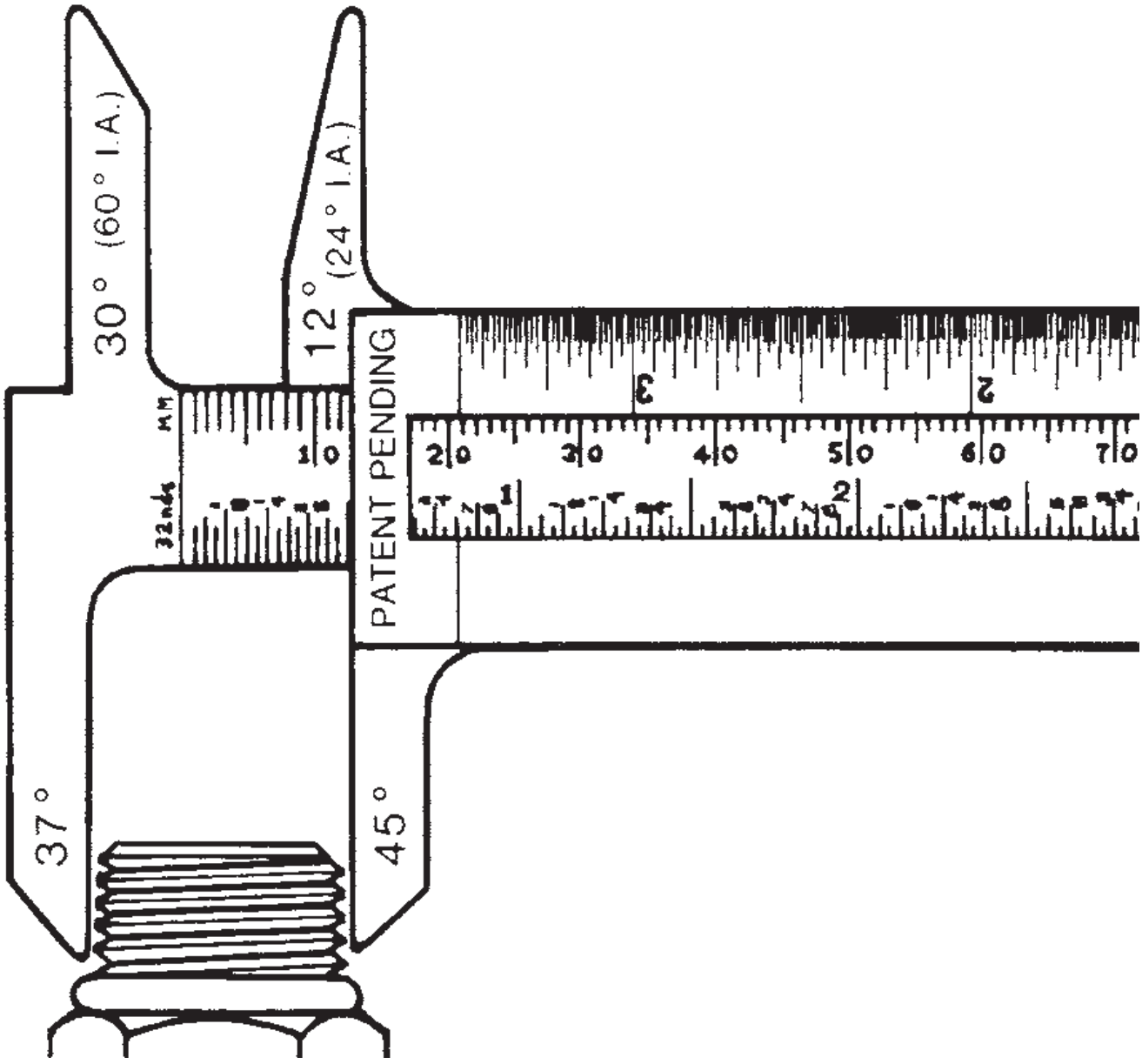
How to Identify Fluid Ports and Connectors



Powering Business Worldwide

Accurate identification of ports and connectors in fluid piping systems is necessary before the correct hose or tube assembly can be selected and installed. With this booklet and a few simple tools, measurement and identification is easy.

Most connectors commonly used in fluid piping systems are included in this booklet. The connections are listed under headings divided by the country of origin to provide further assistance in identification.

Please consult your Eaton representative for assistance in identifying connectors not found in this booklet.

How to Use This Booklet

Visually identify the part by comparing it with the illustration shown for each type of connection. Take measurements of the I.D., O.D., threads and angles as appropriate. Compare the measurements to the charts to convert to the correct dash and/or thread size and the parts series.

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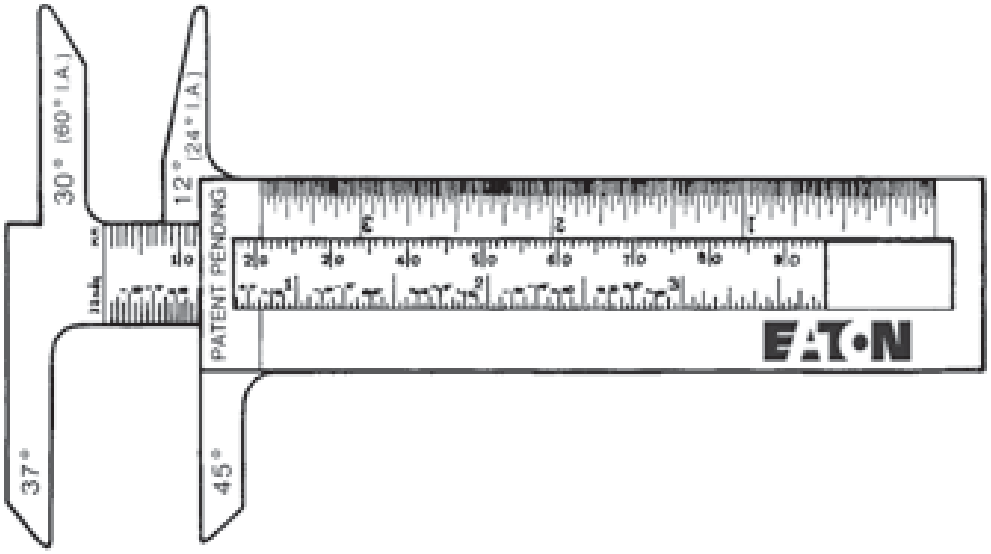
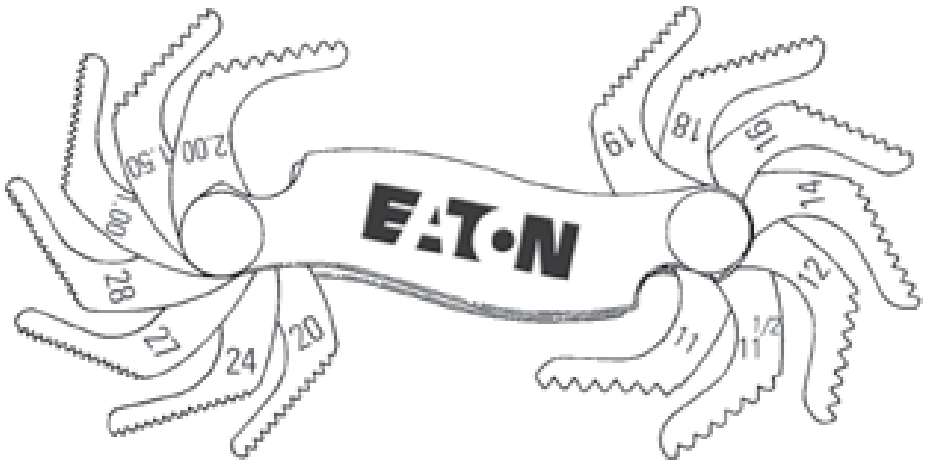
Measuring Tools

A seat angle gauge, thread pitch gauge and an I.D./O.D. caliper are necessary to make accurate measurements of commonly used connectors. Eaton offers a unique caliper that offers the capabilities of both a caliper and a seat angle gauge in one unit.



I.D./O.D. Angle Gauge Caliper

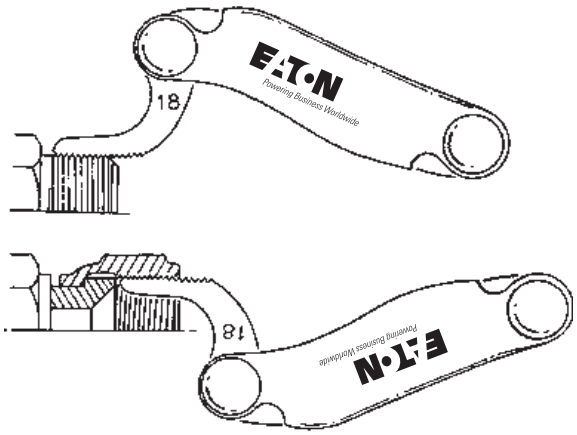


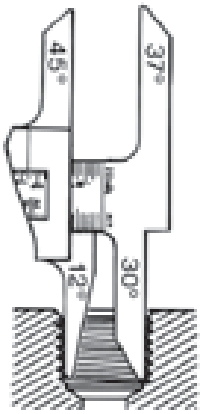
Thread Pitch Gauge

How to Measure Threads

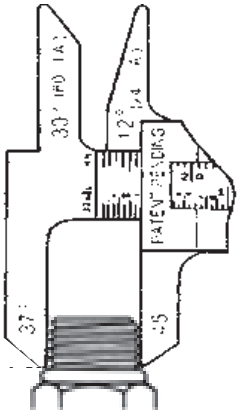
Use a thread pitch gauge to determine the number of threads per inch or the distance between threads in metric connections. Place the gauge on the threads until the fit is snug. Match the measurement to the charts.

Measure the thread diameter with an I.D./ O.D. caliper as shown. Match the measurements to the charts.





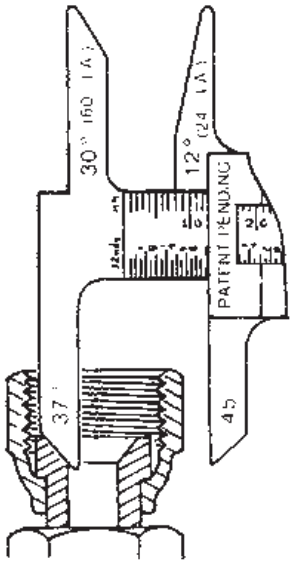
I.D.



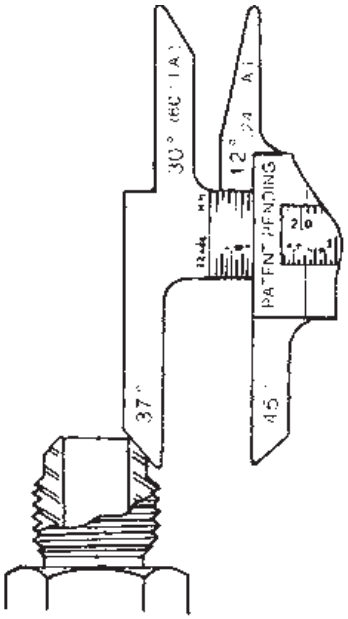
O.D.

How to Measure Sealing Surface Angles

Female connections are usually measured by inserting the gauge into the connection and placing it on the sealing surface. If the centerlines of the connection and gauge are parallel, the correct angle has been determined.



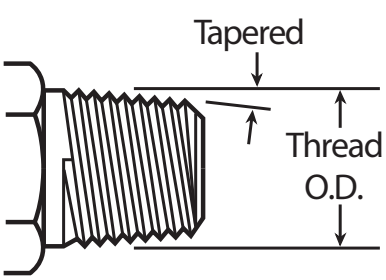
Male flare type connectors are usually measured by placing the gauge on the sealing surface. If the centerlines of the connection and gauge are parallel, the correct angle has been determined.



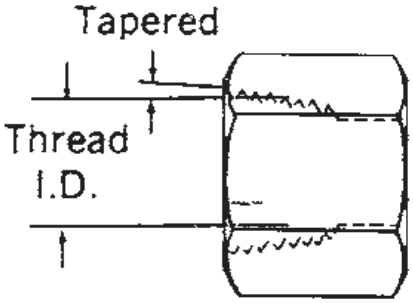
American Connections

NPTF (National Pipe Tapered Fuel)

This connection is still widely used in fluid power systems, even though it is not recommended by the National Fluid Power Association (N.F.P.A.) for use in hydraulic applications. The thread is tapered and the seal takes place by deformation of the threads.



Male Half



Female Half

NPTF Threads

Measure thread diameter and subtract 1/4-inch to find the nominal pipe size.

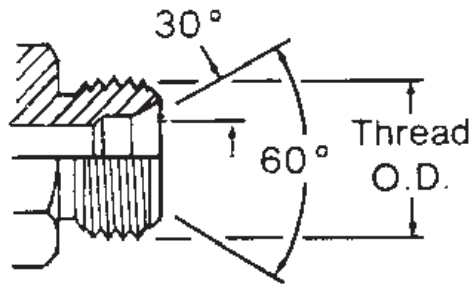
Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
1/8	02	1/8-27	13/32 (.41)	3/8 (.38)
1/4	04	1/4-18	17/32 (.54)	1/2 (.49)
3/8	06	3/8-18	11/16 (.68)	5/8 (.63)
1/2	08	1/2-14	27/32 (.84)	25/32 (.77)
3/4	12	3/4-14	1 1/16 (1.05)	1 (.98)
1	16	1-11 1/2	1 5/16 (1.32)	1 1/4 (1.24)
1 1/4	20	1 1/4-11 1/2	1 21/32 (1.66)	1 19/32 (1.58)
1 1/2	24	1 1/2-11 1/2	1 29/32 (1.90)	1 13/16 (1.82)
2	32	2-11 1/2	2 3/8 (2.38)	2 5/16 (2.30)

American Connections

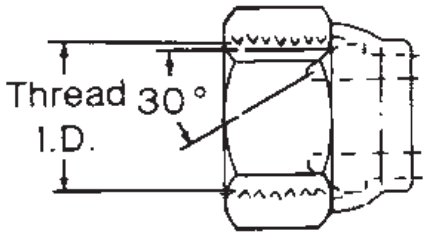
NPSM (National Pipe Straight Mechanical)

This connection is sometimes used in fluid power systems. The female half has a straight thread and an inverted 30° seat. The male half of the connection has a straight thread and a 30° internal chamfer. The seal takes place by compression of the 30° seat on the chamfer. The threads hold the connection mechanically.

Note: A properly chamfered NPTF male will also seal with the NPSM female.



Male Half



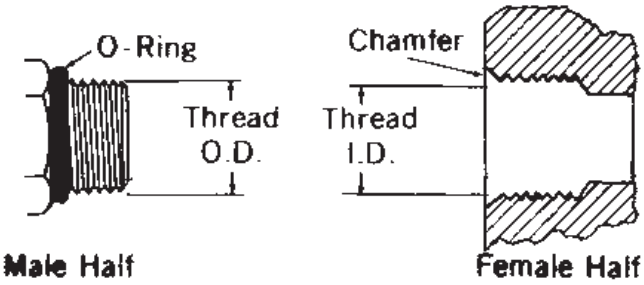
Female Half

Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
1/8	02	1/8-27	13/32 (.41)	3/8 (.38)
1/4	04	1/4-18	17/32 (.54)	1/2 (.49)
3/8	06	3/8-18	11/16 (.68)	5/8 (.63)
1/2	08	1/2-14	27/32 (.84)	25/32 (.77)
3/4	12	3/4-14	1 1/16 (1.05)	1 (.98)
1	16	1-11 1/2	1 5/16 (1.32)	1 1/4 (1.24)
1 1/4	20	1 1/4-11 1/2	1 21/32 (1.66)	1 19/32 (1.58)
1 1/2	24	1 1/2-11 1/2	1 29/32 (1.90)	1 13/16 (1.82)
2	32	2-11 1/2	2 3/8 (2.38)	2 5/16 (2.30)

American Connections

SAE J1926 Straight Thread O-Ring Boss (ORB)

This port connection is recommended by the N.F.P.A. for optimum leakage control in medium and high pressure hydraulic systems. The male connector has a straight thread and an O-Ring. The female port has a straight thread, a machined surface (minimum spotface) and a chamfer to accept the O-Ring. The seal takes place by compressing the O-Ring into the chamfer. The threads hold the connection mechanically.



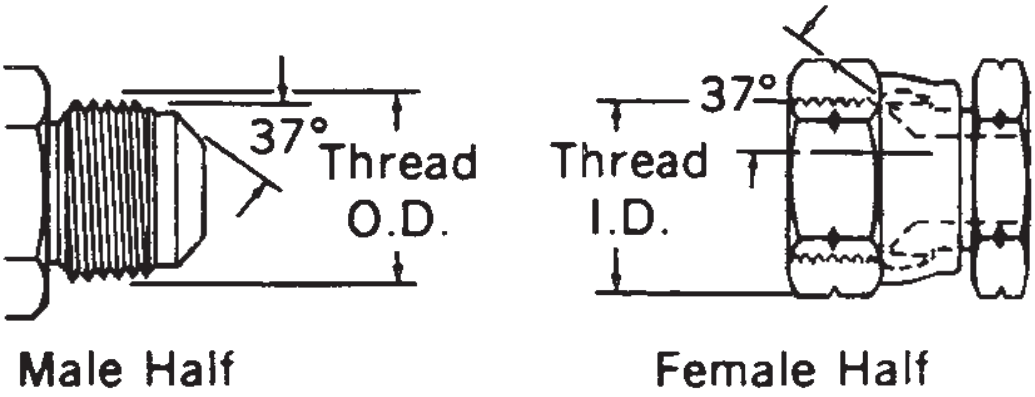
Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
1/8	02	5/16-24	5/16 (.31)	9/32 (.27)
3/16	03	3/8-24	3/8 (.38)	11/32 (.34)
1/4	04	7/16-20	`7/16 (.44)	13/32 (.39)
5/16	05	1/2-20	1/2 (.50)	15/32 (.45)
3/8	06	9/16-18	9/16 (.56)	17/32 (.51)
1/2	08	3/4-16	3/4 (.75)	11/16 (.69)
5/8	10	7/8-14	7/8 (.88)	13/16 (.81)
3/4	12	1 1/16-12	1 1/16 (1.06)	1 (.98)
7/8	14	1 13/16-12	1 3/16 (1.19)	1 1/8 (1.10)
1	16	1 5/16-12	1 5/16 (1.31)	1 1/4 (1.23)
1 1/4	20	1 5/8-12	1 5/8 (1.63)	1 9/16 (1.54)
1 1/2	24	1 7/8-12	1 7/8 (1.88)	1 13/16 (1.79)
2	32	2 1/2-12	2 1/2 (2.50)	2 7/16 (2.42)

American Connections

SAE J514 JIC/37˚ Hydraulic

This connection is very common in fluid power systems. Both the male and female halves of the connections have 37° seats. The seal takes place by establishing a line of 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 37° flare and SAE 45° flare are the same. However, the sealing surface angles are not the same.*



Male Half Female Half

American Connections

SAE J514 JIC Hydraulic (cont.)

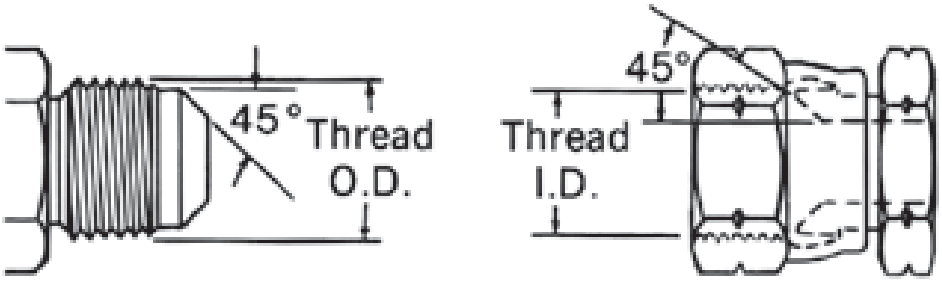
Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
1/8	02	5/16-24	5/16 (.31)	9/32 (.27)
3/16	03	3/8-24	3/8 (.38)	11/32 (.34)
1/4	04	7/16-20	`7/16 (.44)	13/32 (.39)
5/16	05	1/2-20	1/2 (.50)	15/32 (.45)
3/8	06	9/16-18	9/16 (.56)	17/32 (.51)
1/2	08	3/4-16	3/4 (.75)	11/16 (.69)
5/8	10	7/8-14	7/8 (.88)	13/16 (.81)
3/4	12	1 1/16-12	1 1/16 (1.06)	1 (.98)
7/8	14	1 13/16-12	1 3/16 (1.19)	1 1/8 (1.10)
1	16	1 5/16-12	1 5/16 (1.31)	1 1/4 (1.23)
1 1/4	20	1 5/8-12	1 5/8 (1.63)	1 9/16 (1.54)
1 1/2	24	1 7/8-12	1 7/8 (1.88)	1 13/16 (1.79)
2	32	2 1/2-12	2 1/2 (2.50)	2 7/16 (2.42)

American Connections

SAE J512 45°

This connection is commonly used in refrigeration, automotive and truck piping systems. The connector is frequently made of brass. Both the male and female connectors have 45° seats. The seal takes place 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 37° flare and SAE 45° flare are the same. However, the sealing surface angles are not the same.*



Male Half Female Half

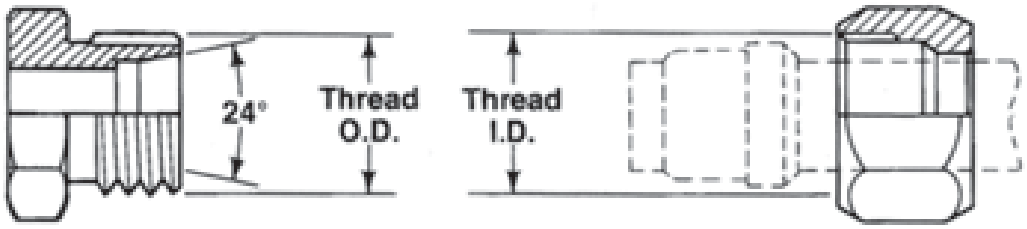
Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
1/8	02	5/16-24	5/16 (.31)	9/32 (.27)
3/16	03	3/8-24	3/8 (.38)	11/32 (.34)
1/4	04	7/16-20	7/16 (.44)	13/32 (.39)
5/16	05	1/2-20	1/2 (.50)	15/32 (.45)
3/8	06	5/8-18	5/8 (.63)	9/16 (.57)
1/2	08	3/4-16	3/4 (.75)	11/16 (.69)
5/8	10	7/8-14	7/8 (.88)	13/16 (.81)
3/4	12	1 1/16-14	1 1/16 (1.06)	1 (.99)
7/8	14	1 1/4-12	1 1/4 (1.25)	1 5/32 (1.16)
1	16	1 3/8-12	1 3/8 (1.38)	1 9/32 (1.29)

American Connections

Ermeto® Flareless Tube Fittings SAE J514

The male Ermeto connection has straight threads and a 24° seat. The female Ermeto connections incorporates a bite-type sleeve used in conjunction with a tube and female nut. When the female nut is tightened the seal is made between the sleeve and the 24° seat. A seal is also made between the sleeve and the tubing.

The threads retain the connection.

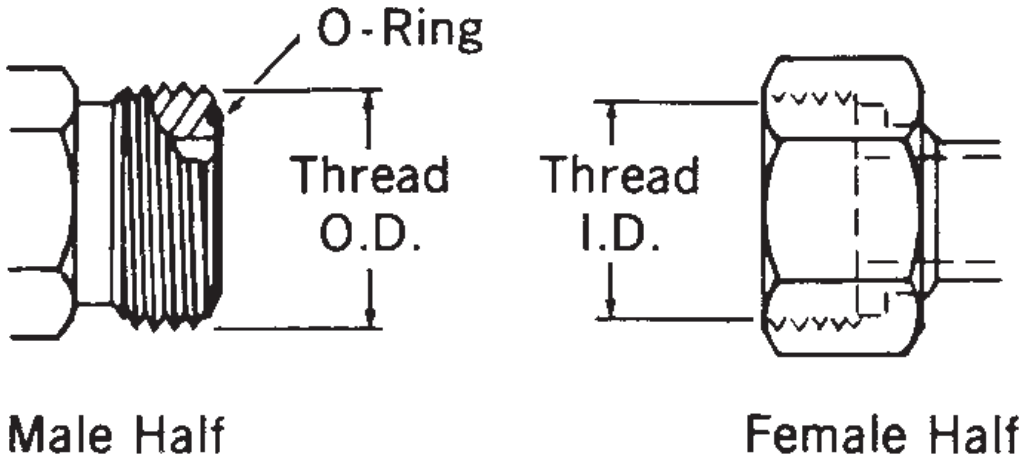


Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
-2	1/8	5/16-24	5/16	9/32
-3	3/16	3/18-24	3/8	11/32
-4	1/4	7/16-20	7/16	13/32
-5	5/16	1/2-20	7/16	13/32
-6	3/8	9/16-18	9/16	1/2
-8	1/2	3/4-16	3/4	11/16
-10	5/8	7/8-14	7/8	13/16
-12	3/4	1 1/16-12	1 1/16	31/32
-14	7/8	1 3/16-12	1 3/16	1 1/8
-16	1	1 5/16-12	1 3/16	1 1/8
-20	1 1/4	1 5/8-12	1 5/8	1 17/32
-24	1 1/2	1 7/8-12	1 7/8	1 13/16
-32	2	2 /12-12	2 1/2	2 7/16

American Connections

SAE J1453 O-Ring Face Seal

This connection offers the very best leakage control available today. The male connector has a straight thread and an O-Ring in the 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.

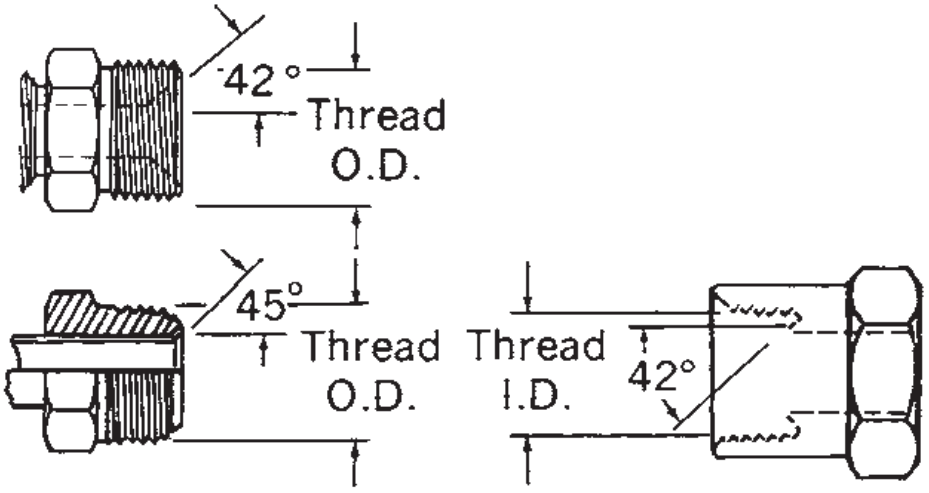


Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
1/4	04	9/16-18	9/16 (.56)	17/32 (.51)
3/8	06	11/16-16	11/16 (.69)	5/8 (.63)
1/2	08	13/16-16	13/16 (.82)	3/4 (.75)
5/8	10	1-14	1 (1.00)	15/16 (.93)
3/4	12	1 3/16-12	1 3/16 (1.19)	1 1/8 (1.11)
1	16	1 7/16-12	1 7/16 (1.44)	1 3/8 (1.36)
1 1/4	20	1 11/16-12	1 11/16 (1.69)	1 5/8 (1.61)
1 1/2	24	2-12	2 (2.00)	1 15/16 (1.92)

American Connections

SAE J512 Inverted

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 surfaces. The threads hold the connection mechanically.



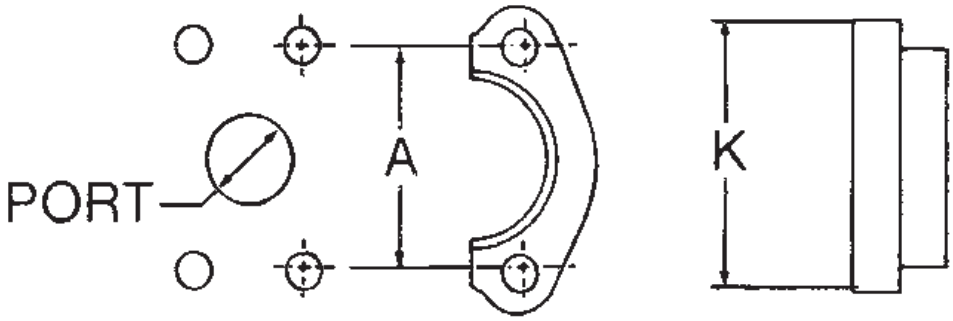
Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (in)	Female Thread I.D. (in)
1/8	02	5/16-28	5/16 (.32)	9/32 (.28)
3/16	03	3/8-24	3/8 (.38)	11/32 (.34)
1/4	04	7/16-24	7/16 (.44)	13/32 (.40)
5/16	05	1/2-20	1/2 (.50)	15/32 (.45)
3/8	06	5/8-18	5/8 (.63)	9/16 (.57)
7/16	07	11/16-18	11/16 (.69)	5/8 (.63)
1/2	08	3/4-18	3/4 (.75)	23/32 (.70)
5/8	10	7/8-18	7/8 (.88)	13/16 (.82)
3/4	12	1 1/16-16	1 1/16 (1.06)	1 (1.00)

American Connections

SAE J518 4-Bolt Flange*

This connection is commonly used in fluid power systems. There are two pressure ratings. Code 61 is referred to as the "standard" series and Code 62 is the "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 takes place on the O-Ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.



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

SAE J518 4-Bolt Flange (cont.)

Inch Size (Inch Dash)	Port Hose Bolt I.D. Inch Fraction (Decimal)	Bolt Dimensions Inch (Decimal)		Bolt Hole Spacing "A" Inch (Decimal)	
		Cd. 61	Cd. 62	Cd. 61	Cd. 62
1/2 (08)	1/2 (.50)	5/16-18x1 1/4	5/16-18x1 1/4	1 1/2 (1.50)	1 19/32 (1.50)
3/4 (12)	3/4 (.75)	3/8-16x1 1/4	3/8-16x1 1/2	1 7/8 (1.88)	2 (2.00)
1 (16)	1 (1.00)	3/8-16x1 1/4	7/16-14x1 3/4	2 1/16 (2.06)	2 1/4 (2.25)
1 1/4 (20)	1 1/4 (1.25)	7/16-14x1 1/2	1/2-13x1 3/4	2 5/16 (2.31)	2 5/8 (2.63)
1 1/2 (24)	1 1/2 (1.50)	1/2-13x1 1/2	5/8-11x2 1/4	2 3/4 (2.75)	3 1/8 (2.63)
2 (32)	2 (2.00)	1/2-13x1 1/2	3/4-10x2 3/4	2 1/16 (3.06)	3 13/16 (3.81)

Inch Size (Inch Dash)	Port Hose I.D. Inch Fraction (Decimal)	Flanged Head Diameter "K" Inch (Decimal)	
		Cd. 61	Cd. 62
1/2 (08)	1/2 (.50)	1 3/16 (1.19)	1 1/4 (1.25)
3/4 (12)	3/4 (.75)	1 1/2 (1.50)	1 5/8 (1.63)
1 (16)	1 (1.00)	1 3/4 (1.75)	1 7/8 (1.88)
1 1/4 (20)	1 1/4 (1.25)	2 (2.00)	2 1/8 (2.13)
1 1/2 (24)	1 1/2 (1.50)	2 3/8 (2.38)	2 1/2 (2.50)
2 (32)	2 (2.00)	2 13/32 (2.81)	3 1/8 (3.13)

SAE J518 4-Bolt Flange (cont.)

How to Measure

Four Bolt Flange—First measure the port hole diameter using the caliper. Next, measure the longest bolt hole spacing from center-to-center (Dimension "A") or measure the flanged head diameter.

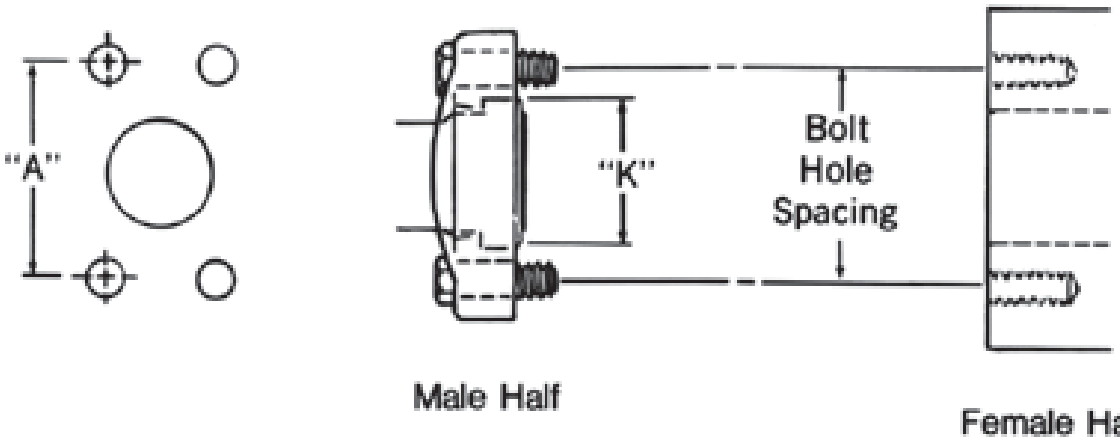
Note: CAT flanges have a .560" flange thickness (in all sizes) to correspond Caterpillar® split flanges. Other flange dimensions are identical to Code 62.

ISO Connection

ISO/DIS 6162 4-Bolt Flange*

This connection is commonly used in fluid power systems. There are two pressure ratings. PN 35/350 bar (Code 61) is the "standard" series, and PN 415 bar (Code 62) is the high pressure series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger for the high pressure, PN 415 bar connection. Both metric and inches bolts are used. The port will have an "M" stamped on it if metric bolts are required.

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 takes place on the o-ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.



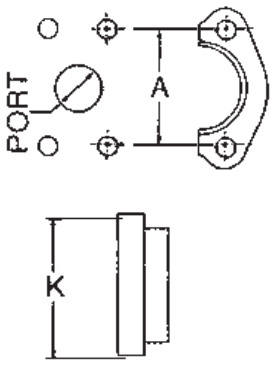
**ISO/DIS 6162, DIN 20066, JIS B 8363 and SAE J518 are interchangeable, except for bolt sizes.*

ISO Connection

ISO/DIS 6162 4-Bolt Flange* (cont.)

		Bolt Dimensions mm (in)		Bolt Hole Spacing "A" mm (in)	
Size mm (Inch) [Dash]	**Port Hole mm (in)**	**PN 35/350 Bar (Cd. 61)**	**PN 415 Bar (Cd. 62)**	**PN 35/350 Bar (Cd. 61)**	**PN 415 Bar (Cd. 62)**
13 (½) [08]	12.7 (.50)	M8x1.25x25 5/16-18 x 1¼	M8x1.25x30 5/16-18 x 1¼	38.10 (1.50)	40.49 (1.57)
19 (¾) [12]	19.1 (.75)	M10x1.5x30 3/8-16 x 1¼	M10x1.5x35 3/8-16 x 1½	47.63 (1.88)	50.80 (2.00)
25 (1) [16]	25.4 (1.00)	M10x1.5x30 3/8-16 x 1¼	M12x1.75x45 7/16-14 x 1¾	52.37 (2.06)	57.15 (2.25)
32 (1¼) [20]	31.7 (1.25)	M10x1.5x30 7/16-14 x 1½	M14x2x45 ½-13 x 1¾	58.72 (2.31)	66.68 (2.63)
38 (1½) [24]	38.0 (1.50)	M12x1.75x35 ½-13 x 1½	M16x2x55 5/8-11 x 2¼	69.85 (2.75)	79.38 (3.13)
50 (2)	50.8 (2.00)	M12x1.75x35 ½-13 x 1½	M20x2.5x70 ¾-10 x 2¾	77.77 (3.06)	96.82 (3.81)

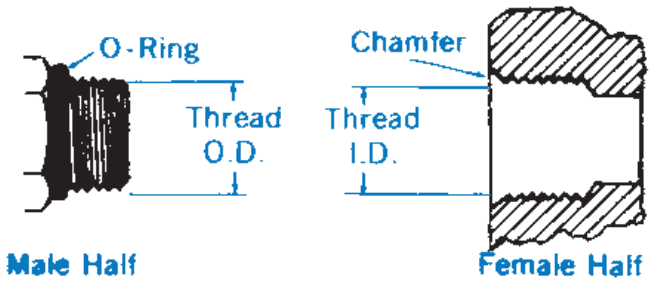
	Flanged Head Diameter "K" mm (in)	
Inch Size	**PN 35/350 (Cd. 61)**	**PN 415 Bar (Cd. 62)**
1/2	30.18 (1.19)	31.75 (1.25)
3/4	38.10 (1.50)	41.28 (1.63)
1	44.45 (1.75)	47.63 (1.88)
1 1/4	50.80 (2.00)	53.98 (2.13)
1 1/2	60.33 (2.38)	63.50 (2.50)
2	71.42 (2.81)	79.38 (3.13)



ISO Connection

ISO 6149 Port and Stud Ends with ISO 261 Threads and O-Ring Seal

This port connection is similar to the SAE J514 Straight Thread O-Ring Boss (ORB). The major difference is that this connection uses metric threads. The male connector has a straight thread and an O-Ring. The female port has a straight thread, a machined surface (minimum spotface) and a chamfer to accept the O-Ring. The seal takes place by compressing the O-Ring into the chamfer. The threads hold the connection mechanically.



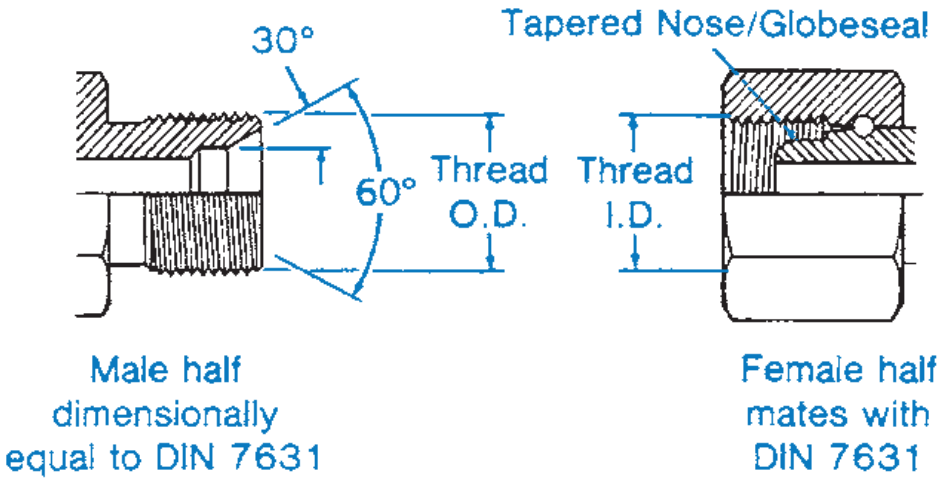
Metric Thread	Male Thread O.D. mm	Female Thread I.D. mm
M8 x 1	8	7
M10 x 1	10	9
M12 x 1,5	12	10,5
M14 x 1,5*	14	12,5
M16 x 1,5	16	14,5
M18 x 1,5	18	16,5
M22 x 1,5	22	20,5
M27 x 2	27	25
M33 x 2	33	31
M42 x 2	42	40
M48 x 2	48	46
M60 x 2	60	58

**M14 x 1,5: Recommended for diagnostic port application.*

German Connections

DIN 7631 Series

This connection is frequently used in hydraulic systems. The male has a straight metric thread and a 60° (included angle) recessed cone. The female has a straight thread and a tapered nose/ Globeseal™ seat. The seal takes place by contact between the cone of the male and the nose of the tapered nose/Globeseal flareless swivel. The threads hold the connection mechanically.



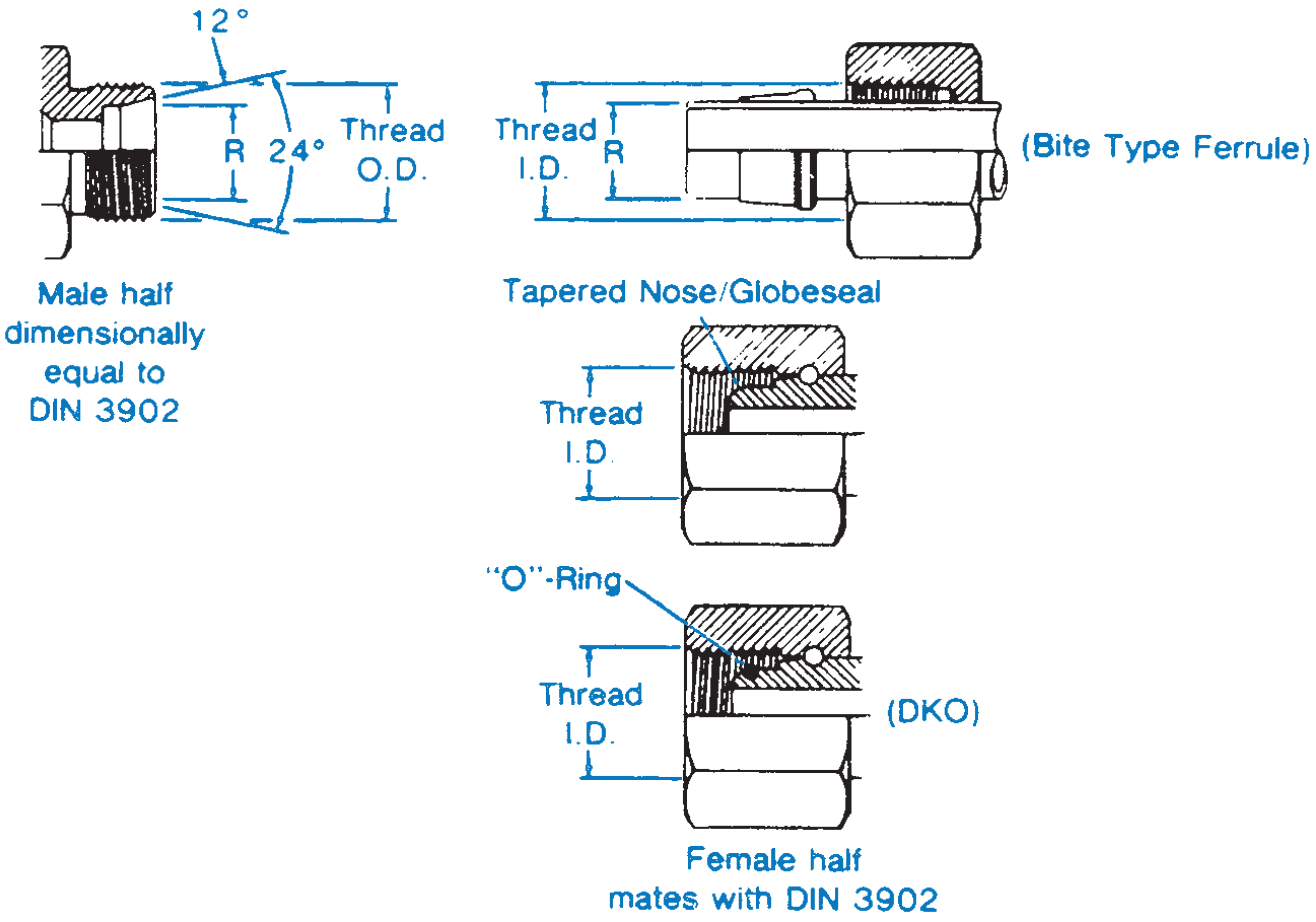
Use with Pipe/Tube O.D. mm	Metric Thread Size	Male Thread O.D. mm	Female Thread I.D. mm
6	M12 x 1,5	12	10,5
8	M14 x 1,5	14	12,5
10	M16 x 1,5	16	14,5
12	M18 x 1,5	18	16,5
15	M22 x 1,5	22	20,5
18	M26 x 1,5	26	24,5
22	M30 x 1,5	30	28,5
28	M38 x 1,5	38	36,5
35	M45 x 1,5	45	43,5
42	M52 x 1,5	52	50,5

German Connections

DIN 3902 Series

This connection style consists of a common male and three different female halves.

The male has a straight metric thread, a 24° included angle and a recessed counterbore that matches the tube O.D. used with it. The female may be a tube, nut and ferrule, a tapered nose/Globeseal flareless swivel or a tapered nose/Globeseal flareless swivel with an O-Ring in the nose (DKO type).



German Connections

DIN 3902 Series (cont.)

Tube O.D. "R" Dim. l.RH.*	Tube O.D. "R" Dim. S.RH†	Metric Thread Size	Male Thread O.D.	Female Thread I.D.
6		M12 x 1,5	12	10,5
8	6	M14 x 1,5	14	12,5
10	8	M16 x 1,5	16	14,5
12	10	M18 x 1,5	18	16,5
	12	M20 x 1,5	20	18,5
15	14	M22 x 1,5	22	20,5
	16	M24 x 1,5	24	22,5
18		M26 x 1,5	26	24,5
22	20	M30 x 2,0	30	28
28	25	M36 x 2,0	36	34
	30	M42 x 2,0	42	40
35		M45 x 2,0	45	43
42	38	M52 x 2,0	52	50

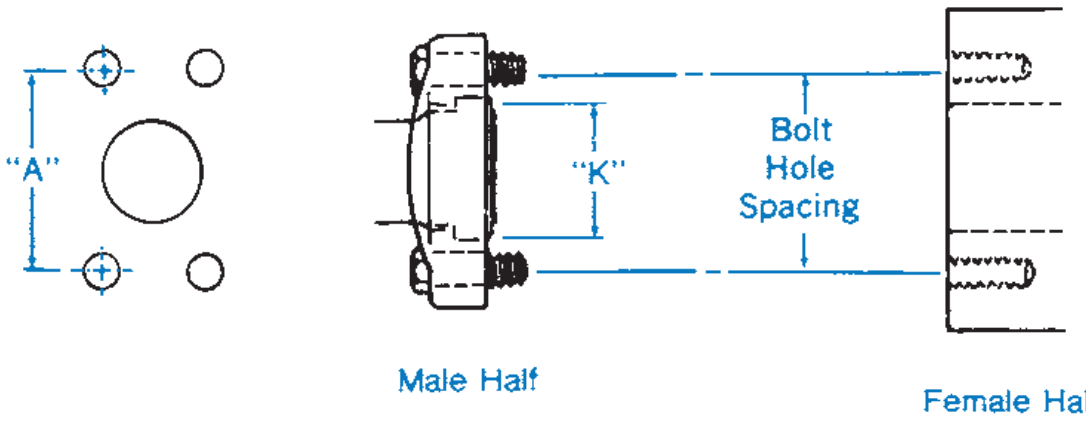
**l.RH. is a light duty system.*
†s.RH. is a heavy duty system.

German Connections

DIN 20066 4-Bolt Flange*

This connection is commonly used in fluid power systems. There are two pressure ratings. Form R (Code 61) is referred to as the "standard duty" series, and Form S (Code 62) is the "heavy duty" 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, Form S connection. Both metric and inch bolts are used.

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 takes place on the o-ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.



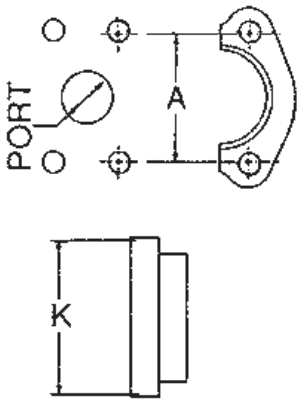
**DIN 20066, ISO/DIS 6162, JIS B 8363 and SAE J518 are interchangeable, except for bolt sizes.*

German Connections

DIN 20066 4-Bolt Flange* (cont.)

		Bolt Dimensions mm (in)		Bolt Hole Spacing "A" mm (in)	
Size mm (Inch) [Dash]	Port Hole mm (in)	Form R (Cd. 61)	Form S (Cd. 62)	Form R (Cd. 61)	Form S (Cd. 62)
13 (½) [08]	12.7 (.50)	M8x1.25x25 5/16-18 x 1¼	M8x1.25x30 5/16-18 x 1¼	38.10 (1.50)	40.49 (1.57)
19 (¾) [12]	19.1 (.75)	M10x1.5x30 3/8-16 x 1¼	M10x1.5x35 3/8-16 x 1½	47.63 (1.88)	50.80 (2.00)
25 (1) [16]	25.4 (1.00)	M10x1.5x30 3/8-16 x 1¼	M12x1.75x45 7/16-14 x 1¾	52.37 (2.06)	57.15 (2.25)
32 (1¼) [20]	31.7 (1.25)	M10x1.5x30 7/16-14 x 1½	M14x2x45 ½-13 x 1¾	58.72 (2.31)	66.68 (2.63)
38 (1½) [24]	38.0 (1.50)	M12x1.75x35 ½-13 x 1½	M16x2x55 5/8-11 x 2¼	69.85 (2.75)	79.38 (3.13)
50 (2)	50.8 (2.00)	M12x1.75x35 ½-13 x 1½	M20x2.5x70 ¾-10 x 2¾	77.77 (3.06)	96.82 (3.81)

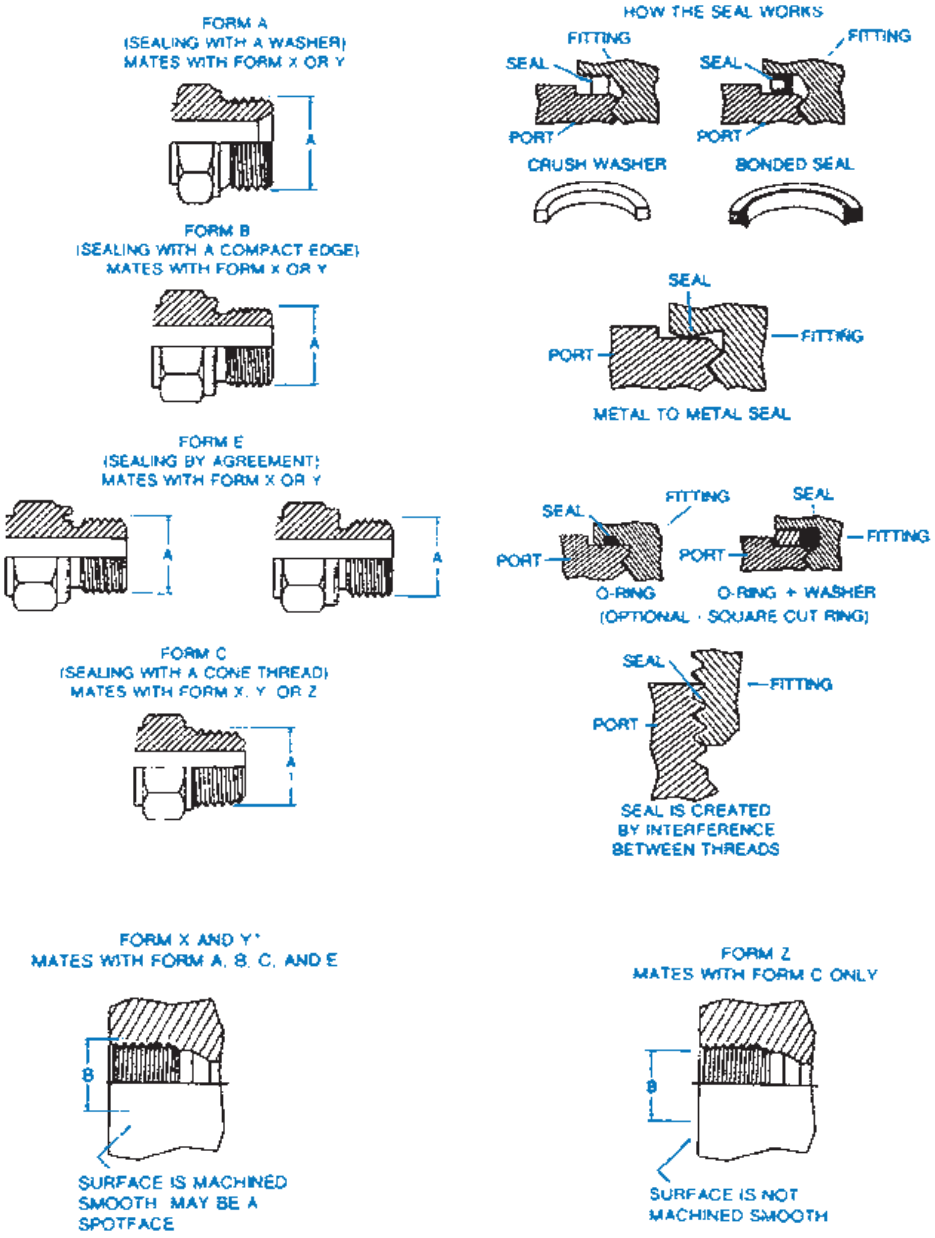
Flanged Head Diameter "K" mm (in)		
Inch Size	Form R (Cd. 61)	Form S (Cd. 62)
1/2	30.18 (1.19)	31.75 (1.25)
3/4	38.10 (1.50)	41.28 (1.63)
1	44.45 (1.75)	47.63 (1.88)
11/4	50.80 (2.00)	53.98 (2.13)
11/2	60.33 (2.38)	63.50 (2.50)
2	71.42 (2.81)	79.38 (3.13)



German Connections

DIN 3852 – Male Connectors and Female Ports

This DIN is controlled by Germany, but other countries may use it as a reference for their connector and port designs. The chart below illustrates the various forms and how they seal.



German Connections

DIN 3852 Metric Threads

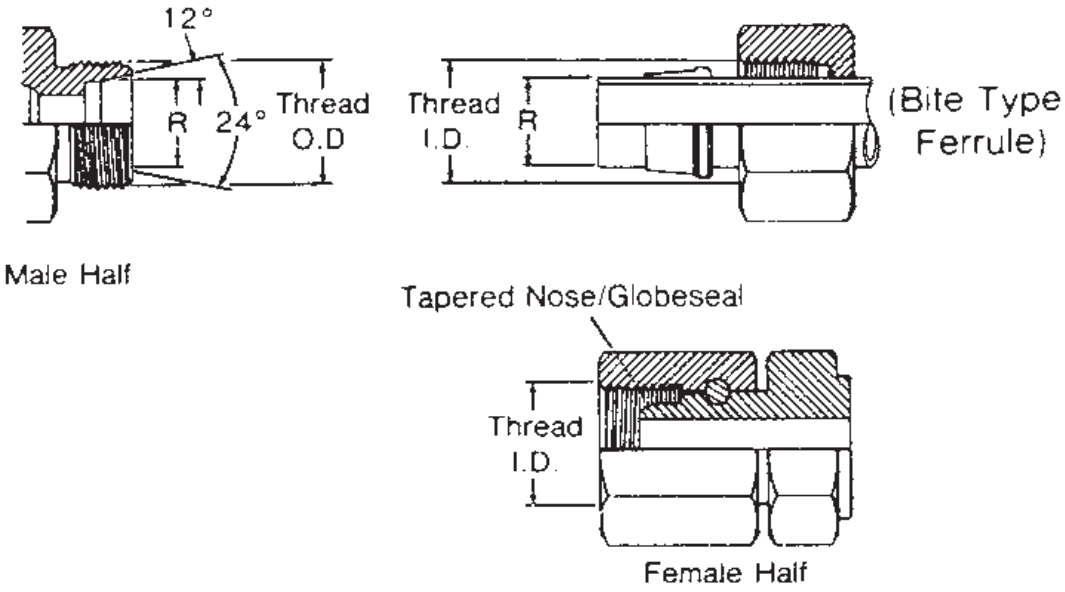
Metric Threads	Male Thread O.D. "A" mm	Female Thread I.D. "B" mm
M12 x 1,5	12	10,5
M14 x 1,5	14	12,5
M16 x 1,5	16	14,5
M18 x 1,5	18	16,5
M20 x 1,5	20	18,5
M22 x 1,5	22	20,5
M24 x 1,5	24	22,5
M26 x 1,5	26	24,5
M27 x 2	27	25
M30 x 1,5	30	28,5
M30 x 2	30	28
M33 x 2	33	31
M36 x 1,5	36	34,5
M36 x 2	36	34
M38 x 1,5	38	36,5
M38 x 2	38	36
M42 x 1,5	42	40,5
M42 x 2	42	40
M45 x 1,5	45	43,5
M45 x 2	45	43
M48 x 1,5	48	46,5
M48 x 2	48	46
M52 x 1,5	52	50,5
M52 x 2	52	50

For DIN 3852 Whitworth pipe thread dimensions, see BSPT/BSPP dimensions on page 33. They are the same.

French Connections

Millimetrique and GAZ Series

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



French Connections

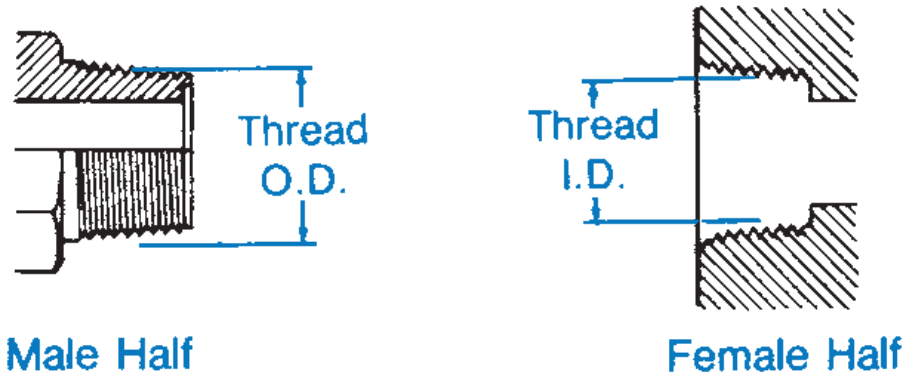
Millimetrique and GAZ Threads

Tubing O.D. "R" Dim. mm	"GAZ" Pipe O.D. "R" Dim. mm	Metric Thread Size	Male Thread O.D. mm	Female Thread I.D. mm
6		M12 x 1,0	12	11
8		M14 x 1,5	14	12,5
10		M16 x 1,5	16	14,5
12		M18 x 1,5	18	16,5
14	13,25	M20 x 1,5	20	18,5
15		M22 x 1,5	22	20,5
16	16,75	M24 x 1,5	24	22,5
18		M27 x 1,5	27	25,5
22	21,25	M30 x 1,5	30	28,5
25		M33 x 1,5	33	31,5
28	26,75	M36 x 1,5	36	34,5
30		M39 x 1,5	39	37,5
32		M42 x 1,5	42	40,5
35	33,50	M45 x 1,5	45	43,5
38		M48 x 1,5	48	46,5
40	42,25	M52 x 1,5	52	50,5
45		M54 x 2,0	52	52
	48,25	M58 x 2,0	58	55

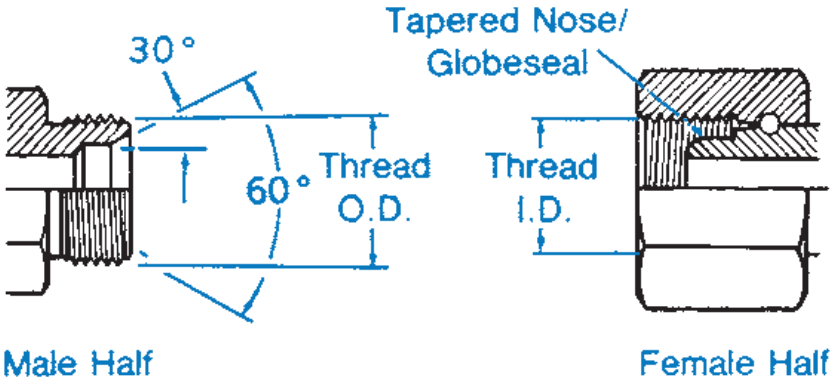
British Connections

British Standard Pipe (BSP)

The BSPT (tapered) connection is similar to the NPT, except that the thread pitches are different in most sizes, and the thread form and O.D.'s are close but not the same. Sealing is accomplished by thread distortation. A thread sealant is recommended.



The BSPP (parallel) male is similar to the NPSM male except the thread pitches are different in most sizes. The female swivel BSPP has a tapered nose/ Globeseal flareless swivel which seals on the cone seat of the male.



British Connections

BSPT/BSPP Threads

Inch Size	Dash Size	Nominal Thread Size*	Male Thread O.D. (in)		Female Thread I.D. (in)	
1/8	02	1/8-28	3/8	.38	11/32	.35
1/4	04	1/4-19	33/64	.52	15/32	.47
3/8	06	3/8-19	21/32	.65	19/32	.60
1/2	08	1/2-14	13/16	.82	3/4	.75
5/8	10	5/8-14	7/8	.88	13/16	.80
3/4	12	3/4-14	1 1/32	1.04	31/32	.97
1	16	1-11	1 5/16	1.30	1 7/32	1.22
1 1/4	20	1 1/4-11	1 21/32	1.65	1 9/16	1.56
1 1/2	24	1 1/2-11	1 7/8	1.88	1 25/32	1.79
2	32	2-11	2 11/32	2.35	2 1/4	2.26

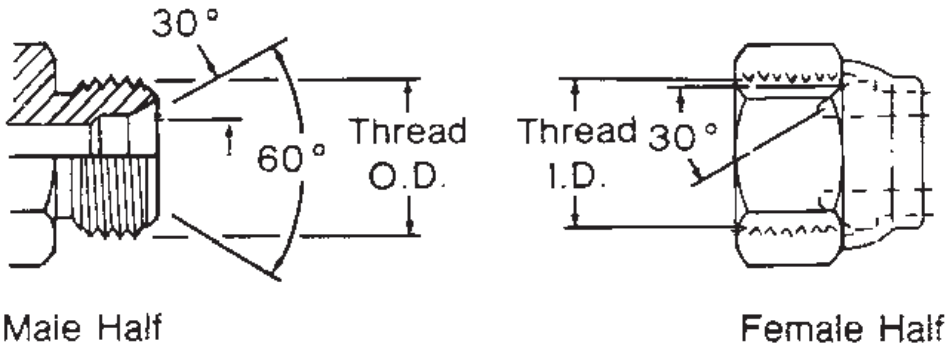
**Frequently, the thread size is expressed as a fractional dimension preceded by the letter "G" or the letter "R." The "G" represents a parallel thread, and the "R" indicates a tapered thread. For example, BSPP 3/8-19 may be expressed as G3/8, and BSPT 3/8-19 may be expressed as R 3/8.*

Japanese Connections

JIS 30° Male (Inverted) Seat, Metric Threads

(Threads per JIS B 0207)

The JIS parallel (metric) is the same as the JIS parallel (PF), except for the thread difference.



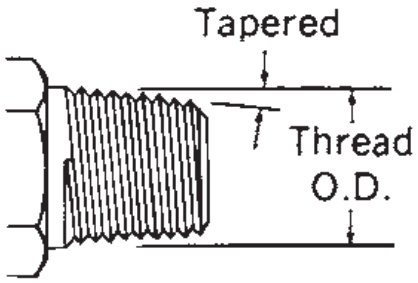
Size mm	Dash Size Equivalent	Thread Size	Male Thread O.D. mm	Female Thread I.D. mm
6	04	M14 x 1,5	14	12,5
9	06	M18 x 1,5	18	16,5
12	08	M22 x 1,5	22	20,5
19	12	M30 x 1,5	30	28,5
25	16	M33 x 1,5	33	31,5
32	20	M42 x 1,5	42	40,5

Japanese Connections

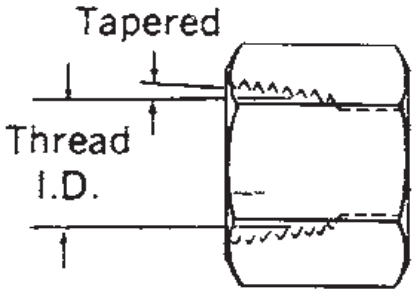
JIS Tapered Pipe (PT)

(Threads per JIS B 0203)

The JIS tapered thread is similar to the BSPT connection in design, appearance and dimensions. The JIS tapered thread and the BSPT connection are interchangeable.



Male Half



Female Half

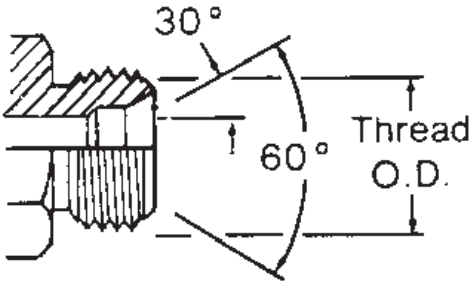
Inch Size	Size mm (Dash)	Nominal Thread Tapered Size	Male Thread O.D.		Female Thread I.D.	
		(Similar to BSPP)	Frac.	mm	Frac.	mm
1/4	6 (04)	1/4-19	33/64	13,2	15/32	11,9
3/8	9 (06)	3/8-19	21/32	16,7	19/32	15,3
1/2	12 (08)	1/2-14	13/16	21,0	3/4	19,2
3/4	19 (12)	3/4-14	1 1/32	26,4	31/32	24,6
1	25 (16)	1-11	1 5/16	33,3	1 7/32	30,9
1 1/4	32 (20)	1 1/4-11	1 21/32	41,9	1 9/16	39,6
1 1/2	38 (24)	1 1/2-11	1 7/8	47,8	1 25/32	45,5
2	50 (32)	2-11	2 11/32	59,7	2 1/4	57,4

Japanese Connections

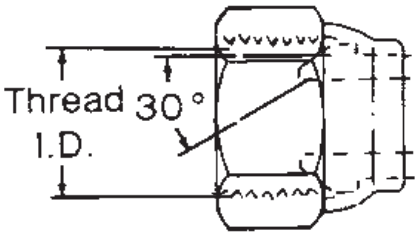
JIS 30° Male Inverted Seat, Parallel Pipe Threads

(Threads per JIS B 0202)

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



Male Half



Female Half

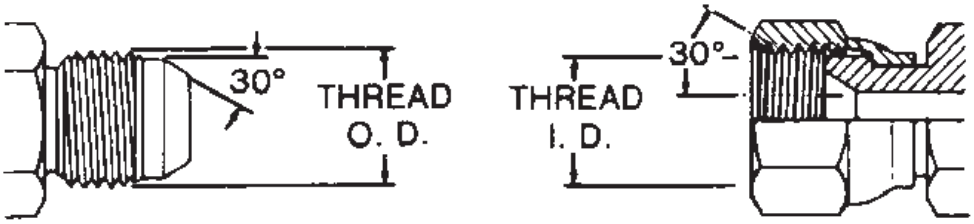
Inch Size	Size mm (Dash)	Nominal Thread Tapered Size	Male Thread O.D.		Female Thread I.D.	
		(Similar to BSPP)	Frac.	mm	Frac.	mm
1/4	6 (04)	1/4-19	33/64	13,2	15/32	11,9
3/8	9 (06)	3/8-19	21/32	16,7	19/32	15,3
1/2	12 (08)	1/2-14	13/16	21,0	3/4	19,2
3/4	19 (12)	3/4-14	1 1/32	26,4	31/32	24,6
1	25 (16)	1-11	1 5/16	33,3	1 7/32	30,9
1 1/4	32 (20)	1 1/4-11	1 21/32	41,9	1 9/16	39,6
1 1/2	38 (24)	1 1/2-11	1 7/8	47,8	1 25/32	45,5
2	50 (32)	2-11	2 11/32	59,7	2 1/4	57,4

Japanese Connections

JIS 30° Female (Cone) Seat, Parallel Pipe Threads

(Threads per JIS B 0202)

The Japanese JIS 30° flare is similar to the American SAE 37° flare connection in application as well as sealing principles. However, the flare angle and dimensions are different. The threads are similar to BSPP.



MALE HALF FEMALE HALF

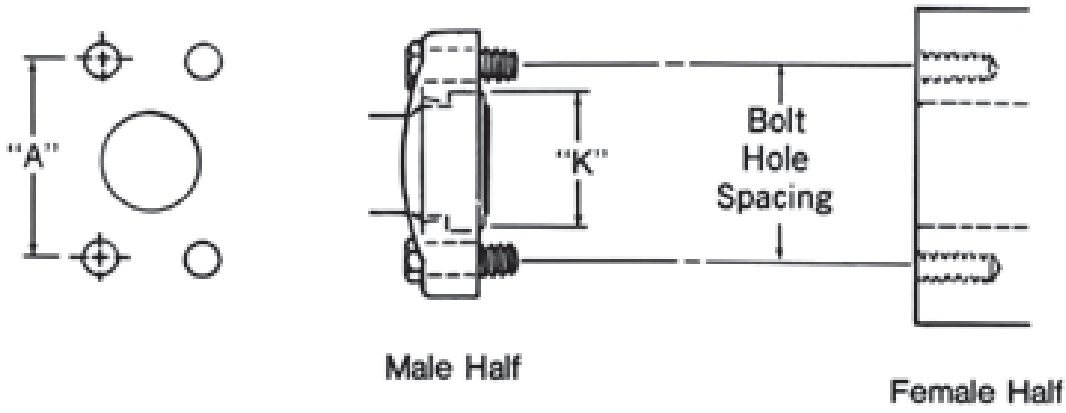
Inch Size	Size mm (Dash)	Nominal Thread Tapered Size	Male Thread O.D.		Female Thread I.D.	
		(Similar to BSPP)	Frac.	mm	Frac.	mm
1/4	6 (04)	1/4-19	33/64	13,2	15/32	11,9
3/8	9 (06)	3/8-19	21/32	16,7	19/32	15,3
1/2	12 (08)	1/2-14	13/16	21,0	3/4	19,2
3/4	19 (12)	3/4-14	1 1/32	26,4	31/32	24,6
1	25 (16)	1-11	1 5/16	33,3	1 7/32	30,9
1 1/4	32 (20)	1 1/4-11	1 21/32	41,9	1 9/16	39,6
1 1/2	38 (24)	1 1/2-11	1 7/8	47,8	1 25/32	45,5
2	50 (32)	2-11	2 11/32	59,7	2 1/4	57,4

Japanese Connections

JIS B 8363 4-Bolt Flange*

This connection is commonly used in fluid power systems. There are two pressure ratings. Type I (Code 61) is referred to as the "standard" series, and Type II (Code 62) is the "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, Type II connection. Both metric and inch bolts are used.

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 takes place on the O-Ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.



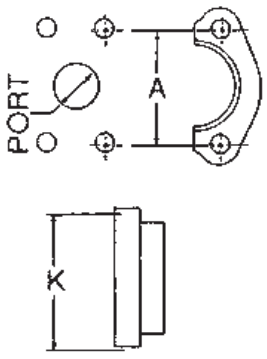
**JIS B 8363, ISO/DIS 6162, DIN 20066 and SAE J518 are interchangeable, except for bolt sizes.*

Japanese Connections

JIS B 8363 4-Bolt Flange (cont.)

		Bolt Dimensions mm (in)		Bolt Hole Spacing "A" mm (in)	
Size mm (Inch) [Dash]	**Port Hole mm (in)**	**Type I (Cd.61)**	**Type II (Cd.62)**	**Type I (Cd.61)**	**Type II (Cd.62)**
12 (½) [08]	12.7 (.50)	M8x1.25x30 5/16-18 x 1¼	M8x1.25x30 5/16-18 x 1¼	38.10 (1.50)	40.49 (1.57)
19 (¾) [12]	19.1 (.75)	M10x1.5x30 3/8-16 x 1¼	M10x1.5x40 3/8-16 x 1½	47.63 (1.88)	50.80 (2.00)
25 (1) [16]	25.4 (1.00)	M10x1.5x30 3/8-16 x 1¼	M12x1.75x45 7/16-14 x 1¾	52.37 (2.06)	57.15 (2.25)
32 (1¼) [20]	31.7 (1.25)	M10x1.5x40 7/16-14 x 1½	M14x2x45 ½-13 x 1¾	58.72 (2.31)	66.68 (2.63)
38 (1½) [24]	38.0 (1.50)	M12x1.75x40 ½-13 x 1½	M16x2x55 5/8-11 x 2¼	69.85 (2.75)	79.38 (3.13)
50 (2)	50.8 (2.00)	M12x1.75x40 ½-13 x 1½	M20x2.5x70 ¾-10 x 2¾	77.77 (3.06)	96.82 (3.81)

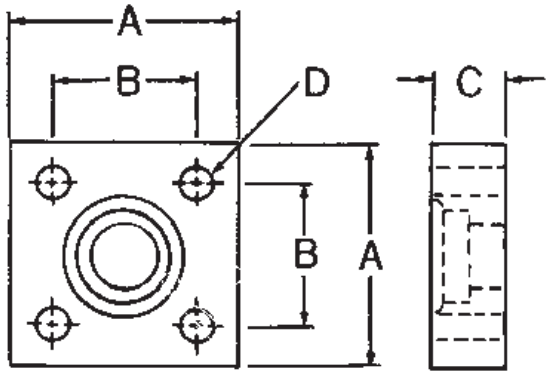
	Flanged Head Diameter "K" mm (in)	
Inch Size	**Type I (Cd.61)**	**Type II (Cd.62)**
1/2	30.18 (1.19)	31.75 (1.25)
3/4	38.10 (1.50)	41.28 (1.63)
1	44.45 (1.75)	47.63 (1.88)
1 1/4	50.80 (2.00)	53.98 (2.13)
1 1/2	60.33 (2.38)	63.50 (2.50)
2	71.42 (2.81)	79.38 (3.13)



Japanese Connections

JIS 210 Kgf/cm2 4-Bolt Square Flange

The JIS 4-bolt square flange connection is similar in concept to the SAE 4-bolt flange connection, except that the JIS bolt pattern is square and the flange itself is different.



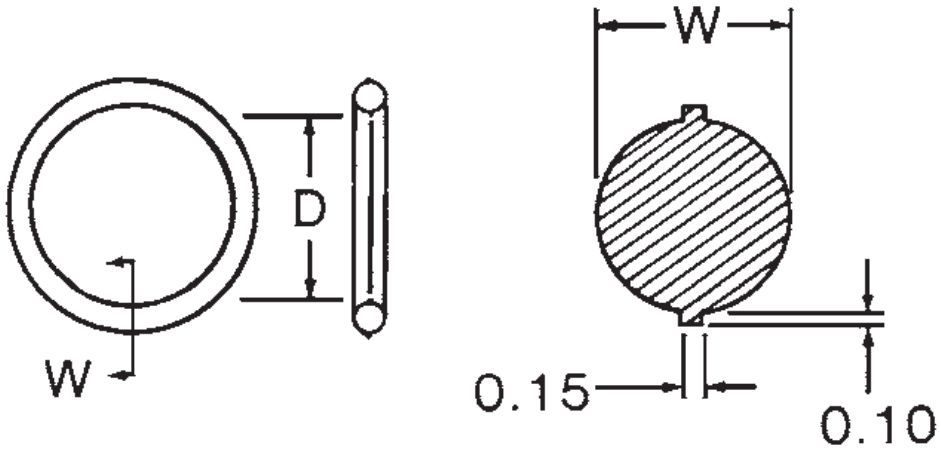
Size mm	Appx. Inch Size	Bolt Size mm*	Dim. "A" mm	Dim. "B" mm	Dim. "C" mm	Bolt Hole Dim. "D" mm
12	½	M10x1.5x55 (80)		63	40	2211
19	¾	M10x1.5x55 (80)		68	45	2211
25	1	M12x1.75x70 (100)	80	53	28	13
32	1¼	M12x1.75x70 (100)	90	63	28	13
38	1½	M16x2.0x90 (100)		100	70	3618
38	1½	M16x2.0x90 (130)		100	70	3618
50	2	M16x2.0x90 (130)		112	80	3618

**Bolt Length for Long Design*

Japanese Connections

JIS 210 Kgf/cm2 O-Ring

Nominal Size mm	Dim. “D“ mm	Dim. “W“ mm
12	24.4±0.15	3.1±0.1
19	29.4±0.15	3.1±0.1
25	34.4±0.15	3.1±0.1
32	39.4±0.15	3.1±0.1
38	49.4±0.15	3.1±0.1
50	59.4±0.15	3.1±0.1



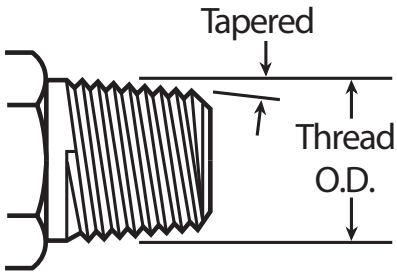
Oil Pan-Plug Threads

How to Identify Oil Pan-Plug Thread Sizes

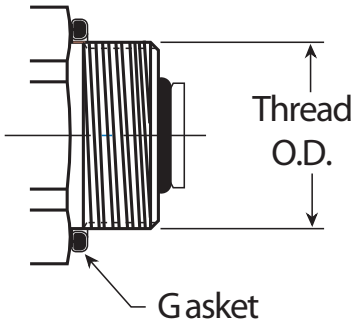
These connections are found on engine oil pans of all types ranging from on and off road vehicles, marine vessels, and construction equipment, to in-plant equipment fluid reservoirs. The thread styles range from straight threads with no chamfers to NPTF threads.

Eaton has selected a single jacketed copper crush gasket to use on all FLOCS coupling and adapter straight threads where sealing is against the pan itself. In these applications there will be plugs on the equipment to measure, so the male thread dimension is given in this chart.

NPTF Thread



Straight Thread



Oil Pan-Plug Threads

How to Identify Oil Pan-Plug Thread Sizes (cont.)

Thread Size	Male Thread O.D.	FD14 Drain Coupling	FF1187 90° Adapter
	Inch (mm)	Part Number	Part Number
1/2-20 UNF	0.50 (12.6)	FD14-1002-01-06	FF1187-0801S
M18 x 1.5	0.70 (18.0)	FD14-1002-02-06	FF1187-0802S
M14 x 1.25	0.55 (14.0)	FD14-1002-03-06	FF1187-0803S
M10 x 1	0.39 (10.0)	N/A	FF1187-0804S
1 1/4-18 UNEF	1.24 (31.6)	FD14-1002-05-06	FF1187-0805S
1-18 UNS	0.99 (25.2)	FD14-1002-06-06	FF1187-0806S
7/8-18 UNS	0.87 (22.1)	FD14-1002-07-06	FF1187-0807S
5/8-18 UNF	0.62 (15.7)	FD14-1002-08-06	FF1187-0808S
3/4-16 UNF	0.74 (18.9)	FD14-1002-09-06	FF1187-0809S
7/8-14 UNF	0.87 (22.0)	FD14-1002-10-06	FF1187-0810S
M24 x 2	0.94 (24.0)	FD14-1002-11-06	FF1187-0811S
9/16-18 UNF	0.56 (14.1)	FD14-1002-12-06	FF1187-0812S
1 1/8-12 UNF	1.12 (28.4)	FD14-1002-14-06	FF1187-0814S
M20 x 1.5	0.78 (20.0)	FD14-1002-16-06	FF1187-0816S
M25 x 1.5	0.98 (25.0)	FD14-1002-17-06	FF1187-0817S

Oil Pan-Plug Threads

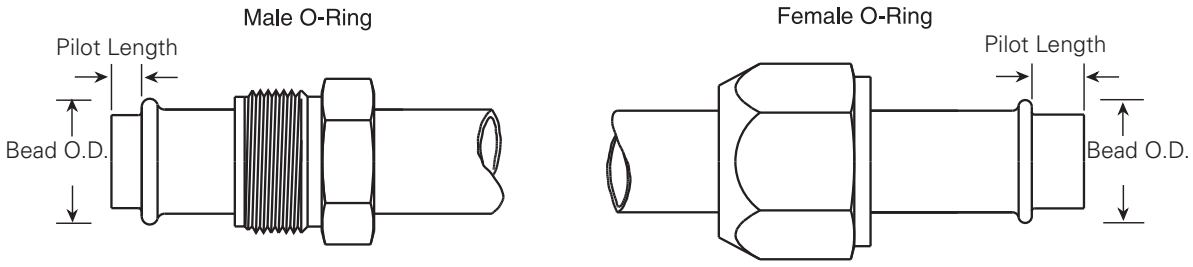
How to Identify Oil Pan-Plug Thread Sizes (cont.)

Thread Size	Male Thread O.D.	FD14 Drain Coupling
	Inch (mm)	Part Number
M22 x 1.5	0.86 (22.0)	FD14-1002-18-06
M24 x 1.5	0.94 (24.0)	FD14-1002-19-06
11/16-12 UN	1.06 (26.8)	FD14-1002-20-06
M30 x 1.5	1.18 (30.0)	FD14-1002-21-06
1/2-14 UNS	0.49 (12.5)	FD14-1002-22-06
M12 x 1.5	0.47 (12.0)	FD14-1002-23-06
M14 x 1.5	0.55 (14.0)	FD14-1002-24-06
M12 x 1.75	0.47 (12.0)	FD14-1002-25-06
3/4-14 Dryseal NPTF	1.05 (26.7)	FD14-1002-26-06

O-Ring Pilot Threads

How to Identify O-Ring Pilot Thread Sizes

This connection is common to air conditioning systems, both in vehicle and commercial applications. Both the male and female halves of the connections have a pilot, either long or short. The seal takes place by compressing an o-ring adjacent to the bead of the tube. The threads hold the connection together mechanically.



O-Ring Pilot Threads

How to Identify O-Ring Pilot Thread Sizes (cont.)

		Male Thread O.D. (in)			Female Thread I.D. (in)		
Inch Size	Dash Size	Nominal Thread	Frac.	Decimal	Nominal	Frac.	Decimal
3/8	06	5/8-18	5/8	.62	5/8-18	9/16	.57
1/2	08	3/4-18	3/4	.75	3/4-16	11/16	.69
5/8	10	7/8-18	7/8	.87	7/8-14	13/16	.81
3/4	12	11/16-16	11/16	1.06	11/16-14	1	.99

		Long Pilot		Short Pilot	
Inch Size	Nominal Tube Size	Bead O.D. (in)	Pilot Length	Bead O.D. (in)	Pilot Length
3/8	06	.52	.28	.52	.19
1/2	08	.64	.39	.64	.19
5/8	10	.77	.39	.77	.19
3/4	12	.91	.39	.91	.19

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