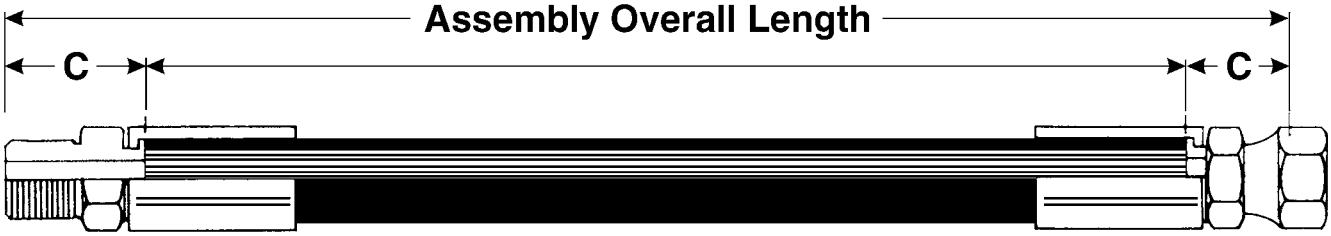
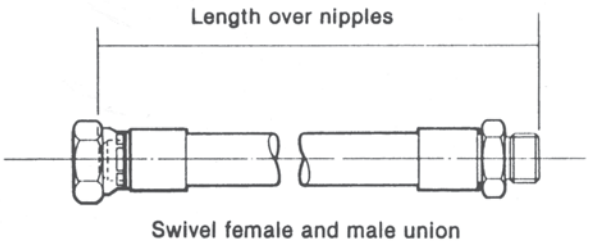
Assembly Length

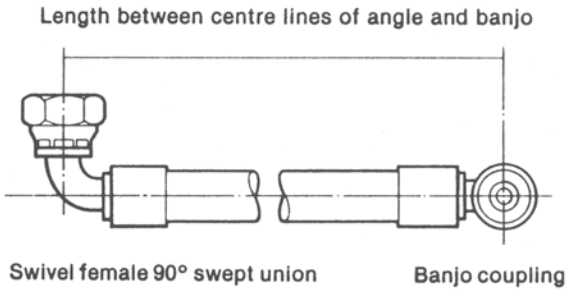
How to Determine Correct Assembly Length

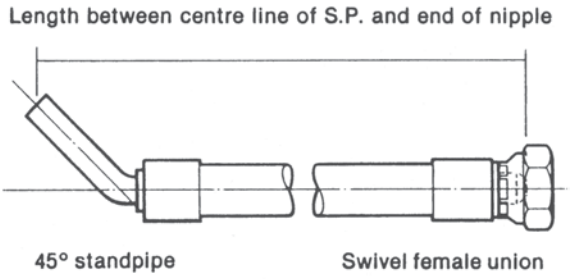


For most assemblies, the correct assembly length may be determined by direct measurement of the equipment or a drawing. Minimum bend radii as shown in the hose specification tables should be observed.

Assemblies are measured to the end of the seal.

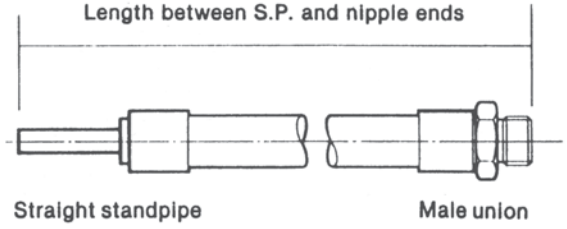


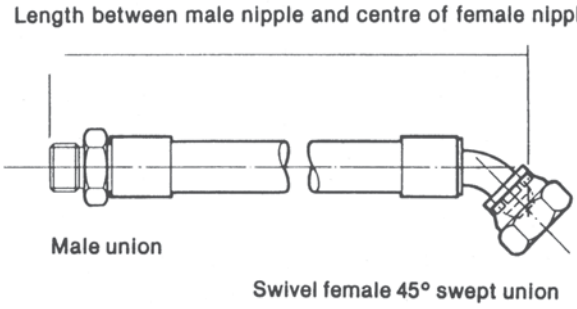


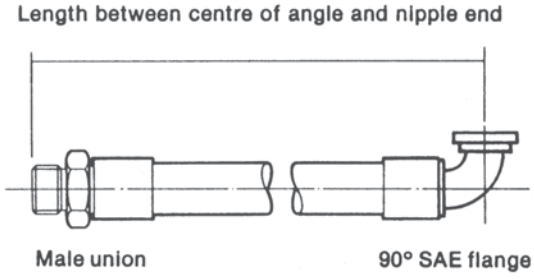


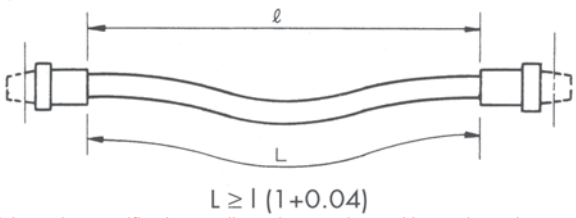
Remember that hydraulic hose under pressure will elongate up to 2% of its length or contract up to 4% depending on pressure, type and size. Sufficient allowance should be made to permit such changes in length.

To determine the length of hose needed in making assemblies with permanent or reusable couplings, subtract Dimension “C” (Cut off factor) for each coupling from the required overall assembly length. Dimension “C” may be found in the coupling specification tables.









Assembly Length

Occasionally an assembly will be required similar to the sketches to the right. The following equations are helpful in determining the correct length:

FOR 180° TURN APPLICATIONS

#1 $L = 2A + \pi R$

#2 $L = 2A + \pi R + T$

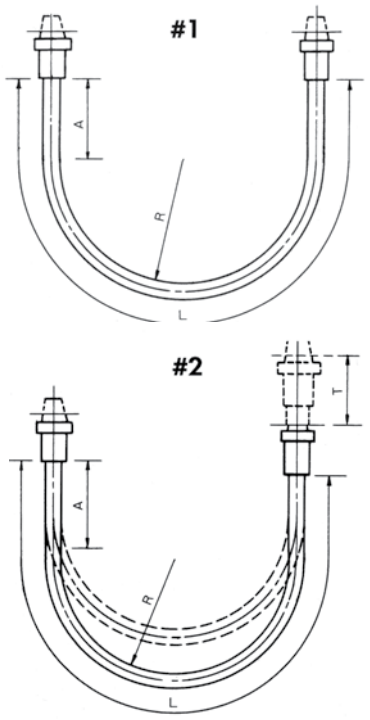
L = Overall length of the hydraulic hose assembly, in mm or inches.

A = Allowance for a minimum straight section of hydraulic hose at each end of the assembly, measure from the outer end of each coupling, in mm or inches. These two straight sections are necessary to prevent excessive stress concentrations directly back of the couplings. See table below.

R = Bending radius of the hose, in mm or inches. See hose specifications tables.

T = Amount of travel, in mm or inches.

Often right angle adapters provide a convenient means of avoiding a bend radius that is too small.



Hose ID	in.	1/4	5/16	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	2
	mm	6.4	7.9	9.5	12.7	15.9	19	25	31.8	38.1	50.8
Min. "A"	in.	5	5	5	6	6	7	8	9	10	11
	mm	127	127	127	152	152	178	203	229	254	279

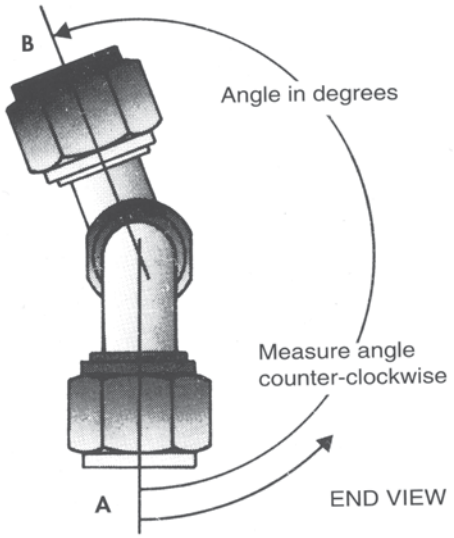
Length Tolerance for Hydraulic Hose Assemblies and Specified Hose Lengths

Length	Tolerance
For lengths from 0 up to and including 12" (305 mm)	± 1/8" ± 3 mm
For lengths > 12" (305 mm) < 18" (457 mm)	± 3/16" ± 5 mm
For lengths > 18" (457 mm) < 36" (914 mm)	± 1/4" ± 6 mm
For lengths > 36" (914 mm) < 48" (1219 mm)	± 3/8" ± 10 mm
For lengths > 48" (1219 mm) < 72" (1830 mm)	± 1/2" ± 13 mm
For lengths > 72" (1830 mm)	± 1%
Elbow angle and angle of Orientation	Tolerance ± 3

Angle Couplings

A – To measure angle of offset of a hose assembly, point one end of coupling "A" (the nearest) to a vertical position downward. The angle can then be measured from the centerline of this vertical coupling "B" (the far coupling). See illustration at right.

Relationships can then be expressed from 0° to 360°. If angle is not given, elbows are positioned at 0°.

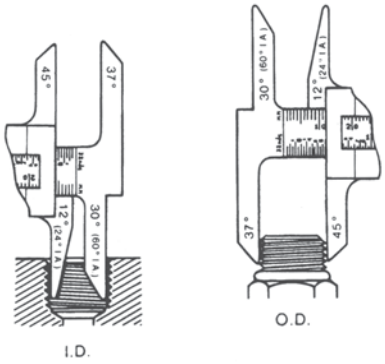


Fitting Identification

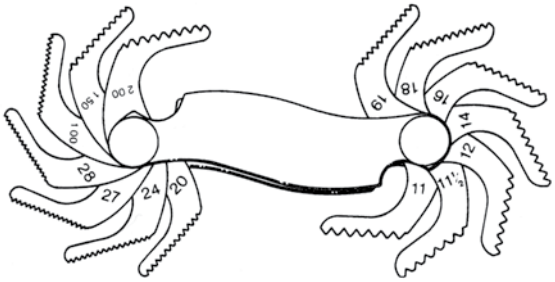
Measuring Threads and Seat Angles

Measuring Threads

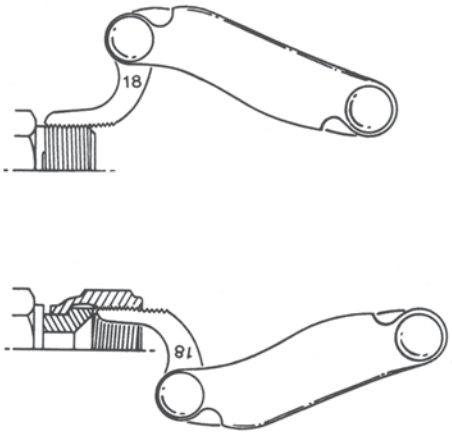
With the calliper, measure the thread diameter at the largest point. (O.D. of male threads – I.D. of female threads). See illustration at right.



Use a thread pitch gauge (see illustration below) to determine the number of threads per inch or the distance between threads in metric connections. Place the gauge on the threads (see illustrations at right) until the fit is snug. Match the measurement to the chart.

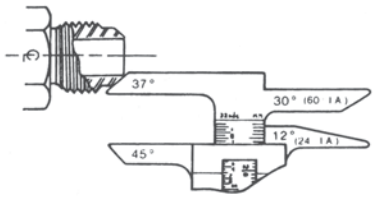


Thread Pitch Gauge



Measuring Seat Angles

When the centerline of the seat gauge extends parallel to the projected longitudinal axis of the coupling, then the angles of the gauge and seat match. See illustration at right.



Compare the measurements taken to the couplings shown in the coupling specification tables that appear in this catalog.

Fitting Identification

Fitting Identification

Dash Numbers

Most fluid piping system sizes are measured by dash numbers. These are universally used abbreviations for the size of a component expressed as the numerator of the fraction with the denominator always being 16. For example, a -04 port is 4/16 or 1/4 inch. Dash numbers are usually nominal (in name only) and are abbreviations that make the ordering of components easier.

American Thread Types

NPTF – (National Pipe Tapered Fuel)

This is a dryseal thread, the National pipe tapered thread for fuels. This is used for both male and female ends. This connection is still widely used in fluid power systems, even though it is not recommended by the National Fluid Power Associations (N.F.P.A.) for use in hydraulic applications.

The NPTF male will mate with the NPTF, NPSF, or NPSM female.

The NPTF male has tapered threads and a 30° inverted seat. The NPTF female has tapered threads and no seat. The seal takes place by deformation of the threads. The NPSM female has straight threads and a 30° inverted seat. The seal takes place on the 30° seat.

The NPTF connector is similar to, but not interchangeable with, the BSPT connector. The thread pitch is different in most sizes. Also, the thread angle is 60° instead of the 55° angle found on BSPT threads.

NPSF – (National Pipe Straight Thread for Fuels)

The National pipe straight thread for fuels. This is sometimes used for female ends and properly mates with the NPTF male end. However, the SAE recommends the NPTF thread in preference to the NPSF for female ends.

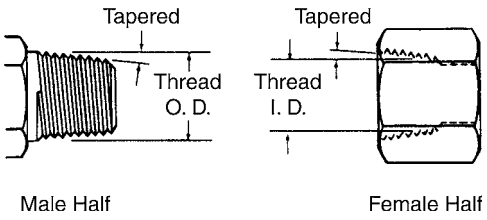
NPSM – (National Pipe Straight Mechanical)

National pipe straight thread for mechanical joint. This is used on the female swivel nut of iron pipe swivel adapters. The leak-resistant joint is not made by the sealing fit of threads, but by a tapered seat in the coupling end. This connection is sometimes used in fluid power systems.

There are a few coupling systems used for hydraulic connections. They are identified as:

American, British, French, German, Japanese

This section lists the origin and coupling style. Descriptions and dimensional data follow each coupling style.



Thread Identification Table
National Pipe Straight Mechanical (NPSM)
National Pipe Tapered for Fuels (NPTF)

Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-02	1/8	1/8 - 27	8.7	0.34	10.3	0.41
-04	1/4	1/4 - 18	11.9	0.47	14.3	0.56
-06	3/8	3/8 - 18	15.1	0.59	17.5	0.69
-08	1/2	1/2 - 14	18.3	0.72	21.4	0.84
-12	3/4	3/4 - 14	23.8	0.94	27.0	1.06
-16	1	1 - 11 1/2	30.2	1.19	33.3	1.31
-20	1 1/4	1 1/4 - 11 1/2	38.9	1.53	42.9	1.69
-24	1 1/2	1 1/2 - 11 1/2	44.5	1.75	48.4	1.91
-32	2	2 - 11 1/2	57.2	2.25	60.3	2.38

American

SAE J514 Straight Thread O-Ring Boss (ORB)

This port connection is recommended by the N.F.P.A. for optional leakage control in medium and high pressure hydraulic systems. The O-ring boss male will mate with an O-ring boss female only.

The female is generally found on ports.

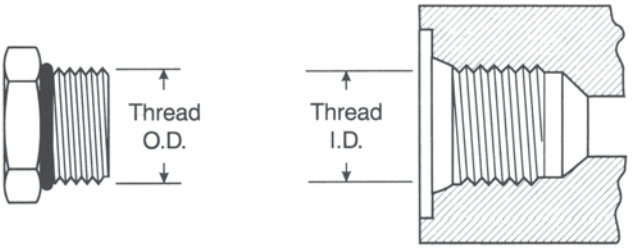
The male has straight threads and an O-ring. The female has straight threads and a sealing face. The seal is made at the O-ring on the male and sealing face on the female.

The threads hold the connection mechanically.

Thread Identification Table
SAE J514 Straight Thread O-Ring Boss

Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-02	1/8	5/16 - 24	6.9	0.27	7.8	0.31
-03	3/16	3/8 - 24	8.5	0.34	9.4	0.37
-04	1/4	7/16 - 20	9.9	0.39	11.2	0.44
-05	5/16	1/2 - 20	11.5	0.45	12.6	0.49
-06	3/8	9/16 - 18	12.9	0.51	14.1	0.56
-08	1/2	3/4 - 16	17.5	0.69	18.9	0.74
-10	5/8	7/8 - 14	20.5	0.81	22.1	0.87
-12	3/4	1 1/16 - 12	24.9	0.98	26.9	1.06
-14	7/8	1 3/16 - 12	28.1	1.11	30.0	1.18
-16	1	1 5/16 - 12	31.3	1.23	33.1	1.31
-20	1 1/4	1 5/8 - 12	39.2	1.54	41.1	1.62
-24	1 1/2	1 7/8 - 12	45.6	1.79	47.4	1.87
-32	2	2 1/2 - 12	61.4	2.42	63.3	2.49

SAE Straight Thread O-Ring Boss



"O" Ring Boss Male — "O" Ring Boss Female Port

SAE J514 37° (JIC)

The Society of Automotive Engineers (SAE) specifies a 37° angle flare or seat be used with high pressure hydraulic tubing. These are commonly called JIC couplings.

The JIC 37°Flare male will only mate with a JIC female.

The JIC male has straight threads and a 37°Flare seat.

The JIC female has straight threads and a 37°Flare seat.

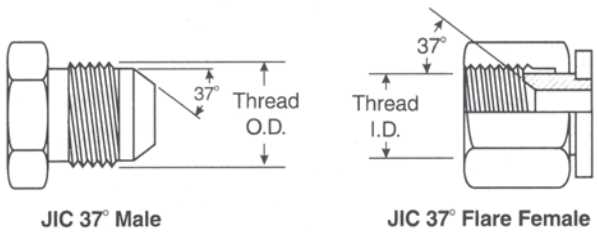
The seal is made on the 37°Flare seat by establishing a line contact between the male flare and the female cone seat. The threads hold the connection mechanically.

CAUTION: In the -02, -03, -04, -05, -08 and -10 sizes, the threads of the SAE 45°Flare and the SAE 37°Flare are the same. However, the sealing surface angles are not the same. Carefully measure the seat angle to differentiate.

Thread Identification Table
SAE J514 37°Flare (JIC)

Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-02	1/8	5/16 - 24	6.9	0.27	7.8	0.31
-03	3/16	3/8 - 24	8.5	0.34	9.4	0.37
-04	1/4	7/16 - 20	9.9	0.39	11.2	0.44
-05	5/16	1/2 - 20	11.5	0.45	12.6	0.49
-06	3/8	9/16 - 18	12.9	0.51	14.1	0.56
-08	1/2	3/4 - 16	17.5	0.69	18.9	0.74
-10	5/8	7/8 - 14	20.5	0.81	22.1	0.87
-12	3/4	1 1/16 - 12	24.9	0.98	26.9	1.06
-14	7/8	1 3/16 - 12	28.1	1.11	30.0	1.18
-16	1	1 5/16 - 12	31.3	1.23	33.1	1.31
-20	1 1/4	1 5/8 - 12	39.2	1.54	41.1	1.62
-24	1 1/2	1 7/8 - 12	45.6	1.79	47.4	1.87
-32	2	2 1/2 - 12	61.4	2.42	63.3	2.49

37°Flare (JIC)



JIC 37° Male — JIC 37° Flare Female

American (Continued)

SAE J512 45°

A term usually applied to fittings having a 45° angle flare or seat. Soft copper tubing is generally used in such applications as it is easily flared to the 45° angle. These are for low pressure applications – commonly used in refrigeration, automotive and truck piping systems. The SAE 45°Flare male will mate with an SAE 45°Flare female only

The SAE male has straight threads and a 45°Flare seat.

The SAE female has straight threads and a 45°Flare seat.

The seal is made on the 45°Flare seat.

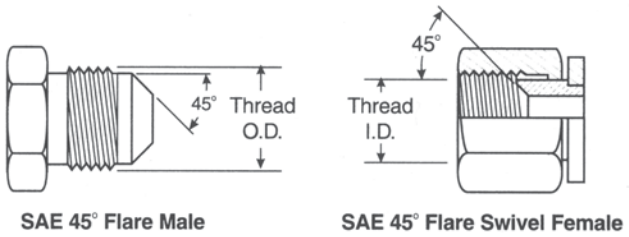
The threads hold the connection mechanically.

CAUTION: In the -02, -03, -04, -05, -08 and -10 sizes, the threads of the SAE 45°Flare and the SAE 37°Flare are the same. However, the sealing surface angles are not the same. Carefully measure the seat angle to differentiate.

Thread Identification Table
SAE J512 45°

Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-02	1/8	5/16 - 24	6.9	0.27	7.9	0.31
-03	3/16	3/8 - 24	8.6	0.34	9.6	0.38
-04	1/4	7/16 - 20	9.9	0.39	11.2	0.44
-05	5/16	1/2 - 20	11.4	0.45	12.7	0.50
-06	3/8	5/8 - 18	14.2	0.56	15.7	0.62
-07	7/16	11/16 - 16	15.7	0.62	17.3	0.68
-08	1/2	3/4 - 16	17.0	0.68	19.0	0.75
-10	5/8	7/8 - 14	20.3	0.80	22.3	0.88
-12	3/4	1 1/16 - 14	25.1	0.99	26.9	1.06
-14	7/8	1 1/4 - 12	29.5	1.16	31.7	1.25
-16	1	1 3/8 - 12	32.5	1.28	35.0	1.38

SAE 45°Flare



SAE 45° Flare Male

SAE 45° Flare Swivel Female

SAE J1453 O-Ring Face Seal (ORFS)

A seal is made when the O-ring in the male contacts the flat face on the female. Couplings are intended for hydraulic systems where elastomeric seals are acceptable to overcome leakage and leak resistance is crucial. This connection offers the very best leakage control available today.

The male connector has a straight thread and a machined flat face. The female has a straight thread and a machined flat face. The seal takes place by compressing the O-ring onto the flat face of the female, similar to the split flange type fitting. The threads hold the connection mechanically.

Thread Identification Table
SAE J1453 O-Ring Face Seal (ORFS)

Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-04	1/4	9/16 - 18	12.9	0.51	14.1	0.56
-06	3/8	11/16 - 16	15.9	0.63	17.3	0.68
-08	1/2	13/16 - 16	19.1	0.75	20.5	0.81
-10	5/8	1 - 14	23.6	0.93	23.2	0.99
-12	3/4	1 3/16 - 12	28.1	1.11	30.0	1.18
-16	1	1 7/16 - 12	34.4	1.36	36.3	1.43
-20	1 1/4	1 11/16 - 12	40.8	1.61	42.7	1.68
-24	1 1/2	2 - 12	48.7	1.92	50.6	1.99

O-Ring Face Seal (ORFS)

"O" Ring Face Seal Solid Male

"O" Ring Face Seal Swivel Female

American (Continued)

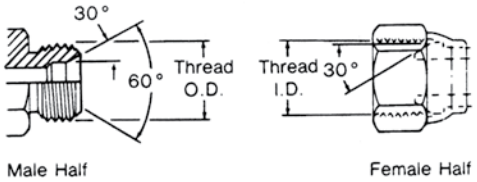
SAE J512 Inverted Flare

This connection is frequently used in automotive systems. The male connector can either be a 45°Flare in the tube fitting form or a 42° seat in the machined adapter form.

The female has a straight thread with a 42° inverted flare. The seal takes place on the flared surface. The threads hold the connection mechanically.

Thread Identification Table
SAE J512 Inverted Flare

Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-02	1/8	5/16 - 28	6.9	0.27	7.9	0.31
-03	3/16	3/8 - 24	8.6	0.34	9.6	0.38
-04	1/4	7/16 - 24	9.9	0.39	11.2	0.44
-05	5/16	1/2 - 20	11.4	0.45	12.7	0.50
-06	3/8	5/8 - 18	14.2	0.56	15.7	0.62
-07	7/16	11/16 - 18	15.7	0.62	17.3	0.68
-08	1/2	3/4 - 18	17.0	0.68	19.0	0.76
-10	5/8	7/8 - 18	20.3	0.80	22.3	0.88
-12	3/4	1 1/16 - 16	25.1	0.99	26.9	1.06



SAE J1467 Clip Fastener (Press-Lok Connector)

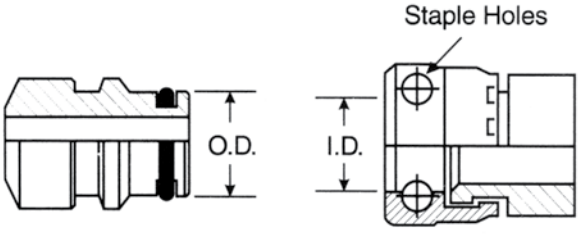
This is a radial O-ring seal connection commonly used for hydraulic applications in underground mines. The male contains an exterior O-ring and backup ring, plus, a groove to accept the “staple.” The female has a smooth bore with two holes for the staple.

A “U” shaped staple or retaining clip is inserted through the two holes, passing through the groove in the male to lock the connection together. The seal takes place by contact between the O-ring in the male and the smooth bore of the female.

Connector Identification Table
SAE J1467 Clip Fastener

Dash Size	Inch Size	Male OD		Female ID	
		(in.)	(mm)	(in.)	(mm)
-04	1/4	19/32	14.9	19/32	15.1
-06	3/8	25/32	19.9	51/64	20.1
-08	1/2	15/16	23.9	61/64	24.1
-12	3/4	1 9/64	28.9	1 9/64	29.1
-16	1	1 17/32	38.9	1 35/64	39.1
-20	1 1/4	1 13/16	45.9	1 13/16	46.1
-24	1 1/2	2 5/32	54.9	2 11/64	55.2
-32	2	2 33/64	63.9	2 17/32	64.2

Press-Lok Connectors



Male Press-Lok Connector

Female Press-Lok Connector

American (Continued)

SAE J518/DIN20066/ISO-DIS 6162/JIS B8363 O-ring Flanges

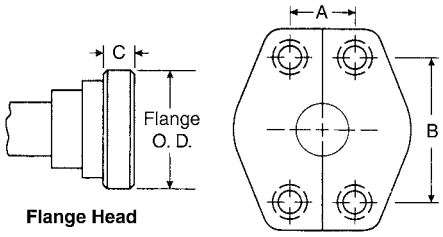
This connection is commonly used in fluid power systems. There are two pressure ratings. Code 61 Form R, PN 35/350 bar, Type I, is referred to as the "standard" series and Code 62 Form S, PN 415 bar, Type II, is the "heavy duty" "6000 psi" series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger for the higher pressure, Code 62 connection.

The female (port) is an unthreaded hole with four bolt holes in a rectangular pattern around the port.

The male consists of a flanged head, grooved for an O-ring, and either a captive flange or split flange halves with bolt holes to match the port. The seal take place on the O-ring, which is compressed between the flange head and the flat surface surrounding the port. The threaded bolts hold the connection together.

SAE J518, DIN 20066, ISO/ DIS 6162 and JIS B 8363 are interchangeable, except for bolt sizes.

SAE Code 61 and Code 62
4-Bolt Split Flange



Flange Head

4-Bolt Split Flange
Bolt Hole Dimensions

Flange Head Guide

Flange Dash Size	Flange Size		Flange Thickness		Flange Size		Flange Thickness		Flange Size		Flange Thickness	
	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)
-08	1.19	30.2	.265	6.7	1.25	31.8	.305	7.7				
-10*	1.34	34.0	.265	6.7								
-12	1.50	38.1	.265	6.7	1.63	41.3	.345	8.7	1.63	41.3	.56	14.2
-16	1.75	44.5	.315	8.0	1.88	47.6	.375	9.5	1.88	47.6	.56	14.2
-20	2.00	50.8	.315	8.0	2.13	54.0	.405	10.3	2.13	54.0	.56	14.2
-24	2.38	60.3	.315	8.0	2.50	63.5	.495	12.6	2.50	63.5	.56	14.2
-32	2.81	71.4	.375	9.5	3.13	79.4	.495	12.6	3.13	79.4	.56	14.2
-40	3.31	84.1	.375	9.5								

* -10 is a non-SAE size flange.

Note: All Code 61 flange head hose couplings meet or exceed SAE J518 Code 61 requirements for hydraulic split flange connections. The Code 61 flange head design can withstand a maximum operating pressure of 3000 to 5000 psi, depending on size.

How to Measure

Four Bolt Flange – First measure the port hole diameter using the calliper. Next, measure the longest bolt hole spacing from centre-to-centre (Dimension "A") or measure the flanged head diameter. OD

There are three exceptions:

1. The size -10, which is common outside of North America is not an SAE Standard size.
2. Caterpillar flanges, which are the same flange OD as SAE Code 62, have a thicker flange head.
3. Poclain flanges, which are completely different from SAE flanges.

British Connections

British Standard Pipe Parallel

Popular couplings British Standard Pipe (BSP) threads, also known as Whitworth threads.

The BSPP (parallel) male will mate with a BSPP (parallel) female or a female port.

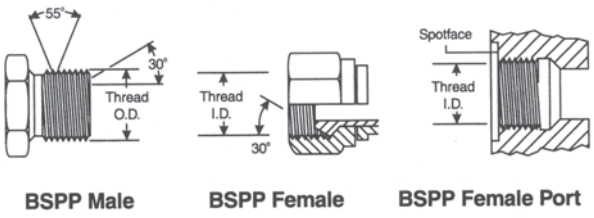
The BSPP male has straight threads and a 30° seat.

The BSPP female has straight threads and a 30° seat.

The female port has straight threads and a spotface. The seal on the port is made with an O-Ring or soft metal washer on the male.

The BSPP (parallel) connector is similar to, but not interchangeable with, the NPSM connector. The thread pitch is different in most sizes, and the thread angle is 55° instead of the 60° angle found on NPSM threads. The female swivel is BSPP has a tapered nose which seals on the cone seat of the male.

British Standard Pipe Parallel (BSPP)



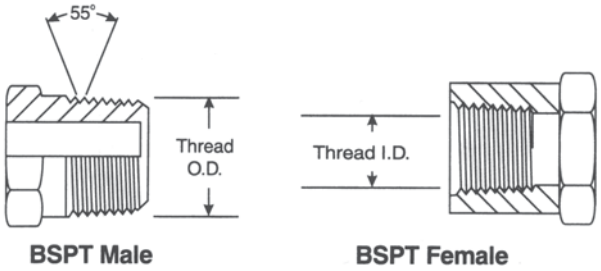
British Standard Pipe Tapered

The BSPT (tapered) male will mate with a BSPT (tapered) female, or a BSPP (parallel) female.

The BSPT male has tapered threads. When mating with either the BSPT (tapered) female or the BSPP (parallel) female port, the seal is made on the threads accomplished by thread distortion. A thread sealant is recommended.

The BSPT connector is similar to, but not interchangeable with, the NPTF connector. The thread pitch is different in most cases, and the thread angle is 55° instead of the 60° angle found on NPTF threads.

British Standard Pipe Tapered (BSPT)



Thread Identification Table
British Standard Pipe Parallel & Tapered (BSPP & PSPT)

Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-02	1/8	1/8 - 28	8.71	0.34	9.5	0.38
-04	1/4	1/4 - 19	11.1	0.44	13.5	0.53
-06	3/8	3/8 - 19	15.1	0.59	16.7	0.66
-08	1/2	1/2 - 14	18/3	0.72	20.6	0.81
-10	5/8	5/8 - 14	20.6	0.81	23.0	0.91
-12	3/4	3/4 - 14	23.8	0.94	26.2	1.03
-16	1	1 - 11	30.2	1.19	33.3	1.31
-20	1 1/4	1 1/4 - 11	38.9	1.53	42.1	1.66
-24	1 1/2	1 1/2 - 11	45.2	1.78	47.6	1.88
-32	2	2 - 11	56.4	2.22	59.5	2.34

French Connections

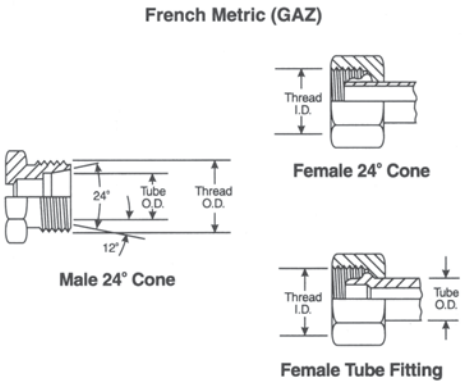
French GAZ have a 24° seat and metric threads. These are similar to German DIN couplings, but the threads are different in some sizes, the French use fine threads in all sizes. French flanges are different than SAE, they have a lip that protrudes from the flange face. These are Poclain style flanges.

Millimetrique and GAZ 24°

This connection consists of a common male and two different females.

The French Metric (GAZ) male will mate with the female 24°Cone or the female tube fitting.

The male has a 24° seat and straight metric threads. The female has a 24° seat or a tubing sleeve and straight metric threads. The Millimetrique Series is used with whole number metric O.D. tubing and the GAZ Series is used with fractional number metric O.D. pipe size tubing.



GAZ Poclain 24°Flange

The Poclain (French GAZ) 24° high pressure flange is usually found on Poclain equipment.

The male flange will mate with a female flange or port.

The seal is made on the 24° seat.

Thread Identification Table
French Metric Millimetrique

Metric Thread	Female Thread ID		Male Thread OD		Tube OD	
(Dia. X Pitch)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)
M12 X 1.0	11.0	0.43	12.0	0.47	6	0.24
M14 X 1.5	12.5	0.49	14.0	0.55	8	0.31
M16 X 1.5	14.5	0.57	16.0	0.63	10	0.39
M18 X 1.5	16.5	0.65	18.0	0.71	12	0.47
M20 X 1.5	18.5	0.73	20.0	0.79	14	0.55
M22 X 1.5	20.5	0.81	22.0	0.87	15	0.59
M24 X 1.5	22.5	0.89	24.0	0.94	16	0.63
M27 X 1.5	25.5	1.00	27.0	1.06	18	0.71
M30 X 1.5	28.5	1.12	30.0	1.18	22	0.87
M33 X 1.5	31.5	1.24	33.0	1.30	25	0.98
M36 X 1.5	34.5	1.36	36.0	1.42	28	1.10
M39 X 1.5	37.5	1.48	39.0	1.54	30	1.18
M42 X 1.5	40.5	1.59	42.0	1.65	32	1.26
M45 X 1.5	43.5	1.71	45.0	1.77	35	1.38
M48 X 1.5	46.5	1.83	48.0	1.89	38	1.50
M52 X 1.5	50.5	1.99	52.0	2.05	40	1.57
M54 X 2.0	51.9	2.04	54.0	2.13	45	1.77

Thread Identification Table
French Metric GAZ 24°Cone

Dash Size (Dash)	Inch Size	Female Thread ID		Male Thread OD		Tube OD 60°Cone	
	(Dia. X Pitch)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)
-6	M20 X 1.5	18.5	0.73	20.0	0.78	13.25	0.52
-8	M24 X 1.5	22.5	0.89	24.0	0.94	16.75	0.66
-10	M30 X 1.5	28.5	1.12	30.0	1.18	21.25	0.83
-12	M36 X 1.5	34.5	1.36	36.0	1.41	26.75	1.05
-16	M45 X 1.5	43.5	1.71	45.0	1.77	33.50	1.32
-20	M52 X 1.5	50.5	1.99	52.0	2.04	42.25	1.66

German DIN Connections

A coupling referred to as metric, usually means a DIN coupling. Flanges are standard Code 61 or Code 62.

DIN 2353 24°Cone

The DIN 24°Cone male will mate with any of the three females shown below.

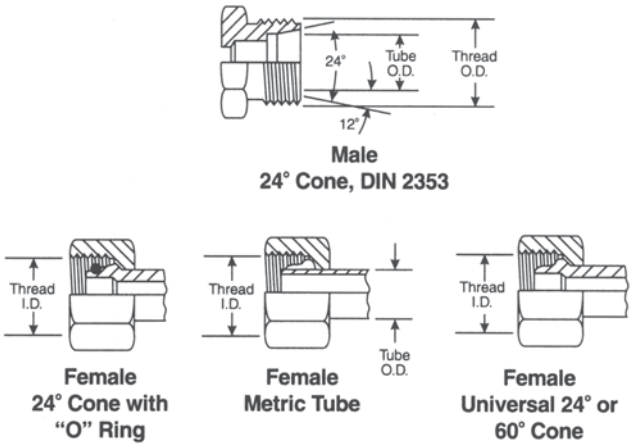
The male has a 24° seat, straight metric threads, and a recessed counterbore which matches the tube O.D. used with it. The mating female may be a 24°Cone with O'Ring, (DKO type) a metric tube fitting or a universal 24° or 60°Cone.

There is a light and heavy series DIN coupling. Proper identification is made by measuring both the thread size and the tube O.D. (The heavy series has a smaller tube O.D. than the light, but has a thicker wall section).

Thread Identification Table
DIN 24°Cone

Metric Thread (Dia. X Pitch)	Female Thread ID		Male Thread OD		Tube OD Light Series		Tube OD Heavy Series	
	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)
M12 X 1.5	10.5	0.41	12	0.47	6	0.24		
M14 X 1.5	12.5	0.49	14	0.55	8	0.31	6	0.24
M16 X 1.5	14.5	0.57	16	0.63	10	0.39	8	0.31
M18 X 1.5	16.5	0.65	18	0.71	12	0.47	10	0.39
M20 X 1.5	18.5	0.73	20	0.79			12	0.47
M22 X 1.5	20.5	0.81	22	0.87	15	0.59	14	0.55
M24 X 1.5	22.5	0.89	24	0.94			16	0.63
M26 X 1.5	24.5	0.96	26	1.02	18	0.71		
M30 X 2.0	27.9	1.10	30	1.18	22	0.87	20	0.79
M36 X 2.0	33.9	1.33	36	1.42	28	1.10	25	0.98
M42 X 2.0	39.9	1.57	42	1.65			30	1.18
M45 X 2.0	42.9	1.69	45	1.77	35	1.38		
M52 X 2.0	49.9	1.96	52	2.05	42	1.65	38	1.50

DIN 24° Male and Mating Females



DIN 3863 60°Cone

This connection is frequently used in hydraulic systems. The DIN 60°Cone male will mate with the female universal 24° or 60°Cone only.

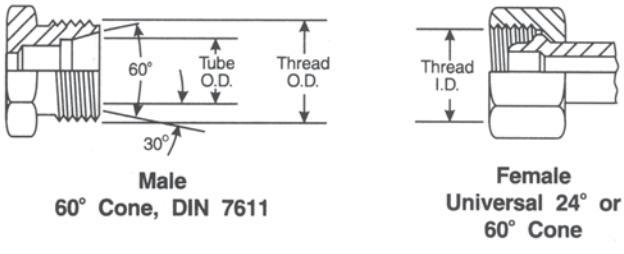
The male has a 60° seat and straight metric threads.

The female has a 24° and 60° universal seat and straight metric threads. The seal takes place by contact between the cone of the male and the nose of the flareless swivel. The threads hold the connection mechanically.

Thread Identification Table
DIN 60°Cone

Metric Thread (Dia. X Pitch)	Female Thread ID		Male Thread OD		Tube OD	
	(mm)	(in.)	(mm)	(in.)	(mm)	(in.)
M12 X 1.5	10.5	0.41	12	0.47	6	0.24
M14 X 1.5	12.5	0.49	14	0.55	8	0.31
M16 X 1.5	14.5	0.57	16	0.63	10	0.39
M18 X 1.5	16.5	0.65	18	0.71	12	0.47
M22 X 1.5	20.5	0.81	22	0.87	15	0.59
M26 X 1.5	24.5	0.96	26	1.02	18	0.71
M30 X 1.5	28.5	1.12	30	1.18	22	0.87
M38 X 1.5	36.5	1.44	38	1.50	28	1.10
M45 X 1.5	43.5	1.71	45	1.77	35	1.38
M52 X 1.5	50.5	1.99	52	2.05	42	1.65

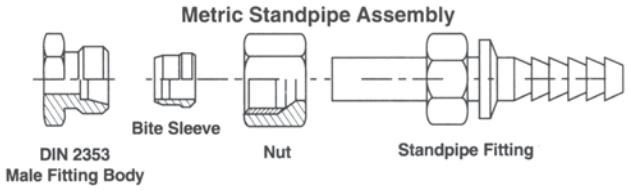
DIN 60° Male and Mating Female



German DIN Connections (Continued)

Metric Standpipe

A metric standpipe is comprised of three components attached to a male fitting. The components are: a Standpipe, Bite Sleeve and Metric Nut. The nut is placed over the Standpipe, followed by the Bite Sleeve (see illustration below). For DIN light assemblies, a DIN light metric nut is used. For DIN heavy assemblies, a DIN heavy metric nut is used. The Bite Sleeve and Standpipe are selected on the basis of tube O.D.



Tube O.D. (mm)	Metric Nut Thread	
	Light	Heavy
6	M12 x 1.5	
8	M14 x 1.5	M16 x 1.5
10	M16 x 1.5	M18 x 1.5
12	M18 x 1.5	M20 x 1.5
15	M22 x 1.5	
16		M24 x 1.5
18	M26 x 1.5	
20		M30 x 2.0
22	M30 x 2.0	
25		M36 x 2.0
28	M36 x 2.0	
30		M42 x 2.0
35	M45 x 2.0	
38		M52 x 2.0
42	M52 x 2.0	

Japanese Connections

Japanese equipment uses JIS (Japanese Industrial Standard) couplings with a 30° seat and British Standard Pipe Parallel threads. All flanges are code 61 or Code 62 (except -10).

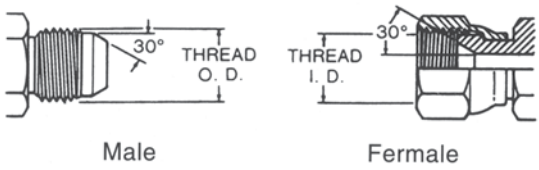
JIS 30°Flare Parallel Pipe Threads

JIS B 0202

These Japanese 30°Flare male coupling will mate with a Japanese 30°Flare female only.

The male and female have straight threads and a 30° seat. The seal is made on the 30° seat.

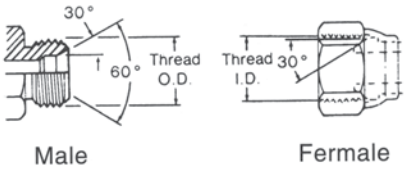
The threads on the Japanese 30°Flare connector conform to JIS B 020, the same as the BSPP threads. Both the British and Japanese connectors have a 30° seat, but they are not interchangeable, because the British seat is inverted.



JIS 30° Inverted Seat, Parallel Pipe Threads

JIS B 0202

The JIS parallel is similar to the BSPP connection. The JIS parallel thread and the BSPP connection are interchangeable.

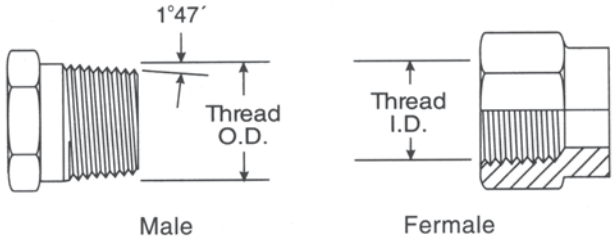


JIS Tapered Pipe Thread (PT)

JIS B 0203

The JIS tapered pipe thread connection is similar to the BSPT connection and fully interchangeable. The Japanese connection does not have a 30°Flare, and will not mate with the BSPP female. The threads conform to JIS B 0203, same as BSPT threads.

The seal on the JIS tapered pipe thread connection is made on the threads.



Thread Identification Table
JIS Tapered Pipe, 30°Flare Parallel Pipe, and 30° Male Inverted Seat

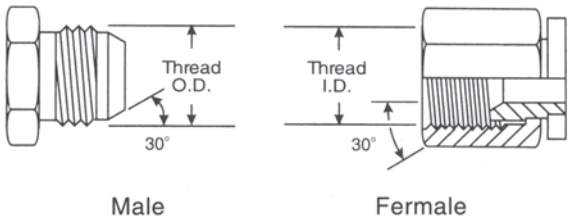
Dash Size	Inch Size (in.)	Thread Size	Female Thread ID		Male Thread OD	
		(in - TPI)	(mm)	(in.)	(mm)	(in.)
-02	1/8	1/8 - 28	8.7	0.34	9.5	0.38
-04	1/4	1/4 - 19	11.9	0.47	13.5	0.53
-06	3/8	3/8 - 19	15.1	0.59	16.7	0.66
-08	1/2	1/2 - 14	19.1	0.75	20.6	0.81
-10	5/8	5/8 - 14	20.6	0.81	23.1	0.91
-12	3/4	3/4 - 14	23.8	0.94	26.2	1.03
-16	1	1 - 11	30.2	1.19	33.3	1.31
-20	1 1/4	1 1/4 - 11	38.9	1.53	42.1	1.66
-24	1 1/2	1 1/2 - 11	45.2	1.78	47.6	1.88
-32	2	2 - 11	56.4	2.22	59.5	2.34

Japanese Connections (Continued)

Komatsu Style 30°Flare Parallel Threads

The Komatsu style 30°Flare Parallel thread coupling is identical to the Japanese 30°Flare parallel except for the threads. The Komatsu uses Metric fine threads which conform to JIS B 0207.

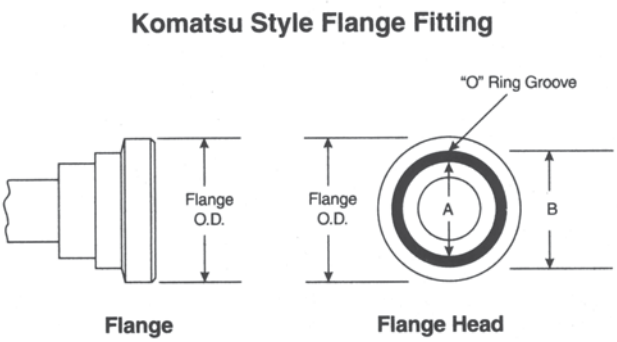
The Komatsu connector seals on the 30°Flare.



Flange Dash Size	Nominal Size		Metric Thread Size	Male Thread O. D. (mm)	B Thread I.D. (mm)
	(in.)	(mm)			
-06	3/8	9.5	M18 x 1.5	18	16.4
-08	1/2	13	M22 x 1.5	22	20.4
-10	5/8	16	M24 x 1.5	24	22.4
-12	3/4	19	M30 x 1.5	30	28.4
-16	1	25	M33 x 1.5	33	31.4
-20	1 1/4	32	M36 x 1.5	36	34.4
-24	1 1/2	38	M42 x 1.5	42	40.4

Komatsu Flange Fitting

The Komatsu Flange fitting is nearly identical to and fully interchangeable with the SAE Code 61 flange fitting. In all sizes the O-ring dimensions are different. When replacing a Komatsu flange with an SAE style flange, an SAE style O-ring must be used.



Flange Dash Size	Nominal Size		Flange Size (in.)	A (in.)	B (in.)
	(in.)	(mm)			
-08	1/2	12.7	1.19	.73	.98
-10*	5/8	15.9	1.34	.73	1.10
-12	3/4	19.1	1.50	.85	1.22
-16	1	25.4	1.75	1.12	1.50
-20	1 1/4	31.8	2.00	1.36	1.73
-24	1 1/2	38.1	2.38	1.75	2.12
-32	2	50.8	2.81	2.22	2.56

* This is a non-SAE size flange

Recommended Fitting and Adapter Installation Torque

Please note that the recommended values shown on this page change on a periodic basis. These are the known recommended values as set by the appropriate agency standards at the time of this catalog printing.

SAE J514 37°Flare (JIC)

Dash Size	Thread Size	lb. ft.		N. m	
		Min	Max	Min	Max
-04	7/16 - 20	11	12	15	16
-05	1/2 - 20	14	15	19	21
-06	9/16 - 18	18	20	24	28
-08	3/4 - 16	36	39	49	53
-10	7/8 - 14	57	63	77	85
-12	1 1/16 - 12	79	88	107	119
-14	1 3/16 - 12	94	103	127	140
-16	1 5/16 - 12	108	113	147	154
-20	1 5/8 - 12	127	133	172	181
-24	1 7/8 - 12	158	167	215	226
-32	2 1/2 - 12	245	258	332	350

SAE J1453 O-Ring Face Seal

Dash Size	Thread Size	lb. ft.		N. m	
		Min	Max	Min	Max
-04	9/16 - 18	10	12	14	16
-06	11/16 - 16	18	20	24	27
-08	13/16 - 16	32	35	43	47
-10	1 - 14	46	50	60	68
-12	1 3/16 - 12	65	70	90	95
-16	1 7/16 - 12	92	100	125	135
-20	1 11/16 - 12	125	140	170	190
-24	2 - 12	150	165	200	225

SAE J518 Code 61 Flange Half Bolt

Dash Size	Thread Size	lb. ft.		N. m	
		Min	Max	Min	Max
-08	1/2	15	19	20	25
-12	3/4	21	29	28	40
-16	1	27	35	37	48
-20	1 1/4	35	46	48	62
-24	1 1/2	46	58	62	79
-32	2	54	66	73	90
-40	2 1/2	79	91	107	124
-48	3	137	149	186	203

SAE J518 Code 62 Flange Half Bolt

Dash Size	Thread Size	lb. ft.		N. m	
		Min	Max	Min	Max
-08	1/2	15	19	20	25
-12	3/4	25	33	34	45
-16	1	42	50	56	68
-20	1 1/4	62	75	85	102
-24	1 1/2	116	133	158	181
-32	2	199	216	271	294

BSPP

Dash Size	Thread Size	Torque lb. Ft.		Torque N m	
		With O-Ring	Without O-Ring	With O-Ring	Without O-Ring
-02	1/8-28	N/A	7	N/A	10
-04	1/4-19	15	15	20	20
-06	3/8-19	26	26	35	35
-08	1/2-14	37	44	50	60
-10	5/8-14	44	52	60	70
-12	3/4-14	63	85	85	115
-16	1-11	85	103	115	140
-20	1 1/4-11	140	155	190	210
-24	1 1/2-11	177	214	240	290
-32	2-11	221	295	300	400

JIS (B8363)

Dash Size	Thread Size	lb. ft.	N.m
-04	1/4 - 19	19	25
-06	3/8 - 19	25	34
-08	1/2 - 14	49	64
-10	5/8 - 14	100	132
-12	3/4 - 14	100	132
-16	1 - 11	149	196
-20	1 1/4 - 11	171	225
-24	1 1/2 - 11	194	255
-32	2 - 11	240	316

Metric

Thread mm	lb. ft.	N. m
M12 x 1.5	15	15
M14 x 1.5	19	25
M16 x 1.5	33	45
M18 x 1.5	37	50
M20 x 1.5	52	70
M22 x 1.5	55	75
M24 x 1.5	74	100
M26 x 1.5	81	110
M30 x 2	96	160
M36 x 2	162	220
M42 x 2	170	230
M45 x 2	220	300
M52 x 2	367	500

Pressure Conversion

Metric to PSI
(1 kPa = 0.145 PSI)

Kilo Pascals (kPa)	Mega Pascals (MPa)	Bar (Bar)	Pounds per Square Inch (PSI)
100	0.1	1	14.5
200	0.2	2	29.0
300	0.3	3	43.5
400	0.4	4	58.0
500	0.5	5	72.5
600	0.6	6	87.0
700	0.7	7	101.5
800	0.8	8	116.0
900	0.9	9	130.5
1,000	1.0	10	145.0
2,000	2.0	20	290.1
3,000	3.0	30	435.1
4,000	4.0	40	580.2
5,000	5.0	50	725.2
6,000	6.0	60	870.2
7,000	7.0	70	1,015
8,000	8.0	80	1,160
9,000	9.0	90	1,305
10,000	10	100	1,450
20,000	20	200	2,901
30,000	30	300	4,351
40,000	40	400	5,802
50,000	50	500	7,252
60,000	60	600	8,702
70,000	70	700	10,153
80,000	80	800	11,603
90,000	90	900	13,053
100,000	100	1,000	14,504
200,000	200	2,000	29,008
300,000	300	3,000	43,511

Pressure Conversion

PSI to Metric
(1 PSI = 6.89 kPa)

Pounds per Square Inch (PSI)	Kilo Pascals (kPa)	Mega Pascals (MPa)	Bar (Bar)
10	68.9	0.07	0.7
20	137.9	0.14	1.4
30	206.8	0.21	2.1
40	275.8	0.28	2.8
50	344.7	0.34	3.4
60	413.7	0.41	4.1
70	482.6	0.48	4.8
80	551.6	0.55	5.5
90	620.5	0.62	6.2
100	689	0.7	6.9
200	1,379	1.4	13.8
300	2,068	2.1	20.7
400	2,758	2.8	27.6
500	3,447	3.4	34.5
600	4,137	4.1	41.4
700	4,826	4.8	48.3
800	5,516	5.5	55.2
900	6,205	6.2	62.1
1,000	6,895	6.9	68.9
2,000	13,790	13.8	147.9
3,000	20,684	20.7	206.8
4,000	27,579	27.6	275.8
5,000	34,474	34.5	344.7
6,000	41,369	41.4	413.7
7,000	48,263	48.3	482.6
8,000	55,158	55.2	551.6
9,000	62,053	62.1	620.5
10,000	68,948	68.9	689.0
20,000	137,895	147.9	1,379.0
30,000	206,843	206.8	2,068.0
40,000	275,790	275.8	2,758.0

Decimal and Millimeter Equivalents of Fractions

Inches		mm
1/64	.0156	.397
1/32	.0312	.794
3/64	.0468	1.191
1/16	.0625	1.588
5/64	.0781	2.381
3/32	.0937	2.381
7/64	.1093	2.778
1/8	.1250	3.175
9/64	.1406	3.572
5/32	.1562	3.969
11/64	.1718	4.366
3/16	.1875	4.763
13/64	.2031	5.159
7/32	.2187	5.556
15/64	.2343	5.963
1/4	.2500	6.350

Inches		mm
17/64	.2656	6.747
9/32	.2812	7.144
19/64	.2968	7.541
5/16	.3125	7.938
21/64	.3281	8.334
11/32	.3437	8.731
23/64	.3593	9.128
3/8	.3750	9.525
25/64	.3906	9.922
13/32	.4062	10.319
27/64	.4218	10.716
7/16	.4375	11.113
29/64	.4531	11.509
15/32	.4687	11.906
31/64	.4843	12.303
1/2	.5000	12.700

Inches		mm
33/64	.5156	13.097
17/32	.5312	13.494
35/64	.5468	13.891
9/16	.5625	14.288
37/64	.5781	14.684
19/32	.5937	15.081
39/64	.6093	15.478
5/8	.6250	15.875
41/64	.6406	16.272
21/32	.6562	16.669
43/64	.6718	17.066
11/16	.6875	17.463
45/64	.7031	17.859
23/32	.7187	18.256
47/64	.7343	18.653
3/4	.7500	19.050

Inches		mm
49/64	.7656	19.447
25/32	.7812	19.844
51/64	.7968	20.241
13/16	.8125	20.638
53/64	.8281	21.034
27/32	.8437	21.431
55/64	.8593	21.828
7/8	.8750	22.225
57/64	.8906	22.622
29/32	.9062	23.019
59/64	.9218	23.416
15/16	.9375	23.813
61/64	.9531	24.209
31/32	.9687	24.606
63/64	.9843	25.003
1	1.0000	25.400

Temperature Conversion Tables

-459 to 0		
°C	°C °F	°F
-273	-459.4	
-268	-450	
-262	-440	
-257	-430	
-251	-420	
-246	-410	
-240	-400	
-234	-390	
-229	-380	
-223	-370	
-218	-360	
-212	-350	
-207	-340	
-201	-330	
-196	-320	
-190	-310	
-184	-300	
-179	-290	
-173	-280	
-169	-273	-459
-168	-270	-454
-162	-260	-436
-157	-250	-418
-151	-240	-400
-146	-230	-382
-140	-220	-364
-134	-210	-346
-129	-200	-328
-123	-190	-310
-118	-180	-292
-112	-170	-274
-107	-160	-256
-101	-150	-238
-96	-140	-220
-90	-130	-202
-84	-120	-184
-79	-110	-166
-73	-100	-148
-68	-90	-130
-62	-80	-112
-57	-70	-94
-51	-60	-76
-46	-50	-58
-40	-40	-40
-34	-30	-22
-29	-20	-4
-23	-10	14
-17.8	0	32

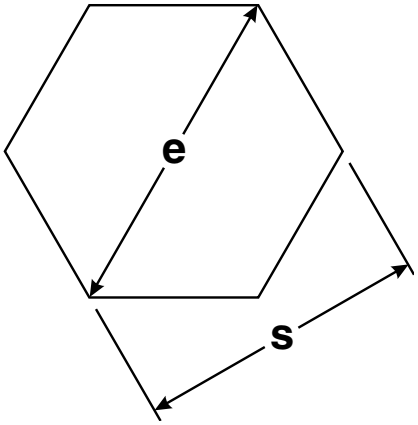
0 to 100						
°C	°C °F	°F		°C	°C °F	°F
-17.8	0	32.0		10.0	50	122.0
-17.2	1	33.8		10.6	51	123.8
-16.7	2	35.6		11.1	52	125.6
-16.1	3	37.4		11.7	53	127.4
-15.6	4	39.2		12.2	54	129.2
-15.0	5	41.0		12.8	55	131.0
-14.4	6	42.8		13.3	56	132.8
-13.9	7	44.6		13.9	57	134.6
-13.3	8	46.4		14.4	58	136.4
-12.8	9	48.2		15.0	59	138.2
-12.2	10	50.0		15.6	60	140.0
-11.7	11	51.8		16.1	61	141.8
-11.1	12	53.6		16.7	62	143.6
-10.6	13	55.4		17.2	63	145.4
-10.0	14	57.2		17.8	64	147.2
-9.4	15	59.0		18.3	65	149.0
-8.9	16	60.8		18.9	66	150.8
-8.3	17	62.6		19.4	67	152.6
-7.8	18	64.6		20.0	68	154.4
-7.2	19	66.2		20.6	69	156.2
-6.7	20	68.0		21.1	70	158.0
-6.1	21	69.8		21.7	71	159.8
-5.6	22	71.6		22.2	72	161.6
-5.0	23	73.4		22.8	73	163.4
-4.4	24	75.2		23.3	74	165.2
-3.9	25	77.0		23.9	75	167.0
-3.3	26	78.8		24.4	76	168.8
-2.8	27	80.6		25.0	77	170.6
-2.2	28	82.4		25.6	78	172.4
-1.7	29	84.2		26.1	79	174.2
-1.1	30	86.0		26.7	80	176.0
-0.6	31	87.8		27.2	81	177.8
0	32	89.6		27.8	82	179.6
0.6	33	91.4		28.3	83	181.4
1.1	34	93.2		28.9	84	183.2
1.7	35	95.0		29.4	85	185.0
2.2	36	96.8		30.0	86	186.8
2.8	37	98.6		30.6	87	188.6
3.3	38	100.4		31.1	88	190.4
3.9	39	102.2		31.7	89	192.2
4.4	40	104.0		32.2	90	194.0
5.0	41	105.8		32.8	91	195.8
5.6	42	107.6		33.3	92	197.6
6.1	43	109.4		33.9	93	199.4
6.7	44	111.2		34.4	94	201.2
7.2	45	113.0		35.0	95	203.0
7.8	46	114.8		35.6	96	204.8
8.3	47	116.6		36.1	97	206.6
8.9	48	118.4		36.7	98	208.4
9.4	49	120.2		37.2	99	210.2
				37.8	100	212.0

100 to 1,000						
°C	°C °F	°F		°C	°C °F	°F
38	100	212		260	500	932
43	110	230		266	510	950
49	120	248		271	520	968
54	130	266		277	530	986
60	140	284		282	540	1004
66	150	302		288	550	1022
71	160	320		293	560	1040
77	170	338		299	570	1058
82	180	356		304	580	1076
88	190	374		310	590	1094
93	200	392		316	600	1112
99	210	410		321	610	1130
100	212	413		327	620	1148
104	220	428		332	630	1166
110	230	446		338	640	1184
116	240	464		343	650	1202
121	250	482		349	660	1220
127	260	500		354	670	1238
132	270	518		360	680	1255
138	280	536		366	690	1274
143	290	554		371	700	1292
149	300	572		377	710	1310
154	310	590		382	720	1328
160	320	608		388	730	1346
166	330	626		393	740	1364
171	340	644		399	750	1382
177	350	662		404	760	1400
182	360	680		410	770	1418
188	370	698		416	780	1436
193	380	716		421	790	1454
199	390	734		427	800	1472
204	400	752		432	810	1490
210	410	770		438	820	1508
216	420	788		443	830	1526
221	430	806		449	840	1544
227	440	824		454	850	1562
232	450	842		460	860	1580
238	460	860		466	870	1598
243	470	878		471	880	1616
249	480	896		477	890	1634
254	490	914		482	900	1652
				488	910	1670
				493	920	1688
				499	930	1706
				504	940	1724
				510	950	1742
				516	960	1760
				521	970	1778
				527	980	1795
				532	990	1814
				538	1000	1832

Look up the reading in the middle (shaded) column. To determine equivalent in Fahrenheit, look in right hand column; to determine equivalent in Centigrade, look in left hand column. Example: -20°F = -29°C (left).

Hexagon Across Corner Dimensions

The across corner dimensions are calculated using the factor 1.1547. Should the corners be rounded, the across corner dimensions will be smaller than shown in the table below.



Metric Hex Sizes		Inch Hex Sizes Hexagons in inches and mm; Across corner dimensions in mm											
s	e	s			e	s			e	s			e
mm	mm	In	In	mm	mm	In	In	mm	mm	In	In	mm	mm
10	11.5	1/4	0.25	6.4	7.4	1 1/4	1.25	31.8	36.7	2 5/16	2.31	58.7	67.8
12	13.8	9/32	0.28	7.1	8.2	1 9/32	1.28	32.5	37.5	2 3/8	2.38	60.3	69.6
14	16.2	5/16	0.31	7.9	9.1	1 5/16	1.31	33.3	38.5	2 7/16	2.44	61.9	71.5
17	19.6	11/32	0.34	8.7	10.0	1 11/32	1.34	34.1	39.4	2 1/2	2.50	63.5	73.3
19	21.9	3/8	0.38	9.2	10.6	1 3/8	1.38	34.9	40.3	2 9/16	2.56	65.1	75.2
22	25.4	13/32	0.41	10.3	11.9	1 13/32	1.41	35.7	41.2	2 5/8	2.63	66.7	77.0
24	27.7	7/16	0.44	11.1	12.8	1 7/16	1.44	36.5	42.1	2 11/16	2.69	68.3	78.9
27	31.2	15/32	0.47	11.9	13.7	1 15/32	1.47	37.3	43.1	2 3/4	2.75	69.9	80.7
30	34.6	1/2	0.50	12.7	14.7	1 1/2	1.50	38.1	44.0	2 13/16	2.81	71.4	82.4
32	36.9	17/32	0.53	13.5	15.6	1 17/32	1.53	38.9	44.9	2 7/8	2.88	73.0	84.3
36	41.6	9/16	0.56	14.3	16.5	1 9/16	1.56	39.7	45.8	2 15/16	2.94	74.6	86.1
41	47.3	19/32	0.59	15.1	17.4	1 19/32	1.59	40.5	46.8	3	3.00	76.2	88.0
46	53.1	5/8	0.63	15.9	18.4	1 5/8	1.63	41.3	47.7	3 1/16	3.06	77.8	89.8
50	57.7	21/32	0.66	16.7	19.3	1 21/32	1.66	42.1	48.6	3 1/8	3.13	79.4	91.7
55	63.5	11/16	0.69	17.5	20.2	1 11/16	1.69	42.9	49.5	3 3/16	3.19	81.0	93.5
60	69.3	23/32	0.72	18.3	21.1	1 23/32	1.72	43.7	50.5	3 1/4	3.25	82.6	95.4
65	75.0	3/4	0.75	19.1	22.0	1 3/4	1.75	44.5	51.4	3 5/16	3.31	84.1	97.1
70	80.0	25/32	0.78	19.8	22.9	1 25/32	1.78	45.2	52.2	3 3/8	3.38	85.7	99.0
75	86.5	13/16	0.81	20.6	23.8	1 13/16	1.81	46.0	53.1	3 7/16	3.44	87.3	100.8
80	92.4	27/32	0.84	21.4	24.7	1 27/32	1.84	46.8	54.0	3 1/2	3.50	88.9	102.7
85	98.0	7/8	0.88	22.2	25.6	1 7/8	1.88	47.6	55.0	3 9/16	3.56	90.5	104.5
90	104	29/32	0.91	23.0	26.6	1 29/32	1.91	48.4	55.9	3 5/8	3.63	92.1	106.3
95	110	15/16	0.94	23.8	27.5	1 15/16	1.94	49.2	56.8	3 11/16	3.69	93.7	108.2
100	116	31/32	0.97	24.6	28.4	1 31/32	1.97	50.0	57.7	3 3/4	3.75	95.3	110.0
105	121	1	1.00	25.4	29.3	2	2.00	50.8	58.7	3 13/16	3.81	96.8	11.8
110	127	1 1/32	1.03	26.2	30.3	2 1/32	2.03	51.6	59.6	3 7/8	3.88	98.4	113.6
115	133	1 1/16	1.06	27.0	31.2	2 1/16	2.06	52.4	60.5	3 15/16	3.94	100.0	115.5
120	139	1 3/32	1.09	27.8	32.1	2 3/32	2.09	53.2	61.4	4	4.00	101.6	117.3
130	150	1 1/8	1.13	28.6	33.0	2 1/8	2.13	54.0	62.4	4 1/8	4.13	104.8	121.0
135	156	1 5/32	1.16	29.4	33.9	2 5/32	2.16	54.8	63.3	4 1/4	4.25	108.0	124.7
145	167	1 3/16	1.19	30.2	34.9	2 3/16	2.19	55.6	64.2	4 3/8	4.38	111.1	128.3
150	173	1 7/32	1.22	31.0	35.8	2 1/4	2.25	57.5	66.0	4 1/2	4.50	114.3	132.0