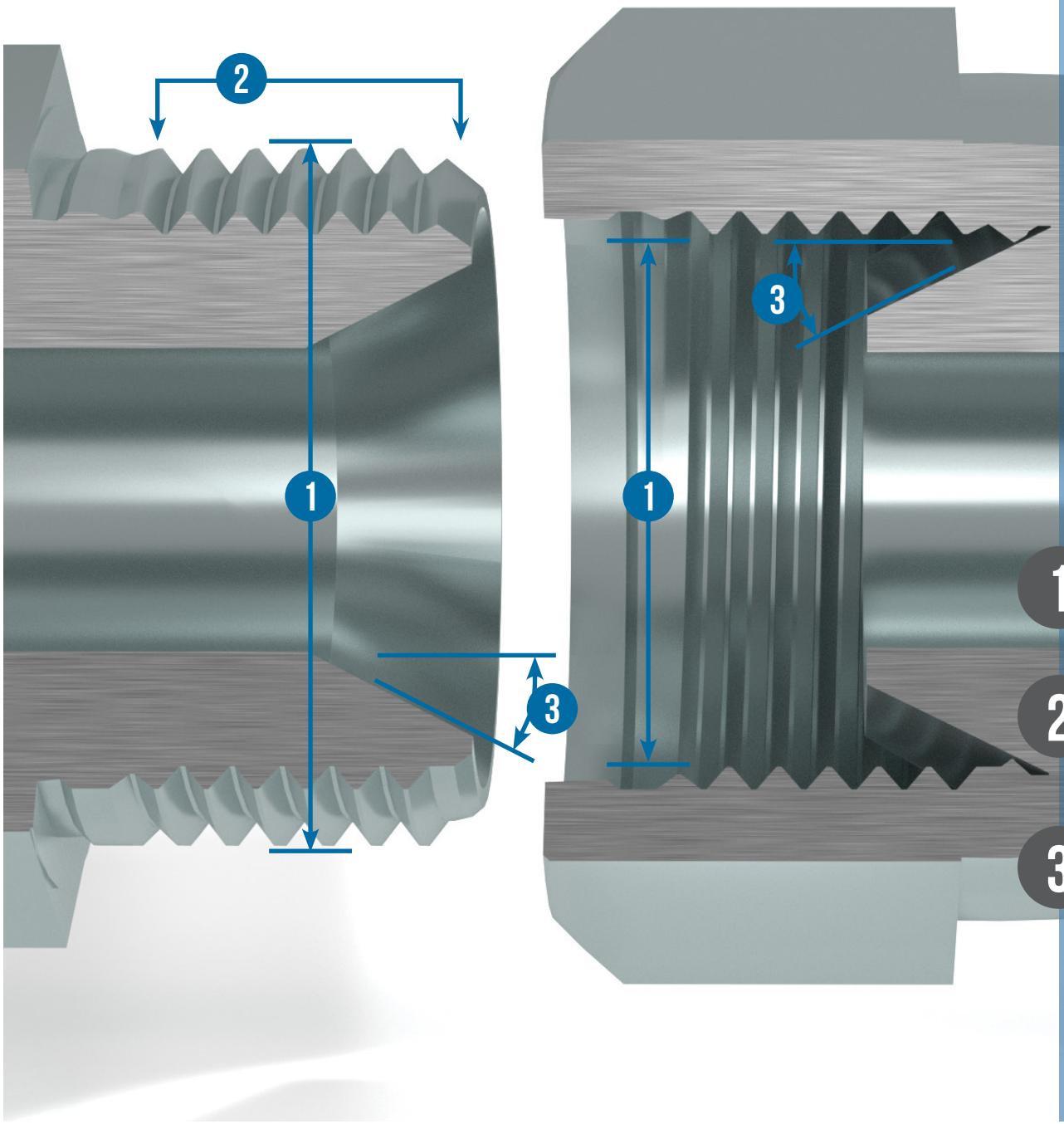
BRENNAN

THREAD IDENTIFICATION & MEASUREMENT GUIDE



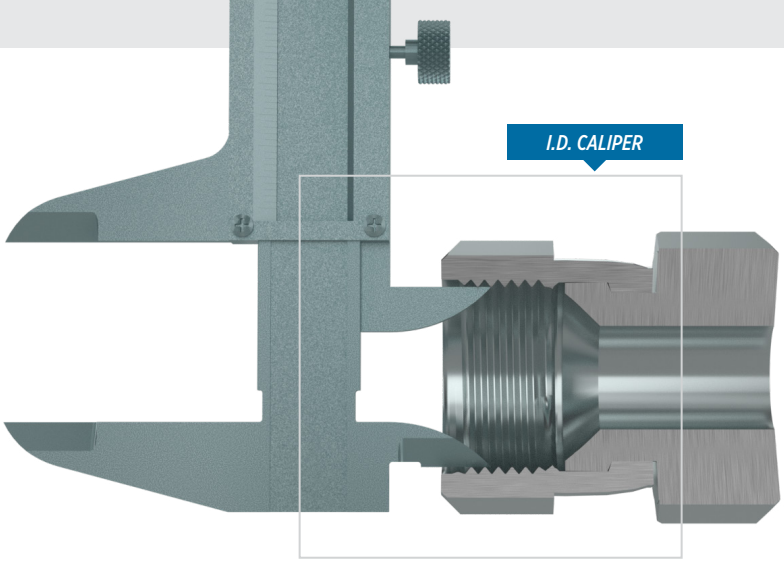
The precise identification of fluid line connectors is critical before selecting and installing the correct fittings. In this guide we will cover some of the most common hydraulic fluid transfer, piping and instrumentation systems and how to measure them in the field.

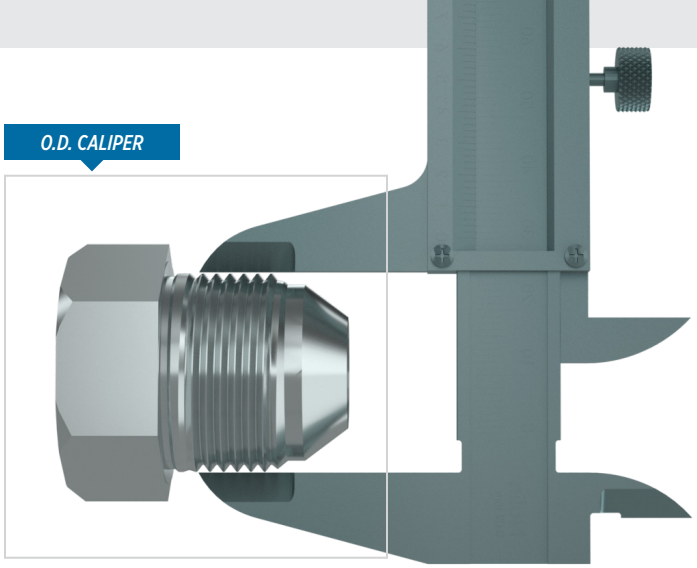
HOW TO MEASURE THREADS

1 **FIRST,** use a combination O.D./I.D. caliper to measure the thread diameter. Note: The threads of a used fitting can become worn and distorted, so the measurements may not be exact.

2 **SECOND,** use a thread pitch gauge to identify the number of threads per inch. For metric connections, measure the distance between threads. Place the gauge on the threads until it fits snugly, match your measurements with the thread chart provided at the back of this guide.

3 **THIRD,** if the port is angled, determine the seat angle by using a gauge on the sealing surface. The centerline of the fitting and the gauge must be parallel.





MEASURING TOOLS

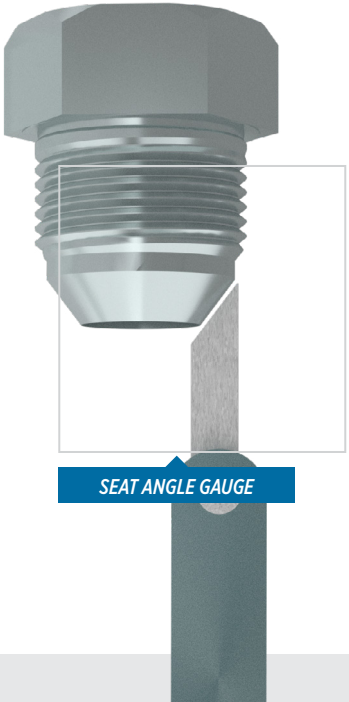
By using a combination of three tools, identifying connectors is easy to do. Using an **I.D./ O.D. CALIPER**, **THREAD PITCH GAUGE** and **SEAT ANGLE GAUGE** allow you to make accurate measurements of most connections. Many thread ID calipers provide both a caliper and a seat angle gauge in one tool.

The **I.D./O.D. CALIPER** is used to measure the O.D. of a male thread and I.D. of a female thread. (Important: When matching gauge measurements to thread charts keep in mind that threads on connections that have been in-service may be worn and distorted from use, causing inexact comparison to the thread tables.

For English, British and other European threads the thread pitch gauge measures the threads per inch. However, for metric threads the gauge will identify the distance between the threads.

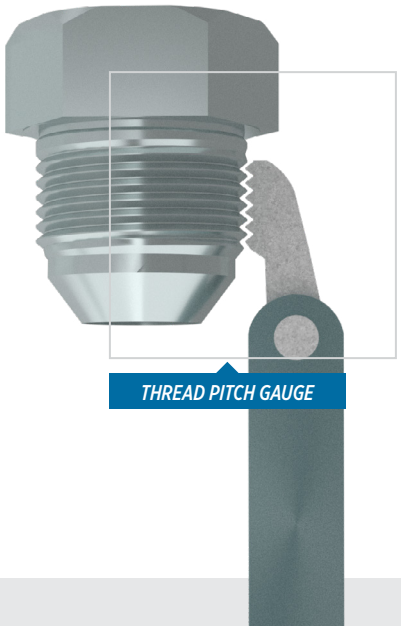
The **SEAT ANGLE GAUGE** is used by placing the gauge angle on the sealing surface. The centerline of the fitting end and the gauge should be parallel.

In the English system the thread size and pitch (number of threads per inch) are given, along with the thread type.



MEASURING THREADS

Using the **THREAD PITCH GAUGE**, align the gauge on the threads and make sure it is snug. Match the measurement to the a thread chart. Then measure the thread diameter with the I.D./ O.D. caliper. Match those measurements to the chart. There is a thread chart provided in the back of this guide.



MEASURING SEALING SURFACE ANGLES

FEMALE CONNECTIONS are measured by inserting the ID portion of the gauge into the connection on the sealing surface. Be sure the centerlines of the connection and gauge are parallel to identify the correct angle. For **MALE FLARE TYPE CONNECTIONS**, place the gauge on the sealing surface to establish the measurement. Again, be sure the centerlines of the connection and gauge are parallel to identify the correct angle. See image on the far left for detail.

US AMERICAN CONNECTIONS

NATIONAL PIPE TAPERED (NPT)

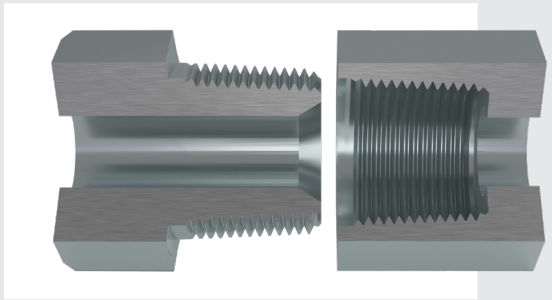
NPT (National Pipe Tapered) style pipe threads are have been widely used for over 100 years. NPT is a U.S. standard for tapered threads used on pipes and fittings. They are used to effectively seal pipes for fluid and gas transfer. The nominal pipe size can be identified by physically measuring the thread diameter, then subtracting ¼".

They are available in iron or brass for low-pressure applications and carbon steel and stainless steel for high-pressure.

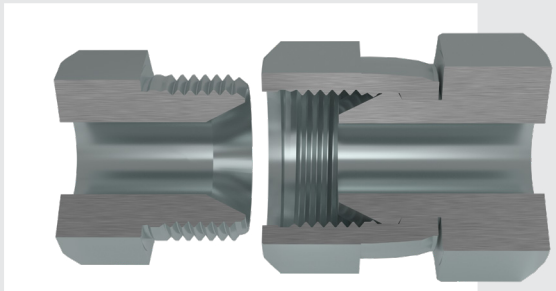
NPTF (National Pipe Tapered Fuel) style connections are widely used in fluid power systems. They have a tapered thread by which a seal is made by deformation of the threads. NPTF Threads are measured at the thread diameter and subtracting ¼ -inch to establish the nominal pipe size.

NPSM (National Pipe Straight Mechanical) connections are also often found in fluid power systems. The female component incorporates a straight thread with an inverted 30° seat. The male component has a straight thread and a 30° internal chamfer. A seal is made by compression of the 30° seat on the chamfer. This is considered a mechanical connection. If an NPTF male is properly chamfered it will also seal with an NPSM female connection.

NPTF



NPSM



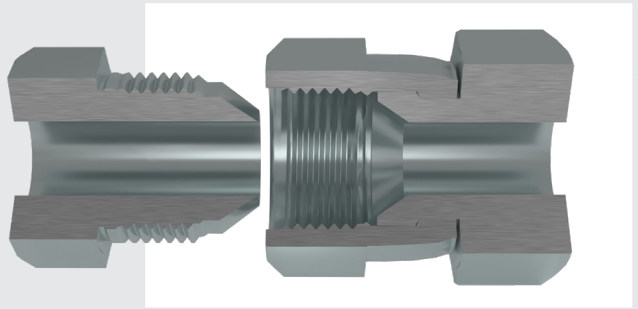
SOCIETY OF AUTOMOTIVE ENGINEERS THREAD (SAE)

SAE J1926 Straight Thread O-ring Boss (ORB) is recommended by the National Fire Protection Association (N.F.P.A.) for leak prevention in medium and high pressure hydraulic systems. The male connection is a straight thread with an O-ring. The female port has a straight thread and a machined surface to provide a smooth, flat, surface (minimum spotface), along with a chamfer where the O-ring seats. It seals when the O-ring is compressed into the chamfer when mating the male connection. This is also considered a mechanical connection.

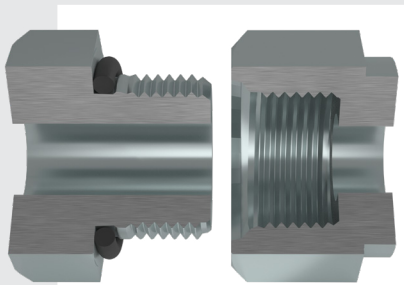
SAE J514 JIC/37˚ Hydraulic connections are common in most fluid power systems. Both male and female components have 37° seats. The seal is made by establishing contact between the male flared and the female coned seat. This is also considered a mechanical connection.

SAE J512 45° connections are used in automotive, refrigeration and truck pipe systems. These connectors are typically brass material. The male and female connections have 45° seats, where the seal is made where the male flare and the female cone meet. This is a mechanical connection, also.

NOTE dash sizes: -02, -03, -04, -05, -08 and -10 of SAE 37° and SAE 45° have the same threads, but NOT the same seat angles. Intermixing the two different types of fittings will result in leakage, so use care in measuring seat angles.



SAE JIC/37˚

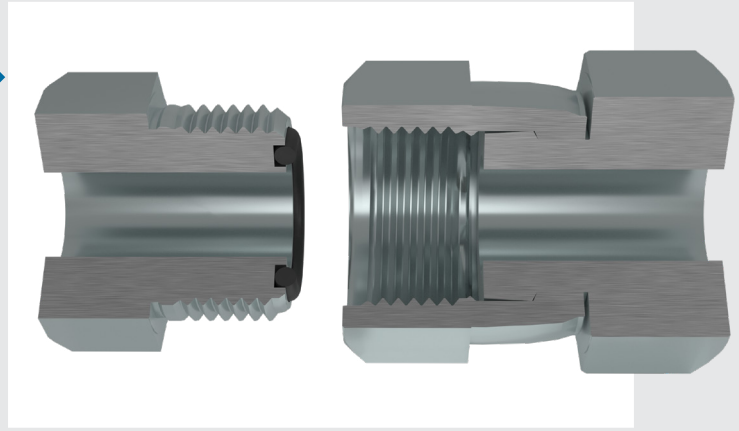


SAE Straight Thread O-ring Boss

SAE J1453 (ORFS) O-ring Face Seal connections are considered the best for leak control. 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 maintain the connection mechanically.

SAE J512 Inverted connections are typically used in automotive systems. The male connector is either a 45° flare within the tube fitting or a 42° seat in the machined adapter. The female incorporates a straight thread with a 42° inverted flare. The fittings are sealed at the flared surfaces. These threads also maintain a mechanical connection.

SAE (ORFS)



SAE J518 4-Bolt Flange* There are two pressure ratings for these connections; Code 61 which is considered the standard series and Code 62 is the 6000 PSI series. The design is the same for each series, yet the flanged head diameters and bolt hole spacing are larger for the 6000 PSI high pressure Code 62 connection. The female port of the fitting is a smooth, un-threaded port with four bolt holes set in a rectangular pattern in around the port. The male is a flanged head, with a groove for an O-ring and either split or captive flange halves and bolt holes which match the port. The seal is made where the O-ring is compressed between the flanged head and the flat surface the port. The connection is held by threaded bolts.

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

MEASURING FOUR BOLT FLANGES: Use a caliper to measure the port hole, then measure the flanged head diameter or the longest bolt hole spacing from center-to-center. To correspond with Caterpillar® split flanges, CAT flanges have incorporated a 560" flange thickness. All other flange dimensions are identical to Code 62.

SAE 4-Bolt Flange

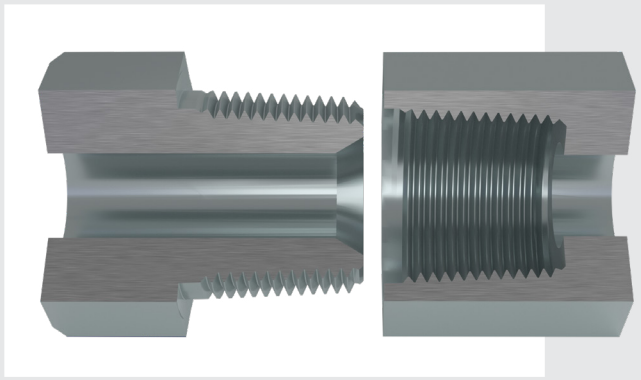
UK BRITISH CONNECTIONS

BRITISH STANDARD PIPE (BSP) and **BSPT** (tapered) connections are comparable to NPT, except most sizes have a different thread pitch, plus the O.D.'s and thread form are close, but not the same. Sealing takes place by distortion of the threads. Because of this, thread sealants are recommended when securing these connections.

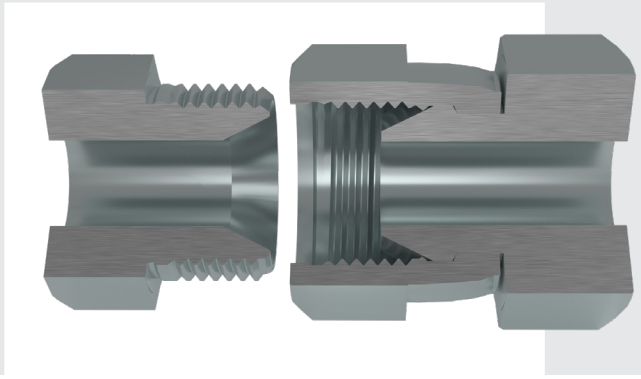
BSPP (parallel) male connection is comparable to NPSM male except most sizes have a different thread pitch. A captive seal is made using metal to metal angled surfaces or a combination of metal to metal and an O-ring. This type of connection is very similar (but not interchangeable) with the American NPSM male. The female swivel BSPP has a tapered nose flareless swivel where the seal occurs on the cone seat of the male connector.

NOTE: the thread sizes are often expressed as fractional dimensions preceded by the letters "G" or "R", where "G" represents a parallel thread and "R" represents a tapered thread. Example; BSPT 5/8-14 can be designated by R 5/8 and BSP 1/16-28 can be designated by G1/16.

BSPT (tapered)



BSPP (parallel)



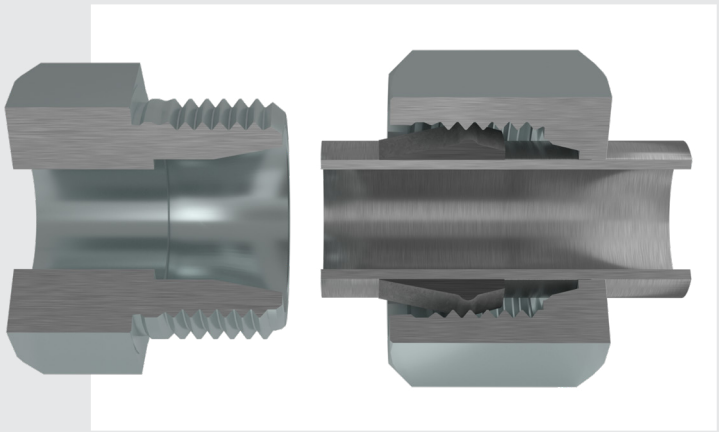
GER GERMAN CONNECTIONS

DIN 7631 Series is a common metric style connection in hydraulic systems. The male connector has a straight metric thread with a 60° angle on a recessed cone. The female has a straight thread with a seat that is a tapered nose. The contact of the cone of the male and the tapered nose of the female flareless swivel is where the seal takes place. This is also a mechanical connection.

DIN EN ISO 8434-1 Standard Series is a common male with three different possible female halves. The straight metric thread male has a 24° angle. Its recessed counter-bore matches the tube O.D. it is connected to. The female may be one of the following:

- A tube, nut and ferrule (compression style, pictured below)
- A tapered nose flareless swivel
- A tapered nose flareless swivel with a DKO style O-ring in the nose.

DIN 3852 – is a male connector and female port. It is a style controlled by German specifications. Other countries sometimes use it as a reference for connector and port designs.



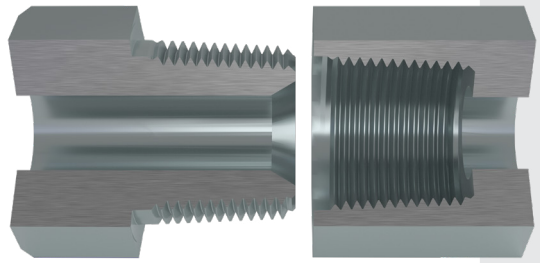
DIN EN ISO 8434-1 Standard

JPN JAPANESE CONNECTIONS

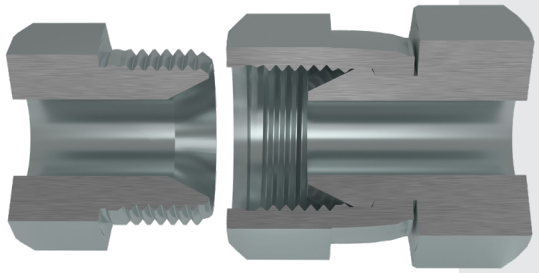
JIS Tapered Pipe (PT) has threads per JIS B 0203. These are JIS tapered threads and are comparable to the design of BSPT connections in their dimensions and appearance. JIS tapered thread connections are interchangeable with BSPT connections.

JIS 30° Male Inverted Seat connections are parallel pipe threads per JIS B 0202. JIS parallel connections are comparable to BSPP connections. JIS parallel thread connections are interchangeable with BSPP connections.

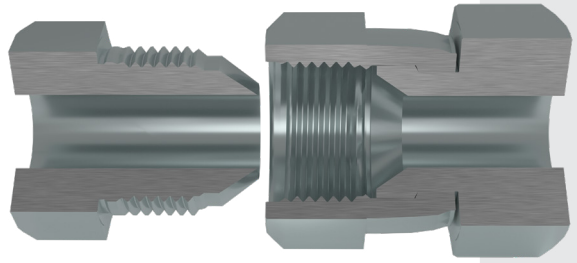
JIS Tapered Pipe



JIS Male Inverted Seat



JIS Female (cone)



JIS 30° Female (Cone) Seat are parallel pipe threads per JIS B 0202. Japanese JIS 30° flare connections are comparable to American SAE 37° flare connections in application and sealing principles. Yet, JIS 30° flare angle and dimensions are different, with threads that are similar to BSPP.

JIS B 8363 4-Bolt Flange connections are frequently used in fluid power systems. There are two pressure ratings for JIS B 8363 4-Bolt Flange fittings:

1) *Type I Code 61 is the standard series 4-Bolt Flange*

2) *Type II Code 62 is the 6000 PSI series*

Each design concept is the same, yet the flanged head diameters and bolt hole spacing are larger for the Type II 6000 PSI connection. Metric and inch bolts are each used with these connectors. The male connector has a flanged head with a groove for seating an O-ring and either a captive flange or split flange with bolt holes to correspond to the port. The female port of the fitting is a smooth, un-threaded port with four bolt holes set in a rectangular pattern in around the port. The seal is made where the O-ring is compressed between the flanged head and the flat surface the port. The connection is held by threaded bolts.

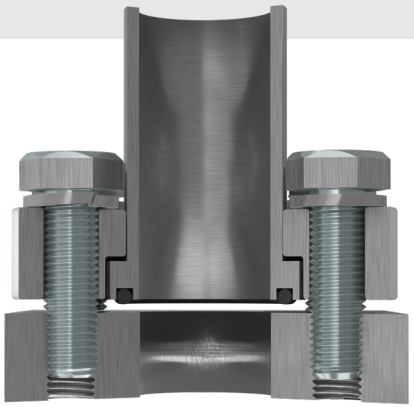
JIS 210 Kgf/cm2 4-Bolt Square Flange incorporates a JIS 4-bolt square flange connection which is comparable to SAE 4-bolt flange connections, with one difference - the flange itself is different and the JIS bolt pattern is square.

JIS 4-Bolt Flange

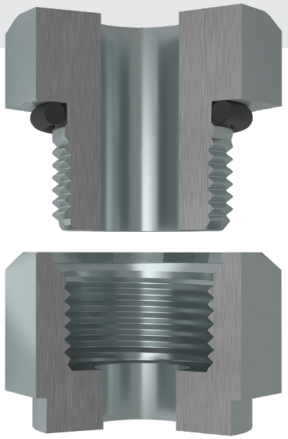
ISO CONNECTIONS

ISO/DIS 6162 4-Bolt Flange* is another common connection found in fluid power systems. There are two pressure ratings for this connection; Code 61: PN 35/350 bar which is considered the standard series Code 62: PN 415 bar which is the high pressure series. They maintain the same design, yet with the bolt hole spacings and flanged head diameters being larger on the PN 415 bar high pressure connection. Inch or metric bolts are found in these connections, however there is an "M" stamped on the port if metric bolts are to be used. The female port of the fitting is a smooth, un-threaded port with four bolt holes set in a rectangular pattern in around the port. The male is a flanged head, with a groove for an O-ring to seat and either split or captive flange halves and bolt holes which match the port. The seal is made where the O-ring is compressed between the flanged head and the flat surface the port. The connection is held by threaded bolts.

ISO 6149 Port and Stud Ends with **ISO** 261 Threads and O-ring Seal though it is similar to the SAE J514 Straight Thread O-ring Boss (ORB), this type connection incorporates metric threads. The male connector has straight threads with an O-ring. The female port is also straight threads machined surface to provide a smooth, flat, accurately located surface (minimum spotface), along with a chamfer where the O-ring seats. It seals when the O-ring is compressed into the chamfer when mating the male connection. This is also considered a mechanical connection.



ISO/DIS 4-Bolt Flange



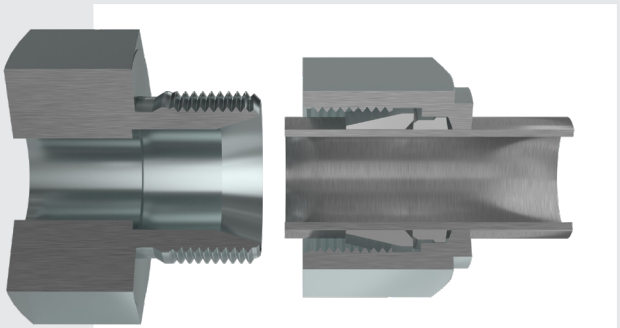
ISO 261 Threads and O-ring Seal

INSTRUMENTATION FITTINGS

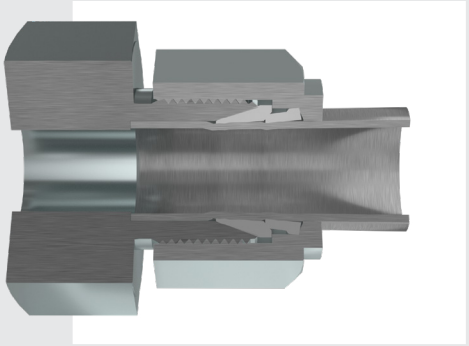
Double and Single Ferrule Instrumentation Fittings. Instrumentation fittings are widely used in fluid or gas transfer applications such as refineries, chemical plants and food processing plants. The male end of a double-ferrule instrumentation fitting has a recessed counter-bore which matches the tube O.D. being used, plus an inner cone. The seal is made between the front ferrule and the cone. The tubing is held in place by the swaging action caused by the tightening of the nut, which forces the front and back ferrules to bite into the tubing (see illustration below), firmly holding it in place. This allows for the use of un-flared tubing with these connectors.

The single-ferrule instrumentation fitting is similar, but has a larger front ferrule and no back ferrule. The sealing method is also similar. Both types of instrumentation fittings are commonly available in stainless steel and brass.

Instrumentation fittings have UNEF (extra fine) threads and sizing is determined by the outside diameter of the tubing being used.



Double Ferrule Fitting



Sealed Connection

CONCLUSION

When selecting fitting connections it is critical to follow the manufacturers' recommendations and specifications. Otherwise there can be leakage or premature failure of the joint or hose. The cost of corrective maintenance to fix these problems can far exceed the cost of the fitting and installation labor. Exceeding the manufacturers' pressure ratings can also cause leakage or high pressure release of gas or fluid that can cause serious injury and catastrophic failure to the entire system. Too much pressure can also increase friction, leading to premature wear of components and higher torque drag.

Ensure the material of the fitting is compatible with the application, such as the chemical composition of the fluid being used, its temperature, and the external environment.

Just as critical is the proper selection of O-rings and other seal materials. Be sure they are rated for the particular gas or fluid being transferred, the temperature and environment as well.

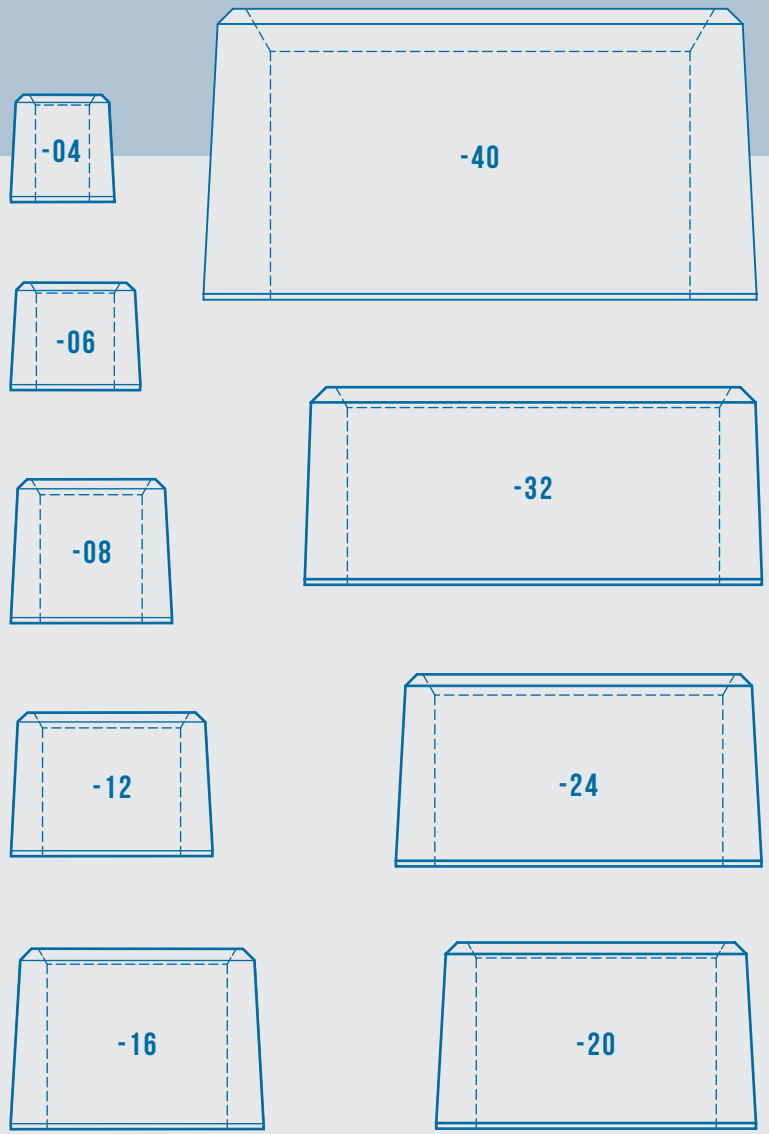
In some extreme applications, it is also important to isolate the connection from the environment with an elastomeric boot, bellows, or cover to help isolate the seal area from a particularly dirty or harsh environment.

The proper use of tube, hose and pipe clamps can also reduce stress and vibration on fittings and tubing and prevent premature leakage or failure.

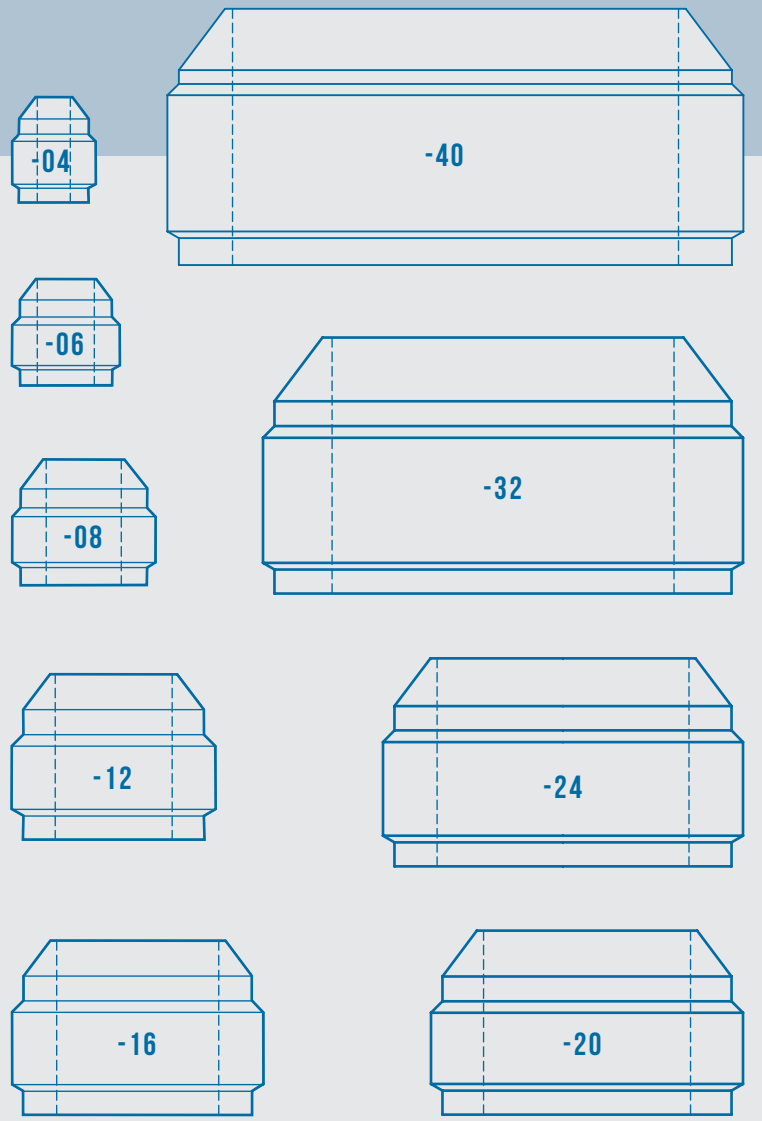
SOURCES:

- Veyance
- Hydraulics & Pneumatics
- Hose Assembly Tips
- Engineering 360
- Eaton

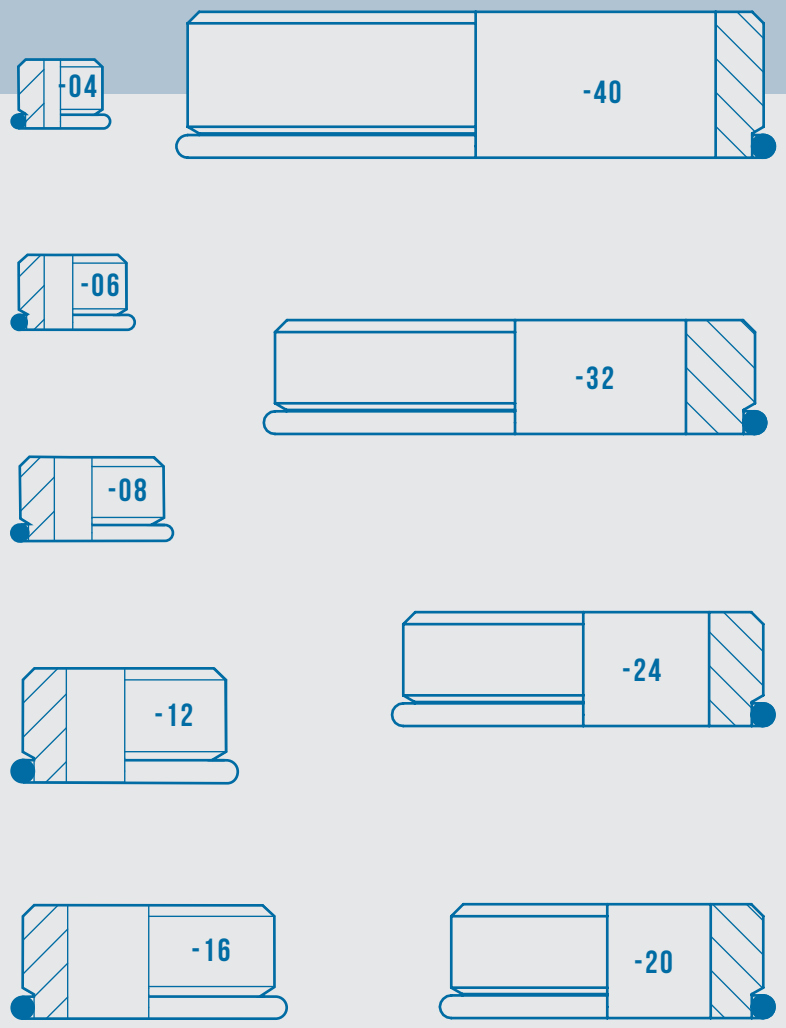
MALE PIPE THREAD SIZES



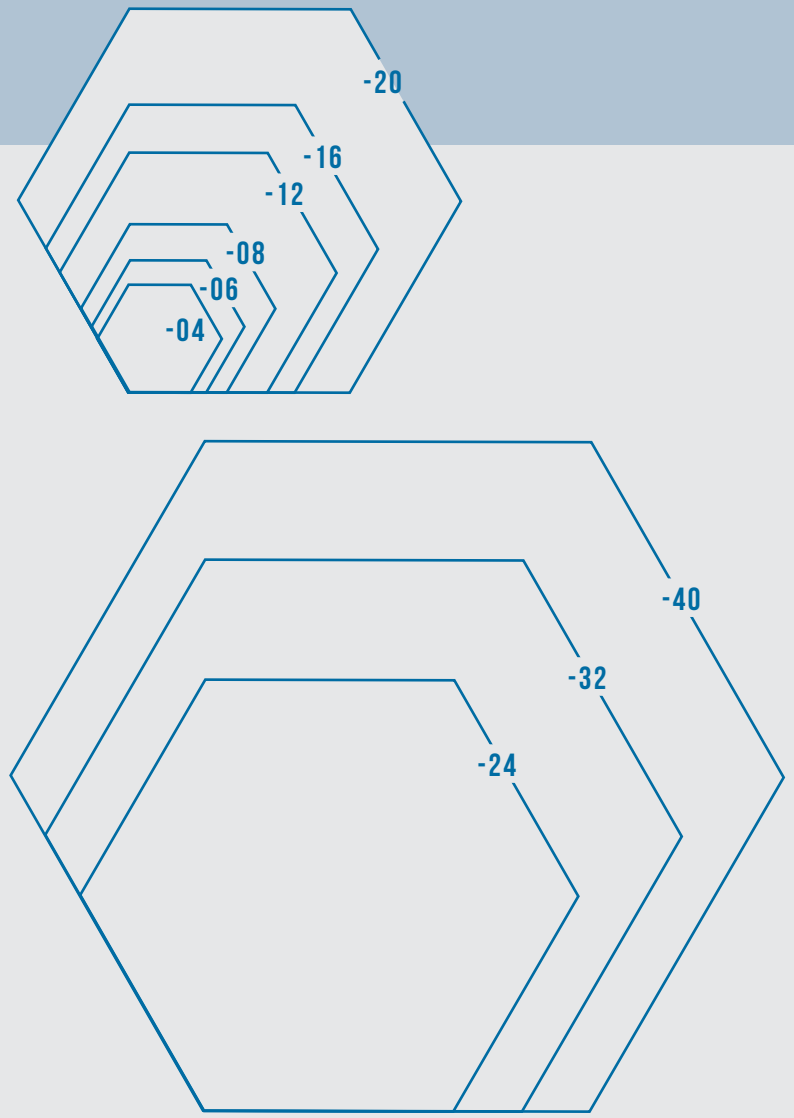
SAE 37° FLARE THREAD SIZES



SAE ORB THREAD SIZES



SAE 37° SWIVEL NUT SIZES



THREAD DIMENSION TABLE

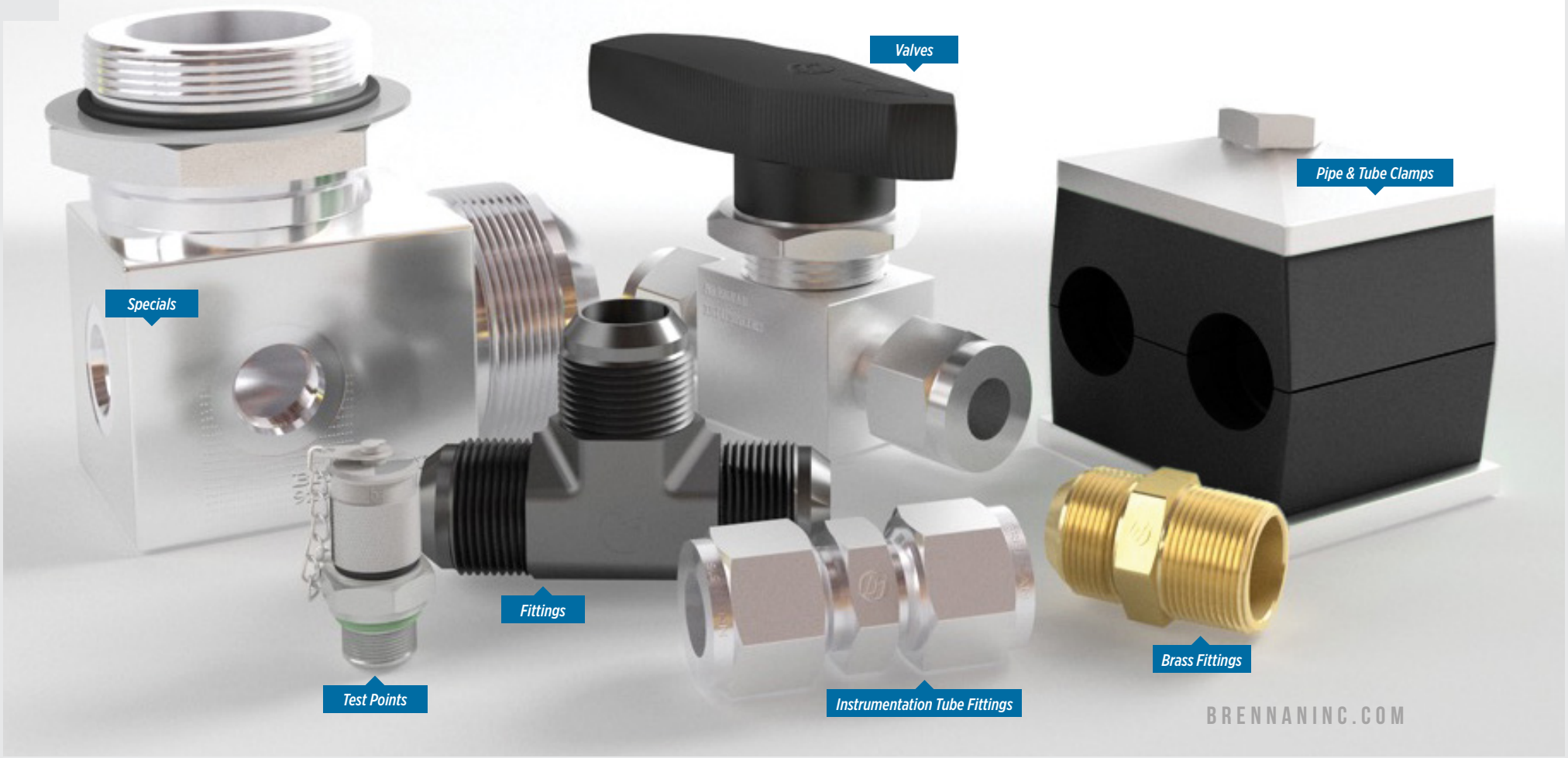
DASH SIZE	2	3	4	5	6	7	8
TUBE O.D.	1/8	3/16	1/4	5/16	3/8	7/16	1/2
HOSE I.D.	1/8	3/16	1/4	5/16	3/8		1/2
JIC 37-FLARE THREAD	5/16 - 24	3/8 - 24	7/16 - 20	1/2 - 20	9/16 - 18		3/4 - 16
SAE O-RING THREAD	5/16 - 24	3/8 - 24	7/16 - 20	1/2 - 20	9/16 - 18		3/4 - 16
NPTF PIPE THREAD	1/8 - 27		1/4 - 18		3/8 - 18		1/2 - 14
NPSM SWIVEL THREAD	1/8 - 27		1/4 - 18		3/8 - 18		1/2 - 14
FLAT FACE THREAD			9/16 - 18		11/16 - 16		13/16 - 16
CODE 61 FLANGE HEAD O.D.							1.19
CODE 62 FLANGE HEAD O.D.							1.25
BRITISH THREAD BSPP/BSPT	1/8 - 28		1/4 - 19		3/8 - 19		1/2 - 14
BRAKE THREAD			7/16 - 24		17/32 - 24		11/16 - 20
SAE 45-FLARE THREAD	5/16 - 24	3/8 - 24	7/16 - 20	1/2 - 20	5/8 - 18	11/16 - 24	3/4 - 16
INVERTED FLARE THREAD	5/16 - 24	3/8 - 24	7/16 - 24	1/2 - 20	5/8 - 18	11/16 - 18	3/4 - 18
COMPRESSION THREAD	5/16 - 24	3/8 - 24	7/16 - 20	1/2 - 20	9/16 - 18	3/4 - 16	1 - 1-1/2 - 12
METRIC THREAD	10	12	14	16	18	20	22
	M 10X1.0	M 12X1.5	M 14X1.5	M 16X1.5	M 18X1.5	M 20X1.5	M 22X1.5

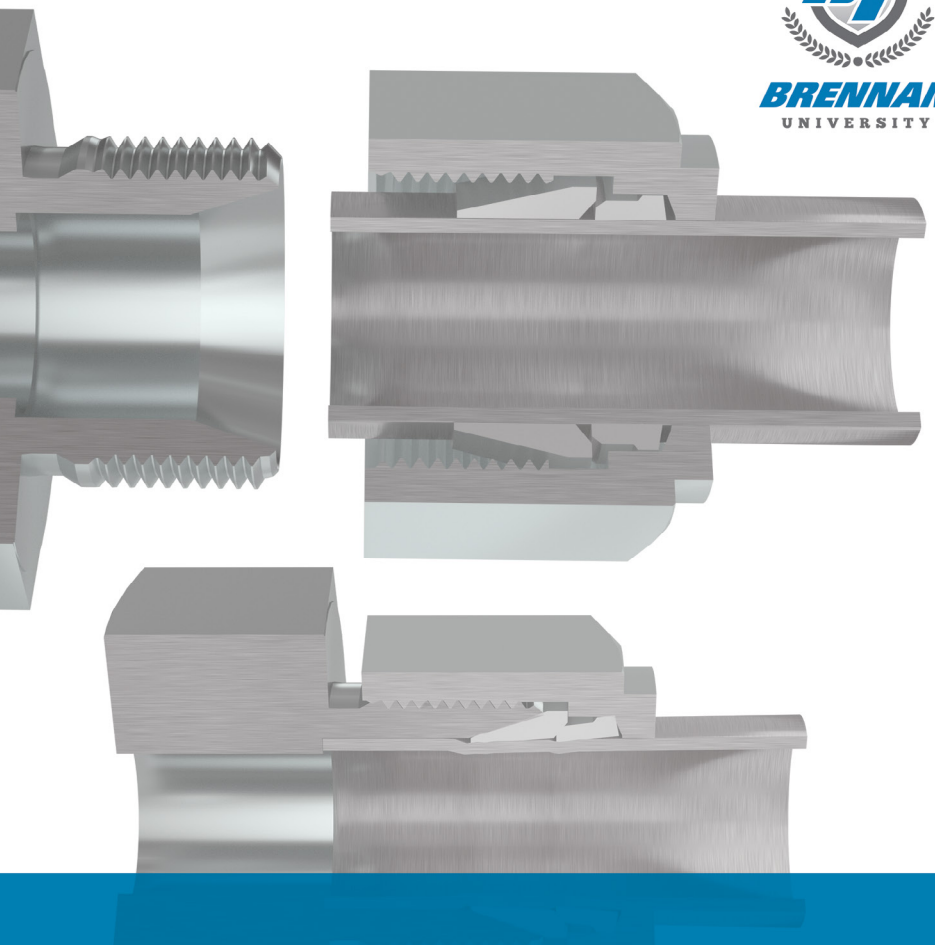
JIC - SAE • METRIC/INTERNATIONAL

●	●	●	●	●	●	●	●	●
5/8	3/4	7/8	1	1-1/4	1-1/2	2	2-1/2	3
5/8	3/4		1	1-1/4	1-1/2	2	2-1/2	3
7/8 - 14	1-1/16 - 12	1-3/16 - 12	1-5/16 - 12	1-5/8 - 12	1-7/8 - 12	2-1/2 - 12	3 - 12	3-1/2 - 12
7/8 - 14	1-1/16 - 12	1-3/16 - 12	1-5/16 - 12	1-1/4	1-7/8 - 12	2-1/2 - 12		
	3/4 - 14		1 - 11-1/2	1-1/4	1-1/2 - 11-1/2	2 - 11-1/2	2-1/2 - 8	3 - 8
	3/4 - 14		1 - 11-1/2	1-1/4	1-1/2 - 11-1/2	2 - 11-1/2		
1 - 14	1-3/16 - 12	1-5/16 - 12	1-7/16 - 12	1-1/4	2 - 12			
	1.50		1.75	2.00	2.38	2.81	3.31	4.00
	1.62		1.88	2.12	2.50	3.12		
	3/4 - 14		1 - 11	1-1/4 - 11	1-1/2 - 11			
13/16 - 18	1 - 18							
7/8 - 14	1-1/16 - 14							
7/8 - 18	1-1/16 - 16							
1-5/16 - 12	1-5/16 - 12	1-7/8 - 12	2-1/2-12					
24	26	27	30	33	36	42	48	
M 24X1.5	M 26X1.5	M 27X2.0	M 30X2.0	M 33X2.0	M 36X2.0	M 42X2.0	M 48X2.0	

ABOUT BRENNAN

In business for over 65 years, Brennan supplies customers worldwide with more than 50,000 standard and special hydraulic fittings and adapters in sizes ranging from 1/16 to 3 inches. These include a wide choice of fitting and adapter types such as tube, O-ring face seal, instrumentation, metric bite type, push-to-connect, conversion and flareless bite type, as well as valves, clamps and swivels. Brennan products are stocked at strategically located full-service distribution centers across North America, Europe and Asia.





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Our Fittings 101 series is made up of videos covering each of the different fitting types found in this guide. It also includes a quick video on how to measure threads in three easy steps.

LOOKING FOR MORE INFORMATION?

Check out our whitepapers and essential resource pages for more info on how each of these fitting types work, the industries they're used in, and more.

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