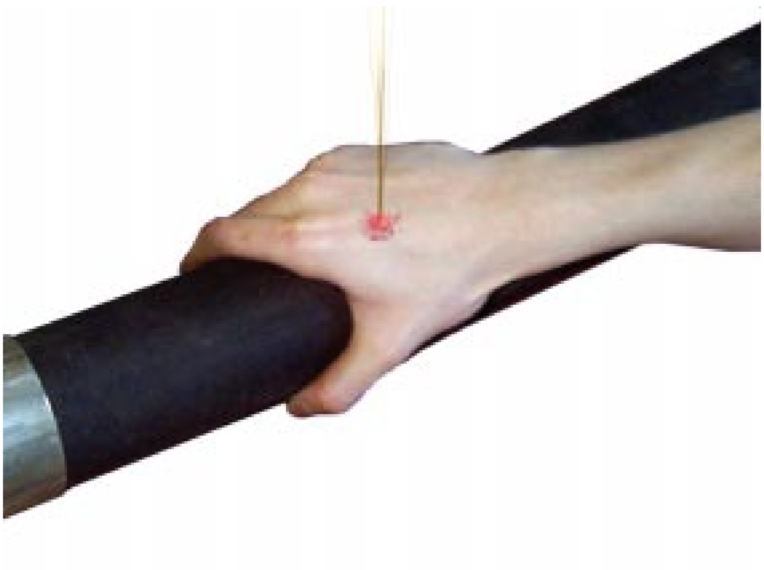
CONTENTS

SECTION	SUBJECT
Section 1:	Safety
Section 2:	What is a hose assembly
Section 3:	Hose
Section 4:	Fittings
Section 5:	Assembly
Section 6:	Installation of hose assembly
Section 7:	Testing and failures

Section 1.

SAFETY



SAFETY

Before we learn how to make hydraulic hose assemblies we firstly must look at the safety aspect involved.

The basic principles of any hydraulic system is force transmission produced by a fluid under high pressure. In transmitting this force the relevant fluid will travel through a hose or tube, between a hydraulic pump to an actuator.

In this section we will cover all aspects of safety relevant to the flexible hose and it's end terminations.

Be aware that...

1. Highly pressurized fluid escaping from a small pin hole can be invisible and yet, exert extreme force capable of penetrating the skin or other body tissues, possibly causing severe injury or death.

2. Pressurized hydraulic fluids, if released in an uncontrolled manner, can exert tremendous explosive force.

3. Some hydraulic fluids are highly flammable.

And...

1. Always position a shield between you and any pressurized hydraulic lines when working next to them.

2. Do not use your hands to check for leaks.

3. Always use the correct sized spanners on hexagon terminations.

4. When using Swaging, Skiving, and hose cutting machines, always read the safety instructions relevant to the equipment.

Section 2.

WHAT IS A HOSE ASSEMBLY

WHAT IS A HOSE ASSEMBLY

A hose assembly in its simplest form consists of a piece of hydraulic hose and two fittings one either end.

Explained thus you may think there is nothing very difficult to making up a hose assembly, but this is not strictly true.

In making up a hose assembly which will fit correctly and withstand the rigors of the application, various critical factors have to be addressed.

Hose Selection

1. **Hose Internal Diameter (Bore)** - Hose manufactures measure the bore in six teenths of an inch.

   For example 3/8" diameter = 6/16 therefore the dash size is 6.

   German DIN quote the nearest metric size but the hose is actually manufactured to inch measurements for the inside diameter.

   Example: 3/8 = 0.375 inches (9.53mm) therefore the dash size is 10.

2. **Pressure** - After determining the system pressure, hose selection must be so that the recommended maximum operating pressure is equal to or greater than the system pressure.

3. **Temperature** - Care must be taken to ensure that the fluid and ambient temperatures, both static and transient, do not exceed the limitations of the hose.

4. **Fluid Compatibility** - Hose selection must ensure compatibility of the hose tube, cover and fittings with the fluid used.

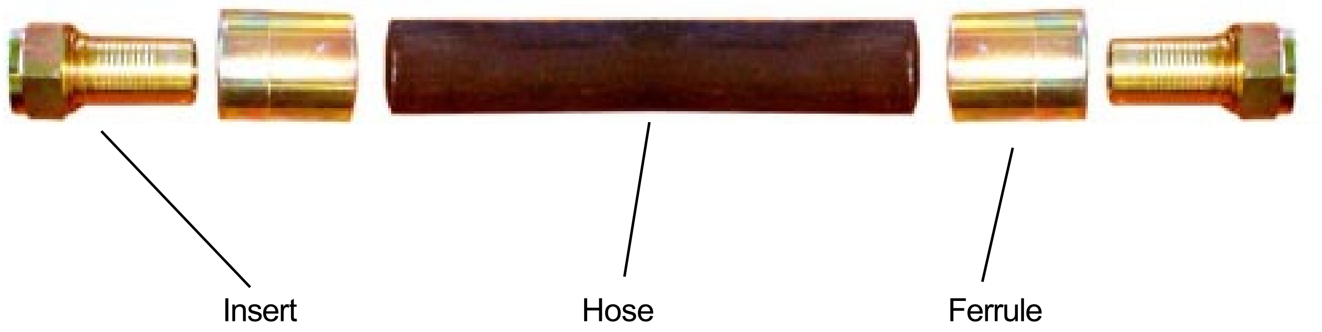
WHAT IS A HOSE ASSEMBLY

5. **Environment** - Care must be taken to ensure that the hose and fittings are either compatible or protected from the environment to which they are exposed. Environmental conditions such as ultraviolet light, ozone, salt water, chemicals and air pollutants can cause degradation and premature failure and thus must be considered.

6. **Mechanical Loads** - External forces which must be considered include excessive flexing, twisting, kinking, tensile or side loads, bend radius and vibration.

7. **Proper end fitting** - Care must be taken to ensure proper compatibility exists between the hose and coupling as per manufacture's recommendations.

8. **Specifications and Standards** - When selecting hose, government, industry and manufacture's specifications and recommendations must be reviewed as applicable.



Section 3.

HOSE

The definition of the term “Hose”, according to an authoritative dictionary on the English language describes it as a “flexible tube for conveying water”.

This is simplicity in itself and could not be less factual. Of all the industrial rubber products hose is one of the most diverse and complex products.

Developed in the early 1800’s from rubber tubing used in experiments on gases. It evolved through the century as technology improved by employing canvas reinforcement and other natural fibres to provide a means of conveying different types of medium at lower pressures.

In the early 1900’s the first hydraulic hoses became available at higher pressure ratings. Manufactured in short lengths there was still a long way to go to reach the standards available today.

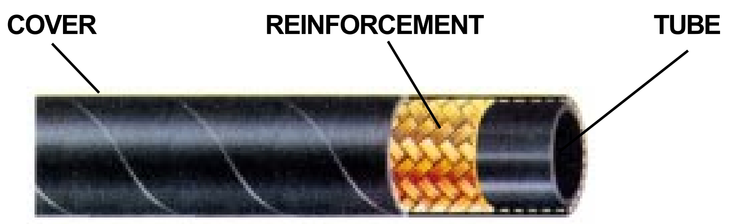
Early machinery relied on mechanical means such as levers, pulleys, chain drives, etc. to provide movement of the working system. Hydraulic systems employing pumps, valves and rams provide a means of refining the method of activating moving parts. Hydraulic steel piping was used to convey the hydraulic fluid but movement was limited.

As the higher pressure hydraulic braided and spiral hoses were developed it permitted radial and lateral movement.

Very high shock loads can occur in the hydraulic system when lifting heavy loads and rubber hose can dampen vibrations that steel tube will not withstand.

Hose Construction

Hose consists of a tube or lining, a reinforcement and cover.



Liner

A synthetic rubber whose properties will make it resistant to the medium carried and have a hardness suitable for the retention of the coupling. Will flex at -40°C and not leak at 100°C.

Reinforcement

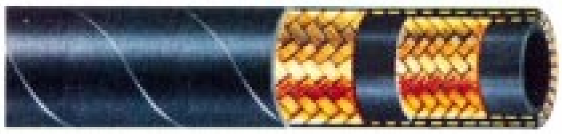
This can be of high tensile plated wire brass, or textile materials and provides the strength in the hose to resist the pressure.

It is applied in braided or spiral layers.

Braided

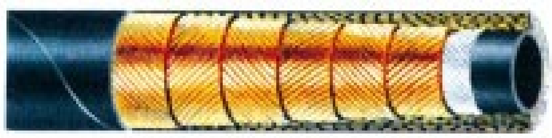
This has a woven effect and when more than one braid is laid a thin layer of rubber is applied between the braids to act as a friction to prevent the braids rubbing together when under pressure.

The wires are braided in a helical form with an angle designed to allow the hose to contract a small amount when under pressure.



Spiral

Spiral consists of two opposing layers laid over the liner. One in one direction with a rubber layer between a opposing layer in the opposite layer.



Multiple layers of spiral or braid are built into the hose according to the designed pressure required.

Cover

The cover is made of a synthetic rubber to protect the reinforcement from any external damage,

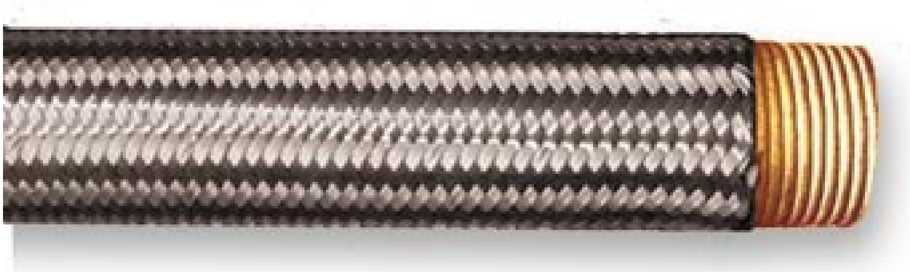
The material has to be resistance to abrasion, extreme temperatures, chemicals and ozone.

General

There are many types of hose for a variety of applications such as air/water, oxyacetylene, chemical, brewers, suction, car radiator, refrigeration and petrol to name just a few. All are designed to suit not only the internal working conditions but also the external conditions.

While this section on hose construction has focused on synthetic rubber hose, we should also be aware of the PTFE-Teflon (Polytetraflouroeythlene) hoses which are playing an increasing part in industrial and hydraulic applications. They are much superior to rubber in many ways; having a temperature range of -60°C to 250°C, are also nonadhesive, permitting unrestricted flow of almost any fluid, noncorrosive, nonflammable, and low permeability.

Manufactured with a smooth bore convoluted PTFE lining, reinforced with one or two stainless steel wire braids. Widely used in chemical and steel applications. This is covered in more detail under the Astraflex products.



CONVOLUTED P.T.F.E. HOSE

SMOOTH BORE P.T.F.E. HOSE

Hydraulic Hose Performance Criteria

1. Pressure

There are five basic types of industrial hose, classified in the following pressure

Low Pressure	Any working pressure below 250 psi	17 bar
Medium Pressure	350 to 3000 psi	24 to 204 bar
High Pressure	1125 to 5000 psi	77 to 340 bar
Very High Pressure	3000 to 5000 psi	204 to 340 bar
Ultra High Pressure	2250 to 6250 psi	153 to 425 bar

The pressure a hose can withstand varies according to the size. A small bore hose will carry a higher rating compared with a larger bore hose with the same construction.

Typical examples of hose falling into these pressure categories:-

Low Pressure

One textile braid reinforcement with synthetic rubber liner and cover.

Application: Air, water, fuel, gasoline, diesel fuels.
(Not recommended for hydraulic use)

Medium Pressure SAE 100R1A/R1T and SAE 100R5

One single braid reinforced with synthetic rubber liner and cotton or rubber braid cover.

Application: Hydraulic, fuel oil, lubricating oil, air and water.

High Pressure SAE 100R2A/R2AT

Two wire braid reinforcement with a synthetic rubber liner and cover

Application: Hydraulic, fuel and lubricating oils, gasoline and air

Very High Pressure SAE 100R9R, SAE 100R12 and 4SP

Have a four spiral wire reinforcement with a synthetic rubber liner and cover.

Application: Suitable for higher working and impulse pressures in hydraulic applications.

Ultra High Pressure SAE 100R13 and 4SH

SAE 100R13 have four spiral layers up to an inside diameter of 1" (25mm) and six spiral layers from 1.1/4" to 2" inside diameter. Synthetic rubber liner and cover.
4SH has four spiral layers for all diameters.

Application: Designed to withstand extremely severe high surge peaks when severe working conditions are encountered.

2. Standard Specification

Hydraulic hoses are manufactured to American and European standard specifications.

The American is the SAE (Society of Automotive Engineers) and European which is German DIN (Deutsche Industrial Norme).

There are also special manufacture's specifications which are neither DIN or SAE. For example the ITR Ranger spiral series and Duo Compact in braided hose. Other manufacture's do likewise which leads to total confusion until eventually DIN and SAE adopt some of them as an industrial standard. We will concentrate on the more commonly used specifications in the German DIN and SAE.

The American SAE specifications are known worldwide. Most hoses in the USA are produced to these specifications. On the other hand in Europe most hose is manufactured to German DIN. This has a higher working pressure than corresponding SAE equivalent and is suitable for all markets.

DIN AND SAE COMPARISONS

HOSE CONSTRUCTION			SAE SPEC.	DIN SPEC.
Non Skive	Thin Cover	1-Wire Braid	SAE100R1AT	DIN20022-1SN
Non Skive	Thin Cover	2-Wire Braid	SAE100R2AT	DIN20022-2SN
Skive	Standard Cover	1-Wire Braid	SAE100R1A	DIN20022-1ST
Skive	Standard Cover	2-Wire Braid	SAE100R2A	DIN20022-2ST
Skive	Standard Cover	4-Spiral	SAE100R12	-
Skive	Standard Cover	4/6-Spiral	SAE100R13	-
Skive	Standard Cover	4-Spiral	-	DIN20023-4SP
Skive	Standard Cover	4-Spiral	-	DIN20023-4SH

DIFFERENCES

Braided Hose One and Two Wire

DIN Standards have a higher working and burst pressure rating than SAE, otherwise they are dimensionally the same.

Spiral Hose

<u>DIN 20023-4SP</u>

This has a higher has a higher working and burst pressure than SAE100R12. It is dimensionally different but can be used in place of SAE100R12.

<u>DIN20023-4SH & SAE100R13</u>

This DIN specification exceeds SAE100R13 pressure ratings for sizes 3/4 and 1” but the R13 in sizes 1.1/4, 1.1/2 and 2” has a higher working pressure being of a 6 spiral wire construction for these three sizes and is less flexible.

Both hoses differ dimensionally.

This combination of SAE and DIN hydraulic hoses offers a range of specifications to suit the majority of applications cost effectively and meeting pressure and flexibility criteria.

The following chart is a comparison between SAE and DIN standard specifications for your information.

COMPARISONS BETWEEN SAE AND DIN STANDARDS

Specification	Hose Bore	Hose O.D.	Wire O.D.	Max. Working Pressure	Min. Burst Pressure	Min. Bend Radii
SAE100R2AT	1/2"	0.875	0.781	3500	14000	7.00
DIN20022-2SN	1/2"	0.875	0.781	4042	16170	7.09
SAE100R2AT	1"	1.500	1.375	2000	8000	12.00
DIN20022-2SN	1"	1.500	1.375	2425	9555	11.81
SAE100R12	1"	1.495	1.375	4000	16000	12.00
DIN20023-4SP	1"	1.563	1.390	4116	16464	13.40
SAE100R13	1.1/4"	1.962	1.842	5000	20000	16.50
DIN20023-4SH	1.1/4"	1.791	1.650	4778	19110	18.10
SAE100R13	2"	2.800	2.680	5000	20000	25.00
DIN20023-4SH	2"	2.681	2.488	3675	14700	27.56

3. WORKING PRESSURE

This is the actual maximum pressure at which the hose should work and not be exceeded, otherwise it will reduce the life of the hose.

4. BURST PRESSURE

The minimum burst is four times the working pressure, although the design pressure is much higher to achieve this minimum and better impulse performance.

Sometimes working pressures are stated at higher ratings than the SAE or DIN Standard by certain manufacturers. This is arrived at by carrying out a series of burst tests and taking 25% of a constant burst pressure to arrive at the working pressure.

5. Proof Pressure

This pressure is twice the working pressure and is used to test the hose manufacture and hose assemblies for leaks. The pressure is held for not less than 30 seconds and not more than 60 seconds without indication of failure or leakage.

6. Impulse Pressure

This pressure is created by pressure surges from conditions encountered during the operation of a machine using hydraulics.

For example when a hydraulic digger suddenly encounters a rock that results in a higher pressure than the working pressure, the system will react with a pressure surge to move the object.

Hoses are tested to impulse peaks 125% to 150% above working pressure, according to the style of the hose and have to withstand this for a specified number of impulse cycles.

7. Operating Temperature

Hydraulic hoses are designed to operate between -40°C (-104°F) and +100°C (+212°F).

Special high temperature hoses operate between -40°C (-104°F) and +150°C (+302°F).

Continuous operation at or near maximum rated temperatures will materially reduce the service life of the hose.

8. Ambient Temperature

Very high or low ambient (outside of hose) temperature will effect the cover and reinforcement materials, thus influencing the life of the hose.

9. Bend Radius

The bend radius is the minimum radius measured to the inside of the hose curvature and should conform to the manufacturer's catalogue specifications.

Section 4.

HYDRAULIC FITTINGS

HYDRAULIC FITTINGS

Fittings are designed for mounting on to hydraulic hose. The fitting must be compatible to the hose in order to withstand the rigors encountered in extreme severe working conditions.

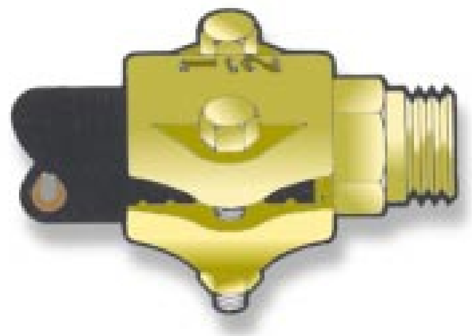
There are many different types but most fall into four basic categories:-

1) Permanently attached (swaged or crimped)

2) Reusable (screwed together)

3) Push In (no sleeve or ferrule)

4) Clamp Type



HYDRAULIC FITTINGS

Couplings can be manufactured from different materials namely:-

Leaded steel for free machining (Spec 230 M07 Pb to BS970 PT3)

Stainless type 316

Brass

Aluminium

Fittings made from normal leaded steel are the most common and to protect them from corrosion they are Electro Zinc Plated and finished with a Gold Passivation. The finish must be suitable to withstand a 72 hour salt spray test.

Swage ferrules for braided and multi-spiral hose are stress relieved by an annealing process to prevent cracking. We will now concentrate on the fittings generally used by the industry for wire braided and multi-spiral hose.

1. Permanently Attached

a) Two Piece: FERRULE (Sleeve) and INSERT sometimes referred to as a NIPPLE.

More cost effective to manufacture than a pre-assembled fitting and the cost to stock is less.

The fitting offers good retention to the hose, particularly in the skived variety.

Two types are produced for one and two wire braided hose.

SKIVE and NON SKIVE

The Insert is common for one and two wire braided hose, and skive and non skive ferrules. There are four ferrules one for each hose type:

SAE100R1A	SAE100R2A	- Non Skive
SAE100R1AT	SAE100R2AT	- Skive

HIFLEX

The exceptions are sizes 1/2", 5/8" and 3/4" where we use one ferrule for one and two wire thin cover hose R1AT and R2AT.

For multi-spiral there is a different range which falls into two categories:

Multi-spiral - External Skive
Interlock Multi-spiral - Internal & External skive.

Multi-spiral SAE100R9R, 4SP and SAE100R12

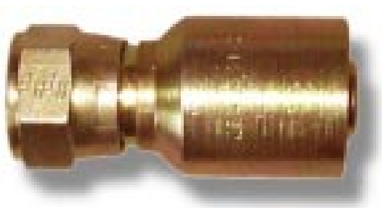
All hoses are externally skived and the same ferrule and insert is suitable for all hoses with different swage diameters.

Interlock Multi-spiral SAE100R13 and 4SH

This hose is internally and externally skived. A common insert is used for SAE100R13 and 4SH hose with different ferrules. Sometimes referred to as the wire trap fitting.

b) Permanently Attached

This fitting is very popular in the USA. It is a pre-assembled fitting where the ferrule is attached to the insert.



They are used for both braided and spiral hoses. They are preferred to two piece fittings because ferrule selection is eliminated, therefore room for error and the hose preparation is minimal as they are mainly used on thin cover braided hose.

Even non-skive multi-spiral fittings have recently been introduced in the USA.

2. Reusable

This fitting consists of two parts - *ferrule and insert* - both of which screw together. As the term implies this fitting can be reused. When the hose fails the fittings can be assembled on to a new hose.

The fitting is secured to the hose by screwing the ferrule unto the hose. The insert, which is tapered, is screwed into the ferrule, which in effect clamps the hose between the ferrule and the insert.

3. Push In

Used on specially designed hose for low pressure applications.

The fitting, which has large barbs on the insert, is simply pushed into the hose.

No outer sleeve or retention clips are used to retain the insert in place.

When internal pressure is applied to the hose assembly the hose tightens down onto the barbs and provides a adequate seal.

4. Clamp Type

This fitting consists of an insert and two clamps.

The insert is pushed into the hose and the clamps are placed over the hose, engaging in an annular groove in the insert. The clamps are secured by two bolts which are tightened down to hold the fittings in place.

FITTING SELECTION

End Terminations

These fall into four categories:

1. British Standards
2. American SAE Standards
3. Metric DIN Standards
4. Japanese Standards

1. <u>BRITISH STANDARDS - HYDRAULIC CONNECTORS BS5200 : 1997</u>

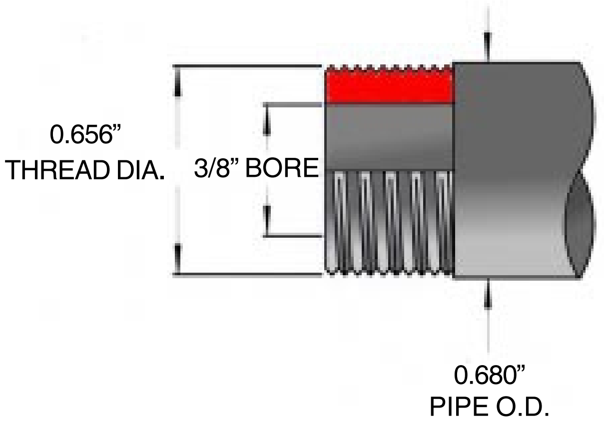
British Standard Pipe Thread BS2779 : 1986

These are specified by the nominal thread diameter which was based on the measurement of pipe diameters.

<u>For example:</u>

3/8 BSP thread has a major diameter of 0.656”

Nominal Pipe Bore
3/8” inside diameter
0.680 outside diameter.



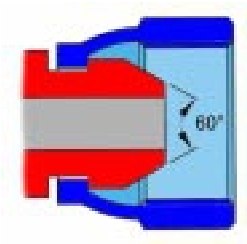
HIFLEX

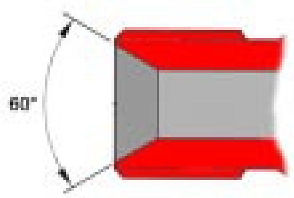
There are two types of threads:

BSPP parallel thread

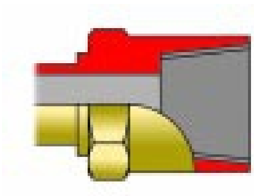
BSPT tapered thread

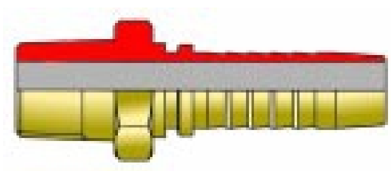
BSPP thread is used on a female and male fitting and has a 60° sealing cone.





FEMALE **MALE**

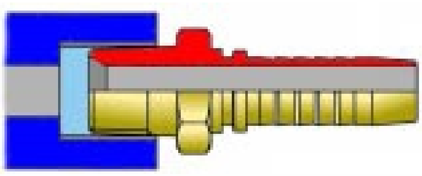




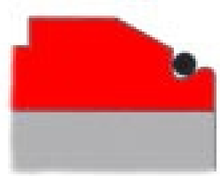
BSP Males can make a connecting seal in one of three ways:

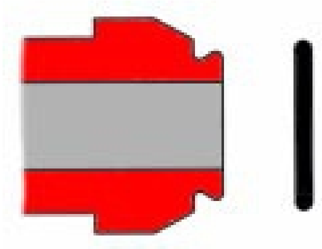
1. 60° Conical seal male to female.
2. Dowty seal between face of hexagon and pump or valve face.
3. Copper washer seal between special sealing face on hexagon to DIN 3852 Form B and pump or valve face.

BSPT Thread seals by thread interference.



BSP O-RING





The 'O' ring has been introduced as a second seal should the nut loosen under vibration in the hydraulic system, then the 'O' ring will provide a second seal and prevent oil leaks.

Conical seals by virtue of the radius will seal on a 60° cone immaterial of tolerance of angle but are subject to leaking.

2. AMERICAN SAE TERMINATIONS SAEJ512

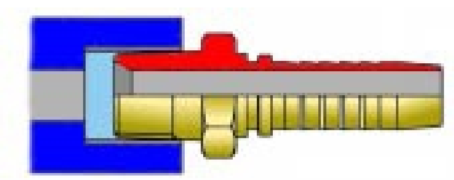
The range consists of the following:

1. NPTF (National Pipe Thread Find)
2. JIC Female 30° Flare (Japanese Industrial Council)
3. JIC Male
4. SAE 'O' Ring Boss
5. SAE Female 45° Flare
6. SAE Male
7. SAE Flange 3000 psi Series 61
8. SAE Flange 6000 psi Series 62

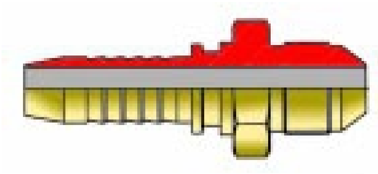
NPTF Male Dry Seal Tapered Pipe Thread

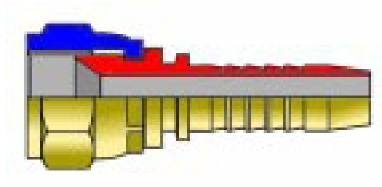
In America this is one of the most common threads but less in Europe where Metric and BSP threads are more common. Similar to BSPT it is important to exercise care during selection. The NPTF male has a 60° internal cone to seat with a NPSM thread found in adaptors.

The normal method of sealing is by thread interference with its mating part providing a leak free joint.



JIC Female, Males and ‘O’ Ring Boss



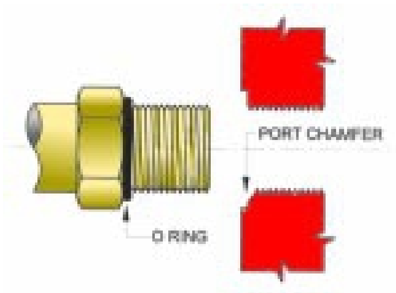


The threads in JIC Females and Males are not JIC but UNF. (***Unified National Fine Thread***)

JIC refers to the method of sealing on an angle of 37° for the Male and Female.

The ‘O’ ring boss is similar to the JIC Male except it does not have a 37° cone but is a flat face. The sealing is achieved by an ‘O’ ring placed in the annular groove behind the thread.

It’s mating part has an annular recess to accept the ‘O’ ring, which seals under the pressure applied, when the male is tightened into place. ‘O’ rings should be lubricated to prevent damage under assembly.



Thread size on the outside diameter of the thread.

HYDRAULIC FITTINGS

SAE SCREW THREADS 45 DEGREE FLARE

The 45 degree flare fitting seals in the same manner as the 37 degree flare except the flare angle is different.The threads are the same as the 37 degree and the o-ring boss except in dash sizes 6 and 12. Here, as in the 37 degree, the purpose of the threads is just to hold the parts together. Sealing is obtained on the flare seat. To identify, measure the thread O.D., number of threads per inch and determine the seat angle. (see figures 1 & 2) This fitting is intended for low pressure applications such as automotive and refrigerating systems.

SAE 45° SCREW THREAD

Thread Size or Dash No.	Nominal Thread Size (ins)	Threads per inch	Male Thread O.D. (mm)	Female Thread I.D. (mm)
2	5/6	24	7.9	6.7
3	3/8	24	9.5	8.3
4	7/16	20	11.1	9.9
5	1/2	20	12.7	11.5
6	5/8	18	15.8	14.4
8	3/4	16	19.0	17.4
10	7/8	14	22.2	20.6
12	1.1/16	14	26.9	25.0

Thread O.D.

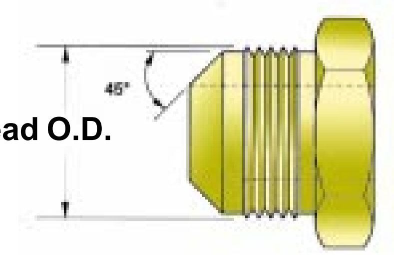


Fig. 1

Thread I.D.

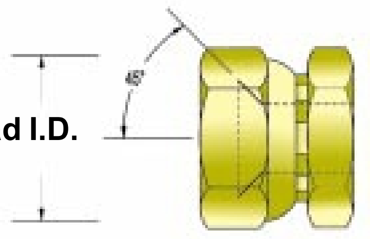


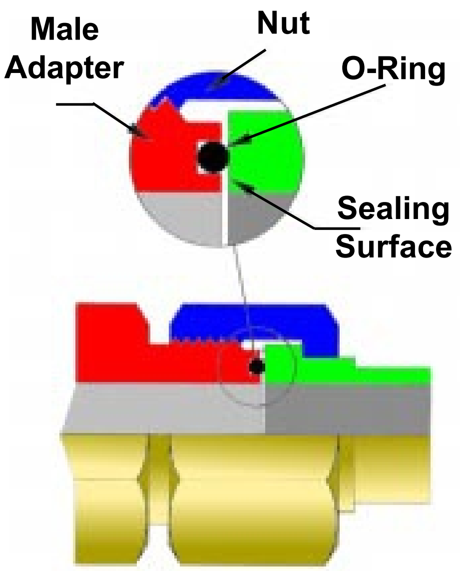
Fig. 2

O-Ring Face Seal

Another type of fitting that uses SAE straight screw thread, which is relatively new on the market, is called the O-Ring Face Seal. In this fitting the o-ring is placed in the face of the fitting and in front of the male thread. When properly assembled, the seal is rated at 6000 psi up to -16. The 1.1/4 and 1.1/2 are rated at 4000psi.

SAE 45° SCREW THREAD

Dash Size	Nominal Size	Threads per inch	Male Thread O.D. (mm)	Female Thread I.D. (mm)
-4	9/16	18	14.2	12.7
-6	11/16	16	17.4	15.8
-8	13/16	16	20.6	19.0
-10	1	14	25.4	23.8
-12	1.3/16	12	30.1	27.7
-16	1.7/16	12	36.5	34.1
-20	1.11/16	12	42.8	40.4
-24	2	12	50.8	48.4



HIFLEX

SAE FLANGE HEAD FITTINGS

Fig. 1

Flange head fittings are generally used in very high pressure service. They obtain a seal by trapping an ‘o’ ring between the groove in the face of the fitting and the flat face of the port. They are attached with split flange halves, bolts and lock washers (see figure 1).

There are two types in general use. SAE Code 61 for maximum system pressures of 3000 to 5000 psi depending on size. SAE Code 62 for pressures of 6000 psi in all sizes. Code 61 and 62 are not dimensionally interchangeable as can be seen in the chart below. To identify correctly measure the flange O.D. and compare to the charted dimension. (see figs 2 & 3).

Caterpillar also uses a Code 62 style flange with a 14.2 thickness - See table below.

Flange Dash Size	Flange O.D. Code 61 A (mm)	Flange O.D. Code 62 A (mm)	Flange Port B (mm)	Code 61 C (mm)	Code 62 C (mm)
8	30.1	31.7	1/2”	38.1	39.9
12	38.1	41.2	3/4”	47.6	50.8
16	44.4	47.6	1”	52.3	57.1
20	50.8	53.9	1.1/4”	58.7	66.6
24	60.3	63.5	1.1/2”	69.8	79.3
32	71.4	79.3	2”	77.7	96.8

Flange Thickness D (mm)	Code 61 D (mm)	Code 62 D (mm)	‘Fat Cat’ D (mm)
8	6.7	7.7	14.2
12	6.7	8.7	14.2
16	8	9.5	14.2
20	8	10.2	14.2
24	8	12.5	14.2
32	9.5	12.5	14.2

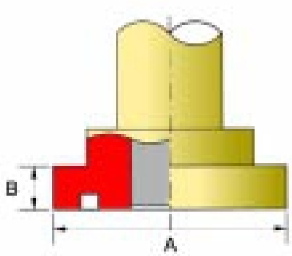


Fig. 2

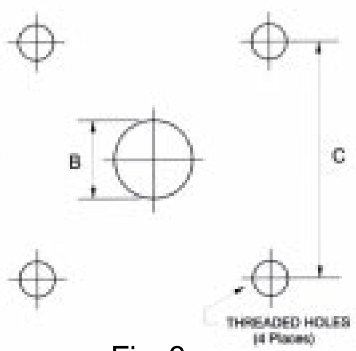


Fig. 3

Flange Dash Size	Maximum Recommended W.P. for Code 61		Maximum Recommended W.P. for Code 62	
	PSI	MPa	PSI	MPa
8	5000	34.5	6000	41.4
12	5000	34.5	6000	41.4
16	5000	34.5	6000	41.4
20	4000	27.8	6000	41.4
24	3000	20.7	6000	41.4
32	3000	20.7	6000	41.4

3. METRIC THREADS

There are two types of Metric Threads

German DIN
French Norm

The German DIN is now the accepted thread in Europe but the French Norm is still in use, particularly for replacement parts.

German DIN

The range comprises of the following fittings:-

Metric Females

1. DKL Low pressure with 12° angle seal.
2. DKOL Low pressure with 12° angle and ‘O’ ring seal.
3. DKS High pressure with 12° angle seal.
4. DKOS High pressure 12° angle and ‘O’ ring seal.
5. DKM Spherical cone DIN 7631

Metric Male

6. CEL Low pressure compression male.
7. CES High pressure compression male.

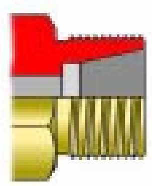
Standpipes

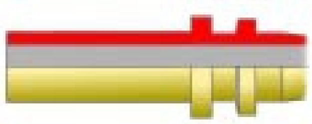
8. RSL Low pressure standpipe
9. RSS High pressure standpipe

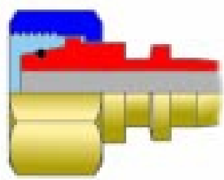
Banjo

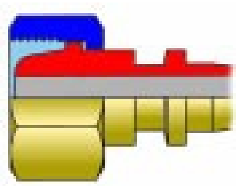
10. Metric Banjo and Bolt

Identification



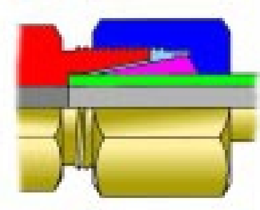






Low and high pressure fittings are similar in appearance and so it is most important to be able to identify both types.

Originally metric fittings were the compression type for rigid pipes, therefore the size reference is based on the diameter of the pipe together with the corresponding thread.



For example:

Low pressure pipe is 12mm O.D.	(A Dia, Fig. 1)
Thread 18x1.5mm	(B Dia, Fig. 2)
High pressure pipe is 10mm O.D.	(A Dia, Fig. 1)
Thread 18x1.5mm	(B Dia, Fig. 2)

For flexible hose fittings the metric female was introduced to replace the rigid pipe, the cutting ring and the nut. The pipe size is sometimes used as a reference in the part number to distinguish between low and high pressures.

High Pressure Thread	High Pressure Pipe	Low Pressure Thread	Low Pressure Pipe
16 x 1.5	8	12 x 1.5	6
18 x 1.5	10	14 x 1.5	8
20 x 1.5	12	16 x 1.5	10
22 x 1.5	14	18 x 1.5	12
24 x 1.5	16	22 x 1.5	15
30 x 2.0	20	26 x 2.0	18
36 x 2.0	25	30 x 2.0	22
42 x 2.0	30	36 x 2.0	28
52 x 2.0	38	45 x 2.0	35
		52 x 2.0	42

By measuring the A Dia. of the compression stud we can determine the pipe size and pressure rating; High pressure or Low pressure. The corresponding HP or LP female will fit

French Norm

The Norm consists of metric females, standpipes and compression males similar to the German DIN in appearance but differ dimensionally.

Compression Male

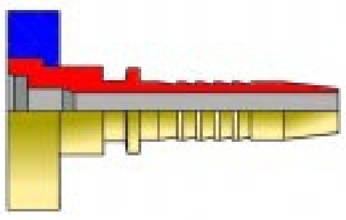
Type EMM		Type EMG		Standpipe	
Thread	Pipe Diameter	Thread	Pipe Diameter	Actual O.D.	Ref. O.D.
14 x 1.5	8	20 x 1.5	13.25	13.25	13
16 x 1.5	10	24 x 1.5	16.75	16.75	17
18 x 1.5	12	30 x 1.5	21.25	21.25	21
20 x 1.5	14	36 x 1.5	26.75	26.75	27
22 x 1.5	15	45 x 1.5	33.50	33.50	33
24 x 2.0	16	52 x 2.0	42.25	42.25	42
27 x 2.0	18	58 x 2.0	48.25	48.25	49
30 x 2.0	22				
33 x 2.0	25				
36 x 1.5	28				
39 x 1.5	30				
48 x 1.5	38				

The cone angle in the compression stud is 12° and metric cone profile is designed to suit. French Norm is also referred to as French GAZ.

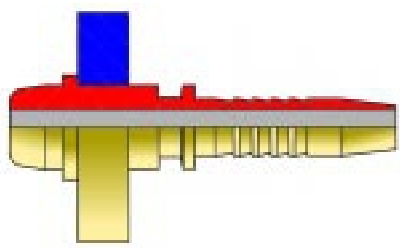
Poclain Couplings

This is a French flange type coupling as used by the French machine manufacturer Poclain.

The flange replaced the nut on the standard coupling and is secured in place on the machine manifold by bolts. The seal is accomplished by either a compression end or cone which is secured by the flange being bolted in place.



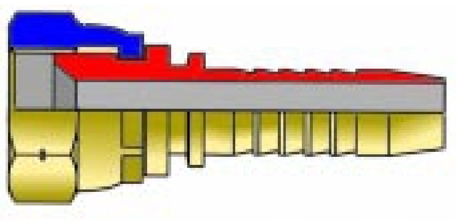
POCLAIN FEMALE FLANGE



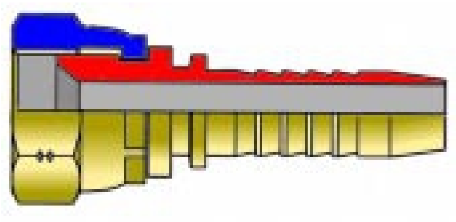
POCLAIN MALE FLANGE

4. JAPANESE THREADS

The two most commonly used threads are Toyota and Komatsu which are made up of a combination of BSP and Metric.



SBN4



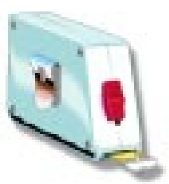
SMK4

Japanese Flange Fitting

These are similar the SAE flanges except the thickness and the diameter are different.

Section 5.

ASSEMBLY



Assembly of Reusable Non-Skive Hose Assemblies

The following steps show the correct procedure for the assembly of reusable non-skive hose assemblies.

1. Cut the hose squarely to the desired length using a fine toothed hacksaw or preferably a cutoff machine.
It is important to ensure that the outer cover of the hose end remains oil free.

2. Do not lubricate either the end of the hose or the internal threads of the ferrule. Place the ferrule in a vice, screw the hose anti-clockwise into the ferrule until the hose bottoms.
Now back off half a turn maximum.

3. Lubricate the hose insert over the taper area only, (not the threads) with the fluid which is to be used in the hose or any other compatible lubricant.

4. Screw the insert into the ferrule until it seats. No further tightening will be necessary.

Assembly of Reusable Skived Hose Assemb

The following steps show the correct procedure for the assembly of reusable skived hose assemblies.

1. Cut the hose squarely to the desired length using a fine toothed hacksaw or preferably a cutoff machine. Remove dirt particles from the bore of the hose. Place the mandrel in the vice and push the hose end onto the mandrel. Mark the hose from the first notch on the ferrule, then cut squarely down to the wire braiding.

2. Slit the cover to be removed longitudinally around the diameter of the hose. Then slice the unwanted cover off the wire braiding.

3. Clean up with a wire brush to remove any remaining pieces of hose cover from the wire braiding. It is important that steps are taken to ensure that the wire braiding remains oil free.

4. Place the ferrule into a vice. Do not lubricate either the braiding or the internal threads of the ferrule. Screw the hose into the ferrule anti-clockwise until the hose bottoms.

5. Lubricate the fitting on the taper area only and not the threads with the fluid that is to be used in the hose or any other compatible lubricant.

6. Screw the ferrule into the insert until it seats. No further tightening will be necessary.

NOTE: If an external skive machine is available ignore steps 1 - 3 inclusive.
Using the machine instructions remove the outer cover as required.

Assembly of Swaged Skived Hose Assemblies

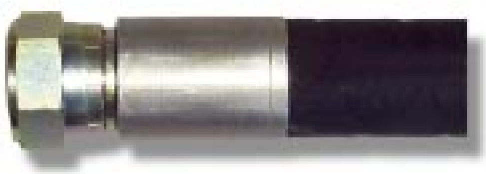
The following steps show the correct procedure for the assembly of swaged skived hose assemblies.

1. Cut the hose squarely to the desired length using a fine tooth hacksaw or preferably a cutoff machine. Remove dirt particles from the bore of the hose. Place the mandrel into the vice and push the hose onto the mandrel.

2. Skive off the outer cover of the hose down to the reinforcement over length ‘L’. See appropriate dimension on a Flexequip swage chart.

3. Push the ferrule onto the end of the ferrule until it bottoms. Lubricate the tail of the insert with the fluid to be used in the hose or a compatible lubricant. Push the insert into the hose until the stop collar ‘B’ meets the hose.

4. Place the assembly into the swaging machine and swage down as required. See appropriate dimension on a Flexequip swage chart.



NOTE: Insert collapse should be checked with either an appropriate mandrel, or an internal measuring instrument.

ASSEMBLY

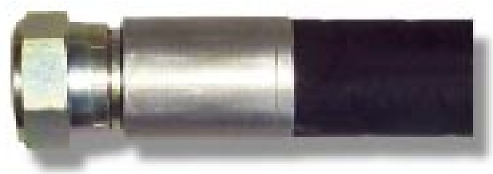
Assembly of Swaged Non-Skived Hose Assemblies

The following steps show the correct procedure for the assembly of swaged non-skived hose assemblies.

1. Cut the hose squarely to the desired length using a fine toothed hacksaw or preferably a cutoff machine.
   Remove dirt particles from the bore of the hose.

2. Push the ferrule into one end of the hose until it bottoms. Lubricate the tail of the ferrule with the fluid to be used in the hose or any other compatible lubricant. Push the insert into the hose until the stop collar 'B' meets the hose end.

3. Place the assembly into the swaging machine and swage down as required. See the appropriate dimension on a Flexequip swage chart.



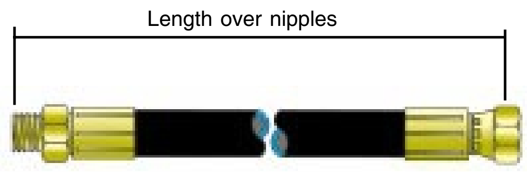
NOTE: Insert collapse should be checked with either an appropriate mandrel or an internal measuring instrument.

HIFLEX

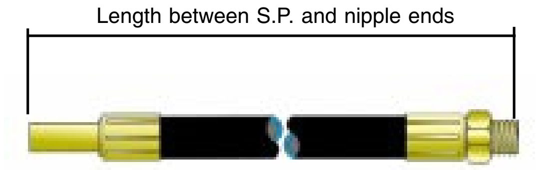
ASSEMBLY

How to Measure Hose Assemblies

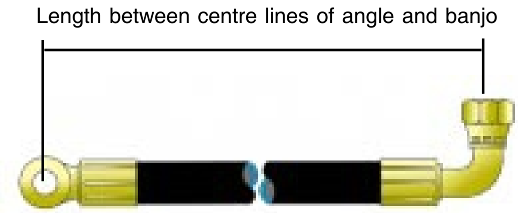
The following steps show the correct procedure for measuring hose assemblies.



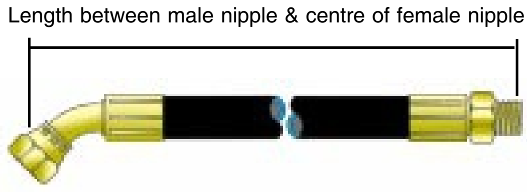
Swivel female & male union



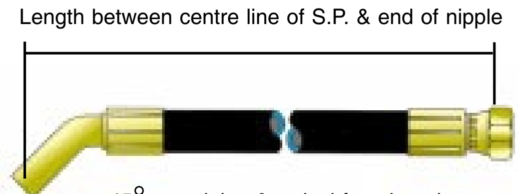
Straight standpipe & male union



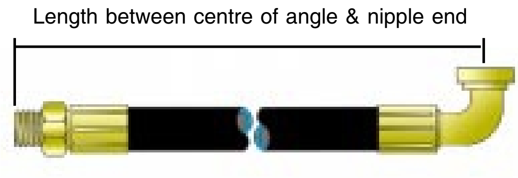
Banjo coupling & swivel female 90° swept union



Swivel female 45° swept union & male union



45° standpipe & swivel female union

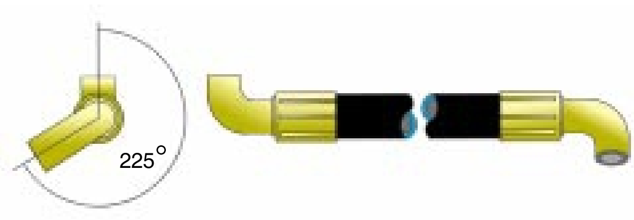


Male union & 45° SAE flange

Standard Tolerances

Assembly Length:

000mm - 305mm	± 3mm
305mm - 457mm	± 4mm
457mm - 914mm	± 6mm
914mm upwards	± 1%
Elbow angle	± 3%



Angular Relationships

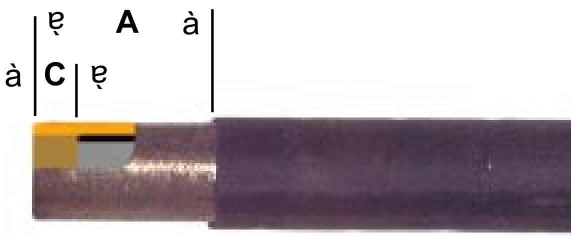
Hold the assembly so that you can look along the length of the hose with the fitting furthest away from you in a vertical position. Measure the angle between the vertical fitting and the one nearest to you in a clockwise direction. Relationships can then be expressed from 0° to 360°

Assembly of INTERLOCK Skived Hose Assemblies

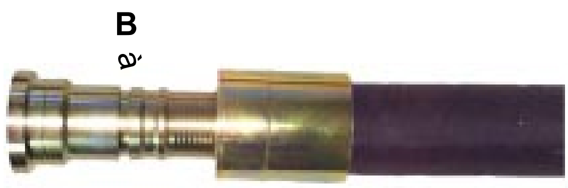
The following steps show the correct procedure for the assembly of Interlock skived hose assemblies.

1. Cut the hose squarely to the desired length using a fine toothed hacksaw or preferably a cutoff machine. Remove dirt particles from the bore of the hose.

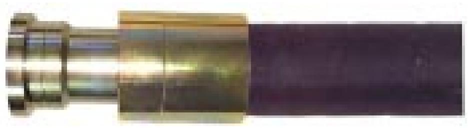
2. Now skive the outer cover to length ‘A’ and the inner tube to length ‘C’, using dimensions acquired from a Flexequip swage chart. Care should be taken when skiving not to disturb the wire spiral layers.



3. Push the ferrule into one end of the hose. Lubricate the tail end of the insert with the fluid to be used in the hose any other compatible lubricant. Push the insert into the end of the hose until stop collar ‘B’ meets the end of the hose.



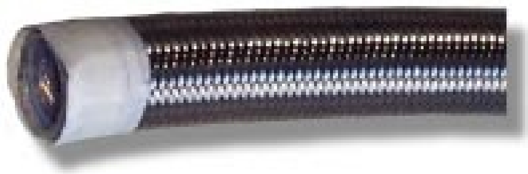
4. Place the assembly into the swaging machine and swage down as required. See appropriate dimension on a Flexequip swage chart.



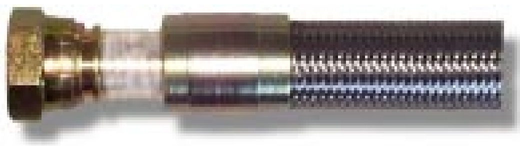
NOTE: Insert collapse should be checked with either an appropriate mandrel or an internal measuring instrument.

Assembly of Convoluted P.T.F.E. Hose Assemblies

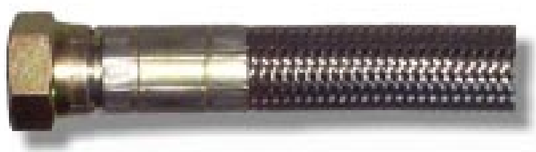
The following steps show the correct procedure for the assembly of convoluted P.T.F.E. hose assemblies.



1. Wrap hose with masking tape or PVC insulation tape at the point of cutoff. Cut the hose squarely to the desired length, through the taped up area, using a fine toothed hacksaw or preferably a cutoff machine. Remove dirt particles from the bore of the hose.



2. Push the ferrule onto the end of the hose. Wrap the tail end of the insert along the the full length with 2 layers of PTFE tape. Push the insert into the end of the hose until stop collar 'B' meets the end of the hose.

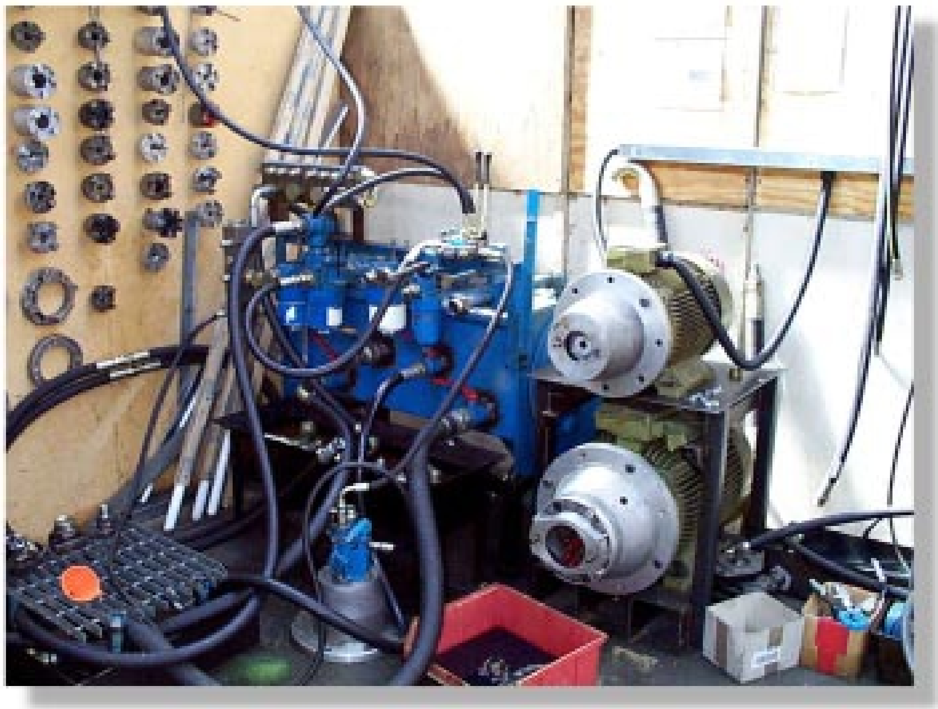


3. Place the assembly into the swaging machine and swage down as required. See the appropriate dimension on a Flexequip swage chart.

NOTE: Insert collapse should be checked with either an appropriate mandrel, or an internal measuring instrument. The correct swaging of this type of copupling is <u>very critical</u> to ensure a leak proof hose assembly.

Section 6.

INSTALLATION OF HOSE ASSEMBLIES



INSTALLATION of HOSE ASSEMBLIES

Having exercised attention to detail when selecting the proper hose and fittings and making the hose assembly it is now important to install the assembly correctly onto the machine. Unless this is done in the proper way premature failure can occur to the rubber seals, threads and the hose.

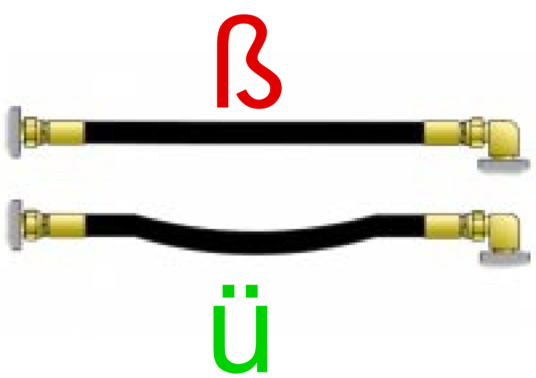
ASSEMBLY GUIDELINES

Proper routing of hoses not only offers a good appearance but means fewer connectors, crossovers and less hose.

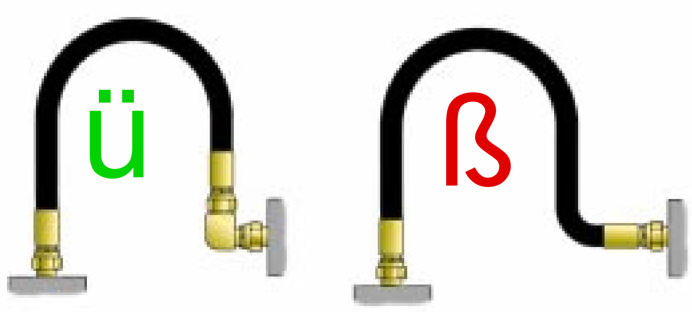
From years of practical experience the industry has developed the following guidelines for installing and routing hoses.

<u>General Routing Guides</u>

The following are industrial accepted assembly installation and routing guidelines developed from years of practical experience. They are intended to help you gain the highest level of performance from hydraulic hose assemblies and reduce maintenance costs and downtime.

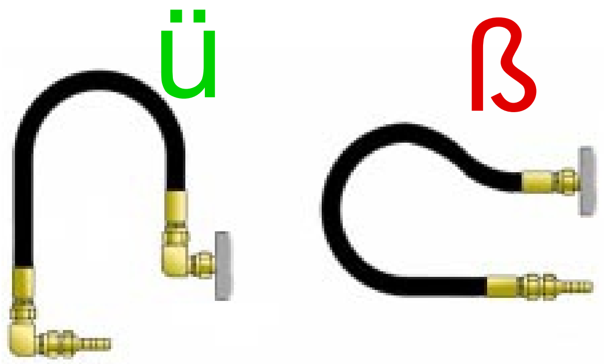


Since hose may change in length from +2% to -4% under the surge of high pressure, provide sufficient slack for expansion and contraction.

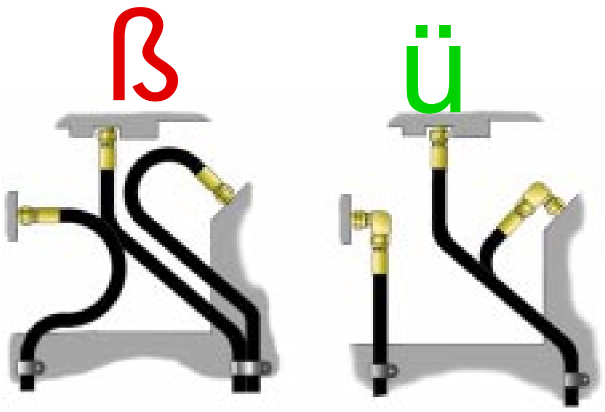


Avoid sharp twists or bends in the hose by using proper angle adaptors.

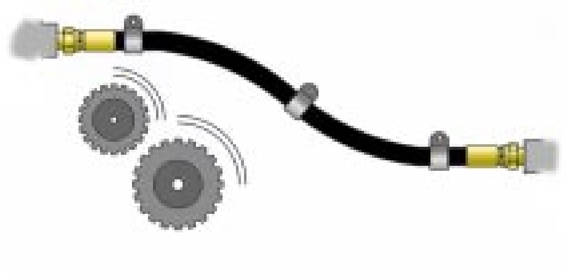
INSTALLATION of HOSE ASSEMBLIES



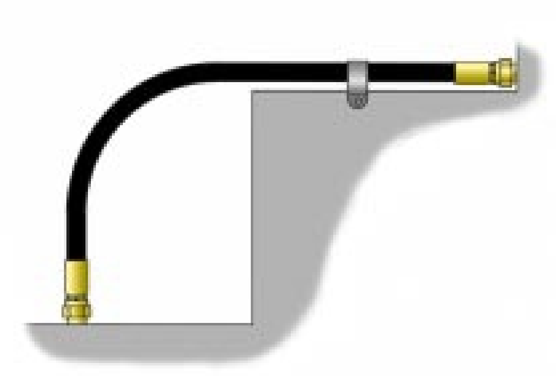
Where the radius falls below the required minimum, an angle adaptor should be used as shown above, to avoid sharp bends in the hose.



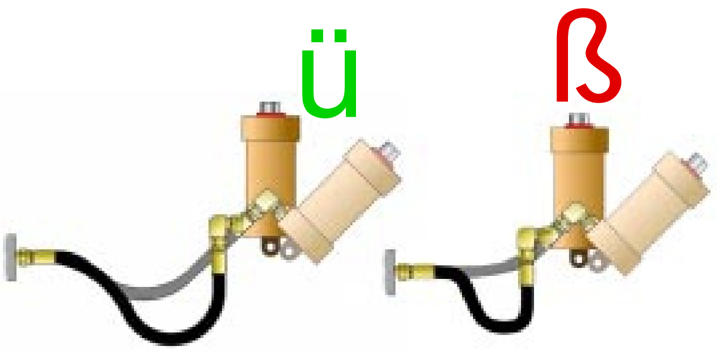
Obtain direct routing of hose through the use of 45° and 90° adaptors and fittings. Improve appearance by avoiding excessive hose length.



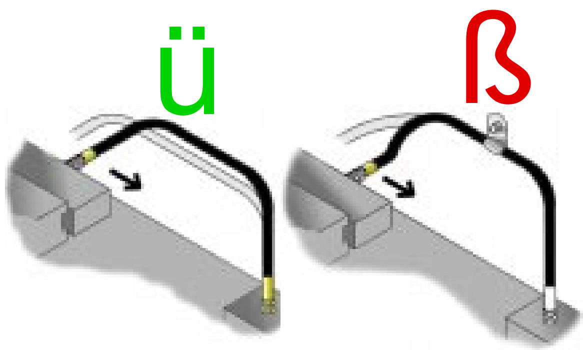
Clamp hoses away from moving machinery.



Due to changes in length when the hose is pressurized do not clamp at bends so curves absorb changes.Do not clamp high and low pressure lines together.

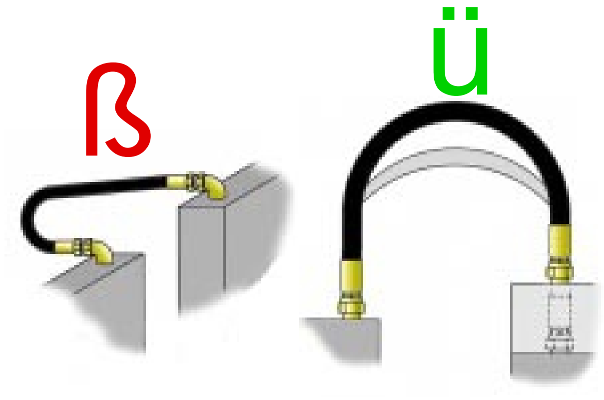


Adequate hose length is most important to distribute movement on flexing applications and to avoid abrasion.

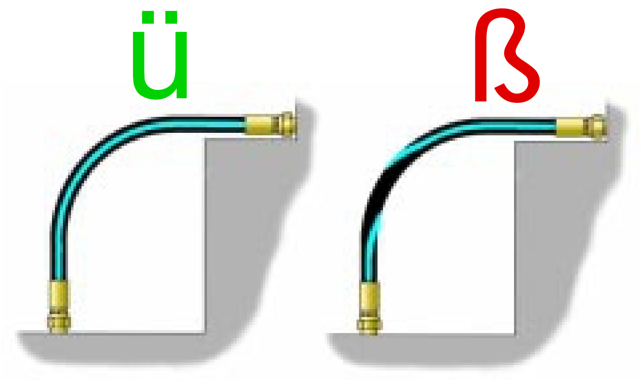


To avoid twisting in the hose line, bend in two planes and clamp hose at change of plane as shown.

INSTALLATION of HOSE ASSEMBLIES



To prevent twisting and distortion, hose should be bent in the same plane as the motion of the boss to which the hose is connected.



A 10% twist can reduce hose life by 90%.

Use a spring guard to avoid abrasion.

INSTALLATION of HOSE ASSEMBLIES

Please observe the specifications on minimum bend radii. If the radius is too small this will put the assembly under unnecessary stress. Be careful not to twist the hose when tightening connectors.

Please note the following when installing hose assemblies:-

The hose expands and contracts under pressure surges, therefore sufficient slack should be allowed to compensate for this.

Length change normally equals +2% to -4% of the length of the hose.

Use torque settings to prevent damage to threads through overtightening.

The bolts securing the flange clamp to the flange head should be evenly tightened at the correct torque setting.

Ensure 'O' ring seals are slightly lubricated prior to assembly to over come friction between working surfaces.

'O' rings must be compatible with the hydraulic fluid and the working temperatures of the machine.

Section 7.

TESTING
&
FAILURES

HIFLEX

Testing Of Newly Completed Hose Assemblies

Once a new hose assembly is completed it is recommended that it is tested hydrostatically at twice the working pressure of the hose.

Firstly the hose assembly should be cleaned by blowing compressed air through it. Secondly the hose should be visually inspected.

The test should then be carried out in a controlled and safe environment with the pressure held for not more than 60 seconds. When test pressure is reached, visually inspect the hose for:-

(a) Any leaks or signs of weakness.

(b) Any twisting of hose.

ANALYSING FAILURES

Everyone in hydraulics encounters hose failures at sometime. Normally there is no problem, the hose is replaced and the equipment goes back to work, but occasionally failures come too frequently with the same type of failure problem. At this point it is time to determine and correct the cause of these failures.

1. Improper Application

Beginning with the most obvious and most common of hose failure, improper application.
Here we must check the following areas.

a) The maximum operating pressure of the hose.

b) The recommended temperature range of the hose.

c) The fluid compatibility of the hose and fittings.

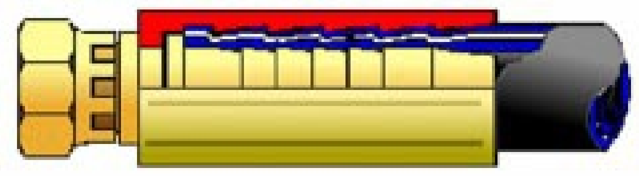
Check all areas against the requirements of the application. If they do not match up you need to select another hose or fitting combination.

2. Improper Assembly and Installation

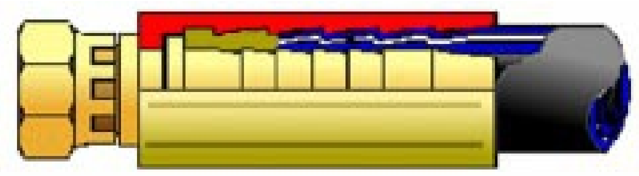
The second major cause of hose assembly failure is improper assembly and installation procedures. This can involve anything from using the wrong fitting on a hose to poor routing of the hose. You should always use the recommended specifications and literature supplied by the hose and fitting manufacturers.

ANALYSING FAILURES continued...

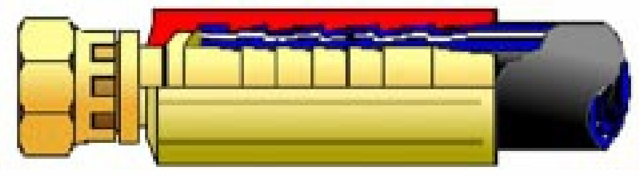
This assembly end termination has been produced correctly, with the hose fully up to the insert stop collar and the ferrule swaged properly.



This assembly end termination has been produced incorrectly, with the hose not pushed fully up to the insert stop collar. This assembly would fail either with the hose pulling off or fluid leakage around the ferrule due to the hose not being held securely to the insert tail.



This assembly end termination has been produced incorrectly, the ferrule having been located incorrectly in relation to the insert. When the ferrule is swaged down the locking collar will deform which could cause the hose to pull off the insert when under pressure.



This assembly end termination has been produced incorrectly, the ferrule having been crimped down excessively. This can cause failure of the insert collapsing or the hose failing at the back of the ferrule.