
1/4	30	1 9/16"	9/16"	**9834K32**	5.24
1/4	40	1 5/8"	11/16"	**9834K42**	6.48
3/8	40	1 5/8"	11/16"	**9834K33**	6.48
3/8	60	2"	7/8"	**9834K43**	8.76
1/2	60	2"	7/8"	**9834K34**	8.38
1/2	70	2 3/8"	1 1/16"	**9834K44**	14.21
3/4	70	2 3/8"	1 1/16"	**9834K35**	15.02
1	100	2 1/2"	1 5/16"	**9834K36**	20.57

About Strainers and Selecting Screen Size

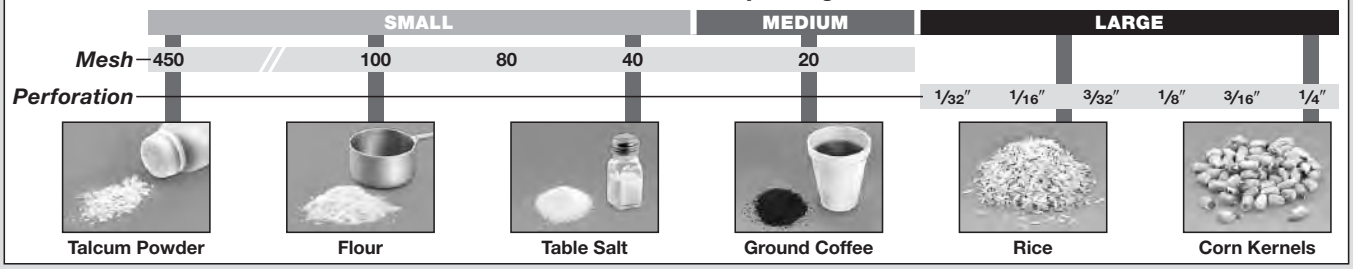
Install strainers before valves, pumps, and instrumentation to prevent damage from debris in your pipeline. They have a screen that is sized to trap the particles you wish to remove. Unthread the plug to clear debris without detaching pipe connections.

Selecting Screen Size

For Small or Medium Particles—Strainers have screens made of wire cloth. Screen size is determined by mesh size, which is the number of openings in a linear inch of the screen. For more information about wire cloth and mesh size, see page 459. ***20 mesh*** traps medium particles. It is the most commonly used screen size and is considered the industry standard.

For Large Particles—Strainers have screens made of perforated metal. Screen size is determined by perforation size, which is the actual diameter of the holes in the screen. Perforated screens are more rigid and durable than mesh screens for a longer service life in harsh environments. They are also good for maintaining flow when straining thick liquids.

Common Particle Sizes and Corresponding Screen Sizes



Bronze Y-Strainers

- Max. Pressure: Water, Oil, Inert Gas, and Diesel Fuel: 200 psi @ 70° F
  Steam: 125 psi @ 400° F
- Temp. Range: –20° to 400° F

Safeguard against damage to valves, pumps, nozzles, and steam traps from debris in your pipeline. Body is bronze and screen is Type 304 stainless steel. Connections are NPT female.

To Order: For *small and large particles*, please specify screen size: mesh or perforations.

Pipe Size	Lg.	Ht.	Plug Pipe Size	Strainer		Replacement Screen	
For Medium Particles—*Screen is 20 mesh.*							
1/4	3 3/16″	2 15/16″	3/8	43935K61	$26.97	43935K881	$11.71
3/8	3 3/16″	2 15/16″	3/8	43935K22	26.22	43935K822	11.57
1/2	3 3/16″	2 15/16″	3/8	43935K23	26.78	43935K832	11.72
3/4	3 15/16″	3 1/2″	3/8	43935K24	36.61	43935K842	11.99
1	4 1/2″	4 1/2″	1/2	43935K25	51.13	43935K852	15.30
1 1/4	5 5/16″	4 3/4″	1/2	43935K26	93.65	43935K862	18.90
1 1/2	6 3/16″	5 1/16″	1/2	43935K27	123.26	43935K872	25.82
2	7 7/16″	6 1/4″	1/2	43935K28	218.52	43935K882	42.00
2 1/2	9″	7 3/4″	1/2	43935K39	383.38	43935K884	157.02
For Small Particles—*Specify 40, 60, 80, 100, 150, or 200 mesh.*							
1/4	3 3/16″	2 15/16″	3/8	43935K91	47.82	43935K92	21.16
3/8	3 3/16″	2 15/16″	3/8	43935K52	45.98	43935K72	21.16
1/2	3 3/16″	2 15/16″	3/8	43935K53	45.98	43935K73	33.76
3/4	3 15/16″	3 1/2″	3/8	43935K54	54.12	43935K74	35.78
1	4 1/2″	4 1/2″	1/2	43935K55	66.40	43935K75	38.56
1 1/4	5 5/16″	4 3/4″	1/2	43935K56	92.88	43935K76	49.40
1 1/2	6 3/16″	5 1/16″	1/2	43935K57	135.15	43935K77	64.28
2	7 7/16″	6 1/4″	1/2	43935K58	196.69	43935K78	100.80
2 1/2	9″	7 3/4″	1/2	43935K59	383.38	43935K79	204.12
For Large Particles—*Specify 1/16″ or 1/8″ perforations.*							
1/2	3 3/16″	2 15/16″	3/8	43935K133	66.18	43935K163	19.66
3/4	3 15/16″	3 1/2″	3/8	43935K134	81.88	43935K164	20.92
1	4 1/2″	4 1/2″	1/2	43935K135	99.76	43935K165	27.48
1 1/4	5 5/16″	4 3/4″	1/2	43935K136	138.88	43935K166	33.26
1 1/2	6 3/16″	5 1/16″	1/2	43935K137	184.76	43935K167	42.84
2	7 7/16″	6 1/4″	1/2	43935K138	302.36	43935K168	62.00
2 1/2	9″	7 3/4″	1/2	43935K139	513.92	43935K169	103.58

Bronze Y-Strainers with Magnetic Plug

- Max. Pressure: Water, Oil, Inert Gas, Acetone, and Diesel Fuel: 400 psi @ 70° F
  Steam: 235 psi @ 400° F
- Temp. Range: –20° to 400° F

Catch small ferrous particles—strainers have a magnet in the plug and a 40 mesh screen. Body is bronze and screen is Type 304 stainless steel. Connections are NPT female.

Pipe Size	Lg.	Ht.	Plug Pipe Size	Strainer		Replacement Screen	
1	4 1/8″	4 3/8″	1/4	4495K43	$289.63	4385K25	$46.52
2	6 5/8″	7 1/16″	3/4	4495K46	566.57	4385K83	127.19

Cast Iron Y-Strainers

- Max. Pressure: Water, Oil, Inert Gas, Acetone, and Diesel Fuel: 400 psi @ 70° F
  Steam: 250 psi @ 406° F
- Temp. Range: –20° to 406° F

A rugged cast iron body provides strength and durability while protecting valves, pumps, and steam traps from debris. Screen is Type 304 stainless steel. Connections are NPT female.

To Order: For *small and large particles*, please specify screen size: mesh or perforations.

Pipe Size	Lg.	Ht.	Plug Pipe Size	Strainer		Replacement Screen	
For Medium Particles—*Screen is 20 mesh.*							
1/4	3″	3 1/2″	3/8	4417K17	$16.49	4417K31	$10.84
3/8	3″	3 1/2″	3/8	4417K19	16.49	4417K32	10.84
1/2	3″	3 1/2″	3/8	4417K21	16.49	4417K33	10.84
3/4	4″	4 1/2″	1/2	4417K22	21.51	4417K34	11.86
1	4 7/8″	5 3/8″	3/4	4417K23	28.59	4417K35	12.86
1 1/4	5 1/8″	5 15/16″	3/4	4417K24	35.93	4417K36	15.62
1 1/2	5 3/4″	6 3/16″	1	4417K25	45.66	4417K37	21.94
2	7 1/4″	8″	1 1/4	4417K26	77.17	4417K58	30.24
2 1/2	8 7/8″	9 3/4″	1 1/4	4417K11	164.87	4417K42	120.96
3	10″	10 15/16″	1 1/2	4417K12	225.25	4417K43	146.16
For Small Particles—*Specify 40, 60, 80, 100, 150, or 200 mesh.*							
1/4	3″	3 1/2″	3/8	4417K61	28.40	4417K72	19.16
3/8	3″	3 1/2″	3/8	4417K62	28.40	4417K73	19.16
1/2	3″	3 1/2″	3/8	4417K63	28.64	4417K74	19.16
3/4	4″	4 1/2″	1/2	4417K64	32.85	4417K75	21.94
1	4 7/8″	5 3/8″	3/4	4417K65	42.76	4417K76	28.22
1 1/4	5 1/8″	5 15/16″	3/4	4417K66	56.12	4417K77	32.02
1 1/2	5 3/4″	6 3/16″	1	4417K67	65.26	4417K78	41.32
2	7 1/4″	8″	1 1/4	4417K68	109.01	4417K79	59.98
2 1/2	8 7/8″	9 3/4″	1 1/4	4417K69	171.46	4417K81	98.28
3	10″	10 15/16″	1 1/2	4417K71	234.26	4417K82	120.96
For Large Particles—*Specify 1/32″, 1/16″, or 1/8″ perforations.*							
1/2	3″	3 1/2″	3/8	4417K83	28.27	4417K74	19.16
3/4	4″	4 1/2″	1/2	4417K84	32.98	4417K75	21.94
1	4 7/8″	5 3/8″	3/4	4417K85	43.00	4417K76	28.22
1 1/4	5 1/8″	5 15/16″	3/4	4417K86	56.27	4417K77	32.02
1 1/2	5 3/4″	6 3/16″	1	4417K87	65.39	4417K78	41.32
2	7 1/4″	8″	1 1/4	4417K88	108.98	4417K79	59.98
2 1/2	8 7/8″	9 3/4″	1 1/4	4417K89	144.32	4417K81	98.28

Brass Y-Strainers for Drinking Water

- Max. Pressure: 400 psi @ 70° F
- Temp. Range: 33° to 353° F

Trap and remove debris from pipelines. Strainers are for use with drinking (potable) water. Screen size is 20 mesh. Body is brass and screen is Type 304 stainless steel. Connections are NPT female.

Pipe Size	Lg.	Ht.	Plug Pipe Size	Strainer		Replacement Screen	
1/2	2 3/4″	2 3/4″	1/4	1090N11	$56.83	1090N21	$12.28
3/4	3 3/16″	3 3/16″	1/4	1090N12	82.43	1090N22	21.55
1	3 3/4″	3 3/4″	1/2	1090N13	102.68	1090N23	26.81

About Filters and Particle Sizes

Use a filter to reduce contaminants in your process media. Filters trap particles of a specific size and larger. Contaminants are so small that the particle size is measured in microns—a unit of length equal to one millionth of a meter or 0.0000394 of an inch.

Common Particle Sizes in Microns

Water Filters

For information about pipe size, see pages 2-3.

High-Temperature Water Filters

Remove particles from hot water lines. Water filters have a max. temperature of 160° F. Housing is glass-reinforced nylon. Water filters with a ½ pipe size have a black housing; ¾ pipe size have an orange/red housing. Connections are NPT female.

Pipe Size	Max. Flow, gpm	Overall Dia.	Overall Ht.	Max. psi	Particle Size, microns	Water Filters		Replacement Cartridges OD	Replacement Cartridges Ht.		
Reduces Particles											
½	2	4 3/8″	12″	125	5	5190K62	$85.74	2 1/2″	9 7/8″	8147K52	$6.07
¾	5	4 7/8″	7″	125	5	5190K73	89.67	2 5/8″	4 7/8″	5190K83	10.88
¾	10	4 7/8″	12″	125	5	5190K74	109.33	2 5/8″	9 3/4″	5190K84	13.76

Quick-Change Water Filters

Swap cartridges with a turn of your wrist—filters come with a cartridge that connects directly to the filter head. Water flow stops automatically when the cartridge is disconnected. Filter head is white polypropylene. Maximum temperature is 100° F. Connections are push-to-connect tube fittings.

For Tube OD	Max. Flow, gpm	Overall Dia.	Overall Ht.	Max. psi	Particle Size, microns	Water Filters		Replacement Cartridges OD	Replacement Cartridges Ht.		
Reduces Taste, Odor, and Chlorine—NSF/ANSI 42 Certified											
¼″	0.5	3″	12″	125	5	8484T61	$46.00	2 5/8″	9″	8484T66	$34.51
¼″	0.75	3″	12″	125	Not Rated	8484T51	36.24	2 5/8″	9″	8484T56	23.86
Reduces Taste, Odor, Chlorine, and Lead—NSF/ANSI 42 and 53 Certified											
¼″	0.5	3″	12″	125	0.5	8484T31	47.88	2 5/8″	9″	8484T36	35.38

Easy-to-Clean Water Filters

¾ and 1 Pipe Size

2 Pipe Size

There's no need to stop your water supply and disassemble these filters for cleaning. Turn the handle to flush debris from the cartridge and purge dirty water through the drain at the bottom; drain is threaded for connection to pipe or hose. Bowl is clear polycarbonate so you can monitor debris collecting in the cartridge without stopping flow.

Water filters for ¾ and 1 pipe size have NPT male threaded connections. Maximum temperature is 120° F.

Water filter for 2 pipe size has a female unthreaded socket end. Connect to pipe using a PVC primer and cement (see series 74605A on pg. 3558). Maximum temperature is 73° F.

Pipe Size	Max. Flow, gpm	Overall Lg.	Overall Ht.	Max. psi	Choose a Particle Size, microns	Water Filters		Replacement Cartridges OD	Replacement Cartridges Ht.		
Reduces Particles											
¾	25	6″	12″	100	105, 150, 250	5159K61	$81.33	1 3/8″	5 3/4″	5159K91	$41.94
1	39	6″	12″	100	105, 150, 250	5159K64	87.92	1 3/8″	5 3/4″	5159K91	41.94
2	100	5 1/2″	17 7/8″	150	105, 150, 250	5159K67	148.82	1 7/8″	10″	5159K97	42.99

Drinking Water Filters

Prepare water for use in beverages, food preparation, and ice production. Both the water filter and replacement cartridge meet NSF/ANSI Standards 42 and 53. They also prevent scale formation, which can damage equipment. Housing is polypropylene and has two ¼″ slots for mounting. Maximum temperature is 100° F. Filter comes with a flow-control valve, adapters, and a 5-ft. length of ⅜″ tubing for under-sink installation between a water line and faucet. Pipe connections are NPT female.

Pipe Size	Max Flow, gpm	Overall Dia.	Overall Ht.	Max. psi	Particle Size, microns	Water Filter		Replacement Cartridge OD	Replacement Cartridge Ht.		
Reduces Algae, Taste, Odor, Lead, and Iron											
⅜	0.75	4″	16″	125	0.5	9839K16	$273.67	4″	10 1/4″	9839K17	$124.50

Deionized Water Filters

Made from pure polypropylene, this filter housing doesn't contain fillers, colorants, or plasticizers that can leach into deionized water. It comes with a cartridge that filters particles from your deionized water line. Filter housing is opaque white so it blocks light to minimize algae growth. Maximum temperature is 100° F. Connections are NPT female.

Pipe Size	Max Flow, gpm	Overall Dia.	Overall Ht.	Max. psi	Particle Size, microns	Water Filter		Replacement Cartridge OD	Replacement Cartridge Ht.		
Reduces Particles											
¾	10	5 3/32″	12 1/16″	100	0.2	1354N11	$157.92	2 3/4″	9 3/4″	1354N12	$86.59

For information about particle size, see page 440.

About Filter Bags

Use filter bags to trap and remove particles of a specific size and larger from liquids. For information about particle size, see page 440. Select the best material for your application using the chart below.

Felt and fiber filter bags have high dirt-holding capacity. They trap particles throughout the thickness of the fabric, which prevents clogs and pressure drops. Fiber filter bags hold more dirt than felt bags.

Mesh filter bags are often used as the first stage of filtration and to strain small batches of liquids. They trap particles on the surface of the fabric.

	Water	Organic Solvents	Petroleum Oils	Alkalies	Organic Acids	Mineral Acids
Polyester	Good	Good	Excellent	Fair	Good	Fair
Polypropylene	Good	Fair	Fair	Excellent	Excellent	Good
Nylon	Good	Excellent	Excellent	Good	Fair	Poor
Nomex	Good	Excellent	Excellent	Good	Fair	Poor

Bag Size		Bag Trade Size
Dia.	Ht.	
4″	8″	3
	14″	4
5½″	21″	8
	32″	9
7″	16½″	1
	32″	2
8″	32″	12

Felt Filter Bags

Our most popular felt filter bags, use these in a housing to remove contaminants from liquids. All have a sewn seam. They have a metal retaining ring, unless noted.

Tear-resistant polyester bags are reinforced with a layer of polyester mesh.

Dia.	Ht.	Trade Size	Max. Flow, gpm	*Choose a Particle Size: 1, 5, 10, 25, 50, 100, 200 microns*	1-9	10-Up
Polyester—Max. temp. is 300° F						
4″	8″	3	25	**5162K111**	$5.06	$4.31
4″	14″	4	50	**5162K112**	5.47	4.65
5½″	21″	8	100	**5162K113**	6.78	5.76
5½″	32″	9	150	**5162K114**	6.77	5.53
7″	16½″	1	100	**5162K115**	6.69	5.69
7″	32″	2	220	**5162K116**	7.90	6.45
8″	32″	12	275	**5162K117**	9.26	7.55
Tear-Resistant Polyester—Max. temp. is 325° F						
4″	8″	3	20	**6835K57**	5.02	3.91
4″	14″	4	35	**6835K58**	5.86	4.51
5½″	21″	8	60	**6835K59**	6.72	5.23
5½″	32″	9	100	**6835K61**♣	10.81	8.39
7″	16½″	1	65	**6835K62**	6.40	4.98
7″	32″	2	125	**6835K63**	10.52	8.17
FDA-Compliant Polypropylene—Max. temp. is 200° F						
4″	8″	3	25	**51595K81**★	4.98	3.74
4″	14″	4	50	**51595K82**★	6.06	4.54
5½″	21″	8	75	**51595K85**	6.51	4.89
5½″	32″	9	90	**51595K86**	8.91	6.69
7″	16½″	1	90	**51595K83**★	7.68	5.76
7″	32″	2	180	**51595K84**★	10.44	7.84
8″	32″	12	275	**51595K87**	14.25	9.82
High-Temperature Nomex—Max. temp. is 400° F						
4″	8″	3	25	**51635K111**	10.77	7.60
4″	14″	4	50	**51635K211**	16.25	11.60
5½″	21″	8	75	**51635K311**	18.79	14.21
5½″	32″	9	90	**51635K411**	25.85	19.55
7″	16½″	1	90	**51635K611**	22.35	16.47
7″	32″	2	180	**51635K711**	36.66	27.02
8″	32″	12	275	**51635K511**	36.48	28.80

♣ Not available for 100 microns. ★ Bag has a plastic flange.

Extended-Life Felt Filter Bags

Replace bags less frequently—these have two to three times the dirt-holding capacity than our other felt filter bags for a long service life. Made of two separate bags, the inside bag traps large particles and then the outside bag traps small particles. All have a sewn seam and a metal retaining ring.

Dia.	Ht.	Trade Size	Max. Flow, gpm	*Choose a Particle Size: 1, 5, 10, 25, 50, 100 microns*	1-9	10-Up
Polyester—Max. temp. is 300° F						
4″	8″	3	25	**5726K37**	$9.67	$8.23
4″	14″	4	50	**5726K47**	10.57	8.99
5½″	21″	8	100	**5726K57**	13.02	11.08
5½″	32″	9	150	**5726K67**	16.08	13.68
7″	16½″	1	100	**5726K17**	12.65	10.76
7″	32″	2	220	**5726K27**	18.53	15.76
8″	32″	12	275	**5726K77**	21.02	17.88
Polypropylene—Max. temp. is 200° F						
4″	8″	3	25	**5783K38**	10.00	8.51
4″	14″	4	50	**5783K48**	10.86	9.24
5½″	21″	8	100	**5783K58**	13.80	11.74
5½″	32″	9	150	**5783K68**	18.00	15.31
7″	16½″	1	100	**5783K18**	13.76	11.70
7″	32″	2	220	**5783K28**	20.45	17.40
8″	32″	12	275	**5783K78**	24.53	20.87

Seamless Felt Filter Bags

Trap small particles that can pass through pinholes in a seam. These bags are made of molded felt for more uniform filtration than bags with a seam. All have a plastic flange.

Extended-life filter bags have extra-thick felt for greater dirt-holding capacity than standard bags.

Dia.	Ht.	Trade Size	Max. Flow, gpm	*Choose a Particle Size: 1, 5, 10, 25, 50, 100, 200 microns*	1-9	10-Up
Standard						
Polyester—Max. temp. is 200° F						
4″	8″	3	25	**9316T111**	$6.60	$4.53
4″	14″	4	50	**9316T211**	7.01	4.82
5½″	21″	8	100	**9316T311**	8.55	5.88
5½″	32″	9	150	**9316T411**	10.55	7.25
7″	16½″	1	100	**9316T511**	8.46	5.81
7″	32″	2	220	**9316T611**	12.00	8.26
8″	32″	12	275	**9316T78**	13.48	9.27
Polyester—Max. temp. is 300° F						
7″	16½″	1	50	**9299T39**	7.66	6.19
7″	32″	2	100	**9299T49**	11.48	9.27
Polypropylene—Max. temp. is 190° F						
7″	16½″	1	50	**9299T18**	7.66	6.19
7″	32″	2	100	**9299T28**	11.48	9.27
Extended Life						
Polyester—Max. temp. is 300° F						
7″	16½″	1	75	**9301T87**■	13.08	10.51
7″	32″	2	135	**9301T97**■	18.42	14.87
Polypropylene—Max. temp. is 190° F						
7″	16½″	1	75	**9301T67**■	12.11	9.69
7″	32″	2	135	**9301T77**■	17.02	13.62

■ Not available for 200 microns.

Slip-On Felt Filter Bags

Filter material as you fill drums and tanks. Wrap one of these bags around pipe or hose and secure it with a clamp or band (not included). Bags have a sewn seam.

Dia.	Ht.	Max. Flow, gpm	*Choose a Particle Size: 5, 10, 15, 25, 50, 75, 100, 200 microns*	1-9	10-Up
Polyester—Max. temp. is 300° F					
7″	18″	20	**9830K112**	$5.21	$3.80
7″	33″	50	**9830K211**	7.41	5.40
14″	36″	125	**9830K611**	30.67	22.38
Polypropylene—Max. temp. is 200° F					
7″	18″	20	**5859K51**▲	5.62	4.10
7″	33″	50	**5859K61**▲	8.07	5.89

▲ Not available for 15, 75, or 200 microns.

High-Capacity Tie-On Felt Filter Bags

Also known as bottle-neck bags, these have a large surface area for high particle-holding capacity. Use the drawstring to tie bags to pipe or hose. They have a sewn seam.

For Pipe Size	Dia.	Ht.	Max. Flow, gpm	*Choose a Particle Size: 5, 10, 25, 50, 75, 100 microns*	
Polyester—Max. temp. is 275° F					
2	14″	18″	28	**3520T17**	$5.16
2	14″	24″	40	**3520T27**	5.86
3	18″	24″	49	**3520T37**	7.04
3	18″	32″	69	**3520T57**	8.72
4	20″	32″	74	**3520T67**	9.24
6	24″	34″	98	**3520T77**	11.04

About Wire Cloth and Plastic Mesh

Use wire cloth and plastic mesh in filtering applications to remove contaminants.

Type & Application

Most wire cloth and plastic mesh is woven. Often used to make strainers, filter screens, and sieves, the woven style is available in the widest variety of materials and sizes.

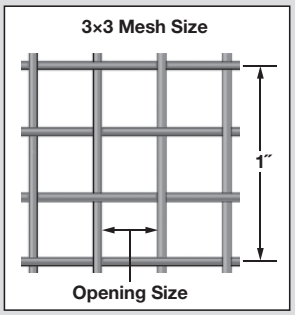
If you're working with abrasive materials such as gravel, choose **extra-rigid crimped wire cloth**. Wires are bent where they intersect, so they nest securely to maintain a consistent opening size. The crimping process also adds strength and rigidity to this wire cloth.

To make your own filter baskets, **easy-to-form welded wire cloth** is the best option. Welded joints keep opening sizes uniform and prevent the sheet from fraying as you bend it into shape.

Use **stretchable molded plastic mesh** to fit around irregular shapes without fraying.

Mesh Size

To replace existing wire cloth and plastic mesh, determine the mesh size by counting the number of openings per inch. If you're not sure about the size you need, select an opening size that is smaller than the particles you wish to remove.



Common Particle Sizes and Corresponding Mesh Sizes (Mesh Shown at Actual Size)


Corn Kernels


Rice

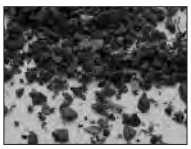
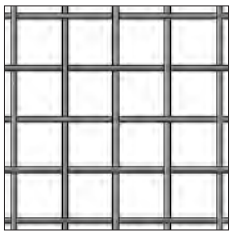

Ground Coffee


Table Salt


Flour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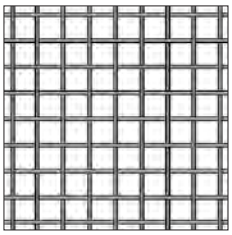
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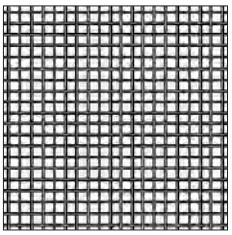
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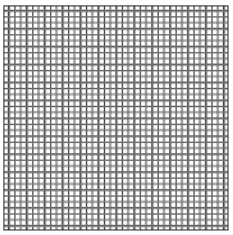
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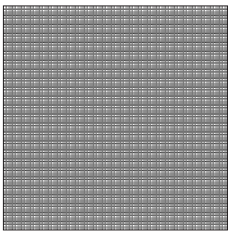
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Wire Cloth Assortments and Sample Packs

Find the best wire cloth for your application—assortments and sample packs include one sheet of the mesh sizes listed.

Assortments—Type 304 Stainless Steel

Keep a convenient range of mesh sizes on hand for maintenance and research projects. Assortments with a 2¾″×1⅝″ sheet size are good for comparing mesh sizes—sheets come labeled with the mesh size dimensions.

Mesh Sizes for Large Particles

Mesh Size	Wire Dia.	Mesh Size	Wire Dia.
2×2	0.063″	8×8	0.028″
3×3	0.047″	10×10	0.025″
4×4	0.047″	12×12	0.023″
5×5	0.041″	14×14	0.02″
6×6	0.035″	16×16	0.018″

Mesh Sizes for Medium Particles

Mesh Size	Wire Dia.	Mesh Size	Wire Dia.
18×18	0.017″	35×35	0.01″
20×20	0.016″	40×40	0.01″
24×24	0.014″	50×50	0.009″
30×30	0.01″	60×60	0.0075″
30×30	0.012″		

Mesh Sizes for Small Particles

Mesh Size	Wire Dia.	Mesh Size	Wire Dia.
70×70	0.0065″	250×250	0.0016″
80×80	0.0055″	325×325	0.0014″
100×100	0.0045″	400×400	0.0011″
150×150	0.0026″	500×500	0.001″
200×200	0.0021″		

Sheet Size		
For Large Particles		
2¾″×1⅝″	9231T11	$14.29
6″×6″	92405T13	31.92
12″×12″	92405T23	92.38
For Medium Particles		
2¾″×1⅝″	9231T16	$13.26
6″×6″	92405T15	21.73
12″×12″	92405T25	67.53
For Small Particles		
2¾″×1⅝″	9231T12	$13.26
6″×6″	92405T17	65.17
12″×12″	92405T27	258.35

Mesh Size Identification Kit—Type 304 Stainless Steel

A handy reference for identifying and comparing mesh sizes, this kit contains 45 samples of wire cloth that come labeled and organized in a three-ring binder. Samples are 2″×3″.

Woven Mesh Sizes

Mesh Size	Wire Dia.	Mesh Size	Wire Dia.	Mesh Size	Wire Dia.	Mesh Size	Wire Dia.	Mesh Size	Wire Dia.	Mesh Size	Wire Dia.
2×2	0.063″	6×6	0.063″	10×10	0.035″	18×18	0.023″	80×80	0.0055″	200×200	0.0021″
3×3	0.063″	7×7	0.028″	12×12	0.023″	20×20	0.016″	100×100	0.0045″	230×230	0.0014″
4×4	0.047″	8×8	0.028″	12×12	0.028″	24×24	0.014″	120×120	0.0036″	250×250	0.0016″
4×4	0.063″	8×8	0.035″	14×14	0.02″	30×30	0.012″	135×135	0.0023″	270×270	0.0014″
5×5	0.041″	8×8	0.063″	16×16	0.018″	40×40	0.01″	150×150	0.0026″	325×325	0.0014″
6×6	0.035″	9×9	0.023″	16×16	0.023″	50×50	0.009″	165×165	0.0019″	400×400	0.001″
6×6	0.047″	10×10	0.025″	18×18	0.017″	60×60	0.0075″	180×180	0.0023″		

Welded Mesh Sizes

Mesh Size	Wire Dia.
2×2	0.063″
2×2	0.047″
3×3	0.047″
4×4	0.032″

Mesh Size Identification Kit 9231T44 $82.57

Wire Diameters Sample Pack—Type 304 Stainless Steel

Compare the opening size and flexibility of 20×20 mesh size with different wire diameters. Includes three samples with wire diameters of 0.009″, 0.014″, and 0.023″. Samples are 4½″×4½″.

Wire Diameters Sample Pack 9231T13 $7.65

Extra-Rigid Sample Pack—Steel

Also known as space cloth, use this sample pack to compare the construction and rigidity of three varieties of extra-rigid wire cloth. Samples are 4½″×4½″.

Extra-Rigid Sample Pack 9231T15 $15.31

About Perforated Sheets

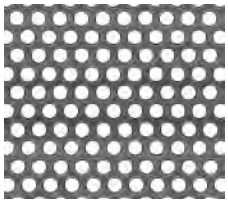
Use perforated sheets to filter, sort, separate, and strain liquids or dry materials. Holes have smooth edges to prevent particle buildup. Perforated sheets are also good for use as protective enclosures such as machine guards and ventilating grills or in architectural installations such as acoustical panels and decorative screens.

Compared to wire cloth, perforated sheets are more rigid and durable for a longer service life in harsh environments. They are also better for maintaining flow when straining thick liquids; the larger the percentage of open area, the greater the flow.

Common Particles and Corresponding Hole Dia.

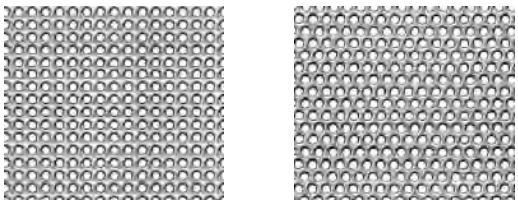
Super-Corrosion-Resistant Type 316 Stainless Steel Perforated Sheets

Able to withstand corrosive solutions and harsh cleaning, these perforated sheets are commonly used in food-processing applications. Type 316 stainless steel has excellent corrosion and abrasion resistance and good weldability and formability. Holes are staggered.



Hole Dia.	Open Area	Center-to-Center Spacing	36″×40″	
0.03″ Thickness (22 Gauge)				
0.0625″	41%	0.094″	3671T11	$225.50
0.125″	40%	0.188″	3671T12	137.17
0.036″ Thickness (20 Gauge)				
0.156″	63%	0.188″	3671T14	134.80
0.048″ Thickness (18 Gauge)				
0.094″	33%	0.156″	3671T15	193.67
0.125″	40%	0.188″	3671T16	197.57
0.06″ Thickness (16 Gauge)				
0.125″	40%	0.188″	3671T17	232.83
0.1875″	51%	0.25″	3671T18	238.77
0.25″	58%	0.313″	3671T19	209.17
0.075″ Thickness (14 Gauge)				
0.125″	40%	0.188″	3671T21	298.87
0.12″ Thickness (11 Gauge)				
0.25″	40%	0.375″	3671T22	463.47

Extra-Thin Brass Perforated Rolls



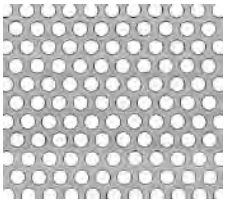
Straight Holes | Staggered Holes

Bend and shape these thin perforated sheets to make strainers that fit your application. Brass is softer than Type 304 stainless steel, so it is easier to form. It also has good corrosion resistance. Maximum length is 50 feet.

Hole Dia.	Open Area	Center-to-Center Spacing	Wd.		Per Ft. 1-9	Per Ft. 10-Up
Straight Holes						
0.016″ Thickness (26 Gauge)						
0.016″	30%	0.026″	24″	9360T12	$90.00	$70.00
0.02″	20%	0.03″	24″	9360T14	75.43	58.65
0.024″	23%	0.044″	24″	9360T16	51.71	40.22
0.027″	23%	0.05″	24″	9360T17	45.23	35.18
0.033″	28%	0.055″	24″	9360T18	38.00	29.55
0.038″	45%	0.05″	24″	9360T29	37.31	29.02
0.04″	29%	0.066″	24″	9360T19	37.56	29.22
0.045″	37%	0.066″	24″	9360T21	36.52	28.41
0.057″	34%	0.086″	24″	9360T23	34.74	27.03
0.065″	33%	0.1″	24″	9360T24	33.30	25.89
0.079″	41%	0.11″	24″	9360T25	33.02	25.69
0.103″	48%	0.132″	24″	9360T26	32.47	25.24
0.138″	43%	0.188″	24″	9360T27	28.20	21.93
Staggered Holes						
0.016″ Thickness (26 Gauge)						
0.016″	22%	0.035″	24″	9360T13	88.57	68.90
0.02″	22%	0.04″	24″	9360T15	61.16	47.57

Lightweight Alloy 3003 Aluminum Perforated Sheets

Lighter in weight than steel and stainless steel, Alloy 3003 aluminum has good corrosion resistance, weldability, and formability. Holes are staggered.



Hole Dia.	Open Area	Center-to-Center Spacing	36″×40″	
0.032″ Thickness (20 Gauge)				
0.0625″	23%	0.125″	9232T111	$46.64
0.0625″	30%	0.109″	9232T161	48.33
0.125″	40%	0.188″	9232T121	39.20
0.1875″	51%	0.25″	9232T131	36.98
0.25″	58%	0.313″	9232T221	39.51
0.05″ Thickness (16 Gauge)				
0.0625″	23%	0.125″	9232T141	63.13
0.0625″	30%	0.109″	9232T151	64.47
0.125″	40%	0.188″	9232T181	52.56
0.1875″	51%	0.25″	9232T211	48.71
0.25″	40%	0.375″	9232T241	63.42
0.063″ Thickness (14 Gauge)				
0.125″	40%	0.188″	9232T171	60.69
0.1875″	51%	0.25″	9232T191	56.56
0.25″	40%	0.375″	9232T231	58.84

High-Strength Lightweight Alloy 6061 Aluminum Perforated Sheets

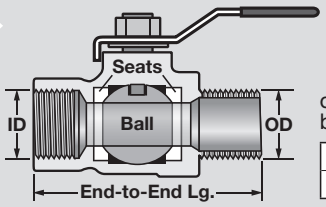
Harder and stronger than our other aluminum perforated sheets, Alloy 6061 has greater wear resistance. It's lightweight and corrosion resistant and has good weldability and formability. Holes are staggered.

Hole Dia.	Open Area	Center-to-Center Spacing	36″×40″	
0.032″ Thickness (20 Gauge)				
0.125″	40%	0.188″	9667T1	$186.84
0.1875″	51%	0.25″	9667T2	173.68
0.05″ Thickness (16 Gauge)				
0.125″	40%	0.188″	9667T3	205.26
0.1875″	51%	0.25″	9667T4	192.11
0.063″ Thickness (14 Gauge)				
0.125″	40%	0.188″	9667T5	218.42
0.1875″	51%	0.25″	9667T6	207.89
0.25″	58%	0.313″	9667T8	213.82
0.25″	40%	0.375″	9667T7	213.82

Small-Particle-Filtering Type 316 Stainless Steel Perforated Sheets

Trap small particles in low-flow applications—these sheets have tiny holes and a small open area. Holes meet a precision size tolerance. Perforated area is 18″×21″; with the unperforated border, overall sheet size is approximately 20″×22″. Type 316 stainless steel has excellent corrosion resistance. Holes are staggered.

Hole Dia.	Open Area	Center-to-Center Spacing		
0.005″ Thickness (42 Gauge)				
0.006″	27%	0.0112″	92315T101	$252.83
0.014″ Thickness (29 Gauge)				
0.015″	21%	0.031″	92315T131	315.83
0.018″	31%	0.031″	92315T132	315.83



About On/Off Valves

Manually open and close these valves to quickly start and stop flow. They are also known as ball valves.

Determining Pipe Size of Your Valve: To choose the correct pipe size, measure the threaded inside diameter (ID) or outside diameter (OD) of your pipe or valve, round up to the nearest threaded ID or OD below, and find the corresponding pipe size listed in the chart.

Threaded ID or OD	1/2"	5/8"	3/4"	1"	1 3/8"	1 5/8"	1 7/8"	2 3/8"	2 7/8"	3 1/2"	4 1/2"
Pipe Size	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3	4

On/Off Valves

Straights:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 600 psi @ 100° F (1/4-2 size); 450 psi @ 100° F (2 1/2-4 size)
- Max. Pressure for Steam: 150 psi @ 366° F
- Temp. Range: -50° to 400° F
- Vacuum Rating: 29.9" Hg

Elbows:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 250 psi @ 250° F
- Max. Pressure for Steam: 150 psi @ 350° F
- Temp. Range: -50° to 350° F
- Vacuum Rating: 29" Hg

Use these valves for simple on/off control in general applications. Body and ball are brass. Seat is PTFE. Valves are full port, so they do not restrict flow. *Straights* are CSA and CSA-US certified, unless noted. *Straights with 1/4 to 2 pipe size* are also UL and C-UL listed and FM approved.

NPT female × female straights have a fluoroelastomer seal, except T-handle valves have a PTFE seal. **NPT female × male straights** have PTFE packing. **Elbows** have a PTFE seal and packing.

Spring-close lever handles automatically close when the lever is released. **T-handles, lockable oval handles,** and **short-lever handles** resist accidental movement when snagged or bumped. *Lockable* valves can be fixed in place with a padlock (not included) with a max. shackle diameter of 9/32".

Straights with extended stem have an extra-long stem for installation through thick insulation.

NPT Female × Female Straights

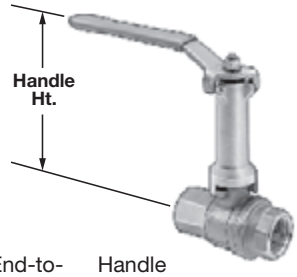
Pipe Size	End-to-End Lg.	Lever		Lockable Lever		Spring-Close Lever		T-Handle		Lockable Oval	
1/4	1 3/4"	47865K21	$8.27	4629K11	$10.83	4088T8	$31.26	4082T12	$9.68	4901K41	$19.54
3/8	1 3/4"	47865K22	8.27	4629K12	10.83	4088T9	31.26	4082T13	9.68	4901K42	19.54
1/2	2 5/16"	47865K23	9.47	4629K13	11.62	4088T11	32.87	4082T14	10.95	4901K43	21.24
3/4	2 1/2"	47865K24	13.36	4629K14	15.83	4088T12	40.89	4082T15	15.30	4901K44	25.39
1	3 3/16"	47865K25	21.44	4629K15	24.74	4088T13	50.87	4082T16	24.02	4901K45	33.70
1 1/4	3 11/16"	47865K26	35.36	4629K16	39.69	4088T14	74.98	4082T17	40.96	4901K46	47.35
1 1/2	4"	47865K27	42.84	4629K17	48.33	4088T15	91.65	4082T18	48.83	4901K47	55.91
2	4 3/4"	47865K28	63.66	4629K18	66.43	4088T16	125.37	4082T21	68.78	4901K48	81.36
2 1/2	6 1/8"	47865K71	180.71	4629K71	194.20					4901K67	224.71
3	7"	47865K72	241.51	4629K72	259.33					4901K49	287.85
4	8 1/2"	47865K73	352.78	4629K73	374.29					4901K61	410.80

NPT Female × Male Straights

Pipe Size	End-to-End Lg.	Lever		Lockable Lever		Short Lever		T-Handle		Lockable Oval	
1/4	2 1/4"	47865K41	$9.29	4629K41	$13.23	47865K11	$10.65	4082T42	$10.45	4901K51	$20.48
3/8	2 1/4"	47865K42	8.90	4629K42	13.23	47865K12	11.37	4082T43	10.45	4901K52	20.48
1/2	2 3/4"	47865K43	10.73	4629K43	13.51	47865K13	12.86	4082T44	12.07	4901K53	22.52
3/4	3"	47865K44	14.93	4629K44	18.53	47865K14	17.88	4082T45	16.80	4901K54	26.93
1	3 5/8"	47865K45	24.09	4629K45	27.88	47865K15	27.44	4082T46	25.81	4901K55	37.04
1 1/4	4 3/16"	47865K46	41.58	4629K46	48.36	47865K16	46.63	4082T47	49.77	4901K62	55.91
1 1/2	4 7/16"	47865K47	46.08	4629K47	54.81	47865K17	52.00	4082T48	54.81	4901K63	64.68
2	5 1/4"	47865K48	68.69	4629K48	80.06	47865K18	76.78	4082T51	80.06	4901K64	91.45
3	8"	47865K49★	296.61	4629K49★	335.79					4901K65★	320.45
4	9 3/8"	47865K51★	460.21	4629K51★	493.73					4901K66★	519.83

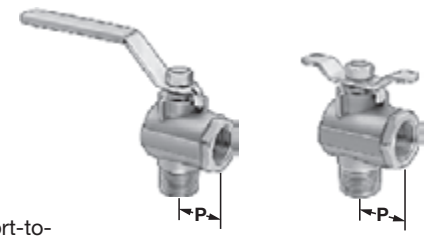
★Not CSA or CSA-US certified.

NPT Female × Female Straights with Extended Stem



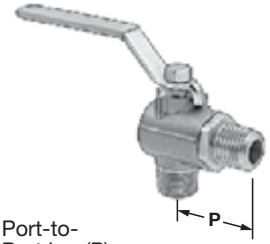
Pipe Size	End-to-End Lg.	Handle Ht.		
1/4	1 3/4"	3 11/16"	4075T21	$22.54
1/2	2 5/16"	3 15/16"	4075T23	23.77
3/4	2 1/2"	4 3/16"	4075T24	31.69
1	3 3/16"	4 5/16"	4075T25	40.80

NPT Male × Female Elbows



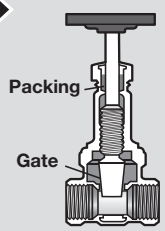
Pipe Size	Port-to-Port Lg. (P)	Lever		T-Handle	
1/4	1"	4847K11	$22.33	4847K14	$23.34
3/8	1"	4847K12	23.81	4847K15	25.05
1/2	1 1/8"	4847K13	23.07	4847K16	29.07

NPT Male × Male Elbows



Pipe Size	Port-to-Port Lg. (P)		
1/4	1 9/16"	4847K21	$22.19
3/8	1 9/16"	4847K22	23.51
1/2	1 7/8"	4847K23	25.85

About Gradual On/Off Valves



Also known as gate valves, these gradually open and close to prevent system damage caused by suddenly starting or stopping flow. All have a gate that provides a tight seal when closed. Most gradual on/off valves require multiple turns of a wheel handle to open or close.

Valves with a Rising Stem—The stem lifts as the valve opens and lowers as the valve closes to provide a visual indication of whether flow is on or off. Since the stem is isolated from the process media, valves with a rising stem have a longer service life than valves with a nonrising stem.

Valves with a Nonrising Stem—The stem stays in the same position whether the valve is open or closed, so these valves are often used underground and in other low-clearance areas.

Gradual On/Off Valves

Class 125:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 200 psi @ 100° F
- Max. Pressure for Steam: 125 psi @ 353° F
- Temp. Range: -20° to 400° F

Class 150:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 300 psi @ 100° F
- Max. Pressure for Steam: 150 psi @ 366° F
- Temp. Range: -20° to 400° F

Class 200:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 400 psi @ 100° F
- Max. Pressure for Steam: 200 psi @ 388° F
- Temp. Range: -20° to 550° F

Class 300:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 1,000 psi @ 100° F
- Max. Pressure for Steam: 300 psi @ 422° F
- Temp. Range: -20° to 550° F

These valves have a durable bronze body and gate for a long service life. Connections are NPT female. Packing is graphite. Valves meet MSS-SP-80.

Rising Stem

Nonrising Stem

Pipe Size	Class 125 End-to-End Lg.			Class 150 End-to-End Lg.			Class 200 End-to-End Lg.			Class 300 End-to-End Lg.		
Rising Stem												
1/4	1 3/4"	4619K31	$30.19	1 3/4"	4599K41	$38.70	1 3/4"	4857K11	$57.59	1 13/16"	4606K11	$75.74
3/8	1 13/16"	4619K32	30.19	1 7/8"	4599K42	38.70	1 7/8"	4857K12	57.59	1 7/8"	4606K12	75.74
1/2	2"	4619K33	27.22	2 1/8"	4599K43	37.41	2 1/4"	4857K13	51.67	2 1/4"	4606K13	71.30
3/4	2 1/8"	4619K34	33.52	2 1/4"	4599K44	43.89	2 1/2"	4857K14	61.85	2 1/2"	4606K14	85.37
1	2 9/16"	4619K35	45.00	2 5/8"	4599K45	57.41	2 7/8"	4857K15	89.07	3"	4606K15	120.56
1 1/4	2 13/16"	4619K36	65.00	2 13/16"	4599K46	78.52	3 1/4"	4857K16	132.93	3 3/8"	4606K16	160.00
1 1/2	2 13/16"	4619K37	77.41	3 1/4"	4599K47	96.30	3 1/2"	4857K17	136.67	3 1/2"	4606K17	187.59
2	3 5/16"	4619K38	97.41	3 5/8"	4599K48	133.89	3 3/4"	4857K18	213.70	3 3/4"	4606K18	275.00
2 1/2	4 3/16"	4619K42	260.37	4 1/2"	4599K51	307.59	4 5/8"	4857K29	652.04	4 5/8"	4606K29	854.26
3	4 5/8"	4619K39	357.22	4 7/8"	4599K49	425.56	5"	4857K19	859.44	5"	4606K19	1,125.74
Nonrising Stem												
1/4	1 3/4"	4619K11	27.96	1 3/4"	4599K19	38.70	1 13/16"	4857K21	78.15	1 13/16"	4606K21	92.22
3/8	1 13/16"	4619K12	27.96	1 13/16"	4599K21	38.70	1 7/8"	4857K22	78.15	1 7/8"	4606K22	92.22
1/2	2"	4619K13	24.81	2"	4599K22	39.63	2 1/4"	4857K23	78.15	2 1/4"	4606K23	89.07
3/4	2 1/8"	4619K14	30.00	2 1/8"	4599K23	42.78	2 1/2"	4857K24	93.52	2 1/2"	4606K24	106.85
1	2 9/16"	4619K15	38.70	2 9/16"	4599K24	56.48	2 7/8"	4857K25	136.56	3"	4606K25	147.41
1 1/4	2 13/16"	4619K16	58.52	2 13/16"	4599K25	75.19	3 1/4"	4857K26	171.48	3 3/8"	4606K26	196.85
1 1/2	2 13/16"	4619K17	67.96	2 13/16"	4599K26	93.89	3 1/2"	4857K27	213.89	3 1/2"	4606K27	246.30
2	3 5/16"	4619K18	88.89	3 5/16"	4599K27	130.74	3 3/4"	4857K28	301.30	3 3/4"	4606K28	392.59
2 1/2	4 3/16"	4619K43	232.22	4 3/16"	4599K29	302.22						
3	4 5/8"	4619K41	283.33	4 5/8"	4599K28	423.70						

Corrosion-Resistant Gradual On/Off Valves

- Max. Pressure for Water, Oil, Air, and Inert Gas: 200 psi @ 350° F
- Max. Pressure for Steam: 120 psi @ 350° F
- Temp. Range: 0° to 350° F

Since these valves have a 316 stainless steel body and gate, they resist corrosion in harsh environments and wet conditions. Packing is PTFE. Stem is nonrising. Valves meet ASTM A351.

NPT

Pipe Size	End-to-End Lg.	NPT Female		Socket Weld	
1/2	2 1/8"	4741K23	$79.28	4874K53	$88.67
3/4	2 5/16"	4741K24	92.67	4874K54	103.08
1	2 11/16"	4741K25	114.86	4874K55	129.86
1 1/4	2 15/16"	4741K26	156.67	4874K56	175.68
1 1/2	3 1/8"	4741K27	228.64	4874K57	256.47
2	3 11/16"	4741K28	269.72	4874K58	304.92

Fast-Acting Gradual On/Off Valves

Lever and Spring-Close Lever:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 125 psi @ 120° F (1-1 1/4 size); 200 psi @ 70° F (1 1/2-3 size)
- Temp. Range: 35° to 150° F (1-1 1/4 size); -40° to 150° F (1 1/2-3 size)

Pull Handle:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 20 psi @ 1000° F (1-3 size); 10 psi @ 1000° F (4 size); 5 psi @ 1000° F (6 size)
- Temp Range: -40° to 1000° F

Pull the handle to start and stop flow faster than valves with a wheel handle. Connections are NPT female.

Lever and **spring-close lever** valves have a brass body and gate. *1 and 1 1/4 pipe size* have a Buna-N seal; *1 1/2 to 3 pipe size* have PTFE packing. *Spring-close levers* are easier to turn than standard lever handles.

Pull-handle valves have a rising stem that lifts as the valve opens and lowers as the valve closes to provide a visual indication of whether flow is on or off. They have a cast iron body, 304 stainless steel gate, and graphite packing.

Lever

Pull Handle

Pipe Size	Lever End-to-End Lg.			Spring-Close Lever End-to-End Lg.			Pull Handle End-to-End Lg.		
1	4"	4684K82	$176.41	4"	4684K42	$175.37	2 13/16"	4723K31	$189.93
1 1/4	2 7/8"	4684K83	163.61	2 7/8"	4684K43	175.37			
1 1/2	3 7/16"	4684K11	265.63	3 7/16"	4684K21	277.26	2 13/16"	4723K32	207.90
2	3 11/16"	4684K12	319.36	3 11/16"	4684K22	336.57	2 13/16"	4723K33	223.30
2 1/2							2 13/16"	4723K34	259.23
3	5 1/16"	4684K13	675.52	5 1/16"	4684K23	685.27	3 5/16"	4723K35	273.60
4							3 5/16"	4723K26	374.83
6							3 13/16"	4723K28	595.47

Gradual & Actuated On/Off Valves

For technical drawings and 3-D models, go to mcmaster.com.

For information about gradual on/off valves, see page 495. For information about pipe size, see pages 2-3.

Note: To choose the correct pipe size, measure the threaded inside diameter (ID) or outside diameter (OD) of your pipe or valve, round up to the nearest threaded ID or OD below, and read down to find the corresponding pipe size.

Threaded ID or OD	1/2"	5/8"	3/4"	1"	1 3/8"	1 5/8"	1 7/8"	2 3/8"	3 1/2"	4 1/2"	6 5/8"
Pipe Size	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	3	4	6

Gradual On/Off Valves for Thick Liquids and Dry Materials

For Thick Liquids:
- Max. Pressure: 150 psi @ 212° F
- Temp. Range: -50° to 212° F

For Dry Materials:
- Max. Pressure: 150 psi @ 400° F
- Temp. Range: -50° to 400° F

Also known as knife valves, these have a sharp gate that slices through thick slurries, wastewater, dry bulk solids, and other materials that would clog other gradual on/off valves. They have unthreaded ANSI Class 150 flange connections and bolt to flanges of the same ANSI class and size. Body is cast iron with a 300 series stainless steel liner. Gate is 316 stainless steel. Stem is rising.

Valves for thick liquids have an EPDM seat for a tight seal when used with viscous liquids. **Valves for dry materials** have a 316 stainless steel seat designed for use with dry media.

Pipe Size	End-to-End Lg.	Flange OD	Flange Bolt Circle Dia.	Flange Bolt Hole Dia.	Flange No. of Bolt Holes	For Thick Liquids		For Dry Materials	
2	1 7/8"	6 1/2"	4 3/4"	5/8"	4			6312T31	$416.39
3	2"	7 7/8"	6"	5/8"	4	6312T13	$545.90	6312T32	495.08
4	2"	9 1/16"	7 1/2"	5/8"	8	6312T14	708.20	6312T33	662.30
6	2 1/4"	11 1/4"	9 1/2"	3/4"	8	6312T16	939.34	6312T35	877.05

Gradual On/Off Valves for Boiler Blow-Off

- Max. Pressure for Water: 250 psi @ 350° F
- Temp. Range: 35° to 350° F

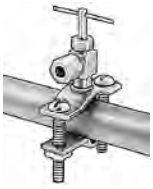
Prevent boiler scale deposits and sediment buildup with these valves designed for boiler drainage applications. Valves meet ASME Section 1 Codes for Boiler and Pressure Vessels, ANSI B16.31 for power piping, and ANSI B31.1. Connections are NPT female. Body and gate are cast iron and packing is EPDM and nylon.

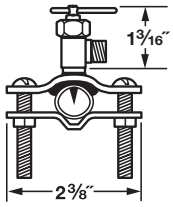
Lever handles open and close faster than wheel handles.

Wheel handles open and close slowly to provide more controlled, shock-resistant flow. Stem is nonrising.

Pipe Size	End-to-End Lg.	Lever		Wheel Handle	
1	3 5/8"	4692K31	$580.59	7917T51	$1,128.69
1 1/4	3 5/8"	4692K32	690.08	7917T52	1,215.08
1 1/2	4 1/2"	4692K33	863.93	7917T53	1,301.48
2	4 5/8"	4692K34	974.02	7917T54	1,548.11

Tap Valves



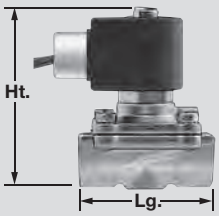


- Max. Pressure for Water, Oil, Air, and Inert Gas: 150 psi @ 180° F
- Temp. Range: 35° to 180° F

Also known as a saddle valve and humidifier valve clamp, this self-piercing valve for copper tubing allows you to tap existing lines to redirect a small amount of liquid for on/off control of a secondary line. It clamps onto tubing with 3/8" to 1 5/16" OD. Outlet connection is a 1/4" compression tube fitting. Body is brass.

4863K12 ..... $13.01

About Actuated On/Off Valves



Also known as solenoid valves, actuated on/off valves are operated by an electrical signal. Use a sensor or switch to direct the electrical signal to open or close the valve. All actuated on/off valves are either normally closed or normally open. **Closed unless energized (normally closed)** valves remain closed until they receive an electrical signal to open. When the signal stops, the valve closes. **Open unless energized (normally open)** valves remain open until they receive an electrical signal to close. When the signal stops, the valve opens.

Many actuated on/off valves require a **minimum pressure drop** across the valve to open and close; the upstream pressure must be greater than the downstream pressure. Valves with a minimum pressure drop use less energy to control flow because they are assisted by the pressure in your pipeline.

To prevent foreign particles from impacting valve performance, install an inline strainer before the actuated on/off valve in your system.

Premium Actuated On/Off Valves

- Use with water, air, and inert gas
- Pressure Drop Across Valve: None required
- Temp. Range: 32° to 180° F (AC Valves); 32° to 150° F (DC Valves)

These top-of-the-line valves are interchangeable with Parker Gold Ring 23C Series and Asco Red Hat 8210G Series.

Connections are NPT female. Body is brass and diaphragm is Buna-N. Valves are closed unless energized (normally closed). They have wire leads, a 1/2 trade size conduit port, and draw a max. of 0.84 amps. All meet NEMA 4X for resistance to washdowns, splashing water, corrosive liquids, and dust and are suitable for outdoor use. Mount in horizontal pipe with the solenoid on top. UL listed and CSA certified.

Pipe Size	Lg.	Ht.	AC Valves Max. psi	120V AC	240V AC	24V AC		DC Valves Max. psi	24V DC	
3/8	2 13/16"	4 1/8"	150	2660K12	2660K13	2660K11	$148.27	40	2660K14	$148.27
1/2	2 13/16"	4 1/8"	150	2660K22	2660K23	2660K21	148.27	40	2660K24	148.27
3/4	2 15/16"	4 3/8"	150	2660K32	2660K33	2660K31	160.00	40	2660K34	160.00

High-Pressure & High-Flow Actuated On/Off Valves

For information about high-pressure actuated on/off valves, see page 507. For information about pipe size, see pages 2-3.

Compact Motor-Driven High-Pressure Actuated On/Off Valves

- Max. Pressure for Water, Oil, Air, and Inert Gas: 1,000 psi @ 100° F
- Max. Pressure for Steam: 150 psi @ 366° F
- Valve Temp. Range: 0° to 450° F
- Vacuum Rating: Not rated

With a slimmer motor than other motor-driven actuated on/off valves, these fit in tight spots and cramped areas. Connections are NPT female. Body and ball are 316 stainless steel for excellent corrosion resistance. Seat is TFM, seal is PTFE, and packing is carbon-filled PTFE. Valves meet NEMA 4X for resistance to washdowns, splashing water, corrosive liquids, and dust and are suitable for outdoor use. All are full port, so they do not restrict flow. Use in horizontal pipeline.

The actuator is direct mount and has a manual override in case of power loss or motor failure. Housing is aluminum. Operates on 120 volts AC @ 50/60 Hz. Has screw terminals with a ½ trade size conduit port. Actuator temperature range is -20° to 145° F.

Pipe Size	Valve, End-to-End Lg.	Overall Lg.	Overall Ht.	On/Off Time, sec.		
1	3 7/16"	4 1/2"	9 3/16"	12	6132K85	$617.20
1 1/2	4 7/16"	4 1/2"	10 5/16"	12	6132K87	815.95
2	5 3/8"	5 3/8"	12 13/16"	20	6132K88	861.91

Motor-Driven High-Pressure Actuated On/Off Valves with Solder-Connect Fittings

- Max. Pressure for Water: 300 psi @ 250° F
- Max. Pressure for Steam: 15 psi @ 250° F
- Valve Temp. Range: 32° to 250° F
- Vacuum Rating: Not rated

Often used for remote on/off control in heating and cooling systems, these valves connect to copper pipe with solder-end fittings. Two fittings (sold separately) are required for installation. Body, ball, and seat are brass and seal is Buna-N. Valves are standard port, so they slightly restrict flow. Can be used in horizontal and vertical pipeline. UL and C-UL listed.

The actuator is direct mount and has a manual override in case of power loss or motor failure. It turns flow on or off in 9 seconds. Housing is aluminum. Has 18" long wire leads. Actuator temperature range is -40° to 160° F.

Required fittings have a union nut on one end that threads onto the valve connection and a solder-end connection on the other end for attaching to copper pipe. Choose fittings based on the tube size you need.

Valves

Voltage @ 50/60 Hz	Valve, End-to-End Lg.	Overall Lg.	Overall Ht.		
24V AC	3 1/2"	3 11/16"	4 1/4"	19005K51	$183.70
120V AC	3 1/2"	3 11/16"	4 1/4"	19005K53	183.70

Required Solder-Connect Fittings

For Copper Tube Size♦	For Tube OD		
1/2	5/8"	19005K61	$13.50
3/4	7/8"	19005K62	14.25
1	1 1/8"	19005K63	28.00

♦Tube size is an accepted industry designation, not an actual size.

Plastic Motor-Driven High-Pressure Actuated On/Off Valves

- Max. Pressure: 235 psi @ 100° F
- Valve Temp. Range: 40° to 140° F
- Vacuum Rating: 26" Hg

These valves automatically start and stop flow for remote on/off control. Use with Schedule 40 and 80 pipe and fittings in horizontal and vertical pipeline. Body and ball are PVC and seat is PTFE. Valves meet NEMA 4X for resistance to washdowns, splashing water, corrosive liquids, and dust and are suitable for outdoor use. All are full port, so they do not restrict flow. Color is dark gray.

The actuator is direct mount. It turns flow on or off in 5 seconds. Housing is plastic. Operates on 120 volts AC @ 60 Hz. Has screw terminal connections with a ½ trade size conduit port. Actuator temperature range is 32° to 110° F.

Valves for drinking water meet NSF/ANSI Standard 61. Seal is EPDM. **Valves for chemicals** have a fluoroelastomer seal.

To Order: Please specify pipe connection: NPT female or socket weld (unthreaded).

Pipe Size	Valve, End-to-End Lg.	Overall Lg.	Overall Ht.	For Drinking Water		For Chemicals	
1/2	3 1/16"	5 3/8"	7 3/8"	4729K61	$433.12	4729K71	$477.33
3/4	3 9/16"	5 3/8"	7 13/16"	4729K62	443.75	4729K72	493.16
1	4"	5 3/8"	8 1/8"	4729K63	451.70	4729K73	500.99
1 1/4	4 5/8"	6 1/16"	8 15/16"	4729K64	467.65	4729K74	528.48
1 1/2	5 5/16"	6 1/16"	9 3/8"	4729K65	480.97	4729K75	461.23
2	6"	6 1/16"	10 3/16"	4729K66	502.18	4729K76	560.12

About High-Flow and Severe-Duty Actuated On/Off Valves

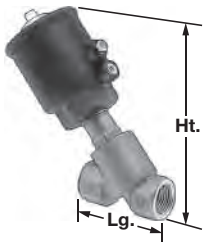
High-Flow Actuated On/Off Valves—Also known as piston and angle-seat valves, these air-driven valves have angled internal components to allow the maximum possible flow.

Severe-Duty Actuated On/Off Valves—Also known as diaphragm valves, these air-driven valves are designed for use with dirty and contaminated liquids that would damage other valves.

High-Flow Actuated On/Off Valves

- Temp Range: 14° to 355° F (For Water, Oil, Air, and Inert Gas); 15° to 366° F (For Steam)

These valves have angled internal components that allow the maximum possible flow for automatic on/off control in high-flow applications. Connections are NPT female. Body is bronze for durability and a long service life. Piston is 431 stainless steel and seal is PTFE. Air inlet is 1/8 NPT female, unless noted.



Pipe Size	Max. psi	Lg.	Ht.	Required psi		
For Water, Oil, Air, and Inert Gas						
Closed Unless Air is On (Normally Closed)						
1/2	240	2 9/16"	6"	60 to 150	7942K41	$213.36
3/4	150	3"	7"	60 to 150	7942K42	222.10
3/4	240	3"	8"	60 to 150	7942K11	232.15
1	90	3 9/16"	7"	60 to 150	7942K12	252.99
1	150	3 9/16"	8"	60 to 150	7942K43	280.29
1 1/4	90	4 3/8"	9"	60 to 150	7942K13	403.11
1 1/4	200	4 5/16"	12"	70 to 145	7942K44★	482.18
1 1/2	60	4 3/4"	10"	60 to 150	7942K14	438.46
1 1/2	240	4 3/4"	13"	60 to 150	7942K45★	764.89
2	40	5 15/16"	10"	60 to 150	7942K15	502.06
2	150	6"	13"	60 to 150	7942K46★	803.70

★ Air inlet is 1/4 NPT female.

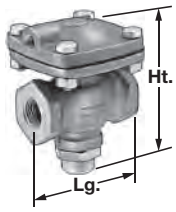
Pipe Size	Max. psi	Lg.	Ht.	Required psi		
For Water, Oil, Air, and Inert Gas (Cont.)						
Open Unless Air is On (Normally Open)						
1/2	240	2 9/16"	7"	65 to 150	7942K51	$305.36
3/4	240	3"	8"	65 to 150	7942K52	313.73
1	240	3 9/16"	8"	65 to 150	7942K53	322.42
For Steam						
Closed Unless Air is On (Normally Closed)						
1/2	150	2 9/16"	7"	65 to 150	4923T61	339.63
3/4	150	3"	8"	65 to 150	4923T62	345.59
1	150	3 9/16"	8"	65 to 150	4923T63	365.83
1 1/4	150	4 7/16"	9"	65 to 150	4923T64	550.92
1 1/2	150	4 3/4"	10"	65 to 150	4923T65	631.90
2	150	5 15/16"	10"	65 to 150	4923T96	714.31

Compact Severe-Duty Actuated On/Off Valves

- Use with water, oil, air, and inert gas
- Temp. Range: -20° to 180° F

At less than half the height of standard severe-duty actuated on/off valves, these are often used in small spaces and low-clearance pipelines. They automatically start and stop flow and are designed for use with dirty and contaminated liquids that would damage other valves. Connections are NPT female. Body is bronze for durability and a long service life. Diaphragm is Buna-N and nylon; seal is 303 stainless steel. Require an air supply of 20 psi, unless noted.

Repair kits include a diaphragm, spring, and seals.



Pipe Size	Max. psi	Lg.	Ht.	Air Inlet Pipe Size	Valves		Repair Kits	
Closed Unless Air is On (Normally Closed)								
1/2	250	2 7/8"	4"	1/8	8168K11★	$281.73	8168K82	$121.02
3/4	250	2 7/8"	4"	1/8	8168K12	287.34	8168K82	121.02
1	250	5 7/8"	7"	1/4	8168K13	790.43	8168K83	234.71
1 1/4	250	5 7/8"	7"	1/4	8168K14	790.43	8168K83	234.71
Open Unless Air is On (Normally Open)								
1/2	250	2 7/8"	4"	1/8	8168K21★	274.85	8168K81	108.38
3/4	250	2 7/8"	4"	1/8	8168K22★	287.34	8168K81	108.38

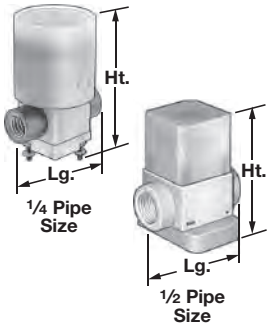
★ Require an air supply of 20 to 45 psi.

Severe-Duty Actuated On/Off Valves for Chemicals

- Temp Range:
  32° to 212° F (1/4 size);
  32° to 300° F (1/2 size)

Also known as Weir-style valves, these have a PTFE body and seals that stand up to harsh acidic solutions in addition to dirty and contaminated liquids. Connections are NPT female. Valves are closed unless air is on (normally closed).

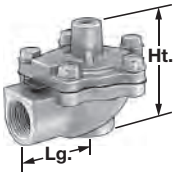
Valve with 1/4 pipe size has two 4-40 studs on the bottom for mounting.



Pipe Size	Max. psi	Lg.	Ht.	Air Supply: Inlet Pipe Size	Air Supply: Required psi		
1/4	60	2 1/8"	2 7/8"	1/8	40 to 60	46545K43	$218.44
1/2	60	1 3/4"	3 3/8"	1/8	60 to 80	45185K24	373.52

Aluminum Valves for Dust Collectors

- Use with air and inert gas
- Temp. Range: -40° to 179° F



Designed for use in dust-collection systems, these valves release bursts of air to knock debris from air filter bags. The valve's inlet connects to your air supply, and the outlet connects to the blow tube in your system.

All connections are NPT female. Body is aluminum. Diaphragm is TPE, except valve with 1 1/2 pipe size, which is Buna-N. Valves are closed unless air is on (normally closed). Require an air supply of 5-125 psi.

For electrical actuation, the solenoid valve (sold separately) connects to the exhaust port. **To Order:** Specify 120V AC, 240V AC, or 24V DC.

Pipe Size	Max. psi	Lg.	Ht.	Exhaust Port Pipe Size		
3/4	125	2 1/4"	3 5/8"	1/8	5496T11	$57.28
1	125	2 11/16"	4 3/8"	1/8	5496T12	68.12
1 1/2	125	3"	5"	3/8	5496T13	163.27
Solenoid Valve (1/8 NPT)					5222T11	67.02

About Large-Diameter Actuated On/Off Valves

Also known as butterfly valves, these are designed for on/off flow control in large pipelines and applications with higher flow rates than other actuated on/off valves. All have a disc that provides a tight seal. With a small number of moving parts, these valves are long lasting and easy to maintain.

Valves with threaded flange holes have a hole pattern that matches ANSI flanges of the same pipe size. Also called lug-style butterfly valves, these can be sandwiched between two flanges or bolted directly to a single flange for servicing one end of the pipeline without depressurizing the other side.

Valves with alignment guides have alignment tabs or unthreaded alignment holes. Also called wafer-style butterfly valves, these must be sandwiched between two flanges in your system.

ANSI Flange Alignment

With Threaded Flange Holes

With Alignment Guides

Motor-Driven Large-Diameter Actuated On/Off Valves CAD

For Water:
- Max. Pressure: 200 psi @ 275° F (Medium Pressure); 250 psi @ 225° F (High Pressure)
- Valve Temp. Range: -30° to 275° F (Medium Pressure); -20° to 225° F (High Pressure)

For Oil:
- Max. Pressure: 200 psi @ 180° F (Medium Pressure); 250 psi @ 180° F (High Pressure)
- Valve Temp. Range: 10° to 180° F (Medium Pressure); -20° to 180° F (High Pressure)

For Chemicals:
- Max. Pressure: 200 psi @ 275° F (Medium Pressure); 250 psi @ 300° F (High Pressure)
- Valve Temp. Range: 10° to 275° F (Medium Pressure); -20° to 300° F (High Pressure)

Automatically start and stop flow in larger pipelines and applications with higher flow rates than other actuated on/off valves. These valves fit ANSI Class 125 and 150 flanges of the same pipe size. Body is iron. All valves have screw terminals with a 1/2 trade size conduit port. Valves meet MSS-SP-67.

Medium-pressure valves have a painted-iron disc. They operate on 120 volts AC @ 60 Hz. Actuator temperature range is -13° to 131° F.

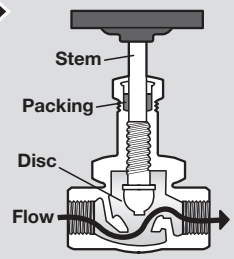
High-pressure valves meet API (American Petroleum Institute) 609 for flow regulation. They operate on 120 volts AC @ 50/60 Hz. Actuator temperature range is -40° to 140° F. *Valves for water* and *valves for oil* have an iron disc; *valves for chemicals* have a 316 stainless steel disc.

Valves for water have an EPDM seat. **Valves for oil** have a Buna-N seat. **Valves for chemicals** have a fluoroelastomer seat to resist a wide range of chemicals.

With Eight Threaded Flange Holes

Pipe Size	End-to-End Lg.	O'all Ht.	Fits ANSI Flange: OD	Bolt Circle Dia.	Bolt Size	Bolt Hole Qty.	On/Off Time, sec.	With Threaded Flange Holes	For Water	For Oil	For Chemicals	With Alignment Guides	For Water	For Oil	For Chemicals
Medium Pressure															
3	1 7/8"	16 1/4"	7 1/2"	6"	5/8"-11	4	13	49985K982	$841.82	$841.82	$1,016.36	49985K984	$827.27	$827.27	$992.73
4	2 1/8"	18 5/8"	9"	7 1/2"	5/8"-11	8	25	49985K983	1,195.08	1,195.08	1,574.55	49985K985	1,178.69	1,178.69	1,476.36
High Pressure															
2	1 13/16"	18 3/8"	6"	4 3/4"	5/8"-11	4	15■	47075K951	1,171.25	1,171.25	1,298.51	47075K955	1,156.07	1,156.07	1,257.97
3	1 15/16"	19 5/8"	7 1/2"	6"	5/8"-11	4	15	47075K952	1,453.81	1,453.81	1,627.85	47075K956	1,408.00	1,408.00	1,566.75
4	2 3/16"	22 15/16"	9"	7 1/2"	5/8"-11	8	15■	47075K953	1,924.09	1,924.09	2,061.49	47075K957	1,865.97	1,865.97	2,037.03
6	2 5/16"	25 5/16"	11"	9 1/2"	3/4"-10	8	30	47075K954	2,321.93	2,321.93	2,639.11	47075K958	2,326.20	2,326.20	2,602.15

■On/off time is 4 seconds for valves for chemicals.



About Flow-Adjustment Valves

Also known as globe valves, these gradually open and close to adjust and regulate flow. They require multiple turns of the wheel handle to fully open and close. With seats that extend into the center of the valve, they are not for applications that require unobstructed flow.

Valves with a Rising Stem—The stem lifts as the valve opens and lowers as the valve closes to provide a visual indication of whether flow is on or off. Since the stem is isolated from the process media, valves with a rising stem have a longer service life than valves with a nonrising stem.

Valves with a Nonrising Stem—The stem stays in the same position whether the valve is open or closed, so these valves are often used underground and in other low-clearance areas.

Flow-Adjustment Valves

Class 125:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 200 psi @ 150°F
- Max. Pressure for Steam: 125 psi @ 353°F
- Temp. Range: -20° to 405°F

Class 150:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 300 psi @ 150°F
- Max. Pressure for Steam: 150 psi @ 366°F
- Temp. Range: -20° to 405°F

Class 200:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 400 psi @ 150°F
- Max. Pressure for Steam: 200 psi @ 388°F
- Temp. Range: -20° to 550°F

Class 300:
- Max. Pressure for Water, Oil, Air, and Inert Gas: 1,000 psi @ 150°F (Straight); 600 psi @ 150°F (Elbow)
- Max. Pressure for Steam: 300 psi @ 421°F
- Temp. Range: -20° to 550°F

Straight

These valves gradually open and close with multiple turns of the wheel handle to adjust and regulate flow. Connections are NPT female. Body is bronze for a long service life. Packing is graphite. Stem is rising. Valves meet MSS-SP-80.

Straights—Class 125 and Class 200 have a bronze disc; Class 150 have a PTFE disc; Class 300 have a 420 stainless steel disc.

Elbows—Class 125 have a brass disc; Class 150 have a PTFE disc; Class 300 have a bronze disc.

Elbow

Pipe Size	Class 125 Port-to-Port Lg. (P)		Class 150 Port-to-Port Lg. (P)		Class 200 Port-to-Port Lg. (P)		Class 300 Port-to-Port Lg. (P)	
Straights								
1/4	1 5/8"	4600K11 $57.76	2 1/16"	4889K11 $63.47	2 1/16"	3983K11 $75.51	2 1/8"	9769K11 $124.69
3/8	1 13/16"	4600K12 57.76	2 1/16"	4889K12 63.27	2 1/16"	3983K12 75.51	2 3/8"	9769K12 124.69
1/2	2 5/16"	4600K13 57.76	2 7/16"	4889K13 63.27	2 7/16"	3983K13 75.51	2 3/4"	9769K13 124.69
3/4	2 9/16"	4600K14 66.53	2 15/16"	4889K14 81.22	2 15/16"	3983K14 98.37	3 3/16"	9769K14 176.94
1	2 15/16"	4600K15 97.56	3 7/16"	4889K15 145.33	3 3/4"	3983K15 164.00	3 5/8"	9769K15 236.89
1 1/4	3 3/8"	4600K16 132.00	3 7/8"	4889K16 252.97	4 1/4"	3983K16 268.22	4 1/8"	9769K16 314.89
1 1/2	3 11/16"	4600K17 174.00	4 1/2"	4889K17 277.17	4 3/4"	3983K17 296.67	4 3/4"	9769K17 457.56
2	4 7/16"	4600K18 260.89	5 3/4"	4889K18 410.22	5 3/4"	3983K18 457.78	5 1/8"	9769K18 694.22
Elbows								
1/4	3/4"	4600K41 63.27	1 1/16"	4889K61 78.16	—	—	1 1/16"	9769K31 86.94
3/8	15/16"	4600K42 63.27	1 3/16"	4889K62 78.16	—	—	1 3/16"	9769K32 86.94
1/2	1"	4600K43 63.27	1 3/16"	4889K63 78.16	—	—	1 1/4"	9769K33 86.94
3/4	1 1/4"	4600K44 86.73	1 7/16"	4889K64 81.22	—	—	1 1/2"	9769K34 118.98
1	1 7/16"	4600K45 122.89	1 3/4"	4889K65 151.56	—	—	1 3/4"	9769K35 188.67
1 1/4	1 11/16"	4600K46 174.00	2 1/16"	4889K66 198.89	—	—	2 1/16"	9769K36 246.22
1 1/2	1 13/16"	4600K47 214.89	2 1/4"	4889K67 274.44	—	—	2 1/4"	9769K37 331.56
2	2 3/16"	4600K48 277.56	2 3/4"	4889K68 416.74	—	—	2 3/4"	9769K38 520.67

Low-Pressure Flow-Adjustment Valves

- Max. Pressure for Water: 175 psi @ 150°F
- Temp. Range: -20° to 150°F

Use these valves for boiler maintenance and other low-pressure plumbing applications. Connections are NPT female. Body is bronze for durability and a long service life. Disc is EPDM and packing is graphite. Stem is rising.

Valves with 1/2 to 2 pipe size are UL listed.

Pipe Size	End-to-End Lg.		
1/4	2"	4695K63	$27.13
3/8	2"	4695K66	27.93
1/2	2 5/16"	4695K64	29.40
3/4	2 5/16"	4695K65	37.44
1	3 1/8"	4695K59	52.87
1 1/4	4 5/16"	4695K6	106.97
1 1/2	4 11/16"	4695K61	149.94
2	5 5/8"	4695K62	167.14

Plastic Flow-Adjustment Valves

- Max. Pressure for Water: 150 psi @ 70°F
- Temp. Range: 40° to 120°F

For a lightweight and corrosion-resistant alternative to metal valves, these have a PVC body. Use with Schedule 40 and 80 pipe and fittings. Disc is polypropylene and packing is EPDM. Color is dark gray. Stem is rising.

Socket-weld valves bond to unthreaded male plastic pipe.


NPT Female

Pipe Size	End-to-End Lg.		
NPT Female			
1/2	3 3/8"	47535K21	$56.08
3/4	3 3/4"	47535K22	59.31
1	4 3/8"	47535K23	99.22
1 1/2	5 1/2"	47535K25	282.55
Socket Weld			
1/2	4 3/8"	47535K41	56.08
3/4	5 1/8"	47535K42	59.31
1	5 15/16"	47535K43	99.22
1 1/2	5 1/2"	47535K45	282.55

Corrosion-Resistant Flow-Adjustment Valves

- Max. Pressure for Water, Oil, Air, and Inert Gas: 200 psi @ 350°F
- Max. Pressure for Steam: 120 psi @ 350°F
- Temp. Range: 0° to 350°F

For exceptional corrosion resistance in harsh conditions, these valves have a 316 stainless steel body and disc. Packing is PTFE. Stem is rising.

Socket-weld valves meet ASTM A351.


Socket Weld

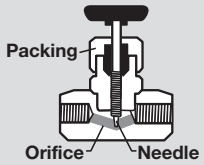
Pipe Size	End-to-End Lg.	NPT Female		BSPT Female		Socket Weld	
1/2	2 5/8"	4742K13	$76.76	4098K53	$102.91	4110K53	$85.70
3/4	2 15/16"	4742K14	92.43	4098K54	119.64	4110K54	104.88
1	3 5/8"	4742K15	102.34	4098K55	140.39	4110K55	113.09
1 1/2	4 11/16"	4742K17	232.16	4098K57	289.46	4110K57	257.80
1 1/4	4 1/8"	4742K16	156.65	4098K56	202.61	4110K56	190.65
2	5 1/2"	4742K18	312.49	4098K58	376.30	4110K58	341.39

Precision Flow-Adjustment Valves

For technical drawings and 3-D models, go to mcmaster.com.

For information about pipe size, see pages 2-3.

About Precision Flow-Adjustment Valves



Also known as needle valves, these valves adjust flow in extremely small increments for metering, sampling, and other applications requiring fine flow control. A threaded needle on the end of the valve stem functions as the control, allowing for a gradual increase or decrease in the size of the orifice. **Valves with packing** have a nut that can be tightened to compress the packing if it leaks.

Cv factor (flow coefficient) is the amount of water (in gallons per minute) with a specific gravity of 1 at 60° F that will pass through a fully open valve with a pressure drop of 1 psi. For pressure drops other than 1 psi or liquids with a different specific gravity, use this formula:

$$GPM = Cv\sqrt{\frac{\text{Pressure Drop}}{\text{Specific Gravity of the Liquid}}}$$

Note: To choose the correct pipe size, measure the threaded inside diameter (ID) or outside diameter (OD) of your pipe or valve, round up to the nearest threaded ID or OD below, and read down to find the corresponding pipe size.

Threaded ID or OD	3/8"	1/2"	5/8"	3/4"	1"	1 3/8"
Pipe Size	1/8	1/4	3/8	1/2	3/4	1

Precision Flow-Adjustment Valves

- Max. Pressure for Water, Oil, Air, and Inert Gas: 2,000 psi @ 400° F (Brass); 5,000 psi @ 400° F (Steel and 303 Stainless Steel)
- Temp. Range: -15° to 400° F

These valves adjust flow in extremely small increments for applications requiring fine flow control. Connections are NPTF (Dryseal) female or BSPT (British Standard Pipe Taper) female. Seals are fluoroelastomer and PTFE; seat is metal-to-metal. Valves have a handle with a locking nut to prevent accidental adjustment.

Brass valves have good corrosion resistance. Needle is brass. **Steel** and **303 stainless steel** valves have a 416 stainless steel needle. *303 stainless steel* valves are more corrosion resistant than brass valves.

Single-direction flow-adjustment valves provide fully adjustable flow from the inlet to the outlet. They have an internal check valve that actuates when the pressure changes to stop flow from the controlled direction and allow free flow in the opposite direction. They are often used to control the speed of air cylinders and air-powered motors.

Pipe Size	End-to-End Lg.	Cv Factor	Orifice Dia.	NPTF Brass		NPTF Steel		NPTF 303 Stainless Steel		BSPT Brass	
Standard Flow Adjustment											
1/8	1 1/2"	0.2	0.107"	4995K11	$24.95	4995K21	$25.55	4995K41	$70.64		
1/4	2"	0.43	0.156"	4995K13	29.83	4995K23	30.41	4995K42	87.68	7822K11	$33.68
3/8	2 1/4"	0.78	0.219"	4995K15	39.14	4995K25	36.17	4995K43	107.75	7822K12	46.87
1/2	2 11/16"	1.24	0.281"	4995K17	58.05	4995K27	45.88	4995K44	146.67		
3/4	2 15/16"	1.93	0.344"	4995K19	89.44						
Single-Direction Flow Adjustment											
1/8	1 3/4"	0.23	0.107"	7824K11	27.88	7824K21	31.20	7824K31	93.13		
1/4	2 3/8"	0.54	0.156"	7824K12	33.61	7824K22	34.94	7824K32	106.23	7822K21	40.90
3/8	2 3/4"	0.83	0.219"	7824K13	44.26	7824K23	41.22	7824K33	140.80	7822K22	51.95
1/2	3 3/16"	1.47	0.281"	7824K14	69.65	7824K24	54.35	7824K44★	204.58		
3/4	3 9/16"	1.9	0.344"	7824K15	109.68	7824K25	99.27				

★Has a T-handle. Body is 316 stainless steel.

Plastic Precision Flow-Adjustment Valves

NPT Female × Male

- Max. Pressure for Water, Air and Inert Gas: 125 psi @ 140° F
- Temp. Range: 33° to 140° F

For use in plastic pipelines, these valves are lighter in weight than metal valves. Seal is EPDM. Valves have a nylon hex nut and threads below the handle for mounting through instrument panels. To panel mount, they require a 7/8" dia. cutout. Note: Cv factor is not rated.

PVC valves have a PVC needle and seat. Color is dark gray. **Polypropylene** valves have a polypropylene needle and seat. Color is white.

Replacement panel-mounting nuts are nickel-plated brass.

Pipe Size	End-to-End Lg.	Orifice Dia.	PVC		Polypropylene	
NPT Female × Female						
1/8	2"	0.175"	7781K21	$18.25	7792K51	$20.64
1/4	2"	0.175"	7781K25	18.25	7792K55	20.64
NPT Female × Male						
1/8	2 1/4"	0.175"	7781K22	18.25	7792K52	20.64
1/4	2 3/8"	0.175"	7781K26	18.25	7792K56	20.64
NPT Male × Male						
1/4	2 11/16"	0.175"	7781K27	18.25	7792K57	20.64
Replacement Panel-Mounting Nut					7781K88	2.59

Plastic Easy-Set Precision Flow-Adjustment Valves

- Max. Pressure for Water, Oil, Air, and Inert Gas: 200 psi @ 200° F
- Temp. Range: 0° to 200° F

A lightweight alternative to metal easy-set valves, these have a locking ring to prevent accidental adjustment. Handle threads are color coded to provide a visual reference point for repeated settings. One full revolution of the handle reveals a new color to indicate the set point.

Connections are NPTF (Dryseal) female. Body is glass-reinforced polyester, needle is zinc-plated steel, seal is Buna-N, and seat is polyester. Color is black. Valves can be panel mounted (mounting nuts sold separately).

Single-direction flow-adjustment valves have an internal check valve that actuates when the pressure changes to stop flow from the controlled direction and allow free flow in the opposite direction.

Optional panel-mounting nuts are plastic. *Valves with 1/8 and 1/4 pipe size* require a 1" dia. panel cutout; *3/8 to 3/4 pipe size* require a 1 3/8" dia. panel cutout.

Valves

Pipe Size	End-to-End Lg.	Cv Factor	Orifice Dia.	Standard Flow Adjustment		Single-Direction Flow Adjustment	
1/8	1 15/16"	0.26	0.101"	4891K71	$24.78	48995K31	$29.52
1/4	1 15/16"	0.48	0.136"	4891K72	32.26	48995K33	35.36
3/8	2 7/8"	1.06	0.187"	4891K73	43.84	48995K35	44.26
1/2	2 7/8"	1.35	0.3"	4891K74	54.74	48995K37	55.18
3/4	3"	1.96	0.347"	4891K75	57.94	48995K39	82.18

Optional Panel-Mounting Nuts

For Pipe Size		
1/8, 1/4	4891K61	$4.64
3/8, 1/2, 3/4	4891K62	4.78

Large-Diameter Flow-Adjustment Valves

For technical drawings and 3-D models, go to mcmaster.com.

For information about precision flow-adjustment valves, see page 518. For information about pipe size, see pages 2-3.

Note: To choose the correct pipe size, measure the inside diameter (ID) or outside diameter (OD) of your pipe or valve, round up to the nearest ID or OD below, and read down to find the corresponding pipe size.

ID or OD	5/8"	3/4"	2 3/8"	2 7/8"	3 1/2"	4 1/2"	5 9/16"	6 5/8"	8 5/8"
Pipe Size	3/8	1/2	2	2 1/2	3	4	5	6	8

Precision Flow-Adjustment Valves for Fuels

- Use with diesel fuel, gasoline, and kerosene
- Max. Pressure: 200 psi @ 70° F
- Temp. Range: -15° to 400° F (unless noted)

Add precise flow control to lines for diesel fuel, gasoline, and kerosene. Body and needle are brass and seat is metal-to-metal. Seal is fluoroelastomer, unless noted.

NPTF (Dryseal) male×barb valves have a barbed fitting that slides into soft plastic or rubber tubing. Secure with a hose clamp.

Pipe Size	For Tube ID	Port-to-Port Lg. (P)	Cv Factor	Orifice Dia.		
NPTF Male × Barb						
3/8	3/8"	1 1/8"	1.5	0.275"	45065K26★	$9.07
3/8	5/8"	1 5/16"	2.9	0.39"	45065K37	11.49
1/2	5/8"	1 1/2"	4.4	0.48"	45065K28★	16.41
1/2	3/4"	1 7/16"	5.5	0.562"	45065K46	20.72
NPTF Male × Female						
3/8	—	15/16"	4.4	0.48"	45065K47	12.52
1/2	—	1 1/8"	5.5	0.562"	45065K48	19.72

★ Seal is Buna-N. Temperature range is -30° to 250° F.

About Large-Diameter Flow-Adjustment Valves

Also known as butterfly valves, these are designed for adjusting and regulating flow in large pipelines and applications with higher flow rates than other flow-adjustment valves. They start and stop flow with a quarter turn of the handle. All have a disc that provides a tight seal when closed and limits turbulence when adjusting flow. With a small number of moving parts, these valves are long lasting and easy to maintain.

Valves with threaded flange holes have a hole pattern that matches ANSI flanges of the same pipe size. Also called lug-style butterfly valves, these can be sandwiched between two flanges or bolted directly to a single flange for servicing one end of the pipeline without depressurizing the other side.

Valves with alignment guides have alignment tabs or unthreaded alignment holes. Also called wafer-style butterfly valves, these must be sandwiched between two flanges in your system.

ANSI Flange Alignment

With Threaded Flange Holes

With Alignment Guides

Flange-Mount Large-Diameter Flow-Adjustment Valves

Lockable Lever Handle with Threaded Flange Holes

Wheel Handle with Alignment Guides

For Water:
- Max. Pressure: 200 psi @ 275° F (Medium Pressure); 250 psi @ 225° F (High Pressure)
- Temp. Range: -30° to 275° F (Medium Pressure); -20° to 225° F (High Pressure);

For Oil:
- Max. Pressure: 200 psi @ 180° F (Medium Pressure); 250 psi @ 180° F (High Pressure)
- Temp. Range: 10° to 180° F (Medium Pressure); -20° to 180° F (High Pressure)

For Chemicals:
- Max. Pressure: 200 psi @ 275° F (Medium Pressure); 250 psi @ 300° F (High Pressure)
- Temp. Range: 10° to 275° F (Medium Pressure); -20° to 300° F (High Pressure)

These valves are designed to adjust and regulate flow in large pipelines and applications with higher flow rates than other flow-adjustment valves. They fit ANSI Class 125 and 150 flanges of the same pipe size. Body is ductile iron. Valves meet MSS-SP-67.

Lockable lever-handle valves can be fixed in place with a padlock (not included). *Medium-pressure* valves accept a padlock with a max. shackle diameter of 5/16"; *high-pressure* valves accept a padlock with a max. shackle diameter of 1/4".

Wheel-handle valves resist accidental movement when snagged or bumped.

Medium-pressure valves have a painted ductile iron disc.

High-pressure valves meet API (American Petroleum Institute) 609 for flow regulation. *Valves for water* and *valves for oil* have a ductile iron disc; *valves for chemicals* have a 316 stainless steel disc.

Valves for water have an EPDM seat. **Valves for oil** have a Buna-N seat. **Valves for chemicals** have a fluoroelastomer seat that stands up to a wide range of chemicals.

Pipe Size	End-to-End Lg.	O'all Ht.	*Fits ANSI Flange* OD	Bolt Circle Dia.	Bolt Size	Bolt Hole Qty.	*With Threaded Flange Holes*	For Water	For Oil	For Chemicals	*With Alignment Guides*	For Water	For Oil	For Chemicals
Lockable Lever Handle—10 Flow-Adjustment Positions														
Medium Pressure														
2	1 3/4"	10 3/4"	6"	4 3/4"	5/8"-11	4	5158K982	$113.89	$113.89	$226.42	5158K988	$97.22	$97.22	$207.55
2 1/2	1 7/8"	11 9/16"	7"	5 1/2"	5/8"-11	4	5158K983	119.44	119.44	243.40	5158K989	105.56	105.56	216.98
3	1 7/8"	12 1/16"	7 1/2"	6"	5/8"-11	4	5158K984	127.78	127.78	243.40	5158K991	113.89	113.89	224.53
4	2 1/8"	13 9/16"	9"	7 1/2"	5/8"-11	8	5158K985	145.95	145.95	324.53	5158K992	130.56	130.56	241.51
5	2 1/4"	14 9/16"	10"	8 1/2"	3/4"-10	8	5158K986	182.50	182.50	422.22	5158K993	165.79	165.79	344.44
6	2 1/4"	15 9/16"	11"	9 1/2"	3/4"-10	8	5158K987	214.63	214.63	466.67	5158K994	202.63	202.63	392.59
High Pressure														
2	1 13/16"	9 5/16"	6"	4 3/4"	5/8"-11	4	5024K951	155.57	155.57	356.00	5024K957	139.22	139.22	338.16
2 1/2	1 15/16"	10 3/16"	7"	5 1/2"	5/8"-11	4	5024K952	160.04	160.04	402.85	5024K958	143.64	143.64	380.13
3	1 15/16"	10 9/16"	7 1/2"	6"	5/8"-11	4	5024K953	177.72	177.72	441.51	5024K959	151.75	151.75	419.35
4	2 3/16"	11 15/16"	9"	7 1/2"	5/8"-11	8	5024K954	214.31	214.31	531.13	5024K961	184.37	184.37	499.31
5	2 5/16"	13 3/16"	10"	8 1/2"	3/4"-10	8	5024K955	294.62	294.62	641.87	5024K962	235.61	235.61	598.15
6	2 5/16"	14 5/16"	11"	9 1/2"	3/4"-10	8	5024K956	342.73	342.73	770.38	5024K963	300.43	300.43	728.23
Wheel Handle—Fully Adjustable Flow														
Medium Pressure														
8	2 1/2"	24 7/16"	13 1/2"	11 3/4"	3/4"-10	8	5158K995	421.43	421.43	786.89	5158K996	390.24	390.24	689.09
High Pressure														
6	2 5/16"	17 3/4"	11"	9 1/2"	3/4"-10	8	5024K964	517.89	517.89	928.30	5024K966	473.20	473.20	898.13
8	2 1/2"	22 1/8"	13 1/2"	11 3/4"	3/4"-10	8	5024K965	596.22	596.22	1,217.72	5024K967	565.53	565.53	1,192.25

Directional-Control Valves

For technical drawings and 3-D models, go to mcmaster.com.

For information about pipe size, see pages 2-3.

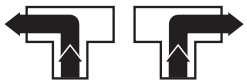
Note: To choose the correct pipe size, measure the threaded inside diameter (ID) or outside diameter (OD) of your pipe or valve, round up to the nearest threaded ID or OD below, and read down to find the corresponding pipe size.

Threaded ID or OD	3/8"	1/2"	5/8"	3/4"	1"	1 3/8"	1 5/8"	1 7/8"	2 3/8"	2 7/8"	3 1/2"
Pipe Size	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2	2 1/2	3

High-Pressure Actuated Directional-Control Valves

- Max. Pressure for Water, Oil, Air, and Inert Gas: 400 psi @ 176° F
- Max. Pressure for Steam: 100 psi @ 340° F
- Valve Temp Range: -4° to 340° F
- Vacuum Rating: 29" Hg

Flow Options



These valves withstand twice the pressure of other actuated directional-control valves. They operate on compressed air and electricity and have a solenoid that turns the air supply on and off. All valves direct flow from the center-port inlet to the left-port outlet when air is off. They cannot shut off flow.

Connections are NPT female. Body is brass, ball is chrome-plated brass, seat is PTFE, and seals are fluoroelastomer and PTFE. Valves meet NEMA 4X for resistance to washdowns, splashing water, corrosive liquids, and dust and are suitable for outdoor use. All are standard port, so they slightly restrict flow. Can be used in horizontal and vertical pipeline.

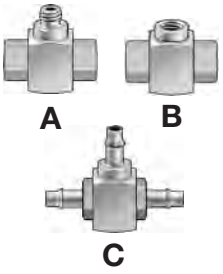
The actuator is directly mounted to the valve body to minimize movement and reduce wear. Requires an air supply of 60 to 125 psi; inlet is 1/4 NPT female. Housing is aluminum. The solenoid operates on 120 volts AC @ 60 Hz. Has screw terminals and a DIN electrical connection with a 1/2 trade size conduit port. Actuator temperature range is 0° to 130° F.

Air-to-divert/air-to-return valves use air pressure to divert flow to the right-port outlet and air pressure to return flow to the left-port outlet.

Air-to-divert/spring-return valves use air pressure to divert flow to the right-port outlet. They automatically return flow to the left-port outlet when the air turns off to ensure the valve only diverts flow to the right port when air is on.

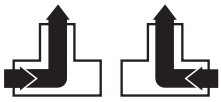
Pipe Size	Valve, End-to-End Lg.	Overall Lg.	Overall Ht.		
Air-to-Divert/Air-to-Return					
1/4	2 11/16"	6"	4 3/4"	5883T21	$301.13
3/8	2 11/16"	6"	4 3/4"	5883T22	301.13
1/2	2 7/8"	6"	4 3/4"	5883T23	302.87
3/4	3 3/16"	6"	4 15/16"	5883T24	309.04
1	3 3/4"	5 9/16"	6 9/16"	5883T25	370.70
1 1/2	4 7/8"	5 9/16"	7 3/4"	5883T27	454.26
2	5 3/4"	6 7/16"	9 1/16"	5883T28	544.07
Air-to-Divert/Spring Return					
1/4	2 11/16"	5 9/16"	5 7/8"	5883T61	$384.09
3/8	2 11/16"	5 9/16"	5 7/8"	5883T62	384.17
1/2	2 7/8"	5 9/16"	5 7/8"	5883T63	386.00
3/4	3 3/16"	5 9/16"	6"	5883T64	392.52
1	3 1/4"	5 9/16"	6 9/16"	5883T65	405.48
1 1/2	4 7/8"	6 7/16"	8 3/16"	5883T67	521.95
2	5 15/16"	9 1/2"	10 5/16"	5883T68	694.17

Pressure-Driven Directional Control Valves



- Max. Pressure for Water, Oil, Air, and Inert Gas: 250 psi @ 230° F
- Temp. Range: 32° to 230° F
- Vacuum Rating: Not rated

Flow Options



Direct flow between one of two side-port inlets and the top-port outlet with these valves that automatically switch between inlets based on pressure. Flow is directed from the higher-pressure inlet to the outlet. Valves cannot shut off flow. Body is brass and seal is Buna-N. Valves are also known as shuttle valves.

Valves with barbed connections are for use with soft plastic or rubber tubing.

	Connection Size	Inlets	Outlet	Lg.		
With UNF Threaded Connections						
A	10-32 UNF	Female	Male	13/16"	6667T11	$8.28
B	10-32 UNF	Female	Female	13/16"	6667T12	8.30
With Barbed Connections						
C	For 1/16" Tube ID	Barbed	Barbed	15/16"	6667T13	9.27
C	For 1/8" Tube ID	Barbed	Barbed	1 3/16"	6667T14	9.27

About Backflow-Prevention Valves

Backflow-prevention valves open to allow flow in one direction and close when flow stops or reverses to prevent system contamination. They are also known as check valves.

Sure-seal backflow-prevention valves have two integral check valves for maximum protection from system contamination. They are also known as dual check valves and reduced pressure zone valves.

Backflow-Prevention Valves

- Max. Pressure: 400 psi @ 70° F, except max. pressure for steam is 125 psi @ 350° F.
- Temp. Range: 33° to 230° F

These valves open to flow in one direction and close when flow stops or reverses. At least 2 psi is required to open valves. Mount in any position. Connections are NPT female.

Nickel-plated brass valves are more corrosion resistant than plain brass valves.

Pipe Size	End-to-End Lg.	Brass		Nickel-Plated Brass	
For Water, Air, and Inert Gas—SBR Seal					
3/8	2 5/8"	7746K49	$32.87	4753K75	$35.17
1/2	2 11/16"	7746K39	32.87	4753K76	35.62
3/4	3 5/16"	7746K821	31.23	4753K77	36.17
1	3 11/16"	7746K831	41.68	4753K78	47.23
1 1/4	4 9/16"	7746K841	48.77	4753K79	58.68
1 1/2	4 7/8"	7746K851	64.13	4753K81	75.79
2	5 9/16"	7746K861	100.34	4753K82	118.70
2 1/2	6 13/16"	7746K43	227.91	4753K83	248.87
3	7 7/16"	7746K46	465.21	4753K84	504.79
For Oil, Diesel Fuel, and Gasoline—Buna-N Seal					
3/8	2 5/8"	7746K37	32.87	4753K65	35.17
1/2	2 11/16"	7746K41	32.87	4753K66	35.62
3/4	3 5/16"	7746K822	31.23	4753K67	38.00
1	3 11/16"	7746K832	41.68	4753K68	50.09
1 1/4	4 9/16"	7746K842	48.77	4753K69	63.15
1 1/2	4 7/8"	7746K852	$64.13	4753K71	$85.40
2	5 9/16"	7746K862	100.34	4753K72	132.79
2 1/2	6 13/16"	7746K44	241.47	4753K73	262.43
3	7 7/16"	7746K47	465.21	4753K74	504.79
For Steam—303 Stainless Steel Seal					
3/8	2 5/8"	4753K41	33.51	4753K51	38.74
1/2	2 11/16"	4753K42	35.34	4753K52	40.36
3/4	3 5/16"	4753K43	39.15	4753K53	44.15
1	3 11/16"	4753K44	54.30	4753K54	59.95
1 1/4	4 9/16"	4753K45	63.89	4753K55	73.96
1 1/2	4 7/8"	4753K46	79.11	4753K56	90.98
2	5 9/16"	4753K47	114.45	4753K57	137.91
2 1/2	6 13/16"	4753K61	267.74	4753K62	288.70
3	7 7/16"	4753K63	505.04	4753K64	542.51

Vacuum-Breaking & Pressure-Relief Valves

For technical drawings and 3-D models, go to mcmaster.com.

For information about pipe size, see pages 2-3.

Note: To choose the correct pipe size, measure the threaded inside diameter (ID) or outside diameter (OD) of your pipe or valve, round up to the nearest threaded ID or OD below, and read down to find the corresponding pipe size.

Threaded ID or OD	3/8"	1/2"	5/8"	3/4"	1"	1 3/8"	1 5/8"	1 7/8"	2 3/8"
Pipe Size	1/8	1/4	3/8	1/2	3/4	1	1 1/4	1 1/2	2

Vacuum-Breaking Valves for Water

- Max. Pressure for Water: 125 psi @ 70° F
- Temp. Range: 33° to 180° F

These valves relieve vacuum to prevent backward suction that can contaminate your system and damage equipment. All are designed for applications with intermittent flow. Valves meet Uniform Plumbing Code for atmospheric discharge, ASSE standard 1001, and are CSA certified. Connections are NPT female.

Bronze valves are harder and more durable than brass valves for an extended service life. *Chrome plating* adds corrosion resistance. *Polished chrome plating* provides a decorative, mirror-like finish in addition to corrosion resistance.

Pipe Size	Port-to-Port Lg. (P)	Ht.		
Brass				
1/2	1 5/16"	2 1/2"	47685K12	$27.44
3/4	1 1/2"	2 15/16"	47685K34	32.31
1	1 5/8"	2 5/16"	47685K36	46.84
1	1 3/4"	3 1/4"	2670K15	118.99
1 1/4	2"	4 1/2"	47685K44	102.11
1 1/2	2 1/4"	4 7/8"	47685K46	125.21
2	2 3/4"	5 9/16"	47685K48	184.87
Dull Chrome-Plated Bronze				
1/4	1"	2 3/8"	9903K31	26.58
3/8	1"	2 3/8"	9903K33	26.58
1/2	1 1/4"	2 1/2"	9903K35	28.20
3/4	1 1/2"	3 1/8"	9903K37	31.58
Polished Chrome-Plated Bronze				
1/4	1"	2 3/8"	9903K51	35.15
3/8	1"	2 3/8"	9903K53	35.15
1/2	1 1/4"	2 1/2"	9903K55	37.68
3/4	1 1/2"	3 1/8"	9903K57	44.95

Vacuum-Breaking Valves with Garden Hose Connections

A

B

- Max. Pressure: 125 psi @ 70° F
- Temp. Range: 32° to 180° F

Stop backward flow in hose and pipe that have garden hose threads (GHT). For intermittent use with water on service sinks and faucets. Body is brass. Valves meet ANSI A112.1.3, are ASSE 1011 listed, and CSA certified B64.2. Connections are 3/4 GHT; inlet is female and outlet is male.

Removable Valves— Tighten set screw to secure in place.

Tamper-Resistant Valves— Tighten set screw until the head breaks off to prevent removal. Valves can be drained.

Mount Type	Ht.	Brass		Chrome-Plated Brass	
(A) For Use with Service Sinks					
Removable	1 1/2"	46605K55	$21.65	46605K58	$28.18
Tamper Resistant	1 1/2"	46605K75	11.86	46605K85	25.28
(B) For Use with Frostproof Outdoor Faucets					
Tamper Resistant	2"	46605K88	27.45		

High-Pressure Vacuum-Breaking Valves for Water, Oil, and Inert Gas

- Max. Pressure for Water, Oil, Air, and Inert Gas: 1,500 psi @ 70° F
- Temp. Range: -10° to 400° F

Rated for 12 times the pressure of standard vacuum-breaking valves for water, these can handle up to 1,500 psi. They relieve vacuum to prevent backward suction that can contaminate your system and damage equipment. Body is 316 stainless steel for exceptional corrosion resistance. Connections are NPT; inlet is female and outlet is male.

Inlet	Outlet	End-to-End Lg.		
1/2	3/4	1 5/16"	8537T74	$95.09
3/4	1	1 7/8"	8537T76	110.07

About Pressure-Relief Valves

Protect piping, tanks, and other equipment from overpressurization with these valves that automatically open at a set pressure. They should be installed as close as possible to the vessel or system they protect.

Pressure-relief valves provide gradual pressure relief. They begin opening at the set pressure and fully open at about 10% over the set pressure, unless otherwise stated. Valves begin closing as pressure drops and fully close when the system pressure is restored below the set pressure.

Fast-acting pressure-relief valves, also known as pop-safety valves, provide immediate pressure relief. They spring fully open at a set pressure and remain open until the system pressure is restored below the set pressure. It's normal for these valves to expel small amounts of liquid or gas as the system pressure approaches the set pressure. Valves with plastic and rubber seals expel less liquid or gas than valves with metal seals.

Pressure-Relief Valves for Water

With Male Inlet

- Temp. Range: 33° to 180° F

These valves are commonly used with pumps in low-pressure water systems. Set pressure is not adjustable. Body is brass and seal is rubber. Connections are NPT. Inlet is on the bottom. Relief port is female (side port).

Pipe Size	Ht.	Choose a Set Pressure, psi		
With Male Inlet				
1/2	4 3/16"	30, 75	4780K11	$72.73
3/4	4 11/16"	30, 75	4780K12	78.60
1	5 11/16"	30, 75	4780K13	106.88
1 1/4	6 1/16"	30, 65	4780K14	164.29
With Female Inlet				
2	6 9/16"	30, 65	4780K16	322.40

Adjustable Pressure-Relief Valves for Water

- Temp. Range: -30° to 160° F

Use the T-handle to alter the set pressure to suit your application. Valves have a locknut that tightens to prevent accidental changes in set pressure. Body is brass and seal is Buna-N. Connections are NPT; inlet is male (bottom port) and relief port is female (side port).

Note: Valves should not be used in applications that require the valve to close completely below the set pressure.

Pipe Size	Ht.		
Choose a set pressure range: 0-50, 0-300, or 0-700 psi			
1/2	6 5/8"	9763K11	$60.96
3/4	6 5/8"	9763K12	60.96
Set pressure range is 0-1,200 psi			
1/2	6 5/8"	9763K55	115.45
3/4	6 5/8"	9763K65	115.45

About Selecting a Mixer

Liquid Thickness and Mixing Speed

Liquid thickness and tank size determine the required mixing speed. Also known as viscosity, liquid thickness is measured in centipoise (cp).

- *Mixers for thin liquids* operate at high speeds for rapid tank turnover. They are also known as direct-drive mixers.
- *Mixers for thick liquids* turn the propeller at low speeds. They're commonly called gear-drive mixers.

Horsepower Recommendations

The motor must be strong enough to mix your liquid. The chart shows horsepower recommendations for ½ to 1 tank turnovers per minute.

- If you need more rapid mixing or are unsure of your viscosity, choose a mixer with more horsepower than the chart recommendation to prevent overloading.
- When mixing the contents of containers with a capacity less than 25 gallons, use a mixer with ¼ horsepower or lower.

Mixer Horsepower Recommendations

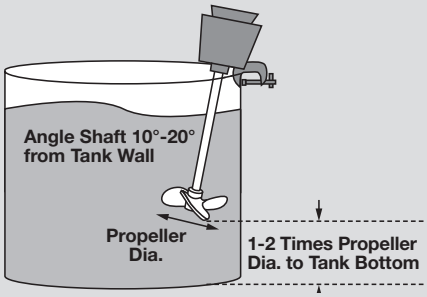
Viscosity, cp	Liquid Example	Mixer Horsepower, Tank Size, gal. 25	50	100	500	1,000	2,000	3,000
1	Water	¼	¼	¼	½	1	1½	2
100	Olive Oil	¼	¼	⅓	1	2	⅓	¾
500	SAE 40 Oil	½	½	½	2	¾	1	1½
1,000	SAE 60 Oil	1	1	1½	¾	1	1½	2
3,000	Honey	⅓	⅓	½	1	1½	2	–
5,000	Molasses	½	½	¾	1½	2	–	–
15,000	Silicone	¾	¾	1	–	–	–	–

Use a mixer for thin liquids Use a mixer for thick liquids

Mixer Mounting and Shafts

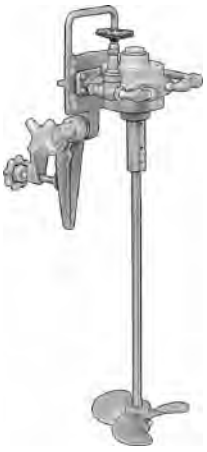
Improper mounting decreases efficiency and can damage the mixer. Mixers for drums, intermediate bulk containers, and pails are sized to fit in your container. For sizing and mounting mixers in larger tanks, follow these guidelines for optimal performance.

- When attaching the mixer to the side of the tank, angle the shaft 10° to 20° from the tank wall for the most efficient tank turnover.
- Clearance from the propeller to the bottom of the tank should be between one to two times the diameter of the propeller.
- For tanks that are deeper than they are wide, use a mixer with more than one propeller.



Air-Powered Mixers

Clamp-Mount Air-Powered Mixers for Tanks


Single Propeller

Blend liquids and prevent separation with these mixers that attach to the side of your tank. They have a needle valve to adjust mixing speed. Air inlet connection is NPT female.

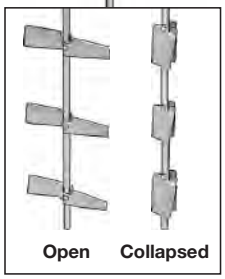
Shaft and propellers are 316 stainless steel. They attach with set screws. Propellers are left hand and move clockwise when viewed from above to direct flow downward for efficient mixing. 2 hp mixers can also be set to move counterclockwise for aeration. Choose a dual-propeller mixer for thorough mixing in tanks that are deeper than they are wide and for faster mixing than single-propeller mixers.

Mixers for thin liquids are for liquids with a viscosity similar to water and light oils. **Mixers for thick liquids** are for liquids with a viscosity similar to honey and molasses.

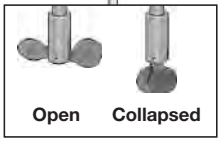
hp	Speed, rpm	Shaft Lg.	Shaft Dia.	Propeller Dia.	Air Consumption @ 80 psi, cfm	Air Inlet	Single Propeller		Dual Propeller	
For Thin Liquids										
1	300-1,750	27″	⅝″	6″	59	¼	34685K54	$899.00	34685K64	$1,024.00
1	300-1,750	36″	⅝″	6″	59	¼	34685K55	919.00	34685K65	1,040.00
1	300-1,750	48″	⅝″	6″	59	¼	34685K56	976.00	34685K66	1,053.00
2	300-1,750	27″	¾″	8″	110	½	34685K75	1,303.00	_____	_____
2	300-1,750	36″	¾″	8″	110	½	34685K76	1,321.00	34685K85	1,543.00
2	300-1,750	48″	¾″	8″	110	½	34685K77	1,350.00	34685K86	1,572.00
2	300-1,750	60″	¾″	8″	110	½	34685K78	1,353.00	34685K87	1,598.89
For Thick Liquids										
½	0-400	30″	¾″	9″	13	¼	_____	_____	3486K42	1,280.41
1	0-400	40″	¾″	11″	25	¼	_____	_____	3486K44	1,427.43
3	0-400	48″	1″	13″	89	½	_____	_____	3486K46	2,980.15

Air-Powered Mixers for Drums


Hand Held with Three Propellers


Open Collapsed


Thread-In


Open Collapsed

Collapsible propellers let you insert these mixers through a 2 NPT opening in 55-gal. drums, so there's no need to remove the lid. They're commonly used with thin liquids such as water and light oils. Adjust mixing speed with the needle valve, unless noted. Air inlet connection is NPT female. Shaft and propellers are 304 stainless steel, unless noted. They attach with set screws. Propellers are left hand and move clockwise when viewed from above to direct flow downward for efficient mixing. Choose a mixer with multiple propellers for faster and more thorough mixing than single-propeller mixers.

Hand Held—Manually direct mixing in your drum.

Thread-In—Screw this mixer into a drum opening for a secure connection.

Thread-In with Clamp—For reduced vibration and noise, this mixer has a clamp in addition to the thread-in connection.

Rim-Clamp Mount—These mixers attach directly to the drum lip.

hp	Speed, rpm	Shaft Lg.	Shaft Dia.	Propeller Qty.	Propeller Dia.	Air Consumption @ 80 psi, cfm	Air Inlet		
Hand Held									
1½	30-3,000	28″	⅜″	3	3″	60	¼	3476K71	$782.77
1½	30-3,000	36″	½″	4	6″	60	¼	3476K73	948.75
Thread-In									
½	300-1,750	29″	⅝″	1	3¾″	59	¼	35005K64★	585.00
Thread-In with Clamp									
1½	30-3,000	36″	½″	4	6″	60	¼	35005K71	1,234.31
Rim-Clamp Mount									
½	350-1,750	33⅛″	⅝″	1	3¾″	25	¼	35005K66★	747.00
1½	30-3,000	36″	½″	4	6″	60	¼	35005K73	1,209.67

★ Does not include needle valve. Shaft and propeller are 316 stainless steel.

About Selecting a Vibrator

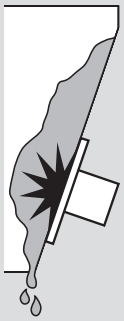
For Dry Materials

Often used to loosen compacted powders and distribute grains, these vibrators emit a high-frequency vibration that shakes material to maintain a steady flow. They're also known as ball and turbine vibrators.

Vibrator strength is measured in pounds of force; every 10 pounds of dry material requires 1 pound of force to move it. If your bin has 200 pounds of dry material, you need a vibrator with at least 20 pounds of force.

- One vibrator can move the contents of a bin with a diameter up to 10 feet.
- For bins larger than 10 feet in diameter, add a second vibrator to the opposite side of the bin. Each vibrator should provide half the total required pounds of force.
- Align vibrators in the direction of flow for best results.

For Wet Materials



Commonly used with sticky slurries and caked-on substances, these vibrators produce a hammer-like pounding action that dislodges material from bin walls. Also known as piston vibrators, they're often used on materials with a moisture content of 5% or more.

Bin wall thickness determines the force required to move the material in the bin. To select a vibrator strong enough for your application, find your bin's wall thickness in the table.

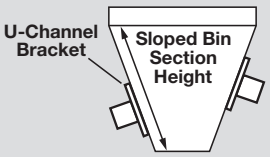
- One vibrator can clear about 4 to 6 feet of a bin wall.
- To clear larger areas of a bin, add a second vibrator to the opposite side of the bin.
- Since they produce a strong pounding action, these vibrators require a solid mount.

Vibrator Mounting

Attach vibrators to a U-channel bracket that is welded to the bin rather than attaching vibrators directly to the bin wall.

To clear the contents of a large bin or move extremely compacted material, add a second vibrator to the opposite side of the bin for even vibration and optimal flow.

Vibrator 1
Mount between one quarter and one third of the way up the sloped section of the bin.

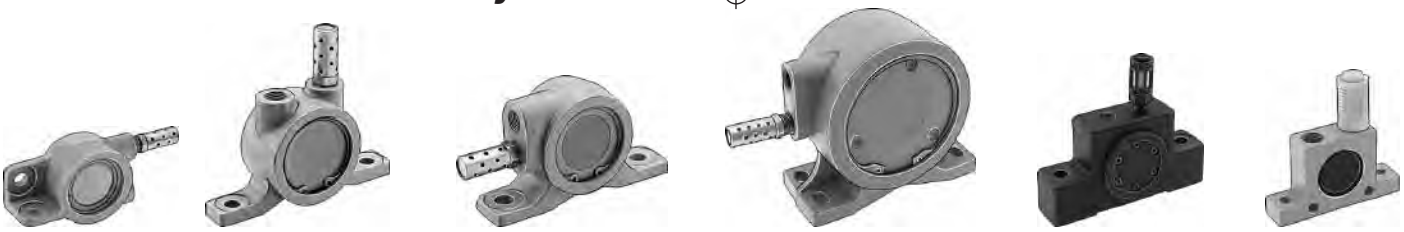


Vibrator 2
Mount halfway up the sloped section of the bin on the opposite side of the first vibrator.

CAD For technical drawings and 3-D models, go to mcmaster.com.

Air-Powered Vibrators

Air-Powered Vibrators for Dry Materials



A B C D E F

Also known as ball vibrators, these produce a high-frequency vibration that shakes powders, grains, and other dry materials to maintain a steady flow through your bin. All vibrators are rated for continuous duty and have a muffler. Air connections are female.

Corrosion-resistant plastic vibrators stand up to splashing water and outdoor environments.

Approx. Material Wt., lbs.	Force, lbs. @ 80 psi	Vibrations per Minute @ 80 psi	cfm @ 80 psi	dB @ 80 psi	Air Connection	Max. Temp., °F	Overall Size Ht.	Overall Size Wd.	Overall Size Dp.	Mounting Holes Size (Qty.)	Mounting Holes Ctr.-to-Ctr.		
Iron													
(A) Right-Angle Mount with Side Inlet													
500	50	22,800	10.8	86	1/8 NPT	250°	1 7/8"	3 1/8"	1 1/8"	11/32" (2)	—	5807K46	$91.14
910	91	20,000	11.3	90	1/8 NPT	210°	2 5/16"	3 11/16"	1 1/4"	3/8" (2)	—	5807K27	105.00
1,240	124	14,800	10	85	1/4 NPT	250°	2 1/2"	4"	1 5/16"	13/32" (2)	—	5807K48	109.37
2,670	267	14,800	13.7	85	1/4 NPT	250°	2 13/16"	4 1/2"	1 1/2"	13/32" (2)	—	5807K49	123.04
3,140	314	9,600	19.8	84	1/4 NPT	250°	3 3/16"	5 3/16"	1 13/16"	17/32" (2)	—	5807K65	144.68
(B) Base Mount with Top Inlet													
190	19	26,000	6	89	1/8 NPT	210°	2 1/8"	3 3/4"	1 1/8"	1/4" (2)	3"	5807K21	115.00
1,330	133	22,400	19	85	1/8 NPT	250°	2 11/16"	5 3/16"	1 3/16"	13/32" (2)	4"	5807K66	120.76
2,750	275	15,000	16	84	1/4 NPT	250°	3 3/8"	5 1/8"	1 1/2"	13/32" (2)	4"	5807K7	133.29
5,680	568	6,200	31	85	3/8 NPT	250°	5 3/8"	7 7/8"	2 5/16"	11/16" (2)	6"	5807K75	240.38
(C) Base Mount with Side Inlet													
310	31	19,000	7.5	89	1/8 NPT	210°	2 3/16"	3 15/16"	1 3/16"	5/16" (2)	3"	5807K68	125.71
660	66	17,000	10	91	1/8 NPT	210°	2 5/8"	5 1/16"	1 5/16"	3/8" (2)	4"	5807K69	131.43
2,520	252	15,500	14.1	88	1/4 NPT	210°	3 5/16"	5 1/16"	1 11/16"	3/8" (2)	4"	5807K71	168.57
4,060	406	11,100	16.3	88	1/4 NPT	210°	4 3/8"	6 3/8"	2 5/16"	1/2" (2)	5"	5807K72	184.21
7,890	789	11,500	18.9	92	1/4 NPT	210°	4 3/8"	6 3/8"	2 5/16"	1/2" (2)	5"	5807K73	173.68
(D) Heavy Duty Base Mount with Side Inlet													
6,440	644	5,500	29	87	3/8 NPT	210°	6"	6 3/8"	3 1/8"	3/8" (4)	5 1/2"	5807K81	362.50
8,020	802	5,000	29	88	3/8 NPT	210°	6"	6 3/8"	3 1/8"	3/8" (4)	5 1/2"	5807K82	375.00
Corrosion-Resistant Plastic													
(E) Base Mount with Top Inlet													
900	90	24,000	9	83★	1/8 NPT	200°	2 5/8"	5"	1 7/16"	3/8" (2)	4"	5873K73	75.17
1,100	110	20,000	10	80★	1/8 NPT	200°	2 5/8"	5"	1 7/16"	3/8" (2)	4"	5873K75	91.67
1,750	175	15,000	17	87★	1/4 NPT	200°	3 1/2"	5 5/8"	1 3/4"	1/2" (2)	4 5/8"	5873K77	99.74
2,350	235	14,000	17	87★	1/4 NPT	200°	3 1/2"	5 5/8"	1 3/4"	1/2" (2)	4 5/8"	5873K79	110.25
2,750	275	9,000	19	82★	1/4 NPT	200°	4"	6 1/2"	2 5/16"	1/2" (2)	5 1/4"	5873K81	121.00
4,650	465	8,500	20	85★	1/4 NPT	200°	4"	6 1/2"	2 5/16"	1/2" (2)	5 1/4"	5873K83	125.50
10,000	1,000	5,300	32	98★	1/2 NPT	200°	5 7/8"	9"	2 1/2"	11/16" (2)	7 1/2"	5873K91	214.50
Aluminum													
(F) Base Mount with Top Inlet													
720	72	34,000	6	78	1/4 BSPP	210°	2"	3 3/8"	13/16"	0.27" (4)	2 11/16"	5874K61	145.00
1,410	141	29,000	6.5	80	1/4 BSPP	210°	2"	3 3/8"	13/16"	0.27" (4)	2 11/16"	5874K62	160.00
1,800	180	22,000	7	82	1/4 BSPP	210°	2 9/16"	4 7/16"	15/16"	0.35" (4)	3 9/16"	5874K63	192.50
2,250	225	18,000	9	85	1/4 BSPP	210°	2 9/16"	4 7/16"	1 1/16"	0.35" (4)	3 9/16"	5874K64	205.00
3,400	340	15,000	11	89	1/4 BSPP	210°	3 3/16"	5 1/16"	1 5/16"	0.35" (4)	4 1/8"	5874K65	262.50
4,200	420	13,000	14	86	1/4 BSPP	210°	3 3/16"	5 1/16"	1 1/2"	0.35" (4)	4 1/8"	5874K66	280.00

★ Decibels @ 60 psi.

Immersion Heaters

For information about pipe size, see pages 2-3.

About Immersion Heaters

Heat water, oil, solvents, process solutions, and viscous liquids through direct contact with the liquid. When choosing a heater, make sure the heating element material and the wattage are right for your liquid. *Note:* To prevent heater failure, do not run heaters dry and keep elements free from sludge, scale, and mineral deposits.

Heating Element Materials and Compatible Liquids

Type 304 Stainless Steel—Offers good corrosion resistance. For use with mildly corrosive process water and liquid detergents. Also good for heat transfer fluids such as propylene and ethylene glycol.

Type 316 Stainless Steel—Offers excellent corrosion resistance. For use with moderately corrosive liquids such as process water with less than 3% acid or alkaline content. Also for use with deionized water.

Incoloy—Offers corrosion resistance. For use with corrosive liquids such as process water with less than 6% acid or alkaline content; up to 2% caustic solutions (unless otherwise indicated).

Steel—For use with oils.

Copper—For use with clean water.

Minimum Wattage Required to Heat Water

The chart shows the minimum wattage required to heat water in a tank. Multiply watts by 3.4 to convert to Btu/Hr.

	Minimum Wattage Required to Heat Water (6-Hr. Warm-Up Time)						
Gallons	10° F Temp. Rise	30° F Temp. Rise	50° F Temp. Rise	70° F Temp. Rise	90° F Temp. Rise	110° F Temp. Rise	130° F Temp. Rise
5	20	70	110	160	200	250	300
10	50	130	220	310	400	500	600
15	70	200	340	470	600	750	850
25	110	340	550	800	1,000	1,200	1,500
50	220	650	1,100	1,600	2,000	2,500	2,900
100	450	1,300	2,200	3,100	4,000	4,900	5,800
200	900	2,700	4,500	6,300	8,100	9,900	11,600
400	1,800	5,400	9,000	12,500	16,100	19,700	23,300

Wattage Required to Heat Other Liquids

To heat water-based solutions (50% or more water), multiply the watts value in the chart above by 0.90.

To heat corrosive solutions (20% or less water), multiply the watts value in the chart above by 0.75.

To heat oils, multiply the watts value in the chart above by 0.43.

Compact Cartridge-Style Immersion Heaters

Don't let their size fool you—these heaters are packed with the power you need to heat liquids in cramped spaces. All have an NPT male screw plug and wire leads for hardwiring. Maximum temperature is 212° F. Heaters should be used with a temperature controller (not included; see pages 663-665 and 667).

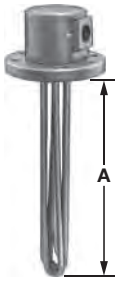
Type 316 Stainless Steel Element for Moderately Corrosive Liquids—For process water with less than 3% acid or alkaline content. Element is UL recognized and CSA certified. Screw plug is Type 316 stainless steel.

Incoloy Element for Water—Screw plug is Type 304 stainless steel. Note: Not for use with process water; alkaline, acid, or caustic solutions.

Watts	Amps	Pipe Size	Element Dia.	Element Lg. (A)		
Type 316 Stainless Steel Element for Moderately Corrosive Liquids						
120V AC, Single Phase						
55	0.46	1/8	1/4"	1 5/8"	4668T51	$74.50
75	0.63	1/4	3/8"	1 9/16"	4668T53	78.44
170	1.42	1/8	1/4"	4 5/8"	4668T52	85.57
250	2.08	1/4	3/8"	4 9/16"	4668T54	89.34
405	3.38	1/2	5/8"	4 7/16"	4668T56	119.28
800	6.7	1	1"	5 1/4"	4668T1	151.40
1,200	10	1	1"	7 3/4"	4668T2	164.93
1,750	14.6	1	1"	11 1/4"	4668T3	176.19
480V AC, Single Phase						
1,800	3.8	1 1/4	1 1/4"	9 1/4"	4668T11	198.31
3,000	6.3	1 1/4	1 1/4"	14 1/4"	4668T12	227.28

Watts	Amps	Pipe Size	Element Dia.	Element Lg. (A)		
Incoloy Element for Water						
120V AC, Single Phase						
500	4.2	3/4	5/8"	4 7/8"	4654T11	$150.75
750	6.3	3/4	5/8"	4 7/8"	4654T12	150.74
1,000	8.3	3/4	5/8"	4 7/8"	4654T13	150.74
240V AC, Single Phase						
500	2.1	3/4	5/8"	4 7/8"	4654T21	150.75
750	3.1	3/4	5/8"	4 7/8"	4654T22	150.74
1,000	4.2	3/4	5/8"	4 7/8"	4654T23	150.74
1,500	6.3	3/4	5/8"	5 3/8"	4654T24	153.56
2,000	8.3	3/4	5/8"	6 3/8"	4654T25	159.01
3,000	12.5	3/4	5/8"	7 7/8"	4654T26	166.75

Flange-Mount Immersion Heaters



For high-volume applications, these extra-large immersion heaters have a flange for mounting to large tanks. Element is Incoloy for use with corrosive liquids such as process water with less than 6% acid or alkaline content; up to 2% caustic solutions.

All heaters are three phase and accept a temperature switch with 3/8" dia. probe (not included; see pages 664-665). They have screw terminals for hardwiring. UL listed and CSA certified. Heaters for *pipe size 3* have four 3/4" dia. flange mounting holes; heaters for *pipe size 5* have eight 7/8" dia. flange mounting holes.

To Order: Please specify 240 or 480 volts AC.

Watts	Amps @ 240V AC	Amps @ 480V AC	Flange Pipe Size	Flange OD	Flange Bolt Circle	Element Lg. (A)		
6,000	14.5	7.2	3	7 1/2"	6"	18"	35065K11	$671.93
12,000	29	14.5	3	7 1/2"	6"	33"	35065K12	770.23
12,000	29	14.5	5	10"	8 1/2"	18"	35065K14	1,048.73
18,000	43.4	21.7	3	7 1/2"	6"	48"	35065K13	868.57
24,000	58	29	5	10"	8 1/2"	33"	35065K15	1,247.27
40,000	96.4	48.2	5	10"	8 1/2"	52"	35065K16	1,383.25

Floating Immersion Heaters

Keep tank fluid from icing and freezing. These heaters automatically turn on when fluid cools to about 45° F and turn off when fluid reaches about 65° F. They have an ABS plastic housing and are for use with clean and deionized water.

Heaters operate on 120V AC, single phase. They have a 6-ft. long power cord with standard three-prong plug and are UL listed. They are for use in metal tanks. To use them in a plastic tank, pair them with a clip-on *heater guard*.

Watts	Amps	O'all Dia.	O'all Ht.	For Max. Tank Size, gal.	Heaters		Heater Guards	
1,000	8.3	8"	4"	150	3639K47	$36.28	3639K61	$16.69
1,500	12.5	8"	4"	300	3639K48	35.61	3639K61	16.69

About Heat Cable

Maintain the temperature and viscosity of process fluids, protect pipes from freezing, and keep roofs and gutters free from snow and ice buildup. To secure heat cable to pipes, use fiberglass tape (see 7574A on page 3586). You should also wrap fiberglass insulation around pipe to protect the cable and ensure maximum heat output (see 5556K on page 3675).

Self-Regulating Heat Cable—Adjusts its heat output in response to surface as well as surrounding temperatures. The hotter the surrounding temperature, the lower the heat output. As a result, a temperature controller is not needed unless a specific, consistent temperature is desired.

Constant-Wattage Heat Cable—Always puts out the designated amount of watts/ft., regardless of the surrounding temperature. Because it's designed to continually supply wattage to the object being heated, it should be used with a temperature controller to prevent burnout. Using a controller also lets you maintain more precise temperatures. Note: To prevent burnout, the cable must not be overlapped and must be in full contact with the surface being heated.

How to Determine Your Power Needs

Total watt output = cable length × watts/ft.

Amp draw = total watt output ÷ volts.

Watts/ft. Needed for Temperature Change

Temperature rise is the fluid temperature you need to maintain minus the minimum surrounding temperature. Watts/ft. ratings are based on using fiberglass insulation.

Watts/ft. Needed for Temperature Change							
Temp. Rise	Insulation Thickness	*Pipe Size to be Heated*					
		½	¾	1	1¼	1½	2
50° F	1″	1.7	1.9	2.2	2.5	2.8	3.3
50° F	1½″	1.3	1.5	1.7	1.9	2.1	2.5
50° F	2″	1.2	1.3	1.4	1.6	1.8	2
100° F	1″	3.5	3.9	4.5	5.3	5.8	6.8
100° F	1½″	2.8	3.1	3.5	4.1	4.4	5.1
100° F	2″	2.4	2.7	3	3.4	3.7	4.3
200° F	1″	7.5	8.6	9.9	11.5	12.6	14.9
200° F	1½″	6.1	6.8	7.7	8.9	9.7	11.2
200° F	2″	5.3	5.9	6.6	7.5	8.1	9.3

For example, to maintain a fluid temperature of 150° F with a minimum ambient temperature of 50° F (temp. rise of 100° F) in an application with 1″ of insulation and a size 1 pipe, you need a heat cable with at least 4.5 watts/ft.

Self-Regulating Heat Cable

Heat Cable with Power-Connection/ Termination Kit

Heat Cable with LED Termination Kit

This cable automatically responds to surrounding temperatures to provide freeze protection and low-temperature maintenance on metal and plastic pipes and tanks. The colder it gets, the greater the heat output; as the temperature increases, the heat output decreases. A power-connection kit (sold below) is required for hardwiring.

All cable is braided copper with leads. It can be overlapped but is not suitable for burying underground. UL listed and CSA certified. **Heavy duty cable** has a plastic outer cover for added durability.

Low-Temperature Heat Cable—Maximum heat output is 150° F. All cable withstands –60° to 185° F temperatures. *Standard cable* is ½″ Wd. × 3⁄16″ Thick. *Heavy duty cable* is 9⁄16″ Wd. × 1⁄4″ Thick.

Medium-Temperature Heat Cable—Maximum heat output is 250° F. Cable withstands –76° to 400° F temperatures and measures 7⁄16″ Wd. × 1⁄4″ Thick. FM approved Class I, Div. 2, Groups B, C, and D.

Power-Connection/Termination Kit—Has what you need (including a junction box and a three-point DIN mount terminal block) to connect power to a run of cable. It also has an end cap, power-connection cover, and adhesive to make an end termination.

LED Termination Kit—This end termination kit has a high-visibility green LED to indicate when your cable is on.

Splice Kit and T-Splice Kit—Have splice-connection covers, wire nuts, and adhesive to make an inline or T-splice connection.

Termination Kit—Includes an end cap, power-connection cover, and adhesive to make an end termination.

Watts/ft.	Max. Lg., ft.		Per Ft. 1-99	Per Ft. 100-Up
Standard Low-Temperature Heat Cable				
120V AC, Single Phase				
3	500	3597K11	$4.61	$3.58
5	500	3597K12	5.41	4.14
8	500	3597K13	5.40	4.11
10	500	3597K14	6.73	5.12
240V AC, Single Phase				
3	500	3597K15	5.29	4.10
5	500	3597K16	5.91	4.45
8	500	3597K17	6.72	5.12
10	500	3597K18	8.12	6.22
Heavy Duty Low-Temperature Heat Cable				
120V AC, Single Phase				
3	500	3597K19	6.35	4.81
5	500	3597K21	7.15	5.53
8	500	3597K22	7.98	6.19
10	500	3597K23	8.31	6.48
240V AC, Single Phase				
8	500	3597K24	9.54	7.44
10	500	3597K26	10.01	7.85

Watts/ft.	Max. Lg., ft.		Per Ft. 1-99	Per Ft. 100-Up
Heavy Duty Medium-Temperature Heat Cable				
120V AC, Single Phase				
9	500	36005K15	$13.30	$10.06
12	500	36005K16	16.10	12.17
15	500	36005K17	18.68	14.13
20	500	36005K18	22.13	16.73
240V AC, Single Phase				
12	500	36005K19	16.83	12.72
20	500	36005K25	22.48	17.00

For Heat Cable Temperature			
Power-Connection/Termination, Termination, and Splice Kits			
Low	Power-Connection/Termination Kit	3597K1	$147.31
Low	LED Termination Kit	3597K2	226.92
Low	Splice Kit	3597K4	13.00
Low	T-Splice Kit	3597K5	147.31
Low	Termination Kits	3597K31	226.92
Medium	Power-Connection/Termination Kit	36005K1	13.00
Medium	LED Termination Kit	36005K2	23.26
Medium	Termination Kits	36005K3	29.23

Ready-to-Use Self-Regulating Heat Cable

120V AC

No need for power-connection and termination kits—an included 6-ft. power cord means this heat cable is ready for action. It automatically responds to surrounding temperatures to provide freeze protection on metal and plastic pipes up to 2½″ diameter. The colder it gets, the greater the heat output; as the temperature increases, the heat output decreases.

All cable is braided copper with a waterproof rubber cover. It measures 7⁄16″ Wd. × 1⁄4″ Thick and can be overlapped. Cable provides 6 watts/ft. @ 40° F and withstands -40° to 150° F temperatures. CSA certified for pipe freeze protection. **120V AC cable** has a three-prong plug. It's also CSA certified for roof and gutter de-icing applications. **240V AC cable** has leads.

Lg., ft.	Watts	Amps		
120V AC, Single Phase				
6	36	0.3	3580K61	$75.97
12	72	0.6	3580K62	96.20
18	108	0.9	3580K63	120.80
24	144	1.2	3580K64	144.34

Lg., ft.	Watts	Amps		
120V AC, Single Phase (Cont.)				
50	300	2.5	3580K65	$262.07
75	450	3.8	3580K66	355.10
100	600	5	3580K67	456.89

Lg., ft.	Watts	Amps		
240V AC, Single Phase				
6	36	0.2	3580K71	$85.13
12	72	0.3	3580K72	112.25
18	108	0.5	3580K73	135.87
24	144	0.6	3580K74	164.94

About Liquid Chillers

Using refrigerant, liquid chillers provide constant, uniform cooling to temperature-sensitive equipment such as spot-welding systems, molds, lasers, X-ray diffraction equipment, and water jackets. The chillers we offer are designed to cool either water or water mixed with ethylene or glycol. They can also be used for cooling metalworking coolants or fluids.

To select a liquid chiller, determine the amount of heat (referred to as heat load) you need to remove from your process to maintain the required temperature. Heat load is typically expressed in Btu/Hr. Use the following formulas as a guide to determine the Btu/Hr. you'll need. Be sure to select a chiller that exceeds that value.

For Water: Btu/Hr. = gpm × 500 × Δtemp. °F (Difference between cooling liquid inlet and outlet temperature).

For Water Mixed with Ethylene or Glycol: Btu/Hr. = gpm × 450 × Δtemp. °F (Difference between cooling liquid inlet and outlet temperature).

Precision Circulating Process Chillers

Using refrigerant, these chillers maintain an accurate temperature between 14° and 158°F. Suitable for cooling water and ethylene glycol, all have an LED display that shows temperature, pressure, and flow for precise control of your process. Chillers have a 1.1-gallon internal tank and include an 8-ft. power cord with plug (see page 846 for plug illustrations). Maximum flow is 3.5 gpm. Refrigerant is 134A. Connections are NPT female. For indoor use only.

Btu/Hr.	AC Voltage (Phase)	Amps	Compressor hp	Pipe Size	NEMA Plug Style	O'all Size Ht.	O'all Size Wd.	O'all Size Dp.		
2,720	120 (1)	12.5	1/4	1/2	5-15	22 5/8"	14 1/2"	27 5/8"	8886T11	$4,651.27
4,090	120 (1)	13.5	1/3	1/2	5-20	22 5/8"	14 1/2"	27 5/8"	8886T12	4,926.56
8,520	208/230 (1)	12.2	3/4	1/2	6-15	22 5/8"	14 1/2"	27 5/8"	8886T13	5,697.03
9,890	208/230 (1)	12.5	1	1/2	6-15	22 5/8"	14 1/2"	27 5/8"	8886T14	6,226.00

Circulating and Open-Loop Process Chillers

6,000-9,000 Btu/Hr.

These efficient chillers offer temperature control from 40° to 100°F. Use them to cool water or water mixed with a maximum of 30% ethylene or propylene glycol. Chillers have an air-cooled condenser and a low-pressure safety control (except the 1/2- and 6-gal. circulating chillers do not have a low-pressure safety control). Those rated 12,000 Btu/Hr. and up also have a high-pressure safety control and a relief valve that ensures the pump will continue to work if flow is restricted. Chillers have screw terminals for hardwiring (except the 1/2-gal. circulating chiller has a 10-ft. power cord with three-prong plug). Refrigerant is 134A. Connections are NPT female. For indoor use only. Note: Btu/Hr. is based on 68°F liquid temperature; 80°F ambient temperature.

Circulating liquid chillers have an internal tank and are for closed-loop cooling of liquids in process equipment (except the 1/2-gal. chiller has an external tank on the back and can be used for both circulating and open-loop applications).

Open-loop liquid chillers are for cooling liquids in a process bath, coolant spray system, or an external tank. Furnished without a tank.

									Circulating Liquid Chillers		Open-Loop Liquid Chillers	
Btu/Hr.	AC Voltage (Phase)	Amps	Compressor hp	Pump Cap., gpm @ psi	Pipe Size	O'all Size Ht.	O'all Size Wd.	O'all Size Dp.	Tank Size, gal.			
3,000	115 (1)	8	1/4	2 @ 8	1/2	13"	14"	17"	1/2	3538K65 $4,004.54		
6,000	115 (1)	14	1/2	2 @ 8	1/2	28"	15"	17"	2	3538K66 4,880.69	35045K56▲	$4,783.59
9,000	115 (1)	20	3/4	4 @ 10	3/4	30"	18"	25"	5	3538K67 5,927.72	35045K57	5,898.17
12,000	230 (1)	12	1	4 @ 60	3/4	38"	22"	26 1/2"	6	3538K68 8,350.21		
20,000	230 (3)	10	1 1/2	10 @ 35	3/4	41"	28"	28"	10	3538K75 11,555.00	35045K81	11,180.00
24,000	230 (3)	14	2	12 @ 50	3/4	41"	28"	28"	10	3538K79 12,177.96	35045K82	11,754.20

▲Pump capacity is 4 gpm @ 10 psi.

High-Flow Circulating Process Chillers

4,300 and 11,300 Btu/Hr.

Equipped with a heavy duty pump, these self-contained chillers achieve higher flow rates than our other chillers for higher cooling capacities. Cooling liquid temperature is adjustable and thermostatically controlled from 50° to 80°F. Use these chillers to cool plain water and water mixed with a maximum of 50% ethylene or propylene glycol. All have an air-cooled condenser, electrical controls with shut-off switch, and a liquid-level sight glass. Connect them to coolant lines and a power source to get them up and running. For indoor use only. Note: Btu/Hr. is based on 65°F liquid temperature; 95° F ambient temperature for chillers rated 4,300 and 11,300 Btu/Hr.; 90° F ambient temperature for chillers rated 24,000 to 60,000 Btu/Hr.

Chillers rated *4,300* and *11,300 Btu/Hr.* contain R134A refrigerant and have a polyethylene internal tank. They also have NPT female connections and casters. Chiller rated 4,300 Btu/Hr. has a 6-ft. power cord with a NEMA 5-20 plug; chiller rated 11,300 Btu/Hr. has a 6-ft. power cord with a NEMA L6-30 plug (see pages 842 and 846 for plug illustrations).

Chillers rated *24,000* to *60,000 Btu/Hr.* have a high-density polypropylene internal tank. They also have screw terminals for hardwiring, NPT female connections, a cleanable air-intake filter, and a manual bypass valve to adjust flow. Chillers rated 24,000 Btu/Hr. contain R134A refrigerant. Chillers rated 36,000 and 60,000 Btu/Hr. contain R407C refrigerant.

Btu/Hr.	AC Voltage (Phase)	Amps	Compressor hp	Tank Size, gal.	Pump Cap., gpm @ psi	Pipe Size	O'all Size Ht.	O'all Size Wd.	O'all Size Dp.		
4,300	115 (1)	15.5	1/2	5	4 @ 50	1/2	28 5/8"	22"	21 1/8"	3531K11	$4,346.48
11,300	230 (1)	17	1	10	4 @ 50	1/2	33 3/8"	31 1/8"	25 1/8"	3531K12	5,235.21
24,000	230 (1)	34	3 1/2	10	10 @ 35	1/2	35 5/8"	33 1/2"	31 5/8"	3531K21	7,556.34
24,000	230 (3)	22	2	10	10 @ 35	1/2	35 5/8"	33 1/2"	31 5/8"	3531K22	8,094.37
36,000	460 (3)	11	3	36	10 @ 45	1 1/2	65"	37"	34 1/2"	3531K23	9,098.59
60,000	460 (3)	16	5	36	15 @ 45	1 1/2	65"	37"	34 1/2"	3531K24	10,619.44

Cold Plates

For a continuously cooled surface that provides contact cooling, connect these plates to process chillers and liquid-to-air cooling systems. All have U-shaped tubes that pass through a thermally conductive aluminum plate. Drill or tap the plate for mounting. Maximum temperature is 392°F.

Cold plates **with copper tubes** are for use with water. Cold plates **with Type 316 stainless steel tubes** are for use with corrosive as well as high-purity fluids, such as deionized water.

Tube Material	Max. psi	Tube OD	Plate Size Lg.	Plate Size Wd.	Plate Size Thick.		
Copper	150	3/8"	6"	3 1/2"	1/2"	35035K32	$67.20
Copper	150	3/8"	12"	3 1/2"	1/2"	35035K42	84.00

Tube Material	Max. psi	Tube OD	Plate Size Lg.	Plate Size Wd.	Plate Size Thick.		
Stainless Steel	150	3/8"	6"	3 1/2"	1/2"	35035K36	$100.80
Stainless Steel	150	3/8"	12"	3 1/2"	1/2"	35035K46	123.90

About Liquid-Level Switches

Activate pumps, motors, and process equipment based on the liquid level in your tank or vessel. Most of our switches can be set to empty a tank (normally open) or to fill a tank (normally closed).

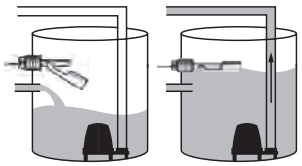
Many liquid-level switches have an amp rating too low to activate equipment directly. If your equipment has a higher amp rating than the switch you're using, you must install a relay for operation. See 47475K on page 608. For additional relays, see pages 980-990.

Selecting a Float-Style Switch—Float-style switches activate when their float is moved by the changing level of your liquid. To ensure that the float is buoyant in your application, choose a switch with a minimum specific gravity at or below your liquid's specific gravity. For example, to use a float switch with gasoline, it must have a minimum specific gravity of 0.74 or less.

Specific Gravity of Common Liquids

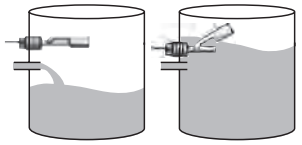
	Specific Gravity @ 70° F		Specific Gravity @ 70° F
Water	1	Gasoline	0.74
Hydraulic Oil	0.90	Butane	0.60
Ethanol	0.79	Propylene	0.52

To Empty a Tank (Normally Open)



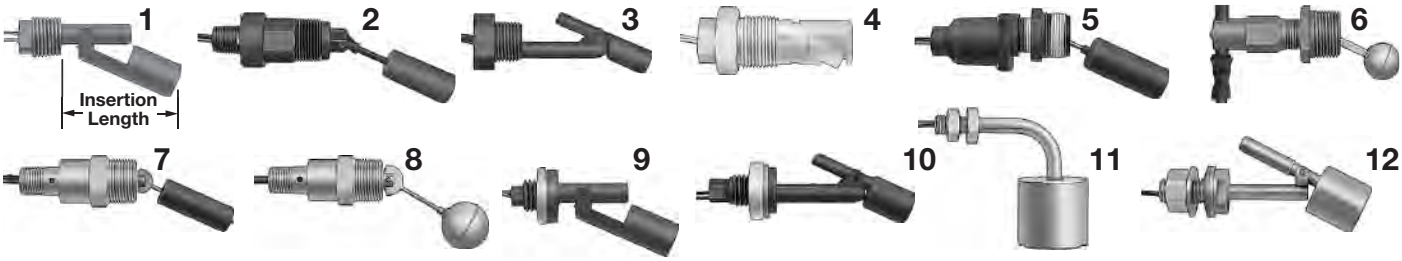
A switch installed to empty a tank (normally open) turns one circuit from "off" to "on" when the liquid level reaches the switch. In the example, the switch activates an internal pump to remove liquid from the tank.

To Fill a Tank (Normally Closed)



A switch installed to fill a tank (normally closed) turns one circuit from "on" to "off" when the liquid level reaches the switch. In the example, liquid is pumped into the tank until the level reaches the switch, which deactivates an external pump.

Horizontal-Mount Liquid-Level Float Switches



When liquid level moves the float, switches activate a pump to empty or fill a tank. They can be installed to turn one circuit from "off" to "on" (normally open) or from "on" to "off" (normally closed). *Styles 1, 3, 4, 6, & 9-12* are single pole, single throw (SPST); *Styles 2, 5, 7 & 8* are single pole, double throw (SPDT). They operate on 120/240 volts AC, unless noted. All mount horizontally through a tank wall. *Styles 4 & 11* have a shield around the float to minimize false switch activation in splashing liquid.

Choose switches with a metal body for durability in harsh conditions.

Switches with Threaded Tank Connection—Pipe and conduit connections are NPT male; spade connections are female. All switches mount from outside the tank.

Switches with Through-Wall Tank Connection—Install through an unthreaded hole in the tank wall. Switches mount from inside the tank and include a nut to secure.

	Tank Connection	Minimum Specific Gravity	Body/Float Material	Max. psi @ 70° F	Temperature Range, ° F	Insertion Lg.	Amps @ 120 volts AC	Electrical Connection		
With Threaded Tank Connection—Plastic Body										
For Water										
1	1/2 NPT	0.71	Polysulfone	150	40° to 225°	2 11/16″	0.16	Wire Leads	**49175K37**	$28.00
2	1 NPT	0.60	Polyphenylene Sulfide	150	40° to 212°	4 3/4″	1.00■	1/2 NPT Conduit	**46235K27**	84.46
2	1 NPT	0.60	Polyphenylene Sulfide	150	40° to 212°	4 3/4″	5.00	1/2 NPT Conduit	**46235K25**	71.24
For Hydraulic Oil and Diesel Fuel										
3	1/2 NPT	0.85	Polybutylene	100	-40° to 149°	2 3/4″	0.28	1/2 NPT Conduit	**50205K32**	28.61
3	1/2 NPT	0.85	Polybutylene	100	-40° to 149°	2 3/4″	0.28	1/4″ Spade	**50205K35**	33.75
3	1/2 NPT	0.85	Polybutylene	100	-40° to 149°	2 3/4″	0.28	Wire Leads	**50205K31**	30.14
3	1 1/4 NPT	0.70	Polyphenylene Sulfide	200	-40° to 190°	4 1/8″	0.50	Wire Leads	**7040T11**	70.82
4	1 NPT	0.85	Polybutylene	100	-40° to 149°	1 7/8″	0.28	1/4″ Spade	**50205K36**	81.11
5	1 1/4 NPT	0.70	Polyphenylene Sulfide	100	32° to 190°	4 13/16″	15.00	Wire Leads	**7040T12**	193.10
For Chemicals, Plating and Cleaning Solutions, and Solvents										
3	1/2 NPT	0.70	Polypropylene	100	-40° to 221°	2 3/4″	0.28	1/4 NPT Conduit	**46515K43**	46.32
3	1/2 NPT	0.85	PVDF	100	-40° to 221°	2 3/4″	0.28	1/2 NPT Conduit	**5082K21**	37.89
4	1 NPT	0.70	Polypropylene	100	-40° to 221°	1 7/8″	0.28	1/2 NPT Conduit	**46515K81**	37.19
4	1 NPT	0.70	Polypropylene	100	-40° to 221°	1 7/8″	0.28	Wire Leads	**46515K71**	46.33
4	1 NPT	0.85	PVDF	100	-40° to 221°	1 7/8″	0.28	1/2 NPT Conduit	**5082K22**	85.19
With Threaded Tank Connection—Metal Body										
For Water										
6	1 NPT	0.70	303 SS/304 SS	350	40° to 200°	1 3/4″	0.50■	1/8 NPT Conduit	**48255K31**	184.57
6	1 NPT	0.90	Brass/Polypropylene	1,000	40° to 200°	1 3/4″	0.50■	1/8 NPT Conduit	**48255K26**	96.60
For Hydraulic Oil and Diesel Fuel										
1	1/2 NPT	0.55	316 SS/Polypropylene	100	-40° to 225°	3 11/16″	0.17	1/2 NPT Conduit	**46515K12**	229.71
1	1/2 NPT	0.65	316 SS/Nylon	100	-40° to 250°	3 11/16″	0.17	1/2 NPT Conduit	**5123K22**	229.71
7	1 NPT	0.80	Brass/Buna-N	150	-40° to 180°	3 7/8″	0.17	1/2 NPT Conduit	**5126K19**	276.38
7	1 NPT	0.85	316 SS/304 SS	500	-40° to 300°	5 5/16″	0.17	1/2 NPT Conduit	**46815K14**	347.33
8	1 NPT	0.90	316 SS	900	-40° to 300°	4 1/8″	0.17	1/2 NPT Conduit	**46815K12**	364.48
With Through-Wall Tank Connection—Plastic Body										
For Water										
9	1/2″ Hole	0.71	Polysulfone	150	40° to 225°	2 11/16″	0.16	Wire Leads	**49175K38**	30.50
9	5/8″ Hole	0.71	Polysulfone	150	40° to 225°	2 11/16″	0.16	Wire Leads	**49175K39**	30.80
For Hydraulic Oil and Diesel Fuel										
10	5/8″ Hole	0.85	Polybutylene	100	-40° to 149°	2 7/8″	0.28	Wire Leads	**50205K33**	35.43
With Through-Wall Tank Connection—Metal Body										
For Chemicals, Plating and Cleaning Solutions, and Solvents										
11	3/8″ Hole	0.80	316 SS	300	-40° to 392°	2 9/16″	0.28	Wire Leads	**46815K18**	71.76
12	1/2″ Hole	0.80	316 SS	100	-40° to 392°	3 3/16″	0.28	Wire Leads	**46815K23**	78.19

■ Not rated for 240 volts AC.

Flowmeters

For information about pipe size, see pages 2-3.

About Flowmeters and Totalizers

Flowmeters measure the rate of flow for a liquid or gas. **Totalizers** measure the cumulative flow volume. **Flowmeter/totalizers** display both the flow rate and the cumulative flow volume.

For the highest degree of accuracy, select a meter that has a flow range with your anticipated flow near the top of the range. Install an inline strainer before your meter to prevent debris from clogging your pipeline and reducing accuracy. For inline strainers, see pages 431 and 433.

Because valves and other restrictions in your system cause turbulent liquid flow that leads to inaccurate readings, install your flowmeter or totalizer with enough straight pipe before and after the device to ensure uniform flow.

Panel-Mount Flowmeters

Standard | Flow Control

Monitor flow rate from your instrument panel. All flowmeters have an acrylic tube and EPR seals. They mount vertically, and flow moves from bottom to top. Connections are NPT; flowmeters with two pipe sizes have internal NPT female threads and external NPT male threads. **Flowmeters for water** have a maximum pressure of 125 psi @ 70°F and a temperature range of 33° to 130°F. **Flowmeters for air** have a maximum pressure of 100 psi @ 70°F and a temperature range of 33° to 100°F.

Standard Flowmeters—*Low flow* have brass fittings. *High flow* have PVC fittings, except 41945K31 and 3281K26 have brass fittings.

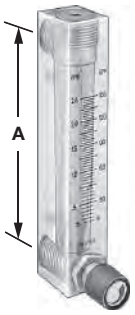
Flowmeters with Flow Control—A valve at the inlet allows you to adjust the flow rate within the range. Choose Type 316 stainless steel for greater corrosion resistance than brass. *Low flow with a brass valve* have brass fittings. *High flow with a brass valve* have PVC fittings, except 41945K73 and 3281K36 have brass fittings. *All with a Type 316 stainless steel valve* have Type 316 stainless steel fittings.

Flowmeters with NIST certificate have been tested and certified to fall within a required tolerance. The certificate comes marked with a calibration date. Record the date of installation to determine when to test the flowmeter again.

Also Available: Repair kits with replacement seals. Please ask for 6766T2 and specify overall height.

Pipe Size Female	Pipe Size Male	O'all Ht.	Ctr.-to-Ctr. Ht. (A)	Accuracy	Available Flow Ranges	Standard		Flow Control: With Brass Valve		Flow Control: With Stainless Steel Valve	
For Water											
Low Flow—Gallons per Hour											
1/4	—	4 1/8"	3"	±6%	0.7-7, 1-12, 2-22, 4-44, 6-60, 7.5-75 gph	4351K121	$60.00	4351K131	$77.00	4351K141	$120.00
Low Flow with NIST Certificate—Gallons per Hour											
1/4	—	4 1/8"	3"	±6%	0.7-7, 2.2-22 gph	3281K11	366.67	3281K12	380.71	3281K13	417.55
High Flow—Gallons per Minute											
1/4	1/2	6 7/8"	5"	±4%	0.1-1, 0.2-2, 0.3-3.5, 0.5-5 gpm	4351K151	78.57	4351K161	93.37	4351K171	200.00
1/4	1/2	8 7/16"	6 7/16"	±3%	0.1-1, 0.2-2, 0.5-5 gpm	4351K181	97.89	4351K191	114.46	4351K261	223.00
1/2	—	14 1/2"	12 1/4"	±2%	0.2-2, 0.35-3.5, 0.5-5, 1-10 gpm	4351K211	167.98	4351K221	206.00	4351K231	375.00
—	1	9 1/8"	6 1/2"	±7%	1-10, 1.5-15, 2-20 gpm	4351K241	116.83	4351K251	258.00	4351K271	380.00
High Flow with NIST Certificate—Gallons per Minute											
1/2	—	14 1/2"	12 1/4"	±2%	0.5-5 gpm	3281K23	524.77	3281K33	496.50	3281K43	644.73
For Air											
Low Flow—Standard Cubic Feet per Hour											
1/4	—	4 1/8"	3"	±6%	2-20, 3-30, 6-60, 10-100, 15-180 scfh	41945K56	60.00	41945K57	77.00	41945K58	120.00
Low Flow with NIST Certificate—Standard Cubic Feet per Hour											
1/4	—	4 1/8"	3"	±6%	2-20, 6-60 scfh	3281K14	366.67	3281K15	380.71	3281K16	417.55
High Flow—Standard Cubic Feet per Minute											
1/4	—	4 1/8"	3"	±6%	0.4-4 scfm	41945K31	60.00	41945K73	77.00	41945K16	120.00
1/4	1/2	6 7/8"	5"	±4%	0.8-8.2, 2.3-23 scfm	41945K59	77.78	41945K61	93.94	41945K62	200.00
1/4	1/2	8 7/16"	6 7/16"	±3%	0.8-8.2, 2.2-22 scfm	41945K63	93.94	41945K64	115.15	41945K71	223.00
1/2	—	14 1/2"	12 1/4"	±2%	2-20, 4.2-42 scfm	41945K72	174.49	41945K65	208.08	41945K66	375.00
—	1	9 1/8"	6 1/2"	±4%	4-40, 6-60 scfm	41945K67	128.62	41945K68	260.61	41945K69	380.00
High Flow with NIST Certificate—Standard Cubic Feet per Minute											
1/4	—	4 1/8"	3"	±6%	0.4-4 scfm	3281K26	366.67	3281K36	380.71	3281K46	417.55

High-Accuracy Panel-Mount Flowmeters



Use these flowmeters for more accurate readings than standard panel-mount flowmeters. All have an acrylic tube and a Type 303 stainless steel valve at the inlet for adjusting flow within the range. They mount vertically, and flow moves from bottom to top.

Maximum pressure is 100 psi @ 70°F; maximum temperature is 150°F. Connections are NPT female. *Flowmeters with 1/4 NPT connections* have Type 303 stainless steel fittings and fluoroelastomer seals. *Flowmeters with 1 NPT connections* have PVC fittings and Buna-N seals.

Pipe Size	O'all Ht.	Ctr.-to-Ctr. Ht. (A)	Accuracy	Flow Range		
For Water—Gallons per Minute						
1/4	6 5/8"	5 1/2"	±3%	0.25-2.5 gpm	2968K31	$200.05
1/4	6 5/8"	5 1/2"	±3%	0.5-5 gpm	2968K34	200.05
1	10 7/8"	8 1/2"	±2%	1-10 gpm	2968K36	329.74
1	10 7/8"	8 1/2"	±2%	2-20 gpm	2968K38	329.74
For Air—Standard Cubic Feet per Minute						
1/4	6 5/8"	5 1/2"	±3%	0.5-5 scfm	2968K42	200.05
1/4	6 5/8"	5 1/2"	±3%	4-20 scfm	2968K44	200.05
1	10 7/8"	8 1/2"	±2%	4-50 scfm	2968K46	329.74

Low-Flow Shatter-Resistant Panel-Mount Flowmeters

Standard | Flow Control

A polycarbonate tube and case make these flowmeters more shatter resistant than flowmeters with glass components. They mount vertically, and flow moves from bottom to top.

Flowmeters have Type 303 stainless steel fittings and fluoroelastomer seals. Accuracy is ±4%, and overall height is 4 13/16". Maximum pressure is 100 psi @ 70°F; maximum temperature is 150°F. Connections are NPT female.

Flowmeters with flow control have a Type 303 stainless steel valve at the inlet so you can adjust the flow rate within the range.

Pipe Size	Flow Range	Standard		Flow Control	
For Water—Gallons per Hour					
1/8	0.2-2.5 gph	5079K12	$67.40	5079K52	$78.09
1/8	0.4-5 gph	5079K15	67.40	5079K53	78.09
1/8	1-10 gph	5079K16	67.40	5079K54	78.09
1/8	2-25 gph	5079K17	67.40	5079K55	78.09
1/8	4-40 gph	5079K18	67.40	5079K56	78.09
For Air—Standard Cubic Feet per Hour					
1/8	0.1-1 scfh	5079K22	67.40	5079K62	78.09
1/8	0.2-2.5 scfh	5079K23	67.40	5079K63	78.09
1/8	0.4-5 scfh	5079K24	67.40	5079K64	78.09
1/8	1-11 scfh	5079K25	67.40	5079K65	78.09
1/8	2-22 scfh	5079K26	67.40	5079K66	78.09
1/8	4-60 scfh	5079K27	67.40	5079K67	78.09

About Pressure Gauges

Install gauges in pipelines and tanks to measure and display pressure. Consider the following in your selection:

Type of Gauge & Application

Pressure gauges measure positive pressure. The most common type of gauge, they're used with pumps, filters, regulators, and in process lines.

Vacuum gauges measure negative pressure (vacuum). They're used with vacuum pumps, packaging equipment, and in suction lines.

Compound gauges measure both pressure and vacuum. Use compound gauges with compressors, refrigeration equipment, and in pump start-up applications.

Differential gauges display the difference between two pressure measurements. They're often used with air-handling equipment to control ventilation for clean rooms and fume hoods.

Connection Material & Process Media

Choose a gauge with a **brass connection** for use with noncorrosive liquids and gases, such as air and water. For corrosive environments that could damage brass, choose a gauge with a **stainless steel connection**. If you require additional protection, use a *gauge guard* (page 635) between the process media and gauge.

For steam and other high-temperature media, install a *siphon tube* (page 635) to protect your gauge. Also known as a pigtail, the tube is filled with water to provide a protective barrier between the internal parts of the gauge and high-temperature media.

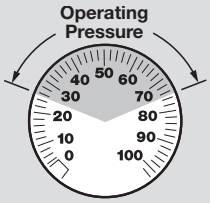
Dry or Liquid-Filled

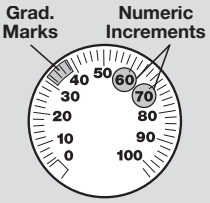
Gauges with a dry dial work well for most applications. For environments prone to vibration, consider a gauge with a liquid-filled dial. They suppress needle flutter for more precise readings. They're also good for use in pipelines that incur pressure spikes because they absorb some of the shock, which may prevent damage to the gauge.

Pressure Range & Dial Face

Choose a range that is about double the normal operating pressure of your application. Your maximum operating pressure should not exceed 75% of the maximum pressure of the gauge.

When replacing an existing gauge, use the graduation marks and numeric increments to select a matching dial face.





Accuracy

Mid-scale accuracy applies to readings that fall between 25% and 75% of the pressure range. *Full-scale accuracy* applies to readings for the entire pressure range.

Gauges with 5% to 2% accuracy are the most commonly used.

Gauges with 1.6% to 1% accuracy are typically required for critical processes, such as food processing and hydraulics.

Gauges with 0.5% to 0.05% accuracy are suitable for testing, laboratory, and calibration applications.

NIST Certification

Many gauges are available with a certificate of calibration traceable to the National Institute of Standards and Technology (NIST). It verifies that the gauge has been tested against a NIST-certified gauge and falls within a required tolerance. The certificate comes marked with a calibration date, which is the actual date of certification. Record the date you install the gauge to determine when to test it again.

Multipurpose Gauges

Single Scale with Bottom Connection

Bottom Connection with Cover

Dual Scale with Center Back Connection

Panel Mount Connection (Back View)

- Use with air, water, hydraulic oil, ethyl alcohol, natural gas, and nitrogen
- Pipe Connection: Brass NPT male
- Accuracy: ±2% mid scale (Grade B)

Our most popular gauges for pressure readings in a wide variety of applications. Lens is impact-resistant polycarbonate. Temp. range is –40° to 150°F. *Gauges with cover* have a rubber sleeve to protect the case from impact.

ABS-plastic-case gauges are more corrosion resistant than steel-case gauges. All have a single scale that displays pressure in psi. *Gauges with NIST certificate* come with a certificate of calibration traceable to NIST.

Steel-case gauges are more impact resistant than ABS-plastic-case gauges. *Single scale* display pressure in psi; *dual scale* display pressure in psi and kPa.

Available Pressure Ranges

Pressure Range psi	Pressure Range kPa	Grad. Marks, psi	Num. Inc., psi
0- 15	0- 100	0.5	1
0- 30	0- 200	0.5	5
0- 60	0- 400	1	5
0-100	0- 700	2	10
0-160	0-1,100	5	20
0-200	0-1,400	5	20
0-300	0-2,000	5	30
0-400	0-2,800	10	50
0- 600	0- 4,000	10	50
0-1,000	0- 7,000	20	200
0-2,000	0-14,000	50	400
0-3,000	0-20,000	100	500
0-4,000	0-28,000	100	1,000
0-5,000	0-35,000	100	1,000
0-6,000	0-40,000	200	1,000

To Order: Please specify pressure range in psi from the chart.

For a drawing of the dial face, go to mcmaster.com, search for the part number, and select a pressure range.

Dial Size	Pipe Size	Bottom Connection		Bottom Connection with Cover		Center Back Connection		Panel Mount Connection Cutout, Dia.	
ABS-Plastic-Case Gauges									
Single Scale									
1½″	⅛	3847K71★	$11.90	2201T23★	$24.56	3847K72★	$11.51	1 31/32″	3847K73★ $16.32
2″	¼	4089K61	10.25	2201T25	23.14	4089K62	12.80	2 7/16″	4089K63 19.98
2½″	¼	4089K64	11.69	2201T27	24.83	4089K65	14.03	3 7/64″	4089K66 24.49
3½″	¼	4089K81	16.53	2201T29	29.93	4089K82	18.72	4 1/64″	4089K83 29.15
Single Scale with NIST Certificate									
1½″	⅛	9796T11★	90.69	2201T31★	103.18	9796T12★	90.34	1 31/32″	9796T13★ 96.43
2″	¼	9796T21	89.22	2201T33	102.02	9796T22	91.49	2 7/16″	9796T23 97.87
2½″	¼	9796T31	90.50	2201T35	103.49	9796T32	92.59	3 5/64″	9796T33 101.88
3½″	¼	9796T41	97.09	2201T37	108.07	9796T42	96.75	4 1/64″	9796T43 106.02
Steel-Case Gauges									
Single Scale									
1½″	⅛	3846K1★	11.90	2201T39★	24.56	3846K2★	11.51	1¾″	3846K4★ 14.91
2″	⅛	3846K411★	10.46	2201T41★	23.35	3846K431★	12.39	2 7/32″	3846K451★ 15.74
2″	¼	3846K6	10.45	2201T43	23.35	3846K8	12.39	2 7/32″	3846K9 15.73
2½″	¼	3846K312	11.00	2201T45	24.14	3846K313	12.95	2¾″	3846K99 18.13
3½″	¼	3846K311	14.91	2201T47	28.30	3846K18	16.02	3 13/16″	3846K19 23.97
4½″	¼	3846K21	22.14	2201T49	35.79	—	—	—	— —
Dual Scale									
1½″	⅛	4000K717★	11.90	2201T51★	24.56	4000K718★	11.51	1¾″	4000K719★ 14.91
2″	⅛	4000K744★	10.46	2201T53★	23.35	4000K745★	12.39	2 7/32″	4000K746★ 15.74
2″	¼	4000K721	10.45	2201T55	23.35	4000K791	12.39	2 7/32″	4000K728 15.73
2½″	¼	4000K722	11.00	2201T57	24.14	4000K726	12.95	2¾″	4000K729 18.13
3½″	¼	4000K713	14.91	2201T59	28.30	4000K727	16.02	3 13/16″	4000K741 23.97
4½″	¼	4000K724	22.14	2201T61	35.79	—	—	—	— —

★ Available only in pressure ranges up to 1,000 psi.

Manometers & Pressure Transmitters

For information about pipe size, see pages 2-3.

Hand-Held Digital Manometers

Dual Scale

Check pressure, differential pressure, and vacuum on the go. Accuracy is ±0.5% full scale. All have a four-digit LCD. They operate on one 9-volt battery (included). Size is 6½″ Ht. × 2 13/16″ Wd. Connections are barbed.

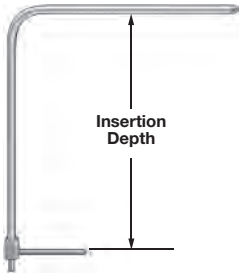
Dual-scale manometers have two scales. Use with air and natural gas. 4125K21 and 4125K23 show readings in inches of H_2O or kPa; 4125K25 shows readings in psi or bar. FM approved as intrinsically safe for Class 1, Division 1, Groups A, B, C, and D; temperature code T4.

Multiscale manometers show readings in inches of H_2O, kPa, psi, inches of Hg, or millibars. Use with air. They store up to 40 readings and have overpressure alarms. CE approved.

Also Available: Manometers with a certificate of calibration traceable to NIST for an additional cost of $180.00. Please ask for 4125K71 and specify dual scale or multiscale and pressure range.

Pressure Range	Resolution	Max. psi	For Tube ID		
Dual Scale					
0- 20 in. of H_2O	0.01	10	1/8″-3/16″	4125K21	$250.59
0-200 in. of H_2O	0.1	30	1/8″-3/16″	4125K23	178.81
0- 30 psi	0.01	60	1/8″-3/16″	4125K25	178.81
Multiscale					
0- 20 in. of H_2O	0.01	10	1/8″-3/16″	4125K41	336.36
0-200 in. of H_2O	0.1	30	1/8″-3/16″	4125K43	217.36
0-553 in. of H_2O	0.01	60	1/8″-3/16″	4125K46	217.36
Optional Nylon Carrying Case				4125K11	53.20

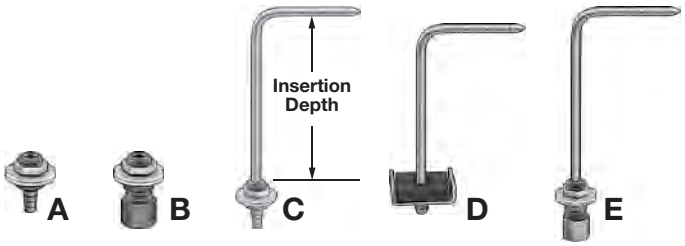
Pressure Tubes for Manometers



Also known as pitot tubes, use these with manometers and differential pressure gauges to measure air velocity. Tubes have inch graduation marks so you can monitor your insertion depth. Use in ducts with a minimum diameter of 10″.

For Tube ID	Insertion Depth		
5/16″	8 5/8″	4039K17	$83.87
5/16″	12 5/8″	4039K11	86.13
5/16″	18 5/8″	4039K12	92.37
5/16″	24 5/8″	4039K13	95.77

Pressure Sensors for Air Ducts



Use these sensors with differential pressure gauges, manometers, and pressure switches to measure the static pressure drop across air filters, cooling coils, and blowers in air-handling equipment. Install sensors in duct through a 3/8″ hole and connect to your gauge with tubing.

Sensors for high velocity have pressure tubes for more accurate measurements in applications with high air flow. *Style D* is held in place with a magnet so you can move it for use in multiple locations.

	Fitting	For Tube Size	Insertion Depth		
For Low Velocity					
A	Barbed	1/8″-3/16″ ID	—	4077K56	$4.65
B	Compression	1/4″ OD	—	4077K55	6.01
For High Velocity					
C	Barbed	1/8″-3/16″ ID	4″	4077K52	10.31
D	Barbed	3/16″ ID	3″	4077K53	11.28
E	Compression	1/4″ OD	4″	4077K51	11.22

Indicating Liquids for Manometers

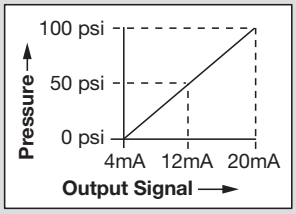
Size	Specific Gravity	Color	Temp. Range		
Full-Strength Refills					
1 oz.	0.826	Red	–20° to 160° F	3974K7	$9.93
1 oz.	1.91	Blue	32° to 140° F	3974K11	137.02
7 oz.	1.75	Blue	30° to 110° F	4037K26	121.88
16 oz.	0.827	Red	35° to 125° F	4037K21	36.86
Concentrated Refills—Dilute with distilled water.					
1 oz.	1	Green	35° to 150° F	3985K71	14.62
15 oz.	1	Green	35° to 125° F	4037K22	69.00

About Pressure Transmitters

Pressure transmitters convert pressure to an electrical signal so you can monitor your application remotely. Also known as pressure sensors and pressure transducers, use them to control system automation or display pressure with a monitoring device (see panel monitors on page 1028). *Max. psi* is the maximum pressure a transmitter can withstand without damage.

Output Signal and Pressure

A transmitter's output signal increases as the application pressure increases. For example, the chart at right illustrates the changing output signal of a transmitter with a pressure range of 0-100 psi and an output signal of 4-20 mA. The transmitter produces a 4 mA signal at 0 psi, a 12 mA signal at 50 psi, and a 20 mA signal at 100 psi.



Pressure Transmitters

- Use with air, water, and hydraulic oil
- Pipe Connection: Type 316 stainless steel NPT male
- Accuracy: See below

Get remote pressure monitoring for automated applications—transmitters convert pressure to an electrical signal. They have screw terminals with a DIN electrical connection. Housing is stainless steel. Temperature range is 32° to 176° F. All are CE approved.

NIST-certified transmitters come with a certificate of calibration traceable to NIST.

High-Accuracy Transmitters—±0.5% Accuracy

Available Pressure Ranges (psi)

Pressure Range	Max. psi	Pressure Range	Max. psi	Pressure Range	Max. psi
0- 15	30	0- 200	400	0- 1,500	2,900
0- 25	60	0- 300	600	0- 3,000	6,000
0- 50	100	0- 500	1,000	0- 5,000	10,000
0- 60	100	0-1,000	1,740	0-10,000	17,400
0-100	200				

To Order: Please specify pressure range from the chart.

	Output Signal	DC Voltage	Pipe Size	Ht.		
Standard	4-20 mA	8-30	1/4	2 3/8″	3196K5	$165.83
Standard	0-10V DC	14-30	1/4	2 3/8″	3196K2	165.83
NIST Certified	4-20 mA	8-30	1/4	2 3/8″	3196K7	247.73
NIST Certified	0-10V DC	14-30	1/4	2 3/8″	3196K9	247.79

Ultra-High-Accuracy Transmitters—±0.25% Accuracy

Available Pressure Ranges (psi)

Pressure Range	Max. psi	Pressure Range	Max. psi	Pressure Range	Max. psi
0-10	58	0- 100	500	0- 1,500	2,900
0-15	72	0- 200	1,160	0- 3,000	7,200
0-25	145	0- 300	1,160	0- 5,000	11,600
0-50	240	0- 500	1,160	0-10,000	17,400
0-60	240	0-1,000	1,740		

To Order: Please specify pressure range from the chart.

	Output Signal	DC Voltage	Pipe Size	Ht.		
Standard	4-20 mA	10-30	1/2	3 1/4″	3200K1	$492.27
NIST Certified	4-20 mA	10-30	1/2	3 1/4″	3200K3	637.22

Pressure Switches

For information about pipe size, see pages 2-3.

About Pressure Switches

Install a switch to automate controls or activate an alarm in your process. For information about electrical switches, see page 937.

Pressure switches operate based on pressure. When the pressure exceeds the actuation point, the switch is activated.

Differential pressure switches operate based on the difference between two pressure connections. When the differential pressure exceeds the actuation point, the switch is activated.

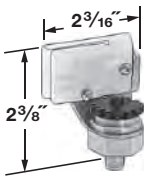
Follow these steps to select a switch for your application:

1. Determine your actuation point—the pressure at which the switch operates. Also known as the setpoint.
2. Determine your deactuation point—the pressure at which the switch resets.
3. Choose a switch with an **actuation range** that contains your actuation point. For best results, your actuation point should fall in the middle of the range.
4. Make sure the switch's **deactuation range** works with your deactuation point—subtract your deactuation point from your actuation point. The resulting value must fall within the deactuation range. Also known as deadband.

Example:

1. Actuation point = 100 psi
2. Deactuation point = 90 psi
3. In Extended-Life Pressure Switches (below), 4735K43 has an actuation range of 20 to 200 psi.
4. 100 psi – 90 psi = 10 psi, which falls in the deactuation range of 5 to 20 psi.

Compact Pressure Switches

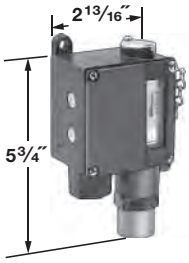


- Use with air, water, hydraulic oil, and diesel fuel
- Pipe Connection: Brass NPT male
- Amp Rating: 10 amps@125/250 volts AC

Activate controls from process lines in tight spaces. Switches are single pole, double throw (SPDT)—they switch one circuit. Accuracy is ±1 psi or ±5%, whichever value is greater. Housing is brass and seal is Buna-N. Temperature range is 0° to 225°F. Switches have spade terminals and are UL recognized.

Actuation Range, psi	Deactuation Range, psi	Max. psi	Pipe Size		
2- 10	0.3- 1.5	250	1/8	3460K21	$29.27
6- 30	0.9- 4.5	250	1/8	3460K41	29.27
20-120	3 -18	250	1/8	3460K61	29.27

Extended-Life Pressure Switches



- Use with air, water, hydraulic oil, and diesel fuel
- Pipe Connection: Type 416 stainless steel NPT female
- Amp Rating: 10 amps@125/250/480 volts AC

Often used with hydraulic presses, compactors, and machine tools, a NEMA 13 enclosure protects these switches from dust and oil for a long service life in harsh environments. Switches are single pole, double throw (SPDT)—they switch one circuit. Accuracy is ±2%. Housing is aluminum and seal is Buna-N. Temperature range is –20° to 165°F. Switches have screw terminals and a ½ NPT female conduit port.

Actuation Range, psi	Deactuation Range, psi	Max. psi	Pipe Size		
20- 200	5- 20	200	1/4	4735K43	$459.72
75- 540	10- 35	540	1/4	4735K45	459.72
100-1,500	30-100	1,500	1/4	4735K46	450.00
235-3,400	60-300	3,400	1/4	4735K48	450.00
425-6,000	120-360	6,000	1/4	4735K49	450.00

High-Pressure Switches

- Use with: See table
- Pipe Connection: Brass NPT male
- Amp Rating: 5 amps@125/250 volts AC

Able to withstand at least 1,000 psi, these switches are often used in pump and hydraulic power applications. Switches are single pole, double throw (SPDT)—they switch one circuit. Accuracy is ±1.5%. Housing is aluminum. Environment temperature range is 0° to 160°F and process temperature range is 0° to 200°F. All are UL recognized, CSA certified, and CE approved.

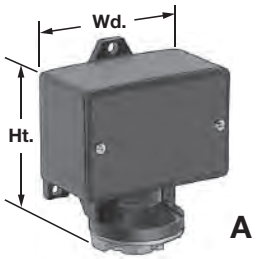
Indoor switches have 1/4″ quick-disconnect terminals. **Washdown switches** have wire leads.

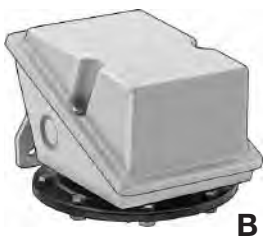
For Air and Water—Switches have a Buna-N seal.

For Oxygen—Switches come cleaned and bagged. They have a fluoroelastomer seal.

Actuation Range, psi	Deactuation Range, psi	Max. psi	Pipe Size	Ht.		
For Air and Water						
Indoor Switches—NEMA 1 Enclosure						
4- 50	1- 6	1,000	1/8	2 3/4″	3427K81	$85.59
10- 150	2- 10	1,500	1/8	2 3/4″	3427K1	85.59
30- 600	8- 60	2,500	1/8	2 3/4″	3427K2	85.59
100-1,500	20-220	8,000	1/4	2 7/8″	3427K82	85.59
180-3,000	50-400	8,000	1/4	2 7/8″	3427K3	85.59
400-4,700	100-600	8,000	1/4	2 7/8″	3427K83	85.59
4,000-7,500	400-950	10,000	1/4	2 7/8″	3427K84	85.59
Washdown Switches—NEMA 4 Enclosure						
4- 50	1- 6	1,000	1/8	2 7/8″	3427K85	97.81
10- 150	2- 10	1,500	1/8	2 7/8″	3427K4	97.81
30- 600	8- 60	2,500	1/8	2 7/8″	3427K5	97.81
100-1,500	20-220	8,000	1/4	3″	3427K86	97.81
180-3,000	50-400	8,000	1/4	3″	3427K6	97.81
400-4,700	100-600	8,000	1/4	3″	3427K87	97.81
4,000-7,500	400-950	10,000	1/4	3″	3427K88	97.81
For Oxygen						
Washdown Switches—NEMA 4 Enclosure						
4- 50	1- 6	1,000	1/8	2 7/8″	3427K12	162.19
10- 150	2- 10	1,500	1/8	2 7/8″	3427K14	162.19
30- 600	8- 60	2,500	1/8	2 7/8″	3427K16	162.19

Washdown Pressure Switches





- Use with air, water, hydraulic oil, gasoline, and diesel fuel
- Pipe Connection: Type 316 stainless steel NPT female
- Amp Rating: 15 amps@125/250/480 volts AC

A NEMA 4X enclosure provides protection from washdowns and splashing water. Switches are single pole, double throw (SPDT). Accuracy is ±1%. Housing is aluminum and seal is fluoroelastomer. Environment temperature range is –20° to 150°F and process temperature range is 20° to 300°F. Switches have screw terminals and a 3/4 NPT female conduit port. They're UL listed and CE approved.

(A) Switches with one actuation point switch one circuit.

(B) Switch with two actuation points has two switches so you can switch two circuits.

Actuation Range	Deactuation Range	Max. psi	Pipe Size	Ht.	Wd.		
(A) With One Actuation Point							
4.5-30 in. of H_2O	2.1-3.5 in. of H_2O	20	1/4	5 1/8″	4″	46025K51	$308.36
2.25- 15 psi	0.7- 2.1 psi	500	1/4	5 1/8″	4″	46025K55	178.16
4.5 - 30 psi	0.7- 2.1 psi	500	1/4	5 1/8″	4″	46025K56	178.16
9 - 60 psi	1.4- 4.9 psi	500	1/4	5 1/8″	4″	46025K57	178.16
15 - 100 psi	2.1- 7 psi	1,000	1/4	5 1/8″	4″	46025K58	178.16
30 - 200 psi	7 - 18.2 psi	1,000	1/4	5 1/8″	4″	46025K59	178.16
60 - 400 psi	7 - 33.6 psi	2,400	1/4	5 1/8″	4″	46025K81	178.16
150 -1,000 psi	42 -154 psi	12,000	1/4	5 1/8″	4″	46025K83	231.51
(B) With Two Actuation Points							
4.5-30 in. of H_2O	2.9-6.8 in. of H_2O	20	1/4	4″	4 1/8″	46025K62	456.87

For information about thermocouples and RTDs, see page 654.

Data-Logging Hand-Held Thermometers

Measure and store thousands of temperature readings and upload data to a PC. Thermometers are °F/°C selectable. All have min./max. memory. They also have a backlit LCD. Batteries are included. CE marked.

Thermometer with Type K Thermocouple Probe—Measure and store up to 8,800 temperature readings from two sources and upload using the RS-232 port. Software and cable are included.

Thermometer with Extended-Life 100-ohm RTD Probe—For more accurate and consistent readings than thermometers with thermocouple probes and a longer service life, this thermometer has a resistance temperature detector (RTD) probe. It logs up to 2,000 time- and date-stamped readings that can be uploaded using the USB port. Conserve battery life with the optional power adapter (sold separately).

With RTD Probe

With Probe Type	Temp. Range	Accuracy	For Use With	Cable Lg.		
Type K Thermocouple	-22° to 572°F	± 1.75°F	Air, Gases, Surfaces	3 ft.	9281T44	$259.19
Extended Life 100-ohm RTD	-58° to 932°F	± 0.1°F	Air, Gases, Liquids, Solids, Surfaces	5 ft.	38655K18	521.91
Optional 120V AC/240V AC Power Adapter for Extended-Life Thermometer					38655K52	80.23
Replacement Type K Thermocouple Probe					9281T21	19.19
Replacement Extended Life 100-ohm RTD Probe					38655K49	148.42

Infrared Thermometers

Check the temperature of hazardous, hard-to-reach, and moving surfaces without risking electrical shock or contamination. These thermometers are often used to locate and diagnose problems in electrical, heating, and ventilation systems. They are °F/°C selectable with a resolution of 0.1. All have an LCD. Response time is 1 second. Thermometers have a laser sight and shut off automatically. Batteries are included. CE marked.

Thermometers with NIST certificate come with a calibration certificate traceable to NIST that states they've passed a test for accuracy.

Thermometers with adjustable emissivity can be calibrated for more accurate readings of shiny surfaces than thermometers with fixed emissivity.

Temp. Range	Accuracy	Emissivity	Max. Working Distance	Overall Size Ht.	Wd.	Dp.	Thermometers		Thermometers with NIST Cert.	
Fixed Emissivity for Dark Surfaces										
-76° to 932°F	±2%	0.95	2 ft.	7″	1½″	3″			9248T57	$145.81
-58° to 1832°F	±1.5%	0.95	25 ft.	9″	2¼″	4″			40045K51	246.59
0° to 750°F	±2%	0.95	8 ft.	6″	1½″	4″	3734K42	$80.65		
Adjustable Emissivity for Light, Dark, and Shiny Surfaces										
-58° to 1200°F	±1%	0.1 to 1	12 ft.	6⅜″	1⅝″	3¼″	9254T61	95.22	9254T72	249.98
-40° to 1022°F	±1%	0.3 to 0.95	12 ft.	7″	2″	6½″	11175K91	227.19	11175K51	388.57
-40° to 1202°F	±1%	0.1 to 1	30 ft.	7″	2″	6½″	11175K93	401.50	11175K53	562.88
-40° to 1472°F	±1%	0.1 to 1	50 ft.	7″	2″	6½″	11175K94	450.47	11175K54	605.64
-22° to 932°F	±1.5%	0.1 to 1	10 ft.	6⅞″	3″	3⅜″	3734K62	111.63		

Pocket Infrared Thermometers

Keep these small thermometers in your pocket or toolkit to spot check the temperature of hazardous, hard-to-reach, and moving surfaces without touching them. They are °F/°C selectable with a resolution of 0.1, unless noted. All have an LCD. Response time is 1 second, except Style D is not rated for response time. Thermometers have a laser sight, unless noted. They shut off automatically. Batteries are included. CE marked, unless noted.

Thermometers with NIST certificate come with a calibration certificate traceable to NIST that states they've passed a test for accuracy.

Thermometers with adjustable emissivity can be calibrated for more accurate readings of shiny surfaces than thermometers with fixed emissivity.

Style E meets IP67 for protection against dust and water submersion.

A

B

C

Temp. Range	Accuracy	Emissivity	Max. Working Distance	Overall Size Ht.	Wd.	Dp.		
Fixed Emissivity for Dark Surfaces								
A -27° to 482°F	±2%	0.95	Not Rated	6″	½″		4231K24♣♦	$63.27
B -25° to 999°F	±5°F	0.95	2 ft.	8 1/16″	2 7/16″	2 3/16″	3612K12	105.66
Fixed Emissivity for Dark Surfaces with NIST Cert.								
C -7° to 230°F	±2.7°F	0.95	10″	2½″	1½″	½″	9203T75♦	48.85
Adjustable Emissivity for Light, Dark, and Shiny Surfaces								
D -4° to 518°F	±2.5%	0.1 to 1	6″	3¾″	2″	1″	9212T21	65.44
E 32° to 932°F	±3.6°F	0.7 to 0.95	15 ft.	6 5/16″	1 11/16″	1 11/16″	6614T31▲	313.19
Adjustable Emissivity for Light, Dark, and Shiny Surfaces with NIST Cert.								
F -67° to 482°F	± 1.8°F	0.05 to 1	16″	4″	2″	¾″	9233T44	82.08

♣ Not CE marked. ♦ Does not have laser sight. ▲ Resolution is 1.

D

E

F

Thermal Imaging Guns

Detect hot spots, leaks, moisture problems, and construction defects invisible to the eye. These imaging guns translate thermal energy into a color image that indicates hotter areas as brighter and cooler areas as darker, so it's easy to identify and diagnose problems on instrument panels, HVAC systems, and other equipment. Imaging guns have adjustable emissivity and can be used on dark, dull, light, and shiny surfaces. They are°F/°C selectable. Both have an LCD. 4006K8 has a laser sight. Thermal imaging guns come with a rechargeable battery, charger, memory card, and USB cable. CE marked.

Temp. Range	Accuracy	Emissivity	Screen Size	Resolution	Overall Size Ht.	Wd.	Dp.		
-4° to 482°F	±2%	0.1 to 1	3″	80×60	9 9/16″	3 11/16″	5½″	4006K5	$1,243.75
-4° to 1200°F	±2%	0.1 to 1	3½″	160×120	9 11/16″	3 13/16″	7 3/16″	4006K8	5,297.05

Thermocouple Probes

About Selecting Temperature Sensors

RTDs (resistance temperature detectors) and thermocouples are temperature sensors that convert readings into electrical signals that can be transmitted to instrumentation such as switches, controllers, recorders, and thermometers.

Selecting a New Temperature Sensor

Though RTDs and thermocouples both measure temperature, they vary in maximum temperature, accuracy, reliability over time, vibration resistance, and cost. Use this chart to determine which sensor type will work best in your application.

	RTDs	Thermocouples
Maximum Temperature	Moderate	Extremely High
Accuracy	High	Moderate
Reliability Over Time	Consistent	Decreases
Vibration Resistance	Low	High
Cost	Moderate	Low

Replacing a Temperature Sensor

RTDs and thermocouples are not interchangeable. RTDs generally have three wires; thermocouples have two wires.

RTDs are available in 100 ohms or 1,000 ohms. RTD types are not interchangeable.

Thermocouples are available in Types J, K, and T. Types are not interchangeable. If you don't know your thermocouple type, use this chart to identify it by the color of the wire leads or connecting plug.

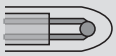
Type	Best for Measuring	Wire Lead Colors	Plug Color
J	High Temperatures	White and Red	Black
K	High, Fluctuating Temperatures	Yellow and Red	Yellow
T	Low Temperatures	Blue and Red	Blue

Thermocouple performance is impacted by the sensor type.

Exposed Sensor

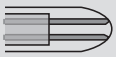
This sensor has no protective sheath, so it has the best response time but no protection from corrosion and damage.

Ungrounded Sensor



This sensor is isolated from the protective sheath, so it has the slowest response time but is protected from the environment and will not create a ground loop.

Grounded Sensor



This sensor is welded to the protective sheath for a faster response time than an ungrounded sensor, but it can create a ground loop that interferes with readings.

Thermocouple Probes for Air

1-3

4

5

6

Monitor ambient air temperature throughout your facility. Accuracy is ±0.75%, unless noted. Probes have an exposed sensor.

Probes with armored cable have an armored cable that protects wiring from corrosion and damage in humid conditions and harsh environments. They have a bayonet mounting connection that securely holds the probe in place in high-vibration environments. The included mounting adapter converts the bayonet connection to a threaded connection. Probes have 2″ long, 20-ga. wire leads.

Type	Temp. Range	Probe Lg.	Response Time, sec.	Max. Cable Temp.		
Standard Cable with Flat-Pin Connector						
(1) Copper Probes (⅛″ dia.) with 3-ft. FEP Cable						
J	32° to 400°F	¼″	7	400°F	6441T671	$46.22
K	-325° to 400°F	¼″	7	400°F	6441T672★	46.22
T	-325° to 400°F	¼″	7	400°F	6441T673	46.22
(2) Copper Probes (⅛″ dia.) with 4-ft. Fiberglass Cable						
J	32° to 895°F	¼″	9	895°F	6441T941	62.19
K	32° to 895°F	¼″	9	895°F	6441T942★	62.19
T	32° to 750°F	¼″	9	895°F	6441T944	62.19
(3) Copper Probes (⅛″ dia.) with 15-ft. FEP Cable						
J	32° to 400°F	¼″	7	400°F	6441T821	79.25
K	-325° to 400°F	¼″	7	400°F	6441T822★	79.25
T	-325° to 400°F	¼″	7	400°F	6441T823	79.25

★ Probe is nickel.

Type	Temp. Range	Probe Lg.	Response Time, sec.	Max. Cable Temp.		
Standard Cable with Flat-Pin Connector (Cont.)						
(4) Stainless Steel Probes (⅛″ dia.) with 4-ft. Polyurethane Cable						
J	32° to 500°F	4″	10	175°F	3868K42■	$94.50
K	-100° to 500°F	4″	10	175°F	3868K43▲	94.50
(5) Stainless Steel Probes (¼″ dia.) with 3.83-ft. Fiberglass Cable						
J	32° to 895°F	2⅛″	10	895°F	3868K641	81.06
K	32° to 895°F	2⅛″	10	895°F	3868K642	81.06
Armored Cable with Wire Leads						
(6) Stainless Steel Probes (3⁄16″ dia.) with 3-ft. Stainless Steel Cable						
J	32° to 900°F	¼″	8	900°F	3860K96	44.94
K	32° to 900°F	¼″	8	900°F	3860K97	43.82
Replacement Mounting Adapter for Style 6					3860K73	11.20

■ Accuracy is ±0.4%. ▲ Accuracy is ±0.2%.

High-Temperature Thermocouple Probes for Air

Thick wire with ceramic insulation stands up to extreme air temperatures in forging, die casting, and heat treating. Probes have 1½″ long wire leads. Accuracy is ±0.75%. Response time is 5 seconds. All have an exposed sensor. *Type J* probes are iron/nickel; *Type K* probes are nickel.

Probe Dia.	Wire Ga.	12″ Length		18″ Length		24″ Length	
Type J Probes—32° to 1400°F Temp. Range							
¼″	14	3859K41	$5.62	3859K42	$8.09	3859K43	$10.56
½″	8	3859K31	10.79	3859K32	16.18	3859K33	21.35
Type K Probes—32° to 2300°F Temp. Range							
¼″	14	3859K44	6.74	3859K45	10.11	3859K46	13.48
½″	8	3859K34	17.30	3859K35	25.84	3859K36	34.38

Thermocouple Probes for Surfaces

Standard

Heavy Duty

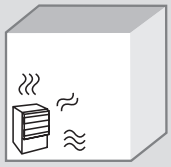
Touch the probe tip to your surface for a quick reading. Probes have 20-ga. wire leads. Wire leads are 2″ long, except heavy duty probes have 3″ long wire leads. Accuracy is ±0.75%.

Standard probes have a fiberglass cable. They have an exposed sensor. *Type J* probes are iron; *Type K* probes are nickel; *Type T* probe is copper.

Heavy duty probes have an armored stainless steel cable that resists wear, abrasion, and corrosion in humid and harsh conditions. A bayonet connection securely holds the probe in place in high-vibration environments. Probes are stainless steel and have a grounded sensor.

Type	Temp. Range	Cable Lg.	Response Time, sec.	Max. Cable Temp.		
Standard—1⁄16″ Dia. × 3⁄8″ Lg. Probe						
J	32° to 900°F	3 ft.	1.8	900°F	9251T91	$19.50
J	32° to 900°F	6 ft.	1.8	900°F	9251T92	21.40
K	32° to 900°F	3 ft.	1.8	900°F	9251T93	19.40
K	32° to 900°F	6 ft.	1.8	900°F	9251T94	22.10
T	32° to 500°F	6 ft.	1.8	900°F	9251T96	21.00
Heavy Duty—3⁄16″ Dia. × ½″ Lg. Probe						
J	32° to 1380°F	8 ft.	2.5	950°F	3860K53	32.86
K	32° to 2280°F	8 ft.	2.5	950°F	3860K59	32.86

About Choosing a Heater



Space Heaters

Heaters use a built-in fan or convection to distribute heated air throughout an area. They are best suited for indoor spaces that are well insulated.

Direct Heaters

Also known as radiant heaters, these heaters transmit waves to warm people and objects rather than the surrounding air. Effective near exposed areas such as loading docks, these heaters are less affected by drafts than space heaters. They can heat spaces but generally take longer than space heaters to do so.

Calculating Heat Output for Space Heaters

To estimate the Btu/Hr. required to heat a space, insert the length, width, and height of the space into the following formula: (Lg.×Wd.×Ht.)×Desired Temperature Increase×3/4

If your space is not well insulated, double the values. In the table below, we show the Btu/Hr. required for some common applications.

Max. Cu. Ft. Heated (Lg.×Wd.×Ht.)	*Btu/Hr. Needed to Increase Temp.* +10° F	+20° F	+30° F	+40° F
Small Spaces—Enclosures, Workstations, Small Offices				
800 cu. ft. (10 ft.×10 ft.×8 ft.)	6,000	12,000	18,000	24,000
Large Spaces—Shops, Garages, Warehouses				
4,800 cu. ft. (20 ft.×20 ft.×12 ft.)	36,000	72,000	108,000	144,000

Calculating Heat Output for Direct Heaters

To estimate the Btu/Hr. required to heat a space, insert the length and width of the space into the following formula: (Lg.×Wd.)×Desired Temperature Increase/0.293

For outdoor use, double the values. In the table below, we show the Btu/Hr. required for some common applications.

Max. Sq. Ft. Heated (Lg.×Wd.)	*Btu/Hr. Needed to Increase Temp.* +10° F	+20° F	+30° F	+40° F
Short Range—One or Two People				
225 sq. ft. (15 ft.×15 ft.)	7,600	15,300	23,000	30,700
Long Range—Several People				
1,600 sq. ft. (40 ft.×40 ft.)	54,600	109,200	163,800	218,400

Space Heaters

Small-Space Portable Electric Heaters

A

B

NEMA 6-30 Plug

C

Carry these heaters to offices, workstations, and other small spaces.

Style A—Adjust the built-in thermostat from 40° to 85° F. Housing is black plastic and is safe to touch during use. Heater shuts off if tipped over or airflow is obstructed. Cord is 6-ft. long and has a two-prong plug. ETL listed.

Style B—Adjust the built-in thermostat from 25° to 95° F. Heater has a steel housing and a 6-ft. cord with a three-prong plug. UL and ETL listed.

Style C—Adjust the built-in thermostat from 35° to 85° F. Use the bracket as a stand or to mount to the wall or ceiling with the 5/16″ mounting holes (fasteners not included). Heaters have a steel housing and a 6-ft. cord with a NEMA 6-30 plug. When operating at 208 volts AC, max. area heated and heat output are reduced by 25%. UL and C-UL listed.

	Max. Cu. Ft. Heated	Heat Output, Btu/Hr.	Airflow, cfm	Watts	Amps	*Overall* Ht.	Wd.	Dp.		
120 Volts AC, Single Phase										
A	680	5,100	90	1,500	12.5	12″	11″	8″	**1810K11**	$64.81
B	750	5,630	120	1,650	13.5	14″	9″	13″	**1810K12**	234.80
208/240 Volts AC, Single Phase										
C	2,540	19,100	260	5,600	23.4	18″	14″	12″	**3688K72**	276.79

Electric Enclosure Heaters

Surface Mount

DIN-Rail Mount

Protect electrical equipment from low temperatures and condensation. Heaters must be hardwired. Components are UL recognized.

Surface-mount heaters have an aluminum housing and a built-in thermostat that adjusts from 0° to 100° F. Mounting fasteners are included. CSA certified.

DIN-rail mount heaters have a plastic housing. *120-volt AC* heaters have a built-in thermostat that adjusts from 32° to 140° F. *Thermostat for 120/240-volt AC heaters* (sold separately) adjusts from 32° to 140° F and is SPST (single pole, single throw).

Surface Mount

Max. Cu. Ft. Heated	Heat Output, Btu/Hr.	Watts	*Overall* Ht.	Wd.	Dp.	120 Volts AC Single Phase Amps			230 Volts AC Single Phase Amps		
45	340	100	6″	4″	4″	1.0	**19095K711**	$306.48	0.5	**19095K712**	$306.48
90	680	200	6″	4″	4″	1.9	**19095K721**	364.28	1.0	**19095K722**	364.28
180	1,360	400	8″	5″	5″	3.7	**19095K731**	421.09	1.9	**19095K732**	421.09
360	2,730	800	8″	5″	5″	7.4	**19095K741**	478.69	3.7	**19095K742**	478.69

DIN-Rail Mount

Max. Cu. Ft. Heated	Heat Output, Btu/Hr.	Watts	Amps	*Overall* Ht.	Wd.	Dp.	Heaters		Thermostats	
120 Volts AC, Single Phase										
290	2,210	650	15.0	4″	7″	5″	**1365K2**	$232.50	_____	____
430	3,240	950	7.9	4″	7″	8″	**1365K1**	275.13	_____	____
120/240 Volts AC, Single Phase										
5	65	20	2.5	4″	2″	3″	**1365K5**	53.33	**1365K6**	$29.51
20	170	50	2.5	5″	3″	4″	**1365K3**	84.67	**1365K6**	29.51
45	340	100	4.5	5″	3″	4″	**1365K4**	122.51	**1365K6**	29.51

Electric Vehicle Heaters

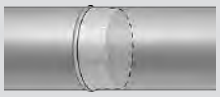
Don't shiver in slow-to-warm vehicles. Hardwire these compact units to your battery. Heaters have a built-in thermostat that adjusts from 0° to 100° F, a remote on/off switch, a fuse, and hardware for floor or wall mounting. Housing is black plastic.

Max. Cu. Ft. Heated	Heat Output, Btu/Hr.	Airflow, cfm	Watts	Amps	*Overall* Ht.	Wd.	Dp.		
12 Volts DC									
140	1,100	100	300	25	8″	6″	5″	**17075K71**	$119.70
24 Volts DC									
290	2,100	100	600	25	8″	6″	5″	**17075K81**	196.00

About Duct Connections

Duct Connections

Some duct and fittings press-fit together while others require connectors, clamps, and brackets. When replacing a component in your system, be sure to match the connection style of your existing duct.



Standard Duct and Fittings

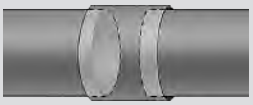
Duct and fittings press-fit together. This design allows you to assemble duct without connectors or clamps.

Spiral Duct and Fittings

To connect two duct ends, you need a fitting. Fittings have a slightly smaller diameter to press-fit into duct.

Quick-Assembly Duct and Fittings

Use a clamp to connect the rolled ends on either end of duct and fittings. Clamps have a quick-release latch that opens and closes to allow access.



Chemical-Resistant PVC Duct and Fittings

To connect two duct ends, you need a fitting. Fittings have a slightly larger diameter to press-fit over duct.

Low-Profile Rectangular Duct and Fittings

Both ends of the duct and fittings have interconnecting ends that lock together with brackets.

Duct-to-Duct Hose Connections

Slip duct hose over duct with a slightly smaller diameter. Standard duct, spiral duct, and chemical-resistant duct generally make the best connections because they have round, even surfaces. To secure the connection, use a worm-drive clamp (see pages 330-334) or duct tape (see page 3579).

Standard Duct and Fittings

No need for clamps or connectors—duct and fittings have a male end that is slightly smaller than its female end for simple assembly.

Galvanized steel has good corrosion resistance. **Aluminum** is lighter in weight than steel and stainless steel and has good corrosion resistance. **304 stainless steel** is more corrosion resistant than steel and aluminum.

Duct

The male end is crimped.

Easy-to-cut duct has an open seam allowing it to be cut with snips prior to installation. The seam snaps together without tools.

Rigid duct has a seam that is already locked in place for greater strength than easy-to-cut duct.

Trade Size/ Female ID	Male OD	Easy-to-Cut: Galvanized Steel 2 ft.	Galvanized Steel 5 ft.	Aluminum 2 ft.	Aluminum 5 ft.	304 Stainless Steel 3 ft.	304 Stainless Steel 5 ft.	Rigid: Galvanized Steel 2 ft.	Galvanized Steel 5 ft.	304 Stainless Steel 2 ft.	304 Stainless Steel 5 ft.
3″	2 7/8″	1766K11 $8.85	—	1773K1 $7.80	$16.70	1767K1 $68.40	$103.40	1768K19 $26.19	$37.50	—	—
4″	3 7/8″	1766K1 8.69	$20.22	1773K2 8.78	18.06	1767K2 56.00	79.48	1768K29 26.74	44.56	18005K1 $83.16	$154.00
5″	4 7/8″	1766K2 8.96	20.84	1773K3 11.12	59.89	1767K3 60.62	88.96	1768K39 41.14	68.56	18005K2 99.48	184.22
6″	5 7/8″	1766K3 10.69	24.85	1773K611 14.00	59.89	1767K4 69.21	107.02	1768K49 43.87	73.11	18005K3 117.36	217.33
7″	6 7/8″	1766K4 12.12	28.18	1773K4 15.85	91.58	1767K5 77.41	119.58	1768K59 46.20	77.00	18005K4 126.12	233.56
8″	7 7/8″	1766K5 13.84	32.19	1773K5 20.21	91.58	1767K6 91.70	136.08	1768K61 50.00	83.33	18005K5 141.72	262.44
9″	8 7/8″	1766K6 15.25	35.46	1773K6 18.80	91.58	1767K7 106.86	147.07	—	—	—	—
10″	9 7/8″	1766K7 16.54	38.87	1773K7 24.56	94.13	1767K8 120.24	162.62	1768K46 56.93	94.89	18005K6 170.76	316.22
12″	11 7/8″	1766K8 19.85	46.17	1773K8 28.75	127.20	1767K9 140.00	194.49	1768K56 63.73	106.22	18005K7 195.34	390.67
14″	13 7/8″	1766K9 24.12	56.10	—	—	—	—	—	—	—	—
16″	15 7/8″	1766K22 30.88	—	—	—	—	—	—	—	—	—
18″	17 7/8″	1766K23 33.36	—	—	—	—	—	—	—	—	—
20″	19 7/8″	1766K24 87.83	—	—	—	—	—	—	—	—	—
22″	21 7/8″	1766K25 114.25	—	—	—	—	—	—	—	—	—
24″	23 7/8″	1766K26 137.65	—	—	—	—	—	—	—	—	—

90° Elbows

Standard elbows can adjust from 90° to straight. The male end is crimped.

Airtight elbows have welded seams to prevent leaks. The male end is tapered.

Standard

Airtight

Trade Size/ Female ID	Male OD	Standard: Galv. Steel	Aluminum	304 SS	Airtight: Galv. Steel	304 SS
3″	2 7/8″	1773K65 $8.11	$6.29	$35.41	1768K88 $160.00	—
4″	3 7/8″	1773K66 8.77	6.19	40.85	17805K81 163.54	$288.89
5″	4 7/8″	1773K67 10.67	8.53	42.09	17805K82 141.20	288.89
6″	5 7/8″	1773K68 11.88	11.42	45.81	17805K83 149.60	310.00
7″	6 7/8″	1773K71 15.46	19.12	53.81	17805K84 155.60	345.60
8″	7 7/8″	1773K9 16.69	20.28	69.36	17805K85 168.80	404.00
9″	8 7/8″	1773K911 21.75	26.46	75.01	—	—
10″	9 7/8″	1773K921 24.94	24.56	87.34	17805K86 242.00	570.60
12″	11 7/8″	1773K931 33.85	44.22	109.40	17805K87 283.60	748.00
14″	13 7/8″	1766K41 54.90	—	—	—	—
16″	15 7/8″	1766K42 89.52	—	—	—	—
18″	17 7/8″	1766K43 90.71	—	—	—	—
20″	19 7/8″	1766K44 99.49	—	—	—	—
22″	21 7/8″	1766K45 126.37	—	—	—	—
24″	23 7/8″	1766K46 139.91	—	—	—	—

(Continued on following page)

About Sound Levels

Measured in decibels (dB), volume ratings indicate how much noise equipment makes. Some common volume levels include a whisper @ 20 dB, a refrigerator @ 40 dB, a conversation @ 60 dB, and a light machine shop @ 90 dB. OSHA recommends hearing protection for exposure to 80 dB and greater.

Equipment-Cooling Blowers

Blow away the heat generated by electronic equipment, induction heaters, and high-wattage bulbs. All blowers have leads for hardwiring.

Standard blowers have an aluminum housing and a galvanized steel wheel. Inlet is round and outlet is rectangular. They have 1/4″ dia. mounting holes, except 91-cfm blower has 5/16″ dia. mounting holes. Fasteners are not included.

Crossflow blowers create a wide stream of air for uniform cooling and ventilating. They have an aluminum housing and wheel and stainless steel flanges with 1/4″ × 1/2″ mounting slots. Fasteners are not included. Components are UL recognized and CSA certified.

Standard

Crossflow

Airflow, cfm	Temp. Range	Volume, dB @ 5 ft.	Overall Size Ht.	Wd.	Dp.	Outlet Size Ht.	Wd.	rpm		
Standard Blowers										
120 Volts AC, Single Phase										
56	–13° to 158° F	57	4 9/16″	3″	4 5/8″	1 5/8″	2 1/4″	2,800	1699K23	$204.21
91	–13° to 131° F	54	6 5/8″	4 1/2″	6 1/4″	2″	3″	1,800	1699K24	187.92
150	–13° to 140° F	62	7 1/2″	4 1/2″	6 7/8″	2″	3″	2,450	1699K21	172.37
Crossflow Blowers										
120 Volts AC, Single Phase										
120	30° to 140° F	61	4 1/4″	11″	3 1/2″	7/8″	7 1/2″	2,600	2087K14	87.90
160	30° to 140° F	69	4 1/4″	14″	3 1/2″	7/8″	10 1/2″	2,600	2087K17	99.93
220	30° to 140° F	58	4 1/4″	17 5/8″	3 1/2″	7/8″	13 1/2″	2,600	2087K22	114.10
12 Volts DC										
58	–4° to 140° F	51	2″	10 1/8″	1 7/8″	5/8″	7 3/4″	4,250	2087K12	81.37
91	–4° to 140° F	51	2″	16 1/4″	1 7/8″	5/8″	13 7/8″	3,600	2087K15	101.97
24 Volts DC										
58	–4° to 140° F	51	2″	10 1/8″	1 7/8″	5/8″	7 3/4″	4,250	2087K13	81.37
91	–4° to 140° F	51	2″	16 1/4″	1 7/8″	5/8″	13 7/8″	3,600	2087K16	101.97

Edge-Flow Equipment-Cooling Blowers

Use in tight spaces where traditional fans won't fit. Air enters through the center of the unit and then expels along the edges. All have leads for hardwiring. AC fans operate at 60 Hz, unless noted.

Square blowers have a fiberglass-reinforced plastic frame with a galvanized steel base plate. Components are UL recognized. Fans are CSA certified.

Round blowers are also known as motorized impellers. Frame is plastic.

Square

Round

Size	Dp.	Airflow, cfm	Volume, dB	Mounting Holes		
Square Blowers						
120 Volts AC, Single Phase						
5.31″ (135 mm)	1.5″	28	50	0.17″	8677K47	$64.83
7.09″ (180 mm)	1.6″	55	49	0.17″	8677K48	75.08
8.66″ (220 mm)	2.2″	130	62	0.21″	8677K49	116.57
12 Volts DC						
5.31″ (135 mm)	1.5″	32	55	0.17″	8677K31	69.33
7.09″ (180 mm)	1.6″	52	58	0.17″	8677K33	82.31
8.66″ (220 mm)	2.2″	120	66	0.21″	8677K35	141.48
24 Volts DC						
5.31″ (135 mm)	1.5″	32	55	0.17″	8677K32	69.33
7.09″ (180 mm)	1.6″	52	58	0.17″	8677K34	82.31
8.66″ (220 mm)	2.2″	120	66	0.21″	8677K36	141.48
Round Blowers						
120 Volts AC, Single Phase						
5.24″ (133 mm)	3.6″	200	66	0.16″	19285K54	103.88
7.48″ (190 mm)	2.7″	365	64	0.16″	19285K56 ★	114.56
8.66″ (220 mm)	2.8″	530	74	0.16″	19285K57 ★	123.30
230 Volts AC, Single Phase						
8.66″ (220 mm)	2.8″	530	74	0.16″	19285K72	123.31

★ Operates at 50/60 Hz.

Equipment-Cooling Fan Trays

Keep unenclosed electronic components cool. Place tray on top of equipment to direct a stream of cool air below. A temperature switch turns the unit on when the temperature reaches 90° F and off when it falls to 86° F. Trays contain two fans. They are single phase, operate on 120 volts AC, and have a 6-ft. cord with two-prong plug. UL listed and CSA certified.

Note: Not for use in enclosed spaces.

Airflow, cfm	Volume, dB	Size Ht.	Wd.	Dp.		
20	18	2 1/16″	15″	7 1/8″	3805T11	$146.82

Machine-Mount Fans

Often used to cool transformers, these single-speed fans have aluminum blades, a galvanized steel guard, and a single phase, dust-resistant totally enclosed nonventilated (TENV) motor. They operate on 120 volts AC and have leads for hardwiring. Mounting holes are 1/2″ dia. for fan with 16″ dia. blade and 3/4″ dia. for fan with 24″ dia. blade. Fasteners are not included.

Optional mounting kit includes a bracket and hardware for attaching fans to machinery.

Blade Dia.	Airflow, cfm	Volume, dB @ 6 ft.	rpm	hp	Size Dia.	Dp.		
16″	4,500	68.2	1,750	1/2	20 1/2″	12 1/4″	1929K12	$620.53
24″	7,400	74.4	1,750	1/2	28″	13 3/4″	1929K18	701.05
Optional Mounting Kit							1929K82	65.45

About Air Conditioner Cooling Capacity

To determine the cooling capacity in Btu/Hr. required to cool an area, you need to know the size of the area and how much you want the temperature to cool. The table at right shows the approximate Btu/Hr. required to achieve the listed temperature reductions in some common spaces.

To estimate the Btu/Hr. required for other spaces, insert the length, width, and height of the space into the following formula:

$$(Lg. \times Wd.) + 2(Lg. \times Ht.) + 2(Wd. \times Ht.)$$

Then multiply the result by your desired temperature reduction in degrees Fahrenheit. The result is the Btu/Hr. you need.

				Btu/Hr. to Reduce Temp.		
	Lg.	Wd.	Ht.	10° F	20° F	30° F
Enclosure	3 ft.	4 ft.	5 ft.	800	1,600	2,400
Small Room	10 ft.	10 ft.	8 ft.	4,200	8,400	12,600
Medium Room	15 ft.	15 ft.	10 ft.	8,200	16,500	24,700
Large Room	20 ft.	20 ft.	12 ft.	13,600	27,200	40,800

Enclosure Air Conditioners

Indoor Ceiling Mount

Indoor Wall Mount

Indoor/Outdoor Wall Mount

Upgrade to an air conditioner when the heat in your enclosure is too much for a fan. These have an adjustable thermostat (68° to 131° F) and terminal blocks for hardwiring. Components are UL and C-UL recognized. Units include mounting hardware and templates. They have integrated condensate evaporators, except 1,000-, 1,700-, and 2,000-Btu units, which drain condensate through a tube. Units also have a programmable alarm and a temperature display, except 1,000-Btu units. *120 volts AC units* operate at 60 Hz, *230 and 460 volts AC units* operate at 50/60 Hz.

Indoor air conditioners are rated NEMA 12 to resist dirt, light water splashes, and oil/coolant dripping.

Indoor/outdoor air conditioners are rated NEMA 4X to resist dirt, washdowns, and corrosion.

Cooling Cap., Btu/Hr.	Size Ht.	Size Wd.	Size Dp.	Fits Opening Ht.	Fits Opening Wd.	120 Volts AC Single Phase Amps			230 Volts AC Single Phase Amps			460 Volts AC Three Phase Amps		
Indoor—Ceiling Mount														
3,600	16 5/16″	23 1/2″	18 3/4″	15 3/8″	19 5/16″	8.7	17495K12	$2,973.21	—	—	—	—	—	—
5,100	16 5/16″	23 1/2″	18 3/4″	15 3/8″	19 5/16″	14.1	17495K13	3,242.74	—	—	—	—	—	—
7,200	16 5/16″	23 1/2″	18 3/4″	15 3/8″	19 5/16″	14.2	17495K29	4,571.77	—	—	—	—	—	—
Indoor—Wall Mount														
1,000	21 5/8″	11″	5 1/2″	21 5/8″	11″	3.3	17495K19	1,625.18	1.7	17495K25	$1,628.39	—	—	—
2,000	21 5/8″	11″	7 7/8″	21 5/8″	11″	5.7	17495K21	2,244.80	2.6	17495K26	2,229.43	—	—	—
3,600	37 3/8″	15 3/4″	10 3/16″	10″	13 3/4″	10	17495K22 ■	2,577.21	4.4	17495K27 ■	2,682.14	—	—	—
5,100	37 3/8″	15 3/4″	10 3/16″	10″	13 3/4″	12.5	17495K23 ■	3,139.59	6	17495K31 ■	3,244.98	2.6	17495K32 ■	$3,856.16
8,000	62 3/16″	15 3/4″	11 3/8″	62 1/8″	15 3/4″	—	—	—	8.5	17495K33	3,740.38	3	17495K34	4,188.31
Indoor/Outdoor—Wall Mount														
1,700	24 3/8″	11 3/16″	11 11/16″	21 5/8″	11″	5.7	17495K41	3,216.27	2.6	17495K42	3,305.16	—	—	—
3,600	40 3/16″	15 7/8″	14 1/8″	10″	13 3/4″	10	17495K43 ■	3,779.52	4.4	17495K44 ■	3,901.19	—	—	—

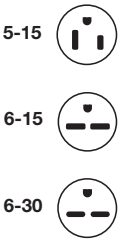
■ Requires two openings. Second opening is 13 3/4″ square.

Air Conditioners

A

B

C With Optional Mounting Sleeve



Stay cool. These air conditioners have an adjustable thermostat (60° to 90° F) and adjustable louvers for directing airflow. All have a control panel and remote control. They also have a 6-ft. cord with a three-prong NEMA plug. UL and C-UL listed. The higher the combined energy efficiency ratio, the more energy efficient the unit. Your operating costs will depend on your utility rates and use. The estimated yearly energy cost is based on electricity cost of $0.12 per kWh. For more information, visit www.ftc.gov/energy.

	Cooling Cap., Btu/Hr.	Combined Energy Efficiency Ratio (CEER)	Est. Yearly Energy Cost, $	Airflow, cfm	Amps	NEMA Plug Style	Size Ht.	Size Wd.	Size Dp.	Fits Opening Size		
Window Mount												
120 Volts AC, Single Phase												
A	5,800	12.1	46.00	190	4.5	5-15	14 1/4″	19 3/4″	21 3/8″	22″ to 42″ Wd.	1843K81	$614.67
A	8,000	12	65.00	220	6.5	5-15	14 1/4″	19 3/4″	21 3/8″	22″ to 42″ Wd.	1843K84	663.32
B	11,900	12	96.00	300	9.5	5-15	15 15/16″	25 15/16″	29″	27 3/8″ to 42″ Wd.	1843K45	909.15
208-230 Volts AC, Single Phase												
B	20,500	10.3	200.00	425	10.2	6-15	17 15/16″	25 15/16″	29″	27 3/8″ to 42″ Wd.	1843K51	1,034.67
B	36,000	9	360.00	725	17.5	6-30	20 3/16″	28″	35 1/2″	29 7/8″ to 42″ Wd.	1843K57	1,734.52
Through-the-Wall Mount												
120 Volts AC, Single Phase												
C	12,000	9.7	120.00	295	10.8	5-15	15 3/4″	26 1/2″	21″	16 3/4″ Ht. x 27″ Wd.	1843K92	824.16
208-230 Volts AC, Single Phase												
C	14,500	9.3	151.00	290	7.6	6-15	15 3/4″	26 1/2″	21″	16 3/4″ Ht. x 27″ Wd.	1843K97	935.24
Optional Mounting Sleeve for Through-the-Wall Mount Units (required for new installations)											1843K93	125.76

About Exhaust Fans

To select the exhaust fan that's right for your facility, you'll need to calculate your rate of air exchange—measured in cfm (cubic feet per minute). Divide the cubic feet of your facility by how often you want to exchange the air.

For example, if your facility is 10,000 cubic feet and you want to exchange the air every 5 minutes, you need an exhaust fan that produces airflow of 2,000 cfm.

$$\text{cfm} = \frac{\text{10,000 cubic feet}}{\text{5 minutes}} = 2{,}000$$

Air Exchange Frequency	
Type of Facility	**Air Exchange**
Engine Room	Every 1 to 3 Minutes
Boiler Room, Foundry, Laboratory	Every 1 to 5 Minutes
Factory	Every 2 to 5 Minutes
Office, Warehouse	Every 2 to 10 Minutes

Room Exhaust Fans


A


B


C


D

Remove stale air and humidity. All fans have a single-phase, permanently lubricated motor, operate on 120 volts AC, and have leads for hardwiring. They are UL listed. All have a white plastic grille. A damper prevents backdrafts, except 10″ dia. duct fan does not have a damper. Fans mount in the ceiling. *Styles A & D* can also mount in the wall. Mounting fasteners are not included. *Styles A & B* have a galvanized steel housing. *Styles C & D* have a black-painted steel housing.

Style B have a light that can operate alone or share a switch with the fan. Use a screw-in medium base bulb up to 100 watts (sold separately).

Duct Size	Airflow, cfm	Volume, dB	*Grille Size* Lg.	*Grille Size* Wd.	*Mounting Size* Lg.	*Mounting Size* Wd.	*Mounting Size* Dp.	Mounting Hole Dia.		
(A) Fans for Round Duct										
3″ Dia.	50	48	9 1/4″	9″	7 1/2″	7 1/4″	3 5/8″	1/8″	**2213K31**	$20.29
3″ Dia.	70	54	9 1/4″	9″	7 1/2″	7 1/4″	3 5/8″	1/8″	**2213K32**	40.56
4″ Dia.	80	34	12″	11 1/2″	10″	9 1/4″	5 3/4″	3/16″	**2213K33**	70.09
4″ Dia.	110	44	12″	11 1/2″	10″	9 1/4″	5 3/4″	3/16″	**2213K1**	95.45
(B) Fans for Round Duct with Light										
4″ Dia.	50	41	11 1/8″	10 5/8″	8 1/4″	8″	5 3/4″	3/16″	**2213K48**	52.51
4″ Dia.	70	38	12 1/8″	11 1/2″	10″	9 1/4″	5 3/4″	3/16″	**2213K56**	81.22
4″ Dia.	110	32	12 1/8″	11 1/2″	10″	9 1/4″	5 3/4″	3/8″	**2213K57**	164.43
100-Watt Incandescent Light Bulb for Style B (Pkg. of 6)									**1728K271**	14.52
(C) Fans for Round Duct										
8″ Dia.	180	55	11 1/2″	11 1/2″	____	8 1/4″ Dia.	7″	3/16″	**2213K17**	74.64
10″ Dia.	350	55	13 1/2″	13 1/2″	____	10 1/4″ Dia.	7″	3/16″	**2213K36**	145.08
(D) Fans for Rectangular Duct										
3 1/4″ Ht. × 10″ Wd.	160	51	11 1/2″	11 1/2″	14″	12″	3 1/4″	3/16″	**2213K46**	127.52
3 1/4″ Ht. × 10″ Wd.	270	58	13 1/2″	13 1/2″	16 3/4″	13 7/8″	3 1/4″	3/16″	**2213K54**	181.48

Ultra-Quiet Room Exhaust Fans


For Round Duct


For Rectangular Duct

Keep noise to a minimum with these ceiling/wall-mount exhaust fans. They have a low rpm motor, 1/2″ thick acoustical insulation, and vibration-resistant motor mounts for quiet operation. Housing is galvanized steel and grille is white-painted steel, except 8″ dia. duct fan has a plastic grille. A damper prevents backdrafts. Fans have a single-phase, permanently lubricated motor, leads for hardwiring, and operate on 120 volts AC. UL listed. Mounting fasteners are not included.

Optional variable-speed fan control fits a single gang electrical box and has leads for hardwiring. Mounting fasteners are included.

Duct Size	Airflow, cfm	Volume, dB	*Grille Size* Lg.	*Grille Size* Wd.	*Mounting Size* Lg.	*Mounting Size* Wd.	*Mounting Size* Dp.	Mounting Hole Dia.		
Fans for Round Duct										
8″ Dia.	230	35	14″	14″	12 1/4″	12 1/4″	11 3/4″	1/2″	**2083K41**	$160.36
Fans for Rectangular Duct										
4 1/2″ Ht. × 18 1/2″ Wd.	480	38	23 1/4″	14″	21 1/2″	12 1/4″	11 3/4″	1/2″	**2083K42**	310.48
8″ Ht. × 12″ Wd.	910	47	23 7/8″	19 7/8″	22″	18″	18″	1/2″	**2083K43**	539.20
Optional Variable-Speed Fan Control									**2083K24**	67.93

Through-the-Wall Room Exhaust Fans


Interior Wall


Exterior Wall

Exhaust air and humidity directly into another room or outdoors without using duct. Grille is white plastic. Fans are single phase, operate on 120 volts AC, and have leads for hardwiring. UL listed.

Interior wall fan has an adjustable sleeve for mounting. Housing is galvanized steel. A knob controls the variable-speed, open dripproof motor.

Exterior wall fans vent to the outside. Fans have a black-painted steel housing and permanently lubricated motor. Fasteners are not included. *180 cfm and 270 cfm fans* wire to your wall switch and have a backdraft damper. *470 cfm fan* has a pull chain.

Airflow, cfm	Volume, dB	*Grille Size* Ht.	*Grille Size* Wd.	*Fits Opening* Ht.	*Fits Opening* Wd.	Mounting Hole Dia.		
Interior Wall—For 3 3/4″ to 5″ thick walls								
250	39	11″	13 3/4″	10 1/4″	12 3/4″	___	**1895K11**	$146.15
Exterior Wall—For 4 1/2″ to 9 1/2″ thick walls								
180	55	11 1/2″	11 1/2″	14 1/4″	14 1/4″	3/16″	**2089K5**	111.65
270	54	13 1/2″	13 1/2″	14 1/4″	14 1/4″	3/16″	**2089K34**	181.28
470	58	13 1/2″	13 1/2″	14 1/4″	14 1/4″	3/16″	**2089K6**	181.28

About Air Filter Efficiency Ratings

Select a filter that has an appropriate MERV (minimum efficiency rating value) rating for your application. Filters with high MERV ratings are effective at trapping small particles but also reduce airflow and may need to be replaced more often than filters with lower ratings.

MERV Rating	1-4	5-8	9-12	13-16
Filter Type	Low Efficiency/Prefilter	General Purpose	High Efficiency	Ultra Efficiency/HEPA
Dust Captured	60-80%	80-95%	90-98%	95-99%
Traps Contaminants Down to	10 microns	3 microns	1 micron	0.3 micron
Typically Used to Trap	Sanding dust, pollen, textile fibers	Cement dust, mold spores	Humidifier dust, auto emissions, oil mist	Bacteria, most smoke
Typical Environments	Equipment protection	Industrial workplaces, office buildings	Office buildings, data centers	Hospitals, laboratories

Panel Air Filters

Often used as replacement filters in HVAC equipment, these filters remove dust and other particles from the air. They meet UL 900 flame retardance requirements. Actual size is up to 5/8″ less than trade size.

Pleated filters are our most popular panel air filters. The pleated design creates greater surface area for filtering, which makes these more effective than unpleated panel filters without reducing airflow. The filter media is a blend of polyethylene and polypropylene. A galvanized steel support grill is bonded to the filter media to prevent sagging. The frame is made of cardboard that's treated to resist humidity. Maximum temperature is 150° F.

Fiberglass—MERV 5 filters trap more dust than fiberglass filters. They have a fiberboard frame with a tin-plated steel grill bonded to each side. Maximum temperature is 180° F.

Fiberglass filters are an economical option. They can be an effective prefilter to protect more expensive filters that catch finer particles. Frame is fiberboard. Maximum temperature is 180° F.

1″ and 2″ Thick

Trade Size	Pleated—MERV 8 1″ Thick	Pkg. of 2	Pkg. of 12	Pleated—MERV 8 2″ Thick	Pkg. of 2	Pkg. of 12	Fiberglass—MERV 5 1″ Thick	Pkg. of 12	Fiberglass—MERV 5 2″ Thick	Pkg. of 12	Fiberglass—Not MERV Rated 1″ Thick	Pkg. of 12	Fiberglass—Not MERV Rated 2″ Thick	Pkg. of 12
6×6	2209K401	$16.20	$89.70				2191K15	$67.64			2063K19	$56.10		
7×7	2209K402	16.20	89.70				2191K21	67.64			2063K431	56.10		
8×8	2209K403	16.20	89.70				2191K23	67.64			2063K21	56.10		
8×16	2209K404	16.20	89.70											
10×10	2209K405	9.85	56.70	2209K464	$15.70	$87.60	2191K22	37.04	2191K63	$52.70	2063K543	35.37	2063K164	$44.40
10×16	2209K406	16.70	90.90				2191K25	74.40			2063K24	71.31		
10×20	2209K407	10.35	58.50	2209K465	11.30	62.59	2191K11	40.57	2191K67	52.43	2063K144	38.40	2063K165	44.40
10×24	2209K408	16.30	93.00	2209K466	17.85	99.60	2191K13	40.57	2191K71	59.40	2063K145	38.40	2063K171	80.95
10×25	2209K409	16.30	93.00				2191K94	40.37			2063K174	35.99		
10×30	2209K411	16.85	96.30	2209K467	19.85	110.10	2191K95	40.64			2063K175	38.84		
12×12	2209K413	10.65	58.50	2209K468	11.58	60.95	2191K14	50.00	2191K88	72.20	2063K453	47.31	2063K172	45.06
12×15	2209K414	15.80	90.00											
12×16	2209K415	15.80	90.00	2209K469	17.99	94.70	2191K37	45.40						
12×18	2209K416	16.40	93.60	2209K471	18.10	99.60	2191K39	56.86			2063K463	52.80		
12×20	2209K417	11.25	61.80	2209K472	11.54	64.46	2191K16	38.73			2063K467	38.40		
12×24	2209K418	9.40	54.00	2209K473	10.74	60.34	2191K38	38.73	2191K69	54.26	2063K146	38.40	2063K683	46.50
12×25	2209K419	16.85	96.30	2209K474	18.33	99.09	2191K17	37.04			2063K28	33.60		
12×30	2209K421	16.85	96.30	2209K475	19.90	110.10	2191K33	49.04			2063K147	46.80		
12×36	2209K422	22.30	126.80	2209K476	23.30	133.09	2191K96	71.35			2063K176	65.76		
14×14	2209K423	15.55	88.80	2209K477	16.59	94.70	2191K41	52.45			2063K473	48.00		
14×18	2209K424	16.30	93.00				2191K43	57.65			2063K177	51.20		
14×20	2209K425	10.00	57.60	2209K478	10.61	60.33	2191K19	38.73	2191K89	54.52	2063K148	37.37	2063K42	46.50
14×24	2209K426	10.20	59.10	2209K479	18.00	103.50	2191K42	54.82			2063K31	50.53		
14×25	2209K427	10.70	61.50	2209K481	11.94	67.33	2191K35	37.57	2191K91	54.52	2063K149	32.70	2063K685	46.50
14×30	2209K428	18.75	107.10	2209K482	22.01	125.10	2191K36	56.87			2063K34	52.80		
14×36	2209K429	22.30	126.80											
15×20	2209K431	10.00	57.60	2209K483	10.61	60.33	2191K44	38.73	2191K75	53.48	2063K151	38.40	2063K168	45.00
15×25	2209K432	13.92	79.50	2209K484	14.53	81.20					2063K35	36.30		
15×30	2209K433	18.75	107.10	2209K485	22.01	125.10					2063K154	45.60		
16×16	2209K434	11.70	66.60	2209K486	12.46	69.94	2191K26	39.82			2063K533	38.74		
16×20	2209K435	9.75	56.40	2209K487	10.97	62.06	2191K47	34.95	2191K76	53.48	2063K153	33.94	2063K72	45.00
16×24	2209K436	10.50	60.00	2209K488	11.67	66.00	2191K45	52.45	2191K72	57.39	2063K553	48.00	2063K713	52.50
16×25	2209K437	10.50	60.00	2209K489	11.67	66.00	2191K48	36.55	2191K79	53.48	2063K155	33.94	2063K78	45.00
16×30	2209K438	15.25	87.00	2209K491	17.45	102.00	2191K46	67.64			2063K66	65.68		
16×32	2209K439	22.30	126.80	2209K492	23.34	133.09					2063K178	62.78		
18×18	2209K441	17.00	97.20	2209K493	18.85	105.90	2191K53	52.45			2063K563	48.00		
18×20	2209K442	13.10	72.90	2209K494	13.13	74.25	2191K57	50.18			2063K565	46.11		
18×22	2209K443	17.00	97.20								2063K179	54.29		
18×24	2209K444	12.10	69.60	2209K495	13.33	74.91	2191K58	52.45	2191K73	59.99	2063K36	48.00	2063K59	57.47
18×25	2209K445	12.10	69.60	2209K496	13.49	76.11	2191K49	48.26			2063K156	45.00		
18×30	2209K446	21.89	120.30	2209K497	25.06	141.00	2191K59	70.64			2063K566	64.80		
18×36	2209K447	22.05	128.44	2209K498	25.30	145.00	2191K97	75.80			2063K181	68.73		
19×27	2209K448	21.89	120.30	2209K499	24.26	137.07	2191K98	50.35			2063K182	40.28		
20×20	2209K449	10.50	60.30	2209K501	11.67	66.00	2191K51	34.95	2191K83	53.48	2063K158	29.70	2063K79	45.00

(Continued on following page)

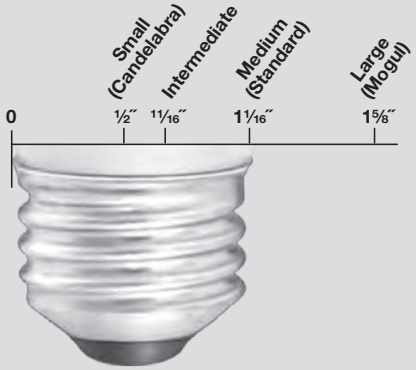
About Screw-In Light Bulbs

The emergence of new technologies has increased the number of lighting options. When selecting a bulb, consider the following:

Make sure the bulb will fit your socket.
To determine the size of your current bulb, measure its base.

Select a bulb that is bright enough for your application.
We've used *equivalent incandescent bulb wattage* to help compare the amount of light produced by incandescent, halogen, CFL, and LED bulbs. Brightness is also measured in *lumens*; the higher the lumens, the brighter the light.

Consider the bulb type, including its energy efficiency and light appearance.
Energy efficiency varies substantially among different types of bulbs. A bulb's *rated life*, as well as its *estimated yearly energy cost,* is based on 3 hours of usage per day at $0.11 per kWh. *Light appearance*, measured in Kelvins, can be warm, neutral, or cool.



Bulb Types	Initial Cost	Energy Efficiency	Light Appearance: Warm Red/Yellow Tones General Purpose (2,400-3,200K)	Light Appearance: Neutral Tones Workspaces (3,200-4,500K)	Light Appearance: Cool White/Blue Tones Inspecting & Reading (4,500-6,500K)
Incandescent—The traditional light bulb. Many have been phased out due to governmental energy requirements but some are still available for special applications. **Halogen—**The closest substitute to incandescent bulbs, these are slightly more energy efficient but generate more heat.	$	Poor	✓		
CFL (Compact Fluorescent Light)—Bulbs are efficient and long lasting but can take several seconds to reach full brightness, and they contain small amounts of mercury (for disposal information, visit www.epa.gov/cfl).	$$	Good	✓	✓	✓
LED (Light-Emitting Diode)—The newest technology. Bulbs generate little heat, tolerate vibration, and are the most efficient and long lasting.	$$$	Excellent	✓	✓	✓

Medium-Base Light Bulbs

Built with a 1 1⁄16″ dia. base, these bulbs fit standard household light sockets. They are 120 volts, except the low-voltage and high-voltage bulbs.
3-way bulbs are for fixtures that have low, medium, and high settings.
Rough-service bulbs have reinforced filaments to tolerate vibration.

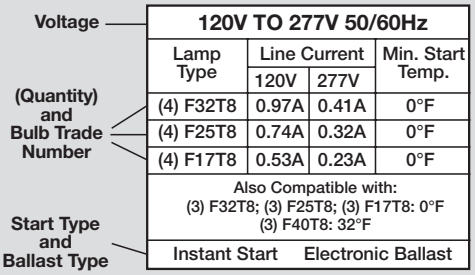
Shatter-resistant bulbs have an outer coating that prevents them from breaking as easily as other bulbs, yet retains glass shards if they do break. They are often used in food service environments.

Equiv. Incand. Bulb Watts	Bright-ness, lumens	Bulb Type	Dim-mable	Shape No.	Color	Light Appearance	Watts	Rated Life, years	Est. Yearly Energy Cost, $	Overall Dia.	Overall Lg.		Small Pack Qty.	Small Pack Pkg.	Large Pack Qty.	Large Pack Pkg.
Standard and Spiral																
General Purpose																
15	100	Incand.	Yes	A15	Frosted	Warm (2,850K)	15	2.2	1.90	1 7⁄8″	3 1⁄2″	15115K72	2	$3.27	—	—
25	190	Incand.	Yes	A19	Frosted	Warm (2,850K)	25	2.2	3.10	2 3⁄8″	4″	15115K61	2	2.80	—	—
40	380	Halogen	Yes	A19	Clear	Warm (2,790K)	29	0.9	3.49	2 3⁄8″	4 1⁄8″	1721K45	2	5.18	—	—
40	450	LED	Yes	A15	Clear	Warm (2,700K)	5.5	22.8	0.66	1 15⁄16″	3 5⁄8″	1796N1	2	13.33	12	$72.00
40	450	LED	Yes	A19	Frosted	Warm (2,700K)	5.5	13.6	0.66	2 3⁄8″	4 3⁄16″	1732N5	1	5.00	12	54.00
40	470	LED	Yes	A19	Frosted	Warm (2,700K)	6	22.8	0.72	2 3⁄8″	4 3⁄16″	1732N8	1	5.68	6	30.27
40	480	LED	Yes	A19	Clear	Warm (2,700K)	6	22.8	0.72	2 7⁄16″	4 3⁄8″	1796N2	2	13.33	8	48.00
40	500	LED	Yes	A19	Frosted	Neutral (4,100K)	6	22.8	0.72	2 1⁄4″	4″	8715K52	1	2.87	12	30.71
40	550	CFL	No	Spiral	Frosted	Warm (2,700K)	9	9.1	1.08	1 7⁄8″	4″	1949K79	1	3.12	12	31.82
40	550	CFL	No	Spiral	Frosted	Neutral (4,100K)	9	9.1	1.08	1 7⁄8″	4″	1949K84	1	3.12	12	31.82
60	750	Halogen	Yes	A19	Clear	Warm (2,920K)	43	0.9	5.18	2 3⁄8″	4 1⁄8″	1721K44	2	5.18	—	—
60	750	Halogen	Yes	A19	Frosted	Warm (2,920K)	43	0.9	5.18	2 3⁄8″	4 1⁄8″	1721K43	2	4.74	—	—

(Continued on following page)

About Replacing a Ballast

Ballast Label



When replacing a ballast, check its label and follow these steps to find an equivalent ballast:

1. Choose a ballast type. Electronic ballasts are lighter, quieter, and more energy-efficient than magnetic ballasts, which are often found in older installations. Upgrading from a magnetic to an electronic ballast may require rewiring.
2. Select the same voltage and start type (preheat, instant start, rapid start, or programmed start) as your existing ballast.
3. Find a ballast that operates the same bulb trade number and quantity as your current model. For example, (4)F32T8 means the ballast will power four 32-watt, T8-sized bulbs.
4. Confirm that the ballast's dimensions will fit in your fixture and that the ballast has as many wires as your current ballast. Ballasts that can operate multiple bulbs may have more wires than you need. Be sure to cap off any unused wires.

Ballasts for Tubular Fluorescent Light Bulbs

Ballasts are UL listed. For fluorescent light bulbs, see pages 750-753.
Electronic—Lighter, quieter, and more energy-efficient than magnetic ballasts.
Magnetic—Often found in older installations.
Preheat ballasts take several seconds to start and require a starter (see page 758).
Instant-start ballasts turn on fastest and are the most energy-efficient but shorten the bulb's life.
Rapid-start ballasts have a slight turn-on delay but produce a longer bulb life than instant-start ballasts. *Low-frequency* ballasts don't interfere with high-frequency electronic equipment.
Programmed-start ballasts produce the longest bulb life but take longer than rapid-start ballasts to turn on. They are often used with motion-sensing light controls.

For Bulb Trade Number	*For Bulb* Type	*For Bulb* Watts	For No. of Bulbs	No. of Wires	Min. Start Temp.	Lg.	Wd.	Dp.	120 Volts AC		277 Volts AC	
Electronic Ballasts												
Instant Start												
F17T8, F25T8, F32T8	T8	17, 25, 32	1	4	0°F	9½″	1⅛″	1⅛″	8345K91	$40.46	8345K91	$40.46
F17T8, F25T8, F32T8	T8	17, 25, 32	2	5	0°F	9½″	1⅛″	1⅛″	8345K92	42.70	8345K92	42.70
F17T8, F25T8, F32T8	T8	17, 25, 32	3 or 4	8	0°F	9½″	1⅜″	1″	8345K81	20.00	8345K81	20.00
F17T8, F25T8, F32T8, F40T8	T8	17, 25, 32, 40	1 or 2	5	0°F	9½″	1⅜″	1″	8345K94★	20.11	8345K94★	20.11
F25T8, F32T8	T8	25, 32	2 or 3	6	0°F	9½″	1⅜″	1″	8345K57	19.27	8345K57	19.27
F72T12, F96T12	T12	55, 75	1 or 2	5	0°F	9½″	1¾″	1¼″	8345K53	37.54	8345K53	37.54
F96T12	T12	60	1 or 2	5	60°F	9½″	1¾″	1¼″	8345K53	37.54	8345K53	37.54
F96T8	T8	59	1 or 2	5	32°F	9½″	1¼″	1″	8345K78	42.85	8345K78	42.85
FBO16, FBO24, FBO31, FBO32, FB32T8	T8 U-Shaped	16, 24, 31, 32	1 or 2	5	-20°F	9½″	1⅝″	1⅛″	9127K25	15.98	9127K25	15.98
Rapid Start												
F30T12, F34T12, F40T12	T12	30, 34, 40	2	8	50°F	9½″	1⅜″	1″	8345K47	22.89	8345K47	22.89
F34T12, F40T12	T12	34, 40	2	8	50°F	9½″	1⅜″	1″	8345K56	26.11		
Rapid Start for High-Output Bulbs												
F48T12/HO, F60T12/HO, F72T12/HO, F96T12/HO	T12	60, 75, 85, 110	1 or 2	8	-20°F	9½″	1¾″	1¼″	8345K71♦	38.05	8345K71♦	38.05
F96T12/HO/SS	T12	95	1 or 2	8	60°F	9½″	1¾″	1¼″	8345K71♦	38.05	8345K71♦	38.05
Low-Frequency Rapid Start												
F32T8	T8	32	2	8	50°F	9½″	2⅜″	1½″	8345K27	38.66	8345K28	39.77
Programmed Start												
F14T5, F21T5, F28T5, F35T5	T5	14, 21, 28, 35	1 or 2	8	0°F	9½″	1⅜″	1″	8345K46■	48.42	8345K46■	48.42
F17T8, F25T8, F32T8	T8	17, 25, 32	1	6	0°F	9½″	1⅜″	1″	8345K61	51.48	8345K61	51.48
F17T8, F25T8, F32T8	T8	17, 25, 32	2	8	0°F	9½″	1⁵⁄₁₆″	1″	8345K63	51.48	8345K63	51.48
Dimmable Programmed Start												
FBO31, FBO32, FO32	T8	32	1	8	50°F	9½″	1¾″	1″	8345K11Ⓔ	54.09	8345K11Ⓔ	54.09
FBO31, FBO32, FO32	T8	32	2	11	50°F	9½″	1¾″	1″	8345K12	54.09	8345K12	54.09
FBO31, FBO32, FO32	T8	32	3	14	50°F	16¾″	1¾″	1″	8345K13	63.64	8345K13	63.64
FBO31, FBO32, FO32	T8	32	4	17	50°F	16¾″	1¾″	1″	8345K14	70.91	8345K14	70.91
FP54T5/HO, FPC55, FT55DL, L58T8	T5	54	2	11	50°F	16¾″	1¾″	1″	8345K16	136.36	8345K16	136.36
FPC55, FT55DL, L58T8	T5	54	1	8	50°F	9½″	1¾″	1″	8345K15	118.18	8345K15	118.18
Programmed Start for High-Output Bulbs												
F24T5/HO, F39T5/HO, FP24/HO, FP39/HO	T5	24, 39	1 or 2	8	-20°F	14¼″	1¼″	⅞″	8345K43	40.80	8345K43	40.80
F54T5/HO	T5	54	3 or 4	15	-20°F	16¾″	1¾″	1¼″	8345K45	102.04	8345K45	102.04
F54T5/HO, FP54/HO	T5	54	1 or 2	8	-20°F	16¾″	1¼″	1″	8345K431	41.67	8345K431	41.67
F96T8/HO	T8	86	1 or 2	8	-20°F	9½″	1¾″	1³⁄₁₆″	8345K95	75.06	8345K95	71.48
Magnetic Ballasts												
Preheat (Requires a Starter)												
F15T8	T8	15	1	2	50°F	3⅛″	1⅜″	1⅞″	8345K131	6.33		
F20T12	T12	20	1	2	50°F	3⅛″	1⅜″	1⅞″	8345K131	6.33		
F4T5, F6T5, F8T5	T5	4, 6, 8	1	2	50°F	3⅛″	1⅜″	1⅞″	8345K151	7.48		
Preheat with Built-In Starter												
F13T8	T8	13	1	5	20°F	6½″	2″	1⅜″	8345K111	25.98		
F13T8	T8	13	2	8	30°F	6½″	2⅜″	1½″	8345K121	39.84		
F14T12, F15T12, F20T12	T12	14, 15, 20	1	5	50°F	6½″	2″	1⅜″	8345K111	25.98		
F15T12, F20T12	T12	15, 20	2	8	50°F	6½″	2⅜″	1½″	8345K121	39.84		

★ Operates one bulb when using F40T8 bulbs. Min. start temperature for F40T8 is 32°F. ♦Operates one bulb when using F96T12/HO bulbs.
■ Operates one bulb when using F35T5 bulbs. Ⓔ Ballast meets Federal minimum efficiency standards.

(Continued on following page)

About Batteries

When choosing a battery, you can compare the **capacity** among similar sizes. The higher the rating, the longer the battery should last.

If you know the milliamp draw of your device, the capacity will give you an estimate of battery life.

Note: For many batteries, recycling or other proper disposal is required by law. They should not be thrown in the trash. For rechargeable batteries, visit www.call2recycle.org or call 1-877-2-RECYCLE. For all other batteries, contact the manufacturer.

Don't see the battery you need? Just tell us what you're looking for and we'll get it for you.

Disposable Batteries

Alkaline batteries offer a good balance of longevity, cost, and performance in low-drain devices such as clocks and radios.
Carbon zinc batteries are an economical choice and are especially suited to low-drain devices such as clocks and radios.
Lithium batteries are lightweight and long lasting. They work well in high-drain devices such as digital cameras.

AA D

Batteries

All have a button-top connection, except 9-volt batteries have a snap-on connection.

	Voltage	Cap., mA-hrs.	Small Packs: Pkg. Qty.		Small Packs: Pkg.	Large Packs: Pkg. Qty.		Large Packs: Pkg.
AA								
Alkaline	1.5	2,850	4	71455K53	$2.94	144	71455K58	$58.15
Alkaline	1.5	2,850	—	—	—	24	71455K61	10.72
Carbon Zinc	1.5	950	4	7697K21	1.38	48	7697K31	16.95
Lithium	1.5	3,025	2	7745K55	5.73	24	7745K65	51.40
AAA								
Alkaline	1.5	1,250	4	71455K62	2.69	24	71455K64	10.72
Carbon Zinc	1.5	450	4	7697K36	1.33	48	7697K26	14.12
Lithium	1.5	1,200	2	7745K11	5.73	—	—	—
AAAA								
Alkaline	1.5	625	2	71455K57	3.67	24	71455K66	41.02
C								
Alkaline	1.5	8,350	6	71455K54	6.49	72	71455K63	65.21
Carbon Zinc	1.5	2,800	6	7697K22	3.18	72	7697K32	34.34
Lithium	3	4,800	1	7821K67	21.92	—	—	—
D								
Alkaline	1.5	20,500	6	71455K55	7.32	72	71455K65	96.43
Carbon Zinc	1.5	5,600	6	7697K23	3.66	72	7697K33	39.49
N								
Alkaline	1.5	1,000	2	71455K69	3.79	12	71455K67	20.09
9V								
Alkaline	9	625	1	71455K56	4.85	12	71455K68	20.77
Carbon Zinc	9	350	1	7697K24	1.32	12	7697K34	16.86
Lithium	9	1,200	1	7745K56	10.73	—	—	—
Battery-Life Tester for AA, AAA, C, D, 9-Volt, and Button/Coin Cell Batteries							6946K34	15.92


N 9V

3LR50, 4LR44, CR12600SE, CR123A, and CR17355

Specialty Size Batteries

Battery Size	Mfr. Equivalent No.	Voltage	Cap., mA-hrs.	Battery Connection	Ht.	Wd.	Dp.		
Alkaline									
3LR50	A23, KE23A-1, LR-V08, MN21, V23GA	12	40	Button Top	1.12″	0.41″ Dia.	—	7735K33	$1.41
4LR44	4LR44H, A544, PX28A, V34PX	6	140	Button Top	1″	0.51″ Dia.	—	7735K31	3.87
Lithium									
2CR5	2CR5M, DL245, EL2CR5, RL2CR5-1	6	1,400	Flat Terminal	1.77″	1.34″	0.67″	7821K66	8.84
CRP2	DL223A, EL223AP, RL223	6	1,400	Flat Terminal	1.42″	1.38″	0.77″	7821K65	10.15
CR12600SE	—	3	1,400	Button Top	2.36″	0.47″ Dia.	—	7821K71	11.50
CR123A	DL123A, EL123A, EL123AP, RL123A,	3	1,400	Button Top	1.36″	0.67″ Dia.	—	7821K63	5.64
CR17355	CR2, DLCR2, EL1CR2, RLCR2-1	3	1,400	Button Top	1.06″	0.61″ Dia.	—	7821K62	9.08
CRV3	DLCRV3B, ELCRV3, RLCRV3-1	3	3,700	Flat Terminal	2.07″	1.14″	0.58″	7821K81	15.88

2CR5, CRP2, and CRV3

Extreme-Temperature Disposable Batteries

Designed for long life, these batteries maintain performance in low-to-high temperature environments. They also resist humidity. These lithium batteries are lightweight and long lasting. They have a button-top connection, unless noted.

For Continuous Use—Power devices with low, long-term energy needs such as sensors and memory backup.
For High-Demand Use—Use in alarms, metering systems, and other equipment with high energy needs.


AA

C

Battery Size	Mfr. Equivalent No.	Voltage	Cap., mA-hrs.	Current Output, mA: Continuous	Current Output, mA: Max.	Temp. Range, °F		
For Continuous Use								
1/2 AA	LS14250, TL-2150	3.6	1,200	35	100	–76° to 185°	6951K59	$5.19
AA	LS14500, TL-2100	3.6	2,600	50	250	–76° to 185°	6951K57	7.70
2/3 A	LS17330	3.6	2,100	25	120	–76° to 185°	6951K65	8.65
A	LS17500	3.6	3,600	100	250	–76° to 185°	6951K66	10.28
C	LS26500, TL-2200	3.6	7,700	150	300	–67° to 158°	6951K13	13.95
D	LS33600, TL-5930	3.6	17,000	200	400	–67° to 185°	6951K12	18.27
For High-Demand Use								
C	LO29SHX	3	3,750	2,500	6,000	–76° to 158°	6951K16	15.87
C	LSH14	3.6	5,800	1,000	1,500	–67° to 158°	6951K14	21.63
D	LO26SHX	3	7,500	4,000	15,000	–76° to 158°	6951K18★	15.58
D	LO26SX	3	7,750	2,500	5,000	–76° to 158°	6951K17	15.87
D	LSH20, TL-2300	3.6	13,000	1,800	3,000	–67° to 185°	6951K15	27.40

★ Has a solder connection.

For information about wire size (AWG), see page 860.

About Quick-Disconnect Terminals

Quick-disconnect terminals provide fast and secure connections for your wiring. Because they are easy to connect and disconnect, these terminals are convenient for applications that require frequent repair or replacement. When an application calls for a ¼″ quick-disconnect, choose a terminal with a 0.250″ tab width.

Quick-Disconnect Terminals

Slide terminals together and pull them apart with ease. All crimp onto your wire and offer fast, secure connections. UL listed and CSA certified, unless noted. **Standard-barrel** terminals require one crimp. **Double-crimp barrel** terminals accept two crimps and provide an extra-tight grip for high-vibration applications.

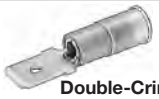
Insulated Barrel

Terminals are rated to 600 volts and 221° F, unless noted. They are made of tin-plated brass, except male double-crimp terminals are zinc-plated brass. **Standard-barrel** terminals have vinyl insulation. **Double-crimp barrel** terminals have nylon insulation, except male terminals with 0.110″ wide tabs have vinyl insulation.


Standard Barrel Female


Standard Barrel Male


Double-Crimp Barrel Female


Double-Crimp Barrel Male

For Wire Size, AWG	Tab Size Wd.	Tab Size Thick.	Insulation Color	Female Pkg. Qty.	Female	Female Pkg.	Female Pkg. Qty.	Female	Female Pkg.	Male Pkg. Qty.	Male	Male Pkg.	Male Pkg. Qty.	Male	Male Pkg.
Standard Barrel															
26-22	0.110″	0.020″	Yellow	10	7060K41★■	$6.49	50	7060K71★■	$18.55	—	—	—	—	—	—
26-22	0.110″	0.032″	Yellow	—	—	—	25	7060K78★■	9.80	—	—	—	—	—	—
22-18	0.110″	0.020″	Red	10	7060K13	3.48	100	7060K17	13.94	10	7060K221■	$7.55	50	7060K222■	$22.20
22-18	0.187″	0.020″	Red	10	7060K18	3.64	100	7060K15	14.58	10	7060K79	3.10	100	7060K25	12.40
22-18	0.250″	0.032″	Red	10	7060K19	3.10	100	7060K16	12.40	10	7060K81	2.99	100	7060K26	11.96
16-14	0.110″	0.020″	Blue	10	7060K28	3.64	100	7060K27	14.58	10	7060K223■	6.36	50	7060K224■	19.28
16-14	0.187″	0.020″	Blue	10	7060K29	3.69	100	7060K11	14.78	10	7060K84■	3.10	100	7060K211■	12.40
16-14	0.250″	0.032″	Blue	10	7060K38	3.52	100	7060K12	14.09	10	7060K88	3.21	100	7060K22	12.83
12-10	0.250″	0.032″	Yellow	10	7060K39	4.14	100	7060K14	16.56	10	7060K89	4.31	100	7060K24	17.24
Double-Crimp Barrel															
22-18	0.110″	0.020″	Red	10	7060K48▲	4.34	50	7060K61▲	12.41	10	7060K98■ ♣	3.35	100	7060K97■ ♣	13.40
22-18	0.187″	0.020″	Red	10	7060K49▲	4.26	50	7060K62▲	12.18	10	7060K91	4.46	50	7060K82	12.73
22-18	0.250″	0.032″	Red	10	7060K58▲	4.11	50	7060K63▲	11.73	10	7060K92	3.96	50	7060K83	11.32
16-14	0.110″	0.020″	Blue	10	7060K59▲	4.02	50	7060K64▲	11.50	10	7060K23■ ♣	3.34	100	7060K212■ ♣	13.35
16-14	0.187″	0.020″	Blue	10	7060K68▲	4.22	50	7060K65▲	12.05	10	7060K93■	3.31	50	7060K96■	9.46
16-14	0.250″	0.032″	Blue	10	7060K69▲	4.07	50	7060K66▲	11.64	10	7060K94	3.86	50	7060K85	11.04
12-10	0.250″	0.032″	Yellow	10	7060K74▲	4.91	50	7060K67▲	14.04	10	7060K95	4.84	50	7060K87	13.82

★ Not voltage rated. ■ Not UL listed or CSA certified. ▲ Rated 300 volts. ♣ Rated 167° F. Made of tin-plated brass.

Fully Insulated

The connection tab is completely covered with nylon insulation. Terminals are rated to 600 volts and 221° F, unless noted. **Female** terminals are tin-plated brass. **Male** terminals are tin-plated copper.


Standard Barrel Female


Standard Barrel Male


Double-Crimp Barrel Female


Double-Crimp Barrel Male

For Wire Size, AWG	Tab Size Wd.	Tab Size Thick.	Insulation Color	Female Pkg. Qty.	Female	Female Pkg.	Male Pkg. Qty.	Male	Male Pkg.
Standard Barrel									
26-24	0.187″	0.020″	Yellow	25	7243K46■	$9.57	—	—	—
22-18	0.250″	0.032″	Red	50	7243K11	14.42	50	7243K12	$14.23
16-14	0.250″	0.032″	Blue	50	7243K21	14.39	50	7243K22	15.08
12-10	0.250″	0.032″	Yellow	25	7243K31	10.04	25	7243K32	9.13
Double-Crimp Barrel									
22-18	0.110″	0.020″	Red	25	7243K111▲	14.50	—	—	—
22-18	0.187″	0.020″	Red	25	7243K112	12.16	25	7243K118	13.08
22-18	0.250″	0.032″	Red	25	7243K114	12.13	25	7243K119	13.14
16-14	0.110″	0.020″	Blue	25	7243K115▲	14.50	—	—	—
16-14	0.187″	0.020″	Blue	25	7243K116	12.26	25	7243K121	13.23
16-14	0.250″	0.032″	Blue	25	7243K117	12.14	25	7243K122	12.96
12-10	0.250″	0.032″	Yellow	25	7243K69	14.83	25	7243K33	12.95

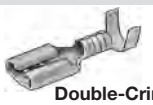
■ Not UL listed or CSA certified. ▲ Rated 300 volts.

Noninsulated

Terminals are rated to 300° F. **Female** terminals are tin-plated brass. **Male** terminals are zinc-plated brass, except 69525K46 and 69525K47 are tin-plated brass.


Standard Barrel Female


Standard Barrel Male

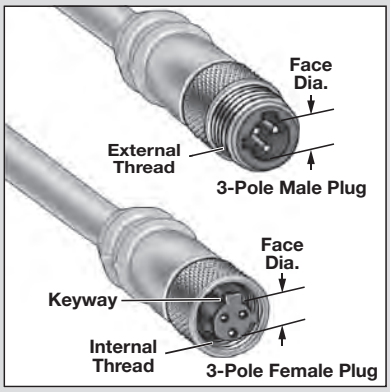

Double-Crimp Barrel Female


Double-Crimp Barrel Male

For Wire Size, AWG	Tab Size Wd.	Tab Size Thick.	Female Pkg. Qty.	Female	Female Pkg.	Male Pkg. Qty.	Male	Male Pkg.
Standard Barrel								
26-24	0.110″	0.020″	100	69525K93■	$8.65	—	—	—
22-18	0.110″	0.020″	100	69525K11	6.85	50	69525K46	$17.38
22-18	0.187″	0.020″	100	69525K12	6.67	100	69525K65	5.59
22-18	0.250″	0.032″	100	69525K13	7.20	100	69525K66	6.90
16-14	0.110″	0.020″	100	69525K14	6.76	50	69525K47■	13.10
16-14	0.187″	0.020″	100	69525K15	7.20	100	69525K77■	7.41
16-14	0.250″	0.032″	100	69525K16	7.20	100	69525K68	6.87
12-10	0.250″	0.032″	100	69525K17	7.58	100	69525K79■	9.71
Double-Crimp Barrel								
22-18	0.187″	0.020″	100	69525K19	8.40	—	—	—
22-18	0.250″	0.032″	100	69525K61	10.00	25	69525K32■	7.51
16-14	0.187″	0.020″	100	69525K63	8.40	25	69525K33■	7.23
16-14	0.250″	0.032″	100	69525K64	10.40	25	69525K34■	7.52

■ Not UL listed or CSA certified.

About 0.2″ to 0.8″ Face Diameter Sensor Connectors



Sensor connectors allow you to quickly replace a damaged component or cable without hardwiring to minimize labor costs and reduce equipment downtime. Primarily used to connect proximity sensors, photoelectric sensors, and limit switches, these connectors are commonly referred to as nano (or pico), micro, and mini connectors.

Factors to Consider when Replacing an Existing Sensor Connector

Face Diameter—Measure the face diameter of your plug or receptacle as shown in the illustration at left. Do not include the threading, coupling nut, or keyways in your measurement.

Keyway—Most connectors have keyways on the face to prevent mismating. Each keyway on the female aligns with a keyway notch on the male. Do you have a single or dual keyway?

Number of Poles—Count the number of pins on a male plug or receptacle, or decide how many wires your device needs for power and control.

Gender and Threading—Male connectors have pins that mate with female connectors. The threading of the collar or locknut is either internal or external. Both the gender and threading need to be opposite to join sensor connectors. For example, a male plug with external thread mates with a female plug or receptacle with internal thread.

Plug or Receptacle—Plugs typically have a cable attached and are connected to a sensor while receptacles have wire leads and are mounted in panels.

Characteristics of Sensor Connectors

Face Dia.	Common Name	Keyway	Number of Poles	Current Ratings (amps)	Max. Voltage (AC/DC)	Available Materials	Typical Application	Pages
0.2″	Nano, Pico	None	3-5	3-4	60/75	PVC, Plastic	8 mm and smaller sensors	830
0.3″	Micro	Single, Dual	2-5	4-5	300/300	PVC, Plastic, Rubber	12 mm and 18 mm sensors	831-832
0.55″-0.8″	Mini	Single	2-12	5-13	600/600	PVC, Plastic, Rubber	18 mm and 30 mm sensors	832-833

0.2″ Face Diameter Nano Connectors

Also called pico and M8 connectors, these are the smallest sensor connectors we offer. Use them for low-current devices such as 8 mm and smaller proximity sensors, miniature photoelectric sensors, and other miniature control components. Connectors have a 0.2″ face diameter. They do not have a keyway.

All meet IP67 for protection against temporary water submersion.

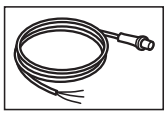
Plugs

Plugs accept 0.14″ to 0.2″ dia. cable with up to 20 AWG wires. They are made of black plastic and are rated to 176°F. Plugs with **insulation-piercing terminals** save time because you don't need to strip your wire. The terminals grip the insulation for a secure hold in high-vibration applications. UL and C-UL recognized.


No. of Poles	AC/DC Voltage	Amps	Male Plugs with External Thread		90° Male Plugs with External Thread		Female Plugs with Internal Thread		90° Female Plugs with Internal Thread	
Screw Terminals										
3	60	4	6889K81	$16.64	—	—	6889K82	$13.54	—	—
4	30	4	6889K83	17.81	—	—	6889K84	13.54	—	—
Insulation-Piercing Terminals										
3	32	3	6889K11	15.05	—	—	6889K12	13.06	—	—
4	32	3	6889K13	16.02	—	—	6889K14	13.81	—	—
Solder Terminals										
3	60/75	4	6889K51	24.26	6889K52	$24.40	6889K53	24.40	6889K54	$24.40
4	60/75	4	6889K61	28.74	6889K62	29.62	6889K63	27.54	6889K64	27.92

Plugs with Cable and Receptacles with Leads

All of these plugs and receptacles are rated to 221°F. UL listed and CSA certified. **Plugs** are made of plastic molded to a 13-ft. 24 AWG cable with yellow PVC jacket. **Receptacles** are made of nickel-plated brass and have 12″ long 24 AWG wire leads with PVC insulation. There are M8 external threads for panel mounting.



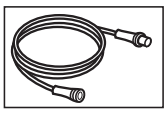
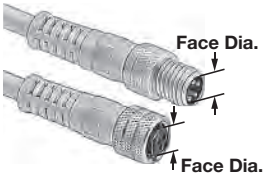




No. of Poles	AC/DC Voltage	Amps	Male Plugs with External Thread		90° Male Plugs with External Thread		Female Receptacles with Internal Thread		Female Plugs with Internal Thread		90° Female Plugs with Internal Thread		Male Receptacles with External Thread	
3	60/75	4	7138K11	$19.42	7138K17	$19.42	7138K27	$13.10	7138K14	$19.42	7138K21	$19.42	7138K24	$10.88
4	60/75	4	7138K12	23.10	7138K18	23.10	7138K28	14.46	7138K15	23.10	7138K22	23.10	7138K25	12.02
5	60/75	3	7138K13	27.12	7138K19	27.12	7138K29	16.08	7138K16	27.12	7138K23	27.12	7138K26	13.77

Cables with Plugs on Each End

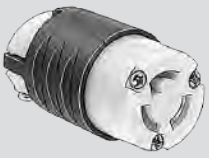
Make connections without hardwiring. Connectors consist of a 13-ft. 24 AWG cable with yellow PVC jacket and yellow plastic plugs on each end. One end has a female plug with internal threads and the other end has a male plug with external threads. All are rated to 221°F. UL listed and CSA certified.

No. of Poles	AC/DC Voltage	Amps	Female Plug and Male Plug		Female Plug and 90° Male Plug	
3	60/75	4	7138K51	$32.71	7138K52	$32.71
4	60/75	4	7138K53	38.21	7138K54	38.21

About NEMA Turn-Lock Plugs, Connectors, and Receptacles

Plug



Connector

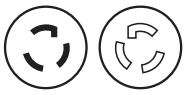
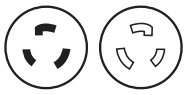
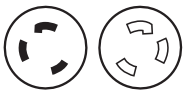
Receptacle

After mating plugs with connectors or receptacles, give them a quarter turn to lock the connection. The locked connection remains secure in high-vibration applications and prevents accidental disconnection, so it is suitable for critical connections. All conform to National Electrical Manufacturers' Association (NEMA) configurations for plugs and connectors/receptacles.

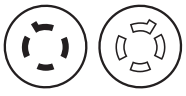
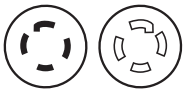
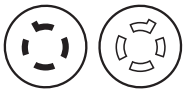
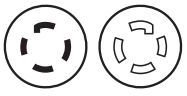
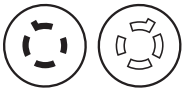
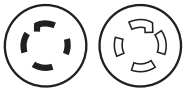
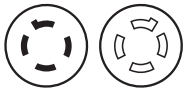
To replace a device, first check it for a NEMA-style number. It may have a NEMA number ending with a P, C, or R, signifying either a plug, connector, or receptacle. For example, an L5-15P is an L5-15 plug. If you are buying a plug, the NEMA style must match your existing NEMA connector or receptacle. Different NEMA turn-lock styles are not compatible; for example, an L5-15 plug will not fit an L5-20 receptacle.

If you do not have a NEMA-style number, match the plug, connector, or receptacle you're replacing to a diagram in the chart below, making sure the voltage and amp ratings match your requirements. If you don't see a diagram that matches your configuration, see page 845 for space-saver (NEMA midget) styles and non-NEMA styles, and page 846 for NEMA straight-blade styles.

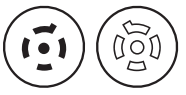
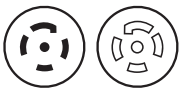
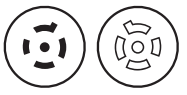
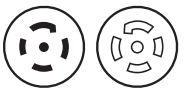
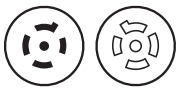
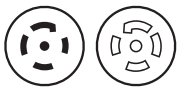
Three Blades—Grounded

 125V AC, 15 Amps L5-15	 125V AC, 20 Amps L5-20	 125V AC, 30 Amps L5-30	 250V AC, 15 Amps L6-15	 250V AC, 20 Amps L6-20
 250V AC, 30 Amps L6-30	 277V AC, 15 Amps L7-15	 277V AC, 20 Amps L7-20	 277V AC, 30 Amps L7-30	
 480V AC, 20 Amps L8-20	 480V AC, 30 Amps L8-30	 600V AC, 20 Amps L9-20	 600V AC, 30 Amps L9-30	

Four Blades—Grounded

 125/250V AC, 20 Amps L14-20	 125/250V AC, 30 Amps L14-30	 250V AC, 20 Amps L15-20	 250V AC, 30 Amps L15-30
 480V AC, 20 Amps L16-20	 480V AC, 30 Amps L16-30	 600V AC, 30 Amps L17-30	

Five Blades—Grounded

 120/208V AC 20 Amps L21-20	 120/208V AC 30 Amps L21-30	 277/480V AC 20 Amps L22-20	 277/480V AC 30 Amps L22-30	 347/600V AC 20 Amps L23-20	 347/600V AC 30 Amps L23-30

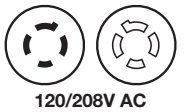
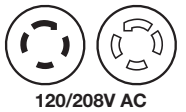
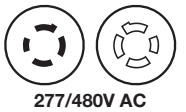
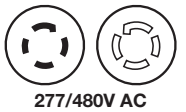
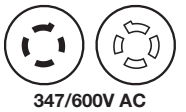
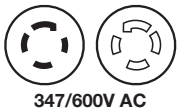
Two Blades—Non-Grounded

 125V AC, 15 Amps L1-15	 250V AC, 20 Amps L2-20

Three Blades—Non-Grounded

 125/250V AC, 20 Amps L10-20	 125/250V AC, 30 Amps L10-30

Four Blades—Non-Grounded

 120/208V AC 20 Amps L18-20	 120/208V AC 30 Amps L18-30	 277/480V AC 20 Amps L19-20	 277/480V AC 30 Amps L19-30	 347/600V AC 20 Amps L20-20	 347/600V AC 30 Amps L20-30

For information about cord type, see page 870. For information about wire gauge, see page 860.

About Extension Cords

Voltage dissipates over the length of an extension cord—the longer the cord, the less power available to run your tool. Too much voltage loss can decrease the efficiency of your tool and shorten its operating life.

To minimize voltage drop, choose the proper gauge cord based on the power required by your tool and the shortest possible cord length you need. The chart at right provides some examples of tools that are commonly used with extension cords.

	Power Draw	Recommended Wire Gauge for 50-ft. Cord	Recommended Wire Gauge for 100-ft. Cord
Industrial Fan, Floodlight	10 amps	16	16
Power Drill, Wet/Dry Vacuum	13 amps	16	14
Circular Saw, Angle Grinder	15 amps	14	12
Air Compressor, Pressure Washer	20 amps	12	10

Outdoor Extension Cords

All of these extension cords have a PVC jacket and resist water, making them suitable for outdoor use. They have a three-blade NEMA 5-15 plug and connector, except turn-lock cords have a NEMA L5-20 plug and connector. All are rated 125 volts AC. Cords stay flexible in temperatures from –4° to 140° F. Meet OSHA requirements. UL listed, except red cord with white stripe and 50-ft. and 100-ft. neon cords are ETL listed.

Cords—All are type SJTW.

Cords with Power-Indicating Light—The connector end is transparent and illuminates when the cord has power. Cords are type SJTW.

Abrasion-Resistant Cords—The jacket is extra thick to protect the internal wires. Use in areas with high traffic or where the cord comes in contact with rough surfaces. Cords are type STW.

Turn-Lock Cords—The connection locks to stay secure in high-vibration applications and prevent accidental disconnection. These cords have a higher amp rating than the other cords to handle high-power tools. 8049K21 and 8049K22 have an SJTW cord. 8049K23 has an STW cord.

Wire Gauge	Cord Color	Stripes	Cord Dia.	10 ft. to 50 ft. Amps		10 ft.	25 ft.	50 ft.	100 ft. Amps		100 ft.
Cords											
16	Orange		5/16″	13	7438K51	$7.57	$13.24	$21.74	10	7438K35	$42.50
16	Dark Green		5/16″	13	7438K57	9.38	21.40	37.19	10	7438K93	73.60
14	Orange		3/8″	15	7438K54	13.10	19.46	39.17	13	7438K84	62.63
12	Orange		7/16″	15	7438K55	23.15	58.80	83.52	15	7438K43	160.84
12	Yellow	Black	7/16″	15	8208K501	18.15	35.60	51.18	15	6911K761	84.85
10	Orange		5/8″	15	7438K56	39.78	79.27	158.10	15	7438K46	302.13
Cords with Power-Indicating Light											
12	Blue		7/16″	15	8208K111	—	35.87	48.01	15	8208K81	79.64
12	Yellow		7/16″	15	7438K58	—	32.33	53.29	15	7438K28	76.12
12	Neon Green		7/16″	15	8208K112	—	35.87	67.96	15	8208K42	110.39
12	Neon Pink		7/16″	15	8208K113	—	35.87	67.96	15	8208K46	110.39
12	Neon Red		7/16″	15	8208K114	—	35.87	67.96	15	8208K83	110.39
12	Blue	Red	7/16″	15	8208K502	19.20	36.64	47.14	15	8208K63	77.45
12	Green	Yellow	7/16″	15	8208K52	—	—	47.14	15	8208K62	77.45
12	Orange	Blue	7/16″	15	8208K503	19.20	36.64	47.14	15	8208K65	77.45
12	Pink	Lime Green	7/16″	15	8208K504	19.20	36.64	47.14	15	8208K64	77.45
12	Red	White	7/16″	15	6911K771	—	—	62.27	—	—	—
12	Neon Green	Red	7/16″	15	8208K505	21.29	41.81	66.36	—	—	—
10	Yellow		9/16″	15	7438K59	—	77.31	102.37	15	7438K85	158.65
10	Blue	Red	9/16″	15	8208K92	—	—	92.71	15	8208K94	157.71
10	Fluorescent Green	Red	9/16″	15	8208K91	—	—	92.71	15	8208K93	157.71
Abrasion-Resistant Cords											
14	Orange		1/2″	15	7522K11	—	31.13	72.55	13	7522K53	111.14
12	Orange		9/16″	15	7522K12	—	55.02	98.88	15	7522K77	172.64
Turn-Lock Cords											
12	Yellow		7/16″	20	8049K21	—	—	59.63	15	8049K22	89.38
12	Yellow		5/8″	20	8049K23	—	—	72.95	—	—	—

Harsh Environment Extension Cords

A thermoplastic rubber jacket gives these extension cords the ability to resist moisture, oils, chemicals, and UV light. They are suitable for outdoor use and are a good choice for dirty and greasy environments. Cords have a three-blade NEMA 5-15 plug and connector. Rated 125 volts AC. Cords stay flexible in temperatures from –58° to 194° F. Meet OSHA requirements. UL listed, except 50-ft. and 100-ft. striped cords are ETL listed.

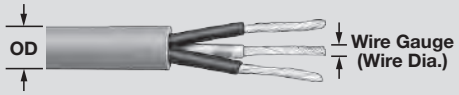
Cords—All are type SJEOW.

Cords with Power-Indicating Light—The connector end is transparent and illuminates when the cord has power. Cords are type SJEOW.

Abrasion-Resistant Cords with Power-Indicating Light—The jacket is extra thick to protect the internal wires. Use in areas with high traffic or where the cord comes in contact with rough surfaces. The connector end is transparent and illuminates when the cord has power. Cords are type SEOW.

Wire Gauge	Cord Color	Stripes	Cord Dia.	10 ft. to 50 ft. Amps		10 ft.	25 ft.	50 ft.	100 ft. Amps		100 ft.
Cords											
16	Blue		3/8″	13	6953K21	$10.60	$21.65	$36.52	10	6953K13	$62.36
14	Blue		7/16″	15	6953K22	12.77	26.60	46.94	13	6953K16	81.53
14	Green		3/8″	15	8146K11	—	29.56	54.16	13	8146K33	94.26
12	Blue		5/8″	15	6953K23	19.60	41.57	72.33	15	6953K18	141.71
12	Green		7/16″	15	8146K12	—	38.49	83.95	15	8146K36	115.89
Cords with Power-Indicating Light											
16	Yellow		5/16″	13	8047K11	13.29	23.08	35.07	10	8047K63	58.74
14	Yellow		3/8″	15	8047K12	16.94	29.58	43.50	13	8047K66	73.41
12	Yellow		7/16″	15	8047K13	22.84	38.92	64.56	15	8047K69	111.74
12	Blue	Orange	7/16″	15	8208K15	—	39.61	61.67	15	8208K34	112.49
10	Yellow		9/16″	15	8047K14	—	67.44	95.88	15	8047K73	199.74
10	Blue	Orange	7/16″	15	8208K97	—	—	122.54	15	8208K98	219.03
Abrasion-Resistant Cords with Power-Indicating Light											
14	Yellow		1/2″	15	7522K13	—	41.62	64.02	13	7522K63	130.96
12	Yellow		9/16″	15	7522K14	—	54.57	105.57	15	7522K66	159.44

About Wire and Cable



Shown with Three 18-ga. Wires (18/3)

Wire consists of a metal conductor, usually copper or tinned copper, that is covered by insulation. The diameter of a wire without its insulation is known as wire gauge or American Wire Gauge (AWG). The smaller the wire gauge, the larger the diameter of the wire. Gauges with the largest wire diameters have the designation MCM.

Cable consists of two or more wires. In addition to the insulation covering each wire, cable has a layer of outer insulation surrounding all the wires. The wire gauge of cable is the diameter of each individual wire without its insulation. One wire is usually used as a ground.

Wire Gauge Dimensions

Wire Gauge	Wire Dia. Inches	Wire Dia. mm	Wire Gauge	Wire Dia. Inches	Wire Dia. mm	Wire Gauge	Wire Dia. Inches	Wire Dia. mm	Wire Gauge	Wire Dia. Inches	Wire Dia. mm
36	0.005″	0.13	22	0.025″	0.64	8	0.129″	3.26	3/0	0.410″	10.40
34	0.006″	0.16	20	0.032″	0.81	6	0.162″	4.12	4/0	0.460″	11.68
32	0.008″	0.20	18	0.040″	1.02	4	0.204″	5.19	250 MCM	0.500″	12.70
30	0.010″	0.26	16	0.051″	1.29	2	0.258″	6.54	300 MCM	0.540″	13.72
28	0.013″	0.32	14	0.064″	1.63	1	0.289″	7.35	350 MCM	0.590″	14.99
26	0.016″	0.41	12	0.080″	2.05	1/0	0.324″	8.25	400 MCM	0.630″	16.00
24	0.020″	0.51	10	0.102″	2.59	2/0	0.365″	9.27	500 MCM	0.700″	17.78

Amp Rating

The larger the wire diameter, the more current the wire can carry (as measured in amps). However, the amp rating of wire decreases when the temperature of its surrounding environment increases, when the wire is close to or bundled with other wires, or when the wire is enclosed in conduit or a raceway. To allow comparisons among different types of wire, we present the maximum amps for an unenclosed single wire or cable at an 86° F ambient temperature. For more information on amp ratings for your specific environment, reference Article 310 in the National Electrical Code (NEC).

Flexibility

Bend and Stay—Useful for long, straight runs and other applications where you need wire to stay in the shape you bend it. This wire is usually solid and easier to terminate than stranded wire.

Flexible—You can bend this wire, but it does not hold its shape. Use it for jobs that require pulling wire around curves and corners in conduit. This wire is usually stranded.

Ultra Flexible—This spaghetti-like wire is limp, so it can handle tighter curves than flexible wire. Also for use in applications that require periodic flexing, such as CNC machines. This wire is usually stranded.

Continuous-Flex—This wire is designed to be in motion, so it's a good choice for robotics applications. It is usually stranded.

Wire

Stranded Wire

Solid Wire

- Stranded Wire: Flexible; Solid Wire: Bend and Stay
- Temperature Range: -40° to 220° F
- Insulation: PVC

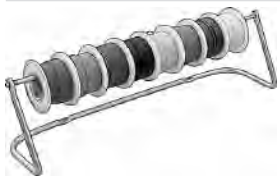
This wire is also known as hook-up wire. Use for internal wiring of electrical panels and equipment. UL flame rated VW-1. UL recognized and CSA certified.
300V AC—Meets UL 1007/1569.
600V AC—Meets UL 1015.

Wire

To Order: Please specify black, blue, brown, gray, green, green/yellow, orange, purple, red, white, or yellow.

Wire Ga.	Amps @ 86° F	300V AC OD		25 ft.	50 ft.	100 ft.	200 ft.	500 ft.	600V AC OD		25 ft.	50 ft.	100 ft.	200 ft.	500 ft.
Stranded Wire															
28	4	0.05″	8054T31	$2.68	$4.86	$8.83	$15.89	$33.11							
26	5	0.05″	8054T11	2.73	4.96	9.02	16.24	33.82	0.08″	8054T21	$2.96	$5.37	$9.77	$17.59	$36.64
24	7	0.06″	8054T12	3.02	5.48	9.97	17.95	37.39	0.09″	8054T22	3.18	5.76	10.48	18.86	39.30
22	10	0.06″	8054T13	3.25	5.91	10.74	19.33	40.27	0.1″	8054T23	3.40	6.18	11.23	20.21	42.11
20	13	0.07″	8054T14	3.96	7.19	13.08	23.54	49.05	0.1″	8054T24	4.48	8.13	14.79	26.62	55.46
18	18	0.08″	8054T15	5.03	9.14	16.61	29.90	62.29	0.11″	8054T25	5.56	10.09	18.35	33.03	68.81
16	24	0.09″	8054T16	6.98	12.67	23.04	41.47	86.40	0.12″	8054T26	7.31	13.27	24.12	43.42	90.45
14	33	0.11″	8054T17	11.27	20.47	37.21	66.98	139.54	0.14″	8054T27	11.64	21.14	38.43	69.17	144.11
12	45	0.12″	8054T18	16.52	29.99	54.52	98.14	204.45	0.16″	8054T28	19.59	35.57	64.67	116.41	242.51
10	58	0.16″	8054T19	25.92	47.05	85.55	153.99	320.81	0.19″	8054T29	29.09	52.81	96.02	172.84	360.07
Solid Wire															
24	7	0.05″	8251T1	2.42	4.39	7.98	14.36	29.93	0.08″	8428T1	3.02	5.48	9.96	17.93	37.35
22	10	0.06″	8251T2	3.09	5.61	10.20	18.36	38.25	0.09″	8428T2	3.70	6.71	12.20	21.96	45.75
20	13	0.06″	8251T3	4.55	8.26	15.01	27.02	56.29	0.1″	8428T3	4.77	8.66	15.75	28.35	59.06
18	18	0.07″	8251T4	6.03	10.95	19.91	35.84	74.66	0.1″	8428T4	6.52	11.84	21.52	38.74	80.70

Wire Assortments



Have multiple colors of 300V AC wire on hand. Carry the included rack or wall mount it using the two 1/4″ dia. mounting holes (fasteners not included).
Stranded Wire—Includes spools of wire in five colors: black, blue, green, red, and white.
Solid Wire—Includes spools of wire in eight colors: black, blue, brown, green, orange, red, white, and yellow.

Wire Ga.	Stranded Wire Five 25-ft. Spools		Stranded Wire Five 100-ft. Spools		Solid Wire Eight 25-ft. Spools	
26	9948T23	$42.16	9948T28	$69.94		
24	9948T24	43.34	9948T29	72.32	9948T21	$51.54
22	9948T25	45.84	9948T31	83.60	9948T22	62.46
20	9948T26	54.51	9948T32	108.06	9948T17	82.53
18	9948T27	57.48	9948T33	142.38	9948T18	90.01

About Wire and Cable Protection

Protect wire and cable from the environment with heat-shrink tubing and sleeving. **Heat-shrink tubing** is tight-fitting protective insulation for electrical connections. **Sleeving** has a looser fit and is used to bundle multiple wires and cables, and offer protection from heat and abrasion. Sleeving can also be used over heat-shrink tubing to bundle wires and cables or provide extra protection.

Heat-Shrink Tubing (pages 875-882)

When heat is applied, the tubing contracts to conform to whatever it's surrounding. To fit inside the tubing, your wire or cable assembly must be smaller than the tubing's ID before shrinking. To have a tight fit, the smallest portion of your assembly must be the same as or larger than the ID after shrinking.

Shrink ratio is the relationship between the ID before shrinking and the ID after shrinking. For example, a 2 to 1 shrink ratio means that the tubing ID will be half as large after shrinking. When heat is applied, the length of the tubing also shrinks slightly (usually less than 15%). For tools to apply heat, see pages 882 and 2789-2790.

Before Shrinking

After Shrinking

● Excellent ◓ Good

Heat-Shrink Tubing Material Characteristics

Material	Properties	Shrink Temp., °F	Minimum Temp., °F	Flexibility	Electrical Insulation	Abrasion Resistance	Chemical Resistance
Polyolefin/ Olefin	A general purpose heat-shrink tubing that is more flexible than PVC and easy to shrink.	195° to 285°	–65° to –40°	●	◓		◓
PVC	More economical than polyolefin with excellent chemical resistance.	215° to 285°	0°	●	◓	◓	●
Rubber/ Elastomer	Stays flexible at temperature extremes and resists oils and fuels.	275° to 350°	–100° to –65°	●	◓	◓	◓
PVDF (Kynar)	High strength at a low shrink temperature.	350°	–65°	◓	◓	●	●
FEP	Excellent chemical and abrasion resistance at a lower shrink temperature than PTFE.	420°	–400°	◓	●	●	●
PTFE	Good for harsh environments and high temperatures.	660°	–450°	◓	●	●	●
PEEK	Rigid material with the best strength and chemical resistance.	575°	–20°		●	●	●

Sleeving (pages 882-889)

Most sleeving slides over wire and cable. It's easiest to use for new installations and areas where there is not an electrical connector. **Wrap-around** sleeving has a slit along its length, making it convenient for field installations.

Slide-On

Wrap-Around

● Excellent ◓ Good

Sleeving Material Characteristics

Material	Application	Maximum Temp., °F	Minimum Temp., °F	Flexibility	Abrasion Resistance
Polyethylene	Bundling	190° to 200°	–75° to –40°	●	◓
Polyester	Bundling	175° to 300°	–100° to 0°	●	◓
PVC	Chemical Protection	220°	0°	◓	◓
Corrugated Plastic	Abrasion Protection	200° to 300°	–40°	◓	●
Nylon	Abrasion Protection	200° to 300°	–75° to –40°	●	●
Nomex	Abrasion Protection	400°	–320°	●	●
PTFE	Abrasion Protection	480° to 500°	–450° to –90°	◓	●
PEEK	Abrasion Protection	480°	–90°	●	●
Metal	Abrasion Protection	Not Rated	Not Rated	◓	●
Fiberglass	Heat Protection	1000° to 1400°	–90° to 0°	●	◓
Silica	Heat Protection	1800° to 2300°	–100° to –40°	●	◓
Ceramic	Heat Protection	1100° to 2600°	Not Rated	●	◓

Heat-Shrink Tubing

- Material: Polyolefin
- Shrink Ratio: 2 to 1
- Shrink Temperature: 250° F
- UL recognized and CSA certified (except clear tubing)
- AMS (formerly MIL)-DTL-23053/5 Classes 1 (color tubing) & 2 (clear tubing)

The most popular choice for general purpose use, polyolefin tubing is flexible and doesn't shrink much lengthwise. Temperature range is –65° to 275° F.

To Order: Please specify black, blue, clear, green, red, white, or yellow.

ID		Wall Thick.	1-ft. Lengths		4-ft. Lengths		25-ft. Spools		Large Spools			Jumbo Spools		
Before Shrinking	After Shrinking	After Shrinking	Pkg. of 10		Each		Each		Lg., ft.		Each	Lg., ft.		Each
0.06″	0.03″	0.02″	7496K41	$6.97	7856K11	$1.80	7856K71	$10.68	100	7856K31	$44.57	1,000	7856K51	$346.22
0.09″	0.05″	0.02″	7856K67	7.49	7856K12	1.89	7856K72	10.77	100	7856K32	46.83	500	7856K52	181.67
0.13″	0.06″	0.02″	7856K63	7.97	7856K13	1.99	7856K73	12.42	100	7856K33	50.07	500	7856K53	194.33
0.19″	0.09″	0.02″	7496K42	9.47	7856K14	2.36	7856K74	15.56	100	7856K34	59.50	250	7856K54	113.89
0.25″	0.13″	0.03″	7496K43	11.75	7856K15	2.97	7856K75	20.09	100	7856K35	72.76	200	7856K55	116.09
0.38″	0.19″	0.03″	7496K44	13.21	7856K16	3.34	7856K76	23.73	100	7856K36	80.54	200	7856K56	128.49
0.5″	0.25″	0.03″	7496K45	14.60	7856K17	3.76	7856K77	26.24	100	7856K37	90.07	200	7856K57	143.56
0.75″	0.38″	0.03″	7496K46	19.99	7856K18	5.01	7856K78	32.92	50	7856K38	65.63	200	7856K58	199.33
1″	0.5″	0.04″	7856K65	33.17	7856K19	7.46	7856K79	39.27	50	7856K39	78.01	100	7856K59	151.87
1.5″	0.75″	0.04″	7856K64	65.37	7856K21	13.91	7856K81	73.81				100	7856K61	285.82
2″	1″	0.05″	7856K66	77.38	7856K22	19.29	7856K82	86.24				100	7856K62	394.89

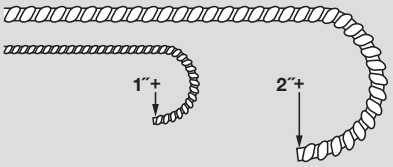
About Conduit

Conduit protects wire and cable from damage. When selecting conduit, consider where it will be installed and how flexible it needs to be for your application. Each type of conduit has specific fittings. The fittings are not interchangeable among conduit types.

Choosing Flexible or Rigid Conduit

	Conduit Type	Characteristics	Applications	Pages
Flexible Conduit—Use where wire needs to make tight bends or withstand vibration, such as connection points to machines or fixtures.				
	Plastic	Not as strong as metal conduit, but is lightweight and resists corrosion.	Wiring inside walls, robotics, automated equipment.	890-891
	Liquid-Tight Plastic and Metal	Has an outer cover with a metallic or non-metallic core. Resists oil and moisture.	Environments where liquids, oil, or grease are present.	892-894
	Metal	Good strength and crush resistance. Typically has the ability to make tight bends.	Areas where there is potential for physical damage. Often used for motor connections.	894-895
Rigid Conduit—Use for long, straight runs along building walls and floors. Also provides good crush protection.				
	Thin-Wall (EMT) Metal	General purpose metal conduit that is easier to bend and cut than medium- and thick-wall conduit.	Runs along walls and ceilings, away from high-traffic areas.	896-897
	Medium- and Thick-Wall (Rigid) Metal	Intended for heavy duty applications, this is our most crush-resistant metal conduit.	Areas where there is potential for physical damage.	898-899
	PVC	Lightweight, easy to install, and resists corrosion.	Outdoor use, including burial.	901

Bend Radius for Flexible Conduit

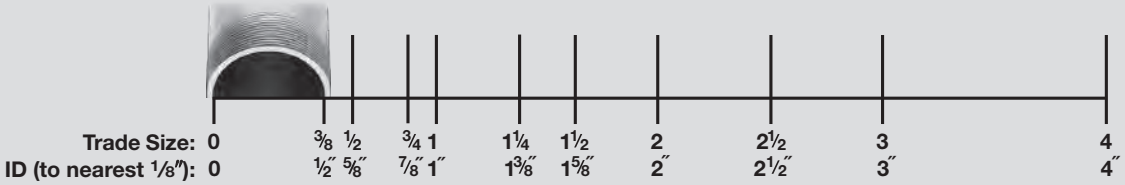


Bend radius, measured from the center of the bend to the edge of the conduit, can be used to compare flexibility among conduit. It indicates how tightly you can bend conduit without damaging it or shortening its life. The smaller the bend radius, the greater the flexibility.

Determining Conduit Trade Size

To be compatible, conduit and fittings must be of the same type and have the same trade size. **Trade size** is an industry designation for conduit and fittings. For threaded fittings, trade size also designates the NPT or NPSM pipe size of the threaded end.

You can use the scale below to find the trade size of your conduit. Measure the inside diameter (ID) of your conduit, then select the trade size on the scale that corresponds to your measurement.



Flexible Plastic Conduit and Fittings

Make tight bends in machine and equipment wiring with this corrugated nylon conduit. Also known as electrical nonmetallic tubing (ENT), it withstands vibration, is flame retardant, and resists oil, solvents, and UV light. When used with fittings for flexible plastic conduit, it seals out air and liquid. Color is black.

Conduit

Temperature range is -40° to 220° F. UL recognized.
Crush resistant conduit has thicker corrugations than standard conduit.

Trade Size	ID	OD	Bend Radius	Lengths, ft.	Standard	Per Ft. 1-99	Per Ft. 100-Up	Crush Resistant	Per Ft. 1-99	Per Ft. 100-Up
3/8	0.45″	0.62″	1″	10, 25, 50, 100	6959T11	$0.86	$0.69	6959T17	$1.63	$1.30
1/2	0.63″	0.83″	2″	10, 25, 50, 100	6959T12	1.37	1.10	6959T18	2.40	1.92
3/4	0.89″	1.12″	2″	5, 10, 25, 50, 100	6959T13	2.19	1.75	6959T19	3.97	3.17
1	1.08″	1.36″	3″	5, 10, 25, 50	6959T14	2.40	1.97	6959T21	4.39	3.59
1 1/4	1.4″	1.67″	4″	2, 5, 10, 25, 50	6959T15	3.42	2.80	6959T22	6.22	5.09
1 1/2	1.85″	2.15″	4″	2, 5, 10, 25, 50	6959T16	4.84	3.95	6959T23	8.67	7.11

Fittings

Tabs on one end snap into grooves in conduit; the other end attaches to a knockout in an outlet box or enclosure. All are nylon and meet IP68 for continuous submersion and IP69K for high-pressure, high-temperature washdowns.

Straight and **90° elbow adapters** have a temperature range of -40° to 235° F. UL recognized.

Tee connectors and **wye connectors and reducers** have a temperature range of -20° to 210° F.

Trade Size	Straight Adapters		90° Elbow Adapters		Tee Connectors	
3/8	6963T11	$6.02	6963T18	$11.28	6963T25	$19.21
1/2	6963T12	6.28	6963T19	11.61	6963T26	19.63
3/4	6963T13	11.15	6963T21	19.32	6963T27	21.71
1	6963T14	14.01	6963T22	23.94	6963T28	24.96
1 1/4	6963T15	20.68	6963T23	33.38	6963T29	28.52
1 1/2	6963T17	26.02	6963T24	39.76	6963T31	29.69

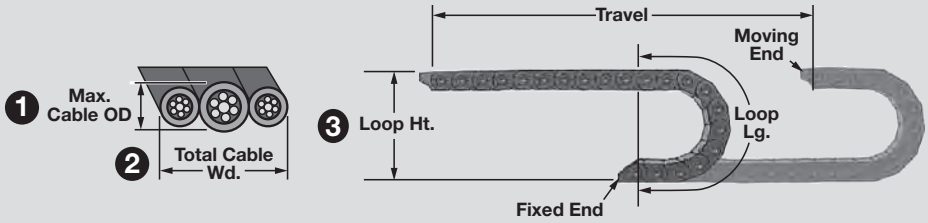
Wye Connectors and Reducers

Trade Size (A)	(B)		
3/8	3/8	6963T32	$19.84
1/2	3/8	6963T33	21.34
3/4	1/2	6963T34	22.24
1	3/4	6963T35	22.44
1 1/4	1	6963T36	24.46
1 1/2	1 1/4	6963T37	26.40

About Cable and Hose Carriers

Carriers support and protect cable and hose during machine movement while also reducing safety hazards. They are often used between fixed and moving portions of machines. During installation, evenly distribute cable and hose weight within the carrier. The fixed end of the carrier should be mounted at the midpoint of travel. See pages 865-869 for flexible cable that is suitable for use with carriers.

Selecting the Right Carrier for Your Cable or Hose



1. Measure the OD of your largest cable.

2. Measure the total width of your cables. This will enable you to choose a carrier that is wider than the sum of the ODs of your cables (total cable width).

3. Keep in mind how much vertical clearance you have. The loop height indicates the minimum vertical clearance required for the carrier. Also, take into account the flexibility of the carrier. The bend radius indicates how tightly the carrier can bend. To prevent damage to your cable, the bend radius of the carrier should be larger than or equal to the bend radius of your cable.

4. Once you have selected a part number, use the formula to determine the carrier length you need. We provide Loop Lg. for all of our carriers and you supply the travel length according to your application.

$$\text{Loop Lg., ft.} + \frac{\text{Travel, ft.}}{2} = \text{Carrier Length, ft.}$$

Example: Suppose you've selected a carrier with a loop length of 0.4 ft. and your application requires 6 ft. of travel. Using the formula, the carrier length necessary is 3.4 ft. Round up to the nearest foot and order a total of 4 ft. of carrier.

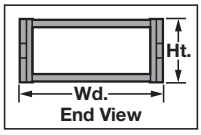
Snap-Together Cable and Hose Carriers

Connect lengths of carrier without tools—snap the links together to create the exact length you need to support and protect moving cable and hose. Lengths can be joined by hand, but a screwdriver is required for disassembly. Carriers are made of black nylon. Operating temperature is –40° to 245°F.

Open carriers promote air flow to prevent heat buildup and keep cable and hose visible. *Feed-through carriers* require cable and hose to be threaded through the entire length. *Lay-in carriers* have snap-on cross bars that allow access at any point along the length and make it easy to install cable and hose without threading it through.

Enclosed lay-in carriers protect cable and hose from damage caused by dirt, chips, and debris. They have snap-on cross bars that allow access at any point along the length and make it easy to install cable and hose without threading it through.

Mounting brackets are black nylon. Mounting fasteners are not included.



For Total Cable Wd.	Ht.	Wd.	Bend Radius	Loop Ht.	Loop Lg., ft.	Lengths, ft.	Open Feed-Through Carriers	Per Ft.	Open Lay-In Carriers	Per Ft.	Enclosed Lay-In Carriers	Per Ft.	Mounting Brackets	Pair
For 0.2″ Max. Cable OD														
0.2″	0.6″	0.5″	1.1″	2.8″	0.4	1, 3, 6	4516T44	$11.07	4409T21	$14.28			4556T31	$6.51
For 0.3″ Max. Cable OD														
0.3″	0.6″	0.7″	1.1″	2.8″	0.4	1, 3, 6	4516T45	11.81	4409T22	15.56			4556T32	7.30
0.3″	0.8″	0.7″	1.5″	3.7″	0.5	1, 3, 6	4516T52	14.40	4409T28	18.14			4556T38	8.44
0.5″	0.6″	0.9″	1.1″	2.8″	0.4	1, 3, 6	4516T46	12.47	4409T23	15.74			4556T33	8.12
0.6″	0.6″	1.1″	1.1″	2.8″	0.4	1, 3, 6	4516T47	13.35	4409T24	15.98			4556T34	9.21
0.9″	0.6″	1.5″	1.1″	2.8″	0.4	1, 3, 6	4516T48	16.05	4409T25	18.56			4556T35	10.05
1.3″	0.6″	1.9″	1.1″	2.8″	0.4	1, 3, 6	4516T49	16.47	4409T26	18.95			4556T36	10.72
1.6″	0.6″	2.3″	1.1″	2.8″	0.4	1, 3, 6	4516T51	17.28	4409T27	19.60			4556T37	11.40
For 0.5″ Max. Cable OD														
0.5″	0.8″	0.9″	1.5″	3.7″	0.5	1, 3, 6	4516T53	15.05	4409T29	18.33			4556T39	9.49
0.5″	0.9″	1.0″	1.5″	3.9″	0.6	1, 3, 6	55835K93	12.43	4409T35	19.67			55835K121	9.83
0.6″	0.8″	1.1″	1.5″	3.7″	0.5	1, 3, 6	4516T54	15.93	4409T31	18.58			4556T41	10.56
0.9″	0.8″	1.5″	1.5″	3.7″	0.5	1, 3, 6	4516T55	18.63	4409T32	21.14			4556T42	11.40
1.3″	0.8″	1.9″	1.5″	3.7″	0.5	1, 3, 6	4516T56	19.07	4409T33	21.56			4556T43	12.07
1.6″	0.8″	2.3″	1.5″	3.7″	0.5	1, 3, 6	4516T57	19.86	4409T34	22.21			4556T44	12.74
For 0.6″ Max. Cable OD														
0.8″	0.9″	1.4″	1.5″	3.9″	0.6	1, 3, 6	55835K94	12.83	4409T36	20.19			55835K122	9.83
1.2″	0.9″	1.9″	1.5″	3.9″	0.6	1, 3, 6	55835K95	13.98	4409T37	21.30			55835K123	9.83
1.6″	0.9″	2.4″	1.5″	3.9″	0.6	1, 3, 6	55835K96	14.74	4409T38	22.42			55835K124	9.83
For 0.9″ Max. Cable OD														
1.2″	1.4″	2.1″	2.2″	5.7″	0.9	1, 3, 6	4516T21	14.95	4409T51	18.09			4556T82	11.00
1.2″	1.4″	2.1″	3.9″	9.3″	1.4	1, 3, 6	4516T22	14.95	4409T52	18.09	4591T11	$30.70	4556T82	11.00
1.2″	1.4″	2.1″	4.9″	11.2″	1.6	1, 3, 6	4516T23	14.95	4409T53	18.09	4591T12	30.70	4556T82	11.00
1.8″	1.4″	2.9″	2.2″	5.7″	0.9	1, 3, 6	4516T24	16.60	4409T54	19.74			4556T83	11.00
1.8″	1.4″	2.9″	3.9″	9.3″	1.4	1, 3, 6	4516T25	16.60	4409T55	19.74	4591T13	32.28	4556T83	11.00
1.8″	1.4″	2.9″	4.9″	11.2″	1.6	1, 3, 6	4516T26	16.60	4409T56	19.74	4591T14	32.28	4556T83	11.00
2.4″	1.4″	3.7″	2.2″	5.7″	0.9	1, 3, 6	4516T27	18.67	4409T57	21.56			4556T84	11.00
2.4″	1.4″	3.7″	3.9″	9.3″	1.4	1, 3, 6	4516T28	18.67	4409T58	21.56	4591T15	32.79	4556T84	11.00
2.4″	1.4″	3.7″	4.9″	11.2″	1.6	1, 3, 6	4516T29	18.67	4409T59	21.56	4591T16	32.79	4556T84	11.00
3.3″	1.4″	4.7″	2.2″	5.7″	0.9	1, 3, 6	4516T31	21.86	4409T61	25.62			4556T85	11.00
3.3″	1.4″	4.7″	3.9″	9.3″	1.4	1, 3, 6	4516T32	21.86	4409T62	25.62	4591T17	34.35	4556T85	11.00
3.3″	1.4″	4.7″	4.9″	11.2″	1.6	1, 3, 6	4516T33	21.86	4409T63	25.62	4591T18	34.35	4556T85	11.00

(Continued on following page)

About Choosing an Electrical Switch

An electrical switch is used to turn power to a device on and off. This occurs when the switch closes or opens a set of contacts within an electrical circuit. The contacts act like a bridge that closes to allow electricity to pass through the circuit.

Switch Style—Choose the style that's right for your application. The following pages include push-button, toggle, rocker, foot switch, limit switch, and relay styles, among others.

Industry Designation—A standard naming convention that describes the contact for each switch.

Number of Poles: Determine the number of circuits you'll need to switch. Each circuit requires at least one set of contacts or "poles." The number of poles on a switch is indicated by the first two letters of the contact type (SP for single pole, DP for double pole, etc.).

A *single throw (ST)* switch is designed to be either open (off) or closed (on) before switching. A switch designed to be open is called normally open (NO), while a switch designed to be closed is normally closed (NC).

A *double throw (DT)* switch can be wired to be normally open or normally closed, offering greater flexibility. Another advantage of a double throw switch is that it can shift power between devices.

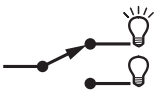
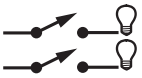
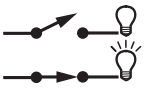
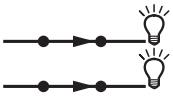
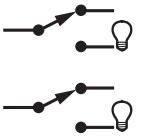
For example, in the diagrams at right, **SPST-NO** shows a single circuit that controls one device (a light bulb) and requires a single pole switch. **SPDT** shows a single pole double throw switch used to switch power between two lights. **DPST-NO** shows two circuits that power two light bulbs and require a double pole switch.

Switch Action—Decide if you want the switch to stay on only while you press it, such as your car horn (momentary), or if you want the switch to stay on when released, as with most light switches (maintained). Momentary switches "spring back" and maintained switches "stay switched."

Amp or Load Rating—You need to know how much electrical current will flow through the switch at the voltage of your circuit. You can compute this current if you know the amount of power required by the device you want to control.

For example, you have a 60 watt bulb powered by a 120 volt AC power supply. Use the formula **Current (amps) = Power (watts) ÷ Voltage (volts)** to calculate that the light bulb will draw 0.5 amps of current. You must select a switch with an amp rating higher than 0.5 amps at 120 volts AC. Remember, the required amp rating may change when there is a change in voltage.

Input Voltage—Some switches are activated by pressing a button (physical force), while other switches, such as relays, are activated by applying a voltage (electrical force). Relays need an input voltage (also known as a control or coil voltage) to operate. If your switch requires electrical activation, make sure your system can supply the appropriate voltage. If you need to use multiple relays, you may also want to look at power consumption (the amps or volt-amps drawn by the coil of the relay) to ensure your system can supply the required amount.

Industry Designation (● = Terminal)	No. of Circuits	Before Switching, Circuit Is	No. of Terminals
 **SPST-NO—**Single Pole Single Throw, Normally Open	1	Off	2
 **SPST-NC—**Single Pole Single Throw, Normally Closed	1	On	2
 **SPDT—**Single Pole Double Throw, Can Be Wired Normally Open or Normally Closed	1	1 Off or 1 On	3
 **DPST-NO—**Double Pole Single Throw, Normally Open	2	2 Off	4
 **DPST-NO/NC—**Double Pole Single Throw, 1 Normally Open and 1 Normally Closed	2	1 Off and 1 On	4
 **DPST-NC—**Double Pole Single Throw, Normally Closed	2	2 On	4
 **DPDT—**Double Pole Double Throw, Can Be Wired Normally Open or Normally Closed	2	2 Off or 2 On	6

30 mm Panel Cutout Metal Push-Button Switches

Their durable construction withstands abuse in demanding environments. Body is metal; button is plastic, unless noted. Switches mount in a 30 mm (1 3/16″) dia. panel cutout and have screw terminal connections. Depth behind panel is 1 3/4″. Rated 6 amps @ 120 volts AC and 5 amps @ 24 volts DC with a maximum voltage of 600 AC and DC. UL listed and CSA certified. For replacement contacts and accessories, see 65575K on page 939.

Washdown switches are rated NEMA 4 and 13 for splashing water and oil/coolant spraying. 1 3/4″ dia. mushroom switch has a metal button. ***Corrosion-resistant washdown*** switches are oil- and watertight as well as rated NEMA 4X for protection from corrosion.

To Order: Please specify button color where necessary.


Flush


Projecting


Mushroom

No. of Circuits	Before Switching, Circuit Is	Switch Action	No. of Terminals	Industry Designation	Available Colors	Washdown		Corrosion-Resistant Washdown	
Flush (1″ Dia.)									
1	Off	Springs Back (Momentary)	2	SPST-NO	Black, Green, Red	75759K2	$36.73	75759K41	$39.78
1	On	Springs Back (Momentary)	2	SPST-NC	Black, Green, Red	75759K8	39.78	75759K42	39.78
2	1 Off, 1 On	Springs Back (Momentary)	4	DPST-NO/NC	Black, Green, Red	75759K5	53.09	75759K43	53.96
Projecting (1″ Dia.)									
1	Off	Springs Back (Momentary)	2	SPST-NO	Black, Green, Red	75759K3	38.96	75759K44	39.78
1	On	Springs Back (Momentary)	2	SPST-NC	Red	75759K34	38.96	75759K45	39.78
2	1 Off, 1 On	Springs Back (Momentary)	4	DPST-NO/NC	Black, Green, Red	75759K6	53.09	75759K46	53.96
Mushroom (1 3/4″ Dia.)									
2	1 Off, 1 On	Springs Back (Momentary)	4	DPST-NO/NC	Red	75759K51	80.18	75759K47	82.16
2	1 Off, 1 On	Stays Switched (Maintained)	4	DPST-NO/NC	Red	75759K53	105.98	75759K48	100.80
Mushroom (2 1/2″ Dia.)									
1	Off	Springs Back (Momentary)	2	SPST-NO	Red	75759K13	62.24	75759K49	77.44
1	On	Springs Back (Momentary)	2	SPST-NC	Red	75759K17	65.07	75759K52	75.11

About Motor Switches and Starters

Motor switches provide manual on/off control of a motor circuit. They can also be used in other circuits, including lighting and electric heat circuits. There is no overload protection.

Motor starters provide on/off control of a motor circuit with the additional benefit of overload protection. This protection monitors the current flowing to a motor and opens the circuit if the current exceeds the full-load amp rating. The full-load amp rating is the current the motor is expected to continuously draw under normal conditions. This rating is often found on the motor's faceplate.

If the full-load amp rating is not shown on your motor's faceplate, you can estimate the amp rating (given the motor's hp and voltage) using a chart. Go to mcmaster.com and search for **7603KAC**.

Manual Motor Switches

Silver contacts dissipate heat and extend switch life. All stay switched (maintained) and have screw terminal connections. UL listed and CSA certified.

Indoor enclosure is nylon and rated NEMA 1.

Rain-tight enclosure is aluminum and rated NEMA 3R.

Washdown enclosure is polyester and rated NEMA 4X. It can also be used as a motor disconnect switch.

Hazardous-location enclosure is aluminum and rated NEMA 7 and 9.

Open

Indoor Enclosure

Rain-Tight Enclosure

Washdown Enclosure

Hazardous Location Enclosure

	Amps @ 600V AC	AC Motor hp Rating @ 240V	Ht.	Wd.	Dp.		
Switch Two Circuits (DPST-NO)—For Single-Phase Motors							
Open	30	3	3.7″	1.8″	1.8″	7657K33	$34.27
Open	60	5	3.8″	1.7″	1.7″	7657K35	134.89
Indoor Enclosure	30	3	3.9″	2.8″	2.8″	7657K31	39.33
Indoor Enclosure	60	5	4.3″	4.7″	3.9″	7657K36	164.54
Rain-Tight Enclosure	30	3	5.8″	4.5″	3.3″	7657K34	64.44
Haz. Loc. Enclosure	30	3	5.9″	2.3″	4.3″	7657K32	228.10
Switch Three Circuits (3PST-NO)—For Three-Phase Motors							
Open	30	7.5	3.7″	1.8″	1.8″	7657K23	72.51
Open	60	10	3.8″	1.7″	1.7″	7657K25	165.12
Indoor Enclosure	30	7.5	3.9″	2.8″	2.8″	7657K21	76.53
Indoor Enclosure	60	10	4.3″	4.7″	3.9″	7657K26	193.18
Rain-Tight Enclosure	30	7.5	5.8″	4.5″	3.3″	7657K24	109.60
Washdown Enclosure	30	7.5	7.6″	5.1″	4.1″	7657K61	303.92
Haz. Loc. Enclosure	30	7.5	5.9″	2.3″	4.3″	7657K22	297.70

Manual Reversing Motor Switches

Also known as drum switches, these motor switches have three positions: forward, off, and reverse. All have screw terminal connections. UL listed and CSA certified.

Indoor steel and **plastic enclosures** are rated NEMA 1.

Watertight enclosure is rated NEMA 4.

Indoor Steel Enclosure

Watertight Steel Enclosure

	AC Motor hp Rating							
	Single Phase	*Three Phase*						
	115V	230V	440V	Switch Action	Ht.	Wd.	Dp.	
Indoor Steel Enclosure								
	1½	–	–	Stays Switched (Maintained)	4.5″	2.4″	4.5″	7065K21 $48.14
	1½	2	1	Springs Back (Momentary)	4.5″	2.4″	4.5″	7065K22 61.60
	1½	2	1	Stays Switched (Maintained)	4.5″	2.4″	4.5″	7065K23 58.00
	1½	3	3	Stays Switched (Maintained)	4.8″	3.2″	3.6″	7826K24★ 293.22
	2	5	7½	Stays Switched (Maintained)	4.8″	3.2″	3.6″	7826K25★ 318.64
	2	5	7½	Stays Switched (Maintained)	5.4″	3.5″	5.8″	7065K25 121.75
Indoor Plastic Enclosure								
	1½	2	2	Stays Switched (Maintained)	5.3″	2.5″	2.8″	7826K22 151.43
Watertight Steel Enclosure								
	1½	2	2	Stays Switched (Maintained)	5.2″	4.6″	3.8″	7826K42 423.73
	2	5	7½	Stays Switched (Maintained)	7.6″	5.1″	4.3″	7826K45★ 503.39

★ Contacts can be converted to spring back (momentary).

Manual Motor Starters

Compact size makes these starters ideal when multiple motor circuits are housed in one panel. Built to IEC standards, they have three poles, screw clamp connections, and an adjustable overload relay that allows you to set the exact overload amperage you need. Mount on a standard 35 mm DIN rail (see page 813) or in an *enclosure*, which you don't have to open to control the starter. Rated 25 amps @ 600 volts AC. UL listed, CSA certified, and CE marked.

Note: Ensure the full-load amp rating of your motor falls within the starter's adjustable overload amp range.

Enclosure with external lever has four PG-16 threaded holes for conduit.

Auxiliary contacts allow you to add a signal, alarm, or other device. They have one normally open and one normally closed contact. Rated 1 amp @ 400 volts AC.

Starter

Enclosure

Enclosure with Lever

	AC Motor hp Rating							
	Single Phase		*Three Phase*					
Overload Amp Range	120V	240V	240V	480V	Ht.	Wd.	Dp.	
Starters								
1-1.6	—	1/10	—	¾	3.5″	2.1″	3″	6559K61 $105.43
1.6-2.5	—	⅛	½	1	3.5″	2.1″	3″	6559K62 105.43
2.5-4	⅛	⅓	1	2	3.5″	2.1″	3″	6559K63 105.43
4-6.3	¼	½	1½	3	3.5″	2.1″	3″	6559K64 105.43
6.3-9	⅓	1	2½	5	3.5″	2.1″	3″	6559K65 123.27
9-12.5	½	2	3	7½	3.5″	2.1″	3″	6559K66 123.27
12.5-16	1	2½	5	10	3.5″	2.1″	3″	6559K67 123.27
16-20	1½	3	5	10	3.5″	2.1″	3″	6559K68 130.00
20-25	2	3	7½	15	3.5″	2.1″	3″	6559K69 137.38
Accessories								
Enclosure (7.1″ Ht. × 4.9″ Wd. × 4.5″ Dp.)								6559K53 21.11
Enclosure with Lever (5.9″ Ht. × 3.7″ Wd. × 5.2″ Dp.)								6559K52 38.36
Auxiliary Contacts								6559K45 20.80
PG-16 to ½″ NPT Thread Adapter								7805K73 7.83

About Choosing a Proximity Switch

When choosing a replacement proximity switch, there are several specifications to consider.

No. of Wires—Most DC switches have three wires; AC have two.

Diameter—Measure the threaded body of your switch to determine this size in mm. This is also the metric thread size.

Mounting Style—*Flush* switches (also known as shielded) can mount in metal that's even with the sensor surface. *Projecting* switches (also known as unshielded) require the area around the sensor to be free of metal but provide a longer sensing distance.

Output—DC switches typically require a choice between *PNP* or *NPN,* which depends on the input required by your programmable logic controller (PLC) or other control device. PNP output is more common. For DC switch tester, see page 978.

Sensing Distance—This is based on the type of metal being sensed. The distance we provide is for mild steel. To find the approximate distance for other materials, multiply the sensing distance by the correction factor: *stainless steel:* 0.7; *brass:* 0.5; *aluminum:* 0.4; *copper:* 0.3.

3-Wire DC Metallic-Object Proximity Switches

Detect metallic objects without coming into contact with them. Also known as inductive proximity switches, these have short-circuit, overload, and reverse-polarity protection. Meet IP67 requirements for washdown. UL and C-UL listed and CE marked.

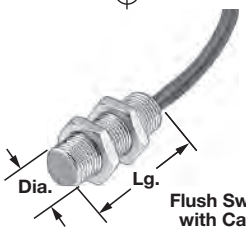
Switches with cable include a 6½-ft. cable with wire leads. They operate on 15-34 volts DC and have a 150 mA output rating and temperature range of -13° to 185°F, unless noted.

Switches with male plug quickly connect and disconnect for changeout and repair. They operate on 10-30 volts DC and have a 200 mA output rating and temperature range of -13° to 158°F, unless noted.

Cables with female plug mate with male plug switches. Cable is 12 ft. long. For more information about female plugs with cable, see page 830 for 7138K and page 831 for 6897K.

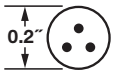
Plated-brass switches resist corrosion. They have a plastic face.

Stainless steel switches are Type 303 for excellent corrosion, impact, and abrasion resistance. They have a stainless steel face except switches with 1.5 and 2.5 mm maximum sensing distance have a plastic face.

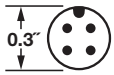


Flush Switch with Cable

Projecting Switch with Male Plug



Plug for 8 mm Dia.



Plug for 12-30 mm Dia.

Dia., mm	Mounting Style	Output	Maximum Sensing Distance, mm	Housing Material	Switches with Cable: Lg., mm			Switches with Male Plug: Lg., mm			Cables with Female Plug	
Switch One Circuit from Off to On (Normally Open)												
8	Flush	PNP	1.5	Plated Brass	30	7674K812♣	$83.49	50	73635K71★	$69.23	7138K14	$19.42
8	Flush	PNP	3	Stainless Steel	45	7674K13■	92.18	60	7674K15	95.65	7138K14	19.42
8	Flush	NPN	1.5	Plated Brass	30	7674K811♣	83.49	50	73635K5★	69.08	7138K14	19.42
8	Flush	NPN	3	Stainless Steel	45	7674K12■	92.52	60	7674K14	92.08	7138K14	19.42
8	Projecting	PNP	3	Plated Brass	30	7674K814	83.49	50	73635K97★	83.49	7138K14	19.42
8	Projecting	PNP	6	Stainless Steel	45	7674K17■	96.15	60	7674K19	93.93	7138K14	19.42
8	Projecting	NPN	2.5	Plated Brass	30	7674K813♣	83.49	—	—	—	—	—
8	Projecting	NPN	2.5	Stainless Steel	—	—	—	45	73635K66▲	59.05	7138K14	19.42
8	Projecting	NPN	6	Stainless Steel	45	7674K16■	93.93	60	7674K18	95.42	7138K14	19.42
12	Flush	PNP	2	Plated Brass	30	7674K71■	60.82	—	—	—	—	—
12	Flush	PNP	2	Stainless Steel	50	7674K816■	85.60	60	73635K21	87.60	6897K26	32.30
12	Flush	PNP	4	Plated Brass	—	—	—	45	73635K65	53.01	6897K26	32.30
12	Flush	NPN	2	Plated Brass	35	7674K72	47.48	—	—	—	—	—
12	Flush	NPN	2	Stainless Steel	50	7674K815■	86.11	60	73635K41	87.39	6897K26	32.30
12	Flush	NPN	4	Plated Brass	—	—	—	45	73635K64	53.20	6897K26	32.30
12	Projecting	PNP	4	Plated Brass	40	7674K39♣	58.75	60	73635K69	49.77	6897K26	32.30
12	Projecting	NPN	4	Plated Brass	35	7674K21	47.48	60	73635K68	49.65	6897K26	32.30
18	Flush	PNP	5	Plated Brass	40	7674K79♣	69.08	63.5	7674K86	52.44	6897K26	32.30
18	Flush	PNP	5	Stainless Steel	50	7674K831■	89.13	63.5	73635K22	89.76	6897K26	32.30
18	Flush	NPN	5	Plated Brass	50	7674K74■	73.46	63.5	7674K85	79.54	6897K26	32.30
18	Flush	NPN	5	Stainless Steel	50	7674K819■	69.08	63.5	73635K42	51.99	6897K26	32.30
18	Projecting	PNP	8	Plated Brass	35	7674K25	88.85	63.5	7674K26	89.88	6897K26	32.30
18	Flush	PNP	12	Plated Brass	51	7674K833■	74.77	63.5	73635K775	75.86	6897K26	32.30
18	Projecting	NPN	8	Plated Brass	35	7674K23	53.26	63.5	7674K24	50.71	6897K26	32.30
18	Flush	NPN	12	Plated Brass	51	7674K832■	53.26	63.5	73635K765	51.00	6897K26	32.30
30	Flush	PNP	10	Plated Brass	35	7674K78	57.88	48.5	7674K88	29.22	6897K26	32.30
30	Flush	PNP	10	Stainless Steel	50	7674K835■	107.65	63.5	73635K23	107.24	6897K26	32.30
30	Flush	NPN	10	Plated Brass	35	7674K77	57.88	48.5	7674K87	28.85	6897K26	32.30
30	Flush	NPN	10	Stainless Steel	50	7674K834■	100.35	63.5	73635K43	98.99	6897K26	32.30
30	Projecting	PNP	15	Plated Brass	35	7674K31	57.88	63.5	7674K32	28.85	6897K26	32.30
30	Projecting	NPN	15	Plated Brass	35	7674K27	57.88	63.5	7674K28	28.85	6897K26	32.30
Switch One Circuit from On to Off (Normally Closed)												
8	Flush	PNP	2	Plated Brass	30	7674K837♣	83.49	50	73635K74★	83.49	7138K14	19.42
8	Flush	NPN	1.5	Stainless Steel	35	—	—	45	73635K78▲	59.05	7138K14	19.42
8	Projecting	PNP	2.5	Stainless Steel	35	7674K393■	46.24	45	73635K83▲	59.05	7138K14	19.42
8	Projecting	NPN	2.5	Stainless Steel	35	7674K938	59.05	45	73635K82▲	59.05	7138K14	19.42
12	Flush	PNP	2	Plated Brass	35	7674K35	47.48	60	73635K81	48.77	6897K36	38.80
12	Projecting	PNP	4	Plated Brass	35	7674K38	47.48	60	73635K85	47.75	6897K36	38.80
12	Projecting	NPN	4	Plated Brass	35	7674K37	47.48	60	73635K84	47.68	6897K36	38.80
18	Flush	PNP	5	Plated Brass	30	7674K49♣	85.55	63.5	7674K44	51.00	6897K36	38.80
18	Flush	NPN	5	Plated Brass	35	7674K41	51.71	63.5	7674K42	51.66	6897K36	38.80

♣Operate on 10-30V DC and have a 100 mA output rating and temperature range of –13° to 158°F.
★ Have a 100 mA output rating. ■ Operate on 10-30V DC and have a 200 mA output rating and temperature range of –13° to 158°F.
▲Operate on 15-34V DC and have a 150 mA output rating and temperature range of –13° to 185°F.

Choose-a-Manufacturer Proximity Switches

If you need a proximity switch made by a specific manufacturer, just tell us what you need and we'll get it for you.

To Order: Please ask for 6693T999 and specify the manufacturer and manufacturer part number.

Manufacturer	
Balluff	Pepperl+Fuchs
Baumer	Schneider Electric/Square D
Contrinex	Sick
Eaton	Turck
IFM Efector	Other Manufacturers
Omron	

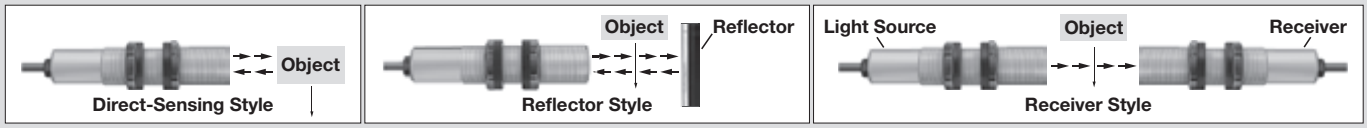
Universal-Object Proximity Switches

Detect both metallic and nonmetallic objects with these projecting switches. Also known as capacitive proximity switches, they have a plastic housing that meets IP66 for washdowns, a 6½-ft. cable with wire leads, and an LED power indicator. Output rating is 200 mA. Temperature range is –13° to 158°F except for 30 mm dia. switches, which have a temperature range of 14° to 131°F. **3-wire DC switches** operate on 10-30 volts DC. **2-wire AC switches** operate on 90-250 volts AC.

Also Available: Proximity switches made by a specific manufacturer. Please ask for 6693T999 and specify manufacturer and manufacturer part number.

Dia., mm	Mounting Style	Maximum Sensing Distance, mm	Housing Material	Lg., mm	3-Wire DC Switches PNP Output		3-Wire DC Switches NPN Output		2-Wire AC Switches	
Switch One Circuit from Off to On (Normally Open)										
12	Projecting	4	Plastic	80	7675K84	$138.97	7675K83	$138.97	7675K81	$192.41
18	Projecting	8	Plastic	80	7675K85	149.66	7675K54	149.66	7675K82	171.03
30	Projecting	15	Plastic	80	7675K86	144.31	7675K52	144.31	7675K51	192.41
Switch One Circuit from On to Off (Normally Closed)										
12	Projecting	4	Plastic	80	7675K94	138.97	7675K93	138.97	7675K91	192.41
18	Projecting	8	Plastic	80	7675K95	149.66	7675K48	149.66	7675K92	171.03
30	Projecting	15	Plastic	80	7675K96	144.31	7675K42	144.31	7675K41	192.41

About Light Beam Sensing Switches



Also known as photoelectric switches, these use a light beam to detect the presence or absence of an object made of any material. They have a longer sensing distance than proximity switches.

Direct-Sensing Style—They have the shortest sensing distance for use in confined spaces and can be adversely affected by the color or surface of the target object. The light source and receiver are in the same housing. Switches detect the target object when the light beam reflects off the object back into the receiver.

Reflector Style—They have a longer sensing distance than direct-sensing switches. The light source and receiver are in the same housing, but switches use a reflector. They detect the target object when it passes between the switch and the reflector, interrupting the beam.

Receiver Style—They have the longest sensing distance. The light source and receiver are in separate housings that must be lined up facing each other. Switch detects the target object as it breaks the light beam between the light source and receiver.

Switch Operation—*On when object present* switch when a target object is present (similar to a normally open switch). *On when object absent* switch when the target object is absent (similar to a normally closed switch).

Light Beam Sensing Switches

Switch for AC Input

Plug for DC Input

Plug for AC Input

Mount these threaded switches in an 18 mm dia. panel cutout. They have a signal strength indicator and watertight plastic housing. Temp. range is –13° to 131°F. Rated IP67 for washdowns. CE marked.

DC Input—Operate on 10-30 V DC and have a 100 mA output rating. 45 mm long, unless noted. *Reflector* switches require a reflector (sold separately below). *Switches with cable* have a 4-wire cable. **To Order:** Please specify PNP or NPN output.

AC Input—Operate on 24-250 V AC and have a 300 mA output rating. 85mm long, unless noted. *Switches with cable* have a 3-wire cable. UL listed and CSA certified. *Reflector* switches include a reflector.

Switch Style	Sensing Distance	Switches with Cable		Switches with Male Plug	
DC Input—On When Object Present or Absent					
Direct Sensing	4″	65845K15★	$71.92	65845K17	$71.92
Reflector	13.1 ft.	65845K16★	75.64	65845K18	75.64
AC Input—On When Object Present					
Direct Sensing	12″	65845K46	96.00	65845K73■	96.00
Reflector	6.5 ft.	65845K66	138.00	65845K77■	146.00
Receiver	66 ft.	65845K56	135.00	65845K75■	131.40
AC Input—On When Object Absent					
Direct Sensing	12″	65845K47	96.00	65845K74■	95.38
Reflector	6.5 ft.	65845K67	138.00	65845K78■	138.00
Receiver	66 ft.	65845K57	135.00	65845K76■	131.40
Accessories					
Cable with Female Plug for DC Switches				6897K36	38.80
Cable with Female Plug for AC Switches				65845K79	45.00
Optional Mounting Bracket for DC Switches				65845K13	4.52
Optional Mounting Bracket for AC Switches				65845K14	13.50
Reflector for DC Switches				65845K41	23.60
Replacement Reflector for AC Switches				7363K33	13.50

★ Length is 41 mm. ■ Length is 104 mm.

Flat-Body Light Beam Sensing Switches

Switch with Male Plug

Plug for DC Input

Plug for AC Input

Fit these small, flat-body switches into tight spaces. They can be set to switch on when an object is present or on when an object is absent. Switches have an 18 mm dia. threaded face and plastic housing with 3 mm dia. mounting holes spaced 24 mm apart. Output rating is 100 mA. Temperature range is –4° to 158°F. They're watertight and oil tight for outdoor use, meeting NEMA 4X and 13. Meet IP67 for washdowns. UL and C-UL recognized, CSA certified, and CE marked.

Switches with male plug quickly connect and disconnect.

DC Input—Operate on 10-30 volts DC and have PNP and NPN outlets. *Switches with cable* are 2⅛″ Lg.×½″ Wd.×1³⁄₁₆″ Ht. and have a 6½-ft. 4-wire cable. *Switches with male plug* are 2⅞″ Lg.×½″ Wd.×1³⁄₁₆″ Ht.

AC Input—Operate on 24-240 volts AC. *Switches with cable* are 2⅝″ Lg.×½″ Wd.×1³⁄₁₆″ Ht. and have a 6½-ft. 2-wire cable. *Switches with male plug* are 3⁵⁄₁₆″ Lg.×½″ Wd.×1³⁄₁₆″ Ht.

Reflector switches include a 3⁵⁄₁₆″ dia. reflector.

Switch Style	Sensing Distance	Switches with Cable		Switches with Male Plug	
DC Input					
Direct Sensing	15″	9539T7	$105.43	9539T11	$105.43
Reflector	10 ft.	9539T8	116.38	9539T12	125.26
Receiver	100 ft.	9539T9	155.43	9539T14	155.43
Cable with Female Plug				6897K36	38.80
Replacement Reflector				9539T15	5.39
AC Input					
Direct Sensing	15″	9539T1	127.17	9539T4	127.17
Reflector	10 ft.	9539T2	136.48	9539T5	135.86
Receiver	100 ft.	9539T3	184.78	9539T6	184.78
Cable with Female Plug				6897K86	28.50
Replacement Reflector				9539T15	5.39

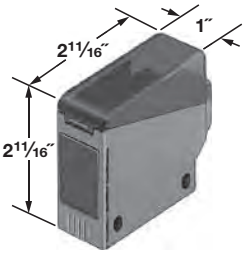
Light Beam Sensing Switches with Relay Output

With a built-in relay output, you can switch loads up to 3 amps at 250 volts AC. Output can be set to switch on when an object is present or on when an object is absent. Operate on 24-240 volts AC and DC. Switches have screw terminal connections, ABS plastic housing, and a mounting bracket with two 3⁄16″ dia. holes (screws not included). Temperature range is –13° to 131°F. Meet IP66 for washdowns. CE marked.

Time delay switches have delay-on, off-delay, and switch-on initiated interval timing functions (see About Timer Relays on page 988). They're adjustable from 0.1 to 5 seconds.

Reflector switches include a 1⅝″ Lg.×2⅜″ Ht. reflector.

Switch Style	Sensing Distance		
Standard			
Direct Sensing	3.3 ft.	9231K11	$103.08
Reflector	23 ft.	9231K12	117.16
Receiver	65.6 ft.	9231K13	140.99
Replacement Reflector		9231K31	16.89
Time Delay			
Direct Sensing	3.3 ft.	9231K21	136.28
Reflector	23 ft.	9231K22	135.52
Receiver	65.6 ft.	9231K23	174.94
Replacement Reflector		9231K31	16.89



High-Amp Relays

For information about electrical switches, see page 937.

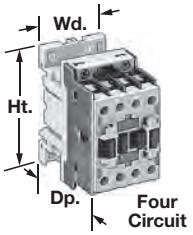
About High-Amp Relays

High-amp relays (also known as contactors) use an electrical signal or control voltage to remotely switch high-amp circuits such as lighting and large motors. They are typically rated for applications up to 50 hp.

Full load amp rating is the maximum amount of current a relay can switch for a motor.

Resistive load amp rating is the maximum amount of current a relay can switch for other electrical loads such as heaters.

High-Amp Relays



Switch motors and lighting. Also known as IEC contactors, these relays are built to International Electrotechnical Commission dimensional standards. Mechanical life is 20 million cycles, significantly longer than that of Infrequent-Cycle High-Amp Relays. They mount to 35 mm DIN rail and have 0.17″ dia. holes for surface mounting (fasteners not included). All have touchsafe screw terminal connections to prevent contact with live terminals. Connections are accessible from the front for side-by-side mounting. Contacts spring back (momentary) when power is removed. UL and C-UL listed.

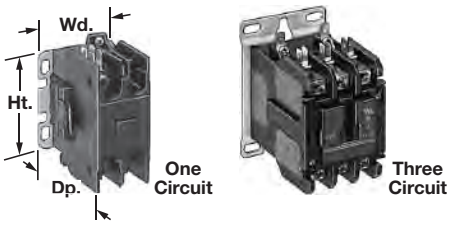
Relays with **AC control voltage** have a power draw of 6.5 VA. **To Order:** Please specify control voltage: 24 AC, 120 AC, or 240 AC.

Relays with **24 DC control voltage** have a power draw of 5.4 watts.

Auxiliary contacts allow you to add a signaling device or control another relay. They switch two circuits, one on and one off (DPST-NO/NC). You can add one front-mount contact per relay or two side-mount contacts per relay.

Amp Rating @ 600V AC		*AC Motor hp Rating*							**AC Control Voltage**			**24 DC Control Voltage**		
		Single Phase		*Three Phase*										
Full Load	Resistive Load	120V	240V	240V	480V	600V	Ht.	Wd.	Dp.			Dp.		
Switch Three Circuits On (3PST-NO)—With One Auxiliary Contact to Switch One Circuit On (1 NO)														
6	20	½	1½	3	5	5	2.3″	1.7″	2.2″	70255K61	$41.00	2.2″	70255K17	$62.23
11	28	1	2	5	7½	10	3.2″	1.8″	3.2″	70255K32	52.13	3.9″	70255K42	95.14
17	32	1	3	5	10	15	3.2″	1.8″	3.2″	70255K33	63.45	3.9″	70255K43	113.00
17	32	2	3	7½	15	15	3.2″	1.8″	3.2″	70255K34	91.66	3.9″	70255K44	132.53
Switch Three Circuits On (3PST-NO)—With One Auxiliary Contact to Switch One Circuit Off (1 NC)														
6	20	½	1½	3	5	5	2.3″	1.7″	2.2″	70255K62	41.00	2.2″	70255K18	62.23
11	28	1	2	5	7½	10	3.2″	1.8″	3.2″	70255K35	52.13	3.9″	70255K45	95.14
17	32	1	3	5	10	15	3.2″	1.8″	3.2″	70255K36	63.45	3.9″	70255K46	113.00
17	32	2	3	7½	15	15	3.2″	1.8″	3.2″	70255K37	91.66	3.9″	70255K47	132.53
Switch Four Circuits On (4PST-NO)														
9	25	¾	2	3	5	7½	3.2″	1.8″	3.2″	70255K65	55.29	3.9″	70255K28	97.79
11	28	1	2	5	7½	10	3.2″	1.8″	3.2″	70255K39	69.16	—	—	—
17	32	1	3	5	10	15	3.2″	1.8″	3.2″	70255K55	86.32	3.9″	70255K49	133.18
22	45	2	5	7½	15	20	3.5″	2.4″	3.5″	70255K41	100.11	4.2″	70255K66	152.12
32	55	3	7½	15	30	30	3.5″	2.4″	3.5″	70255K27	220.03	4.2″	70255K38	297.60
Auxiliary Contact for Relays Rated 6 Full-Load Amps—Front Mount													70255K13	$12.59
Auxiliary Contact for Relays Rated 9-32 Full-Load Amps—Front Mount													70255K14	11.86
Auxiliary Contact for Relays Rated 9-32 Full-Load Amps—Side Mount													70255K26	11.86

Infrequent-Cycle High-Amp Relays



Also called definite-purpose contactors, these relays meet UL 508 standards for air conditioning and heating. Mechanical life is 500,000 cycles. They have at least three holes for surface mounting (fasteners not included). Relays have screw terminal connections and ¼″ quick-disconnect terminals except 6564K89, which has screw terminals only. Connections are accessible from the front for side-by-side mounting. Contacts spring back (momentary) when power is removed. UL recognized, CSA certified, and CE marked.

Relays with **AC Control Voltage—To Order:** Please specify control voltage: 24 AC, 120 AC, or 208/240 AC.

Also Available: Auxiliary contacts. Please ask for 6564K99 and specify the McMaster-Carr part number of your relay and whether you want to switch one circuit on (1 NO) or off (1 NC).

Amp Rating @ 600V AC		*AC Motor hp Rating*								**AC Control Voltage**			**24 DC Control Voltage**		
		Single Phase		*Three Phase*						Power			Power		
Full Load	Resistive Load	115V	230V	230V	460V	575V	Ht.	Wd.	Dp.	Draw			Draw, Watts		
Switch One Circuit On (SPST-NO)															
25	30	2	3	—	—	—	3.2″	2.0″	2.3″	6 VA	6564K85★	$29.12	—	—	—
30	40	2	5	—	—	—	3.2″	2.0″	2.3″	6 VA	6564K72★	31.60	—	—	—
40	50	3	7½	—	—	—	3.2″	2.0″	2.3″	6 VA	6564K86★	45.26	—	—	—
Switch Two Circuits On (DPST-NO)															
15	20	¾	2	3	5	5	3.8″	2.4″	3.4″	7 VA	6564K91	47.08	3.1	6564K511	$86.45
20	30	1½	3	—	—	—	3.2″	2.0″	2.3″	6.5 VA	6564K73★	47.99	—	—	—
25	35	2	3	—	—	—	3.2″	2.0″	2.3″	6.5 VA	6564K74★	53.89	3.1	6564K513■	95.43
30	40	2	5	—	—	—	3.2″	2.0″	2.3″	6.5 VA	6564K75★	50.20	3.1	6564K516■	111.05
40	50	3	7½	—	—	—	3.2″	2.0″	2.3″	6.5 VA	6564K76★	78.15	3.1	6564K519■	99.50
50	65	3	10	15	30	30	3.8″	2.4″	3.4″	10 VA	6564K77	140.00	3.1	6564K523	130.12
60	75	5	10	20	40	40	3.8″	2.6″	4.0″	50.4 VA	6564K78	141.23	5.1	6564K525	130.21
75	90	5	15	20	50	50	3.8″	2.6″	4.0″	50.4 VA	6564K87	171.83	5.1	6564K527	155.10
90	120	7½	20	30	50	50	5.1″	3.4″	4.8″	19 VA	6564K79	273.49	—	—	—
Switch Three Circuits On (3PST-NO)															
15	20	¾	2	3	5	5	3.8″	2.4″	3.4″	7 VA	6564K92	56.95	3.1	6564K512	99.00
25	35	2	3	7½	10	10	3.8″	2.4″	3.4″	7 VA	6564K93	59.58	3.1	6564K514	103.57
30	40	2	5	10	15	15	3.8″	2.4″	3.4″	7 VA	6564K94	73.33	3.1	6564K517	112.95
40	50	3	7½	10	20	20	3.8″	2.4″	3.4″	7 VA	6564K95	89.23	3.1	6564K521	112.02
50	65	3	10	15	30	30	3.8″	2.4″	3.4″	10 VA	6564K96	145.70	3.1	6564K524	140.33
60	75	5	10	20	40	40	3.8″	2.6″	4.0″	50.4 VA	6564K97	143.31	5.1	6564K526	128.33
75	90	5	15	20	50	50	3.8″	2.6″	4.0″	50.4 VA	6564K88	184.00	5.1	6564K528	164.19
90	120	7½	20	30	50	50	5.1″	3.4″	4.8″	19 VA	6564K98	307.98	—	—	—
120	140	—	—	—	—	—	7.2″	4.1″	5.9″	49.8 VA	6564K89	487.84	—	—	—
Switch Four Circuits On (4PST-NO)															
25	35	2	3	7½	10	10	3.8″	2.7″	3.4″	50.4 VA	6564K1	75.05	5.1	6564K515	103.98
30	40	2	5	10	15	15	3.8″	2.7″	3.4″	50.4 VA	6564K2	87.55	5.1	6564K518	113.71
40	50	3	7½	10	20	20	3.8″	2.7″	3.4″	50.4 VA	6564K3	96.66	5.1	6564K522	101.52
Indoor (NEMA 1) Enclosure for Three-Circuit Relays Rated 60 Full-Load Amps and Four-Circuit Relays														6564K889	$132.58

★ Auxiliary contacts not available. ■ Size is 3.8″ Ht. × 2.4″ Wd. × 3.4″ Dp.

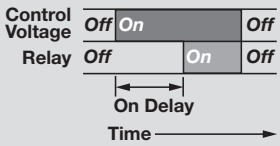
Timer Relays

For information about electrical switches, see page 937.

About Timer Relays

Timer relays, or time-delay relays, have contacts that open or close based on a time delay once control voltage is applied or removed.

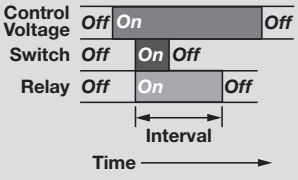
On-Delay (Delay-On-Make)



You set how long it takes for the relay to turn on after control voltage is applied.

Example: A drill starts pumping lubricant immediately, but it does not start rotating until the set time has elapsed.

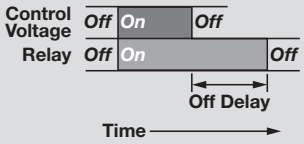
Switch-On Initiated Interval (Single-Shot)



Unlike interval timer relays, these require a switch to activate the timing function instead of control voltage (which is applied the entire time). When you turn on the switch, the relay turns on. It stays on for the interval time and then turns off.

Example: Lights in a storage room are turned on with a switch and stay on for a set time before turning off.

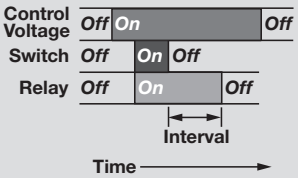
Off-Delay (Power-Off Delay)



When control voltage is applied, the relay turns on. When the control voltage is removed, the relay stays on for the off-delay time and then turns off.

Example: A motor shuts off and its cooling system continues to run for a set time.

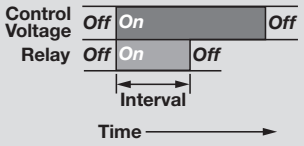
Switch-Off Initiated Interval (Delay-On-Break)



A switch is required to activate the timing function instead of control voltage (which is applied the entire time). When you turn on the switch, the relay turns on. When you turn off the switch, the relay stays on for the interval time and then turns off.

Example: A projector's light is turned off with a switch, but its cooling fan continues to run for a set time.

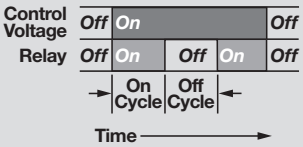
Interval



When control voltage is applied, the relay turns on. It stays on for the interval time and then turns off.

Example: When a part moving down a conveyor reaches a certain location, a cleaning spray comes on for a set time.

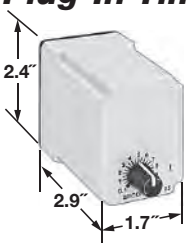
Repeat Cycle

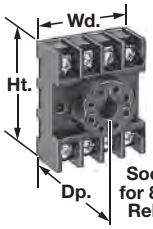


When control voltage is applied, the relay turns on for the on-cycle time. Then the relay turns off for the off-cycle time. This process repeats until the control voltage is removed.

Example: A flashing light.

Plug-In Timer Relays





Socket for 8-Pin Relays

Socket for 11-Pin Relays

Turn knobs to adjust the delay between the time relays receive the control signal and the time relays turn on or off. Use in applications such as paint and conveyor lines where machinery needs to turn on or off after a set period of time. All plug into a socket.

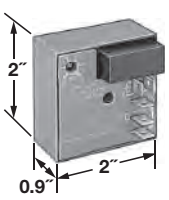
Relays switch two circuits on or off (DPDT), except switch-on initiated interval (single-shot) relays switch one circuit on or off (SPDT). All are rated 10 amps @ 240 volts AC and 8 amps @ 28 volts DC. Mechanical life is 10 million cycles, except off-delay (power-off delay) relays have a life of 2 million cycles. UL recognized, CSA certified, and CE marked, except off-delay (power-off delay) relays are not CSA certified.

Sockets mount to 35 mm DIN rail or surface mount using the two 0.17″ dia. holes (fasteners not included).

Control Voltage	Overall Timing Range	Power Draw		
On-Delay (Delay-On-Make)—8 Pins				
24 AC/DC	0.1-10 sec.	83 mA	7268K32	$52.89
24 AC/DC	0.6-60 sec.	83 mA	7268K34	52.89
120 AC/DC	0.05-1 sec.	17 mA	7268K21	52.89
120 AC/DC	0.1-10 sec.	17 mA	7268K23	52.89
120 AC/DC	0.3-30 sec.	17 mA	7268K24	52.89
120 AC/DC	0.6-60 sec.	17 mA	7268K25	52.89
120 AC/DC	1.8-180 sec.	17 mA	7268K26	52.89
120 AC/DC	3-300 sec.	17 mA	7268K51	52.89
120 AC/DC	6-600 sec.	17 mA	7268K52	52.89
120 AC/DC	36-3,600 sec.	17 mA	7268K54	52.89
12 DC	0.1-10 sec.	170 mA	7268K91	52.95
12 DC	0.6-60 sec.	170 mA	7268K92	52.95
Off-Delay (Power-Off Delay)—8 Pins				
24 AC/DC	0.05-1,800 sec.	100 mA	7268K48	97.46
120 AC/DC	0.05-1,800 sec.	20 mA	7268K47	97.46
Interval—8 Pins				
120 AC/DC	0.05-5 sec.	17 mA	7630K31	59.29
120 AC/DC	0.6-60 sec.	17 mA	7630K32	59.29
120 AC/DC	0.1-10 min.	17 mA	7630K33	59.29
120 AC/DC	0.6-60 min.	17 mA	7630K34	59.29
Switch-On Initiated Interval (Single-Shot)—8 Pins				
120 AC/DC	0.1-10 sec.	17 mA	7630K41	56.84
120 AC/DC	0.6-60 sec.	17 mA	7630K42	56.84
Switch-Off Initiated Interval (Delay-On-Break)—11 Pins				
24 AC/DC	0.1-10 sec.	83 mA	7268K72	57.76
24 AC/DC	0.6-60 sec.	83 mA	7268K74	57.76

Control Voltage	Overall Timing Range	Power Draw		
Switch-Off Initiated Interval (Delay-On-Break)—11 Pins (Cont.)				
24 AC/DC	36-3,600 sec.	83 mA	7268K77	$57.76
120 AC/DC	0.05-5 sec.	17 mA	7268K42	57.76
120 AC/DC	0.1-10 sec.	17 mA	7268K43	57.76
120 AC/DC	0.3-30 sec.	17 mA	7268K44	57.76
120 AC/DC	0.6-60 sec.	17 mA	7268K45	57.76
120 AC/DC	1.2-120 sec.	17 mA	7268K4	57.76
120 AC/DC	1.8-180 sec.	17 mA	7268K46	57.76
120 AC/DC	3-300 sec.	17 mA	7268K61	57.76
120 AC/DC	6-600 sec.	17 mA	7268K62	57.76
120 AC/DC	36-3,600 sec.	17 mA	7268K64	57.76
Repeat Cycle—8 Pins				
24 AC/DC	0.1-10 sec.	83 mA	7630K81	76.32
24 AC/DC	0.6-60 sec.	83 mA	7630K83	76.32
24 AC/DC	1.8-180 sec.	83 mA	7630K85	76.32
120 AC/DC	0.05-5 sec.	17 mA	7630K11	76.32
120 AC/DC	0.1-10 sec.	17 mA	7630K12	76.32
120 AC/DC	0.6-60 sec.	17 mA	7630K14	76.32
120 AC/DC	1.8-180 sec.	17 mA	7630K16	76.32
120 AC/DC	3-300 sec.	17 mA	7630K17	76.32
120 AC/DC	0.1-10 min.	17 mA	7630K18	76.32
120 AC/DC	0.3-30 min.	17 mA	7630K23	76.32
12 DC	1.8-180 sec.	170 mA	7630K59	76.32
Sockets				
For 8-Pin Relays (2″ Ht. × 1.6″ Wd. × 1″ Dp.)			7122K19	4.71
For 11-Pin Relays (2″ Ht. × 2.3″ Wd. × 1″ Dp.)			7122K21	7.25

Surface-Mount Timer Relays



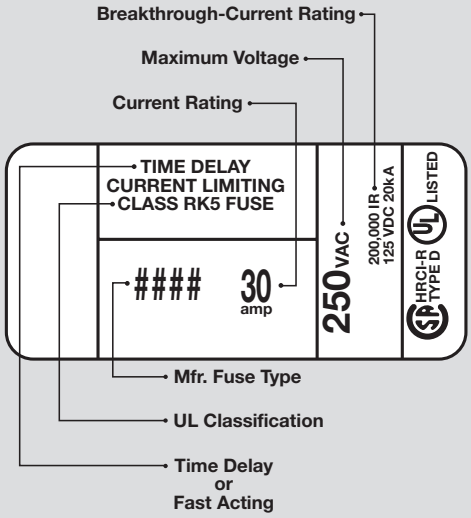
Relays surface mount and have an on-delay (delay-on-make) timing function. Adjust the delay with the built-in variable switch (potentiometer). Relays switch one circuit on or off (SPDT). All have 0.25″ quick-disconnect terminals and a 0.17″ dia. mounting hole (fastener not included). Rated 8 amps @ 250 volts AC. Mechanical life is 10 million cycles. UL and C-UL recognized.

Control Voltage	Overall Timing Range	Power Draw		
120 AC	0.05 sec.-1 sec.	29 mA	77055K45	$44.12
120 AC	0.25 sec.-5 sec.	29 mA	77055K46	44.12
120 AC	0.5 sec.-10 sec.	29 mA	77055K47	44.12
120 AC	3 sec.-60 sec.	29 mA	77055K48	44.12

Control Voltage	Overall Timing Range	Power Draw		
120 AC	15 sec.-300 sec.	29 mA	77055K49	$44.12
120 AC	30 sec.-10 min.	29 mA	77055K51	44.12
12 DC	3 sec.-60 sec.	292 mA	77055K631	47.12
12 DC	15 sec.-300 sec.	292 mA	77055K632	47.12

About Fuses

How to Read Your Fuse Label



Fuses interrupt overload and short-circuit currents. Overload currents typically are up to 10 times larger than the fuse's available current rating and occur when your equipment draws more current than it needs. Short circuits are greater than 10 times the fuse's current rating and occur when the current finds a "shortcut" outside its normal path.

Time-delay fuses delay opening on low-level overloads until the overload has been sustained for a specific amount of time. This prevents the fuse from blowing when exposed to harmless temporary overload currents such as motor start-ups and switching surges. Some time-delay fuses are also known as dual-element fuses.

Fast-acting fuses do not have a time-delay opening. Use them when temporary overload currents are not present. Suitable for resistive loads that don't surge, such as heating and lighting.

Current rating is the maximum current that a fuse carries under normal conditions.

Breakthrough-current rating, labeled on the fuse as IR, is the maximum current that a fuse can safely stop in the event of a short circuit.

UL Class	V AC	*Fuse Type Cross Reference* Bussmann	Ferraz Shawmut	Littelfuse	McM Part No.	See Pg.
UL Class Fuses						
RK1	250	LPN-RK	A2D-R	LLN-RK	**74445K**	994
RK1	600	LPS-RK	A6D-R	LLS-RK	**74445K**	994
RK1	600	KTS-R	A6K-R	KLS-R	**6616K**	994
RK5	250	FRN-R	TR-R	FLN-R	**7049K**	995
RK5	250	FRN-R-ID	TR-R-ID	FLN-R-ID	**7487K**	995
RK5	600	FRS-R	TRS-R	FLS-R	**7049K**	995
RK5	600	FRS-R-ID	TRS-R-ID	IDSR	**7487K**	995
J	600	LPJ-SP	AJT	JTD	**70325K**	995
J	600	LPJ-SPI	AJT	JTD-ID	**5054T**	995
J	600	JKS	A4J	JLS	**6985K**	995
L	600	KRP-C	A4BQ	KLPC	**4241K**	995
K5	250/600	NON/NOS	OT/OTS	NLN/NLS	**7072K**	995
T	300/600	JJN/JJS	A3T/A6T	JLLN/JLLS	**70455K**	996
H	250/600	REN/RES	RF/RFS	RLN/RLS	**7073K**	996
Fuses for Sensitive Electronics						
___	150/250	FWA/FWX	A15QS/A30QS	L15S/L25S	**74475K**	998
___	500/700	FWH/FWP	A50QS/A70QS	L50S/L70S	**74475K**	998
Midget Fuses						
CC	600	FNQ-R	ATQ-R	KLD-R	**7714K**	998
CC	600	LP-CC	ATD-R	CCMR	**72035K**	998
CC	600	KTK-R	ATM-R	KLK-R	**74495K**	998
G	600/480	SC	AG	SLC	**74485K**	998
___	250	BAF	OTM	BLF	**7059K**	998
___	250	FNM	TRM	FLM	**7706K**	998
___	500	FNQ	ATQ	FLQ	**7713K**	998
___	600	KTK	ATM	KLK	**74505K**	998
___	600	BBS	SBS	BLS	**6036T**	998
___	600	DCM	ATM	KLKD	**4397K**	998
Glass-Tube and Ceramic-Tube Fuses						
___	250/125/32	AGC/AGX	GGC/GGX	312	**7085K**	1000
___	250/32	MDL	GDL	313	**7085K**	1000
___	250/125	C520/C519	SMG/STG	225/229	**3686T**	1000
___	250/125	GBB/ABC	GAB	322/314	**71385K**	1000
___	250	MDA	GSA	326	**71385K**	1000
___	250/125	GDB/GMA	GSB/GGM	217/235	**6978K**	1000
___	250	GDC	GDG	218	**6978K**	1000
___	250	GDA/S505	GSD/GSF	216/215	**6986K**	1000
___	500	___	___	477	**6986K**	1000
___	450/500	___	___	505	**71385K**	1000
Lift Truck and Automotive Fuses						
___	125	ANN	CNN	CNN	**70635K**	1001
___	125V AC/DC	ACK	ACK	CCK	**4142K**	1001
___	125V AC/DC	AFX	ALS	___	**4142K**	1001
___	32V DC	___	___	MIDI/MEG	**9180K**	1002
___	32V AC/DC	ATM	AF2	MINI/297	**7460K**	1002
___	32V AC/DC	ATC	AF	ATO/257	**7460K**	1002
___	32V AC/DC	MAX	AF3	MAXI/299	**7460K**	1002

UL Class Fuses

Don't see the fuse you need? Just tell us what you're looking for and we'll get it for you.

UL Class RK1 Fuses

Time Delay Ferrule Style

Time Delay Knife-Blade Style

Fast Acting Ferrule Style

Fast Acting Knife-Blade Style

A rejection-style end design safeguards against replacement errors. ½- to 60-amp fuses are ferrule style; 80- to 600-amp fuses are knife-blade style. UL listed and CSA certified. For fuse blocks, see 7688K and 4294K on page 997.

Time Delay—Also known as dual-element fuses. AC breakthrough current is 300,000 amps; DC breakthrough current is 100,000 amps.

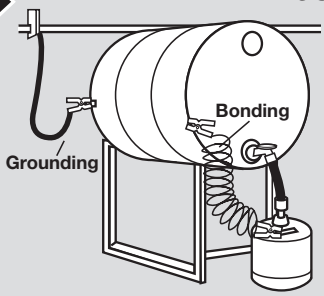
Fast Acting—AC breakthrough current is 200,000 amps; DC breakthrough current is 20,000 amps.

Choose a Current, A	V AC/V DC	*Overall* Dia.	Lg.		Each♦
Time Delay					
Manufacturer Equivalent: A2D-R, LLN-RK, LPN-RK					
½, 1, 1¼, 2	250/125	9/16″	2″	**74445K1**	$10.32
2½, 3, 5, 6	250/125	9/16″	2″	**74445K2**	10.33
10, 15, 20, 30	250/125	9/16″	2″	**74445K3**	8.81
40, 50, 60	250/125	13/16″	3″	**74445K63**	16.19
100	250/250	1 3/16″	5 7/8″	**74445K64**	36.37
200	250/250	1 11/16″	7 1/8″	**74445K65**	79.97
400	250/250	2 3/8″	8 5/8″	**74445K66**	144.02
600	250/250	2 7/8″	10 3/8″	**74445K67**	227.93
Manufacturer Equivalent: A6D-R, LLS-RK, LPS-RK					
½, 1, 1¼, 2, 2½	600/300	13/16″	5″	**74445K4**	21.82
3, 5, 10	600/300	13/16″	5″	**74445K5**	20.26
15, 20, 30	600/300	13/16″	5″	**74445K6**	18.26

♦ Prices are 10% lower when you buy in quantities of 10 or more.

Choose a Current, A	V AC/V DC	*Overall* Dia.	Lg.		Each♦
Time Delay (Cont.)					
Manufacturer Equivalent: A6D-R, LLS-RK, LPS-RK (Cont.)					
35, 40, 50, 60	600/300	1 1/16″	5 1/2″	**74445K73**	$32.44
100	600/300	1 3/16″	7 7/8″	**74445K74**	69.10
200	600/300	1 11/16″	9 5/8″	**74445K75**	137.09
400	600/300	2 3/8″	11 5/8″	**74445K76**	269.19
600	600/300	2 7/8″	13 3/8″	**74445K77**	361.66
Fast Acting					
Manufacturer Equivalent: A6K-R, KLS-R, KTS-R					
1, 2, 3, 4, 5, 6, 8, 10	600/250	13/16″	5″	**6616K11**	28.55
12, 15, 20, 25, 30	600/250	13/16″	5″	**6616K21**	28.55
40, 50, 60	600/300	1 1/16″	5 1/2″	**6616K33**	57.45
80, 90, 100	600/300	1 5/16″	7 7/8″	**6616K34**	114.95

About Bonding and Grounding for Static Control



Static electricity can be generated by material processing such as mixing, pouring, pumping, filtering, and agitating. Bonding and grounding equipment and containers can reduce static electricity in your environment and reduce the chance of a static spark igniting flammable vapors. Conductive metal objects such as screens, rims of nonconductive drums, probes, spray nozzles, and high-pressure cleaning equipment can become statically charged.

Bonding systems connect two or more pieces of equipment to keep the same electric potential among them, which prevents static sparking. ***Grounding*** systems electrically connect equipment to ground, which prevents equipment from becoming sufficiently charged to cause a static spark.

When the potential for static electricity problems exists, you should always comply with OSHA requirements as outlined in Section 1910.106 and 1910.107 of the OSHA code. NFPA 77 also provides guidance on static electricity. Flammable liquid dispensing should be performed in accordance with all federal, state, and local laws.

Bonding and Grounding Clamps and Cable

Aluminum Hand Clamp

Hand Clamp with Serrated Jaw

Stainless Steel Hand Clamp

Quick-Release Hand Clamp

C-Clamp

Create a grounding path with these metal clamps and cable to prevent static charge buildup.

Hand Clamps—*Aluminum* clamp has stainless steel points. *Stainless steel* clamp has tungsten carbide points.

Hand Clamp with Serrated Jaw—Has a flat steel-plated jaw to prevent damage to unpainted surfaces, posts, or thin materials.

Quick-Release Hand Clamps—Jaw opens if the cable is pulled. They have stainless steel points and are used to ground vehicles.

C-Clamps—*Bronze* clamp has bronze points. *Galvanized steel* clamps have stainless steel points.

Insulated Coiled Cable—Galvanized steel with an orange vinyl coating.

Material	Jaw Opening	Accepts Cable Dia.		
Hand Clamps				
Aluminum	1 1/8"	Up to 1/8"	70345K73	$14.68
Stainless Steel	1 1/2"	Up to 1/4"	70345K77	171.00
Hand Clamp with Serrated Jaw				
Aluminum	1"	Up to 1/8"	70345K81	20.14
Quick-Release Hand Clamps				
Aluminum	1 1/4"	Up to 1/4"	70345K74	53.80
Bronze	1 1/4"	Up to 3/8"	70345K75	67.32
C-Clamps				
Bronze	1 1/8"	Up to 1/4"	70345K66	53.80
Galvanized Steel	3/4"	Up to 1/4"	70345K65	13.28
Galvanized Steel	2 1/2"	Up to 1/4"	70345K67	14.38
Insulated Coiled Cable				
5-ft. Length; 1/8" Diameter			70345K11	9.07
10-ft. Length; 1/8" Diameter			70345K12	18.09
20-ft. Length; 1/8" Diameter			70345K13	27.28
20-ft. Length; 1/4" Diameter			70345K14	39.00

Bonding and Grounding Cable with Connectors

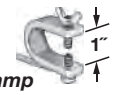
Cable with Two Connectors

Coiled Cable with Two Connectors

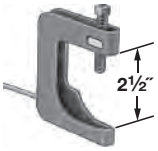
Alligator Clip

Hand Clamp

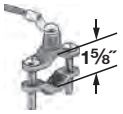
Terminal



C-Clamp



Large Dia. Pipe Clamp



Small Dia. Pipe Clamp

Quick-Release Hand Clamp

Choose the cable and connector configuration to suit your bonding or grounding requirements.

Cable with three connectors consists of a straight line of cable with a clamp at either end and one in the middle.

Cable is galvanized steel. *Bare* and *insulated cable* are 1/8" dia. *Insulated cable* has a clear vinyl coating. *Insulated coiled cable* has an orange vinyl coating. *Heavy duty insulated coiled cable* is 3/16" dia.

Alligator clips are copper. *Hand clamps* are aluminum. *Terminals* are tin-plated copper for cable with a terminal on both ends; galvanized steel for cable with a hand clamp and terminal. *C-clamps* are galvanized steel. *Large diameter pipe clamps* are plated steel. *Small diameter pipe clamps* are bronze. Quick-release hand clamp is aluminum and opens when the cable is pulled.

Also Available: Additional cable lengths for Cable with Two Connectors. For bare and insulated cable, please ask for 6955K888; for insulated coiled cable, ask for 6955K53. Specify connector types and length.

Cable with Two Connectors

Connector Type	Cable Lg.		
Bare Cable			
Alligator Clip on Both Ends	3 ft.	6955K3	$22.34
Hand Clamp on Both Ends	3 ft.	6955K9	44.93
Terminal on Both Ends	3 ft.	6955K4	10.20
C-Clamp and Alligator Clip	3 ft.	6955K2	33.51
Hand Clamp and C-Clamp	3 ft.	6955K8	44.80
Insulated Cable			
Hand Clamp on Both Ends	3 ft.	6955K12	46.24
Terminal on Both Ends	3 ft.	6955K6	13.11
C-Clamp and Alligator Clip	3 ft.	6955K5	34.83
Hand Clamp and C-Clamp	3 ft.	6955K13	46.12
Large Diameter Pipe Clamp and C-Clamp	3 ft.	6955K7	67.24
Insulated Coiled Cable			
Hand Clamp on Both Ends	10 ft. extended	7610K71	44.45
Hand Clamp on Both Ends	20 ft. extended	7610K21	49.74
Hand Clamp on Both Ends	30 ft. extended	7610K22	55.50
Hand Clamp and Terminal	5 ft. extended	7610K66	30.56
Hand Clamp and Terminal	10 ft. extended	7610K67	31.66
Hand Clamp and Terminal	20 ft. extended	7610K68	38.03
Hand Clamp and Terminal	30 ft. extended	7610K65	44.41
Hand Clamp and Small Diameter Pipe Clamp	10 ft. extended	7610K69	41.97
Hand Clamp and Small Diameter Pipe Clamp	20 ft. extended	7610K81	48.22
Hand Clamp and C-Clamp	10 ft. extended	7610K72▲	46.59
Heavy Duty Insulated Coiled Cable			
Quick-Release Hand Clamp and Terminal	20 ft. extended	6997K55	77.80

▲C-clamp jaw opening is 3/4".

(Continued on following page)

AC to AC Transformers

About AC to AC Voltage Transformers

Transformers— An AC to AC transformer typically converts alternating current (AC) from one voltage to another. It can be designed to "step up" (boost or increase) voltage or "step down" (buck or decrease) voltage. Transformers consist of two or more coils. When voltage is sent to the primary coil, it magnetizes the coil's core, inducing a voltage in the secondary coil.

Sensitive Equipment Transformers— Also known as isolating transformers, their primary and secondary coils are electrically isolated from each other. The transformer protects sensitive equipment from any input voltage spikes. They are typically larger and more expensive than transformers with connected primary and secondary coils.

High-Inrush Transformers— Also known as control transformers, these are designed for applications with high-inrush loads temporarily exceeding the VA (volt-amps) power output, such as starting and stopping motors. They have electrically isolated primary and secondary coils like sensitive equipment transformers.

Selecting the Right Transformer

1. Determine your input (line) and output (load) voltages and choose a transformer with matching input and output voltages.

2. Determine the power required by the equipment you're running. It's usually listed in kVA (kilovolt-amps) or VA (volt-amps) on the equipment's nameplate.

Choose a transformer with a power output that is equal to or greater than your equipment's power requirements.

For single-phase equipment, use this formula to find VA:

VA = Volts × Amps

For three-phase equipment, use this formula to find VA:

VA = Volts × Amps × 1.73

Sensitive Equipment AC to AC Transformers

Single Phase

Three Phase

Protect your sensitive equipment from input voltage spikes. The cores and coils are sealed to eliminate corrosion and insulation damage. Enclosure is rated UL-3R for indoor and outdoor use except single-phase transformers with 750-5,000 VA output are rated NEMA 3R. Also known as isolating transformers, they have copper wire lead connections except three-phase transformers with 30,000 and higher VA output, which have a bus bar. Wall mountable except for three-phase transformers with 15,000 and higher VA output, which are floor mount. Operate on 60 Hz. UL listed and CSA certified except single-phase transformers with 750-5,000 VA output are UL and C-UL listed.

Single-phase constant voltage transformers are used when you need to isolate the input and output voltages without changing their values.

Voltage (VAC)		Power					
Input	Output	Output, VA	Ht.	Wd.	Dp.		
Single Phase							
240/480	120/240	750	11.3″	5.3″	6.5″	7131K19	$159.07
240/480	120/240	1,000	11.3″	5.3″	6.5″	7131K21	182.20
240/480	120/240	1,500	13.3″	6.3″	7.8″	7131K22	255.75
240/480	120/240	3,000	13.3″	6.3″	7.8″	7131K23	380.00
240/480	120/240	5,000	15″	10.2″	10.6″	7131K24	555.00
240/480	120/240	7,500	15.2″	13.5″	10.8″	7131K25	613.05
240/480	120/240	10,000	15.2″	13.5″	10.8″	7131K26	719.25
240/480	120/240	15,000	16.9″	14.1″	11.6″	7131K27	898.78
240/480	120/240	25,000	18.4″	16.1″	13.3″	7131K28	1,186.27
Three Phase							
480	208y/120	3,000	10.4″	12.4″	7.5″	7131K38	707.63
480	208y/120	6,000	11.8″	14.2″	8.8″	7131K39	878.90
480	208y/120	9,000	14″	17.8″	11.5″	7131K41	1,076.50
480	208y/120	15,000	18.9″	20.3″	9″	7131K42	1,423.15
480	208y/120	30,000	25.5″	24.4″	19.4″	7131K43	1,817.57
480	208y/120	45,000	25.5″	24.4″	19.4″	7131K44	2,165.77
480	208y/120	75,000	29.4″	28.2″	22.4″	7131K45	3,071.23
Single Phase Constant Voltage							
120/240	120/240	1,000	10.5″	5.5″	5.1″	6989K21	225.38
120/240	120/240	2,000	13″	5.5″	5.1″	6989K23	378.47
120/240	120/240	3,000	11.5″	10.3″	7.1″	6989K24	469.42
120/240	120/240	5,000	14.4″	10.3″	7.1″	6989K25	672.72

Sensitive Equipment AC to AC Transformers with Plug and Outlet

NEMA 5-15 **NEMA 6-15**

Easily connect and disconnect devices that need 115 VAC power that's free of voltage spikes. They're also known as isolating transformers. Operate on 50/60 Hz.

With NEMA 5-15 Plug and NEMA 5-15 Outlet— Also known as constant voltage transformers, use when you need to isolate the input and output voltages without changing their values.

Voltage (VAC)		Power					
Input	Output	Output, VA	Ht.	Wd.	Dp.		
With NEMA 5-15 Plug and NEMA 5-15 Outlet							
115	115	150	3.9″	3.1″	4.2″	70245K71	$117.45
115	115	250	4.7″	3.8″	4.4″	70245K72	170.15
115	115	500	4.7″	3.8″	6″	70245K73	230.76
115	115	1,000	5.4″	4.4″	8.1″	70245K74	366.78
With NEMA 6-15 Plug and NEMA 5-15 Outlet							
230	115	100	3.5″	2.8″	3.6″	70245K81	127.78
230	115	250	4.7″	3.8″	4.4″	70245K83	155.87
230	115	500	4.7″	3.8″	6″	70245K84	196.93
230	115	1,000	5.4″	4.4″	8.1″	70245K85	379.48

Power-Conditioning Sensitive Equipment AC to AC Transformers

Get protection against three-millisecond power dips and spikes and electromagnetic interference. These transformers also isolate output and input voltage (output regulation is ±3% with input voltage fluctuations from +10% to –20%). They're also known as isolating transformers. All have screw terminal connections, are wall or floor mountable, and operate on 60 Hz. UL listed and CSA certified.

Voltage (VAC)		Power Output,					
Input	Output	VA	Ht.	Wd.	Dp.		
120/208/240/480	120/208/240	140	4.4″	6″	8.5″	7425K33	$448.08
120/208/240/480	120/208/240	250	4.4″	6″	9.7″	7425K34	586.54
120/208/240/480	120/208/240	500	6.5″	6.3″	12.3″	7425K35	871.15
120/208/240/480	120/208/240	750	6.5″	6.3″	13.3″	7425K36	1,103.85
120/208/240/480	120/208/240	1,000	6.5″	6.3″	14.2″	7425K37	1,321.15
120/208/240/480	120/208/240	1,500	9.9″	9.4″	17.6″	7425K39	1,778.85
120/208/240/480	120/208/240	3,000	9.9″	9.4″	19.9″	7425K42	3,050.94

Step-Down AC to AC Transformers

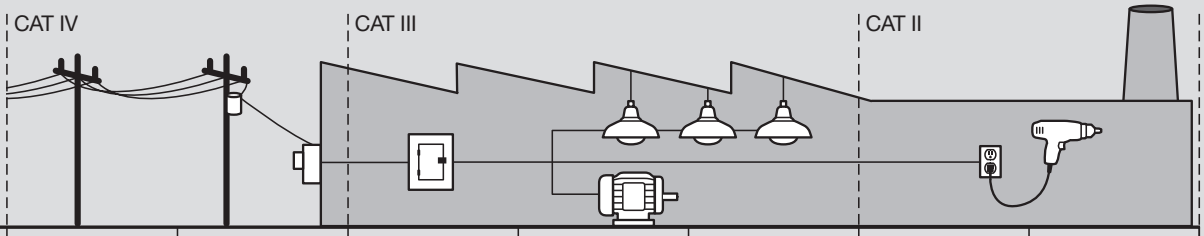
Even if you only have a 240 VAC connection, these transformers can power 120 VAC or 240 VAC devices. They're also known as auto transformers. The coils and cores are sealed to eliminate corrosion and insulation damage; enclosure is rated UL-3R for indoor and outdoor use. All have copper wire lead connections, are wall mountable, and operate on 60 Hz. UL listed and CSA certified.

Voltage (VAC)		Power					
Input	Output	Output, VA	Ht.	Wd.	Dp.		
240	120/240	1,000	9.1″	4.4″	4.2″	7029K43	$214.12
240	120/240	1,500	9.7″	4.5″	4.5″	7029K44	272.78
240	120/240	2,000	10.5″	5.5″	5.1″	7029K45	307.35
240	120/240	3,000	11.6″	5.5″	5.1″	7029K46	368.85
240	120/240	5,000	13″	5.5″	5.1″	7029K47	619.67

About Safety Ratings for Electrical Testing

Choosing the right electrical testing equipment depends on where you will be using it and what level of voltage protection you need. Safety rating standards are set by the International Electrotechnical Commission (IEC). The closer you are to the utility power source, the higher the category (CAT) safety rating your testing equipment needs to have. As part of the safety rating, electrical testing equipment is also given a voltage rating.

The safety rating also takes into account the equipment's ability to resist a voltage spike, also known as transient overvoltage protection. These spikes from lightning or a power surge can damage your electrical equipment.



Safety Rating	CAT IV, 1,000V	CAT IV, 600V	CAT III, 1,000V	CAT III, 600V	CAT III, 300V	CAT II, 600V	CAT II, 300V
Transient Overvoltage Protection	12,000V	8,000V	8,000V	6,000V	4,000V	4,000V	2,500V
Applications	Three-phase power at utility connection • Outdoor overhead and underground cable runs • Electricity meters		Three-phase distribution panels and wiring • Commercial lighting systems • Feeder circuits • Permanently installed loads such as switchgears and three-phase motors			Single-phase loads plugged into electrical receptacles • Most 120V or 240V equipment inside a building • Appliances and portable tools	

Fluke Multimeters

Rely on the quality and durability of a Fluke multimeter when taking voltage, resistance, and other electrical measurements.

Multimeters with calibration certificate include a NIST-traceable document stating that they have passed a test for accuracy.

Average sensing multimeters take accurate AC measurements when testing equipment that has a linear load and draws current in a smooth sine wave, such as standard induction motors.

True RMS multimeters take accurate AC measurements regardless of the load type or sine wave shape. This is important for testing electronic devices that draw current in short pulses that can distort the shape of the wave, such as computers and adjustable-speed drives.

Display count is an industry designation and not an actual value. For example, a 1,000-count meter shows numbers up to 999. A higher display count means the meter can give a more precise measurement.

General Purpose Multimeters

Maximum resistance is 40 MΩ, except maximum resistance of Fluke 77IV is 50 MΩ, and Fluke 113 is 60 kΩ. Maximum capacitance is 9,999 µF, except Fluke 114 does not measure capacitance. Batteries are included. These multimeters are CSA certified to U.S. and Canadian standards.

Mfr. Model No.	Safety Rating	Max. AC/DC Voltage	DC Voltage Accuracy	Max. Current AC	Max. Current DC	Max. Frequency	Display Count	Includes	Meters		Meters with Calibration Certificate	
Average Sensing												
77IV	IV, 600V	1,000V	0.3%	10 A	10 A	100 kHz	6,000	Test Leads	7093K82	$354.99	7093K84	$451.32
True RMS												
113	III, 600V	600V	2%	—	—	1 kHz	6,000	Test Leads	7093K141	149.99	7093K142	236.18
114	III, 600V	600V	0.5%	—	—	—	6,000	Test Leads	7093K753	169.99	7093K754	256.18
115	III, 600V	600V	0.5%	10 A	10 A	50 kHz	6,000	Test Leads	7093K755	199.99	7093K756	286.18
116	III, 600V	600V	0.5%	600 µA	600 µA	100 kHz	6,000	Temp. Probe, Test Leads	7093K751	195.99	7093K752	282.18
117	III, 600V	600V	0.5%	10 A	10 A	100 kHz	6,000	Test Leads	7093K761	214.99	7093K762	301.18
117/323	III, 600V	600V	0.5%	400 A	10 A	100 kHz	6,000	Carrying Case, Fluke 323 Clamp Meter, Magnetic Hanger, Test Leads	7093K765	354.99	7093K766	505.83

High-Accuracy Multimeters

These Fluke multimeters provide results at least twice as accurate as general purpose Fluke multimeters. Maximum resistance is 50 MΩ. Maximum capacitance is 9,999 µF. Batteries are included. These multimeters are UL listed and CSA certified, except Fluke 83V, 87V, 87V/E2, and 87V/IMSK are CSA certified to U.S. and Canadian standards.

Mfr. Model No.	Safety Rating	Max. AC/DC Voltage	DC Voltage Accuracy	Max. Current AC	Max. Current DC	Max. Frequency	Display Count	Includes	Meters		Meters with Calibration Certificate	
Average Sensing												
83V	IV, 600V	1,000V	0.1%	10 A	10 A	200 kHz	6,000	Alligator Clips, Test Leads	7093K53	$399.99	7093K531	$534.35
88V	IV, 600V	1,000V	0.1%	10 A	10 A	200 kHz	20,000	High-Impact Holster, Test Leads	7093K143	499.99	7093K144	615.34
True RMS												
175	IV, 600V	1,000V	0.15%	10 A	10 A	100 kHz	6,000	Test Leads	7093K19	299.99	7093K191	392.52
177	IV, 600V	1,000V	0.09%	10 A	10 A	100 kHz	6,000	Test Leads	7093K22	329.99	7093K222	422.52
179	IV, 600V	1,000V	0.09%	10 A	10 A	100 kHz	6,000	Temp. Probe, Test Leads	7093K23	349.99	7093K231	442.52
87V	IV, 600V	1,000V	0.05%	10 A	10 A	200 kHz	20,000	Alligator Clips, Temp. Probe, Test Leads	7093K75	429.99	7093K551	565.62
87V/E2	IV, 600V	1,000V	0.05%	10 A	10 A	200 kHz	20,000	Alligator Clips, Carrying Case, Magnetic Hanger, Temp. Probe, Test Leads	7093K86	599.99	7093K651	712.80

(Continued on following page)

About Air Compressors

Air-Flow and Pressure Requirements—It's important to consider your compressor's air flow in cubic feet per minute (cfm). To determine the air-flow requirements, total the cfm requirements of all the air-powered tools your compressor will be operating simultaneously. Your compressor should also exceed the pressure (psi) requirement of the highest-pressure-rated tool to which it will be supplying power. Add 20%-30% to allow for system variables and future expansion.

Stationary Air Compressors

Horizontal

Vertical

These compressors have an ASME-rated tank and are continuous duty. They turn on when the tank falls to the activation pressure and turn off when the tank reaches the maximum pressure. All generate lubricated air and come lubricated with 30W oil. Body and crank case are cast iron. Compressors have a relief valve, pressure gauge, and manual tank drain. Outlet is NPT female. UL listed.

Electric compressors have overload protection and must be hardwired.

Gas-powered compressor has an electric starter.

Airflow, cfm @ Max. Pressure	Max. Pressure, psi	Activation Pressure, psi	hp	Full Load Current, amps	Tank Cap., gal.	Decibel Rating	Outlet Pipe Size	Horizontal Overall Lg.	Horizontal Overall Wd.	Horizontal Overall Ht.			Vertical Overall Lg.	Vertical Overall Wd.	Vertical Overall Ht.		
Electric Compressors																	
200V AC@60 Hz, Three Phase																	
17.2	175	135	5	17.5	80	74	¾	70″	23″	47″	4364K21	$2,480.00	37″	24″	74″	41905K21	$2,225.64
22.6	175	135	7½	25.3	80	80	¾	70″	23″	47″	4364K411	2,801.60	37″	24″	74″	41905K41	2,535.38
35	175	135	10	32.2	120	86	1	78″	28″	55″	4364K61	4,173.60	—	—	—	—	—
230V AC@60 Hz, Single Phase																	
17.2	175	135	5	28	80	74	¾	70″	23″	47″	4364K1	2,679.20	37″	24″	74″	41905K1	2,451.56
22.6	175	135	7½	40	80	80	¾	70″	23″	47″	4364K3	3,083.20	37″	24″	74″	41905K3	2,766.97
230V AC@60 Hz, Three Phase																	
17.2	175	135	5	15.2	80	74	¾	70″	23″	47″	4364K22	2,480.00	37″	24″	74″	41905K22	2,225.64
22.6	175	135	7½	22	80	80	¾	70″	23″	47″	4364K42	2,801.60	37″	24″	74″	41905K42	2,535.38
35	175	135	10	28	120	86	1	78″	28″	55″	4364K62	4,173.60	—	—	—	—	—
460V AC@60 Hz, Three Phase																	
17.2	175	135	5	7.6	80	74	¾	70″	23″	47″	4364K23	2,480.00	37″	24″	74″	41905K23	2,225.64
22.6	175	135	7½	11	80	80	¾	70″	23″	47″	4364K43	2,801.60	37″	24″	74″	41905K43	2,535.38
35	175	135	10	14	120	86	1	78″	28″	55″	4364K63	4,173.60	—	—	—	—	—
Gas-Powered Compressor																	
With 1.9-Gallon Fuel Tank																	
23.6	175	165	14	—	30	120	½	42″	21″	40″	41865K1	2,854.40	—	—	—	—	—

Replacement Belts, Filter Elements, and Oil

Drive Belt for 5 hp Motor	4364K71	$35.48	Drive Belt for 14 hp Motor	4364K74	$58.76
Drive Belt for 7½ hp Motor	4364K72	44.53	Filter Element	4364K75	25.44
Drive Belt for 10 hp Motor	4364K73	51.60	30W Oil (1 qt.)	4364K76	37.68

Portable Air Compressors

Single Tank

Single Tank with Wheels

Double Tank with Wheel

Compressors turn on when the tank falls to the activation pressure and they turn off when the tank reaches the maximum pressure. They have a single-phase motor with an electric starter and thermal overload protection. Tank has a manual drain.

Single-tank compressor is continuous duty, does not require lubrication, and generates nonlubricated air. It has a relief valve, a tank pressure gauge, and an outlet pressure gauge. Body and crank case are aluminum. It has a 5-ft. cord with plug. Outlet is NPT female.

Single-tank compressor with wheels is intermittent duty, generates lubricated air, and requires 30W oil for lubrication. It has a relief valve, a tank pressure gauge, and an air intake filter. Body is steel and crank case is aluminum. It has an 8-ft. cord with plug. Outlet is NPT male.

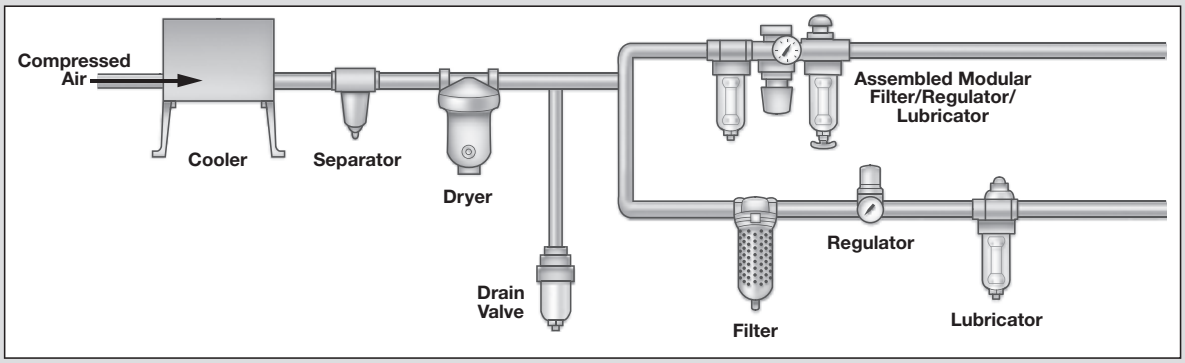
Double-tank compressors with wheel are continuous duty, generate lubricated air, and require 10W to 40W oil for lubrication. They have a pressure gauge and two quick-disconnect fittings. Body and crank case are cast iron. They have a 6-ft. cord with plug. Outlet is NPT female. UL listed.

Airflow, cfm @ 90 psi	Max. Pressure, psi	Activation Pressure, psi	hp	AC Voltage @ 60 Hz	Full Load Current, amps	Tank Cap., gal.	Decibel Rating	Outlet Pipe Size	Overall Lg.	Overall Wd.	Overall Ht.	Weight, lbs.		
Compressors														
Single Tank														
3	150	120	4/5	120	10	6	82	¼	16″	16″	18″	34	9965K62	$165.39
Single Tank with Wheels														
6.5	140	110	3	120	13.8	5.2	90	¼	19½″	19″	29″	88	9965K64	397.05
Double Tank with Wheel														
5.7	135	95	2	115	15	8	74	⅜	43″	18″	25″	175	4309K6	983.36
11.3	135	95	3	230	15	8	77	⅜	43″	18″	25″	175	4309K7	1,023.29

Replacement Belts, Filter Elements, and Oil for Double-Tank Compressors with Wheel

Drive Belt for 2 hp Motor	4309K11	$48.00	Filter Element	4309K13	$16.00
Drive Belt for 3 hp Motor	4309K12	27.20	20W40 Oil (0.5 liters)	4309K14	17.60

About Air Preparation



High-pressure air isn't all you get when you use a compressor—you also get water, dirt, oil, and other contaminants. Before using compressed air, it should be filtered, regulated, and in some cases, lubricated. Correctly prepared air ensures the quality and service life of your air-powered tools and equipment, including air cylinders.

Moisture Removal (Pages 1041-1045)—The first step toward dry air starts with air coolers (also known as aftercoolers), moisture separators, air dryers, and moisture drain valves. Place these items after a compressor to remove moisture from the compressed air before it enters your system. *Air coolers* (page 1041) lower the compressed air temperature, while *moisture separators* (pages 1041-1042) dispose of the condensation that occurs during this process. *Air dryers* (pages 1044-1045) remove any remaining moisture, while *moisture drain valves* (pages 1041-1043) allow you to discharge the moisture.

Filters (Pages 1045-1049)—Once you've cooled your air and removed the majority of moisture, it's necessary to filter out the remaining dirt particles, oil, oil vapors, and other damaging elements. Air filters remove solid particles and any remaining water from your system, while oil-removal or coalescing filters remove oil mist. We also offer odor-removal air filters and bacteria-removal air filters. Install filters upstream of regulators and lubricators to protect them from contamination.

Regulators (Pages 1049-1053)—Control air pressure to increase performance, save energy, and ensure the continuous, safe operation of your air-powered equipment. The pressure you need should be in the middle of the given regulating range. Relieving-style regulators exhaust excess downstream pressure; nonrelieving regulators do not.

Lubricators (Page 1053)—Introduce oil droplets into compressed air at a controlled rate. They provide point-of-use lubrication.

Filter/Regulator/Lubricators (Pages 1054-1060)—Also known as FRLs, these products conveniently combine a filter, regulator, and lubricator into a compact unit.

Water-Cooled Air Coolers

Connect these coolers to a cold-water line to cool hot air coming from a compressor—no electricity needed. Also known as after-coolers, all require a flow rate of 3 gpm per 100 scfm and are able to cool air to within 15° F of your inlet water. The cooling action condenses most of the water from your compressed air system. A moisture separator with drain is required to collect the condensed water (sold separately; see 43775K51-43775K55 on page 1042).

Coolers have a brass shell and copper tube assembly. They also have cast iron end caps that can be removed for cleaning. Max. pressure is 250 psi. Max. temperature is 250° F. Inlet and outlet connections are NPT female.

Pipe Size		Max. scfm	O'all Size				
Air	Water	@100 psi	Ht.	Wd.	Dp.		
1 1/2	1/2	40	3 1/2"	2 5/8"	3 3/8"	43865K76	$397.37
1 1/2	1/2	80	3 1/2"	2 5/8"	4 2 3/8"	43865K77	458.77
1 1/2	1/2	150	3 1/2"	2 5/8"	5 1 3/8"	43865K78	487.72
2 1/2	1	310	6 1/4"	5 1/4"	5 0 1/2"	43865K79	909.17

Moisture Separators with Oil-Removal Filter

In addition to removing water and solids down to 3 microns, these separators trap oil droplets down to 5 ppm. Place them after your compressor and air cooler, or at the point of use in applications that don't require an air cooler.

All have an automatic drain and a liquid-level indicator. Body and bowl are aluminum. Filter is cotton paper for pipe sizes 1/8 and 1/4; fiber with a stainless steel core for all others. Max. pressure is 145 psi for pipe sizes 1/8 and 1/4; 250 psi for all others. Max. temperature is 140° F. Inlet and outlet connections are NPT female.

Pipe Size	Max. scfm @ 100 psi	O'all Size Ht.	Wd.	Dp.	Separators		Repl. Filter Elements	
1/8	11	6 7/8"	2 1/2"	2 3/4"	7341K42	$91.57	7341K44	$43.08
1/4	26	7 3/8"	3"	3 1/4"	7341K43	115.88	7341K45	43.08
3/8	20	9 1/8"	4 1/8"	4 1/8"	7341K31	255.05	7341K1	63.22
1/2	20	9 1/8"	4 1/8"	4 1/8"	7341K32	255.05	7341K1	63.22
1/2	35	11 1/8"	4 1/8"	4 1/8"	7341K34	283.03	7341K2	69.44
1/2	60	13 3/8"	4 1/8"	4 1/8"	7341K36	372.47	7341K3	100.53
3/4	100	15 5/8"	5 1/4"	5 1/4"	7341K37	436.34	7341K4	112.96
1	100	15 5/8"	5 1/4"	5 1/4"	7341K38	436.34	7341K4	112.96

Fan-Cooled Air Coolers

Also known as aftercoolers, these coolers have a fan to chill hot air coming from compressors. The cooling action condenses most of the water from your compressed air system. A moisture separator with drain is required to collect the condensed water (sold separately; see 43775K51-43775K55 on page 1042). All coolers have a steel housing. They also have a heat exchanger with aluminum fins and copper tubing. Mount to the floor, wall, or ceiling (except 150-scfm cooler is for floor mounting only).

Coolers have a 1/12 hp, single-phase motor (except 150-scfm cooler has a 1/4 hp motor) that operates on 115 volts AC @ 60 Hz. Max. scfm ratings are based on cooling hot compressed air to within 15° F of the ambient air. Max. pressure is 250 psi. Max. temperature is 250° F. Inlet and outlet connections are NPT male. Motor has UL recognized components; CSA certified.

Pipe Size	Max. scfm @ 80-125 psi	O'all Size Ht.	Wd.	Dp.		
1/2	20	22"	2 0 3/8"	9 5/8"	5171K51	$462.31
1/2	35	22"	2 0 3/8"	9 5/8"	5171K52	517.69
1	50	4 2 1/4"	2 6 1/8"	1 5 1/2"	5171K53	625.38
1 1/2	100	4 2 1/4"	2 6 1/8"	1 5 1/2"	5171K54	928.46
1 1/2	150	4 6 1/2"	4 3 1/2"	1 8 3/4"	5171K55	1,323.08

High-Pressure Moisture Drain Valves

Remove condensate in compressed air systems that have as much as 600 psi of pressure. Back pressure from compressed airflow activates a disc in these valves, which allows moisture to escape. The moisture is atomized as it is discharged, eliminating the need for discharge piping. An integral muffler minimizes noise.

Connect these valves to your air compressor, air cooler, moisture separator, dryer, or filter. If used outdoors, mount them vertically to prevent freezing. Body is steel; internal parts are stainless steel. Max. temperature is 220° F. Inlet and outlet connections are NPT female. All meet OSHA noise requirements.

Pipe Size	Discharge Cap. @ 100 psi, gpm	O'all Size Ht.	Wd.	Dp.		
3/8	0.4	5"	2 5/8"	2 5/8"	4372K5	$481.82
1/2	0.4	5 1/2"	2 5/8"	2 5/8"	4372K8	481.82
Replacement Muffler for 4372K5					4372K3	26.79
Replacement Muffler for 4372K8					4372K4	35.71

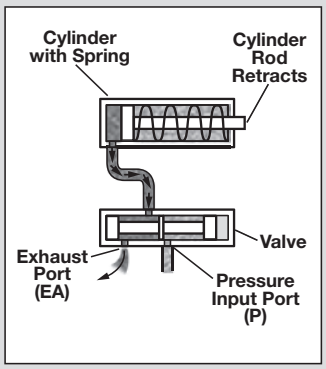
About Choosing a Directional Control Valve

Sending air pressure to the right place at the right time and then exhausting that pressure when it's no longer needed is a directional control valve's job. Use the following information to select a valve that fits your application.

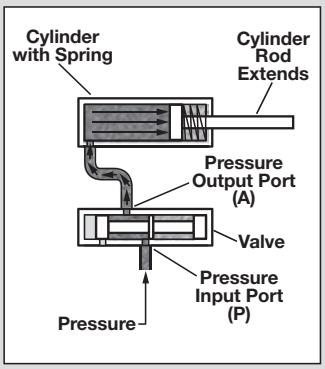
Choose a Valve to Control a Single-Acting Air Cylinder with Spring Return or a Double-Acting Air Cylinder

To Control a Single-Acting Cylinder with Spring Return— Choose a *3-way valve*. All 3-way valves have *two positions* (open and closed). A *normally open valve* lets air pass through the valve when it is in its resting position. A *normally closed valve* stays closed until activated.

The most common 3-way valve has three ports: one pressure input port to connect to your compressed air source, one pressure output port to connect to your cylinder, and one exhaust port. The following illustration shows a 3-way, two-position valve controlling a single-acting spring-return cylinder:



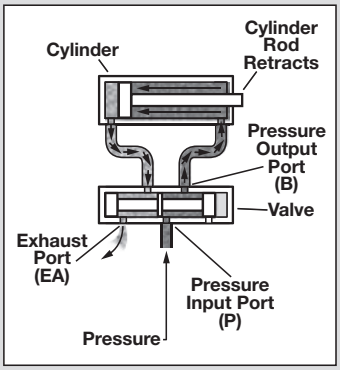
Valve Position 1— Valve is closed and exhausts air as the spring retracts the cylinder rod.



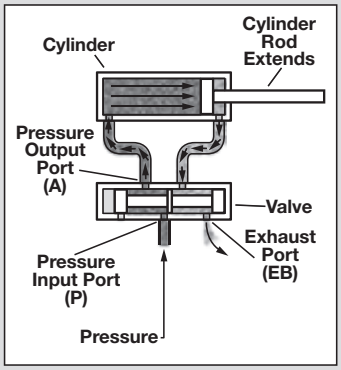
Valve Position 2— Valve is open and sends pressure to extend the cylinder rod.

To Control a Double-Acting Cylinder— Choose a *4-way valve*. They are available with *two positions* (open and closed) or *three positions* (open, center, and closed). For three-position valves, choose the center function: closed (all ports closed), exhaust (both exhaust ports open), or pressure (air flowing to both pressure outputs).

The most common 4-way valve has two positions and five ports: one pressure input port to connect to your compressed air source, two pressure output ports to connect to your cylinder, and two exhaust ports. The following illustration shows a 4-way, two-position valve controlling a double-acting cylinder:



Valve Position 1— Valve sends pressure to output B to retract the cylinder rod while EA exhausts air.



Valve Position 2— Valve sends pressure to output A to extend the cylinder rod while EB exhausts air.

Select Your Valve Configuration

Method of Operation— Valves can be operated manually, automatically, or with a solenoid. Once a *manual-return valve* is moved into a position, the valve stays in that position until you move the operator (lever, knob, or pedal) again. For *automatic-return valves*, a spring returns the valve to its original position once you let go of the operator. *Solenoids* send a signal to activate the valve and allow automation with computers and programmable logic controllers (PLCs).

Number of Ports— *3-way valves* have two or three ports. Two-port styles do not have a separate exhaust port, while three-port styles do. Choose three ports to extend and retract cylinders at the same speed.

4-way valves have four or five ports. Choose four ports (which have one exhaust outlet) to extend and retract cylinders at the same speed. Choose five ports (which have two exhaust outlets) to extend and retract cylinders at different speeds.

Flow Coefficient (Cv)— Flow coefficient is a measurement that indicates how much airflow a control valve can provide to your cylinder. The higher the flow coefficient value, the higher the airflow rate. Looking at valves with the same port size, but different flow coefficient values and not sure which one to choose? Select the one with the higher flow coefficient value because low airflow can slow down your entire system.

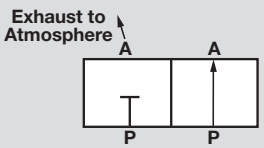
Match Your National Fluid Power Association (NFPA) Diagrams

Found on most directional control valves, these diagrams depict airflow and valve action. They're useful for replacing control valves—match the diagram on your valve to the diagrams shown here to determine the number of ways, ports, and positions you need.

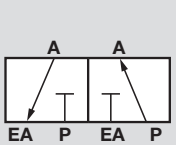
P= Pressure input port
A and **B=** Pressure output ports
EA and **EB=** Exhaust ports

Some valves use a numbering system:
1= Pressure input port
2 and **3=** Pressure output ports
4 and **5=** Exhaust ports

3-Way Valves, Two Positions

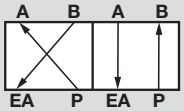


With Two Ports

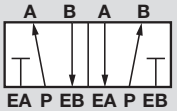


With Three Ports

4-Way Valves, Two Positions

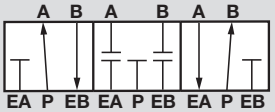


With Four Ports

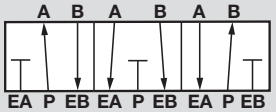


With Five Ports

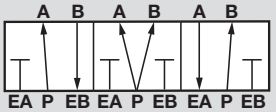
4-Way Valves, Three Positions



With Five Ports (Closed Center)



With Five Ports (Exhaust Center)



With Five Ports (Pressure Center)

Solenoid Air Directional Control Valves with Flow Controls

In addition to sending air pressure to the right place at the right time, these valves can control the speed of that air pressure. All of these solenoid-operated valves can be operated remotely as well as in automated processes.

Valves are made of polyacetal and have an 8 mm female DIN connector and two M14 exhaust ports. Power draw is 2.7 watts for DC valves; 3.7 volt-amps for AC valves. Not vacuum rated.

Single-solenoid valves move into position when electrical current is supplied; a spring returns the valves to their original position once current is removed.

Double-solenoid valves move into position when electrical current is supplied to the first solenoid and return to their original position when current is supplied to the second solenoid.

To Order: Please specify 24V DC or 120V AC.

No. of Ports	Positions No.	Positions Center	Port Size, Inlet/Outlet	Max. scfm @ 100 psi	Flow Coefficient	Operating Pressure Range, psi	Wd.	Ht.	Single Solenoid Lg.			Double Solenoid Lg.		
4-Way Valves for Double-Acting Cylinders														
5	2		For 1/4" Tube OD	24.7	0.7	20-150	1 3/8"	2 3/4"	4 3/4"	4666A7	$124.60	7 3/8"	4666A5	$204.96
5	2		For 3/8" Tube OD	24.7	0.7	20-150	1 3/8"	2 3/4"	4 3/4"	4666A2	124.60	7 3/8"	4666A1	204.96
5	3	Closed	For 1/4" Tube OD	24.7	0.7	20-150	1 3/8"	2 3/4"	____	____	____	7 3/8"	4666A8	303.96
5	3	Pressure	For 1/4" Tube OD	24.7	0.7	20-150	1 3/8"	2 3/4"	____	____	____	7 3/8"	4666A9	377.84
5	3	Closed	For 3/8" Tube OD	24.7	0.7	20-150	1 3/8"	2 3/4"	____	____	____	7 3/8"	4666A3	303.96
5	3	Pressure	For 3/8" Tube OD	24.7	0.7	20-150	1 3/8"	2 3/4"	____	____	____	7 3/8"	4666A4	377.84

About Flow Control Valves

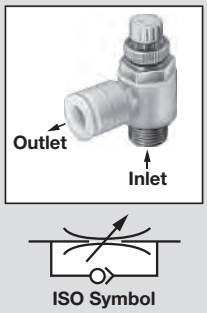
Also known as cylinder speed controls, flow control valves let you control the extension or retraction speed of your air cylinder. They regulate airflow in the flow-control direction (inlet to outlet) and allow air to flow freely in the other direction. Use the dial on the valve to adjust the airflow rate.

Connect flow control valves to the port of your cylinder. Choose a valve to control airflow as it exits the cylinder (meter out) or control airflow as it enters the cylinder (meter in). When in doubt, meter out.

Flow Coefficient (Cv)—Is a measurement that indicates how much airflow a control valve can provide to your cylinder. The higher the flow coefficient value, the higher the airflow rate. Looking at valves with the same port size, but different flow coefficient values and not sure which one to choose? Select the one with the higher flow coefficient value because low airflow can slow down your entire system.

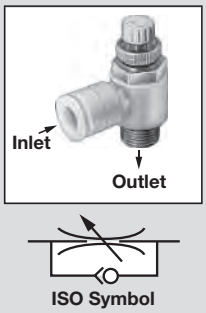
ISO Symbol—Found on most flow control valves, this symbol depicts the direction of airflow through the valve.

Valve Controls Airflow as it Exits Cylinder (Meter Out)



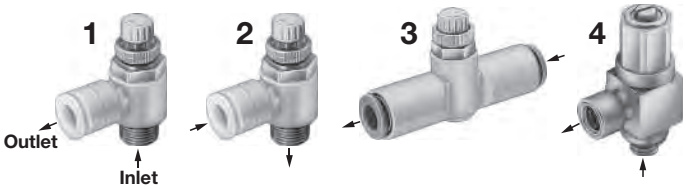
ISO Symbol

Valve Controls Airflow as it Enters Cylinder (Meter In)



ISO Symbol

Corrosion-Resistant Air Flow Control Valves



Made with stainless steel parts, these valves can handle corrosive environments. They regulate airflow in the flow-control direction (inlet to outlet) and let air flow freely in the other direction. Maximum pressure is 145 psi.

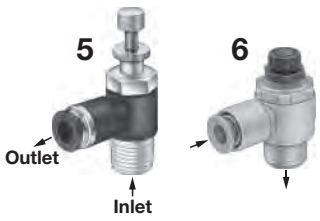
Plastic Valves—Have Type 303 stainless steel internal parts. Use the dial to adjust the airflow rate.

All-Stainless-Steel Valves—Made entirely of Type 316 stainless steel. Use the adjustment screw to adjust the airflow rate.

Inlet	Outlet	Max. scfm @ 100 psi	Flow Coefficient		
Plastic Valves with Stainless Steel Internal Parts					
(1) Male Thread to Push-to-Connect Tube—Meter Out					
10-32 UNF	For 1/8" OD	4	1.5	9066K34	$21.67
1/8 NPT	For 1/8" OD	4.79	0.15	9066K11	23.27
1/8 NPT	For 1/4" OD	6.07	0.19	9066K12	23.27
1/4 NPT	For 1/4" OD	12.45	0.39	9066K13	28.09
1/4 NPT	For 3/8" OD	12.45	0.39	9066K14	32.89
1/2 NPT	For 3/8" OD	21.39	0.67	9066K16	60.78
1/2 NPT	For 1/2" OD	45.98	1.44	9066K17	60.20
(2) Push-to-Connect Tube to Male Thread—Meter In					
For 1/8" OD	10-32 UNF	4	1.5	9066K35	29.07
For 1/4" OD	1/8 NPT	6.07	0.19	9066K18	25.28
For 1/4" OD	1/4 NPT	12.45	0.39	9066K19	30.10
For 3/8" OD	1/4 NPT	12.45	0.39	9066K21	33.49
(3) Push-to-Connect Tube to Push-to-Connect Tube—Meter In/Out					
For 1/8" OD	For 1/8" OD	4	1.5	9066K36	14.40
For 1/4" OD	For 1/4" OD	6.07	0.19	9066K31	20.60
For 3/8" OD	For 3/8" OD	24.91	0.78	9066K32	48.00
For 1/2" OD	For 1/2" OD	37.36	1.17	9066K33	52.43
All-Stainless-Steel Valves					
(4) Male Thread to Female Thread—Meter Out					
10-32 UNF	10-32 UNF	1.72	0.006	9066K22	99.24
1/8 NPT	1/8 NPT	8.38	0.087	9066K23	95.07
1/4 NPT	1/4 NPT	15.3	0.32	9066K24	108.56
3/8 NPT	3/8 NPT	28.97	0.566	9066K25	146.04

Precision-Adjust Air Flow Control Valves

A fine-adjustment dial allows tighter control of airflow and cylinder speed than other flow control valves. These valves regulate airflow in the flow-control direction (inlet to outlet) and let air flow freely in the other direction. Made of plastic. Maximum pressure is 145 psi.



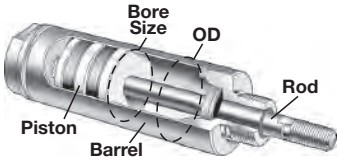
Inlet	Outlet	Max. scfm @ 100 psi	Flow Coefficient		
(5) Male Thread to Push-to-Connect Tube—Meter Out					
10-32 UNF	For 1/8" OD	2.5	0.03	4076K29	$21.32
10-32 UNF	For 5/32" OD	3	0.04	4076K32	21.32
10-32 UNF	For 1/4" OD	3	0.006	4076K21	26.04
1/8 NPT	For 1/8" OD	0.07	0.006	4076K37	17.68
1/8 NPT	For 5/32" OD	7.5	0.11	4076K33	21.32
1/8 NPT	For 5/32" OD	13	0.18	4076K27	26.64
1/8 NPT	For 1/4" OD	13	0.18	4076K22	28.61
1/4 NPT	For 5/32" OD	13	0.18	4076K28	29.31
1/4 NPT	For 1/4" OD	13	0.18	4076K23	30.49
1/4 NPT	For 3/8" OD	18.5	0.27	4076K25	46.93
3/8 NPT	For 3/8" OD	65★	____	4076K26	56.37
1/8 BSPT	For 4 mm OD	4.79	0.15	4057T11	21.12
1/8 BSPT	For 6 mm OD	6.07	0.19	4057T12	21.12
1/8 BSPT	For 8 mm OD	6.07	0.19	4057T13	21.12
1/4 BSPT	For 4 mm OD	7.02	0.22	4057T14	23.46
1/4 BSPT	For 6 mm OD	10.54	0.33	4057T15	23.46
1/4 BSPT	For 8 mm OD	12.45	0.39	4057T16	23.46
1/4 BSPT	For 10 mm OD	12.45	0.39	4057T17	18.00
(6) Push-to-Connect Tube to Male Thread—Meter In					
For 1/8" OD	10-32 UNF	0.07	0.006	4076K39	17.40
For 1/4" OD	1/8 NPT	2.42	0.006	4076K38	20.60
For 1/4" OD	1/4 NPT	1.5	0.6	4076K34	20.25
For 3/8" OD	1/4 NPT	1.5	0.6	4076K35	24.28
For 4 mm OD	1/8 BSPT	4.79	0.15	4057T18	21.12
For 4 mm OD	1/4 BSPT	7.02	0.22	4057T22	23.46
For 6 mm OD	1/8 BSPT	6.07	0.19	4057T19	21.12
For 6 mm OD	1/4 BSPT	10.54	0.33	4057T23	23.46
For 8 mm OD	1/8 BSPT	6.07	0.19	4057T21	21.12
For 8 mm OD	1/4 BSPT	12.45	0.39	4057T24	23.46
For 10 mm OD	1/4 BSPT	12.45	0.39	4057T25	23.46

★ Max. scfm @ 87 psi.

About Air Cylinders

Air cylinders operate on compressed air to create linear force. They're used to push, pull, open, close, lift, lower, position, and sort.

Measure the Cylinder OD to Help Determine Bore Size



Bore size is the ID of the cylinder barrel. Since you can't measure inside the cylinder, use the OD as a guide—bore size is about .125″-.25″ smaller than the cylinder OD.

Identify Bore Size and Stroke Length by Bimba Part Number

Find the numeric portion of the part number. The first two or three digits correspond to a bore size in the table. The remaining digits indicate stroke length.

Bimba Number	Bore Size	Bimba Number	Bore Size	Bimba Number	Bore Size
007	5/16″	06	7/8″	24	1 3/4″
01	7/16″	09	1 1/16″	31	2″
02	9/16″	12	1 1/4″	50	2 1/2″
04	3/4″	17	1 1/2″	70	3″

Examples:

SR-041-D — Bore Size = 3/4″ — Stroke Lg. = 1″

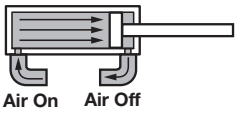
016-D — Bore Size = 7/16″ — Stroke Lg. = 6″

170.5 — Bore Size = 1 1/2″ — Stroke Lg. = 1/2″

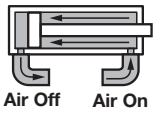
SR-090.75 — Bore Size = 1 1/16″ — Stroke Lg. = 3/4″

Double Acting

Most of our cylinders are double acting. They use air to exert force in both directions to push and pull. Cylinders have two ports.



Air extends the rod.

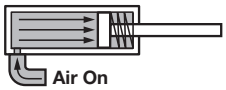


Air retracts the rod.

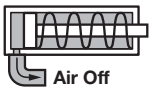
Single Acting

Single-acting cylinders use air to exert force in one direction and have a spring that returns the rod to its original position. They have one port. Choose from push-style cylinders and pull-style cylinders.

Push-Style Cylinders

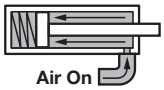


Air extends the rod.

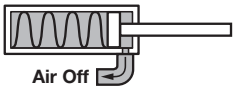


A spring retracts the rod.

Pull-Style Cylinders

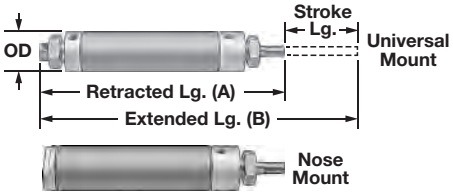


Air retracts the rod.



A spring extends the rod.

Double-Acting Round Body Air Cylinders CAD



Create linear motion with the most popular of our air cylinders. Barrel and rod are 300 series stainless steel and end caps are aluminum. Force is given at 100 psi; max. pressure is 250 psi. Temperature range is –20° to 200°F. Ports are female. Cylinders are not repairable.

Universal-mount cylinders have threads on both ends to mount in a fixed position or you can use the hole on the back end to pivot mount. They come with two nuts and a pivot pin with retaining rings.

Nose-mount cylinders have threads on the rod end and come with a nut to mount in a fixed position.

Stroke Lg.	Length (A)	Length (B)		
Universal Mount				
5/16″ Bore Size (0.36″ OD)—Force is 7 lbs.; Ports are 10-32 UNF				
1/2″	3.07″	3.57″	6498K945	$28.35
1″	3.57″	4.57″	6498K846	29.27
1 1/2″	4.07″	5.57″	6498K13	30.23
2″	4.57″	6.57″	6498K847	31.19
2 1/2″	5.07″	7.57″	6498K16	32.18
3″	5.57″	8.57″	6498K848	33.08
4″	6.57″	10.57″	6498K849	35.00
7/16″ Bore Size (0.5″ OD)—Force is 15 lbs.; Ports are 10-32 UNF				
1/2″	3.81″	4.31″	6498K601	30.22
1″	4.31″	5.31″	6498K602	31.27
1 1/2″	4.81″	6.31″	6498K603	32.36
2″	5.31″	7.31″	6498K604	33.41
2 1/2″	5.81″	8.31″	6498K32	34.53
3″	6.31″	9.31″	6498K605	35.56
4″	7.31″	11.31″	6498K606	37.70
5″	8.31″	13.31″	6498K607	39.84
6″	9.31″	15.31″	6498K608	41.98
8″	11.31″	19.31″	6498K5	46.29
10″	13.31″	23.31″	6498K321	50.63
12″	15.31″	27.31″	6498K644	54.84
9/16″ Bore Size (0.62″ OD)—Force is 25 lbs.; Ports are 10-32 UNF				
1/2″	3.75″	4.25″	6498K854	30.26
1″	4.25″	5.25″	6498K855	31.29
1 1/2″	4.75″	6.25″	6498K364	32.42
2″	5.25″	7.25″	6498K856	33.43
2 1/2″	5.75″	8.25″	6498K365	34.53
3″	6.25″	9.25″	6498K857	35.58
4″	7.25″	11.25″	6498K858	37.72
5″	8.25″	13.25″	6498K859	39.88
6″	9.25″	15.25″	6498K864	42.07
8″	11.25″	19.25″	6498K865	46.35
10″	13.25″	23.25″	6498K866	52.92
12″	15.25″	27.25″	6498K867	57.21
5/8″ Bore Size (0.69″ OD)—Force is 31 lbs.; Ports are 10-32 UNF				
1/2″	3.94″	4.44″	6498K428	45.34

Stroke Lg.	Length (A)	Length (B)		
Universal Mount (Cont.)				
5/8″ Bore Size (0.69″ OD)—Force is 31 lbs.; Ports are 10-32 UNF (Cont.)				
1″	4.44″	5.44″	6498K429	$46.68
1 1/2″	4.94″	6.44″	6498K792	47.96
2″	5.44″	7.44″	6498K432	49.23
2 1/2″	5.94″	8.44″	6498K793	50.51
3″	6.44″	9.44″	6498K433	51.81
4″	7.44″	11.44″	6498K434	54.30
5″	8.44″	13.44″	6498K435	56.37
6″	9.44″	15.44″	6498K436	59.03
8″	11.44″	19.44″	6498K438	64.62
10″	13.44″	23.44″	6498K441	69.73
12″	15.44″	27.44″	6498K442	74.86
3/4″ Bore Size (0.86″ OD)—Force is 40 lbs.; Ports are 1/8 NPT				
1/2″	5.03″	5.53″	6498K631	31.28
1″	5.53″	6.53″	6498K632	32.09
1 1/2″	6.03″	7.53″	6498K633	33.27
2″	6.53″	8.53″	6498K634	34.28
2 1/2″	7.03″	9.53″	6498K443	35.39
3″	7.53″	10.53″	6498K635	36.40
6″	10.53″	16.53″	6498K638	42.87
8″	12.53″	20.53″	6498K639	47.51
12″	16.53″	28.53″	6498K642	55.72
Other Stroke Lengths: 4″, 5″, 7″, 9″, 10″, 14″, 16″, 18″, 24″			6498K922	
1 1/16″ Bore Size (1.12″ OD)—Force is 90 lbs.; Ports are 1/8 NPT				
1/2″	5.12″	5.62″	6498K651	35.12
1″	5.62″	6.62″	6498K652	36.17
1 1/2″	6.12″	7.62″	6498K653	36.93
2″	6.62″	8.62″	6498K654	38.36
2 1/2″	7.12″	9.62″	6498K407	39.47
3″	7.62″	10.62″	6498K655	40.46
6″	10.62″	16.62″	6498K658	46.87
8″	12.62″	20.62″	6498K659	51.17
12″	16.62″	28.62″	6498K662	59.74
Other Stroke Lengths: 4″, 5″, 7″, 9″, 10″, 14″, 16″, 18″, 22″, 24″, 28″, 30″, 36″			6498K924	

Stroke Lg.	Length (A)	Length (B)		
Universal Mount (Cont.)				
1 1/4″ Bore Size (1.34″ OD)—Force is 120 lbs.; Ports are 1/8 NPT				
1/2″	6.38″	6.88″	6498K437	$49.91
1″	6.88″	7.88″	6498K972	51.29
1 1/2″	7.38″	8.88″	6498K973	52.69
2″	7.88″	9.88″	6498K974	54.03
2 1/2″	8.38″	10.88″	6498K451	55.41
3″	8.88″	11.88″	6498K975	56.75
6″	11.88″	17.88″	6498K978	64.89
8″	13.88″	21.88″	6498K979	70.35
12″	17.88″	29.88″	6498K982	81.27
Other Stroke Lengths: 4″, 5″, 7″, 9″, 10″, 14″, 16″, 18″, 22″, 24″, 28″, 30″, 36″			6498K926	
1 1/2″ Bore Size (1.56″ OD)—Force is 170 lbs.; Ports are 1/8 NPT				
1/2″	6.01″	6.51″	6498K671	53.25
1″	6.51″	7.51″	6498K983	54.86
1 1/2″	7.01″	8.51″	6498K984	56.84
2″	7.51″	9.51″	6498K985	58.22
2 1/2″	8.01″	10.51″	6498K504	59.88
3″	8.51″	11.51″	6498K986	61.49
6″	11.51″	17.51″	6498K989	71.40
8″	13.51″	21.51″	6498K995	77.99
12″	17.51″	29.51″	6498K997	91.18
Other Stroke Lengths: 4″, 5″, 7″, 9″, 10″, 14″, 16″, 18″, 22″, 24″, 28″, 30″, 36″			6498K928	
2″ Bore Size (2.08″ OD)—Force is 310 lbs.; Ports are 1/4 NPT				
1/2″	7.44″	7.94″	6498K557	83.14
1″	7.94″	8.94″	6498K474	85.02
1 1/2″	8.44″	9.94″	6498K558	86.93
2″	8.94″	10.94″	6498K476	88.74
2 1/2″	9.44″	11.94″	6498K559	90.66
3″	9.94″	12.94″	6498K477	92.45
6″	12.94″	18.94″	6498K481	103.56
8″	14.94″	22.94″	6498K482	110.97
12″	18.94″	30.94″	6498K568	125.93
Other Stroke Lengths: 4″, 5″, 7″, 9″, 10″, 14″, 16″, 18″, 22″, 24″, 28″, 30″, 36″			6498K931	

(Continued on following page)

About Electric Motors

When replacing a motor, use the information on your motor's nameplate to guide your selection. Although each manufacturer displays information differently on the motor nameplate, the specifications below are the most important to consider.

Specification	Example
Voltage—Match the voltage.	VOLTS 208-230/460
Phase—Match the phase.	PH 3
Frame Size—Match the NEMA frame number.	FRAME 56
Horsepower—Select the same hp or higher.	H.P. 3/4
Max. rpm—Select the same rpm ±5%.	R.P.M. 1725
Enclosure Type—Match the enclosure type.	ENCL TEFC

Understanding Enclosure Types

ODP (open drip proof) enclosures are for relatively clean, dry, well-ventilated indoor locations.

TEFC (totally enclosed fan cooled) enclosures offer more protection than ODP enclosures. They are not airtight, but can be used in dirty, dusty, and damp environments. They have an external fan that blows air over the outside of the motor for cooling.

TENV (totally enclosed non-ventilated) enclosures are similar to TEFC enclosures, except they do not have a fan. They rely on air circulation from the motion of the motor for cooling.

TEAO (totally enclosed air over) enclosures are dust-tight. Designed for use with blowers and fans, mount motors in the airflow of the blower or fan they're driving.

AC Motors

For technical drawings and 3-D models, go to mcmaster.com.

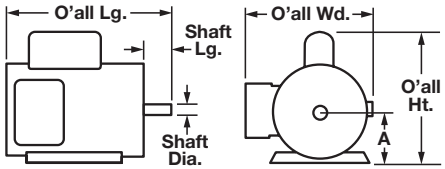
Base-Mount AC Motors

ODP Enclosure

TEFC Enclosure

TEAO Enclosure

TENV Enclosure



Replace old base-mount motors to keep your equipment moving. Motors are rated for continuous duty and mount at any angle. They have wire leads, unless noted. Shaft is keyed and comes with key stock, except NEMA 48 and 48Z motors have a D-profile shaft. You can wire for clockwise or counterclockwise rotation; instructions are included.

Enclosure is steel and has a welded base, unless noted. Motors with a max. temperature of 266° F meet insulation Class B; those with a max. temperature of 311° F meet insulation Class F. They're UL recognized and CSA certified.

To use a motor with a variable frequency drive (AC motor speed control), choose a three-phase motor that's inverter rated. For Programmable Three-Phase AC Motor Speed Controls, see page 966.

Motors with overload protection turn off in overload conditions to prevent motor damage. **Manual** overload protection must be reset manually to start the motor after it cools. **Automatic** overload protection starts the motor automatically after it cools.

Motors with a **vibration-damping base** have rubber rings between the base and enclosure to minimize vibration.

				Overall			Shaft					
hp	Max. rpm	Amps @ Full Load	Enclosure Type	Lg.	Wd.	Ht.	Dia.	Lg.	Center to Base (A)	Overload Protection	Max. Temp., °F	
115/208-230 Volts AC, Single Phase												
NEMA 48												
1/3	1,725	6/3.6-3	TEFC	10 3/4"	8 1/2"	7 1/2"	1/2"	1 1/2"	3"		266°	5990K123 $359.75
1/3	1,740	3.4/2.5-1.7	ODP	9 3/4"	9"	8 1/8"	1/2"	1 1/2"	3"		311°	5990K151 405.52
1/2	1,725	7.4/4.3-3.7	TEFC	11 1/2"	8 1/2"	7 1/2"	1/2"	1 1/2"	3"		266°	5990K124 399.11
NEMA 56												
1/3	1,725	6/3.6-3	ODP	11"	6 3/4"	8"	5/8"	1 7/8"	3 1/2"	Automatic	266°	5990K122★ 267.29
1/3	1,740	3.4/2.5-1.7	ODP	10 1/8"	9"	8 5/8"	5/8"	1 7/8"	3 1/2"		311°	5990K152 405.52
1/2	1,725	7.4/4.3-3.7	TEFC	12"	9"	8"	5/8"	1 7/8"	3 1/2"	Automatic	266°	5990K35 451.75
1/2	1,725	8.4/4.8-4.2	ODP	11 3/4"	7"	8"	5/8"	1 7/8"	3 1/2"	Automatic	266°	5990K17★■ 395.80
1/2	3,450	7/4.1-3.5	TEFC	11 1/2"	8 1/2"	8 3/4"	5/8"	1 7/8"	3 1/2"		266°	5990K71 323.28
3/4	1,725	8.2/5.4-4.1	TEFC	12 1/2"	9"	8 3/4"	5/8"	1 7/8"	3 1/2"	Automatic	266°	5990K36 546.05
3/4	1,725	8.4/5.4-4.2	TEFC	12 1/2"	8 1/2"	8 3/4"	5/8"	1 7/8"	3 1/2"		311°	5990K73 435.18
3/4	3,450	9.6/6.1-4.8	TEFC	12"	8 1/2"	8 3/4"	5/8"	1 7/8"	3 1/2"		266°	5990K72 363.69
NEMA 56/56H												
1	1,725	13.4/7.4-6.7	ODP	11 1/2"	6 3/4"	9 1/4"	5/8"	1 7/8"	3 1/2"	Automatic	266°	5990K31★■ 527.40
1	3,450	11.8/6.1-5.9	TEFC	13"	9 1/2"	9 1/4"	5/8"	1 7/8"	3 1/2"		266°	5990K75 421.71
1	3,480	7.8/4.3-3.9	ODP	12 1/2"	7 1/2"	9"	5/8"	1 7/8"	3 1/2"	Automatic	311°	5990K316★■ 483.32
1 1/2	3,450	16/8.4-8	TEFC	13"	9 1/2"	9 1/4"	5/8"	1 7/8"	3 1/2"		266°	5990K79 564.68
NEMA 56H												
3/4	1,140	7.8/3-3.9	TEFC	13"	9 1/2"	9 1/4"	5/8"	1 7/8"	3 1/2"		266°	5990K74 768.74
1	1,725	11.8/6.3-5.9	TEFC	13"	9 1/2"	9 1/4"	5/8"	1 7/8"	3 1/2"		311°	5990K76 494.25
1	1,725	11.8/6.3-5.9	TEFC	13"	10"	9 1/4"	5/8"	1 7/8"	3 1/2"	Automatic	311°	5990K99 569.57
1 1/2	1,725	12.4/6.8-6.2	TEFC	14"	9 1/2"	9 1/4"	5/8"	1 7/8"	3 1/2"		266°	5990K81 570.92
NEMA 56YZ												
1/2	1,700	5.2/2.8-2.6	TEAO	12 3/4"	7"	8 3/4"	5/8"	3"	3 1/2"	Automatic	266°	5990K215★ 400.20
NEMA 143T												
1	1,725	12.8/7-6.4	TEFC	13 1/2"	9 1/2"	9 1/4"	7/8"	2 1/4"	3 1/2"		311°	5990K112 543.74
NEMA 145T												
1 1/2	1,725	21/9.6-10.5	ODP	13"	10 1/4"	9"	7/8"	2 1/4"	3 1/2"	Manual	266°	5990K109 713.16
1 1/2	1,755	14/7.3-7	TEFC	13 1/2"	9 1/2"	9 1/4"	7/8"	2 1/4"	3 1/2"		311°	5990K125 624.29
NEMA 184T												
1 1/2	1,140	16.4/8.6-8.2	TEFC	16 3/4"	11 1/4"	11 1/4"	1 1/8"	2 3/4"	4 1/2"		311°	5990K111 1,325.36
115/230 Volts AC, Single Phase												
NEMA 48												
1/4	1,725	2.6/1.3	ODP	10"	8"	8 1/4"	1/2"	1 1/2"	3"		311°	5990K131 376.44
1/2	1,725	4.7/3.2-2.4	ODP	10 3/4"	8"	8 1/4"	1/2"	1 1/2"	3"		266°	5990K132 454.12
1/2	3,450	4.9/2.5	ODP	10"	8"	8 1/4"	1/2"	1 1/2"	3"		311°	5990K133 423.05
NEMA 48Z												
1/4	1,700	4.8/2.4	TEAO	11 1/2"	6 3/4"	8 1/4"	1/2"	2 1/2"	3"	Automatic	266°	5990K202★ 365.25
1/3	1,700	5.6/2.8	TEAO	12"	6 3/4"	8 1/4"	1/2"	2 1/2"	3"	Automatic	266°	5990K203★ 397.28

★ Enclosure has a vibration-damping base. ■ Motor has screw terminals.

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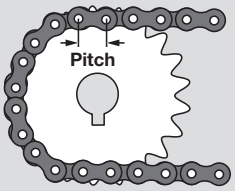
About Roller Chain and Sprockets



Roller chain links engage with matched sprocket teeth to transmit power between rotating shafts. Since there's no slippage and little stretch, chain drives can handle heavy loads and high torque.

Sizing Roller Chain and Sprockets—ANSI roller chain and sprockets have a standard ANSI number. Metric roller chain and sprockets have a standard ISO number. Only use chain and sprockets with the same number together.

If you don't know the ANSI or ISO number of your chain or sprocket, determine size by measuring pitch. Pitch is the distance between the pin centers of a chain link.

Modifying Roller Chain Length—Reduce chain length with a chain breaker (see page 1125). Join and extend chain with individual links.

Connecting links are also known as master links. They're used to join the ends of a chain length. The side plate is easy to remove for attaching to chain.

Adding links are also known as roller links. They require two connecting links to join chain.

Add-and-connect links are also known as half links and offset links. A combination of connecting and adding links, they join chain that requires an odd number of links. The side plate is easy to remove for attaching to chain.

Choosing a Sprocket Bore Style—Drive sprockets attach to rotating shafts and transmit power to your roller chain. They connect to the shaft with a bore; the bore style determines how they will attach.

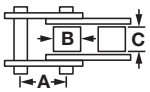
- **Machinable-bore sprockets** have an unfinished bore that can be machined for a custom fit.
- **Finished-bore sprockets** fit directly on a shaft and attach with set screws and/or keyways that reduce slippage.
- **Bushing-bore sprockets** mate with a compatible bushing that attaches to the shaft. The same sprocket can be used with multiple shaft diameters.

ANSI Roller Chain and Links

Run conveyors and power machinery with this general purpose steel roller chain. It comes with connecting links; one for 1- to 20-ft. lengths, five for 50-ft. lengths, and ten for 100-ft. lengths.

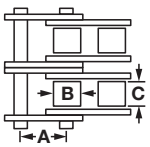
Heavy Duty—The links have thick side plates to handle double the working loads of standard chain.

Single Strand



ANSI No.	Pitch (A)	Roller Dia. (B)	Roller Wd. (C)	Working Load, lbs.	Roller Chain Lengths, ft.		Roller Chain Per Ft.	Connecting Links	Connecting Links Each	Adding Links	Adding Links Each	Add-and-Connect Links	Add-and-Connect Links Each
Standard													
25	1/4"	0.130"	1/8"	88	1-20, 50, 100	6261K171	$5.14	6261K108	$1.00	6261K106	$0.62	6261K105	$2.00
35	3/8"	0.200"	3/16"	199	1-20, 50, 100	6261K172	3.90	6261K191	.82	6261K241	.70	6261K261	1.78
40	1/2"	0.312"	5/16"	356	1-20, 50, 100	6261K173	4.54	6261K193	.87	6261K243	.73	6261K263	2.01
41	1/2"	0.306"	1/4"	168	1-20, 50, 100	6261K174	4.40	6261K192	.87	6261K242	.64	6261K262	1.97
50	5/8"	0.400"	3/8"	561	1-20, 50, 100	6261K175	5.98	6261K194	1.09	6261K244	1.03	6261K264	2.38
60	3/4"	0.469"	1/2"	803	1-20, 50, 100	6261K176	7.78	6261K195	1.40	6261K245	1.46	6261K265	3.28
80	1"	0.625"	5/8"	1,432	1-20, 50, 100	6261K177	13.70	6261K196	2.60	6261K246	2.64	6261K266	5.25
100	1 1/4"	0.750"	3/4"	2,235	1-20, 50, 100	6261K178	22.20	6261K181	3.86	6261K211	4.22	6261K271	8.88
120	1 1/2"	0.875"	1"	3,207	1-20, 50	6261K179	32.46	6261K182	6.05	6261K212	7.14	6261K272	13.62
140	1 3/4"	1.000"	1"	4,354	1-20, 50	6261K185	39.98	6261K183	8.34	6261K213	10.88	6261K273	18.69
160	2"	1.125"	1 1/4"	5,727	1-20, 50	6261K186	50.06	6261K184	11.67	6261K214	15.97	6261K274	25.92
Heavy Duty													
35H	3/8"	0.200"	3/16"	670	1-20, 50	7265K2	10.49	7265K224	2.10	7265K226	.64	—	—
40H	1/2"	0.312"	5/16"	1,030	1-20, 50	7265K3	12.43	7265K324	2.24	7265K326	.89	—	—
50H	5/8"	0.400"	3/8"	1,620	1-20, 50	7265K4	12.62	7265K424	2.20	7265K426	1.96	7265K425	4.76
60H	3/4"	0.469"	1/2"	2,000	1-20, 50	7265K5	10.55	7265K524	2.06	7265K526	1.81	7265K525	4.40
80H	1"	0.625"	5/8"	3,400	1-20, 50	7265K6	17.64	7265K624	3.06	7265K626	3.06	7265K625	6.85
100H	1 1/4"	0.750"	3/4"	5,200	1-20, 50	7265K7	29.62	7265K724	5.66	7265K726	6.38	7265K725	11.76
120H	1 1/2"	0.875"	1"	7,000	1-20, 50	7265K8	42.74	7265K824	8.73	7265K826	9.54	7265K825	18.13
140H	1 3/4"	1.000"	1"	9,200	1-20, 50	7265K9	52.60	7265K924	13.86	7265K926	14.58	7265K925	29.02
160H	2"	1.125"	1 1/4"	12,300	1-20	7265K11	67.49	7265K927	17.78	—	—	7265K928	36.69

Double Strand

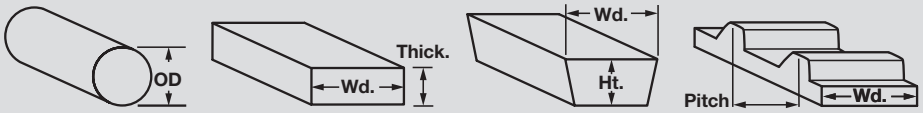


ANSI No.	Pitch (A)	Roller Dia. (B)	Roller Wd. (C)	Working Load, lbs.	Roller Chain Lengths, ft.		Roller Chain Per Ft.	Connecting Links	Connecting Links Each	Adding Links	Adding Links Each	Add-and-Connect Links	Add-and-Connect Links Each
Standard													
35-2	3/8"	0.200"	3/16"	810	1-20, 50, 100	6261K711	$9.71	6261K221	$2.08	6261K103	$1.51	6261K841	$4.52
40-2	1/2"	0.312"	5/16"	1,370	1-20, 50, 100	6261K712	10.39	6261K223	2.17	6261K104	1.71	6261K842	4.73
50-2	5/8"	0.400"	3/8"	2,380	1-20, 50, 100	6261K713	13.57	6261K224	2.33	6261K109	2.44	6261K843	5.67
60-2	3/4"	0.469"	1/2"	3,315	1-20, 50, 100	6261K714	18.30	6261K225	3.24	6261K116	3.38	6261K844	7.99
80-2	1"	0.625"	5/8"	5,610	1-20, 50	6261K715	29.44	6261K226	4.88	6261K117	6.05	6261K845	12.48
100-2	1 1/4"	0.750"	3/4"	8,600	1-20, 50	6261K91	48.18	6261K922	9.31	6261K118	8.90	6261K923	21.75
120-2	1 1/2"	0.875"	1"	11,560	1-20, 50	6261K81	66.80	6261K706	13.13	—	—	6261K92	28.71
140-2	1 3/4"	1.000"	1"	15,300	1-20	6261K82	83.69	6261K707	17.85	—	—	6261K709	38.41
160-2	2"	1.125"	1 1/4"	20,230	1-20	6261K83	106.92	6261K708	24.51	—	—	6261K94	53.16
Heavy Duty													
50H-2	5/8"	0.400"	3/8"	2,400	1-20, 50, 100	5871K3	30.74	5871K13	4.19	—	—	5871K33	15.24
60H-2	3/4"	0.469"	1/2"	3,400	1-20, 50, 100	5871K4	28.34	5871K14	4.93	—	—	5871K34	10.48
80H-2	1"	0.625"	5/8"	5,800	1-20, 50	5871K5	45.91	5871K15	8.17	—	—	5871K35	27.57

About Sizing Belts

Replacing a Belt—V-belts and timing belts are marked with a trade size for easy reordering. If your belt does not have a trade size, use the belt's measurements to find a replacement.

1. Measure the dimensions of your existing belt.



Round Belt | Flat Belt | V-Belt | Timing Belt

2. Wrap a string around the existing belt to measure the outer circle.

3. Round the outer circle down to nearest whole number to account for belt stretch.

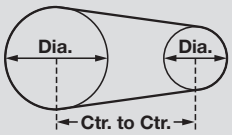
Sizing a New Belt—Follow these steps to estimate belt outer circle for a new system.

1. Add the diameters of your pulleys.

2. Multiply the sum of Step 1 by 1.6.

3. Multiply the Ctr.-to-Ctr. by 2.

4. Add Steps 2 and 3.



Round Belting

Quick-Connect Hollow-Core Belting

Solid-Core Belting with Textured Surface

Heavy Duty Solid-Core Belting

Run this chemical- and abrasion-resistant urethane belting in light duty conveying and power-transmission applications. Inch sizes are made from FDA-listed material for use with food and beverage.

Belting with a smooth surface is easy to clean. *Belting with a textured surface* grips material better than belting with a smooth surface.

Quick-Connect Hollow-Core Belting—Join the ends with the hollow-core round belting connectors sold separately on this page.

Solid-Core Belting—Choose this belting for stronger connections than quick-connect hollow-core belting. Join the ends of this belting with the solid-core round belting connectors sold separately on this page or use a welding kit (see 62065K41 on page 1155). **Heavy duty solid-core belting** is reinforced with a polyester cord for increased strength.

Quick-Connect Hollow-Core Belting

OD	Clear: Min. Pulley Dia.		Per Ft.	Yellow: Min. Pulley Dia.		Per Ft.
Inch—Smooth Surface						
3/16"	2"	6567K1	$0.87	1 1/2"	6567K56	$0.87
1/4"	2 1/2"	6567K2	1.63	2"	6567K57	1.63
5/16"	3"	6567K3	2.10	2 1/2"	6567K58	2.10
3/8"	3 1/2"	6567K4	3.01	3"	6567K59	3.01
7/16"	____	____	____	3 1/2"	6567K61	4.15
1/2"	4 1/2"	6567K5	5.71	4"	6567K62	5.71
9/16"	____	____	____	4 1/2"	6567K63	6.10
5/8"	5 1/2"	6567K6	7.84	5"	6567K64	7.84
Metric—Smooth Surface						
6 mm	____	____	____	50 mm	1114N1	1.17
8 mm	____	____	____	63 mm	1114N3	1.77
10 mm	____	____	____	76 mm	1114N5	2.97

Solid-Core Belting

OD	Min. Pulley Dia.	Choose a Color		Per Ft.
Inch—Smooth Surface				
3/32"	3/4"	Clear, Orange	59725K728	$0.58
1/8"	1"	Clear, Orange	59725K729	.70
3/16"	1 1/2"	Clear, Orange	59725K731	1.00
1/4"	2"	Clear, Orange	59725K732	1.26
5/16"	2 1/2"	Clear, Orange	59725K733	2.09
3/8"	3"	Clear, Orange	59725K734	2.80
1/2"	4"	Clear, Orange	59725K735	4.78
Metric—Textured Surface				
2 mm	19 mm	Green	8112K31	1.06
4 mm	36 mm	Green	8112K32	1.54
6 mm	53 mm	Green	8112K33	2.72
8 mm	71 mm	Green	8112K34	3.98
Metric—Smooth Surface				
2 mm	19 mm	Green	8112K41	.88
4 mm	36 mm	Green	8112K42	1.00
6 mm	53 mm	Green	8112K43	1.84
8 mm	71 mm	Green	8112K44	3.16

Heavy Duty Solid-Core Belting

OD	Min. Pulley Dia.	Green	Per Ft.
Inch—Smooth Surface			
1/8"	1 3/4"	2126T1	$6.22
3/16"	2"	2126T2	6.88
1/4"	2 3/4"	2126T3	6.96
5/16"	3 7/16"	2126T4	7.72

Hollow-Core Round Belting Connectors

Press these connectors into quick-connect hollow-core round belting to join the ends.

Plastic connectors are corrosion resistant in harsh environments.

For Belt OD: Inch	Metric	Pkg. Qty.	Aluminum	Pkg.	Plastic	Pkg.
3/16"	____	25	6567K26	$9.58	____	____
1/4"	6 mm	25	6567K22	10.81	6567K65	$12.56
5/16"	8 mm	25	6567K23	14.35	6567K69	12.00
3/8", 7/16"	10 mm	20	6567K24	10.45	6567K66	13.18
1/2"	____	10	6567K25	8.74	6567K67	10.13
9/16"	____	10	6567K27	12.68	____	____
5/8"	____	10	6567K28	14.48	____	____

Solid-Core Round Belting Connectors

Join solid-core round belting by trimming belting ends to a point and twisting them into the threaded ends of these steel connectors. They have a joint to accommodate turns. These connectors are for use with urethane, rubber, and leather round belting.

For Belt OD		
3/16"	6180K12	$20.78
1/4"	6180K14	20.76
5/16"	6180K15	21.34
3/8"	6180K16	22.08
7/16"	6180K17	24.78

Adjustable-Length Round Belting

Lengthen or shorten this belting without tools or connectors—the interlocking links attach and detach with a twist. Belting is polyester-reinforced urethane. Color is red.

OD		Per Ft.
5/16"	2243K11	$13.98
3/8"	2243K12	13.98
1/2"	2243K13	14.50
9/16"	2243K14	17.90
3/4"	2243K15	20.22

Extended-Life Leather Round Belting

Belting

Connector

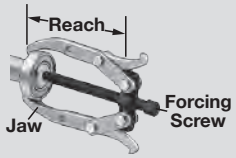
More elastic than urethane, this leather belting resists permanent stretch for a long service life. Color is tan. Join belting ends with steel connectors (sold separately).

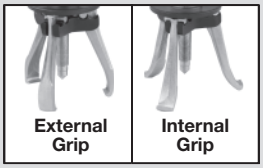
Joining tool cuts belting, punches holes for connectors, and secures connectors to belting ends.

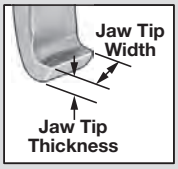
OD	Belting	Per Ft.	Connectors	Each
1/8"	6170K11	$0.95	1848K31	$1.00
3/16"	6170K12	1.16	1848K32	.52
1/4"	6170K13	1.53	1848K32	.52
9/32"	6170K14	1.83	1848K33	.54
5/16"	6170K15	2.09	1848K33	.54
3/8"	6170K16	2.81	1848K34	.54
Joining Tool			1848K1	79.41

External Grip Pullers

About External and Internal Grip Pullers







Use jaw-style pullers to grip bearings, gears, wheels, bushings, and pulleys. When space allows, select a three-jaw puller for better stability and more evenly distributed pulling force.

Capacities listed should be used as a guide. If you can grip and reach an object, your puller will normally have enough power to pull it. When in doubt, choose the next larger puller size.

External Grip Pullers

Two Jaws with T-Handle Forcing Screw

Two Jaws with Tips at Both Ends

Three Jaws

Combination Two/Three Jaws with Tips at Both Ends

Grip bearings, gears, and wheels from the outside edge to pull them off a shaft. Pullers are steel with a steel forcing screw. Pullers with a 21⁄8″ reach have a T-handle forcing screw.

Pullers with combination two/three jaws have mounting holes in both a two-jaw and three-jaw configuration, so you can attach the jaws either way to suit your application.

Pullers with jaw tips on both ends have a different jaw tip size on each end for versatility in fitting bearings, gears, and wheels.

Replacement jaws are sold individually. For replacement forcing screws, see page 1157.

For OD	Reach	Cap., tons	Forcing Screw Thread Size	Forcing Screw Lg.	Jaw Tip Location	Jaw Tip Wd. × Thick.	Pullers		Replacement Jaws	
Two Jaws										
1⁄2″-3 1⁄4″	2 1⁄8″	1	5⁄16″-24	3 7⁄8″	One End	1⁄4″ × 3⁄16″	6340K71	$45.52		
1⁄2″-4″	3 1⁄4″	2	3⁄8″-24	4 7⁄8″	Both Ends	1⁄4″ × 3⁄16″; 1⁄2″ × 1⁄8″	6340K21	48.43	6340K2	$21.60
1⁄2″-6″	3 1⁄4″	5	9⁄16″-20	7″	Both Ends	3⁄8″ × 5⁄16″; 3⁄4″ × 1⁄4″	6340K31	56.89	6340K3	21.57
1⁄2″-6″	5 1⁄2″	5	9⁄16″-20	7″	Both Ends	3⁄8″ × 5⁄16″; 3⁄4″ × 1⁄4″	6340K22	66.40	6340K4	21.60
1⁄2″-9″	5″	7	11⁄16″-18	9″	Both Ends	1″ × 5⁄16″; 1″ × 3⁄8″	6340K32	91.08	6340K5	43.28
1⁄2″-9 1⁄2″	8 3⁄4″	7	11⁄16″-18	9″	One End	1″ × 3⁄8″	6340K23	91.08	6340K6	33.26
1⁄2″-12″	11″	13	13⁄16″-16	12 1⁄2″	One End	1″ × 9⁄16″	6340K24	154.70		
1⁄2″-15 1⁄2″	15 1⁄4″	13	13⁄16″-16	12 1⁄2″	One End	1″ × 9⁄16″	6340K25	163.30		
1⁄2″-16″	18 3⁄4″	17 1⁄2	1″-14	13 3⁄4″	One End	15⁄16″ × 13⁄16″	6340K27	346.25		
1⁄2″-20″	22 1⁄4″	25	1 1⁄4″-12	16″	One End	1 1⁄2″ × 1 1⁄16″	6340K79	546.71		
Three Jaws										
1⁄2″-3 1⁄4″	2 1⁄8″	1	5⁄16″-24	3 7⁄8″	One End	1⁄4″ × 3⁄16″	6340K72	56.92		
1⁄2″-14″	14 1⁄2″	17 1⁄2	1″-14	13 3⁄4″	One End	15⁄16″ × 13⁄16″	6340K42	453.99		
1⁄2″-16″	18 3⁄4″	17 1⁄2	1″-14	13 3⁄4″	One End	15⁄16″ × 13⁄16″	6340K43	472.19		
1⁄2″-20″	22 1⁄4″	25	1 1⁄4″-12	16″	One End	1 1⁄2″ × 1 1⁄16″	6340K84	777.50		
Combination Two/Three Jaws										
1⁄2″-4 3⁄4″	3 1⁄4″	2	3⁄8″-24	4 7⁄8″	Both Ends	1⁄4″ × 3⁄16″; 1⁄2″ × 1⁄8″	6340K41	56.92	6340K2	21.60
1⁄2″-7″	3 1⁄4″	5	9⁄16″-20	7″	Both Ends	3⁄8″ × 5⁄16″; 3⁄4″ × 1⁄4″	6340K51	63.74	6340K3	21.57
1⁄2″-7″	5 1⁄2″	5	9⁄16″-20	7″	Both Ends	3⁄8″ × 5⁄16″; 3⁄4″ × 1⁄4″	6340K53	72.86	6340K4	21.60
1⁄2″-10 1⁄2″	5″	7	11⁄16″-18	9″	Both Ends	1″ × 5⁄16″; 1″ × 3⁄8″	6340K52	120.32	6340K5	43.28
1⁄2″-11″	8 3⁄4″	7	11⁄16″-18	9″	One End	1″ × 3⁄8″	6340K54	117.43	6340K6	33.26
1⁄2″-12″	11″	13	13⁄16″-16	12 1⁄2″	One End	1″ × 9⁄16″	6340K55	257.87		
1⁄2″-17″	15 1⁄4″	13	13⁄16″-16	12 1⁄2″	One End	1″ × 9⁄16″	6340K56	268.33		

Quick-Hold External Grip Pullers

Two Jaws

Three Jaws

These pullers have a cage around the jaws that keeps them aligned so you can secure bearings and pulleys quickly. Use them to grip bearings, gears, and wheels from the outside edge to pull them off a shaft. Pullers are steel with an iron T-handle on the forcing screw. The cage has a black powder-coated finish.

Replacement jaws are sold individually.

Also Available: Replacement parts. Please ask for 6169K9 and specify forcing screw, pin, or jaw head, puller capacity, and puller style (two or three jaws).

For OD	Reach	Cap., tons	Forcing Screw Thread Size	Forcing Screw Lg.	Jaw Tip, Wd. × Thick.	Pullers		Replacement Jaws	
Two Jaws									
1⁄4″-3 1⁄4″	2 1⁄4″	1	5⁄16″-24	5 1⁄2″	11⁄32″ × 1⁄8″	6169K2	$74.55	6169K137	$15.02
1⁄2″-5″	4″	2	9⁄16″-16	9 5⁄8″	5⁄8″ × 3⁄16″	6169K31	139.09	6169K324	26.29
1⁄2″-7″	6″	6	5⁄8″-14	12 3⁄4″	3⁄4″ × 1⁄4″	6169K13	190.00	6169K144	33.49
3⁄4″-12″	8″	12	3⁄4″-14	16 1⁄4″	7⁄8″ × 9⁄32″	6169K17	216.39	6169K174	43.42
1″-14″	9 5⁄8″	14	3⁄4″-14	19 1⁄4″	1″ × 11⁄32″	6169K15	232.79	6169K164	46.40
2 1⁄2″-18″	12″	25	1 1⁄8″-14	26″	1 1⁄4″ × 1⁄2″	6169K23	547.54	6169K244	112.12
3″-25″	14″	35	1 1⁄4″-14	31 1⁄2″	17⁄16″ × 11⁄16″	6169K25	677.05	6169K264	167.64
Three Jaws									
1⁄4″-4 1⁄2″	3″	2	3⁄8″-24	7″	7⁄16″ × 3⁄16″	6169K1	104.55	6169K114	18.00
1⁄2″-5″	4″	5	9⁄16″-16	9 5⁄8″	5⁄8″ × 3⁄16″	6169K32	162.73	6169K324	26.29
1⁄2″-7″	6″	10	5⁄8″-14	12 3⁄4″	3⁄4″ × 1⁄4″	6169K14	192.62	6169K144	33.49
3⁄4″-12″	8″	17	3⁄4″-14	16 1⁄4″	7⁄8″ × 9⁄32″	6169K18	247.54	6169K174	43.42
1″-14″	9 5⁄8″	20	3⁄4″-14	19 1⁄4″	1″ × 11⁄32″	6169K16	273.77	6169K164	46.40
2 1⁄2″-18″	12″	30	1 1⁄8″-14	26″	1 1⁄4″ × 1⁄2″	6169K24	685.25	6169K244	112.12
3″-25″	14″	40	1 1⁄4″-14	31 1⁄2″	17⁄16″ × 11⁄16″	6169K26	828.69	6169K264	167.64

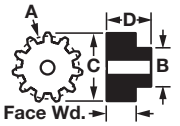
Set—Contains two-jaw puller with a 6-ton capacity and three-jaw pullers with 5-, 10-, and 20-ton capacities. 6169K63 $728.31

About Gears

For gears and racks to mesh correctly, they must have the same pressure angle and pitch. Gears with a 20° pressure angle have teeth with a wider profile than gears with a 14½° pressure angle, so they have greater strength to handle high loads.

To determine the pitch of a gear, divide the number of teeth by the pitch diameter. For example, a gear with 16 teeth and a ½″ pitch diameter has a pitch of 32. You can also use a gear tooth pitch identifier (see page 1159).

Metal Gears and Gear Racks—14½° Pressure Angle



Also known as spur gears, these gears have a 14½° pressure angle that maximizes contact between mating teeth for smooth operation. For gears and racks to mesh correctly, they must have the same pressure angle and pitch. Use these gears and racks with other components that have a 14½° pressure angle. All are steel.

Gears have a plain bore that comes machined for the shaft diameter listed; gears with a range are machinable up to the maximum size listed.

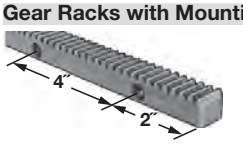
Gears

No. of Teeth	Pitch Dia. (A)	Hub Dia. (B)	OD (C)	O'all Wd. (D)	For Shaft Dia.		
32 Pitch—3/16″ Face Wd.							
16	0.5″	0.406″	0.56″	0.5″	3/16″	6325K89	$15.98
18	0.563″	0.406″	0.63″	0.5″	3/16″	6325K94	15.98
20	0.625″	0.531″	0.69″	0.5″	1/4″	6325K95	17.49
24	0.75″	0.656″	0.81″	0.5″	5/16″	6325K96	21.78
40	1.25″	0.875″	1.31″	0.563″	3/8″	6325K97	32.79
24 Pitch—1/4″ Face Wd.							
12	0.5″	0.375″	0.58″	0.563″	1/4″	6325K31	16.88
15	0.625″	0.5″	0.71″	0.563″	1/4″	6325K63	17.57
16	0.666″	0.547″	0.75″	0.563″	5/16″	6325K75	17.98
20	0.833″	0.719″	0.92″	0.563″	5/16″	6325K87	22.03
21	0.875″	0.75″	0.96″	0.563″	3/8″	6325K64	22.53
24	1″	0.875″	1.08″	0.625″	3/8″	6325K88	25.48
36	1.5″	1.125″	1.58″	0.625″	3/8″-5/8″	6325K65	34.13
48	2″	1.25″	2.08″	0.625″	3/8″-11/16″	6325K66	39.80
72	3″	1.375″	3.08″	0.75″	1/2″-13/16″	6325K67	59.61
20 Pitch—3/8″ Face Wd.							
12	0.6″	0.469″	0.7″	0.75″	5/16″	6325K81	13.49
15	0.75″	0.609″	0.85″	0.75″	3/8″	6325K68	17.98
16	0.8″	0.656″	0.9″	0.75″	3/8″	6325K82	18.03
20	1″	0.859″	1.1″	0.75″	3/8″	6325K83	21.58
23	1.15″	0.969″	1.25″	0.75″	3/8″	6325K69	23.62
24	1.2″	1.063″	1.3″	0.75″	3/8″-9/16″	6325K84	22.53
25	1.25″	1.109″	1.35″	0.75″	3/8″-5/8″	6325K71	22.95
32	1.6″	1.438″	1.7″	0.875″	3/8″-7/8″	6325K85	30.34
36	1.8″	1.625″	1.9″	0.875″	3/8″-15/16″	6325K72	34.56
48	2.4″	2″	2.5″	0.875″	3/8″-11/4″	6325K86	43.21
60	3″	2″	3.1″	0.875″	3/8″-11/4″	6325K73	50.34
16 Pitch—1/2″ Face Wd.							
12	0.75″	0.563″	0.88″	0.938″	3/8″	6325K11	17.57
14	0.875″	0.688″	1″	0.938″	3/8″	6325K12	19.57
16	1″	0.812″	1.13″	0.938″	1/2″	6325K13	22.03
18	1.125″	0.938″	1.25″	0.938″	1/2″	6325K14	23.62
20	1.25″	1.063″	1.38″	0.938″	1/2″-9/16″	6325K15	23.95
22	1.375″	1.188″	1.5″	0.938″	1/2″-5/8″	6325K74	24.02
24	1.5″	1.313″	1.63″	0.938″	1/2″-3/4″	6325K16	25.48
28	1.75″	1.5″	1.88″	1″	1/2″-7/8″	6325K76	33.71
30	1.875″	1.625″	2″	1″	1/2″-15/16″	6325K17	35.59
32	2″	1.75″	2.13″	1″	1/2″-1″	6325K18	39.80
36	2.25″	2″	2.38″	1″	1/2″-11/4″	6325K77	40.88
40	2.5″	2″	2.63″	1″	1/2″-11/4″	6325K19	45.74
48	3″	2″	3.13″	1″	1/2″-11/4″	6325K21	52.87
60	3.75″	2″	3.88″	1″	1/2″-11/4″	6325K78	67.19
12 Pitch—3/4″ Face Wd.							
12	1″	0.75″	1.17″	1.25″	1/2″	6325K22	22.53
14	1.167″	0.906″	1.33″	1.25″	1/2″	6325K23	25.48
15	1.25″	1″	1.42″	1.25″	5/8″	6325K79	28.23
16	1.333″	1.063″	1.5″	1.25″	5/8″	6325K24	29.27
18	1.5″	1.25″	1.67″	1.25″	5/8″-11/16″	6325K25	30.76
20	1.667″	1.406″	1.83″	1.25″	5/8″-13/16″	6325K26	33.71
12 Pitch—3/4″ Face Wd. (Cont.)							
24	2″	1.75″	2.17″	1.25″	5/8″-1″	6325K27	$42.79
30	2.5″	2.25″	2.67″	1.375″	5/8″-15/16″	6325K28	46.12
32	2.667″	2.25″	2.83″	1.375″	5/8″-15/16″	6325K29	50.34
36	3″	2.5″	3.17″	1.375″	5/8″-11/2″	6325K1	52.87
40	3.333″	2.5″	3.5″	1.375″	5/8″-11/2″	6325K2	55.63
42	3.5″	2.5″	3.67″	1.375″	5/8″-11/2″	6325K3	57.54
48	4″	2.5″	4.17″	1.5″	5/8″-11/2″	6325K32	74.40
60	5″	2.75″	5.17″	1.5″	3/4″-13/4″	6325K4	88.92
10 Pitch—1″ Face Wd.							
12	1.2″	0.938″	1.4″	1.625″	5/8″	6325K33	28.89
14	1.4″	1.125″	1.6″	1.625″	5/8″	6325K34	33.71
15	1.5″	1.219″	1.7″	1.625″	3/4″	6325K5	35.59
16	1.6″	1.313″	1.8″	1.625″	3/4″	6325K35	39.80
18	1.8″	1.531″	2″	1.625″	3/4″-7/8″	6325K36	42.79
20	2″	1.719″	2.2″	1.625″	3/4″-1″	6325K37	46.12
24	2.4″	2.125″	2.6″	1.625″	3/4″-11/4″	6325K38	51.83
25	2.5″	2.219″	2.7″	1.625″	3/4″-11/2″	6325K6	51.83
28	2.8″	2.125″	3″	1.875″	3/4″-11/4″	6325K7	57.08
30	3″	2.125″	3.2″	1.875″	3/4″-11/4″	6325K39	76.89
35	3.5″	2.25″	3.7″	1.875″	3/4″-15/16″	6325K8	67.19
40	4″	2.25″	4.2″	1.875″	7/8″-15/16″	6325K42	96.08
48	4.8″	2.5″	5″	1.875″	7/8″-11/2″	6325K43	110.41
60	6″	2.5″	6.2″	1.875″	7/8″-11/2″	6325K9	86.39
8 Pitch—1¼″ Face Wd.							
12	1.5″	1.125″	1.75″	2″	3/4″	6325K44	44.67
14	1.75″	1.375″	2″	2″	3/4″-13/16″	6325K45	51.83
16	2″	1.625″	2.25″	2″	7/8″-15/16″	6325K46	58.15
17	2.125″	1.75″	2.38″	2″	7/8″-1″	6325K41	59.00
18	2.25″	1.875″	2.5″	2″	7/8″-1 1/8″	6325K47	62.37
20	2.5″	2.125″	2.75″	2″	7/8″-15/16″	6325K48	69.53
22	2.75″	2.375″	3″	2″	7/8″-15/8″	6325K51	59.00
24	3″	2.625″	3.25″	2.25″	7/8″-15/8″	6325K49	105.54
28	3.5″	2.625″	3.75″	2.25″	7/8″-15/8″	6325K53	77.73
32	4″	2.875″	4.25″	2.25″	1″-1 13/16″	6325K52	124.35
36	4.5″	3″	4.75″	2.25″	1″-17/8″	6325K54	110.41
40	5″	3″	5.25″	2.25″	1″-17/8″	6325K59	134.43
6 Pitch—1½″ Face Wd.							
12	2″	1.5″	2.33″	2.375″	1″	6325K55	60.18
14	2.333″	1.812″	2.67″	2.375″	1″-11/16″	6325K56	68.50
15	2.5″	2″	2.83″	2.375″	1″-11/4″	6325K92	76.89
16	2.666″	2.156″	3″	2.375″	1″-15/16″	6325K57	85.55
18	3″	2.5″	3.33″	2.375″	1″-11/2″	6325K58	93.86
20	3.333″	2.844″	3.67″	2.375″	1″-13/4″	6325K93	100.49
22	3.666″	3″	4″	2.375″	1″-17/8″	6325K98	115.27
24	4″	3″	4.33″	2.5″	1 1/8″-17/8″	6325K61	134.89
30	5″	3.125″	5.33″	2.5″	1 1/8″-2″	6325K62	174.69
36	6″	3.25″	6.33″	2.5″	1 1/8″-2 1/8″	6325K122	201.62
48	8″	4.125″	8.33″	2.5″	1 1/8″-2 1/2″	6325K123	313.16

Gear Racks without Mounting Holes—Come longer than the length listed so you have room to finish the ends.

Face Wd.	Ht.	2-ft. Length		4-ft. Length		6-ft. Length	
32 Pitch							
3/16″	3/16″	6295K11	$15.58	6295K242	$27.84	6295K243	$38.95
24 Pitch							
1/4″	1/4″	6295K12	16.16	6295K232	29.42	6295K233	41.24
20 Pitch							
3/8″	3/8″	6295K13	19.32	6295K112	35.47	6295K113	50.50
16 Pitch							
1/2″	1/2″	6295K14	25.39	6295K123	45.23	6295K124	68.24
12 Pitch							
3/4″	1/2″	6295K15	22.26	6295K132	45.48	6295K133	69.60
3/4″	3/4″	6295K16	25.50	6295K142	51.88	6295K143	74.95
10 Pitch							
1″	5/8″	6295K17	$30.74	6295K152	$57.20	6295K153	$83.41
1″	1″	6295K18	37.52	6295K163	64.43	6295K164	94.16
8 Pitch							
1 1/4″	3/4″	6295K19	42.07	6295K172	76.74	6295K173	111.51
1 1/4″	1 1/4″	6295K21	55.81	6295K182	92.84	6295K183	135.90
6 Pitch							
1½″	1″	6295K22	59.83	6295K192	107.37	6295K193	154.65
1½″	1½″	6295K23	72.91	6295K212	140.61	6295K213	197.77

Gear Racks with Mounting Holes



These racks come with counterbored holes and finished ends, so no machining is required. They have 12 mounting holes spaced 4″ apart, starting 2″ from each end. Fasteners not included.

Pitch	Face Wd.	Ht.	For Screw Size	4-ft. Length	
24	1/4″	1/4″	No. 0	5170T1	$55.52
20	3/8″	3/8″	No. 3	5170T2	61.46
16	1/2″	1/2″	No. 8	5170T3	69.58
12	3/4″	3/4″	1/4″	5170T4	86.15

About Shafts

When selecting a shaft, diameter and straightness tolerances are characteristics to consider. Tighter tolerances ensure uniform distribution of loads and improve accuracy and repeatability. The straighter your shafts are, the smoother your system will operate.

Hardened Shafts

The choice for linear motion applications, hardened shafts are used with linear ball bearings and linear sleeve bearings. All of our hardened shafts have micron finishes that are ideal for linear bearings, slides, and other precision applications. A shaft's finish affects frictional resistance and smoothness of travel as well as the efficiency and life of linear bearings. The lower the micron value, the smoother the finish.

Case hardness is a heat-treating process to harden the outside surface (the case) of shafts. Since bearings travel directly on shafts, they cause shafts to wear. Harder shafts provide more wear resistance. The higher the case value, the harder the shaft.

Drive Shafts

Designed for rotary motion applications, drive shafts are often used with gears, sprockets, and other power transmission components. They can also be used with rotary bearings. Many of these shafts have ANSI keyways for a secure hold in higher-torque applications. Most often, these shafts are not hardened, so they're easier to machine than hardened shafts.

Hardened Shafts

For technical drawings and 3-D models, go to mcmaster.com. CAD

Don't see the shafts you need? Just tell us what you're looking for and we'll get it for you.

Hardened Shafts CAD

Shafts are case hardened and precision ground for exacting diameter and straightness tolerances. They have a 9 rms micron finish (unless noted) for inch sizes; 12 rms micron finish (unless noted) for metric sizes. Straightness tolerance is 0.002″ per foot for inch sizes; 0.03 mm per 300 mm (unless noted) for metric sizes. Ends are beveled.

For shaft supports, see page 1176.

Shaft Dia.	Dia. Tolerance
1/8″-3/16″	–0.0005″ to –0.0002″
1/4″-1 1/4″, 1 3/4″	–0.001″ to –0.0005″
1 1/2″	–0.0011″ to –0.0006″
2″	–0.0013″ to –0.0006″

Shaft Dia.	Dia. Tolerance
3 mm	–0.008 to –0.002 mm
4-6 mm	–0.008 to 0 mm
8-10 mm	–0.009 to 0 mm
12, 15, 16 mm	–0.011 to 0 mm
13 mm	–0.017 to –0.006 mm
20-30 mm	–0.013 to 0 mm
35-50 mm	–0.016 to 0 mm

Inch Sizes—Steel

Shafts are 1566 steel; they're stronger than stainless steel shafts but are less corrosion resistant. Case hardness is Rockwell C60.

Lg.	1/4″ Dia.		3/8″ Dia.		1/2″ Dia.		5/8″ Dia.		3/4″ Dia.		7/8″ Dia.	
3″	6061K411	$4.50	6061K418	$4.59	6061K426	$4.59	6061K434	$4.66	6061K442	$4.74	6061K449	$5.05
4″	6061K412	4.89	6061K419	4.78	6061K427	4.84	6061K435	4.85	6061K443	5.04	6061K451	5.18
5″	6061K413	5.00	6061K421	4.89	6061K428	4.89	6061K436	5.28	6061K444	5.49	6061K452	6.52
6″	6061K11	5.00	6061K12	5.00	6061K13	5.08	6061K111	5.56	6061K14	6.13	6061K331	7.82
7″	6061K414	5.11	6061K422	5.00	6061K429	5.12	6061K437	5.92	6061K445	7.66	6061K453	9.11
8″	6061K101	5.11	6061K102	5.17	6061K103	5.13	6061K104	6.26	6061K105	8.14	6061K106	9.63
9″	6061K21	5.11	6061K22	5.17	6061K23	5.45	6061K121	7.04	6061K24	9.08	6061K332	11.70
10″	6061K107	5.18	6061K108	5.94	6061K109	6.26	6061K112	7.77	6061K113	11.02	6061K114	13.02
12″	6061K31	5.84	6061K32	6.93	6061K33	8.14	6061K131	9.38	6061K34	12.17	6061K333	15.64
14″	6061K415	6.92	6061K423	9.00	6061K431	8.82	6061K438	10.90	6061K446	15.40	6061K454	18.28
15″	6061K315	7.29	6061K325	8.68	6061K335	9.43	6061K122	11.78	6061K345	15.61	6061K334	19.57
16″	6061K416	8.63	6061K424	10.27	6061K432	10.07	6061K439	12.46	6061K447	17.64	6061K455	20.86
18″	6061K41	8.74	6061K42	10.41	6061K43	11.12	6061K141	14.01	6061K44	18.22	6061K336	21.69
20″	6061K417	10.83	6061K425	12.86	6061K433	13.52	6061K441	15.59	6061K448	22.02	6061K456	25.53
24″	6061K51	11.87	6061K52	13.90	6061K53	15.12	6061K151	18.68	6061K54	24.32	6061K337	28.95
30″	6061K81	14.63	6061K82	17.34	6061K79	18.16	6061K123	22.36	6061K545	28.59	6061K338	34.44
36″	6061K61	17.52	6061K62	20.88	6061K63	22.17	6061K161	26.85	6061K64	34.93	6061K339	41.34
42″	6061K91	20.46	6061K92	24.35	6061K636	25.74	6061K124	31.33	6061K646	40.75	6061K341	48.26
48″	6061K71	23.20	6061K72	28.24	6061K73	28.01	6061K171	35.81	6061K74	46.58	6061K342	55.12
60″	6061K324	28.57	6061K326	36.01	6061K83	35.00	6061K181	44.78	6061K84	55.58	6061K343	65.81
72″	6061K327	35.64	6061K328	43.19	6061K93	44.48	6061K191	53.73	6061K94	66.66	6061K344	78.93
84″	6061K211	46.20	6061K212	47.63	6061K213	50.13	6061K214	62.69	6061K215	81.49	6061K346	98.85
96″	6061K312	48.51	6061K313	57.61	6061K314	60.49	6061K316	72.03	6061K317	92.40	6061K347	115.24

Lg.	1″ Dia.		1 1/8″ Dia.		1 1/4″ Dia.		1 1/2″ Dia.		1 3/4″ Dia.		2″ Dia.	
3″	6061K601	$4.83	6061K609	$6.42	6061K618	$6.36	6061K627	$7.98	6061K654	$14.45	6061K657	$17.68
4″	6061K602	6.43	6061K611	8.55	6061K619	8.47	6061K628	10.65	6061K637	19.28	6061K658	23.57
5″	6061K603	8.07	6061K612	10.69	6061K621	10.58	6061K629	13.33	6061K638	24.10	6061K647	29.46
6″	6061K604	9.66	6061K613	12.84	6061K622	12.70	6061K631	15.96	6061K639	28.90	6061K648	35.35
7″	6061K605	11.29	6061K614	15.00	6061K623	14.83	6061K632	18.62	6061K641	33.74	6061K649	41.27
8″	6061K606	12.90	6061K615	17.10	6061K624	16.94	6061K633	21.31	6061K642	38.55	6061K651	47.16
9″	6061K607	14.50	6061K616	19.27	6061K625	19.06	6061K634	23.98	6061K643	43.38	6061K652	53.06
10″	6061K608	16.09	6061K617	21.39	6061K626	21.20	6061K635	26.63	6061K644	48.21	6061K653	58.94
12″	6061K35	17.78	6061K351	21.46	6061K36	21.16	6061K37	27.00	6061K221	48.86	6061K38	62.47
18″	6061K45	24.23	6061K353	28.48	6061K46	30.05	6061K47	37.88	6061K222	68.50	6061K48	85.13
24″	6061K55	34.84	6061K354	36.18	6061K56	40.11	6061K57	50.50	6061K223	91.32	6061K58	113.52
30″	6061K25	38.05	6061K355	45.20	6061K16	50.12	6061K17	63.13	6061K224	114.17	6061K18	148.64
36″	6061K65	47.12	6061K356	54.27	6061K66	57.43	6061K67	72.31	6061K225	137.02	6061K68	162.90
42″	6061K656	60.97	6061K357	60.43	6061K26	67.02	6061K27	84.38	6061K226	145.96	6061K28	190.03
48″	6061K75	62.85	6061K358	69.04	6061K76	76.59	6061K77	96.44	6061K227	166.83	6061K78	217.18
60″	6061K85	77.03	6061K359	86.33	6061K86	95.73	6061K87	120.56	6061K228	208.51	6061K88	271.51
72″	6061K95	94.28	6061K361	103.61	6061K96	114.87	6061K97	138.33	6061K229	250.22	6061K98	325.79
84″	6061K216	112.19	6061K362	115.63	6061K217	134.06	6061K218	168.81	6061K219	291.93	6061K311	380.07
96″	6061K318	118.69	6061K363	142.69	6061K319	159.01	6061K321	184.47	6061K322	333.69	6061K323	471.61

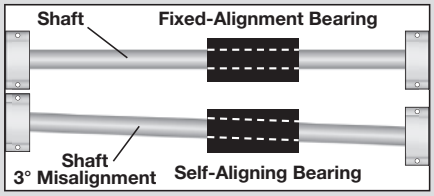
(Continued on following page)

About Linear Bearings

Linear Ball Bearings (pages 1177-1182)— The choice for smooth linear motion in debris-free environments. Compared to linear sleeve bearings, they operate with less friction, so you can run them at higher speeds. Linear ball bearings are for use on hardened shafts. They usually require lubrication.

Linear Sleeve Bearings (pages 1182-1185)— Because they do not require lubrication, linear sleeve bearings outperform linear ball bearings in dirty environments. They also take on higher loads. Use with hardened or unhardened shafts.

Parallel-Shaft Applications for Linear Sleeve Bearings— For best results in this common setup, use a *fixed-alignment bearing* on one shaft and a *self-aligning bearing*, which accommodates minor shaft misalignment, on the other.



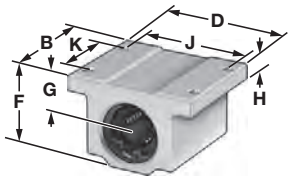
Mounted Linear Ball Bearings

A complete mounted linear bearing comes ready to use with the bearing installed inside a 6061 aluminum housing. They have end seals to keep lubricants in and dirt out. Temperature range is -4° to 176° F, unless noted. For use with hardened shafts made of steel, chrome-plated steel, or stainless steel with a hardness of at least Rockwell C50. Bearings are replaceable.

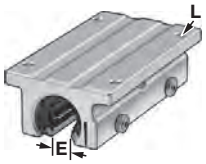
Bearings for Support Rail Shafts— Designed for applications requiring maximum rigidity.

Inch bearings are self aligning and handle up to 1° of shaft misalignment in any direction, unless noted. Bearing shell is acetal; balls are steel. Center height tolerance (G) is ±0.001″, unless noted.

Metric bearings are fixed-alignment style and are for use where shaft alignment is unlikely. Bearing shell and balls are steel. Center height tolerance is ±0.020 mm.



For Round Shafts



For Support Rail Shafts

For Shaft Dia.	Dynamic Load Cap., lbs.	O'all Lg. (B)	O'all Wd. (D)	Wd. (E)	O'all Ht. (F)	Ctr. Ht. (G)	Base Thick. (H)	Mounting Holes Center-to-Center (J)	(K)	Mounting Holes Dia. (L)		
For Round Shafts												
1/4″	60	1 3/16″	1 5/8″	—	13/16″	7/16″	3/16″	1.313″	3/4″	5/32″	6255K31	$40.20
1/4″	95	2 1/2″	1 5/8″	—	13/16″	7/16″	3/16″	1.313″	2″	5/32″	9338T42	95.00
1/4″	120	2 1/2″	1 5/8″	—	13/16″	7/16″	3/16″	1.313″	2″	5/32″	6255K61★	111.57
3/8″	95	1 5/16″	1 3/4″	—	15/16″	1/2″	3/16″	1.438″	7/8″	5/32″	6255K32	42.02
3/8″	150	2 3/4″	1 3/4″	—	15/16″	1/2″	3/16″	1.438″	2 1/4″	5/32″	9338T43	99.00
3/8″	200	2 3/4″	1 3/4″	—	15/16″	1/2″	3/16″	1.438″	2 1/4″	5/32″	6255K62★	116.60
1/2″	230	1 11/16″	2″	—	1 1/4″	11/16″	1/4″	1.688″	1″	5/32″	9338T1	53.76
1/2″	370	3 1/2″	2″	—	1 1/4″	11/16″	1/4″	1.688″	2 1/2″	5/32″	9338T7	106.45
5/8″	400	1 15/16″	2 1/2″	—	1 5/8″	7/8″	9/32″	2 1/8″	1 1/8″	3/16″	9338T2	59.33
5/8″	640	4″	2 1/2″	—	1 5/8″	7/8″	9/32″	2 1/8″	3″	3/16″	9338T8	117.38
3/4″	470	2 1/16″	2 3/4″	—	1 3/4″	15/16″	5/16″	2 3/8″	1 1/4″	3/16″	9338T3	66.60
3/4″	750	4 1/2″	2 3/4″	—	1 3/4″	15/16″	5/16″	2 3/8″	3 1/2″	3/16″	9338T9	131.81
1″	850	2 13/16″	3 1/4″	—	2 3/16″	1 3/16″	3/8″	2 7/8″	1 3/4″	7/32″	9338T4	92.88
1″	1,300	6″	3 1/4″	—	2 3/16″	1 3/16″	3/8″	2 7/8″	4 1/2″	7/32″	9338T11	183.90
1 1/4″	1,200	3 5/8″	4″	—	2 13/16″	1 1/2″	7/16″	3 1/2″	2″	7/32″	9338T5	136.60
1 1/4″	1,900	7 1/2″	4″	—	2 13/16″	1 1/2″	7/16″	3 1/2″	5 1/2″	7/32″	9338T12	270.40
1 1/2″	1,400	4″	4 3/4″	—	3 1/4″	1 3/4″	1/2″	4 1/8″	2 1/2″	9/32″	9338T6	178.45
1 1/2″	2,300	9″	4 3/4″	—	3 1/4″	1 3/4″	1/2″	4 1/8″	6 1/2″	9/32″	9338T13	353.29
2″	2,400	5″	6″	—	4 1/16″	2 1/8″	5/8″	5 1/4″	3 1/4″	13/32″	9338T41	266.69
2″	3,000	5″	6″	—	4 1/16″	2 1/8″	5/8″	5 1/4″	3 1/4″	13/32″	6255K39★	303.18
For Support Rail Shafts												
1/2″	230	1 1/2″	2″	1/4″	1 3/32″	11/16″	1/4″	1.688″	1″	5/32″	9338T14	64.60
1/2″	370	3 1/2″	2″	1/4″	1 3/32″	11/16″	1/4″	1.688″	2 1/2″	5/32″	9338T21	127.83
5/8″	400	1 3/4″	2 1/2″	5/16″	1 13/32″	7/8″	9/32″	2 1/8″	1 1/8″	3/16″	9338T15	74.98
5/8″	640	4″	2 1/2″	5/16″	1 13/32″	7/8″	9/32″	2 1/8″	3″	3/16″	9338T22	148.43
3/4″	470	1 7/8″	2 3/4″	3/8″	1 17/32″	15/16″	5/16″	2 3/8″	1 1/4″	3/16″	9338T16	82.36
3/4″	750	4 1/2″	2 3/4″	3/8″	1 17/32″	15/16″	5/16″	2 3/8″	3 1/2″	3/16″	9338T23	163.00
1″	850	2 5/8″	3 1/4″	1/2″	1 31/32″	1 3/16″	3/8″	2 7/8″	1 3/4″	7/32″	9338T17	115.21
1″	1,300	6″	3 1/4″	1/2″	1 31/32″	1 3/16″	3/8″	2 7/8″	4 1/2″	7/32″	9338T24	228.10
1 1/4″	1,200	3 3/8″	4″	9/16″	2 31/64″	1 1/2″	7/16″	3 1/2″	2″	7/32″	9338T18	170.76
1 1/4″	1,900	7 1/2″	4″	9/16″	2 15/32″	1 1/2″	7/16″	3 1/2″	5 1/2″	7/32″	9338T25	338.12
1 1/2″	1,400	3 3/4″	4 3/4″	11/16″	2 29/32″	1 3/4″	1/2″	4 1/8″	2 1/2″	9/32″	9338T19	213.50
1 1/2″	2,300	9″	4 3/4″	11/16″	2 29/32″	1 3/4″	1/2″	4 1/8″	6 1/2″	9/32″	9338T26	422.69
2″	2,400	4 3/4″	6″	15/16″	3 21/32″	2 1/8″	5/8″	5 1/4″	3 1/4″	13/32″	6255K59	270.38
For Metric Round Shafts (Dimensions in mm)												
8	60	30	34	—	22	11	6	24	18	M4	9338T51	45.90
8	95	58	34	—	22	11	6	24	42	M4	9338T31	91.36
10	80	35	40	—	26	13	8	28	21	M5	9338T52	45.54
10	130	68	40	—	26	13	8	28	46	M5	9338T32	91.24
12	110	36	42	—	28	15	8	30.5	26	M5	9338T53	45.26
12	180	70	42	—	28	15	8	30.5	50	M5	9338T33	92.58
20	195	50	54	—	41	21	11	40	40	M6	9338T54	68.20
20	310	96	54	—	41	21	11	40	70	M6	9338T34	135.00
25	220	67	76	—	51.5	26	12	54	50	M8	9338T55	88.56
30	350	72	78	—	59.5	30	15	58	58	M8	9338T56	114.30

★Max. temperature is 185° F; handles up to 1/2° of shaft misalignment; height tolerance (G) is ±0.003″.

About Carriages and Guide Rails

Ball Bearing Carriages—Operating with less friction than sleeve and roller bearing carriages, ball bearing carriages provide accurate movement and positioning in high-speed, high-load applications. See pages 1186-1190.

Roller Bearing Carriages—With a larger contact area than ball bearing carriages, roller bearing carriages provide better positioning accuracy and support heavier loads. See page 1190.

Sleeve Bearing Carriages—With fewer moving parts and no need for lubrication, sleeve bearing carriages perform better in dusty and wet environments than ball and roller bearing carriages. They're also better at handling impact and vibration than ball and roller bearing carriages. See pages 1190-1192.

Track Roller Carriages—Transport light-to-moderate loads at high speeds. Use in applications where accurate positioning is not required. See pages 1192-1193.

Load Fastening

Standard

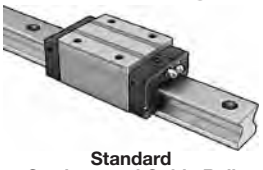
Flanged

Standard carriages are narrower than flanged carriages, making them better for confined spaces. They allow mounting from the top of your load into the carriage.

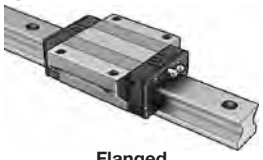
Flanged carriages have through-holes for access when fastening loads. They allow mounting from the bottom of the carriage into the load.

ⓘ For static and moment load capacities, go to mcmaster.com and search by carriage part number.

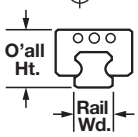
Ball Bearing Carriages and Guide Rails CAD



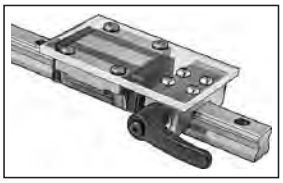
Standard
Carriage and Guide Rail
(Sold Separately)



Flanged
Carriage and Guide Rail
(Sold Separately)



Hand Brake



Hand Brake Shown Installed

Mount these steel carriages and guide rails in any orientation without affecting load capacity. Carriages come lubricated and have rubber end seals to keep lubricant in and dirt out. Maximum temperature is 175° F.

Quiet Ride—A plastic cage separates the ball bearings to minimize noise, reduce heat buildup, and eliminate ball collisions.

Standard carriages have four mounting holes and allow mounting from the top of your load into the carriage. **Flanged** carriages have four mounting holes and allow mounting from the bottom of the carriage into your load. *Quiet-ride* carriages also allow mounting from the top of your load into the carriage.

Add a **hand brake** to lock carriages in position. To install, fasten the brake to the same mounting surface as your carriage. **Mounting hole plugs** protect mounting fasteners from corrosion.

Note: Carriages can only be used with guide rails listed on the same line in the table.

ⓘ For additional guide rail lengths, go to mcmaster.com and search by guide rail part number.

	Carriages								Guide Rails				Hand Brakes	
				Mounting Holes										
Rail Wd., mm	Dynamic Load Cap., lbs.	O'all Ht., mm	Wd., mm	Lg., mm	Thread Size/ Dia., mm	Dp., mm		Each	Lengths, mm	For Mounting Fastener Thread Size		Per mm		Each
Carriages and Guide Rails														
Standard														
15	1,850	28	34	57	M4	5	6709K12	$118.97	220; 460; 820; 1,600	M4	6709K33	$0.32	1685N6	$132.43
20	3,100	30	44	74	M5	6	6709K14	127.59	280; 460; 820; 1,240	M5	6709K43	.39	1685N8	126.15
23	4,450	40	48	83	M6	8	6709K16	153.45	280; 460; 820; 1,240	M6	6709K53	.40	1685N15	148.80
28	6,250	45	60	98	M8	10	6709K18	168.97	280; 440; 1,000; 1,240	M8	6709K63	.42	1685N19	157.17
34	8,350	55	70	109	M8	12	6709K21	184.48	280; 440; 1,000; 1,240	M8	6709K73	.44	1685N26	166.40
45	13,450	70	86	139	M10	17	6709K23	258.62	570; 885; 1,200; 1,620	M12	6709K83	.50	1685N31	184.62
53	19,850	80	100	163	M12	18	6709K25	382.76	780; 1,020; 1,260; 1,500	M14	6709K93	.69	1685N37	212.06
Flanged														
15	1,850	24	47	57	4.5	7	6709K11	118.97	220; 460; 820; 1,600	M4	6709K33	.32	1685N1	119.63
20	3,100	30	63	74	6	10	6709K13	127.59	280; 460; 820; 1,240	M5	6709K43	.39	1685N8	126.15
23	4,450	36	70	83	7	10	6709K15	153.45	280; 460; 820; 1,240	M6	6709K53	.40	1685N12	129.97
28	6,250	42	90	98	9	10	6709K17	168.97	280; 440; 1,000; 1,240	M8	6709K63	.42	1685N17	135.88
34	8,350	48	100	109	9	13	6709K19	184.48	280; 440; 1,000; 1,240	M8	6709K73	.44	1685N21	139.57
45	13,450	60	120	139	11	15	6709K22	258.62	570; 885; 1,200; 1,620	M12	6709K83	.50	1685N28	152.74
53	19,850	70	140	163	14	17	6709K24	382.76	780; 1,020; 1,260; 1,500	M14	6709K93	.69	1685N32	177.23
Quiet-Ride Carriages and Guide Rails														
Standard														
15	3,150	28	34	64	M4	5	6688K11	125.45	220; 460; 640; 820	M4	6688K33	.35	1685N7	133.66
20	5,000	30	44	79	M5	5	6688K12	140.00	280; 460; 820; 1,000	M5	6688K43	.40	1685N11	140.68
23	7,100	40	48	92	M6	8	6688K13	165.45	280; 460; 820; 1,240	M6	6688K53	.41	1685N16	151.38
28	10,050	45	60	106	M8	10	6688K14	185.45	440; 760; 1,000; 1,640	M8	6688K63	.42	1685N19	157.17
34	14,000	55	70	122	M8	12	6688K15	198.18	440; 760; 1,000; 1,640	M8	6688K73	.44	1685N27	168.98
45	18,600	70	86	140	M10	17	6688K16	280.00	570; 885; 1,200; 1,620	M12	6688K83	.53	1685N31	184.62
53	28,750	80	100	171	M12	18	6688K17	398.18	780; 1,020; 1,260; 1,500	M14	6688K93	.73	1685N38	214.77
Flanged														
15	3,150	24	47	64	M5	8	6688K21	125.45	220; 460; 640; 820	M4	6688K33	.35	1685N5	131.08
20	5,000	30	63	79	M6	10	6688K22	140.00	280; 460; 820; 1,000	M5	6688K43	.40	1685N11	140.68
23	7,100	36	70	92	M8	12	6688K23	165.45	280; 460; 820; 1,240	M6	6688K53	.41	1685N15	148.80
28	10,050	42	90	106	M10	15	6688K24	185.45	440; 760; 1,000; 1,640	M8	6688K63	.42	1685N17	135.88
34	14,000	48	100	122	M10	15	6688K25	198.18	440; 760; 1,000; 1,640	M8	6688K73	.44	1685N25	164.43
45	18,600	60	120	140	M12	18	6688K26	280.00	570; 885; 1,200; 1,620	M12	6688K83	.53	1685N28	152.74
53	28,750	70	140	171	M14	21	6688K27	398.18	780; 1,020; 1,260; 1,500	M14	6688K93	.73	1685N36	208.25
Mounting Hole Plugs for Guide Rails														
For M4 Fastener Size											6709K2	Each	$0.57	
For M5 Fastener Size											6709K3	Each	$1.09	
For M6 Fastener Size											6709K4	Each	$1.18	
For M8 Fastener Size											6709K5	Each	$1.52	
For M12 Fastener Size											6709K7	Each	$1.87	
For M14 Fastener Size											6709K8	Each	$2.83	

About Precision Acme Threaded Rods

Count on precision Acme threaded rods to simply and effectively convert rotary motion into smooth, precise linear motion. Although not as efficient as ball screws, they're more economical and are great for handling jobs with lower speeds and fewer cycles.

Precision Acme threads are broader, stronger, and more square than standard V-shaped threads, which means they're better suited for carrying loads. They have a 2C (self-centering; tight and precise) thread fit and a smooth finish that increases rod life by reducing friction. Lower-precision general purpose Acme threaded rods have a 2G (general) thread fit. The 2C and 2G thread fits are compatible, but when used together you will lose the precision of the 2C thread fit.

Acme Size—Indicates the diameter of the rod and the number of threads per inch. For example, a rod with an Acme size of ½″-8 has a diameter of ½″ with 8 threads per inch.

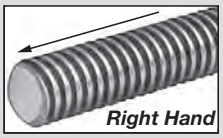
Travel Distance per Turn—The distance a nut will travel with one revolution of the threaded rod. Accuracy for travel distance per turn is 0.009″ or better per foot.

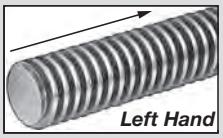
Standard- and ***Fast-Travel Rods—***The number of individual threads on a rod determines how fast a nut will travel on the rod. Our ***standard-travel rods*** (also known as single-start rods) are the most common rods and have a single thread that runs the length of the rod. Our ***fast-travel rods*** (also known as multiple-start rods) have multiple threads that run the length of the rod. Standard-travel rods must be used with standard-travel nuts and fast-travel rods must be used with fast-travel nuts.

Speed Ratio—Indicates how fast a nut will travel on the threaded rod. The first number in the speed ratio corresponds to the number of starts for that rod or nut. Compared to standard-travel rods, fast-travel rods provide more travel (speed) for each turn of the rod. For example:

Acme Size and Style of Rod	Speed Ratio	Travel Distance per Turn	Travel Distance per 100 Turns
¾″-8 Standard Travel	1:1	⅛″	12½″
¾″-8 Fast Travel	2:1	¼″	25″
¾″-8 Fast Travel	4:1	½″	50″

Right-Hand and Left-Hand Threads





Turn the threaded rods clockwise and your nuts will travel in the direction shown. *Note:* Right-hand threads are the most common threads.

Standard-Travel Precision Acme Threaded Rods

The workhorse of precision Acme threaded rod, these standard-travel (single-start) rods have a 1:1 speed ratio. Accuracy for travel distance per turn is 0.009″ or better per foot. Use with standard-travel nuts that have the same Acme size. For nuts, see the following page.

1018 Carbon Steel—Minimum tensile strength is 64,000 psi. Hardness is 126-180 Brinell. ***Heat-Treated 4140 Alloy Steel—***Harder than 1018 carbon steel, these rods ensure greater strength and durability. Minimum tensile strength is 125,000 psi. Hardness is 271 Brinell. All have a black-oxide finish. ***Type 304 Stainless Steel—***The choice for corrosion resistance. Minimum tensile strength is 72,000 psi. Hardness is 150-220 Brinell.

Precision Acme Threaded Rods

To Order: Please specify 3-ft. or 6-ft. lengths (except for Acme size ¼″-16 and ¼″-20 Type 304 Stainless Steel rods, which are only available in 6-ft. lengths).

Acme Size	Travel Dist. per Turn	Right-Hand Threads	Per Ft.	Left-Hand Threads	Per Ft.
1018 Carbon Steel					
¼″-16	1/16″	99030A632	$3.21	99030A832	$3.21
⅜″-8	⅛″	99030A126	4.40	———	———
⅜″-10	1/10″	99030A127	4.40	99030A827	3.95
⅜″-16	1/16″	99030A134	4.39	99030A934	4.34
½″-10	1/10″	99030A805	4.69	99030A905	4.69
⅝″-8	⅛″	99030A809	7.17	99030A909	7.17
⅝″-10	1/10″	99030A428	4.38	99030A928	6.49
¾″-5	⅕″	99030A813	9.26	99030A913	9.26
¾″-6	⅙″	99030A817	9.51	99030A917	9.51
¾″-8	⅛″	99030A275	13.07	99030A875	16.33
¾″-10	1/10″	99030A852	16.16	99030A552	10.13
¾″-16	1/16″	99030A277	21.27	99030A977	22.70
1″-4	¼″	99030A218	14.38	99030A918	14.38
1″-5	⅕″	99030A225	10.04	99030A925	10.04
1″-6	⅙″	99030A829	10.75	99030A929	10.75
1″-8	⅛″	99030A276	21.43	99030A976	23.15
1″-10	1/10″	99030A833	11.15	99030A933	11.15
1¼″-4	¼″	99030A841	11.48	99030A941	11.48
1¼″-5	⅕″	99030A845	11.78	99030A945	11.78
1½″-4	¼″	99030A853	13.89	99030A953	13.89
1½″-10	1/10″	99030A631	26.26	99030A931	26.26
2″-2	½″	99030A608	65.05	99030A908	65.05
2″-4	¼″	99030A857	29.47	99030A657	29.47
2″-5	⅕″	99030A623	77.46	99030A923	77.46
2½″-2	½″	99030A810	91.49	99030A910	91.49
2½″-3	⅓″	99030A614	68.37	99030A914	68.37
2½″-4	¼″	99030A865	62.48	99030A965	62.48
Heat-Treated 4140 Alloy Steel					
⅜″-8	⅛″	98940A261	9.43	98940A263	9.43
⅜″-10	1/10″	98940A271	10.51	98940A273	10.51
⅜″-12	1/12″	98940A281	14.12	98940A283	14.12
⅜″-16	1/16″	98940A291	12.73	98940A293	12.73
½″-10	1/10″	98940A321	11.76	98940A323	11.76
⅝″-5	⅕″	98940A331	13.83	98940A333	13.83

Acme Size	Travel Dist. per Turn	Right-Hand Threads	Per Ft.	Left-Hand Threads	Per Ft.
Heat-Treated 4140 Alloy Steel (Cont.)					
⅝″-8	⅛″	98940A341	$20.54	98940A343	$20.54
⅝″-10	1/10″	98940A351	22.15	98940A353	22.15
¾″-5	⅕″	98940A361	27.31	98940A363	27.31
¾″-6	⅙″	98940A371	18.19	98940A373	18.19
¾″-10	1/10″	98940A381	29.89	98940A383	29.89
1″-4	¼″	98940A391	24.81	98940A393	24.81
1″-5	⅕″	98940A441	33.24	98940A443	33.24
1″-6	⅙″	98940A451	36.12	98940A453	36.12
1″-10	1/10″	98940A461	37.29	98940A463	37.29
1¼″-4	¼″	98940A481	31.49	98940A483	31.49
1¼″-5	⅕″	98940A491	30.66	98940A493	30.66
1½″-4	¼″	98940A541	35.46	98940A553	35.46
1½″-5	⅕″	98940A551	46.07	98940A563	46.07
2″-4	¼″	98940A561	73.12	98940A573	73.12
Type 304 Stainless Steel					
¼″-16	1/16″	98980A962	18.80	———	———
¼″-20	1/20″	98980A830	20.55	———	———
⅜″-8	⅛″	98980A520	15.54	98980A220	20.62
⅜″-10	1/10″	98980A535	14.73	98980A831	20.62
⅜″-12	1/12″	98980A545	14.93	98980A247	11.67
⅜″-16	1/16″	98980A526	14.15	98980A326	18.59
½″-10	1/10″	98980A570	12.20	98980A332	24.32
⅝″-8	⅛″	98980A585	16.00	98980A285	21.86
⅝″-10	1/10″	98980A587	20.26	98980A287	23.29
¾″-5	⅕″	98980A590	21.21	98980A290	25.08
¾″-6	⅙″	98980A593	21.49	98980A293	26.26
¾″-10	1/10″	98980A595	23.45	98980A295	27.75
1″-4	¼″	98980A605	34.43	98980A305	41.12
1″-5	⅕″	98980A610	34.40	98980A210	37.50
1″-6	⅙″	98980A309	42.40	98980A815	44.83
1″-10	1/10″	98980A311	47.29	98980A230	47.29
1¼″-5	⅕″	98980A135	64.47	98980A145	64.47
1½″-4	¼″	98980A401	93.69	98980A404	101.44
2″-4	¼″	98980A845	137.83	98980A835	183.31

18″ Long Precision Acme Threaded Rods

All of these rods are made of heat-treated 4140 alloy steel and have right-hand threads.

Acme Size	Travel Distance per Turn		Each
⅜″-12	1/12″	98940A303	$18.55
½″-10	1/10″	98940A305	23.06
⅝″-8	⅛″	98940A306	28.44
¾″-6	⅙″	98940A307	35.17

Acme Size	Travel Distance per Turn		Each
1″-5	⅕″	98940A308	$39.70
1¼″-5	⅕″	98940A309	44.19
1½″-4	¼″	98940A401	68.54
2″-4	¼″	98940A405	118.29

About Ball Screws and Ball Nuts

A ball nut contains ball bearings that circulate in the groove of a ball screw to reduce friction between the nut and the screw. Together they provide smooth, precise positioning control over the full length of the ball screw. They also convert rotary motion to linear motion more efficiently than precision Acme threaded rods. *Note:* Ball nuts are furnished with a cardboard tube to keep ball bearings in place. Do not remove the tube until you are ready to install the nuts onto the screws.

Travel Distance per Turn—Also known as screw lead, travel distance per turn is the distance a ball nut moves with one revolution of the ball screw. For proper fit, choose ball nuts with the same diameter and travel distance per turn as the ball screw.

Interior View of a Ball Nut on a Ball Screw

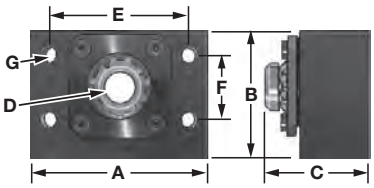
Ball Screws, Ball Nuts, and End Mounting Blocks

Ball Screws and End Mounting Blocks

Ball Screws—All are made of hardened alloy steel. They have right-hand rolled threads. Accuracy for travel distance per turn is ±0.004″ per foot. Rockwell hardness is C56. Temperature range is –65° to +300° F with a high-temperature lubricant. For use with ball nuts that have the same screw diameter and travel distance per turn. **To Order:** Please specify screw length in whole feet up to the maximum length listed.

End Mounting Blocks—Support ball screws (sold separately) to help eliminate wobble. Made of steel, each includes bearings, replaceable seals, a locknut, and a washer. Use one end mounting block for a floating setup or two end mounting blocks for a rigid setup. *Note:* The end of your ball screw must be machined before installing it into an end mounting block.

Ball Screw



End Mounting Block

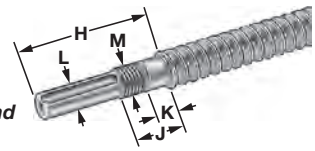
Ball Screws					End Mounting Blocks							
Screw Dia.	Travel Distance per Turn	Max. Screw Lg., ft.		Per Ft.	(A)	(B)	(C)	Dia. (D)	Ctr.-to-Ctr. (E)	Ctr.-to-Ctr. (F)	Dia. (G)		Each
3/8″	1/8″	2	5966K24	$36.05									
1/2″	1/2″	2	5966K25	47.94	2 3/4″	2″	1 51/64″	23/64″	2″	1 3/8″	0.281″	60755K12	$330.05
5/8″	13/64″	6	5966K26	21.93	3″	1 7/8″	1 11/16″	15/32″	2 1/4″	1 1/8″	0.281″	60755K13	458.02
3/4″	13/64″	6	5966K13	31.61	3 1/2″	2 1/8″	1 27/32″	19/32″	2 1/2″	1 3/8″	0.281″	60755K14	468.23
3/4″	1/2″	6	5966K22	37.45	3 1/2″	2 1/8″	1 27/32″	19/32″	2 1/2″	1 3/8″	0.281″	60755K14	468.23
1″	1/4″	8	5966K27	47.40	4 1/2″	2 3/4″	2 21/64″	25/32″	3 1/4″	1 3/4″	0.469″	60755K15	530.18
1″	1/2″	8	5966K23	46.21	4 1/2″	2 3/4″	2 21/64″	25/32″	3 1/4″	1 3/4″	0.469″	60755K15	530.18
1″	1″	8	5966K31	48.02	4 1/2″	2 3/4″	2 21/64″	25/32″	3 1/4″	1 3/4″	0.469″	60755K15	530.18
1 1/2″	1/4″	8	5966K28	70.28	6 1/2″	3 5/8″	3″	1 3/16″	4 3/4″	2″	0.656″	60755K16	708.77
1 1/2″	1/2″	8	5966K76	59.19	6 1/2″	3 5/8″	3″	1 3/16″	4 3/4″	2″	0.656″	60755K16	708.77
1 1/2″	1″	8	5966K39	76.34	6″	3 3/8″	2 29/32″	63/64″	4 1/4″	2″	0.656″	60755K17	634.97
2 1/4″	1/2″	8	5966K29	93.21	8 1/2″	5 5/8″	4 5/32″	1 25/32″	6 5/8″	3 5/8″	0.812″	60755K18	1,342.24
2 1/4″	1″	8	5966K33	117.73	8 1/2″	5 5/8″	4 5/32″	1 25/32″	6 5/8″	3 5/8″	0.812″	60755K18	1,342.24

Ball Screws with One Machined End and End Mounting Blocks

Ball Screws with One Machined End—Identical to the ball screws above, except these have one end that has already been machined for you. The machined end fits perfectly into an end mounting block (sold separately) and is ready to connect to your motor. It has a standard Type III journal with drive extension. To adjust the length, the non-machined end can be cut to size.

End Mounting Blocks—For information and illustration, see above.

Ball Screw with One Machined End

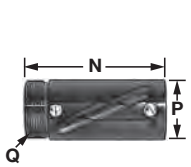


Ball Screws with One Machined End									2-ft. Lengths		4-ft. Lengths		6-ft. Lengths		End Mounting Blocks (Dimensions Above)	
Screw Dia.	Travel Distance per Turn	Overall Machined Lg. (H)	Lg. (J)	Lg. (K)	Dia. (L)	Dia. (M)	Keyway, Wd. × Lg.			Each		Each		Each		Each
5/8″	13/64″	3.292″	1.99″	1.56″	0.406″	0.47″	1/8″	× 1 1/4″	5966K2	$189.62	5966K6	$223.68	5966K21	$257.75	60755K13	$458.02
3/4″	13/64″	3.180″	2.18″	1.71″	0.500″	0.59″	1/8″	× 7/8″	5966K4	230.56	5966K7	305.57	5966K32	380.62	60755K14	468.23
1″	1/4″	4.028″	2.71″	2.18″	0.625″	0.78″	3/16″	× 1 1/4″	5966K5	214.27	5966K8	272.98	5966K41	331.69	60755K15	530.18

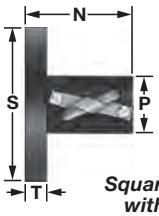
Ball Nuts and Ball Nuts with Flange

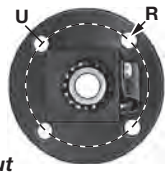
All of these ball nuts are made of heat-treated alloy steel with a black-oxide finish. The maximum play between the screw and the nut is 0.015″. Rockwell hardness is C56. Temperature range is –65° to +300° F.

For use with ball screws that have the same screw diameter and travel distance per turn. Load capacities are based on using a ball screw and a ball nut together.



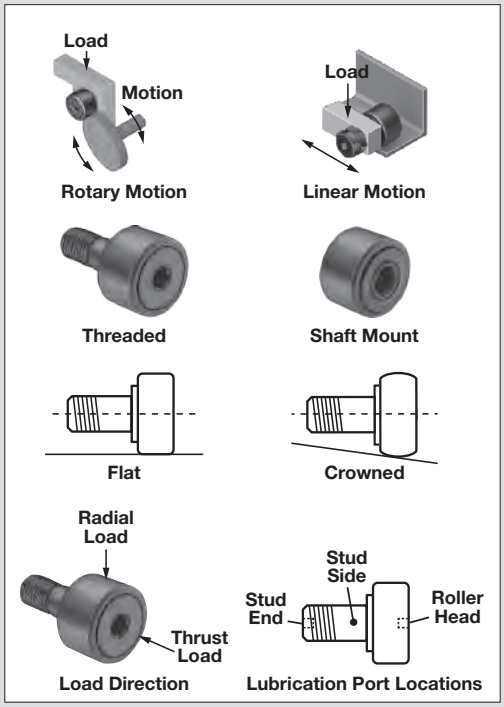
Round Ball Nut





Square Ball Nut with Flange

Ball Nuts							Ball Nuts with Flange					
Screw Dia.	Travel Distance per Turn	Load Cap., lbs.	Lg. (N)	(P)	Thread (Q)	Each	Dia. (R)	Dia. (S)	(T)	Bolt Circle (U)		Each
Round Ball Nuts												
3/8″	1/8″	136	1″	3/4″ Dia.	0.664″-32	5966K14 $110.36	0.177″	1 39/64″	0.270″	1.240″	5966K44	$164.30
3/4″	13/64″	1,900	2 57/64″	1 5/16″ Dia.	1.173″-18	5966K1 75.78	0.281″	2 39/64″	0.530″	2.090″	5966K3	129.45
3/4″	1/2″	3,263	3″	1 5/16″ Dia.	1 1/4″-18	5966K42 254.21	0.281″	2 5/8″	0.530″	2.090″	5966K79	298.87
1″	1/2″	3,890	3 1/8″	1 5/8″ Dia.	1 9/16″-18	5966K43 288.09	0.266″	3 1/4″	0.630″	2.750″	5966K81	324.59
1 1/2″	1/4″	4,198	2 7/8″	2 3/32″ Dia.	1 31/32″-18	5966K18 346.52	0.397″	4 13/64″	0.520″	3.440″	5966K48	437.24
1 1/2″	1/2″	14,513	5 19/32″	2 5/8″ Dia.	2.36″-18	5966K34 472.09	0.531″	4 21/32″	0.780″	3.875″	5966K35	536.34
2 1/4″	1/2″	21,306	6 11/16″	3 3/8″ Dia.	3.137″-12	5966K19 776.57	0.656″	5 3/8″	1.582″	4.375″	5966K49	906.13
Square Ball Nuts												
1/2″	1/2″	786	1 7/8″	3/4″ × 1″	15/16″-16	5966K15 229.41	0.266″	2 39/64″	0.530″	2.090″	5966K45	298.65
5/8″	13/64″	778	1 23/32″	1″ × 1″	15/16″-16	5966K16 35.14	0.266″	2 39/64″	0.530″	2.090″	5966K46	86.73
1″	1/4″	1,612	2 11/32″	1 1/2″ × 1 1/2″	1 9/16″-18	5966K17 56.97	0.266″	3 1/4″	0.630″	2.750″	5966K47	118.94
1″	1″	2,142	3″	1 1/2″ × 1 1/2″	1 9/16″-18	5966K74 146.86	0.266″	3 1/4″	0.630″	2.750″	5966K82	194.31
1 1/2″	1″	7,560	3 5/8″	2 1/4″ × 2 1/4″	2 1/4″-20	5966K167 379.40	0.531″	4 15/16″	1.020″	4.125″	5966K84	467.13



About Track Rollers

Also known as cam followers, track rollers have a thick outer roller that runs directly on a flat surface.

Roller Style

Threaded—Thread the stud directly into a component or secure with a nut for through-hole mounting.

Shaft Mount—Also known as yoke-style cam followers, these rollers have more mounting flexibility than threaded track rollers. They're typically mounted onto a shaft or clevis rod end.

Roller Profile

Flat—The choice for perfectly flat surfaces, these rollers offer the best surface-to-surface contact.

Crowned—Have a slight curve, which is invisible to the naked eye, to stay centered on surfaces that are not perfectly aligned and/or not perfectly flat.

Load Direction and Load Capacity

Radial load refers to the force that is applied perpendicular to the roller's outer surface.

Thrust load, also known as axial load, refers to the force that is applied parallel to the end of the roller.

Static load capacity is the weight a roller can support while stationary.

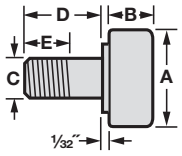
Dynamic load capacity is the weight a roller can support while in motion.

Lubrication Port Locations

Most threaded track rollers have a lubrication hole in the side of the stud (access can be difficult once rollers are installed). Others allow lubrication through the end of the stud and head of the roller. Lubrication holes in all three points allow maximum access.

Shaft-mount track rollers usually have a lubrication hole or groove in the roller's inner ring.

Threaded Track Rollers



Also known as cam followers, track rollers support loads while guiding and positioning work. Lubrication holes are in the end and the side of the stud, unless noted. All are steel with a black-oxide finish. They have needle roller bearings and a hex socket head. Mounting nut not included. Maximum temperature is 250° F.

Crowned rollers have a slight curve, which is invisible to the naked eye, to stay centered on surfaces that are not perfectly aligned and/or not perfectly flat.

Sealed rollers have end seals to protect rolling elements from dirt and contamination.

Roller Dia. (A)	Roller Wd. (B)	Stud Dia. (C)	Stud Lg. (D)	Thread Size	Thread Lg. (E)	Max. rpm	Radial Load Cap., lbs. Static	Radial Load Cap., lbs. Dynamic	Unsealed		Sealed	
Flat												
1/2"	3/8"	3/16"	5/8"	10-32	1/4"	11,000	790	650	1460T11★	$22.69	1460T41★	$23.02
9/16"	3/8"	3/16"	5/8"	10-32	1/4"	10,000	790	650	1460T12★	24.06	1460T42★	27.31
5/8"	7/16"	1/4"	3/4"	1/4"-28	5/16"	9,000	1,200	950	1460T13★	22.88	1460T43★	22.90
11/16"	7/16"	1/4"	3/4"	1/4"-28	5/16"	8,000	1,200	950	1460T14★	25.52	1460T44★	29.77
3/4"	1/2"	3/8"	7/8"	3/8"-24	3/8"	6,000	2,000	1,600	1460T15	21.73	1460T45	25.04
7/8"	1/2"	3/8"	7/8"	3/8"-24	3/8"	5,000	2,000	1,600	1460T16	23.73	1460T46	24.19
1"	5/8"	7/16"	1"	7/16"-20	1/2"	4,800	3,000	2,200	1460T17	27.54	1460T47	29.06
1 1/8"	5/8"	7/16"	1"	7/16"-20	1/2"	3,400	3,000	2,200	1460T18	29.29	1460T48	31.10
1 1/4"	3/4"	1/2"	1 1/4"	1/2"-20	5/8"	3,100	4,200	3,900	1460T19	32.31	1460T49	34.83
1 3/8"	3/4"	1/2"	1 1/4"	1/2"-20	5/8"	2,800	4,200	3,900	1460T21	33.96	1460T51	36.38
1 1/2"	7/8"	5/8"	1 1/2"	5/8"-18	3/4"	2,500	5,600	4,800	1460T22	41.71	1460T52	44.75
1 5/8"	7/8"	5/8"	1 1/2"	5/8"-18	3/4"	2,300	5,600	4,800	1460T23	40.98	1460T53	44.04
1 3/4"	1"	3/4"	1 3/4"	3/4"-16	7/8"	2,200	7,900	6,300	1460T24	51.21	1460T54	55.58
1 7/8"	1"	3/4"	1 3/4"	3/4"-16	7/8"	2,000	7,900	6,300	1460T25	51.73	1460T55	56.15
2"	1 1/4"	7/8"	2"	7/8"-14	1"	1,400	10,000	8,000	1460T26	66.35	1460T56	73.46
2 1/4"	1 1/4"	7/8"	2"	7/8"-14	1"	1,300	10,000	8,000	1460T27	79.79	1460T57	81.00
2 1/2"	1 1/2"	1"	2 1/4"	1"-14	1 1/8"	1,100	16,000	11,000	1460T28	90.52	1460T58	91.74
2 3/4"	1 1/2"	1"	2 1/4"	1"-14	1 1/8"	1,000	16,000	11,000	1460T29	119.90	1460T59	135.22
3"	1 3/4"	1 1/4"	2 1/2"	1 1/4"-12	1 1/4"	950	24,000	15,000	1460T31	165.42	1460T61	180.48
3 1/4"	1 3/4"	1 1/4"	2 1/2"	1 1/4"-12	1 1/4"	850	24,000	15,000	1460T32	168.24	1460T62	207.80
Crowned												
1/2"	3/8"	3/16"	5/8"	10-32	1/4"	11,000	790	650			3659K11★	30.52
9/16"	3/8"	3/16"	5/8"	10-32	1/4"	10,000	790	650			3659K45★	29.71
5/8"	7/16"	1/4"	3/4"	1/4"-28	5/16"	9,000	1,200	950			3659K12★	29.22
11/16"	7/16"	1/4"	3/4"	1/4"-28	5/16"	8,000	1,200	950			3659K46★	36.83
3/4"	1/2"	3/8"	7/8"	3/8"-24	3/8"	6,000	2,000	1,600			3659K13	27.80
7/8"	1/2"	3/8"	7/8"	3/8"-24	3/8"	5,000	2,000	1,600			3659K14	27.92
1"	5/8"	7/16"	1"	7/16"-20	1/2"	4,800	3,000	2,200			3659K15	32.44
1 1/8"	5/8"	7/16"	1"	7/16"-20	1/2"	3,400	3,000	2,200			3659K16	34.38
1 1/4"	3/4"	1/2"	1 1/4"	1/2"-20	5/8"	3,100	4,200	3,900			3659K17	37.86
1 3/8"	3/4"	1/2"	1 1/4"	1/2"-20	5/8"	2,800	4,200	3,900			3659K18	40.32
1 1/2"	7/8"	5/8"	1 1/2"	5/8"-18	3/4"	2,500	5,600	4,800			3659K19	45.78
1 5/8"	7/8"	5/8"	1 1/2"	5/8"-18	3/4"	2,300	5,600	4,800			3659K21	45.00
1 3/4"	1"	3/4"	1 3/4"	3/4"-16	7/8"	2,200	7,900	6,300			3659K22	56.26
1 7/8"	1"	3/4"	1 3/4"	3/4"-16	7/8"	2,000	7,900	6,300			3659K23	58.22
2"	1 1/4"	7/8"	2"	7/8"-14	1"	1,400	10,000	8,000			3659K24	76.69
2 1/4"	1 1/4"	7/8"	2"	7/8"-14	1"	1,300	10,000	8,000			3659K25	82.85
2 1/2"	1 1/2"	1"	2 1/4"	1"-14	1 1/8"	1,100	16,000	11,000			3659K26	102.58
2 3/4"	1 1/2"	1"	2 1/4"	1"-14	1 1/8"	1,000	16,000	11,000			3659K27	141.74
3"	1 3/4"	1 1/4"	2 1/2"	1 1/4"-12	1 1/4"	950	24,000	15,000			3659K28	208.48
3 1/4"	1 3/4"	1 1/4"	2 1/2"	1 1/4"-12	1 1/4"	850	24,000	15,000			3659K29	236.80

★No lubrication holes.

About Ball and Roller Bearings

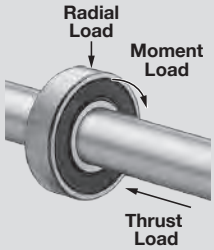
Ball and roller bearings operate with less friction than plain bearings, so they can run at higher speeds. Roller bearings generally support higher loads than ball bearings but run at lower speeds.

Open bearings dissipate heat more efficiently than shielded and sealed bearings.

Shielded bearings block out dust and other contaminants, but do not dissipate heat as efficiently as open bearings.

Sealed bearings block out dust and other contaminants better than open and shielded bearings, but retain the most heat.

Load Direction



All bearings are designed to handle radial loads, thrust loads, moment loads, or a combination of the three. Radial loads are perpendicular to the shaft. Thrust loads are parallel to the shaft. Moment loads are twisting forces that result from offset loads.

Bearing Trade Number

A bearing's trade number is sometimes part of a longer string of letters and numbers stamped on the bearing's side. A bearing's trade number is comprised of its Size and Seal Type.

Size—Bearings with the same size values will have the same ID and OD.

Seal Type—Shielded bearings are coded ZZ or 2Z. Sealed bearings are coded RS or 2RS. Open bearings will not have a code for seal type.

Ball Bearings


Open


Shielded

Sealed with Retaining Ring

Use these steel bearings to support radial loads. They come lubricated and withstand temperatures from -20° to 230°F, unless otherwise stated. Made to ABEC-1 tolerance standards, unless noted. *Sealed* bearings have a Buna-N seal.

Bearings **with retaining ring** have a removable retaining ring that holds the bearing inside a housing. *Sealed* bearings withstand temperatures from -40° to 210°F.

Inch

Trade No.	For Shaft Dia.	For Housing ID	Dynamic Load Cap., lbs.	Open Wd.	Open Max. rpm			Shielded Wd.	Shielded Max. rpm			Sealed Wd.	Sealed Max. rpm		
R2	1/8"	3/8"	140	5/32"	60,000	60355K501★	$6.21	5/32"	54,000	60355K41	$6.56	5/32"	56,000	60355K851	$3.37
R3	3/16"	1/2"	290	5/32"	50,000	60355K502★	6.90	0.196"	41,500	60355K42	6.81	0.196"	43,000	60355K861	3.35
R4	1/4"	5/8"	320	3/16"	43,000	60355K503★	5.98	0.196"	31,000	60355K43	6.48	0.196"	31,000	60355K701	6.80
R4A	1/4"	3/4"	620	—	—	—	—	9/32"	39,500	60355K44	7.16	9/32"	30,000	60355K702	8.46
R6	3/8"	7/8"	750	7/32"	33,300	60355K504★	5.78	9/32"	22,000	60355K45	6.48	9/32"	22,000	60355K703	6.88
R8	1/2"	1 1/8"	1,100	1/4"	25,500	60355K505★	6.27	5/16"	16,500	60355K601	7.08	5/16"	16,500	60355K704	9.08
R10	5/8"	1 3/8"	1,300	9/32"	20,000	60355K506★	6.66	11/32"	12,000	60355K602	8.63	11/32"	12,000	60355K705	9.40
R12	3/4"	1 5/8"	1,750	5/16"	17,000	60355K507★	7.92	7/16"	10,500	60355K603	10.80	7/16"	10,500	60355K706	11.12
R14	7/8"	1 7/8"	2,250	3/8"	14,500	60355K508★	10.36	1/2"	9,000	60355K604	12.48	1/2"	9,000	60355K707	13.85
R16	1"	2"	2,400	3/8"	14,500	60355K509★	11.19	1/2"	9,000	60355K605	12.34	1/2"	9,000	60355K708	13.92
R18	1 1/8"	2 1/8"	2,150	3/8"	15,000	60355K211	11.66	1/2"	15,000	60355K812	13.50	—	—	—	—
R20	1 1/4"	2 1/4"	2,400	3/8"	15,000	60355K22	12.83	1/2"	15,000	60355K821	13.36	—	—	—	—
R20	1 1/4"	2 1/4"	3,150	—	—	—	—	—	—	—	—	1/2"	7,500	3760T254	62.86
R22	1 3/8"	2 1/2"	3,550	7/16"	10,500	60355K511★	32.05	9/16"	6,300	60355K606	43.64	—	—	—	—
R24	1 1/2"	2 5/8"	3,750	7/16"	10,000	60355K512★	44.73	9/16"	5,900	60355K607	49.96	—	—	—	—

★ Requires lubrication.

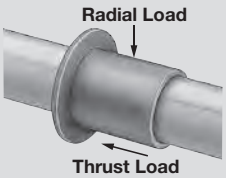
Metric—Dimensions in millimeters

Trade No.	For Shaft Dia.	For Housing ID	Open Wd.	Open Dynamic Load Cap., lbs.	Open Max. rpm			Shielded Dynamic Load Cap., lbs.	Shielded Max. rpm			Sealed Dynamic Load Cap., lbs.	Sealed Max. rpm		
607	7	19	6	—	—	—	—	580	45,000	5972K261	$12.86	580	22,000	5972K225	$21.35
608	8	22	7	730	36,000	5972K91	$4.56	730	30,000	5972K501	4.91	730	20,000	5972K222	5.20
626	6	19	6	—	—	—	—	520	40,000	6661K11■	13.73	520	24,000	6661K81■	19.61
627	7	22	7	—	—	—	—	—	—	—	—	730	20,000	5972K502	6.95
629	9	26	8	1,000	34,000	5972K93	7.91	1,000	28,000	5972K321	5.37	1,000	19,000	5972K231	9.92
634	4	16	5	—	—	—	—	440	53,000	5972K634	26.76	—	—	—	—
635	5	19	6	580	53,000	5972K197	16.50	580	45,000	5972K263	18.41	—	—	—	—
6000	10	26	8	1,000	34,000	5972K94	6.78	1,000	28,000	5972K322	7.25	1,000	19,000	5972K81	7.95
6001	12	28	8	1,100	32,000	5972K95	7.59	1,100	26,000	5972K323	7.95	1,100	18,000	5972K82	8.24
6002	15	32	9	1,250	30,000	5972K358	7.72	1,250	24,000	5972K324	7.97	1,250	16,000	5972K83	8.65
6003	17	35	10	1,300	28,000	5972K311	8.78	1,300	22,000	5972K325	9.19	1,300	14,000	5972K84	10.13
6004	20	42	12	—	—	—	—	2,200	19,000	6661K17■	28.11	2,200	11,000	6661K87■	30.63
6005	25	47	12	—	—	—	—	2,650	16,000	6661K18■	23.31	2,650	9,500	6661K88■	34.70
6006	30	55	13	—	—	—	—	3,100	14,000	6661K19■	29.33	3,100	8,000	6661K89■	39.53
6007	35	62	14	3,550	28,000	5972K312	13.58	3,000	11,000	5972K365	13.49	3,550	7,500	5972K85	15.81
6008	40	68	15	—	—	—	—	4,000	12,000	5972K269	37.52	—	—	—	—
6009	45	75	16	—	—	—	—	4,750	11,000	5972K271	53.56	—	—	—	—
6010	50	80	16	—	—	—	—	4,900	10,000	5972K272	63.42	4,900	5,600	5972K234	74.92
6011	55	90	18	—	—	—	—	6,700	9,100	5972K273	113.60	6,700	5,000	5972K235	85.20
6012	60	95	18	—	—	—	—	7,050	8,500	5972K274	105.92	7,050	4,500	5972K236	89.68
6013	65	100	18	—	—	—	—	7,300	8,100	5972K301	87.52	7,300	4,300	5972K237	99.94
6014	70	110	20	—	—	—	—	9,100	7,300	5972K302	116.98	9,100	4,000	5972K238	126.78

■ Made to ABEC-3 tolerance standards.

(Continued on following page)

About Sleeve and Thrust Bearings



Also known as plain bearings, these bearings have no moving parts and are the simplest type of bearing. They generally handle higher temperatures than ball and roller bearings and perform better in dirty environments.

Sleeve bearings (pages 1232-1242) support radial loads (perpendicular to the shaft).

Flanged sleeve bearings (pages 1243-1249) have a flange that acts as a built-in thrust bearing, allowing the bearing to support combined radial loads (perpendicular to the shaft) and thrust loads (parallel to the shaft).

Thrust bearings (pages 1250-1253) separate adjacent shaft components and prevent friction in applications with thrust loads (parallel to the shaft).

Oil-Embedded Sleeve Bearings

Startup friction causes these porous bronze bearings to release a thin layer of oil on the bearing's surface.

Standard—Also known as Oilite® bearings. Lubricated with SAE 30 oil. Temperature range is -35° to 300°F.

Ultra-Low Friction—For applications with frequent starts and stops, the oil in these bearings contains particles of slippery PTFE that lubricate the bearing during startup. Lubricated with SAE 20 or SAE 80 oil. Temperature range is -40° to 300°F.

High Load—Increased iron content makes these bearings stronger and more resistant to shock loads than standard oil-embedded bearings, and dynamic load capacity is about double; however they operate at lower speeds. Lubricated with SAE 90 oil. Color is silver because of the iron. **SAE 863 bronze** bearings withstand temperatures from -15° to 300°F. **Iron-copper** bearings support heavier loads than SAE 863 bronze bearings. Temperature range is 10° to 220°F.

Food Grade—The SAE 20 oil in these bearings is suitable for incidental contact with food. Temperature range is -75° to 300°F. **SAE 841 bronze** bearings handle higher speeds than SAE 863 bronze bearings. **SAE 863 bronze** bearings have increased iron content, making them stronger and more resistant to shock loads than SAE 841 bronze bearings. Color is silver because of the iron.

Note: Dynamic load capacity is the maximum load a bearing can withstand at a given shaft speed. If your application's load and speed requirements are below the values listed, the bearing will work.

Standard SAE 841 Bronze

For Housing ID	Lg.	Dynamic Load Cap., lbs. @ Speed		
For 3/64" Shaft Dia.—Load @ 120 rpm				
5/32"	3/16"	17	6391K481	$13.15
For 1/16" Shaft Dia.—Load @ 120 rpm				
1/4"	1/4"	31	6391K482	13.15
For 5/64" Shaft Dia.—Load @ 120 rpm				
1/4"	1/4"	39	6391K483	13.15
For 3/32" Shaft Dia.—Load @ 120 rpm				
1/4"	1/4"	46	6391K484	13.15
For 1/8" Shaft Dia.—Load @ 120 rpm				
3/16"	1/8"	31	6391K611	.56
7/32"	1/4"	60	6391K612	.55
1/4"	1/8"	31	6391K113	.56
1/4"	1/4"	60	6391K111	.57
1/4"	3/8"	90	6391K112	.51
1/4"	1/2"	125	6391K613	.77
3/8"	1/4"	60	6391K614	.68
For 5/32" Shaft Dia.—Load @ 120 rpm				
7/32"	1/4"	75	6391K615	13.15
1/4"	3/8"	115	6391K485	13.15
For 3/16" Shaft Dia.—Load @ 120 rpm				
1/4"	1/4"	90	6391K122	.46
1/4"	3/8"	140	6391K125	.69
1/4"	1/2"	185	6391K124	.73
1/4"	5/8"	230	6391K123	.98
5/16"	1/4"	90	6391K114	.48
5/16"	3/8"	140	6391K115	.58
5/16"	1/2"	185	6391K116	.58
5/16"	5/8"	230	6391K616	.63
3/8"	1/4"	90	6391K617	.95
3/8"	1/2"	185	6391K618	1.20
For 7/32" Shaft Dia.—Load @ 120 rpm				
5/16"	3/8"	160	6391K486	15.31
For 1/4" Shaft Dia.—Load @ 120 rpm				
5/16"	1/4"	125	6391K126	.43
5/16"	1/2"	250	6391K127	.67
5/16"	3/4"	370	6391K401	.93
3/8"	1/4"	125	6391K131	.46
3/8"	3/8"	185	6391K136	.56
3/8"	1/2"	250	6391K132	.67
3/8"	5/8"	310	6391K133	.79
3/8"	7/8"	430	6391K134	1.20
3/8"	1"	500	6391K135	.82
7/16"	3/8"	185	6391K619	.85
7/16"	1/2"	250	6391K621	1.13
7/16"	5/8"	310	6391K622	1.35
1/2"	1/2"	250	6391K141	1.24
1/2"	5/8"	310	6391K402	2.00
1/2"	3/4"	370	6391K142	1.42
1/2"	1"	500	6391K143	2.36
For 5/16" Shaft Dia.—Load @ 120 rpm				
3/8"	1/4"	155	6391K403	.59
3/8"	3/8"	230	6391K152	.81
3/8"	1/2"	310	6391K153	.86
3/8"	5/8"	390	6391K154	.72
For 5/16" Shaft Dia.—Load @ 120 rpm (Cont.)				
3/8"	3/4"	460	6391K155	$0.83
3/8"	1"	620	6391K156	1.20
7/16"	1/4"	155	6391K161	.58
7/16"	3/8"	230	6391K162	.58
7/16"	1/2"	310	6391K163	.70
7/16"	5/8"	390	6391K164	.82
7/16"	3/4"	460	6391K165	.88
7/16"	1"	620	6391K166	1.23
1/2"	1/4"	155	6391K623	.72
1/2"	3/8"	230	6391K404	.90
1/2"	1/2"	310	6391K405	.91
1/2"	3/4"	460	6391K406	1.58
1/2"	1"	620	6391K443	2.08
1/2"	1 1/4"	780	6391K444	2.14
For 3/8" Shaft Dia.—Load @ 120 rpm				
7/16"	1/4"	185	6391K624	.56
7/16"	1/2"	370	6391K625	.60
1/2"	1/4"	185	6391K171	.58
1/2"	3/8"	280	6391K172	.68
1/2"	1/2"	370	6391K173	.72
1/2"	5/8"	460	6391K174	.73
1/2"	3/4"	560	6391K176	1.24
1/2"	7/8"	650	6391K175	1.17
1/2"	1"	750	6391K178	1.19
1/2"	1 1/4"	930	6391K179	1.40
9/16"	3/8"	280	6391K181	1.10
9/16"	1/2"	370	6391K182	1.13
9/16"	3/4"	560	6391K183	1.31
9/16"	1"	750	6391K184	1.52
9/16"	1 1/4"	930	6391K185	2.33
5/8"	1/2"	370	6391K186	1.23
5/8"	5/8"	460	6391K187	1.88
5/8"	3/4"	560	6391K188	1.47
5/8"	1"	750	6391K189	2.28
3/4"	1/2"	370	6391K626	1.09
3/4"	1"	750	6391K511	2.72
For 7/16" Shaft Dia.—Load @ 120 rpm				
9/16"	1/2"	430	6391K117	1.08
9/16"	5/8"	540	6391K118	.93
9/16"	3/4"	650	6391K627	1.21
9/16"	1"	870	6391K119	1.41
9/16"	1 1/4"	1,050	6391K407	2.49
5/8"	1/2"	430	6391K192	1.33
5/8"	3/4"	650	6391K194	1.37
5/8"	1"	870	6391K195	1.70
For 1/2" Shaft Dia.—Load @ 120 rpm				
5/8"	3/8"	370	6391K211	.79
5/8"	1/2"	500	6391K212	.84
5/8"	9/16"	560	6391K213	1.42
5/8"	5/8"	620	6391K216	1.11
5/8"	3/4"	750	6391K214	1.18
5/8"	7/8"	870	6391K408	1.77
5/8"	1"	1,000	6391K215	1.37
For 1/2" Shaft Dia.—Load @ 120 rpm (Cont.)				
5/8"	1 1/8"	1,100	6391K409	$1.61
5/8"	1 1/4"	1,250	6391K217	1.82
5/8"	1 1/2"	1,500	6391K411	1.53
5/8"	3"	3,000	6391K1	36.07
11/16"	1/2"	500	6391K196	1.37
11/16"	5/8"	620	6391K197	1.38
11/16"	3/4"	750	6391K198	1.57
11/16"	1"	1,000	6391K199	1.75
11/16"	1 1/8"	1,100	6391K201	2.31
3/4"	3/8"	370	6391K521	1.50
3/4"	1/2"	500	6391K221	2.00
3/4"	5/8"	620	6391K222	2.44
3/4"	3/4"	750	6391K223	2.78
3/4"	1"	1,000	6391K225	3.51
3/4"	1 1/8"	1,100	6391K412	3.12
3/4"	1 1/4"	1,250	6391K226	3.25
3/4"	1 1/2"	1,500	6391K413	4.71
3/4"	3"	3,000	6391K3	36.34
7/8"	1/2"	500	6391K628	2.93
7/8"	1"	1,000	6391K629	4.29
1"	3/4"	750	6391K631	3.19
1"	1"	1,000	6391K414	4.82
1"	1 1/2"	1,500	6391K632	6.03
1"	3"	3,000	6391K4	30.30
For 9/16" Shaft Dia.—Load @ 60 rpm				
3/4"	1/2"	560	6391K231	1.55
3/4"	3/4"	840	6391K232	1.90
3/4"	1"	1,100	6391K233	2.02
3/4"	1 1/4"	1,400	6391K234	2.85
3/4"	1 3/8"	1,500	6391K235	3.09
For 5/8" Shaft Dia.—Load @ 60 rpm				
3/4"	3/8"	460	6391K633	1.02
3/4"	1/2"	620	6391K241	1.07
3/4"	5/8"	780	6391K246	1.25
3/4"	3/4"	930	6391K247	1.26
3/4"	7/8"	1,050	6391K242	1.34
3/4"	1"	1,250	6391K243	2.19
3/4"	1 1/8"	1,400	6391K244	1.65
3/4"	1 1/4"	1,550	6391K245	1.97
3/4"	1 1/2"	1,850	6391K415	2.25
3/4"	3"	3,750	6391K6	34.67
13/16"	1/2"	620	6391K251	1.40
13/16"	5/8"	780	6391K634	2.01
13/16"	3/4"	930	6391K253	1.74
13/16"	1"	1,250	6391K255	2.97
13/16"	3"	3,750	6391K7	34.74
7/8"	5/8"	780	6391K202	1.94
7/8"	3/4"	930	6391K203	2.29
7/8"	1"	1,250	6391K204	2.62
7/8"	1 1/4"	1,550	6391K635	3.18
7/8"	1 1/2"	1,850	6391K205	4.07
7/8"	1 3/4"	2,150	6391K416	4.62
7/8"	3"	3,750	6391K8	34.67

(Continued on following page)

Bearing Heaters

About Bearing Heaters

Heating your bearings makes them easier to install and reduces damage to your shafts during installation. The heaters work by expanding your bearing's inner race, so you get a snug fit without forcing a tight-fitting bearing onto a shaft. Heaters can also be used on gears, sprockets, pulleys, and bushings. ***Induction bearing heaters*** will not magnetize heated items.

Cone-Mount Bearing Heaters

Automatic (Shown w/Bearing)

For fast, even heat transfer, these heaters boast a cone-shape design. The cone is aluminum and the base is chrome-plated steel, unless noted. Heaters operate on 120 VAC, 60 Hz and have a heating time of 2 to 30 minutes. Furnished with an on/off switch and an 8-ft. power cord with three-prong plug. All are UL Listed, unless noted.

Manual heater includes a temperature-indicating crayon. The crayon mark melts when bearing reaches 250° F with ±25° F accuracy.

Automatic heaters include a thermostat that automatically brings the temperature up to 250° F with ±25° F accuracy.

Bearing ID Range	Watts	Ht. × Wd.		Each
Manual Heater				
3/8″- 5 3/4″	725	10″ × 10″	6519K11	$446.73
Automatic Heaters				
3/4″- 8″	725	10″ × 10″	6519K19	680.57
5 1/2″-18″	1450	14″ × 21″	6519K21•	1,318.85

• Base is aluminum. Not UL Listed.

Ultra-Portable Miniature Induction Bearing Heater

Shaped like a large flashlight, this 2 1/2″ OD × 15″ Lg. induction-style heater easily fits in your hand to go where you go. It's perfect for use on bearings that are up to 2″ ID and 3″ OD. The heater housing is made of plastic.

Heater operates on 120 VAC, 50/60 Hz and includes three heating coils to handle a variety of heating jobs. It also has a thermal switch for thermal overload protection. Furnished with a 6-ft. power cord with three-prong plug and a plastic carrying case.

This heater can also be used on stubborn and rusted nuts. It is not rated for temperature. Demagnetization is not necessary after heating.

6083K11 ..... Each $517.48

Portable Digital Induction Bearing Heater

Take this completely portable heater anywhere it's needed. It has a heat clamp with a 2″ × 2″ opening to hold bearings that are 2″ wide and smaller with a 0.8″ to 4″ ID. The clamp is iron encased in phenolic plastic.

Heater operates on 110 or 240 VAC, 50/60 Hz and has a temperature range of 32° to 392° F with ±6° F accuracy. It has a time control that lets you vary the heating time from 0 to 60 minutes to prevent overheating. Furnished with a 6.6-ft. power cord (plug not included, see pages 836-842), temperature probe, heat-resistant gloves, and a padded carrying case with shoulder strap. Demagnetization is not necessary after heating.

5208A6 ..... Each $2,349.90

Hot-Plate Bearing Heater

An aluminum heating plate uniformly heats the top and bottom of your bearings. It adjusts to fit bearings up to 2″ thick and can heat more than one bearing at a time. The plate is housed in a 5″ Ht. × 16″ Wd. × 10″ Dp. metal case that minimizes heat loss and prevents dirt from entering your bearings.

Heater includes a thermostat that adjusts from 120° to 390° F with ±18° F accuracy. The thermostat has an automatic shut-off in case of thermostat failure. Heater operates on 115 VAC, 50/60 Hz and is rated to 1000 watts. Furnished with a 6.6-ft. power cord (plug not included, see pages 836-842). Demagnetization is not necessary after heating.

6503K45 ..... Each $1,403.06

Fast-Heating Digital Induction Bearing Heater

Heat a 60-lb. bearing in just 20 minutes. This fast-heating induction style heater comes with three sizes of steel crossbars (0.5″, 1.1″, and 1.7″ sq.) that hold bearings with a 0.8″ to 11.8″ ID. Maximum bearing weight is 88 lbs.

Heater operates on 110 VAC, 50/60 Hz and has a temperature range of 32° to 482° F with ±3.6° F accuracy. It automatically demagnetizes bearings after heating and includes a temperature probe, 0- to 60-minute time control, circuit breaker with over-current protection, and automatic over-heating protection.

Heater housing is steel and glass-filled polyamide. It measures 8.2″ Ht. × 17.7″ Wd. × 7.6″ Dp. Furnished with a 4.6-ft. power cord with a NEMA 5-20 plug.

7167K11 ..... Each $3,261.10

Crossbar Induction Bearing Heaters

These induction-style heaters have laminated steel crossbars to handle a wide range of bearing ODs and widths. They heat most bearings in 2 to 20 minutes.

The heaters include two sizes of crossbars. The crossbar size determines the bearing ID that can be accommodated (see listing for sizes). For the fastest heating, use the largest crossbar that fits through your bearing. The maximum heating temperature is 250° F. Temperature-indicating crayons are recommended (not included; see 3261K on page 639).

Heaters have an on/off switch, a grounded outer case, and 6-ft. long three-wire power cord. Model 6174K63 has a NEMA 5-20 plug (see page 840 for plug configurations); models 6174K64 and K66 do not have a plug and must be hardwired. Heaters can be used for demagnetizing.

Max. Bearing OD	Wd.	Crossbar Sizes (sq.)	Voltage @ 60 Hz	O'all Size, Ht. × Wd.		Each
11″	4″	3/4″, 2″	110 VAC	9 3/4″ × 11 1/4″	6174K63	$1,493.66
22″	8″	1 1/4″, 3″	220 VAC	17 1/4″ × 17 1/4″	6174K64	3,122.62
22″	12 1/4″	1 1/4″, 3″	440 VAC	17 1/4″ × 21 3/4″	6174K66	3,397.67

Accessories

Riser Blocks—Use these blocks to lift bearing heater crossbars to accommodate larger diameter bearings for heaters listed above.

For Heater	Maximum Bearing OD	Block Size, Lg. × Wd. × Ht.		Per Pair
6174K63	14″	2 5/8″ × 2 5/8″ × 2 3/8″	6174K71	$290.37
6174K64 and 6174K66	32″	3 5/8″ × 3 5/8″ × 5″	6174K72	375.57

About Shaft Collars


Set Screw


One-Piece Clamp-On


Two-Piece Clamp-On


Hinged One-Piece Clamp-On

Shaft collars are useful for holding and positioning components on a shaft. They can also serve as mechanical stops and stroke limiters. When choosing a shaft collar, make sure the collar material is the same as your shaft material. There are four main styles of shaft collars:

Set Screw—Slide collar onto an unhardened shaft and tighten the included set screw, which bites into the shaft for a tight hold.

One-Piece Clamp-On—Slide collar onto a shaft and secure it in place with one screw (included). Collars clamp evenly around the shaft to provide more holding power than set screw shaft collars, plus they won't mar the shaft.

Two-Piece Clamp-On—These come apart so you can install and remove them from a shaft without having to remove other components. They're also good for applications where you don't have access to the end of a shaft. Position collar on a shaft and secure it in place with two screws (included). Collars clamp evenly around the shaft to provide superior holding power, plus they won't mar the shaft.

Hinged One-Piece Clamp-On—You'll get the benefits of a two-piece collar in a one-piece design. Swing collar open, position and close it on a shaft, and then secure it in place with one screw. The screw is captive so it won't fall out, making these collars good for use in tight areas where you can't hold the screw in place. These collars clamp evenly around the shaft to provide superior holding power, plus they won't mar the shaft.

Set Screw Shaft Collars

Slide a collar onto your shaft and tighten the hex-socket set screw, which bites into the shaft for a tight hold.

Black-oxide steel offers some corrosion resistance. **Zinc-plated steel** offers better corrosion resistance than black-oxide steel. **Aluminum** is lightweight with good corrosion resistance. **Type 303 stainless steel** offers excellent corrosion resistance. **Type 316 stainless steel** offers superior corrosion and chemical resistance. **Brass** is spark resistant. **Nylon** is excellent for food-processing applications. Color is white. Collars are USDA compliant, made from FDA-compliant resins, and meet 3-A sanitary standard requirements. **Sintered steel** is made from powdered metal and is much lighter than other steel collars.

Steel, Aluminum, and Stainless Steel

For Shaft Dia.	OD	Wd.	Black-Oxide Steel		Zinc-Plated Steel		Aluminum		Type 303 Stainless Steel		Type 316 Stainless Steel	
1/16"	1/4"	3/16"	9414T1	$1.57	6432K71	$1.24	9946K1	$4.46	6462K71	$5.11	9943K11	$13.97
3/32"	3/8"	3/16"	9414T2	1.57	6432K72	1.24	9946K2	4.02	6462K72	5.11	9943K12	13.97
1/8"	3/8"	1/4"	9414T3	1.12	6432K17	1.03	9946K41	1.53	6462K17	3.83	9943K13	11.95
5/32"	7/16"	1/4"	9414T4	1.57	6432K73	1.24	9946K3	4.07	6462K73	5.11	9943K14	13.97
3/16"	7/16"	1/4"	9414T5	1.12	6432K19	1.03	9946K42	1.53	6462K19	4.03	9943K15	9.95
1/4"	1/2"	5/16"	9414T6★	1.15	6432K12★	1.05	9946K11	2.49	6462K12	3.17	9943K16	9.86
5/16"	5/8"	5/16"	9414T7	1.20	6432K13	1.13	9946K12	3.01	6462K13	3.63	9943K17	10.70
3/8"	3/4"	3/8"	9414T8	1.30	6432K14	1.21	9946K13	2.69	6462K14	3.86	9943K18	12.11
7/16"	7/8"	7/16"	9414T9	1.55	6432K15	1.31	9946K14	2.69	6462K15	4.51	9943K19	13.97
1/2"	1"	7/16"	9414T11	1.60	6432K16	1.39	9946K15	2.94	6462K16	4.74	9943K21	14.11
9/16"	1"	7/16"	9414T12	1.75	6432K22	1.63	9946K16	3.12	6462K22	5.57	9943K22	17.41
5/8"	1 1/8"	1/2"	9414T13	1.90	6432K18	1.74	9946K17	3.33	6462K18	5.80	9943K23	17.65
11/16"	1 1/4"	9/16"	9414T14	2.38	6432K24	2.13	9946K18	3.94	6462K24	8.11	9943K24	24.41
3/4"	1 1/4"	9/16"	9414T15	2.35	6432K21	2.09	9946K19	3.93	6462K21	7.17	9943K25	21.41
13/16"	1 1/4"	9/16"	9414T76	2.59	6432K26	2.56	9946K4	5.12	6462K26	9.94	9943K26	30.05
7/8"	1 1/2"	9/16"	9414T17	2.80	6432K23	2.56	9946K22	4.58	6462K23	10.31	9943K27	30.38
15/16"	1 1/2"	9/16"	9414T18	3.02	6432K35	2.87	9946K23	4.95	6462K35	13.54	9943K28	40.95
1"	1 1/2"	5/8"	9414T19	2.85	6432K25	2.66	9946K24	4.95	6462K25	12.77	9943K29	37.78
1 1/16"	1 3/4"	5/8"	9414T21	4.90	6432K37	4.32	9946K25	6.20	6462K37	17.89	9943K31	52.78
1 1/8"	1 3/4"	5/8"	9414T22	4.67	6432K27	4.00	9946K26	6.23	6462K27	15.74	9943K32	46.11
1 3/16"	2"	11/16"	9414T23	5.05	6432K28	4.70	9946K27	8.26	6462K28	19.63	9943K33	57.27
1 1/4"	2"	11/16"	9414T24	5.42	6432K29	4.98	9946K28	8.26	6462K29	19.63	9943K34	61.27
1 5/16"	2 1/8"	11/16"	9414T25	5.92	6432K31	5.25	9946K29	8.96	6462K31	23.29	9943K35	65.11
1 3/8"	2 1/8"	3/4"	9414T26	6.42	6432K32	5.30	9946K31	8.94	6462K32	22.91	9943K36	65.11
1 7/16"	2 1/4"	3/4"	9414T27	6.60	6432K33	5.57	9946K32	9.34	6462K33	24.63	9943K37	70.43
1 1/2"	2 1/4"	3/4"	9414T28	6.78	6432K34	5.73	9946K33	9.32	6462K34	24.91	9943K38	70.43
1 9/16"	2 1/2"	13/16"	9414T29	7.40	6432K39	9.13	9946K5	15.89	6462K39	38.86	9943K39	95.51
1 5/8"	2 1/2"	13/16"	9414T31	7.88	6432K36	7.48	9946K6	15.89	6462K36	35.31	9943K41	86.59
1 11/16"	2 1/2"	13/16"	9414T32	8.25	6432K41	8.79	9946K7	17.05	6462K41	38.86	9943K42	95.51
1 3/4"	2 5/8"	7/8"	9414T33	8.70	6432K38	9.86	9946K43	10.27	6462K38	45.74	9943K43	110.46
1 13/16"	2 3/4"	7/8"	9414T34	9.45	6432K44	13.69	9946K8	17.09	6462K44	50.83	9943K44	123.57
1 7/8"	2 3/4"	7/8"	9414T35	10.25	6432K51	11.65	9946K9	17.78	6462K51	50.83	9943K45	123.57
1 15/16"	3"	7/8"	9414T36	10.80	6432K42	10.51	9946K44	13.33	6462K42	51.83	9943K46	122.51
2"	3"	7/8"	9414T37	11.32	6432K43	10.74	9946K45	13.73	6462K43	51.83	9943K47	117.65
2 1/8"	3"	7/8"	9414T38	12.77	6432K52	13.85	9946K51	20.06	6462K52	65.34	9943K48	151.46
2 3/16"	3 1/4"	15/16"	9414T39	13.65	6432K53	15.64	9946K52	24.82	6462K53	82.37	9943K49	190.97
2 1/4"	3 1/4"	15/16"	9414T41	14.20	6432K45	12.22	9946K53	24.66	6462K45	64.91	9943K51	149.24
2 5/16"	3 1/4"	15/16"	9414T42	14.45	6432K54	16.71	9946K54	24.82	6462K54	87.40	9943K52	204.30
2 3/8"	3 1/4"	15/16"	9414T43	14.65	6432K55	17.18	9946K55	24.82	6462K55	87.40	9943K53	195.78
2 7/16"	3 1/2"	1"	9414T44	15.22	6432K46	14.43	9946K56	28.50	6462K46	78.37	9943K54	174.43
2 1/2"	3 1/2"	1"	9414T45	15.78	6432K47	15.00	9946K46	17.89	6462K47	82.83	9943K55	178.84
2 5/8"	4"	1 1/8"	9414T46	19.20	6432K56	30.29	9946K57	39.11	6462K56	101.57	9943K56	253.65
2 11/16"	4"	1 1/8"	9414T47	21.30	6432K57	31.25	9946K58	39.11	6462K57	129.40	9943K57	277.76
2 3/4"	4"	1 1/8"	9414T48	23.45	6432K58	31.25	9946K59	37.42	6462K58	129.40	9943K58	277.76
2 7/8"	4"	1 1/8"	9414T49■	30.95	6432K59	29.90	9946K61	37.42	6462K59	158.60	9943K59	338.19
2 15/16"	4"	1 1/8"	9414T51■	31.25	6432K48	31.61	9946K62	39.38	6462K48	159.60	9943K61	325.14
3"	4"	1 1/8"	9414T52■	27.62	6432K49	31.61	9946K47	37.40	6462K49	158.60	9943K62	325.14
3 1/2"	4 3/4"	1 1/8"	9414T53▲	35.70	6432K61	50.06	9946K63	41.35	6462K61	227.50	9943K63	457.32
4"	5"	1 1/8"	9414T54	44.98	6432K62	80.00	9946K64	44.11	6462K62	363.70	9943K64	731.02
4 1/2"	5 1/2"	1 1/4"	9414T55	56.17	6432K63	80.00	9946K65	47.87	6462K63	363.70	9943K65	731.02
5"	6"	1 1/4"	9414T56	67.47	6432K64	116.60	9946K66	50.91	6462K64	530.34	9943K66	1,065.96
6"	7"	1 1/4"	9414T57	78.42	6432K66	132.06	9946K67	54.96	6462K66	606.24	9943K68	1,218.54

★ 9/32" Wd. ■ 4 1/4" OD. ▲ 4 1/2" OD.

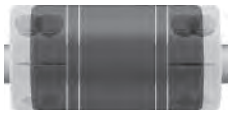
(Continued on following page)

About Shaft Couplings

Couplings connect two shafts and transfer motion from one to the other. There are two types of couplings: rigid and flexible.

Rigid couplings connect two shafts that are aligned. They are also good for handling high-torque applications.

Flexible couplings connect two shafts that are misaligned. Use the chart below as a guide to select the right coupling for your application. For actual performance ratings, please see the individual products. For applications that need to handle higher misalignment than what is listed below, see U-joints (pages 1285-1287).

Type of Shaft Misalignment	Amount of Misalignment	Couplings Best Suited for Starting and Stopping or Forward and Reverse Motion	Couplings Best Suited for Continuous Motion
Rigid Couplings			
 None	None	Set Screw ... pg. 1276 One-Piece ... pgs. 1277-1278 Two-Piece ... pgs. 1277-1278	Set Screw ... pg. 1276 One-Piece ... pgs. 1277-1278 Two-Piece ... pgs. 1277-1278
Flexible Couplings			
 Parallel	Less than 0.02″	Standard Replaceable-Center ... pg. 1279 Zero-Backlash Replaceable-Center ... pg. 1280 Replaceable-Center Slotted-Disc ... pg. 1281 Servomotor ... pg. 1281 Helical ... pg. 1282 High-Speed Bellows ... pg. 1283	Heavy Duty Replaceable-Center ... pg. 1284 Heavy Duty High-Torque ... pg. 1284 Heavy Duty High-Torque Replaceable-Center ... pg. 1284 Over-Torque-Prevention ... pg. 1285
	0.02″ to 0.125″	Quick-Install Replaceable-Center ... pg. 1279 High-Misalignment Replaceable-Center ... pg. 1281 High-Precision Bellows ... pg. 1282 Ultra-Flexible High-Misalignment ... pg. 1283	Over-Torque-Prevention Vibration-Damping ... pg. 1283 Replaceable-Center Vibration-Damping ... pg. 1283
 Angular	Less than 1.5°	Standard Replaceable-Center ... pg. 1279 Replaceable-Center Slotted-Disc ... pg. 1281 Servomotor ... pg. 1281	Heavy Duty Replaceable-Center ... pg. 1284 Heavy Duty High-Torque Replaceable-Center ... pg. 1284
	1.5° to 15°	Quick-Install Replaceable-Center ... pg. 1279 High-Misalignment Replaceable-Center ... pg. 1281 Helical ... pg. 1282 High-Precision Bellows ... pg. 1282 High-Speed Bellows ... pg. 1283 Ultra-Flexible High-Misalignment ... pg. 1283	Over-Torque-Prevention Vibration-Damping ... pg. 1283 Replaceable-Center Vibration-Damping ... pg. 1283 Over-Torque-Prevention ... pg. 1285
 Axial	Less than 0.1″	Servomotor ... pg. 1281 Helical; High-Precision Bellows ... pg. 1282 High-Speed Bellows ... pg. 1283	Heavy Duty High-Torque Replaceable-Center ... pg. 1284
	0.1″ to 0.32″	Heavy Duty Replaceable-Center ... pg. 1284	Replaceable-Center Vibration-Damping ... pg. 1283 Heavy Duty Replaceable-Center ... pg. 1284

Make Sure the Couplings You Have Selected Can Handle Your Torque and RPM Requirements

Couplings are rated by maximum torque and maximum rpm. Use this formula to determine the maximum torque you need:

$$\text{Max. Torque (in.-lbs.)} = \frac{\text{hp} \times 63{,}000}{\text{rpm}}$$

Set Screw Rigid Shaft Couplings


Without Keyway

Slide a coupling onto your shafts and tighten the two set screws, which bite into the shafts for a tight hold. When used with a key on a keyed shaft, couplings *with keyway* provide a more secure hold. They have standard ANSI keyway dimensions.

Black-oxide steel offers some corrosion resistance. Max. rpm is 3,450 for shaft dia. up to 3/4″; 1,740 for all others. **Aluminum** is lightweight with good corrosion resistance. Max. rpm is 2,025 for shaft dia. up to 3/4″; 1,020 for all others. **Type 303 stainless steel** offers excellent corrosion resistance. Max. rpm is 3,450 for shaft dia. up to 3/4″; 1,740 for all others.

Also Available: Metric sizes of black-oxide steel and Type 303 stainless steel couplings. Please ask for 5395T888 and specify black-oxide steel or Type 303 stainless steel, for shaft diameter, and with or without ISO-DIN keyway.

For Shaft Dia.	Lg.	OD	Black-Oxide Steel: With Keyway — Max. Torque, in.-lbs.			Black-Oxide Steel: Without Keyway — Max. Torque, in.-lbs.			Aluminum: Without Keyway — Max. Torque, in.-lbs.			Type 303 Stainless Steel: With Keyway — Max. Torque, in.-lbs.			Type 303 Stainless Steel: Without Keyway — Max. Torque, in.-lbs.		
3/16″	3/4″	1/2″				52	6412K9	$6.81	30	2424K9	$9.90				52	6099K11	$23.13
1/4″	3/4″	1/2″				69	6412K11	8.20	40	2424K11	9.12				43	6099K21	16.63
5/16″	1″	5/8″				86	6412K12	9.25	50	2424K12	10.29				54	6099K22	19.17
3/8″	1″	3/4″	175	6412K8	$15.30	175	6412K13	10.15	105	2424K13	11.37	175	6099K29	$26.76	110	6099K23	19.63
1/2″	1 1/2″	1″	470	6412K41	15.72	235	6412K14	11.60	140	2424K14	12.66	470	6099K41	35.90	145	6099K24	25.15
5/8″	2″	1 1/4″	1,185	6412K42	19.32	465	6412K15	14.53	275	2424K15	16.56	1,185	6099K42	51.95	290	6099K25	36.05
3/4″	2″	1 1/2″	1,420	6412K43	21.82	560	6412K16	16.40	330	2424K16	18.88	1,420	6099K43	64.24	350	6099K26	44.34
7/8″	2″	1 3/4″	1,660	6412K44	27.05	655	6412K17	21.18	385	2424K17	24.27	1,660	6099K44	77.07	410	6099K27	53.10
1″	3″	2″	3,785	6412K45	31.48	750	6412K18	23.48	440	2424K18	28.02	3,785	6099K45	118.61	465	6099K28	83.20
1 1/8″	3″	2 1/8″				1,180	6412K31	35.23	695	2424K19	40.59				735	6099K46	82.07
1 1/4″	4″	2 1/4″	6,310	6412K47	43.58	1,310	6412K32	43.42	770	2424K21	49.88	6,310	6099K47	193.63	815	6099K48	101.20
1 3/8″	4 1/2″	2 1/2″				1,440	6412K33	61.15	845	2424K22	69.24				900	6099K49	139.54
1 1/2″	4 1/2″	2 1/2″				1,575	6412K34	89.25	925	2424K23	105.32				980	6099K51	212.46

Over-Torque-Prevention Flexible Shaft Couplings

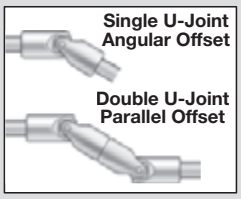
If they exceed maximum torque, these couplings disengage, sound an alarm, and then automatically re-engage once the over-torque condition is eliminated. Torque can be adjusted ±10% of the factory setting. Maximum rpm is 1,800. No lubrication is required.

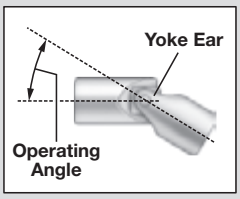
Couplings have a steel body and aluminum hubs. They also have a keyway with standard ANSI keyway dimensions (except 6609K11 does not have a keyway) that, when used with a key on a keyed shaft, provides a more secure hold. All fasten to your shafts with two set screws, which bite into the shafts for a tight hold.

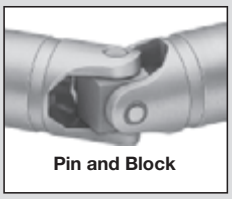
To Order: Please specify maximum torque: 25, 50, 75, 100, or 125 in.-lbs.

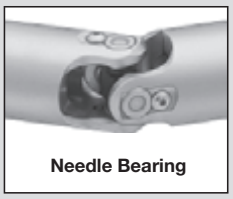
For Shaft Dia.	Lg.	OD	Max. Misalignment Parallel	Angular		
1/2"	3"	3 1/2"	0.031"	6°	6609K11	$80.00
5/8"	3"	3 1/2"	0.031"	6°	6609K12	83.33
3/4"	3"	3 1/2"	0.031"	6°	6609K13	86.96
7/8"	3"	3 1/2"	0.031"	6°	6609K14	$88.89
1"	3"	3 1/2"	0.031"	6°	6609K15	90.91

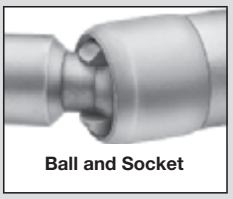
About U-Joints (Universal Joints)











U-joints are used to connect two shafts that have a high amount of misalignment. When choosing a U-joint, consider the amount of misalignment as well as the speed (rpm) and torque the joint will need to transmit. The more the shafts are misaligned, the less speed and torque the U-joint will be able to transmit.

Single U-joints compensate for angular offset, while **double U-joints** compensate for parallel offset. When using two single U-joints or one double U-joint, the U-joints must be installed at the same operating angle and the yoke ears must be aligned. As the operating angle increases, the working torque decreases.

Optional protective boots, also known as bellows, keep lubricant in and contaminants out. They are sold separately on page 3972.

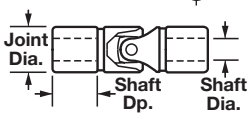
Pin-and-Block U-Joints—Have the simplest design: a block and two pins. They work at slower speeds but transmit greater torque than needle-bearing U-joints of similar size.

Needle-Bearing U-Joints—Needle bearings reduce side-to-side play (backlash), increasing rpm capability. They can operate at much higher speeds than pin-and-block and ball-and-socket U-joints.

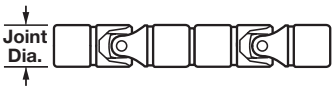
Ball-and-Socket U-Joints—Operate smoothly, with no side-to-side play (backlash) so they are good for applications requiring consistent motion and precise control. They generally transmit lower torque than pin-and-block U-joints and work at slower speeds than needle-bearing U-joints.

Pin-and-Block U-Joints

Single U-Joint with Bored Ends



Double U-Joint with Unbored Ends



Simple yet strong, these U-joints connect shafts at angles up to 25°. Maximum rpm is 1,750. All have grooves for holding protective boots (not included; please see page 3972). U-joints *with keyway and set screw* connect to shafts with an included set screw and a keyway with standard ANSI keyway dimensions. To connect all others, drill a hole through the joint and shaft and insert a spring pin (not included; please see pages 3451-3457).

Type 303 stainless steel offers excellent corrosion resistance.

Unbored Ends—Have a small centered starter hole for boring.

For Shaft★ Dia.	Dp.	Joint Dia.	O'all Lg.	Max. Torque, in.-lbs.	Working Torque (in.-lbs. @ 300 rpm) 3° Angle	10° Angle		
Bored Ends								
Steel Single U-Joints with Keyway and Set Screw								
1/2"	1"	1"	3 3/8"	1,560	595	200	8285K33	$68.85
9/16"	1"	1"	3 3/8"	1,560	595	200	8285K11	68.85
5/8"	1"	1 1/8"	3 1/2"	2,880	785	260	8285K13	84.42
3/4"	1 1/16"	1 1/4"	3 3/4"	5,220	980	330	8285K15	90.70
7/8"	1 3/8"	1 3/4"	5"	10,680	2,005	675	8285K25	160.45
1"	1 3/8"	1 3/4"	5"	10,680	2,005	675	8285K18	160.45
1 3/16"	1 1/2"	2"	5 7/16"	15,600	2,635	885	8285K31	189.00
1 1/2"	2"	2 1/2"	7"	33,120	3,950	1,330	8285K22	271.06
1 13/16"	2 3/4"	3"	9 1/16"	65,400	5,750	1,940	8285K24	416.38
Steel Single U-Joints								
1/4"	5/8"	1/2"	2"	375	150	51	6443K24	50.37
5/16"	11/16"	5/8"	2 1/4"	540	245	83	6443K46	51.56
3/8"	7/8"	3/4"	2 11/16"	765	330	110	6443K27	51.56
7/16"	7/8"	7/8"	3"	1,175	445	150	6443K28	65.00
1/2"	1"	1"	3 3/8"	1,560	595	200	6443K49	71.00
9/16"	1"	1 1/8"	3 1/2"	2,880	785	260	6443K39	87.06
5/8"	1 1/16"	1 1/4"	3 3/4"	5,220	980	330	6443K62	93.53
3/4"	1 3/16"	1 1/2"	4 1/4"	7,920	1,425	480	6443K65	112.47
7/8"	1 3/8"	1 3/4"	5"	10,680	2,005	675	6443K74	165.47
1"	1 1/2"	2"	5 7/16"	15,600	2,635	885	6443K75	194.28
1 1/4"	2"	2 1/2"	7"	33,120	3,950	1,330	6443K76	318.50
1 1/2"	2 3/4"	3"	9 1/16"	65,400	5,750	1,940	6443K77	489.25
Type 303 Stainless Steel Single U-Joints								
3/8"	7/8"	3/4"	2 11/16"	510	330	110	6443K51	131.88
1/2"	1"	1"	3 3/8"	1,040	595	200	6443K53	177.50
Bored Ends (Cont.)								
Type 303 Stainless Steel Single U-Joints (Cont.)								
5/8"	1 1/16"	1 1/4"	3 3/4"	3,480	980	330	6443K78	$216.00
3/4"	1 3/16"	1 1/2"	4 1/4"	5,280	1,425	480	6443K79	256.57
1"	1 1/2"	2"	5 7/16"	10,400	2,635	885	6443K82	402.93
Steel Double U-Joints								
1/4"	5/8"	1/2"	4"	375	150	51	6443K26	127.09
5/16"	11/16"	5/8"	4 1/2"	540	245	83	6443K56	133.09
3/8"	7/8"	3/4"	5 3/8"	765	330	110	6443K83	133.09
1/2"	1"	1"	6 3/4"	1,560	595	200	6443K57	178.69
5/8"	1 1/16"	1 1/4"	7 1/2"	5,220	980	330	6443K85	218.17
3/4"	1 3/16"	1 1/2"	8 1/2"	7,920	1,425	480	6443K94	258.77
Unbored Ends								
Steel Single U-Joints								
3/8"	5/8"	1/2"	2"	375	150	51	6443K12	45.31
1/2"	11/16"	5/8"	2 1/4"	540	245	83	6443K42	46.31
5/8"	7/8"	3/4"	2 11/16"	765	330	110	6443K13	46.31
Steel Double U-Joints								
3/8"	5/8"	1/2"	4"	375	150	51	6443K15	114.88
1/2"	11/16"	5/8"	4 1/2"	540	245	83	6443K52	116.53
5/8"	7/8"	3/4"	5 3/8"	765	330	110	6443K63	119.94
11/16"	7/8"	7/8"	6"	1,175	445	150	6443K64	148.69
3/4"	1"	1"	6 3/4"	1,560	595	200	6443K55	160.69
1"	1 1/16"	1 1/4"	7 1/2"	5,220	980	330	6443K29	196.29
1 1/8"	1 3/16"	1 1/2"	8 1/2"	7,920	1,425	480	6443K38	234.63

★ For U-Joints with unbored ends, dimensions shown are the maximum shaft diameter and depth.

About Rod Ends

Rod ends are connectors that support loads and allow motion control. You'll find them in a multitude of applications: steering, tensioning, and controlling movement at pivot points.

Ball Joint Rod Ends (pages 1289-1295)— Have a housing and a ball that swivels to handle angular misalignment. They're also known as rod-end bearings. *Ball-joint linkages* are ball-joint rod ends with studs attached to simplify mounting.

Solid Rod Ends (pages 1298-1300)— Have no moving parts and are designed to handle heavier static loads. Also known as swing bolts and eyebolts, their one-piece body doesn't allow angular misalignment.

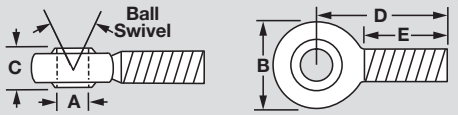
Left- and right-hand rod ends (ball joint or solid style) create connections that adjust for tension.

Ball-joint linkages handle misalignment as well as changes in direction.

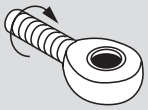
CAD For technical drawings and 3-D models, go to mcmaster.com.

Ball Joint Rod Ends

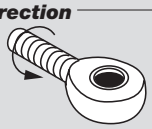
Dimensions



Thread Direction



Right-hand threaded shank tightens when turned clockwise. This is the most common thread.



Left-hand threaded shank tightens when turned counterclockwise.

Steel Ball Joint Rod Ends

Our general purpose rod ends will meet your basic connection needs.

Inch sizes have a zinc-plated steel housing and chrome-plated steel ball (unless noted).

Inch sizes with grease fitting are easy to lubricate. Housing is steel. Ball is chrome-plated steel.

Inch sizes with oversized shank have a shank that is one size larger than the ball ID to handle greater stress. Housing is zinc-plated steel. Ball is chrome-plated steel.

Inch sizes with self-lubricating insert have a zinc-plated steel ball that glides on a PTFE-lubricated, carbon-fiber-reinforced plastic insert, which provides wear resistance and doesn't require lubrication. Housing is zinc-plated steel.

Metric sizes have an alloy steel ball. Housing is zinc-plated steel (unless noted).

Male Threaded

Female Threaded with Grease Fitting

To Order: Please specify right- or left-hand shank threads.

Shank Thread Size	Ball ID (A)	Max. Ball Swivel	O'all Wd. (B)	O'all Thick. (C)	Male-Threaded Shank (D)	Male-Threaded Shank Thread Lg. (E)	Male-Threaded Shank Static Radial Load Cap., lbs.			Female-Threaded Shank (D)	Female-Threaded Shank Thread Lg. (E)	Female-Threaded Shank Static Radial Load Cap., lbs.		
Inch Sizes														
6-32	1/8"	22°	1/2"	1/4"	15/16"	9/16"	700	60645K61	$5.95	13/16"	7/16"	1,510	60645K78	$5.81
8-32	5/32"	30°	7/16"	5/16"	1"	9/16"	Not Rated	60645K98 ♦▲	7.50	7/8"	3/8"	Not Rated	60645K97 ♦▲	7.50
10-32	3/16"	20°	5/8"	5/16"	1 1/4"	3/4"	1,558	60645K11	3.53	1 1/16"	1/2"	2,079	60645K31	3.32
1/4"-28	1/4"	27°	3/4"	3/8"	1 9/16"	1"	2,835	60645K12	3.26	1 5/16"	1 1/16"	3,820	60645K32	3.11
5/16"-24	5/16"	22°	7/8"	7/16"	1 7/8"	1 1/4"	4,517	60645K13	3.37	1 3/8"	1 1/16"	5,110	60645K33	3.67
3/8"-24	3/8"	22°	1"	1/2"	1 15/16"	1 1/4"	6,323	60645K14	3.78	1 5/8"	1 3/16"	6,323	60645K34	3.78
7/16"-20	7/16"	21°	1 1/8"	9/16"	2 1/8"	1 3/8"	7,897	60645K15	5.31	1 13/16"	1 5/16"	7,897	60645K35	5.80
1/2"-20	1/2"	20°	1 5/16"	5/8"	2 7/16"	1 1/2"	10,046	60645K16	6.58	2 1/8"	1 1/16"	10,046	60645K36	6.58
5/8"-18	5/8"	26°	1 1/2"	3/4"	2 5/8"	1 5/8"	11,385	60645K17	9.94	2 1/2"	1 3/8"	11,385	60645K37	9.64
3/4"-16	3/4"	24°	1 3/4"	7/8"	2 7/8"	1 3/4"	15,894	60645K18	12.34	2 7/8"	1 9/16"	15,894	60645K38	12.74
1"-12	1"	17°	2 3/4"	1 3/8"	4 1/8"	2 1/8"	43,541	60645K62	49.79	4 1/8"	2 1/8"	43,541	60645K72	49.79
1"-14	1"	17°	2 3/4"	1 3/8"	4 1/8"	2 1/8"	43,541	60645K63	49.79	4 1/8"	2 1/8"	43,541	60645K73	49.79
1 1/4"-12	1 1/4"	7°	2 3/4"	1 1/16"	4 1/8"	2 1/8"	44,500	60645K65 ★	101.22	4 1/8"	2 1/8"	44,500	60645K75 ★	102.74
1 1/2"-12	1 1/2"	6.5°	3 1/2"	1 5/16"	5 3/8"	3"	64,770	60645K66 ★	160.48	5 3/8"	2 5/8"	64,770	60645K76 ★	163.03
2"-12	2"	6°	5"	1 3/4"	8"	4 1/2"	153,528	60645K67 ★	288.55	8"	4"	153,528	60645K77 ★	302.88
Inch Sizes with Grease Fitting														
3/8"-24	3/8"	22°	1"	1/2"	1 15/16"	1 1/4"	3,507	4444T1	4.93	1 5/8"	13/16"	5,100	4444T21	4.93
7/16"-20	7/16"	21°	1 1/8"	9/16"	2 1/8"	1 3/8"	4,481	4444T2	6.98	1 13/16"	15/16"	6,420	4444T22	6.98
1/2"-20	1/2"	20°	1 5/16"	5/8"	2 7/16"	1 1/2"	5,870	4444T3	7.05	2 1/8"	1 1/16"	9,100	4444T23	6.98
5/8"-18	5/8"	26°	1 1/2"	3/4"	2 5/8"	1 5/8"	6,869	4444T4	8.30	2 1/2"	1 3/8"	9,800	4444T24	8.30
3/4"-16	3/4"	24°	1 3/4"	7/8"	2 7/8"	1 3/4"	9,436	4444T5	10.05	2 7/8"	1 9/16"	14,250	4444T25	10.05
1"-12	1"	17°	2 3/4"	1 3/8"	4 1/8"	2 1/8"	37,010	4444T6	54.25	4 1/8"	2 1/8"	43,541	4444T26	54.25
1"-14	1"	17°	2 3/4"	1 3/8"	4 1/8"	2 1/8"	37,010	4444T7	54.25	4 1/8"	2 1/8"	43,541	4444T27	54.25
Inch Sizes with Oversized Shank														
1/4"-28	3/16"	20°	3/4"	5/16"	1 9/16"	1"	3,435	60645K81	3.78	1 5/16"	1 1/16"	4,197	60645K91 ♦	3.78
5/16"-24	1/4"	27°	7/8"	3/8"	1 7/8"	1 1/4"	5,534	60645K82	4.46	—	—	—	—	—
3/8"-24	5/16"	22°	1"	7/16"	1 15/16"	1 1/4"	6,853	60645K83	4.59	1 5/8"	13/16"	6,323	60645K92 ♦	4.86
1/2"-20	3/8"	22°	1 1/8"	1/2"	2 1/8"	1 3/8"	8,278	60645K85	7.28	—	—	—	—	—
3/4"-16	5/8"	26°	1 3/4"	3/4"	2 7/8"	1 3/4"	16,922	60645K89	10.68	—	—	—	—	—
1 1/4"-12	1"	17°	2 3/4"	1 3/8"	4 1/8"	2 1/8"	43,541	60645K64	49.79	4 1/8"	2 1/8"	40,889	60645K74	49.79
Inch Sizes with Self-Lubricating Insert														
10-32	3/16"	13°	5/8"	5/16"	1 1/4"	3/4"	1,174	2458K11	5.23	1 1/16"	1/2"	1,220	2458K31	5.23
1/4"-28	1/4"	16°	3/4"	3/8"	1 9/16"	1"	2,168	2458K12	5.38	1 5/16"	1 1/16"	2,500	2458K32	5.38
5/16"-24	5/16"	14°	7/8"	7/16"	1 7/8"	1 1/4"	2,796	2458K13	5.44	1 3/8"	1 1/16"	2,753	2458K33	5.44
3/8"-24	3/8"	12°	1"	1/2"	1 15/16"	1 1/4"	4,012	2458K14	5.67	1 5/8"	13/16"	3,950	2458K34	5.67
7/16"-20	7/16"	14°	1 1/8"	9/16"	2 1/8"	1 3/8"	4,244	2458K15	6.76	1 13/16"	15/16"	4,300	2458K35	6.76
1/2"-20	1/2"	12°	1 5/16"	5/8"	2 7/16"	1 1/2"	6,453	2458K16	9.82	2 1/8"	1 1/16"	6,453	2458K36	9.82
5/8"-18	5/8"	16°	1 1/2"	3/4"	2 5/8"	1 5/8"	7,400	2458K17	14.44	2 1/2"	1 3/8"	7,400	2458K37	14.44
3/4"-16	3/4"	14°	1 3/4"	7/8"	2 7/8"	1 3/4"	10,937	2458K18	18.27	2 7/8"	1 9/16"	10,937	2458K38	18.27
Metric Sizes—Dimensions in mm														
M3×0.5	3	30°	9.8	6.4	25	14	Not Rated	59935K11 ♦▲	7.50	22	10	Not Rated	59935K13 ♦▲■	7.50
M4×0.7	4	30°	11	6.9	25	14	Not Rated	59935K12 ♦▲	7.50	22	10	Not Rated	59935K14 ♦▲♣	7.50
M5×0.8	5	14°	16	8	33	20	1,161	59935K41	9.69	27	14	1,593	59935K51	9.45
M6×1	6	23°	19	9	36	22	1,640	59935K42	6.02	30	14	2,674	59935K52	6.12
M8×1.25	8	28°	22	12	42	25	3,055	59935K43	6.84	36	17	3,414	59935K53	6.41
M10×1.5	10	26°	27	14	48	29	4,726	59935K44	8.98	43	21	5,114	59935K54	8.94
M12×1.75	12	27°	30	16	54	33	5,804	59935K45	12.00	50	24	5,804	59935K55	12.02
M16×2	16	33°	38	21	66	40	8,405	59935K47	21.18	64	33	8,405	59935K57	21.18
M20×1.5	20	29°	46	25	78	47	12,836	59935K48	34.16	77	40	12,836	59935K58	35.59

♦ Right-hand shank threads only. ▲ Machined steel housing and ball. ★ Phosphate-plated bearing steel ball.
■ Overall width is 11 mm. Overall thickness is 4.9 mm. ♣ Overall thickness is 4.9 mm.

About Gas Springs

Gas springs are typically used to assist in opening lids, covers, windows, conveyors, and seats—similar to a hatchback opening on a car. If you want to close an object, you will need a pulling gas spring (see page 1309).

Note: All gas springs contain nitrogen gas and a seal lubricant that also provides slam-resistant damping at the end of the stroke. To avoid loss of force, you should store and install gas springs rod-end down.

Choosing the Right Force

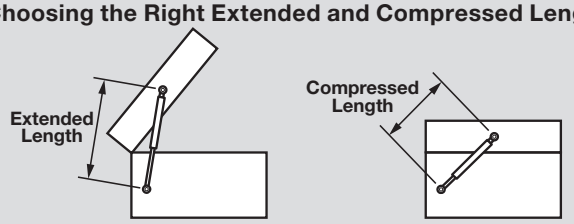
Your gas spring must have enough force to lift your object and hold it open, yet not too much force that you can't push it back to its original position. To determine the right amount of force, you'll need to know the weight of the object you're moving. One way to do this is to use a force gauge (see page 2379).

If you can't weigh your object, use the following chart to help determine its weight so you can estimate the force you'll need:

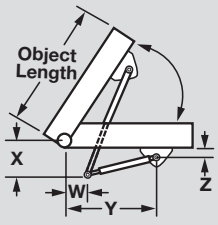
Material Weight per Square Foot (12″×12″)

Thickness	Steel	Aluminum	Plastic
1/16″	2.5 lbs.	0.83 lbs.	0.17 lbs.
1/8″	5.0 lbs.	1.71 lbs.	0.58 lbs.
1/4″	10.0 lbs.	3.61 lbs.	1.10 lbs.

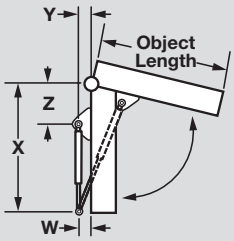
Choosing the Right Extended and Compressed Length



To determine the extended length that's right for your application, open your lid as wide as you need and measure the distance between the two mounting points. For compressed length, close your lid (or lower it to where you need it) and measure the distance between the two mounting points.



Horizontal-to-Vertical Lift



Vertical-to-Horizontal Lift

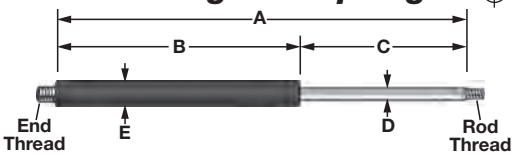
A Guide to Choosing the Correct Gas Springs

The examples illustrate how the length, weight, and opening direction of your object as well as the mounting position of the springs can affect which gas springs are right for your application. Find an example that is similar to your application and use it as a guide to select your springs. The values are based on using two gas springs (one on each side of the object), a 90° opening, and the center of gravity at the middle of the object.

Note: The recommended force rating is per spring.

For Object Length	For Object Weight	Recommended Gas Spring: Force Rating	Recommended Gas Spring: Extended Length	Recommended Gas Spring: Compressed Length	Recommended Mounting Position: (W)	(X)	(Y)	(Z)
Horizontal-to-Vertical Lift								
12″	20 lbs.	40 lbs.	10.71″	6.77″	1″	1″	11.19″	0.89″
12″	40 lbs.	40 lbs.	10.71″	6.77″	1″	1.5″	10.69″	0.89″
18″	60 lbs.	70 lbs.	13.74″	8.27″	1″	2.5″	12.72″	0.89″
18″	100 lbs.	100 lbs.	13.74″	8.27″	1.25″	3″	12.22″	0.89″
30″	40 lbs.	50 lbs.	18.22″	10.35″	2″	3.5″	16.18″	0.89″
Vertical-to-Horizontal Lift								
12″	20 lbs.	40 lbs.	10.71″	6.77″	2.5″	12.22″	0.89″	2″
12″	40 lbs.	50 lbs.	10.71″	6.77″	2.5″	11.77″	0.89″	3″
18″	60 lbs.	100 lbs.	13.74″	8.27″	2.5″	15.09″	0.89″	3″
18″	100 lbs.	130 lbs.	13.74″	8.27″	2.5″	14.66″	0.89″	4″
30″	40 lbs.	70 lbs.	18.22″	10.35″	1.5″	19.32″	0.89″	5.5″

Add-a-Fitting Gas Springs CAD



These gas springs have threaded ends so you can use them with any combination of end fittings, studs, and mounting brackets (sold separately on pages 1305 and 1306). Select end fittings with a thread size that matches the rod and end thread sizes of your gas spring. Temperature range is -22° to 176° F, unless noted.

Steel gas springs have a steel body and rod and a rubber seal.

316 stainless steel gas springs have excellent corrosion resistance in damp environments. The body and rod are 316 stainless steel. The seal is rubber.

Extend. Lg. (A)	Comp. Lg. (B)	Stroke Lg. (C)	Choose an Extension Force, lbs.	Rod Dia. (D)	Body Dia. (E)	Steel		316 Stainless Steel	
M6 Rod and End Thread Size									
5.51″	3.54″	1.97″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.71″	9416K14★	$14.61	4175T1■	$49.56
5.9″	3.54″	2.36″	15, 20, 30, 40, 50, 60, 70, 80	0.23″	0.59″	9416K11	11.93	4175T2▲	43.47
8.15″	4.61″	3.54″	15, 20, 30, 40, 50, 60, 70, 80	0.23″	0.59″	9416K12	14.24	4175T4▲	46.51
8.35″	5.2″	3.15″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.71″	9416K24★	14.92	4175T3■	54.34
10.71″	6.77″	3.94″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.75″	9416K15★	15.70	4175T5	57.57
13.74″	8.23″	5.51″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.75″			4175T6	61.76
13.74″	8.27″	5.47″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.73″	9416K16	15.69		
15.63″	9.33″	6.3″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.75″	9416K17★	16.41	4175T7	64.58
18.19″	10.32″	7.87″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.75″			4175T8	65.79
18.22″	10.35″	7.87″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.73″	9416K18	17.95		
18.62″	10.35″	8.27″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.75″	9416K19★	18.47	4175T9	67.71
22.36″	12.52″	9.84″	15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 130	0.31″	0.75″	9416K2★	21.56	4175T15	70.65
M8 Rod and End Thread Size									
18.18″	10.31″	7.87″	25, 50, 75, 100, 125, 150, 175, 200, 225, 250	0.39″	0.85″	9416K28	20.83		
18.22″	10.35″	7.87″	25, 50, 75, 100, 125, 150, 175, 200, 225, 250	0.39″	0.87″			4175T21	75.28
26.38″	16.14″	10.24″	25, 50, 75, 100, 125, 150, 175, 200, 225, 250	0.39″	0.85″	9416K21	23.39	4175T23♣	87.21
28″	15.2″	12.8″	25, 50, 75, 100, 125, 150, 175, 200, 225, 250	0.39″	0.85″	9416K22	23.96	4175T25♣	91.75
30.02″	16.25″	13.77″	25, 50, 75, 100, 125, 150, 175, 200, 225, 250	0.39″	0.87″	9416K54■	17.82		
33.94″	17.8″	16.14″	25, 50, 75, 100, 125, 150, 175, 200, 225, 250	0.39″	0.85″	9416K23	26.83	4175T27♣	104.89
M10 Rod and End Thread Size									
18.9″	10.9″	8″	200, 250, 300, 350, 400, 500, 550	0.55″	1.1″	9416K51■	72.18	4175T35	120.50
26.77″	14.77″	12″	200, 250, 300, 350, 400, 500, 550	0.55″	1.1″	9416K52■	90.50	4175T36	137.98
34.84″	18.84″	16″	200, 250, 300, 350, 400, 500, 550	0.55″	1.1″	9416K53■	120.18	4175T37	167.20

★Body dia. is 0.73″. ■ Temp. range is -13° to 158° F. ▲Rod dia. is 0.24″. Temp. range is -13° to 158° F. ♣ Body dia. is 0.87″.

Threaded-Body Shock Absorbers

About Selecting Shock Absorbers

$$\text{Energy Cap. (in.-lbs.)} = \frac{\text{Weight (lbs.)}}{772} \times \text{Velocity}^2\ \text{(in. per second)}$$

To select the best shock absorber for your application, you need to find the energy capacity your application requires. Use this formula to calculate the energy capacity required to stop a horizontal-moving load. For example, if you have a 250-lb. load moving at 25 inches per second, your calculation is (250 lbs. ÷ 772) × 25^2 = 202.4 in.-lbs. energy capacity.

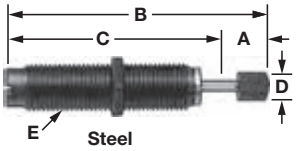
Note: Choose a shock absorber with a higher energy capacity than you calculated. Factors such as driving force or an inclined surface will increase the energy capacity required.

Threaded-Body Shock Absorbers

Install shock absorbers in gantry systems, presses, and at stops along conveyors—they counteract the energy of moving objects to prevent damage to equipment and material. All are filled with hydraulic fluid and come with a mounting nut. Use Threaded Mounting Blocks for Shock Absorbers (not included, see page 1311) for mounting.

Nylon and **urethane rubber bumpers** are nonmarring. **Aluminum bumpers** are nonmagnetic.

Self-Adjusting Shock Absorbers



Steel

Accommodate changing loads and energy without manual adjustment. Shock absorbers have a stainless steel rod, unless noted.

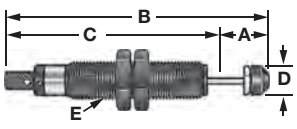
Steel shock absorbers have a black-oxide finish, unless noted. Temperature range is 32° to 150°F, except shock absorbers with an aluminum bumper have a temperature range of -22° to 140°F and shock absorbers with a urethane rubber bumper have a temperature range of 14° to 176°F.

Corrosion-resistant stainless steel shock absorbers are excellent for use in damp environments. Temperature range is -20° to 140°F.

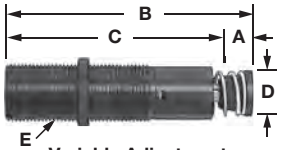
Energy Capacity, in.-lbs.	Max. Cycles per Min.	Stroke Lg. (A)	Extended Lg. (B)	Compressed Lg. (C)	Bumper Dia. (D)	Bumper Material	Inch: Thread Size (E)			Metric: Thread Size (E)		
Steel												
9	33	0.2″	1.22″	1.02″	___	___	___	___	___	M6×0.5	3692K24★	$39.83
11	53	0.2″	1.52″	1.32″	0.19″	Acetal	___	___	___	M8×0.75	3692K11	40.74
11	53	0.2″	1.52″	1.32″	0.19″	Acetal	___	___	___	M8×1	3692K13	40.74
20	167	0.26″	2.27″	2.01″	0.3″	Steel	3/8″-32	3740K11■	$40.95	M10×1	3692K15■	40.95
75	56	0.4″	2.76″	2.36″	0.3″	Acetal	1/2″-20	3740K12■	53.56	___	___	___
75	56	0.4″	2.76″	2.36″	0.3″	Steel	___	___	___	M12×1	3692K16■	53.56
100	10	0.25″	2.75″	2.5″	0.25″	Aluminum	9/16″-18	9530K46	74.04	M14×1.5	9530K66	74.04
123	41	0.5″	3.66″	3.16″	0.47″	Nylon	9/16″-18	3740K19■	91.58	M14×1	3692K27■	92.67
200	10	0.5″	3.75″	3.25″	0.25″	Aluminum	3/4″-16	9530K47	78.27	M20×1.5	9530K67	78.27
225	22	0.63″	4.5″	3.87″	0.47″	Steel	9/16″-18	3740K15■	81.40	M14×1.5	3692K19■	78.08
250	26	1″	4.75″	3.75″	0.38″	Aluminum	1″-12	9530K48	125.20	M25×1.5	9530K68	125.20
288	23	0.5″	4.07″	3.57″	0.66″	Nylon	3/4″-16	3740K21■	97.34	M20×1.5	3692K28■	95.35
300	22	0.75″	4.62″	3.87″	0.66″	Steel	3/4″-16	3740K16■	83.29	M20×1.5	3692K21■	81.59
600	17	1″	5.76″	4.76″	0.9″	Nylon	1″-12	3740K22■	130.28	M25×1.5	3692K29■	130.28
620	11	0.59″	4.15″	3.56″	0.66″	Steel	3/4″-16	3740K1■	183.54	___	___	___
650	10	1″	4.75″	3.75″	0.38″	Aluminum	1″-12	9530K51	127.65	M25×1.5	9530K71	127.65
650	15	1″	5.62″	4.62″	0.9″	Steel	1″-12	3740K18■	121.39	M25×1.5	3692K23■	121.42
975	14	1.58″	7.44″	5.86″	0.9″	Steel	1″-12	3740K3■	210.96	___	___	___
1,042	12	1.6″	8.31″	6.71″	0.87″	Urethane Rubber	1″-12	6528K11▲	166.56	___	___	___
1,860	5	0.91″	5.51″	4.6″	0.9″	Steel	1″-12	3740K2■	222.29	___	___	___
2,000	10	1″	5.25″	4.25″	0.5″	Aluminum	1 1/4″-12	9530K52	165.59	M33×1.5	9530K72	165.59
3,472	8	2″	9.57″	7.57″	1.18″	Urethane Rubber	___	___	___	M36×1.5	6528K12▲	207.90
5,000	10	2″	8.25″	6.25″	0.63″	Aluminum	1 3/8″-12	9530K54	187.80	M36×1.5	9530K74	187.80
Corrosion-Resistant Stainless Steel												
100	10	0.25″	2.75″	2.5″	0.25″	Stainless Steel	9/16″-18	9553K1	133.27	___	___	___
200	10	0.5″	3.75″	3.25″	0.25″	Stainless Steel	3/4″-16	9553K2	139.33	___	___	___
250	27	1″	4.75″	3.75″	0.38″	Stainless Steel	1″-12	9553K3	218.08	___	___	___
650	10	1″	4.75″	3.75″	0.38″	Stainless Steel	1″-12	9553K4	218.08	___	___	___
2,000	10	1″	5.25″	4.25″	0.5″	Stainless Steel	1 1/4″-12	9553K5	290.77	___	___	___
5,000	10	2″	8.25″	6.25″	0.63″	Stainless Steel	1 3/8″-12	9553K7	327.12	___	___	___

★ Does not have a bumper. ■ Has a black ultra-corrosion resistant coating. ▲ Rod is chrome-plated steel. Includes two hex mounting nuts.

Adjustable Shock Absorbers



Four-Position Adjustment



Variable Adjustment

Turn the knob on these shock absorbers to change deceleration to suit varying loads and speeds. They have a chrome-plated steel rod, unless noted.

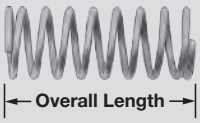
Four-position adjustment shock absorbers are steel with a black oxide finish. They come with two mounting nuts. Temperature range is 14° to 176°F.

Variable adjustment shock absorbers have a temperature range of 32° to 150°F. *Aluminum* shock absorbers have a black anodized finish; *steel* shock absorbers have a black ultra-corrosion resistant coating.

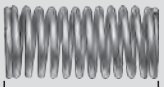
Energy Capacity, in.-lbs.	Max. Cycles per Min.	Stroke Lg. (A)	Extended Lg. (B)	Compressed Lg. (C)	Bumper Dia. (D)	Bumper Material	Inch: Thread Size (E)			Metric: Thread Size (E)		
Four-Position Adjustment—Steel												
87	60	0.6″	4.33″	3.73″	0.47″	Urethane Rubber	5/8″-18	6528K21	$207.90	___	___	___
260	30	0.8″	5.08″	4.28″	0.71″	Urethane Rubber	7/8″-14	6528K22	200.86	___	___	___
712	15	1″	6.02″	5.02″	0.87″	Urethane Rubber	1″-12	6528K23	233.51	___	___	___
Variable Adjustment—Aluminum												
275	18	0.5″	4.35″	3.85″	0.5″	Urethane Rubber	3/4″-16	3742K27♣	93.40	___	___	___
715	15	1″	5.62″	4.62″	0.62″	Urethane Rubber	1″-12	3742K28	140.66	___	___	___
Variable Adjustment—Steel												
35	25	0.4″	3.31″	2.91″	0.3″	Steel	1/2″-20	3742K11♦	77.16	M12×1	3691K11♦	$78.80
200	25	0.5″	3.67″	3.17″	0.47″	Nylon	9/16″-18	3742K12♦	93.84	M14×1.5	3691K12♦	93.84
300	22	0.75″	4.67″	3.92″	0.66″	Steel	3/4″-16	3742K19♦	88.01	___	___	___
600	17	1″	5.6″	4.6″	0.9″	Steel	1″-12	3742K21♦	139.79	___	___	___
1,500	7	0.91″	5.44″	4.53″	1″	Steel	1 1/4″-12	3742K15	200.93	M33×1.5	3691K15	196.83
3,450	5	0.91″	5.69″	4.78″	1.38″	Steel	1 3/4″-12	3742K16	280.34	M45×1.5	3691K16	274.62
6,900	2	1.91″	7.69″	5.78″	1.38″	Steel	1 3/4″-12	3742K17	293.71	M45×1.5	3691K17	287.71
10,350	2	2.91″	9.69″	6.78″	1.38″	Steel	1 3/4″-12	3742K18	307.23	___	___	___

♣ Rod is nickel-plated steel. ♦ Rod is stainless steel.

About Compression Springs




Closed Ends




Closed and Ground Flat Ends

When a compression spring is pushed together (compressed), it pushes back to return the spring to its original length. They're commonly used in shock absorbers and to secure batteries.

Compression springs are made of steel music wire (for high strength), spring-tempered steel (for heat resistance), or stainless steel (for corrosion resistance). They are available with closed ends as well as with closed and ground flat ends. On springs with closed ends, the last two coils are close together. On springs with closed and ground flat ends, the last coil is flush so the springs stand straighter and are easier to stack.

Rate—As you push a compression spring, it gets harder to push. The higher the rate, the harder it is to compress the spring.

Note: Spring ID = Spring OD − (Wire Dia. × 2).

Compression Springs

Spring OD	Wire Dia.	Compressed Lg.	Max. Load, lbs.	Rate, lbs./inch	Pkg. Qty.		Pkg.
Steel Music Wire—Closed Ends							
0.937″ Overall Length							
0.187″	0.012″	0.25″	0.20	0.29	12	9657K81	$5.05
1″ Overall Length							
0.156″	0.016″	0.43″	1.40	2.45	12	9657K59	6.75
0.156″	0.028″	0.78″	6.70	30.09	12	9657K63	6.75
0.187″	0.012″	0.30″	0.32	0.46	12	9657K43	6.75
0.187″	0.014″	0.36″	0.49	0.76	12	9657K46	6.75
0.187″	0.020″	0.44″	1.97	3.53	12	9657K49	6.75
0.187″	0.023″	0.60″	3.33	8.29	12	9657K53	6.75
0.187″	0.028″	0.66″	5.72	16.91	12	9657K56	6.75
0.218″	0.016″	0.34″	0.69	1.04	12	9657K66	6.75
0.218″	0.018″	0.36″	1.09	1.71	12	9657K69	6.75
0.218″	0.023″	0.42″	2.84	4.93	12	9657K73	6.75
0.218″	0.028″	0.54″	4.98	10.73	12	9657K76	6.75
0.25″	0.020″	0.39″	1.05	1.72	12	9657K39	6.75
1.03″ Overall Length							
0.531″	0.105″	0.80″	93.29	491.00	6	9657K91	15.03
1.25″ Overall Length							
0.281″	0.039″	0.60″	11.36	17.50	12	9657K83	5.17
1.312″	0.125″	0.59″	63.60	120.00	3	9657K103	10.04
1.375″ Overall Length							
0.156″	0.016″	0.57″	1.40	1.72	12	9657K61	6.75
0.156″	0.028″	1.06″	6.70	21.07	12	9657K64	6.75
0.187″	0.012″	0.44″	0.31	0.33	12	9657K44	6.75
0.187″	0.014″	0.50″	0.49	0.56	12	9657K47	6.75
0.187″	0.020″	0.60″	1.92	2.47	12	9657K51	6.75
0.187″	0.023″	0.75″	3.33	5.36	12	9657K54	6.75
0.187″	0.028″	0.80″	5.72	9.99	12	9657K57	6.75
0.218″	0.016″	0.47″	0.69	0.76	12	9657K67	6.75
0.218″	0.018″	0.49″	1.04	1.18	12	9657K71	6.75
0.218″	0.023″	0.58″	2.88	3.62	12	9657K74	6.75
0.218″	0.028″	0.72″	4.98	7.58	12	9657K77	6.75
0.25″	0.020″	0.51″	1.09	1.26	12	9657K41	6.75
1.75″ Overall Length							
0.156″	0.016″	0.77″	1.40	1.43	12	9657K62	6.75
0.156″	0.028″	1.34″	6.70	16.20	12	9657K65	6.75
0.187″	0.012″	0.51″	0.36	0.29	12	9657K45	6.75
0.187″	0.014″	0.61″	0.49	0.43	12	9657K48	6.75
0.187″	0.020″	0.71″	2.24	2.15	12	9657K52	6.75
0.187″	0.023″	0.84″	3.33	3.65	12	9657K55	6.75
0.187″	0.028″	1.10″	5.72	8.79	12	9657K58	6.75
0.218″	0.016″	0.60″	0.69	0.60	12	9657K68	6.75
0.218″	0.018″	0.69″	0.84	0.79	12	9657K72	6.75
0.218″	0.023″	0.74″	2.88	2.86	12	9657K75	6.75
0.218″	0.028″	0.94″	4.98	6.13	12	9657K78	6.75
0.25″	0.020″	0.67″	0.97	0.90	12	9657K42	6.75
1.97″ Overall Length							
0.312″	0.022″	0.53″	0.95	0.66	12	9657K84	12.24
2.188″ Overall Length							
0.59″	0.040″	0.38″	6.80	3.80	12	9657K92	12.24
Steel Music Wire—Closed and Ground Flat Ends							
1.063″ Overall Length							
0.688″	0.148″	0.81″	213.35	1,255.00	1	9657K251	15.95
1.75″ Overall Length							
0.75″	0.125″	1.06″	117.13	221.00	3	9657K96	17.01
2″ Overall Length							
0.875″	0.120″	1.01″	106.92	108.00	6	9657K252	21.28
2.03″ Overall Length							
0.938″	0.080″	0.64″	21.82	15.70	6	9657K101	11.34
2.56″ Overall Length							
1.015″	0.120″	1.15″	75.40	55.44	6	9657K253	19.55
2.63″ Overall Length							
0.438″	0.048″	0.95″	10.96	6.60	12	9657K88	21.42
2.84″ Overall Length							
0.625″	0.080″	1.08″	39.06	31.00	6	9657K94	11.34
3.06″ Overall Length							
0.875″	0.091″	1.09″	39.36	20.50	6	9657K254	16.74
Steel Music Wire—Closed and Ground Flat Ends (Cont.)							
4.06″ Overall Length							
0.687″	0.105″	1.95″	76.25	53.70	3	9657K95	$12.55
Zinc-Plated Steel Music Wire—Closed Ends							
0.25″ Overall Length							
0.12″	0.020″	0.16″	4.14	46.00	12	9657K256	4.97
0.125″	0.016″	0.11″	2.65	18.90	12	9657K257	4.97
0.18″	0.018″	0.10″	2.01	13.50	12	9657K258	4.97
0.24″	0.020″	0.09″	1.94	12.50	12	9657K259	4.97
0.25″	0.020″	0.09″	2.13	13.20	12	9657K261	4.97
0.375″ Overall Length							
0.12″	0.016″	0.17″	2.32	11.20	12	9657K262	4.97
0.125″	0.016″	0.15″	2.43	11.00	12	9657K263	4.97
0.18″	0.018″	0.12″	2.30	9.15	12	9657K264	4.97
0.5″ Overall Length							
0.125″	0.016″	0.19″	2.50	8.10	12	9657K266	4.97
0.75″ Overall Length							
0.125″	0.016″	0.24″	3.12	6.10	12	9657K281	4.97
1″ Overall Length							
0.12″	0.022″	0.60″	6.00	14.85	12	9657K294	4.97
0.125″	0.022″	0.50″	7.98	15.80	12	9657K295	5.17
0.18″	0.018″	0.26″	2.34	3.15	12	9657K296	4.97
0.24″	0.020″	0.22″	2.11	2.70	12	9657K298	4.97
1.25″ Overall Length							
0.25″	0.023″	0.47″	2.24	2.87	12	9657K112	5.58
1.375″ Overall Length							
0.281″	0.028″	0.58″	3.49	4.36	12	9657K108	5.16
0.312″	0.031″	0.58″	4.73	5.98	12	9657K35	6.15
1.5″ Overall Length							
0.312″	0.023″	0.57″	1.03	1.11	12	9657K107	5.16
0.375″	0.025″	0.55″	1.04	1.09	12	9657K33	6.01
0.375″	0.028″	0.54″	1.92	2.01	12	9657K135	5.71
2.5″ Overall Length							
0.25″	0.028″	1.11″	4.00	2.88	12	9657K171	5.94
Zinc-Plated Steel Music Wire—Closed and Ground Flat Ends							
0.375″ Overall Length							
0.3″	0.022″	0.09″	2.11	7.30	12	9657K265	10.51
0.5″ Overall Length							
0.18″	0.024″	0.21″	5.55	18.95	12	9657K267	10.51
0.187″	0.029″	0.23″	11.89	43.50	12	9657K268	7.67
0.24″	0.022″	0.13″	3.27	8.75	12	9657K269	10.51
0.24″	0.029″	0.19″	7.25	23.50	12	9657K271	10.51
0.25″	0.026″	0.15″	5.78	16.30	12	9657K272	10.22
0.3″	0.026″	0.13″	4.23	11.30	12	9657K273	10.51
0.3″	0.035″	0.19″	10.05	32.80	12	9657K274	10.51
0.36″	0.041″	0.21″	11.05	38.70	12	9657K275	10.51
0.375″	0.035″	0.19″	5.00	16.10	12	9657K276	10.22
0.48″	0.055″	0.24″	18.66	72.00	12	9657K277	10.51
0.5″	0.062″	0.27″	23.73	104.80	6	9657K278	5.90
0.6″	0.045″	0.16″	7.96	23.20	12	9657K279	10.51
0.75″ Overall Length							
0.18″	0.024″	0.30″	5.48	12.10	12	9657K282	10.51
0.187″	0.029″	0.32″	12.11	28.10	12	9657K283	7.67
0.24″	0.022″	0.17″	3.24	5.60	12	9657K284	10.51
0.25″	0.026″	0.18″	6.51	11.50	12	9657K285	10.22
0.3″	0.022″	0.13″	2.51	4.05	12	9657K286	10.51
0.3″	0.041″	0.36″	13.39	34.40	12	9657K287	10.51
0.36″	0.041″	0.29″	11.10	24.30	12	9657K288	10.51
0.375″	0.035″	0.29″	4.13	8.90	12	9657K289	10.51
0.48″	0.045″	0.24″	11.30	22.00	12	9657K291	10.51
0.5″	0.062″	0.38″	23.39	62.40	6	9657K292	5.90
0.6″	0.045″	0.20″	8.02	14.50	12	9657K293	10.51
1″ Overall Length							
0.18″	0.024″	0.38″	5.55	9.00	12	9657K297	10.51
0.24″	0.026″	0.29″	5.27	7.40	12	9657K299	10.51
0.3″	0.022″	0.16″	2.52	3.00	12	9657K301	10.51
0.3″	0.041″	0.46″	13.64	25.30	12	9657K302	10.51
0.312″	0.026″	0.23″	3.07	4.00	12	9657K303	10.22

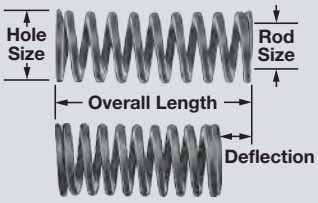
(Continued on following page)

About Die Springs

Die springs are a special type of compression spring that are made from rectangular wire to withstand heavy loads with minimum deflection (the distance the spring compresses). Use them to make and maintain dies, die sets, punching tools, stamping tools, and jigs. A general rule for die springs is to use several short springs rather than one long spring for the least amount of spring compression.

Deflection—The distance a spring compresses when a given load is applied. It is commonly expressed as a percentage of the overall length.

Rate—As you push a die spring, it gets harder to push. The higher the rate, the harder it is to compress the spring.



High-Performance Chrome-Silicon Steel Die Springs

Manufactured to handle repetitive punching and stamping jobs, these springs have high tensile strength for reliable, consistent operation over a long lifetime. Ends are closed and ground flat so springs stand straight and are easy to stack. They follow the Raymond die springs color code.

Fits Hole Size	Fits Rod Size	O'all Lg.	Wire Ht.	Wire Wd.	Load, lbs.	Rate, lbs./ inch		
Blue, Medium Load—Load at 25% deflection. Max. deflection is 50%.								
0.375″	0.188″	1″	0.039″	0.070″	15	60	9573K11	$1.53
0.375″	0.188″	1.25″	0.039″	0.070″	17	54	9573K21	1.88
0.375″	0.188″	1.5″	0.039″	0.070″	15	40	9573K12	2.25
0.375″	0.188″	1.75″	0.039″	0.070″	15	34	9573K23	2.40
0.375″	0.188″	2″	0.039″	0.070″	14	28	9573K13	2.85
0.375″	0.188″	2.5″	0.039″	0.070″	15	24	9573K29	2.94
0.375″	0.188″	3″	0.039″	0.070″	16	21	9573K14	3.43
0.375″	0.188″	12″	0.039″	0.070″	18	6	9573K31	14.57
0.5″	0.281″	1″	0.052″	0.093″	28	110	9573K15	2.08
0.5″	0.281″	1.25″	0.052″	0.093″	26	82	9573K16	2.20
0.5″	0.281″	1.5″	0.052″	0.093″	26	68	9573K17	2.54
0.5″	0.281″	1.75″	0.052″	0.093″	26	60	9573K33	2.59
0.5″	0.281″	2″	0.052″	0.093″	28	55	9573K18	3.01
0.5″	0.281″	2.5″	0.052″	0.093″	28	45	9573K43	3.23
0.5″	0.281″	3″	0.052″	0.093″	26	35	9573K19	3.71
0.5″	0.281″	3.5″	0.052″	0.093″	26	30	9573K44	3.92
0.5″	0.281″	12″	0.052″	0.093″	21	7	9573K45	14.72
0.625″	0.344″	1″	0.069″	0.109″	41	164	9573K46	2.38
0.625″	0.344″	1.25″	0.069″	0.109″	40	128	9573K47	2.46
0.625″	0.344″	1.5″	0.069″	0.109″	41	108	9573K22	2.85
0.625″	0.344″	2″	0.069″	0.109″	44	88	9573K24	3.40
0.625″	0.344″	2.5″	0.069″	0.109″	38	60	9573K25	3.61
0.625″	0.344″	3″	0.069″	0.109″	42	56	9573K26	4.05
0.625″	0.344″	3.5″	0.069″	0.109″	42	48	9573K27	4.42
0.625″	0.344″	4″	0.069″	0.109″	44	44	9573K28	4.75
0.75″	0.375″	1″	0.075″	0.165″	78	312	9573K48	4.35
0.75″	0.375″	1.25″	0.075″	0.165″	80	256	9573K79	4.66
0.75″	0.375″	1.5″	0.075″	0.165″	75	200	9573K32	4.72
0.75″	0.375″	1.75″	0.075″	0.165″	77	176	9573K51	4.34
0.75″	0.375″	2″	0.075″	0.165″	72	144	9573K34	4.60
0.75″	0.375″	2.5″	0.075″	0.165″	75	120	9573K35	4.86
0.75″	0.375″	3″	0.075″	0.165″	72	96	9573K36	5.34
0.75″	0.375″	3.5″	0.075″	0.165″	70	80	9573K37	5.98
0.75″	0.375″	4″	0.075″	0.165″	72	72	9573K38	6.38
0.75″	0.375″	4.5″	0.075″	0.165″	72	64	9573K39	6.96
0.75″	0.375″	5″	0.075″	0.165″	75	60	9573K41	7.77
0.75″	0.375″	6″	0.075″	0.165″	75	50	9573K42	8.98
0.75″	0.375″	12″	0.075″	0.165″	72	24	9573K59	17.71
1″	0.5″	1″	0.100″	0.215″	138	550	9573K62	5.61
1″	0.5″	1.25″	0.100″	0.215″	141	450	9573K63	5.84
1″	0.5″	1.5″	0.100″	0.215″	131	350	9573K64	6.03
1″	0.5″	1.75″	0.100″	0.215″	131	300	9573K65	6.48
1″	0.5″	2″	0.100″	0.215″	130	260	9573K52	5.32
1″	0.5″	2.5″	0.100″	0.215″	125	200	9573K53	5.70
1″	0.5″	3″	0.100″	0.215″	124	165	9573K54	6.34
1″	0.5″	3.5″	0.100″	0.215″	131	150	9573K55	6.64
1″	0.5″	4″	0.100″	0.215″	120	120	9573K56	7.05
1″	0.5″	4.5″	0.100″	0.215″	117	104	9573K57	8.26
1″	0.5″	5″	0.100″	0.215″	120	96	9573K58	8.80
1″	0.5″	6″	0.100″	0.215″	120	80	9573K61	10.82
1.25″	0.625″	1.5″	0.115″	0.285″	186	496	9573K66	8.74
1.25″	0.625″	2″	0.115″	0.285″	176	352	9573K67	7.72
1.25″	0.625″	2.5″	0.115″	0.285″	180	288	9573K68	8.25
1.25″	0.625″	3″	0.115″	0.285″	180	240	9573K69	9.32
1.25″	0.625″	3.5″	0.115″	0.285″	175	200	9573K71	10.01
1.25″	0.625″	4″	0.115″	0.285″	176	176	9573K72	10.91
1.25″	0.625″	4.5″	0.115″	0.285″	180	160	9573K73	12.09
1.25″	0.625″	5″	0.115″	0.285″	170	136	9573K74	13.15
1.25″	0.625″	6″	0.115″	0.285″	180	120	9573K76	16.02
1.25″	0.625″	7″	0.115″	0.285″	182	104	9573K75	17.42
1.25″	0.625″	8″	0.115″	0.285″	176	88	9573K77	20.11
1.5″	0.75″	2″	0.135″	0.345″	265	530	9573K81	8.34
1.5″	0.75″	2.5″	0.135″	0.345″	281	450	9573K82	9.38
1.5″	0.75″	3″	0.135″	0.345″	270	360	9573K83	10.91
1.5″	0.75″	3.5″	0.135″	0.345″	263	300	9573K84	12.28
Blue, Medium Load (Cont.)								
1.5″	0.75″	4″	0.135″	0.345″	270	270	9573K85	$13.90
1.5″	0.75″	4.5″	0.135″	0.345″	259	230	9573K86	15.08
1.5″	0.75″	5″	0.135″	0.345″	263	210	9573K87	16.78
1.5″	0.75″	5.5″	0.135″	0.345″	254	185	9573K78	18.91
1.5″	0.75″	6″	0.135″	0.345″	255	170	9573K89	19.84
2″	1″	2.5″	0.195″	0.468″	625	1,000	9573K91	17.74
2″	1″	3″	0.195″	0.468″	623	830	9573K92	19.65
2″	1″	3.5″	0.195″	0.468″	567	648	9573K93	22.35
2″	1″	4″	0.195″	0.468″	600	600	9573K94	24.38
2″	1″	5″	0.195″	0.468″	588	470	9573K96	29.33
2″	1″	8″	0.195″	0.468″	570	285	9573K99	54.33
Red, Medium to Heavy Load—Load at 20% deflection. Max. deflection is 37%.								
0.375″	0.188″	1″	0.046″	0.073″	18	90	9584K11	1.61
0.375″	0.188″	1.25″	0.046″	0.073″	18	73	9584K16	2.00
0.375″	0.188″	1.5″	0.046″	0.073″	20	67	9584K17	2.29
0.375″	0.188″	1.75″	0.046″	0.073″	20	58	9584K18	2.46
0.375″	0.188″	2″	0.046″	0.073″	20	50	9584K12	3.01
0.5″	0.281″	1″	0.061″	0.094″	34	168	9584K19	2.11
0.5″	0.281″	1.25″	0.061″	0.094″	33	130	9584K21	2.35
0.5″	0.281″	1.5″	0.061″	0.094″	29	95	9584K13	2.69
0.5″	0.281″	2″	0.061″	0.094″	30	75	9584K14	3.24
0.625″	0.344″	1″	0.081″	0.123″	60	300	9584K15	2.69
0.625″	0.344″	1.5″	0.081″	0.123″	57	190	9584K22	2.52
0.625″	0.344″	2″	0.081″	0.123″	59	148	9584K24	3.61
0.625″	0.344″	2.5″	0.081″	0.123″	58	115	9584K25	4.02
0.625″	0.344″	3″	0.081″	0.123″	60	100	9584K26	4.26
0.75″	0.375″	1″	0.093″	0.156″	100	500	9584K29	4.80
0.75″	0.375″	1.25″	0.093″	0.156″	95	380	9584K31	5.00
0.75″	0.375″	1.5″	0.093″	0.156″	96	320	9584K32	4.26
0.75″	0.375″	2″	0.093″	0.156″	99	248	9584K34	4.94
0.75″	0.375″	2.5″	0.093″	0.156″	96	192	9584K35	5.28
0.75″	0.375″	3″	0.093″	0.156″	86	144	9584K36	5.89
0.75″	0.375″	3.5″	0.093″	0.156″	90	128	9584K37	5.78
0.75″	0.375″	4″	0.093″	0.156″	96	120	9584K38	7.01
1″	0.5″	1″	0.115″	0.218″	152	760	9584K41	5.96
1″	0.5″	1.25″	0.115″	0.218″	156	624	9584K43	6.30
1″	0.5″	1.5″	0.115″	0.218″	149	496	9584K44	6.64
1″	0.5″	2″	0.115″	0.218″	160	400	9584K52	6.12
1″	0.5″	2.5″	0.115″	0.218″	155	310	9584K53	6.72
1″	0.5″	3″	0.115″	0.218″	150	250	9584K54	7.17
1″	0.5″	3.5″	0.115″	0.218″	151	216	9584K55	7.85
1″	0.5″	4″	0.115″	0.218″	147	184	9584K56	8.55
1″	0.5″	4.5″	0.115″	0.218″	153	170	9584K57	9.36
1″	0.5″	5″	0.115″	0.218″	144	144	9584K58	10.65
1″	0.5″	6″	0.115″	0.218″	144	120	9584K61	12.39
1.25″	0.625″	1.5″	0.156″	0.281″	343	1,144	9584K45	9.17
1.25″	0.625″	2″	0.156″	0.281″	346	864	9584K67	8.30
1.25″	0.625″	2.5″	0.156″	0.281″	312	624	9584K68	8.88
1.25″	0.625″	3″	0.156″	0.281″	307	512	9584K69	10.04
1.25″	0.625″	3.5″	0.156″	0.281″	308	440	9584K71	10.78
1.25″	0.625″	4″	0.156″	0.281″	294	368	9584K72	11.63
1.25″	0.625″	4.5″	0.156″	0.281″	288	320	9584K46	16.40
1.25″	0.625″	6″	0.156″	0.281″	300	250	9584K76	17.68
1.5″	0.75″	2″	0.187″	0.312″	432	1,080	9584K81	11.18
1.5″	0.75″	2.5″	0.187″	0.312″	428	856	9584K82	12.63
1.5″	0.75″	3″	0.187″	0.312″	374	624	9584K83	14.72
1.5″	0.75″	3.5″	0.187″	0.312″	370	528	9584K84	15.89
1.5″	0.75″	4″	0.187″	0.312″	384	480	9584K85	17.50
1.5″	0.75″	5″	0.187″	0.312″	368	368	9584K87	21.19
1.5″	0.75″	6″	0.187″	0.312″	365	304	9584K89	25.16
2″	1″	2.5″	0.225″	0.437″	592	1,184	9584K91	20.07
2″	1″	3″	0.225″	0.437″	576	960	9584K92	21.89
2″	1″	5″	0.225″	0.437″	560	560	9584K96	32.61
2″	1″	8″	0.225″	0.437″	563	352	9584K99	64.39

(Continued on following page)

Bolt-On Cleats for Conveyor Belts

Convert any smooth conveyor belt into a belt for inclines. Cut cleats to the length you need with a utility knife.

Abrasion-Resistant EPDM— More durable than nitrile, EPDM also has better resistance to acids and weather. Cleats attach to belts with the included bolts and nuts. Maximum temperature is 300° F.

Food-Grade Oil-Resistant Nitrile— The smooth surface is easy to clean and prevents build up of debris. Nitrile resists acids, abrasion, and weather. Cleats have integral threaded inserts for a secure connection and attach to belts with the included stainless steel screws and washers. Maximum temperature is 240° F. FDA compliant.

Abrasion-Resistant EPDM

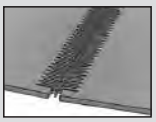
Food-Grade Oil-Resistant Nitrile

Ht.	Lg.	For Max. Belt Thickness	Min. Pulley Dia.	Black		White	
Abrasion-Resistant EPDM							
1¼″	48″	0.43″	3″	5881K14	$50.01	———	———
2″	48″	0.43″	3″	5881K16	67.10	———	———
3″	48″	0.43″	3″	5881K18	75.17	———	———
4″	48″	0.55″	4″	5881K24	111.09	———	———
Food-Grade Oil-Resistant Nitrile							
⅝″	24″	0.31″	2″	6131K21	57.18	6131K71	$62.70
1″	24″	0.31″	2″	6131K22	57.30	6131K72	62.82
1½″	24″	0.31″	2″	6131K23	57.40	6131K73	62.91
2″	24″	0.31″	2″	6131K24	70.90	6131K74	77.43

About Conveyor Belt Lacing

Lacing Style	Belt Thickness	Page
Hammer-On Alligator	Up to 0.31″	1359
Press-On Clipper	Up to 0.39″	1360
Staple-On Alligator	0.0625″ to 0.25″	1361
Bolt-On	0.25″ to 0.625″	1361

Hammer-On Alligator



Press-On Clipper

Staple-On Alligator

Bolt-On

Lacing creates a strong, reliable connection on belting ends that provides more convenient belt installation than “endless” (continuous-loop) belts.

Hammer-On Alligator— Lacing is low profile and requires no special tools for installation.

Press-On Clipper— A lacer clinches these low-profile hooks onto the belt for reduced installation time and consistent connections.

Staple-On Alligator— Staples secure the lacing plates to the conveyor belt for a strong, impact-resistant connection.

Bolt-On— The heaviest duty style we offer, lacing consists of plates compressed into the belt by bolts and nuts.

Hammer-On Alligator Lacing for Conveyor Belts

Since the only tool you’ll need to install this lacing is a hammer, it’s perfect for repairs and areas where lacing machines would be difficult to use. The low-profile, one-piece design runs smoothly over idler rollers without catching on conveyed products. Lacing can be cut to size with wire-cutting pliers. Each box includes lacing, connecting pins, and an installation gauge pin with clips, except No. 00 lacing does not require clips.

Type 316 stainless steel lacing provides better corrosion resistance than galvanized steel and is nonmagnetic.

Also Available: Extra connecting pins and installation clips. For connecting pins, please ask for 6110K888 and specify lacing number and length. For clips, please ask for 6110K777 and specify lacing number.

For Belt Thickness	Min. Pulley Dia.	Recommended Lacing
Up to 0.06″	1″	No. 00
0.06″ to 0.09″	1½″	No. 1A, 1S
0.09″ to 0.14″	2″	No. 7, 7S
0.13″ to 0.16″	2½″	No. 15, 15S
0.16″ to 0.19″	3″	No. 20, 20S
0.19″ to 0.22″	4″	No. 25
0.22″ to 0.28″	5″	No. 27
0.28″ to 0.31″	7″	No. 35

End View

Galvanized Steel

Length	No. 00 Lacing Pkg. of 4		No. 1A Lacing Pkg. of 4		No. 7 Lacing Pkg. of 4		No. 15 Lacing Pkg. of 4	
12″	6110K129	$31.61	6110K135	$30.96	6110K155	$29.61	6110K178	$30.96
14″	6110K121	36.84	6110K131	36.06	6110K151	34.54	6110K171	36.06
16″	6110K122	42.13	6110K132	41.26	6110K152	39.50	6110K172	41.26
18″	6110K123	47.36	6110K133	46.38	6110K153	44.40	6110K173	46.38
20″	6110K124	52.66	6110K134	51.56	6110K154	49.36	6110K174	51.56
24″	6110K125	63.21	6110K136	61.88	6110K156	60.30	6110K176	61.88
30″	6110K101	77.17	6110K139	77.33	6110K159	74.04	6110K179	77.33
36″	6110K126	94.77	6110K142	92.79	6110K162	90.45	6110K182	92.79
48″	6110K127	126.35	6110K144	123.72	6110K164	120.61	6110K184	123.72

Length	No. 20 Lacing Pkg. of 4		No. 25 Lacing Pkg. of 4		No. 27 Lacing Pkg. of 4		No. 35 Lacing Pkg. of 4	
12″	6110K217	$36.26	6110K235	$36.26	6110K255	$34.91	6110K274	$44.74
14″	6110K211	42.25	6110K231	42.25	6110K251	40.71	6110K271	52.23
16″	6110K212	48.30	6110K232	48.30	6110K252	46.55	6110K272	59.66
18″	6110K213	54.32	6110K233	54.32	6110K253	52.39	6110K273	67.14
20″	6110K214	62.13	6110K234	60.36	6110K254	58.17	6110K102	70.85
24″	6110K432	72.43	6110K411	75.07	6110K417	69.85	6110K423	89.53
30″	6110K433	90.56	6110K412	93.85	6110K418	87.26	6110K424	111.88
36″	6110K434	108.63	6110K413	112.58	6110K419	104.72	6110K425	134.23
48″	6110K436	144.89	6110K415	144.89	6110K421	139.61	6110K426	179.00

Type 316 Stainless Steel

Length	No. 1S Lacing Pkg. of 4		No. 7S Lacing Pkg. of 4		No. 15S Lacing Pkg. of 4		No. 20S Lacing Pkg. of 4	
12″	6116K106	$62.28	6116K145	$70.67	6116K164	$79.35	6116K184	$107.74
14″	6116K121	72.70	6116K141	82.49	6116K161	92.60	6116K181	125.65
16″	6116K101	78.93	6116K142	94.26	6116K162	105.79	6116K182	143.61
18″	6116K123	93.46	6116K143	106.09	6116K163	119.00	6116K183	161.56
20″	6116K102	98.67	6116K144	117.86	6116K104	125.65	6116K105	170.53
24″	6116K126	124.61	6116K146	141.44	6116K166	158.72	6116K186	215.44
36″	6116K103	177.57	6116K152	212.11	6116K172	238.07	6116K192	323.18

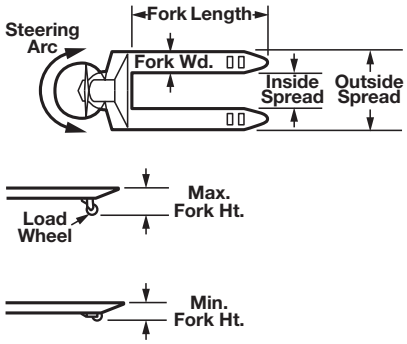
Battery-Powered Pallet Trucks

No more struggling to move a load—this truck requires only minimal effort to start and stop, which makes it more ergonomic and efficient than manual pallet trucks. Truck is for use with 30″ to 40″ wide pallets, on inclines or declines up to 10°.

A hydraulic pump raises and lowers the rounded forks at the touch of a button while a variable-speed throttle controls forward and reverse speed. An automatic brake stops the truck when the handle is released. Truck also has a safety button that automatically reverses the direction of travel if the truck comes in contact with the operator.

Truck includes 24 VDC batteries, a charger, and a 6-ft. cord with a three-prong plug. Operates for eight hours on a full charge when used intermittently. A discharge indicator lets you know when batteries need charging.

Truck is steel with a red plastic cover. Steer and load wheels are polyurethane.

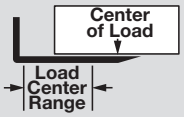


Before selecting a pallet truck, determine the weight of your load as well as the size and style of your pallets. The most commonly used pallets measure 48″ Lg.×40″ Wd.

Cap., lbs.	Fork Size, Lg.×Wd.	Fork Spread Outside	Fork Spread Inside	Fork Ht. Min.	Fork Ht. Max.	O'all Lg.	Handle Ht.	Steering Arc	Wheel Dia.	No. of Batteries		Each
4,500	45½″×6¾″	27″	13½″	3¼″	85⁄8″	685⁄8″	47″	180°	10″/3¼″	4	2207T31	$6,580.00

About Load Center

Load center is measured horizontally from the back of forks or a platform. To help ensure safe and balanced lifting, the center of a balanced load should not be positioned past the load center. Also, the overall length of a balanced load should never be more than twice the load center.



Improperly Balanced Load

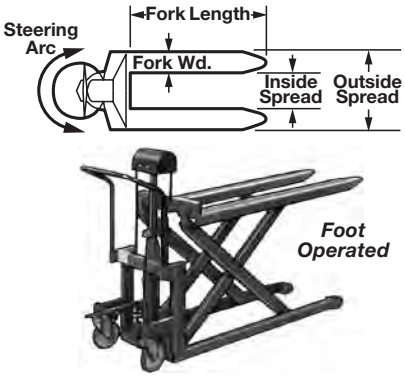
Load-Positioning Lift Trucks

The load-moving benefit of a pallet truck combined with the load-positioning capabilities of a lift truck. Trucks are made of steel and have polyurethane steer and load wheels. A relief valve prevents pressure build-up to provide overload protection.

Note: Use with open-bottom pallets only.

Foot-operated trucks have a single-speed hydraulic pump that raises the load 13⁄16″ per stroke and a lever to control lowering the forks. The steer wheels swivel for better maneuverability; one has a face wheel brake to prevent movement when using the truck as a lift table. Trucks have a black and blue enamel finish.

Hand-operated trucks have a lever on the handle to raise and lower the forks. A two-speed hydraulic pump raises the load 3⁄8″ per stroke. Trucks are yellow with a black handle. All have a powder-coated finish.



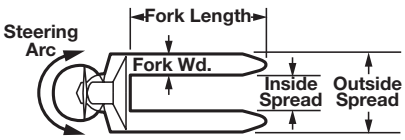
Cap., lbs.	Fork Size, Lg.×Wd.	Fork Spread Outside	Fork Spread Inside	Fork Ht. Min.	Fork Ht. Max.	Load Center	O'all Size, Lg.×Ht.	Handle Ht.	Steering Arc	Wheel Dia.	Base Leg Spread Outside	Base Leg Spread Inside		Each
Foot-Operated Trucks														
1,000	42½″×6″	20½″	8½″	35⁄16″	3213⁄16″	22″	6115⁄16″×42½″	3913⁄16″	180°	6″/2¾″	16¼″	9″	9735T37	$1,531.20
1,000	42½″×6″	27″	15″	35⁄16″	3213⁄16″	22″	6115⁄16″×42½″	3913⁄16″	180°	6″/2¾″	23″	15¼″	9735T38	1,608.00
Hand-Operated Trucks														
3,000	48″ ×7″	20½″	6½″	3¼″	31½″	24″	64½″ ×67″	48″	180°	8″/3″	18″	8½″	4980T51	1,919.71
3,000	48″ ×7″	27″	13″	3¼″	31½″	24″	64½″ ×67″	48″	180°	8″/3″	25″	15½″	4980T52	1,919.71

Lift-and-Tilt Lift Truck

Look no further if you need a truck that not only moves your load, but will also lift and tilt your pallets and containers for better load positioning.

This steel truck has two hand-operated levers; one to raise and lower the forks and one to tilt the forks. The dual-position hydraulic pump raises the load 7⁄16″ per stroke as well as tilts the forks up to 90°. Truck has a yellow and black powder-coated finish. Steer and load wheels are polyurethane.

Note: Use with open-bottom pallets only.

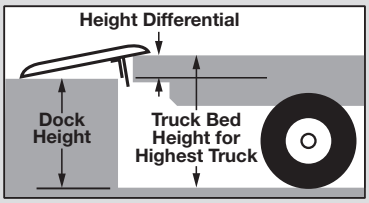


Cap., lbs.	Fork Size, Lg.×Wd.	Fork Spread Outside	Fork Spread Inside	Fork Ht. Horizontal Min.	Fork Ht. Horizontal Max.	Fork Ht. Vertical Min.	Fork Ht. Vertical Max.	Load Center Min.	Load Center Max.	O'all Size, Lg.×Ht.	Handle Ht.	Steering Arc	Wheel Dia.	Base Leg Spread Outside	Base Leg Spread Inside		Each
2,200	31″×6½″	21½″	8½″	3¼″	11″	29″	37″	7½″	15½″	41″×44¼″	44¼″	170°	5″/3″	20¾″	13½″	9516T1	$1,617.56

Warning! **Never exceed capacities. Never use to lift people.**

Dock Levelers, Dockboards & Dock Plates

About Dock Levelers, Dockboards, and Dock Plates



Use dock levelers, dockboards, and dock plates to bridge gaps between loading docks and trucks that are loading and unloading cargo. There are three factors to consider when making your selection:

Height Differential— The difference between the height of your loading dock and the height of your truck bed. The larger the height differential, the longer your dockboard or dock plate should be.

To calculate height differential, subtract the height of your dock from the height of the truck bed (typically 55″ for most semi-trailers and 59″ for refrigerated trailers and container trailers).

Width— Your leveler, dockboard, or dock plate should be 12″ to 18″ wider than your forklift or pallets (whichever is wider). Wider dockboards and dock plates also offer greater maneuverability when placing material inside the trailer.

Capacity— The weight of the load plus the weight of your loading equipment (hand truck, forklift, lift truck, etc.). Load capacities shown are for a single-shift operation. For multiple shifts, choose a board with a capacity 5,000 lbs. higher than your actual expected loads.

Dock Levelers

Standard

Permanently attach levelers to bridge the gap between the edge of your dock and the truck you're loading or unloading. For use with a forklift, pallet, or hand truck.

Each leveler has a steel deck plate; a hinged, steel lip plate; and two 13″ Lg. × 12″ Wd. × 4″ Thick. rubber bumpers that are attached to steel bumper blocks. Dual extension springs act as a counterbalance to aid the leveler as it mechanically lifts the lip plate onto the truck bed; the springs return the lip plate to its original position when the truck pulls away. The deck plate and lip plate have a diamond-pattern tread for positive traction.

Weld levelers to a dock face with a min. 8″ wide steel channel embedded into concrete at the dock edge. If the dock edge does not have an 8″ wide steel channel, use the ***optional installation kit*** (sold separately) for bolt-on mounting.

Standard Levelers— An included lifting hook raises the lip plate. Comes with a hanger for storing the lifting hook when not in use.

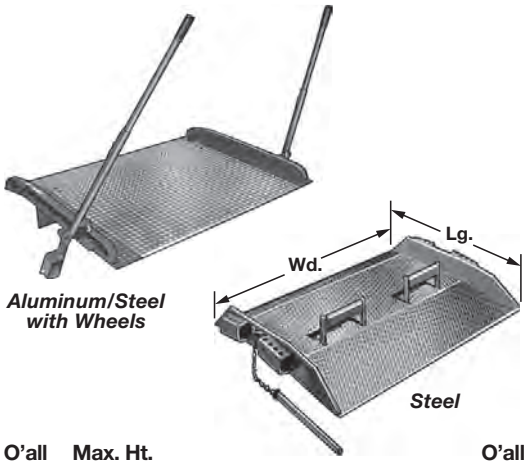
Levelers with Handle— Pull the self-storing handle back about 50° and then return it to its original vertical position to lift the lip plate. It's so easy, there's no need to bend, push, or lean.

Note: To determine your load, take the gross weight of your equipment, add your typical load weight, and then multiply by two.

Plate Wd.	O'all Wd.	Max. Ht. Differential	Lg.	Load Cap., lbs.	Standard	Each	With Handle	Each
66″	102″	±5″	27¾″	20,000	8749T21	$990.91	8749T23	$1,081.82
72″	108″	±5″	27¾″	20,000	8749T22	1,045.45	8749T24	981.82

Optional Installation Kit (includes ramp plate, 17 anchor bolts, and four angles; color is gray) ... 8749T53 Each $281.82

Dockboards



Aluminum/Steel with Wheels

Steel

The best portable choice for handling heavy loads, these dockboards usually require you to use a forklift to move them to your dock. For use when loading and unloading trucks using forklifts, battery-operated hand trucks, and other powered equipment. All have a tread-plate surface for positive traction, plus side curbs to lessen the chance of vehicle runoff.

Aluminum/Steel Dockboards— Have steel curbs bolted to an aluminum tread plate. The curbs are painted high-visibility yellow.

Aluminum/Steel Dockboards with Wheels— Telescoping handles with wheels allow one person to lift and position these dockboards without using a forklift. Retract the handles when the dockboard is in position. All have steel curbs bolted to an aluminum tread plate. The curbs are painted blue.

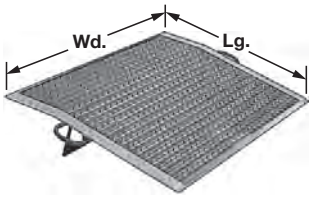
Steel Dockboards— The heaviest dockboards we offer, these are built to endure high-traffic use. Made of steel with welded-on steel side curbs. Dockboards have steel pins that you drop into any of the eight holes along their edges—this anchors the dockboard in the space between the dock and the truck. All have forklift loops that flip up for easy maneuvering and fold flat when not in use. Color is gray with blue side curbs.

O'all Wd.	Max. Ht. Differential	Lg.		Each
Aluminum/Steel				
10,000-lb. Load Capacity				
60″	±7″	48″	21905T82	$749.05
60″	±10″	60″	21905T83	926.33
60″	±12″	72″	21905T34	1,126.43
15,000-lb. Load Capacity				
60″	±5″	36″	21905T81	640.89
60″	±7″	48″	21905T52	906.43
60″	±10″	60″	21905T74	1,108.57
60″	±12″	72″	21905T75	1,338.93

O'all Wd.	Max. Ht. Differential	Lg.		Each
Aluminum/Steel (Cont.)				
20,000-lb. Load Capacity				
60″	±5″	36″	21905T84	$693.67
Aluminum/Steel with Wheels				
10,000-lb. Load Capacity				
60″	±5″	48″	8178T11	1,172.42
60″	±7″	60″	8178T12	1,272.53
15,000-lb. Load Capacity				
60″	±5″	48″	8178T13	1,303.81
60″	±7″	60″	8178T14	1,641.46

O'all Wd.	Max. Ht. Differential	Lg.		Each
Steel				
15,000-lb. Load Capacity				
60″	±5″	48″	2244T21	$1,221.04
60″	±7″	60″	2244T22	1,437.27
60″	±8½″	72″	2244T23	1,657.83
72″	±5″	48″	2244T31	1,340.56
72″	±7″	60″	2244T32	1,558.96
72″	±8½″	72″	2244T33	1,778.45
72″	±10″	84″	2244T34	1,993.63

Aluminum Dock Plates



Lighter than steel, these aluminum dock plates have two handles for manual positioning at your dock. Use with hand trucks, pallet trucks, and other walk-on/walk-off loading and unloading equipment. A tread-plate surface provides positive traction.

O'all Wd.	Max. Ht. Differential	Lg.	Load Cap., lbs.		Each
⅜″ Thick					
36″	±4″	30″	3,000	2251T28	$303.94
36″	±5″	36″	2,500	2251T72■	395.73
36″	±7″	48″	1,900	2251T29	441.54
42″	±4″	30″	3,300	2251T33	321.96
48″	±3″	24″	5,200	2251T34	315.69
48″	±4″	30″	4,100	2251T35	379.73
48″	±5″	36″	3,500	2251T36	439.40
48″	±7″	48″	2,600	2251T38	566.29
48″	±9″	60″	1,800	2251T92	697.40
60″	±5″	36″	4,100	2251T43	535.38

■ Edges are high-visibility yellow.

O'all Wd.	Max. Ht. Differential	Lg.	Load Cap., lbs.		Each
⅜″ Thick (Cont.)					
60″	±7″	48″	2,900	2251T47	$692.13
72″	±3″	24″	7,200	2251T77■	594.47
½″ Thick					
48″	±5″	36″	5,300	2251T53	510.74
48″	±7″	48″	3,800	2251T57	669.35
60″	±3″	24″	10,000	2251T58	462.79
60″	±4″	30″	7,800	2251T59	590.85
60″	±5″	36″	6,600	2251T66	680.38
72″	±4″	30″	9,500	2251T67	683.67
72″	±5″	36″	7,800	2251T68	775.50

About Casters and Wheels

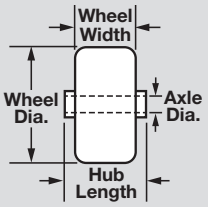
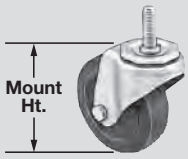


Plate Caster



Stem Caster

Capacity

To determine the capacity required, divide the weight of your load by the number of casters. Choose an even higher capacity if your application involves shock loads (the impact of a load being dropped) or rolling over rough surfaces or obstructions such as thresholds.

Rolling Effort

The force required to start a wheel rolling and keep it rolling is affected by the size of the wheel, the shape of the tread, and the type of bearings in the wheel. Generally, the larger the wheel, the more easily it rolls. Rounded treads start rolling and turn easier than flat treads.

Wheel Material

The hardness of a wheel affects wheel traction, shock absorption, durability, and rolling effort. Softer wheels are quiet and have excellent shock absorption and traction on rough surfaces. Harder wheels are very durable, have higher capacities, and roll more easily on smooth surfaces and carpeting, but can be noisy and damaging to floors. If floor protection is a concern, choose a nonmarking material such as phenolic, nonmarking rubber, polyurethane, nylon, or glass-filled nylon. For replacement wheels, see pages 1458-1466.

		Floor Type				*Operating Environment*			
Wheel Hardness	Wheel Material	**Smooth Concrete, Steel**	**Hardwood, Brick, Tile, Linoleum, Asphalt**	**Ribbed**	**Carpet**	**Oil, Grease, Solvents, Mild Acids**	**Mild Alkalines**	**High Temp. (Above 160° F)**	**Low Temp. (Below –20° F)**
Extra Hard	Iron	✓				✓	✓	✓	✓
	Stainless Steel	✓				✓	✓	✓	✓
	Steel	✓				✓	✓	✓	✓
	Nylon	✓	✓		✓	✓	✓	✓	
	Glass-Filled Nylon	✓	✓		✓	✓		✓	✓
	Phenolic	✓			✓	✓		✓	✓
	Polypropylene	✓			✓				
	Polyurethane	✓	✓		✓	✓	✓		✓
	Rubber	✓	✓		✓				
Hard	Polyurethane	✓	✓	✓		✓	✓		✓
	Rubber	✓	✓	✓					
Soft	Polyurethane	✓	✓	✓		✓	✓		✓
	Neoprene	✓	✓	✓		✓	✓	✓	✓
	Rubber	✓	✓	✓					

Caster Selection Guide

The chart below lists our most popular casters for a given mounting style, capacity range, and operating environment.

	Plate Casters			**Stem Casters and Bracket Casters**
	2,000 lbs. and Up Pages 1425-1428, 1451	**700 to 2,000 lbs.** Pages 1428-1437, 1451	**Up to 700 lbs.** Pages 1437-1451	**Up to 1,100 lbs.** Pages 1452-1457
	 For powered towing, stamping trucks, scrap bins, and storage racks	 For utility trucks, trash containers, and production dollies	 For appliances, carts, and furniture	 For furniture, scaffolding, gates, and doors
	Page	**Page**	**Page**	**Page**
Standard	Brute 1426 Compact Alliance 1426 Stronghart 1427	Gladiator 1430 Spartan 1432-1433 Mauler 1434	Samson 1438 Cart-King 1441 Cart-Smart 1440, 1449	Threaded-Stem 1453 Friction-Grip Stem 1455
Corrosion Resistant	Corrosion-Resistant 1428	Washdown 1435	Washdown 1444 Corrosion-Resistant 1450	Washdown Easy-Roll Threaded-Stem 1452
Leveling	—	Leveling 1436	Leveling 1446, 1449	Leveling Threaded-Stem 1454
Shock Absorbing	Easy-Turn Air-Ride 1428	Shock-Absorbing 1436 Air-Ride 1437	Shock-Absorbing 1447 Air-Ride 1447, 1449	Shock-Absorbing Side-Mount 1457
High Temperature	—	High-Temperature 1434	Ultra-High Temperature 1446	Heavy Duty Threaded-Stem 1452
Low Profile	Compact Alliance 1426	Low-Profile 1437	Low-Profile 1448, 1450	Low-Profile Threaded-Stem 1453 Low-Profile Side-Mount 1457
Static Control	—	—	Static-Control 1442, 1449	Threaded-Stem 1453
Food Service	—	Patriot Food-Service 1435	Food-Service 1443	Wire Shelving Friction-Grip Stem 1456
Track	V-Groove Wheel 1451 Flanged-Wheel 1451	V-Groove Wheel 1451 Flanged-Wheel 1451	V-Groove Wheel 1451 Flanged-Wheel 1451	—

About Leveling Mounts

In addition to leveling the supports or legs of equipment, mounts position equipment above the floor for easier cleaning and inspection. Mounts that swivel compensate for uneven floors.

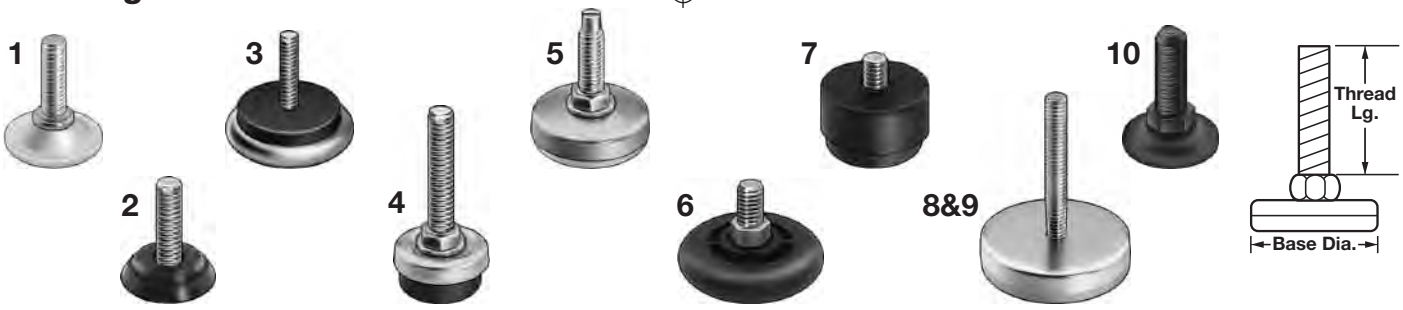
Vibration-damping leveling mounts also isolate vibration and noise transmitted from machines. Performance is measured by deflection (the distance the mount moves when subjected to force). Generally the higher the deflection rating, the greater the vibration and noise isolation.

Before selecting a mount, consider how your machine weight is distributed. If the weight is evenly distributed, use the following formula to find the capacity required per mount:

$$\text{Capacity per Mount} = \frac{\text{Total Machine Weight}}{\text{No. of Mounting Points}}$$

If the weight is unevenly distributed, select the capacity for each mount based on where the weight is concentrated.

Leveling Mounts with Threaded Stud



(1) Light Duty—Stud is zinc-plated steel; base is white plastic. Not rated for temperature or capacity.

(2) High Temperature—Stud is zinc-plated steel; base is black plastic.

(3) Cushion Rest—The black plastic cushion on top of the 304 stainless steel base provides padding between your furniture and the mount. Stud is zinc-plated steel. The 100-lb. capacity mount has a tee nut insert for mounting to unthreaded wood feet.

(4) Nonmarring—A black plastic cushion on the bottom of these mounts protects surfaces from scratches and wear. Mount is zinc-plated steel. Stud has a hex nut for height adjustment.

(5) Easy Adjust—A hex nut at the base of the stud and a slotted stud tip allow easy height adjustment. Stud is zinc-plated steel. Base is nickel-plated steel with a nonmarring plastic bottom.

(6) Low-Clearance Easy Adjust—Use when there is little room between the machine base and floor. Stud is galvanized steel. Base is black plastic.

(7) Self Adjusting—Often used on wobbly tables, these mounts automatically adjust up to 5/16" to compensate for uneven floors. Stud is zinc-plated steel. Base is black plastic.

(8) Heavy Duty—Use these zinc-plated steel mounts on heavy machines and equipment. Base has a nonmarring plastic bottom.

(9) Corrosion Resistant—Made of 303 stainless steel, these mounts resist corrosion from water and most chemicals. Base has a nonmarring plastic bottom.

(10) Oil Resistant—Made entirely of black plastic, these mounts won't scratch your surface.

Inch

Thread Size	Thread Lg.	Cap. per Mount, lbs.	Base Dia.	O'all Ht.	Pkg. Qty.		Pkg.
(1) Light Duty							
1/4"-20	1/2"	—	1 1/8"	7/8"	4	23015T81	$1.94
1/4"-20	1"	—	1 1/8"	1 3/8"	4	23015T82	1.82
5/16"-18	1"	—	1 1/8"	1 7/16"	4	23015T85	1.93
(2) High Temperature (-30° to 350° F)							
1/4"-20	1/2"	50	1 1/8"	15/16"	4	2284T51	2.74
1/4"-20	1"	50	1 1/8"	1 3/8"	4	2284T52	3.00
5/16"-18	1"	50	1 1/8"	1 3/8"	4	2284T54	3.14
5/16"-18	1 1/2"	50	1 1/8"	1 7/8"	4	2284T55	3.26
(3) Cushion Rest (-20° to 170° F)							
8-32	3/8"	50	1 1/8"	13/16"	4	2515T12	4.33
1/4"-20	7/8"	100	1 9/16"	1 3/8"	4	2515T16	7.58
1/4"-20	7/8"	125	1 1/4"	1 3/8"	4	2515T15	5.22
3/8"-16	1 5/8"	300	1 9/16"	2 1/4"	4	2515T17	9.25
(4) Nonmarring (-20° to 170° F)							
5/16"-18	3/4"	150	1 1/8"	1 1/2"	4	2515T18	7.05
5/16"-18	1 1/2"	150	1 1/8"	2 1/4"	4	2515T21	7.85
3/8"-16	3"	150	1 1/8"	3 3/4"	4	2515T19	11.57
1/2"-13	3"	200	1 9/16"	4 1/16"	4	2515T22	14.05
(5) Easy Adjust (-45° to 180° F)							
1/4"-20	1"	50	1 3/4"	1 5/8"	4	23015T67	5.74
5/16"-18	1"	50	1 3/8"	1 9/16"	4	23015T61	4.63
5/16"-18	1"	50	1 3/4"	1 5/8"	4	23015T32	4.57
5/16"-18	1 1/2"	50	1 3/8"	2 1/16"	4	23015T62	4.80
5/16"-18	2"	50	1 3/8"	2 3/4"	4	23015T63	5.20
3/8"-16	1"	50	1 3/8"	1 9/16"	4	23015T64	5.03
3/8"-16	1 1/2"	50	1 3/8"	2 1/16"	4	23015T65	5.23
3/8"-16	1 1/2"	50	1 3/4"	2 1/8"	4	23015T34	5.57
3/8"-16	3 1/2"	50	1 3/8"	4 1/16"	4	23015T66	6.11
(6) Low-Clearance Easy Adjust (32° to 113° F)							
3/8"-16	5/8"	110	2"	1 7/16"	1	21015T21	3.29
(7) Self Adjusting (32° to 125° F)							Each
1/4"-20	5/16"	100	1 1/2"	1 1/2"	—	9995T91	$5.36
5/16"-18	5/16"	100	1 1/2"	1 1/2"	—	9995T92	5.99
3/8"-16	5/16"	100	1 1/2"	1 1/2"	—	9995T93	6.89
(8) Heavy Duty (-20° to 170° F)							
10-24	1 1/2"	250	1 3/16"	2 1/2"	—	62805K31	2.02
1/4"-20	1 1/2"	250	1 3/16"	2 1/2"	—	62805K32	2.05
5/16"-18	1 1/2"	250	1 3/16"	2 1/2"	—	62805K33	2.12
5/16"-18	2"	250	2"	3"	—	62805K34	2.48

Thread Size	Thread Lg.	Cap. per Mount, lbs.	Base Dia.	O'all Ht.		Each
(8) Heavy Duty (Cont.)						
3/8"-16	2"	250	2"	3"	62805K35	$2.55
3/8"-16	2"	250	2 3/8"	3"	62805K36	2.80
3/8"-16	4"	250	2 3/8"	5"	62805K37	3.00
1/2"-13	2"	250	2 3/8"	3"	62805K38	3.31
1/2"-13	2"	500	2 3/4"	3 1/16"	62805K41	4.08
1/2"-13	4"	250	2 3/8"	5"	62805K39	3.79
1/2"-13	4"	500	2 3/4"	5 1/16"	62805K42	4.55
1/2"-13	4"	500	3 3/16"	5 1/8"	62805K45	7.76
1/2"-13	6"	500	3 3/16"	7 1/8"	62805K46	8.53
5/8"-11	2"	500	2 3/4"	3 1/16"	62805K43	5.45
5/8"-11	4"	500	2 3/4"	5 1/16"	62805K44	6.24
5/8"-11	4"	500	3 3/16"	5 1/8"	62805K47	8.53
5/8"-11	6"	500	3 3/16"	7 1/8"	62805K48	9.39
3/4"-10	2"	500	2 3/4"	3 1/16"	62805K71	7.08
3/4"-10	4"	500	2 3/4"	5 1/16"	62805K72	8.03
3/4"-10	4"	500	3 3/16"	5 1/8"	62805K73	9.82
3/4"-10	6"	500	3 3/16"	7 1/8"	62805K74	10.85
(9) Corrosion Resistant (-20° to 170° F)						
10-24	1 1/2"	250	1 3/16"	2 1/4"	1942K71	4.97
1/4"-20	1 1/2"	250	1 3/16"	2 1/4"	1942K72	5.11
5/16"-18	1 1/2"	250	1 3/16"	2 1/4"	1942K73	6.14
5/16"-18	2"	250	2"	3"	1942K41	6.20
3/8"-16	2"	250	2"	3"	1942K74	7.94
3/8"-16	2"	250	2 3/8"	3"	1942K42	8.13
3/8"-16	4"	250	2 3/8"	5"	1942K43	9.15
1/2"-13	2"	250	2 3/8"	3"	1942K75	10.37
1/2"-13	2"	500	2 3/4"	3"	1942K45	11.93
1/2"-13	4"	250	2 3/8"	5"	1942K44	9.50
1/2"-13	4"	500	2 3/4"	5"	1942K46	12.35
1/2"-13	4"	500	3 3/16"	5"	1942K48	16.55
1/2"-13	6"	500	3 3/16"	7"	1942K49	15.48
5/8"-11	2"	500	2 3/4"	3"	1942K47	13.78
5/8"-11	4"	500	2 3/4"	5 1/16"	1942K76	17.28
5/8"-11	4"	500	3 3/16"	5"	1942K51	16.25
5/8"-11	6"	500	3 3/16"	7 1/8"	1942K77	18.81
3/4"-10	2"	500	2 3/4"	3 1/16"	1942K52	18.15
3/4"-10	4"	500	2 3/4"	5 1/16"	1942K53	21.46
3/4"-10	4"	500	3 3/16"	5 1/8"	1942K54	22.55
3/4"-10	6"	500	3 3/16"	7 1/8"	1942K55	26.20

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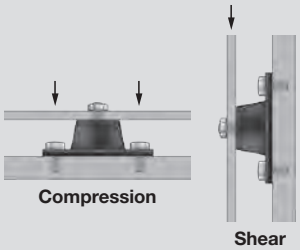
About Vibration-Damping Mounts



Vibration-damping mounts isolate vibration and noise transmitted to and from machinery. They reduce maintenance costs, prolong equipment life, and protect floors. Performance is measured by deflection (the distance the mount moves when subjected to force). Generally, the higher the deflection rating, the greater the vibration and noise isolation.

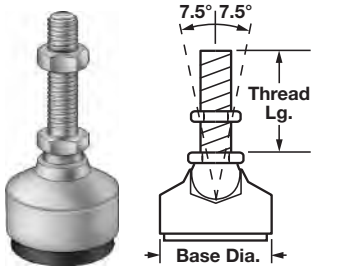
Most vibration-damping mounts are used in *compression* applications. Some mounts can also be used in *shear* applications, where force is applied to the stud or bolt hole from the side.

Before selecting a mount, consider how your machine weight is distributed. If the weight is evenly distributed, use the following formula to find the capacity required per mount:

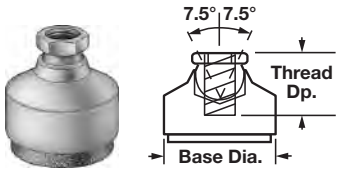
$$\text{Capacity per Mount} = \frac{\text{Total Machine Weight}}{\text{No. of Mounting Points}}$$

If the weight is unevenly distributed, select the capacity for each mount based on where the weight is concentrated.

Swivel Vibration-Damping Leveling Mounts



With Threaded Stud



With Threaded Hole

Use these mounts to minimize vibration and noise to prolong machine life and protect floors. Their ball-and-socket design swivels 7.5° to compensate for uneven floors. They're zinc-plated steel. Cushion is rubber and has a temperature range of -20° to 170° F.

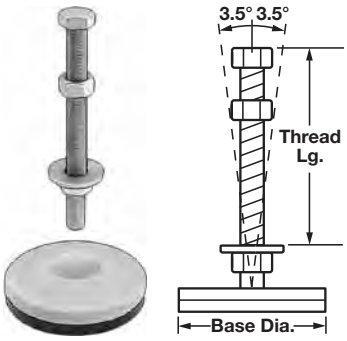
Standard mounts have a black cushion. **High capacity** mounts have a brown cushion.

Mounts **with threaded stud** come with a removable locknut. Stud is zinc-plated steel.

Mounts **with threaded hole** can be used with your own threaded stud or bolt to build a mount that fits your needs.

Thread Size	Cap. per Mount, lbs.	Deflect. @ Cap.	Base Dia.	With Threaded Stud: Thread Lg.	With Threaded Stud: O'all Ht.			With Threaded Hole: Thread Dp.	With Threaded Hole: O'all Ht.		
Standard											
1/4"-20	150	0.05"	1 1/4"	1 1/4"	2 11/16"	6330K41	$13.47	5/16"	1 7/16"	6319K61	$11.64
5/16"-18	200	0.05"	1 1/4"	2"	3 1/2"	6330K43	14.16	3/8"	1 1/2"	6319K63	12.27
3/8"-16	200	0.05"	1 1/4"	2"	3 1/2"	6330K21	12.20	3/8"	1 1/2"	6319K41	10.58
1/2"-13	1,000	0.04"	1 7/8"	2"	3 3/4"	6330K28	20.65	7/16"	1 3/4"	6319K37	18.30
5/8"-11	1,800	0.05"	2 1/2"	2"	3 7/8"	6330K29	30.20	7/16"	1 7/8"	6319K38	23.24
3/4"-10	2,500	0.06"	3"	2"	4 1/8"	6330K31	39.21	9/16"	2 1/8"	6319K51	36.46
1"-8	4,500	0.06"	4"	3 1/2"	6"	6330K32	55.13	11/16"	2 1/2"	6319K52	50.62
1 1/4"-7	10,000	0.06"	6"	4"	6 7/8"	6330K33	70.93	1 1/4"	2 7/8"	6319K53	69.82
High Capacity											
1/4"-20	750	0.05"	1 1/4"	1 1/4"	2 11/16"	6330K42	22.67	5/16"	1 7/16"	6319K62	21.00
5/16"-18	900	0.05"	1 1/4"	2"	3 1/2"	6330K44	23.87	3/8"	1 1/2"	6319K64	22.13
3/8"-16	995	0.05"	1 1/4"	2"	3 1/2"	6330K34	20.56	3/8"	1 1/2"	6319K54	19.07
1/2"-13	2,400	0.06"	1 7/8"	2"	3 3/4"	6330K35	27.40	7/16"	1 3/4"	6319K55	26.89
5/8"-11	4,400	0.06"	2 1/2"	2"	3 7/8"	6330K36	41.54	7/16"	1 7/8"	6319K56	34.90
3/4"-10	6,500	0.08"	3"	2"	4 1/8"	6330K37	55.09	9/16"	2 1/8"	6319K57	51.00
1"-8	11,800	0.08"	4"	3 1/2"	6"	6330K38	79.53	11/16"	2 1/2"	6319K58	71.45
1 1/4"-7	27,100	0.08"	6"	4"	6 7/8"	6330K39	114.02	1 1/4"	2 7/8"	6319K59	109.51

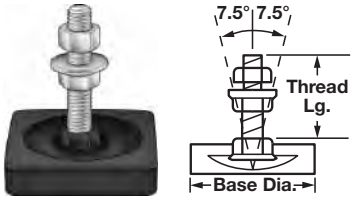
Low-Clearance Swivel Vibration-Damping Leveling Mounts



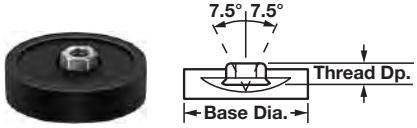
A two-piece design requires less clearance than one-piece mounts and simplifies installation—raise your machine just enough to slide the base underneath, then insert the stud from above. Use these mounts to minimize vibration and noise to prolong machine life and protect floors. The stud rests in an unthreaded depression in the center of the base and swivels 3.5° to compensate for uneven floors. They have a cast iron base with a black rubber cushion that's good for use indoors in dry conditions. Temperature range is -40° to 200°. Stud is zinc-plated steel.

Thread Size	Thread Lg.	Cap. per Mount, lbs.	Deflect. @ Cap.	Base Dia.	O'all Ht.		
5/16"-24	3 1/2"	250	0.04"	2 1/2"	4 1/4"	6011K11	$33.10
1/2"-20	5 1/2"	500	0.04"	3 1/2"	6 5/8"	6011K12	49.74
1/2"-20	5 1/2"	1,000	0.04"	3 1/2"	6 5/8"	6011K13	58.84
3/4"-16	5 1/2"	2,000	0.04"	7"	6 7/8"	6011K14	123.93
3/4"-16	5 1/2"	4,000	0.04"	7"	6 7/8"	6011K15	148.85
3/4"-16	5 1/2"	8,000	0.06"	7"	7"	6011K18	182.65
3/4"-16	5 1/2"	12,000	0.06"	7"	7"	6011K19	219.60

Extreme-Force Swivel Vibration-Damping Leveling Mounts



Square Base with Threaded Stud



Round Base with Threaded Hole

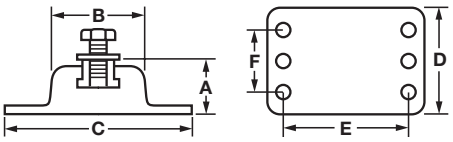
Higher deflection ratings translate to greater vibration and shock isolation. These mounts have a black rubber base that grips the floor for stability and is resistant to oil and grease. Their ball-and-socket design swivels 7.5° to compensate for uneven floors. Temperature range is -20° to 180° F.

Mounts **with threaded stud** include a removable locknut and a flange nut. Stud is zinc-plated steel.

Mounts **with threaded hole** can be used with your own threaded stud or bolt to build a mount that fits your needs.

Thread Size	Cap. per Mount, lbs.	Deflect. @ Cap.	Base Size	With Threaded Stud: Thread Lg.	With Threaded Stud: O'all Ht.			With Threaded Hole: Thread Dp.	With Threaded Hole: O'all Ht.		
Square Base											
1/2"-13	350	0.13"	3" Sq.	2 5/8"	3 1/2"	63965K47	$19.96	1/2"	7/8"	63965K45	$12.60
1/2"-13	700	0.13"	3" Sq.	2 5/8"	3 1/2"	63965K48	22.51	1/2"	7/8"	63965K46	14.14
Round Base											
1/2"-13	500	0.13"	3" Dia.	2 5/8"	3 1/2"	63965K66	21.59	1/2"	1"	63965K62	13.59
1/2"-13	1,000	0.13"	3" Dia.	2 5/8"	3 1/2"	63965K67	23.51	1/2"	1"	63965K63	14.74
3/4"-10	3,700	0.13"	5" Dia.	4 5/8"	6 3/8"	63965K68	44.04	3/4"	1 3/4"	63965K64	34.85
3/4"-10	8,000	0.13"	5" Dia.	4 5/8"	6 3/8"	63965K69	48.14	3/4"	1 3/4"	63965K65	37.28

Seismic Bolt-Down Vibration-Damping Mounts



Limit damage during moderate earthquakes. These mounts have a seismic rating of 1g (acceleration of gravity) and dissipate vibration and noise in compression and shear load applications. Use the six holes in the base to bolt down these mounts to keep your equipment stationary (fasteners not included). Made of neoprene rubber, they have good resistance to oil and gasoline. Base is steel. Mounts come with a cadmium-plated steel bolt and washer for height adjustment. Temperature range is -20° to 225°F. Color is black.

Thread Size	Thread Lg.	Cap. per Mount, lbs.	Deflect. @ Cap.	Shear Cap. per Mount, lbs.	Shear Deflect. @ Cap.	Durometer	O'all Ht. (A)	Base Dia. (B)	Base Lg. (C)	Base Wd. (D)	Mounting Hole Dia.	Mounting Hole Ctr.-to-Ctr. (E)	Mounting Hole Ctr.-to-Ctr. (F)		
1/2"-13	1 1/4"	250	0.15"	200	0.09"	30A	1.875"	2.75"	4.75"	3"	0.438"	3.875"	2"	5724K41	$57.31
1/2"-13	1 1/4"	525	0.15"	420	0.09"	45A	1.875"	2.75"	4.75"	3"	0.438"	3.875"	2"	5724K42	57.31
1/2"-13	1 1/4"	1,000	0.15"	800	0.09"	60A	1.875"	2.75"	4.75"	3"	0.438"	3.875"	2"	5724K43	57.31
5/8"-11	1 1/4"	1,400	0.15"	400	0.09"	40A	1.875"	3.5"	6.25"	3.75"	0.563"	5"	2.5"	5724K44	68.85
5/8"-11	1 1/4"	2,100	0.15"	600	0.09"	50A	1.875"	3.5"	6.25"	3.75"	0.563"	5"	2.5"	5724K45	68.85
5/8"-11	1 1/4"	3,500	0.15"	1,000	0.09"	60A	1.875"	3.5"	6.25"	3.75"	0.563"	5"	2.5"	5724K46	68.85

About Vibration-Damping Pads

Place pads under equipment, such as drill presses, milling machines, saws, and air conditioning units to minimize vibration and noise transmitted to and from machinery. Performance is measured by deflection (the distance the pad material moves when subjected to force)—the higher the rating, the greater the vibration isolation. Stack pads for increased deflection; metal shims are recommended between layers.

Before selecting a pad, consider how your machine weight is distributed. If the weight is evenly distributed, use the following formulas to find the capacity per mounting point in lbs./sq. in.

$$\text{Capacity per Mounting Point} = \frac{\text{Total Machine Weight}}{\text{No. of Mounting Points}}$$

$$\text{lbs./sq. in.} = \frac{\text{Capacity per Mounting Point}}{\text{Area (in sq. in.)}}$$

If the weight is unevenly distributed, select the capacity for each mount based on where the weight is concentrated.

Depending on your application, some pad materials are better suited than others. Use this chart to compare the resistance qualities of different materials:

Material	Oil	Weather	Tear	Abrasion
PVC	Fair	Fair	Fair	Fair
Natural Rubber	Poor	Fair	Excellent	Excellent
Recycled Rubber	Excellent	Excellent	Excellent	Excellent
Silicone	Good	Excellent	Fair	Good
Nitrile	Excellent	Poor	Fair	Good
Neoprene	Good	Good	Fair	Good

Vibration-Damping Pads

Natural Rubber

Recycled Rubber

These vibration-damping pads resist abrasion and tears, providing excellent durability. Color is black.

Natural rubber pads have a waffle texture composed of 2" squares for a suction-cup grip between machinery and the floor. Temperature range is -20° to 180°F.

Recycled rubber pads have a higher capacity for heavier equipment than natural rubber pads. They have excellent oil and weather resistance. Temperature range is -20° to 200°F.

Lg.	Wd.	Thick.	Cap. per Mounting Point, lbs./sq. in.	Deflect. @ Cap.	Durometer		
Natural Rubber							
6"	6"	3/8"	45	0.06"	45A	60015K42	$11.72
6"	6"	3/4"	30	0.11"	40A	60015K43	18.62
18"	18"	3/8"	45	0.06"	45A	60015K21	61.03
18"	18"	3/4"	30	0.11"	40A	60015K41	93.55
Recycled Rubber							
35"	35"	1/2"	225	0.22"	45A	60015K54	115.00
35"	35"	1"	225	0.44"	55A	60015K55	149.50

Chemical-Resistant Vibration-Damping Pads

Made of fiber-reinforced PVC, these pads endure exposure to corrosive chemicals, such as cleaning solvents, chlorine, and hydrochloric acid. Pads that are 5/8" thick also contain cork for increased deflection and vibration damping. Temperature range is 32° to 150°F. Color is green.

Pads

Lg.	Wd.	Thick.	Cap. per Mounting Point, lbs./sq. in.	Deflect. @ Cap.	Durometer		Each
20"	10"	1/4"	174	0.04"	85A	5998K4	$22.15
20"	10"	5/8"	116	0.05"	80A	5998K5	57.12
39"	20"	1/4"	174	0.04"	85A	5998K1	77.25
39"	20"	5/8"	116	0.05"	80A	5998K2	215.13

Pad Packs

Packs contain four 1/4" thick pads and four 5/8" thick pads.

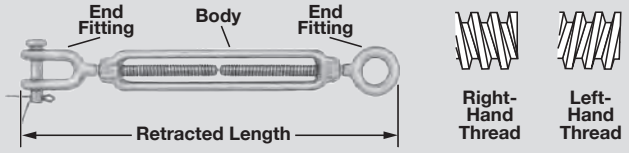
Lg.	Wd.	Cap. per Mounting Point, lbs./sq. in.	Deflect. @ Cap.	Durometer		Pkg. of 8
2"	2"	90	0.05"	80A	60105K61	$10.00
3"	3"	90	0.05"	80A	60105K62	21.52
4"	4"	90	0.05"	80A	60105K63	35.49
5"	5"	90	0.05"	80A	60105K64	53.06
6"	6"	90	0.05"	80A	60105K65	74.82
8"	8"	90	0.04"	80A	60105K66	125.22
10"	10"	90	0.04"	80A	60105K67	195.65

Vibration-Damping Pads for Precision Equipment

These soft pads work well for isolating vibration with light loads such as lab and testing equipment. Made of silicone rubber, pads have a nubby texture on top to secure your equipment, while a smooth bottom grips the underlying surface. Temperature range is -40° to 375°F.

Lg.	Wd.	Thick.	Cap. per Mounting Point, lbs./sq. in.	Deflect. @ Cap.	Durometer	Color		
4"	4"	1/4"	2	0.09"	10A	Gray	1075N1	$94.38
4"	4"	1/4"	6	0.11"	20A	Gray	1075N2	94.38
4"	4"	1/4"	11	0.11"	40A	Green	1075N3	94.38

About Turnbuckles and End Fittings



Turnbuckles are mechanical coupling devices that adjust length and tension. They consist of two threaded end fittings and a threaded body. One end fitting has right-hand threads (fitting tightens clockwise), and the other end has left-hand threads (fitting tightens counterclockwise). The turnbuckle body has matching right- and left-hand internal threads. Turning the turnbuckle body adjusts the end fittings an equal amount on each end.

Turnbuckles

Suited to your toughest applications, these turnbuckles have a strong, seamless, forged construction (unless noted).

Clevis end fittings include a clevis pin with cotter pin. **Stub end fittings** are unthreaded. **Stud end fittings** are fully threaded. End fittings with **oval eyes** have more room than round eyes to attach connectors.

Galvanized steel turnbuckles have a thick coating for corrosion resistance. Meet ASTM F1145-05 Type 1, Grade 1. **316 stainless steel** turnbuckles have excellent resistance to salt water and chemicals. Meet ASTM F1145-92 Type 1.

Also Available: Jam nuts for galvanized steel turnbuckles. Please ask for 3000T751 and specify thread size.

Eye to Eye

Cap., lbs.	Retracted Lg.	Max. Adjustment	(A)	(B)	Thread Size		
Galvanized Steel with Round Eyes							
500	8″	4″	1/2″	—	1/4″-20	2999T51	$13.37
800	9″	4 1/2″	5/8″	—	5/16″-18	2999T52	16.62
1,200	11 1/2″	6″	3/4″	—	3/8″-16	2999T53	17.96
2,200	13″	6″	1″	—	1/2″-13	2999T54	20.92
2,200	16″	9″	1″	—	1/2″-13	2999T55	28.79
2,200	19″	12″	1″	—	1/2″-13	2999T56	33.32
3,500	13 1/2″	6″	1 1/4″	—	5/8″-11	2999T57	26.33
3,500	17″	9″	1 1/4″	—	5/8″-11	2999T58	38.45
3,500	20 1/2″	12″	1 1/4″	—	5/8″-11	2999T59	41.77
5,200	14 3/4″	6″	1 1/2″	—	3/4″-10	2999T61	44.97
5,200	18″	9″	1 1/2″	—	3/4″-10	2999T62	53.89
5,200	21 3/4″	12″	1 1/2″	—	3/4″-10	2999T63	62.98
5,200	27 3/4″	18″	1 1/2″	—	3/4″-10	2999T64	79.62
7,200	18″	6″	1 3/4″	—	7/8″-9	2999T481	70.60
7,200	22 1/2″	12″	1 3/4″	—	7/8″-9	2999T65	80.77
7,200	28 1/2″	18″	1 3/4″	—	7/8″-9	2999T66	106.36
10,000	17″	6″	2″	—	1″-8	2999T67	83.88
10,000	25″	12″	2″	—	1″-8	2999T68	91.39
10,000	31″	18″	2″	—	1″-8	2999T69	121.91
316 Stainless Steel with Oval Eyes							
500	8″	4″	5/16″	3/4″	1/4″-20	3022T31	27.82
800	9 1/4″	4 1/2″	7/16″	15/16″	5/16″-18	3022T32	39.52
1,200	11 1/2″	6″	1/2″	1 1/8″	3/8″-16	3022T33	54.38
2,200	13″	6″	3/4″	1 7/16″	1/2″-13	3022T34	86.59
3,500	14 1/2″	6″	7/8″	1 3/4″	5/8″-11	3022T35	145.77
5,200	16 1/4″	6″	1″	2 1/16″	3/4″-10	3022T36	208.62

Clevis to Eye

Cap., lbs.	Retracted Lg.	Max. Adjustment	(A)	(B)	(C)	(D)	Thread Size		
Galvanized Steel with Round Eye									
500	8 1/4″	4″	1/2″	—	3/8″	1/4″	1/4″-20	3000T51	$16.37
800	9 1/4″	4 1/2″	5/8″	—	15/32″	1/4″	5/16″-18	3000T52	19.42
1,200	11 1/2″	6″	3/4″	—	1/2″	5/16″	3/8″-16	3000T53	21.89
2,200	13 1/4″	6″	1″	—	5/8″	7/16″	1/2″-13	3000T54	23.19
2,200	16 1/4″	9″	1″	—	5/8″	7/16″	1/2″-13	3000T55	29.93
2,200	19 1/4″	12″	1″	—	5/8″	7/16″	1/2″-13	3000T56	35.03
3,500	14 3/4″	6″	1 1/4″	—	7/8″	1/2″	5/8″-11	3000T57	32.04
3,500	18″	9″	1 1/4″	—	7/8″	1/2″	5/8″-11	3000T58	41.00
3,500	21 1/4″	12″	1 1/4″	—	7/8″	1/2″	5/8″-11	3000T59	47.16
5,200	15 3/4″	6″	1 1/2″	—	15/16″	5/8″	3/4″-10	3000T61	48.18
5,200	18 3/4″	9″	1 1/2″	—	15/16″	5/8″	3/4″-10	3000T62	53.65
5,200	22″	12″	1 1/2″	—	15/16″	5/8″	3/4″-10	3000T63	65.82
5,200	28″	18″	1 1/2″	—	15/16″	5/8″	3/4″-10	3000T64	80.69
7,200	19″	6″	1 3/4″	—	1 1/8″	3/4″	7/8″-9	3000T32	80.14
7,200	23 1/2″	12″	1 3/4″	—	1 1/8″	3/4″	7/8″-9	3000T65	84.88
7,200	29 1/2″	18″	1 3/4″	—	1 1/8″	3/4″	7/8″-9	3000T66	112.42
10,000	19 1/4″	6″	2″	—	1 3/16″	7/8″	1″-8	3000T67	91.48
10,000	25 1/4″	12″	2″	—	1 3/16″	7/8″	1″-8	3000T68	99.64
10,000	31 1/4″	18″	2″	—	1 3/16″	7/8″	1″-8	3000T69	139.77
316 Stainless Steel with Oval Eye									
500	8″	4″	5/16″	3/4″	7/16″	1/4″	1/4″-20	3022T41	28.69
800	9 1/4″	4 1/2″	7/16″	15/16″	1/2″	1/4″	5/16″-18	3022T42	40.74
1,200	11″	6″	1/2″	1 1/8″	9/16″	5/16″	3/8″-16	3022T43	60.90
2,200	12 1/2″	6″	3/4″	1 7/16″	5/8″	3/8″	1/2″-13	3022T44	86.69
3,500	14″	6″	7/8″	1 3/4″	3/4″	1/2″	5/8″-11	3022T45	130.00
5,200	15 3/4″	6″	1″	2 1/16″	1″	5/8″	3/4″-10	3022T46	194.81

Hook to Hook

Cap., lbs.	Retracted Lg.	Max. Adjustment	(E)	Thread Size		
Galvanized Steel						
400	8 1/2″	4″	1/4″	1/4″-20	2997T51	$13.37
700	9 1/2″	4 1/2″	1/2″	5/16″-18	2997T52	16.62
1,000	12″	6″	5/8″	3/8″-16	2997T53	17.96
1,500	14 1/4″	6″	13/16″	1/2″-13	2997T54	20.92
1,500	17 1/4″	9″	13/16″	1/2″-13	2997T55	28.79
1,500	20 1/4″	12″	13/16″	1/2″-13	2997T56	33.32
2,200	14 3/4″	6″	13/16″	5/8″-11	2997T57	26.33
2,200	17 3/4″	9″	13/16″	5/8″-11	2997T58	38.45
2,200	20 3/4″	12″	13/16″	5/8″-11	2997T59	41.77
3,000	16 3/4″	6″	7/8″	3/4″-10	2997T61	44.97
3,000	19 3/4″	9″	7/8″	3/4″-10	2997T62	53.89
3,000	22 3/4″	12″	7/8″	3/4″-10	2997T63	62.98
3,000	28 3/4″	18″	7/8″	3/4″-10	2997T64	79.62
5,000	20″	6″	1 1/4″	1″-8	2997T67	83.88
5,000	25 1/2″	12″	1 1/4″	1″-8	2997T68	91.39
316 Stainless Steel—Cast						
300	7″	4″	3/8″	1/4″-20	3022T612	27.82
500	7 3/4″	4 1/2″	7/16″	5/16″-18	3022T622	39.52
700	10 1/2″	6″	1/2″	3/8″-16	3022T632	54.38
1,000	10 1/2″	6″	9/16″	1/2″-13	3022T642	86.59

Hook to Eye

Cap., lbs.	Retracted Lg.	Max. Adjustment	(A)	(B)	(E)	Thread Size		
Galvanized Steel with Round Eye								
400	8 1/4″	4″	1/2″	—	1/4″	1/4″-20	2998T51	$13.37
700	9 1/4″	4 1/2″	5/8″	—	1/2″	5/16″-18	2998T52	16.62
1,000	11 3/4″	6″	3/4″	—	5/8″	3/8″-16	2998T53	17.96
1,500	13 3/4″	6″	1″	—	13/16″	1/2″-13	2998T54	20.92
1,500	16 3/4″	9″	1″	—	13/16″	1/2″-13	2998T55	28.79
1,500	19 3/4″	12″	1″	—	13/16″	1/2″-13	2998T56	33.32
2,200	14 1/4″	6″	1 1/4″	—	13/16″	5/8″-11	2998T57	26.33
2,200	17 1/2″	9″	1 1/4″	—	13/16″	5/8″-11	2998T58	38.45
2,200	20 3/4″	12″	1 1/4″	—	13/16″	5/8″-11	2998T59	41.77
3,000	15 3/4″	6″	1 1/2″	—	7/8″	3/4″-10	2998T61	44.97
3,000	19″	9″	1 1/2″	—	7/8″	3/4″-10	2998T62	53.89
3,000	22 1/4″	12″	1 1/2″	—	7/8″	3/4″-10	2998T63	62.98
3,000	28 1/4″	18″	1 1/2″	—	7/8″	3/4″-10	2998T64	79.62
5,000	19 3/4″	6″	2″	—	1 1/4″	1″-8	2998T67	83.88
5,000	25 1/4″	12″	2″	—	1 1/4″	1″-8	2998T68	91.39
316 Stainless Steel with Oval Eye—Cast								
300	7 1/2″	4″	5/16″	3/4″	3/8″	1/4″-20	3022T611	27.82
500	8 1/2″	4 1/2″	3/8″	15/16″	7/16″	5/16″-18	3022T621	39.52
700	10 3/4″	6″	1/2″	1 1/8″	1/2″	3/8″-16	3022T631	54.38
1,000	12″	6″	3/4″	1 7/16″	9/16″	1/2″-13	3022T641	86.59

(Continued on following page)

About Pulleys

To Calculate the Load on a Single Pulley

Rope Angle	Multiply Load By
0°	2.00
30°	1.93
45°	1.84
60°	1.73
90°	1.41
120°	1.00
150°	0.52
160°	0.35
180°	0.00

Pulleys are wheels with a groove. **Mounted pulleys** have a housing with mounting holes. **Hanging pulleys** have a housing and hardware such as a hook for suspending.

Use multiple pulleys to reduce the force needed to move a load and to reduce the amount of load movement for finer motion control.

Use pulleys **for horizontal pulling** to assist with horizontal pulling or to guide a rope.

Capacity—The rope angle affects the load on a pulley. Use the chart to determine the capacity you'll need based on the angle of your rope. For example, if you are lifting a 100-lb. load at 0° straight down with a single pulley, then the load on your pulley is 200 lbs.

Size Selection—To minimize the bending stress on your rope, you should choose the largest possible pulley OD.

Pulley Diameter Checkers—Also known as groove gauges, these measure the groove of your pulley to check for wear as well as determine the correct wire rope size. Includes 14 gauges in 1/4" to 1 1/2" wire rope diameters.

3181T51 ..... $28.21

Metal Pulleys for Wire Rope

These pulleys are also known as sheaves. Pulleys *with bearings* are easier to turn than pulleys without bearings.
Stainless steel is more corrosion resistant than iron and steel.

	For Rope Dia.	OD	Cap., lbs.	Pulley Dia. (A)	For Shaft Dia. (B)	Wd.		
For Horizontal Pulling								
Iron								
1	1/4"	3"	950	2 3/8"	3/8"	9/16"	3168T25	$31.91
1	3/8"	3"	1,250	2 1/4"	3/8"	13/16"	3168T26	37.89
1	1/2"	5"	3,000	3 7/8"	3/4"	1 1/16"	3168T43	64.74
Steel								
1	7/8"	5 7/8"	4,300	4 3/8"	1 1/2"	1 3/4"	3175T69	149.46
Steel with Bearings								
2	3/64"	1/2"	35	3/8"	1/8"	3/16"	3434T21	4.25
2	3/32"	1 1/16"	175	7/8"	3/16"	5/16"	3434T22	4.67
2	1/8"	1"	125	3/4"	3/16"	3/8"	3434T74	4.48
2	3/16"	1 1/4"	175	7/8"	1/4"	7/16"	3434T23	5.42
2	1/4"	1 3/4"	275	1 1/4"	3/8"	1/2"	3434T24	7.56
3	3/16"	1 1/4"	85	1"	5/32"	7/16"	3164T11	11.82
3	7/32"	2 3/4"	300	2 3/16"	5/8"	9/16"	3164T28	9.94
3	11/32"	2 3/4"	300	2 3/8"	3/8"	9/16"	3164T18	11.47
3	1 1/32"	3"	300	2 3/8"	3/8"	1 1/16"	3164T22	11.54
3	3/8"	2 7/8"	300	2 9/16"	1/4"	1/2"	3164T13	10.97
3	3/8"	3 1/16"	300	2 9/16"	3/8"	1/2"	3164T23	12.59
3	3/8"	4 1/16"	450	3 9/16"	3/8"	3/4"	3164T25	16.04
3	7/16"	3 3/8"	325	2 11/16"	3/8"	11/16"	3164T33	13.76
3	1/2"	3"	275	2 5/8"	5/16"	3/4"	3164T16	10.97
3	17/32"	2 7/8"	300	2 1/4"	1/2"	13/16"	3164T26	12.25
Stainless Steel								
4	1/8"	2 1/4"	1,000	1 7/8"	1/4"	13/16"	31695T21	31.43
4	3/16"	3 1/4"	1,500	2 3/4"	3/8"	15/16"	31695T23	59.97
4	1/4"	4 1/4"	3,000	3 1/2"	1/2"	1 1/8"	31695T25	96.62
4	5/16"	5 1/4"	5,000	4 3/8"	1/2"	1 3/8"	31695T27	156.02
4	3/8"	6 1/4"	8,000	5 1/4"	1/2"	1 5/8"	31695T29	178.62
Stainless Steel with Bearings								
4	1/8"	2 1/4"	1,000	1 7/8"	3/8"	13/16"	3628T11	42.18
4	3/16"	3 1/4"	1,200	2 3/4"	1/2"	15/16"	3628T22	75.62
4	1/4"	4 1/4"	1,200	3 1/2"	1/2"	1 1/16"	3628T23	87.18

	For Rope Dia.	OD	Cap., lbs.	Pulley Dia. (A)	For Shaft Dia. (B)	Wd.		
For Lifting								
Steel								
1	1/4"	4"	1,200	3 1/4"	1/2"	13/16"	3175T41	$62.14
1	1/4"	4"	1,200	3 1/4"	3/4"	13/16"	3175T42	60.31
1	5/16"	5"	1,800	4"	3/4"	1"	3175T45	83.31
1	3/8"	4"	1,600	3 1/8"	1/2"	13/16"	3175T43	60.14
1	3/8"	4"	1,700	3 1/8"	3/4"	13/16"	3175T44	62.26
1	3/8"	4 1/8"	1,600	3"	1"	1 1/2"	3175T46	78.17
1	3/8"	6"	2,700	4 15/16"	1 1/4"	1 1/8"	3175T49	110.74
1	3/8"	6"	2,800	5"	3/4"	1 1/16"	3175T47	108.63
1	3/8"	6"	2,800	5"	1"	1 1/16"	3175T48	107.77
1	3/8"	8"	3,600	6 1/2"	1 1/4"	1 3/8"	3175T61	176.60
1	1/2"	6"	3,200	4 7/8"	3/4"	1 1/16"	3175T62	107.97
1	1/2"	6"	3,600	4 7/8"	1"	1 1/16"	3175T63	108.89
1	1/2"	6"	3,600	4 15/16"	1 1/4"	1 1/8"	3175T64	110.83
1	1/2"	8"	4,800	6 5/8"	1"	1 3/8"	3175T65	174.94
1	5/8"	6"	3,200	5"	3/4"	1 1/16"	3175T66	108.03
1	5/8"	6"	4,200	5"	1"	1 1/16"	3175T67	108.94
1	5/8"	8"	6,000	6 5/8"	1 1/4"	1 3/8"	3175T68	176.80
5	1/8"	2 1/2"	675	2 1/4"	1/2"	1/2"	3434T78	7.46
5	3/16"	1 1/2"	525	1"	1/2"	1/2"	3434T116	3.76
5	3/16"	2"	600	1 1/2"	1/2"	1/2"	3434T117	5.04
5	1/4"	2 1/2"	675	2"	1/2"	1/2"	3434T118	7.95
5	1/4"	3"	800	2 1/2"	1/2"	1/2"	3434T119	10.15
5	5/16"	3 1/2"	1,550	3"	3/4"	11/16"	3434T121	14.50
5	3/8"	4"	1,700	3 1/4"	3/4"	11/16"	3434T79	18.67
5	3/8"	5"	1,850	4 1/4"	3/4"	11/16"	3434T81	30.08
5	3/4"	6"	6,000	5 3/16"	1"	1"	3164T82	36.46
Steel with Bearings								
6	1/8"	2 1/4"	1,000	2"	12 mm	13/16"	3183T18	115.82
6	1/4"	4 1/4"	3,500	3 3/4"	20 mm	13/16"	3183T11	169.27
6	3/8"	6"	7,000	5 5/16"	30 mm	1 1/2"	3183T12	210.00
6	1/2"	8"	10,500	7"	35 mm	1 11/16"	3183T13	287.64
6	5/8"	10"	16,000	8 3/4"	45 mm	2"	3183T14	444.50

Machinable Pulleys

Customize the groove and bore to fit your application. The center of the pulley has a pilot hole so you can drill a bore to match a specific shaft size. Made of nylon, pulleys are easy to machine yet resist impact and corrosion. They are for use with wire rope and rope. Capacity is not rated.

OD		1/4" Wd.	1/2" Wd.	3/4" Wd.	1" Wd.	1 1/2" Wd.	2" Wd.
1"	9453T11	$11.06	$11.71	$12.35	$12.95	$14.19	$15.47
1 1/2"	9453T12	11.06	11.71	12.35	12.95	14.19	15.47
2"	9453T13	11.06	11.71	12.35	12.95	14.19	15.47
3"	9453T14	18.55	19.62	20.65	22.75	24.89	27.01
4"	9453T15	20.54	22.94	23.97	27.39	30.86	34.28
6"	9453T16	27.71	31.61	35.52	43.29	51.08	58.85

Warning: Never use to lift people or items over people.

About Sling Configurations and Capacity

Slings can be used in different configurations depending on the type of load you are lifting. The charts below show how capacity is impacted by different sling configurations. For example, a one-leg sling that is used vertically with a rated capacity of 2,400 lbs. will have a reduced capacity of 1,900 lbs. when used as a choker and an increased capacity of 4,800 lbs. when used as a basket.

One-Leg Slings

Lowest Capacity → Highest Capacity

Choker

- Holds irregular or unbalanced loads securely
- Wraps around thin objects for lifting

Vertical

- Most common lift configuration
- Attaches to your load with a hook

Basket

- More stable, distributes the load evenly
- Strongest one-leg configuration

Multi-Leg Slings

Lowest Capacity → Highest Capacity

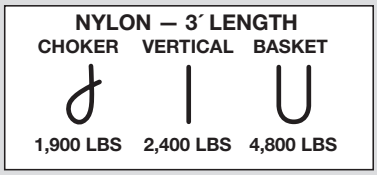
30° Angle

45° Angle

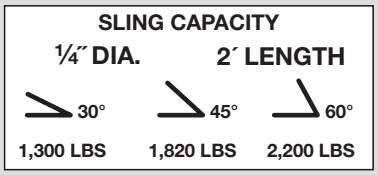
60° Angle

- Multi-leg slings provide more stability and control to the load being lifted than one-leg slings.
- The sling's lift angle affects rated lifting capacity. As the angle of the sling decreases, the sling capacity also decreases.
- 30° angle significantly reduces capacity, but can be used when you have limited vertical clearance. Slings should never be used at an angle less than 30°.

One-Leg Capacity Label—Slings are labeled with capacity in the choker, vertical, and basket configurations.



Multi-Leg Capacity Label—Slings are labeled with capacity at a 30°, 45°, and 60° angle.



Web Slings

Lightweight and flexible, web slings are less likely than other slings to mar, scratch, or dent fragile loads. They include a tag that shows the material, length, and capacities in each configuration. Maximum temperature is 180°F. Slings meet OSHA 1910.184 and ANSI specification B30.9.

Note: Web slings are susceptible to cuts and abrasion and should not be exposed to sharp edges. They have a red warning core that becomes visible when the sling is worn and should be removed from use.

Nylon slings stretch more than polyester, minimizing shock to the load. Choose nylon when greasy conditions exist.

Polyester slings have minimal stretch to provide more control over the load. They resist most acids and have blue thread sewn through the material to distinguish them from nylon.

Flat Eye

Also known as Type 3 slings, the eyes lie in a flat position for easy removal from beneath loads.

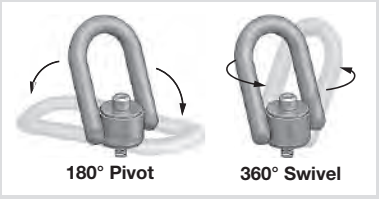
Capacity, lbs.												
Choker	Vertical	Basket	Eye Lg.	Choose a Material		3 ft.	4 ft.	5 ft.	6 ft.	8 ft.	10 ft.	Other Lgs., ft.
1″ Web Width												
950	1,200	2,400	8½″	Nylon, Polyester	9073T631	$10.46	$11.18	$11.90	$12.62	$14.06	$15.50	3 to 20
1,200	1,500	3,000	8½″	Nylon, Polyester	3403T429	13.25	14.18	15.11	16.04	17.90	19.76	3 to 20
1,900	2,400	4,800	8½″	Nylon, Polyester	9072T631	14.42	16.04	17.66	19.28	22.52	25.76	3 to 20
2,475	3,100	6,200	10″	Nylon, Polyester	3383T429	16.15	18.35	20.55	22.75	27.15	31.55	3 to 20
4,400	5,500	11,000	10″	Nylon, Polyester	9077T1	35.13	40.03	44.93	49.83	59.63	69.43	3 to 20
2″ Web Width												
1,900	2,400	4,800	10″	Nylon, Polyester	9073T632	____	13.75	15.17	16.60	19.44	22.28	4 to 20
2,475	3,100	6,200	10″	Nylon, Polyester	3403T431	18.06	19.58	21.10	22.62	25.66	28.70	3 to 20
3,800	4,800	9,600	10″	Nylon, Polyester	9072T632	19.55	22.50	25.45	28.40	34.30	40.20	3 to 20
4,950	6,200	12,400	10″	Nylon, Polyester	3383T431	20.10	23.51	26.92	30.33	37.15	43.97	3 to 20
8,800	11,000	22,000	10″	Nylon, Polyester	9077T2	46.94	55.10	63.26	71.42	87.74	104.06	3 to 20
3″ Web Width												
2,625	3,300	6,600	11″	Nylon, Polyester	9073T11	____	30.05	32.30	34.55	39.05	43.55	4 to 20
3,750	4,700	9,400	11″	Nylon, Polyester	3403T432	28.11	30.11	32.11	34.11	38.11	42.11	3 to 20
5,275	6,600	13,200	11″	Nylon, Polyester	9072T14	____	31.81	35.65	39.49	47.17	54.85	4 to 20
7,500	9,400	18,800	12″	Nylon, Polyester	3383T432	32.78	37.38	41.98	46.58	55.78	64.98	3 to 20
13,100	16,400	32,800	12″	Nylon, Polyester	9077T3	76.29	86.63	96.97	107.31	127.99	148.67	3 to 20
4″ Web Width												
4,950	6,200	12,400	12″	Nylon, Polyester	3403T433	39.16	42.06	44.96	47.86	53.66	59.46	3 to 20
6,900	8,600	17,200	12″	Nylon, Polyester	9072T15	____	42.65	47.95	53.25	63.85	74.45	4 to 20
10,000	12,500	25,000	12″	Nylon, Polyester	3383T433	42.43	48.63	54.83	61.03	73.43	85.83	3 to 20
16,300	20,400	40,800	12″	Nylon, Polyester	9077T4	93.03	106.75	120.47	134.19	161.63	189.07	3 to 20
6″ Web Width												
7,500	9,400	18,800	14″	Nylon, Polyester	3403T434	68.25	74.21	80.17	86.13	98.05	109.97	3 to 20
15,025	18,800	37,600	14″	Nylon, Polyester	3383T434	72.22	83.53	94.84	106.15	128.77	151.39	3 to 20
24,475	30,600	61,200	14″	Nylon, Polyester	9077T5	137.42	160.70	183.98	207.26	253.82	300.38	3 to 20

(Continued on following page)

About Lifting with Hoist Rings

Designed for angular lifting, hoist rings resist stresses that would bend or break an eyebolt. They have a lifting ring that pivots 180° front to back and a base that swivels 360° to compensate for pitch, roll, and sway when lifting heavy or unbalanced loads.

Safety Note: Hoist rings should never be used at an angle less than 30°. Install the base of the hoist ring flush to the mounting surface and tighten to the recommended torque that is stamped on the ring. For torque wrenches, see pages 2864-2868.



Hoist Rings—For Lifting


Forged


Machined

With a lifting ring that pivots 180° front to back and a base that swivels 360°, hoist rings resist stresses that would bend or break an eyebolt. All are made of black-oxide steel.

Machined hoist rings have a smooth finish to protect slings and hooks from damage and excess wear during lifting.

Note: Capacities listed are for vertical lifting only. As the lift angle changes from vertical, the amount of weight the hoist ring can lift is significantly reduced. For example, when lifting a 1,000 lb. load at a 45° angle, you must choose a hoist ring with a capacity of at least 1,400 lbs.

Thread Size	Thread Lg.	Inside Wd.	O'all Ht.	Vertical Cap., lbs.		
Inch Thread						
Forged						
1/4"-20	9/16"	1 1/4"	3 7/8"	550	2994T59	$55.19
5/16"-18	9/16"	1 1/4"	3 7/8"	800	2994T61	55.19
5/16"-18	1 1/16"	1 1/4"	4 3/8"	800	2994T62	55.19
3/8"-16	9/16"	1 1/4"	3 7/8"	1,000	2994T63	55.19
3/8"-16	1 1/16"	1 1/4"	4 3/8"	1,000	2994T64	55.19
1/2"-13	3/4"	2"	6 1/8"	2,500	2994T91	66.85
1/2"-13	3/4"	2"	7 5/8"	2,500	2994T42	74.38
1/2"-13	1"	2"	6 3/8"	2,500	2994T65	66.85
1/2"-13	1"	2"	7 7/8"	2,500	2994T92	74.38
1/2"-13	1 1/16"	1 1/4"	4 3/8"	2,250	2994T41	55.19
1/2"-13	1 1/4"	2"	6 5/8"	2,500	2994T66	66.85
1/2"-13	1 1/4"	2"	8 1/8"	2,500	2994T93	74.38
5/8"-11	3/4"	2"	6 1/8"	4,000	2994T94	66.85
5/8"-11	3/4"	2"	7 5/8"	4,000	2994T43	74.38
5/8"-11	1"	2"	6 3/8"	4,000	2994T67	66.85
5/8"-11	1"	2"	7 7/8"	4,000	2994T95	74.38
5/8"-11	1 1/4"	2"	6 5/8"	4,000	2994T68	66.85
5/8"-11	1 1/4"	2"	8 1/8"	4,000	2994T96	74.38
3/4"-10	1"	2"	6 3/8"	5,000	2994T69	69.44
3/4"-10	1"	2"	7 7/8"	5,000	2994T44	77.31
3/4"-10	1"	3"	8 3/8"	7,000	2994T445	151.17
3/4"-10	1"	3"	10"	7,000	2994T455	168.29
3/4"-10	1 1/4"	3"	8 5/8"	7,000	2994T72	151.17
3/4"-10	1 1/4"	3"	10 1/4"	7,000	2994T97	168.29
3/4"-10	1 1/2"	2"	6 7/8"	5,000	2994T71	69.44
3/4"-10	1 1/2"	2"	8 3/8"	5,000	2994T45	77.31
3/4"-10	1 1/2"	3"	8 7/8"	7,000	2994T73	151.17
7/8"-9	1"	3"	8 3/8"	8,000	2994T475	151.17
7/8"-9	1"	3"	10"	8,000	2994T485	168.29
7/8"-9	1 1/4"	3"	8 5/8"	8,000	2994T74	151.17
7/8"-9	1 1/4"	3"	10 1/4"	8,000	2994T98	168.29
1"-8	1 1/4"	3"	8 5/8"	10,000	2994T76	156.85
1"-8	1 1/4"	3"	10 1/4"	10,000	2994T85	174.62
1"-8	1 1/2"	3"	8 7/8"	10,000	2994T75	156.85
1"-8	1 1/2"	3"	10 1/2"	10,000	2994T99	174.62
1"-8	2 1/4"	3"	9 5/8"	10,000	2994T77	156.85
1"-8	2 1/4"	3"	11 1/4"	10,000	2994T78	174.62
1 1/4"-7	1 7/8"	4"	11 1/8"	15,000	2994T79	220.69
1 1/4"-7	2 5/8"	4"	11 7/8"	15,000	2994T81	238.31
1 3/8"-6	2 5/8"	4"	11 7/8"	20,000	2994T82	304.55
1 1/2"-6	2 5/8"	4"	11 7/8"	24,000	2994T83	274.55
2"-4 1/2	3"	4"	12 1/4"	30,000	2994T84	428.16
2"-8	3"	4"	12 1/4"	30,000	2994T495	428.16
Machined						
1/4"-20	9/16"	13/16"	3 1/4"	600	3052T103	59.57
5/16"-18	3/8"	13/16"	3"	800	3052T102	59.57
5/16"-18	9/16"	13/16"	3 1/4"	800	3052T55	83.04
3/8"-16	9/16"	13/16"	3 1/4"	1,000	3052T56	83.04
1/2"-13	3/4"	1 3/4"	5 5/8"	2,500	3052T58	102.83
1/2"-13	13/16"	1 3/4"	7 1/2"	2,500	3052T132	100.24
1/2"-13	1"	1 3/4"	5 7/8"	2,500	3052T72	102.83
1/2"-13	1 1/16"	1 3/4"	7 3/4"	2,500	3052T86	88.33
1/2"-13	1 5/16"	1 3/4"	6 1/8"	2,500	3052T122	97.00
5/8"-11	13/16"	1 3/4"	5 5/8"	4,000	3052T73	83.90

Thread Size	Thread Lg.	Inside Wd.	O'all Ht.	Vertical Cap., lbs.		
Inch Thread						
Machined (Cont.)						
5/8"-11	13/16"	1 3/4"	7 1/2"	4,000	3052T15	$88.35
5/8"-11	1 1/16"	1 3/4"	5 7/8"	4,000	3052T119	92.87
5/8"-11	1 1/16"	1 3/4"	7 3/4"	4,000	3052T89	88.33
5/8"-11	1 5/16"	1 3/4"	6 1/8"	4,000	3052T121	92.87
5/8"-11	1 5/16"	1 3/4"	8"	4,000	3052T91	88.33
3/4"-10	1 1/16"	1 3/4"	5 7/8"	5,000	3052T123	92.87
3/4"-10	1 1/16"	1 3/4"	7 3/4"	5,000	3052T92	88.33
3/4"-10	1 1/16"	2 3/4"	7 5/8"	7,000	3052T64	176.81
3/4"-10	1 5/16"	1 3/4"	6 1/8"	5,000	3052T124	92.87
3/4"-10	1 5/16"	1 3/4"	8"	5,000	3052T133	100.24
3/4"-10	1 9/16"	1 3/4"	6 3/8"	5,000	3052T125	92.87
3/4"-10	1 9/16"	1 3/4"	8 1/4"	5,000	3052T93	88.33
3/4"-10	1 9/16"	2 3/4"	8 1/8"	7,000	3052T126	209.53
3/4"-10	1 9/16"	2 3/4"	9 3/4"	7,000	3052T95	180.58
7/8"-9	1 1/16"	2 3/4"	7 5/8"	8,000	3052T65	180.20
1"-8	1 5/16"	2 3/4"	7 7/8"	10,000	3052T66	179.32
1"-8	1 5/16"	2 3/4"	9 1/2"	10,000	3052T97	180.58
1"-8	1 9/16"	2 3/4"	8 1/8"	10,000	3052T67	191.95
1"-8	1 9/16"	2 3/4"	9 3/4"	10,000	3052T98	180.58
1"-8	2 5/16"	2 3/4"	8 7/8"	10,000	3052T127	221.58
1"-8	2 5/16"	2 3/4"	10 1/2"	10,000	3052T101	180.58
1 1/8"-8	2 5/16"	2 3/4"	8 7/8"	10,000	3052T115	244.02
1 1/4"-7	1 15/16"	3 1/2"	10 5/8"	15,000	3052T68	289.92
1 1/4"-8	1 15/16"	3 1/2"	10 5/8"	15,000	3052T116	328.14
1 1/2"-6	2 3/4"	4 1/2"	15 1/4"	24,000	3052T74	474.13
1 1/2"-8	2 3/4"	4 1/2"	15 1/4"	24,000	3052T131	475.33
2"-4 1/2	3"	4 1/2"	15 1/2"	30,000	3052T69	512.92
2"-8	3"	4 1/2"	15 1/2"	30,000	3052T117	478.23
2 1/2"-4	4"	6"	20 7/8"	50,000	3052T75	1,336.64
2 1/2"-8	4"	6"	20 7/8"	50,000	3052T118	1,236.17
Metric Thread—Dimensions in millimeters						
Forged						
M8×1.25	16	33	98	875	3005T71	63.78
M8×1.25	21	33	103	875	3005T115	63.78
M10×1.5	16	33	98	975	3005T72	63.78
M10×1.5	26	33	108	975	3005T125	63.78
M12×1.75	25	50	160	2,300	3005T73	77.24
M12×1.75	25	50	200	2,300	3005T74	85.96
M12×1.75	32	50	167	2,300	3005T135	77.24
M12×1.75	32	50	207	2,300	3005T185	85.96
M14×2	25	50	161	3,300	3005T145	77.24
M14×2	25	50	200	3,300	3005T195	85.96
M14×2	32	50	168	3,300	3005T155	77.24
M14×2	32	50	207	3,300	3005T205	85.96
M16×2	25	50	160	4,175	3005T75	77.24
M16×2	25	50	200	4,175	3005T76	85.96
M16×2	32	50	167	4,175	3005T165	77.24
M16×2	32	50	207	4,175	3005T215	85.96
M20×2.5	25	50	160	4,850	3005T175	80.24
M20×2.5	25	50	200	4,850	3005T225	89.33
M20×2.5	28	71	216	6,600	3005T235	174.69
M20×2.5	28	71	257	6,600	3005T265	194.47
M20×2.5	38	50	173	4,850	3005T77	80.24
M20×2.5	38	50	213	4,850	3005T78	89.33

(Continued on following page)

Warning: Never use to lift people or items over people.

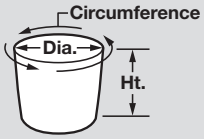
About Choosing the Proper Size Plastic Bags

Match the gallon capacity of your container to the gallon capacity listed in each bag presentation. If the exact capacity is not listed, choose a larger size. To determine the bag size for an unmarked container, calculate the bag circumference and height required (see below).

Round Containers

For bag circumference, multiply the container's diameter by 3.14.

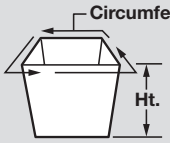
For bag height, take the container's height, add ½ of its diameter, and then add 2″ for overhang.



Square or Rectangular Containers

For bag circumference, add all four sides together.

For bag height, take the container's height, add ½ of its shortest width, and then add 2″ for overhang.



Multipurpose Plastic Bags

These bags are designed to resist tears and punctures by stretching around items with sharp edges. Twist ties are included.

Cap., gal.	Circum.	Ht.	Wd.	Bags: Pkg. Qty.	Bags: Black	Bags: Clear	Bags: Pkg.	Bags with Dispenser: Pkg. Qty.	Bags with Dispenser: Black	Bags with Dispenser: Clear	Bags with Dispenser: Pkg.
Medium Duty—0.8 to 1.2 mils											
4	34″	17″	17″	1,000	4166T161	4166T162	$45.64	250	4166T791	4166T792	$15.36
7	40″	22″	20″	1,000	4166T181	4166T182	76.45	250	4166T811	4166T812	24.68
8	42″	24″	21″	500	4166T191	4166T192	43.16	100	4166T821	4166T822	12.12
10	47″	27″	23½″	500	4166T221	4166T222	45.98	100	4166T202	4166T203	13.70
10	48″	24″	24″	500	4166T211	4166T212	48.26	100	4166T113	4166T114	16.94
11	46″	27″	23″	500	4166T304	4166T305	50.85	100	4166T841	4166T842	11.44
15	48″	32″	23″	500	4166T231	4166T232	60.44	100	4166T851	4166T852	14.53
16	44″	37″	22″	500	4166T241	4166T242	70.61	100	4166T861	4166T862	18.69
18	48″	40″	24″	500	4166T205	4166T206	103.10	100	4166T215	4166T12	21.58
20	59″	34″	29½″	300	4166T251	4166T252	61.83	100	4166T871	4166T872	28.11
22	49″	38″	24½″	200	4166T302	4166T303	36.72	100	4166T881	4166T882	21.39
23	54″	39″	27″	300	4166T311	4166T312	52.31	100	4166T891	4166T892	24.20
30	60″	40″	30″	200	4166T307	4166T216	45.29	100	4166T431	4166T13	26.43
32	68″	38″	34″	300	4166T361	4166T362	75.42	100	4166T911	4166T912	38.40
35	71″	45″	35½″	200	4166T218	4166T219	68.50	50	4166T554	4166T555	19.80
35	71½″	40″	35¾″	200	4166T391	4166T392	56.25	50	4166T225	4166T226	21.32
35	74″	43″	37″	200	4166T481	4166T482	63.17	50	4166T228	4166T229	23.66
40	78″	42½″	39″	200	4166T491	4166T492	65.25	50	4166T235	4166T236	24.70
55	72″	58″	36″	200	4166T545	4166T546	107.65	50	4166T548	4166T549	31.08
55	76″	60″	38″	100	4166T671	4166T672	40.11	50	4166T244	4166T245	28.23
56	88″	47″	44″	100	4166T591	4166T592	34.26	50	4166T238	4166T239	25.63
Heavy Duty—1.5 to 2 mils											
30	60″	37″	30″	250	4166T261	4166T262	65.25	50	4166T247	4166T248	19.05
33	66″	40″	33″	250	4166T381	4166T382	95.18	50	4166T582	4166T581	27.95
35	52″	48″	26″	100	4166T411	4166T412	34.90	50	4166T253	4166T254	21.46
35	81″	43″	40½″	200	4166T321	4166T322	85.78	50	4166T256	4166T257	29.86
40	84″	46″	42″	100	4166T454	4166T455	62.81	25	4166T265	4166T266	27.60
45	78″	48″	39″	100	4166T571	4166T572	59.92	30	4166T277	4166T278	26.77
45	80″	48″	40″	100	4166T461	4166T462	61.10	30	4166T259	4166T263	27.43
50	92″	50″	46″	100	4166T514	4166T515	60.70	50	4166T722	4166T721	36.30
55	72″	57″	36″	100	4166T268	4166T269	64.38	50	4166T561	4166T15	35.75
55	72″	58″	36″	100	4166T761	4166T762	66.74	30	4166T274	4166T275	29.82
56	85″	47″	42½″	100	4166T621	4166T622	65.28	30	4166T283	4166T284	28.56
56	85″	48″	42½″	100	4166T631	4166T632	67.20	30	4166T286	4166T287	29.12
56	88″	47″	44″	100	4166T611	4166T612	57.66	50	4166T732	4166T731	31.24
60	76″	60″	38″	100	4166T694	4166T695	84.72	30	4166T742	4166T741	27.74
65	108″	62″	54″	30	4166T771	4166T772	48.98	—	—	—	—
Extra-Heavy Duty—2.5 to 3 mils											
26	52″	43″	26″	100	4166T351	4166T352	51.17	25	4166T289	4166T293	19.98
30	60″	36″	30″	100	9387T121	9387T122	85.84	25	9387T111	9387T112	25.79
33	66″	39″	33″	100	9387T141	9387T142	101.66	25	9387T131	9387T132	30.13
35	81″	43″	40½″	100	4166T341	4166T342	94.03	25	4166T295	4166T296	29.53
45	80″	46″	40″	100	9387T161	9387T162	128.38	25	9387T151	9387T152	34.16
45	84″	46″	42″	100	4166T471	4166T472	104.44	25	4166T952	4166T951	30.40
55	72″	58″	36″	100	4166T781	4166T782	101.73	25	4166T972	4166T971	30.04
55	76″	60″	38″	50	4166T711	4166T712	60.06	20	4166T992	4166T991	28.67
56	85″	48″	42½″	100	4166T651	4166T652	113.58	20	4166T298	4166T299	27.98
56	88″	47″	44″	100	4166T661	4166T662	110.63	25	4166T982	4166T981	32.47
56	92″	50″	46″	100	4166T531	4166T532	122.38	25	4166T962	4166T961	36.18
65	116″	62″	58″	30	4166T941	4166T942	52.42	—	—	—	—
95	122″	66″	61″	30	4166T921	4166T922	59.40	—	—	—	—
95	126″	66″	63″	30	4166T931	4166T932	61.36	—	—	—	—

Choose-a-Color Plastic Bags

Identify contents by color with these tear-resistant bags. Twist ties are not included.

Cap., gal.	Circum.	Ht.	Wd.	Available Colors	Pkg. Qty.		Pkg.
Heavy Duty—1.5 to 2 mils							
18	48″	40″	24″	*Semi-Clear*: Blue, Green, Yellow; *Opaque*: Orange, Red, White	200	4038T22	$57.24
30	60″	40″	30″	*Semi-Clear*: Blue, Green, Yellow; *Opaque*: Orange, Red, White	100	4038T23	35.78
55	72″	57″	36″	*Semi-Clear*: Blue, Green, Yellow; *Opaque*: Orange, Red, White	50	4038T21	40.80
Extra-Heavy Duty—3 mils							
55	72″	57″	36″	*Semi-Clear*: Blue, Green, Yellow; *Opaque*: Orange, Red, White	50	4038T24	61.17

About Glove Sizing

To determine your glove size, wrap a tape measure around your palm. The number, in inches, corresponds to a unisex letter size as shown in the chart. Finger cot sizes are based on their respective glove size.

Size, inches	6	7	8	9	10	11	12
Size, letter	XS	S	M	L	XL	2XL	3XL

Glove length is measured from the tip of the middle finger to the end of the glove.

Thickness is measured in mils (1 mil = 0.001″). Thicker materials are more durable and will last longer; thinner materials offer better dexterity.

Inspect gloves prior to use for tears, cracks, pinholes, and deterioration.

Disposable Gloves

ⓘ For additional information about the chemical compatibility of these gloves, go to mcmaster.com and search by part number.

Disposable Gloves

Chemical-Resistant Nitrile, Chemical-Resistant Neoprene, and Sure-Grip Latex

General Purpose PVC

Quick-Change Polyethylene

These single-use gloves prevent cross contamination and provide the dexterity needed for intricate work. They are ambidextrous. All are made from FDA-compliant materials for food contact. Boxes of gloves fit dispensers sold on page 1839, unless noted.

Powder-free gloves are good for applications where particulate contamination is a concern. **Lightly powdered** gloves are easy to pull on and off.

Chemical-Resistant Nitrile—Protect your hands from incidental chemical contact such as spills and splashes. These gloves are also a good alternative for those concerned about latex allergies.

Chemical-Resistant Neoprene—These durable gloves resist tears and chemical spills and splashes better than any other disposable glove we offer.

Sure-Grip Latex (Natural Rubber)—Designed for jobs that require tactile precision, these gloves have a tacky grip.

General Purpose PVC—These economical gloves are good for applications that require a moderate amount of dexterity and durability.

Quick-Change Polyethylene—Commonly used in food preparation, these loose-fitting gloves quickly slip on and off.

Thick., mils	Lg.	Color	Surface	Choose a Size	Box Qty.		Box 1-5	Box 6-Up
Powder Free								
Chemical-Resistant Nitrile								
3.5	9″	Black	Textured	XS-2XL	100	52555T19	$17.22	$15.51
4	9″	Blue	Smooth	XS-2XL	50	52555T17	12.05	10.71
4	9″	Green	Textured	S-XL	20	52555T64	5.10	4.53
4.5	9″	Black	Textured	XS-2XL	100	52555T42	17.30	15.58
4.5	9″	Blue	Textured	XS-XL	100	52555T44	18.34	16.53
4.5	12″	Blue	Textured	S-2XL	50	52555T22	18.03	16.25
5	9″	Blue	Textured	S-XL	100	52555T1	14.35	12.80
5	9″	Green	Smooth	S-XL	100	52555T5	17.33	15.60
5.5	9″	White	Textured	S-XL	100	52555T15	19.90	17.75
5.5	12″	Blue	Textured	S-3XL	50	52555T43♦	14.64	13.18
6	11″	Black	Textured	S-XL	50	52555T62	13.36	12.34
6	11″	Blue	Smooth	S-XL	50	52555T2★	18.07	16.06
6	12″	Green	Textured	S-XL	50	52555T6	14.84	13.49
8	9″	Blue	Smooth	S-XL	10	52555T66	3.92	3.49
8	9″	Blue	Smooth	S-XL	50	52555T67	13.90	12.64
Chemical-Resistant Neoprene								
6.5	9″	Green	Textured	XS-XL	100	8552T5	17.01	15.70
Sure-Grip Latex								
4.5	9″	Black	Textured	XS-XL	100	6072T83	18.41	16.70
6	9″	Beige	Textured	S-L	100	6072T35	13.11	11.83
6	9″	Beige	Textured	XL	90	6072T34	13.11	11.83
7	12″	Beige	Textured	S-XL	50	6072T1	16.97	15.40
13	12″	Blue	Textured	S-XL	50	6072T94	17.43	15.53
General Purpose PVC								
3.5	9″	Clear	Smooth	S-XL	100	5599T51	12.62	11.65
5	9½″	Beige	Smooth	S-XL	150	5599T15▲	13.46	12.50
Quick-Change Polyethylene								
1	10½″	Clear	Textured	S-L	500	9737T27■	10.14	8.72
1	18″	Clear	Smooth	L	250	9737T59	49.58	45.46
Lightly Powdered								
Chemical-Resistant Nitrile								
4	9″	Blue	Smooth	S-XL	100	52555T3	16.22	14.59
4	9″	Blue	Smooth	S-2XL	20	52555T63	4.85	4.31
4	9″	Blue	Smooth	XS-XL	50	52555T16	11.36	10.10
5	9″	Green	Smooth	S-XL	100	52555T9	14.89	13.30
5	9½″	Blue	Textured	S-XL	100	52555T95	17.03	15.27
8	9″	Blue	Smooth	S-XL	10	52555T65	5.20	4.62
8	9″	Blue	Smooth	S-XL	50	52555T7	19.20	17.07
Sure-Grip Latex								
5	9″	Beige	Smooth	S-XL	100	6072T2	9.71	8.80
General Purpose PVC								
5	10″	Blue	Smooth	S-XL	100	5327T4	9.83	9.32
5	10″	White	Smooth	S-XL	100	5327T9	9.14	8.55
6.5	10″	Green	Smooth	S-XL	100	5327T6★	15.44	13.82

♦ 3XL gloves have a box quantity of 40.
▲ XL gloves have a box quantity of 130.
★ Order 52795T216 for a compatible clear plastic dispenser (10″ × 6⅜″ × 3¾″; holds one box).
■ Dispenser box is not available.

Cut-Resistant Gloves

For information about gloves and sizing, see page 1838.

About Cut-Resistant Gloves

Our cut-resistant gloves meet the ANSI/ISEA 105-2011 standard, which designates levels of cut resistance based on the force needed to cut through the material of the glove using a razor blade.

Cut Level	Common Applications	Downward Force of Blade
2	Packing boxes, assembling parts, and handling light material.	501 - 1,000 grams
3	Handling pallets and metal parts with burs.	1,001 - 1,500 grams
4	Working with sheet metal, glass, and other material with sharp edges.	1,501 - 3,500 grams
5	Using cutting blades and knives.	3,501 grams or greater

Cut-Resistant Gloves


Open Fingertip (Uncoated)


Dot Grip


Palm Coated


Fully Coated


Glove with Sleeve

Protect your hands from cuts and scratches. Gloves have a snug-fit cuff, except fully coated gloves have an open cuff.

Kevlar gloves absorb moisture. **Dyneema** gloves are thinner, more breathable, and more form fitting than Kevlar gloves.

Latex-coated gloves are water resistant. *Nitrile-coated* gloves are oil resistant and have better abrasion resistance than other coated gloves. *Polyurethane-coated* gloves offer good tactility for precision handling and delicate tasks. *PVC-coated* gloves provide a good grip in wet, dry, and oily conditions.

Glove Style	Coating Material	Lg.	Color	Choose a Size		Kevlar Pair 1-11	Kevlar Pair 12-Up	Dyneema Pair 1-11	Dyneema Pair 12-Up
Open-Fingertip Gloves									
Level 2 Cut Resistance									
Uncoated	___	9″	Yellow	S,L	6086T75	$6.29	$5.66	___	___
Dot Grip	PVC	9″	Yellow	S-L	6086T8	6.84	6.12	___	___
Level 3 Cut Resistance									
Dot Grip	PVC	9″	Yellow	S-L	6086T9	10.30	9.23	___	___
Full Gloves									
Level 2 Cut Resistance									
Uncoated	___	9½″	Yellow	S-L	6086T23	5.60	5.04	___	___
Dot Grip	PVC	9½″	Yellow	S-L	6086T34	6.35	5.69	___	___
Criss-Cross Grip	PVC	9½″	Yellow	S-L	6086T47	6.35	5.69	___	___
Palm Coated	Latex	10″	Yellow/Blue	S-XL	53545T24	11.50	10.46	___	___
Palm Coated	Nitrile	9½″	Yellow/Black	XS-XL	53545T27	8.07	7.58	___	___
Palm Coated	Polyurethane	9″	Blue	XS-2XL	9465T5	___	___	$11.42	$10.38
Palm Coated	Polyurethane	9″	Gray	XS-2XL	9465T4	___	___	13.30	11.79
Fully Coated	Nitrile	11″	Rust	L,XL	53545T25	12.52	11.75	___	___
Fully Coated	PVC	14″	Yellow/Black	M-2XL	9465T98	___	___	26.10	23.73
Level 3 Cut Resistance									
Uncoated	___	9½″	Yellow	S-L	6086T25	9.09	8.18	___	___
Uncoated—Low Lint	___	9½″	Yellow	S-L	56125T3	8.85	8.02	___	___
Dot Grip	PVC	9½″	Yellow	S-L	6086T36	10.33	9.25	___	___
Palm Coated	Polyurethane	9″	Gray/Black	XS-2XL	9465T6	___	___	13.52	12.29
Palm Coated	Polyurethane	10″	Gray/Black	S-2XL	9465T7	___	___	15.50	14.10
Fully Coated	Nitrile	11″	Black	M-XL	53545T23	11.56	10.85	___	___
Level 4 Cut Resistance									
Uncoated	___	9½″	Green	XS-2XL	6086T42	13.44	12.10	___	___
Dot Grip	PVC	9½″	Yellow	S-XL	6086T31	11.62	10.46	___	___
Leather Palm	___	9½″	Green	M-2XL	6086T33	21.78	19.60	___	___
Palm Coated	Latex	10″	White/Blue	S-XL	9465T12	___	___	17.62	16.02
Palm Coated	Nitrile	9½″	Yellow/Blue	XS-XL	53545T28	18.79	16.66	___	___
Palm Coated	Polyurethane	10″	White/Gray	XS-2XL	9465T8	___	___	18.03	16.38
Level 5 Cut Resistance									
Uncoated	___	9½″	Yellow	S-L	6086T95	10.07	9.06	___	___
Dot Grip	PVC	9½″	Yellow	S-L	6086T96	10.42	9.38	___	___
Palm Coated	Nitrile	9″	Gray	XS-2XL	9465T9	___	___	27.51	25.01
Gloves with Sleeve									
Level 2 Cut Resistance									
Uncoated	___	18″	Yellow	M,L	59495T18	17.09	15.67	___	___
Uncoated	___	22″	Yellow	M,L	59495T26	19.91	18.25	___	___

Cut-Resistant Clean Room Gloves

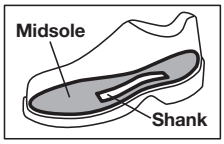
Handle sharp objects when contamination is a concern. These polyurethane-coated Dyneema gloves are lint free and packaged in a clean room containing fewer than 100 particles larger than 0.5 microns per cubic foot. They have a snug-fit cuff.

Cut-Resistance Level	Clean Room Class	Color	Lg.	Choose a Size		Pair
Level 2	100	Gray	9½″	XS-2XL	6223A11	$17.50

Footwear Size Conversion Chart

Men's Whole	5		6		7		8		9		10		11		12		13		14		15	
Men's Half	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15	15½
Women's	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15	15½	16	16½	17	17½

Work Shoes and Boots




General Purpose and Chemical-Resistant 6″ PVC


General Purpose 16″ PVC


Chemical-Resistant Premium PVC/ Polyurethane


Heat Resistant


Cold Resistant

Before you step into your work area, make sure you have the right footwear. These shoes and boots come in whole sizes, unless noted. Order your normal shoes size, except order one size up for Insulated Leather Boots.

Safety toe styles meet ASTM F2413-11. Toe is steel, except insulated leather has a composite safety toe. *Steel shanks* provide additional support for demanding work such as ladder climbing. *Composite midsoles* are similar in strength to steel but lighter in weight. *Steel midsoles* provide protection from punctures when working around glass, nails, and scrap metal.

General Purpose—The economical choice for keeping your feet dry in water and mud. *Rubber* is abrasion resistant. *PVC/Polyurethane* is more durable than PVC.

Chemical Resistant—*Premium PVC/Polyurethane* has better chemical resistance than PVC/polyurethane. *Neoprene rubber* holds up when exposed to petrochemicals, animal fats, and some acids.

Heat Resistant—Also known as firefighters' boots, these insulated rubber boots provide the heat protection and durability required by firefighters. The uppers are foam insulated. Boots meet OSHA 29 CFR 1910.136 and 1910.156. They are UL certified to NFPA 1971 standard for structural firefighting.

Cold Resistant—These insulated leather boots have waterproof rubber bottoms and multiple-layer insulation.

Ht.	Features	Color	Choose a Whole Shoe Size	Plain Toe	Pair	Safety Toe	Pair
General Purpose							
PVC							
6″	Steel Shank	Black	Men's 6-13			50615T42	$32.80
14″		White	Women's 5-10	5061T6	$26.22		
16″		Black	Men's 6-14	5311T5	18.10	5311T17	21.00
16″	Steel Shank	White	Men's 6-13	5311T7	27.00	5311T9	30.46
PVC/Polyurethane							
10″		Black	Women's 5-10			1468N2	43.46
Rubber							
16″	Steel Shank	Black	Men's 7-13			5266T3	60.00
Chemical Resistant							
PVC/Polyurethane							
6″	Steel Shank	Black	Men's 6-13			52865T1	36.56
15″	Steel Shank	Black	Men's 5-15	5547T3	30.76	5547T5	34.14
16″	Steel Midsole	Black	Men's 6-15			56085T3	68.38
Premium PVC/Polyurethane							
16″	Steel Shank	Brown	Men's 6-15	5454T1	60.67	5454T2	63.47
Neoprene Rubber							
12″		Brown	Men's 5-13	52325T2	110.00	52325T4	115.00
16″		Brown	Men's 5-13	52325T6	119.60	52325T8	120.00
Heat Resistant							
Insulated Rubber—Protects to 500° F							
15″	Steel Shank	Black	Men's 5-15★			9133T7	230.77
Cold Resistant							
Insulated Leather—Protects to -148° F							
13″	Composite Midsole	Black	Men's 7-15			1740T11	242.16

★ Available in 1/2 sizes.

Waders

Keep dry when you're in deep water, mud, and sludge. All waders fit over socks. Lengths are approximate and measured from the bottom of the heel to the top of the wader. *Steel toe* style meets ASTM F2413-11 for impact and compression. *Steel shank* provides additional support for demanding work such as extensive ladder climbing. *Steel midsole* provides extra protection when working around glass, nails, and scrap metal. Meets ASTM F2413-11 and CSA Z195-09, Grade 1 for puncture resistance.

Hip Waders—Provide protection to mid-thigh. All have adjustable straps with snaps that loop through your belt for a secure fit.

Chest Waders—All have adjustable suspenders. *General purpose rubber* waders have insulated boots. *Insulated neoprene* waders have insulation throughout. Knees and seat are reinforced.

Material	Toe	Features	Color	Seam Lg. Inner	Seam Lg. Outer	Choose a Whole Shoe Size		Pair
Hip Waders								
General Purpose Rubber	Steel	Steel Shank	Black	30″	36″	Men's 7-14	5268T64	$105.00
Oil-Resistant PVC	Plain		Black	32″	35″	Men's 7-13	51955T11	91.68
Oil-Resistant PVC	Steel		Black	32″	35″	Men's 7-13	51955T22	95.08
Oil-Resistant PVC	Steel	Steel Midsole	Black	32″	35″	Men's 8-13	51955T44	128.24
Chest Waders								
General Purpose Rubber	Steel	Steel Midsole	Dk. Green	31″	52″	Men's 6-14	5268T81	170.00
Oil-Resistant PVC	Plain	Steel Shank	Black	32″	57″	Men's 7-13	51955T33	150.60
Oil-Resistant PVC	Steel	Steel Midsole	Black	32″	57″	Men's 8-13	51955T55	188.20
Insulated Neoprene	Plain		Brown	32″	49″	Men's 7-13	56035T7	178.01
Replacement Nylon Adjustable Suspenders (Brown) for Rubber Chest Waders							5268T62	20.00
PVC and Rubber Repair Kit							5268T32	14.00


Hip Waders

Sizing Guidelines for Rainwear

The chart below is a general guideline for sizing. Proper fit varies with individual body shape and underclothing.

	XS	S	M	L	XL	2XL	3XL	4XL	5XL	6XL
Chest	34″-35″	36″-38″	39″-41″	42″-44″	45″-47″	48″-49″	50″-51″	52″-54″	55″-57″	58″-60″
Waist	28″-29″	30″-32″	33″-35″	36″-38″	39″-41″	42″-43″	44″-45″	46″-47″	48″-50″	51″-53″

Rainwear

Disposable | **Standard** | **Flame Resistant**

Disposable

Good for single-use applications, these lightweight PVC garments are the economical choice for working in wet environments. *Jackets* have a snap front and snaps on the collar for the detachable hood. *Pants* have an elastic waist and snaps on the ankles. *Bib overalls* have adjustable elastic suspenders and snaps on the ankles.

	Choose a Color	Choose a Size		
Hooded Poncho	Clear, Orange, Yellow	One Size	52115T1	$4.60
Suit—Jacket, Detachable Hood, and Pants	Yellow	M-2XL	5380T2	8.35
Suit—Jacket, Detachable Hood, and Bib Overalls	Yellow	M-2XL	5380T3	12.07

Standard

These sturdy garments resist tears and mildew for long-term use. They're also washable. *Hooded poncho* has snaps on each side. *Pants* have an elastic waist and snaps on the ankles. *Bib overalls* have adjustable elastic suspenders and an inner chest pocket with a zipper. *Jacket* has a snap front and wrists, plus collar snaps for the detachable hood. *Hooded jacket* has two front pockets and a snap front with a storm flap. *Hooded coat* has two front pockets and a two-way zipper front with a storm flap.

Breathable Gore-Tex/nylon clothing is lightweight and allows perspiration to evaporate.

	General Purpose PVC-Coated Polyester				Breathable Gore-Tex/Nylon			
	Choose a Color	Choose a Size			Choose a Color	Choose a Size		
Garments								
Hooded Poncho	Yellow	One Size	53535T6	$13.12				
Pants	Green, Yellow	S-4XL	53535T62	35.00	Blue, Yellow	S-2XL	11975T33	$292.76
Bib Overalls	Green, Yellow	XS-6XL	53535T63	44.00				
Jacket					Blue, Yellow	S-2XL	11975T21	304.51
Detachable Hood					Blue, Yellow	One Size	11975T65	81.30
Hooded Jacket	Green, Yellow	XS-6XL	53535T61	44.00				
Hooded Coat	Green, Yellow	S-4XL	53535T64	75.00				
Hat	Yellow	M-XL	53535T65	24.00				
Suits								
Hooded Jacket and Pants	Green, Yellow	S-4XL	53535T67	72.41				
Hooded Jacket and Bib Overalls	Green, Yellow	XS-4XL	53535T66	81.03				
Jacket, Detachable Hood, and Pants					Blue, Yellow	S-2XL	11975T82	648.17

Flame Resistant

In addition to being waterproof, these garments also stand up to oil and flames. They are mildew resistant and washable and meet ASTM D6413 for flame resistance. *Bib overalls* have adjustable elastic suspenders. *Jacket* and *coat* have a snap front with a storm flap, plus collar snaps for the detachable hood. *Hooded jacket* has a snap front with double storm flaps. *Hooded coveralls* have a snap front.

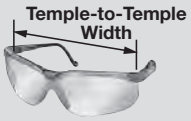
Chemical-resistant PVC-coated polyester clothing protects against incidental contact with acids, chemicals, and solvents. It meets ASTM F903 for resistance to penetration by liquids.

	Chemical-Resistant PVC-Coated Polyester				Heavy Duty PVC-Coated Polyester			
	Color	Choose a Size			Color	Choose a Size		
Garments								
Bib Overalls	Green	S-2XL	5892T2	$28.62	Orange	S-4XL	5393T64	$60.00
Jacket	Green	S-2XL	5892T1	31.83				
Hooded Jacket	Green	S-2XL	5892T7	36.03	Orange	S-4XL	5393T62	60.00
Coat	Green	S-2XL	5892T9	50.57				
Hooded Coveralls	Green	S-2XL	5892T8	77.18				
Detachable Hood	Green	One Size	5892T19	5.03				
Suits								
Hooded Jacket and Bib Overalls	Green	S-2XL	5892T5	64.65	Orange	S-4XL	5393T66	117.24
Jacket and Bib Overalls	Green	S-2XL	5892T3	60.45				

About Safety Glasses

The following applies to all of our safety glasses, unless noted:

- Meet ANSI Z87.1-2003 high-impact standards
- Provide 99% or greater UV protection
- Lenses are polycarbonate



Wraparound Safety Glasses

Semi-mirrored lenses are clear with a slight mirror coating for varying light conditions.
Mirrored lenses reflect the most sunlight.

Regular Lenses

- Scratch-resistant lenses
- Adjustable arm length
- 5½″ temple-to-temple width
- Polycarbonate/ABS frame; nylon arms

Lens Color/Finish	Glasses: Black Frame	Glasses: Blue Frame		Repl. Lenses	
Clear	9741T411	9741T412	$7.84	9741T51	$5.20
Clear/Semi-Mirrored	9741T61		9.75		
Clear/Mirrored	9741T431	9741T432	11.91	9741T53	8.73
Brown	9741T421	9741T422	8.38	9741T52	5.98

Oversized Lenses

- Scratch-resistant lenses
- Adjustable arm length
- 5¼″ temple-to-temple width
- Nylon frame and arms

Lens Color/Finish	Frame Color		
Clear	Black	2404T21	$7.90
Clear/Fog Free	Black	2404T31	8.70
Clear/Semi-Mirrored	Black	2404T61	10.60
Clear/Mirrored	Black	2404T41	10.60

Wraparound Safety Glasses with Interchangeable Lenses

- Scratch-resistant lenses
- Adjustable arm length
- 5¼″ temple-to-temple width
- Polyurethane frame; nylon arms

Switch out lenses to change the look of your glasses. Lenses are interchangeable. The adjustable tilt at the hinges allows you to angle the glasses toward or away from the cheeks for a comfortable fit.

Lens Color/Finish	Frame Color	Glasses		Repl. Lenses	
Clear	Black	1696T63	$8.25		
Clear/Fog Free	Black	1696T64	9.02	1696T78	$5.56

Comfort-Fit Wraparound Safety Glasses

- Scratch-resistant lenses
- Adjustable arm length
- Temple-to-temple width: 5⅛″ for regular lenses; 5¼″ for oversized lenses
- Polycarbonate frame; nylon arms

A padded frame makes these glasses the ultimate in comfort. They are ventilated to increase airflow and reduce moisture buildup. The adjustable tilt at the hinges allows you to angle the glasses toward or away from the cheeks for a comfortable fit.

Semi-mirrored lenses are clear with a slight mirror coating for varying light conditions.

Mirrored lenses reflect the most sunlight.

Lens Color/Finish	Glasses: Black Frame	Glasses: Blue Frame		Repl. Lenses	
Regular Lenses					
Clear	9210T101	9210T103	$9.62	9210T71	$4.53
Clear/Fog Free	9210T601	9210T603	10.90	9210T76	5.51
Clear/Semi-Mirrored	9210T501	9210T503	11.60	9210T75	6.96
Clear/Mirrored	9210T401	9210T403	11.60	9210T74	6.96
Amber	9210T201	9210T203	10.60	9210T72	5.63
Brown	9210T301	9210T303	10.60	9210T73	5.63
Oversized Lenses					
Clear	3637T17		10.38	3637T44	5.21
Clear/Fog Free	3637T22		11.67	3637T46	6.40
Clear/Semi-Mirrored	3637T67		12.28	3637T68	7.58
Clear/Mirrored	3637T33		12.28	3637T64	7.58
Amber	3637T28		11.33	3637T52	6.30
Gray	3637T31		11.33	3637T57	6.30


Regular


Oversized

Wraparound Safety Glasses with Metal Frame

- Scratch-resistant lenses
- 5½″ temple-to-temple width
- Nickel alloy frame and arms

The metal frame provides durability while the padded nosepiece and rubber arm tips ensure these are comfortable to wear.

Semi-mirrored lenses are clear with a slight mirror coating for varying light conditions.

Lens Color/Finish		
Clear	5734T13	$9.93
Clear/Semi-Mirrored	5734T17	11.97
Gray	5734T15	10.94

Economy Wraparound Safety Glasses

- Scratch-resistant lenses
- 5¼″ temple-to-temple width
- Polycarbonate frame; nylon arms

Lens Color	Frame Color		
Clear	Clear	7475T42	$3.49
Brown	Clear	7475T72	3.83

Hard Hats with Face Shield and Earmuffs

These hard hats give all-in-one head, face, and ear protection. Face shield has an 8″ Ht. × 15½″ Wd. × 0.040″ Thick. clear polycarbonate lens that meets ANSI Z87.1-1989. Hard hat is cap style and made of orange ABS plastic. Hard hats are Type 1, Class E, meaning they protect against blows to the top of the head only and are proof-tested at 20,000 volts. They meet ANSI Z89.1-1997. All have a ratchet suspension that adjusts with an easy-turn knob to fit head sizes 6 to 9. Earmuffs have a noise reduction rating (NRR) of 22 dB and meet ANSI S3.19-1974. Lift the face shield and earmuffs when not in use.

Optional steel wire mesh lens is 6¾″ Ht. × 12″ Wd. and meets ANSI Z87.1-1989.

Hard Hat with Face Shield and Earmuffs	5191T61	$45.00
Optional Steel Wire Mesh Lens	5191T63	8.26
Replacement Polycarbonate Lens	5191T62	4.29
Replacement Face Shield Bracket	5191T77	8.43
Replacement Earmuffs	5191T75	24.14

Air-Circulating Face Shields

A built-in, low-noise fan creates a constant flow of filtered air across your face for protection from wood dust particles. Meets ANSI Z87.1-2010 high-impact standards. Face shield has a 7″ Ht. × 12″ Wd. × 0.04″ Thick. clear polycarbonate lens and a ratchet adjustment with an easy-turn knob to fit head sizes 6⅜ to 7¾. It includes a lens cover, filter, rechargeable battery, 120V AC charger, and a carrying case.

		Each
Face Shield	7049T2	$470.21
Replacement Parts		
Lens	7049T42	34.21
Rechargeable Battery	7049T5	81.08
		Pkg.
Filters (2/Pkg.)	7049T43	$61.42
Lens Covers (10/Pkg.)	7049T41	38.68

Disposable Face Shields

Use these for light duty applications that don't require much impact resistance. Face shields have a clear acetate lens, stretch-to-fit rubber headband, and padded frame for comfort.

Note: Shields do not meet ANSI Z87.1-2003.

Lens Ht.	Wd.	Thick.		
7½″	12″	0.005″	56955T21	$4.71
9½″	11¾″	0.005″	56955T34	5.12

About Selecting Welding Shades

The guidelines below are for common welding applications and are based on American National Standards Institute/Accredited Standards Committee (ANSI/ASC) Z49.1-2005.

Arc Current, amps	Minimum Shade No.	Suggested Shade No.
Shielded Metal Arc Welding		
60 to 160	8	10
160 to 250	10	12
Gas Metal Arc Welding (MIG)		
60 to 160	10	11
160 to 250	10	12
Gas Tungsten Arc Welding (TIG)		
Less than 150	8	12
150 to 500	10	14
Torch Brazing		
____	___	3 to 4

Arc Current, amps	Minimum Shade No.	Suggested Shade No.
Air Carbon Arc Cutting		
Less than 500	10	12
Plasma Arc Welding		
Less than 20	6	6 to 8
20-100	8	10
100-400	10	12
Plasma Arc Cutting		
Less than 300	8	9
300 to 400	9	12

Plate Thickness	Minimum Shade No.	Suggested Shade No.
Gas Welding		
Less than ⅛″	___	4 to 5
⅛″ to ½″	___	5 to 6
Greater than ½″	___	6 to 8
Oxygen Cutting		
Less than 1″	___	3 to 4
1″ to 6″	___	4 to 5
Greater than 6″	___	5 to 6

Welding Glasses

Protect your eyes during welding jobs. These glasses have green polycarbonate lenses and a brow guard for added protection. Meet ANSI Z87.1-2003 high-impact standards.

Comfort-fit wraparound glasses have a padded frame and nosepiece for added comfort. Frame and arms are black polycarbonate. Arm length is adjustable.

Panoramic and **eyeglass-fit panoramic** glasses have a black nylon frame and arms. Arm length is adjustable. *Eyeglass-fit* can be worn over your prescription eyeglasses.

Magnifying glasses have magnifiers at the bottom of the lenses, a black nylon frame and arms, and a padded nosepiece for comfort. For information about magnification, see page 2366.

Shade No.	Temple-to-Temple Wd.	Glasses		Repl. Lenses	
Standard					
Comfort-Fit Wraparound					
3	5½″	5803T12	$15.47	5803T22	$9.58
5	5½″	5803T13	16.78	5803T23	10.89
Comfort-Fit Wraparound—Oversized lenses					
3	5¼″	5803T31	15.25	5803T41	10.69
5	5¼″	5803T32	16.45	5803T42	12.07
Panoramic					
3	5⅜″	9313T4	14.51	____	___
5	5⅜″	9313T5	15.89	____	___
Eyeglass-Fit Panoramic					
3	6″	47515T24	16.69	____	___
5	6″	47515T25	18.09	____	___
Magnifying					
1.38X (138%) Magnification					
5	5½″	5783T1	24.67	____	___
1.5X (150%) Magnification					
5	5½″	5783T2	24.67	____	___
1.63X (163%) Magnification					
5	5½″	5783T3	24.67	____	___

Comfort-Fit Wraparound

Panoramic

Eyeglass-Fit Panoramic

Magnifying

About Hearing Protection

Earmuffs and earplugs are rated by the Noise Reduction Rating (NRR) guidelines, which are enforced by OSHA. The NRR of a hearing protector indicates its noise reduction capabilities measured in decibels (dB). The higher the NRR, the greater the noise reduction capability. The protectors on this and the previous page are tested in accordance with ANSI S3.19-1974.

For sound level meters, see page 1898.
For more information about decibel levels, see page 1910.

Caution: Prolonged exposure at or above 85 dB requires the use of hearing protection. The actual amount of protection depends on proper size and fit, the position in which the protector is worn, as well as your specific work environment.

Choosing a Hearing Protector

OSHA recommends that you choose a hearing protector with an NRR value that is two times the difference between your existing and desired noise level.

For example, if your noise level is 93 dB and you want your exposure to be no higher than 80 dB, the difference is 13 dB. You should choose a protector with an NRR of 26 dB or higher.

Hard-Hat Mount Earmuffs

Snap these earmuffs on and off your slotted hard hat. Earmuffs should be worn over the head to offer proper protection and noise reduction. They have plastic ear cups, spring-wire arms, and foam ear cushions. Hard hat sold separately.

Polyethylene hard hat with slots has a six-point ratchet suspension. **To Order:** Please specify hard hat color: blue, green, high-visibility orange, orange, red, white, or yellow. For more hard hats, see page 1890.

NRR, dB	Ear Cup Color	Earmuffs	Pair	Repl. Cushions	Pair
23	Yellow	55095T13	$21.58	9205T12	$13.84
27	Black	55095T7	27.38	9206T9	16.40
Polyethylene Hard Hat with Slots (Type 1, Class E)				52645T27	15.89

Earplugs

These soft, pliable earplugs provide comfortable hearing protection. Choose from separate (unattached) pairs and corded (connected with a plastic cord, unless noted) pairs that can be worn around your neck when not in use.

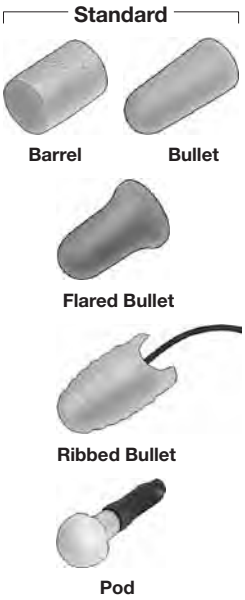
Standard—All are made of foam.

Roll-up plugs roll for insertion into your ear and then expand to conform to the shape of your ear canal. *Ribbed bullet* plugs provide added grip that keeps plugs from backing out of your ear.

No-roll plugs slide right into your ear. *Pod* plugs have a flexible plastic grip that makes them easy to insert and remove without touching the actual plug.

Comfort-Fit—These washable plugs are made of soft plastic.

Metal-detector-grade earplugs have an enclosed ball bearing that can be sensed by metal detectors. Good for food preparation areas.



Standard

	NRR, dB	Color	Separate Pairs/ Pkg.		Separate Pkg.	Corded Pairs/ Pkg.		Corded Pkg.
Roll Up								
Barrel	29	Yellow	25	54315T18	$7.63	25	54315T27	$13.47
Barrel	29	Yellow	200	54315T11	35.61	200	54315T14	71.77
Barrel	31	Yellow	200	2975T36	50.46	200	2975T38	95.09
Bullet	33	Green	25	6207T53	8.54	25	6207T58	13.68
Bullet	33	Green	200	6207T57	37.65	100	6207T59	36.58
Flared Bullet	33	Orange	200	54725T32	33.21	100	54725T34	31.42
Ribbed Bullet	31	Yellow	—	—	—	200	3675T46	110.42
No Roll								
Barrel	29	Orange	200	8074T3	32.78	100	8074T5	26.00
Pod	28	Yellow	100	53965T3	40.65	100	53965T6	64.93

Comfort Fit

	NRR, dB	Color	Size	Separate Pair		Corded Pair	
3-Ribbed Cone	25	Yellow	M	56135T2	$1.54	56135T3	$1.85
3-Ribbed Cone	27	Purple	M	56135T6	1.52	56135T7	2.13
Metal-Detector-Grade 3-Ribbed Cone	27	Blue	M	—	—	56135T8	2.55
4-Ribbed Cone	27	Green	S	—	—	56105T61★	1.40
4-Ribbed Cone	27	Blue	M	54875T6	.97	54875T7	1.30
4-Ribbed Cone	27	Blue	M	—	—	56105T62★	1.40

★Cord is detachable.

Earplugs with Headband

More rigid than a cord, the headband on these foam earplugs can be worn under the chin or behind the head. They form a seal over the entrance to your ear canal but don't rest inside so they're a good choice for frequent on/off use. All earplugs have a flexible plastic band and should be worn in the position or positions that have a Noise Reduction Rating (NRR) listed.

Pod and **flared cone** earplugs include one pair of replacement plugs.

	NRR, dB Behind Head	NRR, dB Under Chin	Color	Earplugs	Pair	Replacement Plugs Pairs/ Pkg.	Replacement Plugs Pkg.
Cone	17	20	Yellow	54975T1	$8.53	5	54975T2 $40.21
Ball	—	17	Yellow	55245T8	5.60	5	55245T9 15.52
Pod	—	23	Orange	55085T3	5.19	1	55085T5 2.82
Flared Cone	—	25	Orange	53895T8	5.19	1	53895T9 2.82

About Mirror Materials

Glass mirrors are economical and easy to clean.

Plastic-coated glass mirrors are laminated to keep shards from falling out of the frame if the glass breaks.

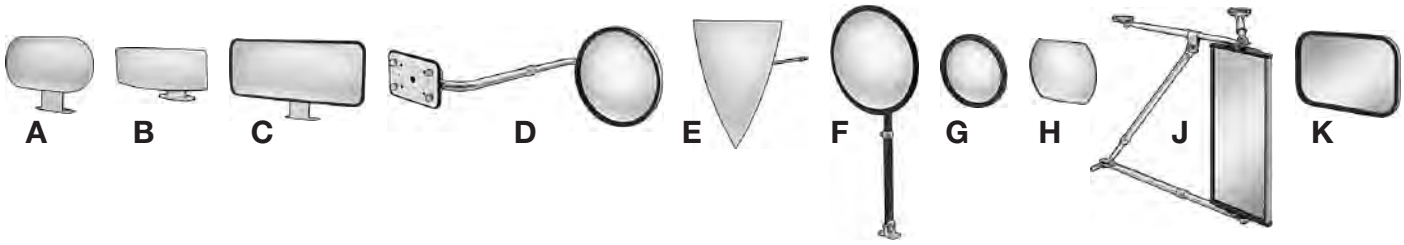
Tempered glass mirrors are more impact resistant than plastic-coated glass mirrors, but are heavier. If broken, they shatter into small pebbles rather than sharp shards.

Acrylic mirrors are lightweight and more impact resistant than glass mirrors, but may scratch. If broken, the mirror will split into a few large pieces rather than small, sharp shards.

Steel and **zinc** mirrors will not break, shatter, or crack. They are chrome plated for corrosion resistance.

Stainless steel mirrors are stronger and more corrosion resistant than steel and zinc mirrors.

Safety Mirrors



Convex mirrors provide a wide field of view for seeing around corners, down aisles, and over counters. **Flat** mirrors show objects to scale. All are suitable for outdoor use.

Styles A and *C* have two 1/4″ dia. mounting holes; *Style B* has four 3/16″ dia. mounting holes. Fasteners not included.

Style D includes mounting fasteners.

Style E mounts through a drilled hole and is secured with the included fasteners.

Style F includes mounting fasteners.

Style G includes a threaded ball stud and mounting fasteners, except 9208T46 has an adhesive back for surface mounting.

Style H has an adhesive back for surface mounting.

Style J is also known as a West Coast mirror. Mounting fasteners are included.

Style K has a 3/8″ threaded ball stud for use with the mounting brackets sold separately on this page.

		Mirror	Backing		
Convex					
A	3″×7″ with Tilting Arm	Chrome-Plated Zinc	Chrome-Plated Zinc	9186T22	$30.18
B	3″×7″ with Tilting Arm	Chrome-Plated Steel	Chrome-Plated Steel	9186T12	79.00
C	4″×12″ with Tilting Arm	Glass	Plastic	9186T35	38.09
D	8″ Dia. with 14″ Fixed Arm	Glass	Chrome-Plated Steel	9208T42	78.22
E	10″×10″ with 8″ Fixed Arm	304 Stainless Steel	304 Stainless Steel	9179T2	66.39
F	8″ Dia. with 15″ to 21″ Telescoping Arm	Glass	Enamel-Coated Steel	6089T1	22.58
F	8″ Dia. with 15″ to 21″ Telescoping Arm	Acrylic	Enamel-Coated Steel	6089T5	23.40
G	4″ Dia. with Fixed Arm	Glass	Foam	9208T46	2.45
G	5″ Dia. with Swivel Arm	Glass	Powder-Coated Steel	9208T22	10.82
G	6″ Dia. with Swivel Arm	Glass	Powder-Coated Steel	9208T24	11.85
H	4″×6″ with Fixed Arm	Glass	Foam	9208T53	4.58
Flat					
J	16″×6″ with 15″ to 22″ Telescoping Arm	Glass	Aluminum	6074T1	74.93
K	6″×9″ with Swivel Arm	Glass	Powder-Coated Steel	9208T13	12.60
K	6″×9″ with Swivel Arm	Glass	Chrome-Plated Steel	9208T15	15.55
K	8″×11″ with Swivel Arm	Glass	Powder-Coated Steel	9208T36	18.80
K	8″×11″ with Swivel Arm	Glass	Chrome-Plated Steel	9208T38	19.22
Replacement Mirror for Style J				6074T5	15.78

Mounting Brackets for Safety Mirrors

Attach your mirror to one of these brackets for mounting versatility indoors and out. Brackets are black powder-coated steel, except Style D has a chrome-plated finish.

Style A clamps onto a rod or tubing that's up to 3/4″ in diameter.

		Bracket Hole Dia.	Fits Mirror Stud Size		
A	Fixed Arm Clamp Mount	—	3/8″	6051T21	$5.60
B	Fixed Arm Screw Mount	1/4″	3/8″	6051T22	10.75
C	Telescoping Arm, 9″ to 15″	1/4″	5/16″	6051T23	24.43
D	Telescoping Arm, 14″ to 20″	5/16″	5/16″	6051T27	11.95
E	Tripod Telescoping Arm, 22″ to 28″	1/4″	3/8″	6051T24	39.24

Portable Convex Safety Mirrors

Position these mirrors wherever you need a wide field of view for improved safety and surveillance. **Styles A** and **C** have a flexible arm. **Style A** clip has a max. opening of 2 3/4″. **Style D** is suitable for outdoor use.

	Size	Mirror	Backing	Mounting Arm Lg.		
Clamp Base						
A	7″ Dia.	Acrylic	Plastic	—	66725T4	$32.50
Magnetic Base						
B	4″ Dia.	Glass	Aluminum	—	2511T3	44.86
B	6″ Dia.	Glass	Steel	—	2511T5	51.62
B	8″ Dia.	Glass	Steel	—	2511T4	57.50
B	12″ Dia.	Acrylic	Hardboard	—	2511T6	63.50
B	18″ Dia.	Acrylic	Hardboard	—	2511T7	75.75
C	7″ Dia.	Acrylic	Plastic	—	66725T6	46.67
D	6″×9″	Glass	Chrome-Plated Steel	—	2511T8	60.14
Freestanding Iron Base with Telescoping Arm						
E	18″ Dia.	Acrylic	Hardboard	37″ to 57″	10825T14	186.05
E	26″ Dia.	Acrylic	Hardboard	41″ to 61″	10825T22	220.93

Flashing Lights

About Relative Visibility of Signal Lights

Signal light visibility depends on a combination of light pattern and candlepower. When choosing a light pattern, think about where the light will be placed and how much attention you want it to draw.

Flashing—Commonly found on loading docks and railroad crossings, these lights are often used to notify workers of hazardous areas.

Revolving—More visible than flashing lights, these rotating lights are commonly found on hazards with moving parts, such as access gates.

Strobe—Intense bursts of light that reflect off surrounding objects make strobes the most visible. They're often used to call attention to hazards in motion, such as forklifts.

Candlepower (cp) indicates how bright a light appears at a distance. Common examples include a car's taillights (50 cp), traffic signals (600 cp), headlights (15,000 cp), high beams (50,000 cp), and police car searchlights (150,000 cp).

Surface-Mount Flashing Lights

Incandescent

Vibration Resistant

High Visibility and Long Life

The light pattern draws more attention to machine issues and work hazards than a continuous light. All lights meet NEMA 4X for outdoor use and washdown environments. Lenses are plastic.

Incandescent—*Surface-mount* lights include mounting fasteners. 12V DC light has one 80″ wire lead. 24V and 36V DC lights have two 80″ wire leads. *Magnetic-mount with vehicle plug* light has a 15-ft. cord with a 12-volt vehicle plug. *Vibration-resistant surface mount* lights have a pad below the base to absorb shock and vibration. They come with mounting fasteners and have two 30″ wire leads.

High Visibility Halogen—Lights have a 3/4 NPT male connection for pipe mounting and include fasteners for surface mounting. They have 18″ wire leads.

Long-Life LED—These lights provide years of maintenance-free operation. *Surface-mount* light includes fasteners and has two 15″ wire leads. UL listed. *Pipe mount/surface mount* lights have a 3/4 NPT male connection for pipe mounting and include fasteners for surface mounting. They have two 18″ wire leads. *Vibration-resistant surface mount* light has a pad below the base to absorb shock and vibration. It comes with mounting fasteners and has two 15″ wire leads.

Dia.	Ht.	Amps	Candlepower	Choose a Color	Lights		Repl. Bulbs		Repl. Lenses	
Incandescent										
Surface Mount—304 Stainless Steel Base										
12V DC	5 3/4″	7 3/4″	2.8	450	Amber, Blue, Green, Red, White	5808T92	$58.79	14335T91	$1.19	5849T57	$17.97
24V DC	5 3/4″	7 3/4″	1.7	450	Amber, Blue, Green, Red, White	5808T94	70.76	5808T6	9.00	5849T57	17.97
36V DC	5 3/4″	7 3/4″	0.9	450	Amber, Blue, Green, Red, White	5808T95	70.76	5808T291	9.18	5849T57	17.97
Magnetic Mount with Vehicle Plug—304 Stainless Steel Base										
12V DC	5 3/4″	7 3/4″	2.8	450	Amber, Blue, Green, Red, White	5808T93	73.15	14335T91	1.19	5849T57	17.97
Vibration-Resistant Surface Mount—Plastic Base										
12V DC	4 1/2″	7″	2.8	450	Amber, Blue, Green, Red, White	5932T51	63.89	1505K443	10.40	5849T57	17.97
24V DC	4 1/2″	7″	1.7	450	Amber, Blue, Green, Red, White	5932T52	63.89	5808T6	9.00	5849T57	17.97
High-Visibility Halogen										
Pipe Mount/Surface Mount—Plastic Base										
120V AC	3 1/4″	3 7/8″	0.2	879	Amber, Blue, Green, Red, White	1507T3	184.16	1507T45	33.54	1507T7	41.80
24V AC	3 1/4″	3 7/8″	0.8	653	Amber, Blue, Green, Red, White	1507T2	184.16	1507T9	33.54	1507T7	41.80
24V DC	3 1/4″	3 7/8″	0.8	653	Amber, Blue, Green, Red, White	1507T4	184.16	1507T9	33.54	1507T7	41.80
Long-Life LED										
Surface Mount—304 Stainless Steel Base										
120V AC	5 3/4″	7 3/4″	0.2	795	Amber, Blue, Green, Red, White	5808T86	82.07	5808T98	11.80		
Pipe Mount/Surface Mount—Plastic Base										
120V AC	3 1/4″	3 7/8″	0.1	Not Rated	Amber, Blue, Green, Red	1507T5	205.81			1507T7	41.80
24V DC	3 1/4″	3 7/8″	0.1	Not Rated	Amber, Blue, Green, Red	1507T6	205.81			1507T7	41.80
Vibration-Resistant Surface Mount—304 Stainless Steel Base										
120V AC	4 1/2″	7″	0.2	795	Amber, Blue, Green, Red, White	5932T94	74.96	5846T86	9.46		

Flashing Lights with Buzzer

Lights have a pulsing buzzer that sounds 85 dB at 10 ft. The buzzer warns workers of hazards even when they're outside a direct line of sight. Suitable for outdoor use. Lenses are plastic; bases are aluminum. Lights have two 6″ wire leads. Size is 6″ Dia. × 7 3/8″ Ht.

Surface mount (fasteners not included) or pipe mount using the 1/2 NPT female connection. Lights are UL listed, except 12V and 24V DC incandescent lights.

To Order: Please specify lens color: amber, blue, green, red, or white.

	Amps	Candlepower	Lights		Repl. Bulbs	
Incandescent						
120V AC	0.29	2,374	5753T83	$346.53	5753T81	$13.49
12V DC	1	5,049	5753T71	346.53	5753T75	1.14
24V DC	1	5,049	5753T72	346.53	5753T87	1.49
LED						
120V AC	0.18	Not Rated	5753T15	420.06		
24V DC	0.3	Not Rated	5753T14	420.06		
Replacement Lens			5753T77	63.87		

Solar-Powered Flashing Lights

Submersible

Place these LED lights in full sun and their batteries charge during daylight hours. Lights automatically switch on at dusk and off at dawn. They have a plastic lens and base and are suitable for outdoor use.

Portable lights have a magnetic base for quick positioning. They can be switched on or off with the press of a button. Includes two AA batteries.

Submersible light meets IP68. The lens has an integrated bird-deterrent spike. The base has four 1/2″ dia. mounting holes (fasteners not included). Includes a sealed battery.

Dia.	Ht.	Choose a Color		
Portable—Magnetic Mount				
4″	5″	Amber, Blue, Red	8470T3	$108.89
Submersible—Surface Mount				
5 3/8″	5 1/2″	Amber	8470T1	253.97
Replacement Sealed Battery for Submersible Light			8470T2	56.36

One-Way-View Flashing Lights

Side-Mount Oval

Back-Mount Round

Back-Mount Rectangle

Direct your signal with these lights; they flash in one direction. All have long-life LED bulbs, plastic lenses, and an aluminum frame. Suitable for outdoor use. Mounting hardware not included. **Flashing** lights flash in a series of four flashes per cycle. They operate on 0.3 amps at 12-24 volts DC. Side-mount lights have two 1/4″ dia. mounting holes; back mount lights have four 1/4″ dia. mounting holes. **Flashing/continuous** lights can switch between being continuous or flashing. They operate on 0.3 amps at 12-80 volts DC. Light has three 12″ wire leads.

				Side Mount			Back Mount		
Shape	Ht.	Dp.	Choose a Color	Wd.			Wd.		
Flashing									
Round	6″	2″	Amber, Red	6″	8772T1	$70.66	8″	8772T4	$73.43
Oval	6″	2″	Amber, Red	6″	8772T6	70.66	8″	8772T8	73.43
Flashing/Continuous									
Rectangle	2 3/8″	1 1/4″	Amber, Blue, Green, Red, White				5 1/2″	3072T1	117.67

Accident Prevention Signs

Alert people to potential hazards in the workplace. Danger, Warning, and Caution headers meet OSHA requirements. All header colors meet ANSI Z535 specifications.

DANGER Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury. Typically used in extreme conditions. Danger headers have white letters on a red background.

CAUTION Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury. Caution headers are black and yellow.

WARNING Indicates a moderately hazardous situation that, if not avoided, may result in death or serious injury. Warning headers have black letters on an orange background.

NOTICE Indicates general instructions that are unrelated to bodily harm or safety. Notice headers have italicized white letters on a blue background.

Accident Prevention Signs

Adhesive-backed vinyl signs are 0.004″ thick.
Plastic signs are 0.055″ thick and have four 3/16″ dia. mounting holes (screws are not included).
Aluminum signs are 0.04″ thick and have four 3/16″ dia. mounting holes (screws are not included).
To Order: Please specify material.

	Adhesive-Backed Vinyl		Plastic		Aluminum	
Wd. × Ht.	1-5	6-Up	1-5	6-Up	1-5	6-Up
10″ × 7″	$6.61	$5.85	$9.35	$7.95	$11.61	$9.80
14″ × 10″ and 10″ × 14″	8.62	7.47	12.85	10.92	16.42	13.82
20″ × 14″ and 14″ × 20″	13.84	11.75	20.20	17.18	25.90	22.09

Personal Protection

10″ × 7″	8355T107	57095T38	57095T36	8355T101	57095T41	57095T43	5052T76
14″ × 10″	8355T108	57095T39	57095T37	8355T102	57095T42	57095T44	5052T77
20″ × 14″	8355T109	57095T81	57095T68	8355T103	57095T83	57095T85	5052T81

Personal Protection

Confined Space

10″ × 7″	57095T18	8355T64	57095T12	5052T78	8355T132	8355T127	8355T123
14″ × 10″	57095T19	8355T65	57095T13	5052T79	8355T133	8355T128	8355T124
20″ × 14″	57095T21	8355T38	57095T14	5052T54	8355T141	8355T106	8355T105

Electrical Hazards

10″ × 7″	8355T66	8355T68	8355T14	75025T21	75025T25	75025T11	57095T69
14″ × 10″	8355T67	8355T69	8355T15	75025T22	75025T26	75025T12	57095T77
20″ × 14″	8355T31	8355T32	8355T16	75025T23	75025T27	75025T13	57095T15

Electrical Hazards

Security and Admittance

10″ × 7″	8355T687	8355T11	8355T17	8355T21	8355T48	8355T73	8355T75
14″ × 10″	8355T693	8355T12	8355T18	8355T22	8355T49	8355T74	8355T76
20″ × 14″	8355T284	8355T13	8355T19	8355T23	8355T33	8355T34	8355T35

Security and Admittance

10″ × 7″	8355T86	8355T669	75025T31	75025T34	75025T37	57095T45	5052T63
14″ × 10″	8355T87	8355T671	75025T32	75025T35	75025T38	57095T46	5052T64
20″ × 14″	8355T36	8355T672	75025T33	75025T36	75025T39	57095T87	5052T55

Security and Admittance

10″ × 7″	5052T11	5052T15	5052T19	5052T51	5052T74	5052T23	5052T114
14″ × 10″	5052T12	5052T16	5052T21	5052T52	5052T75	5052T27	5052T115
20″ × 14″	5052T13	5052T17	5052T22	5052T53	5052T86	5052T28	5052T116

(Continued on following page)

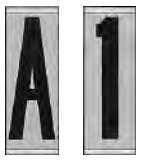
About Character Width

The width of a character is typically one-half its height. Narrower characters, such as 1 or A will be less, while M or W will be more.

Peel-and-Stick Characters

1½″-8″ Characters

1″, 10″, and 12″ Characters


Characters with Background


Pocket Book

For long-lasting use inside and out, characters are adhesive-back vinyl.

Characters—*Individual characters* are 0-9, A-Z, $, ¢, period, comma, and dash. *Number sets* include 10 each of 0-9. *Letter sets* include 10 each of A-Z. *Number and letter sets* include six each of E; five each of A,I,R,S, and 1; four each of L,O,P,T; three each of F,G,H,M,N,U,W, and the number 0; two each of B,C,D,K,V,Y, 2-9, $, and ¢; and one each of J,Q,X,Z. All letters are uppercase.

Characters with Background—*Individual characters* are 0-9, A-Z, and dash. *Number sets* include 0-9. *Letter sets* include A-Z. All letters are uppercase.

To Order: For individual characters, please specify character.

Characters

Character Ht.	Available Character Colors	Individual Characters Pkg. Qty.		Pkg.	Sets: Number		Sets: Letter		Sets: Number and Letter	
1″	Black, Blue, Orange, Red, White, Yellow	10	5752T141	$4.13	5752T642	$38.92	5752T84	$100.00	5752T151	$39.61
1½″	Black, Blue, Orange, Red, White, Yellow	10	5752T142	4.45	5752T643	40.22	5752T847	100.12	5752T152	42.90
2″	Black, Blue, Orange, Red, White, Yellow	10	5752T143	4.83	5752T644	45.00	5752T854	113.42	5752T153	46.46
3″	Black, Blue, Orange, Red, White, Yellow	10	5752T144	7.07	5752T645	68.28	5752T861	174.47	5752T154	69.65
4″	Black, Blue, Orange, Red, White, Yellow	10	5752T145	10.90	5752T646	103.68	5752T868	233.12	5752T155	106.26
5″	Black, Blue, Orange, Red, White, Yellow	5	5752T146	7.78	5752T647	136.14	5752T875	353.98	5752T156	138.80
6″	Black, Blue, Orange, Red, White, Yellow	5	5752T491	10.12	5752T648	185.09	5752T882	481.91	5752T157	191.60
8″	Black	1	5752T192	4.14	5752T583	263.03	5752T89	690.74	5752T795	267.81
10″	Black	1	5752T193	5.34	5752T589	388.49	5752T897	1,262.95	5752T796	391.20
12″	Black	1	5752T194	6.46	5752T595	504.05	5752T905	1,508.70	5752T797	495.84

Characters with Background

Character Ht.	Color: Character	Color: Background	O'all Size Ht.	O'all Size Wd.	Individual Characters Pkg. Qty.		Pkg.	Sets: Qty. Each Char.	Sets: Number		Sets: Letter	
5/8″	Black	Yellow	3/4″	9/16″	32	5838T4	$1.60	32	5838T542	$12.90	5838T541	$34.67
1″	Black	Yellow	1½″	7/8″	10	5838T1	1.60	10	5838T514	13.33	5838T513	34.67
2″	Black	Yellow	2¼″	7/8″	10	5838T2	2.00	10	5838T526	16.67	5838T525	43.33
3″	Black	Yellow	3½″	1½″	6	5838T3	3.20	6	5838T538	25.00	5838T537	68.60
4″	Black	Yellow	5″	1¾″	5	5838T6	4.04	5	5838T571	31.29	5838T569	80.60
6″	Black	Yellow	9″	5″	1	5838T7	4.04	1	5838T583	32.13	5838T572	80.60

Pocket Books—Hold 360 5/8″ high black characters on ½″×¾″ yellow labels. *Number set* includes 60 zeros and 30 each of 1-9 and dash. *Number and letter set* includes 27 zeros; 15 each of 1-9; 12 each of A-E; nine each of dash and I; and six each of F-H and J-Z.

Pocket Books		
Number Set	5838T32	$9.80
Number and Letter Set	5838T31	9.80

Reflective Peel-and-Stick Characters


With Background

Characters reflect light—even in dark environments. They are uppercase, have an adhesive back, and can be used outdoors.

Characters are vinyl. *Individual characters* are 0-9, A-Z, $, ¢, period, comma, and dash. *Number sets* include 10 each of 0-9. *Letter sets* include 10 each of A-Z. *Number and letter sets* include six each of E; five each of A,I,R,S, and 1; four each of L,O,P,T; three each of F,G,H,M,N,U,W, and the number 0; two each of B,C,D,K,V,Y, 2-9, $, and ¢; and one each of J,Q,X,Z.

Characters with background are vinyl cloth. *Individual characters* are 0-9 and A-Z. *Number sets* include 50 each of 0 and 1; and 25 each of 2-9. *Letter sets* include 22 each of A,E,I,O; 20 each of L,N,R,S,T; 10 each of B,C,D,F,G,H,J,K,M,P,U,W,Y; and five each of Q,V,X,Z.

To Order: For individual characters, please specify character.

Characters

Character Ht.	Available Character Colors	Individual Characters Pkg. Qty.		Pkg.	Sets: Number		Sets: Letter		Sets: Number and Letter	
1½″	Black, Blue, Red, White	5	12365T923	$4.50	12365T5	$64.94	12365T1	$172.22	12365T933	$82.00
2″	Black, Blue, Red, White	5	12365T924	5.20	12365T6	75.10	12365T2	199.14	12365T934	95.78
3″	Black, Blue, Red, White	5	12365T925	8.05	12365T7	115.70	12365T3	306.86	12365T935	144.64
4″	Black, Blue, Red, White	5	12365T926	9.57	12365T8	139.32	12365T4	369.48	12365T936	166.81

Characters with Background

Character Ht.	Color: Character	Color: Background	O'all Size Ht.	O'all Size Wd.	Individual Characters Pkg. Qty.		Pkg.	Sets: Number		Sets: Letter	
1½″	Yellow	Black	1 7/8″	1 3/8″	25	5973T3	$13.19	5973T1	$133.12	5973T2	$149.38
2½″	Yellow	Black	2 7/8″	1¾″	25	5973T13	16.18	5973T11	161.90	5973T12	183.78
3¾″	Yellow	Black	4 5/16″	2 7/8″	10	5973T65	13.89	5973T21	313.64	5973T22	328.57

Weather-Resistant Peel-and-Stick Characters

Made of a durable polyester-laminated vinyl, these adhesive-back uppercase characters hold up in moisture, rain, and other wet conditions. *Number sets* include 0-9. *Letter sets* include A-Z.

To Order: For individual characters, please specify character (0-9, A-Z).

Character Ht.	Character Color	Available Background Colors	O'all Size Ht.	O'all Size Wd.	Individual Characters Pkg. Qty.		Pkg.	Sets: Number Qty. Each 0-9			Sets: Letter Qty. Each A-Z		
1″	Black	Clear, White, Yellow	1½″	7/8″	50	14985T14	$7.41	10	14985T52	$15.50	10	14985T55	$35.88
2″	Black	Clear, White, Yellow	2¼″	7/8″	50	14985T26	11.21	10	14985T62	23.12	10	14985T65	54.65
3″	Black	Clear, White, Yellow	3½″	1½″	24	14985T38	13.45	6	14985T72	35.29	6	14985T75	76.75
4″	Black	Clear, White, Yellow	5″	1¾″	20	14985T47	14.79	5	14985T12	38.17	5	14985T15	84.38
5″	Black	Clear, White, Yellow	6″	3″	12	14985T63	16.37	3	14985T22	42.06	3	14985T25	92.88
6″	Black	Clear, White, Yellow	7″	4″	4	14985T77	17.93	1	14985T32	46.32	1	14985T35	102.13

Paint Markers

For information about paint, see page 2200.

About Paint and Ink Markers

Paint markers work well even on dirty, rusty, wet, and oily surfaces. They leave textured marks you can feel with your hand.
Ink markers work best on a clean, dry surface. Marks dry faster than paint and are smooth to the touch.
Both paint and ink markers are permanent.

Ultra Fine (≤0.5 mm) | Extra Fine (0.6-0.8 mm) | Fine (0.9-1.2 mm) | Medium (1.3-2.4 mm) | Bold (2.5-4.5 mm) | Broad (>4.5 mm)

Paint Markers

Write on metal, plastic, rubber, wood, and paper with these oil-based paint markers. Marking temperature range is –20° to 150°F.
Fine Tip—Paint dries in 25-35 seconds.
Medium Tip—Can also be used on glass, concrete, leather, and vinyl. Paint dries in 25-35 seconds.
Bold Tip—Paint dries in 1-2 minutes.
Bold/Broad Tip—Tip is reversible for a bold or broad mark. Paint dries in 1 minute.
Marker sets include one each of available colors listed.

Tip	Stroke Width	Available Colors	Markers	Each	Repl. Tips Pkg. Qty.		Pkg.
Individual Markers							
Fine	1 mm	Black, Blue, Gold, Green, Orange, Purple, Red, Silver, White, Yellow	14295T15	$3.56	2	14295T17	$1.84
Medium	1.9 mm	Black, Blue, Light Blue, Gold, Green, Orange, Pink, Purple, Red, Silver, White, Yellow	1597T2	4.02	10	1597T6	4.17
Medium (with Screw-On Cap and Clip)	1.9 mm	Black, Blue, Green, Orange, Red, Silver, White, Yellow	1597T7	4.35	10	1468T47	4.08
Bold	4 mm	Black, Blue, Light Blue, Brown, Gold, Green, Orange, Purple, Red, Silver, White, Yellow	16625T27	4.27	12	16625T51	9.33
Bold/Broad	3 mm/5 mm	Black, Blue, Green, Red, White, Yellow	16625T41	3.70	12	16625T42	7.12
Marker Sets							
Bold	4 mm	Black, Red, Silver, White, Yellow	16625T28	20.17	12	16625T51	9.33
Bold/Broad	3 mm/5 mm	Black, Green, Red, White, Yellow	16625T37	14.10	12	16625T42	7.12

Fade-Resistant Paint Markers

These rich colors won't fade in sunlight or exposure to weather. Use on glass, metal, plastic, and wood. Marking temperature range is 35° to 130°F. Paint is water-based and dries in 60 seconds. Tip is reversible for a bold or broad mark.
Marker set includes one each of black, blue, orange, red, white, and yellow.
Adhesive-backed holder functions as a cap and keeps your marker easily accessible and in one place.

To Order: For individual markers, please specify black, blue, gold, gray, green, orange, pink, purple, red, silver, white, or yellow.

Tip	Stroke Width	Markers		Marker Set	
Bold/Broad	3 mm/5 mm	5040T11	$2.75	5040T32	$19.14
Adhesive-Backed Marker Holder				5040T12	Each $8.82

Wet-Environment Paint Markers

Use on wet metal, plastic, rubber, concrete, wood, glass—and even underwater. Markers have a stainless steel ball tip and oil-based paint that is fade and chip resistant. Marking temperature range is –20° to 150°F. Paint dries in 25-35 minutes.
Large capacity markers have twice the volume.

Tip	Stroke Width	Available Colors		
Standard				
Fine	1.2 mm	Black, Red, White, Yellow	16105T18	$4.60
Medium	2.4 mm	Black, Blue, Green, Orange, Red, White, Yellow	16105T29	4.60
Bold	3.2 mm	White, Yellow	16105T3	4.60
Large Capacity				
Medium	2.4 mm	Black, Blue, Green, Orange, Red, White, Yellow	16105T58	5.84
Bold	3.2 mm	White, Yellow	16105T6	5.84

High-Purity Paint Markers

Used in nuclear facilities, the paint in these markers is low in chlorides and halogens so it won't degrade or contaminate marking surfaces. Use on metal, glass, and plastic. Paint is oil-based, except black, which is alcohol-based. Marking temperature range is –20° to 150°F. Dries in 3-4 minutes.

Tip	Stroke Width	Available Colors		
Fine	1.2 mm	Black, White, Yellow	2802T2	$7.20
Bold	3.2 mm	Black, White, Yellow	2802T8	7.20

High-Visibility Paint Markers

Make marks that stand out, especially on dark surfaces. Use on metal, glass, plastic, and paper. Paint is oil-based and permanent.
For gold and silver colors, marking temperature is not rated. Paint dries in 15 seconds. For fluorescent colors, marking temperature is –50° to 150°F. Paint dries in 60-90 seconds.

Tip	Stroke Width	Available Colors		
Fine	1.2 mm	Gold, Silver	8667T3	$3.19
Bold	2.8 mm	Silver	8667T16	3.87
Bold	3.2 mm	Fluorescent: Green, Orange, Pink, Yellow	4375T22	4.70

Glow-in-the-Dark Paint Markers

Paint stores energy from exposure to light to create luminescent marks you can see in the dark. Works on porous and nonporous surfaces and has a stroke width of 13 mm. Marking temperature range is 15° to 245°F. Dries in 5-10 minutes.

4194T1 ..... $16.88

High-Temperature Paint Markers

Paint holds up in extreme heat. Use on nonporous surfaces. Marking temperature range is –20° to 150°F.

Tip	Stroke Width	Color	Max. Temp.	Drying Time		
Medium	2.4 mm	White	800°F	30 min.	2862T614	$6.22
Bold	3 mm	Yellow	1,800°F	10 min.	2862T616	5.40

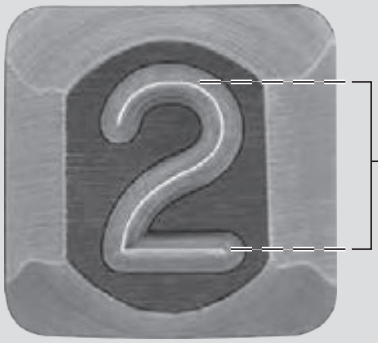
Removable-Mark Paint Markers

Writing comes off with water or a mild detergent. Use on glass, metal, plastic, and other nonporous surfaces. Marking temperature range is 0° to 150°F. Paint is alcohol-based and dries in 30-60 seconds.

To Order: Please specify black, blue, green, red, white, or yellow.

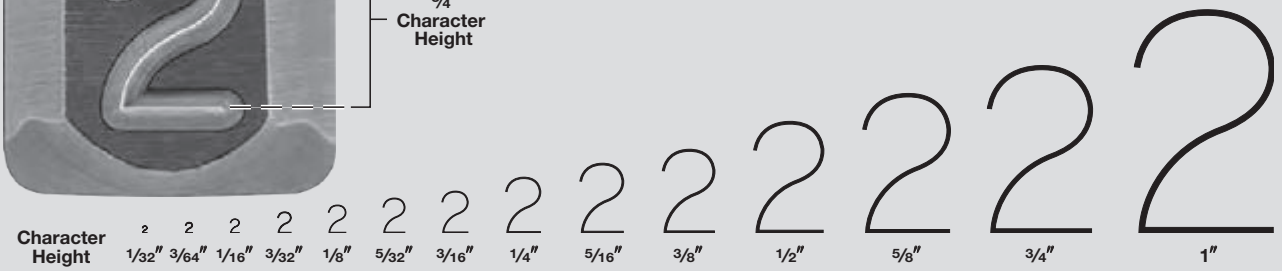
Tip	Stroke Width	Remove With		
Bold	3.2 mm	Water	7162T22	$6.32
Bold	3.2 mm	Detergent	7162T11	6.66

About Character Height



When you look at the face of a stamp, you'll notice the character is raised. The distance between the upper and lower raised ridges is known as the *character height*. This height is used to measure stamp size. If a stamp does not have a size marking on the shank, measure the character height to order the correct size.

The actual impression a stamp makes is larger than its character height and varies depending upon how hard you strike the stamp, the hardness of the material, and wear.



Steel Stamps

AB12

1/4" Character Ht.

Make your mark on metal. Stamps are designed for continuous use on materials with a Rockwell hardness up to C30 for *standard duty* and *heavy duty stamps*; and up to C50 for *extra-heavy duty stamps*, which have a thicker shank to handle more demanding jobs. All characters are uppercase.

Sets come in a compartmented case. *Number sets* contain 0-9 (6 doubles as 9). *Letter sets* contain A-Z; standard duty and heavy duty stamps also have an ampersand (&). *Number and letter sets* contain 0-9 (6 doubles as 9), A-Z, and an ampersand (&).

To Order: For individual characters, please specify number (0-9) or letter (A-Z); for standard duty and heavy duty stamps, you can also specify period, dash, or ampersand (&).

Character Ht.	Shank Size, sq.	Shank Lg.	Individual Characters		Sets: Number		Sets: Letter		Sets: Number and Letter	
Standard										
1/16"	1/4"	2 3/8"	1558T54	$2.02	1558T13	$15.24	1558T33	$45.76	1558T101	$60.85
3/32"	1/4"	2 3/8"	1558T61	2.02	1558T15	15.24	1558T35	45.76	1558T102	60.85
1/8"	1/4"	2 3/8"	1558T64	2.02	1558T16	15.24	1558T36	45.76	1558T103	60.85
5/32"	5/16"	2 7/16"	1558T67	2.63	1558T17	19.07	1558T37	62.88	1558T104	78.10
3/16"	5/16"	2 3/8"	1558T71	2.63	1558T18	19.07	1558T38	62.88	1558T105	78.10
1/4"	3/8"	2 5/8"	1558T77	3.16	1558T21	22.76	1558T41	69.91	1558T106	92.98
5/16"	1/2"	2 3/4"	1558T79	3.70	1558T22	29.34	1558T42	89.95	1558T107	120.45
3/8"	1/2"	2 7/8"	1558T84	4.44	1558T23	34.02	1558T43	102.07	1558T108	132.47
1/2"	5/8"	3"	1558T91	5.90	1558T25	49.82	1558T45	149.47	1558T109	197.68
Heavy Duty										
1/32"	1/4"	2 3/8"	1556T51	3.77	1556T29	22.45	1556T11	66.23	1556T201	84.79
3/64"	1/4"	2 3/8"	1556T52	4.20	1556T31	24.49	1556T12	74.81	1556T202	94.96
1/16"	5/16"	2 1/2"	1556T61	3.00	1556T33	17.49	1556T14	51.23	1556T203	65.63
3/32"	5/16"	2 1/2"	1556T65	3.00	1556T35	17.49	1556T16	51.23	1556T204	65.63
1/8"	5/16"	2 1/2"	1556T71	3.00	1556T37	17.49	1556T18	51.23	1556T205	65.63
5/32"	3/8"	2 3/4"	1556T74	3.28	1556T38	19.69	1556T19	58.22	1556T206	73.75
3/16"	3/8"	2 3/4"	1556T76	3.66	1556T39	20.91	1556T21	61.70	1556T207	78.13
1/4"	7/16"	3"	1556T8	3.69	1556T42	23.73	1556T23	71.12	1556T208	90.63
5/16"	9/16"	3 1/8"	1556T85	4.59	1556T43	29.44	1556T24	88.80	1556T209	112.67
3/8"	9/16"	3 1/8"	1556T89	5.47	1556T44	34.27	1556T25	102.55	1556T211	129.26
1/2"	3/4"	3 3/4"	1556T94	8.39	1556T46	55.12	1556T27	160.02	1556T212	214.84
5/8"	3/4"	3 3/4"	1556T97	12.86	1556T47	111.91	1556T28	347.90	1556T213	430.42
3/4"	7/8"	3 3/4"	1556T101	19.10	1556T121	156.42	1556T111	469.22	1556T214	606.96
1"	1 1/4"	4 1/2"	1556T103	64.91	1556T123	584.23	1556T113	1,752.58	1556T215	2,267.18
Extra Heavy Duty										
1/8"	1/2"	3 1/2"	8965T4	8.93	8965T12	53.33	8965T34	158.17		
3/16"	9/16"	3 1/2"	8965T5	10.83	8965T15	64.65	8965T37	194.04		
1/4"	5/8"	3 1/2"	8965T6	13.05	8965T18	78.16	8965T39	233.77		
3/8"	3/4"	3 1/2"	8965T3	22.92	8965T11	167.29	8965T33	484.08		

Stainless Steel Stamps

AB12

1/4" Character Ht.

These stamps are corrosion-resistant so they won't rust and flake with exposure to moisture and chemicals. They are made from 440C stainless steel and can be sanitized in an autoclave. For continuous use on materials with a Rockwell hardness up to C50.

Sets come in a compartmented case. *Number sets* contain 0-9 (6 doubles as 9). *Letter sets* contain A-Z and an ampersand (&).

To Order: For individual characters, please specify number (0-9), letter (A-Z), dash, period, @, or ampersand (&).

Character Ht.	Shank Size, sq.	Shank Lg.	Individual Characters		Sets: Number		Sets: Letter	
1/8"	1/2"	3"	3770T11	$13.60	3770T41	$122.30	3770T51	$366.90
1/4"	1/2"	3"	3770T21	15.20	3770T42	136.60	3770T52	409.80
3/8"	1/2"	3"	3770T31	17.90	3770T43	161.00	3770T53	483.00

About Selecting Pipe Markers

Our pipe markers meet ANSI/ASME 13.1, which requires that markers have a flow-direction arrow, identify contents with a message, and indicate hazard classifications with a specific background color.

The ANSI/ASME background color designations are:
Toxic and Corrosive Fluids—Orange
Flammable Fluids—Yellow
Low-Hazard Gas—Blue
Potable, Cooling, Boiler Feed, and Other Water—Green
Fire-Quenching Fluids—Red

To select a pipe marker for new installations, choose the message from the table below that corresponds to the contents of your pipe. For messages with multiple background color options, choose the color that best identifies the hazardous properties of the contents according to the ANSI/ASME background color designations.

To replace a pipe marker for existing installations, choose the message and background color from the table below that matches your existing pipe marker.

If you don't see the message you need, pipe markers with other messages are available.

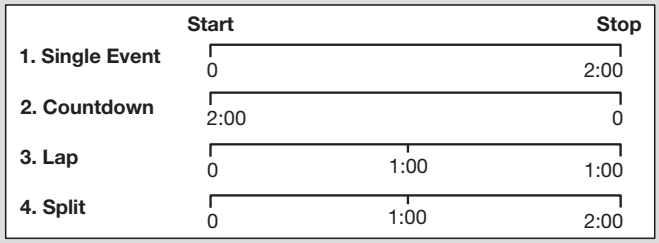
Markers with orange and yellow backgrounds have a black message. Markers with blue, green, and red backgrounds have a white message.

Message	Choose a Background Color
Acid	Orange, Yellow
Air	Blue, Green
Air Return	Blue
Air Supply	Blue
Ammonia	Yellow
Argon	Blue, Green, Orange
Blank (no message)	Blue, Green, Orange, Red, Yellow
Carbon Dioxide	Orange, Yellow
Caustic	Orange, Yellow
Chilled Water	Green
Chilled Water Return	Green
Chilled Water Supply	Green
Chlorine	Yellow
City Water	Green
Cold Water	Green
Cold Water Return	Green
Cold Water Supply	Green
Compressed Air	Blue
Compressed Air 80 PSI	Blue
Compressed Air 120 PSI	Blue
Condensate	Orange, Yellow
Condensate Return	Orange, Yellow
Condenser Water	Green
Condenser Water Return	Green
Condenser Water Supply	Green
Coolant	Green, Yellow
Coolant Return	Green, Yellow
Coolant Supply	Green, Yellow
Cooling Water	Green
Cooling Water Return	Green
Cooling Water Supply	Green
Deionized Water	Green
Domestic Cold Water	Green
Domestic Hot Water	Green, Yellow
Domestic Hot Water Return	Green, Yellow
Domestic Hot Water Supply	Green, Yellow
Drain	Green, Orange, Yellow
Endo Gas	Yellow
Exhaust	Blue, Yellow
Filtered Water	Green
Fire Protection Water	Red
Fire Sprinkler Water	Red
Fuel Oil	Yellow
Gas	Yellow
Glycol	Green, Orange, Yellow
Glycol Return	Orange, Yellow
Glycol Supply	Orange, Yellow
Grease	Orange, Yellow
Heating Water Return	Yellow
Heating Water Supply	Yellow
Helium	Green, Yellow

Message	Choose a Background Color
Hi Press Condensate	Orange, Yellow
Hi Press Steam	Green, Yellow
Hot Oil	Yellow
Hot Oil Return	Yellow
Hot Oil Supply	Yellow
Hot Water	Green, Yellow
Hot Water Return	Green, Yellow
Hot Water Supply	Green, Yellow
Hydraulic Oil	Yellow
Hydrogen	Orange, Yellow
Instrument Air	Blue, Green
Lo Press Condensate	Orange, Yellow
Lo Press Steam	Green, Yellow
Medical Air	Blue, Yellow
Natural Gas	Yellow
Nitrogen	Blue, Green, Orange
Nitrous Oxide	Blue, Orange
Nonpotable Water	Green, Yellow
Outside Air	Blue
Oxygen	Green, Orange, Yellow
Plant Air	Blue
Potable Water	Green
Potable Cold Water	Green
Potable Hot Water	Green, Yellow
Process Water	Green, Yellow
Propane Gas	Yellow
Raw Water	Green
Return	Green, Orange, Yellow
Roof Drain	Green
Sanitary Drain	Green
Sanitary Sewer	Green
Sanitary Vent	Blue
Soft Water	Green
Sprinkler	Red
Sprinkler Fire	Red
Sprinkler Water	Red
Steam	Green, Yellow
Steam Return	Green, Yellow
Steam Supply	Green, Yellow
Storm Drain	Green
Supply	Green, Orange, Yellow
Tempered Water	Green, Yellow
Tower Water	Green
Tower Water Return	Green
Tower Water Supply	Green
Treated Water	Green
Vacuum	Green, Yellow
Vent	Green, Orange, Yellow
Waste	Orange, Yellow
Waste Water	Yellow
Water	Green, Orange, Yellow

About Stopwatch Timing Functions

1. Single-event timing records one event.
2. Countdown timing indicates the time remaining before an event is scheduled to occur.
3. Lap timing displays the elapsed time, from start to finish, of several separate events. *Lap memory* indicates how many previous laps the stopwatch can recall.
4. Split timing records the combined time of events. Press button once to display the elapsed time for the first event. Press again to display the combined elapsed time of the first and second events.



Stopwatches

Pause timing with the press of a button. Stopwatches have a plastic lens and an inset dial that measures total time.
Stopwatch with NIST certificate comes with a certificate of calibration traceable to NIST.

Max. Time	Accuracy	Case Material		
Standard				
30 min.	±1.5 sec./hr.	Chrome-Plated Metal	1303T12	$78.44
60 min.	±1.5 sec./hr.	Black Plastic	1303T11	141.14
With NIST Certificate				
30 min.	±1.5 sec./hr.	Chrome-Plated Metal	9548T11	238.21

Digital Stopwatches

Time events with a high level of accuracy. These stopwatches are water resistant, can pause timing with the press of a button (unless noted), and include a lanyard. Case and lens are plastic. Case color is black (unless noted). Batteries included.
Optional aluminum clipboard has a clamp to hold the stopwatch and a clip to hold paper.
Backlit stopwatch allows you to time events in low-light conditions.
Stopwatches with NIST certificate come with a certificate of calibration traceable to NIST. *Split timing* stopwatches meet ISO 17025 standards.

			Stopwatch				Stopwatch with Alarm			
Timing Functions	Clock	Accuracy	Max. Time	Lap Memory			Max. Time	Lap Memory		
Standard										
Lap and Split Timing	No	±0.04 sec./hr.	10 hr.	—	1314T15▲	$26.68	—	—	—	—
Countdown, Lap, and Split Timing	No	±0.04 sec./hr.	10 hr.	7	1234T5	36.12	10 hr.	—	8434T13	$26.91
Countdown, Lap, and Split Timing	Yes	±0.02 sec./hr.	—	—	—	—	20 hr.	500	8434T11★	44.84
Backlit										
Lap Timing	Yes	±0.125 sec./hr.	—	—	—	—	24 hr.	—	2504T12♦	47.26
With NIST Certificate										
Split Timing	Yes	±0.04 sec./hr.	—	—	—	—	24 hr.	—	6327T77	36.57
Split Timing	Yes	±0.4 sec./hr.	—	—	—	—	24 hr.	—	6327T44■	23.48
Lap and Split Timing	No	±0.02 sec./hr.	30 hr.	16	1314T19▲	47.29	—	—	—	—
Optional 9″ x 12½″ Aluminum Clipboard for 1314T15 and 1314T19									12495T8	26.73

▲ Does not have a pause button. ★ Case is gray. ♦ Case is clear. ■ Case is yellow.

Combination Wristwatch/Weather Monitors

Monitor your environment when working outdoors; this wristwatch not only displays time and date but also temperature, barometric pressure, and altitude. Temperature range is 14° to 140° F/–10° to 60° C. Other functions include a countdown timer that can be set to 3, 5, 10, 15, or 45 minutes; the ability to pause timing functions; and a digital compass. Watch has a gray plastic case and black rubber band with a buckle closure. Battery included.

		Stopwatch				
Face Dia.	Clock	Timing Functions	Max. Time	Lap Memory		
1⅛″	12/24 hr.	Countdown, Lap, and Split Timing	100 hrs.	100	8431T61	$81.63

Timers

All have black numerals and markings. Case is plastic.
Styles A and **B** are spring wound and count down to an alarm. **Style C** runs on a battery (included), counts up, and has a second hand.


A


B

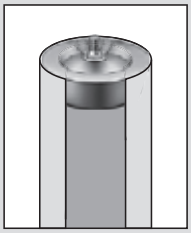

C

	Max. Time	Resolution	Max. Alarm Duration	O'all Size Ht.	O'all Size Wd.	O'all Size Dp.	Battery (Qty.)	Case Color		
A	60 min.	1 Min.	1 sec.	3¾″	3¾″	2″	—	White	8451T11	$8.00
B	30 min.	1 Min.	1 sec.	3½″	3″	2½″	—	Black	1300T2	56.23
B	60 min.	1 Min.	1 sec.	3½″	3″	2½″	—	Black	1300T3	56.23
C	60 min.	1 Sec.	No Alarm	6¾″	5¼″	3¾″	AA (1)	White	8441T26	194.82

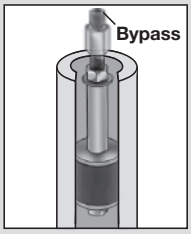
Expansion Plugs

About Expansion Plugs

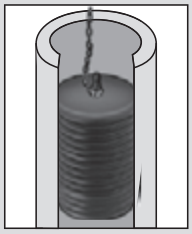
Test your systems for leaks by inserting an expansion plug into a pipe or tube for a tight seal before applying pressure.



Standard (End-of-Pipe Use)



For Inside-Pipe Use (Shown with Bypass)



Inflatable

Most expansion plugs have a top and bottom plate that, when tightened, squeeze against an expanding center ring to create a seal against the inside of the pipe. They work best with perfectly round pipes.

Standard plugs are designed to cap and seal pipes at the opening.

Plugs **for inside-pipe use** create a seal deeper within the pipe.

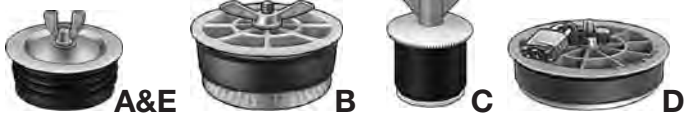
Inflatable plugs compensate for pipe that is not perfectly round. Fill the plug with air or water to create a secure, inside-pipe seal up to 24″ in diameter.

Plugs **with bypass** have an access tube that allows you to add media and relieve back pressure in the pipeline.

If you do not know your pipe size, select a plug based on the actual pipe or tube ID. For information about pipe size, please see pages 2-3.

Maximum back pressure is the amount of pressure a plug can withstand without moving. *Water, feet of head* refers to the pressure resulting from the height of the water above the plug.

Wing Nut Expansion Plugs



Twist the wing nut on these plugs to expand the seal and close off pipes.

(A-C) Zinc-plated steel and **plastic** plugs have a rubber seal.

(D) Lockable plastic plugs have a nitrile seal and a 5⁄16″ max. shackle diameter.

(E) Stainless steel plugs have a neoprene seal, unless noted.

For Pipe Size	For Actual Pipe ID Min.	Max.	Maximum Back Pressure Air, psi	Water, ft. of head	Overall Ht.		
(A) Zinc-Plated Steel—Temperature range is –20° to 125°F							
1 1⁄2	1.44″	1.65″	2	5	2 9⁄16″	2613K21	$2.48
2	1.96″	2.25″	2	5	2 5⁄8″	2613K23	2.67
3	2.86″	3.25″	2	5	2 11⁄16″	2613K25	4.35
4	3.78″	4.50″	2	5	3 1⁄4″	2613K27	5.42
5	4.62″	5.30″	1	2	3 9⁄16″	2613K29	10.20
6	5.62″	6.40″	1	2	3 3⁄16″	2613K31	11.93
(B) Plastic—Temperature range is –20° to 125°F							
1 1⁄2	1.48″	1.65″	17	40	1 3⁄4″	2645K41	5.28
2	1.90″	2.17″	17	40	1 7⁄8″	2645K42	6.08
3	2.80″	3.10″	17	40	2 1⁄2″	2645K43	8.10
4	3.80″	4.06″	17	40	2 1⁄2″	2645K44	9.97
6	5.77″	6.08″	17	40	3 3⁄4″	2645K45	24.36
8	7.70″	8.03″	17	40	3 3⁄4″	2645K48	46.13
(C) Plastic—Temperature range is –40° to 180°F							
1⁄2	0.49″	0.60″	100	230	2 3⁄8″	2439K41	9.18
3⁄4	0.74″	0.90″	100	230	2 1⁄2″	2439K42	9.41
1	0.98″	1.20″	100	230	2 1⁄2″	2439K43	10.03
1 1⁄4	1.23″	1.45″	50	115	2 1⁄2″	2439K64	13.69
1 1⁄2	1.48″	1.75″	50	115	2 1⁄2″	2439K65	14.70
(D) Lockable Plastic—Temperature range is –20° to 125°F							
1-1 1⁄4	1.00″	1.38″	6	15	2 1⁄2″	24395K69	19.38
2	1.90″	2.31″	6	15	2 1⁄2″	24395K73	21.50
3	2.80″	3.10″	6	15	2 5⁄8″	24395K71	23.46
4	3.80″	4.38″	6	15	3″	24395K75	24.80
6	5.77″	6.08″	6	15	4″	24395K77	50.58
(E) Stainless Steel—Temperature range is 0° to 175°F							
1⁄2	0.48″	0.55″	10	24	1 11⁄16″	2613K61	13.11
5⁄8	0.57″	0.67″	10	24	1 11⁄16″	2613K62	13.38
3⁄4	0.72″	0.80″	10	24	1 11⁄16″	2613K63	13.62
7⁄8	0.82″	0.92″	10	24	1 11⁄16″	2613K64	13.79
1	0.94″	1.05″	5	12	2 7⁄16″	2613K65	13.92
1 1⁄4	1.21″	1.36″	5	12	2 1⁄16″	2613K66	14.28
1 1⁄2	1.44″	1.65″	2	5	2 9⁄16″	2613K51★	13.60
1 3⁄4	1.70″	1.80″	5	12	2 7⁄16″	2613K67	14.74
2	1.96″	2.25″	2	5	2 5⁄8″	2613K52★	14.93
2 1⁄4	2.22″	2.35″	5	12	2 15⁄16″	2613K68	24.19
2 1⁄2	2.44″	2.60″	5	12	2 13⁄16″	2613K69	24.40
2 3⁄4	2.63″	2.85″	5	12	2 13⁄16″	2613K71	24.58
3	2.86″	3.25″	2	5	2 11⁄16″	2613K53★	24.02
3 1⁄4	3.13″	3.35″	5	12	2 15⁄16″	2613K72	26.25
3 1⁄2	3.44″	3.60″	5	12	2 15⁄16″	2613K73	26.62
3 3⁄4	3.69″	3.85″	5	12	2 15⁄16″	2613K74	30.58
4	3.78″	4.30″	2	5	3 1⁄4″	2613K54★	26.51
5	4.62″	5.30″	1	2	3 9⁄16″	2613K55★	41.82
6	5.62″	6.40″	1	2	3 3⁄16″	2613K56★	46.53

★ Seal material is nitrile.

Wing Nut Expansion Plugs for Tubing

Designed for metal and rigid plastic tubing, these zinc-plated steel plugs have a neoprene seal. Temperature range is 0° to 150°F.

For Tube OD	For Actual Tube ID Min.	Max.	Maximum Back Pressure Air, psi	Water, ft. of head	Overall Ht.		
1⁄4″	0.18″	0.19″	100	230	1 3⁄8″	2552K51	$8.94
3⁄8″	0.27″	0.31″	100	230	1 3⁄4″	2552K52	9.77
1⁄2″	0.39″	0.43″	100	230	1 7⁄8″	2552K53	10.12
5⁄8″	0.52″	0.54″	100	230	2 1⁄8″	2552K54	12.07
3⁄4″	0.64″	0.74″	100	230	2 1⁄2″	2552K55	12.52
7⁄8″	0.74″	0.99″	100	230	3 7⁄8″	2552K56	18.16
1 1⁄8″	0.99″	1.24″	100	230	3 7⁄8″	2552K57	20.12

Wing Nut Expansion Plugs for Inside-Pipe Use

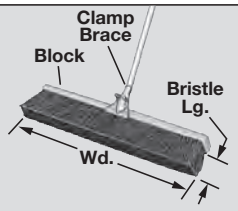
Plastic

Stainless Steel

Insert these plugs deep within your pipe to seal it off from the inside. Seals are rubber. Temperature range is 0° to 125°F.

For Pipe Size	For Actual Pipe ID Min.	Max.	Maximum Back Pressure Air, psi	Water, ft. of head	Overall Ht.		
Plastic							
4	3.80″	4.06″	17	40	2 1⁄2″	2645K51	$9.97
6	5.77″	6.08″	17	40	3 3⁄4″	2645K52	24.36
8	7.70″	8.03″	17	40	3 3⁄4″	2645K46	46.13
Stainless Steel with Extended Brass Stem							
1⁄2	0.50″	0.60″	17	40	11″	2988A41	17.00
3⁄4	0.75″	0.86″	17	40	11″	2988A42	17.00
1	0.82″	0.93″	17	40	11″	2988A43	18.50
1 1⁄4	1.15″	1.35″	17	40	11″	2988A44	18.50
1 1⁄2	1.40″	1.65″	17	40	11″	2988A45	19.00
1 1⁄2	1.40″	1.65″	17	40	17″	2988A51	20.00
2	1.80″	2.15″	17	40	11″	2988A46	22.00
2	1.80″	2.15″	17	40	17″	2988A52	20.00
2 1⁄2	2.35″	2.55″	17	40	11″	2988A47	22.50
2 1⁄2	2.35″	2.55″	17	40	17″	2988A53	24.00
3	2.95″	3.15″	17	40	11″	2988A48	45.00
4	3.95″	4.04″	17	40	11″	2988A49	59.00

About Brooms



Smooth-surface brooms sweep away fine to medium dust and dirt on nonporous surfaces such as tile, wood, linoleum, and smooth concrete.

Semi-smooth-surface brooms handle heavier debris on surfaces such as sidewalks and driveways.

Rough-surface brooms move heavy, wet, and hard-to-move debris on asphalt and rough concrete such as street pavement.

Push Brooms

All brooms include a 60″ long handle. Those 24″ and wider include a clamp-style brace for handle support, unless noted.

Smooth-Surface Push Brooms

Brooms have a threaded handle.

Plastic Bristles—Come in two styles. *Standard* have a wood handle, wood block, and blue bristles. *Chemical-resistant* have a black, plastic-coated steel handle with an aluminum tip, plastic block, and gray bristles.

Horsehair Bristles—All bristles are soft for fine sweeping. They have a wood handle, wood block, and black bristles.

Broom Wd.	Plastic Bristles: Bristle Lg.			Horsehair Bristles: Bristle Lg.		
With Standard Bristles						
14″	2¾″	7313T14	$18.32	3″	7167T2	$27.45
16″	2¾″	7313T13	20.15	3″	7167T6	29.09
18″	2¾″	7313T16	20.63	3″	7167T4	30.90
24″	2¾″	7313T17	26.60	3″	7167T5	40.22
30″	2¾″	7313T18	38.41	3″	7167T7	50.98
36″	2¾″	7313T19	45.11	3″	7167T8	68.51
With Chemical-Resistant Bristles						
18″	3″	7502T21	26.06	—	—	—
24″	3″	7502T22★	30.45	—	—	—

★ Does not include a clamp-style brace.

Semi-Smooth-Surface Push Brooms

Brooms have a threaded wood handle, a wood block, and black bristles.

Natural Bristles—Resist solvents and heat.

Blended Bristles—All are made of blended soft horsehair and plastic bristles. The 14″ through 24″ wide brooms also have a natural bristle center to dislodge heavier dirt.

Broom Wd.	Natural Bristles: Bristle Lg.			Blended Bristles: Bristle Lg.		
14″	—	—	—	2¾″	7168T2	$24.12
16″	—	—	—	2¾″	7168T3	26.37
18″	—	—	—	2¾″	7168T4	26.97
24″	3″	7169T15	$34.69	2¾″	7168T5	31.03
30″	3″	7169T16	40.18	2¾″	7168T6	45.43
36″	3″	7169T17	53.29	2¾″	7168T7	50.89

Rough-Surface Push Brooms

All have a wood handle and a wood block.

Natural Bristles—Color is reddish brown.

Plastic Bristles—Resist solvents, acids, and chemicals. *Standard bristles* are blue. *Long bristles* are black.

Brooms *with standard bristles*, also known as garage brooms, sweep heavy soils and debris. All have a threaded handle.

Brooms *with long bristles* are also known as street brooms. These stand up to the heaviest debris and move large, bulky trash. Handle is tapered.

Broom *with heavy duty long bristles* is the same as the long-bristled brooms above, except it has stiffer and thicker bristles.

Broom Wd.	Natural Bristles: Bristle Lg.			Plastic Bristles: Bristle Lg.		
With Standard Bristles						
18″	4″	7172T62	$24.25	2⅞″	7174T14	$25.18
24″	4″	7172T63★	27.77	2⅞″	7174T15	29.20
36″	4″	7172T65★	38.48	2⅞″	7174T17	41.20
With Long Bristles						
16″	6¼″	7179T4	18.80	—	—	—
18″	6¼″	7179T41	19.94	6″	7152T45	25.77
24″	6¼″	7179T42★	24.91	6″	7152T46★	29.32
With Heavy Duty Long Bristles						
16″	6¼″	7155T16	22.15	—	—	—

★ Does not include a clamp-style brace.

Adjustable-Angle Push Brooms

Reach tight and confined areas—simply adjust the handle to the angle you need. Handle attaches to a steel swivel socket, and the angle is secured with a threaded bolt. Brooms have a 59″ long, two-piece steel and wood handle. Block is plastic with a steel back. Bristles are made of chemical-resistant plastic.

Semi-Smooth Surface—Bristles are black.

Rough Surface—Bristles are brown.

Broom Wd.	Semi-Smooth Surface: Bristle Lg.			Rough Surface: Bristle Lg.		
14″	3″	72085T41	$37.06	3⅜″	70695T61	$38.65
18″	3″	72085T42	41.22	3⅜″	70695T62	42.43
24″	3″	72085T43	46.25	3⅜″	70695T63	47.61
Replacement Handle					72085T5	16.58

Dura-Block Push Brooms

A durable, rust-resistant steel strip locks in bristles without the added weight of wood and plastic blocks. All brooms have a 60″ long black steel handle with a bolt and wing nut connector. Bristles are made of chemical-resistant plastic.

Smooth-Surface—Bristles are maroon.

Semi-Smooth Surface—Bristles are brown.

Rough Surface—Bristles are black.

Broom Wd.	Bristle Lg.	*Smooth Surface*	*Semi-Smooth Surface*	*Rough Surface*	
18″	3″	7357T221	7352T221	7339T11	$20.82
24″	3″	7357T222	7352T222	7339T12	23.10
30″	3″	7357T223	7352T223	7339T13	34.46
36″	3″	7357T224	7352T224	7339T14	37.42
Repl. Handle for 18″ and 24″ Brooms				7357T17	10.05
Repl. Handle for 30″ and 36″ Brooms				7357T18	14.63

Twist-Resistant Handle Push Brooms

A zinc-plated steel, clamp-style brace locks the handle into the wood block, preventing damage from unnecessary handle twisting. All have a 60″ long wood handle. Bristles are made of chemical-resistant plastic. Bristle color is orange, except *semi-smooth-surface* bristles, which are orange and black.

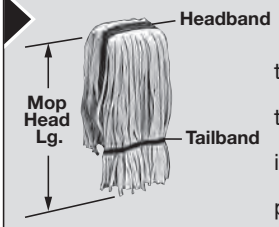
Broom Wd.	Bristle Lg.	*Smooth Surface*	*Semi-Smooth Surface*	*Rough Surface*	
18″	3″	6378T442	6378T413	6378T418	$30.54
24″	3″	6378T443	6378T414	6378T419	34.94
30″	3″	6378T444	6378T415	6378T422	39.73
36″	3″	6378T445	6378T416	6378T421	46.36
Replacement Handle (Without Brace)				6378T31	6.40
Replacement Anchor Brace				6378T32	4.84

Multisurface Twist-Resistant Handle Push Brooms

Effective on all floor surfaces, these brooms have rough-surface bristles in the front for heavy and wet debris, and smooth-surface bristles in back for finer debris. Bristles are made of chemical-resistant plastic. Front bristles are black; rear bristles are blue. Brooms have a 60″ long wood handle with a clamp-style brace for added support. Block is made of wood.

Broom Wd.	Bristle Lg.		
18″	2″-2¼″	7736T11	$27.44
24″	2″-2¼″	7736T12	33.04
36″	2″-2¼″	7736T13	44.79
Replacement Handle (Without Brace)		6378T31	6.40
Replacement Anchor Brace		6378T32	4.84

Wet Mops



About Wet Mops

***Ply*—**The number of yarn threads twisted together to make a single strand in a mop head. The greater the ply, the more durable the mop.

***Weight*—**Sometimes referred to as a mop's size, this is the actual weight of the dry mop head. The heavier the mop head, the more liquid it can hold.

***Headband*—**Located at the top of the mop head, this strip of fabric holds the mop strands together and is used to attach the mop head to the handle.

***Tailband*—**Located at the bottom of the mop head, this strip of fabric secures the mop head strands to prevent them from tangling and allows the strands to lay flat for wide, even mop coverage.

Wet Mop Heads

The economical choice for wet-mop heads. They can't be laundered; just toss them out when worn.

Cotton Cut-End Mop Heads

Our most popular cut-end mop heads, these are off-white and offer good absorption. Headband is 1¼" deep. Handle sold separately; see styles A-C on page 2131.

Approx. Weight	Approx. Lg. × Wd.		Each ♦	Approx. Lg. × Wd.		Each ♦
	4 Ply			*8 Ply*		
12 oz.	14" × 5½"	7317T16	$3.23	14" × 5½"	7317T11	$3.51
16 oz.	16" × 5½"	7317T17	4.25	16" × 5½"	7317T12	4.64
20 oz.	18" × 6"	7317T18	5.12	18" × 6"	7317T13	5.65
24 oz.	20" × 6"	7317T19	6.03	20" × 6"	7317T14	6.67
32 oz.	22" × 6½"	7317T21	8.00	22" × 6½"	7317T15	8.83
	16 Ply			*32 Ply*		
12 oz.	14" × 5½"	7317T31	$3.82	14" × 5½"	7317T34	$4.61
16 oz.	16" × 5½"	7317T22	5.08	16" × 5½"	7317T25	6.02
20 oz.	18" × 6"	7317T35	6.10	18" × 6"	7317T38	7.49
24 oz.	20" × 6"	7317T23	7.39	20" × 6"	7317T26	8.82
32 oz.	22" × 6½"	7317T24	9.59	22" × 6½"	7317T27	11.70

♦ Prices are approximately 10% lower when you purchase 12 or more.

Rough-Surface Cotton-Blend Mop Heads

Without Tailband

The strongest and most shed-resistant mop heads we carry. All are white and work well on rough flooring such as stone and concrete. Made of a blend of rayon and polyester tubular strands. Headband is 1¼" deep. Handle sold separately; see styles A-C on page 2131.

Approx. Weight	Approx. Lg. × Wd.		1-11	12-Up
Cut End without Tailband				
16–20 oz.	19½" × 6½"	6505T33	$9.99	$8.89
24–32 oz.	21½" × 6½"	6505T34	11.17	9.95
Looped End with Tailband				
16–20 oz.	19½" × 6½"	6505T37	11.10	9.88
24–32 oz.	21½" × 6½"	6505T38	13.22	11.76

Highly Absorbent Rayon Cut-End Mop Heads

These mop heads absorb more liquid and dry faster than cotton mop heads. They are white, 8 ply, low linting, and are excellent for applying floor finishes and disinfectants. Headband is 1¼" deep. Handle sold separately; see styles A-C on page 2131.

Approx. Weight	Approx. Lg. × Wd.		1-11	12-Up
16 oz.	14" × 6½"	6329T32	$4.84	$4.36
20 oz.	16" × 6½"	6329T37	5.82	5.24
24 oz.	18" × 6½"	6329T34	6.82	6.14
32 oz.	20" × 6½"	6329T36	8.89	8.00

Highly Absorbent Rayon Cut-End Mop Heads w/Scrub Pad

Mop heads are white, 8 ply, and come with a 6" × 4½" nylon/polyester scrub pad at the base of the headband for more difficult cleaning jobs. Headband is 1¼" deep. Handle sold separately; see styles A-C on page 2131.

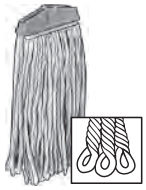
Approx. Weight	Approx. Lg. × Wd.		1-11	12-Up
16 oz.	15½" × 6"	6386T16	$8.34	$7.49
20 oz.	17" × 6"	6386T13	9.51	8.55
24 oz.	18½" × 6"	6386T14	10.64	9.55
32 oz.	21" × 6"	6386T17	12.93	11.62

Durable Cotton-Blend Cut-End Mop Heads

A blend of cotton and synthetic yarns makes these off-white, 4-ply mop heads more absorbent than standard cotton. Headband is 1½" deep. Handle sold separately; see styles A-C on page 2131.

Approx. Weight	Approx. Lg. × Wd.		1-11	12-Up
16 oz.	16" × 7"	7407T11	$6.39	$5.79
20 oz.	17" × 7"	7407T12	7.53	6.81
24 oz.	19" × 7¼"	7407T13	8.71	7.88
32 oz.	22" × 7½"	7407T14	11.24	10.17

Wet Mop Heads with Threaded Handle Holder



"Closed" ends form small circles to avoid fraying and offer more durability. Mops are 4 ply. Handle sold separately; for additional threaded handles, see 7255T on page 2127.

***Cotton*—**Color is off-white.

***Synthetic*—**More durable and absorb more than cotton. Color is white.

Approx. Weight	Approx. Lg. × Wd.		Each ♦	Approx. Lg. × Wd.		Each ♦
	Cotton			*Synthetic*		
20 oz.	18½" × 7¼"	64035T52	$8.05	19" × 7¼"	64035T55	$8.26
24 oz.	20½" × 7½"	64035T53	8.89	21" × 7½"	64035T56	9.42
28 oz.	21" × 7¾"	64035T54	9.87	21½" × 7¾"	64035T57	10.18

60" Threaded Wood Handle ..... 7255T4 **Each** $7.43

♦ Prices are approximately 10% lower when you purchase 12 or more.

Washable Wet Mop Heads

All mop heads have a tailband and come with looped ends—no cut ends to fray or unravel. They are lower linting than cut-end mop heads and can be laundered and reused.

Choose-a-Color Cotton-Blend Mop Heads

Assign different colored mops to different areas to eliminate cross contamination. Made of a 4-ply blend of cotton and synthetic material for durability. They have a 5" deep headband. Handle sold separately; see style D on page 2131. **To Order:** Where necessary, please specify color: blue or green.

Approx. Weight	Approx. Lg. × Wd.		*Off-White* Each ♦	*Choose-a-Color* Each ♦
11 oz.	17" × 6¼"	7458T11	$8.29	7458T25 $9.56
17 oz.	19½" × 6¼"	7458T12	10.60	7458T26 12.30
22 oz.	21½" × 6¼"	7458T13	12.40	7458T27 15.51
26 oz.	22" × 6¼"	7458T14	16.08	7458T28 19.89

♦ Prices are approximately 10% lower when you purchase 12 or more.

Clean Room Polyester Mop Head

You can use this mop head in Class 1 clean rooms. Mop head is white, weighs 16 oz., measures 15¼" Lg. × 7½" Wd., and has tubular strands. Headband is 3" deep. Handle sold separately; see style E on page 2131.

63695T71 ..... 1-11 $29.13 12-Up $24.97

Choose-a-Color Microfiber Mop Heads

Assign different colored mops to different jobs and areas to help eliminate cross contamination. These microfiber mop heads provide excellent liquid and dirt pick-up, dry floors faster, and are washable. Headband is 3½" deep. Handle sold separately; see style B on page 2131. **To Order:** Please specify blue, green, red, or yellow.

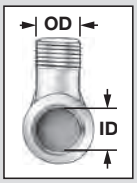
Approx. Weight	Approx. Lg. × Dia.		1-4	5-Up
11 oz.	14" × 6"	3636T11	$16.45	$14.78
16 oz.	14" × 6"	3636T12	22.26	20.00

High-Performance Cotton-Blend Mop Heads

These white, 4-ply mop heads are made of a blend of cotton and synthetic material to withstand heavy use. Headband is 5" deep. Handle sold separately; see style D on page 2131.

Approx. Weight	Approx. Lg. × Wd.		1-5	6-Up
16 oz.	14" × 6"	8199T44	$18.65	$16.44
23 oz.	17" × 6"	8199T45	22.31	19.66
29 oz.	17" × 6"	8199T46	27.44	24.19

Spray Nozzles



Please Read Before Ordering: Pipe size is the accepted industry designation, not the actual size. To determine pipe size, measure the inside diameter (ID) or outside diameter (OD), as shown at left. Then, round up to the closest fitting ID or OD listed in the chart and select the corresponding pipe size. For example, if your fitting ID or OD measures 1 3/16″, the next highest ID or OD in the chart is 1 3/8″, and its corresponding pipe size is 1″.

Fitting ID or OD	3/8″	1/2″	5/8″	3/4″	1″	1 3/8″	1 5/8″	1 7/8″	2 3/8″
Pipe Size	1/8″	1/4″	3/8″	1/2″	3/4″	1″	1 1/4″	1 1/2″	2″

About Spray Nozzles

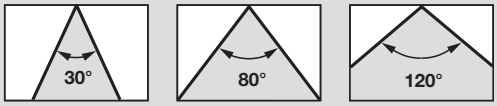
Spray nozzles are used for jobs such as cleaning, cooling, rinsing, controlling dust, applying coatings, humidification, pressure washing, and air drying. Use the chart at the top of the page to determine the proper pipe size.

Brass offers good corrosion resistance. ***Copper-nickel*** is more corrosion and rust resistant than brass. ***Stainless steel*** has better corrosion, abrasion, and chemical resistance than brass. It also has good internal abrasion resistance. ***PVC*** offers very good corrosion and chemical resistance. ***PVDF*** offers excellent chemical and corrosion resistance. ***PFA*** and ***PTFE*** are chemical resistant and the most corrosion-resistant materials we offer.

Spray Patterns

Flat | *Full Cone* | *Hollow Cone* | *Square* | *Solid Stream*

Spray Angles



Flat Spray Nozzles

All nozzles produce a flat, thin spray pattern. Good for washing parts and jobs that involve products moving on a conveyor.

Flat Spray Nozzles

Flat

Great for general cleaning, washing asphalt and concrete, air drying, etching, foam control, and applying coatings. Maximum pressure is 1,000 psi. All have an NPT male connection.

Brass nozzles have a maximum temperature of 450° F. ***Type 303 stainless steel nozzles*** have a maximum temperature of 800° F.

To Order: For all nozzles, please specify spray angle: 30°, 50°, 65°, 80°, or 120°.

Pipe Size	Flow Rate, gpm 20 psi	40 psi	100 psi	1,000 psi	Orifice Dia.	O'all Wd. (Hex Size)	O'all Lg.	Brass	Each 1-9	Each 10-Up	Stainless Steel	Each 1-9	Each 10-Up
1/8″	0.3	0.5	0.7	2.5	0.05″	7/16″	7/8″	3404K73	$5.00	$4.47	3404K78	$12.43	$11.12
1/8″	0.5	0.8	1.2	4.0	0.07″	7/16″	7/8″	3404K11	5.00	4.47	3404K26	12.43	11.12
1/8″	0.7	1.0	1.5	5.0	0.08″	7/16″	7/8″	3404K74	5.00	4.47	3404K79	12.43	11.12
1/8″	1.4	2.0	3.1	10.0	0.10″	7/16″	7/8″	3404K12	5.00	4.47	3404K27	12.43	11.12
1/8″	2.1	3.0	4.7	15.0	0.14″	7/16″	7/8″	3404K13	5.00	4.47	3404K28	12.43	11.12
1/4″	0.3	0.5	0.7	2.5	0.05″	9/16″	1 1/16″	3404K75	5.34	4.81	3404K64	13.14	11.75
1/4″	1.0	1.5	2.3	7.5	0.09″	9/16″	1 1/16″	3404K14	5.34	4.81	3404K29	13.14	11.75
1/4″	2.1	3.0	4.7	15.0	0.14″	9/16″	1 1/16″	3404K15	5.34	4.81	3404K34	13.14	11.75
1/4″	2.8	4.0	6.3	20.0	0.15″	9/16″	1 1/16″	3404K16	5.34	4.81	3404K35	13.14	11.75
1/4″	3.5	5.0	7.9	25.0	0.17″	9/16″	1 1/16″	3404K17	5.34	4.81	3404K36	13.14	11.75
3/8″	2.8	4.0	6.3	20.0	0.15″	11/16″	1 1/4″	3404K18	5.40	4.81	3404K37	17.95	16.13
3/8″	4.9	7.0	11.1	35.0	0.20″	11/16″	1 1/4″	3404K19	5.40	4.81	3404K38	17.95	16.13
3/8″	7.0	10.0	15.8	50.0	0.25″	11/16″	1 1/4″	3404K76	5.40	4.81	3404K65	17.95	16.13
1/2″	4.2	6.0	9.4	30.0	0.18″	7/8″	1 1/2″	3404K77	7.19	6.46	3404K66	23.62	21.21
1/2″	5.6	8.0	12.6	40.0	0.21″	7/8″	1 1/2″	3404K43	7.19	6.45	3404K54	23.62	21.21
1/2″	7.0	10.0	15.8	50.0	0.25″	7/8″	1 1/2″	3404K24	7.19	6.45	3404K39	23.62	21.21
1/2″	8.4	12.0	19.0	60.0	0.26″	7/8″	1 1/2″	3404K44	7.19	6.45	3404K55	23.62	21.21
1/2″	10.6	15.0	23.7	75.0	0.29″	7/8″	1 1/2″	3404K45	7.19	6.45	3404K56	23.62	21.21
1/2″	14.1	20.0	31.6	100.0	0.34″	7/8″	1 1/2″	3404K46	7.19	6.45	3404K57	23.62	21.21
3/4″	21.2	30.0	47.4	150.0	0.42″	1 1/8″	1 3/4″	3404K47	17.12	15.30	3404K58	59.12	52.88
3/4″	28.3	40.0	63.2	200.0	0.50″	1 1/8″	1 3/4″	3404K25	17.12	15.30	3404K42	59.12	52.88
1″	28.3	40.0	63.2	200.0	0.50″	1 3/8″	2 3/16″	3404K48	35.05	31.54	3404K59	121.43	108.36
1″	53.0	75.0	119.0	375.0	0.68″	1 3/8″	2 3/16″	3404K49	35.05	31.54	3404K67	121.43	108.36

Wide-Angle Deflected Flat Spray Nozzles

Flat

Spray Angle

Deflection Angle

An extra-wide spray angle is deflected 75°, producing a low-impact spray for maximum coverage. The angle makes these nozzles a good choice for rinsing and cooling jobs as well as for foam control and applying coatings. Maximum pressure is 60 psi. All have an NPT male connection.

Brass nozzles have a maximum temperature of 800° F. ***Type 303 stainless steel nozzles*** have a maximum temperature of 1400° F.

Pipe Size	Flow Rate, gpm 20 psi	40 psi	60 psi	Spray Angle	Orifice Dia.	O'all Wd. (Hex Size)	O'all Lg.	Brass	Each 1-9	Each 10-Up	Stainless Steel	Each 1-9	Each 10-Up
1/8″	0.1	0.1	0.1	120°	0.02″	7/16″	9/16″	30995K31	$4.97	$4.47	30995K21	$20.81	$18.74
1/8″	0.1	0.2	0.2	148°	0.03″	7/16″	13/16″	30995K32	4.97	4.47	30995K22	20.81	18.74
1/8″	0.7	1.0	1.2	132°	0.07″	7/16″	15/16″	30995K1	5.63	5.03	30995K11	22.02	19.65
1/8″	1.4	2.0	2.4	150°	0.11″	7/16″	15/16″	30995K3	5.63	5.03	30995K13	22.02	19.65
1/4″	2.1	3.0	3.7	144°	0.12″	9/16″	15/16″	30995K5	7.46	6.65	30995K15	26.70	23.86
1/4″	2.8	4.0	4.9	144°	0.15″	9/16″	15/16″	30995K7	7.46	6.65	30995K17	26.70	23.86
3/8″	4.2	6.0	7.3	138°	0.18″	11/16″	1 1/2″	30995K9	8.83	7.91	30995K19	31.25	28.10
3/8″	5.7	8.0	9.8	136°	0.20″	11/16″	1 1/2″	30995K33	8.83	7.91	30995K23	31.25	28.10
3/8″	6.4	9.0	11.0	144°	0.22″	11/16″	1 1/2″	30995K34	8.83	7.91	30995K24	31.25	28.10
1/2″	7.1	10.0	12.2	141°	0.24″	7/8″	1 11/16″	30995K35	9.67	8.65	30995K25	36.90	32.95
1/2″	9.9	14.0	17.1	130°	0.29″	7/8″	2″	30995K36	9.67	8.65	30995K26	36.90	32.95
3/4″	17.0	24.0	29.0	135°	0.37″	1 1/16″	2 3/8″	30995K37	15.52	13.84	30995K27	57.65	51.39
3/4″	25.0	36.0	44.0	136°	0.46″	1 1/2″	2 5/8″	30995K38	25.95	23.13	30995K28	94.70	85.10

(Continued on following page)

About Static Control Mats

Static electricity discharge (also known as electrostatic discharge or ESD) is one of the most common causes of electrical equipment damage and malfunction. Walking on a static control mat drains the electrical charge from you before it causes problems. Some static control mats require ground cords for best performance (see individual presentations).

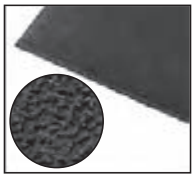
For additional static control products, see page 1005.

Effectiveness in Draining a Static Charge

The three types of static control mats are classified by their surface resistivity range (see chart). Expressed in ohms, surface resistivity measures how much a mat resists draining a static charge. The lower the surface resistivity (the lower the resistance), the faster and more effectively the mats drain the electrical charge.

Type of Mat	Draining Rate	Surface Resistivity
Antistatic	Slowest	10^9-10^{11} ohms
Static Draining	↓	10^6-10^9 ohms
Conductive	Fastest	10^3-10^6 ohms

Antistatic Antifatigue Sponge Mats



Get static control and comfort. Mats have a surface resistivity of 10^9 ohms for draining static electricity without a ground cord. Plus they're made of cushioned vinyl sponge to reduce fatigue. A textured surface provides traction. Mats resist stains and chemicals, but should be cleaned immediately after spills. Have tapered edges on all four sides. For indoor use.

To Order: Please specify black, brown, or light gray.

Standard Size Mats

Wd. × Lg.	Thick.		Each
24″ × 36″	3/8″	6930T21	$30.09
36″ × 48″	3/8″	6930T22	62.60
36″ × 60″	3/8″	6930T23	78.45
36″ × 72″	3/8″	6930T24	93.89
36″ × 96″	3/8″	6930T11	125.49
36″ × 10 ft.	3/8″	6930T25	156.87
36″ × 12 ft.	3/8″	6930T12	188.23
36″ × 30 ft.	3/8″	6930T26	469.20
48″ × 60″	3/8″	6930T13	96.32
48″ × 72″	3/8″	6930T41	115.32
48″ × 96″	3/8″	6930T42	154.02
48″ × 10 ft.	3/8″	6930T14	192.63

Custom Length Mats

Wd.	Thick.	Full Roll		Per Ft.
36″	3/8″	60 ft.	6930T51★	$17.71
48″	3/8″	60 ft.	6930T52★	21.85

★ Minimum length is 2-ft.

Conductive Antifatigue Mats

With surface resistivity of 10^6 ohms, these mats offer the fastest, most effective draining of static electricity. All require a ground cord (sold separately) that plugs directly into the grounding snap located on one corner of each mat. Color is black. For indoor use.

Wear-Resistant Antifatigue Sponge Mats

Mats have a hard layer of diamond-tread vinyl to provide excellent traction and durability, along with a vinyl sponge backing to reduce fatigue. They have tapered edges on all four sides.

Wd. × Lg.	Thick.		Each
18″ × 36″	9/16″	69065T2	$83.36
24″ × 36″	9/16″	69065T4	98.36
36″ × 48″	9/16″	69065T6	192.85
36″ × 60″	9/16″	69065T8	243.38
36″ × 72″	9/16″	69065T9	292.12
36″ × 10 ft.	9/16″	69065T11	482.24
36″ × 30 ft.	9/16″	69065T14	1,341.49
15-ft. Ground Cord		69065T21	13.64

Interlocking Antifatigue Mats

A diamond-tread surface gives this rubber mat excellent traction. It has interlocking connectors to link multiple mats together for any size or shape you need. You can cut connectors off with a utility knife for a finished look.

Wd. × Lg.	Thick.		Each
36″ × 36″	1/2″	7585T25	$86.09
15-ft. Ground Cord		69065T21	13.64

Static-Draining Mats

V-Rib

Carpet Top

Wear-Resistant Antifatigue Sponge

V-Rib Mats—Have a surface resistivity of 10^8-10^9 ohms for good static draining without a ground cord. Plus, the V-ribs provide more traction than the carpet-top and wear-resistant mats. Mats are vinyl and resist grease, oil, and chemicals. Color is light gray. For indoor and outdoor use.

Carpet-Top Mats—With a surface resistivity of 10^7-10^8 ohms, they provide better static control than the V-rib mats and still don't need a ground cord. They have a nylon carpet top that removes dirt and moisture from your shoes and a rubber backing that keeps mats in place. Mats also have tapered edges on all four sides. Color is black. For indoor use.

Wear-Resistant Antifatigue Sponge Mats—Have a surface resistivity of 10^6-10^{10} ohms and require a ground cord (sold separately). Cord plugs directly into the grounding snap located on one corner of each mat. The top and bottom of these mats are smooth, hard vinyl for durability, with a vinyl sponge center for cushioning. They have tapered edges on all four sides. Color is black. For indoor use.

Standard Size Mats

Wd. × Lg.	Thick.		Each
V-Rib Mats			
36″ × 48″	1/8″	68165T61	$56.39
36″ × 72″	1/8″	68165T62	84.59
36″ × 10 ft.	1/8″	68165T63	140.98
48″ × 60″	1/8″	68165T64	93.43
48″ × 10 ft.	1/8″	68165T65	186.86
Carpet-Top Mats			
24″ × 35″	3/8″	6848T212	29.98
35″ × 47″	3/8″	6848T213	59.95
35″ × 59″	3/8″	6848T223	74.97
35″ × 69″	3/8″	6848T233	89.90
35″ × 118″	3/8″	6848T235	149.90
45″ × 69″	3/8″	6848T243	119.90
45″ × 95″	3/8″	6848T253	159.92
Wear-Resistant Antifatigue Sponge Mats			
18″ × 36″	1/2″	8531T1	90.24
24″ × 36″	1/2″	8531T3	104.76
36″ × 48″	1/2″	8531T5	214.90
36″ × 60″	1/2″	8531T7	248.13
36″ × 72″	1/2″	8531T8	293.32
36″ × 10 ft.	1/2″	8531T9	488.88
36″ × 30 ft.	1/2″	8531T11	1,313.39
48″ × 72″	1/2″	8531T12	451.27
48″ × 96″	1/2″	8531T14	601.69
15-ft. Ground Cord		69065T21	13.64

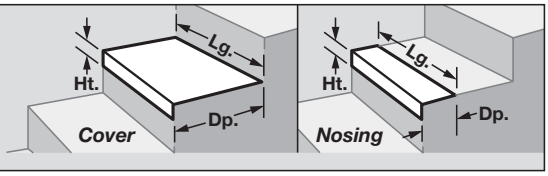
Custom Length Mats

Wd.	Thick.	Full Roll		Per Ft.
V-Rib Mats				
36″	1/8″	60 ft.	68165T67	$17.84
48″	1/8″	60 ft.	68165T68	23.48
Carpet-Top Mats				
35″	3/8″	40 ft.	6848T51	19.16
45″	3/8″	40 ft.	6848T52	24.87

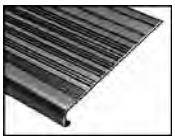
About Stair Tread Covers and Nosing

Stair tread covers and nosing not only protect worn stairs, they also provide a slip-resistant surface.

Covers protect the entire stair surface. On worn stairs, they provide a new stair surface. ***Nosing*** protects the front portion of the stair.



Stair Tread Covers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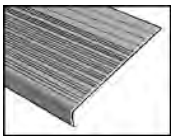
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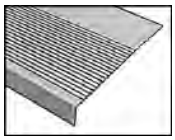
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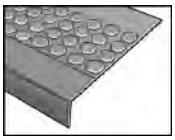
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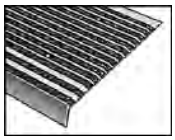
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H

(A&B) Oil- and Chemical-Resistant Vinyl Covers— Fit square-nose concrete and wood stairs. To install, use stair tread adhesive sold separately. For indoor use.

(C-F) High-Traffic Rubber Covers— Fit square-nose concrete and wood stairs. To install, use stair tread adhesive sold separately. *Style F* comes with two 1″ wide abrasive strips for added traction. For indoor use.

(G) Corrosion-Resistant Aluminum Covers with Grit— A grit top gives these covers excellent traction in high-traffic areas. The color in the table below refers to grit. Covers have 1/4″ dia. countersunk mounting holes. To install, use construction adhesive sold separately on page 3555, or screw in place; see pg. 3445 for concrete screws or see 90031A on page 3086 for #10 wood screws. For indoor and outdoor use.

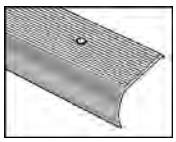
(H) Corrosion-Resistant Plastic Covers with Grit— Made of fiberglass reinforced plastic (FRP) for superior corrosion resistance in harsh environments. Cover has a yellow glow-in-the-dark nose for high visibility. To install use construction adhesive sold separately on page 3555, then drill and screw in place; see pages 3068, 3109, and 3119 for stainless steel truss-head screws. For indoor and outdoor use.

Stair tread adhesive for Styles A-F covers 125-150 sq. ft./gal. Color is white. For indoor use.

To Order: For all stair tread covers, please specify color and length from the available choices listed in the table.

Dp.	Ht.	Thick.	Available Colors		36″ Lg.	42″ Lg.	48″ Lg.	54″ Lg.	60″ Lg.	72″ Lg.
Oil- and Chemical-Resistant Vinyl										
A 9 5/8″	7/8″	1/8″	Black, Brown	6843T11	$17.43	$20.38	$23.25	_____	_____	$34.15
B 12″	1 1/4″	3/16″	Black, Brown, Lt. Gray	6864T12	31.42	36.49	41.71	$46.95	$52.18	61.29
High-Traffic Rubber										
C 12 1/4″	1 9/16″	1/8″	Black, Brown, Lt. Gray	6929T29	53.38	62.29	71.18	80.09	88.97	106.76
D 13″	1 7/8″	1/4″	Black, Marbled Brown, Marbled Lt. Gray	6910T13	61.80	72.10	82.40	92.70	103.00	123.60
E 12″	2″	7/32″	Black, Brown, Lt. Gray	6291T15	61.72	72.01	82.30	92.58	102.87	123.45
F 13″	1 5/8″	3/16″	Black, Marbled Brown, Marbled Lt. Gray	6249T17	60.24	70.28	80.32	90.36	100.40	120.48
Corrosion-Resistant Aluminum with Grit										
G 8 7/8″	1 1/8″	9/32″	Black, Black with Yellow, Lt. Gray	6847T12	67.60	78.86	90.13	101.39	112.66	135.19
G 10 7/8″	1 1/8″	9/32″	Black, Black with Yellow, Lt. Gray	6847T13	90.64	105.74	120.85	135.96	151.06	181.28
Corrosion-Resistant Plastic with Grit										
H 12″	1 1/2″	1/8″	Dark Gray with Yellow	6127T59	70.50	82.26	94.00	105.76	117.74	141.05
Stair Tread Adhesive for Styles A-F (1 gal. can)									62695T82	46.40

Stair Tread Nosing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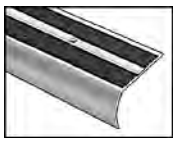
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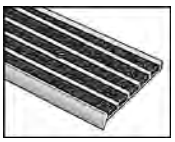
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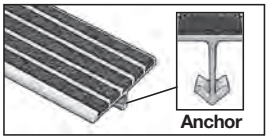

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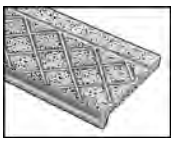
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(J&K) Aluminum Nosing— An etched and anodized finish provides a slip-resistant surface. Simple to install, just screw nosing into place. For wood stairs, use #4 wood screws (see 90031A on page 3086). For indoor and outdoor use.

Style J has a ribbed surface. *Style K* has two abrasive strips for added traction.

(L&M) Aluminum Nosing with Grit— Five channels embedded with grit provide excellent traction and slip resistance. For indoor and outdoor use.

Style L can be installed in fresh concrete as well as on existing stairs. It has 1/4″ dia. countersunk holes for concrete screws (see page 3445). *Style M* has an integral anchor for installation in fresh concrete; no fasteners required.

(N) Cast Aluminum and Cast Iron Nosing with Grit— Embedded with abrasive grit for traction, this durable nosing can handle heavy traffic and rough environments. Ideal for concrete-filled, steel framed stairs. Mounting hardware included.

Cast aluminum is for indoor and outdoor use. *Cast iron* is for indoor use.

Nosing epoxy compound is for use between nosing and front edge of a stair to prevent cracks. Covers 75 lin. ft./qt. For indoor and outdoor use.

To Order: Please specify length.

Dp.	Ht.	Thick.		36″ Lg.	42″ Lg.	48″ Lg.	60″ Lg.	72″ Lg.	144″ Lg.
Aluminum									
J 2 1/2″	1 1/2″	1/8″	6282T23	$15.46	$20.44	$19.96	$29.11	$30.45	$62.58
K 3″	1 1/16″	3/32″	6282T24	36.27	52.83	49.26	67.88	69.94	111.12
Aluminum with Grit— **To Order:** *Please specify grit color: black or yellow.*									
L 2 7/8″	1/4″	1/4″	6846T14	31.86	37.17	42.48	53.10	63.72	127.44
M 2 7/8″	1/4″	1/4″	7745T59	27.31	31.85	36.40	45.51	54.60	109.20
Cast Aluminum with Black Grit									
N 2 11/16″	3/8″	5/16″	6952T11	40.21	46.92	53.61	67.00	80.40	_____
N 3 11/16″	3/8″	5/16″	6952T12	51.84	60.45	69.10	86.38	103.65	_____
Cast Iron with Black Grit									
N 2 11/16″	3/8″	5/16″	6861T16	47.56	55.52	63.42	79.25	95.10	_____
N 3 11/16″	3/8″	5/16″	6861T17	60.62	70.70	80.80	101.00	121.20	_____
Nosing Epoxy Compound for Styles J-N (1 qt. can)								62695T86	42.67

About Paint and Protective Coatings

Use the table below to select a paint or coating based on the properties most important to your application. ● Excellent ◓ Good ○ Poor

Paint	Fade Resistance	Abrasion Resistance	Fast Drying	Adhesion	Low Odor
 **Water Based (Page 2202)—** Also called latex paint, these clean up with soap and water.	●	◓	●	◓	●
Solvent Based (Pages 2201–2203)— Also called oil or alkyd paint, these clean up with solvent-based thinners and removers.	◓	●	◓	●	○

Protective Coatings	Fade Resistance	Abrasion Resistance	Corrosion Resistance	Chemical Resistance	Moisture Resistance
 **Polyurethane (Page 2204)—** Many of these coatings are ready to use without mixing. They're often used in outdoor applications on dumpsters, hoppers, and structural steel.	●	●	◓	●	◓
 **Rubber (Page 2204)—** Waterproof and insulate surfaces with these durable coatings. They can be used to create tool grips, seal leaks, and reduce vibration.	◓	●	◓	◓	●
 **Epoxy (Page 2205)—** Often a two-part mix, these thick coatings can be used in high-humidity environments. Apply on pipes, storage tanks, and equipment that is immersed in water.	○	●	●	●	●
 **Stainless Steel and Galvanizing (Pages 2205–2206)—** These permanent coatings bond to the surface for long-term protection against rust and corrosion. Use on bare metal, machinery, tools, and dies.	●	○	●	●	◓
 **Peel Away Coatings and Corrosion-Inhibiting Films (Pages 2206–2207)—** Remove these temporary coatings after use. They're for short- and long-term protection of metal during shipping and storage.	—	◓	●	◓	●

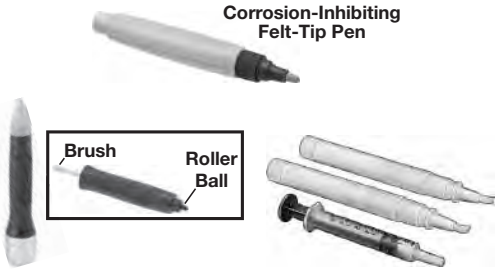
Surface Preparation and Clean Up

For proper adhesion, make sure that all surfaces are completely free of moisture, grease, dirt, and rust before applying paint or coating. For rust, paint, and coating removers, see pages 2206-2207.

Primers— For optimal adhesion, use these undercoats to extend the life of paint and coatings. Primers are listed with corresponding paint and coatings; for additional primers, see page 2203.

Thinners— Use to dilute thick paint or for clean-up. For paint thinners, see page 2202.

Touch-Up Paint Pens



Roller-Ball/Brush Pen | Fillable Brush Pen Set

Corrosion-Inhibiting Felt-Tip Pen— Seal out moisture on scratched painted metal. Paint is water based.

Roller-Ball/Brush Pen— This touch-up paint applicator has both a roller-ball pen and a tapered brush tip for precision application on painted metal. Paint is solvent based.

Fillable Brush Pen Set— Fill these pens with water-based paint for a tidy touch-up. Use the included syringe to fill the pen. Then snap on the brush tip and twist to lock it in place. Pens are reusable.

	Cap., oz.	Colors		
Corrosion-Inhibiting Felt-Tip Pen	1/8	Clear	9959T21	$8.83
Roller-Ball/Brush Pen	1/2	Flat Black	9959T52	14.64
Roller-Ball/Brush Pen	1/2	Gloss Black	9959T41	14.64
Fillable Brush Pen Set (2 Pens with Syringe)	1/8	_____	9959T2	7.98

Aerosol Clear Protective Coatings

Add a tough, long-lasting protective coating to your surfaces. All are solvent based.

Acrylic Coatings— These flexible coatings protect against rust and corrosion. Use on metal, paper, and wood surfaces.

Shellac— Use this coating to seal, finish, and protect brass, ceramic, copper, glass, metal, tile, and wood. It has a slight yellow tint.

Lacquers for Nonferrous Metals— Protect brass, bronze, copper, and silver from moisture, chemicals, oxidation, and abrasion. The outdoor coating provides UV resistance.

Lacquers for Wood— Apply these wear-resistant coatings to wood. They protect surfaces from scuffs, water, and oil damage.

	For Use	Finish	Size, net wt.	Dry Time Touch	Dry Time Overall	Max. Temp.		1-11	12-Up
Acrylic Coating	Outdoor	Flat	12 oz.	5 min.	24 hrs.	150°F	7850T5	$6.20	$5.57
Acrylic Coating	Outdoor	Gloss	12 oz.	5 min.	24 hrs.	150°F	7850T4	6.20	5.57
Acrylic Coating with UV Inhibitors	Outdoor	Gloss	11 oz.	15 min.	24 hrs.	120°F	7850T8	7.95	7.15
Shellac	Indoor	Semi-Gloss	12 oz.	15 min.	1 hr.	160°F	7655T1	11.99	10.76
Lacquer for Nonferrous Metals	Indoor	Gloss	12 oz.	5 min.	8 hrs.	150°F	76885T73	14.02	11.67
Lacquer for Nonferrous Metals	Outdoor	Gloss	12 oz.	5 min.	8 hrs.	160°F	76885T75	15.02	12.50
Lacquer for Wood	Indoor	Flat	12 oz.	15 min.	4 hrs.	250°F	20035T56	10.83	9.95
Lacquer for Wood	Indoor	Gloss	12 oz.	15 min.	4 hrs.	250°F	20035T57	10.83	9.95

About Lubricants, Grease, and Oil

	Features/Applications	Pages
Multipurpose Lubricants	Easy to apply, these lubricants penetrate tight spots that grease and oil can't reach. Use them to free and lubricate moving parts and equipment.	2238-2240
Coating Lubricants	Select Petroleum Jelly to protect metal parts and equipment surfaces, O-Ring Lubricants to reduce friction between mating parts, and Mold-Release Lubricants to protect and free molded parts.	2241-2242
Antiseize Lubricants	A combination of solid lubricants, grease, and anticorrosion additives, these lubricants prevent the sticking or jamming as well as corrosion that can occur in metal-to-metal contact.	2242-2244
Grease	Compared to penetrating lubricants and oil, grease adheres better and lasts longer so you don't have to apply it as often. Additives such as PTFE and molybdenum disulfide improve performance.	2244-2249
Oil	Oil is typically used where it can be circulated through a piece of equipment or machinery. Choose oil when spraying or splashing are contained, as in a gearbox or engine compartment.	2248-2254

Lubricants

LPS, CRC 3-36, Sprayon Rust Breaker Penetrant, 3-in-1, and ***Starrett M1*** are NSF registered H2 for applications with no possibility of food contact. ***Aerosols*** have a male stem except for Dow Corning Molykote Silicone 557 and Loctite Silicone, which have a female stem.

WD-40 (–10° to +200° F)

Size		Each	Pkg. Qty.	
3-oz. Aerosol	1347K413	$3.07	12	$32.88
8-oz. Flip-Up Straw Aerosol	1347K483	6.21	12	67.08
11-oz. Flip-Up Straw Aerosol	1347K365	6.88	12	74.04
12-oz. Flip-Up Straw Aerosol	1347K384	7.27	12	78.00
16-oz. Aerosol	1347K375	7.12	12	76.44
18-oz. Big-Blast Aerosol	1347K394	7.96	12	85.56
20-oz. Spray Trigger Nonaerosol	1347K433	11.53	12	123.90
1-gal. Container	1347K323	25.05	4	89.72
5-gal. Container	1347K33	106.24	—	—
55-gal. Drum	1347K34	1,095.56	—	—
Empty 16-oz. Spray Bottle	1347K313	3.83	4	13.73

LPS (–50° to +300° F)

#1 Greaseless— Meet MIL-C-23411A.
#2 Industrial Strength— Meet MIL-C-16173D, Grade 3, Class I and MIL-C-81309D, Type III.

Size		Each	Pkg. Qty.	
#1 Greaseless				
11-oz. Aerosol	1200K214	$11.63	12	$129.22
20-oz. Spray Pump	1200K222	21.76	12	230.39
1-gal. Container	1200K713	54.77	4	202.85
5-gal. Container	1200K23	244.01	—	—
55-gal. Drum	1200K24	2,022.65	—	—
#2 Industrial Strength				
11-oz. Aerosol	1200K334	11.52	12	127.92
20-oz. Spray Pump	1200K342	24.21	12	256.43
1-gal. Container	1200K732	54.41	4	197.03
5-gal. Container	1200K74	242.41	—	—

CRC 3-36

Size		Each	Pkg. Qty.	
For Metals *(–50° to +250° F)*				
5-oz. Aerosol	1420K123	$6.80	12	$76.06
11-oz. Aerosol	1420K146	7.81	12	87.52
1-gal. Container	1420K162	48.13	4	179.69
5-gal. Container	1420K18	204.51	—	—
For Plastics *(Max. temperature is to +250° F)*				
11-oz. Aerosol	1420K152	9.34	12	104.60
Ultra-Lite Dry Film *(–40° to +300° F)*				
11-oz. Aerosol	1420K312	10.53	12	117.88
1-gal. Container	1420K332	65.63	4	245.00
5-gal. Container	1420K35	278.93	—	—

Sprayon Rust Breaker Penetrant (–20° to +550° F)

Size		Each	Pkg. Qty.	
10-oz. Aerosol	10615K233	$8.40	12	$90.72
14-oz. Spray Pump	10615K242	12.85	12	138.69
1-gal. Container	10615K252	45.70	4	166.17

3-in-1 (–25° to +300° F)

Size		Each	Pkg. Qty.	
3-oz. Squirt Spout	1271K103	$2.72	24	$59.28
8-oz. Squirt Spout	1271K604	4.52	12	49.32

Liquid Wrench L1 (0° to +320° F)

Size		Each	Pkg. Qty.	
4-oz. Squirt Spout	1233K212	$3.00	12	$31.96
11-oz. Aerosol	1233K225	5.04	12	53.79
16-oz. Squirt Spout	1233K233	7.06	12	75.31
1-gal. Container	1233K242	33.85	4	128.03

Dow Corning Molykote Silicone 557 (–40° to +110° F)

Size		Each	Pkg. Qty.	
11-oz. Aerosol	1254K122	$27.12	12	$295.44

Loctite Silicone (–58° to +400° F)

Size		Each	Pkg. Qty.	
5.3-oz. Tube	10255K633	$18.67	12	$200.84
13-oz. Aerosol	10255K652	8.02	12	86.35

Starrett M1 (–40° to +120° F)

Size		Each	Pkg. Qty.	
12-oz. Aerosol	1007K214	$10.40	12	$111.55
1-gal. Container	1007K122	58.33	4	206.91

Break-Free CLP (–65° to +400° F)

Size		Each	Pkg. Qty.	
4-oz. Squeeze Bottle	1172K842	$7.58	10	$66.74
12-oz. Aerosol	1172K853	13.86	12	146.55
16-oz. Spray Pump	1172K862	23.77	10	209.48
1-gal. Container	1172K872	108.21	4	381.46

Wipes (20/Box) **1172K91** **Box** 1-5 $6.93 6-Up $6.12

Boeshield T-9 (–30° to +300° F)

Meet MIL-C-16173D.

Size		Each	Pkg. Qty.	
4-oz. Aerosol	10215K232	$9.28	12	$99.48
12-oz. Aerosol	10215K252	18.33	12	196.56
1-gal. Container	10215K752	128.57	4	459.56

Kroil (Not rated for temperature.)

Size		Each	Pkg. Qty.	
16-oz. Aerosol	1463K132	$23.33	12	$255.93
8-oz. Container	1463K112	12.04	24	264.13

Antiseize Lubricating Tapes

Allowing easy, no-mess assembly and disassembly, these lubricants won't run or rub off your threaded connections—just wrap tape tightly around threads. Size is ½" Wd. x 50 ft. Lg.

Copper— Made of copper and PTFE. Not recommended for stainless steel.

Nickel— Made of nickel and PTFE. Excellent for metals, especially stainless steel and aluminum. Color is silver.

	Temperature Range		Roll 1-4	Roll 5-Up
Copper	–450° to +2200° F	2290K1	$11.23	$10.08
Nickel	–450° to +2400° F	2290K2	16.83	15.12

Clean-Hands Antiseize Dispenser

Neatly, quickly, and efficiently apply antiseize to parts with this trigger-gun dispenser. It threads directly to the top of most 8-oz. and 1-lb. brush-top antiseize lubricant cans. Dispenser is made of steel and comes furnished with a brush tip.

1800K8 ..... $51.42

About Grease

There are several reasons to use grease as a lubricant: It adheres better than oil; it tends not to leak or run; and it can be formulated for conditions such as high temperatures, extreme pressure, and varying loads and speeds. It also resists moisture to prevent corrosion.

Grease Components— Grease is a semisolid made of base oil, thickener, and additives.

Base oils do the lubricating. Petroleum oil is the most economical. Synthetic oil (nonpetroleum) lasts longer and can generally withstand higher temperatures. Semisynthetic oil (a blend of petroleum and synthetic) balances lower cost with longer-lasting performance.

Thickeners are solid particles that hold the base oil in place. The chart below is a guide for comparing the relative properties of the most common thickeners.

Thickener	Heat Resistance	Moisture Resistance	Oxidation Resistance★
Aluminum	Fair	Good	Excellent
Calcium Sulfonate	Good	Excellent	Excellent
Carbon Black	Excellent	Fair	Good
Clay	Excellent	Fair	Good
Elastomer	Excellent	Good	Good
Lithium	Good	Good	Fair
High-Performance Lithium	Excellent	Excellent	Fair
PTFE	Good	Good	Good
Silica	Excellent	Excellent	Good
Silicone	Excellent	Excellent	Good
Sodium	Excellent	Poor	Poor

★ Oxidation of lubricants can produce sludge, varnish, gum, and acid.

Grease Consistency— The NLGI (National Lubricating Grease Institute) rates grease by its consistency on a numeric scale. The most common NLGI number is 2. Lower numbers are softer and flow better, while higher numbers are firmer, tend to stay in place, and are a good choice when leakage is a concern.

The table below compares the most common NLGI grades with household products that have similar consistencies.

NLGI No.	Consistency Comparison
0	Brown Mustard
1	Tomato Paste
2	Peanut Butter
3	Vegetable Shortening

Lithium-Thickened Grease

These multipurpose lubricants offer good heat and moisture resistance.

Mobilux EP 111— Made of oil and molybdenum disulfide, these black greases are wear resistant and suitable for high-speed rotating couplings as well as low-speed open gears and plain bearings.

Mobilux EP 1 and ***EP 2—*** This brown multipurpose grease offers rust and corrosion resistance for use in moist or wet conditions.

Dow Corning Molykote BR-2 Plus— Contain molybdenum disulfide to withstand extreme pressures. These black greases are suitable for moderate- to high-speed ball and roller bearings, conveyors, and shop equipment.

Dow Corning Molykote 44 with Silicone— Use these off-white silicone-based synthetic greases for antifriction bearings; plastic and rubber parts under light loads; and moderate- to high-speed applications.

Shell Gadus S2 High-Speed Coupling Grease— Suitable for low and high speeds and heavy loads, use this dark brown grease on geared and flexible chain couplings.

Shell Gadus S2 V220— Fortified with extreme-pressure additives, this brown grease can handle heavy, suddenly applied (shock) loads in bearing applications.

Shell Gadus S2 V100— This is a low-noise grease. Color is brown.

White Lithium— This grease is for general lubrication. Stem is male.

White Lithium with PTFE— PTFE additive provides protection from friction. Aerosol has a female stem.

Marine Grade— These purple greases cling to surfaces, so they won't be washed away by water or salt.

Synthetic— Long-lasting with a wide temperature range, this light gray grease is great for bearings and gears as well as most plastics.

Bio-Based— This ester-based grease resists water and protects from rust. It also contains extreme-pressure additives for heavy duty applications. Color is brown.

Size	NLGI No.	Each	Pkg. Qty.	
Mobilux EP 111 *(+14° to +248° F)*				
Cartridge for Grease Gun (13.7 oz.)	1	1416K174	$3.82	10 $34.21
35-lb. Container	1	1416K15	124.31	— —
Mobilux EP 1 *(–4° to +266° F)*				
Cartridge for Grease Gun (13.7 oz.)	1	1416K414	3.82	10 34.25
Mobilux EP 2 *(–4° to +266° F)*				
Cartridge for Grease Gun (13.7 oz.)	2	1416K434	3.89	10 34.88
Dow Corning Molykote BR-2 Plus *(–20° to +265° F)*				
Cartridge for Grease Gun (14.1 oz.)	2	10605K425	11.51	10 104.47
35-lb. Container	2	10605K43	243.43	— —
Dow Corning Molykote 44 with Silicone *(–40° to +400° F)*				
5.3-oz. Tube	2	1252K232	30.90	12 336.57
Cartridge for Grease Gun (14.1 oz.)	2	1252K252	78.33	10 710.95
8-lb. Container	2	1252K27	504.75	— —
Shell Gadus S2 High-Speed Coupling Grease *(–10° to +250° F)*				
Cartridge for Grease Gun (14.1 oz.)	0-1	8670T122	9.55	10 86.93
■ Temperature range is –22° to +350° F.				

Size	NLGI No.	Each	Pkg. Qty.	
Shell Gadus S2 V220 *(–4° to +212° F)*				
Cartridge for Grease Gun (14.1 oz.)	2	8670T133	$6.12	10 $55.67
Shell Gadus S2 V100 *(–22° to +266° F)*				
Cartridge for Grease Gun (14.1 oz.)	2	8670T142	6.19	10 56.21
White Lithium *(0° to +335° F)*				
10.25-oz. Aerosol	2	1380K294	5.21	12 55.82
White Lithium with PTFE *(–10° to +300° F)*				
10-oz. Aerosol	2	1284K754■	11.94	12 130.91
Cartridge for Grease Gun (14 oz.)	2.5	1380K22	6.52	— —
1-lb. Container	2.5	1380K353	7.46	16 106.19
35-lb. Container	2.5	1380K23	152.17	— —
Marine Grade *(0° to +325° F)*				
Cartridge for Grease Gun (14 oz.)	2	10175K153	6.26	30 158.96
35-lb. Container	2	10175K19	144.57	— —
Synthetic *(–50° to +400° F)*				
Cartridge for Grease Gun (14 oz.)	1	1431K102	15.03	20 255.22
Bio-Based *(0° to +350° F)*				
Cartridge for Grease Gun (14 oz.)	2	3246K322	12.67	10 114.03

For information about lubricants, grease, and oil, see page 2238. For more on grease, see page 2244.

Extreme-Pressure Grease and Oil

Able to withstand pressures up to 50,000 psi, these lubricants also repel water and resist corrosion. Use them on lathes, machine ways, cams, and bearings. Grease is thickened with petroleum wax and is green; oil is black.

Size		Each	Pkg. Qty.	
Grease				
4-oz. Tube	1392K314	$8.61	24	$181.92
Cartridge for Grease Gun (14 oz.)	1392K582	21.36	10	188.17
1-gal. Container	1392K322	178.18	2	313.92
Oil				
4-oz. Tube	1392K342	8.61	24	182.04
1-gal. Container	1392K352	156.96	2	280.52

No-Spill Fluid Containers

Even when turned upside down, these containers keep fluids inside. Use them to hold lubricants, cutting fluids, and many other liquids without worrying about spills. Containers are made of polyethylene. They include an applicator brush as well as a plug for storing liquids. Size is 3″ Dia.x2½″ Ht.

Color of Container Top	Capacity		Each
Red	3.9 oz.	1023K111	$7.67
White	3.9 oz.	1023K112	7.67
Blue	3.9 oz.	1023K113	7.67

About Oil

Viscosity is the thickness, or resistance to flow, of an oil. Various organizations have different scales on which oil viscosity is measured. The *International Organization for Standardization (ISO) and Society of Automotive Engineers (SAE)* each assign a grade number. Oils with higher numbers are thicker than those with lower numbers. The *Saybolt Seconds Universal (SSU)* viscosity test measures the number of seconds it takes for 60 cc (cubic centimeters) of oil to flow through a specified diameter hole. The *American Gear Manufacturers Association (AGMA)* has its own grading system specific to industrial gear oil.

Additives improve specific characteristics of an oil, such as load capacity and corrosion resistance. *Detergent additives* prevent sludge and other engine deposits by keeping unwanted particles suspended in the oil. These suspended particles are later removed when the oil passes through a filter. Detergents are most commonly found in engine oils. *Nondetergent oils* are suitable for applications in which the formation of sludge and other deposits is not a problem and no filter is present.

Oil Brand Name Cross Reference

	ExxonMobil	ChevronTexaco	Shell	McMaster-Carr Equivalent	Page
Machine Oil	DTE Light, Medium, Heavy	Regal R&O	Vitrea/Turbo T	**3025K**	2249
Gear Oil	Mobilgear 600 Series	Meropa	Omala	**2284K**	2250
Hydraulic Oil	DTE 20 Series/Excel ISO	Rando HD	Tellus Plus	**1016K**	2250
Way Oil	Vactra	Way Lubricant	Tonna V	**1017K**	2251
Spindle Oil	Velocite	Spindura	Spindle Oil	**13595K**	2251

Machine Oil

Meet your general purpose needs with these nondetergent oils. Suitable for machine tools, circulating systems, and reciprocating equipment, they all resist rust and oxidation.

Mobil DTE—Color is amber.

Standard—Also known as turbine oil, these oils are comparable to Regal R&O and Vitrea/Turbo. ISO grade 22 and 32 are yellow; ISO grade 46-150 are amber.

Food Grade—NSF registered H1 for applications with incidental food contact. Color is clear.

Extendable-Spout Oiler—Filled with standard machine oil, this oiler telescopes to 7″ and flexes to reach lubrication points. Oil is yellow.

Grade ISO	Grade SAE	SSU @ 100° F	1 Gallon	Each	Pkg. Qty.		5 Gallon	Each
Mobil DTE								
32	10	158	2158K142	$29.33	6	$158.74	2158K34	$121.75
68	20	325	2158K152	29.33	6	175.98	2158K35	121.75
100	30	495	2158K162	29.33	6	158.74	2158K36	121.75
150	40	840	2158K172	30.30	6	163.96	2158K37	125.82
Standard								
22	5W	100	3025K212	19.98	6	109.34	3025K23	83.14
32	10W	150	3025K252	19.98	6	109.34	3025K27	83.14
46	10	225	3025K292	19.98	6	109.34	3025K32	83.14
68	20	335	3025K342	19.98	6	109.34	3025K36	83.14
100	30	500	3025K382	20.47	6	112.90	3025K41	85.18
150	40	750	3025K432	20.87	6	125.22	3025K45	86.82
Food Grade								
46	20	237	1400K113	36.18	4	130.25	1400K15	161.27
68	20	348	1400K212	38.60	4	138.93	1400K25	161.27
100	30	542	1400K312	38.60	4	138.93	1400K35	161.27
150	40	791	1400K412	41.56	4	149.60	1400K45	176.45
Extendable-Spout Oiler—*4 oz. Squeeze Bottle*								
32	10W	155	1244K141	**Each**	$3.48		**Pkg. of 12**	$37.52

Extendable-Spout Oiler

Air Compressor Oil

Designed for most major manufacturers' compressors, these nondetergent oils reduce wear on rings, cylinders, and other moving parts.

Mobil Rarus 427—Color is amber.

Standard—ISO grade 32 and 46 are yellow. ISO grade 68, 100, and 150 are amber.

Grade ISO	Grade SAE	SSU @ 100° F	1 Gallon	Each	Pkg. of 6	5 Gallon	Each
Mobil Rarus 427							
100	30	530	2158K252	$35.44	$189.03	2158K45	$145.54
Standard							
32	10W	150	14015K232	20.93	108.00	14015K26	84.31
46	10	225	14015K332	21.86	112.80	14015K36	87.76
68	20	300	14015K433★	27.91	96.00	14015K46	101.45
100	30	500	14015K732	22.79	117.60	14015K76	92.51
150	40	750	14015K832	22.92	118.32	14015K86	93.16
Food Grade							
32	10W	150	8763T322	58.75	317.82	8763T37	250.00
46	—	225	8763T422	58.75	317.82	8763T47	250.00

★ Package quantity is 4.

Food Grade—NSF registered H1 for applications with incidental food contact. Color is clear.

Synthetic—Change your oil less often with these long-lasting synthetic oils. ISO grade 32, 68, and 100 are yellow. ISO grade 46, 150, and 220 are amber.

Grade ISO	Grade SAE	SSU @ 100° F	1 Gallon	Each	Pkg. of 6	5 Gallon	Each
Food Grade (Cont.)							
68	20	330	8763T522	$58.75	$317.82	8763T57	$250.00
100	30	500	8763T622	58.75	317.82	8763T67	250.00
150	40	750	8763T722	59.66	322.80	8763T77	253.33
Synthetic							
32	10W	150	1411K112	60.00	320.00	1411K15	230.00
46	20	209	1411K412	95.49	509.29	1411K45	358.16
68	20	300	1411K212	60.00	319.98	1411K25	230.00
100	30	500	1411K312	60.00	319.98	1411K35	230.00
150	40	666	1411K512	105.39	562.08	1411K55	397.74
220	50	1,009	1411K612	99.46	530.44	1411K65	374.04

About Grease Fitting Threads

In general, grease fitting threads follow pipe thread conventions and are either tapered or straight.

Tapered Pipe Threads

PTF and NPTF—Also known as Dryseal, these threads are tapered for leakproof installations. Compatible with NPT threads, but some leak-free characteristics are lost.

Metric and British Pipe Threads—Tapered in accordance with DIN standards established by the German Institute for Standardization and adopted by ISO (International Organization for Standardization).

Straight Threads

1/4"-28 Taper—Threads are tapered but they are designed to be installed into a 1/4"-28 straight threaded hole. Also known as SAE-LT threads (Society of Automotive Engineers Lubrication Threads).

UNF and UNEF—Similar to threads on a machine screw or bolt. They require a sealant, such as an O-ring, to minimize leakage.

Grease Fittings

Satisfy most general purpose lubrication requirements. All have a ball check to keep out dirt and other contaminants, unless noted. Max. pressure is 10,000 psi, unless noted. Threads are male, unless noted.

Steel fittings are zinc plated. ***Stainless steel***, ***brass***, and ***Monel*** fittings withstand corrosive conditions. Stainless steel is more corrosion resistant than brass; Monel is the most corrosion resistant.

Metric, BSPT, and ***BSF*** fittings meet DIN 71412 standards.

Straight Fittings

Material	O'all Ht.	Hex Size	Pkg. Qty.		Pkg. 1-9	Pkg. 10-Up
1/8" Pipe Thread (PTF)						
Steel	9/16"	7/16"	10	1095K65	$3.41	$2.98
Steel	11/16"	7/16"	10	1095K11	3.41	2.99
Steel	1 1/4"	7/16"	10	1095K12	11.24	9.84
Steel	1 3/4"	7/16"	5	1095K13	8.62	7.55
Steel	2 5/8"	3/8"	1	1095K14	3.09	2.70
Steel w/ Cap	31/32"	7/16"	1	1095K16▲	3.81	3.34
Stainless	3/4"	7/16"	5	1293K11	10.38	8.90
Brass	19/32"	7/16"	5	3088K16	7.37	6.32
Brass	11/16"	7/16"	5	3088K18	8.77	7.52
Monel	5/8"	7/16"	1	1292K31	9.33	8.16
Monel	3/4"	7/16"	1	1292K32	10.51	9.40
1/8" Female Pipe Thread (NPTF)						
Steel	1"	1/2"	10	1095K15	12.19	10.66
1/4" Pipe Thread (PTF)						
Steel	7/8"	9/16"	10	1095K31	12.80	11.20
Stainless	53/64"	9/16"	1	1293K32●	8.59	7.36
Stainless	7/8"	19/32"	1	1293K36	10.64	9.12
3/8" Pipe Thread (NPTF)						
Steel	51/64"	43/64"	5	1095K54	9.77	8.55
1/4"-28 Taper (for straight thread UNF holes)						
Steel	35/64"	5/16"	10	1095K41	2.31	2.02
Steel	11/16"	5/16"	10	1095K42	4.32	3.78
Steel	31/32"	5/16"	10	1095K43	6.07	5.31
Steel	1 1/8"	5/16"	10	1095K68	11.09	9.71
Steel	1 5/8"	5/16"	5	1095K69	9.28	8.12
Stainless	17/32"	5/16"	5	1293K21	10.38	8.90
Stainless	19/32"	9/32"	3	1293K42	7.37	6.32
Monel	17/32"	5/16"	1	1292K41	6.72	5.88
6-40 Straight Thread (UNF)						
Steel	1/2"	1/4"	10	1095K86▲	8.11	7.09
10-32 Straight Thread (UNF)						
Steel	15/32"	1/4"	10	1095K87▲	3.65	3.19
Steel	1/2"	1/4"	10	1095K88▲	5.80	5.08
1/4"-28 Straight Thread (UNF)						
Steel	33/64"	9/32"	10	1095K44	3.05	2.66
Brass	17/32"	9/32"	5	3088K3	5.62	4.81
Brass	19/32"	9/32"	5	3088K5	5.62	4.81
3/8"-24 Straight Thread (UNF)						
Steel	5/8"	7/16"	10	1095K96●	5.51	4.83
Stainless	19/32"	7/16"	3	1293K47	10.53	9.02
Brass	19/32"	7/16"	5	3088K14	7.37	6.32
5/16"-24 Straight Thread (UNF)						
Steel	21/32"	3/8"	10	1095K51	6.34	5.54
Steel	2 61/64"	11/32"	3	1095K83	7.67	6.71

▲No ball check. ●Max. psi is 8,000.

Material	O'all Ht.	Hex Size	Pkg. Qty.		Pkg. 1-9	Pkg. 10-Up
5/16"-24 Straight Thread (UNF) (Cont.)						
Stainless	19/32"	11/32"	3	1293K44	$8.95	$7.67
Brass	19/32"	11/32"	5	3088K11	6.14	5.27
5/16"-32 Straight Thread (UNEF)						
Steel	21/32"	3/8"	10	1095K61	4.88	4.27
M5×0.8						
Steel	15 mm	7 mm	10	1105K13	8.95	7.67
M6×0.75						
Steel	15 mm	7 mm	10	1105K16	3.60	3.09
M6×1						
Steel	14 mm	7 mm	10	1105K71●	3.52	3.03
Steel	24 mm	7 mm	10	1105K11	13.77	11.80
Steel	29 mm	7 mm	5	1105K21	8.14	7.12
Steel	41 mm	7 mm	1	1105K31	3.33	2.83
Stainless	13 mm	7 mm	3	2250K11●	5.85	5.01
Brass	14 mm	7 mm	5	3088K21	5.26	4.51
M8×1						
Steel	15 mm	9 mm	10	1105K72●	4.92	4.24
Stainless	15 mm	9 mm	1	2250K14●	2.99	2.56
Brass	15 mm	9 mm	5	3088K26	5.62	4.81
M8×1.25						
Steel	15 mm	9 mm	10	1105K81●	5.04	4.34
Stainless	15 mm	9 mm	1	2250K21●	3.46	2.96
Brass	15 mm	9 mm	5	3088K27	5.62	4.81
M10×1						
Steel	15 mm	11 mm	10	1105K73●	5.72	4.93
Stainless	15 mm	11 mm	1	2250K17●	3.64	3.12
Brass	15 mm	11 mm	5	3088K45	7.02	6.02
M10×1.5						
Steel	15 mm	11 mm	10	1105K82●	8.44	7.28
M12×1						
Steel	18 mm	14 mm	10	1105K41	14.27	12.23
M12×1.5						
Steel	18 mm	14 mm	5	1105K51	8.15	6.98
M14×1.5						
Steel	18 mm	14 mm	5	1105K61	7.96	6.73
1/8"-28 BSPT						
Steel	15 mm	11 mm	10	2408K11	3.69	3.16
Stainless	15 mm	11 mm	5	9276K11●	15.41	13.79
1/4"-19 BSPT						
Steel	20 mm	14 mm	10	2408K17●	10.44	8.80
Stainless	20 mm	14 mm	1	9276K14●	8.59	7.58
5/16"-22 BSF (British Standard Fine)						
Steel	15 mm	9 mm	10	2408K31	5.01	4.29

90° Angle Fittings

Material	O'all Ht.	Hex Size	Pkg. Qty.		Pkg. 1-9	Pkg. 10-Up
1/8" Pipe Thread (PTF)						
Steel	27/32"	7/16"	10	1095K27	$7.47	$6.53
Steel	1 13/16"	7/16"	3	1095K67	11.76	10.29
Stainless	7/8"	7/16"	1	1293K12	6.39	5.48
Monel	7/8"	7/16"	1	1292K33	22.92	20.06
1/4" Pipe Thread (PTF)						
Steel	15/16"	9/16"	10	1095K95●	11.17	9.78
Stainless	15/16"	9/16"	1	1293K34●	16.92	14.45
3/8" Pipe Thread (PTF)						
Steel	51/64"	43/64"	3	1095K55	9.55	8.36
1/4"-28 Taper (for straight thread UNF holes)						
Steel	3/4"	3/8"	10	1095K47	8.08	7.07

●Max. psi is 8,000.

Material	O'all Ht.	Hex Size	Pkg. Qty.		Pkg. 1-9	Pkg. 10-Up
1/4"-28 Taper (for straight thread UNF holes) (Cont.)						
Steel	51/64"	3/8"	10	1095K93●	$8.23	$7.20
Stainless	3/4"	3/8"	1	1293K22	4.79	4.11
Monel	3/4"	3/8"	1	1292K42	16.52	14.45
1/4"-28 Straight Thread (UNF)						
Brass	45/64"	11/32"	3	3088K9	7.90	6.77
M6×0.75						
Steel	18 mm	9 mm	10	1105K18	12.59	10.79
M6×1						
Steel	18 mm	9 mm	10	1105K76●	9.12	7.86
Stainless	18 mm	9 mm	3	2250K13●	15.90	13.51
Brass	18 mm	9 mm	5	3088K24	12.63	10.83

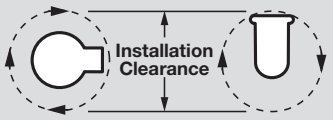
(Continued on following page)

About Oil-Hole Covers and Oil Cups

Oil-hole covers and oil cups are convenient and dependable ways to apply oil to parts in hard-to-reach areas. Install them on machinery, motors, bearings, blocks, and all kinds of moving parts. They have a self-closing hinged cover (unless noted) that keeps contaminants out of your oil and equipment. ***Oil-hole covers*** do not hold oil. Any oil poured in the cover passes into the part to be lubricated. ***Oil cups*** have a reservoir that holds oil. Oil that is poured in the cup is held in the reservoir and passes through gradually. For this reason, we list a capacity for all of our oil cups. The advantage of oil cups is that they decrease the frequency of manual lubrication.

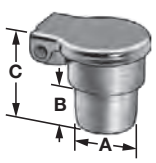
Choose from drive-in and threaded styles. ***Drive-in*** covers have plain walls and are designed to be lightly tapped into a hole. ***Threaded*** covers and cups provide a more secure fit. There are several different thread types: NPT is National Pipe Taper; UNF is Unified National Fine; and UNEF is Unified National Extra Fine.

Installation clearance is a measurement that represents the overall diameter of the path of a cover or cup as you rotate it into place on your machinery.

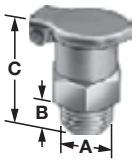


Straight (Top View) *Elbow (Front View)*

Oil-Hole Covers



Drive-In



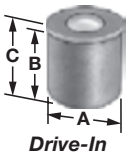
Threaded

Made of zinc-plated steel, unless noted. Connections are male.
Drive-in covers have a tapered shank that controls insertion depth.

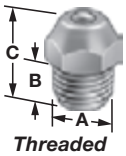
(A)	(B)	(C)	Installation Clearance		1-9	10-Up
Drive-In						
3/16"	7/32"	15/32"	3/4"	1232K31	$2.24	$2.02
1/4"	5/32"	13/32"	11/16"	1231K1	4.67	4.20
1/4"	1/4"	7/16"	3/4"	1232K12	4.84	4.36
5/16"	7/32"	1/2"	3/4"	1231K2	7.58	6.82
3/8"	7/32"	17/32"	25/32"	1231K3	11.91	10.72
7/16"	5/16"	11/16"	29/32"	1231K4	14.36	12.92
1/2"	3/8"	13/16"	17/32"	1232K15	10.49	9.44
3/4"	9/16"	13/16"	113/16"	1232K17	12.73	11.46
7/8"	1/2"	11/16"	113/16"	1232K18	14.24	12.82
1"	19/32"	15/16"	23/32"	1232K19	19.84	17.86
1 1/4"	13/16"	111/16"	27/16"	1232K21	28.53	25.68
6 mm	6 mm	12 mm	16 mm	1357K41●	4.02	3.62
7 mm	6 mm	14 mm	19 mm	1357K42●	4.16	3.74
Threaded						
10-32 UNF	3/16"	9/16"	3/4"	1229K12	9.91	8.92
1/8"-27 NPT	1/4"	13/16"	13/16"	1229K18	10.51	9.46
1/8"-27 NPT	9/32"	7/8"	29/32"	1229K19	13.16	11.84
1/8"-27 NPT	13/32"	15/32"	17/32"	1229K22	9.91	8.92
1/4"-32 UNEF	5/32"	9/16"	11/16"	1229K11	10.71	9.64
1/4"-32 UNEF	3/16"	9/16"	3/4"	1229K13	27.51	24.76
1/4"-32 UNEF	1/4"	3/4"	3/4"	1229K15	22.87	20.58
1/4"-18 NPT	13/32"	15/32"	17/32"	1229K23	11.58	10.42
5/16"-32 UNEF	1/4"	27/32"	13/16"	1229K28	11.58	10.42
3/8"-18 NPT	3/8"	19/32"	17/32"	1229K26	20.31	18.28
1/2"-14 NPT	9/16"	17/16"	17/16"	1229K27	17.76	15.98
M5×0.8	4 mm	15 mm	16 mm	1319K51■	8.62	7.76
M6×1	5 mm	15 mm	19 mm	1319K52■	10.31	9.28
M8×1.25	5 mm	16.5 mm	19 mm	1319K53■	10.29	9.26

●Nickel-plated steel. ■ Nickel-plated brass.

Easy-Fill Oil-Hole Covers



Drive-In



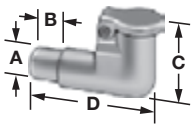
Threaded

Fill your equipment with oil without lifting a hinged cover. These low-profile covers have a self-closing ball valve. When you're ready to fill, the pressure of your oil container easily depresses the ball.

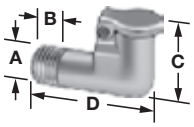
Drive-in covers are zinc-plated steel. ***Threaded*** cover is zinc-plated brass. Connection is male.

(A)	(B)	(C)	Installation Clearance		1-9	10-Up
Drive-In						
3/16"	1/4"	9/32"	7/32"	1214K1	$2.38	$2.14
1/4"	9/32"	5/16"	9/32"	1214K2	2.47	2.22
5/16"	5/16"	3/8"	11/32"	1214K3	2.44	2.20
3/8"	3/8"	15/32"	13/32"	1214K4	10.00	9.00
7/16"	15/32"	17/32"	15/32"	1214K5	11.07	9.96
1/2"	17/32"	9/16"	17/32"	1214K6	7.76	6.98
Threaded						
1/4"-32 UNEF	7/32"	7/16"	3/8"	1211K1	3.71	3.34

Elbow-Style Oil-Hole Covers



Drive-In



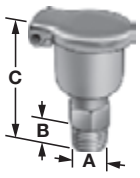
Threaded

Choose elbow-style covers for side-mounted applications and for lubricating equipment where you don't have enough vertical clearance for straight covers. All covers are die cast zinc.

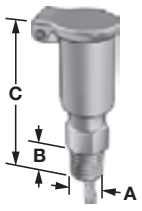
Threaded covers have male connections.

(A)	(B)	(C)	(D)	Install. Clear.		1-9	10-Up
Drive-In							
3/16"	5/32"	19/32"	3/4"	1/4"	1239K17	$24.49	$22.04
1/4"	1/4"	11/16"	1"	5/16"	1239K11	14.18	12.76
5/16"	1/4"	25/32"	7/8"	13/32"	1239K15	15.33	13.80
3/8"	9/32"	25/32"	13/32"	13/32"	1239K19	22.02	19.82
Threaded							
10-32 UNF	5/32"	19/32"	3/4"	11/16"	1227K11	11.22	10.10
1/8"-27 NPT	1/4"	25/32"	13/32"	15/16"	1227K16	16.67	15.00
1/4"-32 UNEF	3/16"	19/32"	3/4"	11/16"	1227K12	12.36	11.12
5/16"-32 UNEF	3/16"	25/32"	13/32"	15/16"	1227K21	23.31	20.98
3/8"-24 UNF	1/4"	25/32"	13/32"	15/16"	1227K15	18.38	16.54

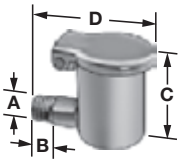
Oil Cups



Straight



Straight Wick-Feed



Elbow

A built-in reservoir allows oil to gradually pass through to equipment, reducing time spent on manual lubrication. Cups are zinc-plated steel and have NPT male connections.

Straight wick-feed oil cups protect bearings from dust and foreign matter. The wick extends through the threaded connection of the cup and keeps the bearing moist, even after the oil cup is drained.

Elbow style is for side-mounted applications and where vertical space is limited.

(A)	(B)	(C)	(D)	Install. Clear.	Cap., oz.		1-9	10-Up
Straight								
1/8"-27	5/16"	1 1/2"	—	17/32"	1/16	1230K11	$12.91	$11.62
1/8"-27	5/16"	121/32"	—	17/16"	1/8	1230K12	14.47	13.02
1/8"-27	5/16"	129/32"	—	113/16"	5/16	1230K13	12.07	10.86
1/4"-18	3/8"	2"	—	113/16"	5/16	1230K14	18.09	16.28
3/8"-18	3/8"	29/16"	—	27/16"	15/16	1230K16	71.73	64.56
Straight Wick-Feed								
1/8"-27	11/32"	25/32"	—	17/16"	1/8	1221K13	40.47	36.42
1/8"-27	3/8"	2"	—	17/32"	1/16	1221K12	20.16	18.14
1/8"-27	3/8"	213/32"	—	2"	5/8	1221K26	36.80	33.12
1/4"-18	3/8"	215/32"	—	2"	5/8	1221K15	35.56	32.00
Elbow								
1/8"-27	5/16"	15/16"	111/32"	119/32"	1/8	1237K11	23.42	21.08
1/8"-27	5/16"	17/16"	111/16"	2 5/8"	1/2	1237K13	25.69	23.12
1/4"-18	7/16"	17/16"	115/16"	2 1/2"	1/2	1237K14	12.78	11.50
3/8"-18	7/16"	21/16"	213/32"	4"	1 7/8	1237K17	45.84	41.26
1/2"-14	9/16"	21/16"	3 1/2"	4"	3 3/4	1237K18	78.29	70.46

About Oil Reservoirs and Tanks

Oil reservoirs serve as a central dispenser for lubrication systems.

Adjustable-Flow Oil Reservoirs—Adjust the oil flow from a drop to a steady stream. Some of these oil reservoirs have special features such as multiple outlets, brushes for chain lubrication, and a solenoid to start oil flow when equipment starts running and to stop oil flow when equipment stops.

Constant-Level Oil Reservoirs—Used primarily on equipment that requires a constant supply or bath of oil.

Outlet Connections—Many of our reservoirs and sight-flow needle valves have outlets with NPTF or PTF pipe threads (also known as Dryseal). Connections prevent leaks and ensure pressure-tight joints without a lubricant or sealer. They connect to NPT threads but may lose some of their leakproof qualities.

Oil Reservoirs

Reservoirs have aluminum top and bottom plates around a clear plastic bowl and a self-closing vented fill cap. When using these reservoirs in flow-regulating applications, they require a sight-flow needle valve (sold separately on page 2272). Maximum temperature is 140° F.

Cap., oz.	Bowl Dia.	1/8" NPTF Male Outlet: O'all Ht.			1/4" NPTF Male Outlet: O'all Ht.		
1	1½"	3"	1169K11	$21.80	3 3/16"	1169K13	$23.56
1 3/8	1¾"	2 15/16"	1169K14	19.62	2 15/16"	1169K15	23.89
1¾	2"	3⅛"	1169K16	30.05	3⅜"	1169K12	36.72
2½	2"	3½"	1169K17	28.12	3¾"	1169K18	27.57
5	2½"	4⅛"	1169K19	30.67	4 5/16"	1169K21	27.90
8	2½"	5 3/16"	1169K23	45.84	5⅜"	1169K24	43.13
9	3"	5⅜"	1169K27	53.70	5½"	1169K28	52.24
		3/8" NPTF Male Outlet: O'all Ht.			1/2" NPTF Male Outlet: O'all Ht.		
12	3"	6 7/16"	1169K31	$49.55	6 5/8"	1169K32	$51.27
16	3½"	6 9/16"	1169K35	55.03	6⅝"	1169K36	55.03
32	4¼"	7 15/16"	1169K41	70.11	8 1/16"	1169K42	70.38
64	5½"	9 15/16"	1169K43	106.98	10⅛"	1169K44	109.16
128	5½"	14 15/16"	1169K45	149.02	15¼"	1169K46	151.76

Pressure-Equalizing Oil Reservoirs

A venting tube equalizes pressure between the reservoir and bearing so you can lubricate non-vented, closed, and sealed bearing housings while keeping out contaminants. A ball check valve below the sight chamber prevents sudden back pressure from affecting flow. Turn on and off using the toggle switch on top of the unit.

Reservoirs have aluminum top and bottom plates around a clear acrylic bowl and include a fill cap. When using them in flow-regulating applications, they require a sight-flow needle valve (sold separately on page 2272). Maximum temperature is 160° F.

Cap., oz.	Bowl Dia.	O'all Ht.	Outlet, NPTF male		
1½	1¾"	5⅝"	¼"	1157K21	$121.12
2½	2"	5 15/16"	⅜"	1157K22	125.74
5	2½"	6 9/16"	⅜"	1157K24	105.80
9	3"	7 13/16"	½"	1157K25	161.70
16	3½"	8 13/16"	½"	1157K26	155.14

High-Temperature Oil Reservoirs

Made of polycarbonate, these reservoirs withstand temperatures up to 225° F. They include a self-closing vented fill cap. When used in flow-regulating applications, they require a sight-flow needle valve (sold separately on page 2272).

Reservoirs ***with filter*** have an aluminum filter with Type 304 stainless steel wire cloth. Filter is 100 mesh (100 openings per linear inch of mesh) and removable. For information about mesh openings and particle filtration, see page 459.

Cap., oz.	Bowl Dia.	O'all Ht.	Outlet, NPT male	Without Filter		With Filter	
2½	2"	4 7/16"	⅜"	1358K21	$24.60	1358K11	$36.71
5	2 7/8"	4½"	½"	1358K22	24.81	1358K12	37.46
9	2 7/8"	5¾"	½"	1358K23	29.52	1358K13	41.58
16	3 5/8"	6 13/16"	½"	1358K24	35.63	1358K14	42.34
32	3 5/8"	10 3/16"	½"	1358K25	51.98	1358K15	60.95
64	5"	11 1/16"	½"	1358K26	57.97	1358K16	63.34

Hydraulic Tanks

5-Gallon Capacity

A high maximum temperature of 250° F combined with large capacity makes these tanks suitable for circulating oil systems and hydraulic power units.

Tanks are heavy duty steel. They have a 40-micron filter built into their removable fill/breather cap and include a liquid-level gauge. Outlet is ½" NPT female. Mounting fasteners not included.

1- and ***2-gallon reservoirs*** have four 11/32" dia. mounting holes.

5- and ***10-gallon reservoirs*** have four 17/32" dia. mounting holes.

Cap., gal.	Overall Size: Ht.	Wd.	Dp.	No. of Outlets/ Return Lines	Return, NPT female		
1	12¼"	6"	7½"	1/_	____	1149K11	$278.26
2	12¼"	10"	7½"	1/1	½"	1149K14	332.86
5	14"	16"	10"	2/2	1"	1149K16	426.37
10	17½"	20"	12"	2/2	1"	1149K18	504.54

Adjustable-Flow Oil Reservoirs

The precision needle valve on top of these reservoirs allows you to adjust the flow rate using the attached toggle switch. Reservoirs have aluminum top and bottom plates around either a clear plastic or glass bowl and include a vented fill cap. A sight glass allows you to view the flow. Maximum temperature is 160° F for the plastic bowl and 250° F for the glass bowl.

Direct Mount—Thread directly into bearing housings, pumps, and other machinery.

Remote Mount—Connect a pipe or tube fitting to reach remote or isolated equipment. Furnished with a nut and washer for mounting.

Direct Mount

Cap., oz.	Bowl Dia.	O'all Ht.	Outlet, NPTF male	Plastic Bowl		Glass Bowl	
5/8	1½"	4 9/16"	⅛"	1167K91	$33.98	1167K51	$35.39
1	1½"	5 3/16"	¼"	1167K92	37.55	1167K52	38.69
1½	1¾"	5⅜"	¼"	1167K94	34.40	1167K53	37.19
2½	2"	5¾"	⅜"	1167K96	42.48	1167K54	45.71
5	2½"	6⅜"	⅜"	1167K98	40.16	1167K56	48.83
9	3"	7⅝"	⅜"	1167K11	58.98	1167K21	71.64
9	3"	7 13/16"	½"	1167K12	58.79	1167K22	74.12
12	3"	8 15/16"	⅜"	1167K13	60.32	____	____
12	3"	9⅛"	½"	1167K14	64.74	____	____
16	3½"	8 15/16"	⅜"	1167K15	63.34	1167K23	87.40
16	3½"	9⅛"	½"	1167K16	64.06	1167K24	90.40
32	4¼"	10⅛"	½"	1167K17	87.38	1167K25	141.53
64	5½"	12 1/16"	½"	1167K18	131.79	1167K26	181.16
128	5½"	17 1/16"	½"	1167K19	179.23	____	____

Replacement Sight Glass for 1½" to 2½" Bowl Dia.	1167K2	1.80
Replacement Sight Glass for 3" and Larger Bowl Dia.	1167K1	1.82

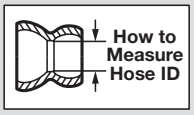
Remote Mount

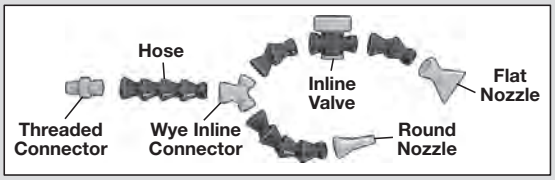
Cap., oz.	Bowl Dia.	O'all Ht.	Outlet, NPTF female	Mounting Threads, UNF male	Plastic Bowl	
5/8	1½"	4 3/16"	⅛"	9/16"-18	1175K41	$45.84
1	1½"	5 5/16"	⅛"	9/16"-18	1175K42	43.88
1½	1¾"	5 7/16"	⅛"	9/16"-18	1175K43	42.78
2½	2"	5¾"	⅛"	9/16"-18	1175K44	51.07
5	2½"	6⅜"	⅛"	9/16"-18	1175K45	52.59
9	3"	7"	⅛"	5/8"-18	1175K11	62.89
12	3"	8⅜"	⅛"	5/8"-18	1175K49	68.25
16	3½"	8 15/16"	⅛"	5/8"-18	1175K12	62.81
32	4¼"	9⅜"	⅛"	5/8"-18	1175K13	88.58
64	5½"	12 3/16"	⅛"	5/8"-18	1175K14	124.00
128	5½"	16 5/16"	⅛"	5/8"-18	1175K15	174.58

Coolant Hose

For coolants, see page 2252.

About Any-Which-Way Coolant Hose





Assemble and disassemble Any-Which-Way coolant hose by snapping components together or pulling them apart. This can be done by hand, but ***assembly pliers*** and ***separation tools*** (sold separately) make the task easier.

Note: To ensure compatibility, select the hose and component color that matches your current system.

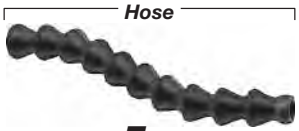
Loc-Line Any-Which-Way Coolant Hose

Hose Assembly

Coolant Supply Connectors

Coolant Supply Valves

Hose



Nozzles

Inline Connectors

Inline Valves

End Cap

Motion-Reducing Extension

Manifolds

Assembly Pliers

Custom build your own system to deliver coolant, cutting oils, water, and air in almost any direction. Once in position, hose stays put—there's no spring back or wandering caused by vibration. Made of acetal. Maximum operating temperature is 170° F.

(1) Hose assemblies have a hose, connectors, and round nozzles.

(16) Circular nozzle assemblies surround your cutting tool with 15 nozzles that can be precisely aimed to remove chips and debris.

(26) Motion-reducing extensions not only reduce motion at higher pressures, but also reduce sagging in longer lines.

(27) Bracket-mount manifolds have one inlet, four outlets, and two 1/4" dia. mounting holes (fasteners included). Expand with ***(20) tee inline connectors*** (sold separately).

(28) Magnetic-base manifold has one inlet, four outlets, and a 25-lb. holding force. It also has 1/4" NPT female connections and comes with three 1/4" plugs and one 3/8" barbed connector. Expand with ***(19) wye inline connectors*** (sold separately).

(29) Assembly pliers make it easier to connect your Any-Which-Way coolant hose to the components.

1/4" ID (0.64" OD)—Max. pressure is 30 psi. Max. flow rate is 250 gph.

	Connectors, NPT Male	Nozzles, Orifice Dia.		Each
Hose Assembly—*Color is blue and orange.*				
(1) 13" Lg.	1/8", 1/4"	1/16", 1/8", 1/4"	10095K11	$7.95

	Pkg. Qty.		Pkg.
Coolant Supply Connectors—*Color is orange.*			
(2) 1/8" NPT Male	4	10095K29	$3.95
(2) 1/4" NPT Male	4	10095K31	3.95
(2) 1/4" BSPT Male	4	10095K111	3.95
(3) 1/8" NPT Female	4	10095K64	5.02
(4) 1/4" Flare Nut, 7/16"-20 SAE Female	4	10095K88	5.98
(4) 3/8" Flare Nut, 5/8"-18 SAE Female	4	10095K87	5.98
Coolant Supply Valves—*Color is blue and orange.*			
(5) 1/4" NPT Male	2	10095K51	9.97
(6) 1/4" NPT Female	2	10095K93	9.97
Hose—*Color is blue.*			
(7) 1 ft. Lg.	1	10095K42	5.98
(7) 5 ft. Lg.	1	10095K97	28.20
(7) 25 ft. Lg.	1	10095K14	131.66
(7) 50 ft. Lg.	1	10095K55	263.33

	Orifice Size	Pkg. Qty.		Pkg.
Nozzles—*Color is orange.*				
(8) Round	1/16" Dia.	4	10095K17	$3.95
(8) Round	1/8" Dia.	4	10095K21	3.95
(8) Round	1/4" Dia.	4	10095K24	3.95
(9) 90° Round	1/16" Dia.	4	10095K112	5.53
(9) 90° Round	1/8" Dia.	4	10095K57	5.53
(9) 90° Round	1/4" Dia.	4	10095K58	5.53
(10) 3/4" 90° Spray Bar	3/32" Dia. (6 holes)	2	10095K1	5.98
(11) 7/16" Flat	1/16" Ht. x 7/16" Wd.	4	10095K83	6.33
(12) 7/16" Flat	1/16" Dia. (5 holes)	4	10095K84	6.33
(12) 1" Flat	3/64" Dia. (7 holes)	4	10095K114	6.33

	Orifice Size	Pkg. Qty.		Pkg.
Nozzles—*Color is orange. (Cont.)*				
(13) 1" Flat	1/16" Ht. x 61/64" Wd.	2	10095K26	$5.98
(14) 1" Flat	3/64" Ht. x 1" Wd.	2	10095K77	5.98
(15) 1 1/2" Swivel	3/64" Dia. (16 holes)	2	10095K59	8.85
(15) 1 17/32" Swivel	1/16" Dia. (16 holes)	2	10095K61	8.85
(15) 2 1/2" Swivel	5/64" Dia. (20 holes)	2	10095K66	9.36
Circular Nozzle Assembly—*Color is orange.*				
(16) 3 5/8" Dia.	5/64" Dia.	1	10095K71	17.77

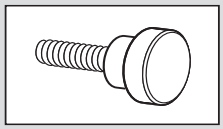
	Pkg. Qty.		Pkg.
Inline Connectors—*Color is orange.*			
(17) Double Socket Inline	4	10095K43	$4.40
(18) 90° Elbow Inline	2	10095K48	5.53
(19) Wye Inline	2	10095K35	5.98
(20) Tee Inline	2	10095K91	6.63
Inline Valves—*Style 23 is blue and orange; Style 24 is orange.*			
(23) Inline	2	10095K52	9.97
(24) Inline Check	2	10095K69	9.97
End Cap—*Color is orange.*			
(25) End Cap	4	10095K113	3.95
Motion-Reducing Extension—*Color is blue and orange.*			
(26) 3 11/16" Lg.	4	10095K85	13.33

	Overall Size, Ht. x Wd. x Dp.		Each
Manifolds—*Style 27 is blue and orange; Style 28 is blue.*			
(27) Bracket Mount	1 13/16" Ht. x 4 1/4" x 1"	10095K62	$13.33
(28) Magnetic Base	1 3/16" Ht. x 2 1/8" Dia.	10095K49	29.16

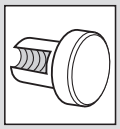
		Each
Assembly Pliers—*Color is blue.*		
(29) Assembly Pliers	10095K41	$11.10

(Continued on following page)

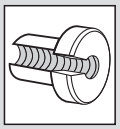
About Knobs



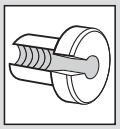
Threaded Stud



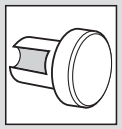
Threaded



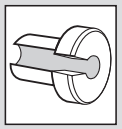
Threaded Through Hole



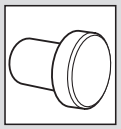
Through Hole with Threaded Insert



Unthreaded



Unthreaded Through Hole

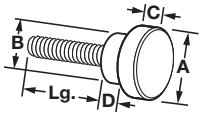


Solid Hub

Knobs provide excellent gripping action for positioning, tightening, and holding fixtures, equipment, and machinery. Because knobs require no tools for adjusting, they're a good alternative to fasteners.

Knobs with Threaded Stud—Ready to install. See pages 2280-2284.
Knobs with Threaded or Unthreaded Hole—Mount to your rod, shaft, or fastener. See pages 2285-2293.
Knobs with Solid Hub—Ready for you to machine to your own specifications. See page 2294.

Knobs with Threaded Stud



Easy Clean—One-piece construction eliminates joints that can collect dirt and debris. Excellent for food-processing applications.

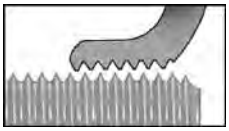
Thread Size	Lg.	(A)	(B)	(C)	(D)		Each ♦
Round with Knurled Rim							
(1) Zinc-Plated Cast Iron with Steel Stud							
1/4"-20	1 3/4"	1 1/2"	5/8"	3/8"	1/2"	6042K85	$7.78
1/4"-20	3"	1 1/2"	5/8"	3/8"	1/2"	6042K86	9.11
5/16"-18	1 3/4"	2"	3/4"	3/8"	1/2"	6042K87	8.44
5/16"-18	3"	2"	3/4"	3/8"	1/2"	6042K88	9.49
3/8"-16	1 3/4"	2"	3/4"	3/8"	1/2"	6042K89	9.38
3/8"-16	3"	2"	3/4"	3/8"	1/2"	6042K9	10.40
1/2"-13	1 3/4"	2 1/4"	1 1/8"	1/2"	1"	6042K91	16.67
1/2"-13	3"	2 1/4"	1 1/8"	1/2"	1"	6042K92	17.84
5/8"-11	1 3/4"	2 1/4"	1 1/8"	1/2"	1"	6042K93	17.84
5/8"-11	3"	2 1/4"	1 1/8"	1/2"	1"	6042K94	18.18
(1) Black-Oxide Steel with Steel Stud							
10-24	1/2"	3/4"	1/2"	1/4"	3/8"	6079K11	3.95
10-24	1"	3/4"	1/2"	1/4"	3/8"	6079K12	4.10
1/4"-20	3/4"	3/4"	1/2"	1/4"	3/8"	6079K13	4.05
1/4"-20	1 1/4"	3/4"	1/2"	1/4"	3/8"	6079K14	4.13
1/4"-20	1 3/4"	1"	5/8"	1/4"	1/2"	6079K15	4.72
1/4"-28	1 3/4"	1"	5/8"	1/4"	1/2"	6079K32	4.74
5/16"-18	1 3/4"	1"	5/8"	1/4"	1/2"	6079K17	4.72
5/16"-18	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	6079K19	5.90
5/16"-18	3"	1"	5/8"	1/4"	1/2"	6079K18	5.03
5/16"-18	3"	1 1/2"	3/4"	5/16"	11/16"	6079K21	6.08
5/16"-24	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	6079K33	5.59
3/8"-16	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	6079K22	5.90
3/8"-16	1 3/4"	2"	1"	3/8"	3/4"	6079K24	7.15
3/8"-16	3"	1 1/2"	3/4"	5/16"	11/16"	6079K23	6.08
3/8"-16	3"	2"	1"	3/8"	3/4"	6079K25	7.33
3/8"-24	1 3/4"	2"	1"	3/8"	3/4"	6079K34	6.82
1/2"-13	1 3/4"	2"	1"	3/8"	3/4"	6079K26	7.15
1/2"-13	1 3/4"	2 1/2"	1 1/2"	9/16"	15/16"	6079K28	12.13
1/2"-13	3"	2 1/2"	1 1/2"	9/16"	15/16"	6079K29	12.56
1/2"-20	1 3/4"	2 1/2"	1 1/2"	9/16"	15/16"	6079K35	11.54
5/8"-11	1 3/4"	2 1/2"	1 1/2"	9/16"	15/16"	6079K31	12.79
(1) Brass with Type 303 Stainless Steel Stud							
10-24	1"	3/4"	1/2"	1/4"	3/8"	5125K61	5.66
1/4"-20	1 1/4"	3/4"	1/2"	1/4"	3/8"	5125K62	6.06
1/4"-20	1 3/4"	1"	5/8"	1/4"	1/2"	5125K63	8.23
1/4"-28	1 3/4"	1"	5/8"	1/4"	1/2"	5125K64	8.23
5/16"-18	3"	1"	5/8"	1/4"	1/2"	5125K65	10.54
5/16"-18	3"	1 1/2"	3/4"	5/16"	11/16"	5125K66	19.94
5/16"-24	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	5125K67	17.57
3/8"-16	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	5125K68	19.00
3/8"-16	3"	1 1/2"	3/4"	5/16"	11/16"	5125K69	20.60
3/8"-24	1 3/4"	2"	1"	3/8"	3/4"	5125K71	28.51
1/2"-13	1 3/4"	2"	1"	3/8"	3/4"	5125K72	29.26
(1) Type 303 Stainless Steel with Type 303 SS Stud							
10-24	1/2"	3/4"	1/2"	1/4"	3/8"	6091K41	9.25
10-24	1"	3/4"	1/2"	1/4"	3/8"	6091K42	9.25
1/4"-20	3/4"	3/4"	1/2"	1/4"	3/8"	6091K43	8.95
1/4"-20	1 1/4"	3/4"	1/2"	1/4"	3/8"	6091K44	9.67
1/4"-20	1 3/4"	1"	5/8"	1/4"	1/2"	6091K45	11.06
1/4"-28	1 3/4"	1"	5/8"	1/4"	1/2"	6091K61	11.06
5/16"-18	1 3/4"	1"	5/8"	1/4"	1/2"	6091K46	10.47

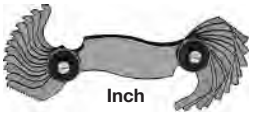
Thread Size	Lg.	(A)	(B)	(C)	(D)		Each ♦
Round with Knurled Rim (Cont.)							
(1) Type 303 Stainless Steel with Type 303 SS Stud (Cont.)							
5/16"-18	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	6091K48	$12.61
5/16"-18	3"	1"	5/8"	1/4"	1/2"	6091K47	11.13
5/16"-18	3"	1 1/2"	3/4"	5/16"	11/16"	6091K49	13.08
5/16"-24	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	6091K62	12.63
3/8"-16	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	6091K51	13.69
3/8"-16	1 3/4"	2"	1"	3/8"	3/4"	6091K53	16.75
3/8"-16	3"	1 1/2"	3/4"	5/16"	11/16"	6091K52	14.19
3/8"-16	3"	2"	1"	3/8"	3/4"	6091K54	17.14
3/8"-24	1 3/4"	2"	1"	3/8"	3/4"	6091K63	16.75
1/2"-13	1 3/4"	2"	1"	3/8"	3/4"	6091K55	16.75
1/2"-13	1 3/4"	2 1/2"	1 1/2"	9/16"	15/16"	6091K56	28.31
1/2"-13	3"	2 1/2"	1 1/2"	9/16"	15/16"	6091K57	28.31
1/2"-20	1 3/4"	2 1/2"	1 1/2"	9/16"	15/16"	6091K64	28.31
5/8"-11	1 3/4"	2 1/2"	1 1/2"	9/16"	15/16"	6091K58	29.81
(1) Easy-Clean Type 303 Stainless Steel with Type 303 SS Stud							
1/4"-20	1 3/4"	1"	5/8"	1/4"	1/2"	6890K1	15.83
5/16"-18	1 3/4"	1 1/2"	3/4"	5/16"	11/16"	6890K2	18.51
3/8"-16	1 3/4"	2"	1"	3/8"	3/4"	6890K3	23.23
1/2"-13	1 3/4"	2"	1"	3/8"	3/4"	6890K4	23.26
(2) Domed Aluminum with Steel Stud							
1/4"-20	1 3/4"	1"	5/8"	1/2"	7/16"	7762K14	12.14
5/16"-18	1 3/4"	1"	5/8"	1/2"	7/16"	7762K17	12.40
3/8"-16	1 3/4"	2"	1"	11/16"	1/2"	7762K23	17.84
1/2"-13	1 3/4"	2 1/4"	1 1/4"	3/4"	5/8"	7762K26	20.51
(3) Black Nylon w/ Type 302 Stainless Steel Stud *(–15° to +150°F)*							
1/4"-20	3/4"	1"	5/8"	1/4"	1/2"	1373T51	2.80
5/16"-18	3/4"	1 3/4"	1"	5/8"	7/16"	1373T52	6.22
(3) Black Phenolic w/ Type 302 Stainless Steel Stud *(–30° to +400°F)*							
10-32	1/2"	1"	5/8"	3/8"	1/8"	1373T11	3.75
10-32	1/2"	1 1/4"	3/4"	1/2"	1/4"	1373T21	3.95
10-32	1/2"	1 3/4"	1"	1/2"	7/16"	1373T31	4.28
10-32	1"	1"	5/8"	3/8"	1/8"	1373T12	5.67
10-32	1"	1 1/4"	3/4"	1/2"	1/4"	1373T22	5.95
10-32	1"	1 3/4"	1"	1/2"	7/16"	1373T32	6.30
1/4"-20	3/4"	1"	5/8"	3/8"	1/8"	1373T57	2.58
1/4"-20	3/4"	1 1/4"	3/4"	1/2"	1/4"	1373T55	2.65
1/4"-20	3/4"	1 3/4"	1"	1/2"	7/16"	1373T53	2.83
1/4"-20	1 3/8"	1 1/4"	3/4"	1/2"	1/4"	1373T56	2.75
1/4"-20	1 1/2"	1"	5/8"	3/8"	1/8"	1373T58	2.42
5/16"-18	1/2"	1"	5/8"	3/8"	1/8"	1373T15	5.20
5/16"-18	1/2"	1 1/4"	3/4"	1/2"	1/4"	1373T25	5.53
5/16"-18	1/2"	1 3/4"	1"	1/2"	7/16"	1373T35	5.83
5/16"-18	3/4"	1 3/4"	1"	1/2"	7/16"	1373T54	6.47
5/16"-18	1"	1"	5/8"	3/8"	1/8"	1373T16	6.05
5/16"-18	1"	1 1/4"	3/4"	1/2"	1/4"	1373T26	6.35
5/16"-18	1"	1 3/4"	1"	1/2"	7/16"	1373T36	6.75
(4) Black Polypropylene with Steel Stud *(+30° to +190°F)*							
1/4"-20	3/4"	1 1/4"	9/16"	1/2"	3/8"	63625K31	3.43
1/4"-20	3/4"	1 9/16"	11/16"	1/2"	7/16"	63625K32	3.50
5/16"-18	3/4"	1 9/16"	11/16"	1/2"	7/16"	63625K33	3.75
3/8"-16	1"	2"	13/16"	5/8"	1/2"	63625K34	5.31
3/8"-16	1"	2 3/8"	15/16"	13/16"	9/16"	63625K35	5.88

(Continued on following page)

♦ Prices are 10% lower when you buy in quantities of 10 or more.

Threads per Inch and Thread Pitch Identifiers





Determine threads per inch and thread pitch on a variety of external and internal threads. Use to measure screws, bolts, threaded rods, and nuts, unless noted. Identifiers are steel, unless noted.

No. of Identifiers	For Threads per Inch/ Thread Pitch	*Folded Size* Lg.	Wd.		
Inch (UNC and UNF)					
22	9 to 40	2¾″	½″	2071A1	$23.19
30	4 to 43	2¾″	½″	2071A25	20.50
30	6 to 60	2¾″	½″	2071A3	25.41
51	4 to 84	2¼″	2¼″	2071A24	41.30
Inch (UNC and UNF)/Metric					
28	4 to 56/0.5 to 6 mm	2¾″	½″	2071A26	23.66
51	4 to 42/0.4 to 7 mm	2¾″	½″	2071A68	47.96
Metric					
20	0.4 to 7 mm	2¾″	½″	2071A18	10.47
28	0.25 to 2.5 mm	2½″	½″	2071A65	48.50
28	0.25 to 2.5 mm	2¾″	½″	2071A67	23.65
Pipe Size (Whitworth)					
28	4 to 62	2¾″	⅝″	2071A19★	11.26
28	4 to 60	2¾″	¾″	2071A4★	40.20
Acme					
16	1 to 12	4¾″	1″	2071A69■	98.99

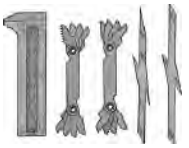
★ Not for use with nuts. ■ Identifier is stainless steel.

Threads per Inch and Center Identifiers

Identify threads per inch on external threads and find the center of your workpiece to line up thread-cutting tools. Use to measure UNC and UNF bolts, threaded rods, and screws. This identifier is steel with a corrosion-resistant satin-chrome finish that reduces glare. Overall size is 2¼″ Lg. × ¾″ Wd. × 3⁄64″ Thick.

For Threads per Inch		
14, 20, 24, 32	2072A11	$25.50

Thread Identifier Sets



Set includes a caliper, two steel gauges, two steel angle gauges, and an instruction book. Measure external and internal threads on threaded rods, bolts, screws, pipe, and nuts. The set comes in a folding plastic case.

For Thread Type		
UNC, UNF, NPT, BSPT, BSPP	7863K1	$57.04

Acme Thread Identifiers

Identify external Acme threads and use as a guide while grinding and cutting Acme threads to a 29° included angle. Use to measure screws, bolts, and threaded rods with 1 to 10 threads per inch. Identifier is steel. Overall size is 3⅜″ Wd. × 1⅝″ Ht. × 7⁄64″ Thick.

8615A69		$24.32

Screw Size Identifiers

Find external thread size, screw size, thread pitch, diameter, or drill bit size. Identifiers are steel, unless noted.

Inch (UNC and UNF)—Use to measure screws, bolts, threaded rods, pins, rivets, and drill bits. Also measures diameters from 0.73″ to 5⁄16″.

Metric—Use to measure screws, bolts, and threaded rods.

Material	For Thread Size/ Thread Pitch	For Screw Size	Wd.	Ht.	Thick.		
Inch (UNC and UNF)							
Plastic	1-64 to 5⁄16″-32	No. 1 to 5⁄16″	3″	5⅛″	7⁄64″	98728A111	$11.17
Steel	1-64 to 5⁄16″-32	No. 1 to 5⁄16″	3″	5⅛″	5⁄64″	98728A112	21.02
Metric							
Plastic	0.35 to 3 mm	M2.3 to M24	9½″	4″	7⁄16″	8567A11	12.58
Steel	M2 × 0.25 to M7 × 1	M2 to M7	3″	5⅜″	3⁄32″	98728A114	22.41
Steel	M8 × 0.75 to M14 × 2	M8 to M14	5⅛″	5⅜″	⅛″	98728A116	24.29

Screw, Bolt, and Nut Size Identifiers

Use to measure external and internal fastener threads on screws, threaded rods, nuts, and bolts. Identifiers are plastic.

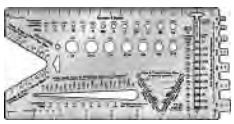
Inch—Measure #8 to ¾″ screw sizes and #8 to ⅝″ nut sizes.

Inch/Metric—Measure #6 to 1″ and M6 to M22 screw sizes; and #8 to ⅝″ nut sizes.

Metric—Measure M6 to M16 screw sizes; M10 to M24 nut sizes; and 1 mm to 2 mm thread pitch.

	Wd.	Ht.	Thick.		
Inch	7½″	2⅜″	1⁄64″	98845A650	$3.71
Inch/Metric	9″	3¾″	1⁄64″	98845A670	5.14
Metric	5¼″	3⅜″	1⁄64″	98845A660	3.71

All-in-One Identifiers



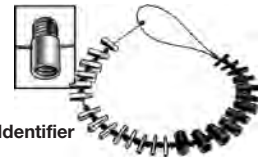
Find tube, pipe, fastener, wire, and drill bit sizes with one tool. Use to measure the size of tubes and tube fittings (copper and CPVC), pipe and pipe fittings (steel, brass, and PVC), screws, bolts, threaded rods, nuts, nails, wire, and drill bits. Identifiers are plastic.

Standard identifier has graduation marks at 16ths of an inch and mm on one side.

Deluxe identifier measures more sizes than standard identifier. It has graduation marks at 32nds of an inch on one side and mm on the other side.

	Wd.	Ht.		
Standard	8 11⁄16″	4¼″	20165A33	$2.43
Deluxe	10½″	3½″	20165A34	4.93

Thread-It Screw, Bolt, and Nut Size Identifiers



Thread your fastener into holes or onto plugs for quick and accurate size identification. Use to measure internal and external UNC and UNF threads on threaded rods, bolts, nuts, and screws. Identifiers are steel.

Inch—Measure 23 sizes: #6, #8, #10, and ¼″ to 1″.

Inch/Metric—Measure 26 sizes: #6, #8, #10, ¼″ to ½″, and M4 × 0.7 to M12 × 1.75.

Metric—Measure 21 sizes: M3 × 0.5 to M24 × 3.

Wall-Mount Inch/Metric—Mount this identifier to a wall for easy access. It measures 28 sizes: #6, #8, #10, ¼″ to 9⁄16″, and M4 × 0.7 to M12 × 1.75. Identifier has three 5⁄16″ mounting holes (fasteners not included). It is 3″ Wd. × 39″ Ht. × ½″ Thick.

Inch	20375A14	$34.90
Inch/Metric	20375A21	36.21
Metric	20375A17	34.90
Wall-Mount Inch/Metric	20375A27	49.00

Size Identifiers

Pipe Size Rulers

Measure outer diameter and mark lines around pipe. A pipe size conversion chart is printed on these rulers. They're fiber-reinforced rubber for grease, oil, gasoline, and salt water resistance. Max. temp. is 360° F. Rulers are gray with white graduations at 16ths of an inch and 2 mm.

For Pipe OD	Measuring Lg.	Lg.	Wd.	Thick.		
1″ to 6″/2 mm to 60 cm	28″	30″	2 5/8″	3/64″	8991A71	$12.17
2″ to 16″/2 mm to 78 cm	36″	60″	3 7/8″	3/64″	8991A73	18.23
6″ to 30″/2 mm to 77 cm	36″	120″	5 1/4″	3/64″	8991A75	36.19

Pipe Size Tape Measures

Wrap this pocket-size tape measure around pipe and fittings to determine size. It measures PVC, galvanized steel, and iron pipe sizes 1/8 to 18, as well as CPVC and copper pipe sizes 1/4 to 12. The blade locks in place and retracts with the push of a button. Rulers are white plastic with red graduations. Blade is 5/16″ Wd. × 1/64″ Thick.

2219A21 ..... $10.72

Drill Bit Size Identifiers

Inch

Measure drill bit sizes with these identifiers. They are steel and have a 1/8″ dia. mounting hole.

Wire gauge 1 to 60 identifier includes a tap size conversion chart.

	Wd.	Ht.	Thick.		
Letter A to Z	2 1/2″	6 1/2″	5/64″	8986A65	$16.90
Inch 1/16″ to 1/2″	2 1/2″	6 1/2″	5/64″	8986A67	16.90
Wire Gauge 1 to 60	2 1/2″	6 1/2″	5/64″	8986A68	16.90
Wire Gauge 61 to 80	1″	3″	5/64″	8986A66	19.77
Metric 1.5 to 12.5 mm	2 1/2″	6 1/2″	5/64″	8986A64	28.37

Drill Bit Point Identifiers

Verify 118° drill point angles after sharpening. The gauge slides along a ruler; has black graduation marks at quick-reading 32nds and quick-reading 64ths on the front, and 8ths and 16ths on the back. Quick-reading graduation marks are labeled with numeric increments that are less than 1″. Ruler has a hook for alignment. It is 6″ Lg. × 3/4″ Wd. Gauge and ruler are steel. Overall size is 6 1/4″ Lg. × 2 5/32″ Wd. × 3/64″ Thick.

8609A51 ..... $69.01

Wire and Sheet Metal Size Identifiers

American Wire Gauge

Read gauge numbers on one side of these identifiers and their decimal equivalents on the other. Identifiers are steel and 3 1/4″ dia.

American wire gauge identifier shows the same markings as Brown & Sharpe gauges. Use it on aluminum, brass, and copper wire.

U.S. steel wire gauge identifier shows the same markings as Washburn & Moen and American Steel and Wire Co. gauges.

For Gauge Type	For Gauge	For Wire Dia./ Sheet Thick.		
U.S. Standard Iron and Steel Gauge	36 to 0	0.0070″ to 0.3125″	8622A53	$27.97
American Wire Gauge	36 to 0	0.0050″ to 0.3250″	19305A33	27.98
U.S. Steel Wire Gauge	36 to 0	0.0070″ to 0.3125″	19305A34	80.00

Diameter Identifiers

Measure the outside diameter of small round- and hex-shaped objects such as rods, drill bits, bolts, and tubing with this pocket-size tool. It measures diameters from 3/32″ to 1 1/8″ and 4 mm to 26 mm. Identifier has wear-resistant white etched markings at 64ths of an inch and millimeters. It is blue aluminum and 5 1/2″ long. Includes a belt clip.

6821A1 ..... $14.29

Pipe, Tubing, and Hose Size Identifiers

Pipe, Tubing, and Hose

Pipe, Pipe Fittings, and Hose

Determine pipe size and inner and outer diameter.

Pipe, Tubing, and Hose—Identifier measures external NPT pipe threads up to 3/4 and tubing OD and hose ID up to 1″. It has a compression fitting chart. Identifier is plastic. Overall size is 9″ Wd. × 3 3/4″ Ht. × 7/64″ Thick.

Pipe, Pipe Fittings, and Hose—Identifier measures external and internal NPT pipe threads up to pipe size 2 and hose ID to 1 1/4″. It is corrosion-resistant stainless steel. Overall size is 3 3/4″ Wd. × 4 1/2″ Ht. × 1/32″ Thick.

Pipe, Tubing, and Hose	1976A22	$4.50
Pipe, Pipe Fittings, and Hose	20195A34	19.91

Pipe Thread Identifiers

Check external NPT thread size and taper. The identifier measures 1/16, 1/8, 1/4, 3/8, and 1/2 pipe size. It is blue aluminum. Overall size is 2″ Wd. × 3″ Ht. × 1/4″ Thick.

1980A1 ..... $17.27

Tap and Drill Reference Rules

One side of this stainless steel rule lists tap and drill sizes for UNF, UNC, metric ISO, and American standard pipe threads. The other side has a decimal equivalent table for 1/64″ to 63/64″ sizes and an easy-to-read 6″ rule graduated in inches to 64ths. Overall size is 7″ Lg. × 1 1/4″ Wd.

2119A21 ..... $6.45

Radius Identifiers

Check convex and concave radii of tools, patterns, and dies with these pocket-size tools. Identifiers are steel.

No. of Identifiers	For Radius	*Folded Size* Lg.	Wd.		
30	1/32″ to 1/4″ (1/64″ increments)	2 3/4″	1/2″	8625A58	$13.66
32	17/64″ to 1/2″ (1/64″ increments)	3 1/2″	3/4″	8625A68	14.60
34	1 to 3 mm (0.25 mm increments); 3 to 7 mm (0.5 mm increments)	2 3/4″	5/8″	8625A78	37.15

Precision Radius Identifiers

Find precise convex and concave radii of tools, patterns, and dies. These identifiers are stainless steel, unless noted. They come in a vinyl pouch.

Certified Starrett identifiers include a NIST calibration certificate stating that they have passed a test for accuracy.

Optional gauge holder is steel. It is 4″ long.

No. of Identifiers	For Radius		
Mitutoyo			
8	9/16″ to 1″ (1/16″ increments)	2204A36	$394.29
26	0.01″ to 0.03″ (0.005″ increments); 0.04″ to 0.10″ (0.01″ increments); 0.12″ to 0.30″ (0.02″ increments); 0.35″ to 0.50″ (0.05″ increments)	2204A65	158.49
Starrett			
8	9/32″ to 1/2″ (1/32″ increments)	2204A2	84.00
16	1/32″ to 17/64″ (1/64″ increments)	2204A1	91.01
16	1/32″ to 1/2″ (1/32″ increments)	2204A4	113.01
21	1 to 7 mm (0.5 mm increments); 8 to 15 mm (1 mm increments)	2204A54	168.00
25	1/64″ to 17/64″ (1/64″ increments); 9/32″ to 1/2″ (1/32″ increments)	2204A3♦	193.01
Certified Starrett			
16	1/32″ to 1/2″ (1/32″ increments)	2204A47	152.90
25	1/64″ to 17/64″ (1/64″ increments); 9/32″ to 1/2″ (1/32″ increments)	2204A46♦	204.49
Economy			
8	9/16″ to 1″ (1/16″ increments)	2204A41■	308.50
25	1/64″ to 17/64″ (1/64″ increments); 9/32″ to 1/2″ (1/32″ increments)	2204A55♦	34.17
Optional Gauge Holder		2204A6	25.01

♦ Comes with a gauge holder. ■ Identifier is steel.

Illuminated Magnifiers

About Magnification

When it comes to magnification, the power you need depends on your application. Higher magnification reveals fine details, but it also results in a smaller field of view, so you will have to move the object around to see more of it. The example below shows the enhancement of a razor blade at different magnification powers.

1.25X to 2.25X enhances details you can already see. Use this range to read serial numbers and assemble circuit boards.

2.5X to 5X brings out details you may otherwise miss. Use this range for general inspection and to find flaws in your workpiece.

7X to 20X picks up features you can't see with your naked eye. Use this range to find imperfections in surfaces.

Working distance is the point where your object will be in the best possible focus. The higher the magnification, the closer you will need to be.

Adjustable-Arm Illuminated Magnifiers

All magnifiers have a glass lens and a metal spring arm that provides smooth positioning. They operate on 120 volts AC and include a cord with plug. Field of view is approximately the same as lens diameter.

Styles A-K come with a bulb.

Fluorescent magnifiers produce a cool, even, white light. 6788T24 is UL listed.

Halogen magnifiers provide the brightest light but also generate the most heat. UL listed.

LED magnifiers offer long life; they'll shine for 50,000 hours. They emit a focused, even light beam for distortion-free viewing and are dimmable. UL listed, unless noted.

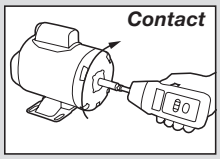
Incandescent magnifier is the most economical choice for general inspection work and requires a 60-watt incandescent bulb. ETL listed.

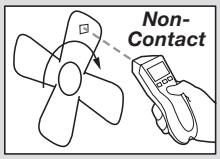
Magnification	Working Distance	Arm Lg.	Lens Dia.	Shade Material	Choose a Color	Clamp Base: Clamping Thick.			Weighted Base: Base Size		
Fluorescent											
(A) Economy											
1.75X	13″	36″	5″	Metal	Black, White	2½″	14695T5	$137.77			
1.75X	13″	45″	5″	Metal	Black, White	2½″	14695T7	139.81			
2.25X	8″	36″	5″	Metal	Black, White	2½″	14695T6	150.93			
2.25X	8″	45″	5″	Metal	Black, White	2½″	14695T8	150.93			
(B) Distortion Free—Precision-ground lens provides a higher-quality viewing area with minimal edge distortion											
2X	10″	43″	7½″	Metal	Beige	2½″	6788T9	427.50		6788T8■	$427.50
2.25X	8″	30″	5″	Plastic	Black	—	—	—	10½″ Dia.	6788T24	294.94
(C) Enhanced Visibility—Textured surfaces and irregularities are more visible											
2.25X	8″	28″	5″	Plastic	Almond, Black, Gray	2¼″	1462T15	276.75			
2.25X	8″	42″	5″	Plastic	Almond, Black, Gray	2¼″	1462T17	276.75			
Halogen											
(D) Standard—Use where electrostatic discharge is a concern											
1.75X	13″	30″	5″	Plastic	Black	—	—	—	10½″ Dia.	1035T57	243.13
1.75X	13″	45″	5″	Plastic	Black	2¾″	1035T56	219.94			
LED											
(E) Economy											
1.75X	13″	30″	5″	Metal	Light Gray	2¼″	1465T63	183.30	9¾″ Dia.	1465T62	305.50
1.75X	13″	45″	5″	Metal	Light Gray	2¼″	1465T61	183.30			
2.25X	8″	30″	5″	Metal	Light Gray	2¼″	1465T65	194.41	9¾″ Dia.	1465T66	316.61
2.25X	8″	45″	5″	Metal	Light Gray	2¼″	1465T64	194.41			
(F) Standard—Dim the light for a clear view of highly reflective surfaces											
2X	10″	43″	6″	Metal	Black, White	2½″	6573T25	427.50			
2X	10″	43″	7½″	Metal	Black, White	2½″	6573T26	523.93	14″x12″	6573T28	613.54
(G) Vibration Resistant—Arm locks into position with wing nuts											
1.75X	13″	30″	5″	Metal	Black	2⅝″	8538T32♦	299.00			
(H) Enhanced Visibility—Textured surfaces and irregularities are more visible											
2.25X	8″	28″	5″	Plastic	Black, Gray	—	—	—	10″x8″	1462T23	339.75
(J) Static Control											
1.75X	13″	28″	5″	Metal	Black	2″	8477T46	395.18	10″x8″	8477T44	460.64
1.75X	13″	42″	5″	Metal	Black	2″	8477T49	395.18			
2.25X	8″	28″	5″	Metal	Black	2″	8477T45	395.18	10″x8″	8477T43	460.64
2.25X	8″	42″	5″	Metal	Black	2″	8477T47	395.18			
5X	2.5″	42″	3″	Metal	Black	2″	10025T61	436.09			
(K) Wide-Angle Lens											
1.88X	12″	30″	4½″x6¾″	Metal	Light Gray	2¾″	3405A45	455.47	10″ Dia.	3405A46	555.45
1.88X	12″	45″	4½″x6¾″	Metal	Light Gray	2¾″	3405A44	455.47			
2X	10″	43″	5¼″x7″	Metal	Black, White	2½″	6573T27	534.64	14″x12″	6573T29	623.96
Incandescent											
(L) Economy											
1.75X	10″	33″	4″	Plastic	Black	2¼″	66045T74	67.08			

■The base is not weighted; it permanently mounts to work surface with the included screws. ♦Not UL listed.

(Continued on following page)

Tachometers





About Tachometers

Tachometers measure the speed of rotating parts on machines such as shafts, gears, and belts.

Contact tachometers come in direct contact with an object and are an excellent choice for dirty and dusty environments.

Noncontact tachometers have a beam of light or laser that reflects off a piece of reflective tape attached to the rotating point.

Contact Tachometers

- Range: 0.5 to 19,999 rpm
- Accuracy: ±0.05% of reading

Units of Measure
Revolutions/min.
Feet/min.
Meters/min.

Measure speed in three different units with one tachometer. These units include a tip for measuring shafts with a center hole, tip for measuring flat end surfaces, 4″ circumference speed wheel, and a case. They have an LCD and plastic housing. Operate on four AA batteries (included). Choose with or without a certificate of calibration traceable to NIST.

Tachometer	8714T11	$206.24
Tachometer with NIST Certificate	8714T22	332.13
Tip for Shafts with Center Hole	8714T41	12.92
Tip for Flat End Surfaces	8714T45	12.93
4″ Circumference Speed Wheel	8714T46	12.92
Replacement AA Batteries (Pkg. of 4)	71455K53	2.94

High-Accuracy Contact Tachometers

- Range: 0.1 to 25,000 rpm
- Accuracy: ±0.006% of reading

Units of Measure	
Revolutions/min., hr.	Yards/min., hr.
Inches/min.	Meters/min., hr.
Feet/min., hr	Miles/hr.
Total Revolutions	Length—m, cm, in., ft., yd.

The most accurate tachometers we offer. Units include two tips for measuring shafts with a center hole, one tip for measuring flat end surfaces, speed wheel, 3½″ extension shaft, and a case. They have an aluminum housing and come with a certificate of calibration traceable to NIST. Operate on two AA batteries (included).

Choose an ***LCD display*** for use in bright light or ***LED display*** for dimly lit areas.

Note: Units are calibrated to work with either a 6″ or 12″ circumference speed wheel but not both.

Display	Speed Wheel		
LCD	6″ Circumference	11995T71	$292.50
LED	6″ Circumference	11995T72	292.50
LED	12″ Circumference	11995T73	352.08
3½″ Extension Shaft		11995T56	14.00
Tip for Shafts with Center Hole		11995T53	8.27
Tip for Flat End Surfaces		11995T54	8.27
6″ Circumference Speed Wheel		11995T55	38.18
12″ Circumference Speed Wheel		11995T75	63.64
Replacement AA Batteries (Pkg. of 4)		71455K53	2.94

High-Accuracy Noncontact Tachometers

- Range: 5 to 99,999 rpm
- Measuring Distance: Up to 3 ft.
- Accuracy: ±0.01% of reading
- Unit of Measure: Revolutions/Minute

Take precise measurements from a distance. This tachometer has an LCD and plastic housing. It includes 12″ of reflective tape and a ¼″-20 female threaded bushing for tripod mounting. Operates on two AA batteries (included).

Tachometer	11765T58	$162.96
Plastic Carrying Case	11765T61	38.89
Reflective Tape Roll (5 ft. Lg. × ½″ Wd.)	7178A12	12.42
Reflective ½″ Sq. Tape Tabs (Sheet of 35)	15975T21	5.25
Replacement AA Batteries (Pkg. of 4)	71455K53	2.94

Noncontact Tachometers

- Range: 2 to 99,999 rpm
- Measuring Distance: Up to 20″
- Accuracy: ±0.05% of reading
- Unit of Measure: Revolutions/Minute

Get an accurate measurement while keeping clear of moving equipment. Tachometers have an LCD and plastic housing. They include 2 ft. of reflective tape and operate on one 9-volt battery (included). Choose with or without certificate of calibration traceable to NIST.

Tachometer	1905T22	$157.37
Tachometer with NIST Certificate	1905T42	242.69
Reflective Tape Roll (5 ft. Lg. × ½″ Wd.)	7178A12	12.42
Reflective ½″ Sq. Tape Tabs (Sheet of 35)	15975T21	5.25
Replacement 9-Volt Battery (Pkg. of 1)	71455K56	4.85

Contact/Noncontact Tachometers

- Range: Contact: 0.5 to 20,000 rpm; Noncontact: 5 to 200,000 rpm
- Measuring Distance: Up to 25 ft.
- Accuracy: Contact: ±0.05% of reading; Noncontact: ±0.01% of reading

Units of Measure	
Revs./sec., min., hr.	Yards/sec., min., hr.
Inches/sec., min., hr.	Centimeters/sec., min., hr.
Feet/sec., min., hr.	Meters/sec., min., hr.

Capture high speed readings from a distance in noncontact mode, or use the included 4″ circumference speed wheel to switch to contact mode. It includes one tip for measuring shafts with a center hole, one tip for measuring flat end surfaces, 5 ft. of reflective tape, ¼″-20 female threaded bushing for tripod mounting, and a case. Unit has an LCD and plastic housing and comes with a certificate of calibration traceable to NIST. Operates on two AA batteries (included).

BNC cable sends signals from the tachometer to a vibration data collector.

Tachometer with NIST Certificate	11765T75	$314.72
BNC Cable	11765T91	52.50
Reflective Tape Roll (5 ft. Lg. × ½″ Wd.)	7178A12	12.42
Reflective ½″ Sq. Tape Tabs (Sheet of 35)	15975T21	5.25
Replacement AA Batteries (Pkg. of 4)	71455K53	2.94

High-Accuracy Contact/Noncontact Tachometers

- Range: 6 to 99,999 rpm
- Measuring Distance: Up to 20 ft.
- Accuracy: ±0.006% of reading

Units of Measure	
Revolutions/min.	Inches/min.
Feet/min.	Yards/min.
Meters/min.	Length—m, in., ft., yd.

Switching from contact to noncontact mode is as easy as attaching the included adapter. Tachometers include one tip for measuring shafts with a center hole, one tip for measuring flat end surfaces, speed wheel, 7″ of reflective tape, ¼″-20 female threaded bushing for tripod mounting, and a case. They have an aluminum housing and come with a certificate of calibration traceable to NIST. Operate on two AA batteries (included).

Choose an ***LCD display*** for use in bright light or ***LED display*** for dimly lit areas.

Display	Speed Wheel		
LCD	6″ Circumference	11835T71	$319.76
LCD	12″ Circumference	11835T81	377.42
LED	6″ Circumference	11835T51	319.76
LED	12″ Circumference	11835T61	377.42
3½″ Extension Shaft		11995T56	14.00
Tip for Shafts with Center Holes		11995T53	8.27
Tip for Flat End Surfaces		11995T54	8.27
6″ Circumference Speed Wheel		11995T55	38.18
12″ Circumference Speed Wheel		11995T75	63.64
Reflective Tape Roll (5 ft. Lg. × ½″ Wd.)		7178A12	12.42
Reflective ½″ Sq. Tape Tabs (Sheet of 35)		15975T21	5.25
Replacement AA Batteries (Pkg. of 4)		71455K53	2.94

Powered Sheet Metal Nibblers

About Powered Nibblers and Powered Cutters

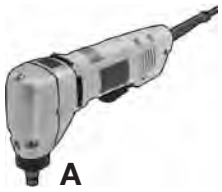
Sheet Metal Nibblers—Create an almost burr-free cut with no edge distortion. A nibbler punches small pieces out of the material, producing some waste.

Sheet Metal Cutters—Also known as right-angle shears, these cut with less effort compared to manual cutters. There's little material waste, but they leave slightly rough edges. They're best for straight patterns on flat material, and they also cut curves and notches.

Cutters for Thin, Pliable Materials—These scissor-like cutters minimize material loss and edge distortion in thin, pliable materials.

Smooth-Edge Sheet Metal Cutters—Also known as slotting shears, these make two parallel cuts to create a waste strip that peels away from the remaining material, leaving two smooth edges with little distortion. Use for cutting straight lines, contours, and irregular shapes. They're not for cutting tight curves or corrugated material.

Electric Sheet Metal Nibblers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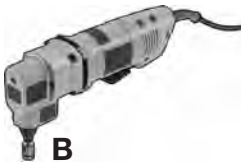

B


C


D


E

Punch small pieces out of material to create an almost burr-free cut with no material distortion. To start cuts in the center of material, drill a starting hole. These nibblers have an aluminum housing, except Style C is magnesium. All include one punch, one die, and instructions.

Style A has a round punch that can rotate 360°. Can cut flat stock up to 60″ per minute. Not for corrugated or uneven material. Nibbler can change cutting direction as desired (no cutting radius required). Has a lever switch. Overall length is 9¾″. Nibbler operates on 120 volts AC/DC, 3 amps, and has an 8-ft. power cord with two-prong plug. UL listed, CSA certified, and meets OSHA requirements.

Style B has a round punch that can rotate 360°. Can cut uneven and corrugated materials up to 84″ per minute. Nibbler can change cutting direction as desired (no cutting radius required). Has a lever switch. Overall length is 10½″. Operates on 120 volts AC/DC, 6.5 amps, and has an 8-ft. power cord with two-prong plug. UL listed, CSA certified, and meets OSHA requirements.

Style C cuts flat stock and uneven and corrugated material up to 105″ per minute. Has a toggle switch and a reversible side handle. Overall length is 12¼″. Operates on 120 volts AC/DC, 4 amps, and has an 8-ft. power cord with two-prong plug. UL listed, C-UL listed, and meets OSHA requirements.

Style D cuts flat stock up to 48″ per minute. Not for corrugated or uneven material. Has a trigger switch with a locking button. Overall length is 13″. Operates on 110 volts AC, 3-5 amps, and has a 10-ft. power cord with three-prong plug.

Style E cut flat stock up to 48″ per minute. Not for corrugated or uneven material. Nibblers have a locking trigger switch and include an extra punch. They can also cut aluminum when used with the punch, die, and stripper for aluminum (sold separately). Overall length is 14¼″. Nibblers operate on 120 volts AC, 15 amps, and have a 10-ft. power cord with three-prong plug.

	For Max. Thick.											
	Steel	Stainless Steel	Aluminum	Cut Wd.	No-Load Strokes/ Minute	Min. Cut Radius▲	Starting Hole Dia.	Nibblers		Replacement Punch		Replacement Die	
A	3/64″	3/64″	3/32″	1/4″	2,100	0″	1/2″	3601A71	$403.51	3601A72★	$78.32	____	____
B	1/16″	3/64″	3/32″	1/4″	1,950	0″	5/8″	4942A71	582.69	4942A72	80.50	4942A73	$80.50
C	1/8″	3/32″	5/64″	0.24″	1,000	2 1/2″	1 21/32″	3604A71	1,037.50	3604A72	61.85	3604A73	207.08
D	11/64″	1/8″	3/16″	0.21″	260	6″	2 1/2″	3557A12	820.00	3557A24	24.54	3557A22	42.95
E	1/4″	11/64″	3/8″	1/4″	240	8″	3 1/2″	3819A77	1,195.00	3819A14	21.68	3819A11	70.91
E	1/4″	11/64″	3/8″	1/4″	240	32″	3 1/2″	3819A1	1,195.00	3819A14	21.68	3819A11	70.91

Accessories for Style E

Punch (Recommended for cutting stainless steel)	3819A16	23.05
Punch (Required for cutting aluminum)	3819A15	27.27
Die (Required for cutting aluminum)	3819A12	73.64
Stripper (Required for cutting aluminum)	3819A17	93.41

▲The smallest arc (or curve) the tool can cut. Radius x 2 equals the smallest diameter circle the tool can cut. ★ Punch and die set.

Air-Powered Sheet Metal Nibblers


A


B


C


D

These nibblers punch small pieces out of material to create an almost burr-free cut with no material distortion. To start cuts in the center of material, drill a starting hole. Nibblers have an aluminum housing and a lever switch, unless otherwise stated. They include one punch, one die, and instructions. Operate on 90 psi air pressure and require a 3/8″ hose (not included), except Style C, which requires 100 psi and a 1/2″ hose.

Style A cuts corrugated material up to 62″ per minute. Overall length is 7 1/16″. Air inlet is 1/4 NPT female. Air consumption is 21 cfm.

Style B cuts corrugated or uneven material up to 46½″ per minute. Includes an extra punch. Overall length is 7″. Air inlet is 1/4 NPT female. Air consumption is 4 cfm. Housing is plastic.

Style C cuts flat stock and corrugated or uneven material up to 55″ per minute. Overall length is 12″. Air Inlet is 3/8 NPT female. Air consumption is 27 cfm.

Style D cuts flat stock up to 48″ per minute. Not for corrugated or uneven material. Has a locking trigger-style switch. Overall length is 12″. Air inlet is 3/8 NPT female. Air consumption is 21-23 cfm.

	For Max. Thick.											
	Steel	Stainless Steel	Aluminum	Cut Wd.	No-Load Strokes/ Minute	Min. Cut Radius▲	Starting Hole Dia.	Nibblers		Replacement Punch		Replacement Die	
A	3/64″	___	1/32″	1/4″	3,200	1/4″	1/2″	37615A71	$170.24	37615A66	$18.57	37615A67	$35.60
B	3/64″	___	3/64″	3/16″	2,600	3/16″	3/8″	3761A75	211.60	3761A86	16.56	3761A87	40.08
C	3/32″	5/64″	1/8″	1/4″	192	2″	1 1/2″	3837A3	740.00	3837A62	23.86	3837A52	31.50
D	11/64″	1/8″	11/64″	3/16″	192	6″	2 1/2″	24745A13	935.59	3557A24	24.54	3557A22	42.95

▲ The smallest arc (or curve) the tool can cut. Radius x 2 equals the smallest diameter circle the tool can cut.

About Drill Bits

Bit Materials

High-speed steel bits are for general use in most materials.

Cobalt steel bits are better than high-speed steel for drilling very hard materials such as stainless steel, titanium alloys, and nickel alloys.

Carbide-tipped bits resist wear better than high-speed steel and cobalt steel, particularly in abrasive materials such as fiberglass and aluminum.

Carbide bits are harder, stronger, and offer greater wear resistance than high-speed steel, cobalt steel, and carbide-tipped bits. However, they require rigid toolholding to prevent breakage and should not be used in hand-held drilling applications.

Treatments & Coatings

Uncoated (Bright Finish)— Surface is untreated. For general purpose drilling of most metals, wood, and plastic.

Black-Oxide Treatment— Color is dull black. For drilling of ferrous metals such as steel, stainless steel, and cast iron.

Black-and-Gold-Oxide Treatment— Color is black and gold. Resists breakage better than black-oxide bits when drilling ferrous metals such as steel, stainless steel, and cast iron.

Extended-Life Coatings— These coatings extend the life of bits by forming a barrier against heat and abrasion.

Extended-Life Coating	Color
Long-Life TiN (titanium nitride)	Bright gold
Extra-Life TiCN (titanium carbonitride)	Violet/blue-gray
Super-Life TiAlN (titanium aluminum nitride)	Dark violet/blue-gray
Ultra-Life TiN/TiAlN	Dark violet/blue-gray

Bit Shank Diameter

The shank diameter of each drill bit is the same as or slightly smaller than the drill bit size, unless otherwise stated.

Bit Length

Though ***jobbers' length*** bits are highly versatile, you may require shorter or longer bits for your specific application.

Short-length bits have maximum rigidity and a shorter overall length for drilling straighter, shallower holes than jobbers' and maintenance-length bits.

Maintenance-length bits are more rigid and drill shallower holes than jobbers' length bits.

Extended-reach bits are for hard-to-reach spots and drilling deeper holes than jobbers' length bits.

Short Length
Pages 2502, 2504, 2506, 2508-2510

Maintenance Length
Page 2507

Jobbers' Length
Pages 2492-2507

Extended Reach
Pages 2511-2513

Jobbers' Bits Application Guide

Jobbers' drill bits are the most widely used because they're rigid enough to make accurate hole sizes in a variety of materials and long enough to drill the hole depths required for most applications.

Select a jobbers' drill bit based on the material you plan to drill. Bits with a "Good" rating are both effective and economical; bits with a "Better" rating offer longer life; and bits with a "Best" rating are designed for superior performance.

Note: For drill bits for masonry, concrete, and wood, see pages 2520-2526.

For Drilling	GOOD Pages	BETTER Pages	BEST Pages
Alloy Steel and Carbon Steel	General Purpose High-Speed Steel Jobbers' Drill Bits, Black Oxide 2494-2498	General Purpose High-Speed Steel Jobbers' Drill Bits, Long-Life TiN Coated 2494-2498	General Purpose High-Speed Steel Jobbers' Drill Bits, Super-Life TiAlN Coated 2494-2496
Cast Iron	General Purpose High-Speed Steel Jobbers' Drill Bits, Black Oxide 2494-2498	General Purpose High-Speed Steel Jobbers' Drill Bits, Long-Life TiN Coated 2494-2498	Carbide-Tipped Drill Bits for Difficult-to-Drill Materials 2502
Hard Steel	General Purpose High-Speed Steel Jobbers' Drill Bits, Super-Life TiAlN Coated 2494-2496	Straight-Flute Carbide-Tipped Drill Bits for Hard Steel 2504	Ultra Duty Carbide Drill Bits for Tool Steel and Dies 2503
Stainless Steel	Heat-Resistant Cobalt Steel Jobbers' Drill Bits 2500-2501	Heavy Duty Chip-Clearing Cobalt Steel Jobbers' Drill Bits 2499	High-Speed Steel Jobbers' Drill Bits for Stainless Steel 2505
Nickel Alloys/ Titanium Alloys	Heat-Resistant Cobalt Steel Jobbers' Drill Bits, Uncoated (Bright Finish) 2500-2501	Heat-Resistant Cobalt Steel Jobbers' Drill Bits, Ultra-Life TiN/TiAlN Coated 2500-2501	High-Speed Steel Jobbers' Drill Bits for Stainless Steel 2505
Aluminum	General Purpose High-Speed Steel Jobbers' Drill Bits, Uncoated (Bright Finish) 2494-2496	Heavy Duty Chip-Clearing High-Speed Steel Jobbers' Drill Bits, Long-Life TiN Coated 2498	High-Performance Carbide Jobbers' Drill Bits for Aluminum 2504
Brass and Bronze	General Purpose High-Speed Steel Jobbers' Drill Bits, Black Oxide 2494-2498	High-Speed Steel Jobbers' Drill Bits for Brass and Bronze 2505	High-Performance Carbide Jobbers' Drill Bits for Aluminum 2504
Plastic	General Purpose High-Speed Steel Jobbers' Drill Bits, Uncoated (Bright Finish) 2494-2496	General Purpose High-Speed Steel Jobbers' Drill Bits, Long-Life TiN Coated 2494-2498	High-Speed Steel Jobbers' Drill Bits for Plastic 2505
Fiberglass	General Purpose High-Speed Steel Jobbers' Drill Bits, Extra-Life TiCN Coated 2494-2496	General Purpose High-Speed Steel Jobbers' Drill Bits, Super-Life TiAlN Coated 2494-2496	Carbide-Tipped Drill Bits for Difficult-to-Drill Materials 2502
Composites	Carbide-Tipped Drill Bits for Difficult-to-Drill Materials 2502	Carbide Jobbers' Drill Bits for Fiber-Reinforced Composites 2506	Carbide Jobbers' Drill Bits for Composites 2506
Glass and Ceramics		Carbide-Tipped Drill Bits for Glass and Ceramics 2505	

About Masonry Drill Bits

Bits have alloy steel bodies with carbide tips that can be resharpened. Bits are made to ANSI standards (where applicable).

Hammer Drilling Bits

Also called percussion or impact bits, these bits drill holes using simultaneous rotary and hammering action to break masonry materials, such as concrete, into tiny granules. This dual action allows bits to drill faster and penetrate materials with less pressure than drilling-only bits. These bits can be used with hammer drills or rotary hammers. If you need a shank adapter, see our 89385A series on page 2522.

Drilling-Only Bits

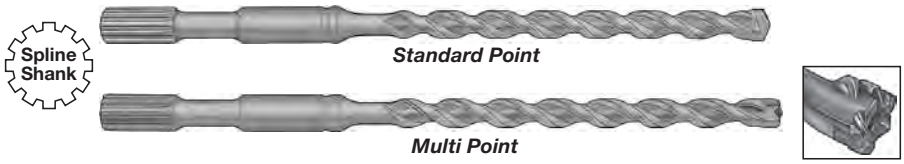
These bits drill holes using rotary action. They don't break up masonry materials like hammer drilling bits, but they do grind it up when you apply pressure. Use these bits with portable electric drills, cordless drills, and hammer drills (rotary-mode only).

Drill Bit Shank Styles

How to Avoid Premature Bit Failure

1. Do not let bit come into contact with embedded rebar (reinforcing bar). If you do encounter rebar, move the hole or switch to a rebar cutting bit, such as our 28655A series on page 2523.
2. Frequently withdraw the bit from the hole to clean out dust to lessen the chance of the drill bit binding in the hole.
3. Keep the bit's shank clean and lubricated.
4. Do not pour water into the hole while drilling. The extreme change in temperature may cause the bit's carbide tip to fail.

Spline-Shank Masonry Drill Bits for Rotary Hammers



The shank has 12 splines to keep an optimum fit between the bit and the bit holder during the heavy impact produced by a spline-drive rotary hammer. Shank is 3/4" dia. ***Multi-point*** bits have five carbide cutters in the tip, resulting in less vibration, smoother and rounder holes, faster drilling, and longer bit life.

Standard Point

Bit Size	Drilling Depth	O'all Lg.		
3/8"	4"	10"	8783A18	$38.40
3/8"	8"	14"	8783A71	47.16
3/8"	12"	18"	8783A19	50.22
7/16"	8"	14"	8783A72	51.20
1/2"	8"	14"	8783A11	42.67
1/2"	12"	18"	8783A22	44.09
1/2"	16"	22"	8783A23	56.18
1/2"	22"	28"	8783A73	67.56
1/2"	36"	42"	8783A74	121.60
9/16"	8"	14"	8783A13	53.38
9/16"	12"	18"	8783A46	57.30
5/8"	8"	14"	8783A12	50.05
5/8"	12"	18"	8783A25	50.49
5/8"	16"	22"	8783A26	$62.61
5/8"	22"	28"	8783A77	81.52
11/16"	8"	14"	8783A15	56.50
3/4"	8"	14"	8783A16	57.26
3/4"	12"	18"	8783A28	56.89
3/4"	16"	22"	8783A29	60.73
3/4"	22"	28"	8783A79	82.94
13/16"	8"	14"	8783A61	57.25
13/16"	16"	22"	8783A62	73.65
7/8"	8"	14"	8783A17	68.85
7/8"	12"	18"	8783A31	61.82
7/8"	16"	22"	8783A32	72.00
7/8"	22"	28"	8783A82	91.02
1"	8"	14"	8783A48	$68.44
1"	12"	18"	8783A34	70.86
1"	16"	22"	8783A35	78.30
1"	22"	28"	8783A84	94.58
1 1/8"	8"	14"	8783A52	88.69
1 1/8"	16"	22"	8783A43	105.78
1 1/4"	8"	14"	8783A54	100.44
1 1/4"	16"	22"	8783A37	98.13
1 1/4"	22"	28"	8783A85	137.24
1 3/8"	16"	22"	8783A63	142.48
1 1/2"	16"	22"	8783A45	135.63

Multi Point

Bit Size	Drilling Depth	O'all Lg.		
5/8"	8"	14"	8809A11	$48.35
5/8"	12"	18"	8809A12	61.02
5/8"	36"	42"	8783A78	122.43
3/4"	8"	14"	8809A13	54.76
3/4"	12"	18"	8809A14	66.13
3/4"	16"	22"	8809A15	76.09
3/4"	36"	42"	8783A81	$130.23
7/8"	8"	14"	8809A18	57.60
7/8"	12"	18"	8809A19	70.40
7/8"	36"	42"	8783A83	148.16
1"	8"	14"	8809A16	62.58
1"	12"	18"	8809A17	76.09
1"	36"	42"	8783A51	$169.66
1 1/8"	16"	22"	8809A21	97.42
1 1/4"	16"	22"	8809A22	113.07
1 3/8"	16"	22"	8809A23	132.27
1 1/2"	16"	22"	8809A24	153.60
1 1/2"	36"	42"	8783A58	245.16

Tapered Round-Shank Masonry Drill Bits for Rotary Hammers

Also known as A-taper bits, they fit all rotary hammers with a taper-shank chuck. An adapter (sold separately) is required for use in spline-drive and SDS-Plus drive rotary hammers.

Adapters are made of steel and include a bit removal tool (also called a drift pin).

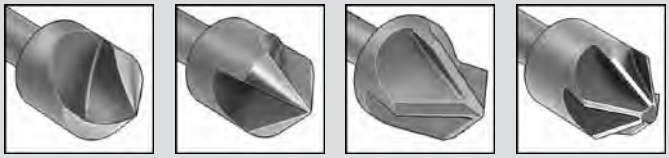
Bit Size	Drilling Depth	O'all Lg.		
1/4"	4 1/4"	6"	2808A31	$12.94
5/16"	4 1/4"	6"	2808A32	13.61
3/8"	4 1/4"	6"	2808A33	15.09
3/8"	7 1/4"	9"	2808A44	21.59
3/8"	10 1/4"	12"	2808A55	23.67
1/2"	4 1/4"	6"	2808A35	23.61
1/2"	7 1/4"	9"	2808A46	27.86
1/2"	10 1/4"	12"	2808A56	32.14
1/2"	17 1/4"	19"	2808A64	$49.97
9/16"	7 1/4"	9"	2808A47	29.00
9/16"	10 1/4"	12"	2808A57	37.70
5/8"	3 1/4"	5"	2808A37	29.42
5/8"	7 1/4"	9"	2808A48	28.68
5/8"	10 1/4"	12"	2808A58	38.38
3/4"	7 1/4"	9"	2808A51	38.43
3/4"	10 1/4"	12"	2808A61	44.46

Spline-Shank Adapter for Spline-Drive Rotary Hammers ..... 2813A47 ..... $56.15
SDS-Plus Shank Adapter for SDS-Plus Drive Rotary Hammers ..... 2813A53 ..... 43.14

About Countersinks

Countersinks form a cone-shaped opening at the top of a hole, which acts as a seat for the head of a screw or rivet. They can also be used for chamfering, deburring, and creating openings for holding material between centers.

Flutes



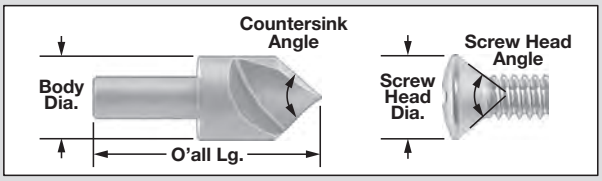
Fast Cut (Single Flute) — *General Purpose (Three Flutes)* — *General Purpose (Four Flutes)* — *Smooth Finish (Six Flutes)*

Fast Cut— Have one flute and won't vibrate at high speeds. Also great for cutting smaller holes.

General Purpose— Have two, three, or four flutes. Tool life increases with more flutes because the cutting load is distributed over more edges. However, fewer flutes provide better chip clearance, which is a consideration when machining stringy materials like plastic.

Smooth Finish— Have six flutes. These remove more material per revolution and have a longer life than other countersinks.

Body Diameter and Countersink Angle



The countersink body diameter must be equal to or larger than the head diameter of the screw, center, or rivet being countersunk. Use a pilot hole that's larger than 10% of the countersink body diameter.

- ***60° Countersink Angle:*** For holding workpieces between the centers on a lathe.
- ***82° Countersink Angle:*** For flat- and oval-head inch screws.
- ***90° Countersink Angle:*** For flat- and oval-head metric screws. They're also great for chamfering.
- ***100° Countersink Angle:*** For rivets.
- ***120° Countersink Angle:*** For rivets.

Drill-Bit Countersinks

When used in combination with your drill bit (not included), these tools let you drill and countersink wood-screw holes in one quick operation. They attach to the body of your drill bit with two set screws and can be easily adjusted up and down for any length wood screw. All countersinks have four flutes.

Carbon steel countersinks have an 82° angle and are for use in wood and plastic.

High-speed steel countersinks come in your choice of an 82° or 90° angle and are for use in wood, plastic, and most metals. **To Order:** Please specify 82° or 90° countersink angle.

Stop collars control the cutting depth of your countersinks. The inside diameter of the stop collar fits the outside diameter of your countersink. Collars attach easily with two set screws and can be easily adjusted for depth. Made of steel with a black-oxide surface treatment.

Drill Bit Not Included

Stop Collar Sold Separately

Drill Bit Countersinks and Stop Collars

For Screw Size	Fits Drill Bit Size	Body Dia.	O'all Lg.	DRILL BIT COUNTERSINKS Carbon Steel	Each	High-Speed Steel	Each	STOP COLLARS OD	Wd.		Each
#3	3/32″	1/4″	3/4″	2785A12	$9.35	2910A63	$19.00	1/2″	1/4″	2903A11	$3.16
#4	7/64″	5/16″	7/8″	2785A13	9.35	2910A42★	19.00	9/16″	1/4″	2903A12	3.22
#5	1/8″	3/8″	7/8″	2785A21	8.42	2910A43	17.20	5/8″	1/4″	2903A13	3.45
#6	9/64″	3/8″	7/8″	2785A22	8.42	2910A44	17.20	5/8″	1/4″	2903A13	3.45
#7	5/32″	3/8″	7/8″	2785A23	8.42	2910A64	17.20	5/8″	1/4″	2903A13	3.45
#7	5/32″	1/2″	7/8″	2785A35	9.35	2910A62	19.00	3/4″	1/4″	2903A15	3.91
#8	11/64″	3/8″	7/8″	2785A24	8.42	2910A46	17.20	5/8″	1/4″	2903A13	3.45
#9	3/16″	3/8″	7/8″	2785A25	8.42	2910A47	17.20	5/8″	1/4″	2903A13	3.45
#9	3/16″	1/2″	7/8″	2785A37	9.35	2910A57	19.00	3/4″	1/4″	2903A15	3.91
#9	3/16″	5/8″	1 1/16″	2785A53	12.47	2910A53	25.98	7/8″	1/4″	2903A17	4.65
#10	13/64″	3/8″	7/8″	2785A26	8.42	2910A59	17.20	5/8″	1/4″	2903A13	3.45
#10	13/64″	7/16″	7/8″	2785A31	9.35	2910A48	17.18	11/16″	1/4″	2903A14	3.82
#10	13/64″	1/2″	7/8″	2785A38	9.35	2910A49	19.00	3/4″	1/4″	2903A15	3.91
#12	7/32″	3/8″	7/8″	2785A27	8.42	2910A61	17.20	5/8″	1/4″	2903A13	3.45
#12	7/32″	1/2″	7/8″	2785A39	9.35	2910A51	19.00	3/4″	1/4″	2903A15	3.91
#14	1/4″	1/2″	7/8″	2785A52	9.35	2910A52	19.00	3/4″	1/4″	2903A15	3.91
#16	1/4″	5/8″	1 1/16″	2785A54	12.47	2910A54	25.98	7/8″	1/4″	2903A17	4.65
#16	9/32″	5/8″	1 1/16″	2785A56	12.47	2910A55	25.98	7/8″	1/4″	2903A17	4.65
#18	5/16″	5/8″	1 1/16″	2785A58	12.47	2910A56	25.98	7/8″	1/4″	2903A17	4.65

★ Overall length is 3/4″.

Drill Bit Countersink Sets

All countersinks have an 82° countersink angle. Sets are furnished in a wood stand.

7-Piece Sets— You'll get one each 3/8″ body dia. countersink for 1/8″, 9/64″, 5/32″, 11/64″, and 3/16″ dia. drill bits; one 7/16″ body dia. countersink for a 13/64″ dia. drill bit; and one 1/2″ body dia. countersink for a 7/32″ dia. drill bit.

		Per Set
Carbon Steel Set	2785A46	$63.96
High-Speed Steel Set	2910A41	117.97

14-Piece Sets— You'll get one each 3/8″ body dia. countersinks for 1/8″, 9/64″, 5/32″, 11/64″, and 3/16″ dia. drill bits; one 7/16″ body dia. countersink for a 13/64″ dia. drill bit; four 1/2″ body dia. countersinks for 3/16″, 13/64″, 7/32″, and 1/4″ dia. drill bits; and four 5/8″ body dia. countersinks for 3/16″, 1/4″, 9/32″, and 5/16″ dia. drill bits.

		Per Set
Carbon Steel Set	2785A48	$144.51
High-Speed Steel Set	2910A45	272.09

Hex Shank Combination Drill Bits and Countersinks for Wood

Make holes for wood plugs in one easy operation. These combination tools consist of a general purpose, high-speed steel jobbers' drill bit and a hardened steel countersink. Tools have an 82° countersink angle and a hex shank that fits all quick-change and standard drill chucks. Bits are securely held by a set screw and can be adjusted up to 1″ for different screw lengths.

For Screw Size Hardwood	Softwood	Drill Bit Size	Drill Bit/Countersinks	Each	Replacement Drill Bits	Each
#4	—	5/64″	2747A21	$8.06	8870A15	$1.23
—	#6	3/32″	2747A22	8.06	8870A16	1.24
#6	#8	7/64″	2747A23	8.06	8870A17	1.24
#8	#10	1/8″	2747A24	8.06	8870A18	1.44
#10	#12	9/64″	2747A25	8.06	8870A19	1.36

Countersinks for Aluminum, Brass, and Bronze

Three spiral flutes leave a clean, smooth finish on soft metals such as aluminum, brass, and bronze. Made of high-speed steel. **To Order:** Please specify 60°, 82°, 90°, 100°, or 120° countersink angle.

Body Dia.	Shank Dia.	O'all Lg.		Each
1/4″	1/4″	1 1/4″	2742A511	$11.92
3/8″	1/4″	1 5/8″	2742A512	13.31
1/2″	1/4″	2″	2742A513	17.41
5/8″	1/4″	2 1/4″	2742A514	24.00
3/4″	1/2″	3″	2742A515	32.22
1″	1/2″	3 1/4″	2742A517	53.47
1 1/4″	5/8″	3 1/2″	2742A519	96.98
1 1/2″	3/4″	3 7/8″	2742A521	135.47
2″	3/4″	4 1/4″	2742A522	250.24

Five-Piece Sets— You'll get one countersink in each of the following body diameters: 1/4″, 3/8″, 1/2″, 5/8″, and 3/4″. Furnished in a plastic case. **To Order:** Please specify 60°, 82°, 90°, 100°, or 120° countersink angle.

2742A601 ..... Per Set $95.43

Solid-Carbide Drill-Point Countersinks

Longer-lasting than high-speed steel drill-point countersinks and great for hard and abrasive materials. The tips of these countersinks have small drill points and are double-ended—if one end becomes worn, simply turn the tool around.

Use ***60° countersinks*** to create the holes needed to machine material between centers. The drill tip creates a small gap that prevents damage to the points of live or dead centers. The tips on ***82°*** and ***90° countersinks*** create a small pilot hole at the bottom of the countersunk hole to facilitate drilling.

Uncoated tools are for use with hardened steel, nonferrous metals such as aluminum, and nonmetallic materials. ***Coated tools*** offer superior performance and longer life. *TiCN* (titanium carbonitride) coated tools last longer than uncoated tools and are best for general purpose cutting of steel. They are also the best option for cuts in cast aluminum. *TiAlN* (titanium aluminum nitride) is the best choice for materials up to Rockwell hardness C50. Not for use on aluminum. *AlTiN* (aluminum titanium nitride) is for high-speed machining on materials with a Rockwell hardness between C50 and C70. Not for use on aluminum.

To Order: Please specify 60°, 82°, or 90° countersink angle. For coated tools, also specify TiCN, TiAlN, or AlTiN coating.

Countersinks

Trade Size	Drill Size	Body Dia.	O'all Lg.	Uncoated	Each	Coated	Each
00	0.025″	1/8″	1 1/2″	2925A51	$17.85	2936A11	$23.90
0	1/32″	1/8″	1 1/2″	2925A52	16.75	2936A12	22.62
1	3/64″	1/8″	1 1/2″	2925A53	15.62	2936A13	21.40
2	5/64″	3/16″	2″	2925A54	24.65	2936A14	32.26
3	7/64″	1/4″	2″	2925A55	27.99	2936A15	39.02
4	1/8″	5/16″	2 1/2″	2925A56	38.27	2936A16	54.20
5	3/16″	7/16″	2 3/4″	2925A57	56.84	2936A17	79.42
6	7/32″	1/2″	3″	2925A58	78.04	2936A18	103.14
7	1/4″	5/8″	3 1/2″	2925A59	123.20	2936A19	162.36
8	5/16″	3/4″	4″	2925A61	162.35	2936A21	210.22

Six-Piece Countersink Sets

You'll get one countersink in each of the following trade sizes: 1, 2, 3, 4, 5, and 6. Furnished in a metal case.

To Order: For coated countersink sets, please specify TiCN, TiAlN, or AlTiN coating.

	Uncoated	Per Set	Coated	Per Set
60° Countersink Angle	2925A22	$241.93	2936A31	$284.00
82° Countersink Angle	2925A72	241.93	2936A32	284.00
90° Countersink Angle	2925A73	241.93	2936A33	284.00

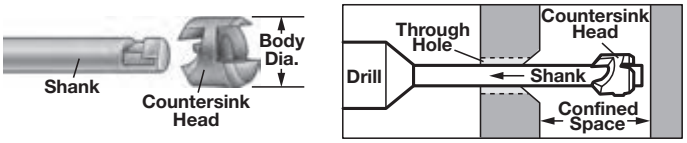
Hand-Driven Countersinks

A manually powered, angled shank makes it easy to countersink and debur next to a shoulder and in hard-to-reach holes.

Complete tool is furnished in a plastic case and includes a 5″ long plastic handle and four high-speed steel countersinks with a 90° countersink angle in 1/8″, 1/4″, 5/16″, and 3/8″ body diameters.

		Each
Complete Tool	28775A61	$58.71
Replacement Parts		
5″ Long Plastic Handle	28775A67	6.61
1/8″ Countersink	28775A62	6.32
1/4″ Countersink	28775A63	17.26
5/16″ Countersink	28775A64	17.63
3/8″ Countersink	28775A65	17.54

Tight-Spot Reverse Countersinks



When you can't get at your work with a regular tool, these reverse countersinks do the trick. Simply put the shank (sold separately) in your drill chuck, insert shank into a through hole, and attach the countersink head on the end. Pull back on the drill to countersink the backside of the hole. Shanks are 6″ long and are tempered steel; countersink heads are high-speed steel.

For Hole Dia.	Body Dia.	COUNTERSINK HEADS 82°	Each	100°	Each	SHANKS Dia.	Each
3/32″	5/16″	3309A41	$23.40	3309A11	$23.09	3/32″	3309A31 $8.00
1/8″	5/16″	3309A42	23.40	3309A12	23.09	1/8″	3309A32 8.76
5/32″	5/16″	3309A43	23.40	3309A13	23.09	5/32″	3309A33 9.05
1/8″	3/8″	3309A44	24.50	3309A14	24.13	1/8″	3309A32 8.76
5/32″	3/8″	3309A45	24.50	3309A15	24.13	5/32″	3309A33 9.05
3/16″	3/8″	3309A46	24.50	3309A16	24.13	3/16″	3309A34 9.79
5/32″	1/2″	3309A47	26.10	3309A17	25.49	5/32″	3309A33 9.05
3/16″	1/2″	3309A48	26.10	3309A18	25.49	3/16″	3309A34 9.79
1/4″	1/2″	3309A49	26.10	3309A19	25.49	1/4″	3309A35 10.17

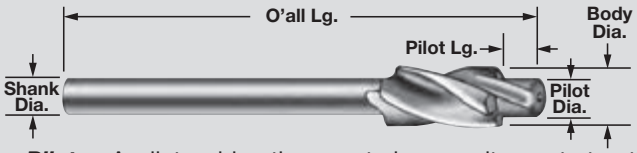
About Counterbores

Counterboring

Counterboring— Enlarge the top portion of an existing hole, forming a cylindrical-shaped opening with a flat bottom that acts as a seat for the head of a screw or wood plug.

Shallow Counterboring

Shallow Counterboring— Bore a shallow spot (1/8″ or less) around a hole so that the head of the screw, bolt, or nut is slightly raised above the surface of the material (also known as spot facing).



Pilots— A pilot guides the counterbore as it penetrates the material, keeping it centered over the drilled screw hole and ensuring a level seat for the screw head. ***Counterbores with built-in pilots*** have a counterbore and pilot made from one piece of steel. ***Changeable-pilot counterbores*** have a removable pilot, allowing you to use various pilot diameters in a single tool.

Drill-Bit Counterbores for Wood and Plastic

Drill Bit Not Included

Stop Collar Sold Separately

Simply position one of these counterbores on your standard jobbers' or guide-point (brad-point) drill bit and lock it into position with the two set screws. You can now drill and counterbore in a single step.

All are made of steel and have four flutes. Drill bits are not included. For general purpose jobbers' drill bits, see pages 2494-2498.

Stop collars control the cutting depth of your counterbore. They attach with two set screws and are made of steel.

Body Dia.	Fits Drill Size	O'all Lg.	Counterbores	Each	Stop Collars OD	Wd.	Each
5/8″	3/16″	1″	3105A11 ✓	$25.33	7/8″	1/4″	2903A17 $4.65
5/8″	1/4″	1″	3105A21	23.95	7/8″	1/4″	2903A17 4.65
3/4″	1/4″	1″	3105A12 ✓	28.52	1″	1/4″	2903A18 4.80
3/4″	5/16″	1 1/8″	3105A13 ✓	26.96	1″	1/4″	2903A18 4.80
7/8″	3/8″	1 1/4″	3105A14 ✓	35.73	1 1/8″	1/4″	2903A19 4.95
1″	7/16″	1 3/8″	3105A15 ✓	40.78	1 1/4″	5/16″	2903A21 5.42
1 1/8″	1/2″	1 1/2″	3105A16 ✓	54.00	1 3/8″	5/16″	2903A32 5.64
1 1/4″	9/16″	1 5/8″	3105A22	56.47	1 1/2″	3/8″	2903A23 6.38

Six-Piece Drill-Bit Counterbore Set— Includes one each of the above counterbores marked with a ✓. The set comes in a wood stand.

3105A31 ..... **Per Set** $216.23

About Chucking Reamers and Hand Reamers

Reamers are rotary cutting tools used to enlarge an existing hole to an exact size, as well as provide a smooth finish to the walls of the hole. Reaming may be done with a variety of machine tools or by hand. *Note:* When using a reamer, never rotate it in the reverse direction of the cut. This will ruin its accuracy.

Types of Reamers

***Chucking Reamers*—**Also known as machine reamers, they are used in drill presses, turret lathes, screw machines, and other machine tools. The shank is round or Morse taper and the cutting end of the reamer is ground with a 45° chamfer angle for easy hole entry.

***Hand Reamers*—**A square portion on the end of the shank allows the reamer to be turned by hand with an adjustable wrench or a straight-handle tap wrench. Most hand reamers have a slight taper at the cutting end for easy hole entry.

Reamer Material

High-speed steel is used on a wide variety of materials including tool steel, cast iron, and aluminum.

Cobalt steel can be run up to 25% faster than high-speed steel and has better abrasion and heat resistance for longer tool life. Use on hard-to-machine materials such as nickel alloys, stainless steel, Inconel, and titanium.

Carbide tipped and ***solid carbide*** have better abrasion resistance and retain a sharper, harder edge at higher temperatures than high-speed steel and cobalt steel. Typically used on abrasive materials such as cast iron, nonferrous alloys, plastics, and hardened steels.

Solid carbide offers more wear resistance for the most accuracy but requires rigid tool holding to prevent breakage.

High-Speed Steel and Cobalt Steel Chucking Reamer Sets

All reamers have a round shank.

***Standard-Length Reamers*—**Shank diameter is slightly smaller than the reamer cutting diameter except 3008A5, which is equal to the reamer cutting diameter.

***Drill-Length Reamers*—**Have the same overall length as a jobbers' twist drill bit for added rigidity. The shank diameter is the same as the cutting diameter.

Straight-flute reamers are used for most jobs. ***Spiral-flute*** reamers are right-hand spiral, right-hand cut. They are ideal where chip removal is necessary, such as in blind holes. They also give a smoother finish and work well where there is an interrupted cut, such as in keyways.

Size Range	Pieces Per Set	Flute Style	Case		
High-Speed Steel Standard Length					
Fractional Sizes					
1/16"-1/2"×32nds	15	Straight	Roll Pouch	3008A24	$279.53
1/16"-1/2"×64ths	29	Straight	Wood	3008A8	697.62
1/16"-1/2"×64ths	29	Straight	Metal	3008A17	674.12
1/16"-1/2"×64ths	29	Spiral	Metal	3008A9	779.48
Wire Gauge Sizes					
1-60	60	Straight	Metal	3008A13	1,009.57
61-80	20	Straight	Metal	3008A5	385.05
Dowel-Pin Sizes					
1/8"-1/2"×16ths	14	Straight	Metal	3002A39	434.00
Metric Sizes					
1- 7 mm×0.5 mm	13	Straight	Wood	3008A15	292.51
1-13 mm×0.5 mm	25	Straight	Metal	3008A16	575.34
Decimal Sizes—*Includes 7 oversize and 7 undersize reamers*					
0.124"-0.499"/ 0.126"-0.501"	14	Straight	Roll Pouch	3087A21	300.93
0.124"-0.499"/ 0.126"-0.501"	14	Straight	Wood	3087A22	322.81
0.124"-0.499"/ 0.126"-0.501"	14	Spiral	Wood	3087A23	380.42

Size Range	Pieces Per Set	Flute Style	Case		
High-Speed Steel Drill Length					
Fractional Sizes					
1/16"-1/4"×64ths	13	Straight	Metal	3008A1	$172.05
1/16"-1/2"×32nds	15	Spiral	Metal	3008A34	295.75
1/16"-1/2"×64ths	29	Straight	Metal	3008A2	544.13
Letter Sizes					
A-Z	26	Straight	Metal	3008A3	521.48
Wire Gauge Sizes					
1-60	60	Straight	Metal	3008A4	810.76
Cobalt Steel Standard Length					
Dowel-Pin Sizes					
1/8"-1/2"×16ths	14	Straight	Metal	3002A79	514.89
Decimal Sizes—*Includes 7 oversize and 7 undersize reamers*					
0.124"-0.499"/ 0.126"-0.501"	14	Straight	Wood	3087A24	401.52
0.124"-0.499"/ 0.126"-0.501"	14	Spiral	Wood	3087A25	456.89

High-Speed Steel and Cobalt Steel Chucking Reamers

Straight Flute

Spiral Flute

Straight-flute reamers are used for most jobs.

Spiral-flute reamers have right-hand spiral, right-hand cut. They are ideal where chip removal is necessary, such as in blind holes. They also give a smoother finish and work well where there is an interrupted cut, such as in keyways.

High-Speed Steel Fractional Sizes—Round Shank

Shank diameter is slightly smaller than the reamer cutting diameter. *Straight flute* cutting diameter tolerance is +0.0002", –0.0000". *Spiral flute* cutting diameter tolerance is +0.0002", –0.0000" for 1/32" to 1/2"; +0.0003", –0.0000" for 17/32" to 5/8"; and +0.0004" to +0.0001" for 21/32" to 1 1/2".

Dia.	Flute Lg.	O'all Lg.	No. of Flutes	Straight Flute		Spiral Flute	
1/32"	1/2"	2 1/2"	4	2995A111	$18.37		
3/64"	1/2"	2 1/2"	4	2995A112	16.93	3106A09	$17.41
1/16"	1/2"	2 1/2"	4	2995A59	15.95	3106A11	17.41
5/64"	3/4"	3"	4	2995A113	13.66	3106A12	14.03
3/32"	3/4"	3"	4	2995A114	13.97	3106A13	13.90
7/64"	7/8"	3 1/2"	4	2995A115	14.63	3106A14	14.55
1/8"	7/8"	3 1/2"	4	2995A61	14.82	3106A15	11.86
9/64"	1"	4"	4	2995A116	14.58	3106A16	17.41
5/32"	1"	4"	4	2995A62★	18.86	3106A18	17.41
11/64"	1 1/8"	4 1/2"	6	2995A117	18.09	3106A17	18.59
3/16"	1 1/8"	4 1/2"	6	2995A63	16.85	3106A19	17.66
13/64"	1 1/4"	5"	6	2995A118	18.23	3106A21	18.84
7/32"	1 1/4"	5"	6	2995A64	19.12	3106A22	19.05
15/64"	1 1/2"	6"	6	2995A119	20.98	3106A23	19.62
1/4"	1 1/2"	6"	6	2995A65	20.25	3106A24	19.08
17/64"	1 1/2"	6"	6	2995A121	21.01	3106A25	24.96
9/32"	1 1/2"	6"	6	2995A66	22.49	3106A26	23.43
19/64"	1 1/2"	6"	6	2995A122	25.27	3106A27	25.02
5/16"	1 1/2"	6"	6	2995A67	$22.63	3106A28	$22.60
21/64"	1 1/2"	6"	6	2995A123	27.82	3106A29	26.85
11/32"	1 1/2"	6"	6	2995A68	25.62	3106A31	26.89
23/64"	1 3/4"	7"	6	2995A124	31.26	3106A32	26.84
3/8"	1 3/4"	7"	6	2995A69	25.95	3106A33	24.16
25/64"	1 3/4"	7"	6	2995A125	30.46	3106A34	28.88
13/32"	1 3/4"	7"	6	2995A71	27.25	3106A35	30.26
27/64"	1 3/4"	7"	6	2995A126	30.81	3106A36	30.28
7/16"	1 3/4"	7"	6	2995A72	27.84	3106A37	28.79
29/64"	1 3/4"	7"	6	2995A127	32.68	3106A38	32.99
15/32"	1 3/4"	7"	6	2995A73	33.00	3106A39	33.03
31/64"	2"	8"	6	2995A128	34.31	3106A41	33.05
1/2"	2"	8"	6	2995A74	32.43	3106A42	30.98
17/32"	2"	8"	8	2995A75	43.57	3106A43★	38.49
9/16"	2"	8"	8	2995A76	43.13	3106A44	39.45
19/32"	2"	8"	8	2995A77	54.62	3106A45	39.51
5/8"	2 1/4"	9"	8	2995A78	57.98	3106A46	46.14
21/32"	2 1/4"	9"	8	2995A79	63.01	3106A47	48.57

★ Has 6 flutes.

(Continued on following page)

Gear Cutters

Mill spur or pinion gears with a 14½° pressure angle. Also known as involute gear cutters, cutters may be sharpened repeatedly. All are high-speed steel and have a standard keyway. Determine the cutter number you need based on the number of teeth in your gear.

To Order: Please specify the cutter number (1-8) from the chart at right.

No. of Teeth to Be Cut	Please Specify Cutter No.	No. of Teeth to Be Cut	Please Specify Cutter No.
135 and Up	1	21 to 25	5
55 to 134	2	17 to 20	6
35 to 54	3	14 to 16	7
26 to 34	4	12 to 13	8

Cutter No. 5

Pitch	Cutter Dia.	Hole Dia.	Available Cutter Nos.		
4	3⅝″	1″	1-5, 7-8	3034A928	$179.73
5	3¾″	1¼″	1-8	3034A912	166.14
6	3⅛″	1″	1-8	3034A913	132.34
7	2⅞″	1″	1-8	3034A931	128.48
8	2⅞″	1″	1-8	3034A914	107.70
10	2⅜″	⅞″	1-6, 8	3034A915	84.58
10	2¾″	1″	1-8	3034A933	97.17
12	2¼″	⅞″	1-8	3034A916	76.26
12	2⅝″	1″	1-8	3034A935	86.29
14	2⅛″	⅞″	1-8	3034A917	$71.20
14	2½″	1″	1-8	3034A936	87.11
16	2⅛″	⅞″	2-8	3034A918	73.34
16	2½″	1″	1-8	3034A937	87.11
20	2″	⅞″	1-8	3034A921	66.01
20	2⅜″	1″	1-8	3034A939	78.16
24	1¾″	⅞″	1-6, 8	3034A922	65.19
32	1¾″	⅞″	1-4, 6-8	3034A923	62.06
48	1¾″	⅞″	1-8	3034A924	62.06

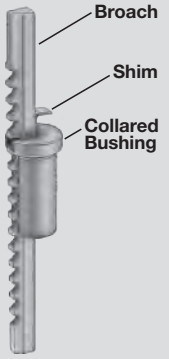
About Keyway Broaches

Keyway broaches are straight, multitoothed, high-speed steel cutting tools for making keyways. Each tooth's cutting edge is a few thousandths of an inch larger than the one before. The cutting edges increase until they reach the required size. Broaches are for use in hand and hydraulic arbor presses and are great for maintenance and short-run production operations.

Bushings for keyway broaches rest inside the arbor hole of your workpiece. They have a slot that works as a guide for broaches. With bushings, you can use a single broach in a variety of arbor holes. Bushings for smaller arbor holes are collared for easier handling. The collar rests on top of the workpiece rather than being supported from below.

Shims for keyway broaches slide between the broach and bushing to set the depth of the keyway.

Note: Broaches have a style designation of A, B, B1, C, C1, D, D1, or E. For proper fit, broaches, bushings, and shims used together must have the same letter designation.



Keyway Broach Sets

Sets contain combinations of broaches and bushings and include the necessary shims. They come in a wood box.

Keyway Sizes	Broach Style	Bushing Sizes for Hole Dia.	Bushing Type	No. of Keyway Variations		
1/16″, 3/32″, 1/8″	A	1/4″, 5/16″, 3/8″, 7/16″, 1/2″	Collared	15	3152A12	$223.28
1/8″ 3/16″, 1/4″	B C	1/2″, 5/8″, 3/4″ 7/8″, 1″, 1 1/8″, 1 1/4″, 1 3/8″, 1 1/2″	Collared	15	3152A16	$336.02
1/8″, 3/16″ 1/4″, 3/8″	B C	1/2″, 5/8″, 3/4″, 7/8″ 1″, 1 1/8″, 1 1/4″, 1 3/8″, 1 1/2″	Collared	18	3152A29	$390.68
1/8″, 3/16″ 1/4″, 3/8″	B C	1/2″, 9/16″, 5/8″, 11/16″, 3/4″, 13/16″, 7/8″ 15/16″, 1″, 1 1/16″, 1 1/8″, 1 3/16″, 1 1/4″, 1 5/16″, 1 3/8″, 1 7/16″, 1 1/2″, 1 9/16″	Collared	36	3152A38	$502.32
1/8″, 3/16″ 1/4″, 5/16″, 3/8″	B C	1/2″, 9/16″, 5/8″, 11/16″, 3/4″, 13/16″, 7/8″ 15/16″, 1″, 1 1/16″, 1 1/8″, 1 3/16″, 1 1/4″, 1 5/16″, 1 3/8″, 1 7/16″, 1 1/2″, 1 9/16″	Collared	47	3152A39	$578.26
5/16″, 3/8″, 7/16″, 1/2″	D	1 1/2″, 1 5/8″, 1 3/4″, 1 7/8″, 2″, 2 1/8″, 2 1/4″, 2 1/2″	Plain	32	3152A41	$732.35
1/8″, 3/16″ 1/4″, 5/16″ 3/8″, 7/16″, 1/2″ 5/8″, 3/4″	B C D E	1/2″, 9/16″, 5/8″, 11/16″, 3/4″, 13/16″, 7/8″ 15/16″, 1″, 1 1/16″, 1 1/8″, 1 3/16″, 1 1/4″, 1 5/16″, 1 3/8″, 1 7/16″, 1 1/2″, 1 9/16″ 1 7/16″, 1 1/2″, 1 9/16″, 1 5/8″, 1 11/16″, 1 3/4″, 1 13/16″, 1 7/8″, 1 15/16″, 2″, 2 1/16″, 2 1/8″, 2 3/16″, 2 1/4″ 2 5/16″, 2 3/8″, 2 7/16″, 2 1/2″, 2 9/16″, 2 5/8″, 2 11/16″, 2 3/4″, 2 13/16″, 2 7/8″, 2 15/16″, 3″	Plain and Collared	102	3152A49	$2,531.98
2, 3 mm	A	6, 8, 10 mm	Collared	6	2801A11	$175.87
4, 5 mm 6, 8 mm	B1 C1	12, 14, 15, 16 mm 18, 19, 20, 22, 24, 25, 26, 28, 30 mm	Collared	26	2801A12	$452.68
10, 12, 14 mm	D1	32, 34, 35, 36, 38, 40, 42, 44, 45, 46, 48, 50 mm	Plain	36	2801A13	$705.46

Shims for Keyway Broaches

When broaching in multiple passes, shims are necessary to ensure full keyway depth. All are made of steel. Use with the keyway broaches on page 2576.

Keyway Size	Broach Style	Shim Thick.	Shim Lg.		
1/8″	A	0.0310″	1 1/4″	8836A11	$4.15
1/8″	B	0.0310″	1 13/16″	8836A12	4.15
5/32″	B	0.0420″	1 13/16″	8836A13	4.15
3/16″	B	0.0500″	1 13/16″	8836A14	4.15
3/16″	C	0.0500″	2 11/16″	8836A15	4.15
1/4″	C	0.0625″	2 11/16″	8836A16	4.15
5/16″	C	0.0550″	2 11/16″	8836A17	4.10
5/16″, 7/16″	D	0.0560″	6 1/4″	8836A19	5.56
3/8″	C	0.0625″	2 11/16″	8836A18	4.10
3/8″	D	0.0625″	6 1/4″	8836A21	5.56
1/2″	D	0.0625″	6 1/4″	8836A23	5.58
5/8″, 3/4″	E	0.0625″	6 3/4″	8836A24	5.75

Keyway Size, mm	Broach Style	Shim Thick.	Shim Lg.		
3	A	0.0310″	1 1/4″	8836A31	$4.15
4	B1	0.0380″	1 13/16″	8836A32	4.15
5	B1	0.0500″	1 13/16″	8836A33	4.15
5	C	0.0470″	2 11/16″	8836A34	4.15
6	C1	0.0625″	2 11/16″	8836A35	4.15
8	C	0.0500″	2 11/16″	8836A36	4.10
10, 12	D	0.0560″	6 1/4″	8836A37	5.56
14	D	0.0625″	6 1/4″	8836A39	5.56
16, 18	E	0.0560″	6 3/4″	8836A41	5.73

Taps

For information about pipe thread types, see pages 2-3.

Straight Pipe and Conduit Thread Taps

Create straight threads to connect pipes in low-pressure applications. Taps are uncoated high-speed steel for making threads in most metals and plastics. Turn these taps by hand with a tap wrench. Tap shanks fit standard size tap wrenches.

Pipe Size	Threads per Inch	Thread Lg.	Overall Lg.	NPS Drill Bit Size			NPSF Drill Bit Size		
1/8	27	3/4″	2 1/8″	T	2526A31	$24.28	R	2526A41	$24.28
1/4	18	1 1/16″	2 7/16″	15/32″	2526A32	26.97	7/16″	2526A43	26.97
3/8	18	1 1/16″	2 9/16″	19/32″	2526A33	35.26	37/64″	2526A44	35.26
1/2	14	1 21/32″	3 1/8″	19 mm	2526A34	56.26	18 mm	2526A45	56.26
3/4	14	1 3/8″	3 1/4″	61/64″	2526A35	78.96	59/64″	2526A46	78.96
1	11 1/2	1 3/4″	3 3/4″	1 13/64″	2526A36	119.93	—	—	—

British Standard Pipe and Conduit Thread Taps

Cut threads that meet British standards. These taps are uncoated high-speed steel for making threads in most metals and plastics. Turn these taps by hand with a tap wrench.

Pipe Size	Threads per Inch	Thread Lg.	Overall Lg.	BSPT Drill Bit Size, mm			BSPP Drill Bit Size, mm		
1/8	28	3/4″	2 1/8″	8.4	8328A11	$16.78	8.8	8328A21	$16.78
1/4	19	1 1/16″	2 7/16″	11.2	8328A12	18.00	11.8	8328A22	18.00
3/8	19	1 1/16″	2 9/16″	14.5	8328A13	23.15	15	8328A23	23.15
1/2	14	1 3/8″	3 1/8″	18	8328A14	36.75	19	8328A24	36.75
3/4	14	1 3/8″	3 1/4″	22	8328A15	50.83	24	8328A25	50.83
1	11	1 3/4″	3 3/4″	30	8328A16	78.52	30	8328A26	78.52
1 1/4	11	1 3/4″	4″	38.5	8328A17	113.92	39.5	8328A27	113.92
1 1/2	11	1 3/4″	4 1/4″	44.5	8328A18	151.78	45	8328A28	151.78
2	11	1 3/4″	4 1/2″	56	8328A19	212.28	57	8328A29	212.28

Metric Pipe and Conduit Thread Taps

Use these taps to make tapered threads in metric sizes. They're uncoated high-speed steel for making threads in most metals and plastics. Turn these taps by hand with a tap wrench.

Thread Size, mm	Thread Pitch, mm	Thread Lg.	Overall Lg.	Drill Bit Size, mm		
M8	1	7/8″	2 1/4″	6.9	1017N111	$60.00
M10	1	3/4″	2 1/4″	8.9	1017N112	64.00
M12	1.5	7/8″	2 1/2″	10.2	1017N113	76.00
M14	1.5	7/8″	2 3/4″	12.2	1017N114	99.74
M16	1.5	7/8″	2 1/2″	14	1017N115	110.00
M18	1.5	7/8″	3 3/8″	16	1017N116	150.00
M20	1.5	7/8″	3 3/16″	18	1017N117	170.00
M22	1.5	7/8″	3 3/16″	20	1017N118	196.00

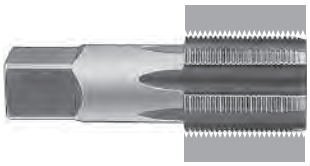
Garden Hose, Spark Plug, and Compressed Gas Thread Taps

Tap the unique thread sizes for garden hose, spark plug, and compressed gas connections. These taps are made of uncoated high-speed steel. Thread close to the bottom of closed-end holes with these bottoming-chamfer taps. They have 1-2 tapered threads to guide the tap into the hole. Turn them by hand with a tap wrench.

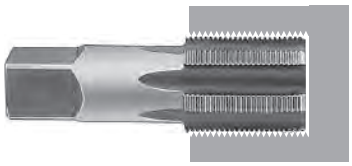
Compressed gas thread taps are also known as National Gas Outlet (NGO) taps.

Thread Size	Thread Lg.	Overall Lg.	Drill Bit Size		
Garden Hose					
3/4″-11 1/2	1 1/2″	4″	31/32″	2477A21	$85.90
Spark Plug					
7/8″-18	27/32″	4 11/16″	20 mm	2477A32	75.84
M14 x 1.25mm	1 21/32″	3 19/32″	12.8 mm	2477A31	36.59
M18 x 1.5mm	1 13/16″	4 1/32″	16.5 mm	2477A22	54.48
Compressed Gas					
0.830″-14	27/32″	4 11/16″	19 mm	2477A23	130.75
0.965″-14	2 1/2″	5 5/16″	57/64″	2477A24	156.92

Large Diameter Eight- and Twelve-Pitch Taps



For Through-Hole Threading



For Closed-End Hole Threading

Also known as constant pitch taps, these have the same number of threads per inch across all thread sizes. They're often used for high-pressure oil field and power generation applications. Taps are uncoated high-speed steel and are for use on most metals and plastics. Turn them by hand with a tap wrench.

Taps for through-hole threading are for start-to-finish tapping of through-holes. They have a plug chamfer with 3-5 tapered threads at the tip to guide the tap into the hole.

Taps for closed-end hole threading make threads close to the bottom of closed-end holes. They have a bottoming chamfer with 1-2 tapered threads to guide the tap into the hole.

Thread Size	Thread Lg.	Overall Lg.	Drill Bit Size	For Through-Hole Threading	For Closed-End Hole Threading	
Eight Pitch—Eight threads per inch						
1 1/8″-8	2 9/16″	5 7/16″	1″	2597A11	2597A71	$57.26
1 1/4″-8	2 9/16″	5 3/4″	1 1/8″	2597A12	2597A72	75.06
1 3/8″-8	3″	6 1/16″	1 1/4″	2597A13	2597A73	82.08
1 1/2″-8	3″	6 3/8″	1 3/8″	2597A14	2597A74	95.70
1 5/8″-8	3 3/16″	6 11/16″	1 1/2″	2597A15	2597A75	113.09
1 3/4″-8	3 3/16″	7″	1 5/8″	2597A16	2597A76	144.38
2″-8	3 9/16″	7 5/8″	1 7/8″	2597A18	2597A78	182.54
2 1/4″-8	3 9/16″	8 1/4″	2 1/8″	2597A21	2597A81	266.04
2 1/2″-8	4″	8 3/4″	2 3/8″	2597A23	2597A83	312.91
Twelve Pitch—Twelve threads per inch						
1 1/16″-12	1 1/2″	4″	63/64″	26625A11	26625A31	60.11
1 5/16″-12	1 1/2″	4″	1 15/64″	26625A13	26625A33	80.28
1 5/8″-12	2″	5″	1 9/16″	26625A14	26625A34	118.79
1 3/4″-12	2″	5″	1 11/16″	26625A15	26625A35	141.01
2″-12	2″	5″	1 15/16″	26625A17	26625A37	169.54
2 1/4″-12	2″	5 1/4″	2 3/16″	26625A19	26625A39	231.28
2 1/2″-12	2″	5 1/4″	2 7/16″	26625A22	26625A42	287.34

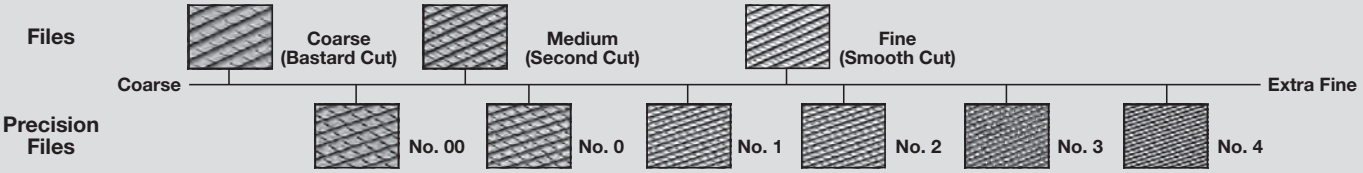
About Files

Most files do not include a handle but do have a tang that fits into a handle (see page 2684). File length listed does not include the tang.

Files, also known as American-pattern and machinists' files, are used to remove material quickly.

Precision files, also known as Swiss-pattern files, are made to exacting measurements to ensure smoothness and are useful for finishing delicate and intricate parts.

Finishes

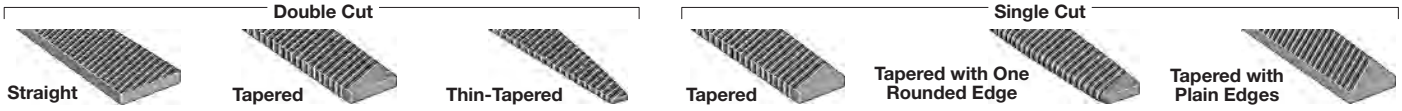


Cut Patterns

Double-cut files have two sets of diagonal rows of teeth on one or both sides of the file. They are often used with heavier pressure than single-cut files for rapid material removal.

Single-cut files have one set of diagonal rows of teeth on one or both sides of the file. They are often used with light pressure to slowly remove material and sharpen tool-cutting surfaces.

Rectangular Files



Files for deburring, sharpening, and polishing.

Double-cut straight files are also known as hand files. They are double cut on both sides. One edge is plain (without teeth) to protect adjacent surfaces and the other edge is double cut (except the 8″ long, 1/2″ wide file has a single-cut edge).

Double-cut tapered files are also known as flat files. They are double cut on both sides and single cut on both edges.

Double-cut thin-tapered files are also known as warding files. They are double cut on both sides, single cut on both edges, and taper extremely. Files are often used to make notches in keys.

Single-cut tapered files and **single-cut tapered files with one rounded edge** are also known as mill files. They are single cut on both sides and both edges. Files are often used to sharpen milling and circular saws.

Single-cut tapered files with plain edges are also known as lathe files. They are single cut on both sides and have plain edges (without teeth) to protect adjacent surfaces. Files are often used to shape material on a lathe.

Lg.	Wd.	Thick.	Coarse Finish		Medium Finish		Fine Finish	
Double-Cut Straight								
6″	9/16″	1/8″	4254A6	$8.49	4254A7	$8.81	4254A8	$10.37
8″	1/2″	1/8″	4242A12	11.80				
8″	3/4″	3/16″	4254A9	9.91	4254A11	11.98	4254A12	12.16
10″	15/16″	3/16″	4254A13	13.81	4254A21	16.30	4254A26	16.42
12″	1 1/8″	1/4″	4254A27	19.44	4254A28	21.07	4254A29	21.95
Double-Cut Tapered								
4″	7/16″	1/16″	4219A11	7.86	4219A19	8.40	4219A31	9.77
6″	9/16″	1/8″	4219A12	8.33	4219A22	8.70	4219A32	10.40
8″	11/16″	1/8″	4219A13	10.33	4219A23	11.33	4219A33	12.14
10″	7/8″	1/8″	4219A14	12.81	4219A24	14.72	4219A34	16.05
12″	1 1/8″	3/16″	4219A15	17.47	4219A25	19.70	4219A35	21.81
14″	1 5/16″	1/4″	4219A16	23.91	4219A26	27.56	4219A36	30.30
16″	1 1/2″	1/4″	4219A37	31.70				
Double-Cut Thin-Tapered								
4″	7/16″	1/16″	4230A11	9.86	4230A21	10.81	4230A31	11.77
6″	5/8″	1/16″	4230A12	10.81	4230A22	12.28	4230A32	13.60
8″	3/4″	1/16″	4230A13	13.60	4230A23	15.51	4230A33	17.12

Lg.	Wd.	Thick.	Coarse Finish		Medium Finish		Fine Finish	
Single-Cut Tapered								
4″	7/16″	1/16″	4225A11	$5.63			4225A31	$8.56
6″	9/16″	1/8″	4225A12	5.63	4225A22	$8.09	4225A32	8.58
8″	11/16″	1/8″	4225A13	6.63	4225A23	9.07	4225A33	10.12
10″	7/8″	1/8″	4225A14	8.60	4225A24	11.63	4225A34	12.42
12″	1 1/8″	3/16″	4225A15	14.12	4225A25	15.35	4225A35	16.84
14″	1 5/16″	1/4″	4225A16	19.07	4225A39	14.55	4225A36	23.40
16″	1 1/2″	1/4″	4225A37	29.65				
Single-Cut Tapered with One Rounded Edge								
8″	11/16″	1/8″	4270A13	10.54				
10″	7/8″	1/8″	4270A14	13.47				
12″	1 1/8″	3/16″	4270A15	17.35				
Single-Cut Tapered with Plain Edges								
10″	1″	3/16″	4223A1	16.77			4223A4	21.07
12″	1 1/8″	1/4″	4223A2	22.63			4223A5	28.28
14″	1 1/4″	3/16″	4223A3	30.56				

Half-Round Files

Use on concave, convex, and flat surfaces. **Double-cut** files are double cut on both sides. The 4″ long medium-finish file is tapered. **Single-cut** files are single cut on the convex side and double cut on the flat side (except the coarse-finish file is single cut on both sides).

Lg.	Wd.	Thick.	Coarse Finish		Medium Finish		Fine Finish	
Double Cut								
4″	7/16″	1/8″	4221A11	$11.81	4221A21	$9.30		
6″	9/16″	1/8″	4221A12	12.19				
8″	3/4″	3/16″	4221A13	14.74	4221A23	16.30		
10″	15/16″	1/4″	4221A14	18.28	4221A24	21.51		
12″	1 1/8″	5/16″	4221A15	23.49	4221A25	25.58		
14″	1 5/16″	5/16″	4221A16	30.56	4221A26	32.98		
16″	1 1/2″	3/8″	4221A37	40.05				
Single Cut								
4″	7/16″	1/8″					4221A31	$13.65
6″	9/16″	1/8″			4221A22	13.93	4221A32	14.35
8″	3/4″	3/16″					4221A33	17.47
10″	15/16″	1/4″					4221A34	20.86
12″	1 1/8″	5/16″					4221A35	26.88
14″	1 5/16″	5/16″	4221A17	21.49			4221A36	35.58

Round Files

Also known as rat-tail files, these are good for filing holes and concave surfaces. Files are single cut (except 14″ files are double cut) and tapered.

Lg.	Dia.	Coarse Finish		Medium Finish		Fine Finish	
4″	1/8″	4233A11	$6.77	4233A17	$7.44	4233A24	$8.09
6″	1/4″	4233A12	6.60	4233A18	7.53	4233A25	8.28
8″	5/16″	4233A13	7.77	4233A19	8.93	4233A26	10.00
10″	3/8″	4233A14	10.00	4233A21	11.86	4233A27	13.00
12″	1/2″	4233A15	13.91	4233A22	15.81	4233A28	17.23
14″	5/8″	4233A16	19.74	4233A29	14.10	4233A31	16.43

Round Files for Chain Saws

Get between teeth on chain saws to sharpen their cutting edges. Also known as blunt round chain saw files, these fine-finish files have a knurled cut, similar to a double cut.

Lg.	Dia.		
6″	1/8″	4246A8	$2.17
6″	5/32″	4246A9	2.17
8″	3/16″	4246A1	2.09
8″	7/32″	4246A2	2.09
8″	1/4″	4246A3	$2.63
8″	5/16″	4246A4	3.36
8″	3/8″	4246A6	3.60

Norton Toolroom Grinding Wheels for Metals

Use these wheels for precision grinding on surface, cylindrical, and tool and cutter grinders. They are also known as Type 1 wheels and straight wheels. The size listed is wheel dia. × thick. × arbor hole size. The rpm listed is the maximum. 46-grit and 60-grit wheels produce a rough surface texture. 80-grit to 150-grit wheels produce a smooth surface texture. Truing and cleaning before first use is recommended.

General Purpose—Wheels are aluminum oxide, which is the most common abrasive used in grinding metal. They have a VBE bond. *38A white* wheels stay cool during use, so they're a good choice for heat-sensitive applications.

Long Life—Wheels have a more durable abrasive so they remove more material and last longer than the general purpose wheels. *32AA purple* wheels are a blend of aluminum oxide and ceramic aluminum oxide, which lasts up to twice as long as 32A wheels. They have a VTR bond. *5SG blue* wheels are ceramic aluminum oxide, which lasts up to five times as long as 32A wheels. They have a VS bond.

About Norton Numbers

To reorder a wheel using a Norton number, match the abrasive type, grit, and grade. Bond is determined by the abrasive type.

Example:

38A60-MVBE

Abrasive Type — Grit — Grade — Bond

General Purpose—38A White for Light Material Removal

Grit	Grade		
Size: 3″×1″×½″; 10,825 rpm			
60	M	4397A311	$11.19
80	M	4397A312	11.19
Size: 6″×½″×1¼″; 4,140 rpm			
60	K	4397A17	24.90
80	K	4397A18	24.90
Size: 7″×¼″×1¼″; 3,600 rpm			
46	I	4397A19	23.90
60	I	4397A22	23.90
60	J	4397A23	23.90
60	K	4397A314	23.90
80	I	4397A24	23.90
80	K	4397A25	23.90
100	I	4397A26	23.90
100	J	4397A27	23.90
100	K	4397A316	23.90
120	K	4397A28	23.90
150	K	4397A317	41.90
150	L	4397A318	41.90
Size: 7″×½″×1¼″; 3,600 rpm			
46	H	4397A29	29.79
46	I	4397A31	29.79
46	J	4397A319	29.79
46	K	4397A32	29.79
60	H	4397A33	29.79
60	I	4397A34	29.79
60	J	4397A321	29.79
60	K	4397A322	29.79
80	H	4397A36	29.79
80	I	4397A37	29.79

★ 3,105 max. rpm.

Grit	Grade		
Size: 7″×½″×1¼″ (Cont.)			
80	J	4397A323	$29.79
80	K	4397A324	29.79
100	I	4397A39	29.79
Size: 8″×¼″×1¼″; 3,600 rpm			
60	I	4397A42	28.78
80	I	4397A44	28.78
100	I	4397A326	28.78
100	K	4397A46	28.78
Size: 8″×½″×1¼″; 3,600 rpm			
46	H	4397A48★	35.74
46	I	4397A49★	35.74
46	J	4397A51	35.74
46	K	4397A327	35.74
60	I	4397A53	35.74
60	J	4397A54	35.74
60	K	4397A55	35.74
80	I	4397A328	35.74
80	K	4397A57	35.74
Size: 8″×¾″×1¼″; 3,600 rpm			
46	K	4397A61	42.53
60	I	4397A63	42.53
Size: 10″×¾″×3″; 2,485 rpm			
46	J	4397A67	66.36
Size: 12″×1″×3″; 2,070 rpm			
46	H	4397A329	105.52
46	J	4397A332	105.52
Size: 12″×1″×5″; 2,070 rpm			
46	I	4397A333	105.52

General Purpose—32A Purple for Med. to Heavy Material Removal

Grit	Grade		
Size: 6″×1½″×1¼″; 4,140 rpm			
46	K	47145A115	$30.12
60	K	47145A117	30.12
80	J	47145A118	30.12
Size: 7″×¼″×1¼″; 3,600 rpm			
46	H	47145A119	28.95
46	I	47145A121	28.95
60	H	47145A122	28.95
60	I	47145A123	28.95
60	J	47145A124	28.95
60	K	47145A125	28.95
80	I	47145A126	28.95
80	J	47145A127	28.95
80	K	47145A128	28.95
100	I	47145A129	28.95
100	J	47145A211	28.95
120	K	47145A131	28.95
Size: 7″×⅜″×1¼″; 3,600 rpm			
60	I	47145A214	32.56
80	K	47145A224	32.56
Size: 7″×½″×1¼″; 3,600 rpm			
46	H	47145A134	37.40
46	I	47145A136	37.40
46	J	47145A342	37.40
46	K	47145A137	37.40
60	H	47145A139	37.40
60	I	47145A141	37.40
60	J	47145A142	37.40
60	K	47145A143	37.40
80	I	47145A144	37.40
80	J	47145A345	37.40
80	K	47145A145	37.40
100	I	47145A146	37.40
120	L	47145A147	37.40

★ 3,105 max. rpm.

Grit	Grade		
Size: 7″×¾″×1¼″; 3,600 rpm			
46	H	47145A148	$43.16
60	K	47145A152	43.16
Size: 7″×1″×1¼″; 3,600 rpm			
46	H	47145A216	49.55
60	I	47145A217	49.55
Size: 8″×¼″×1¼″; 3,600 rpm			
46	H	47145A153★	34.90
60	I	47145A154	34.90
60	K	47145A155	34.90
80	K	47145A157	34.90
100	I	47145A158	34.90
Size: 8″×½″×1¼″; 3,600 rpm			
46	H	47145A161★	44.52
46	I	47145A163★	44.52
46	J	47145A346	44.52
46	K	47145A165	44.52
60	H	47145A166	44.52
60	I	47145A167	44.52
60	J	47145A168	44.52
60	K	47145A169	44.52
80	I	47145A171	44.52
80	K	47145A348	44.52
Size: 8″×¾″×1¼″; 3,600 rpm			
46	H	47145A174★	51.48
46	I	47145A219★	51.48
46	J	47145A175	51.48
46	K	47145A349	51.48
60	J	47145A176	51.48
60	K	47145A221	51.48
Size: 8″×1″×1¼″; 3,600 rpm			
46	K	47145A351	60.67
60	I	47145A352	60.67

General Purpose—32A Purple (Cont.)

Grit	Grade		
Size: 10″×¾″×3″; 2,485 rpm			
46	I	47145A177	$96.88
60	I	47145A178	96.88
Size: 10″×1″×3″; 2,485 rpm			
46	H	47145A179	112.33
60	I	47145A183	112.33
60	K	47145A184	112.33
Size: 12″×¾″×3″; 2,070 rpm			
46	I	47145A185	131.29
60	I	47145A186	131.29
Size: 12″×1″×3″; 2,070 rpm			
46	H	47145A187	153.83
46	I	47145A188	153.83
60	I	47145A191	153.83
Size: 12″×1″×5″; 2,070 rpm			
46	H	47145A355	153.83
60	K	47145A356	153.83
Size: 12″×1½″×3″; 2,070 rpm			
46	I	47145A358	213.52

Grit	Grade		
Size: 12″×1½″×5″; 2,070 rpm			
46	H	47145A361	$213.52
46	J	47145A363	213.52
60	K	47145A365	213.52
Size: 12″×2″×1¼″; 2,070 rpm			
46	K	47145A366	273.33
Size: 14″×1″×5″; 1,800 rpm			
46	I	47145A192	205.98
80	K	47145A368	205.98
Size: 14″×1½″×5″; 1,800 rpm			
46	H	47145A194	285.10
46	I	47145A195	285.10
46	J	47145A372	285.10
46	K	47145A373	285.10
60	H	47145A374	285.10
Size: 14″×2″×5″; 1,800 rpm			
46	I	47145A376	363.93
46	J	47145A377	363.93
46	K	47145A378	363.93

Long Life—32AA Purple for Med. to Heavy Material Removal

Grit	Grade		
Size: 6″×¼″×1¼″; 4,140 rpm			
80	K	44475A22	$30.36
Size: 6″×½″×1¼″; 4,140 rpm			
46	K	44475A23	36.52
60	K	44475A24	36.52
Size: 7″×¼″×1¼″; 3,600 rpm			
46	I	44475A25	35.03
80	I	44475A29	35.03
80	K	44475A31	35.03
Size: 7″×½″×1¼″; 3,600 rpm			
46	I	44475A32	43.64
46	J	44475A33	43.64
46	K	44475A34	43.64
60	I	44475A35	43.64
60	J	44475A36	43.64
60	K	44475A37	43.64
80	I	44475A38	43.64
80	K	44475A39	43.64

★ 3,105 max. rpm.

Grit	Grade		
Size: 8″×¼″×1¼″; 3,600 rpm			
60	I	44475A41	$42.22
80	K	44475A43	42.22
Size: 8″×½″×1¼″; 3,600 rpm			
46	I	44475A44★	52.26
46	K	44475A45	52.26
60	I	44475A46	52.26
60	J	44475A47	52.26
80	K	44475A49	52.26
Size: 8″×¾″×1¼″; 3,600 rpm			
46	J	44475A51	62.26
60	J	44475A52	62.26
Size: 10″×1″×3″; 2,485 rpm			
46	I	44475A53	125.38
Size: 12″×1″×3″; 2,070 rpm			
46	I	44475A55	170.86
60	I	44475A56	170.86

Long Life—5SG Blue for Heavy Material Removal

Grit	Grade		
Size: 7″×¼″×1¼″; 3,600 rpm			
46	I	44595A11	$61.28
60	I	44595A34	61.28
60	J	44595A35	61.28
60	K	44595A36	61.28
80	K	44595A39	61.28
100	K	44595A23	61.28
Size: 7″×½″×1¼″; 3,600 rpm			
46	I	44595A44	76.38
46	J	44595A45	76.38
46	K	44595A46	76.38
60	I	44595A47	76.38
60	J	44595A48	76.38
60	K	44595A49	76.38
80	J	44595A82	76.38
80	K	44595A83	76.38
80	L	44595A84	76.38
Size: 7″×¾″×1¼″; 3,600 rpm			
46	K	44595A12	91.45
60	K	44595A13	91.45
Size: 8″×½″×1¼″; 3,600 rpm			
46	I	44595A53★	91.45
46	J	44595A54	91.45
60	I	44595A55	91.45

★ 3,105 max. rpm.

Grit	Grade		
Size: 8″×½″×1¼″ (Cont.)			
60	J	44595A56	$91.45
80	K	44595A88	91.45
Size: 8″×¾″×1¼″; 3,600 rpm			
46	J	44595A59	109.00
60	J	44595A63	109.00
Size: 10″×1″×3″; 2,485 rpm			
46	J	44595A16	183.59
60	K	44595A18	183.59
Size: 12″×¾″×3″; 2,070 rpm			
60	I	44595A19	162.28
Size: 12″×1″×3″; 2,070 rpm			
46	I	44595A91	250.22
46	K	44595A92	250.22
Size: 12″×1″×5″; 2,070 rpm			
46	J	44595A25	250.22
Size: 14″×1″×3″; 1,800 rpm			
46	I	44595A21	334.98
Size: 14″×1″×5″; 1,800 rpm			
46	J	44595A68	334.98
60	J	44595A69	334.98
Size: 14″×1½″×5″; 1,800 rpm			
60	I	44595A76	463.53

About Sanding Abrasives

Sanding abrasives are either coated abrasives, which have a layer of abrasive grains applied to a paper, fiber, or cloth backing; or nylon mesh abrasives, which have mesh embedded with abrasive grains. Both come in a variety of forms and create a range of finishes.

For Use On	Abrasive	Benefit
Multipurpose	Aluminum Oxide	Tough and fracture resistant, this abrasive can be used on most materials.
	Zirconia Alumina	Sands faster and lasts longer than aluminum oxide, and can also be used on most materials.
	Nylon Mesh	The cushioned structure gives you control over the finish.
Stainless Steel, Titanium, and Hard Metals	Zirconia Alumina	Good for use on hard materials, these abrasives cut faster and last longer than aluminum oxide. Ceramic alumina is harder than zirconia alumina so it lasts longer, but requires you to apply more force to abrade properly.
	Ceramic Alumina	
Aluminum, Brass, and Soft Metals	Abrasives with Special Coating	Aluminum is tough to sand because it is less heat resistant than other metals and tends to build up on the abrasive surface. The best products for aluminum have a clog-resistant feature such as a special coating to prevent material buildup or more space between the grains.
	Silicon Carbide	One of the sharpest abrasives, it's able to cut through aluminum and soft metals without generating much heat, which prevents material buildup.
Wood	Garnet	Used in woodworking, particularly for finishing, garnet abrades more slowly than aluminum oxide, but produces a smoother finish on wood surfaces.
Nonmetals— Plastics, Masonry, and Ceramics	Silicon Carbide	The best choice for soft nonmetals, it's very sharp and abrades quickly under light pressure. It also works on hard nonmetals, but will not last as long.
	Diamond	The best choice for sanding hard nonmetals, this tough abrasive lasts far longer than silicon carbide.

Finishes

Low grit numbers leave a rough finish and a dull appearance, mid-range grit numbers leave a smooth to extra-smooth finish and a brushed or matte appearance, and high grit numbers leave a polished finish and a satin or mirrored appearance. Diamond is very hard and does not break down like most abrasives, so it leaves a rougher finish than other abrasive grains of the same grit. Coated abrasives are generally used for grinding, blending, deburring, finishing, and polishing. Nylon mesh abrasives are good for light smoothing, cleaning, and polishing.

Application	Grinding, Smoothing, and Blending																			
	Deburring																			
	Cleaning, Texturing, and Finishing																			
	Polishing																			
Finish	Rough				Smooth						Extra Smooth						Polished			
Abrasive Grit	16	24	36	60	80	100	120	150	180	220	240	280	320	360	400	500	800	1200	2000+	
Nylon Mesh Grade	Extra Coarse			Coarse		Medium			Fine		Very Fine			Ultra Fine			Micro Fine			

Forms

Sheets	Pads	Rolls/ Cords	Discs	Belts	Flap Wheels	Sleeves	Spiral Wound Rolls	Bits
								
Pages 2705-2708	Pages 2708-2709	Pages 2710-2712	Pages 2712-2722	Pages 2723-2726	Pages 2727-2729	Pages 2730-2731	Page 2732	Page 2733

Sandpaper

When your sanding jobs involve shapes and contours, flexible paper sheets are a good choice. They're coated with aluminum oxide for sanding most materials. All are 9″ × 11″.

Choose 36-80 grit for a rough finish, 100-220 grit for a smooth finish, 240-400 grit for an extra-smooth finish, and 500-2500 grit for a polished finish.

Clog Resistant— Have a special coating for clog resistance.

Waterproof— Resist deterioration when used wet.

Grit	Small Packs: Pkg. Qty.		Small Packs: Pkg.	Large Packs: Pkg. Qty.		Large Packs: Pkg.
Standard						
36	5	4673A77	$9.75	25	4673A27	$38.33
40	10	4673A76	13.63	25	4673A26	33.33
50	5	4673A75	7.49	50	4673A25	58.89
60	5	4673A74	6.57	50	4673A24	50.00
80	15	4673A73	13.63	50	4673A23	44.44
100	15	4673A72	12.31	100	4673A22	80.00
120	15	4673A71	12.31	100	4673A21	80.00
150	15	4673A69	12.31	100	4673A19	82.22
180	15	4692A75	10.80	100	4692A5	62.50
220	15	4692A74	10.80	100	4692A4	62.50
240	15	4692A73	10.77	100	4692A3	66.92
320	15	4692A71	10.80	100	4692A1	48.00
Clog Resistant						
80	15	47025A89	16.71	50	47025A59	44.31
100	15	47025A88	17.89	100	47025A58	78.82
120	15	47025A87	17.89	100	47025A57	78.82
150	15	47025A86	17.89	100	47025A56	78.82
180	15	47025A85	14.33	100	47025A55	78.82
220	15	47025A84	14.94	100	47025A54	78.82
320	15	47025A81	14.94	100	47025A51	78.82
400	15	47025A44	15.65	100	47025A41	88.67
600	15	47025A45	16.67	100	47025A42	95.00
800	15	47025A46	16.67	100	47025A43	95.00

Grit	Small Packs: Pkg. Qty.		Small Packs: Pkg.	Large Packs: Pkg. Qty.		Large Packs: Pkg.
Waterproof						
40	10	6835A61	$10.63	100	6835A42	$92.73
50	10	6835A62	9.17	100	6835A43	80.00
60	10	6835A63	8.13	100	6835A44	70.91
80	5	6835A67	5.31	50	6835A47	37.83
120	5	6835A68	5.05	50	6835A48	34.15
150	5	6835A69	5.05	50	6835A49	33.20
180	5	6835A71	5.05	50	6835A51	33.20
220	15	6835A41	16.36	50	6835A21	40.46
240	5	6835A72	5.05	50	6835A52	33.20
320	15	6835A37	16.36	50	6835A17	40.46
360	5	6835A73	5.05	50	6835A53	33.20
400	15	6835A36	16.36	50	6835A16	40.46
500	5	6835A74	5.05	50	6835A54	33.20
600	15	6835A35	17.05	50	6835A15	40.46
800	5	6835A46	8.35	50	6835A45	40.46
1000	5	6835A75	5.05	50	6835A55	33.20
1200	5	6835A76	5.05	50	6835A56	33.20
1500	5	6835A77	5.05	50	6835A57	33.20
2000	5	6835A78	5.05	50	6835A58	33.20
2500	5	6835A79	5.05	50	6835A59	33.20

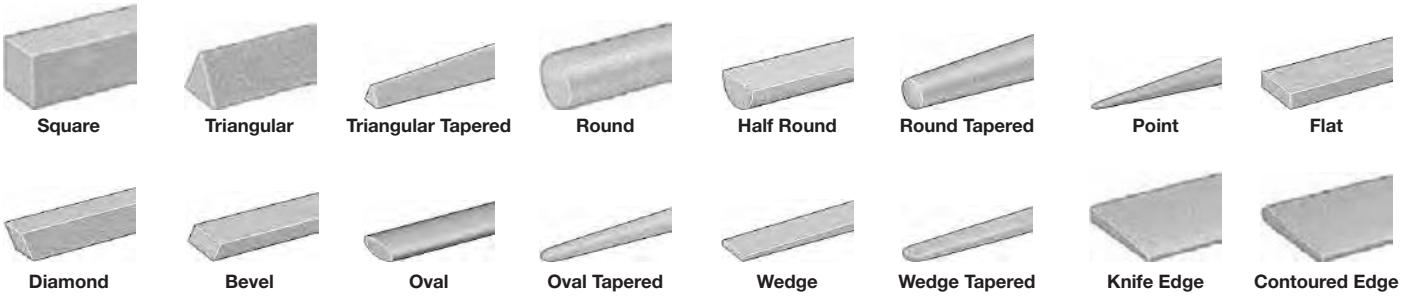
50-Piece Clog-Resistant Sheet Assortment— You'll get 10 sheets each of 60, 80, 120, 180, and 220 grits. 8234A41 $28.68

About Finishing

Finishing removes surface imperfections resulting in a precise, flat finish at a microscopic level. Achieving the flattest finish may require multiple steps using progressively higher grits or lower micron ratings.

Texture and Appearance	Smooth → Extra Smooth → Polished												
Metal Finish Equivalent	Semi-Reflective (#2B)		Dull (#3)	Brushed (#4)		Satin (#6)	Buffed (#7)			Mirror (#8)			
Grit Size	120	180	280		320		400	600	800	1000	1200	1600	2000	>2000
Micron Size	100	70	40		34		24	18	10	8	5	3	1	<0.5
Grade	Medium	Fine		Very Fine			Ultra Fine			Micro Fine				
Surface Flatness at a Microscopic Level (Approx. R_a µm)	200-150				100-50				20-10				<1	

Smoothing and Polishing Stones



Choose the shape that best matches the contour of your work surface. Use these stones to maintain tools, molds, and dies.

Smoothing—Oil filled and made of aluminum oxide, which abrades slowly to create a consistent surface. Also known as India stones.

Choose 100 grit (gray, except knife- and contoured-edge stones are brown) for a smooth finish and 240 grit (brown) or 320 grit (orange) for an extra-smooth finish.

Polishing—Have fine grains that produce a polished finish. Also known as Arkansas stones. Color is gray, unless noted. Grit is approximate. We recommend using a water-soluble or oil-based lubricant (see page 2740) with these stones.

Individual Stones

Lg.	Wd.	Thick.	Smoothing 100, 240, or 320 Grit		Polishing 800 Grit	
Square						
4″	1/4″	—	4497A21	$7.30	4433A12	$12.21
4″	3/8″	—	4497A22	7.30	4433A11	13.79
4″	1/2″	—	4497A23	7.30	4433A13	17.75
5″	1/4″	—	—	—	4456A16♦	18.49
6″	3/8″	—	—	—	4433A14	20.08
6″	1/2″	—	4497A24	11.83	4433A15	25.93
6″	3/4″	—	4497A25	12.70	—	—
6″	1″	—	4497A26	14.17	—	—
Triangular						
4″	1/4″	—	4498A51	9.43	4433A22	13.40
4″	3/8″	—	4498A52	10.33	4433A21	13.83
4″	1/2″	—	4498A53	10.33	4433A23	18.90
5″	1/4″	—	—	—	4456A15♦	18.49
6″	3/8″	—	—	—	4433A24	21.36
6″	1/2″	—	4498A54	13.61	4433A25	25.04
6″	3/4″	—	4498A55	13.93	—	—
6″	1″	—	4498A56	15.83	—	—
Triangular Tapered						
4″	1/2″	1/4″	4507A76	11.43	—	—
Round						
4″	1/4″ Dia.	—	4499A81	12.09	4433A31	15.73
4″	3/8″ Dia.	—	4499A82	12.97	—	—
4″	1/2″ Dia.	—	4499A83	12.97	—	—
6″	3/8″ Dia.	—	—	—	4433A32	27.09
6″	1/2″ Dia.	—	4499A84	16.18	4433A33	32.75
6″	3/4″ Dia.	—	4499A85	14.73	—	—
6″	1″ Dia.	—	4499A86	15.28	—	—
Half Round						
4″	1/4″	—	4500A51	8.69	—	—
4″	5/16″	—	4500A52	8.69	—	—
4″	3/8″	—	4500A53	9.49	—	—
4″	1/2″	—	4500A54	11.02	—	—
Round Tapered						
4″	1/2″ Dia.	1/4″	8742A21	$16.42	—	—
Point						
3″	5/16″ Dia.	—	8743A31	18.86	4433A38	$23.40
Flat						
4″	1/2″	3/16″	—	—	4433A34	14.60
Diamond						
4″	1/2″	3/16″	—	—	4433A36	23.41
4″	9/16″	3/16″	4507A71	15.69	—	—
Bevel						
4″	1/2″	3/16″	—	—	4433A35	13.64
Oval						
4″	1/2″	3/16″	—	—	4433A37	19.82
Oval Tapered						
4″	1/2″- 3/16″	3/16″-1/16″	4507A72	11.43	—	—
Wedge						
4″	5/16″	3/16″-1/16″	4507A73	11.43	—	—
Wedge Tapered						
4″	3/8″- 3/16″	1/8″-1/16″	4507A75	11.43	—	—
Knife Edge						
3″	1″	1/4″-1/8″	—	—	4433A39	21.33
4″	1″	1/8″-1/16″	4415A21	14.35	—	—
Contoured Edge						
3″	1 3/4″	1/4″-1/16″	—	—	4504A1★	55.56
4″	7/16″	3/16″-1/8″	4507A74	11.43	—	—
4″	1″	7/16″-3/16″	4620A11■	10.64	—	—
4″	1 1/4″	1/4″-1/8″	—	—	4504A3★	54.23
4″	1 3/4″	3/8″-1/8″	—	—	4504A2★	90.53
4 1/2″	1 3/4″	1/4″-3/32″	4620A12	13.02	—	—
4 1/2″	1 3/4″	3/8″-1/8″	4620A13	13.02	—	—
4 1/2″	1 3/4″	1/2″-3/16″	4620A14	13.02	—	—
5″	1″	5/16″-3/32″	4620A15■	13.02	—	—

♦ Made of 1800-grit ceramic alumina. Color is white. ★ Color is white. ■ Not available in 100 grit.

Four-Piece Sets

4″ Polishing Set—Stones are approximately 900 grit. Also known as Arkansas stones. Includes one each of: 1/4″ square, triangular, and round stones; plus a 1/4″×1″ knife-edge stone in a box. Color is off-white. 4433A41 $52.80

6″ Polishing Set—Stones are approximately 900 grit. Also known as Arkansas stones. Includes one each of: 3/8″ square, triangular, and round stones; plus a 3/8″×1″ knife-edge stone in a box. Color is off-white. 4433A42 $87.03

5″ Long-Lasting Polishing Set—Stones are 1800-grit ceramic alumina. Includes one each of: 1/4″ square, triangular, and round stones; plus a 5″ contoured-edge stone in a sheath. Color is white. 4456A17 $73.30

About Brushes

Select the Best Bristle Material for Your Application

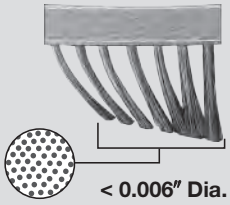
When choosing a brush, keep the following points in mind:
- Select a bristle that is softer than your workpiece to avoid surface wear and scratches.
- Stainless steel, brass, and nonmetal bristles won't leave behind corrosive debris that could cause rust on your workpiece.

For Use On	Application						
	Deburring	Removing Rust and Stains	Removing Paint and Tape	Pipe and Tube Cleaning	Surface Cleaning	Surface Finishing	Polishing
Steel	Steel	Steel	Steel	Steel	Steel and Nylon	Abrasive Nylon	Animal Hair
Stainless Steel and Aluminum	Stainless Steel and Brass	Stainless Steel and Brass	Stainless Steel and Brass	Stainless Steel and Brass	Stainless Steel and Brass	Abrasive Nylon	Animal Hair
Plastics	Stainless Steel and Nylon	———	Steel and Stainless Steel	Nylon	Nylon, Natural Fiber, and Hog Hair	Abrasive Nylon	Animal Hair

Select the Right Bristle Diameter

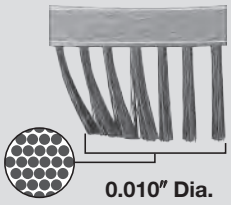
Light Cleaning and Deburring

- Small, Thin Burs
- Spotty Rust
- Less than 2 Layers of Paint
- Partially Plugged Tubes
- Light Dirt, Grease, and Dust



< 0.006″ Dia.

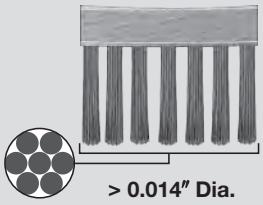
Thin, Loosely Packed, Flexible Bristles



0.010″ Dia.

Heavy Cleaning and Deburring

- Large, Chunky Burs
- Full Coating of Rust
- More than 2 Layers of Paint
- Mostly Plugged Tubes
- Weld Spatter
- Thick, Caked Dirt and Grease



> 0.014″ Dia.

Thick, Tightly Packed or Twisted, Rigid Bristles

Brush Types

Wheel Brushes	Cup Brushes	End Brushes	Disc Brushes	Tube Brushes	Hand Brushes
					
Pages 2753-2756	Pages 2757-2759	Pages 2757-2760	Page 2760	Pages 2761-2767	Pages 2767-2770

Cleaning Brushes for Buffing Machines

For Steel and for Stainless Steel and Aluminum

For Dusting All Materials

Gently clean your work surface with the thin, flexible bristles on these brushes. Bristles are crimped, except horsehair bristles. Brushes have a wood hub with a lead center so they're easy to mount on tapered spindles (see page 2751).

Brush Dia.	Arbor Hole	Bristle Dia.	Bristle Lg.	Brush Thick.	Max. rpm		
For Steel—Steel bristles							
3″	1/4″	0.003″	7/8″	1/2″	3,000	4848A32	$25.00
4″	1/2″	0.004″	1 1/4″	1″	3,000	4848A33	61.84
6″	1/2″	0.004″	1 3/4″	1″	3,000	4848A35	81.58
Low Scratch for Stainless Steel and Aluminum—Brass bristles							
3″	1/4″	0.003″	7/8″	1/2″	3,000	4848A52	27.37
4″	1/2″	0.004″	1 1/4″	1″	3,000	4848A53	65.79
6″	1/2″	0.004″	1 3/4″	1″	3,000	4848A55	92.11
For Dusting All Materials—Horsehair bristles							
4″	1/2″	———	1 1/4″	1″	3,000	4880A1	33.75
4″	1/2″	———	1 1/4″	1 1/4″	3,000	4880A4	59.69

Arbor-Hole Reducers and Shank Adapters for Wheel Brushes

Change the arbor on a wheel brush to work with your tool.

Snap-in metal and **plastic arbor-hole reducers** decrease the arbor hole of the brush to fit the shaft on your machine.

Use **metal arbor hole to shank adapters** to mount brushes on drills and grinders for bits and burs. Overall length is approximately 1 3/4″.

Snap-in Metal Arbor-Hole Reducers

Reduce Arbor Hole	For Brush Dia.		Pair
2″ to 1/2″	6″	4844A28	$2.31
2″ to 5/8″	6″ and 8″	4844A29	2.31
2″ to 3/4″	6″, 8″, and 10″	4844A31	2.31
2″ to 7/8″	6″, 8″, and 10″	4844A32	2.31
2″ to 1″	Up to 12″	4844A33	2.31
2″ to 1 1/4″	Up to 12″	4844A34	2.31
2″ to 1 1/2″	Up to 12″	4844A35	2.31

Plastic Arbor-Hole Reducers

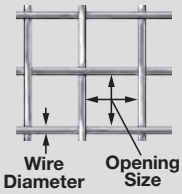
Reduce Arbor Hole	For Brush Dia.		Pkg. of 12
1/2″ to 1/4″	Up to 3″	4873A21	$3.31
1/2″ to 3/8″	Up to 3″	4873A22	3.73
5/8″ to 1/2″	Up to 6″	4873A23	3.58

Metal Arbor Hole to Shank Adapters

Fits Arbor Hole	Shank Dia.	For Brush Dia.	Max. Brush Thick.		Each
1/4″	3/16″	Up to 2″	3/4″	4875A18	$3.64
3/8″	1/4″	Up to 3″	3/8″	4875A11	3.16
1/2″	1/4″	Up to 3″	3/8″	4875A12	3.48

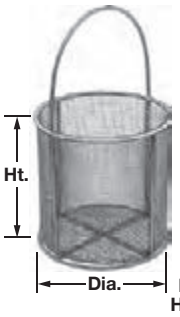
Wire Baskets

About Wire Baskets



Steel offers high strength at a low cost. Use for applications where corrosion resistance is less important.
Stainless steel withstands a continuous service temperature of 1450°F.
Type 304 stainless steel is corrosion resistant.
Type 316 stainless steel is corrosion resistant and offers additional resistance to acids and salt water.
Wire diameter is the thickness of the wire.
Opening size is the size of the space between adjacent wires.

Steel and Stainless Steel Wire Baskets



Loop Handle


Swing Handle


Dual-Grip Handle

Loop Handle


Square Handle


Dual-Grip Handle

Baskets with 0.021″ Opening Size—Wire diameter is 0.012″. Do not use with sharp objects.
Baskets with 5/64″ Opening Size—Wire diameter is 3/64″.
Baskets with 3/16″ Opening Size—Wire diameter is 1/16″.
Also Available Additional sizes. Please ask for 3287K999 and specify basket size, shape, material, opening size, and handle style.

Round Baskets

When the **swing handle** is laid down it extends beyond the basket diameter, making it easier to grab. **To Order** Please specify loop, swing, or dual-grip handle and 0.021″, 5/64″, or 3/16″ opening size.

Overall Size Dia.	Overall Size Ht.	Handle Ht. Loop	Handle Ht. Swing	Handle Ht. Dual Grip	Cap., lbs. Opening Size 0.021″	Cap., lbs. Opening Sizes 5/64″ and 3/16″	Steel with Dull Finish	Steel with Dull Finish Opening Size 0.021″	Steel with Dull Finish Opening Size 3/16″	Type 304 Stainless Steel with Dull Finish	Type 304 Stainless Steel with Dull Finish Opening Size 0.021″	Type 304 Stainless Steel with Dull Finish Opening Size 5/64″	Type 304 Stainless Steel with Dull Finish Opening Size 3/16″
6 5/8″	6 5/8″	7″	7″	3″	15	50	3290K61	$134.09	$114.98	3289K61	$155.70	$155.70	$138.16
8 5/8″	8 5/8″	8″	8″	3″	15	50	3290K63	141.29	123.30	3289K63	182.44	182.44	154.68
9 5/8″	10 5/8″	8″	8″	3″	15	50	3290K65	171.98	132.78	3289K65	211.25	211.25	165.02
10 5/8″	6 5/8″	8″	8″	3″	15	50	3290K66	167.72	127.72	3289K66	202.18	202.18	154.93
10 5/8″	10 5/8″	8″	8″	3″	15	50	3290K68	160.50	130.99	3289K68	222.84	222.84	166.13
10 5/8″	12 5/8″	8″	8″	3″	15	50	3290K69	171.62	140.07	3289K69	230.17	230.17	174.44
12 5/8″	12 5/8″	10″	10″	3″	15	50	3290K72	209.69	171.42	3289K72	270.29	270.29	209.09
12 5/8″	15 5/8″	10″	10″	3″	15	50	3290K73	221.82	178.87	3289K73	285.37	285.37	225.33
15 5/8″	12 5/8″	12″	12″	3″	15	50				3289K74	294.02	294.02	240.06
18 3/4″	18 3/4″	12 1/2″	12 1/2″	3″	15	50	3290K75	312.32	288.91	3289K75	462.70	462.70	378.21

Rectangular Baskets

To Order Please specify loop, square, or dual-grip handle and 0.021″, 5/64″, or 3/16″ opening size.

Overall Size Ht.	Overall Size Wd.	Overall Size Dp.	Handle Ht. Loop and Square	Handle Ht. Dual Grip	Cap., lbs.	Steel with Dull Finish	Steel with Dull Finish Opening Size 0.021″	Steel with Dull Finish Opening Size 3/16″	Type 304 Stainless Steel with Dull Finish	Type 304 Stainless Steel with Dull Finish Opening Size 0.021″	Type 304 Stainless Steel with Dull Finish Opening Size 5/64″	Type 304 Stainless Steel with Dull Finish Opening Size 3/16″
4 1/4″	11″	5″	4″	3″	40	3294K61	$101.39	$80.75	3293K61	$149.33	$149.33	$129.36
6 1/2″	13″	7″	6″	3″	40	3294K63	120.64	107.29	3293K63	171.42	171.42	162.12
6 1/2″	13″	9″	6″	3″	40	3294K64	129.13	109.51				
6 1/2″	13″	10″	6″	3″	40				3293K65	202.32	202.32	183.67
6 1/2″	15″	9″	6″	3″	40	3294K66	125.80	117.01				
6 1/2″	15″	11″	6″	3″	40	3294K67	119.38	113.65	3293K67	208.88	208.88	199.60
6 1/2″	15″	13″	6″	3″	40				3293K68	210.27	210.27	205.93
6 1/2″	17″	11″	6″	3″	40	3294K69	126.53	122.80	3293K69	205.77	205.77	192.87
6 1/2″	19″	13″	6″	3″	40	3294K71	151.67	127.93	3293K71	228.19	228.19	232.40
6 1/2″	19″	19″	6″	3″	40				3293K72	296.78	296.78	286.97
6 1/2″	21″	13″	6″	3″	40	3294K74	142.24	148.87	3293K74	240.51	240.51	238.04
10 1/2″	11″	11″	10″	3″	40				3293K62	223.83	223.83	205.51
12 1/2″	19″	19″	12″	3″	40	3294K73	178.42	199.74	3293K73	360.46	360.46	319.68
12 1/2″	25″	25″	12″	3″	40	3294K75	274.82	260.32	3293K75	440.42	440.42	407.85

Snap-Lid Steel Wire Baskets

The hinged lid flips out of the way for filling and closes securely with a snap. Baskets are galvanized steel. Wire diameter is 0.025″ and opening size is 0.125″.
The lid and bottom are plastic. The lid has a hole that accepts a wire tie or other fastener.

Overall Size Dia.	Overall Size Ht.	Cap., lbs.		
2 1/4″	7 1/4″	2 1/2	3238K6	$10.13
4 3/8″	7 1/4″	5	3238K8	13.67

Long-Handle Steel Wire Baskets

Keep hands clear of solutions. All are chrome-plated steel. Wire dia. is 0.031″ and opening size is 0.134″, except the 13 1/2″ dia. basket has 0.158″ openings. The diameter listed is the top of the basket.

Overall Size Dia.	Overall Size Ht.	Handle Lg.		
9″	5″	7 1/2″	3218K22	$47.09
9 7/8″	5 1/4″	8 1/2″	3218K33	50.11
11 3/8″	6 1/4″	10 3/8″	3218K44	55.27
13 1/2″	6″	11 1/2″	3218K55	69.73

Infrared Heaters & Heat Lamps

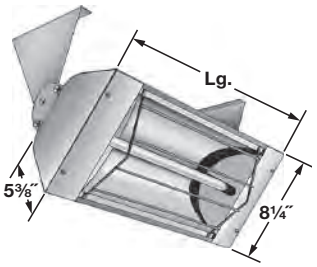
About Infrared Heating

Also known as radiant heating, infrared heating is used to dry and cure; remove moisture; and deliver localized heat. Since radiant heat is absorbed by an object—and not by the air around the object—infrared heaters are good for use in locations where it is difficult to control the ambient temperature.

Consider the following factors that affect infrared heating:

1. The operating temperature, which refers to the surface temperature of the heating element, not the heat output. Output varies with the distance the heater is from the object being heated.
2. The size of the object being heated and its ability to conduct, transmit, and absorb infrared heat.
3. The size of the heater and the presence of reflectors. Reflectors channel radiant energy to get a more concentrated and efficient heat output.
4. If heating items on a moving line, consider your material and exposure time.

Long-Distance Infrared Heaters



Wall and Ceiling Mount


Portable

Create radiant heat to warm, cure, and dry from as far away as 8 feet. Heaters have a quartz-tube heating element, an aluminum reflector, and a steel housing. UL listed.

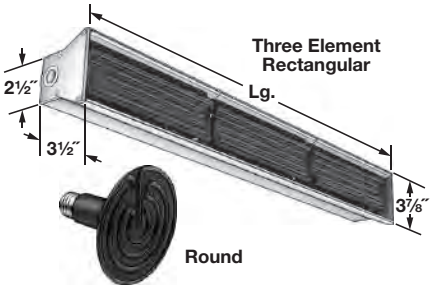
Wall and Ceiling Mount—Designed for horizontal mounting indoors and out. Use the included brackets to permanently mount heaters. Brackets also allow you to tilt heaters up to 60°. Heaters are insulated and must be hardwired. They have a wiring box that accepts ½″ conduit. Can be used for continuous operation.

Portable—Heaters attach to a 6-ft. tall wheeled stand on a 26½″×30″ base and are designed for indoor use. They have a 6-ft. cord with three-prong plug. *1,500-watt heaters* are for intermittent use and have a maximum continuous operation time of 35 minutes. *2,000-watt heaters* are for intermittent use and have a 60-minute timer with automatic shut-off. The heads rotate for use in horizontal and vertical positions.

To Order: For replacement heating elements, please specify 120, 240, or 480 volts AC/DC where available.

Watts	Operating Temp., °F	Overall Size Lg.	Wd.	Dp.	Heaters 120 Volts AC/DC		240 Volts AC/DC		480 Volts AC/DC		Replacement Heating Element	
Wall and Ceiling Mount												
750	1400°	19″	8¼″	5⅜″	1737K12	$210.45	1737K41	$210.45			1737K73	$55.75
1,000	1400°	33″	8¼″	5⅜″	1737K13	320.56	1737K42	320.56			1737K74	77.15
1,500	1400°	33″	8¼″	5⅜″	1737K16	320.56	1737K43	320.56			1737K75	77.15
2,000	1400°	39″	8¼″	5⅜″			1737K44	344.76	1737K84	$344.76	1737K76	100.00
3,000	1400°	61¼″	8¼″	5⅜″			1737K45	403.67	1737K85	403.67	1737K77	134.93
Portable												
1,500	1125° to 1325°	36″	3½″	3½″	1825K411	269.91	1825K412	269.91			1825K44	77.15
2,000	1125° to 1325°	36″	3½″	3½″	1825K19	539.96	1825K31	539.96			1825K48	85.69

Close-Up Infrared Heaters



Position these heaters 6″-8″ from what you want to dry, cure, or warm. A nickel-chromium resistance wire is embedded in the ceramic body to heat with greater efficiency than our other infrared heaters. Can be used for continuous operation. Operate on 220/230 volts AC (unless noted) and have a wattage tolerance of ±5%. Note: Do not use in hazardous locations such as enclosed areas exposed to fumes.

Rectangular—Heating elements are 9⅝″ Lg.×2⅜″ Ht.×1 7/16″ Dp. and have a slightly concave profile. Heaters come with mounting screws, reflector, and ceramic terminal blocks. Has leads for hardwiring.

Round—Heating elements are 4¾″ Dia.×4⅞″ Dp. and have a flat profile. Heaters have a light-bulb style, screw-in receptacle.

Number of Elements	Watts Per Element	Watts Total	Operating Temp.,°F	Overall Size Lg.	Wd.	Dp.	Heaters		Replacement Heating Element	
Rectangular										
1	250	250	756°	10″	3⅞″	3½″	3110K81	$163.44	3110K21	$25.78
1	400	400	942°	10″	3⅞″	3½″	3110K82	163.44	3110K22	25.78
1	650	650	1156°	10″	3⅞″	3½″	3110K84	163.44	3110K23	25.78
1	1,000	1,000	1420°	10″	3⅞″	3½″	3110K85	163.44	3110K24	25.78
2	650	1,300	1156°	20″	3⅞″	3½″	3110K86	265.52	3110K23	25.78
2	1,000	2,000	1420°	20″	3⅞″	3½″	3110K87	265.52	3110K24	25.78
3	650	1,950	1156°	30″	3⅞″	3½″	3110K88	346.88	3110K23	25.78
3	1,000	3,000	1420°	30″	3⅞″	3½″	3110K89	346.88	3110K24	25.78
4	1,000	4,000	1420°	40″	3⅞″	3½″	3110K91	428.33	3110K24	25.78
5	1,000	5,000	1420°	50″	3⅞″	3½″	3110K92	509.58	3110K24	25.78
Round										
1	500	500	900°	4¾″ Dia.		4⅞″	3110K93★	28.11		
1	500	500	900°	4¾″ Dia.		4⅞″	3110K94	28.11		

★ Operates on 120 volts AC.

Hand-Held Drying and Curing Heat Lamps

This handy lamp heats, dries, softens, and defrosts while illuminating your work surface. Temperature ranges from 182° F (12″ from the work surface) to 363° F (5″ from the work surface). This lamp is for intermittent use and has a maximum continuous operation time of 30 minutes. Operates on 110 volts AC and has a 9½-ft. cord with two-prong plug. It has a plastic housing with aluminum reflector and insulated swivel handle. Comes with a 600-watt quartz bulb rated for 75 hours of use and a pair of protective glasses.

Optional stand is 6 ft. tall and folds down to 39″.

Heat Lamp	3343K11	$126.45
Optional Aluminum Stand	3343K14	53.74
Replacement Quartz Bulb (600 watts, 75 hours)	1535K96	28.54

About Wire-Cutting Pliers

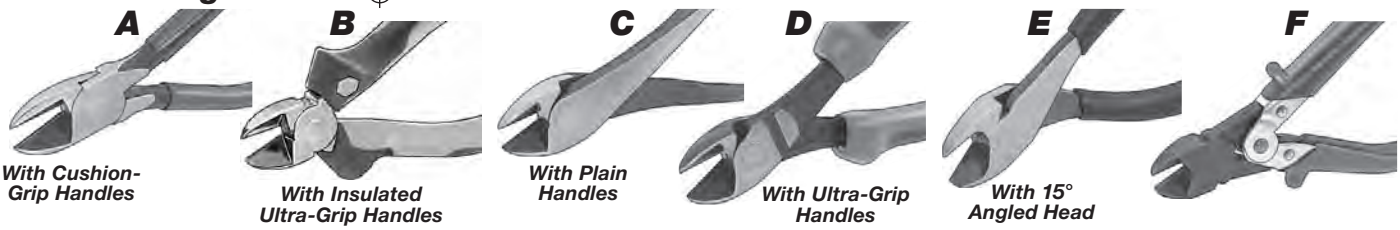
Wire-cutting pliers, also known as diagonal-cutting pliers, produce one of three cuts: standard, semiflush, or flush. These styles refer to the amount of "pinch" left on the tip of the wire after it has been cut.

***Standard*—**These pliers produce a deep, pointed, pinched end. Use for electrical and general applications.

***Semiflush*—**The most widely used cut for electronics assembly, these pliers produce a slightly pointed pinched end. They are generally more accurate than standard-cut pliers.

***Flush*—**Pliers produce a cut with virtually no "pinch," creating clean connections for easy soldering. Flush-cut pliers are not as long lasting as standard and semiflush.

Wire-Cutting Pliers



With Cushion-Grip Handles | *With Insulated Ultra-Grip Handles* | *With Plain Handles* | *With Ultra-Grip Handles* | *With 15° Angled Head*

Also known as diagonal-cutting pliers and dike pliers, these tools have cutting edges that are beveled for close cutting and hardened for long-lasting sharpness and durability. Pliers have oval-shaped heads and are made of forged steel unless indicated otherwise.

***General Purpose*—**For cutting soft steel wire and copper wire. The *Type 420 stainless steel* pliers offer good corrosion resistance. *Type 420 stainless steel pliers with plain handles* are also autoclavable for sterile environments.

***High Leverage*—**The joint rivets are closer to the cutting edges to provide more cutting power than general purpose pliers. In addition to cutting soft steel wire and copper wire, pliers can cut most hardened wire.

***Ultra High Leverage*—**Have super-tough cutting edges to cut through steel-reinforced wire (ACSR), hardened wire, and nails (in addition to cutting soft steel wire and copper wire).

***Compound Leverage*—**The jaws and the handles have leverage points to permit easy cutting of soft steel wire and copper wire.

Pliers ***with spring return*** have jaws that automatically open after the cut is made to reduce operator fatigue.

Pliers ***with high-visibility handles*** have neon-colored grips for easy identification; grips are available in green, orange, and red.

Pliers ***with static-dissipative (ESD-safe) handles*** have cushion grips that dissipate electrostatic charges to protect sensitive electronic components.

Pliers ***with insulated handles*** comply with IEC 60900 and ASTM F1505-01 standards and are tested to 1000 volts; they have finger guards to keep your fingers away from the jaws.

Pliers ***with ultra-grip handles*** have grips that are made of hard and soft materials to offer a more comfortable grip than cushion grips.

Cut Style	O'all Lg.	Jaw Lg.	Max. Wire Size, AWG (Dia.)	Spring Return		Each
General Purpose						
With Cushion-Grip Handles						
A Standard	6 3/8"	7/8"	10 (0.101")	No	3711A3	$20.94
A Standard	6 3/8"	7/8"	10 (0.101")	Yes	3711A6	23.74
A Standard	7 1/2"	1 1/16"	8 (0.128")	No	3711A8	21.45
A Standard	7 1/2"	1 1/16"	8 (0.128")	Yes	3711A9	24.75
Type 420 Stainless Steel with Plain Handles						
A Semiflush	6"	7/8"	14 (0.064")	No	5520A16	28.15
A Semiflush	7"	7/8"	14 (0.064")	No	5520A17	40.92
Type 420 Stainless Steel with Cushion-Grip Handles						
A Standard	6 1/4"	7/8"	14 (0.064")	No	5520A15	30.90
With High-Visibility Cushion-Grip Handles						
To Order: Please specify neon color: green, orange, or red.						
A Standard	6 3/8"	7/8"	10 (0.101")	No	5712A11	18.54
With Static-Dissipative (ESD-Safe) Cushion-Grip Handles						
A Standard	4 1/2"	5/8"	18 (0.040")	No	3711A1	23.20
A Standard	4 1/2"	5/8"	18 (0.040")	Yes	3711A4	30.55
A Standard	5"	49/64"	18 (0.040")	No	3711A2	26.04
A Standard	5"	49/64"	18 (0.040")	Yes	3711A5	29.27
A Semiflush	5"	49/64"	20 (0.032")	Yes	3620A12	27.27
With Insulated Ultra-Grip Handles						
B Standard	6 5/16"	5/8"	11 (0.090")	No	3619A11	38.06
B Standard	7"	7/8"	12 (0.080")	No	3619A12	40.18
High Leverage						
With Plain Handles						
C Standard	7"	13/16"	8 (0.128")	No	3719A1	18.95
C Standard	7 3/4"	13/16"	8 (0.128")	No	3719A2	20.22

★ The spring return can be engaged and disengaged.

Cut Style	O'all Lg.	Jaw Lg.	Max. Wire Size, AWG (Dia.)	Spring Return		Each
High Leverage (Cont.)						
With Cushion-Grip Handles						
D Standard	7 1/4"	51/64"	12 (0.080")	No	8522A11	$13.68
D Standard	9 27/32"	7/8"	5 (0.182")	No	8522A15	48.66
With Ultra-Grip Handles						
D Standard	5 1/2"	5/8"	14 (0.064")	Yes	57115A14★	27.18
D Standard	6 1/4"	3/4"	12 (0.080")	Yes	57115A16★	27.81
D Standard	7 7/8"	7/8"	6 (0.162")	No	57115A17	44.32
D Standard	9 27/32"	7/8"	5 (0.182")	No	57115A18	54.04
With Insulated Ultra-Grip Handles						
B Standard	9 27/32"	7/8"	5 (0.182")	No	3619A15	80.13
With 12° Angled Head and Cushion-Grip Handles						
E Standard	9 27/32"	7/8"	5 (0.182")	No	56815A33	47.46
With 15° Angled Head and Cushion-Grip Handles						
E Standard	7"	51/64"	12 (0.080")	No	5372A4	16.06
E Flush	7 3/4"	13/16"	22 (0.025")	No	3706A89	22.12
With 30° Angled Head and Long-Reach Cushion-Grip Handles						
E Semiflush	11"	13 3/64"	12 (0.080")	No	57205A25	36.40
Ultra High Leverage						
With Cushion-Grip Handles						
D Standard	8 1/16"	13/16"	6 (0.162")	No	56815A31	35.78
With 12° Angled Head and Cushion-Grip Handles						
E Standard	8 1/16"	13/16"	6 (0.162")	No	56815A32	38.61
Compound Leverage						
With Cushion-Grip Handles						
F Standard	5 1/2"	1/2"	16 (0.050")	Yes	3722A22	62.76

Plastic-Cutting Pliers

Designed for cutting plastics, these extremely sharp pliers make a flush cut that leaves a smooth, finished edge. Not intended for cutting metal or wire.

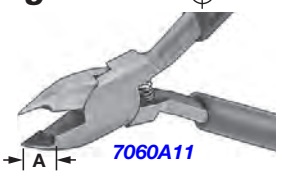
Pliers are made of forged steel with a tapered and flat head that's ground flat on the back side for close trimming in confined areas. All have a spring return.

Pliers ***with adjustable stop*** have an adjustment screw to prevent the jaws from closing completely, which prolongs cutter life. Pliers ***with fatigue-reducing handles*** have contoured handles to minimize wrist strain and provide maximum comfort.

With Adjustable Stop and Cushion-Grip Handles

O'all Lg.	Jaw Lg.	Without Stop	Each	W/Adjustable Stop	Each
With Cushion-Grip Handles					
4 1/4"	1/2"	7059A8	$15.99		
5 1/4"	3/4"	7059A9	17.19		
6 3/8"	7/8"	7059A11	18.70	3695A21	$26.31
7 3/8"	1 1/16"	7059A12	19.35	3695A22	29.46
With Fatigue-Reducing Handles					
7"	1 1/16"			5292A47	33.73

Tip-Cutting Pliers



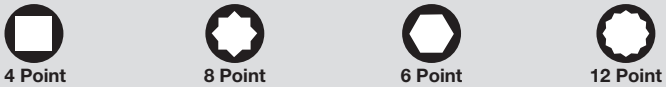
7060A11

Make semiflush cuts in tight spaces; pliers have sharp cutting edges at the tip of each jaw for precise cutting. Made of polished forged steel with cushion-grip handles and a spring return.

7060A11 has a special cutting edge that is rugged enough to cut soft, medium hard, and hard wire. Edge also cuts nickel ribbon wire. 3714A11 cuts copper wire.

O'all Lg.	Jaw Lg.	(A)	Max. Wire Size, AWG (Dia.)		Each
4 1/4"	1/2"	3/16"	16 (0.050")	7060A11	$46.64
5 1/16"	1 1/16"		14 (0.064")	3714A11	40.65

About Impact Sockets and Power Sockets



4-point and **8-point sockets** are for use with square fasteners. 4-point sockets provide more surface contact to prevent rounding while 8-point sockets are easier to position.

6-point and **12-point sockets** are for use with hex fasteners. 6-point sockets provide more surface contact to prevent rounding while 12-point sockets are easier to position.

Fastener-holding sockets have a magnet that holds fasteners in place. They are good for self-tapping screws.

Impact sockets (pages 2852-2858) are made to withstand the high torque and force of impact tools. While they can be used in hand-driven and nonimpact power tools, they will wear more quickly than the sockets designed for those tools.

Note: 3/4" square drive size and larger impact sockets require a locking retainer. Use with an impact wrench that has a pin-style socket retainer, or use a socket retaining ring with tools that have a hole- or hole-and-ring style socket retainer.

Power sockets (pages 2858-2859) have the durability required for nonimpact powered fastening applications such as high-volume production and assembly. They are not for use with impact tools.

1/4" Square Drive Impact Sockets and Accessories

1/4" Square Drive Impact Sockets and Accessories


6 Point


Standard


Deep

These premium-quality sockets, adapters, and extensions are steel with a black finish, unless noted.

Also Available: 6-point impact sockets in metric sizes. Please ask for 53115A42 and specify size: 6, 7, 8, 10, 11, 12, or 13 mm.

Socket Sets—Furnished with a metal clip rail.

6-Pc. Standard Set—Includes sizes 1/4", 5/16", 3/8", 7/16", 1/2", and 9/16".
7236A114 ..... $27.54

11-Pc. Deep Set—Includes sizes 3/16", 7/32", 1/4", 9/32", 5/16", 11/32", 3/8", 7/16", 1/2", 9/16", and 5/8".
7236A116 ..... $64.91

Inch Sizes

Size	O'all Lg.	OD		
6-Pt. Standard				
3/16"	7/8"	1/2"	7236A11	$4.48
7/32"	7/8"	1/2"	7236A12	4.48
1/4"	7/8"	1/2"	7236A13	4.48
9/32"	7/8"	1/2"	7236A14	4.69
5/16"	7/8"	1/2"	7236A15	4.56
11/32"	7/8"	33/64"	7236A16	4.49
3/8"	7/8"	9/16"	7236A17	4.48
7/16"	7/8"	21/32"	7236A18	4.51
1/2"	7/8"	45/64"	7236A19	4.38
9/16"	7/8"	51/64"	7236A21	4.51
6-Pt. Standard—Fastener-Holding				
3/16"	7/8"	1/2"	7236A85	10.14
1/4"	7/8"	1/2"	7236A87	10.55
5/16"	15/16"	1/2"	7236A89	10.55

Size	O'all Lg.	OD		
6-Pt. Standard—Fastener-Holding (Cont.)				
3/8"	15/16"	9/16"	7236A92	$10.90
7/16"	1"	21/32"	7236A93	10.90
1/2"	1"	11/16"	7236A94	11.99
6-Pt. Deep				
3/16"	2"	1/2"	7236A52	5.89
1/4"	2"	1/2"	7236A35	5.89
9/32"	2"	1/2"	7236A53	5.81
5/16"	2"	1/2"	7236A36	5.88
11/32"	2"	33/64"	7236A54	5.88
3/8"	2"	9/16"	7236A37	5.88
7/16"	2"	21/32"	7236A38	5.89
1/2"	2"	11/16"	7236A55	5.89
9/16"	2"	51/64"	7236A57	6.08
5/8"	2"	7/8"	7236A58	5.89

Metric Sizes

Size	O'all Lg.	OD		
6-Pt. Standard				
4 mm	7/8"	1/2"	53115A56	$4.37
5 mm	7/8"	1/2"	53115A57	4.66
5.5 mm	7/8"	1/2"	53115A58	4.69
6 mm	7/8"	1/2"	53115A59	4.72
7 mm	7/8"	1/2"	53115A61	4.75
8 mm	7/8"	1/2"	53115A62	4.78
9 mm	7/8"	33/64"	53115A63	4.80
10 mm	7/8"	9/16"	53115A64	4.82
11 mm	7/8"	21/32"	53115A65	5.06
12 mm	7/8"	11/16"	53115A67	5.34
13 mm	7/8"	47/64"	53115A66	4.93

Accessories


Adapter


Extension

	O'all Lg.		
Adapter: 1/4" sq. F x 3/8" sq. M	1"	7236A97■	$13.59
Adapter: 3/8" sq. F x 1/4" sq. M	1 1/4"	7236A98■	19.55
Extension	2"	7236A42	6.62
Extension	6"	7236A43	10.35

■ Unfinished.

3/8" and 1/2" Square Drive Impact Screwdrivers and Wrenches


6-Piece Set

Use these tools with impact sockets to break frozen bolts and screws free. You can also remove the bit adapter from the impact screwdriver and use as an impact wrench. Strike with a hammer to tighten and loosen fasteners. Made of steel with a black finish. See pages 2872-2879 for a complete selection of 1/4" and 5/16" hex-shank bits.

Impact Screwdriver Sets

6-Piece Sets—Include impact driver, 5/16" and 3/8" slotted bits, No. 2 and No. 3 Phillips bits, 5/16" hex bit adapter, and a plastic case.
With 3/8" Sq. Drive Impact Driver 5610A2 $35.81
With 1/2" Sq. Drive Impact Driver 5610A33 42.95

9-Piece Set—Includes impact driver; 5/16" slotted bit; No. 2 Phillips bit; 3, 4, 5, 6, and 8 mm hex bits; 5/16" hex bit adapter; and a plastic case.
With 3/8" Sq. Drive Impact Driver 6967A12 $39.74

Impact Wrenches

Sq. Drive	O'all Lg.		
3/8"	4 3/4"	5610A1	$26.12
1/2"	5 1/4"	5610A23	32.65

Phillips Bits—5/16" Hex Shank

Size	O'all Lg.		
No. 2	1 1/4"	5750A94	$1.66
No. 3	1 1/4"	5750A95	1.66
No. 4	1 1/4"	5750A96	1.66

Impact Socket Adapter Sets


7-Pc. Set

Use these sets with impact tools and other power tools. Made of steel with a black finish.

6-Pc. Set—Includes female x male square drive adapters in sizes 3/8" x 1/2", 1/2" x 3/8", 1/2" x 3/4", 3/4" x 1/2", 3/4" x 1", and 1" x 3/4".
55805A44 ..... $105.15

7-Pc. Set—Includes female x male square drive adapters in sizes 3/8" x 1/2", 1/2" x 3/8", 1/2" x 3/4", 3/4" x 1/2"; flex adapters in sizes 1/4", 3/8", 1/2"; and a metal clip rail.
55805A12 ..... $147.25

For information about power sockets, see page 2852.

1/4", 3/8", and 1/2" Square Drive Power Sockets and Accessories

(Continued from previous page)

Size	O'all Lg.	OD		
3/8" Drive (Cont.)				
Hex Bit Metric				
4 mm	2 1/4"	3/4"	5620A42	$22.23
5 mm	2 1/4"	3/4"	5620A43	22.23
6 mm	2 1/4"	3/4"	5620A44	22.54
8 mm	2 1/4"	3/4"	5620A45	22.77
10 mm	2 1/4"	3/4"	5620A46	22.83
1/2" Drive				
Hex Bit Inch				
1/4"	2 1/2"	15/16"	5652A21	20.87
5/16"	2 1/2"	15/16"	5652A22	20.22
3/8"	2 1/2"	15/16"	5652A23	20.68
1/2"	2 1/2"	15/16"	5652A24	23.58
9/16"	2 1/2"	15/16"	5652A26	23.89
5/8"	2 1/2"	15/16"	5652A28	22.97
Hex Bit Metric				
8 mm	2 1/2"	15/16"	5677A51	21.57
10 mm	2 1/2"	15/16"	5677A52	21.46
12 mm	2 1/2"	15/16"	5677A53	24.33
14 mm	2 1/2"	15/16"	5677A54	27.47
17 mm	2 1/2"	1 1/8"	5677A56	52.05

Accessories

Hex Shank Adapter

Flexible Extension

Hex shank adapters are for use with tools that accept hex shanks, such as power drills. **Flexible extensions** bend around obstructions so you can access hard-to-reach fasteners. Not for use with impact tools.

	O'all Lg.		
Hex Shank Adapters—Black Finish			
1/4" sq. x 1/4" hex	4"	7236A41	$4.02
1/4" sq. x 1/4" hex	6"	7236A45	4.64
3/8" sq. x 1/4" hex	2"	5553A41	4.45
3/8" sq. x 1/4" hex	4"	5553A65	6.01
3/8" sq. x 1/4" hex	6"	5553A17	6.97
3/8" sq. x 7/16" hex	2 3/4"	5553A66	8.26
1/2" sq. x 7/16" hex	2 3/4"	5549A162	8.18
1/2" sq. x 7/16" hex	5"	5549A56	17.39
1/2" sq. x 5/8" hex	2 3/4"	5549A164	16.56
Flexible Extensions—Chrome-Plated Finish			
3/8" sq. drive	3 3/8"	5496A61	58.51
1/2" sq. drive	3 3/4"	5496A62	64.07

Tool-Holding Heat-Shrink Attachments

Also known as tether loops, these have a heat-shrink sleeve for gripping your tool and a D-ring for attaching to a tool lanyard (not included; see page 1870). Slip the sleeve over your tool and apply heat with a heat gun until the sleeve grips tightly. Shrink temperature is 250° F. To ensure the loop won't slip off, the ends of the tool must be wider than where the loop will rest.

Attachment Shown on Wrench

For Tool Diameter	ID Before Shrinking	Sleeve Lg.	Capacity, lbs.	Ring Inside Lg.	Ring Inside Wd.		
0.25"-0.5"	0.75"	1 3/4"	4	0.47"	0.56"	5166A11	$8.14
0.36"-0.75"	1.1"	1 3/4"	5	0.47"	0.56"	5166A12	8.24
0.55"-1.25"	1.5"	2"	10	0.86"	1.02"	5166A13	8.49
0.75"-1.75"	2"	2"	15	0.86"	1.02"	5166A14	9.54
0.75"-1.75"	2"	4"	25	1.05"	1.56"	5166A15	13.87
1.5"-2.5"	2.75"	2"	20	1.05"	1.56"	5166A16	12.57
1.5"-2.5"	2.75"	4"	25	1.05"	1.56"	5166A17	16.22
2.25"-3.5"	4"	4"	25	1.05"	1.56"	5166A18	27.28

Tool-Holding Rings

Add attachment points to your tools. Slide the ring on and secure it in place with included rubber collar. It rotates so you can turn your tool freely. Use with a tool lanyard (sold separately). Capacity is 2 lbs.

Ring Shown with Tool Lanyard (sold separately)

For Tool Diameter	Ring ID		
0.035"-0.094"	0.14"	1239N11	$6.40
0.094"-0.156"	0.21"	1239N12	6.93
0.156"-0.250"	0.27"	1239N13	8.05
0.219"-0.313"	0.35"	1239N14	8.84

For Tool Diameter	Ring ID		
0.313"-0.438"	0.61"	1239N15	$9.62
0.400"-0.540"	0.61"	1239N16	10.26
0.540"-0.790"	0.85"	1239N17	27.64
0.790"-1.000"	1.1"	1239N18	31.40

Tool Lanyard — 1009N91 — $18.36

About Powered Fastening Tools

The tool you need depends on the fastener you're using. Use the chart below as a general guide. It suggests tightening torque based on using Grade 2 low-strength carbon steel fasteners. Values are approximate. For fasteners smaller than 1/4", see powered screwdrivers on pages 2870-2871 and precision hand-driven screwdrivers on pages 2884-2885.

Air tools require lubrication to operate properly. For air tool oil, see page 2251. For air hose, see pages 292-297.

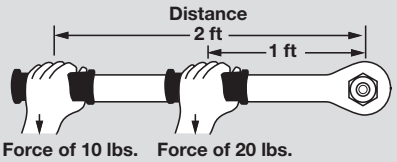
Grade 2 Carbon-Steel Fastener Size:		1/4"-20	5/16"-18	3/8"-16	1/2"-13	5/8"-11	3/4"-10	1"-8	1 1/4"-7	1 1/2"-6
Max. Tightening Torque:	in.-lbs.	61	126	224	546	1088	1929	2800	5596	9737
	ft.-lbs.	5	11	19	46	91	161	233	466	811
Ratchet Wrenches (5 to 100 ft.-lbs.)										
Impact Wrenches (20 to 3000 ft.-lbs.)										
Impact Drivers (7 to 70 ft.-lbs.)										
Powered Screwdrivers (1 to 30 ft.-lbs.)										
Precision Screwdrivers (0.17 to 11 ft.-lbs.)										

Retainer Styles for Ratchet and Impact Wrenches

Quick Change—For quick assembly and changing. *Ball* and *ring* retainers are for sockets. Ball style is spring loaded. *1/4" hex chuck* retainer is for bits.

Positive Locking—For more secure retention of sockets. *Pin* style is spring loaded. *Hole-* and *ring-and-hole* styles require a retaining ring.

About Torque Tools



Torque is a measure of turning or twisting force. It is calculated by multiplying force by distance. For example, if you applied 10 lbs. of force with a 2-ft. wrench, you would get 20 ft.-lbs. of torque; if you applied 20 lbs. of force with a 1-ft. wrench, you would also get 20 ft.-lbs. of torque.

Selecting the Correct Torque Range— For the most accurate performance, the maximum torque you're applying should fall near the middle of the tool's torque range. For example, if you're applying 50 ft.-lbs. of torque, choose a wrench with a range of 5 to 100 ft.-lbs., rather than a range of 5 to 50 ft.-lbs.

Accuracy— Accuracy is usually given for 20-100% of a tool's torque range. For example, if the torque range is 20 to 120 in.-lbs., the accuracy statement is true for measurements between 40 and 120 in.-lbs. Below 20% of the torque range, the tool's accuracy often drops significantly.

Certificates of Calibration— Torque tools are calibrated by the manufacturer; the certificate provides proof of calibration and the date it was completed. Shelf life does not affect the calibration of a torque tool. Common practice is to consider the calibration life to begin at the date of purchase or first use.

Conversions— The chart below shows how to convert between some of the units used to measure torque:

Nm = Newton meters
dNm = deci Newton meters
cNm = centi Newton meters

To Convert From	To	Multiply By
in.-lbs.	in.-oz.	16
in.-lbs.	ft.-lbs.	0.08333
in.-lbs.	cm-kg	1.1519
in.-lbs.	m-kg	0.011519
in.-lbs.	Nm	0.113
in.-lbs.	dNm	1.13
in.-lbs.	cNm	11.3
ft.-lbs.	m-kg	0.1382
ft.-lbs.	Nm	1.356
Nm	dNm	10
Nm	cm-kg	10.2
Nm	m-kg	0.102

To Convert From	To	Multiply By
in.-oz.	in.-lbs.	0.0625
ft.-lbs.	in.-lbs.	12
cm-kg	in.-lbs.	0.8681
m-kg	in.-lbs.	86.81
Nm	in.-lbs.	8.85
dNm	in.-lbs.	0.885
cNm	in.-lbs.	0.0885
m-kg	ft.-lbs.	7.236
Nm	ft.-lbs.	0.7376
dNm	Nm	0.10
cm-kg	Nm	0.09807
m-kg	Nm	9.807

Torque Wrenches

Premium Electronic Torque Wrenches

Track applied torque and tighten fasteners with precision. The large LCD shows track display (values as they're measured) or peak display (highest value). Wrenches store up to 100 torque values and recall up to 100 measurements in order of operation. You can set the desired torque along with high and low tolerance limits. Lights signal when lower limit is met. Lights and audible alarm signal when target is met or upper limit is exceeded.

Accuracy is ±2% of torque setting for indicated torque range (for both clockwise and counterclockwise use). Torque can be measured in in.-lbs., ft.-lbs., and Nm. Download values using the required software and RS-232 cable (sold separately). Wrenches use four AA batteries (included) and come in a plastic case with certificate of calibration traceable to NIST.

Square Drive	Torque Range in.-lbs.	Torque Range ft.-lbs.	Torque Range Nm	Graduations in.-lbs.	Graduations ft.-lbs.	Graduations Nm	O'all Lg.		
1/4"	25 to 250	2 to 21	2.8 to 28	0.1	0.01	0.01	15 1/4"	8545A15	$658.29
3/8"	120 to 1,200	10 to 100	13.6 to 136	1	0.1	0.1	17"	8545A16	676.02
1/2"	300 to 3,000	25 to 250	34 to 339	1	0.1	0.1	23"	8545A17	711.49
Software and RS-232 to PC Cable (6 ft. Lg.)								8545A18	279.24

Electronic Torque Wrenches with Rotating Dial

Rotate the large digital display so you can read it at any angle. Torque wrenches show a track display (values as they're measured) or a peak display (highest value). A touch of a button sets pass/fail mode for quick target tolerance settings from ±1% to ±10%. Colored lights and audible alarm signal to let you know whether you're above, below, or within your target torque range. Accuracy is ±1% of torque setting for entire torque range (for clockwise and counterclockwise use). Wrenches are chrome-plated steel with a plastic grip. They use a 9-volt battery (included), and come in a plastic case with certificate of calibration traceable to NIST.

Square Drive	Torque Range in.-lbs.	Torque Range ft.-lbs.	Torque Range Nm	Graduations in.-lbs.	Graduations ft.-lbs.	Graduations Nm	O'all Lg.		
1/4"	7.5 to 75	0.63 to 6.25	0.84 to 8.5	0.01	0.01	0.01	11"	7767A11	$605.13
1/4"	10 to 100	0.83 to 8.3	1.1 to 11.1	0.1	0.01	0.01	11"	7767A12	638.74
3/8"	25 to 250	2.1 to 20.8	2.8 to 28.2	0.1	0.01	0.01	11"	7767A13	695.00
3/8"	60 to 600	5 to 50	6.8 to 67.8	0.1	0.01	0.1	11"	7767A14	689.07
1/2"	300 to 3,000	25 to 250	33.8 to 338	1	0.1	0.1	22"	7767A15	783.00
3/4"	720 to 7,200	60 to 600	81 to 813	1	0.1	0.1	47"	7767A16	1,452.28

Electronic Torque Wrenches

Set your torque value with the touch of a button. Digital display, colored lights, and an audible alarm let you know whether you're above, below, or have reached your target torque. Wrenches show a track display (values as they're measured) or a peak display (highest value). They have a reversible ratchet head and come in a plastic case with certificate of calibration traceable to NIST.

Wrenches with 120 to 1,200 and 300 to 3,000 in.-lbs. torque range have a steel body and a rubber grip. Accuracy is ±2% (for clockwise use) and ±3% (for counterclockwise use) of torque setting for 20-100% of torque range. Wrenches use two CR123 batteries (included).

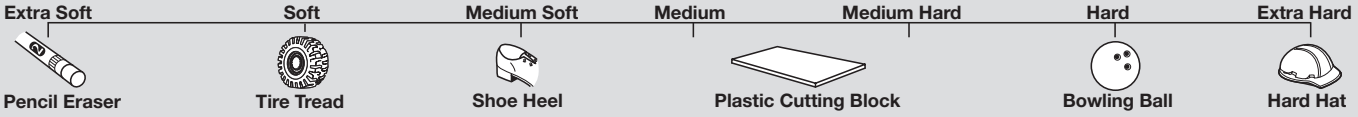
Wrench with 180 to 1,800 in.-lbs. torque range has a steel body and a plastic grip. Accuracy is ±3.5% of torque setting for 20-100% of torque range (for clockwise and counterclockwise use). Requires three AA batteries (sold separately).

Square Drive	Torque Range in.-lbs.	Torque Range ft.-lbs.	Torque Range Nm	Graduations in.-lbs.	Graduations ft.-lbs.	Graduations Nm	O'all Lg.		
3/8"	120 to 1,200	10 to 100	13.6 to 135.6	1	0.1	0.1	17"	8976A45	$346.18
1/2"	180 to 1,800	15 to 150	20.3 to 203	6	0.5	0.6	22 1/2"	8976A31	163.33
1/2"	300 to 3,000	25 to 250	33.8 to 338	1	0.1	0.1	27"	8976A12	401.10
AA Alkaline Battery (Pkg. of 4)								71455K53	2.94

Replaceable-Face Nonmarring Hammers

About Replaceable Plastic Hammer Faces

Replaceable plastic faces range in hardness from extra soft to extra hard. Use the diagram below to determine which hardness is best for your application. *Note:* The color indicating a plastic's grade is not standardized and may vary among manufacturers.



Create-Your-Own Replaceable-Face Hammers, Sledges, and Dead Blows

Hammer with Textured Handle Grip (Shown with Faces, Sold Separately)

Hammer with Safety Handle Grip (Shown with Faces, Sold Separately)

Unassembled (Faces Sold Separately)

Design the perfect striking tool. The bodies and faces are sold separately, so you can customize a hammer, sledge, or dead blow to fit your needs.

Hammer and Sledge Bodies (Without Faces)— Consist of a hammer head and a nonreplaceable solid fiberglass handle for optimal strength. Head is glass-filled nylon to eliminate metal contamination as well as scratching and marring caused by metal-to-metal contact. *Safety handle grip* is ribbed to prevent your hand from slipping.

Dead Blow Hammer and Dead Blow Sledge Bodies (Without Faces)— Consist of a hammer head loaded with steel shot and a nonreplaceable reinforced-fiberglass handle. *PVC head* eliminates metal contamination as well as scratching and marring caused by metal-to-metal contact.

Faces— Screw on to the head. *Plastic* faces are tough, nonmarring PVC. *Brass* faces are medium hard and nonsparking. *Steel* faces are hardened for extra durability.

Hammer and Sledge Bodies (Without Faces)

O'all Wt., lbs.	Face Dia.	O'all Lg.	Handle Grip		Each
Hammer Bodies with Glass-Filled Nylon Head					
3/8	1"	11"	Textured	5877A152	$15.98
1/2	1"	11"	Textured	5877A151	16.35
3/4	1 3/8"	11 3/4"	Textured	5877A115	17.88
13/16	1 1/2"	12 1/2"	Textured	5877A153	18.56
1 1/16	1 1/2"	12 1/2"	Textured	5877A155	19.21
1 1/16	2"	14"	Textured	5877A154	20.54
1 11/16	2"	14"	Textured	5877A157	22.71
Hammer Bodies with Glass-Filled Nylon Head (Cont.)					
1 3/4	1 5/8"	12 1/4"	Textured	5877A116	$23.65
1 13/16	2 1/2"	15"	Textured	5877A156	35.15
2 7/8	3"	15"	Textured	5877A158	45.27
3 3/8	2 1/2"	15"	Textured	5877A159	43.92
4 7/8	3"	15"	Textured	5877A161	54.98
Sledge Bodies with Glass-Filled Nylon Head					
6 5/16	3"	32"	Safety	5877A247	77.94

Dead Blow Hammer Bodies (Without Faces)

O'all Wt., lbs.	Face Dia.	O'all Lg.	Handle Grip		Each
Dead Blow Hammer Bodies with PVC Head					
1 1/16	1"	11 1/2"	Textured	59895A66	$17.86
1 3/16	1 1/2"	12 1/2"	Textured	59895A72	21.51
1 3/4	2"	13 1/2"	Textured	59895A73	34.02
Dead Blow Hammer Bodies with PVC Head (Cont.)					
2 11/16	2 1/2"	14 1/2"	Textured	59895A74	$55.42
4 1/4	3"	15 1/2"	Safety	5989A44	67.84

Plastic Faces

Face Dia.	Thread Size	*Extra Soft (Gray)*	Each	*Soft (Brown)*	Each	*Medium Soft (Red)*	Each	*Medium (Green)*	Each	*Medium Hard (Cream)*	Each	*Hard (Black)*	Each	*Extra Hard (Yellow)*	Each
1"	1/4"-20	5877A31	$5.56	5877A41	$4.35	5877A51	$4.35	5877A61	$4.35	5877A71	$5.29	5877A81	$5.29	5877A91	$5.29
1 3/8"	1/4"-20	_____	____	5877A131	3.94	5877A132	3.94	5877A133	3.94	5877A134	7.31	_____	____	_____	____
1 1/2"	5/16"-18	5877A32	10.29	5877A42	6.42	5877A52	6.42	5877A62	6.42	5877A72	10.25	5877A82	10.25	5877A92	10.25
1 5/8"	5/16"-18	_____	____	5877A141	4.23	5877A142	4.23	5877A143	4.23	5877A144	10.21	_____	____	_____	____
2"	3/8"-16	5877A33	16.46	5877A43	9.79	5877A53	9.79	5877A63	9.79	5877A73	16.31	5877A83	16.42	5877A93	16.42
2 1/2"	7/16"-14	5877A34	27.77	5877A44	16.90	5877A54	16.90	5877A64	16.90	5877A74	27.25	5877A84	26.33	5877A94	26.33
3"	1/2"-13	5877A35	49.31	5877A45	25.65	5877A55	25.65	5877A65	25.65	5877A75	48.38	5877A85	48.38	5877A95	48.38
4"	1/2"-13	_____	____	5877A57	66.79	5877A96	66.79	5877A87	66.79	5877A58	85.98	5877A88	85.98	5877A59	85.98

Metal Faces

Face Dia.	Thread Size	*Soft Brass*	Each	*Steel*	Each	Face Dia.	Thread Size	*Soft Brass*	Each	*Steel*	Each
1 1/2"	5/16"-18	5877A22	$14.90	5877A101	$12.98	2"	3/8"-16	5877A23	$23.73	5877A102	$17.60

Create-Your-Own Replaceable-Face Split-Head Hammers

Hammer Body (Shown with Faces, Sold Separately)

Unassembled (Faces Sold Separately)

It's faster and easier to change the faces on these split-head hammers than on press-fit style hammers. Just loosen the nut under the head, remove the face, insert the new face, and tighten the nut. The hammer bodies and faces are sold separately, so you can create a custom hammer for your application.

Bodies consist of a two-piece malleable iron hammer head, a nut to secure the assembly, and a replaceable hickory handle. ***Faces*** are available in your choice of materials. *Lead* consists of 94% lead and 6% antimony. *Rawhide* provides soft blows—great for assembly work. *Copper* allows high-impact blows but is soft enough not to damage precision parts. *Hard rubber* is made of off-white urethane and is similar in hardness to a bowling ball. *Hard plastic* is made of yellow ultra-high molecular weight (UHMW) polyethylene and is similar in hardness to a hard hat.

Also Available: Replacement handles. Please ask for 5911A61 and specify the McMaster-Carr body part number.

Bodies (Without Faces)

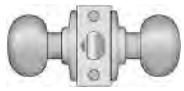
O'all Wt., lbs.	Face Dia.	O'all Lg.		Each
1 1/2	1 1/4"	11"	5911A11	$35.87
1 3/4	1 1/2"	12 1/2"	5911A12	36.25
2 1/2	1 3/4"	13"	5911A13	41.06
3 1/2	2"	14"	5911A14	45.58
5 1/4	2 3/4"	15 3/4"	5911A15	64.52
7	2 3/4"	36"	5911A25	107.83

Faces

Face Dia.	*Lead*	Each	*Rawhide*	Each	*Copper*	Each	*Hard Rubber*	Each	*Hard Plastic*	Each
1 1/4"	5911A36	$46.75	5907A18	$9.43	5905A22	$7.23	5911A16	$7.66	5911A27	$7.66
1 1/2"	5911A37	54.05	5907A19	11.00	5905A23	9.71	5911A17	8.75	5911A28	8.75
1 3/4"	5911A38	80.49	5907A21	15.71	5905A24	13.46	5911A18	12.03	5911A29	12.03
2"	5911A39	108.80	5907A22	18.86	5905A25	19.81	5911A19	14.17	5911A31	14.17
2 3/4"	_____	____	5907A23	34.57	_____	____	5911A21	26.20	5911A51	26.20
2 3/4"	_____	____	5907A23	34.57	_____	____	5911A21	26.20	5911A51	26.20

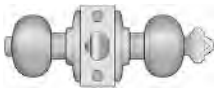
About Door Handles and Knobs

Door Handle and Knob Types



Nonlocking—Also known as passage handles, these do not lock.

Button Locking—Lock the outside handle with the button on the inside handle. Turn the inside handle to release the lock or release it from the outside with a slotted screwdriver. Also known as privacy handles.

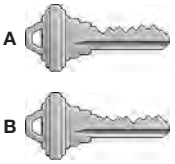


Key and Button Locking—Once the outside handle is locked with the button on the inside handle, turn the inside handle to release the lock or unlock it with a key from the outside. Also known as entrance handles.

Key Locking—The outside handle locks and unlocks with a key while the inside handle can always open the door. Also known as classroom handles.

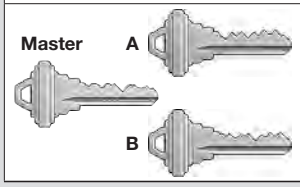
Self Locking with Key—The outside handle is always locked and has to be unlocked with a key while the inside handle can always open the door. Also known as storeroom handles.

Keying Types



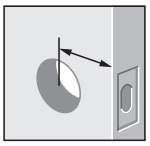
Keyed Differently—Each lock opens with a different key. Locks have random key numbers.

Keyed Alike—Locks with the same part number open with the same key.



Master Keyed—Each lock opens with a different key; a master key opens all locks.

Door Handles



Backset Distance

These Schlage door handles are for right- and left-swinging doors and include a strike plate, mounting hardware, and installation instructions. They are UL listed for three-hour fire doors and have a 3⁷⁄₁₆″ dia. faceplate. Select a handle with the correct backset distance (the distance from the door's edge to the center of the handle's mounting hole) for your door.

Standard—These AL series handles have a 4¼″ long handle that projects 2½″ from the door's face. Latch bolt extends ½″ from the door's edge. Meet ANSI A156.2 Grade 2 for 400,000 cycles.

High Traffic—For frequently used doors, these ND series handles last twice as long as standard door handles. Handle is 4⁹⁄₁₆″ long and projects 2¹⁵⁄₁₆″ from the door's face. Latch bolt extends ½″ from the door's edge. Meet ANSI A156.2 Grade 1 standards for 800,000 cycles.

Keyed handles include two Schlage C style keys. Choose handles *without lock cylinders* if you want to use your own compatible lock cylinder. Master keys for master-keyed handles are sold separately. To Order: For master keys, please specify the handle's backset (2³⁄₈″ or 2¾″) where applicable and the handle's finish (dull chrome or dark bronze).

ⓘ For other door handle brands, go to mcmaster.com and search for Yale, Sargent, or Corbin Russwin door handles.

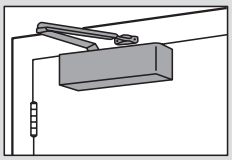
Keying	For Door Thick.	2³⁄₈″ Backset Distance	Dull Chrome	Dark Bronze	2¾″ Backset Distance	Dull Chrome	Dark Bronze	Master Keys	
Standard									
Nonlocking									
No Key	1⅜″-1⅞″	13045A115	$120.92	$140.40	13045A116	$120.92	$140.40		
Button Locking									
No Key	1⅜″-1⅞″	13045A135	137.80	157.30	13045A145	137.80	157.30		
Key and Button Locking									
Keyed Differently	1⅜″-1⅞″	13045A155	176.15	195.65	13045A166	176.15	195.65		
Keyed Alike	1⅜″-1⅞″	13045A175	186.73	208.32	13045A185	186.73	208.32		
Master Keyed	1⅜″-1⅞″	13045A195	188.82	206.70	13045A215	188.82	206.70	13045A911	$7.02
Without Lock Cylinder	1⅜″-1⅞″	13045A225	135.85	155.35	13045A235	135.85	155.35		
Key Locking									
Keyed Differently	1⅜″-1⅞″	13045A435	192.16	214.02	13045A445	192.16	214.02		
Keyed Alike	1⅜″-1⅞″	13045A455	205.47	227.89	13045A465	205.47	227.89		
Master Keyed	1⅜″-1⅞″	13045A475	204.22	226.11	13045A485	204.22	226.11	13045A913	7.02
Without Lock Cylinder	1⅜″-1⅞″	13045A495	148.20	169.47	13045A515	148.20	169.47		
Self Locking with Key									
Keyed Differently	1⅜″-1⅞″	13045A245	176.15	195.65	13045A255	176.15	195.65		
Keyed Alike	1⅜″-1⅞″	13045A265	188.82	208.32	13045A275	188.82	208.32		
Master Keyed	1⅜″-1⅞″	13045A285	188.82	208.32	13045A295	188.82	208.32	13045A912	7.02
Without Lock Cylinder	1⅜″-1⅞″	13045A415	135.85	155.35	13045A425	135.85	155.35		
High Traffic									
Nonlocking									
No Key	1⅝″-2⅛″				11325A315	280.27	295.10		
Button Locking									
No Key	1⅝″-2⅛″				11325A345	322.58	342.41		
Key and Button Locking									
Keyed Differently	1⅝″-2⅛″				11325A375	375.70	395.20		
Keyed Alike	1⅝″-2⅛″				11325A415	375.70	395.20		
Master Keyed	1⅝″-2⅛″				11325A445	375.70	407.88	11325A911	7.35
Without Lock Cylinder	1⅝″-2⅛″				11325A765	353.05	378.29		
Key Locking									
Keyed Differently	1⅝″-2⅛″				11325A825	363.58	382.45		
Keyed Alike	1⅝″-2⅛″				11325A835	363.58	382.45		
Master Keyed	1⅝″-2⅛″				11325A845	363.58	382.45	11325A913	7.26
Without Lock Cylinder	1⅝″-2⅛″				11325A855	346.13	367.14		
Self Locking with Key									
Keyed Differently	1⅝″-2⅛″				11325A515	357.81	370.50		
Keyed Alike	1⅝″-2⅛″				11325A545	363.58	382.45		
Master Keyed	1⅝″-2⅛″				11325A575	375.85	394.72	11325A912	7.57
Without Lock Cylinder	1⅝″-2⅛″				11325A815	346.13	366.25		

About Door Closers

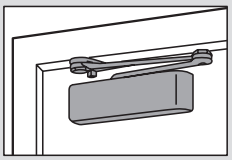
When replacing an existing closer, remove the cover and match the model number and/or mounting hole pattern to a closer in our offering. Or, use one of our closers and a universal mounting plate (see page 2963) which matches most hole patterns.

If you are installing a new closer, choose one that works for your door width. Due to added resistance from wind, closers typically accommodate smaller exterior doors than interior doors.

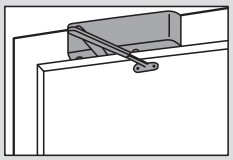
Mounting Positions



Door Mount, Opens In



Door Mount, Opens Out



Frame Mount, Opens Out

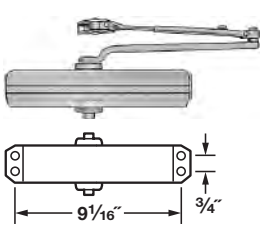
There are three typical mounting positions for door closers; many of our closers are versatile and can be mounted in any of these positions.

Door Mount, Opens In—Also known as regular arm mount, this position allows the door to open in toward the closer.

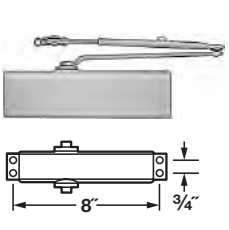
Door Mount, Opens Out—Also known as parallel arm mount, this installation folds the arm in.

Frame Mount, Opens Out—Also known as top frame mount, this position is often used for exterior doors.

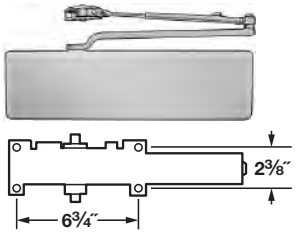
Door Closers



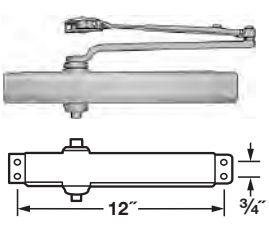
Norton 1601/9300



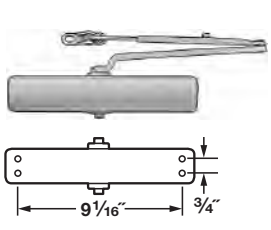
Norton 1700



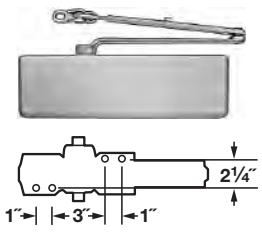
Norton 7500



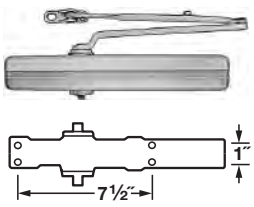
Norton 8301



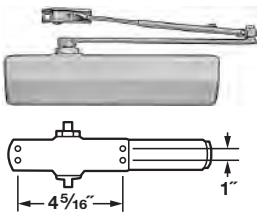
LCN 1261



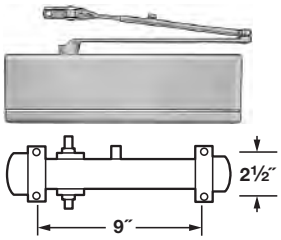
LCN 4040XP/4041



LCN 1460/1461



Corbin Russwin DC3000



Sargent 351

All closers are reversible for right- and left-hand doors and have adjustable opening/closing speed. As listed, some of the closers also have adjustable tension to handle a large range of door sizes. They can replace Yale, Dorma, Falcon, Stanley, Parker, and Cal Royal models with the same mounting hole pattern. Norton and Sargent door closers have an aluminum body; LCN and Corbin Russwin closers are iron. Mounting hardware and installation instructions are included.

Standard closers are UL listed and comply with UL 10C positive pressure fire test. **Hold-open** closers hold the door open until it is released by a slight push or pull on the door.

Heavy Traffic—Use on doors that are frequently opened and closed, such as entrance doors. Closers meet ANSI A156.4 Grade 1 standards for 2,000,000 cycles. Closers *with built-in door stop* prevent doors from opening too far. Closers *with delayed closing* hold doors open for up to 60 seconds before closing.

Moderate Traffic—Often used on office doors, closers meet ANSI A156.4 Grade 2 standards for 1,000,000 cycles.

Light Traffic—Commonly used on storage room doors, closers meet ANSI A156.4 Grade 3 standards.

For Width		*Mounting Position*								
Interior Doors	Exterior Doors	Door Mount, Opens In	Door Mount, Opens Out	Frame Mount, Opens Out	Adjustable Tension	Max. Open Angle	Choose a Color	Standard		Hold Open	
Heavy Traffic											
Norton 7500											
32″-54″	30″-48″	Yes	Yes	Yes	Yes	180°	Brown, Silver	15615A55	$237.27	15615A56	$260.54
Norton 7500 with Built-In Door Stop											
30″-48″	32″-48″	No	Yes	No	Yes	110°	Brown, Silver	15615A35	275.75	15615A36	302.72
Norton 1601											
33″-52″	30″-48″	Yes	Yes	Yes	Yes	180°	Brown, Silver	1475A101	105.41	1475A201	124.75
Norton 1601 with Built-In Door Stop											
28″-48″	28″-48″	No	Yes	No	Yes	110°	Brown, Silver	1475A301	131.19	1475A401	155.59
Norton 1601 with Built-In Door Stop and Shock Absorber											
28″-32″	27″	No	Yes	No	Yes	110°	Brown, Silver	1475A501	204.84	1475A801	237.98
33″-41″	28″-36″	No	Yes	No	Yes	110°	Brown, Silver	1475A601	204.84	1475A901	237.98
42″-48″	28″-36″	No	Yes	No	Yes	110°	Brown, Silver	1475A701	204.84	1475A721	237.98
Norton 8301											
30″-48″	30″-48″	Yes	Yes	Yes	Yes	180°	Brown, Silver	15565A22	164.89	15565A26	185.02
Norton 8301 with Built-In Door Stop											
28″-48″	28″-48″	No	Yes	No	Yes	110°	Brown, Silver	15565A23	191.74	15565A27	217.14
LCN 4040XP											
24″-60″	24″-48″	Yes	Yes	Yes	Yes	120°	Brown, Silver	8082A61	336.43	8082A62	376.37
LCN 4040XP with Built-In Door Stop											
24″-60″	24″-48″	No	Yes	No	Yes	110°	Brown, Silver	1164A71	419.47	1164A72	458.41

(Continued on following page)

About Padlocks

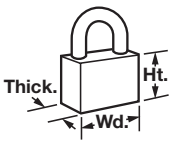
You'll find our basic padlocks on pages 2978-2979. They have random key numbers. If you want to add padlocks or keys to an existing system, purchase a padlock with more than two keys, or create systems of locks (keyed alike or master keyed), see pages 2980-2988. For combination padlocks, see page 2989.

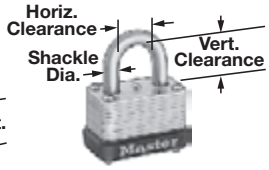
Most padlocks have a locking mechanism with multiple pins or discs. When choosing between padlocks with different numbers of pins or discs, the lock with more pins or discs will be harder to pick.

Strength and corrosion resistance are important factors to consider in selecting a padlock. See the chart at right for the relative strength and corrosion resistance of padlock materials.

Strength		Corrosion Resistance
Solid Steel	Greatest ↑	Brass
Laminated Steel, Plastic-Covered Laminated Steel		Stainless Steel
		Plastic-Covered Laminated Steel
		Plastic
Stainless Steel		Aluminum
Aluminum		Zinc
Brass, Zinc		Solid Steel
Plastic		Laminated Steel

Padlocks





A&C

B

D&E

F

G

H

J

K

- Include two keys.

A steel body and shackle give Styles A-J strength. Style K has a zinc body which is not as strong, but has better corrosion resistance. Choose these locks if you need locks that each open with a different key. All locks have random key numbers.

(A&B) Master Lock Warded Laminated Steel—Have a basic warded locking mechanism and a gray bumper. Shackle is steel. *Style B* have an adjustable vertical shackle clearance.

(C-F) Master Lock Laminated Steel—*Style C* have a blue bumper, a steel shackle, and a four-pin tumbler. *Style D* have gray bumpers, a hardened steel shackle, and a four-pin tumbler. *Style E* have gray bumpers, a hardened steel shackle, and a five-pin tumbler. *Style F* has a hardened steel shackle and a five-pin tumbler.

(G&H) Master Lock Solid Steel—Have a hardened steel shackle and a five-pin tumbler. *Style H* has a protected shackle.

(J) American Lock Solid Steel—Have a hardened steel shackle and a five-pin tumbler.

(K) Zinc—Have a hardened steel shackle and a six-disc tumbler. Body is tan.

	Shackle Clearance Dia.	Shackle Clearance Vert.	Shackle Clearance Horiz.	Body Ht.	Body Wd.	Body Thick.	Model No.		1-5	6-Up
A	5/32″	7/16″	3/8″	3/4″	1″	5/16″	10	1189A41	$2.57	$2.32
A	3/16″	1/2″	1/2″	1 1/8″	1 1/8″	5/8″	105	1189A21	3.29	2.97
A	1/4″	5/8″	9/16″	1 1/8″	1 1/2″	3/4″	22	1189A31	3.41	3.08
A	9/32″	13/16″	13/16″	1 3/16″	1 3/4″	7/8″	500	1189A1	4.32	3.90
B	9/32″	7/8″-2″	13/16″	1 3/16″	1 3/4″	7/8″	510	1182A5	6.52	5.89
B	9/32″	3 1/8″-5 3/8″	13/16″	1 3/16″	1 3/4″	7/8″	517	1182A1	6.89	6.23
C	3/16″	9/16″	1/2″	1 1/8″	1 1/8″	3/4″	7	1176A12	6.98	6.31
C	3/16″	1 1/2″	1/2″	1 1/8″	1 1/8″	3/4″	7	1176A16	8.45	7.63
C	3/16″	2 1/2″	1/2″	1 1/8″	1 1/8″	3/4″	7	1176A61	8.79	7.94
D	9/32″	3/4″	5/8″	1 3/8″	1 9/16″	1 1/16″	3	1176A13	8.77	7.92
D	9/32″	1 1/2″	5/8″	1 3/8″	1 9/16″	1 1/16″	3	1176A17	10.25	9.26
D	9/32″	2″	5/8″	1 3/8″	1 9/16″	1 1/16″	3	1176A65	11.27	10.18
D	5/16″	15/16″	3/4″	1 3/8″	1 3/4″	1 1/8″	1	1176A14	10.07	9.10
D	5/16″	1 1/2″	3/4″	1 3/8″	1 3/4″	1 1/8″	1	1176A18	11.55	10.44
D	5/16″	2 1/2″	3/4″	1 3/8″	1 3/4″	1 1/8″	1	1176A62	11.88	10.73
D	5/16″	5 3/4″	3/4″	1 3/8″	1 3/4″	1 1/8″	1	1176A21	15.12	13.66
D	3/8″	1″	15/16″	1 9/16″	2″	1 1/4″	5	1176A15	12.80	11.56
D	3/8″	1 1/2″	15/16″	1 9/16″	2″	1 1/4″	5	1176A19	14.27	12.89
D	3/8″	2 1/2″	15/16″	1 9/16″	2″	1 1/4″	5	1176A39	14.61	13.19
E	5/16″	15/16″	3/4″	1 7/16″	1 3/4″	1 1/8″	81	1193A11	14.07	12.71
E	5/16″	1 1/2″	3/4″	1 7/16″	1 3/4″	1 1/8″	81	1193A18	15.55	14.05
E	5/16″	2 1/2″	3/4″	1 7/16″	1 3/4″	1 1/8″	81	1193A19	15.87	14.34
E	3/8″	2 1/2″	15/16″	1 1/4″	2″	3/4″	25	1179A15	18.61	16.81
F	5/16″	3″	2 1/4″	1 9/16″	3 1/4″	1 1/8″	101	1905A12	27.27	24.63
G	5/16″	1 3/16″	7/8″	1 15/16″	1 3/4″	7/8″	7040	1491A1	19.05	17.21
H	5/16″	1 3/16″	7/8″	3 3/8″	1 3/4″	7/8″	7045	1491A2	33.79	30.52
J	7/16″	1 1/16″	15/16″	2 1/8″	2 1/2″	1 1/8″	700	12705A21	34.14	30.98
J	7/16″	2″	15/16″	2 1/8″	2 1/2″	1 1/8″	701	12705A25	35.67	32.37
K	1/4″	3/4″	3/4″	1 3/8″	1 1/2″	3/4″	—	1199A1	9.64	8.68
K	1/4″	1 1/4″	3/4″	1 3/8″	1 1/2″	3/4″	—	1199A31	10.53	9.48
K	1/4″	2 3/4″	3/4″	1 3/8″	1 1/2″	3/4″	—	1155A6★	13.78	12.40
K	1/4″	5″	3/4″	1 3/8″	1 1/2″	3/4″	—	1155A7★	13.87	12.48

★Has a brass identification tag.

Weather-Resistant Padlocks

A&B

C

D

- Include two keys.

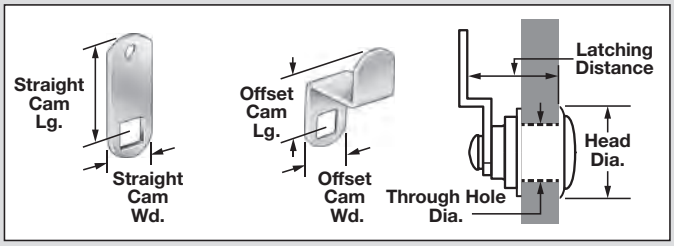
Choose these strong and corrosion-resistant locks if you need locks that each open with a different key. All locks have random key numbers and pins in the tumbler.

(A&B) Abus Lock—Have a stainless steel body. 1831A31 and 1831A11 have a stainless steel shackle. 1831A24 has a hardened steel shackle.

(C&D) Master Lock Pro Series—Have a laminated-steel body with black plastic cover. Shackle is hardened steel. *Style D* have a protected shackle.

	Shackle Clearance Dia.	Shackle Clearance Vert.	Shackle Clearance Horiz.	Body Ht.	Body Wd.	Body Thick.	No. of Pins	Model No.		1-5	6-Up
A	5/16″	1/2″	3/4″	2 3/8″ Dia.	—	1 1/16″	4	24/60	1831A31	$23.82	$21.32
B	3/8″	3/4″	3/4″	2 3/4″ Dia.	—	1 3/16″	5	24/70	1831A11	26.47	23.68
B	15/32″	5/8″	1″	3 5/8″ Dia.	—	1 3/16″	5	26/90	1831A24	61.76	55.26
C	5/16″	1 1/8″	7/8″	2 5/16″	2 1/8″	1 1/2″	5	6121	10885A21	21.57	19.48
C	3/8″	1 3/8″	7/8″	2 5/16″	2 3/8″	1 1/2″	5	6125	10885A22	25.04	22.61
C	7/16″	1 3/8″	7/8″	2 5/16″	2 5/8″	1 1/2″	5	6127	10885A23	29.12	26.31
D	5/16″	3/4″	7/8″	2 5/16″	2 1/8″	1 1/2″	5	6321	11345A23	29.66	26.79
D	3/8″	3/4″	7/8″	2 5/16″	2 3/8″	1 1/2″	5	6325	11345A24	35.09	31.69
D	7/16″	3/4″	7/8″	2 5/16″	2 5/8″	1 1/2″	5	6327	11345A25	40.46	36.55

About Cam Latches and Locks



Cam latches and locks have an attached metal arm that rotates to lock cabinet doors and file drawers.

The cam mechanism is either straight or offset.
Offset cams are often reversible, which means they can be mounted to accommodate different latching distances.

Latching distance is the distance between the outside mounting surface and the inside face of the cam after installation.

Wing-Handle Cam Latches

A quarter-turn clockwise or counterclockwise opens these latches. Select the turn direction when mounting the cam. Each latch comes with a straight cam and a reversible offset cam.
Standard latches fit the most common through-hole size. Mount them in metal, plastic, or wood.
Miniature latches mount in metal or plastic.

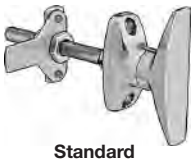
For Through Hole Dia.	For Max. Thick.	Latching Distance	Handle Lg.	Handle Proj.	Straight Cam Lg.	Straight Cam Wd.	Offset Cam Lg.	Offset Cam Wd.	Nickel-Plated Zinc		Black-Painted Zinc	
Standard												
3/4"	1/4"	3/8", 5/8", 7/8"	1 1/2"	1/2"	1 1/4"	5/8"	1 1/8"	5/8"	1820A21	$4.68		
3/4"	9/16"	5/8", 7/8", 1 1/8"	1 1/2"	1/2"	1 1/4"	5/8"	1 1/8"	5/8"	1820A22	4.68		
3/4"	7/8"	7/8", 1 1/8", 1 3/8"	1 1/2"	1/2"	1 1/4"	5/8"	1 1/8"	5/8"	1820A26	4.68		
Miniature												
1/2"	5/16"	1/4", 9/16", 7/8"	1"	5/16"	1 1/8"	3/8"	1 1/8"	3/8"	1820A12	12.30	1820A11	$12.30

Knob Cam Latches

With a finger-grip knob, these latches fit where latches with handles won't. A quarter-turn clockwise or counterclockwise opens the latch. Select the turn direction when mounting the included reversible offset cam. To set the latching distance, turn the collar under the knob. Latch is zinc-plated steel; knob is black nylon. Temperature range is -20° to 185° F. Mount in metal, plastic, or wood.

For Through Hole Dia.	For Max. Thick.	Latching Distance	Knob Dia.	Knob Proj.	Cam Lg.	Cam Wd.		
5/16"	3/16"	3/16"-11/16"	1/2"	1/2"	9/16"	1/4"	1702A39	$16.93
7/16"	1/4"	1/8"-15/16"	3/4"	11/16"	5/8"	1/4"	1702A41	17.45
5/8"	1/2"	3/16"-27/16"	1 1/8"	1"	1 3/8"	5/16"	1702A42	20.02

T- and L-Handle Cam Latches


Standard T-Handle


Tamper-Resistant L-Handle


With Two Handles

Open these latches with a quarter-turn of the handle. Latches are polished chrome-plated zinc, except latch with two handles does not have a polished finish.
Standard and **tamper-resistant** latches come with a straight cam that can be mounted to latch at a single point; for additional strength, position it to drive a bar or rod into as many as two additional latch points. These are the type of latches used with three-point locking systems on filing cabinet doors. Mounting plate is 2 5/16" Lg. × 1 3/16" Wd. Mount latches in metal, plastic, or wood.
Standard latches have a 5/16" Sq. × 3 3/16" Lg. spindle. Mounting hole center-to-center is 1 3/4". Two M4 mounting screws are required (not included). *Tamper-resistant* latches have concealed mounting screws. Spindle is 5/16" Sq. × 9/16" Lg. Mounting hole center-to-center is 1 1/2".
Latch **with two handles** has an inside handle and an outside handle. It comes with an offset cam. Rear projection is 2 9/16". Mount in metal.

For Through Hole Dia.	For Max. Thick.	Latching Distance	Cam Lg.	Cam Wd.	T-Handle Handle Lg.	T-Handle Handle Proj.			L-Handle Handle Lg.	L-Handle Handle Proj.		
Standard—To Order: Please specify turn direction to open: clockwise or counterclockwise.												
7/8"	2 15/16"	3 1/4"	1 7/16"	5/8"	3 3/16"	1 13/16"	1210A921	$12.81	3 5/16"	1 11/16"	1226A421	$14.43
Tamper Resistant—To Order: Please specify turn direction to open: clockwise or counterclockwise.												
7/8"	1/8"	3/8"	1 7/16"	5/8"	3 3/16"	1 13/16"	1210A911	12.42	3 5/16"	1 11/16"	1226A411	17.63
With Two Handles—Select turn direction when mounting the cam.												
3/8"	1 1/2"	1/8"-2"	1 3/4"	5/16"	3"	1 3/4"	11595A41	38.11				
Replacement Handle for Tamper-Resistant L-Handle Cam Latch											1226A81	9.40

Recessed-Handle Cam Latches

The handle is recessed to stay out of the way.

With Inset Handle

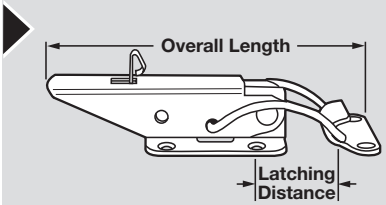
Turn the flat inset grip a quarter-turn clockwise or counterclockwise to open the latch. Select the turn direction when mounting the included reversible offset cam. Latches are zinc-plated steel; handles are ABS plastic. Maximum temperature is 140° F. Mount latches in metal or plastic.

For Through Hole Dia.	For Max. Thick.	Latching Distance	Cam Lg.	Cam Wd.	Mount. Plate Dia.		
Polished Chrome-Plated Handle							
1 11/16"	3/8"	0"-1/2"	9/16"	5/8"	1 15/16"	1625N12	$37.93
Black Powder-Coated Handle							
1 11/16"	3/8"	0"-1/2"	9/16"	5/8"	1 15/16"	1625N11	35.55

With Ring Handle

Fold the ring handle into the recess when not in use. A half-turn clockwise opens the latch. Latch is polished chrome-plated brass and comes with a straight cam and a reversible offset cam. Handle projects 3/16". Mounting plate is 2 1/8" Lg. × 1 7/8" Wd. Mount latch in metal, plastic, or wood.

For Through Hole Dia.	For Max. Thick.	Latching Distance	Cam Lg.	Cam Wd.		
3/4"	1 1/8"	15/16", 1 5/16", 1 11/16"	2"	5/8"	1379A11	$16.71



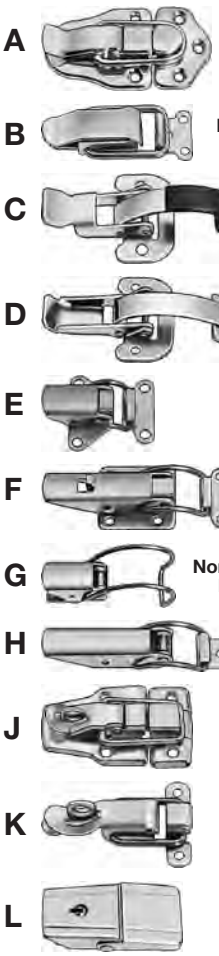
About Draw Latches

Draw latches operate by pulling surfaces together and holding them closed. They are also known as tension latches.

Latching distance is how far apart a mounted latch can be from the surface it's drawing to itself. Specifically, it's the distance between the center of the mounting hole closest to the latch arm and the farthest inside surface of the latching arm when the latch is closed.

The **overall length** listed includes the strike plate.

Draw Latches and Locks



Latch and pull the handle down to close these latches, which are also known as tension latches. Latches have a fixed latching distance. Mounting screws are not included.

Styles C and **G** are strikeless; they hook into a lip or notch in the item being latched.

Style C has a vinyl-coated arm so it won't scratch surfaces.

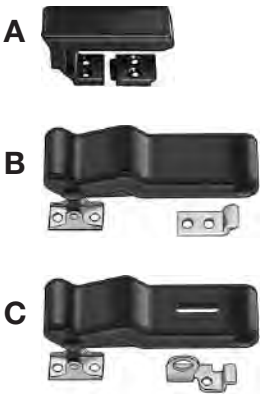
Style F has a safety catch to prevent accidental opening.

Style L opens with key number 931A and comes with one key.

	Latching Distance	Overall Lg.	Overall Wd.	Proj.	Screw Size	For Max. Padlock Shackle Dia.	Finish	Pkg. Qty.		Pkg.
Nonlocking Latches—Steel										
A	3/4"	2 3/4"	17/16"	3/8"	No. 6	—	Brass Plated	5	1766A1	$9.89
A	3/4"	2 3/4"	17/16"	3/8"	No. 6	—	Nickel Plated	5	1766A2	9.89
A	15/16"	3 5/16"	1 3/4"	7/16"	No. 6	—	Brass Plated	5	1766A3	10.05
A	15/16"	3 5/16"	1 3/4"	7/16"	No. 6	—	Nickel Plated	5	1766A4	10.05
B	1 1/16"	2 5/16"	15/16"	1/2"	♦	—	Dull	10	1767A14	10.00
B	1 1/16"	2 5/16"	15/16"	1/2"	No. 5, No. 6	—	Zinc Plated	10	1590A13	10.57
B	15/16"	3 9/16"	1 1/4"	9/16"	♦	—	Dull	5	1590A23	12.85
B	15/16"	3 9/16"	1 1/4"	9/16"	No. 12	—	Zinc Plated	3	1590A21	8.92
										Each
C	1 1/2"	3 3/4"	1 7/8"	15/16"	No. 12	—	Zinc Plated	—	1863A21	$5.73
D	15/8"	4 1/2"	1 7/8"	1 1/16"	♦	—	Zinc Plated	—	1863A18	4.37
D	15/8"	4 1/2"	1 7/8"	1 1/16"	No. 5, No. 12	—	Zinc Plated	—	1863A22	4.00
Nonlocking Latches—300 Series Stainless Steel										
B	1 1/16"	2 5/16"	15/16"	1/2"	No. 5, No. 6	—	Dull	—	1590A43	4.83
E	13/16"	1 7/8"	1 3/8"	1/2"	No. 6	—	Dull	—	1889A34	5.34
F	7/8"	3 7/16"	1 3/16"	7/8"	No. 6	—	Dull	—	1889A43	7.06
G	1 7/16"	2 1/8"	7/8"	9/16"	No. 6	—	Dull	—	1889A22	5.60
H	1 3/8"	3 3/4"	7/8"	1/2"	No. 6	—	Dull	—	1889A37	5.83
Padlockable Latches—Steel										Pkg.
B	1"	5 1/2"	1 1/2"	15/16"	No. 6, No. 8	3/16"	Galvanized	1	1767A45	$4.51
B	15/16"	3 7/8"	15/16"	15/16"	♦	5/16"	Dull	3	1767A42	9.30
B	15/16"	3 7/8"	15/16"	15/16"	No. 10	5/16"	Zinc Plated	3	1767A41	10.95
G	1 1/2"	3 1/8"	7/8"	13/16"	No. 6	5/16"	Zinc Plated	5	1767A43	7.62
J	1 1/8"	2 5/8"	1 1/2"	5/8"	No. 6	1/4"	Nickel Plated	10	1766A61	27.32
K	1 1/16"	2 9/16"	15/8"	13/16"	♦	1/4"	Dull	10	1767A15	12.75
K	1 1/16"	2 9/16"	15/8"	13/16"	No. 6	1/4"	Zinc Plated	5	1590A14	8.99
Padlockable Latches—300 Series Stainless Steel										Each
B	13/16"	3 1/8"	1 1/4"	1/2"	No. 4	3/16"	Polished	—	1889A46	$12.05
K	1 1/16"	2 9/16"	15/8"	13/16"	No. 6	1/4"	Dull	—	1590A45	4.55
Keyed Lock—Steel										
L	1 7/16"	2 1/2"	1 1/4"	1/2"	No. 5	—	Nickel Plated	—	1863A23	6.76

♦ No mounting holes; designed for welding.

Plastic and Rubber Draw Latches



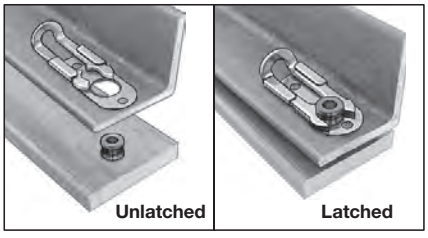
Nonmetal bodies make these latches corrosion resistant. Latching distance is fixed. Mounting screws are not included.

Plastic latches have a temperature range of 32° to 150° F.

Rubber latches absorb vibration and stretch to compensate for slight misalignment. They have 300 series stainless steel strike plates. Temperature range is -20° to 120° F.

	Latching Distance	Overall Lg.	Overall Wd.	Proj.	Screw Size	For Max. Padlock Shackle Dia.	Color	Pkg. Qty.		Pkg.
Nonlocking—Plastic										
A	3/4"	1 3/4"	3/4"	1/4"	No. 4	—	Black	10	1891A48	$12.02
A	1"	2 3/16"	1 1/4"	5/16"	No. 4	—	Black	10	1891A49	15.45
Nonlocking—Rubber										Each
B	1 1/16"	3 1/8"	1 1/4"	13/16"	No. 8	—	Black	—	1070A79	$22.17
B	1 9/16"	4 3/16"	1 1/4"	13/16"	No. 8	—	Black	—	1070A81	14.82
B	1 9/16"	6 1/2"	1 13/16"	1 3/16"	No. 10	—	Black	—	1070A82	23.82
Padlockable—Rubber										
C	3 9/16"	4 3/16"	1 1/4"	15/16"	No. 8	5/16"	Black	—	1070A91	16.45

Slide-Snap Draw Latches



To secure overlapping components, pull the slide over the stud until they snap together. These latches resist shock and vibration. They are dull 304 stainless steel. Latches are 1 3/4" Lg. x 1 1/16" Wd. and project 1/2". Stud has a 3/8" dia. head. Latching distance is fixed. Latches require M3 mounting screws.

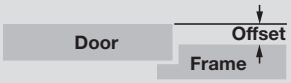
1872A72 includes a steel spacer for installation.

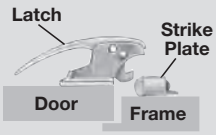
For Mounting Surface Thickness	Latching Distance		
0.046"-0.080"	5/8"	1872A71	$6.12
0.081"-0.128"	5/8"	1872A72	6.51

Push-to-Close Latches

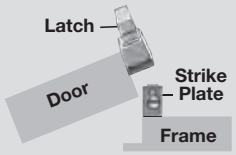
About Push-to-Close Latches

When choosing between a face-mount latch and an edge-mount latch, consider the offset of your door. **Offset** is the space between the front of the door and the frame.



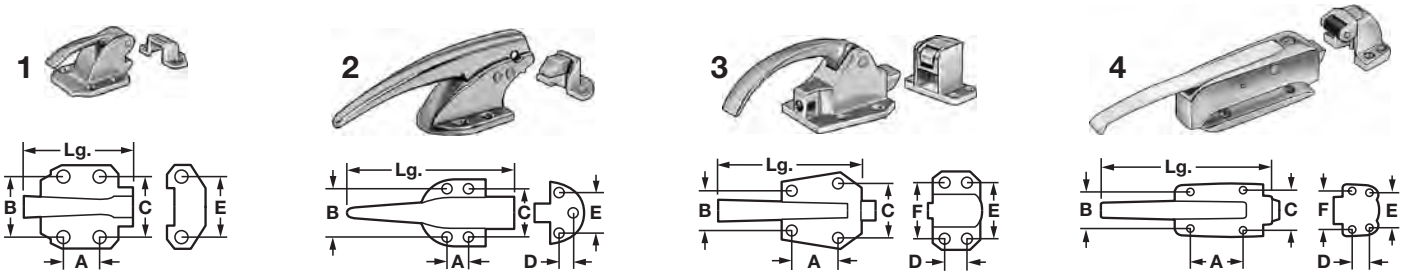


Face-Mount Latches—Mount horizontally to the front of the door with the strike plate mounted on the frame. Strike plate accommodates flush or offset doors.



Edge-Mount Latches—Mount vertically to the side edge of the door with the strike plate mounted behind it on the face of the frame. Latches need a minimum 3/4" offset.

Face-Mount Push-to-Close Latches and Locks with Handle



Keep doors on refrigerators and industrial enclosures closed. Mount these latches and locks horizontally to the face of your door with the strike plate mounted on the frame. Styles 2-4 can mount to oven doors. Mount on the right or left side of the door. Mounting screws are not included.

Nonlocking Latches—Come with three fixed strike plates to accommodate different door offsets. They are not recommended for use on oven doors.

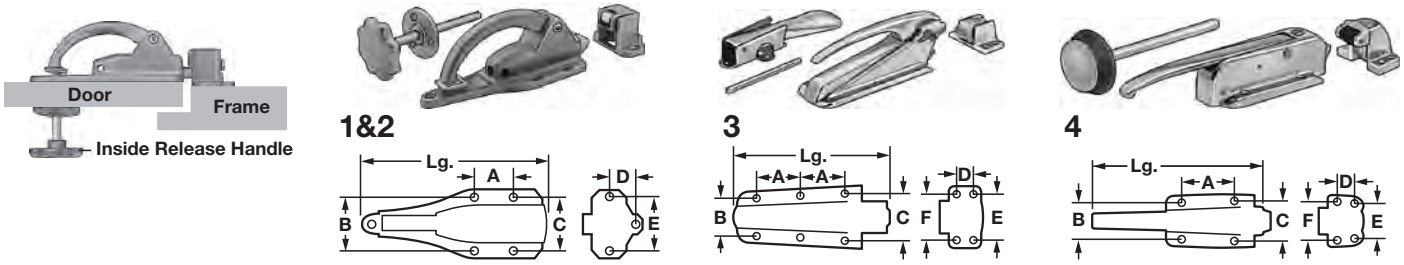
Padlockable Latches—Have an adjustable strike plate to compensate for changes in offset caused by sagging doors and worn or flattened gaskets. Maximum padlock shackle diameter is 1/4".

Keyed Locks—Have an adjustable strike plate to compensate for changes in offset caused by sagging doors and worn or flattened gaskets. Locks come with two keys and open with key number 105. Meet NSF/ANSI standards.

Proj.	Lg.	Center-to-Center (A)	(B)	(C)	(D)	(E)	(F)	Screw Size	For Smaller Offsets Offset Range			For Larger Offsets Offset Range		
Nonlocking Latches—Chrome-Plated Zinc														
1	1 1/8"	2 1/4"	11/16"	1 1/8"	1 1/8"	—	1 1/8"	—	No. 6	0", 1/8", 3/8"	15755A13	$31.76	—	—	—
1	1 5/16"	2 13/16"	7/8"	1 7/16"	1 7/16"	—	1 7/16"	—	No. 8	0", 1/8", 3/8"	15755A11	43.98	—	—	—
Padlockable Latches—Chrome-Plated Zinc														
2	2 1/16"	5 15/16"	13/16"	1 3/8"	1 1/2"	1/2"	1 1/2"	—	No. 8	0" to 3/8"	1266A5	107.66	3/4" to 1 1/4"	1266A1★	$113.04
Padlockable Latches—Polished 304 Stainless Steel														
2	2"	5 1/4"	13/16"	1 5/16"	1 1/2"	7/8"	1 1/2"	—	No. 8	0" to 5/16"	1266A6	73.22	5/8" to 1 1/4"	1266A7	76.88
3	2 5/16"	5 1/4"	1 1/4"	1 3/4"	2 1/16"	3/4"	2 1/16"	2 1/16"	No. 10	0" to 3/8"	1256A1	94.33	1/2" to 1 1/4"	1256A2	99.05
3	2 1/2"	4 1/4"	1 3/8"	1 1/8"	1 5/8"	5/8"	1 5/8"	1 5/8"	No. 8	0" to 1/2"	1256A3	85.89	9/16" to 1 1/4"	1256A4	90.18
Keyed Locks—Dull Zinc														
4	2 7/16"	11"	3 3/8"	2 1/8"	2 1/2"	15/16"	2 5/16"	2 9/16"	1/4"	-1/8" to 1/4"	1576A51	296.17	3/4" to 1 1/2"	1576A52	288.06

★(D) dimension is 7/8".

Face-Mount Push-to-Close Latches and Locks with Emergency Release Handle



An emergency release handle offers a means of escape if the door closes with someone inside your enclosure. Mount these latches and locks horizontally to the face of doors on refrigerators, ovens, and industrial enclosures with the strike plate mounted on the frame. They have an adjustable strike plate to compensate for changes in offset caused by sagging doors and worn or flattened gaskets.

Mount on the right or left side of the door. Mounting screws are not included. Latches and locks require 1/4" mounting screws, except Style 1 latches with 4 1/8" projection require No. 10 screws. *Style 4* locks also require No. 10 screws.

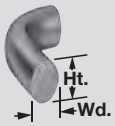
Style 1 is silver-painted iron. **Style 2** is polished 304 stainless steel. **Styles 3&4** are chrome-plated zinc.

Keyed Locks—Come with two keys and open with key number 105. They also accept a padlock. Locks *with fiberglass rod* work in temperatures down to -40° F.

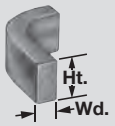
Proj.	Lg.	Center-to-Center (A)	(B)	(C)	(D)	(E)	(F)	For Max. Padlock Shackle Dia.	For Smaller Offsets Offset Range			For Larger Offsets Offset Range		
Padlockable Latches—Iron Release Handle with Steel Rod														
1	3 1/2"	8"	1 3/4"	2 3/8"	2 3/8"	1 3/16"	2 7/16"	—	5/16"	0" to 1/2"	1840A23	$64.15	5/8" to 1 1/4"	1840A25	$64.15
1	4 1/8"	10 5/8"	1 15/16"	3"	3"	1 1/2"	3 1/8"	—	11/32"	0" to 1 1/16"	1840A12	106.11	1 1/16" to 1 1/2"	1840A14	106.11
Padlockable Latches—Stainless Steel Release Handle with Stainless Steel Rod														
2	3 1/2"	8"	1 3/4"	2 3/8"	2 3/8"	1 3/16"	2 7/16"	—	5/16"	0" to 1/2"	1840A31	196.60	5/8" to 1 1/4"	1840A32	208.79
Padlockable Latches—Steel Release Handle with Steel Rod														
3	4"	11 3/4"	3 5/16"	2 7/8"	3 3/8"	1 1/4"	3 1/4"	3 1/4"	5/16"	0" to 3/16"	1267A1	669.54	1 3/8" to 1 7/8"	1267A3	637.09
Keyed Locks—Plastic Release Handle with Steel Rod														
4	2 1/4"	11"	3 3/8"	2 1/8"	2 1/2"	15/16"	2 5/16"	2 9/16"	5/16"	-1/8" to 1/4"	1354A304	329.13	3/4" to 1 1/2"	1354A444	321.25
Keyed Locks—Plastic Release Handle with Fiberglass Rod														
4	2 1/4"	11"	3 3/8"	2 1/8"	2 1/2"	15/16"	2 5/16"	2 9/16"	5/16"	-1/8" to 1/4"	1354A424	340.90	3/4" to 1 1/2"	1354A454	333.01

About Pull Handles

Round Grip—A circular gripping surface allows your hand to pivot in any direction.



Oval Grip—A rounded edge on the gripping surface conforms to your hand and offers more control than round grip.

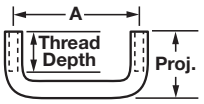


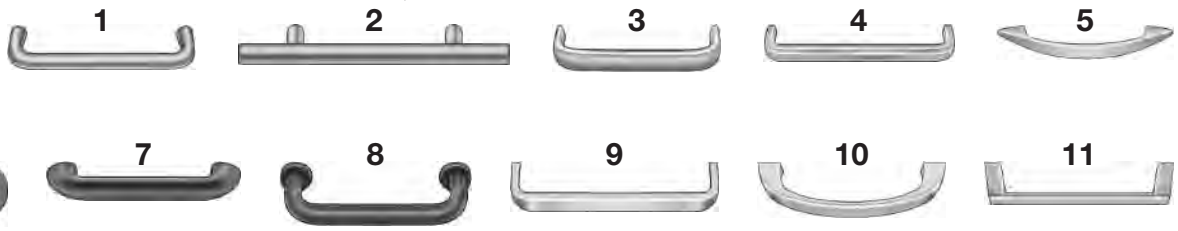
Rectangular Grip—The flat gripping surface prevents your hand from slipping or repositioning, but may be less comfortable than round and oval.

Handle strength varies by fabrication process and material.

Fabrication Process		Material
Forged	**Strongest** ↑	Titanium, Stainless Steel
Cast		Steel
Extruded		Zinc
Formed		Aluminum, Brass
Stamped		Plastic, Rubber

Pull Handles with Threaded Holes





Mounting screws are completely hidden because these handles mount from behind your material. Furnished with mounting screws, unless noted. **Style 1**—*ABS plastic handles* are not rated for temperature. Mounting holes are not threaded, but accommodate #8×1 1/8″ self-tapping screws (included). **Style 7**—Minimum temperature is not rated. Maximum temperature is 215°F. **Style 8**—Temperature range is –40° to 320°F.

Round Grip—Styles 1&2

	(A)	Proj.	Grip Size, Dia.	Thread Size	Thread Depth		
Extruded Aluminum—Dull Anodized Finish							
1	3/4″	1/2″	1/8″	2-56	3/16″	1568A65	$3.98
1	7/8″	1/2″	1/8″	2-56	3/16″	1568A66	4.18
1	1″	1″	3/16″	4-40	1/4″	1568A61	3.31
1	1 1/4″	1″	3/16″	4-40	1/4″	1568A62	3.40
1	2″	1″	3/16″	4-40	1/4″	1568A63	3.51
1	3″	1 5/16″	5/16″	8-32	1/2″	1568A11	4.14
1	3″	2″	1/2″	10-32	3/8″	1568A71	5.73
1	3 1/2″	1 5/16″	5/16″	8-32	1/2″	1568A21	4.41
1	4″	1 5/16″	5/16″	8-32	1/2″	1568A12	4.21
1	4″	1 7/8″	1/2″	10-32	3/4″	1568A14	8.19
1	4 9/16″	1 1/2″	5/16″	8-32	5/16″	1568A69	4.20
1	5″	1 7/16″	5/16″	8-32	1/2″	1568A15	4.99
1	5″	3″	1/2″	10-32	3/4″	1568A26	9.21
1	6″	2 5/8″	3/4″	1/4″-20	9/16″	1435A41	13.65
1	8″	3″	1″	1/4″-20	9/16″	1435A43	20.11
1	10″	3″	1″	1/4″-20	9/16″	1435A47	20.62
1	33 1/16″	2 1/4″	1″	3/8″-24	1″	1435A5	44.84
1	45 1/16″	2 1/4″	1″	3/8″-24	1″	1435A7	82.28
Extruded Aluminum—Black Anodized Finish							
1	3/4″	1/2″	1/8″	2-56	3/16″	1568A67	3.98
1	7/8″	1/2″	1/8″	2-56	3/16″	1568A68	4.18
1	1″	1″	3/16″	4-40	1/4″	1568A41	3.65
1	1 1/4″	1″	3/16″	4-40	1/4″	1568A42	3.59
1	2″	1″	3/16″	4-40	1/4″	1568A64	3.51
1	3″	1 5/16″	5/16″	8-32	1/2″	1568A43	4.40
1	3″	2″	1/2″	10-32	3/8″	1568A72	5.73
1	3 1/2″	1 5/16″	5/16″	8-32	1/2″	1568A44	4.73
1	4″	1 5/16″	5/16″	8-32	1/2″	1568A45	7.10
1	4 9/16″	1 1/2″	5/16″	8-32	5/16″	1568A7	4.20
1	5″	1 7/16″	5/16″	8-32	1/2″	1568A46	8.01
1	6″	1 7/16″	5/16″	8-32	1/2″	1568A47	9.18
Metric Extruded Aluminum—Dull Anodized Finish							
1	64 mm	33 mm	8 mm	M4	12 mm	1568A48	3.00
1	96 mm	33 mm	8 mm	M4	12 mm	1568A49	3.43
1	128 mm	33 mm	8 mm	M4	12 mm	1568A51	3.85
1	160 mm	33 mm	8 mm	M4	12 mm	1568A52	4.23
Extruded Brass—Dull Chrome Finish							
1	3″	1 5/16″	5/16″	8-32	1/2″	1568A31	2.85
1	4″	1 5/16″	5/16″	8-32	1/2″	1568A33	3.37
Extruded Type 303 Stainless Steel—Dull Finish							
1	2″	1″	3/16″	4-40	1/4″	1726A43	5.79
1	3″	1″	3/16″	4-40	1/4″	1726A44	6.36
1	4″	4″	1/4″	6-32	3/8″	1726A1	10.40
1	5″	4″	1/4″	6-32	3/8″	1726A2	10.71
1	6″	4″	1/4″	6-32	3/8″	1726A3	10.72
1	7″	4″	1/4″	6-32	3/8″	1726A4	11.60
Forged Type 303 Stainless Steel—Polished Finish							
1	3″	1 1/2″	5/16″	8-32	5/16″	1726A71	4.78
1	3 1/2″	1 1/2″	5/16″	8-32	5/16″	1726A72	4.91
Forged Type 303 Stainless Steel—Polished Finish (Cont.)							
1	4″	1 1/2″	5/16″	8-32	5/16″	1726A73	$5.00
1	5″	1 1/2″	5/16″	8-32	5/16″	1726A74	5.29
1	6″	1 1/2″	5/16″	8-32	5/16″	1726A75	5.44
Extruded Type 304 Stainless Steel—Dull Finish							
1	3″	1 5/16″	5/16″	8-32	1/2″	1726A31	8.14
1	3 1/2″	1 5/16″	5/16″	8-32	1/2″	1726A32	8.71
1	4″	1 5/16″	5/16″	8-32	1/2″	1726A33	9.37
1	5″	2 13/16″	5/16″	10-32	3/4″	1858A62	10.05
1	6″	2 5/8″	3/4″	1/4″-20	5/8″	1435A25	24.20
1	8″	3 1/2″	1″	1/4″-20	3/4″	1435A27	43.37
1	10″	3 1/2″	1″	1/4″-20	3/4″	1435A29	48.96
Extruded Type 304 Stainless Steel—Polished Finish							
1	1″	1/2″	1/8″	3-56	1/4″	1726A5	7.94
1	3″	1″	1/4″	6-32	1/4″	1726A6	7.98
1	4″	1 1/2″	5/16″	10-32	1/4″	1726A8	9.57
1	5″	1″	1/4″	6-32	1/4″	1726A7	8.46
1	5″	1 1/2″	5/16″	10-32	1/4″	1726A9	9.96
1	5 15/16″	1 1/8″	3/8″	M4	8 mm	1726A46	13.31
Extruded Type 316 Stainless Steel—Dull Finish							
1	3″	1 5/16″	5/16″	8-32	5/16″	18645A21	8.49
1	3 1/2″	1 5/16″	5/16″	8-32	5/16″	18645A22	8.63
1	4″	1 5/16″	5/16″	8-32	5/16″	18645A23	8.98
1	4″	1 3/8″	7/16″	8-32	5/16″	1726A91	8.45
1	5″	1 3/8″	7/16″	8-32	5/16″	1726A92	10.06
1	5″	1 9/16″	3/8″	M5	19 mm	1020A11	19.37
1	6″	1 3/8″	7/16″	8-32	5/16″	1726A93	10.86
1	8 13/16″	1 9/16″	3/8″	M5	19 mm	1020A12	24.90
1	9″	1 3/8″	7/16″	8-32	5/16″	1726A94	12.91
1	12″	1 3/8″	7/16″	8-32	5/16″	1726A95	14.92
1	12 9/16″	1 9/16″	3/8″	M5	19 mm	1020A13	31.70
Extruded Titanium—Polished Finish							
1	3 15/16″	1 3/16″	3/8″	M5	5/16″	1568A81	41.45
1	4 3/4″	1 5/8″	7/16″	M6	5/16″	1568A82	58.39
1	5 7/8″	2″	1/2″	M8	3/8″	1568A83	87.92
ABS Plastic—Polished Chrome Finish							
1	3″	1 1/4″	7/16″	#8	3/8″	11945A13	1.67
1	4″	1 3/8″	7/16″	#8	1/4″	11945A23	1.80
ABS Plastic—Black							
1	3″	1 1/4″	7/16″	#8	3/8″	11945A11	.87
1	4″	1 3/8″	7/16″	#8	1/4″	11945A21	.93
Extruded Steel—Nickel Finish							
2	3″	1 7/16″	1/2″	8-32	1/2″	1325A2	3.29
2	3 1/2″	1 7/16″	1/2″	8-32	1/2″	1325A21	3.42
2	3 3/4″	1 7/16″	1/2″	8-32	1/2″	1325A22	3.42
2	5 1/16″	1 7/16″	1/2″	8-32	1/2″	1325A23	3.64
2	7 9/16″	1 7/16″	1/2″	8-32	1/2″	1325A24	4.58
2	10 1/16″	1 7/16″	1/2″	8-32	1/2″	1325A25	5.78

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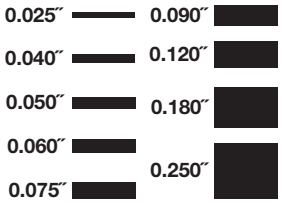
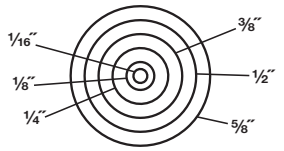
About Hinges

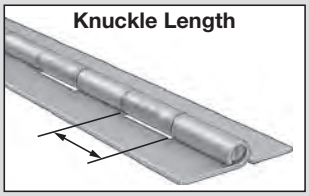
Leaf Thickness



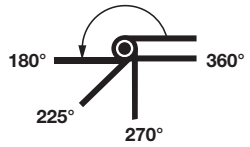
Pin Diameter



Knuckle Length



Range of Motion



Hinge Styles	Door Closed	Door Open	Pages
Surface Mount—The most common type of hinge.			3026-3035; 3037
Extra Clearance—Hinge leaves are offset to accommodate a gasket or trim between the door and frame.			3031
Tight Clearance—Hinge leaves fold closely together to minimize the gap between the door and the frame. Also known as swaged, they're often used on electrical enclosures.			3031
Mortise Mount—Hinge leaves fit into cutouts (mortises) to mount flush with the door and frame edges. They require minimal space between the door and frame.			3035-3036
Half Surface/Half Mortise Mount—Surface mount one leaf and mortise mount the other. They are often used to hang a hollow door on a solid frame.			3036

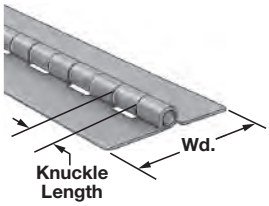
Cutting and Installing Piano Hinges—Most metal piano hinges can be cut between the knuckles with a hacksaw; hinges with a leaf thickness of 0.180″ and thicker may require a band saw. Install *hinges without holes* by spot welding or drilling holes for rivets or screws.

Piano Hinges

For technical drawings and 3-D models, go to mcmaster.com. CAD

Don't see the piano hinge you need? Just tell us what you're looking for and we'll get it for you.

Unfinished Steel Piano Hinges without Holes CAD



Door Closed

Door Open

Hinges have a full range of motion of 270°. All are surface mount. Note: Prices are 15% to 20% lower when you buy 10 or more hinges of the same size.

Wd.	Pin Dia.	Knuckle Lg.		1 ft.	2 ft.	3 ft.	4 ft.	5 ft.	6 ft.	7 ft.	8 ft.
0.025″ Thick Leaf											
3/4″	1/16″	1/4″	15665A901	$1.15	$1.48	$2.13	$2.95	$3.18	$3.28	$4.59	$4.92
1″	1/16″	1/4″	15665A902	1.38	1.77	2.56	3.55	3.82	3.94	5.52	5.91
0.035″ Thick Leaf											
3/4″	5/64″	1/4″	15665A903	1.28	1.64	2.37	2.92	3.35	3.65	4.38	4.93
1 1/16″	5/64″	1/4″	15665A904	1.32	1.69	2.44	3.01	3.45	3.76	4.51	5.08
1 1/4″	5/64″	1/4″	15665A905	1.40	1.80	2.60	3.20	3.67	4.00	4.80	5.40
1 1/2″	5/64″	1/4″	15665A906	1.60	2.06	2.97	3.66	4.19	4.57	5.48	6.17
0.040″ Thick Leaf											
1 1/16″	3/32″	1/2″	15665A907	1.57	2.25	2.93	3.60	4.13	4.50	6.30	6.75
1 1/4″	3/32″	1/2″	15665A908	1.72	2.46	3.19	3.93	4.50	4.91	6.87	7.37
1 1/2″	3/32″	1/2″	15665A909	2.24	3.21	4.17	5.13	5.88	6.41	8.97	9.62
2″	3/32″	1/2″	15665A911	2.43	3.48	4.52	5.56	6.37	6.95	9.73	10.43
0.050″ Thick Leaf											
1 1/16″	1/8″	1/2″	15665A284	1.93	2.48	3.58	4.41	5.05	5.51	7.71	8.27
1 1/4″	1/8″	1/2″	15665A244	2.82	4.03	5.24	6.45	7.39	8.06	11.28	12.09
1 1/2″	1/8″	1/2″	15665A247	2.89	4.13	5.37	6.61	7.57	8.26	11.56	12.39
2″	1/8″	1/2″	15665A286	3.09	4.42	5.75	7.07	8.11	8.84	12.38	12.82
0.060″ Thick Leaf											
1 1/16″	1/8″	1/2″	15665A287	2.62	3.75	4.87	5.99	6.87	7.49	9.74	10.11
1 1/4″	1/8″	1/2″	15665A293	2.50	3.56	4.63	5.70	6.54	7.13	9.98	10.70
1 1/2″	1/8″	1/2″	15665A294	3.14	4.48	5.82	7.17	8.22	8.96	12.54	13.44
1 1/2″	3/16″	1/2″	15665A295	3.51	5.01	6.51	8.02	9.19	10.02	14.03	15.03
1 1/2″	3/16″	1″	15665A299	3.48	4.96	6.45	7.94	9.11	9.93	13.90	14.89
1 3/4″	1/8″	1/2″	15665A301	3.05	4.36	5.66	6.97	8.27	8.71	12.19	13.07
2″	1/8″	1/2″	15665A302	4.08	5.84	7.38	9.15	10.47	11.02	15.98	17.08
2″	3/16″	1/2″	15665A398	4.12	5.88	7.65	9.42	10.79	11.77	16.48	17.66
2″	3/16″	1″	15665A304	4.19	5.98	7.77	9.57	10.97	11.96	16.15	17.34
2 1/2″	1/8″	1/2″	15665A305	4.56	6.51	8.46	10.42	11.94	13.02	16.93	17.97
2 1/2″	3/16″	1/2″	15665A306	4.69	6.70	8.71	10.72	12.29	13.40	17.42	18.09
2 1/2″	3/16″	1″	15665A307	4.64	6.63	8.62	10.61	12.16	13.26	17.24	17.90

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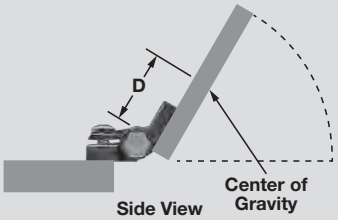
About Position, Lever-Lock, and Friction Hinges

Position, lever-lock, and friction hinges hold small doors, lids, and hatches in position, eliminating the need for latches, door holders, and other secondary support mechanisms. For example, position hinges are often found on lids and machine covers, and friction hinges are used on laptop computers.

Selecting a Hinge for a Horizontally Mounted Door

Hinges on horizontally mounted doors (hatches or lids) must resist the downward pull of gravity; the operation of hinges on vertically mounted doors is not effected. To select the correct hinge(s) for your horizontally mounted door, find the approximate force needed to move the door (torque force). Then, calculate the torque rating your hinge should have.



1. To find torque force, multiply the weight of your door (in pounds) by the distance (D) between the hinges and the door's center of gravity (in inches).
2. Divide the torque force of your door by the number of hinges you wish to use. The result is the torque rating you should exceed per hinge.

Example: Suppose your door weighs 3 lbs., D = 12″, and you wish to use two hinges.
1. Multiply: 3 × 12 = 36. The door's torque force is approximately 36 in.-lbs.
2. Divide: 36 ÷ 2 = 18. The torque rating for each hinge should be greater than 18 in.-lbs.

Incremental-Angle Position Hinges

Push the plastic button to adjust the hinge angle and release it to lock the position. They are strong enough for use on machine guards and racks. Reversible for right- and left-hand doors. The full range of motion is 220°. Mounting screws are not included.

Square arm hinge has a hollow tube so it fits over a 3/4″ wide or into a 1 1/2″ wide square tube. Made of black plastic without screw holes. It is not temperature rated.

Round arm hinge is steel with a black PTFE coating. Each arm has two 1/4″-20 mounting holes. Holes are tapped prior to coating for better corrosion resistance.

	O'all Ht.	Adjustable Increments	Torque, in.-lbs.		
1 1/4″ Square Arm	6 1/8″	10°	450	1258A1	$31.80
3/4″ Round Arm	5 1/4″	10°	1,200	1258A12	123.70

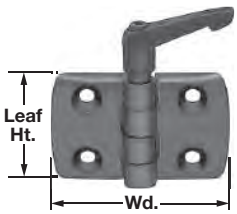
Set-Angle Position Hinges

A detent on these hinges holds doors open at a set angle, but they can be further opened to 180°. Surface mount them on flush-mounted doors such as access doors, machine covers, panels, and lids. Reversible for right- and left-hand doors. Note: Load capacity is based on one hinge per door.

Made of plastic with a nonremovable pin. Temperature range is 32° to 180° F. Hinges require four No. 10 screws (not included), except hinges with a 90° set angle require four No. 8 screws. Furnished with snap-on, plastic covers to conceal the mounting screws.

Set Angle	Leaf Ht.	Wd.	Leaf Thick.	Pin Dia.	Load Cap., lbs.	Torque, in.-lbs.		
Black Plastic								
80°	1 15/16″	2 1/4″	0.360″	29/64″	100	10	14965A41	$16.85
90°	2″	2 3/8″	0.313″	11/64″	1.3	5	14965A46	11.68
115°	1 15/16″	2 1/4″	0.360″	29/64″	100	10	14965A43	16.85
150°	1 15/16″	2 1/4″	0.360″	29/64″	100	10	14965A45	16.85
White Plastic								
90°	2″	2 3/8″	0.313″	11/64″	1.3	5	14965A47	11.68

Lever-Lock Hinges



Tighten the lever to lock these hinges in any position from 0° to 180°. Mount on lids, panels, and doors.

Hinges are made of black nickel-plated aluminum with a black nylon handle and a nonremovable Type 304 stainless steel pin. All have four mounting holes; screws not included.

Leaf Ht.	Wd.	Leaf Thick.	Pin Dia.	Screw Size		
1 7/8″	2 3/8″	0.315″	1/4″	M6	1604A43	$16.56
1 7/8″	3″	0.315″	1/4″	M6	1604A41	16.96
1 7/8″	3 13/16″	0.315″	1/4″	M6	1604A44	18.07
1 7/8″	4 9/16″	0.315″	1/4″	M6	1604A45	19.27

Friction Hinges

Constant resistance through the full range of motion holds lids, panels, and doors at any angle. Apply force to change the hinge position. *Styles 1* and *2* have a 270° range of motion. *Styles 3* and *4* have a 180° range of motion. All are surface mount, reversible for right- and left-hand doors, and have a nonremovable pin. *Styles 1* and *2* have four mounting holes, *Style 3* have five holes, and *Style 4* have six holes; screws not included.

Black nylon hinges have a temperature range of 32° to 140° F.

Polished Type 304 stainless steel hinges include a matching plastic cover to conceal mounting screws.

Leaf Ht.	Wd.	Leaf Thick.	Pin Dia.	Screw Size	Torque, in.-lbs.		
(1) Black-Painted Aluminum—Steel Pin							
1 1/2″	1 9/16″	0.125″	13/32″	No. 8	8	2190A21	$22.25
1 1/2″	1 9/16″	0.125″	13/32″	No. 8	15	2190A22	22.25
(1) Black-Painted Zinc—Steel Pin							
2″	2 1/4″	0.180″	1/2″	No. 10	15	2190A12	26.48
2″	2 1/4″	0.180″	1/2″	No. 10	20	2190A13	24.98
2″	2 1/4″	0.180″	1/2″	No. 10	30	2190A14	23.98
(2) Black Nylon—Steel Pin							
2 1/2″	2 1/4″	0.236″	5/8″	M6	30	1467A1	16.07
2 1/2″	2 1/4″	0.236″	5/8″	M6	40	1467A2	18.07
2 1/2″	2 1/4″	0.236″	5/8″	M6	50	1467A3	18.07
(3) Type 304 Stainless Steel—Type 303 SS Pin							
1 9/16″	1 3/8″	0.063″	5/32″	No. 8	4	1460A1	21.95
1 15/16″	1 11/16″	0.078″	15/64″	No. 8	8	1460A2	27.70
1 15/16″	1 11/16″	0.078″	15/64″	No. 8	15	1460A3	27.70
3 9/16″	3 1/4″	0.094″	5/16″	No. 8	30	1460A4	71.05
3 9/16″	3 1/4″	0.094″	5/16″	No. 8	50	1460A5	77.30
(4) Polished Type 304 Stainless Steel—Type 303 SS Pin							
2 1/8″	1 11/16″	0.078″	17/32″	No. 6, No. 8	20	1783A1	34.40
2 1/8″	1 11/16″	0.078″	17/32″	No. 6, No. 8	30	1783A2	34.40
2 1/8″	3 1/8″	0.078″	29/32″	No. 8, No. 10	40	1783A3	52.98
2 1/8″	3 1/8″	0.078″	29/32″	No. 8, No. 10	60	1783A4	52.98

Adjustable-Friction Hinges

Hold your doors closed or open at any angle up to 180° by tightening or loosening the adjustment screw to change the hinge resistance. Hinges move easily when you apply force and are load rated to handle heavy doors. Surface mount hinges on flush-mounted doors. Reversible for right- and left-hand doors. Note: Load capacity is based on one hinge per door.

Made of plastic with a nonremovable pin and stainless steel adjustment screw and nut. Temperature range is 20° to 150° F. All have four mounting holes; screws not included.

Leaf Ht.	Wd.	Leaf Thick.	Pin Dia.	Screw Size	Load Cap., lbs.	Torque, in.-lbs.		
Black Plastic								
1 11/16″	1 7/16″	0.230″	23/64″	No. 8	200	7	1791A44	$6.92
2 1/2″	2 1/4″	0.200″	37/64″	1/4″	450	35	1791A48	11.15
White Plastic								
1 11/16″	1 7/16″	0.230″	23/64″	No. 8	200	7	1791A51	7.38
2 1/2″	2 1/4″	0.200″	37/64″	1/4″	450	35	1791A52	11.15

About Tapping Screws

While other screws and bolts require holes with threads, tapping screws create their own threads.

Pointed screws are the most common tapping screw. They have a pointed end to penetrate thin materials such as sheet metal, and soft materials such as wood and drywall. In thicker materials, they generally need a starter hole.

Thread-forming and **thread-cutting screws** create reusable threads in metals and plastics. They require a drilled or punched hole to install. Thread-forming screws press threads into material without leaving debris, while thread-cutting screws eject material as they're turned.

Drilling screws save you time and effort by drilling their own holes, creating reusable threads, and fastening materials in a single operation. Use them to fasten metal.

Tapping Screw Selection Guide

	Pointed Pages	**Thread Forming and Thread Cutting** Pages	**Drilling** Pages
For Use In			
Sheet Metal	3063-3071	3071-3075	3076-3079
Steel	—	3073	3076-3079
Iron	—	3072-3073	—
Stainless Steel	—	—	3076-3079
Aluminum and Copper	—	3074	3077
Plastics	3080	3080-3082	—
Composites such as Plastic Lumber	3084	—	—
Wood	3084-3089	—	—
Plywood and Particleboard	3080, 3085	—	—
Drywall	3083	—	3083
For Joining Dissimilar Materials			
Metal to Wood	3071	—	—
Wood to Metal	—	3089	3085
Plastics to Wood	3081	—	—
Insulation to Metal	—	—	3075

Materials

Type 316 Stainless Steel—Our most corrosion resistant stainless steel. Withstands pitting caused by chloride and sulfur. May be mildly magnetic.

18-8 Stainless Steel—Has excellent corrosion resistance. May be mildly magnetic.

Type 410 Stainless Steel—Stronger than Type 316 and 18-8 stainless steel but less corrosion resistant. Not for use with aluminum. Magnetic.

Brass—Nonmagnetic with very good corrosion resistance. An excellent conductor of electricity, it's usually softer than steel and stainless steel.

Aluminum—It's nonmagnetic and one-third the weight of steel. Offers mild resistance to corrosion.

Steel—This low-strength general purpose metal is often plated with zinc for rust resistance.

Finishes

Zinc Plated and **Black Zinc-Plated—**Enhances rust resistance. Black adds a decorative finish.

Black Oxide and **Black Phosphate—**Provides a dark look, adds mild rust resistance, and makes screws easier to thread.

Black Coated—Delivers corrosion resistance and deep, consistent color that won't rub off with repeated use.

Chrome Plated—Bright and attractive. Offers good rust resistance.

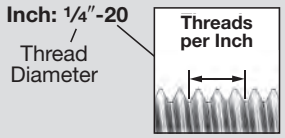
Nickel Plated—A decorative finish that's more rust resistant than zinc plating and less expensive than chrome plating.

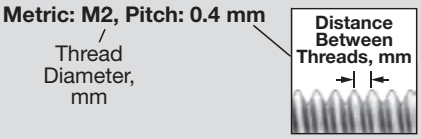
PTFE Coated—This slick coating prevents fasteners from sticking and binding.

Weather-Resistant Coated—Resists corrosion better than zinc plating and minimizes reactions between dissimilar metals.

How to Read a Screw Size

The screw size listed for thread-forming, thread-cutting, and drilling screws is the size of the threads they create.





Decimal Equivalents for Inch Screw Sizes

Inch Screw Size	**Screw No.**										
	0	1	2	3	4	5	6	7	8	9	10
Decimal Size	0.060"	0.073"	0.086"	0.099"	0.112"	0.125"	0.138"	0.151"	0.164"	0.177"	0.190"

Inch Screw Size	**Screw No.**										
	12	14	1/4"	16	18	5/16"	20	24	3/8"	1/2"	5/8"
Decimal Size	0.216"	0.242"	0.250"	0.268"	0.294"	0.312"	0.320"	0.372"	0.375"	0.500"	0.625"

About Installing Screws for Drywall, Composite Wood, and Wood

Screws for Drywall

Drywall screws have a sharp, pointed end that can penetrate drywall without the need for a pilot hole. They come with either coarse threads for holding drywall to wood or fine threads for holding drywall to metal.

Screws for Composite Wood

These screws are designed for use in materials made from a mixture of wood fiber and plastic, such as those commonly used for decking. To prevent splitting, drill a pilot hole slightly smaller than the screw you're installing. Screws with an auger point require a pilot hole only when being used near an edge. See page 2508 for drill bits.

Screws for Wood

Screws for wood can be used to fasten hard wood such as walnut and oak and soft wood such as pine and cedar. To prevent splitting, drill a pilot hole slightly smaller than the screw you're installing. Screws with an auger point require a pilot hole only when used near an edge. See page 2508 for drill bits.

Materials

Type 316 Stainless Steel—Our most corrosion resistant stainless steel, it withstands solvents and pitting caused by chloride and sulfur. It's a good choice for ACQ-treated (arsenic-free) lumber and may be mildly magnetic.

18-8 Stainless Steel—Has excellent corrosion resistance and is a good choice for ACQ-treated (arsenic-free) lumber. It may be mildly magnetic.

Brass—Material is nonmagnetic and has very good corrosion resistance.

Finishes

Zinc Plated and **Black Zinc-Plated**—Enhances rust resistance.

Black Oxide and **Black Phosphate**—Adds mild rust resistance.

Weather-Resistant Coated—Resists corrosion better than zinc plating and minimizes reactions between dissimilar metals.

Hot-Dipped Galvanized—This thick plating provides superior rust resistance compared to zinc-plated steel. A good choice for ACQ-treated (arsenic-free) lumber.

Drill Sizes for Screws for Composite Wood and Wood

Screw Size		No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10	No. 12	No. 14	No. 16	No. 18	No. 20	No. 24
Decimal Equivalent		0.086″	0.099″	0.112″	0.125″	0.138″	0.151″	0.164″	0.177″	0.190″	0.216″	0.242″	0.268″	0.294″	0.320″	0.372″
Drill Size	Hard Wood	3/64″	1/16″	1/16″	5/64″	5/64″	3/32″	3/32″	7/64″	7/64″	1/8″	9/64″	5/32″	3/16″	13/64″	7/32″
	Soft Wood	1/32″	3/64″	3/64″	1/16″	1/16″	1/16″	5/64″	5/64″	3/32″	7/64″	7/64″	9/64″	9/64″	11/64″	3/16″

For Phillips power bits see pages 2872-2873; for square drive power bits see page 2878; for Torx drive power bits see page 2877.

Screws for Drywall

A curved neck sinks into drywall without tearing its paper surface. All screws have a Phillips drive and are made from steel with a rust-resistant finish. Length is measured from the top of the head.

Drywall to Drywall—Hold sheets of drywall together until glue sets. Also hold drywall to metal studs up to 0.036″ thick. Finish is black phosphate.

Drywall to Wood—Hang drywall to wood framing. Screws have a zinc yellow-chromate plating.

Drywall to Wood (High Hold)—Alternating high and low threads maximize holding power. Use to attach drywall to wood framing and metal studs up to 0.036″ thick. Finish is black phosphate.

Drywall to Metal—Attach drywall to metal studs up to 0.036″ thick. Finish is black phosphate.

Drywall to Metal (Coated)—Screws have a gray coating that provides 500 hours of salt spray resistance. Use them to hold drywall to metal studs up to 0.036″ thick.

Drywall to Metal (Drilling)—Have a #2 drill point that powers through drywall and into metal studs up to 0.105″ thick. Finish is black phosphate.

Lg.	Pkg. Qty.		Pkg.
Drywall to Drywall			
10-9—#2 Drive			
1½″	100	90093A400	$6.81
Drywall to Wood			
6-9—#2 Drive			
1″	100	99136A100	3.05
1¼″	100	99136A200	3.25
1⅝″	100	99136A300	3.95
8-8—#2 Drive			
2½″	100	99136A600	9.32
3″	50	99136A700	6.72
Drywall to Wood (High Hold)			
6-18—#2 Drive			
1″	100	90305A112	2.31
1¼″	100	90305A114	2.93
1⅝″	100	90305A116	3.82
2″	100	90305A118	4.80

Lg.	Pkg. Qty.		Pkg.
Drywall to Wood (High Hold)			
6-18—#2 Drive (Cont.)			
2¼″	100	90305A120	$6.47
8-18—#2 Drive			
2½″	100	90305A132	8.32
3″	100	90305A126	12.25
Drywall to Metal			
6-18—#2 Drive			
1″	500	90092A112	6.10
1⅛″	500	90092A113	6.24
1¼″	500	90092A114	7.40
1⅝″	250	90092A116	5.56
2″	250	90092A118	7.38
2¼″	100	90092A120	2.87
8-18—#2 Drive			
2½″	100	90092A132	4.42
3″	100	90092A133	5.22

Lg.	Pkg. Qty.		Pkg.
Drywall to Metal			
10-12—#2 Drive			
3½″	100	90092A140	$11.46
3¾″	50	90092A141	7.82
4″	50	90092A150	7.89
4½″	50	90092A142	8.82
5″	50	90092A143	9.91
6″	25	90092A145	7.29
Drywall to Metal (Coated)			
6-17—#2 Drive			
1″	100	95616A153	3.33
1¼″	100	95616A155	4.59
1⅝″	100	95616A158	6.83
2″	100	95616A162	5.86
8-15—#2 Drive			
2½″	100	95616A207	9.14
3″	100	95616A209	10.81

Lg.	Pkg. Qty.		Pkg.
Drywall to Metal (Coated)			
10-12—#2 Drive			
3¾″	50	95616A262	$12.10
4½″	25	95616A265	9.73
5″	25	95616A270	10.04
6″	25	95616A280	13.73
Drywall to Metal (Drilling)			
6-20—#2 Drive			
1″	100	90093A114	4.26
1⅛″	100	90093A115	4.55
1¼″	100	90093A116	4.68
1⅝″	100	90093A118	5.30
1⅞″	100	90093A121	6.13
8-18—#2 Drive			
2⅜″	100	90093A152	8.22
2⅝″	100	90093A153	9.94
3″	50	90093A154	8.19

Small Head Screws for Drywall

Heads are one-third smaller than those of other drywall screws. Made from rust-resistant black-finish steel. Length is measured from the top of the head.

Sharp Point—Fasten drywall to wood or metal trim and framing up to 0.036″ thick.

Drilling—Have a #2 drill point that bores through drywall and into metal studs up to 0.105″ thick.

Lg.	Pkg. Qty.	Phillips	Pkg.	Square Drive	Pkg.
Sharp Point					
6-18—#1 Drive					
1⅝″	100	90091A112	$2.85	90330A116	$3.54
2¼″	100	90091A114	4.79	90330A120	5.06
8-18—#2 Drive					
3″	100	—	—	90330A154	7.74
Drilling					
6-20—#1 Drive					
1⅝″	100	90091A400	7.12	90330A500	6.74
2¼″	100	90091A500	9.52	90330A600	9.14

Strip-Resistant Screws for Drywall

Ribs under the head act as a brake as the curved neck sinks flush into drywall. Use these screws to join cement board and other dense materials to wood and metal studs. All have a Phillips drive. They're made from steel and coated to resist up to 500 hours of salt spray. Length is measured from the top of the head.

Sharp Point—Fasten drywall to wood and metal studs up to 0.036″ thick.

Drilling—Have a drill point that bores through drywall and into metal studs up to 0.105″ thick.

Lg.	Pkg. Qty.		Pkg.
Sharp Point			
9-15—#2 Drive			
1¼″	100	92050A100	$10.50
1⅝″	100	92050A200	9.29
2¼″	100	92050A300	11.77

Lg.	Pkg. Qty.		Pkg.
Drilling			
8-18—#2 Drive			
1¼″	100	92050A400	$11.97
1⅝″	100	92050A500	11.73
2¼″	100	92050A600	12.39

About Set Screws

Unlike screws that hold materials together with threads, set screws exert pressure at the tip to hold objects in place.

Points

Cup (pgs. 3156-3164)—The cup has a thin edge that digs into the contact surface for high holding power.

Knurl-Grip Cup (pgs. 3161-3162)—A variation of the cup point, this style has knurls for a strong grip.

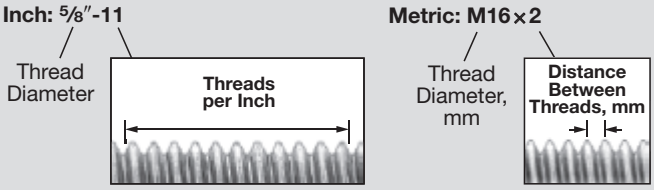
Flat (pgs. 3164-3166)—The blunt tip won't dig into the contact area, which minimizes surface damage.

Oval (pg. 3166)—A small rounded contact surface allows you to make slight adjustments without loosening the screw and also causes minimal surface damage.

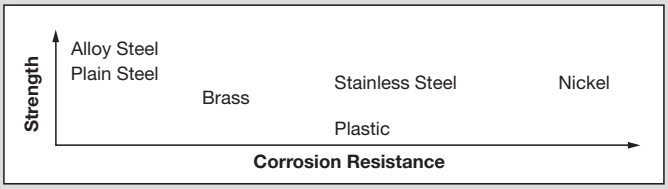
Cone (pg. 3167)—A sharp tip wedges into the contact area for the highest holding power of all set screw styles.

Extended (pgs. 3168-3171)—Also known as dog point, a protruding tip locks within a mating hole or slot in your workpiece. Often used in place of a dowel pin.

How to Read a Screw Size



Materials



Stainless Steel—May be mildly magnetic. Minimum Rockwell hardness is B80 (unless noted). *18-8 stainless steel* is the most common. *Type 316 stainless steel* is more resistant to corrosion, solvents, and pitting caused by chlorides and sulfates than 18-8 stainless steel.

Nickel—Good for marine and chemical-processing environments, material is comparable to Monel. It's strong, heat resistant, and slightly magnetic. Not rated for hardness.

Brass—Nonmagnetic and an excellent conductor of electricity, it has a minimum Rockwell hardness of B55.

Alloy Steel and **Plain Steel**—Both have a minimum Rockwell hardness of C45 (unless noted).

Plastic—Nonconductive and resistant to chemicals and solvents, except mineral acids. Exposure to moisture may cause it to expand.

Inch Hex Sizes

Screw Size	No. 0	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 8	No. 10	1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	3/4″	7/8″	1″	1 1/4″	1 1/2″
Dec. Equiv.	.060″	.073″	.086″	.099″	.112″	.125″	.138″	.164″	.190″	.250″	.312″	.375″	.437″	.500″	.562″	.625″	.750″	.875″	1.00″	1.25″	1.50″
Hex Size	.028″	.035″	.035″	.050″	.050″	1/16″	1/16″	5/64″	3/32″	1/8″	5/32″	3/16″	7/32″	1/4″	1/4″	5/16″	3/8″	1/2″	9/16″	5/8″	3/4″

Metric Hex Sizes

Screw Size	M1.6	M2	M2.5	M3	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30	M36
Hex Size, mm	0.7	0.9	1.3	1.5	2	2.5	3	4	5	6	8	10	12	14	14

Cup Point Set Screws

Screws have a hex socket and a Class 3A thread fit. All dimensions meet ASME B18.3. Length listed is the overall length. **Alloy steel** meets ASTM F912.

Type 316 Stainless Steel

Lg.	Pkg. Qty.		Pkg.
2-56			
1/16″	10	92313A010	$9.55
3/32″	10	92313A013	9.52
1/8″	10	92313A016	9.70
3/16″	5	92313A019	4.53
1/4″	5	92313A022	5.38
4-40			
1/16″	10	92313A099	9.63
3/32″	50	92313A102	7.83
1/8″	25	92313A103	3.23
3/16″	25	92313A105	3.01
1/4″	25	92313A106	3.50
3/8″	50	92313A017	6.00
1/2″	50	92313A109	8.70
6-32			
1/8″	50	92313A142	4.75
3/16″	50	92313A143	4.92
1/4″	25	92313A144	2.58
5/16″	50	92313A411	5.39
3/8″	25	92313A146	3.24
1/2″	50	92313A148	8.43
5/8″	25	92313A412	6.26
3/4″	25	92313A154	6.90
8-32			
1/8″	25	92313A188	3.44
3/16″	25	92313A189	2.99
1/4″	25	92313A190	2.69
5/16″	25	92313A191	2.92
3/8″	25	92313A192	3.06
1/2″	50	92313A194	6.01
8-32 (Cont.)			
5/8″	25	92313A198	$7.27
3/4″	10	92313A204	3.41
10-24			
3/16″	25	92313A237	3.12
1/4″	25	92313A238	3.23
5/16″	25	92313A239	3.12
3/8″	25	92313A240	3.48
1/2″	25	92313A242	4.06
3/4″	25	92313A248	5.80
1″	25	92313A254	6.85
10-32			
1/8″	50	92313A820	6.14
3/16″	25	92313A824	3.12
1/4″	25	92313A825	3.23
5/16″	25	92313A826	3.12
3/8″	25	92313A827	3.48
1/2″	25	92313A829	4.06
5/8″	25	92313A831	3.94
3/4″	25	92313A832	5.80
1″	25	92313A834	6.85
1 1/4″	10	92313A842	4.35
1/4″-20			
3/16″	25	92313A532	3.23
1/4″	25	92313A533	3.37
5/16″	25	92313A534	3.67
3/8″	25	92313A535	4.07
1/2″	25	92313A537	4.69
5/8″	25	92313A539	6.29
3/4″	25	92313A540	7.05
1/4″-20 (Cont.)			
1″	10	92313A542	$4.26
1 1/4″	10	92313A546	5.81
1 1/2″	10	92313A549	6.31
1/4″-28			
1/4″	10	92313A100	5.02
3/8″	10	92313A150	6.92
1/2″	10	92313A413	8.32
5/8″	10	92313A414	10.40
5/16″-18			
1/4″	25	92313A574	4.83
5/16″	25	92313A575	5.32
3/8″	25	92313A576	6.04
1/2″	25	92313A578	7.47
5/8″	10	92313A580	4.51
3/4″	10	92313A581	4.68
1″	10	92313A583	5.82
5/16″-24			
1/4″	10	92313A200	8.29
3/8″	10	92313A250	9.31
1/2″	10	92313A415	9.10
5/8″	10	92313A416	11.13
3/8″-16			
5/16″	25	92313A418	9.57
3/8″	10	92313A617	3.87
1/2″	10	92313A619	4.39
5/8″	10	92313A621	5.56
3/4″	10	92313A622	6.52
7/8″	10	92313A417	8.39
1″	10	92313A624	9.61
3/8″-16 (Cont.)			
1 1/4″	5	92313A419	$6.50
1 1/2″	5	92313A421	6.73
3/8″-24			
3/8″	10	92313A300	10.08
1/2″	5	92313A350	6.41
1″	1	92313A422	2.66
7/16″-14			
1″	5	92313A423	9.39
1/2″-13			
1/2″	10	92313A707	8.70
5/8″	5	92313A709	5.51
3/4″	5	92313A710	6.03
1″	5	92313A712	8.11
1 1/4″	1	92313A425	2.26
1 1/2″	1	92313A718	2.83
2″	1	92313A426	4.55
1/2″-20			
1/2″	1	92313A400	2.02
3/4″	1	92313A427	2.82
1″	1	92313A428	3.44
5/8″-11			
5/8″	1	92313A429	18.25
3/4″	1	92313A431	20.43
1″	1	92313A432	23.04
1 1/2″	1	92313A433	27.58
3/4″-10			
5/8″	1	92313A434	24.24
3/4″	1	92313A435	25.06
1″	1	92313A436	26.16
1 1/2″	1	92313A437	31.87

(Continued on following page)

About Thumb Screw and Binding Post Materials

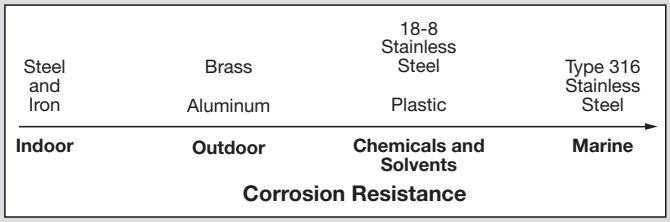
Stainless Steel—May be mildly magnetic.

Steel and **Iron**—These general purpose metals often come with a plating or finish. Zinc plating adds protection in dry, indoor conditions. Black-oxide adds a dark color, but no protection.

Brass—An excellent conductor of electricity, brass is often selected for its decorative properties. It is nonmagnetic.

Aluminum—At one-third the weight of steel, aluminum is strong and nonmagnetic.

Plastic—The ultimate lightweight material and also nonconductive.



Thumb Screws


Thumb Screw


Thumb Screw with Washer

These fully threaded screws are also known as spade head screws. Length is measured from under the head. Inch sizes have a Class 2A thread fit. Metric sizes have a Class 8g thread fit.

Screws with washer sit high above the mounting surface so they're easy to grasp.

Also Available: Thumb screws in other materials and styles. Please ask for the part number and specify thread size and length. *Brass thumb screws* (part number 92427A100) are available in sizes marked with a ★. *Zinc-plated steel thumb screws with a nylon tip* (part number 90772A111) are available in sizes marked with a ■. *Zinc-plated steel thumb screws with a washer* (part number 97008A100) are available in sizes marked with a ▲.

Thumb Screws—18-8 Stainless Steel

Lg.	Pkg. Qty.		Pkg.
8-32			
3/8"	10	91745A192	$9.38
1/2"	10	91745A194	9.51
5/8"	5	91745A196	5.98
3/4"	5	91745A197	6.55
1"	5	91745A199	6.22
10-24			
3/8"	10	91745A240	9.65
1/2"	10	91745A242 ★	9.99
3/4"	5	91745A245 ★	5.55
1"	5	91745A247 ★	7.09
1 1/2"	5	91745A250	8.32
10-32			
3/8"	10	91745A827	9.65
1/2"	10	91745A829 ★	9.94
3/4"	5	91745A831 ★	5.54
1"	5	91745A833 ★	5.82
1 1/2"	5	91745A836	8.34
1/4"-20			
3/8"	5	91745A534	5.26
1/2"	10	91745A537 ★	10.36
1/4"-20 (Cont.)			
5/8"	5	91745A539	$6.14
3/4"	5	91745A540 ★	6.23
1"	5	91745A542 ★	7.09
1 1/4"	5	91745A544	7.82
1 1/2"	5	91745A546 ★	8.75
2"	5	91745A550 ★	8.65
5/16"-18			
1/2"	5	91745A578	11.17
3/4"	5	91745A581 ★	10.31
1"	5	91745A583 ★	10.68
1 1/4"	5	91745A585	11.81
1 1/2"	5	91745A587 ★	12.84
2"	1	91745A591 ★	3.17
3/8"-16			
3/4"	1	91745A622	3.31
1"	1	91745A624 ★	3.35
1 1/4"	1	91745A625	3.70
1 1/2"	1	91745A628 ★	4.35
2"	1	91745A632 ★	4.40

Thumb Screws—Zinc-Plated Steel

Lg.	Pkg. Qty.		Pkg.
6-32			
3/8"	25	96966A110	9.36
1/2"	25	96966A113 ■	9.53
3/4"	25	96966A116	9.61
1"	25	96966A119	9.72
8-32			
3/8"	25	96966A130	9.64
1/2"	25	96966A133 ■	9.73
3/4"	25	96966A136 ■	9.63
1"	25	96966A139	10.21
10-24			
3/8"	25	96966A220	10.15
1/2"	25	96966A223	10.26
3/4"	25	96966A226	10.46
1"	25	96966A229	10.63
10-32			
3/8"	25	96966A260	10.15
1/2"	25	96966A263 ■	10.26
3/4"	25	96966A266 ■	10.46
1"	25	96966A269 ■	10.63
1 1/2"	25	96966A272	11.24
2"	25	96966A275	12.13
1/4"-20			
1/2"	25	96966A622 ■	11.03
3/4"	25	96966A624 ■	11.46
1"	25	96966A626 ■	11.88
1 1/4"	25	96966A628	12.23
1 1/2"	25	96966A630	12.64
2"	25	96966A632	14.13
5/16"-18			
1/2"	10	96966A740 ■	7.03
3/4"	10	96966A742 ■	7.26
1"	10	96966A744 ■	8.05
1 1/4"	10	96966A746	8.27
1 1/2"	10	96966A748	8.54
2"	10	96966A750	9.23
3/8"-16			
3/4"	10	96966A850	9.07
1"	10	96966A852 ■	9.39
1 1/4"	10	96966A854	9.89
1 1/2"	10	96966A856 ■	10.03
2"	10	96966A857	10.80

Thumb Screws—Plain Steel

Lg.	Pkg. Qty.		Pkg.
6-32			
1/4"	50	90181A144	14.21
3/8"	50	90181A146	12.66
1/2"	50	90181A148	12.88
3/4"	50	90181A151	13.05
1"	50	90181A153	13.27
8-32			
3/8"	50	90181A192	13.09
1/2"	50	90181A194	13.04
3/4"	50	90181A197	13.52
1"	50	90181A199	13.98
10-24			
3/8"	50	90181A240	13.81
1/2"	50	90181A242	14.10
3/4"	50	90181A245	14.76
1"	50	90181A247	14.98
1 1/2"	25	90181A251	8.20
10-32			
3/8"	50	90181A827	13.97
1/2"	50	90181A829	14.10
3/4"	50	90181A831	14.49
1"	50	90181A833	14.74
1 1/2"	25	90181A836	8.35
2"	25	90181A838	9.18
1/4"-20			
1/2"	25	90181A537	8.14
3/4"	25	90181A540	8.55
1"	25	90181A542	8.95
1 1/4"	25	90181A544	9.02
1 1/2"	25	90181A546	9.36
2"	25	90181A550	11.13
2 1/2"	25	90181A552	11.59
3"	10	90181A556	6.23

Thumb Screws—Plain Steel (Cont.)

Lg.	Pkg. Qty.		Pkg.
1/4"-28			
1/2"	10	90181A560	$8.27
3/4"	10	90181A565	8.63
1"	10	90181A568	8.91
5/16"-18			
1/2"	25	90181A578	11.04
3/4"	25	90181A581	11.57
1"	25	90181A583	12.11
1 1/4"	25	90181A585	12.64
1 1/2"	25	90181A587	13.32
2"	10	90181A591	6.49
5/16"-24			
3/4"	10	90181A600	$9.34
1"	10	90181A605	9.89
1 1/2"	10	90181A610	10.23
3/8"-16			
3/4"	25	90181A622	14.64
1"	10	90181A624	6.63
1 1/4"	10	90181A626	6.62
1 1/2"	10	90181A628	6.95
2"	10	90181A632	7.95
3"	10	90181A636	9.57

Thumb Screws with Washer—18-8 Stainless Steel

Lg.	Pkg. Qty.		Pkg.
8-32			
3/8"	10	91744A192	11.16
1/2"	10	91744A194	11.12
3/4"	5	91744A197	6.42
1"	5	91744A199	6.63
10-24			
3/8"	10	91744A240	11.55
1/2"	5	91744A242	6.44
3/4"	5	91744A245	6.69
1"	5	91744A247	7.40
10-32			
3/8"	10	91744A827	10.54
1/2"	5	91744A829	6.44
3/4"	5	91744A831	6.51
1"	5	91744A833	7.18
1/4"-20			
1/2"	5	91744A537	6.06
5/8"	5	91744A538	6.82
3/4"	5	91744A540	6.93
1"	5	91744A542	6.91
1 1/4"	5	91744A545	7.76
1 1/2"	5	91744A548	9.83
5/16"-18			
3/4"	1	91744A581	3.21
1"	1	91744A583	3.52
1 1/2"	1	91744A587	3.52
3/8"-16			
1"	1	91744A624	3.77
1 1/2"	1	91744A628	4.15

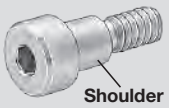
Thumb Screws with Washer—Plain Steel

Lg.	Pkg. Qty.		Pkg.
6-32			
1/4"	25	90179A144 ▲	12.56
3/8"	25	90179A146 ▲	8.95
1/2"	25	90179A148	9.11
3/4"	25	90179A151	9.23
1"	25	90179A153	9.60
8-32			
3/8"	25	90179A192 ▲	9.29
1/2"	25	90179A194 ▲	9.24
10-24			
3/8"	25	90179A240	9.50
1/2"	25	90179A242 ▲	9.61
3/4"	25	90179A245 ▲	9.78
1"	25	90179A247 ▲	10.14
1 1/2"	25	90179A251	11.41
2"	25	90179A253	13.00
10-32			
3/8"	25	90179A827 ▲	9.68
1/2"	25	90179A829 ▲	9.22
3/4"	25	90179A831 ▲	9.78
1"	25	90179A833 ▲	10.15
1 1/2"	25	90179A836 ▲	11.41
2"	25	90179A838	13.00
1/4"-20			
1/2"	25	90179A537 ▲	10.33
3/4"	25	90179A540 ▲	11.68
1"	25	90179A542 ▲	12.03
1 1/4"	25	90179A544 ▲	12.20
1 1/2"	25	90179A546 ▲	13.18
2"	25	90179A550 ▲	14.66
2 1/2"	10	90179A552 ▲	6.45
5/16"-18			
1/2"	25	90179A578 ▲	14.14
3/4"	10	90179A581 ▲	6.55
1"	10	90179A583 ▲	6.75
1 1/2"	10	90179A587 ▲	6.73
2"	10	90179A591 ▲	8.14
2 1/2"	10	90179A593	9.60
3/8"-16			
3/4"	10	90179A622 ▲	8.04
1"	10	90179A624 ▲	8.23
1 1/4"	10	90179A626	8.78
1 1/2"	10	90179A628 ▲	8.93
2"	10	90179A632 ▲	9.70
2 1/2"	10	90179A634	11.30
3"	10	90179A636	14.14

Metric Thumb Screws—Zinc-Plated Cast Iron

Lg., mm	Pkg. Qty.		Pkg.
M5—Pitch: 0.8 mm			
10	5	90359A100	$10.60
16	5	90359A110	11.87
20	5	90359A120	11.03
M6—Pitch: 1 mm			
10	1	90359A130	2.74
16	5	90359A150	12.30
M6 (Cont.)			
20	5	90359A160	$14.42
30	1	90359A170	3.14
M8—Pitch: 1.25 mm			
16	1	90359A180	3.31
20	1	90359A200	3.99

About Shoulder Screws



General Purpose Shoulder Screws (pages 3187-3193)—Shoulders have an undersized tolerance (generally -0.004″ to -0.002″/-0.072 mm to -0.01 mm) to fit most machinery and equipment. Also known as stripper bolts, these screws are commonly used in punch and die assemblies, and as an axle or pivot point.

Precision Shoulder Screws (pages 3193-3197)—Shoulders have a diameter that is twice as precise as standard shoulders (shoulder diameter tolerance is generally -0.001″/-0.025 mm), providing smooth, accurate movement. Use these screws where precision matters, such as in measuring devices, optical fixtures, and laboratory equipment.

Shims for lengthening or shortening shoulders are available on pages 3370-3371.

Material Properties

Alloy Steel—Comparable to Grade 8 steel, these are the strongest shoulder screws we offer.

Stainless Steel—May be mildly magnetic.

18-8 stainless steel has good chemical resistance.

316 stainless steel is more corrosion resistant than 18-8 stainless steel and has excellent resistance to chemicals and salt water.

416 stainless steel and *17-4 PH stainless steel* are nearly twice as strong as 18-8 stainless steel and have the same corrosion resistance.

Nickel—More resistant to acids and salt water than stainless steel. May be mildly magnetic.

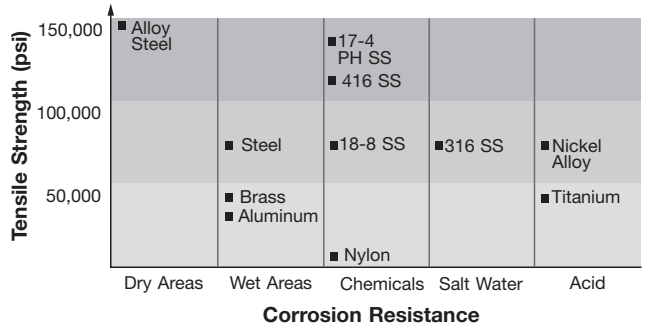
Titanium—High strength-to-weight ratio and more resistant to acids and salt water than nickel.

Brass—Electrically conductive, nonmagnetic, and has good corrosion resistance.

Aluminum—One-third the weight of steel, aluminum is lightweight and has good corrosion resistance.

Plastic—Chemical resistant, nonconductive, and lightweight.

Comparing Strength and Corrosion Resistance



Rockwell Hardness and Tensile Strength

	Min. Rockwell Hardness	Min. Tensile Strength, psi
Alloy Steel	C30	140,000
18-8 Stainless Steel	B55	70,000
316 Stainless Steel	B70	70,000
416 Stainless Steel	C26	120,000
17-4 PH Stainless Steel	C28	130,000
Nickel	B60	70,000
Titanium	B80	40,000
Brass	B55	40,000
Aluminum	___	40,000
Plastic	___	___

Head Dimensions for Shoulder Screws▲

Shoulder Dia.	1/16″	3/32″	1/8″	5/32″	3/16″	7/32″	1/4″	5/16″	3/8″	1/2″	5/8″	3/4″	1″	1 1/4″	1 1/2″
Head Dia.	1/8″	5/32″-3/16″	1/4″-5/16″	9/32″	5/16″-3/8″	5/16″	3/8″-7/16″	7/16″-1/2″	1/2″-9/16″	3/4″	7/8″	1″	1 5/16″	1 3/4″	2 1/8″
Head Ht.	3/64″	3/32″-1/8″	1/8″	1/8″	5/32″	5/32″	3/16″	7/32″	3/16″-1/4″	1/4″-5/16″	3/8″	1/2″	5/8″	3/4″	1″

Shoulder Dia., mm	2	3	4	5	6	8	10	12	16	20	24
Head Dia., mm	3	5	6-8	8-10	10-12	12-13	14-16	20	24	30	36
Head Ht., mm	1	2	3-3.2	4	4.5-5	5.5-6	7	8-9	11	14	16

▲ Head heights for low-profile screws are approximately 1/3 to 2/3 shorter than the dimensions listed above. Dimensions do not apply to flat head or hex head shoulder screws.

Shoulder Screws

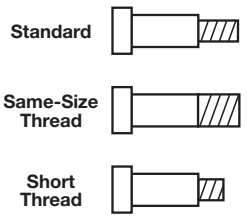
Screws with material certification come with a traceable lot number and material test report.

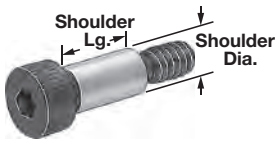
Same-size thread screws have threads the same diameter as the shoulder, allowing them to handle heavy loads.

Short-thread screws have a shorter threaded portion than our standard shoulder screws, making them useful in thin materials.

Inch Sizes—Screws have a Class 3A thread fit. Shoulder diameter tolerance is -0.004″ to -0.002″. Shoulder length tolerance is ±0.005″.

Metric Sizes—Screws have a Class 5g6g thread fit, except same-size thread have Class 6g. Shoulder diameter tolerance is -0.072 mm to -0.01 mm. Shoulder length tolerance is +0.25 mm.





Alloy Steel—Black-Oxide Finish

Shoulder Dia.	Thread Size	Thread Lg.		Choose a Shoulder Length★ 1/8″	3/16″	1/4″	5/16″	3/8″	7/16″	1/2″	5/8″	3/4″	7/8″	1″	1 1/8″	1 1/4″
3/32″	2-56	1/8″	91259A215	$3.45	$3.58	$3.70	$3.83	$3.95	___	$4.08	___	___	___	___	___	___
1/8″	4-40	5/32″	91259A236	2.01	2.02	2.05	1.98	2.07	___	2.09	$2.00	$2.00	___	$2.01	___	___
5/32″	6-32	3/16″	91259A238	2.07	2.08	2.10	1.99	2.13	___	2.19	2.01	2.01	___	2.02	___	___
3/16″	8-32	3/16″	91259A368	2.11	2.54	2.13	1.95	2.54	___	2.22	2.54	2.30	___	2.33	$1.97	$2.56
7/32″	8-32	3/16″	91259A397	1.85	___	1.95	1.95	1.95	___	1.95	1.95	1.96	___	1.96	___	___
1/4″	10-24	3/8″	91259A647	2.40	1.91	1.13	1.12	1.13	$2.56	1.14	1.17	1.19	$3.18	1.26	2.58	1.36
1/4″	10-32	1/4″	91259A222	___	___	2.47	___	___	___	2.56	___	2.62	___	2.76	___	___
5/16″	1/4″-20	7/16″	91259A695	1.92	1.92	1.30	2.47	1.36	2.62	1.34	1.36	1.41	3.29	1.45	2.66	1.58
3/8″	5/16″-18	1/2″	91259A747	5.50	2.10	1.56	2.89	1.57	2.72	1.60	1.61	1.64	4.93	1.65	2.78	1.74
1/2″	3/8″-16	5/8″	91259A764	___	___	3.13	3.12	2.31	2.92	2.39	2.49	2.46	3.22	2.52	3.06	2.57
5/8″	1/2″-13	3/4″	91259A772	___	___	___	4.35	9.56	3.99	7.74	6.80	3.75	4.05	3.84	3.92	3.73
3/4″	5/8″-11	7/8″	91259A819	___	___	___	___	8.60	9.00	11.30	13.91	9.47	7.23	10.06	14.23	10.91
7/8″	3/4″-10	1″	91259A880	___	___	___	___	___	___	___	___	___	___	36.17	___	___
1″	3/4″-10	1″	91259A930	___	___	___	___	___	___	___	___	___	___	21.27	___	___

(Continued on following page)

★ ***Prices are approximately 15% lower when you buy five or more.***

About Socket Head Cap Screws

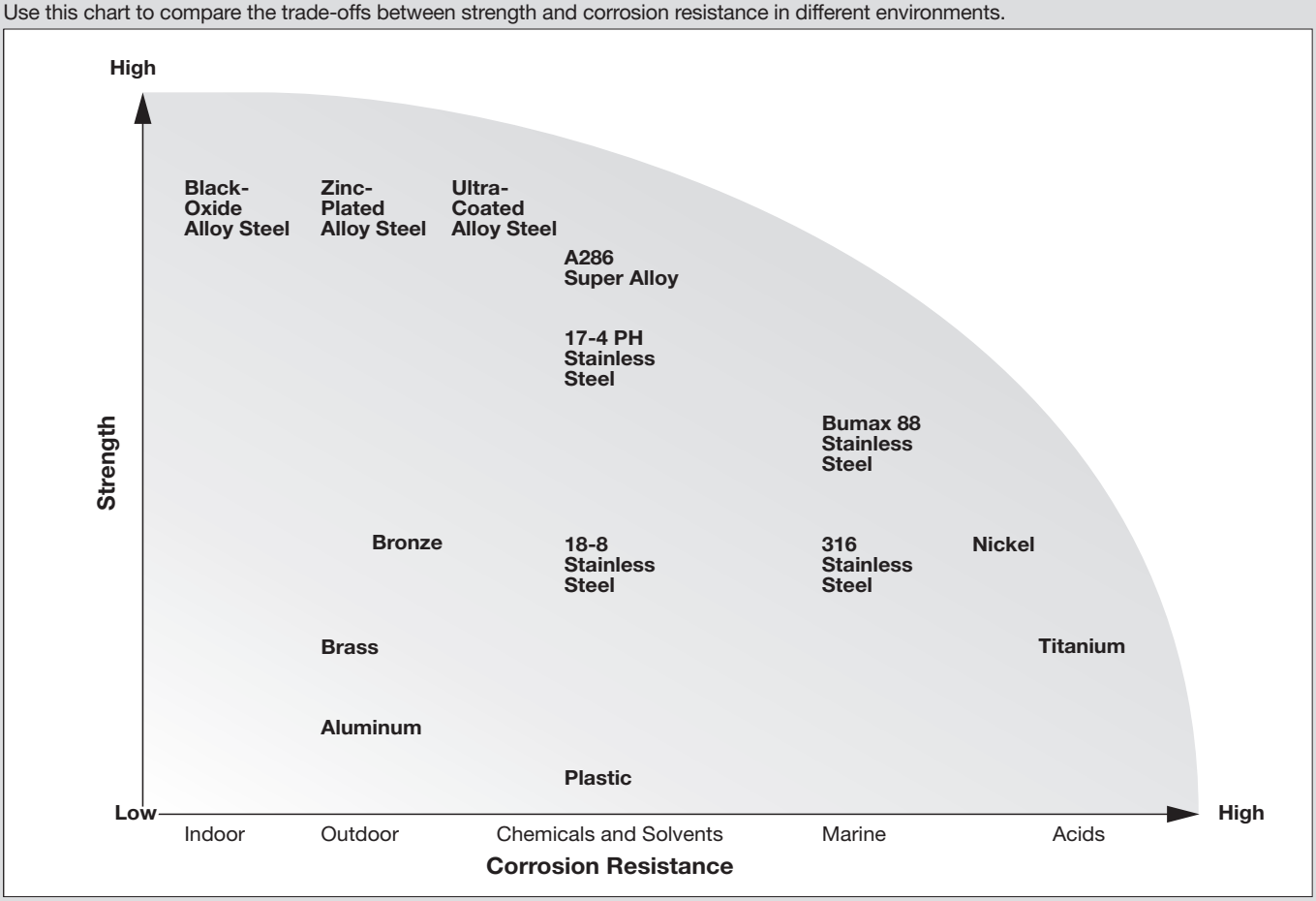
Socket head cap screws are the standard for high-strength fastening. They can be installed in a counterbored hole or above the surface.

Flanged socket heads distribute the holding force to relieve stress at the point of contact.

Low socket heads are about half the height of standard socket heads for use in tight spaces.

Comparing Materials by Strength and Corrosion Resistance

Use this chart to compare the trade-offs between strength and corrosion resistance in different environments.



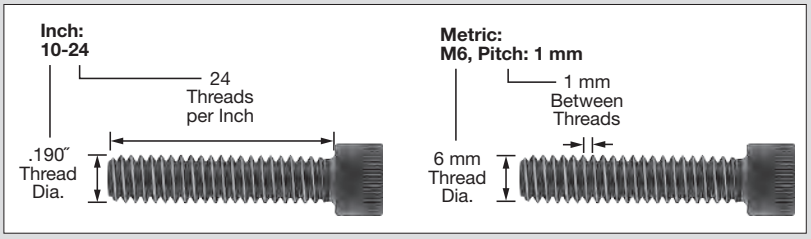
Other Material Properties to Consider

Alloy steel is magnetic.
Stainless steel and **nickel** may be mildly magnetic.
Brass and **bronze** are nonmagnetic and conduct electricity.
Aluminum is extremely lightweight—it's 70% lighter than steel.
Titanium is prized for its high strength-to-weight ratio. It's 40% lighter than steel and comparable in strength to Grade 2 steel.
Plastic is nonconductive and resists chemicals and solvents.

Understanding Screw Size

Inch screw sizes are specified by diameter and threads per inch. For those with a diameter smaller than ¼″, diameter is indicated by a number (e.g., #1 or No.1).

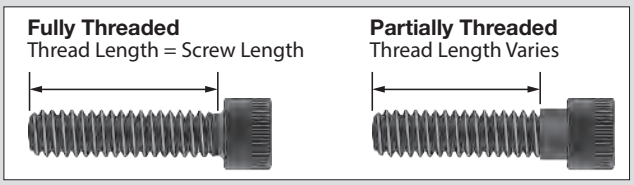
Metric screw sizes are specified by diameter and pitch.



Decimal Equivalents for Inch Screw Sizes

Inch Screw Size	0	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 8	No. 10	No. 12
Decimal Size	.060″	.073″	.086″	.099″	.112″	.125″	.138″	.164″	.190″	.216″

Understanding Thread Length



Fully threaded screws can be screwed all the way into a threaded hole.

Partially threaded screws have an unthreaded portion under the head for more holding power when force is applied from the side. The unthreaded portion is stronger than the threaded portion of a screw.

Screw Dimensions

CAD For technical drawings and 3-D models, go to mcmaster.com and search by part number.

About Cap Screws and Bolts

Choosing a Style

Cap screws and bolts for general-purpose fastening are listed here. For machine T-slot bolts, T-handle bolts, hold-down bolts, anchor bolts, and hanger bolts, see pages 3264-3265.

Hex Head Cap Screws (pages 3229-3254)

Fully threaded screws can be screwed all the way into a threaded or tapped hole. They are also known as tap bolts.

Partially threaded screws have an unthreaded portion under the head that adds strength but prevents them from being screwed all the way into a threaded hole.

Flange Head Screws (pages 3254-3258)

A built-in washer covers oversized holes and distributes the load to reduce stress at the connection point.

Heavy Hex Head Bolts (pages 3260-3261)

The wide head distributes the load and a precise unthreaded portion matches the thickness of the material being fastened.

Square Head Bolts (page 3261)

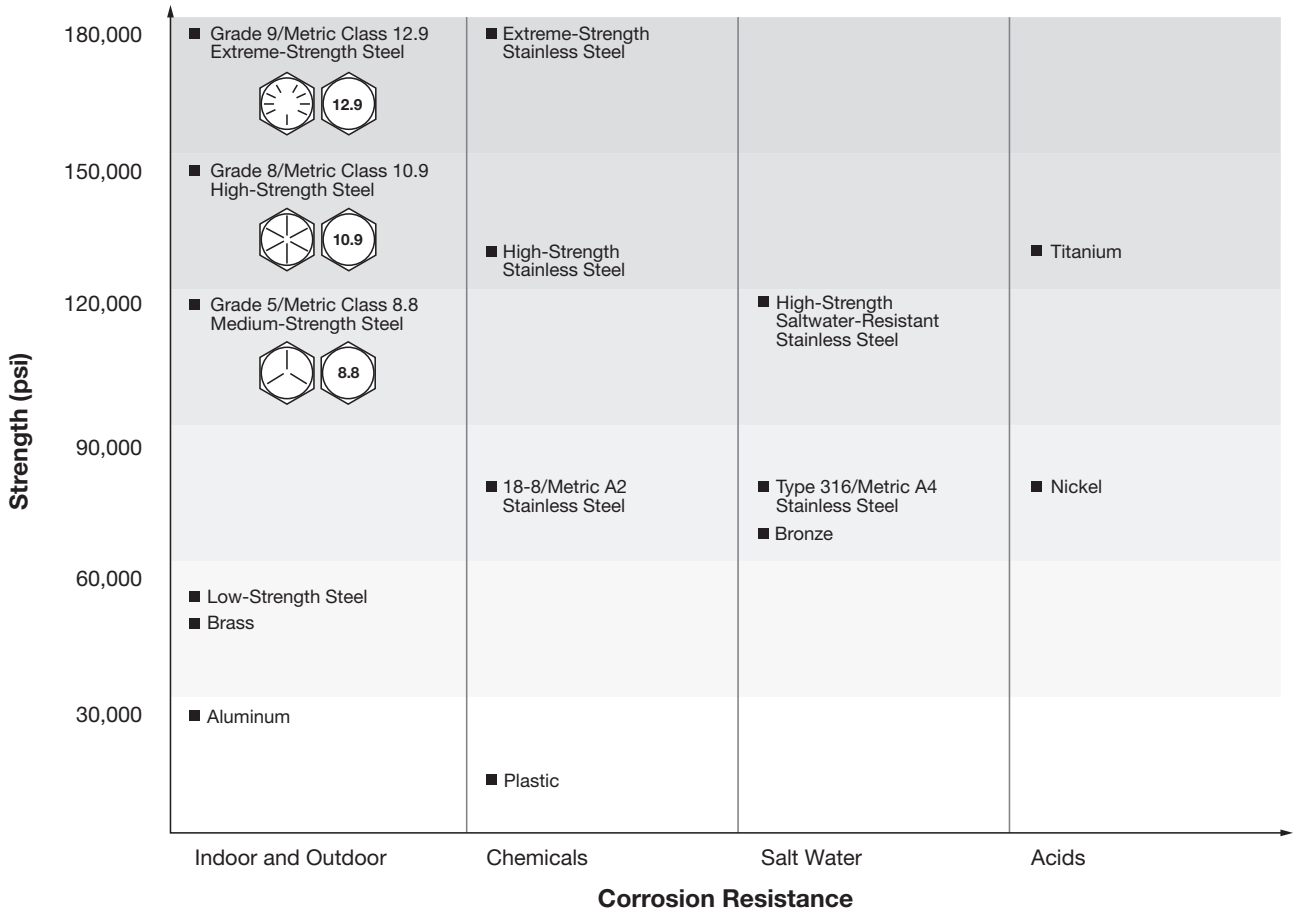
A square head provides more contact with a wrench than a hex head for a secure grip while tightening nuts.

Carriage, Plow & Elevator Bolts (pages 3262-3263)

A square or ribbed neck keeps these bolts from turning when tightening a nut.

Comparing Materials by Strength and Corrosion Resistance

Use the chart below as a guide to understanding the relative strength and corrosion resistance of the screws and bolts we offer.



Other Material Properties to Consider

Steel is magnetic.

Stainless Steel may be mildly magnetic. 18-8 stainless steel includes Types 301, 302, 303, and 304.

Nickel may be mildly magnetic.

Brass and **Bronze** are nonmagnetic and conduct electricity.

Aluminum is extremely lightweight—it's 70% lighter than steel.

Titanium has a high strength-to-weight ratio. It's comparable in strength to medium-strength (Grade 5) steel, yet 40% lighter.

Plastic is nonconductive.

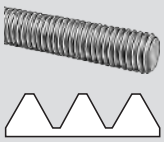
Decimal Equivalents for Inch and Metric Screw and Bolt Sizes

Inch Screw Size	No. 4	No. 6	No. 8	No. 10	1/4″	5/16″	3/8″	7/16″	1/2″	9/16″	5/8″	3/4″	7/8″	1″	2″
Decimal Size	0.112″	0.138″	0.164″	0.190″	0.250″	0.312″	0.375″	0.437″	0.500″	0.562″	0.625″	0.750″	0.875″	1.000″	2.000″

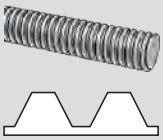
Metric Screw Size	M3	M4	M5	M6	M7	M8	M10	M12	M14	M16	M18	M20	M22	M24	M27	M30
Decimal Size	0.118″	0.157″	0.197″	0.236″	0.275″	0.315″	0.394″	0.472″	0.551″	0.630″	0.708″	0.787″	0.866″	0.945″	1.063″	1.181″

About Threaded Studs and Rods

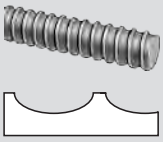
Fully Threaded



Threaded studs and rods (pages 3266-3282) with standard V-shaped threads are often used to anchor structural elements to surfaces, mount wheels and pulleys, and support fixtures in hanging systems. They can also be used as an alternative to a bolt.



Acme threaded studs and rods (pages 3286-3288) have threads that are broader, stronger, and more square than standard threads. Commonly found in vises and screw jacks, they carry heavy loads and are a good choice for applications that require fast threading.



Coil-threaded rods (page 3282) have shallow threads that are spaced far apart for fast threading in applications that require quick assembly and disassembly. Often used in concrete forms, their thread design minimizes the accumulation of debris.

Partially Threaded

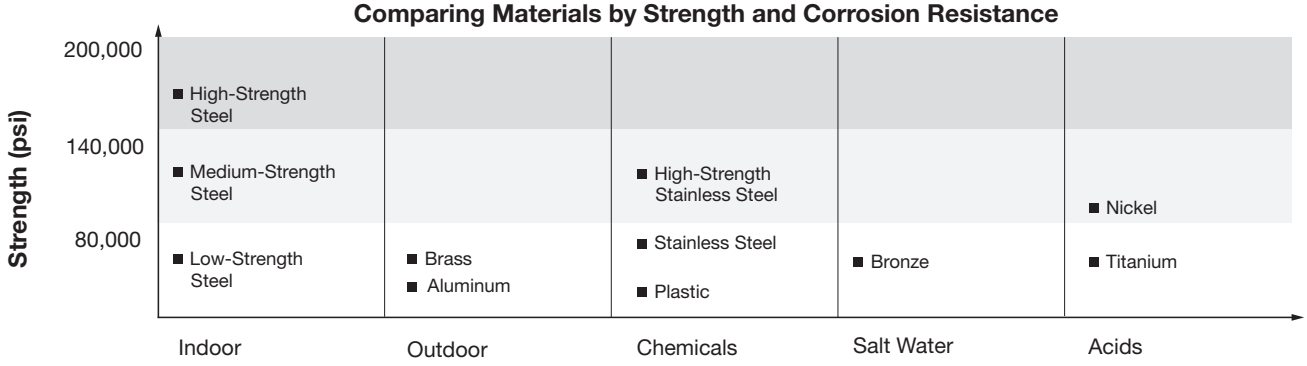
Setup studs (pages 3282-3283) have an unthreaded area in the middle that you can grip with a wrench.

Thread-adapting studs (page 3284) allow you to connect parts with different threads, such as coarse- to fine-threads, right-hand to left-hand threads, and wood screw to machine screw threads.

One-end-threaded studs (page 3284) have an unthreaded end that can be used as a pivot point, hinge, shaft, or locator pin.

Weld, perforated-base, and press-in studs (pages 3285-3286) allow you to permanently attach a stud to a flat surface.

Comparing Materials by Strength and Corrosion Resistance



High-Strength Steel Threaded Studs and Rods—Grade 8

With a minimum tensile strength of 150,000 psi, these uncoated studs and rods are 20% stronger than medium-strength Grade B7 steel. They have a minimum Rockwell hardness of C33. All have a Class 2A thread fit. 3/8″-16 and larger sizes meet ASTM A354BD.

Lg.		Each
8-32		
1/2″	90322A621	$0.56
3/4″	90322A622	.66
1″	90322A623	.77
1 1/2″	90322A624	.87
2″	90322A625	1.01
3″	90322A626	1.31
4″	90322A627	1.67
6″	90322A628	2.53
10-24		
1/2″	90322A629	.64
3/4″	90322A630	.75
1″	90322A631	.88
1 1/2″	90322A632	.99
2″	90322A633	1.15
3″	90322A634	1.49
4″	90322A635	1.91
6″	90322A636	2.83
10-32		
1/2″	90322A637	.66
3/4″	90322A638	.78
1″	90322A639	.92
1 1/2″	90322A640	1.03
2″	90322A641	1.19
3″	90322A642	1.56
4″	90322A643	2.01
6″	90322A644	2.85
1/4″-20		
1″	90322A645	3.13
1 1/4″	90322A646	3.27
1 1/2″	90322A647	3.43
2″	90322A648	3.76
2 1/2″	90322A649	4.23

Lg.		Each
1/4″-20 (Cont.)		
3″	90322A650	$4.99
3 1/2″	90322A651	5.28
4″	90322A652	5.54
5″	90322A653	5.78
6″	90322A654	6.17
8″	90322A655	6.46
1 ft.	90322A656	6.88
2 ft.	90322A657	7.24
3 ft.	90322A658	8.72
6 ft.	90322A659	14.91
1/4″-28		
1″	90322A660	3.76
1 1/2″	90322A661	3.95
2″	90322A662	4.34
3″	90322A663	5.75
4″	90322A664	6.30
1 ft.	90322A665	7.89
2 ft.	90322A666	8.31
3 ft.	90322A667	10.00
6 ft.	90322A668	18.05
5/16″-18		
1″	90322A669	3.87
1 1/4″	90322A670	4.11
1 1/2″	90322A671	4.32
2″	90322A672	4.79
2 1/2″	90322A673	5.31
3″	90322A674	5.90
3 1/2″	90322A675	6.22
4″	90322A676	6.58
5″	90322A677	7.00
6″	90322A678	7.32
8″	90322A679	7.58

Lg.		Each
5/16″-18 (Cont.)		
1 ft.	90322A680	$8.13
2 ft.	90322A681	8.57
3 ft.	90322A682	10.30
6 ft.	90322A683	16.95
5/16″-24		
1″	90322A684	4.44
1 1/2″	90322A685	4.94
2″	90322A686	5.49
3″	90322A687	6.79
4″	90322A688	7.56
1 ft.	90322A689	9.33
2 ft.	90322A690	9.82
3 ft.	90322A691	11.82
6 ft.	90322A692	20.71
3/8″-16		
1″	90322A111	3.23
1 1/4″	90322A112	3.35
1 1/2″	90322A113	3.47
2″	90322A114	3.70
2 1/2″	90322A115	3.93
3″	90322A116	4.17
3 1/2″	90322A117	4.40
4″	90322A118	4.63
5″	90322A119	5.10
6″	90322A120	5.56
8″	90322A121	5.41
1 ft.	90322A122	5.56
2 ft.	90322A123	5.81
3 ft.	90322A100	7.17
4 ft.	90322A124	8.97
5 ft.	90322A125	12.02
6 ft.	90322A105	13.78

Lg.		Each
3/8″-16 (Cont.)		
8 ft.	90322A126	$19.55
12 ft.	90322A110	29.03
3/8″-24		
1″	90322A127	4.43
1 1/2″	90322A128	4.83
2″	90322A129	5.22
3″	90322A130	6.01
4″	90322A131	6.80
1 ft.	90322A132	6.58
2 ft.	90322A133	7.67
3 ft.	90322A134	8.60
6 ft.	90322A135	16.60
7/16″-14		
1 ft.	90322A136	5.50
2 ft.	90322A137	9.35
3 ft.	90322A138	11.52
6 ft.	90322A139	19.80
7/16″-20		
1 ft.	90322A140	6.65
2 ft.	90322A141	10.18
3 ft.	90322A142	14.96
6 ft.	90322A143	25.38
1/2″-13		
1″	90322A144	3.27
1 1/4″	90322A145	3.39
1 1/2″	90322A146	3.50
2″	90322A147	3.74
2 1/2″	90322A148	3.97
3″	90322A149	4.21
3 1/2″	90322A150	4.44
4″	90322A151	4.68
5″	90322A152	5.15

(Continued on following page)

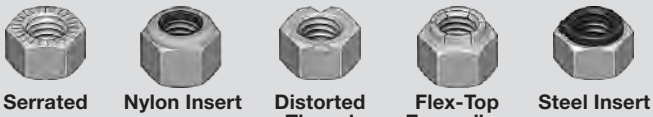
About Nuts, Materials, and Finishes

Types of Nuts

Hex nuts (pages 3291-3302)

Hex | Thin Hex | Extra-Wide Hex | Extra-Wide Thin Hex | High Hex

Locknuts (pages 3304-3311) have a locking feature to resist loosening under vibration.



Serrated | Nylon Insert | Distorted Thread | Flex-Top Expanding | Steel Insert

Low — **Resistance to Loosening** — High

Flange nuts (pages 3309-3311) distribute holding pressure and reduce stress where the nut meets the material surface. Their wide base eliminates the need for a separate washer.

Cap nuts (pages 3312-3314) cover and protect threads while adding a finished appearance.

Square nuts (page 3303) have large sides, which makes them easier to grip with a wrench and keeps them from rotating in channels and square holes.

Thumb and wing nuts (pages 3314-3316) can be tightened or loosened by hand. They're often used in applications that require frequent adjustments.

Twist-on nuts (page 3317) slide smoothly onto threads for quick installation and easy adjustments.

Coupling nuts (pages 3318-3319) are used to connect or extend threaded rod. They're about three-times taller than standard hex nuts.

Tamper-resistant nuts (page 3320) have hard-to-grip uncommon drive styles to reduce the risk of theft and tampering.

Press-in nuts (page 3321) add threads to thin metal or plastic panels. Install using an arbor press or similar pressure tool. Knurls hold the nut in place.

Weld nuts (pages 3324-3325) add threads to metal surfaces.

Comparing Materials by Strength

- Plastic
- Ceramic
- Aluminum
- Low-Strength Steel
- Brass
- Titanium
- 18-8/316 Stainless Steel
- Nickel
- Bronze
- Medium-Strength Steel
- 410 Stainless Steel
- High-Strength Steel
- 17-4 PH Stainless Steel
- Extreme-Strength Steel

Low — High

Comparing Coatings and Finishes by Corrosion Resistance

- Black Oxide
- Zinc Plated
- Galvanized
- Cadmium Plated
- Black Luster Coated
- Nickel Plated
- Zinc Aluminum Coated

Indoor | Outdoor | Chemicals | Salt Water | Acids

Poor — **Excellent**

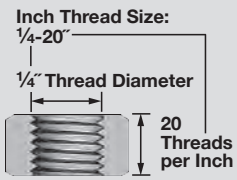
Choosing a Compatible Nut Grade

Match your screw, bolt, or threaded rod with a comparable strength nut.

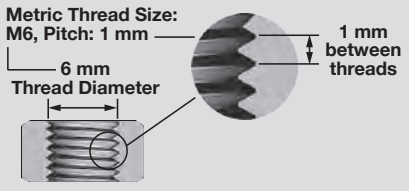
	Screw/Bolt/Rod Grade	Hex Nut Grade	Extra-Wide Hex Nut Grade	Locknut Grade
Steel—Inch Sizes				
Extreme Strength	Grade 9	Grade 9	Grade 2H	Grade 9
High Strength	Grade 8	Grade 8	Grade C	Grade G
Medium Strength	Grade 5	Grade 5	Grade 5	Grade F
Low Strength	Grade 2/Not graded	Grade 2/Not graded	Grade 2/Not graded	Grade 2/Not graded
Steel—Metric Sizes				
Extreme Strength	Class 12.9	Class 12	Grade 2H	Class 12
High Strength	Class 10.9	Class 10	Class 10	Class 10
Medium Strength	Class 8.8	Class 8	Class 8	Class 8
Low Strength	Class 4.6/Class 5.8/ Not graded	Class 4/Class 5/Class 6/ Not graded	Class 4/Class 5/Class 6/ Not graded	Class 4/Class 5/Class 6/ Not graded

Understanding Thread Size

Inch sizes are specified by the diameter of the opening and threads per inch. For those with a diameter smaller than ¼", diameter is indicated by a number (e.g., #1 or No. 1).



Metric sizes are specified by diameter of the opening and pitch.



About Threaded Inserts

Repair stripped threads or convert existing threads between inch and metric sizes.

Inserts for Metal

Helical inserts repair threads while removing less material than other threaded inserts. **Key-locking** and **thread-locking** inserts install into a tapped hole. **Tapping** inserts cut their own threads so you don't have to tap the hole.

Helical
pgs. 3408-3414

Key Locking
pgs. 3414-3416

Tapping
pgs. 3416-3417

Thread Locking
pgs. 3417-3419

Inserts for Plastic and Wood

Add threads to material that is too weak to tap. **Press-fit** inserts are pressed into a drilled hole. **Heat-set** inserts are inserted into plastic; the plastic softens when heated during installation, then it cools to solidify around the insert's knurls and ridges to resist torque and pull-out. **Tapping** inserts cut threads into materials for excellent pull-out resistance. **Hammer-in** inserts have a flange that distributes the load over a large area.

Press Fit
pg. 3420

Heat Set
pg. 3421

Tapping
pgs. 3420; 3422

Hammer In
pgs. 3422-3423

Inserts for Thin Materials

Add threads to material that is too thin to accept an insert. **Rivet nuts** collapse and flare during installation to create a backside flange that grips the material and holds them in place. **Press-in nuts** have knurls on the bottom of the nuts to hold them firmly in place when pressed into panels. **Weld nuts** are welded to metal surfaces for a permanent hold. **Clip-on nuts** slide onto panels for a tight hold.

Rivet Nuts
pgs. 3424-3427

Press-In Nuts
pgs. 3321-3322

Weld Nuts
pg. 3324

Clip-On Nuts
pgs. 3322-3323

How to Install Helical Inserts

Drill a hole using the suggested drill bit size. Thread the hole with a tap (sold separately), then screw the insert onto the installation tool (see pages 3412-3413 for tools). The prong (tang) the tool grips during installation must be properly engaged in the tool's driving contour. Install the insert a quarter to half turn below the surface of the hole. Remove the prong to allow full passage of your screw into the insert.

Thread Size	Drill Bit Size	For Max. Hole Diameter
1-64	#46	0.081″
2-56	#41	0.096″
3-48	7/64″	0.1094″
3-56	#36	0.1065″
4-40	#31	0.125″
4-48	#31	0.125″
5-40	#29	0.136″
6-32	#25	0.1495″
6-40	#25	0.1495″
8-32	#16	0.177″
8-36	#16	0.177″
10-24	#5	0.2055″
10-32	13/64″	0.2031″
12-24	#1	0.228″
1/4″-20	H	0.2656″
1/4″-28	6.7 mm	6.7 mm
5/16″-18	Q	0.332″
5/16″-24	21/64″	0.3281″
3/8″-16	X	0.397″
3/8″-24	25/64″	0.3906″
7/16″-14	29/64″	0.4531″
7/16″-20	29/64″	0.4531″
1/2″-13	17/32″	0.5313″
1/2″-20	33/64″	0.5156″
9/16″-12	19/32″	0.5938″
9/16″-18	37/64″	0.5781″
5/8″-11	21/32″	0.6563″
5/8″-18	41/64″	0.6406″
3/4″-10	25/32″	0.7813″
3/4″-16	49/64″	0.7656″
7/8″-9	29/32″	0.9063″
7/8″-14	57/64″	0.8906″
1″-8	1 1/32″	1.0313″
1″-12	1 1/32″	1.0313″
1″-14	1 1/32″	1.0313″
1 1/8″-7	1 11/64″	1.1719″
1 1/8″-12	1 5/32″	1.1563″
1 1/4″-7	1 19/64″	1.2969″
1 1/4″-8	1 1/4″	1.25″
1 1/4″-12	1 9/32″	1.2813″
1 1/2″-6	1 35/64″	1.5469″
1 1/2″-8	1 1/2″	1.5″
1 1/2″-12	1 17/32″	1.5313″
1 3/4″-8	1 3/4″	1.75″
NPT (National Pipe Taper)		
1/8	W	0.386″
1/4	33/64″	0.5156″
3/8	21/32″	0.6563″
1/2	13/16″	0.8125″
Metric		
M2.2×0.45	2.35 mm	2.35 mm
M2.5×0.45	#37	0.104″
M3×0.5	3.2 mm	3.2 mm
M3.5×0.6	3.7 mm	3.7 mm
M4×0.7	#19	0.166″
M5×0.8	5.3 mm	5.3 mm
M6×1	6.3 mm	6.3 mm
Metric (Cont.)		
M7×1	7.3 mm	7.3 mm
M8×1	8.3 mm	8.3 mm
M8×1.25	8.4 mm	8.4 mm
M10×1	13/32″	0.4063″
M10×1.25	13/32″	0.4063″
M10×1.5	10.5 mm	10.5 mm
M12×1.25	31/64″	0.4844″
M12×1.5	12.5 mm	12.5 mm
M12×1.75	12.5 mm	12.5 mm
M14×1.5	37/64″	0.5781″
M14×2	14.5 mm	14.5 mm
M16×2	16.5 mm	16.5 mm
M18×2.5	47/64″	0.7344″
M20×2.5	13/16″	0.8125″
M24×3	31/32″	0.9688″
M30×3.5	1 7/32″	1.2188″
M36×4	1 15/32″	1.4688″

Helical Inserts

Also known as Heli-Coil inserts, use these to repair threads in metals. The coils expand once installed to securely anchor the insert. Made from 18-8 stainless steel. Minimum tensile strength is 200,000 psi.

Standard inserts in inch sizes meet MS-122 or MS-124 except sizes 1-64, 12-24, 1 1/4″-8, 1 1/2″-8, 1 3/4″-8, left-hand thread, and NPT.

Screw-lock inserts have a polygon-shaped coil to securely hold screws and resist loosening. Inch sizes meet Mil. Spec. 21209 except sizes 1-64 and 1″-14.

Also Available: Lubricated inserts that have a dry film to avoid sticking during installation. Please ask for 91000A555 for standard inserts and 91000A888 for screw-lock inserts, then specify thread size and length.

Taps are for start-to-finish tapping of through-holes. **Also Available:** Taps for closed-end hole threading. Please ask for 91709A555 and specify thread size.

Standard inserts with tool include a tap for through-hole threading, an installation tool, and a drill bit (unless noted).

Thread Size	Installed Lg.	Standard Inserts Pkg. Qty.		Standard Inserts Pkg.	Screw-Lock Inserts Pkg. Qty.		Screw-Lock Inserts Pkg.	Taps	Taps Each	Standard Inserts with Tool Insert Length(s) Included	Qty. Per Lg.		Standard Inserts with Tool Each
1-64	0.073″	10	91732A004	$6.79	5	90296A004	$6.67	91709A090	$42.47				
1-64	0.110″	10	91732A008	6.81	5	90296A008	6.67	91709A090	42.47				
1-64	0.146″	10	91732A011	6.88				91709A090	42.47				
2-56	0.086″	10	91732A203	5.46	10	90296A094	6.53	91709A098	19.54				
2-56	0.129″	10	91732A204	5.26	10	90296A095	7.03	91709A098	19.54	0.129″	10	91732A892	$74.26
2-56	0.172″	10	91732A201	3.64	10	90296A097	4.99	91709A098	19.54				
2-56	0.215″	10	91732A202	3.89	1	90296A099	2.28	91709A098	19.54				

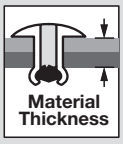
(Continued on following page)

About Blind Rivets

Blind rivets join materials together when you don't have access to both sides. They consist of a *rivet* (a hollow body with a head) and a *mandrel* (a thin nail with a bulbed end). Rivets require a setting tool for installation (see pages 3433-3435).

To hold rivets in large holes and soft materials use Blind Rivet Washers (see 90183A on page 3355).

To select the proper rivet there are several factors to consider:

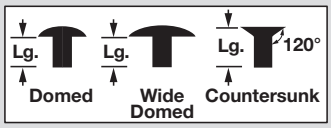


Material Thickness— Make sure the combined thickness of the materials you are joining falls within the rivet's material thickness range.

Diameter— The diameter of the rivet body determines the hole size.

Material— To maximize strength and minimize corrosion, use rivets made of the same material as the components you are fastening. When an exact match isn't possible, choose rivets that are painted or coated.

Shear and Tensile Strengths— To ensure rivets have the strength you need, consider *shear strength* (the amount of force it takes to break a rivet from the side) and *tensile strength* (the amount of pull a rivet can withstand without breaking). *Note:* Joint strength is also affected by the space between the rivets, their distance from the edge of the work, and hole size.

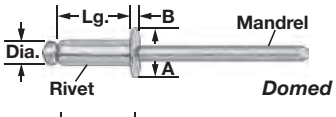


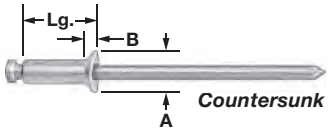
Head Style—*Domed* rivets are suitable for most applications. They have a low profile and a neat appearance. *Wide-domed* rivets have a large head diameter that provides extra holding strength for soft, thin materials or oversized holes. *Countersunk* rivets have an angled head that sits flush when installed.

How to Install a Blind Rivet

Insert the rivet through a hole that passes through the materials being joined. Using a rivet tool with the same size nosepiece as the rivet diameter, grip the mandrel and pull the trigger or lever. The tool pulls the mandrel through the rivet, deforming the rivet's body and breaking off the excess mandrel.

Blind Rivets





Also known as Pop and open-end rivets, these blind rivets meet IFI 114 (Industrial Fasteners Institute) standards, unless noted.

18-8 stainless steel rivets and mandrels have excellent corrosion resistance and may be mildly magnetic.

Aluminum rivets and mandrels are corrosion resistant and nonmagnetic.

Zinc-plated steel rivets with steel mandrels have good rust resistance.

Aluminum rivets with steel mandrels meet MIL-R-24243/1E wherever a dash number is shown. They are corrosion resistant and nonmagnetic.

Head Dimensions

Dia.	Domed (A)	Domed (B)	Wide Domed (A)	Wide Domed (B)	Countersunk (A)	Countersunk (B)
3/32″	0.198″	0.032″	____	____	____	____
1/8″	0.262″	0.04″	0.39″	0.073″	0.22″	0.031″
5/32″	0.328″	0.05″	____	____	____	____
3/16″	0.394″	0.063″	0.65″	0.092″	0.361″	0.05″
1/4″	0.525″	0.08″	____	____	____	____

Shear and Tensile Strengths

Dia.	18-8 Stainless Steel Shear, lbs.	18-8 Stainless Steel Tensile, lbs.	Aluminum Shear, lbs.	Aluminum Tensile, lbs.	Zinc-Plated Steel with Steel Mandrel Shear, lbs.	Zinc-Plated Steel with Steel Mandrel Tensile, lbs.	Aluminum with Steel Mandrel Shear, lbs.	Aluminum with Steel Mandrel Tensile, lbs.
3/32″	230	280	80	130	150	200	120	170
1/8″	420	530	120	150	260	310	170	220
5/32″	650	820	220	350	410	570	260	350
3/16″	950	1,200	310	500	590	810	380	500
1/4″	1,700	2,100	600	750	1,240	1,500	700	920

Material Thickness Range	Lg.	18-8 Stainless Steel Pkg. Qty.	18-8 Stainless Steel	Pkg.	Aluminum Pkg. Qty.	Aluminum	Pkg.	Zinc-Plated Steel with Steel Mandrel Pkg. Qty.	Zinc-Plated Steel with Steel Mandrel	Pkg.	Aluminum with Steel Mandrel Dash No.	Aluminum with Steel Mandrel Pkg. Qty.	Aluminum with Steel Mandrel	Pkg.
Domed														
3/32″ Dia.—*For Hole Size: 0.097″-0.1″ (Drill Size #41)*														
0.032″-0.125″	0.25″	100	97525A300	$11.58	250	97447A105	$9.45	250	97519A003	$11.45	____	250	97517A105	$9.30
0.126″-0.25″	0.375″	100	97525A305	10.37	250	97447A110	9.72	100	97519A005	6.54	____	250	97517A110	8.95
1/8″ Dia.—*For Hole Size: 0.129″-0.133″ (Drill Size #30)*														
0.032″-0.062″	0.212″	100	97525A410	8.78	250	97447A010	8.12	250	97519A010	8.50	A401	250	97517A010	6.05
0.063″-0.125″	0.275″	100	97525A415	8.57	250	97447A015	7.62	250	97519A015	9.77	A402	250	97517A015	6.17
0.126″-0.187″	0.337″	100	97525A420	9.35	250	97447A020	7.47	250	97519A020	9.08	A403	250	97517A020	6.45
0.188″-0.25″	0.4″	100	97525A425	9.25	250	97447A025	8.15	250	97519A025	8.53	A404	250	97517A025	6.57
0.251″-0.312″	0.462″	100	97525A430	9.90	250	97447A125	9.32	250	97519A026	9.11	A405	250	97517A125	7.75
0.313″-0.375″	0.525″	100	97525A435	10.83	250	97447A130	12.12	250	97519A130	10.25	A406	250	97517A130	8.12
0.376″-0.5″	0.65″	50	97525A440	7.55	250	97447A135	10.40	250	97519A140	13.92	A408	100	97517A140	4.30
0.501″-0.625″	0.775″	50	97525A442	10.16	250	97447A145	10.58	100	97519A145	5.97	____	100	97517A145	6.48
5/32″ Dia.—*For Hole Size: 0.16″-0.164″ (Drill Size #20)*														
0.063″-0.125″	0.3″	100	97525A455	13.16	250	97447A030	12.71	250	97519A030	11.78	A502	250	97517A030	7.10
0.126″-0.187″	0.362″	50	97525A458	5.92	250	97447A032	12.74	250	97519A031	11.08	A503	250	97517A032	7.80
0.188″-0.25″	0.425″	50	97525A465	7.48	250	97447A035	12.27	250	97519A035	12.39	A504	250	97517A035	7.87
0.251″-0.375″	0.55″	50	97525A470	9.42	250	97447A040	13.15	250	97519A040	13.21	A506	250	97517A040	9.00
0.376″-0.5″	0.675″	50	97525A473	11.95	100	97447A041	6.53	250	97519A042	10.43	A508	250	97517A041	10.62
3/16″ Dia.—*For Hole Size: 0.192″-0.196″ (Drill Size #11)*														
0.063″-0.125″	0.325″	50	97525A485	10.35	100	97447A045	6.62	250	97519A045	14.22	A602	250	97517A045	9.38
0.126″-0.25″	0.45″	50	97525A490	11.19	100	97447A050	7.23	100	97519A050	6.39	____	250	97517A050	9.38
0.251″-0.375″	0.575″	50	97525A505	13.04	100	97447A055	6.84	100	97519A055	7.15	A606	250	97517A055	11.88
0.376″-0.5″	0.7″	50	97525A510	11.67	100	97447A060	8.62	100	97519A060	8.18	A608	250	97517A060	12.42
0.501″-0.625″	0.825″	25	97525A515	9.58	100	97447A065	10.17	100	97519A065	10.00	A610	100	97517A065	6.25
0.626″-0.75″	0.95″	25	97525A520	10.11	100	97447A070	9.48	100	97519A070	10.63	A612	100	97517A070	7.87
0.751″-0.875″	1.075″	25	97525A522	10.69	50	97447A071	8.82	50	97519A072	8.56	____	100	97517A071	11.88
0.876″-1″	1.2″	____	____	____	50	97447A072	7.08	50	97519A073	9.05	A616	100	97517A072	12.32
3/16″ Dia.—*For Hole Size: 0.201″-0.204″ (Drill Size #7)*														
0.985″-1.181″	1.417″	____	____	____	____	____	____	10	97519A080★	7.40	____	25	97517A073★	9.10
1.182″-1.338″	1.614″	____	____	____	____	____	____	10	97519A082★	10.50	____	25	97517A074★	11.70
1.378″-1.535″	1.811″	____	____	____	____	____	____	10	97519A084★	9.45	____	25	97517A076★	12.78
1.575″-1.732″	2.008″	____	____	____	____	____	____	10	97519A086★	10.60	____	25	97517A077★	14.00
1/4″ Dia.—*For Hole Size: 0.257″-0.261″ (Drill Size F)*														
0.063″-0.25″	0.5″	10	97525A550	4.54	50	97447A651	10.46	100	97519A651	11.56	A804	100	97517A651	11.25
0.251″-0.375″	0.625″	10	97525A553	6.56	50	97447A652	9.01	100	97519A652	13.45	A806	100	97517A652	12.00
0.376″-0.5″	0.75″	10	97525A556	6.71	50	97447A653	10.20	50	97519A653	7.97	A808	100	97517A653	13.50

★ Does not meet IFI 114.

(Continued on following page)

About Tank-Mount Pressure-Regulating Valves

Tank-mount pressure-regulating valves automatically reduce a high inlet pressure from compressed gas tanks to a lower, stable outlet pressure. Consider the following in your selection:

Compressed Gas Association (CGA) Numbers:
The Compressed Gas Association (CGA) provides a standardized system for secure connections to compressed gas tanks. Choose a valve with the same CGA number as your tank and other system components.

Outlet Pressure:
Choose a valve with a maximum outlet pressure that's approximately twice your application's normal operating pressure. Your operating pressure should never exceed 75% of the valve's maximum outlet pressure.

Tank-Mount Pressure-Regulating Valves

These valves automatically reduce a high inlet pressure from compressed gas tanks to a lower, stable outlet pressure. They have a gauge to monitor outlet pressure and a gauge to monitor inlet pressure from the tank, unless noted.

Brass valves have a longer service life than brass/steel valves. **Valves with a stainless steel diaphragm** can withstand harsh environments.

Two-stage valves progressively reduce pressure over two steps for more consistent outlet pressure at all times. They're often used in applications that require a constant outlet pressure regardless of the tank level.

With Female Inlet

Inlet		Material						
CGA No.	Gender	Body	Diaphragm	Stage	Max. Inlet Pressure, psi	Outlet Pressure, psi	Outlet Connection (RH = Right Hand; LH= Left Hand)	
For Acetylene								
300	Female	Brass/Steel	Rubber	Single	500	0-15	9/16"-18 LH Male	7897A62 $148.36
300	Female	Brass/Steel	Rubber	Two	500	0-15	9/16"-18 LH Male	7897A4 377.84
300	Female	Brass	Rubber	Single	500	0-15	9/16"-18 LH Male	7897A2 175.13
300	Female	Brass	Stainless Steel	Two	3,000	0-15	9/16"-18 LH Male	7897A79 422.06
510	Male	Brass/Steel	Rubber	Single	500	0-15	9/16"-18 LH Male	7897A63 148.36
510	Male	Brass/Steel	Rubber	Two	500	0-15	9/16"-18 LH Male	7897A14 377.84
510	Male	Brass	Rubber	Single	500	0-15	9/16"-18 LH Male	7897A7 175.13
510	Male	Brass	Stainless Steel	Single	500	0-15	9/16"-18 LH Male	7897A53 190.51
510	Male	Brass	Stainless Steel	Two	500	0-15	9/16"-18 LH Male	7897A81 422.06
For Argon, Helium, and Nitrogen								
580	Male	Brass/Steel	Rubber	Single	3,000	0-145	9/16"-18 RH Male	7897A65 148.36
580	Male	Brass/Steel	Rubber	Two	3,000	0-125	5/8"-18 RH Female	7897A16 377.84
580	Male	Brass	Rubber	Single	3,000	0-125	9/16"-18 RH Male	7897A38 175.13
580	Male	Brass	Rubber	Single	3,000	0-200	9/16"-18 RH Male	7897A12 175.13
580	Male	Brass	Stainless Steel	Two	3,000	0-50	5/8"-18 RH Female	7897A22 422.06
580	Male	Brass	Stainless Steel	Two	3,000	0-125	5/8"-18 RH Female	7897A23 422.06
For Liquid Argon and Liquid Nitrogen								
580	Male	Brass	Stainless Steel	Single	3,000	0-125	9/16"-18 RH Male	7897A86★ 354.47
580	Male	Brass	Stainless Steel	Single	3,000	0-350	9/16"-18 RH Male	7897A87★ 365.75
For Carbon Dioxide								
320	Female	Brass/Steel	Rubber	Two	3,000	0-125	5/8"-18 RH Female	7897A17 377.84
320	Female	Brass	Rubber	Single	3,000	0-125	9/16"-18 RH Male	7897A39 175.13
For Liquid Carbon Dioxide								
320	Female	Brass	Stainless Steel	Single	3,000	0-350	9/16"-18 RH Male	7897A83★ 365.75
For Hydrogen								
350	Female	Brass	Rubber	Single	3,000	0-125	9/16"-18 LH Male	7897A5 275.55
For Hydrogen and Methane								
350	Female	Brass	Rubber	Two	3,000	2-40	9/16"-18 LH Male	7897A55 575.60
For Oxygen								
540	Female	Brass/Steel	Rubber	Single	3,000	0-145	9/16"-18 RH Male	7897A61 148.36
540	Female	Brass/Steel	Rubber	Two	3,000	0-125	9/16"-18 RH Male	7897A3 377.84
540	Female	Brass	Rubber	Single	3,000	0-125	9/16"-18 RH Male	7897A31 175.13
540	Female	Brass	Rubber	Single	3,000	0-200	9/16"-18 RH Male	7897A1 175.13
540	Female	Brass	Stainless Steel	Single	3,000	0-125	9/16"-18 RH Male	7897A51 190.51
540	Female	Brass	Stainless Steel	Two	3,000	0-125	9/16"-18 RH Male	7897A74 422.06
540	Female	Brass	Stainless Steel	Two	3,000	0-250	1/4 NPT RH Female	7897A75 466.25
For Liquid Oxygen								
540	Female	Brass	Stainless Steel	Single	3,000	0-125	9/16"-18 RH Male	7897A84★ 354.47
For Propane and Propylene								
510	Male	Brass/Steel	Rubber	Single	500	5-50	9/16"-18 LH Male	7897A66 148.36
510	Male	Brass/Steel	Rubber	Two	500	0-50	9/16"-18 LH Male	7897A18 377.84
510	Male	Brass	Rubber	Single	3,000	0-50	9/16"-18 LH Male	7897A13 175.13
For Air								
590	Male	Brass/Steel	Rubber	Single	3,000	0-145	9/16"-18 LH Male	7897A56 153.96
590	Male	Brass	Rubber	Single	3,000	0-125	1/4 NPT RH Male	7897A59 206.53
For Breathable Air								
346	Female	Brass	Rubber	Single	3,000	0-125	9/16"-18 RH Male	7897A57 181.74
346	Female	Brass	Rubber	Single	3,000	0-200	9/16"-18 RH Male	7897A58 181.74

★ Valve does not include a gauge to monitor inlet pressure.

Tank-Mount Pressure-Regulating Valves with Flowmeter for Inert Gas

Commonly used in TIG welding where gas flow/coverage is a concern, these valves measure the gas flow rate in addition to regulating pressure. Valves have a gauge to monitor the outlet flow rate and a second gauge to monitor inlet pressure from the tank. All are single stage. Body is brass.

Kits include a pressure-regulating valve and a 10-ft. long, 3/16" dia. hose with 5/8"-18 male fittings on both ends.

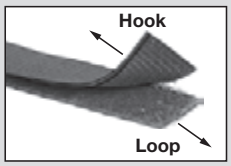
With Male Inlet

Inlet					Valves		Kits	
CGA No.	Gender	Max. Inlet Pressure, psi	Outlet Flow, scfh	Outlet Connection (RH = Right Hand)				
For Argon								
580	Male	3,000	0-60	5/8"-18 RH Female	7997A65	$124.53	7997A67	$167.63
580	Male	3,000	0-100	5/8"-18 RH Female	7997A52	184.07	—	—
For Carbon Dioxide								
320	Female	3,000	0-60	5/8"-18 RH Female	7997A66	124.53	7997A68	167.63
320	Female	3,000	0-100	5/8"-18 RH Female	7997A51	184.07	—	—

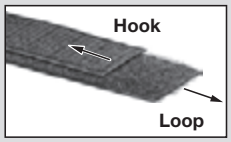
About Hook and Loop

Just like burrs grab onto your clothing, the hook aggressively grabs the loop for a sturdy and reliable fastener. The hook also grabs onto other fabric, such as carpet and upholstery. Use for bundling cable, holding matting in place, putting up signs, holding down tarps, creating display boards, and holding tools.

Open/Close Cycles—Number of times hook and loop can be pressed together and pulled apart until performance reaches 50%.



Pull-Apart Strength



Slide-Apart Strength

Hook and Loop Type	Page(s)	Pull-Apart Strength	Slide-Apart Strength	Open/Close Cycles
General Purpose	3598-3599	Hard	Hard	1,000s
General Purpose Elastic	3598	Easy	Easy	1,000s
Super Adhesive	3599	Hard	Hard	1,000s
Weather Resistant	3599	Easy	Hard	1,000s
One Piece	3600	Easy	Hard	100s
Flame Retardant	3600	Easy	Easy	1,000s
Flame Resistant	3600	Easy	Easy	100s
Heat-Resistant Stainless Steel	3600	Easy	Hard	10s
Mil. Spec.	3600	Hard	Hard	1,000s
Super Wide	3600	Hard	Hard	10s
Marine Grade	3601	Easy	Hard	1,000s
Vinyl Bonding	3601	Very Hard	Very Hard	1,000s
Super-Grip Double Head	3601	Hard	Hard	10s
Self-Lock Hook Head	3601	Easy	Not Rated	10s
Self-Lock Mushroom Head	3601	Easy	Hard	100s

General Purpose Hook and Loop

A combination of moisture and chemical resistance makes this hook and loop the choice for most applications. Made of nylon. *Adhesive back* has acrylic adhesive. *Plain back* can be sewn, stapled, or screwed to your surface.

Hook and **loop** temperature range is –20° to 200° F. **Elastic loop** temperature range is 35° to 120° F.

Wd.	5-ft. Lengths		10-ft. Lengths		15-ft. Lengths		30-ft. Lengths		50-ft. Lengths		75-ft. Lengths	
Hook and Loop												
Adhesive Back—To Order: Please specify beige, black, blue, gray, green, red, or white.												
1/4"	9273K1	$4.97	9273K2	$7.85	9273K3	$11.34	9273K4	$21.80	9273K5	$34.01	9273K6	$43.60
1/2"	9273K11	6.22	9273K17	11.96	9273K24	16.27	9273K31	31.11	9273K37	47.86	9273K93	62.55
5/8"	9273K12	7.36	9273K18	12.19	9273K25	16.36	9273K32	31.93	9273K38	51.73	9273K44 ♣	63.86
3/4"	9273K13	8.00	9273K19	13.03	9273K26	18.83	9273K33	34.96	9273K39	54.19	9273K45 ♣	69.47
1"	9273K14	8.18	9273K21	13.90	9273K27	20.51	9273K34	37.18	9273K41	55.78	9273K46	74.38
1 1/2"	9273K15	11.52	9273K22	20.85	9273K28	31.66	9273K35	56.44	9273K42	91.19	9273K47	112.58
2"	9273K16	14.45	9273K23	26.96	9273K29	38.49	9273K36	70.30	9273K43	105.21	9273K48	141.16
4"	9273K96	36.90	9273K84	58.26	9273K86	84.16	9273K88	161.84	9273K91	252.48	9273K94	323.69
6"	9273K83	47.91	9273K85	75.65	9273K87	109.28	9273K89	210.15	9273K92	327.83	9273K95	420.29
Plain Back—To Order: Please specify beige, black, or white.												
5/8"	9273K49	3.00	9273K55	5.67	9273K61	8.36	9273K66	16.46	9273K72	22.93	9273K77 ♣	26.98
3/4"	9273K51	3.55	9273K56	6.32	9273K62	9.33	9273K67	18.36	9273K73	25.59	9273K78 ♣	30.10
1"	9273K52	4.66	9273K57	6.98	9273K63	10.31	9273K68	20.29	9273K74	29.93	9273K79 ♣	33.26
1 1/2"	9273K53	5.92	9273K58	10.51	9273K64	13.95	9273K69	24.72	9273K75	39.25	9273K81 ♣	48.46
2"	9273K54	7.48	9273K59	13.26	9273K65	17.61	9273K71	31.20	9273K76	49.56	9273K82 ♣	61.18
Hook—To Order: Please specify beige, black, or white.												
Adhesive Back												
1/2"	9489K53	4.54	9489K79	8.73	9489K629	11.88	9489K41	22.71	9489K742	34.94		
5/8"	9489K59	4.10	9489K81	7.01	9489K31	10.46	9489K738	19.02	9489K743	27.97	9489K749	37.29
3/4"	9489K61	4.16	9489K82	7.10	9489K49	10.60	9489K739	19.28	9489K744	28.35	9489K21	37.80
1"	9489K62	4.52	9489K83	7.72	9489K267	11.52	9489K268	20.95	9489K746	30.80	9489K269	41.07
1 1/2"	9489K71	6.88	9489K89	11.74	9489K52	17.53	9489K741	31.88	9489K747	46.88	9489K689	62.50
2"	9489K72	7.92	9489K29	14.88	9489K271	22.22	9489K278	40.40	9489K748	59.41	9489K279	79.21
Plain Back												
5/8"	9489K304	1.68	9489K311	3.70	9489K697	4.79	9489K711	8.35	9489K319	11.64	9489K716	13.69
3/4"	9489K305	1.90	9489K312	4.18	9489K698	5.42	9489K712	9.44	9489K401	13.16	9489K718 ♣	15.48
1"	9489K306	2.60	9489K313	5.68	9489K246	7.37	9489K247	12.84	9489K402	17.89	9489K248	21.05
1 1/2"	9489K307	3.39	9489K314	5.97	9489K699	7.92	9489K713	14.03	9489K404	22.28	9489K719	27.50
2"	9489K308	4.02	9489K315	7.10	9489K261	13.71	9489K277	16.70	9489K405	26.52	9489K281	32.74
Loop—To Order: Please specify beige, black, or white.												
Adhesive Back												
1/2"	9489K147	4.54	9489K165	8.73	9489K179	11.88	9489K187	22.71	9489K189	34.94		
5/8"	9489K148	4.10	9489K166	7.01	9489K101	10.46	9489K104	19.02	9489K191	27.97	9489K108	37.29
3/4"	9489K149	4.16	9489K167	7.10	9489K102	10.60	9489K105	19.28	9489K197	28.35	9489K109	37.80
1"	9489K691	4.52	9489K168	7.72	9489K213	11.52	9489K214	20.95	9489K198	30.80	9489K215	41.07
1 1/2"	9489K156	6.88	9489K169	11.74	9489K103	17.53	9489K107	31.88	9489K199	46.88	9489K201 ♣	62.50
2"	9489K157	8.55	9489K171	16.07	9489K216	23.99	9489K217	43.62	9489K219	64.15	9489K218	85.53
Plain Back												
5/8"	9489K408	1.68	9489K505	3.70	9489K202	4.79	9489K208	8.35	9489K604	11.64	9489K695	13.69
3/4"	9489K409	1.90	9489K506	4.18	9489K206	5.42	9489K209	9.44	9489K605	13.16	9489K696	15.48
1"	9489K501	2.60	9489K507	5.68	9489K287	7.37	9489K288	12.84	9489K606	17.89	9489K289	21.05
1 1/2"	9489K502	3.39	9489K508	5.97	9489K207	7.92	9489K301	14.03	9489K607	22.28	9489K932	27.50
2"	9489K503	4.02	9489K509	7.10	9489K297	9.43	9489K298	16.70	9489K608	26.52	9489K299	32.74
Elastic Loop—To Order: Please specify beige, black, or white.												
Plain Back												
5/8"	9652K67	6.50	9652K73	12.28	9652K78	17.33	9652K84	32.50	9652K89	50.55	9652K95	72.22
3/4"	9652K68	7.62	9652K74	14.39	9652K79	20.32	9652K85	38.10	9652K91	59.26	9652K96	84.66
1"	9652K69	9.59	9652K75	18.11	9652K81	25.57	9652K86	47.94	9652K92	74.58	9652K97	106.54
1 1/2"	9652K71	15.60	9652K76	26.00	9652K82	41.60	9652K87	78.00	9652K93	121.34	9652K98	173.34
2"	9652K72	18.53	9652K77	34.99	9652K83	49.40	9652K88	92.63	9652K94	144.09	9652K99	205.84

♣ Not available in beige.

About Magnetic Poles

Magnets' holding power is concentrated in areas called poles. Similar poles repel each other, and opposite poles attract.

Holding Power on One Face

Two Poles

Four Poles

This orientation concentrates holding power on one face. Magnets with multiple north (N) and south (S) poles have greater holding power on thin material.

Holding Power on Both Faces

Two Poles

Eight Poles

This is the most common pole orientation. Magnets have good pull on both faces.

Flexible Magnets

Use scissors to cut magnets into custom shapes for use as latches, tool holders, display materials, and shelf labels. Magnets are ferrite bonded with synthetic rubber and resist corrosion and demagnetization. Temperature range is 0° to 150° F, except 3M VHB (very high bond) magnets have a temperature range of 0° to 140° F. Color is dark brown to black.

Strips

Holding Power on One Face

Holding Power on Both Faces

Thickness tolerance is ±0.005". Width tolerance is –4% to +8%.
Increased-pull magnets have at least 20% more pull than standard-pull magnets.

Thick.	Wd.	Lengths, ft.	Standard Pull: Max. Pull, lbs. per lin. ft.	Standard Pull: Plain Back	Per Ft.	Standard Pull: Adhesive Back	Per Ft.	Standard Pull: 3M VHB (Very High Bond) Adhesive Back	Per Ft.	Increased Pull: Max. Pull, lbs. per lin. ft.	Increased Pull: Plain Back	Per Ft.	Increased Pull: Adhesive Back	Per Ft.
Holding Power on One Face														
1/32"	1/4"	5, 10, 20, 50, 100	1.4	5759K11	$0.42	5759K12	$0.46			2	5769K63	$0.51	5769K64	$0.57
1/32"	3/8"	5, 10, 20, 50, 100	2	5759K13	.48	5759K14	.56			2.8	5769K65	.63	5769K66	.70
1/32"	1/2"	5, 10, 20, 50, 100	4	5699K14	.21	5759K26	.31	5759K45	$0.89					
1/32"	3/4"	5, 10, 20, 50, 100	8	5699K24	.29	5759K36	.43							
1/32"	1"	5, 10, 20, 50, 100	8	5699K16	.33	5759K28	.53	5759K46	1.53					
1/32"	1 1/2"	5, 10, 20, 50, 100	16	5699K26	.51	5759K38	.78							
1/32"	2"	5, 10, 20, 50, 100	16	5699K55	.64	5759K75	1.05	5759K51	3.09					
1/32"	3"	5, 10, 20, 50, 100	24	5699K29	.95	5759K39	1.42	5759K52	4.44					
1/32"	4"	5, 10, 20, 50, 100	26	5759K15	2.37	5759K16	3.29			35	5769K67	4.00	5769K68	4.86
1/16"	1/4"	5, 10, 20, 50, 100	2.7	5759K17	.43	5759K18	.55			3.9	5769K69	.71	5769K73	.84
1/16"	3/8"	5, 10, 20, 50, 100	4	5759K19	.59	5759K21	.69			5	5769K74	.90	5769K75	.97
1/16"	1/2"	5, 10, 20, 50, 100	6	5699K15	.32	5759K27	.48	5759K53	1.09	9	5769K21	.77	5769K61	1.00
1/16"	3/4"	5, 10, 20, 50, 100	11	5699K25	.40	5759K47	.61							
1/16"	1"	5, 10, 20, 50, 100	12	5699K17	.49	5759K29	.76	5759K54	1.90	18	5769K41	1.30	5769K81	1.66
1/16"	1 1/2"	5, 10, 20, 50, 100	23	5699K27	.73	5759K49	1.13							
1/16"	2"	5, 10, 20, 50, 100	24	5699K62	.96	5759K82	1.74	5759K55	4.12	35	5769K43	4.28	5769K44	4.58
1/16"	3"	5, 10, 20, 50, 100	45	5699K28	1.46	5759K59	1.94			50	5769K51	4.28	5769K91	4.60
1/16"	4"	5, 10, 20, 50, 100	50	5759K22	4.75	5759K33	5.59			70	5769K76	8.00	5769K77	8.71
1/8"	1/4"	5, 10, 20, 50, 100	3	5759K34	.99	5759K35	1.24			4	5769K78	1.53	5769K79	1.72
1/8"	3/8"	5, 10, 20, 50, 100	4	5759K37	1.09	5759K41	1.67			6	5769K84	1.97	5769K85	2.30
1/8"	1/2"	5, 10, 20, 50, 100	8	5699K11	.54	5759K23	.77			12	5769K22	1.21		
1/8"	1/2"	5, 10, 20, 50								12			5769K62	2.47
1/8"	3/4"	5, 10, 20, 50, 100	12	5699K41	.73	5759K63	1.05			18	5769K32	1.85		
1/8"	3/4"	5, 10, 20, 50								18			5769K72	3.58
1/8"	1"	5, 10, 20, 50, 100	16	5699K12	.93	5759K24	1.31			24	5769K42	2.26		
1/8"	1"	5, 10, 20, 50								24			5769K82	4.11
1/8"	1 1/2"	5, 10, 20, 50, 100	24	5699K42	1.33	5759K64	1.89			31	5769K45	6.64	5769K46	6.91
1/8"	2"	5, 10, 20, 50, 100	32	5699K68	1.79	5759K88	2.60			40	5769K47	8.58	5769K48	8.93
1/8"	3"	5, 10, 20, 50, 100	45	5699K49	2.94	5759K69	3.50							
1/8"	3"	5, 10, 20, 50								70	5769K52	6.65	5769K92	8.98
1/8"	4"	5, 10, 20, 50, 100	55	5759K43	8.61	5759K44	9.56			80	5769K86	15.19	5769K87	15.91
3/16"	0.95"	5, 10, 20, 50, 100	15	5699K13	1.87	5759K25	2.18			25	5769K49	5.49	5769K53	7.55
3/16"	1 1/2"	5, 10, 20, 50, 100	24	5699K72	2.67	5759K92	3.20			35	5769K54	6.33	5769K55	10.18
1/4"	5/8"	5, 10, 20, 50, 100	9	5699K73	1.22	5759K93	1.56			14	5769K56	4.67	5769K57	5.67
1/4"	2"	5, 10, 20, 50	31	5699K74	3.38	5759K94	3.98			50	5769K58	14.50	5769K59	15.91
Holding Power on Both Faces														
1/32"	1"	5, 10, 20, 50, 100	6	4774K34	1.07	4774K35	1.26			8	4774K43	1.58	4774K44	1.80
1/32"	2"	5, 10, 20, 50, 100	13	4774K36	1.76	4774K37	2.37			16	4774K45	2.76	4774K46	3.35
1/16"	1"	5, 10, 20, 50, 100	13	4774K38	1.68	4774K39	1.91			16	4774K47	2.66	4774K48	2.89
1/16"	2"	5, 10, 20, 50, 100	26	4774K41	2.16	4774K42	3.16			32	4774K49	5.04	4774K51	5.50
1/16"	3"	5, 10, 20, 50, 100	27	4774K24	2.15	4774K27	4.80			45	4774K29	6.94	4774K31	7.80
3/16"	3"	5, 10, 20, 50, 100	40			4774K28	13.14			65	4774K32	20.43	4774K33	21.76
3/16"	3"	5, 10, 20, 50	40	4774K26	4.43									

(Continued on following page)

Warning! ***Max. pull ratings are based on direct contact with rust-free and unpainted iron plate. Variations in material condition will significantly reduce these ratings. Do not use magnets for lifting over people.***

About O-Rings

Inch O-rings are sized to the SAE standard AS568, which is known as a dash number. Metric O-rings are sized to the actual measured inside dia.

Applications Guide

Use the chart below to identify the best material for your application. Blank boxes indicate a poor rating or no rating. Information is intended for comparison only.

● Excellent
◓ Good

	Buna-N	Viton® Fluoro-elastomer	Silicone	EPDM	Polyurethane	Neoprene	Kalrez	PTFE	FEP	Aflas	Fluoro-silicone	Stainless Steel
Minimum Temperature, °F	–20°	0°	–40°	–40°	–20°	–30°	30°	–100°	15°	25°	–80°	–40°
Maximum Temperature, °F	225°	400°	400°	212°	180°	212°	525°	500°	400°	450°	400°	800°
Resistance to:												
Acids				◓		◓	●	●	●	●		
Alcohol	◓		◓	◓		◓	●	●	●	●	◓	●
Alkalies				●		◓	●	●	●	●		
Anilines						◓	●	●	●	◓	◓	●
Animal/Vegetable Oils	◓	◓	◓		◓	◓	●	●	●			●
Detergents			◓	●			●	●	●	●		●
Gasoline	◓	●			◓	◓	●	●	●	●	●	
Hydraulic Oils	◓	◓				◓	●	●	●	●	●	◓
Hydrocarbons	◓	◓			◓		●	●	●	●		
Ketones							●	●	●	●	◓	●
Refrigerants				◓				●	●			●
Salt Water	◓	◓	◓	◓		◓	●	●	●	◓	●	◓
Steam				◓		◓	●	●	◓	◓	◓	
Synthetic Lubricants		●					●	●	●	●	◓	●
Water	◓			●		◓	●	●	●	◓		●
Weather		◓	◓	◓		◓	●	●	●	●	●	●

O-Ring Size-Identification Tools

Inch Gauge

Deluxe Inch Cone

Use one of these plastic tools to identify your O-ring sizes. Inch tools identify the AS568 dash number. The metric cone identifies the actual O-ring size.

Inch Gauge—This sliding gauge identifies 312 dash numbers with 1/32″ to 13″ IDs in five widths: 0.070″, 0.103″, 0.139″, 0.210″, and 0.275″. It extends to 25″ long.

Standard Inch Cone—Comes as a two-piece measuring system to identify 226 dash numbers in five widths: 0.070″, 0.103″, 0.139″, 0.210″, and 0.275″. The cone identifies 112 dash numbers with 1/4″ to 3″ IDs; an included sizing tape identifies another 114 dash numbers with 3 1/8″ to 8″ IDs.

Deluxe Inch Cone—Identifies 209 dash numbers with 1/4″ to 5 5/8″ IDs in five widths: 0.070″, 0.103″, 0.139″, 0.210″, and 0.275″.

Metric Cone—Identifies 6 to 69 mm IDs in 12 widths: 1, 1.5, 1.6, 1.9, 2, 2.4, 2.5, 3, 3.1, 3.5, 4, and 5 mm.

	Ht.		
Inch Gauge	13 1/2″	9699K51	$23.33
Standard Inch Cone	7 3/4″	9440K41	25.64

	Ht.		
Deluxe Inch Cone	17 5/8″	9440K42	$54.84
Metric Cone	7 7/8″	9440K43	23.79

Multipurpose O-Rings

All O-rings are sized to the SAE standard AS568. They meet ASTM D2000/SAE J200.

Oil-Resistant Buna-N—The most widely used O-ring material, Buna-N also resists grease, hydraulic oils, and abrasion. Temperature range is –20° to 250° F. Durometer is A70 (medium). Color is black.

Chemical-Resistant Viton® Fluoroelastomer—Choose these O-rings for their excellent resistance to boric acid, citric acid, isopropyl alcohol, fuels, and transmission fluid. Temperature range is 0° to 400° F. Durometer is A75 (medium). Color is black.

High-Temperature Silicone—O-rings stand up to temperatures from –80° to 450° F. They resist weather, detergents, and salt water. They're made from FDA-listed materials for use with food and beverage. Durometer is A70 (medium). Color is red.

Steam-Resistant EPDM—These O-rings are peroxide cured, so they're more resistant to high temperatures than standard EPDM. They also resist water and brake fluid. Temperature range is –70° to 250° F. Durometer is A70 (medium). Color is black.

	Fractional Size		Actual Inch Size		Oil-Resistant Buna-N			Chemical-Resistant Viton® Fluoroelastomer			High-Temperature Silicone			Steam-Resistant EPDM		
Dash No.	ID	OD	ID	OD	Pkg. Qty.		Pkg.	Pkg. Qty.		Pkg.	Pkg. Qty.		Pkg.	Pkg. Qty.		Pkg.
Width: 1/32 Fractional (0.040″ Actual)																
001	1/32	3/32	0.029″	0.109″	100	9452K111	$3.56	100	9464K101	$4.92	25	1283N11	$3.60	25	9557K111	$3.31
001-1/2	1/16	1/8	0.070″	0.150″	100	9452K311	4.34	100	9464K181	9.05	—	—	—	25	9557K199	6.74
Width: 3/64 Fractional (0.050″ Actual)																
002	3/64	9/64	0.042″	0.142″	100	9452K112	3.40	100	9464K102	4.16	25	1283N12	3.60	25	9557K112	2.90
Width: 1/16 Fractional (0.060″ Actual)																
003	1/16	3/16	0.056″	0.176″	100	9452K11	3.45	100	9464K103	4.11	25	1283N13	3.60	25	9557K113	3.05
Width: 1/16 Fractional (0.070″ Actual)																
004	5/64	13/64	0.070″	0.210″	100	9452K12	3.51	100	9464K104	4.22	25	1283N14	3.60	25	9557K61	2.95
005	3/32	7/32	0.101″	0.241″	100	9452K13	3.51	100	9464K105	4.36	25	1283N15	3.60	25	9557K62	2.95
006	1/8	1/4	0.114″	0.254″	100	9452K14	3.49	100	9464K11	4.48	25	1283N16	3.34	100	9557K457	7.89
007	5/32	9/32	0.145″	0.285″	100	9452K15	3.49	100	9464K12	4.62	25	1283N17	3.34	100	9557K458	8.19
008	3/16	5/16	0.176″	0.316″	100	9452K16	3.51	100	9464K13	4.95	25	1283N18	3.34	100	9557K459	8.28
009	7/32	11/32	0.208″	0.348″	100	9452K17	2.22	100	9464K14	5.21	25	1283N19	3.34	100	9557K461	8.38
010	1/4	3/8	0.239″	0.379″	100	9452K18	2.25	100	9464K15	5.31	25	1283N21	3.34	100	9557K462	8.38
011	5/16	7/16	0.301″	0.441″	100	9452K19	3.55	100	9464K16	6.32	25	1283N22	3.49	100	9557K463	8.58

(Continued on following page)

Wool Felt

About Selecting Wool Felt

	Hard			Extra Firm	Firm	Medium	Soft	Very Soft		Ultra Soft
Felt Grade	**S2-32**	**S2-24**	**S2-20**	**F1**	**F3**	**F5**	**F7**	**F10**	**F13**	**F26**
Firmness (10% Deflection), psi	121	86	58	21	13	6	6	4	3	1
Density, lbs./sq. yd. @ 1″ thick	32	24	20	16	15.6	12.2	12.2	8.4	8.4	7.2
Minimum Wool Fiber Content	100%	100%	100%	95%	85%	95%	80%	95%	75%	45%
Durometer Hardness (Shore A) ±5	80	55	50	35	35	25	25	20	20	10
Tensile Strength, psi	500	600	500	500	400	400	250	225	75	Not Rated

Wool Felt Selector Pack—Includes seven samples; one 1¾″ x 1⅜″ piece of each of the following felts: F1, F3, F5, F7, F10, F13, and F26. Information about each felt is listed on the back side of the sample sheet.
9248K222 ..... $6.21

Hard Off-White S2 Felt

- Temperature Range: –80° to +200° F
- Vibration Absorption: Excellent
- Abrasion Resistance: Excellent

Made of 100% wool, this is the hardest felt we offer, yet it can still be used for polishing.
Grade S2-32—The hardest of these S2 grades, this material can be used as shock-absorbing bumpers, gaskets, and washers.
Grade S2-24—Slightly less firm than S2-32, this felt is commonly used for buffing, padding, in ink rollers, and in marking devices.
Grade S2-20—Use on polishing wheels for buffing lenses, mirrors, glass, marble, granite, metals, and wood.

	GRADE S2-32				GRADE S2-24				GRADE S2-20			
Thick.	12″×12″		36″×36″		12″×12″		36″×36″		12″×12″		36″×36″	
1/8″	8759K81	$20.21	8759K85	$136.44	8759K31	$15.59	8759K1	$105.24	8759K71	$12.69	8759K51	$85.71
1/4″	8759K82	36.94	8759K86	249.40	8759K33	31.24	8759K3	210.96	8759K73	25.62	8759K53	162.66
3/8″	8759K83	55.24	8759K87	373.00	8759K34	41.56	8759K4	270.57	8759K74	33.71	8759K54	215.96
1/2″	8759K84	75.72	8759K88	511.26	8759K35	55.93	8759K5	388.10	8759K75	38.18	8759K55	255.54

Extra Firm White F1 Felt

Sheets and Sheeting

- Temperature Range:
  Plain back and cord: –80° to +200° F
  Adhesive back: 0° to +180° F
- Vibration Absorption: Excellent
- Abrasion Resistance: Excellent

Composed almost entirely of pure wool, F1 is one of the most versatile graded felts. Its high density provides wear and abrasion resistance when used for polishing, wicking, cushioning, wiping, and gasketing. ***Adhesive-back*** sheets, strips, and discs have a rubber-based adhesive.

Sheets, Sheeting, and Strips

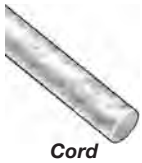
To Order: For sheeting, please specify length: 1, 2, 3, 4, 5, or 10 ft.
To Order: For strips, please specify length: 10, 25, or 50 ft.

Strips

	SHEETS		SHEETING		STRIPS							
	12″×12″		60″ Wide		½″ Wide		1″ Wide		1½″ Wide		2″ Wide	
Thick.	Each		Per Ft.		Per Ft.		Per Ft.		Per Ft.		Per Ft.	
Plain Back												
1/16″	8334K35	$9.04	8755K11	$25.48	5051K151	$0.58	5051K161	$1.13	5051K221	$1.33	5051K231	$2.09
1/8″	8334K31	14.67	8755K12	38.73	5051K51	.90	5051K57	1.53	5051K64	2.21	5051K71	2.80
3/16″	8334K36	23.09	8755K13	53.19	5051K281	1.10	5051K291	2.07	5051K351	3.07	5051K361	3.51
1/4″	8334K32	26.98	8755K14	70.95	5051K52	1.53	5051K58	2.80	5051K65	3.90	5051K72	4.81
3/8″	8334K33	36.97	8755K15	94.46	5051K53	2.47	5051K59	3.74	5051K66	5.09	5051K73	6.83
1/2″	8334K34	49.30	8755K16	121.61	5051K54	2.92	5051K61	4.80	5051K67	6.55	5051K74	9.13
Adhesive Back												
1/16″	8334K15	12.21	_____	_____	5051K421	.77	5051K431	1.20	5051K481	1.79	5051K491	2.10
1/8″	8334K11	17.31	_____	_____	5051K11	.92	5051K17	2.03	5051K24	2.28	5051K31	2.86
3/16″	8334K16	24.85	_____	_____	5051K551	1.34	5051K561	2.30	5051K621	3.22	5051K631	4.16
1/4″	8334K12	29.35	_____	_____	5051K12	1.66	5051K18	3.15	5051K25	4.17	5051K32	5.73
3/8″	8334K13	42.96	_____	_____	5051K13	2.70	5051K19	4.02	5051K26	5.82	5051K33	7.48
1/2″	8334K14	54.08	_____	_____	5051K14	3.03	5051K21	5.23	5051K27	7.75	5051K34	9.35

	SHEETS				STRIPS			
	12″×12″		12″×60″		½″×30″		1″×30″		2″×30″	
Thick.	Each		Each		Each		Each		Each	
Plain Back										
3/4″	8334K38	$71.20	8755K801	$185.49	5051K91	$9.44	5051K93	$16.41	5051K95	$28.55
1″	8334K39	88.37	8755K901	232.18	5051K92	11.91	5051K94	21.43	5051K96	36.33

Cord



Cord

To Order: Please specify length in 5-ft. increments up to the maximum length listed.

Dia.	Max. Length		Per Ft.	Dia.	Max. Length		Per Ft.	Dia.	Max. Length		Per Ft.
1/8″	25 ft.	8767K21	$0.98	1/4″	25 ft.	8767K23	$1.26	1/2″	15 ft.	8767K25	$3.23
3/16″	25 ft.	8767K22	1.07	3/8″	15 ft.	8767K24	1.92				

Discs

Discs

	PLAIN BACK						ADHESIVE BACK					
Thick.	4″ Dia.		6″ Dia.		8″ Dia.		4″ Dia.		6″ Dia.		8″ Dia.	
1/8″	8307K21	$2.90	8307K41	$5.82	8307K61	$9.33	8307K11	$3.82	8307K31	$7.67	8307K51	$11.61
1/4″	8307K22	5.56	8307K42	11.11	8307K62	17.86	8307K12	6.46	8307K32	12.98	8307K52	19.73
3/8″	8307K23	8.02	8307K43	16.03	8307K63	25.76	8307K13	9.00	8307K33	17.99	8307K53	27.24
1/2″	8307K24	10.32	8307K44	20.63	8307K64	31.26	8307K14	11.32	8307K34	22.63	8307K54	34.29

About Selecting Thermal Insulation

A material's resistance to temperature and its ability to block heat are important factors to consider when choosing thermal insulation. *R-value* measures the material's capacity to slow heat flow; the higher the R-value, the better the material insulates. The chart below shows R-value for 1″ thick insulation. To calculate the R-value of additional thicknesses, divide the material's thickness by its K-factor. *K-factor* measures the heat flow rate from one side of the insulation to the other; the lower the K-factor, the better the material insulates.

Use the chart to find the insulation material that best suits your application. If insulating below 0° F, use polyethylene, foam rubber, aerogel, or polyimide insulation.

Insulation Material	Max Temp., °F	R-Value @ 1″ thick	Pages
PVC Foam	160°	4.5	3679
Polystyrene Foam	165°	3.9-5.0	3679
Polyethylene Foam	180°	4.0	3674, 3680
Spray Foam	200°	5.0	3679
Polyurethane	200°	5.3-6.2	3676, 3679
Foam Rubber	220°	3.7	3672-3673, 3680
Cork	265°	3.6	3680
Melamine	350°	4.0	3676, 3680
Fiberglass	350°-1000°	1.7-4.8	3673, 3675, 3681

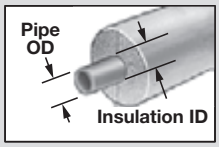
Insulation Material	Max Temp., °F	R-Value @ 1″ thick	Pages
Silicone Foam	390°	2.6	3673, 3680
Aerogel	390°	9.5	3680
Polyimide	550°	4.2	3680
Cellular Glass	900°	3.4	3676
Mineral Wool	1200°	3.7-4.4	3675, 3679-3680
Calcium Silicate	1200°-1700°	1.0	3683
Millboard	1400°-2000°	1.0	3683
Ceramic	1500°-2730°	0.8-3.6	3682
Silica	2000°	1.3	3683

Selecting Insulation for Pipe and Fittings

Pipe and Tubing Application	Good	Better	Best
Hot and Cold Water (up to 200° F)	Polyethylene (pg. 3674)	Low-Temp. Polyethylene (pg. 3674)	Foam Rubber (pgs. 3672-3673)
Steam (up to 400° F)	Polyurethane (pg. 3676)	Melamine (pg. 3676)	Silicone (pg. 3673)
High Temperatures (up to 1200° F)	Fiberglass (pg. 3675)	Cellular Glass (pg. 3676)	Mineral Wool (pg. 3675)

To select the proper pipe insulation, measure the outside diameter (OD) of your pipe with a ruler to find the corresponding insulation ID. Pipe size is the accepted industry designation, not the actual size.

Pipe Size	1/8	1/4	3/8	1/2	3/4	1	1 1/4	2	2 1/2	3	3 1/2	4	6
Pipe OD	3/8″	1/2″	5/8″	27/32″	1 1/16″	1 5/16″	1 5/8″	2 3/8″	2 7/8″	3 1/2″	4″	4 1/2″	6 5/8″
Insulation ID	3/8″	1/2″	5/8″	7/8″	1 1/8″	1 3/8″	1 5/8″	2 3/8″	2 7/8″	3 5/8″	4 1/8″	4 1/2″	6 5/8″



Ultra-Flexible Foam Rubber Pipe Insulation

- Temperature Range: –295° to 220° F, except Slit with Adhesive Strip is –295° to 180° F
- Heat Flow Rate (K-Factor) @ 75° F: 0.25
- Density: 3-6 lbs./cu. ft.
- Color: Black

The most flexible pipe insulation we offer, this soft Buna-N/PVC rubber flexes for easy installation over curved or irregular surfaces and recovers its shape well after compression. Use on chilled water and refrigeration lines and with hot water plumbing. Material has a closed-cell construction for moisture resistance. Insulation can be used outdoors when coated with latex paint; seal seams and joints with contact adhesive (both sold separately). Meets ASTM E84 25/50 for flame and smoke and ASTM C534.

Unslit and Slit with Adhesive Strip Insulation for Pipe and Tubing

Insulation ID	Lg., ft.	UNSLIT 3/8″ Thick		UNSLIT 1/2″ Thick		UNSLIT 3/4″ Thick		SLIT WITH ADHESIVE STRIP 1/2″ Thick		SLIT WITH ADHESIVE STRIP 3/4″ Thick		SLIT WITH ADHESIVE STRIP 1″ Thick	
1/4″	6	4463K23	$2.29	4463K114	$3.39								
3/8″	6	4463K121	2.22	4463K131	3.43	4463K161	$5.12						
1/2″	6	4463K122	2.38	4463K132	3.63	4463K162	5.68						
5/8″	6	4463K123	2.71	4463K133	4.01	4463K163	6.17	44745K21	$6.49	44745K47	$11.07	44745K73	$15.72
3/4″	6	4463K124	2.90	4463K134	4.14	4463K164	6.72	44745K23	7.28	44745K49	11.96	44745K75	17.30
7/8″	6	4463K125	3.04	4463K135	4.48	4463K165	7.39	44745K25	7.94	44745K51	12.28	44745K77	18.74
1 1/8″	6	4463K126	3.46	4463K136	5.04	4463K166	9.05	44745K27	8.88	44745K53	14.16	44745K79	20.28
1 3/8″	6	4463K127	3.95	4463K137	5.51	4463K167	10.30	44745K29	10.14	44745K55	16.06	44745K81	23.59
1 5/8″	6	4463K128	4.89	4463K138	6.39	4463K168	13.89	44745K31	11.08	44745K57	17.32	44745K83	25.58
1 7/8″	6	4463K129	5.93	4463K139	7.75	4463K169	15.70	44745K33	12.39	44745K59	17.99	44745K85	28.39
2 1/8″	6	4463K151	6.07	4463K141	8.34	4463K171	17.18	44745K35	13.46	44745K61	18.62	44745K87	29.75
2 3/8″	6			4463K142	9.92	4463K172	18.48	44745K37	17.22	44745K63	21.38	44745K89	30.92
2 5/8″	6			4463K143	11.08	4463K173	21.61	44745K39	19.52	44745K65	22.24	44745K91	36.37
2 7/8″	6			4463K144	12.53	4463K174	24.67	44745K41	21.61	44745K67	25.38	44745K93	43.28
3 1/8″	6			4463K145	13.06	4463K175	25.22	44745K43	23.04	44745K69	27.59	44745K95	44.87
3 5/8″	6			4463K146	18.35	4463K176	30.80	44745K45	24.93	44745K71	30.15	44745K97	47.03
4 1/8″	6			4463K147	21.36	4463K177	35.30	44745K46	24.08	44745K72	34.87	44745K96	65.18
4 1/2″	6			4463K148	21.84	4463K178	37.54	44745K48	31.11	44745K74	38.87	44745K98	70.77
5 1/2″	6			4463K149	31.40	4463K179	45.30						
6 5/8″	6			4463K191	38.03	4463K192	54.84						

Long-Length Unslit Insulation for Pipe and Tubing

Insulation ID	3/8″ Thick Lg., ft.			1/2″ Thick Lg., ft.		
5/8″	125	4463K411	$56.82	95	4463K511	$63.48
3/4″	110	4463K412	53.42	85	4463K512	58.70
7/8″	95	4463K413	50.31	75	4463K513	58.69
1 1/8″	75	4463K414	43.37	55	4463K514	48.39

(Continued on following page)

About Rubber

Rubber compresses and bounces back to shape, so it is often used in sealing, cushioning, and shock-absorbing applications.

Applications Guide

Use the chart below to identify which materials have resistance to 11 common chemicals. Boxes with a • symbol indicate the chemical will have little or no effect on the material. Blank boxes indicate that the chemical is not recommended for that material. Information is intended for comparison only.

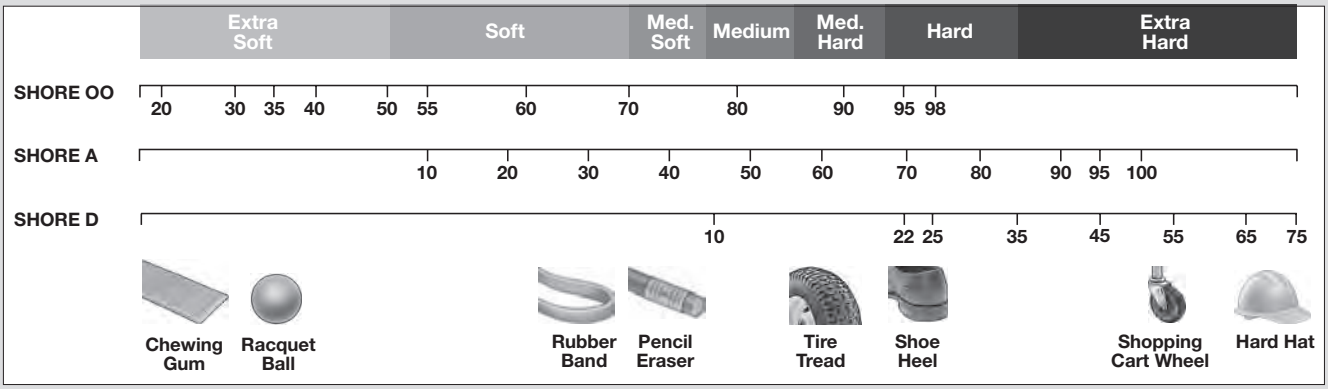
	Minimum Temp., °F	Maximum Temp., °F	Acetic Acids	Animal/Vegetable Oils	Detergents	Gasoline	Grease	Hydraulic Oils	Isopropyl Alcohol	Salt Water	Steam	Synthetic Lubricants	Water	Pages
Multipurpose														
Neoprene	0°	200°			•				•	•			•	3687-3691
High Temperature														
Silicone	-60°	400°	•		•				•	•			•	3691-3696
Oil Resistant														
Buna-N	-20°	170°		•	•	•	•	•	•	•			•	3696-3700
Buna-N/Vinyl	-20°	200°		•	•	•	•	•	•	•			•	3698
Chemical Resistant														
Viton® Fluoroelastomer	0°	400°		•	•	•	•	•	•	•	•	•	•	3700-3701
Aflas	40°	400°			•	•		•	•	•	•	•	•	3697, 3701
Fluorosilicone	-65°	450°		•		•	•	•	•	•			•	3700
Kalrez	0°	525°	•	•	•	•		•	•	•	•		•	3700
Abrasion Resistant														
Polyurethane	-10°	200°		•		•	•						•	3701-3707
Natural Gum	-20°	140°			•				•	•			•	3704, 3706
SBR	-20°	170°								•			•	3704-3705
Weather Resistant														
EPDM	-40°	225°	•		•				•	•	•		•	3707-3709
Butyl	-40°	225°	•		•				•	•	•		•	3708
Santoprene	-50°	250°	•				•			•			•	3708-3709

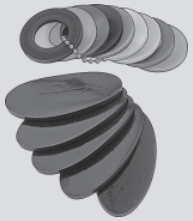
Material Selector Pack—Includes 15 pieces, one each of the following rubber materials: Buna-N, butyl, ECH, EPDM, latex, natural rubber, neoprene, polyethylene, polyurethane, soft polyurethane, Santoprene, SBR, silicone, vinyl, and Viton® fluoroelastomer. Each piece ranges in size from 4″×4″ to 6″×6″ and from 1/16″ to 1/8″ thick.

8450K2 ..... Pkg. $61.13

Durometer Hardness Scales

An international standard for measuring the hardness of rubber and plastic, a durometer rating indicates a material's resistance to surface penetration. There are several durometer scales and a material's durometer rating can fall across more than one scale. For example, a typical shoe heel rates 95 on the Shore OO scale, 70 on the Shore A scale, and 22 on the Shore D scale; all of these ratings indicate that a shoe heel has a relative hardness of hard. As a material gets harder, it generally offers more wear resistance but it becomes less flexible.





Durometer Hardness Selector Pack—Includes 14 pieces, one each of the following durometer hardnesses: 30OO, 40OO, 50OO, 60OO, 70OO, 30A, 40A, 50A, 60A, 70A, 80A, 90A, 95A, and 75D. Each piece is oval or ring shape and ranges in size from 1/8″ to 3/16″ thick.

8450K4 ..... Pkg. $23.53

About Foam

Foam is a rubber or plastic that is not completely solid—it contains cells of air which makes it very lightweight and good for sealing and cushioning applications.

Open-cell foam allows water, air, and gases to be absorbed. **Closed-cell** foam restricts water, air, and gases from being absorbed.

	Weather Resistance			Oil Resistance			Temperature Range	Pages
	Indoor Use	Outdoor Use	Extended Outdoor Use	No Oil Contact	Oil Contact	Extended Oil Contact		
For Sealing								
Viton® Fluoroelastomer	■	■	■	■	■	■	-10° to 400°F	3719
Neoprene	■	■	■	■	■		-70° to 200°F	3710-3711
Nylon	■	■	■				-40° to 400°F	3719
EPDM	■	■	■				-40° to 225°F	3712
Silicone	■	■	■				-100° to 500°F	3714-3718
Buna-N	■	■		■	■	■	-40° to 200°F	3719
Blended Buna-N	■	■		■	■		-40° to 200°F	3718
Blended EPDM	■	■					-40° to 200°F	3713
Vinyl	■	■					-30° to 160°F	3713
Santoprene	■	■					-50° to 275°F	3712
Natural Gum	■	■					-20° to 160°F	3714
For Cushioning								
Polyethylene	■	■					-110° to 160°F	3723-3725
Polyurethane	■						-40° to 225°F	3720-3724
EVA	■	■					-70° to 160°F	3725
Polyimide	■						-300° to 400°F	3718
Ionomer	■	■					-85° to 175°F	3725

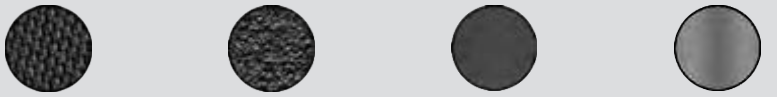
Material Sample Pack—Includes one individually marked piece of each of the materials listed above, except nylon, blended Buna-N, blended EPDM, and santoprene. Each piece is approximately 4″×4″. Thicknesses range from 1/8″ to 1/2″. **2172T21** $48.00

Hardness—Ultra-soft foam compresses easily, while harder foam resists compression. The hardness rating is measured in pounds per square inch (psi) and indicates how much force is required to compress foam 25%.

Ultra Soft 0-4 psi | Extra Soft 5-8 psi | Soft 9-12 psi | Medium 13-19 psi | Medium Hard 20 psi and up

Hardness Sample Pack—Includes six samples, one each of the following pressure ratings: 0.6 psi, 4 psi, 7 psi, 12 psi, 18 psi, and 45 psi. Size is 6″×6″. Thicknesses range from 1/32″ to 1/2″. **2172T11** $32.97

Texture—*Crisscross* texture provides a nonslip gripping surface. *Ultra-smooth* texture provides a sleek surface that's easy to wipe down.



Crisscross | Coarse | Smooth | Ultra Smooth

Multipurpose Neoprene Foam

In addition to having good resistance to water, sunlight, and oxidation, this foam resists swelling when it comes into contact with oil. Color is black.

Strips—Smooth Texture without Skin

Foam has closed-cell construction. Foam minimum temperature is -70° F; maximum temperature is at least 200° F.
Adhesive-back foam has acrylic adhesive with a temperature range of -30° to 200° F.

Thick.	Lg., ft.		Adhesive Back 1/8″ Wd.	3/16″ Wd.	1/4″ Wd.	5/16″ Wd.	1/2″ Wd.	5/8″ Wd.	3/4″ Wd.	7/8″ Wd.	1″ Wd.	1 1/8″ Wd.	1 1/4″ Wd.	1 1/2″ Wd.	1 3/4″ Wd.	2″ Wd.
Medium Hardness																
1/32″	10	**93375K205**	$12.50	$14.58	$15.64	—	$18.76	$20.84	$22.92	—	$27.10	—	—	—	—	$31.26
1/16″	10	**93375K248**	8.86	10.94	13.04	$10.42	15.50	15.84	17.94	$17.92	19.98	$21.68	$22.92	$24.18	$25.84	29.36
3/32″	10	**93375K298**	9.90	12.50	10.42	11.26	15.44	17.08	19.18	20.84	21.68	—	—	—	—	34.60
1/8″	10	**93375K301**	10.94	13.54	14.70	12.08	17.94	17.92	22.02	22.50	25.28	25.00	26.26	30.42	33.76	40.36
3/16″	10	**93375K391**	—	14.58	16.26	17.08	20.84	24.18	27.50	30.42	32.10	—	—	—	—	54.18
1/4″	10	**93375K43**	—	—	18.36	18.76	23.94	25.84	30.54	33.34	36.32	39.18	42.94	46.48	54.18	62.98
5/16″	10	**93375K512**	—	—	—	22.10	28.34	32.92	38.16	43.34	46.26	—	—	—	—	81.70
3/8″	10	**93375K572**	—	—	—	—	30.54	33.76	39.80	44.60	48.68	50.86	57.10	64.18	72.52	88.10
7/16″	10	**93375K586**	—	—	—	—	35.84	45.84	50.44	55.02	57.52	—	—	—	—	106.28
1/2″	10	**93375K728**	—	—	—	—	37.10	38.34	49.46	48.34	61.04	63.78	71.70	80.86	92.12	112.82
3/4″	3	**93375K786**	—	—	—	—	—	—	44.00	—	25.50	27.64	31.02	35.26	40.38	46.64
1″	3	**93375K833**	—	—	—	—	—	—	—	—	38.26	34.76	40.26	47.76	53.90	61.90
2″	3	**93375K701**	—	—	—	—	—	—	—	—	—	—	—	—	—	123.80

(Continued on following page)

About Plastics

Use the charts below to identify the best plastic for your application. Circles indicate that a majority of a material's shapes and sizes meet the applicable rating. Blank boxes indicate a poor rating or no rating. Information is intended for comparison only and is given without obligation or liability.

● Excellent ◓ Good

Clear Multipurpose Plastic

	Maximum Temp., °F	Minimum Temp., °F	Tensile Strength	Impact Strength	Chemical Resistance	Slippery	Machinability	Electrical Insulator	Pages
PETG	140°	–40°	◓	◓	◓				3731
Acrylic	160°	32°	◓				◓	◓	3734-3736
Cast Acrylic	170°	–40°	●				◓	◓	3732-3734
Cellulose	170°	50°		◓				◓	3736
Polycarbonate	180°	–40°	◓	●			◓	◓	3727-3731

Clear Multipurpose Selector Pack—Contains five pieces; one 2″×2″ piece of each plastic listed above. **5331K5** $31.23

Multipurpose Plastic

	Maximum Temp., °F	Minimum Temp., °F	Tensile Strength	Impact Strength	Chemical Resistance	Slippery	Machinability	Electrical Insulator	Pages
UHMW	180°	–20°		●	◓	◓	◓	●	3762-3767
LDPE	120°	50°		●	◓				3758-3759
HDPE	180°	50°		◓	◓		●		3759-3761
Nylon	185°	–40°	●	◓			◓	◓	3745-3748
Cast Nylon	200°	–20°	●			◓	●	●	3749-3750
Delrin® Acetal	180°	–20°	◓	◓		◓	●	●	3751-3754
Polyester	230°	–40°	●				◓	◓	3757
ABS	140°	50°	◓	●			●	●	3744
Polystyrene	155°	0°		◓			●	●	3743
Rexolite Polystyrene	212°	–75°	●	◓				●	3743
Noryl PPO	220°	–40°	◓	◓			●	●	3743

Multipurpose Selector Pack—Contains eleven pieces; one 2″×2″ piece of each plastic listed above. **5331K93** $54.71

Chemical-Resistant Plastic

	Maximum Temp., °F	Minimum Temp., °F	Tensile Strength	Impact Strength	Chemical Resistance	Slippery	Machinability	Electrical Insulator	Pages
PVC	140°	32°	◓		●		◓	●	3737-3740
CPVC	200°	32°	◓	◓	◓		◓	●	3740
Polypropylene	180°	45°		◓	◓		◓	●	3741-3742
Teflon® PTFE	500°	–350°		◓	●	●	◓	●	3768-3770
FEP	400°	–320°		●	●	◓		●	3774
PVDF	265°	–25°	◓	◓	◓	◓	◓		3773
PPS	425°	50°	●		◓		◓	●	3775

Chemical-Resistant Selector Pack—Contains seven pieces; one 2″×2″ piece of each plastic listed above. **5331K92** $55.66

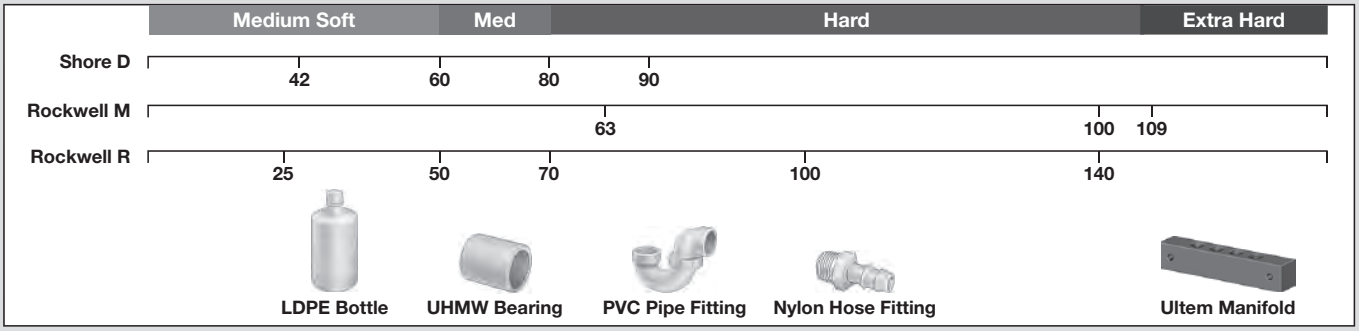
High-Temperature Plastic

	Maximum Temp., °F	Minimum Temp., °F	Tensile Strength	Impact Strength	Chemical Resistance	Slippery	Machinability	Electrical Insulator	Pages
PEEK	480°	–20°	●	◓	◓		●	◓	3776
PFA	500°	–320°		●	●	◓		●	3775
Ultem PEI	335°	–20°	●				◓	●	3775
Torlon PAI	500°	–320°	●		◓	◓	◓		3777
Polyimide	550°	–425°	●		◓		◓	●	3777

High-Temperature Selector Pack—Contains five pieces; one 2″×2″ piece of each plastic listed above. **5331K91** $99.53

Hardness

The hardness of a material is its resistance to surface penetration. Harder materials are more wear resistant but are less flexible. Plastic hardness can be measured on a durometer (Shore) scale or Rockwell scale. The scales have some overlap; therefore, if a material has a hardness rating of Shore 60D, it is the same hardness as those rated Rockwell R50.



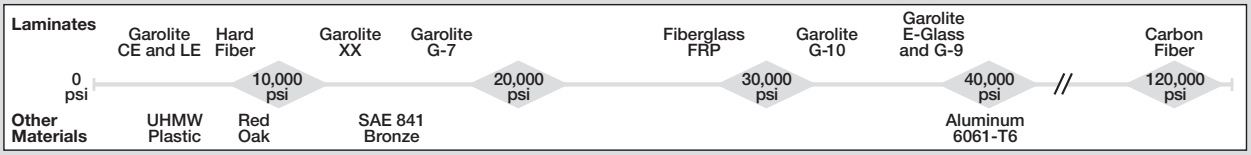
About Plastic Laminates

Hard fiber, fiberglass, Garolite, and carbon fiber (also referred to as plastic laminates and composites) are usually created by combining fiber, paper, or fabric with epoxy or resin. Commonly called thermosets because they are created by setting under heat, they have very different properties than more common plastics such as polyethylene and nylon. They are not designed to be heated, so you cannot bend and form them.

Fiberglass and Garolite Material Selector Pack—Includes one individually marked piece of electrical-grade fiberglass (GPO3) and the following grades of Garolite: XX, CE, LE, G-9, G-10, G-11, and G-7. Each piece is 2″×2″×1/16″.

5331K3 ..... $22.00

Tensile Strength—Refers to the amount of stretching a material can withstand before breaking. E-glass and glass carbon are not rated for tensile strength.



Electrical Insulation—All plastic laminates have some electrical insulating capabilities. Ratings are based on their relative insulating (dielectric) strength, which is the maximum voltage the material can withstand. E-glass, glass carbon, and carbon fiber do not have an electrical insulation rating.

Excellent	Good	Poor
G-11	G-10, G-10/FR4, G-9, XX, G-7, GPO3	Hard Fiber, FRP, CE, LE

Machinability—Plastic laminates are difficult to machine; carbide or diamond-tipped tools are generally required when machining to achieve the best results. The machinability ratings below are based on speed, life of the tooling, and the level of ease to attain a satisfactory finish.

Good	Fair	Difficult
Hard Fiber, XX, CE, LE, Glass Carbon	GPO3, E-glass, Carbon Fiber	FRP, G-9, G-10, G-10/FR4, G-11, G-7

Moisture Resistance—The base material affects the amount of moisture absorbed into the laminates. Cloth-based laminates have a higher absorption rate than laminates with other base materials. E-glass, glass carbon, and carbon fiber are not rated for moisture resistance.

Excellent	Good	Fair	Poor
G-10, G-10/FR4, Carbon Fiber, G-11, GPO3	G-7, G-9	FRP	Hard Fiber, CE, LE, XX

Hard Fiber

Hard Fiber

- Color: Opaque gray, unless noted
- Max. Temperature: 235° F
- Tensile Strength: Good
- Impact Strength: Good
- Electrical Insulator: Poor, except electrical-grade sheets are good
- Machine: Use high-speed steel tooling
- Hardness: Rockwell R70-R80

Also known as vulcanized fiber, this material has a cotton-fabric base that has been chemically treated to produce a hard, dense substance that is also lightweight. Meets UL 94HB for flame retardance, MIL-F-1148A, and MIL-F-10336A, except *electrical-grade sheets* meet UL 94HB and MIL-I-695A.

Rods—Smooth Finish

Length tolerance is ±3″. Straightness tolerance is not rated.

Dia.	Dia. Tolerance	45″ Length	
3/16″	±0.005″	8653K43	$20.20
1/4″	±0.005″	8653K44	24.73
5/16″	±0.006″	8653K45	25.53
3/8″	±0.006″	8653K46	31.17
1/2″	±0.006″	8653K51	36.89
9/16″	±0.006″	8653K52	47.86
5/8″	±0.006″	8653K54	58.78
3/4″	±0.006″	8653K55	74.44

Sheets—Smooth Finish

Width and length tolerances are ±1/8″ for 12″×12″ sheets, ±1″ for 24″×39″ sheets, and ±2″ for 39″×48″ sheets. Flatness tolerance is not rated.

Thick.	Thick. Tolerance	12″×12″		24″×39″		39″×48″	
1/16″	±0.005″	8652K73	$18.39	8652K83	$78.57	8652K93	$126.15
3/32″	±0.007″	8652K74	29.77	8652K84	111.73	8652K94	181.64
1/8″	±0.015″	8652K75	40.47	8652K85	140.46	8652K95	213.79
3/16″	±0.015″	8652K76	54.02	8652K86	197.09	8652K96	267.67
1/4″	±0.015″	8652K77	69.59	8652K87	248.37	8652K97	352.35
3/8″	±0.020″	8652K78	107.58	8652K88	381.33	8652K98	509.39
1/2″	±0.025″	8652K79	127.55	8652K89	482.85	8652K99	761.95

Electrical-Grade Sheets—Smooth Finish

- Color: Opaque gray to blue-green

Also known as fishpaper, these sheets offer good electrical-insulation properties and flexibility. Thickness tolerance is ±10%. Width and length tolerances are ±1/8″ for 12″×12″ sheets, ±1″ for 24″×39″ sheets, and ±2″ for 39″×48″ sheets. Flatness tolerance is not rated.

Thick.	12″×12″		24″×39″		39″×48″	
0.005″	8490K15	$7.08	8490K25	$23.35	8490K35	$35.38
0.010″	8490K11	5.48	8490K21	17.76	8490K31	26.82
0.015″	8490K12	7.18	8490K22	25.19	8490K32	36.34
0.020″	8490K13	$8.62	8490K23	$31.14	8490K33	$47.52
0.025″	8490K16	14.50	8490K26	47.86	8490K36	72.51
0.030″	8490K14	10.32	8490K24	46.39	8490K34	72.02

Tubes—Smooth Finish

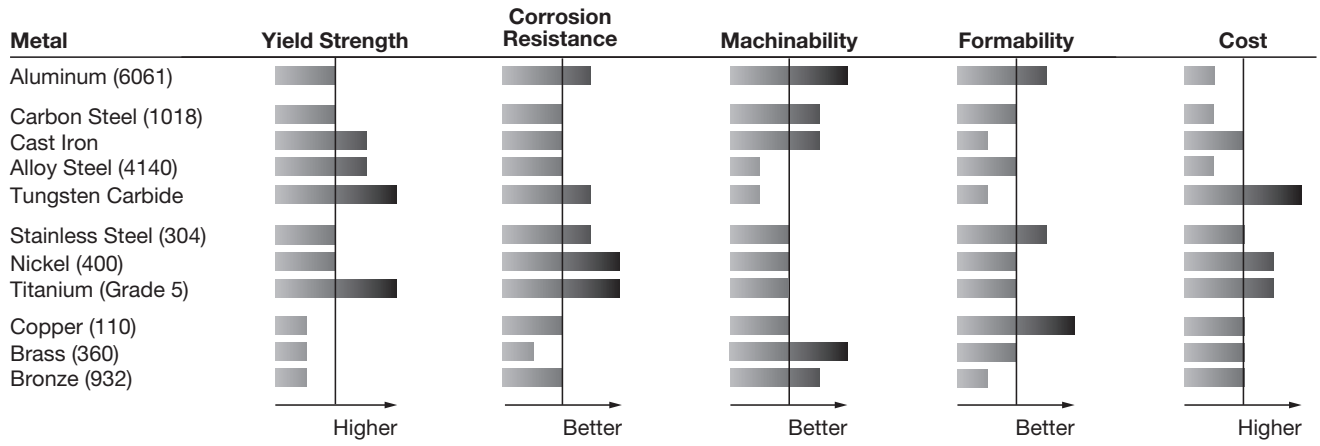
Length tolerance is ±3″. Wall thickness and straightness tolerances are not rated.

OD	ID	Wall Thick.	40″ Length	
9/16″	7/16″	1/16″	8654K29	$23.76
5/8″	1/2″	1/16″	8654K33	23.82
11/16″	7/16″	1/8″	8654K35	33.23
3/4″	1/2″	1/8″	8654K37	32.25
7/8″	3/4″	1/16″	8654K43	$29.33
1″	7/8″	1/16″	8654K49	31.79
1 1/4″	1″	1/8″	8654K55	47.61
1 1/2″	1 1/4″	1/8″	8654K57	49.89
1 3/4″	1 1/2″	1/8″	8654K61	$57.79
2″	1 1/2″	1/4″	8654K63	96.02
2 1/4″	2″	1/8″	8654K65	73.14

About Metals

If you are not sure which metal is right for your application, use the charts below to compare the 11 most common types. The information provided is for use as a general guideline; the properties will vary among the different alloys and grades within each material. For more details about these metals, please see the pages listed below.

Compare Types of Metals



Features and Uses of Metals

		Pages
Aluminum	This general-purpose material is lightweight, corrosion resistant, easy to machine, and a good conductor of heat and electricity. It's often used for pipe fittings, vehicle bodies, and lightweight fasteners.	3799-3827
Carbon Steel	Offers good machinability and weldability at an economical cost but lacks corrosion resistance. This type of steel is used for a variety of structural applications.	3828-3841
Cast Iron	Provides good machinability and strength. It absorbs vibration so finished parts, such as gears and rollers, run more quietly than those made of carbon steel.	3844-3845
Alloy & Tool Steel	When compared to carbon steel, these steels offer greater strength, hardness, and wear resistance. Alloy steel will stand up to high-stress applications. Tool steel is used to make drill bits, punches, chisels, and similar cutting tools.	3845-3868
Tungsten	One of the hardest metals, tungsten is very wear resistant and can withstand extremely high temperatures. It's used to make long-lasting cutting tools.	3868-3869
Stainless Steel	This metal contains at least 10% chromium to increase corrosion resistance. It's used in chemical- and food-processing equipment. Stainless steel is typically not as strong as steel and can be more difficult to machine.	3870-3900
Nickel	It can handle many aggressive chemicals and acids. While nickel is more corrosion resistant than stainless steel, it is also more costly. Nickel is often used in marine applications and chemical-processing equipment.	3901-3902
Titanium	This premium metal is extremely strong yet relatively lightweight. Titanium has excellent resistance to corrosion, pitting, and stress cracking. It's often used for chemical-processing equipment and in marine environments.	3903-3904
Copper, Brass & Bronze	Commonly called red metals, each of these alloys has a high copper content that provides good weather resistance. Copper is an excellent conductor of heat and electricity, while brass and bronze offer good machinability and wear resistance. These metals are commonly used for piping, wire, valves, and bearings.	3905-3925

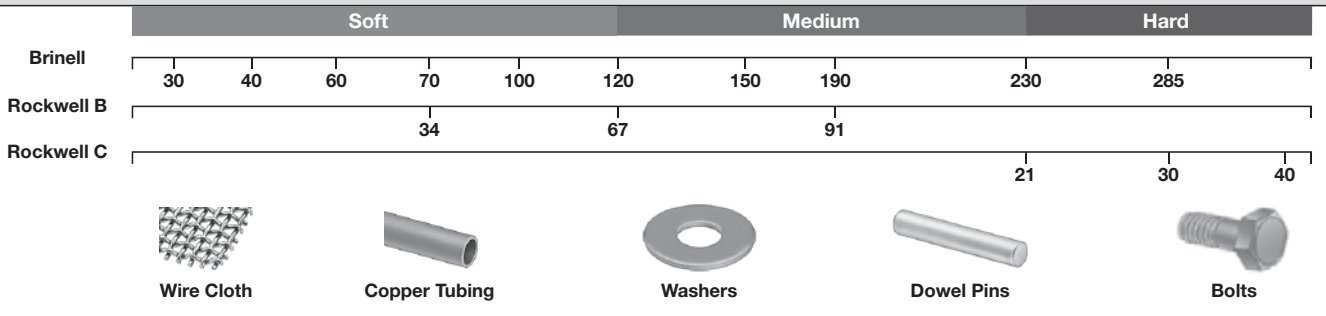
About Aluminum

A lightweight and economical metal, aluminum is a good conductor of heat and electricity. Depending on the alloy, it can either be heat treated or cold worked to increase its strength, but it will typically not be as strong as steel.

A corrosion-resistant layer forms naturally on its surface, so aluminum offers good corrosion resistance to salt water and chemicals. Clean this layer for improved weldability.

Hardness

As hardness increases, metals become more wear resistant, but they can also be less malleable. The chart below shows hardness measured on different scales.



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About Steel

Carbon steel is an economical choice for machining and structural applications, and it can be surface hardened.

Alloy steel has greater strength and hardness than carbon steel, making it useful for high-stress applications. Heat treating can further enhance strength and hardness.

Tool steel is used to make cutting tools, and it can be heat treated for extreme hardness.

● Excellent
◓ Good
○ Poor

Use the charts below to identify the best steel for your application. Circles indicate that a majority of a material's shapes and sizes meet the applicable rating. Information is intended for comparison only and is not guaranteed.

Carbon Steel

	Min. Yield Strength, psi	*Hardness (Rockwell)*		Machin-ability	Weld-ability	Impact Resistance	Wear Resistance	Form-ability	Pages
		Unhardened	Hardened						
Gen. Purpose Low Carbon	30,000	B50	C60	◓	●	____	____	____	3829-3837
High Strength 1045	65,000	B86	C62	◓	◓	____	____	○	3838
Shaft Quality 1060	50,000	____	C60	____	____	◓	◓	○	3838
High Strength 1144	100,000	C23	____	◓	○	○	◓	○	3839
Easy-to-Machine 1117	58,000	B75	B89	●	○	____	____	____	3841
Very Easy-to-Machine 1215	60,000	B85	____	●	○	____	____	○	3839
Ultra Machinable 12L14	60,000	B82	C65	●	○	○	○	○	3840-3841
Abrasion Resistant AR400	140,000	____	C38	◓	●	●	●	◓	3841
Impact Resistant A516	38,000	B78	____	◓	◓	◓	____	____	3841
Spring Steel	50,000	B88	C66	○	◓	●	●	○	3842-3843
Cast Iron	55,000	C20	C60	●	____	____	◓	____	3844-3845

Alloy Steel

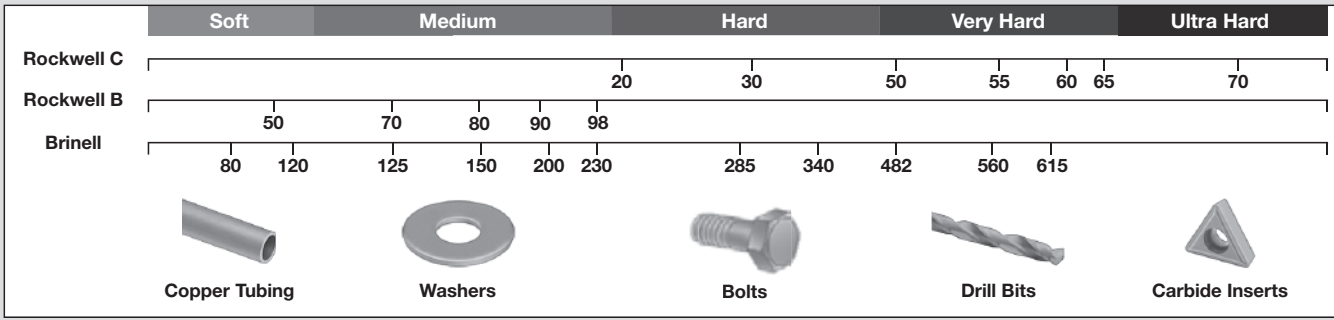
	Min. Yield Strength, psi	*Hardness (Rockwell)*		Machin-ability	Weld-ability	Impact Resistance	Wear Resistance	Form-ability	Pages
		Unhardened	Hardened						
Multipurpose 4140/4142	60,000	B90	C60	◓	◓	◓	◓	◓	3846-3850
Easy-to-Machine 41L40	85,000	B96	C34	●	____	◓	◓	◓	3845
Wear Resistant 4150	48,000	B90	C63	◓	◓	____	◓	____	3845
High Strength A514	100,000	____	C27	◓	◓	◓	○	◓	3845
High Strength 300M	230,000	C23	C54	○	◓	◓	◓	◓	3851
High Strength 4340	68,500	C27	C40	◓	◓	◓	◓	____	3850
Ultra Impact Resistant C300	110,000	C30	C55	○	◓	●	○	◓	3851
Easy-to-Weld 4130	50,000	B85	C60	◓	●	____	____	●	3851-3853
Easy-to-Weld 8620	55,000	B85	C60	◓	●	◓	○	●	3853
Bearing Quality E52100	62,000	C24	C60	○	○	◓	◓	○	3854

Tool Steel

	Min. Yield Strength, psi	*Hardness (Rockwell)*		Machin-ability	Weld-ability	Impact Resistance	Wear Resistance	Form-ability	Pages
		Unhardened	Hardened						
Multipurpose O1	50,000	B85	C65	◓	◓	◓	◓	●	3856-3858
Ultra Machinable W1	50,000	B88	C65	●	◓	◓	◓	●	3855
Wear Resistant A2	51,000	B88	C65	◓	◓	◓	◓	○	3859-3862
Ultra Wear Resistant D2	50,000	B90	C62	○	○	○	●	○	3862-3863
High Temperature H13	52,000	B94	C53	◓	◓	●	◓	○	3862
Shock Resistant S7	50,000	B90	C61	◓	◓	●	◓	◓	3864
Easy-to-Machine P20	101,000	____	C26	◓	____	◓	◓	____	3865
High Speed M2	60,000	B97	C66	○	○	○	●	○	3865-3867
Ultra Wear Resistant M4	60,000	B97	C65	○	____	○	●	____	3868
Ultra-Hard Tungsten Carbide	319,000	____	C79	◓	____	◓	●	○	3868-3869

Hardness

As hardness increases, metals become more wear resistant but they may be less malleable. The chart below shows hardness on different scales.



About Stainless Steel

When you need a corrosion-resistant metal, stainless steel is a practical choice. It contains chromium, which makes it more corrosion resistant than other types of steel. The designation 18-8 refers to stainless steel that has approximately 18% chromium and 8% nickel; it generally applies to types 301, 302, 303, and 304.

Hardening—Some types of stainless steel harden by cold working, and others can be heat treated. The 300 series hardens by cold working, many in the 400 series can be hardened by heat treating, and those designated "PH" can be heat treated by the process of precipitation hardening. All hardness values given below are in the unhardened condition.

Corrosion Resistance—An invisible film forms on the surface of stainless steel when it's in contact with oxygen. This allows it to withstand damage from corrosives including many acids, bases, and detergents, as well as salt water.

Formability—Stainless steel is generally formable and bendable, but types that harden by cold working can require more force to bend than carbon steel.

Machinability—During machining, stainless steel can become gummy and stick to cutting tools, making it typically more difficult to machine than steel.

Weldability—Take care to clean stainless steel before and after welding operations. Contaminants, such as lubricants and particles from grinding tools, will reduce corrosion resistance at welded points.

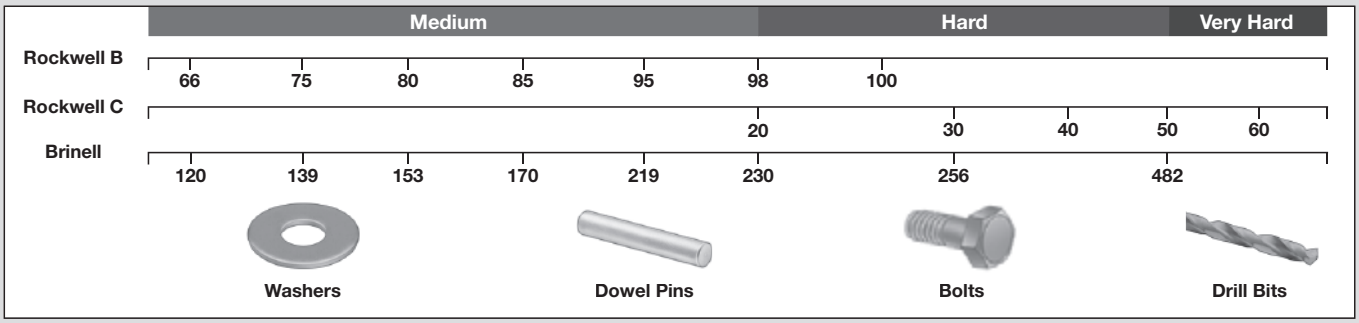
● Excellent
◓ Good
○ Poor

Use the chart below to identify the best stainless steel for your application. Circles indicate that a majority of a material's shapes and sizes meet the applicable rating. Yield strength is approximate and may vary based on size and shape.

Stainless Steel Types	Min. Yield Strength, psi	Hardness, Rockwell	Corrosion Resistance	Formability	Machinability	Weldability	Pages
Multipurpose							
Multipurpose 304	25,000	B75	◓	◓	◓	◓	3871-3879
High Strength 301	75,000	C25	◓	◓	◓	◓	3880
High Temperature 309	30,000	B75	◓	◓	○	◓	3881
Economy-Grade 430	30,000	B75	◓	◓	●	◓	3881
Weldable 321	25,000	B76	◓	◓	◓	◓	3890
Highly Corrosion Resistant							
Super Corrosion Resistant 316	25,000	B74	●	◓	◓	◓	3882-3886
Ultra Corrosion Resistant Alloy 20	35,000	B95	●	___	○	◓	3891
Strengthened A286	50,000	B90	●	◓	◓	◓	3887
Wear Resistant Nitronic 60	50,000	B86	●	○	○	◓	3891
High Strength 2205	65,000	C30	●	◓	◓	◓	3897
Easy-to-Machine							
Easy-to-Machine 303	25,000	B76	◓	◓	●	○	3887-3890
Very Easy-to-Machine 416	40,000	B81	○	◓	●	○	3891-3892
Wear Resistant							
Wear Resistant 410	30,000	B81	○	●	◓	◓	3892-3893
Mold Quality 420	50,000	C25	○	◓	◓	◓	3894
Very Wear Resistant 420V	_____	C28	◓	○	◓	○	3894
Ultra Hard 440C	65,000	C20	○	◓	○	○	3895-3897
Impact Resistant 440A	_____	C54	○	○	◓	○	3894
Blade Quality S30V	95,000	C25	◓	○	◓	○	3897
High Strength							
High Strength 13-8 PH	_____	C39	◓	◓	◓	◓	3898
Very High Strength 15-5 PH	145,000	C35	◓	___	○	___	3898
Corrosion Resistant 17-4 PH	110,000	C28	◓	◓	◓	◓	3898-3900

Hardness

As hardness increases, metals become more wear resistant, but they may be less malleable. The chart below shows hardness on different scales.



Finish

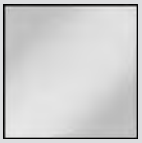
Stainless steel does not always have a shiny finish. In fact, stainless steel is available in a number of finishes, ranging from an unpolished, dull surface to a reflective mirror-like shine.

Unpolished
Not reflective

Ground
Smooth, matte finish

Brushed (#3 Satin)
Shiny with grain lines in one direction

Fine Brushed (#4 Satin)
Shiny with very thin grain lines in one direction



Mirror-Like (#8)
Highly polished with no grain lines