DIN FITINGS AND THE PREDOMINANCE OF METRICS

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The metric system simplifies weights and measures by following the decimal numbering system. Each metric unit increases or decreases in size by 10. For example, when measuring length, 1 meter = 10 decimeters; 1 decimeter = 10 centimeters; and 1 centimeter = 10 millimeters. Using the metric system makes sense to standardize measurements around the globe.

In 1790, The National Assembly of France asked the French Academy of Sciences to create a standard system of weights and measures. Five years later, in 1795, France adopted what we now know as the metric system. It wasn't until 1965 that the metric system was formerly endorsed in Britain. Canada didn't follow suit until 1975. In 1866, Congress legalized the use of the metric system in the United States, although its use was not required. Eventually, in 1957, the U.S. Army and Marine Corps adopted the metric system for use as the basis for their weapons and equipment. In 1988, the United States Congress passed the Omnibus Trade and Competitiveness Act. This act called for all federal government agencies to use the metric system for business by the end of 1992. What happened? We only went part way.

There is a common misconception that only three countries don't use the metric system: the U.S., Liberia and Myanmar. In reality, all countries use the metric system at some level.

METRIC FITTINGS IN INTERNATIONAL HYDRAULIC AND PNEUMATIC APPLICATIONS

As measurements in Europe and other parts of the world converted to metric, hydraulic and pneumatic fittings followed suit, along with all other threads, from bolts to pipe and instrumentation in those markets. Though metric fittings have long been a standard in Europe and other parts of the world, their acceptance in the U.S. has been limited. However, standards for machinery and equipment have driven many global OEM manufacturers to standardize on metric fittings. This is due to their worldwide availability and acceptance, as well as their reliability ensuring a leak free connection.

DIN: DEUTSCHES INSTITUT FÜR NORMUNG, THE GERMAN INSTITUTE FOR STANDARDIZATION - A METRIC THREAD FITTING GAINING WESTERN DOMINANCE

German DIN is the most common European metric fitting, with different sealing versions for different applications. The most common includes an elastomeric seal on the mating surface, which is excellent for better sealing and reusability.

With the increase in equipment being imported into North America from European manufacturers in recent decades, DIN metric fittings have become increasingly common in the U.S., often replacing the use of JIC fittings.

German 235 standards incorporate DIN 3861, DIN 3859 and DIN 2353, which are covered by the ISO 8434 international standard, with 2353 being the most predominant. The use of DIN standards allows for more interchangeability with leading brands of fittings. Historically, JIC fittings have been the industry standard in the U.S. However, they are more susceptible to cracked flares from over torquing. Comparatively, the mated sealing surfaces in hydraulic DIN metric fittings and O-ring face seal fittings serve to reduce the risk of over torquing, providing a more reliable connection.

DIN 2353 Series/ISO 8434-1: The Industry Standard

DIN 2353 fittings are the most widely used metric bite-type fittings in the world. They are commonly used in hydraulic and pneumatic applications for industrial, oil & gas and construction equipment.

DIN 2353 and ISO 8434-1 follow the industry standard for hydraulic metric fittings. These compression or bite-type tube fittings are interchangeable with other fittings utilizing the same 24° cone connection and assembly.

Not to be Confused

When dealing with metrics, hydraulic systems from manufacturers around the world use many different metric thread styles and types of fittings, adapters and sealing techniques. These different thread forms often appear to be the same, yet their slight differences make visual identification rather problematic.

It is critical to identify and match metric thread types accurately at the fitting ends and port connections. If high-pressure hydraulic and gas handling systems are incorrectly matched, it will lead to significant performance problems and safety hazards. It is imperative to use the correct fittings in hydraulic systems to prevent leaks and loss of fluids or gases, avoid system contamination, preserve pump operating life cycles and maintain appropriate operating pressures.

Identifying the Two Common Styles of DIN Fittings

The two most common styles of DIN fittings are the 24⁰ and 60⁰, with 24⁰ being the most popular. The 24⁰ style consists of one male and three female fitting options. The male portion has parallel threads and a very subtle internal seat. However, the female connection falls into one of three categories:

1. The bite type ferrule connection to mate tubing together consists of a ferrule and nut. The ferrule bites the tubing and fits into the 12⁰ seat on the male fitting. When the nut is properly tightened, it provides an extremely robust leak-proof seal.
2. DKO female fittings consist of a nut and a tube. The tube (or pipe) seats into a 12⁰ cone and O-ring on one end, with a barbed tube on the other. The DKO is very common on most hydraulic hose connections. The barbed end of the fitting goes into the ID of the hose, where the OD of the hose is crimped to hold the assembly together.
3. The third 12⁰ female fitting is a Tapered Nose fitting and is similar to the DKO fitting, yet without an O-ring. Instead, the male and female connections work to seal on a metal-to-metal surface. These are the least common of the 24⁰ DIN fittings, as metal-to-metal connections are not as leak-resistant as fittings with ferrules or O-rings.

There are four steps to identify Male DIN fittings:

As seen in the above chart and chemical compatibility guide, there is an abundance of O-ring materials available in a wide variety of sizes, shapes and colors. However, there are seven most recognizable and commonly used materials for O-rings:

1. Thread Pitch

First, identify if the threads are Imperial or Metric. Where U.S. fittings (Imperial) are measured by threads per inch, metric are measured as the distance between the thread crests. Common thread sizes on metric hydraulic fittings are:

a.) 1 mm
b.) 1.5 mm
c.) 2 mm

2. Thread OD

Using a caliper, be sure to angle it at 90⁰ to the fitting to ensure a proper measurement.

a.) As an example of the resultant measurement, if the thread OD is 18 mm and thread pitch is 1.5 mm, it has a call out size of M18 x 1.5.

3. Find the Angle of the Seal

There are two angle points on the end of the caliper, one has a 30⁰ point and the other has a 12⁰ point, which corresponds to the most popular angles in metric fittings. Holding the caliper at 90⁰ to the fitting to ensure an accurate reading, insert into the ID and hold against the edge to determine whether it is a 12⁰ or 30⁰ seat. Then, get the angle of the seal by multiplying the seat angle by 2; i.e., if the seat angle is 12⁰, the angle of the seal 12x2, equaling 24.

4 **Pressure:** As mentioned, DIN fittings come in 24^0 and 60^0 styles. However, a big difference with the 24^0 is they can come in extra light, light, and heavy-duty styles.

a.) LL is the designation for Extra Light Duty, used in low pressure applications
b.) L for Light duty, used in medium pressure applications
c.) S for Heavy duty, used high-pressure applications

If the fitting is a DIN 24^0, it is imperative to determine what application the fitting can withstand. Once the thread size is determined, use the DIN 2353 24° seat chart below to check the tube dimensions, as tube OD is making the connection inside for the fitting. For the 18 mm thread OD example, select the tube dimension which defines whether it is extra light, light or heavy duty. For instance, if the tube OD is 12 mm, it is light duty; if 10 mm, it is heavy duty.

Identifying female DIN fittings:

In some cases, female DIN fittings are easy to identify. On bite type ferrule connections, there will sometimes be stamps on the end of the fitting identifying a series and tube OD. For example, using a metric thread identification chart; if it is stamped with an L and 15, it is a light duty fitting with a 22mm x 1.5 thread for a 15 mm OD tube.

For female fittings without identification, follow the same procedures as the male fitting identification-- however, the threads are on the inside of the fitting.

1 Thread Pitch

First, start by testing for one of the 3 metric thread pitches of the fitting. In most cases using a gauge, it is easy to identify the thread pitch by inserting the gauge in-between the nut and the shaft. If there is a thick tube width, it can be difficult to fit the thread gauge into the fitting. In this case, there is a plastic retaining ring below the nut which can easily clip off, allowing the female nut to slip down the shaft. Then, measure the thread pitch inside the nut, slip the nut back into place and replace the retaining ring.

a). If the fitting is already attached to a hose, the nut can't be removed. In this case, maneuver your gauge to measure at least two threads, which is normally enough to determine the thread pitch.

2 Thread ID

Be sure to measure the ID of the thread and not the OD of the internal tube. Again, angling the caliper at 90^0 to the fitting, insert the female angle points into the fitting. As an example, if it measures a 14.5 mm ID, considering the thread pitch from above as 1.5 mm, identify the "Call Out Size" as:

(Thread ID + Thread Pitch) x Thread Pitch, i.e. (14.5 mm + 1.5 mm) x 1.5 mm = 16 mm x 1.5 mm, equaling a call out size as M16 x 1.5.

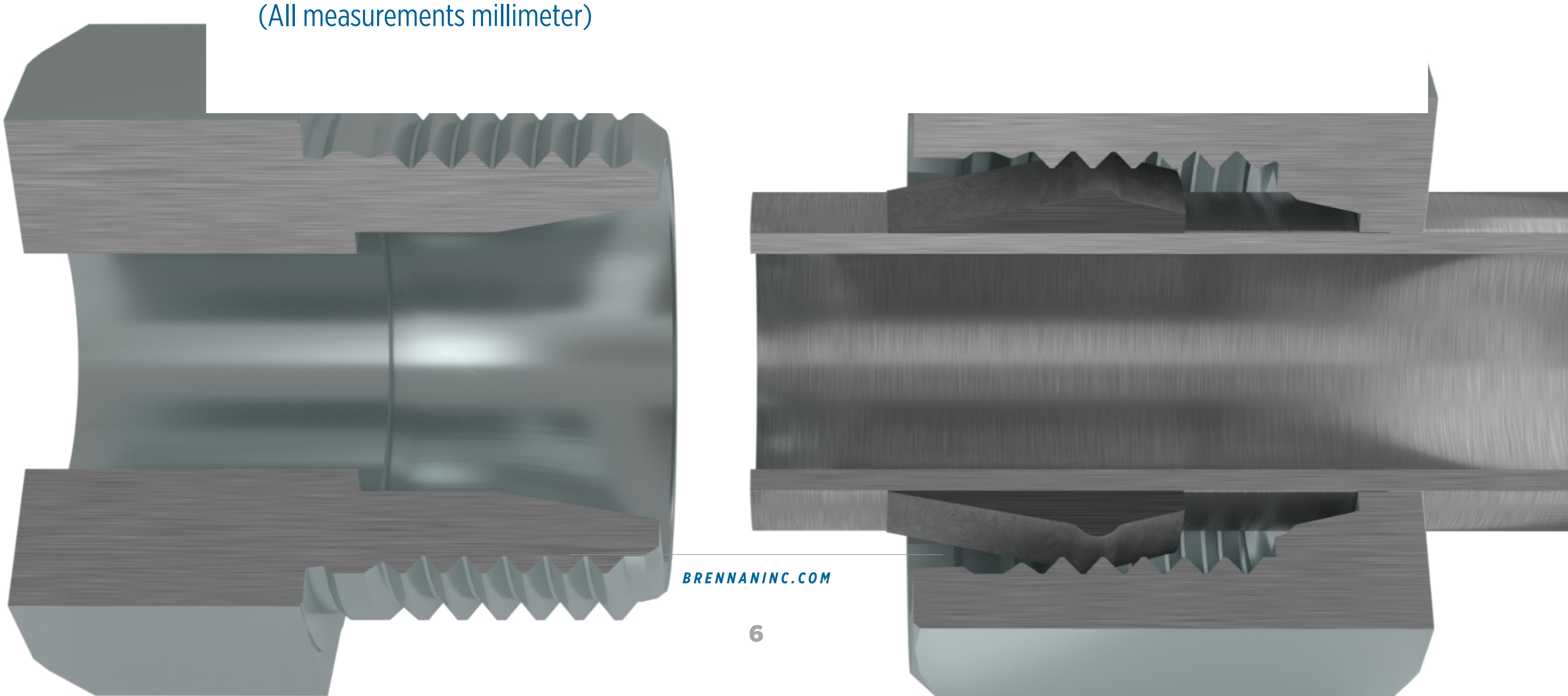
❸ Determine Extra Light, Light or Heavy Duty

This is easy to identify if it is stamped on the fitting with an LL (extra light duty), L (light) or S (heavy). If it is not pre-stamped, simply use a couple of Allen keys (aka hex keys). Specifically, 5/64, 7/64 and 9/64. First, remember it is the OD of the tube that determines the potential Duty (pressure capability) of the fitting (a Go or No-Go chart can be helpful for showing Thread Sizes that correspond to which Allen wrench sizes to use).

a.) Using the example above where the thread size is M16 x 1.5, a Go or No- Go chart will indicate using a 5/64 Allen key. If the Allen key fits snug between the tube and threads, hitting the bottom of the fitting, the chart lists it as a "go" in the heavy duty column, identifying it as a heavy duty S8 female 24° DIN fitting.

DIN 2353 24° SEAT					
Thread Size	Male	Female	Tube OD	Tube OD	Tube OD
M 8 x 1.0	8	7	4		
M 10 x 1.0	10	9	6		
M 12 x 1.0	12	11	8		
M 14 x 1.0	14		10		
M 16 x 1.0	16		12		
M 12 x 1.5	12	10.5		6	
M 14 x 1.5	14	12.5		8	6
M 16 x 1.5	16	14.5		10	8
M 18 x 1.5	18	16.5		12	10
M 20 x 1.5	20	18.5			12
M 22 x 1.5	22	20.5		15	14
M 24 x 1.5	24	22.5			16
M 26 x 1.5	26	24.5		18	
M 30 x 2.0	30	28.5		22	20
M 36 x 2.0	36	33.9		28	25
M 42 x 2.0	42	39.9			30
M 45 x 2.0	45	42.9		35	
M 52 x 2.0	52	49.9		42	38

(All measurements millimeter)



60° DIN Fittings

Identification of the 60° DIN fitting is almost identical as the 24°, except for the angle of the tube. When a 30° seat angle is identified, the steps are the same in determining the thread pitch and OD of a 24° fitting. Yet there are no light or heavy duty fittings for the 60° DIN. Unlike the 24°, the 60° has a round tube end as its sealing surface, making it nearly impossible to measure the angle. The identification is going to be the round tube end itself. Additionally, the thread pitch of a male or female 60° DIN is always going to be 1.5 mm.

Material

DIN 2353 connectors are primarily available in three materials, with associated seals where O-rings are used:

- Carbon steel (zinc-plated or phosphate coated) with a standard nitrile butadiene (Buna-N) seal
- 316 Stainless steel with standard Viton® seal
- Brass with a PTFE (thermoplastic) seal

O-rings with internal lubrication that use material with adequate hardness help prevent spiral failure in long-stroke hydraulic piston applications.

Working Temperature

The allowable working temperature is determined by the material of the connector and seal:

- Carbon steel: -40°C to +120°C
- Carbon steel with Buna-N seal: -35°C to +100°C
- Stainless steel: -60°C to +400°C
- Stainless steel with Viton seal: from -20°C to +200°

Working Pressure

The maximum working (or nominal) pressure of DIN 2353 fittings is dependent on the application: extra light, light or heavy duty, as well as fitting and seal materials.

The table below references recommended working temperatures and pressures based on materials used.

REFERENCE TABLE FOR DIN 2353 CONNECTIONS

ALLOWABLE WORKING TEMPRATURE AND PRESSURE RANGE FOR DIN TYPE TUBE FITTINGS WHICH MEET: ISO 8434-1, DIN 2353 AND DIN EN 3850

FITTING MATERIALS		SEAL MATERIALS			PRESSURE RANGE	
Material	**Working Pressure**	**Designation**	**Material**	**Working Temperature**	**Pressure Designation**	**Working Pressure**
Stainless Steel	-60°C to +400°C	BN	NBR	-35°C to +100°C	Low (LL)	up to 100 bar
Steel	-40°C to +120°C	VT	FKM	-25°C to +200°C	Medium (L)	Up to 500 bar
Brass	-60°C to +175°C	TE	PFTE	-60°C to +240°C	High (S)	Up to 800 bar

(All values metric)

TWO OTHER IMPORTANT DIN SERIES FITTINGS

DIN 3902 Series

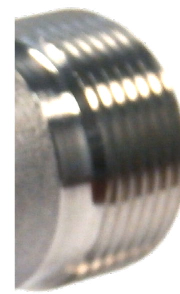
The DIN 3902 connection comprises of a common male and three different female halves. The male has a straight metric thread with a 24° included angle and recessed counterbore to match the tube OD. The female will be one of three styles: a compression tapered nose flareless swivel, a tapered nose flareless swivel with an O-Ring in the nose, or a tube, ferrule, and nut.

Thread OD Light Duty	Tube OD Heavy Duty	Thread Size	Male Thread OD	Female Thread OD
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	28	M52 x 2.0	52	50

(All measurements millimeter)

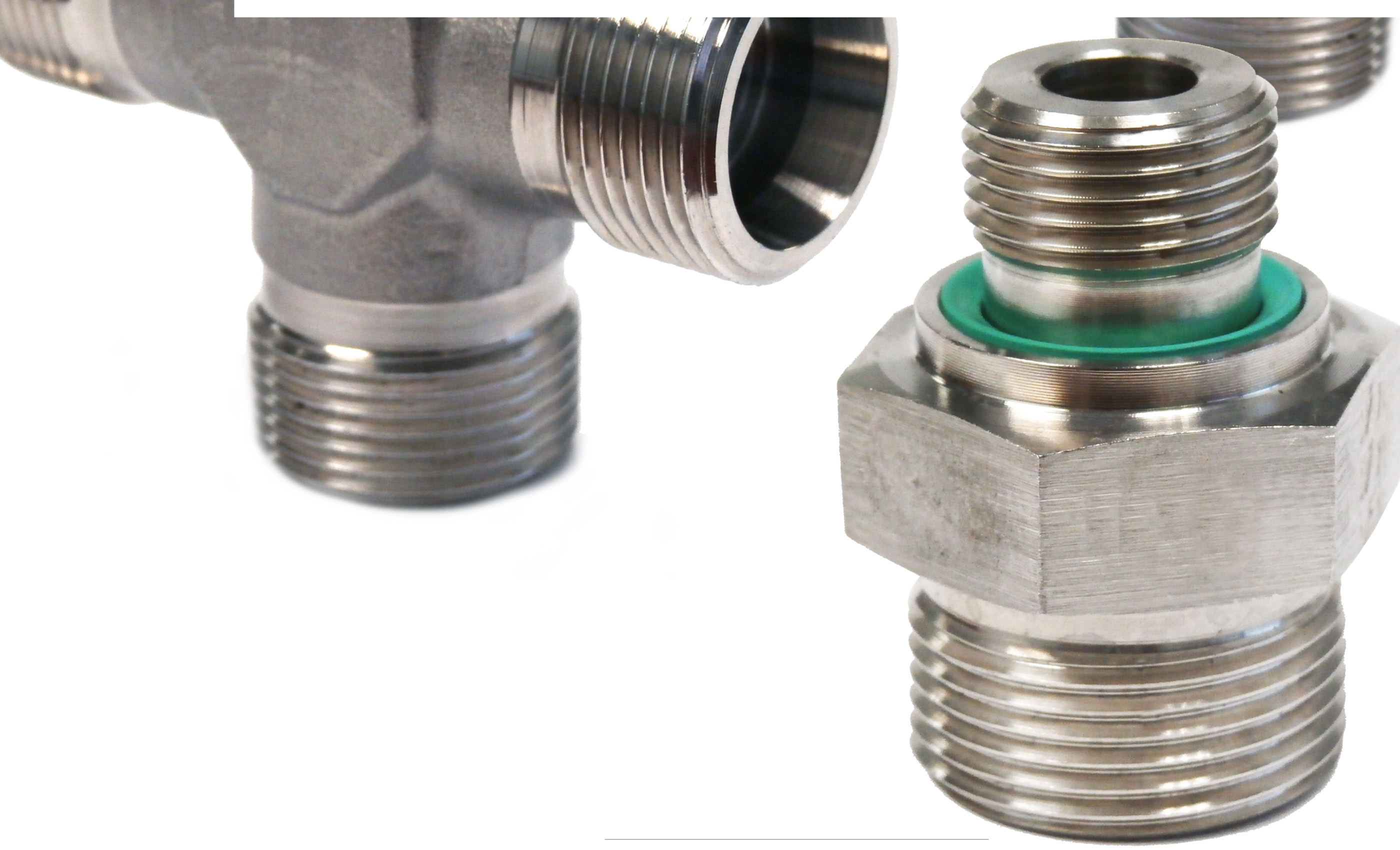
DIN 7631 Series

The DIN 7631 connection is sometimes used in hydraulic systems. The male comprises of a straight metric thread and a 60⁰ included angle with a recessed cone. The female has a straight thread with a tapered nose seat. The seal takes place through contact between the cone of the male and the nose of the tapered flareless swivel. The threads make a mechanical metal-to-metal connection, which is not as reliable for a leak-free seal as a fitting with an O-ring of ferrule and nut.



Tube/Pipe OD	Thread Size	Male Thread OD	Female Thread OD
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

(All measurements millimeter)



CONCLUSION

In today's world market, the use of foreign threaded connections in the hydraulic industry is increasing dramatically. From hydraulic hose to port connections and even grease fittings, metric connections are found in all areas of hydraulic applications. Being able to understand and identify metric threads is imperative to remaining competitive in the global market.

As more equipment is imported into the U.S. from overseas manufacturers, the need to adapt is clear. Major European agricultural equipment manufacturers such as Krone, Lely and Kuhn Group; as well as construction equipment manufacturers like Volvo, Liebherr, Metso and Outotec have a major presence in the U.S. market. Most provide Imperial and Metric options, but the question is how long will that last? Much of the U.S. scientific and academic communities rely heavily on the metric system. When Canada adopted it over 45 years ago, it was painful. The general public and much of industry pushed back hard. After about 10 years, very few looked back. Now, a full generation later, one would be hard pressed to find many Canadians that know how to use the Imperial system. Perhaps one day American football will no longer have 100-yard fields, but 100 meters-- it's only 8 meters longer.

ABOUT BRENNAN

In business for 70 years, Brennan supplies customers worldwide with more than 120,000 standard and special hydraulic fittings, adapters and O-rings 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.

Brennan's Manufacturing Group also produces custom fittings and other items to print specifications. More than just machining, we offer engineering support, quality control, and management of outside services. That gives you a single, comprehensive source for your manufacturing projects.

The information in this paper is believed to be accurate and reliable. However, Brennan Industries makes no warranty, expressed or implied, that information provided in this material will ensure satisfactory performance in each specific application. It is the customer's responsibility to evaluate the material and application prior to use.

SOURCES:

Engineering360

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