MTS FSE MODULAR TRAINING

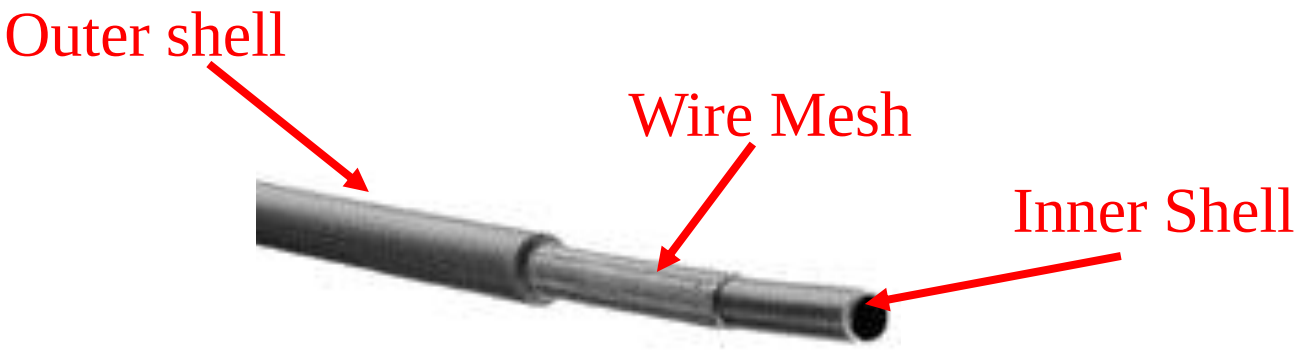
Hose and Fittings

July 9, 2015 rev D

be certain.

Anatomy of a Hydraulic Hose

» Hydraulic hoses are actually a hose within a hose, separated by a wire mesh.



Hydraulic Hoses

- Hydraulic hoses carry hydraulic fluid and connect the Hydraulic Power Unit (HPU) to the hydraulic service manifold (HSM) and any actuators or motors that may be in the system.

- There are normally three hoses for each connection:
  - Pressure
  - Return
  - Drain

Hydraulic Hoses

- The pressure and return hoses are normally a high pressure hose (rated at 3000 psi or higher), while the drain hose is typically a low pressure hose.
- Pressure and return hoses typically use a fitting which is crimped on to the hose
  - This is done with a special machine designed for this purpose
- Hydraulic fittings must meet industry standards for strength and material.
- Hydraulic hoses must meet requirements for cleanliness.

Hydraulic Hoses

- MTS has a published standard for hydraulic hoses which specifies the materials, working pressure, proof and burst pressure.

- If you elect to obtain hydraulic hoses and fitting at a local distributor you must ensure that they conform to these standards.

MTS Hydraulic Hose Specifications

» Pressure Reference Table

- Typical proof pressure is 1.5 x working pressure.
- Typical burst pressure is 4 x working pressure.
- Typical hose application and associated pressures are listed below.

Hose Type	Working Pressure	Proof Pressure	Burst Pressure
High Pressure	5000 psi	7,500 psi	20,000 psi
Pressure	3000 psi	4500 psi	12,000 psi
Return	2000 psi	3000 psi	8000 psi
Drain	100 psi	150 psi	400 psi
Supercharge/Suction	350 psi	525 psi	1400 psi

Working Pressure Vs Proof Pressure

- Working Pressure is the pressure the hose or fitting is expected to see during normal operation.
- Proof Pressure is the pressure which the hose is tested at.
- Proof Pressure must be at least 150 % of the working pressure.

Hydraulic Hose and Fitting Sizing

- Hydraulic hoses and fitting are normally sized in “dash numbers”.
  - Hose size is the inside diameter of the hose
- The dash number is used to specify the size of the hose or fitting in 16th of an inch increments.
- Example:
  - ¾” hose (12/16 of an Inch) would be a -12
  - 1” hose (16/16 of an Inch) would be a -16

Inch Size	Dash Size
1/4	-4
3/8	-6
1/2	-8
3/4	-12
1	-16
1 1/4	-20
1 1/2	-24
2	-32

Hose Installation

- On a typical installation you will have as a minimum of three hoses
  - Pressure - Which carries oil to the actuator
  - Return - Which carries the oil away from the actuator
  - Drain – Which carries the drain oil from the actuator

- On some systems you may also have pilot pressure and pilot return hoses.
  - Pilot Pressure and Pilot return ports not typically found on HPU but are present on HSM
  - Used with 3 stage valves
  - Can be used for hydrostatic bearings.
    - New HSM designs have Hydrostatic bearing connection for hose.
    - Legacy HSM utilize pilot pressure.

Hose Installation

- The HPU, service manifold, and actuators are labeled with either the complete description such as pressure or a letter indicating which hose connects to each fitting.

  - P- Pressure
  - R - Return
  - D - Drain

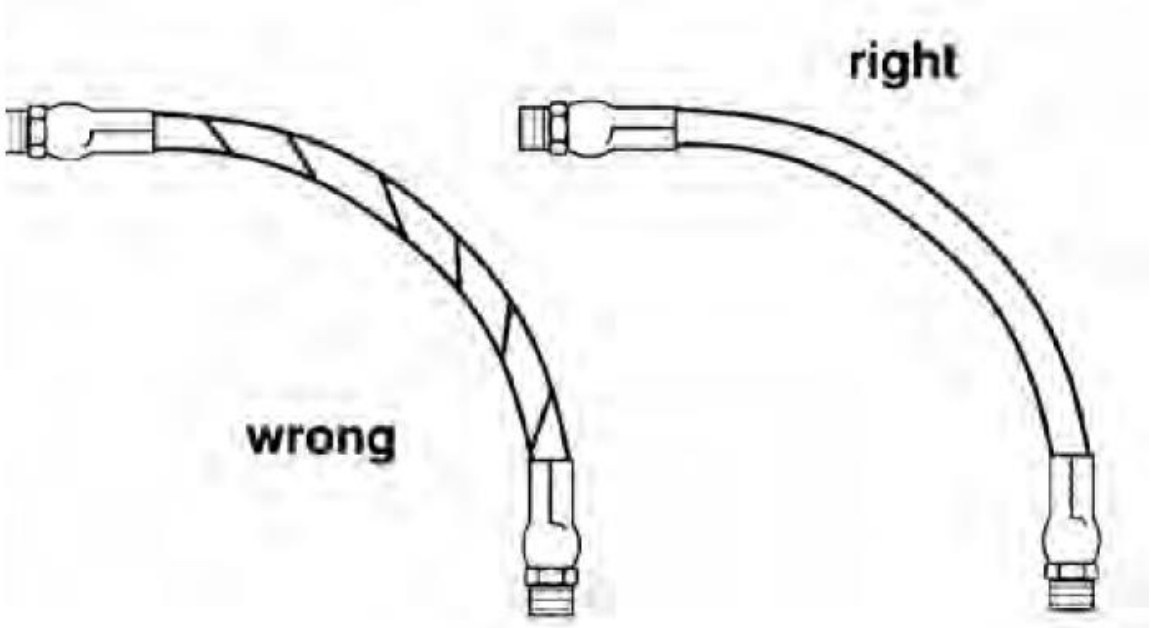
  - PP - Pilot Pressure
  - PR - Pilot Return

Hose Installation

- Hydraulic hoses that are supplied from MTS are flushed and pressured checked prior to shipping.
- The hoses contain clean hydraulic oil when shipped.
- MTS Supplied hoses are shipped with a plug installed at each end to maintain cleanliness
  - Do not remove plugs until immediately before installation
- When you purchase a hose from a local vender unless other wise stated it is NOT cleaned or pressure checked.
- You MUST flush locally supplied hoses prior to connecting them to the system!

Hose Installation

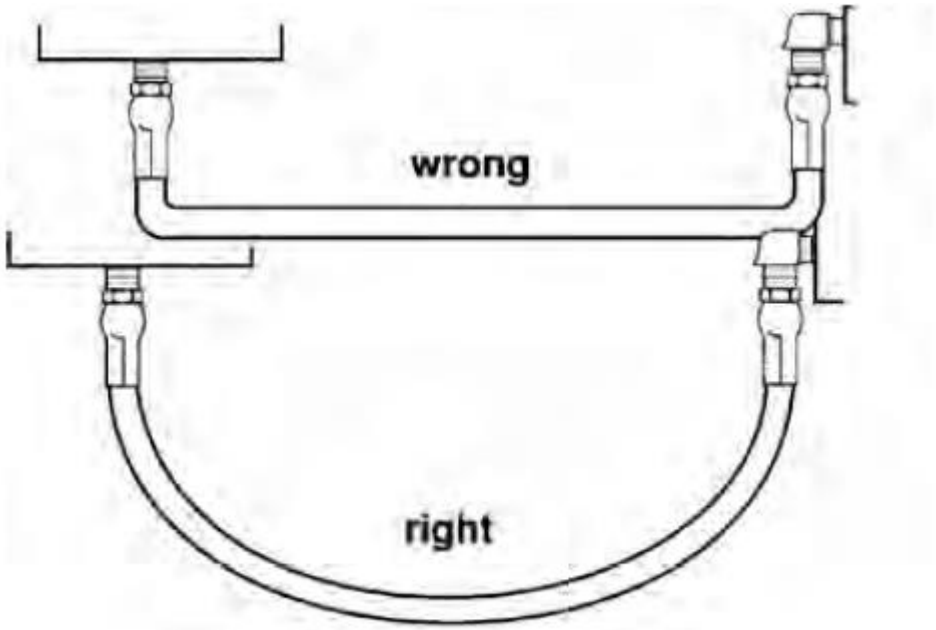
- Do not twist the hose during installation
  - Ensure when tightening fittings the hose does not become twisted
  - Check any motion from swivels to ensure the hose does not twist during movement



Hose is weakened when installed in twisted position.
Pressure in twisted hose tends to loosen fitting connections.

Hose Installation

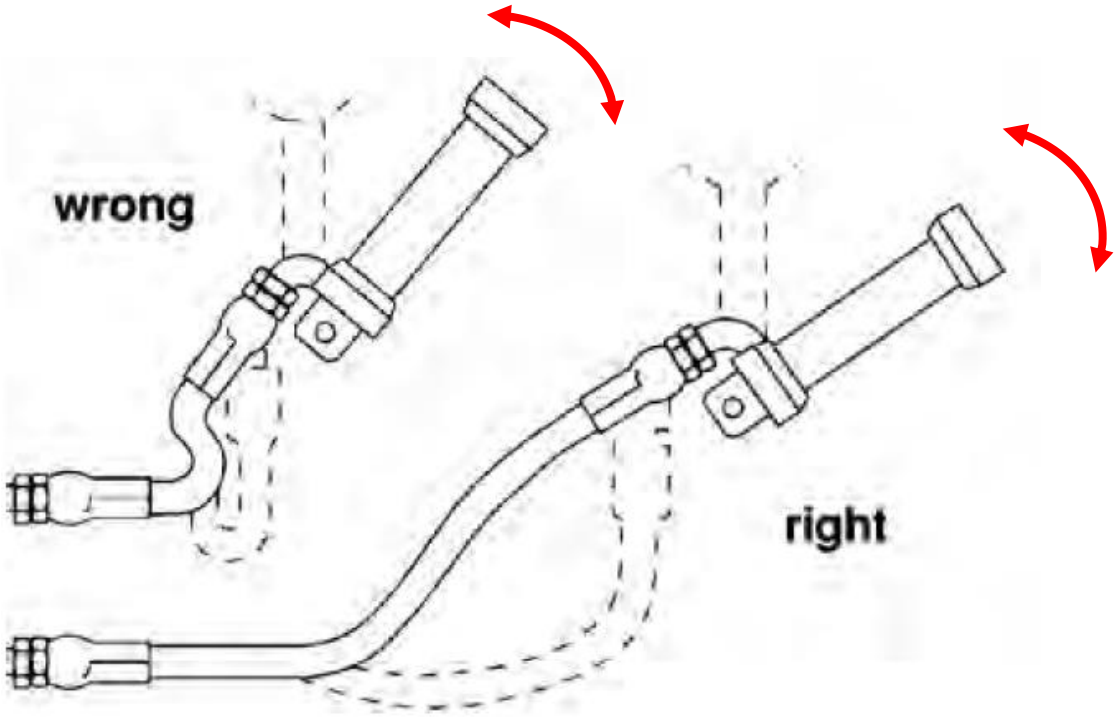
- Hydraulic hose has a specified minimum bend radius.
  - Hoses should not be installed with a radius smaller than the minimum specified
  - The general rule of thumb is do not physically force a hose into a bend.



Ample bend radius should be provided to avoid collapsing of line and restriction of flow.

Hose Installation

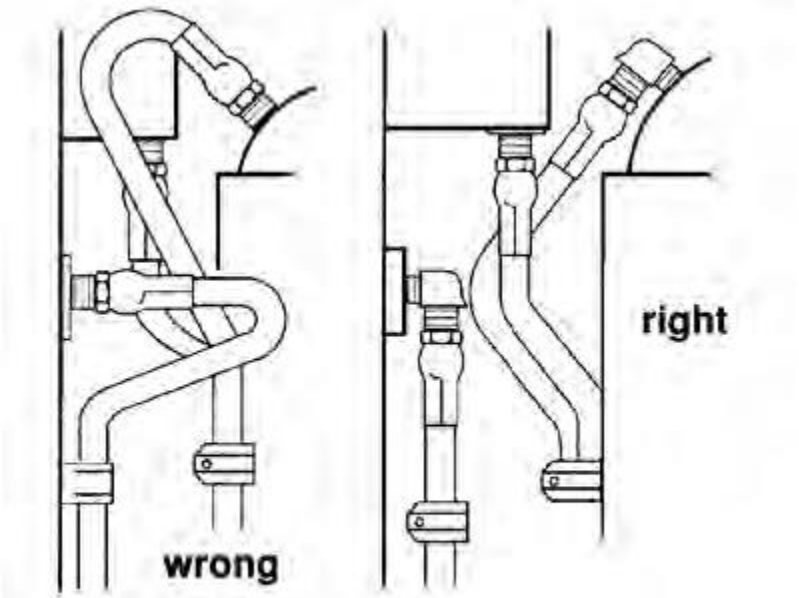
» When installing a hose on a device with a swivel such as an actuator ensure that the hose maintains appropriate bend radius throughout the entire range of movement



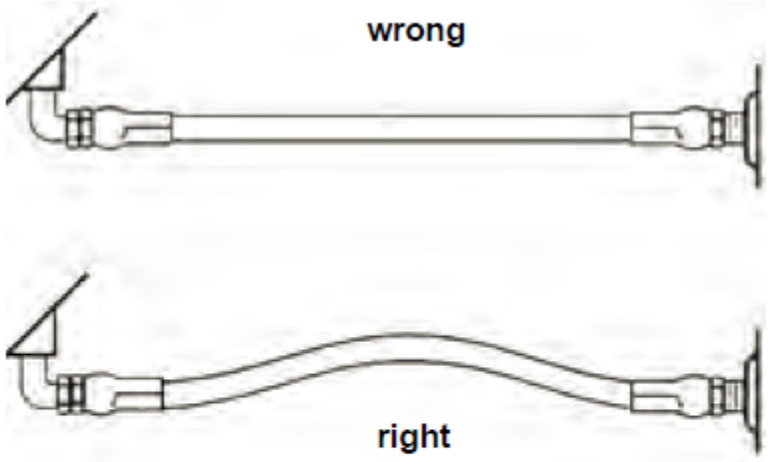
Exceeding minimum bend radius will greatly reduce hose assembly life.

Hose Installation

- Use elbows and other tube adapters to route hoses
- Do not install hoses in a arrangement which creates a rigid or strained configuration.



Use elbows or other adapters as necessary to eliminate excess hose length and to insure neater installation for easier maintenance.



When hose assembly is installed in a flexing application, remember that metal hose fittings are not part of the flexible portion. Allow ample free length for flexing.

Drain Hose

- The drain hose is commonly assembled using Parker Push Lok fittings
  - This is a low pressure hose and fitting system

- The fitting has barbed teeth and is pushed into the hose.

Drain Hose

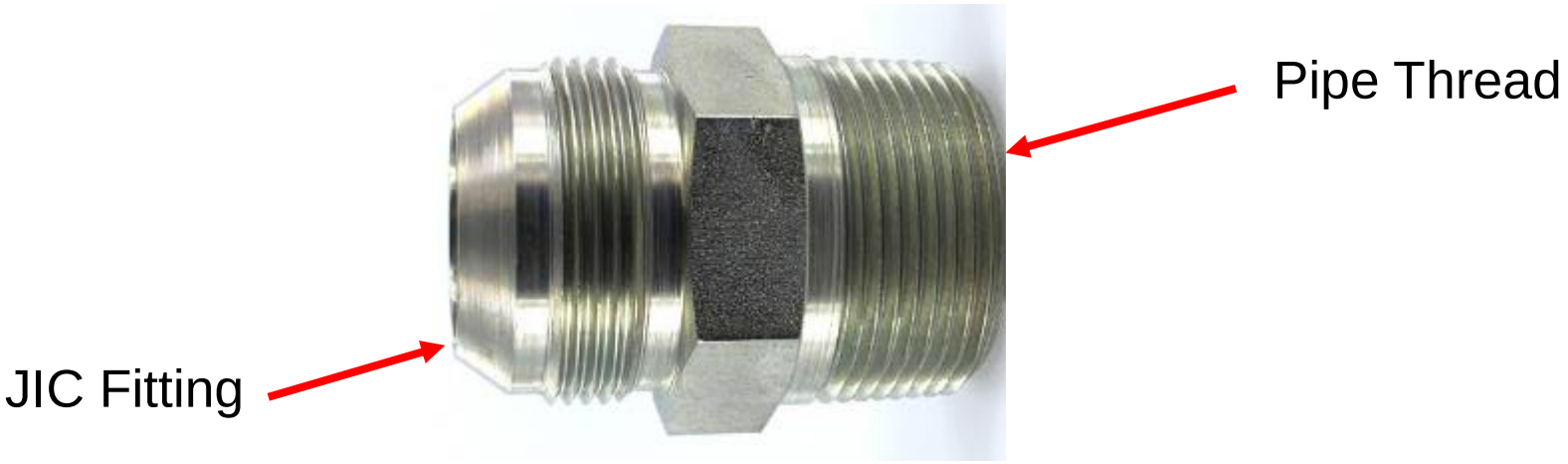
- The typical drain hose is a low pressure hose.
- It carries the drain flow from the actuator back to the HPU.
- Drain lines must be installed on all 244 series actuators.
  - There must not be any restrictions or back pressure.
  - The hose must not be smaller than the fitting size on the actuator.
  - Typical load frame drain is a -6 (3/8”) or larger

Hydraulic Fittings

- There are several different types of hydraulic fittings:
  - Pipe Thread
  - JIC or Flared
  - Boss or O-Ring Boss
  - O-Ring Face Seal
  - Flange Fitting
- MTS components such as HSM and actuators typically use JIC which is a flare type fitting
- HPU's use different types based on requirement
  - Legacy HPU – JIC
  - Modern small HPU – O-Ring Face Seal (ORFS)
  - Modern large HPU – JIC Flare or Split Flange Fitting

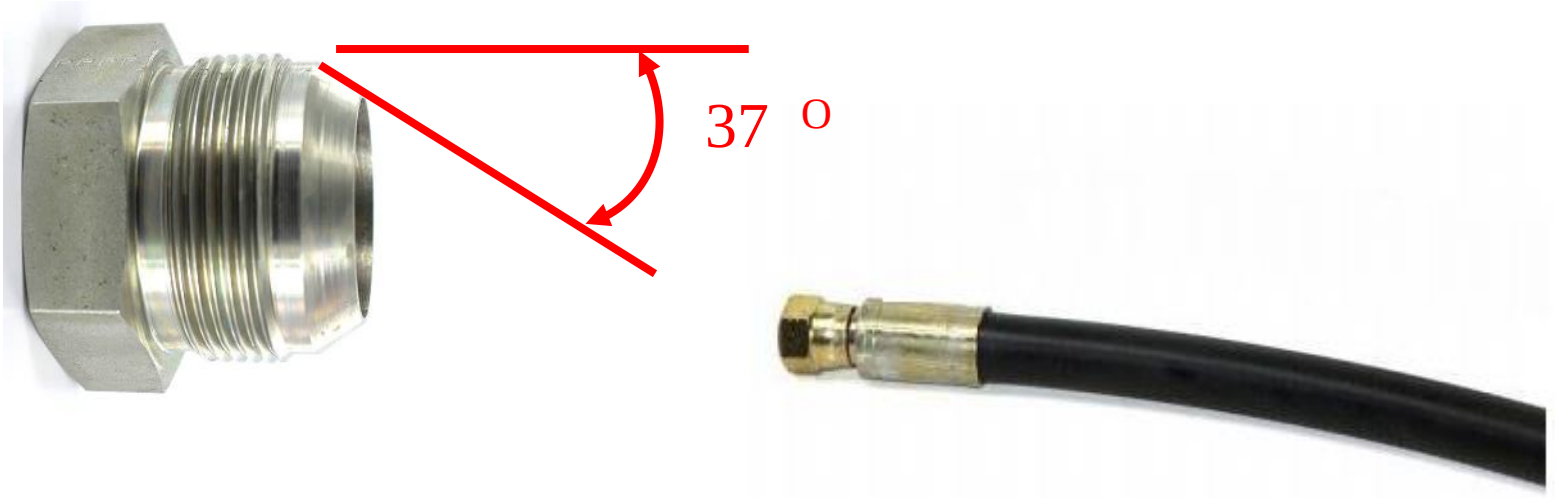
Pipe Thread

- Pipe thread is sized in inches
  - This is different than JIC which is sized in dash numbers
  - The adapter shown below has a -12 JIC on the left and a ½ inch pipe thread on the right



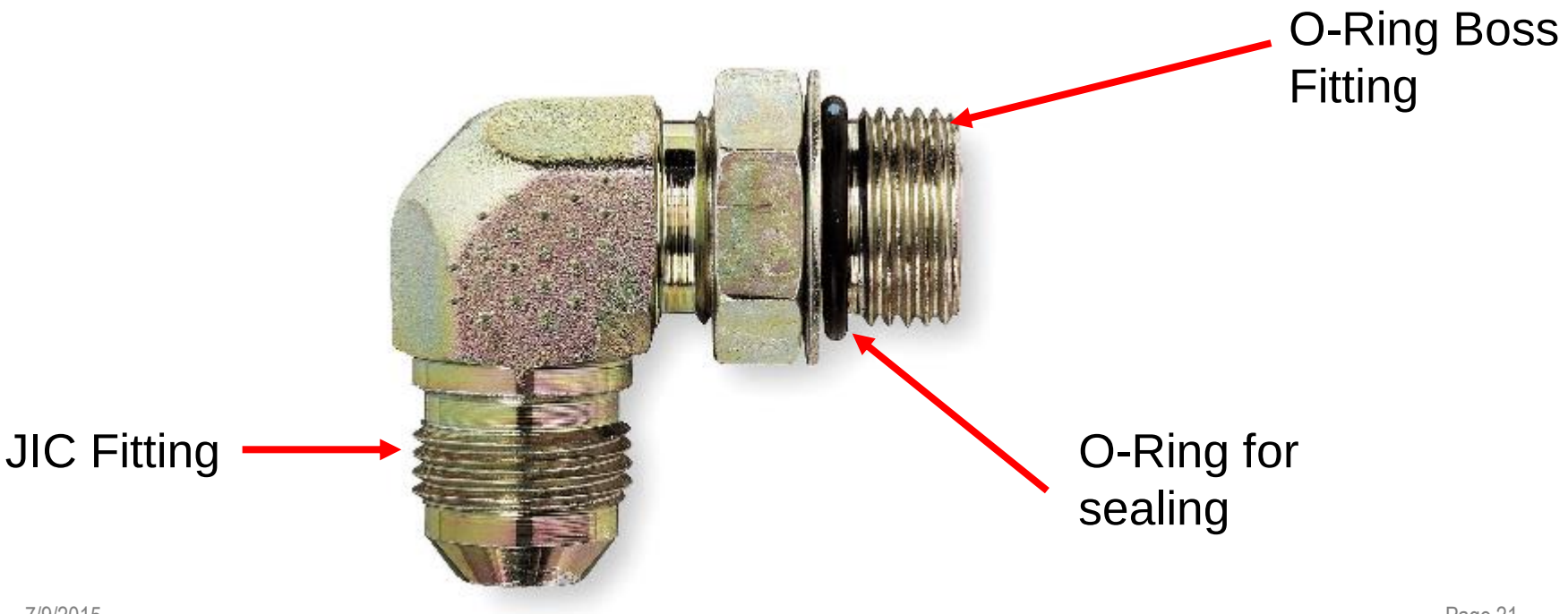
JIC Fitting

- JIC Fittings have a 37 degree flare
  - The flared surface is the sealing surface
  - Scratches or other imperfections will cause the fitting not to seal
  - These are not the same as 45 degree flare used for gas and automotive fittings
  - Using 45 degree flare will cause leaks



O-Ring Boss Fittings

- O-Ring boss fittings are usually found on manifolds
  - Actuator manifolds have a boss to JIC fitting
  - Boss fitting is in the manifold
  - JIC fitting is for the hose
  - The O-ring provides the seal and mates to a machined surface



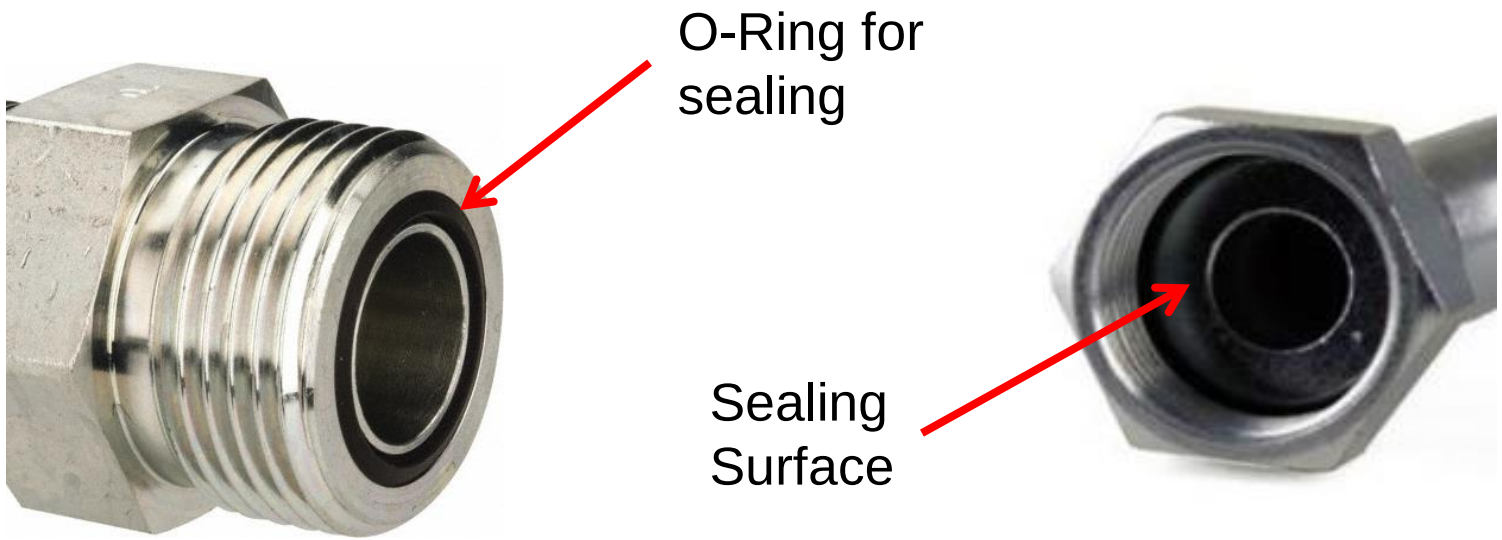
JIC Sizing Reference Chart

JIC 37degree flare sizing

Inch Size	Dash Size	Tread Size	Male thread OD	Female Thread OD
1/8	02	5/16-24	5/16	9/32
3/16	03	3/8-24	3/8	11/32
1/4	04	7/16-20	7/16	13/32
5/16	05	1/2-20	1/2	15/32
3/8	06	9/16-18	9/16	17/32
1/2	08	3/4-16	3/4	11/16
5/8	10	7/8-14	7/8	13/16
3/4	12	1 //16-12	1 1/16	1
7/8	14	1 13/16-12	1 13/16	1 1/8
1	16	1 5/16-12	1 5/16	1 1/4
1 1/4	20	1 5/8-12	1 5/8	1 9/16
1 1/2	24	1 7/8-12	1 7/8	1 13/16
2	32	2 1/2-12	2 1/2	2 7/8

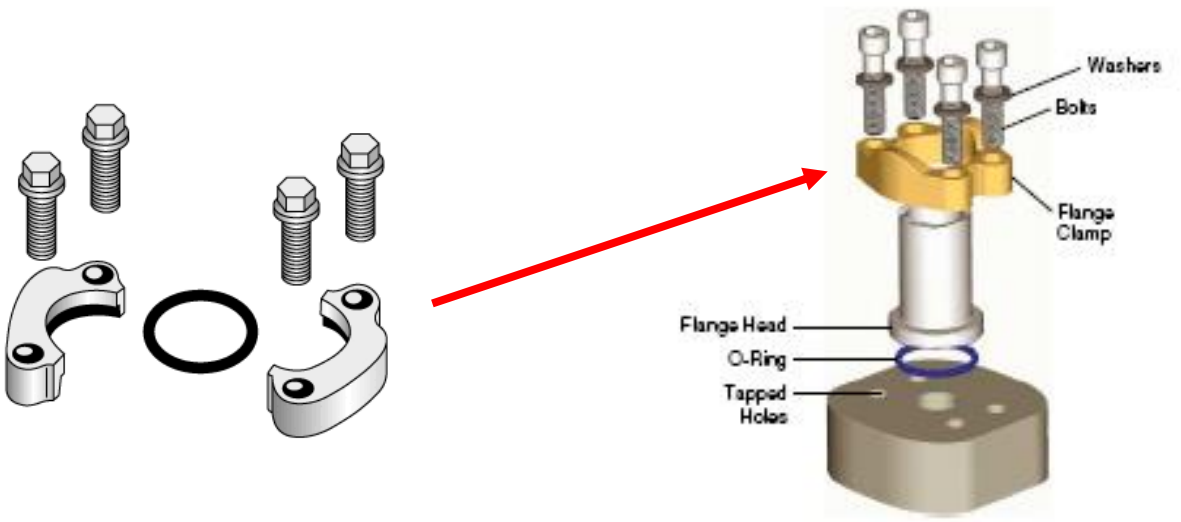
ORFS Fittings

- O-Ring Face Seal fittings use an O-Ring for the sealing surface
  - These are found on small SilentFlo HPU's for Hydraulic connections
  - Hoses are available with a matching ORFS connection
  - Some systems have ORFS to JIC adapters and use JIC hoses



Split Flange Fittings

- Split flange fittings are commonly used for large size high flow connections
  - MTS uses these for 1 ½ inch and 2 inch fittings
- The sealing surface on this type of fitting is an O-ring
- When installing hoses the flange bolts need to be torqued incrementally and equally
  - The bolts must be torqued to specification



Basic Fitting Rules

- Flared and boss fittings - Do NOT use Teflon tape or pipe thread sealant.
- Pipe threads - Pipe thread sealant preferred. Teflon tape can be used if pipe thread sealant not available.
- When using Teflon tape do not allow tape to extend beyond the second thread of the fitting. This is to prevent Teflon from being ingested into hydraulic oil
- If you have to reuse fittings, thoroughly clean them - remove all old tape / sealant.

Specialty Hoses

- Standard pressure and return hoses used at MTS have a 3000 PSI working pressure rating.
- Some applications such as those used with high pressure hydraulic grips have working pressures up to 10,000 PSI.
- These Hoses are encased in a added outer shell.
  - Rated for 10,000 PSI
- MTS uses hoses (Typically –4), that are Orange or Blue in color for this application.

Hardline

- Some customers use hardline tubing in their lab
  - This is typically made from Stainless Steel tubing
  - The HPU is connected to the hardline using a hose
  - The hardline is connected to the system using a hose
  - It is not good practice to connect direct from a HPU to a system with hardline

Hose Flushing

- To flush hoses at a customer location couple pressure and return hoses together with a JIC union type coupling
- Turn on the HPU / HSM
- Oil will flow from pressure to return carrying dirt and particle contamination back to the HPU reservoir where the dirt will get locked in in the filter element
- Flush for a minimum of 20 minutes
- For lower capacity HPU's you will not build any pressure however oil will be flowing
  - There is no restriction in a hose to allow the system to build pressure

Failure Modes for Hydraulic Hoses

- Inspection of a Hydraulic hose may reveal small blisters in the outer shell of the hose.
- This is a indication that the wire mesh may have failed, and the Hydraulic fluid from the inner shell is forcing itself thru the mesh and is causing the blister.
- This hose should be replaced

Fitting Size Identification

» Print out a copy of the document found at the link below. This contains images drawn actual size of different size fittings.

- Fitting End Size Chart

» When printed out this will help to identify fittings

- Pictures are represented actual size
- Print with pdf option selected for Actual Size