TECHNICAL DATA

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See pages 400-404 for Fluid Compatibility

Hose tube identification chart

1. Synthetic rubber	4. AQP
2. PTFE	5. Special application hose
3. Thermoplastic	6. EPDM

Hose dash size to maximum operating pressure

Pressures expressed in psi/bar

Hose Part Number	Page	Hose Tube	HOSE DASH SIZE												
			-02	-03	-04	-05	-06	-08	-10	-12	-16	-20	-24	-32	-40	-48
FC252	51	5						**50**/3	**40**/3	**40**/3	**35**/2					
FC352*	52	5						**100**/7	**100**/7	**100**/7	**90**/6	**85**/6	**85**/6	**75**/5	**60**/4	**50**/3
Recoil Air Hose	42	5			**180**/12		**180**/12	**180**/12								
2575	41	1			**250**/17		**250**/17	**250**/17	**200**/14	**200**/14						
2550	50	5					**225**/16									
2554	50	5					**225**/16									
2570	50	5					**225**/16	**225**/16	**225**/16							
FC647	40	1			**360**/25		**300**/21	**300**/21	**250**/17	**250**/17						
2556	41	1			**360**/25		**300**/21	**300**/21	**250**/17	**250**/17						
FC332	40	4			**250**/17		**250**/17	**250**/17	**250**/17	**250**/17						
2565	41	1			**300**/21		**250**/17	**200**/14	**175**/12	**125**/9						
1531	49	5							**300**/21		**300**/21					
1531A	49	5											**300**/21			
2661*	19	4								**300**/21	**250**/17	**200**/14	**150**/10	**100**/7	**62**/4	**56**/4
FC619	19	1								**300**/21	**250**/17	**200**/14	**150**/10	**100**/7		
FC318*	20	1								**300**/21	**250**/17	**200**/14	**150**/10	**100**/7	**62**/4	**56**/4
CR170	48	5			**350**/24		**350**/24	**350**/24		**350**/24						
FC321	47	5			**350**/24	**350**/24	**350**/24	**350**/24	**350**/24	**350**/24	**350**/24					
1540	55	5			**350**/24		**350**/24	**350**/24	**350**/24	**350**/24	**350**/24	**350**/24	**350**/24			
FC498	21	4			**400**/28		**400**/28	**400**/28	**350**/24	**350**/24						
FC505	56	5			**500**/34		**500**/34	**500**/34	**500**/34	**500**/34						
FC466	20	1			**400**/28		**400**/28	**400**/28	**350**/24	**350**/24						
FC555	55	5								**500**/34	**500**/34	**500**/34				
FC802	54	5			**500**/34		**500**/34	**500**/34	**500**/34	**500**/34	**500**/34					
FC558	54	5							**500**/34	**500**/34	**500**/34	**500**/34	**500**/34			
302A	44	1									**800**/55	**600**/41	**500**/34	**350**/24		
2580	21	1			**1000**/69	**800**/55	**650**/45	**625**/43	**600**/41	**550**/38	**500**/34	**450**/31	**400**/28	**350**/24		
FC186	65	2			**1000**/69	**1000**/69	**1000**/69	**750**/52	**600**/41	**600**/41						
GH134	56	5					**500**/34	**500**/34	**500**/34	**500**/34						
2555	49	1					**1125**/78									
2583	22	1			**1250**/86		**1125**/78	**1000**/69		**750**/52	**565**/39	**375**/26				
FC650	46	4			**1000**/69		**1000**/69	**1000**/69	**1000**/69	**1000**/69						
FC364	64	2						**1250**/86		**1100**/76	**1000**/69	**1000**/69	**750**/52	**500**/34	**100**/7	**100**/7
FC363	63	2						**1250**/86		**1100**/76	**1000**/69	**1000**/69	**750**/52	**500**/34		
FC355	45	4			**1500**/103	**1500**/103	**1500**/103	**1250**/86	**1250**/86	**750**/52	**400**/28	**300**/21	**250**/17	**200**/14		
FC234	45	5				**1500**/103	**1500**/103	**1250**/86	**1250**/86	**750**/52	**400**/28					
FC350	46	4			**2000**/138	**1500**/103	**1500**/103	**1250**/86	**1250**/86	**750**/52	**400**/28	**300**/21	**250**/17			
FC563	64	2						**1250**/86		**1100**/76	**1000**/69	**1000**/69	**750**/52	**500**/34		
2808	67	2						**2750**/190	**2500**/172	**1750**/121	**1500**/103	**1125**/78	**800**/55			
FC211	24	1			**2750**/190		**2250**/155	**2000**/138		**1250**/86	**1000**/69					
FC690	60	3			**2750**/190		**2500**/172	**2500**/172								
FC465	66	2		**3000**/207	**3000**/207	**3000**/207	**2500**/172	**2000**/138	**1500**/103	**1200**/83	**1000**/69	**625**/43				
FC645	66	2					**2500**/172									
2807	65	2		**3000**/207	**3000**/207	**3000**/207	**2500**/172	**2000**/138	**1500**/103	**1200**/83	**1000**/69	**625**/43				

**See hose page for dash sizes not listed.*

DASH SIZE TO MAXIMUM OPERATING PRESSURE

This table is intended as a guide in the selection of hose by maximum operating pressure. It is not a guarantee. Final selection is further dependent on fluid and ambient temperature, concentration of fluid, intermittent or continuous exposure, etc.
For further details on a specific hose see the respective catalog pages or contact Eaton Aeroquip Inc., Industrial Division, Maumee, Ohio, 419-867-2600.

Pressures expressed in psi/bar

Hose Part Number	Page	Hose Tube	HOSE DASH SIZE													
			-02	-03	-04	-05	-06	-08	-10	-12	-16	-20	-24	-32	-40	-48
FC373	57	3		**2500**/172	**3000**/207	**2750**/190	**2500**/172	**2250**/155	**2000**/138		**1250**/86	**1000**/69				
FC372	57	3		**2500**/172	**3000**/207	**2750**/190	**2500**/172	**2250**/155	**2000**/138	**1500**/103	**1250**/86	**1000**/69				
FC300	43	4				**3000**/207	**3000**/207	**2250**/155	**2000**/138	**1750**/121	**1500**/103	**800**/55	**625**/43	**500**/34	**300**/21	**300**/21
FC611	38	6				**3000**/207		**2250**/155	**2000**/138		**1250**/86	**1000**/69	**625**/43	**500**/34	**375**/26	
1503	43	1			**3000**/207	**3000**/207	**2250**/155	**2000**/138	**1750**/121	**1500**/103	**800**/55	**625**/43	**500**/34	**350**/24	**350**/24	
2651	44	1			**3000**/207	**3000**/207	**2250**/155	**2000**/138	**1750**/121	**1500**/103	**800**/55	**625**/43	**500**/34	**350**/24	**350**/24	
303	44	1			**3000**/207	**3000**/207	**2000**/138	**2000**/138	**1750**/121	**1500**/103						
FC639	31	1			**3000**/207		**3000**/207	**3000**/207	**3000**/207	**3000**/207	**3000**/207					
GH681	25	1			**3000**/207		**3000**/207	**3000**/207								
GH683	25	1			**3000**/207		**3000**/207	**3000**/207								
FC194	22	4				**3250**/224		**3000**/207	**2500**/172	**2000**/138	**1750**/121	**1250**/86	**900**/62			
GH194	23	4			**3250**/224		**3000**/207	**2500**/172	**2000**/138	**1800**/124	**1300**/90	**900**/62				
GH663	24	1			**3250**/224		**3000**/207	**2500**/172		**1800**/124	**1300**/90	**950**/66	**725**/50	**580**/40		
2681	23	1		**4000**/276	**3250**/224	**3250**/224	**3000**/207	**2500**/172	**2000**/138	**1750**/121	**1250**/86	**900**/62	**700**/48	**500**/34		
FC701	62	5									**2500**/172	**2500**/172	**2500**/172			
FC702	63	5									**3000**/207	**3000**/207				
GH493	33	1					**4000**/276	**4000**/276	**4000**/276	**4000**/276	**4000**/276	**3000**/207	**2500**/172			
FC323	35	4									**3000**/207	**3000**/207	**3000**/207	**3000**/207	**3000**/207	
FC324	36	4							**4000**/276		**4000**/276	**4000**/276				
FC469	67	2						**4000**/276	**4000**/276	**4000**/276	**4000**/276					
FC374	58	3			**5000**/345	**5000**/345		**4000**/276	**3500**/241		**2250**/155	**2000**/138				
FC375	58	3			**5000**/345	**5000**/345		**4000**/276	**3500**/241		**2250**/155	**2000**/138				
FC212	29	1				**5000**/345		**4000**/276	**3500**/241		**2250**/155	**2000**/138	**1625**/112	**1250**/86	**1125**/78	
2766	30	1			**5000**/345		**4000**/276	**3500**/241		**2250**/155	**2000**/138	**1625**/112	**1250**/86	**1000**/69		
1529	30	1			**5000**/345		**4000**/276	**3500**/241	**2750**/190	**2250**/155	**2000**/138	**1625**/112	**1250**/86	**1125**/78		
FC310	26	1				**5000**/345		**4000**/276	**3500**/241	**2750**/190	**2250**/155	**2000**/138	**1625**/112			
FC693	39	6				**5000**/345		**4000**/276	**3500**/241							
GH120	31	1			**5000**/345		**4000**/276	**3500**/241	**2750**/190	**2250**/155	**2000**/138	**1625**/112	**1250**/86	**1125**/78		
FC510	26	4				**5000**/345		**4000**/276	**3500**/241	**2750**/190	**2250**/155	**2000**/138	**1625**/112			
FC325	36	4									**5000**/345	**5000**/345				
FC273	35	1									**5000**/345	**5000**/345	**5000**/345	**5000**/345	**5000**/345	
FC659	34	1			**4000**/276			**4000**/276	**4000**/276	**4000**/276	**4000**/276	**3000**/207				
FC136	33	1						**5500**/379	**5000**/345	**5000**/345	**4000**/276	**4000**/276	**3000**/207	**2500**/172	**2500**/172	
							4000§/276	**4000§**/276	**4000§**/276							
FC636	39	6									**4000**/276	**4000**/276	**3000**/207	**2500**/172		
FC735	32	1				**5000**/345		**5000**/345	**4250**/293	**3625**/250	**3125**/216	**2500**/172	**2250**/155			
FC736	32	1						**5500**/379	**5000**/345	**5000**/345	**4000**/276	**4000**/276	**3000**/207			
2781	28	1			**5750**/397		**5000**/345	**4250**/293	**3250**/224	**3000**/207	**2500**/172	**2250**/155	**1750**/121	**1250**/86		
FC195	27	4				**5750**/397		**5000**/345	**4250**/293	**3250**/224	**3000**/207	**2500**/172	**2250**/155	**1750**/121	**1250**/86	
GH195	27	4			**5750**/397		**5000**/345	**4250**/293	**3250**/224	**3000**/207	**2500**/172	**2250**/155	**1750**/121	**1500**/103		
GH781	28	1			**5750**/400		**5000**/345	**4250**/293	**3625**/250	**3125**/216	**2500**/172	**2250**/155	**1800**/124	**1300**/90		
GH793	29	1			**5750**/397		**5000**/345	**4250**/293	**3625**/250	**3125**/216	**2500**/172	**2250**/155	**1800**/124	**1300**/90		
GH506	37	1								**6090**/420	**5510**/380	**5075**/350				
FC254	34	1							**7500†**/517		**6250**/431	**5000**/345	**4000**/276	**3000**/207	**3000**/207	
GH466	38	1										**5510**/380				
FC376	59	3			**10000‡**/690	**10000‡**/690		**7500‡**/517								
FC377	59	3			**10000‡**/690	**10000‡**/690		**7500‡**/517								
FC606	37	1										**6000**/414	**6000**/414	**6000**¨/414		
FC579* **	53	1		**10000**/690•												
FC616* **	53	1				**10000**/690										

See hose page for dash sizes not listed. **Up to +212°F * Based on two to one design factor. •Pressure rating approved for static jacking applications.*
†10,000 for water blast applications. ‡Applies only to hose that has suffered no damage, has been properly assembled with hose guards and tested to required proof test pressure.
§Pressure rating with TTC12 fittings.

Agency hose listings

KEY **GOVERNMENT AGENCIES**
DOT/FMVSS – US Department of Transportation, Federal Motor Vehicle Safety Standard
FDA – US Food and Drug Administration (tubes only)
MIL/DOD – US Military Specification, Dept. of Defense
MSHA – US Mine Safety and Health Administration
USCG/MMT – US Coast Guard, Merchant Marine Technical (SAE J1942 has replaced USCG approval)
DNV – Det Norske (Norwegian) Veritas
CGA – Canadian Gas Association

The listings below are intended only as guides in identifying which Aeroquip hoses comply with requirements of various agencies. For current and complete information, contact Eaton Aeroquip.

INDUSTRY AGENCIES
AAMVA – American Association of Motor Vehicle Administrators
AAR – American Association of Railroads
DIN – Deutsche (German) Industrial Norme (Replaced by EN)
EN – Committee for European Normalization
ABS– American Bureau of Shipping
SAE – Society of Automotive Engineers
UL – Underwriters Laboratories

★ = Approved details available from Eaton Aeroquip

*Listing may vary by hose style and size, some hoses may require firesleeve or special procedures depending on specific applications, contact Eaton Aeroquip for details.

Hose Part Number	GOVERNMENT								INDUSTRY						
	Page	DOT/FMVSS	CGA	DNV	FDA*	MIL/DOD	MSHA	USCG/ MMT*	AAMVA	EN	DIN	AAR	ABS	SAE	UL
302A	44					MIL-H-8794									
303	44					MIL-H-8794									
1503	43	106 Type All		★				★	★					100R5, J1402	
1529	30						★	★						100R2A	
1531	49											M618			
1531A	49											M618			
1540	55														
2550	50	106 Type AII							★					J1402	
2554	50					MIL-H-3992									
2555	49														
2556	41			★			★								
2565	41					MIL-H-13444 Type I									
2570	50	106 Type AII							★					J1402	
2575	41						★								
2580	21					MIL-H-24136/3	★	★							
2583	22			★			★			EN 854 Type R3				100R3	
2651	44			★			★	★					★	100R5	
2661	19						★	★					★+	100R4	
2681	23			★			★	★		EN 853 Type 1ST	20 022 Type 1ST			100R1A	
2766	30					MIL-DTL-13531 Type II									
2781	28			★			★	★		EN 853 Type 2ST	20 022 Type 2ST			100R2A	
2807	65			★				★					★	100R14A	
2808	67							★					★		
CR170	48		Type III												
FC136	33			★			★	★		EN 856 Type R12			★	100R12	
FC186	65							★							
FC194	22						★	★		EN 853 Type 1ST	20 022 Type 1ST			100R1A, J1019	
FC195	27						★	★		EN 853 Type 2ST	20 022 Type 2ST			100R2A	
FC211	24						★	★						100R1AT	
FC212	29						★	★						100R2AT	
FC234	45			★			★	★					★	J1527TypeA2	
FC252	51														
FC254	34			★			★	★					★	100R11	
FC273	35			★			★	★		EN 856 Type R13			★	100R13	
FC300	43	106 Type All		★				★	★				★	100R5, J1019, J1402	
FC310	26						★	★		EN 857 Type 1SC			★	100R16	
FC318	20						★							100R4	
FC321	47														UL21

★ = Approved details available from Eaton Aeroquip
+ Firesleeve required. Contact Eaton Aeroquip for details.

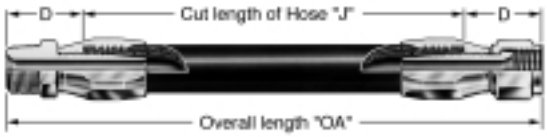
Hose Part Number	Page	GOVERNMENT							INDUSTRY						
		DOT/FMVSS	CGA	DNV	FDA*	MIL/DOD	MSHA	USCG/ MMT*	AAMVA	EN	DIN	AAR	ABS	SAE	UL
FC323	35						★	★		EN 856 Type R12			★	100R11, 100R12	
FC324	36						★	★		EN 856 Type R12			★	100R12	
FC325	36						★	★		EN 856 Type R13				100R13	
FC332	40														
FC350	46	106 Type All		★				★	★				★	J1402	
FC352	52													J20 Part 1 20R1	
FC355	45	106 Type All							★				★	J1402	
FC363	63				★			★							
FC364	64				★										
FC372	57									EN 855 Type R7				100R7	
FC373	57									EN 855 Type R7				100R7	
FC374	58									EN 855 Type R8				100R8	
FC375	58									EN 855 Type R8				100R8	
FC376	59														
FC377	59														
FC414	48														1776
FC465	66													100R14B	
FC466	20									EN 854 Type R6				100R6	
FC469	67														
FC498	21						★			EN 854 Type R6				100R6	
FC505	56													J2064 Type E	
FC510	26						★	★		EN 857 Type 1SC				100R2	
FC555	55														
FC558	54													J2064 Type B Class 1	
FC563	64														
FC579	53						★								
FC606	37						★						★	100R15	
FC611	38														
FC616	53														
FC619	19						★							100R4	
FC636	39														
FC639	31						★							100R17	
FC645	66													100R14B	
FC647	40														
FC650	46														
FC659	34									EN 856 Type R12				100R12	
FC690	60									EN 855 Type R7				100R7	
FC693	39														
FC699	47														
FC701	62														
FC702	63														
FC735	32										20 022 Type 2SN All sizes except -4			100R2AT	
FC736	32													100R12	
FC802	54													J51 Type D	
GH120	31						★							100R16	
GH134	56													J2064 Type E	
GH194	23						★			EN 853 Type 1SN	20 022 Type 1SN		★	100R1AT	
GH195	27						★			EN 853 Type 2SN	20 022 Type 2SN		★	100R2AT	
GH466	38						★			EN 856 Type R13					
GH493	33			★			★	★					★	100R12	
GH506	37						★			EN856 Type 4SH	DIN 20023T2				
GH663	24			★			★	★††		EN 853 Type 1SN	20 022 Type 1SN		★	100R1AT	
GH681	25						★				DIN20022 Type 1				
GH683	25													100R1	
GH781	28			★			★	★		EN 857 Type 2SC			★	100R16	
GH793	29			★			★	★		EN 853 Type 2SN	20 022 Type 2SN		★	100R2AT	
Recoil	41														

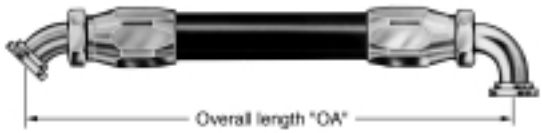
★ = *Approved details available from Eaton Aeroquip*
†† = *-4 thru -16 only*

Assembly Tips

Terms

- *Skive*—Strip, as to strip-off a thin layer of cover material.
- *Dash Size*—The hose or fitting size expressed in 1/16 of an inch.
  The numerator of a fraction whose denominator is 16.
  Example: –8 or –08 is 8/16" = 1/2".
- *Nipple*—The part of a hose fitting that goes into the hose tube.
- *Socket*—The part of a hose fitting that goes over the hose cover or reinforcement.
- *Mandrel*—A round, properly sized, steel bar used for support during assembly of the fitting or skiving the hose cover.
- *Annular Rings*—A series of concentric rings inside the socket.





Reusable fitting tips to remember for easy assembly

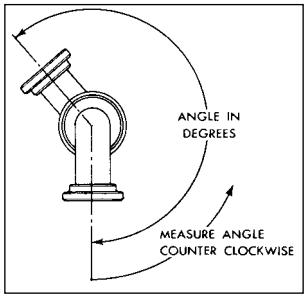
- Part numbers and dash sizes are indicated on fitting sockets.
- It is essential the fitting be mated with a compatible hose style with the same dash size. See Socket Data page 73.
- Reusable fittings that have a notch in the socket serve as a reference for the cover skiving length.
- Familiarize yourself with the assembly instructions before you start to make an assembly.
- For hoses that require skiving, be sure to skive the hose to the proper length and down to the wire reinforcement.
- Use Aeroquip 222070 hose assembly lube liberally on both the inside of the hose and on the fitting nipple. (Check for compatibility.)
- Always cut hose square by using a sharp instrument (hacksaw or cutoff wheel).
- For volume production of hose assemblies, use Aeroquip Assembly Equipment.

Cutting the hose

1. To determine the "J" length (cut length of hose) from "OA" (overall length) deduct "D" dimensions of both end fittings. Consult reusable fitting information pages for "D" dimensions. For hose assemblies with *SOCKETLESS*® fittings, add 1/2" to "J" length. **Tip:** If the old Aeroquip assembly was the right length, simply remove the hose fittings and measure the hose.

2. Cut the hose square. Use a cut-off wheel or fine-tooth hacksaw.

3. Clean the hose bore. Blow out shavings with shop air or flush with a solvent compatible with the hose construction. **Caution:** Follow proper safety procedures.



Phase angle (offset)

When making double elbow assemblies, the following steps should be followed to obtain the desired angle between elbows. Tighten both elbows to maximum allowable gap between socket and nipple hex. Start to position for relative angle between elbows. Finish assembly by adjusting both elbows. Backing off to get desired angle should be avoided.

Fluid compatibility

This chart indicates the suitability of various elastomers and metals for use with fluids to be conveyed. It is intended as a guide only and is not a guarantee. Final selection of the proper hose style, seal, or material of metal components is further dependent on many factors including pressure, fluid and ambient temperature, concentration, duration of exposure, etc.

HOW TO USE THE CHART

1. The chart has separate sections for rating elastomers for use as hose inner tubes and as seals. Ratings for a given elastomer may not always be the same in both sections.
2. Both the elastomer and the metal must be considered when determining suitability of a combination for a hose assembly, adapter with O-Ring, swivel joint or coupling.
3. Locate the fluid to be conveyed and determine the suitability of the elastomeric and metal components according to the resistance ratings shown for each.
4. Specific hose part numbers can be found under the inner tube material groupings in the Hose Tube Identification Chart below.
5. Dimensional and operating specifications for each hose can be found on the catalog pages shown with each hose part number.
6. Information on O-Rings and seal options for swivel joints and couplings, and how to specify them, are shown in the respective sections of this catalog.
7. For further details on the products shown in this catalog, and their applications, contact Eaton Aeroquip Inc., Industrial Division, Maumee, Ohio, 419-867-2600.

RESISTANCE RATING KEY

E = Excellent – Fluid has little or no effect.
G = Good – Fluid has minor to moderate effect.
C = Conditional – Service conditions should be described to Eaton Aeroquip for determination of suitability for application.
U = UNSATISFACTORY

The differences between ratings “E” and “G” are relative. Both indicate satisfactory service. Where there is a choice, the materials rated “E” may be expected to give better or longer service than those rated “G”.

NOTE: Special precautions are necessary in gaseous applications due to the potential volume of gaseous fluid in the system. Unless the cover is perforated, hose styles with rubber or thermoplastic covers are not suitable for gases above 250 psi. Hose styles with perforated covers are so noted in their construction descriptions.

HOSE TUBE IDENTIFICATION CHART

1 Synthetic Rubber

302A	(p. 44)	**2781**	(p. 28)	**FC639**	(p. 31)
303	(p. 44)	**FC136**	(p. 33)	**FC647**	(p. 40)
1503	(p. 43)	**FC211**	(p. 24)	**FC659**	(p. 34)
1529	(p. 30)	**FC212**	(p. 29)	**FC735**	(p. 32)
2555	(p. 49)	**FC254**	(p. 34)	**FC736**	(p. 32)
2556	(p. 41)	**FC273**	(p. 35)	**GH120**	(p. 31)
2565	(p. 41)	**FC310**	(p. 26)	**GH466**	(p. 38)
2575	(p. 41)	**FC318**	(p. 20)	**GH493**	(p. 33)
2580	(p. 21)	**FC414**	(p. 48)	**GH506**	(p. 37)
2583	(p. 22)	**FC466**	(p. 20)	**GH663**	(p. 24)
2651	(p. 44)	**FC579**	(p. 53)	**GH681**	(p. 25)
2681	(p. 23)	**FC606**	(p. 37)	**GH683**	(p. 25)
2766	(p. 30)	**FC616**	(p. 53)	**GH781**	(p. 28)
		FC619	(p. 19)	**GH793**	(p. 29)

2 PTFE

2807	(p. 65)	**FC363**	(p. 63)	**FC469**	(p. 67)
2808	(p. 67)	**FC364**	(p. 64)	**FC563**	(p. 64)
FC186	(p. 65)	**FC465**	(p. 66)	**FC645**	(p. 66)

3 Thermoplastic Elastomer

FC372	(p. 57)	**FC375**	(p. 58)	**FC690**	(p. 60)
FC373	(p. 57)	**FC376**	(p. 59)		
FC374	(p. 58)	**FC377**	(p. 59)		

WARNING: Compatibility of hose fittings with conveyed fluid is an essential factor in avoiding chemical reactions that may result in release of fluids or failure of the connection with the potential of causing severe personal injury or property damage.

4 AQP

2661	(p. 19)
FC194	(p. 22)
FC195	(p. 27)
FC300	(p. 43)
FC323	(p. 35)
FC324	(p. 36)
FC325	(p. 36)
FC332	(p. 40)
FC350	(p. 46)
FC355	(p. 45)
FC498	(p. 21)
FC510	(p. 26)
FC699	(p. 47)
GH194	(p. 23)
GH195	(p. 27)

5 Special Application Hose
(Not Included in Fluid Chart)

FC234 **FC650**	Fuel (pp. 45-46)
CR170 **FC321**	LPG (p. 47)
1531 **1531A**	Railroad Air Brake (p. 49)
Recoil Air Hose	(p. 42)
1540 **FC505** **FC555** **FC558** **FC665** **FC765** **GH134** **FC802**	Refrigeration/ Air Conditioning (pp. 54-56)
FC701 **FC702**	Sewer Cleaning (pp. 62-63)
FC252 **FC352**	Silicone (pp. 51-52)
2550 **2554** **2570** **FC350**	Truck Air Brake (p. 50)

6 EPDM Rubber

FC611 (p. 38) **FC636** (p. 39) **FC693** (p. 39)

SEAL ELASTOMER DATA

Seal Elastomer	Application Specification	Max. Operating Temperature Range
Buna-N†	none	–40°F to +250°F (–40°C to +121°C)
Neoprene	none	–65°F to +300°F (–54°C to +149°C)
EPR (Ethylene Propylene Rubber)/ EPDM	none	–65°F to +300°F (–54°C to +149°C)
Viton*	MIL-R-25897	–15°F to +400°F (–29°C to +204°C)

†Buna-N temperature range -65°F to +225°F. Also per MIL-R-6855.
**Viton is a DuPont trademark.*

E = EXCELLENT
G = GOOD
C = CONDITIONAL
U = UNSATISFACTORY

FLUID	HOSE: Synthetic Rubber 1	PTFE 2	Thermoplastic Elastomer 3	AQP 4	Special Application Hose 5	EPDM 6	SEALS: Buna-N	Neoprene	EPR	Viton*	Urethane	Hytrel	METAL: Steel	Brass	Stainless Steel	Aluminum	Monel
Acetaldehyde	U	E	G	U		E	U	C	C	U	U	G	G	E	E	E	E
Acetic Acid, 10%	U	E	C	G		C	U	E	G	U	U	C	U	U	C	C	U
Acetic Acid, Glacial	U	E	C	G		E	U	U	C	U	U	C	U	U	C	C	C
Acetone	U	E	G	G		E	U	U	G	U	U	G	E	E	E	E	E
Acetophenone	U	E	–	C		E	U	U	E	U	U	–	E	E	E	C	E
Acetyl Acetone	U	E	G	G		E	U	U	G	U	U	G	U	C	C	C	C
Acetyl Chloride	U	E	U	G		U	U	U	U	E	U	G	U	C	C	C	E
Acetylene	U	E	G	G		E	U	U	G	E	G	G	E	E	E	E	E
Air, Hot (Up to +160°F)	E	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Air, Hot (161°F – 200°F)	C	E	G	E		C	G	G	E	E	G	G	E	E	E	E	E
Air, Hot (201°F – 300°F)	U	E	U	C		U	U	G	E	E	U	G	E	E	E	E	E
Air Wet	E	E	C	E		E	E	E	E	E	G	C	U	G	E	E	E
Aluminum Chloride	E	E	E	E		E	E	E	E	E	G	E	U	U	U	U	U
Aluminum Fluoride	E	E	E	E		E	E	E	E	E	G	E	U	U	U	E	C
Aluminum Nitrate	E	E	E	E		E	E	E	E	E	G	E	U	U	C	C	C
Aluminum Sulfate	E	E	G	E		E	E	E	E	E	–	G	U	C	E	C	C
Alums	E	E	E	E		E	E	E	E	E	E	E	U	C	E	C	C
Ammonia, Cold	U	G	U	U		E	E	E	E	U	–	–	E	U	E	E	E
Ammonia, Hot	U	G	U	U		E	U	G	G	U	–	–	E	U	E	E	E
Ammonia, Anhydrous	U	G	U	U		U	E	E	E	U	–	–	E	U	E	E	E
Ammonia, Aqueous	U	G	U	U		E	E	E	E	U	–	–	E	U	E	E	E
Ammonium Carbonate	U	E	C	G		E	U	E	E	U	–	C	C	U	C	C	C
Ammonium Chloride	E	E	C	G		E	E	E	E	U	–	–	U	U	C	C	C
Ammonium Hydroxide	C	E	U	C		E	C	E	E	C	U	U	G	U	C	C	U
Ammonium Nitrate	G	E	C	G		E	E	G	E	U	G	C	G	U	G	G	U
Ammonium Phosphate	E	E	C	E		E	E	E	E	–	G	C	U	C	G	U	G
Ammonium Sulfate/Sulfide	E	E	C	E		E	E	E	E	U	G	C	U	U	G	U	G
Amyl Acetate	U	E	U	U		E	U	U	G	U	U	U	E	E	E	E	E

**Viton is a DuPont trademark.*

This chart is intended for reference use only. The information in this chart pertains strictly to material compatibility and is not intended to be used as an application guide. For information on specific applications not included in this catalog, please contact Eaton Aeroquip.

E = EXCELLENT
G = GOOD
C = CONDITIONAL
U = UNSATISFACTORY

FLUID	HOSE						SEALS							METAL				
	Synthetic Rubber 1	PTFE 2	Thermoplastic Elastomer 3	AQP 4	Special Application Hose 5	EPDM 6	Buna-N	Neoprene	EPR	Viton*	Urethane	Hytrel	Steel	Brass	Stainless Steel	Aluminum	Monel
Amyl Alcohol	G	E	E	E		E	G	C	E	G	C	E	G	G	E	G	G
Aniline, Aniline Oil	U	E	U	C		E	U	U	G	U	U	U	E	U	E	G	G
Aniline Dyes	U	E	U	C		E	U	G	G	U	U	U	C	G	G	G	G
Arsenic Acid	E	E	G	C		E	E	E	E	C	G	G	U	U	G	C	C
Asphalt	C	E	G	E		E	G	C	U	E	G	G	E	G	E	C	E
ASTM #1	E	E	E	E		U	E	E	C	E	E	E	E	E	E	E	E
ASTM #2	G	E	E	E		U	E	G	U	E	G	E	E	E	E	E	E
ASTM #3	G	E	E	E		U	E	G	U	E	G	E	E	E	E	E	E
Automatic Trans. Fluid	G	E	G	E		U	E	G	U	E	C	G	E	E	E	E	E
Barium Chloride	E	E	C	E		E	E	E	E	E	G	C	U	G	G	U	G
Barium Hydroxide	E	E	G	E		E	E	E	E	E	E	G	C	U	G	U	G
Barium Sulfide	E	E	C	E		E	E	E	E	E	G	C	C	U	G	U	U
Benzene, Benzol	U	E	C	C		U	U	U	U	E	U	C	G	E	E	G	E
Benzin	G	E	C	C		U	E	U	U	E	U	C	E	E	E	E	E
Benzoic Acid	U	E	C	C		U	U	U	U	E	G	G	E	G	E	G	G
Benzyl Alcohol	U	E	C	G		E	U	G	E	C	C	C	E	G	E	G	G
Black Sulfate Liquor	G	E	C	C		E	C	U	C	E	U	C	E	C	E	U	U
Blast Furnace Gas	U	U	C	G		U	U	U	E	E	U	C	E	C	E	U	U
Borax	G	E	G	G		E	G	G	E	E	G	G	E	E	E	G	C
Boric Acid	G	E	G	E		E	G	G	E	E	G	G	U	G	C	C	E
Brine	G	E	C	E		E	E	G	E	E	G	C	U	G	C	C	E
Bromine	U	E	U	U		U	U	U	U	E	U	U	U	C	U	C	C
Butane	LPG Approved Hose Only						E	E	U	E	–	–	E	E	E	E	E
Butyl Acetate	U	E	C	C		U	U	U	G	U	U	C	E	E	E	E	E
Butyl Alcohol	U	E	G	E		U	E	G	E	G	G	E	G	G	E	G	E
Butyl Cellosolve	U	E	C	G		E	U	U	G	U	U	C	E	E	E	E	E
Butylene	U	E	–	C		U	C	U	U	E	U	–	E	E	E	E	E
Butyl Stearate	U	E	–	G		U	G	U	U	E	–	–	G	G	G	E	G
Butyraldehyde	U	E	–	C		E	U	U	G	U	U	–	E	E	E	E	G
Calcium Acetate	G	E	C	E		E	G	G	E	U	U	C	G	G	G	C	G
Calcium Bisulfate	E	E	G	G		U	E	E	U	E	G	C	G	C	G	C	U
Calcium Chloride	E	E	E	E		E	E	E	E	E	E	E	G	G	G	C	G
Calcium Hydroxide	E	E	C	E		E	E	E	E	E	U	C	G	G	G	U	G
Calcium Hypochlorite	U	E	C	E		E	U	E	E	E	U	C	C	G	G	C	U
Calcium Nitrate	E	E	E	E		E	E	E	E	E	E	E	E	G	G	G	E
Cane Sugar Liquors	E	E	E	E		E	E	E	E	E	U	G	E	E	E	E	E
Carbitol	G	E	G	E		E	G	G	G	G	U	G	E	E	E	E	E
Carbolic Acid	U	E	U	E		E	U	U	G	E	U	C	U	C	E	–	–
Carbonic Acid	G	E	C	E		E	G	E	E	E	C	C	U	C	E	G	E
Carbon Dioxide	G	E	E	E		E	G	G	E	E	G	E	E	E	E	E	E
Carbon Disulfide	U	E	C	C		U	U	U	U	E	C	C	G	G	G	E	G
Carbon Monoxide	G	E	E	E		E	G	G	E	E	G	E	E	E	E	E	E
Carbon Tetrachloride	U	E	U	C		U	U	U	E	U	G	U	U	G	E	E	E
Castor Oil	E	E	G	E		E	E	E	G	E	G	G	E	E	E	E	E
Cellosolve Acetate	U	E	U	C		E	U	U	G	U	U	C	E	G	E	G	E
China Wood Oil (Tung Oil)	G	E	C	G		U	G	G	U	E	U	C	E	G	E	E	E
Chlorine	U	U	U	U		U	U	U	U	G	U	U	C	C	C	C	C
Chloroacetic Acid	U	E	U	C		E	U	U	U	G	U	U	U	G	U	U	G
Chloroacetone	U	E	U	U		E	U	U	U	E	U	U	U	G	G	G	G
Chlorobenzene	U	E	U	C		U	U	U	U	U	G	U	U	G	G	G	G
Chloroform	U	E	U	C		U	U	U	U	U	E	U	U	G	G	G	G
O-Chlorophenol	U	E	U	C		U	U	U	U	U	E	U	U	G	G	G	G
Chlosulfonic Acid	U	E	U	U		U	U	U	U	G	E	U	U	G	G	G	C
Chrome Plating Solution	U	E	–	C		E	U	U	U	G	E	U	–	G	U	U	U
Chromic Acid	U	E	–	C		E	U	U	U	C	E	U	–	C	C	U	C
Citric Acid	E	E	C	E		E	E	E	E	E	E	C	C	C	C	C	C
Coke Oven Gas	U	E	–	G		U	U	U	E	E	U	–	E	C	E	U	U
Copper Chloride	E	E	E	E		E	E	E	E	E	G	E	U	U	G	U	U
Copper Cyanide	E	E	–	E		E	E	E	E	E	E	–	E	U	G	U	U
Copper Sulfate	E	E	G	E		E	E	E	E	E	G	G	U	C	G	G	G
Cotton Seed Oil	G	E	E	E		U	E	G	C	E	E	E	E	E	E	E	E
Creosote (Coal Tar)	C	E	U	G		U	G	C	U	E	U	C	E	E	E	E	E
Crude Oil	G	E	C	E		U	E	G	U	E	G	C	G	U	G	E	U
Cyclohexanol	G	E	C	E		U	E	G	U	E	C	C	E	E	E	C	E
Cyclohexanone	U	E	G	C		E	U	U	G	U	G	G	E	E	E	C	E
Detergent/Water Solution	E	E	C	E		E	E	E	E	E	C	C	G	E	E	E	E
Diacetone Alchohol (Acetol)	U	E	C	E		E	U	U	U	E	C	C	E	E	E	E	E
Dibenzyl Ether	U	E	–	C		E	U	U	U	G	–	–	G	G	G	E	G
Diesel Oil	C	E	C	G		U	E	C	U	E	C	–	E	E	E	E	E
Diethylamine	G	E	–	C		E	G	G	G	G	–	–	E	E	E	–	E
Dioctyl Phthalate (DOP)	U	E	C	C		E	U	U	G	U	C	C	E	E	E	E	E
Dowtherm A&E	U	E	–	C		U	U	U	U	E	–	–	G	U	E	E	E
Dowtherm 209	C	E	–	E		E	C	U	G	E	U	–	–	–	–	–	–
Ester Blend	C	E	C	E		E	E	E	U	E	U	C	E	E	E	E	E
Ethyl Alcohol (Ethanol)	E	E	C	E		E	E	E	E	E	C	C	E	E	E	G	E
Ethyl Acetate	U	E	–	C		E	U	U	G	U	C	C	E	E	E	G	E
Ethyl Benzene	U	E	–	C		E	U	U	U	E	U	–	E	G	G	G	E
Ethyl Cellulose	G	E	C	C		E	G	G	G	U	C	C	E	G	G	G	G
Ethyl Chloride	U	E	U	C		E	U	U	U	E	U	U	E	E	E	G	G
Ethylene Dichloride	U	E	U	C		U	U	U	G	U	U	U	G	C	G	G	G
Ethylene Glycol	E	E	C	E		E	E	E	E	E	C	C	U	G	E	E	E
Ferric Chloride	G	E	–	E		E	E	G	E	E	–	–	U	U	G	U	U
Ferric Nitrate	E	E	C	E		E	E	E	E	E	C	C	U	U	G	U	U
Ferric Sulfate	G	E	C	G		E	G	G	G	E	C	C	U	U	E	U	U

FLUID	HOSE						SEALS							METAL				
	Synthetic Rubber 1	PTFE 2	Thermoplastic Elastomer 3	AQP 4	Special Application Hose 5	EPDM 6	Buna-N	Neoprene	EPR	Viton*	Urethane	Hytrel	Steel	Brass	Stainless Steel	Aluminum	Monel
Formaldehyde	C	E	C	G		E	C	C	G	G	C	C	E	E	E	G	G
Formic Acid	C	E	U	E		E	C	G	E	U	U	U	U	C	C	C	C
Fuel Oil	G	E	E	E		U	E	G	U	E	G	G	E	E	E	E	E
Furfural	C	E	–	E		E	C	C	G	E	U	–	G	G	G	C	G
Gallic Acid	G	E	–	E		E	G	G	E	U	U	–	U	–	–	C	G
Gasoline	C	E	E	E		U	E	C	U	E	E	E	E	E	E	E	E
Gasohol	U	E	G	E		U	G	G	U	E	E	E	E	E	E	E	E
Glycerine/Glycerol	E	E	E	E		E	E	E	E	E	G	E	E	G	E	E	E
Green Sulfate Liquor	G	E	–	E		E	G	G	E	E	–	–	U	U	E	E	E
Helium	C	G	C	C		E	E	E	E	E	E	E	E	E	E	E	E
Heptane	G	E	E	E		U	E	G	U	E	G	G	E	E	E	E	E
Hexaldehyde	C	E	–	C		E	U	G	G	U	E	G	G	G	E	E	G
Hexane	G	E	E	E		U	E	G	U	E	G	G	E	E	E	E	E
Hydraulic Oils																	
Ester Blend	C	E	C	E		E	E	U	U	E	U	E	E	E	E	E	E
Phos. Ester/Petroleum Blend	U	E	C	E		–	U	U	U	C	U	E	U	E	E	E	E
Silicone Oils	E	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Straight Petroleum Base	E	E	E	E		U	E	G	U	E	E	E	E	E	E	E	E
Straight Phosphate Ester	U	E	C	C		E	U	U	G	C	U	G	E	E	E	E	E
Water Glycol	E	E	C	E		E	E	E	E	E	C	C	E	E	E	G	E
Water Petroleum Emulsion	G	E	C	E		U	E	G	U	E	C	C	E	E	E	G	E
Hydrobromic Acid	U	E	U	C		E	U	U	E	U	U	U	U	U	U	U	U
Hydrochloric Acid	U	E	U	C		C	U	U	G	E	U	U	U	U	U	U	U
Hydrocyanic Acid	C	E	–	C		E	C	C	E	E	–	–	U	G	E	G	G
Hydrofluoric Acid	U	E	U	C		C	U	U	C	U	U	U	U	U	U	U	C
Hydrofluorosilic Acid	G	E	–	G		E	G	G	E	E	–	–	U	U	U	U	U
Hydrogen	C	C	C	C		E	E	E	E	E	E	E	E	E	E	E	E
Hydrogen Peroxide	G	E	G	E		C	G	G	E	E	G	G	U	G	E	U	U
Hydrogen Sulfide, Dry	U	C	C	G		E	U	G	E	U	U	G	E	G	G	G	G
Isocyanate	U	E	U	C		E	U	U	G	E	U	U	G	–	G	–	–
Iso Octane	G	E	E	E		U	E	G	U	E	G	E	E	E	E	E	E
Isopropyl Acetate	U	E	C	U		E	U	U	G	U	U	C	E	–	E	E	E
Isopropyl Alcohol	G	E	C	E		E	G	G	E	E	U	C	E	E	E	G	E
Isopropyl Ether	C	E	–	C		U	E	G	U	U	C	–	G	G	G	–	–
JP-4, JP-5	C	E	G	G		U	E	U	U	E	U	G	E	E	E	E	E
Kerosene	C	E	G	G		U	E	U	U	E	U	G	E	E	E	E	E
Lacquer/Lacquer Solvents	U	E	C	C		U	U	U	U	U	U	G	U	E	E	E	E
Lime Sulfur	C	E	C	E		E	C	E	U	E	G	–	U	E	E	U	U
Linseed Oil	G	E	G	E		U	E	G	U	E	G	G	E	E	E	E	E
LPG	C	–	–	–		U	E	G	U	E	–	–	E	E	E	E	E
Lubricating Oils	See Hydraulic Oils																
Magnesium Chloride	E	E	C	E		E	E	E	E	E	C	C	E	C	C	G	G
Magnesium Hydroxide	G	E	C	E		E	G	G	E	E	C	C	E	G	E	G	G
Magnesium Sulfate	E	E	C	E		E	E	E	E	E	C	C	E	G	E	E	E
Maleic Acid	U	E	C	G		E	U	U	U	E	C	C	E	G	G	G	G
Maleic Anhydride	U	E	C	G		E	U	U	U	E	C	C	G	U	E	G	E
Malic Acid	G	E	–	G		U	G	G	U	G	–	–	E	G	E	G	E
Mercuric Chloride	E	E	E	E		E	E	E	E	E	E	E	E	U	U	U	U
Mercury	E	E	E	E		E	E	E	E	E	E	E	E	U	E	U	G
Methanol	G	E	C	G		E	G	E	E	E	C	C	E	G	G	E	E
Methyl Bromide	U	E	U	C		U	G	U	U	E	U	U	E	E	E	G	E
Methyl Chloride	U	E	U	C		U	U	U	U	E	U	U	E	E	E	U	G
Methyl Butyl Ketone	U	E	C	C		E	U	U	U	E	C	C	E	E	E	E	E
Methyl Ethyl Ketone	U	E	C	C		E	U	U	U	E	U	U	G	G	G	G	G
Methylene Chloride	U	E	U	C		G	U	U	U	G	U	U	G	G	G	G	G
Methyl Isobutyl Ketone	U	E	U	C		G	U	U	U	U	U	U	G	G	G	G	G
Methyl Isopropyl Ketone	U	E	U	C		G	U	U	U	U	U	U	G	G	G	G	G
Methyl Salicylate	U	E	–	E		C	U	U	C	U	–	–	G	E	G	E	G
MIL-L-2104	U	E	E	E		U	E	G	U	E	E	E	E	E	E	E	E
MIL-H-5606	E	E	E	E		U	E	G	U	E	E	E	E	E	E	E	E
MIL-H-6083	E	E	E	E		U	E	E	U	E	E	E	E	E	E	E	E
MIL-L-7808	C	E	G	G		U	G	U	U	E	G	G	G	G	E	E	E
MIL-L-23699	C	E	–	G		U	G	U	U	E	–	–	E	E	E	E	E
MIL-H-46170	G	E	–	G		C	E	G	U	E	–	–	E	E	E	E	E
MIL-H-83282	C	E	–	G		U	E	U	U	E	–	–	E	E	E	E	E
Mineral Oils	C	E	G	E		U	E	G	U	E	G	G	E	E	E	E	E
Naphtha	U	E	G	E		U	C	C	U	E	C	C	E	–	E	–	–
Naphthalene	U	E	G	C		U	U	U	U	E	C	G	E	G	E	G	G
Naphthenic Acid	U	E	–	C		U	C	U	U	E	–	–	E	G	E	G	G
Natural Gas	C	U	–	U		U	E	E	U	E	–	–	G	G	G	G	G
Nickel Acetate	U	E	U	G		E	C	C	E	G	U	U	G	C	E	G	E
Nickel Chloride	G	E	U	E		E	E	E	E	E	U	U	G	G	G	U	G
Nickel Sulfate	E	E	U	E		E	E	E	E	E	U	U	U	G	G	U	G
Nitric Acid, to 10%	U	E	C	C		U	U	U	U	E	U	C	U	U	U	U	U
Nitric Acid, over 10%	U	E	U	U		U	U	U	U	G	U	U	U	E	C	U	U
Nitrobenzene	U	E	U	C		E	U	U	G	U	U	U	E	G	E	E	E
Nitrogen	E	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Octyl Alcohol	E	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Oleic Acid	U	E	G	C		U	U	U	C	G	G	E	C	E	G	C	G
Oleum (Fuming Sulfuric Acid)	U	E	U	U		U	U	U	U	E	U	U	G	U	G	U	U
Oleum (Mineral Spirits)	E	E	G	E		U	E	G	U	E	E	G	E	E	E	E	E
Ortho-Dichlorobenzene	U	E	–	U		U	U	U	U	E	–	–	G	G	G	G	G
Oxalic Acid	G	E	C	G		U	G	G	E	E	C	C	U	C	C	C	C
Oxygen	U	U	U	U		U	–	–	–	–	–	–	G	G	G	G	G

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E = EXCELLENT
G = GOOD
C = CONDITIONAL
U = UNSATISFACTORY

FLUID	HOSE						SEALS							METAL					
	1 Synthetic Rubber	2 PTFE	3 Thermoplastic Elastomer	4 AQP	5 Special Application Hose	6 EPDM	Buna-N	Neoprene	EPR	Viton*	Urethane	Hytrel	Steel	Brass	Stainless Steel	Aluminum	Monel
Palmitic Acid	G	E	E	–		E	E	G	G	E	–	E	G	–	E	G	G
Para-Dichlorobenzene	U	E	–	U		U	U	U	U	E	–	–	G	G	G	G	G
Pentane	E	E	G	E		U	E	E	U	E	U	G	G	G	G	E	G
Perchloric Acid	C	E	U	G		E	U	G	U	E	U	U	U	U	U	U	U
Perchloroethylene	U	E	U	U		U	U	U	U	E	U	U	C	G	G	G	E
Phenol (Carbolic Acid)	U	E	U	E		U	U	U	G	E	U	U	U	E	E	E	G
Phos. Ester/Petroleum Blend	U	E	C	E		–	U	U	U	C	U	G	E	E	E	E	E
Phosphoric Acid	U	E	U	C		E	U	U	G	E	U	U	U	E	U	C	E
Phosphorous Trichloride	U	E	U	C		E	U	U	U	E	U	U	C	U	C	E	E
Potassium Acetate	G	E	–	E		E	G	G	E	U	–	–	C	G	C	U	G
Potassium Chloride	E	E	E	E		E	E	E	E	E	E	E	C	U	G	U	C
Potassium Cyanide	E	E	E	E		E	E	E	E	E	E	E	C	C	C	C	C
Potassium Dichromate	E	E	E	E		E	E	E	E	E	E	E	C	C	C	C	C
Potassium Hydroxide, to 10%	G	E	C	E		E	G	G	E	G	C	C	G	G	G	U	E
Potassium Hydroxide, over 10%	C	E	U	C		E	C	C	E	U	U	U	G	G	G	U	E
Potassium Nitrate	E	E	E	E		E	E	E	E	E	E	E	G	G	E	G	–
Potassium Sulfate	E	E	E	E		E	E	E	E	E	E	E	–	–	–	–	–
Propane	C	–	–	–		U	C	–	–	–	–	–	E	E	E	E	E
Propyl Acetate	U	E	–	G		E	U	U	G	U	–	–	E	–	E	E	E
Propyl Alcohol	E	E	U	E		E	E	E	E	E	U	U	E	E	E	E	E
Propylene	U	E	–	U		U	U	U	E	–	–	–	E	E	E	E	E
Refrigerant R-12	C	–	G	U		U	G	E	C	E	E	E	E	E	E	E	E
Refrigerant R-13	C	–	G	U		U	G	E	C	E	E	E	E	E	E	E	E
Refrigerant R-22	U	C	U	U		U	U	E	C	U	U	U	E	E	E	E	E
Refrigerant R-134a	U	C	U	U		U	E	C	U	U	U	E	E	E	E	E	E
Sewage	E	E	E	E		E	E	E	E	E	E	E	G	G	G	G	E
Silicone Oils	E	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Soap (Water Solutions)	E	E	C	E		E	E	E	E	E	C	C	E	E	E	E	E
Sodium Acetate	G	E	–	E		E	G	G	E	U	–	–	E	E	E	E	E
Sodium Bicarbonate	E	E	E	E		E	E	E	E	E	E	E	G	G	E	G	E
Sodium Borate	E	E	E	E		E	E	E	E	E	E	E	E	E	E	G	–
Sodium Carbonate	E	E	E	E		E	E	E	E	E	E	E	E	G	G	E	E
Sodium Chloride	E	E	E	E		E	E	E	E	E	E	E	U	C	C	C	E
Sodium Cyanide	E	E	E	E		E	E	E	E	E	E	E	E	–	C	U	U
Sodium Hydroxide, to 10%	C	E	G	C		E	U	G	E	G	C	C	C	G	C	U	C
Sodium Hydroxide, over 10%	U	E	C	C		E	U	U	G	E	C	C	C	C	C	U	C
Sodium Hypochlorite	C	E	C	G		C	C	C	E	C	C	C	U	G	U	U	C
Sodium Metaphosphate	E	E	E	E		E	E	E	E	E	G	G	E	G	E	U	G
Sodium Nitrate	G	E	E	E		E	G	G	E	–	E	E	E	C	E	E	E
Sodium Perborate	G	E	–	E		E	G	G	E	E	–	–	C	U	C	U	C
Sodium Peroxide	G	E	–	E		E	G	G	E	E	U	–	U	U	C	C	C

E = EXCELLENT
G = GOOD
C = CONDITIONAL
U = UNSATISFACTORY

FLUID	HOSE						SEALS							METAL					
	1 Synthetic Rubber	2 PTFE	3 Thermoplastic Elastomer	4 AQP	5 Special Application Hose	6 EPDM	Buna-N	Neoprene	EPR	Viton*	Urethane	Hytrel	Steel	Brass	Stainless Steel	Aluminum	Monel
Sodium Phosphates	E	E	E	E		E	E	E	E	E	E	E	U	E	G	U	E
Sodium Silicate	E	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Sodium Sulfate	E	E	E	E		E	E	E	E	E	E	E	C	G	G	E	G
Sodium Sulfide	E	E	E	E		E	E	E	E	E	E	E	C	U	C	U	G
Sodium Thiosulfate	G	E	E	E		E	G	E	E	E	E	E	U	E	C	G	E
Soy Bean Oil	G	E	G	E		U	E	G	U	E	G	G	E	E	E	E	E
Stannic Chloride	E	E	C	E		E	E	G	E	C	C	C	U	E	U	U	E
Steam (up to 388°F)	U	E	U	U		C	U	C	C	U	G	U	E	E	E	G	E
Stearic Acid	G	E	G	G		E	G	G	E	G	E	G	C	C	E	C	E
Stoddard Solvent	G	E	U	E		U	E	G	U	E	U	U	E	E	E	E	E
Straight Petroleum Base	E	E	E	E		U	E	G	U	E	U	E	E	E	E	E	E
Straight Phosphate Ester	U	E	C	C		E	U	U	G	C	U	G	E	E	E	E	E
Styrene	U	E	U	C		U	U	U	U	G	U	U	E	E	E	E	E
Sulfur	C	E	G	G		E	U	U	E	E	E	G	E	U	G	E	E
Sulfur Chloride	U	E	–	C		U	U	U	U	E	–	–	G	–	G	G	U
Sulfur Dioxide	U	E	U	C		E	U	U	G	E	U	U	E	G	G	E	G
Sulfur Trioxide	U	E	U	C		U	U	U	G	E	U	C	G	C	G	G	G
Sulfuric Acid, to 10%	U	E	U	U		E	U	U	G	E	U	C	U	G	C	–	E
Sulfuric Acid, over 10%	U	E	U	U		U	U	U	U	G	U	U	C	C	C	U	C
Sulfurous Acid	C	E	U	G		E	C	C	U	E	U	U	C	C	C	C	U
Tannic Acid	E	E	G	E		E	E	E	E	E	G	G	E	E	E	C	E
Tar (Bituminous)	C	E	G	C		U	G	U	E	U	E	G	G	E	G	E	E
Tartaric Acid	G	E	G	E		E	E	G	G	E	G	G	U	C	C	E	E
Tertiary Butyl Alcohol	G	E	G	G		E	G	G	G	E	G	G	G	G	G	G	G
Titanium Tetrachloride	U	E	–	U		U	C	U	U	E	–	–	E	U	G	U	G
Toluene (Toluol)	U	E	U	U		U	U	U	U	E	U	U	E	E	E	E	E
Trichlorethylene	U	E	U	U		E	U	U	U	E	U	U	E	G	E	E	E
Tricresyl Phosphate	U	E	U	G		E	U	U	E	G	U	U	E	–	C	–	G
Trianthanolamine	C	E	U	E		E	E	G	U	E	U	U	E	U	E	E	E
Tung Oil	G	E	C	G		U	G	G	U	E	G	U	C	G	E	E	E
Turpentine	C	E	G	E		U	G	U	U	E	G	G	G	G	G	G	G
Varnish	C	E	G	–		U	G	U	U	E	G	U	E	G	E	E	E
Vinyl Chloride	U	E	U	U		U	U	U	U	E	U	U	C	E	C	E	E
Water (to +150°F)	E	E	E	E		E	E	E	E	E	E	E	C	G	E	G	E
Water (+151°F to +200°F)	G	E	U	G		E	E	E	E	E	G	U	C	G	E	G	E
Water (+201°F to +350°F)	U	E	U	U		E	U	G	E	U	U	U	C	G	E	G	E
Water Glycol	E	E	C	E		E	E	E	E	E	C	C	E	E	E	G	E
Water Petroleum Emulsion	G	E	C	E		U	E	G	U	E	C	C	C	E	E	G	E
Xylene	U	E	E	U		U	U	U	U	E	U	C	E	E	E	E	E
Zinc Chloride	E	E	E	E		E	E	E	E	E	E	E	E	U	C	G	G
Zinc Sulfate	E	E	–	E		E	E	E	E	E	–	–	U	C	G	C	G

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Hydraulic fluids & lubricating oils

The following is a representative list of fluids and manufacturers. The fluids are grouped under generic "family" heads and arranged alphabetically. For each generic "family" listing we have included maximum fluid temperature recommendations for the four hose classifications on page 400 (1 through 4). Two maximum fluid temperature ratings are listed under designations of "H" and "LP".

The "H" designation is for hydraulic service up to the maximum rated operating pressure of any particular hose in the classification. The "LP" designation is for low-pressure service such as lubricating oil systems or low-pressure hydraulic return lines.

The letter "U" in the box indicates unsatisfactory resistance to the fluid type.

Fluid temperature ratings are predicated on maximum allowable ambient temperatures as follows:

Classifications 1 and 3 (Synthetic Rubber and Thermoplastic Elastomer)

"H" fluid temp. ratings: +140°F ambient

"LP" fluid temp. ratings: +180°F ambient

Classification 2 (PTFE)

"H" fluid temp. ratings: +400°F ambient

"LP" fluid temp ratings: +400°F ambient

Classification 4 (AQP)

"H" fluid temp. ratings: +160°F ambient

"LP" fluid temp. ratings: +250°F ambient

(If "H" fluid temperature is +225°F or less, allowable ambient temperature may be increased to +200°F)

Ambient temperatures in excess of those recommended, in conjunction with maximum fluid temperatures, can materially shorten the service life of the hose.

CAUTION: The fluid manufacturer's recommended maximum operating temperature for any specific name-brand fluid should be scrupulously observed by the user. These recommended temperatures can vary widely between name brands of different fluid compositions, even though they fall into the same generic "family" of fluids.

Exceeding the manufacturer's recommended maximum temperature can result in fluid breakdown, producing by-products that are harmful to elastomeric products, as well as other materials in the system. *If a manufacturer's recommended maximum temperature for his specific fluid is lower than that for the hose rating, it should take precedence over the hose rating for service usage.*

STRAIGHT PETROLEUM-BASE

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	+200°F	+400°F	+200°F	+300°F
LP	+250°F	+450°F	+200°F	+300°F

Fluid Name
Aircraft Hydraulic Oil AA
Ambrex Oils
Arco A.T.F. Dexron
Arco A.T.F. Type F
Arco Fleet Motor
Arco H.T.F. C-2 Fluid
Arco H.T.C. 100 Fluid
Arco 303 Fluid
ATF Special
Automatic Transmission Fluid (Dexron)

Carnea Oils
Citgo Amplex
Citgo ATF, Type F
Citgo ATF, Dexron
Citgo Extra Duty Circulating Oils
Mineral Oil (Heavy Duty) (R & O)
Citgo Motor Oils
Citgo Pacemaker Series Mineral Oil (R & O)
Citgo Pacemaker T Series Mineral Oil (R & O)
Citgo Pacemaker XD Series Mineral Oil (Heavy Duty) (R & O)
Citgo Sentry
Citgo Tractor Hydraulic Fluid
Conoco 303 Fluid
Custom Motor Oil

Dectol R & O Oils
Delo 400 Motor Oils
Delvac Oils
Delvac SHC
Delvac Special 10W-30
Donax T Oils
DTE Oils
Duro
Duro AW

EP Hydraulic Oils
EP Industrial Oils
EP Machine Oils
Energol HL68
Energol HLP C68
Etna Oils
Exxon ATF

Factovis 52 – Conventional R & O Hydraulic Fluid

Gulf Harmony AW
Gulf Security AW
Glide

Hulburt 27 Series
Hydraulic Series
Hydraulic Oils
Hydroil Series

Industron 53 – Anti Wear Hydraulic Fluid

Lubrite Motor 20W-40

Mobil AFT 210
Mobil AFT 220
Mobilfluid 62
Mobilfluid 423
Mobil Hydraulic Oils
Mobiloil Special
Mobiloil Super 10W-40

NUTO Oils

OC Turbine Oils

Peaco Oils
Pennbell Oils
Power-Tran Fluid

Quadroil Series

Rando Oils
Rando Oils HD
Redind Oils
Regal Oils R & O
Rimula Oils
Rotella Oils
Rotella T Oils
RPM Delo 200 Motor Oils
RPM Delo 300 Motor Oils
RPM Delo Special Motor Oils
Rubilene

Shell Brand
Special Motor Oils
Sun R & O Oils
Suntac HP Oils
Suntac WR Oils
Sunvis 700 Oils
Sunvis 800 Oils
Sunvis 900 Oils
Super Hydraulic Oils
Supreme Motor Oils

Tellus Oils
Teresstic Oils
Torque Fluids
Torque Fluid 47
Torque Fluid 56
Tractor Hydraulic Fluid

Union ATF Dexron
Union ATF Type F
Union C-2 Fluid
Union C-P Oil
Union Custom Motor Oil
Union Gas Engine Oil
Union Guardol Motor Oil
Union Heavy Duty Motor Oil
Union Hydraulic Oil AW
Union Hydraulic Tractor Fluid
Union Premium Motor Oil
Union S-1 Motor Oil
Union Special Motor Oil
Union Super Motor Oil
Union Torque Correction Fluid
Union Turbine Oil
Union Turbine Oil XD
Union Unax
Union Unax AW
Union Unax R & O
Union Unax RX
Union Unitec Motor Oil
Univis J13
Univis J26
Univis P32

Vactra Oils
Vitrea Oils

Way Lubricants

XD-3 Motor Oils

WATER AND PETROLEUM OIL EMULSION (FR)

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	+200°F	+250°F	+150°F	+200°F
LP	+200°F	+250°F	+150°F	+200°F

Fluid Name
Aqualube
Astrol #587

Chevron FR Fluid D
Chrysler L-705
Citgo Pacemaker Invert FR Fluid
Conoco FR Hydraulic Fluid

Dasco IFR
Duro FR-HD

Fire Resistant Hydrafluid
Fire Resistant Hydraulic Fluid B
FR 3110 Hydraulic Fluid (invert)
Fyre-Safe W/O

Gulf R & D FR Fluid

Houghto-Safe 5046
Houghto-Safe 5046W
Hulsafe 500
Hy-Chock Oil
Hydrasol A

Ironsides #814-A
Irus Fluid 905

Kutwell 40

Masol Fire Resistant Fluid
Meltran FR 900
Mine Guard
Mobilmet S122

Penn Drake Hydraqua Fluid
Permamul FR
Puro FR Fluid
Pyrogard C
Pyrogard D

Quintolubric 957 Series
Quintolubric 958 Series

Regent Hydrolube #670

SAFOIL Hydraulic Fluid Anti-Wear
Sinclair Duro FR-HD
Solvac 1535G
Staysol FR
Sunsafe F

Union FR Fluid
Union Soluble Oil HD

Veedol Auburn FRH
Veedol Auburn FRH Concentrate

**See CAUTION on page 402 for maximum fluid temperatures and limiting ambient temperatures.*

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WATER AND GLYCOL SOLUTION

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	+200°F	+250°F	+150°F	+200°F
LP	+200°F	+250°F	+150°F	+200°F

Fluid Name
Chem-Trend HF-18
Chem-Trend HF-20
Chevron Glycol FR Fluids
Citgo Glycol FR Fluids
Citgo Glycol FR-20 XD
Citgo Pacemaker

Dasco FR 150
Dasco FR 200
Dasco FR 200 B
Dasco FR 310

Fyrguard 150
Fyrguard 200
Fyre-Safe 225

Gulf FR Fluid G-200
Gulf FR Fluid – G Series

Houghto-Safe 271
Houghto-Safe 416
Houghto-Safe 520
Houghto-Safe 525
Houghto-Safe 616
Houghto-Safe 620
Houghto-Safe 625
Houghto-Safe 640
Hydra Safe 620
Hydra Safe 625
Hydraulic Safety Fluid 200
Hydraulic Safety Fluid 300
Hyspin AF-1
Hyspin AF-2
Hyspin AF-3

Maxmul
Maxmul FR
Melsyn 200
Melsyn Glycol FR

Nyvac FR Fluid
Nyvac FR 200 Fluid
Nyvac 20 (WG)
Nyvac 30 (WG)

Park Water Glycol Hydraulic Fluid
Pennzoil Fluid FR 2X

Quintolubric 700 Series

Santosafe W/G 15
Santosafe W/G 20
Santosafe W/G 30
Standard Glycol FR #15
Standard Glycol FR #20
Standard Glycol FR #25

Ucon Hydrolube 150 CP
Ucon Hydrolube 200 CP
Ucon Hydrolube 275 CP
Ucon Hydrolube 300 CP
Ucon Hydrolube 550 CP
Ucon Hydrolube 900 CP
Ucon Hydrolube 150 DB
Ucon Hydrolube 275 DB
Ucon Hydrolube 150 LT
Ucon Hydrolube 200 LT
Ucon Hydrolube 275 LT
Ucon Hydrolube 300 LT
Ucon M-1
Ucon Hydrolube 200 NM
Ucon Hydrolube 300 NM

STRAIGHT PHOSPHATE-ESTER (FR)

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	U	+400°F	+200°F	+180°F
LP	U	+400°F	+200°F	+200°F

Fluid Name
FR Fluids
Fyrquel 90
Fyrquel 150
Fyrquel 220
Fyrquel 300
Fyrquel 550
Fyrquel 1000
Fyrquel 150 R & O
Fyrquel 220 R & O
Fyrquel 550 R & O

Gulf FR Fluid P-37
Gulf FR Fluid P-40
Gulf FR Fluid P-43
Gulf FR Fluid P-45
Gulf FR Fluid P-47

Houghto-Safe 1010
Houghto-Safe 1055
Houghto-Safe 1115
Houghto-Safe 1120
Houghto-Safe 1130

Pydraul 10E
Pydraul 29-E-LT
Pydraul 30-E
Pydraul 50-E
Pydraul 65-E
Pydraul 115-E

Pyrogard 51
Pyrogard 53
Pyrogard 55

Safetytex 215

Univis P12

PHOSPHATE-ESTER AND PETROLEUM-OIL

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	U	+400°F	+200°F	+180°F
LP	U	+400°F	+200°F	+200°F

Fluid Name
Citgo Synthetic Oil-Fire Resistant
Fyrtek 290
Fyrtek MF
Pydraul 230-C
Pydraul 312-C
Pydraul 540-C

Stauffer SCC 7204

ESTER BLEND TURBINE OILS

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	–	–	–	–
LP	+250°F	+450°F	+200°F	+300°F

Fluid Name
Stauffer Jet I
Stauffer Jet II

SILICONE OILS

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	+200°F	+400°F	+200°F	+300°F
LP	+250°F	+450°F	+200°F	+300°F

Fluid Name
Dow Corning 200 Fluid (100CS)
Dow Corning QF1-2023
Dow Corning 4-3600
Dow Corning 3-3672

POLYOL-ESTER

Maximum fluid temperature recommendation**

	Hose classifications (see page 400)			
	1	2	3	4
H	+200°F	+400°F	–	+225°F
LP	+200°F	+400°F	–	+250°F

Fluid Name
Quintolubric 822 Series

***See CAUTION on page 402 for maximum fluid temperatures and limiting ambient temperatures.*

Lubricant Compatibility Chart

	Hose Style						
Lubricant	**FC802**	**FC505**	**FC555**	**FC558**	**GH134**	**FC665**	**FC765**
Mineral Oil	Y	Y	Y	N	N	Y	Y
PAG	Y	Y	Y	Y	Y	Y	Y
Ester Oil	Y	Y	Y	Y	Y	Y	Y
Alkylbenzene	Y	Y	Y	N	N	Y	Y

Y = Compatible
N = Non-compatible

This chart is intended for reference use only. The information in this chart pertains strictly to material compatibility and is not intended to be used as an application guide. For information on specific applications not included in this catalog, please contact Eaton Aeroquip.

Selection, installation and maintenance of hose and assemblies — SAE J1273 November 1991

SAE recommended practice

The following recommendations on selection, installation and maintenance of hose assemblies was established by the S.A.E. in 1991. Please read these general instructions carefully. More detailed information on many of these subjects is covered in this catalog.

1. *Scope*—Hose (also includes hose assemblies) has a finite life and there are a number of factors which will reduce its life.

This recommended practice is intended as a guide to assist system designers and/or users in the selection, installation, and maintenance of hose. The designers and users must make a systematic review of each application and then select, install, and maintain the hose to fulfill the requirements of the application. The following are general guidelines and are not necessarily a complete list.

WARNING: IMPROPER SELECTION, INSTALLATION, OR MAINTENANCE MAY RESULT IN PREMATURE FAILURES, BODILY INJURY, OR PROPERTY DAMAGE.

2. *References*

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

J516—Hydraulic Hose Fittings
J517—Hydraulic Hose

3. *Selection*—The following is a list of factors which must be considered before final hose selection can be made.

3.1 Pressure—After determining the system pressure, hose selection must be made so that the recommended maximum operating pressure is equal to or greater than the system pressure. Surge pressures higher than the maximum operating pressure will shorten hose life and must be taken into account by the hydraulic designer.

3.2 Suction—Hoses used for suction applications must be selected to insure the hose will withstand the negative pressure of the system.

3.3 Temperature—Care must be taken to insure that fluid and ambient temperatures, both static and transient, do not exceed the limitations of the hose. Special care must be taken when routing near hot manifolds.

3.4 Fluid Compatibility—Hose selection must assure compatibility of the hose tube, cover and fittings with the fluid used. Additional caution must be observed in hose selection for gaseous applications.

3.5 Size—Transmission of power by means of pressurized fluid varies with pressure and rate of flow. The size of the components must be adequate to keep pressure losses to a minimum and avoid damage to the hose due to heat generation or excessive turbulence.

3.6 Routing—Attention must be given to optimum routing to minimize inherent problems.

3.7 Environment—Care must be taken to insure that the hose and fittings are either compatible with 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, therefore, must be considered.

3.8 Mechanical Loads—External forces can significantly reduce hose life. Mechanical loads which must be considered include excessive flexing, twist, kinking, tensile or side loads, bend radius, and vibration. Use of swivel-type fittings or adapters may be required to insure no twist is put into the hose. Unusual applications may require special testing prior to hose selection.

3.9 Abrasion—While hose is designed with a reasonable level of abrasion resistance, care must be taken to protect the hose from excessive abrasion which can result in erosion, snagging and cutting of the hose cover. Exposure of the reinforcement will significantly accelerate hose failure.

3.10 Proper End Fitting—Care must be taken to insure proper compatibility exists between the hose and coupling selected based on the manufacturer's recommendations substantiated by testing to industry standards such as SAE J517. End fitting components from one manufacturer are usually not compatible with end fitting components supplied by another manufacturer (i.e., using a hose fitting nipple from one manufacturer with a hose socket from another manufacturer). It is the responsibility of the fabricator to consult the manufacturer's written instructions or the manufacturer directly for proper end fitting componentry.

3.11 Length—When establishing proper hose length, motion absorption, hose length changes due to pressure, as well as hose and machine tolerances must be considered.

3.12 Specifications and Standards—When selecting hose, government, industry and manufacturers' specifications and recommendations must be reviewed as applicable.

3.13 Hose Cleanliness—Hose components vary in cleanliness levels. Care must be taken to insure that the assemblies selected have an adequate level of cleanliness for the application.

3.14 Electrical Conductivity—Certain applications require that hose be nonconductive to prevent electrical current flow. Other applications require the hose to be sufficiently conductive to drain off static electricity. Hose and fittings must be chosen with these needs in mind.

4. *Installation*—After selection of proper hose, the following factors must be considered by the installer.

4.1 Pre-Installation Inspection—Prior to installation, a careful examination of the hose must be performed. All components must be checked for correct style, size and length. In addition, the hose must be examined for cleanliness, I.D. obstructions, blisters, loose cover, or any other visible defects.

4.2 Follow Manufacturers' Assembly Instructions—Hose assemblies may be fabricated by the manufacturer, an agent for or customer of the manufacturer, or by the user. Fabrication of permanently attached fittings to hydraulic hose requires specialized assembly equipment. Field-attachable fittings (screw style and segment clamp style) can usually be assembled without specialized equipment although many manufacturers provide equipment to assist in the operation.

SAE J517 hose from one manufacturer is usually not compatible with SAE J516 fittings supplied by another manufacturer. It is the responsibility of the fabricator to consult the manufacturer's written assembly instructions or the manufacturers directly before intermixing hose and fittings from two manufacturers. Similarly, assembly equipment from one manufacturer is usually not interchangeable with that of another manufacturer. It is the responsibility of the fabricator to consult the manufacturer's written instructions or the manufacturer directly for proper assembly equipment. Always follow the manufacturer's instructions for proper preparation and fabrication of hose assemblies.

4.3 Minimum Bend Radius—Installation at less than minimum bend radius may significantly reduce hose life. Particular attention must be given to preclude sharp bending at the hose/fitting juncture.

4.4 Twist Angle and Orientation—Hose installations must be such that relative motion of machine components produces bending of the hose rather than twisting.

4.5 Securement—In many applications, it may be necessary to restrain, protect, or guide the hose to protect it from damage by unnecessary flexing, pressure surges, and contact with other mechanical components. Care must be taken to insure such restraints do not introduce additional stress or wear points.

4.6 Proper Connection of Ports—Proper physical installation of the hose requires a correctly installed port connection while insuring that no twist or torque is put into the hose.

4.7 Avoid External Damage—Proper installation is not complete without insuring that tensile loads, side loads, kinking, flattening, potential abrasion, thread damage, or damage to sealing surfaces are corrected or eliminated.

4.8 System Check Out—After completing the installation, all air entrapment must be eliminated and the system pressurized to the maximum system pressure and checked for proper function and freedom from leaks.

NOTE: Avoid potential hazardous areas while testing.

5. *Maintenance*—Even with proper selection and installation, hose life may be significantly reduced without a continuing maintenance program. Frequency should be determined by the severity of the application and risk potential. A maintenance program should include the following as a minimum.

5.1 Hose Storage—Hose products in storage can be affected adversely by temperature, humidity, ozone, sunlight, oils, solvents, corrosive liquids and fumes, insects, rodents and radioactive materials. Storage areas should be relatively cool and dark and free of dust, dirt, dampness and mildew.

5.2 Visual Inspection—Any of the following conditions requires replacement of the hose:

(a) Leaks at fitting or in hose (leaking fluid is a fire hazard)
(b) Damaged, cut, or abraded cover (any reinforcement exposed)
(c) Kinked, crushed, flattened, or twisted hose
(d) Hard, stiff, heat cracked or charred hose
(e) Blistered, soft, degraded, or loose cover
(f) Cracked, damaged, or badly corroded fittings
(g) Fitting slippage on hose

5.3 Visual Inspection—The following items must be tightened, repaired, or replaced as required:

(a) Leaking port conditions
(b) Clamps, guards, shields
(c) Remove excessive dirt buildup
(d) System fluid level, fluid type, and any air entrapment

5.4 Functional Test—Operate the system at maximum operating pressure and check for possible malfunctions and freedom from leaks.

NOTE: Avoid potential hazardous areas while testing.

5.5 Replacement Intervals—Specific replacement intervals must be considered based on previous service life, government or industry recommendations, or when failures could result in unacceptable down time, damage, or injury risk.

Flow capacities of hose assemblies at suggested flow velocities

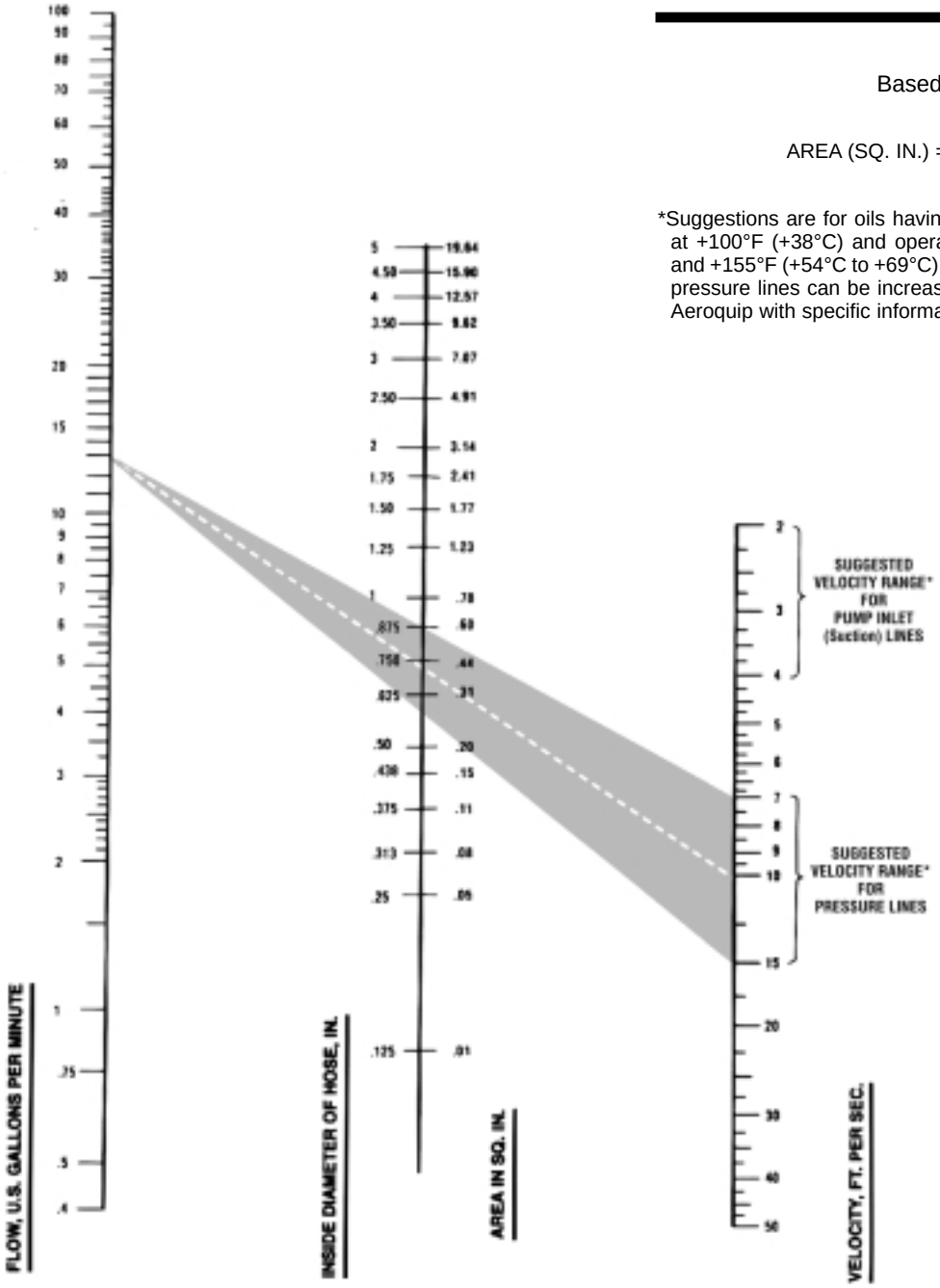
The chart below is designed and provided as an aid in the determination of the correct hose size.

Example:

At 13 U.S. gallons per minute, what is proper hose size within the suggested velocity range for pressure lines?

Solution: Locate 13 U.S. gallons per minute in the left hand column and 10 feet per second in the right hand column (the center of the suggested velocity range for pressure lines). Lay a straightedge across the two points. The inside diameter is shown in the center column nearest the straightedge.

For suction hose, follow the same procedure except use suggested velocity range for pump inlet lines in the right hand column.



Based on Formula

$$\text{AREA (SQ. IN.)} = \frac{\text{G.P.M.} \times 0.3208}{\text{VELOCITY (FT./SEC.)}}$$

*Suggestions are for oils having a maximum viscosity of 315 S.S.U. at +100°F (+38°C) and operating at temperatures between +65°F and +155°F (+54°C to +69°C). Under certain conditions, velocities in pressure lines can be increased up to 25 feet per second. Contact Aeroquip with specific information on your application.

To convert
U.S. gallons into Imperial gallons multiply U.S. gallons by 0.83267. Imperial gallons into U.S. gallons multiply Imperial gallons by 1.20095. U.S. gallons to litres multiply by 3.785. Litres to U.S. gallons, multiply by 0.2642.

* Pressure drop in psi (pounds per square inch)/gpm (gallons per minute) **for 10 feet of hose** (smooth bore) without fittings. Fluid specification: Specific gravity = .85; Viscosity = *v* = 20 centistokes (C.S.), (20 C.S. = 97 S.S.U.).

Hose pressure drop

Hose Dash Size →	-04		-05		-06		-08		-10		-12		-16		-20		-24		-32		-40	-48
Hose I.D. (inches) ←	.19	.25	.25	.31	.31	.38	.41	.50	.50	.63	.63	.75	.88	1.00	1.13	1.25	1.38	1.50	1.81	2.00	2.38	3.00
.25	10	3.1	3.1																			
.50	19	6	6	2.7	2.7																	
1	40	12	12	5.5	5.5	2.4																
2	95	24	24	10	10	4.8	3.5															
3	185	46	46	17	17	7	5	2.2	2.2													
4		78	78	29	29	12	8	3	3	1.2	1.2											
5		120	120	44	44	18	12	4.5	4.5	1.6	1.6	.72										
8				95	95	39	26	10	10	3.6	3.6	1.4	.60									
10						59	40	15	15	5.7	5.7	2	1	.55								
12						80	52	20	20	7.2	7.2	2.6	1.5	.75	.43							
15							75	30	30	10	10	4.2	2.2	1.2	.67	.38						
18							107	40	40	15	15	6.3	3	1.5	.70	.55	.35					
20								49	49	19	19	8	3.4	2	1.1	.65	.43	.27				
25								72	72	26	26	11	5.5	3	1.6	1	.64	.40	.17			
30										34	34	14	7	3.6	2.2	1.3	.80	.52	.22	.14		
35										47	47	19	9.5	5	2.8	1.7	1.1	.70	.27	.18		
40												25	12	6.5	3.4	2.2	1.4	.90	.38	.24		
50												36	17	9	5.3	3.3	2	1.3	.54	.35	.15	
60												50	23	12	7.5	4.4	2.8	1.8	.75	.45	.20	
70													31	17	9.3	6	3.8	2.4	1	.65	.30	
80													38	21	12	7.1	4.6	3	1.2	.76	.34	.11
90													49	27	15	9	5.9	3.8	1.5	1	.45	.13
100														33	19	12	7	4.7	1.9	1.3	.55	.18
150														60	36	22	13	8.5	3.4	2.2	1	.33
200																36	23	15	6	3.9	1.7	.55
250																54	33	22	8.5	5.3	2.5	.75
300																	45	29	12	7.5	4	1.1
400																		51	21	14	6.5	2.2
500																			32	20	10	3
800																					18	5
1000																						10

U.S. Gallons per minute

*Pressure drop values listed are typical of many petroleum based hydraulic oils at approximately +100°F (+38°C). Differences in fluids, fluid temperature and viscosity can increase or decrease actual pressure drop compared to the values listed.

To convert
U.S. gallons into Imperial gallons multiply U.S. gallons by 0.83267. Imperial gallons into U.S. gallons multiply Imperial gallons by 1.20095. U.S. gallons to litres multiply by 3.785. Litres to U.S. gallons, multiply by 0.2642.

Service life factors

Hose assemblies, like other products, have a finite service life. The actual service life of a given hose assembly in a given application is dependent on many variable factors, including those below.

1. Operating pressure
Aeroquip hose lines are rated for continuous operation at the maximum operating pressure specified for the hose. Generally, the operating pressure is one fourth the hose minimum burst pressure.

2. Pressure surges
Almost all hydraulic systems develop pressure surges which may exceed relief valve settings. Exposing the hose to surge pressure above the maximum operating pressure will shorten hose life and must be considered. A surge (rapid and transient rise in pressure) will not be indicated on many common pressure gauges but can be measured using electronic measuring devices. In systems where surges are severe, select a hose with a higher maximum operating pressure.

3. Burst pressure
These are test values only and apply to hose assemblies that have not been used and have been assembled for less than 30 days.

4. High pressure
High pressure gaseous systems especially over 250 psi are very hazardous and should be adequately protected from external shock and mechanical or chemical damage. They should also be suitably protected to prevent whip-lash action in the event of failure.

5. Operating temperatures
Operating temperatures specified refer to the maximum temperature of the fluid or gas being conveyed. High heat conditions may have an adverse effect on hoses due to degradation of the rubber which will limit hose usefulness and reduce fitting retention. In some cases the fluid being conveyed will slow down this degradation whereas other fluids may accelerate it Therefore, the maximum temperature of each hose does not apply to all fluids or gases. Continuous use at maximum temperatures together with maximum pressures should always be avoided. Continuous use at or near the maximum temperature rating will cause a deterioration of physical properties of the tube and cover of most hoses. This deterioration will reduce the service life of the hose.

6. Ambient temperatures
Very high or low ambient (outside of hose) temperatures will affect cover and reinforcement materials, thus reducing the life of the hose.

Ambient temperatures in conjunction with internal temperatures are also an important factor. For specific recommendations, please consult Eaton Aeroquip.

7. Bend radius
Recommended minimum bend radii are based on maximum operating pressures with no flexing of the hose. Safe operating pressure decreases when bend radius is reduced below the recommended minimum. Flexing the hose to less than the specified minimum bend radius will reduce hose life.

8. Electrical conductivity
Textile reinforced thermoplastic hoses are available for electrically nonconductive applications.

For applications requiring electrical isolation by the hose, Aeroquip non-conductive hose has a leakage factor of less than 50 microamperes. By SAE J517 standard, this is considered a safe level of conductivity.

An orange polyurethane cover identifies Aeroquip nonconductive hose. This cover is not perforated, in order to prevent moisture from entering the hose and affecting its overall conductivity.

For added protection against moisture absorption in transit, Aeroquip non-conductive hose in bulk is shipped with cap seals on both ends. To maintain minimum levels of conductivity, cap seals must be placed on Aeroquip non- conductive bulk hose at all times.

9. Chemical resistance
Consider the chemical resistance of the fitting, O-Ring, hose cover and tube stock. Covers are resistant to mildew, cleaning solvents, oils and fuels. See pages 400-404 for chemical resistance of hose tubes, O-Rings and fitting materials.

10. Vacuum service
Maximum negative pressures shown for hoses –16 and larger are suitable only for hose which has suffered no external damage or kinking. If greater negative pressures are required for –16 and larger hoses, the use of an internal support coil is recommended. See page 348. Vacuum service is not recommended for double wire braid or 4 and 6 spiral wire reinforced hose. If vacuum data is not given for a hose, Aeroquip does not recommend it for a vacuum application.

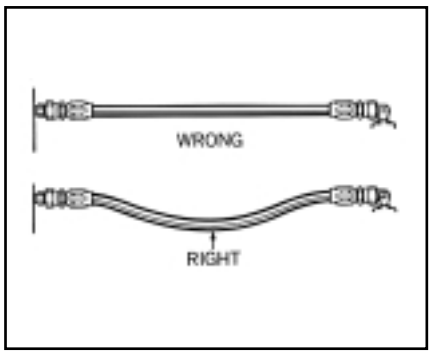
11. Phosphate ester base fluid
No petroleum based oils should contact the tube of an EPDM rubber hose, if the hose is recommended *only* for phosphate ester base hydraulic fluid. Aeroquip AQP Hose compounds are compatible with many industrial phosphate ester base hydraulic fluids *and* all straight petroleum based oils. See pages 399-403.

12. Textile braid (*SOCKETLESS*™) low pressure hose
This hose is not recommended for impulsing hydraulic applications or permanent piping in residential or commercial buildings.

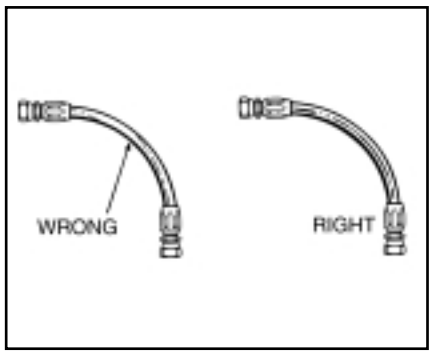
13. Hose fittings
Eaton Aeroquip manufactures hose fittings to meet applicable SAE standards. It is possible to select a fitting with a connecting end that has a performance rating lower than the hose rating. In selecting hose fittings, please consider the performance rating of the connecting end.

IMPORTANT
Hose assembly inspection
Hose assemblies in service should be inspected frequently for leakage, kinking, corrosion, abrasion, or any other signs of wear or damage. Hose assemblies that are worn or damaged should be removed from service and replaced immediately.

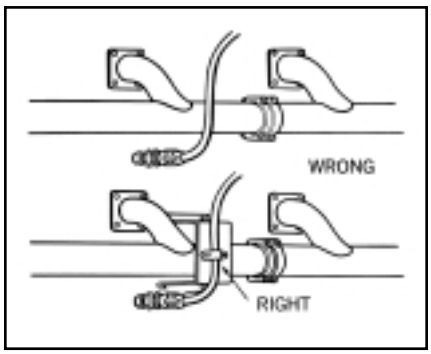
Hose routing and installation



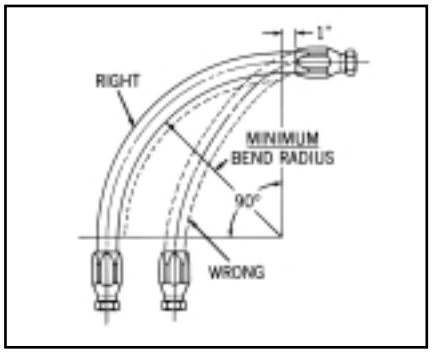
Under pressure, a hose may change in length. Always provide some slack in the hose to allow for this shortening or elongation. (However, excessive slack in hose lines may cause poor appearance.)



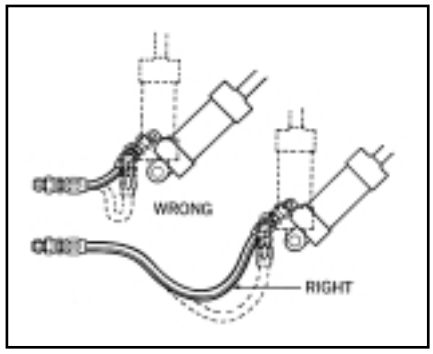
If a hose is installed with a twist in it, operating pressures tend to force it straight. This can loosen the fitting nut. Twisting can cause reinforcement separation and the hose could burst at the point of strain.



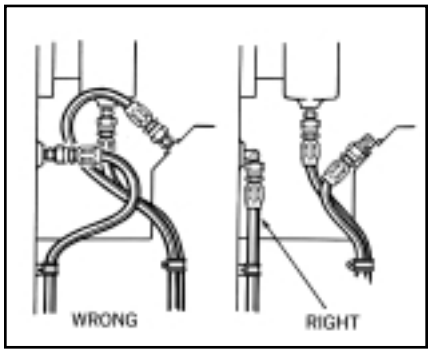
When hose lines pass near an exhaust manifold or other heat source, they should be insulated by a heat resistant boot, firesleeve or a metal baffle. In any application, brackets and clamps keep hoses in place and reduce abrasion. For installations where abrasion to hose cover cannot be prevented with the use of clamps or brackets, a steel protective coil or abrasion resistant sleeve should be placed over the hose.



At bends, provide sufficient hose so that it does not have a bend radius less than its recommended minimum bend radius. Too tight a bend may kink the hose and restrict or stop the fluid flow. In many cases the proper use of adapters and hose fittings can eliminate tight bends or kinks.



In applications where there is considerable vibration or flexing, allow additional hose length. The metal hose fittings, of course, are not flexible, and proper installation protects metal parts from undue stress, and avoids kinks in the hose.

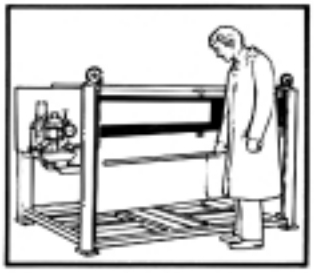


When 90° adapters were used, this assembly became neater-looking and easier to inspect and maintain. It uses less hose, too!

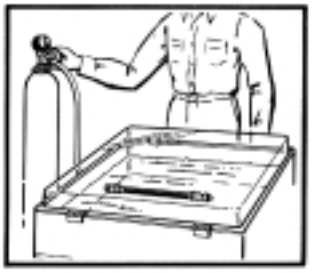
Cleaning, inspection, testing and storage

Clean

Inspect



Proof test-hydrostatic



Proof test-Pneumatic

Maintenance
Hose assemblies in operation should be inspected frequently for leakage, kinking, abrasion, corrosion or any other signs of wear or damage. Worn or damaged hose assemblies should be replaced immediately.

Clean
Clean assembly by blowing out with clean compressed air. Assemblies may be rinsed out with mineral spirits if the tube stock is compatible with oil, otherwise hot water at +150°F max. may be used. Consult Eaton Aeroquip for special cleaning equipment.

Inspect
Examine hose assembly internally for cut or bulged tube, obstructions, and cleanliness. For segment style fittings, be sure that the hose butts up against the nipple shoulder; band and retaining ring are properly set and tight, and segments are properly spaced. Check for proper gap between nut and socket or hex and socket. Nuts should swivel freely. Check the layline of the hose to be sure that the assembly is not twisted. Cap the ends of the hose with plastic covers to keep clean.

Proof test (hydrostatic)
The hose assembly should be hydrostatically tested at twice the recommended working pressure of the hose.

Test pressure should be held for not more than one minute and not less than 30 seconds When test pressure is reached, visually inspect hose assembly for: a) Any leaks or signs of weakness. b) Any movement of the hose fitting in relation to the hose. Any of these defects are cause for rejection.

Caution: Testing should be conducted in approved test stands with adequate guards to protect the operator.

(See Assembly Equipment Section for Aeroquip Proof Test Stands.)

Proof test (pneumatic)
Hose assemblies intended for gas or air service should be tested with air or nitrogen at 100 psi with the assembly immersed in water. Random bubbles may appear over the hose and fitting area when assembly is first pressurized. This should not be construed as a defect. However, if the bubbles persist in forming at a steady rate at any particular point on the hose, the assembly should be rejected.

Caution: Testing should be conducted in approved test stands with adequate guards to protect the operator.

Storage and handling
Hose should be stored in a dark, dry atmosphere away from electrical equipment, and the temperature should not exceed +90°F. Storage in the original shipping container is preferred.

Analyzing failures

Everyone in maintenance encounters hose failures. Normally, there is no problem. The hose is replaced and the equipment goes back in operation. Occasionally the failures come too frequently – the same equipment with the same problems keep popping up. At this point the task is to determine and correct the cause of these repeated failures.

Improper application

Beginning with the most obvious, the most common cause of hose failures – Improper Application – compare the hose specifications with the requirements of the application.

Pay particular attention to the following areas:

1. The maximum operating pressure of the hose.
2. The recommended temperature range of the hose.
3. Whether the hose is rated for vacuum service.
4. The fluid compatibility of the hose.

Check all of these areas against the requirements of the application. If they don't match up, you need to select another hose. It's a good idea at this point to call on your local hose distributor for assistance in selecting the proper hose. Eaton Aeroquip's distributors, for example, are well equipped to perform this service for you. Distributor personnel attend special training courses in hydraulics and hose application conducted by the company. Or, if your problem is particularly difficult, the distributor can call on the services of Eaton Aeroquip's Field Engineering Staff. The company will send in a hose and hydraulic specialist to study the problem and come up with a solution.

Improper assembly and installation

The second major cause of premature hose 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.

Eaton Aeroquip provides excellent training material that you can use to combat this problem. A little time spent in training your maintenance people could pay big dividends in reduced downtime.

You can make use of the material available from Eaton Aeroquip to improve your hose assembly and installation techniques.

This material is available free from Eaton Aeroquip Inc., 3000 Strayer Road, Maumee, Ohio 43537, Fax: 419-867-2629.

External damage

External damage can range from abrasion and corrosion, to hose that is crushed by a lift truck. These are problems that can normally be solved simply once the cause is identified. The hose can be re-routed or clamped, or a fire sleeve or abrasion guard can be used.

In the case of corrosion, the answer may be as simple as changing to a hose with a more corrosion resistant cover or re-routing the hose to avoid the corrosive element.

Faulty equipment

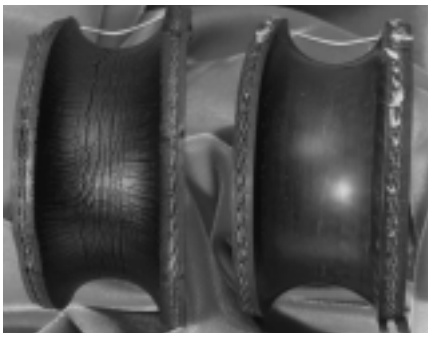
Too frequent or premature hose failure can be the symptom of a malfunction in your equipment. This is a factor that should be considered since prompt corrective action can sometimes avoid serious and costly equipment breakdown. Reprints of an article on "Troubleshooting Hydraulic Systems," which tells you how to spot problems in a hydraulic system are available from Eaton Aeroquip.

Faulty hose

Occasionally a failure problem will lie in the hose itself. The most likely cause of a faulty rubber hose is old age. Check the lay line on the hose to determine the date of manufacture. (2Q99 means second quarter 1999.) The hose may have exceeded its recommended shelf life. If you suspect that the problem lies in the manufacture of the hose (and don't jump to this conclusion until you have exhausted the other possibilities) contact your distributor. Given effective quality control methods, the odds of a faulty batch of hose being released for sale are extremely small. So make sure that you haven't overlooked some other problem area.

Analyzing failures

A physical examination of the failed hose can often offer a clue to the cause of the failure. Following are 22 symptoms to look for along with the conditions that could cause them:



1. Symptom: The hose tube is very hard and has cracked.

Cause: Heat has a tendency to leach the plasticizers out of the tube. This is a material that gives the hose its flexibility or plasticity.

Aerated oil causes oxidation to occur in the tube. This reaction of oxygen on a rubber product will cause it to harden. Any combination of oxygen and heat will greatly accelerate the hardening of the hose tube. Cavitation occurring inside the tube would have the same effect.

2. Symptom: The hose is cracked both externally and internally but the elastomeric materials are soft and flexible at room temperature.

Cause: The probable reason is intense cold ambient conditions while the hose was flexed. Most standard hoses are rated to –40°F (–40°C). Some AQP hoses are rated at –55°F (–49°C). Military specified hoses are generally rated to –65°F (–54°C). PTFE hose is rated to –100°F (–73°C). Some Polyon thermoplastic hoses are rated at –65°F (–54°C).

Analyzing failures

3. Symptom: The hose has burst and examination of the wire reinforcement after stripping back the cover reveals random broken wires the entire length of the hose.

Cause: This would indicate a high frequency pressure impulse condition. SAE im-pulse test requirements for a double wire braid reinforcement are 200,000 cycles at 133% of recommended working pressure. The SAE impulse test requirements for a four spiral wrapped reinforcement (100R-9) are 300,000 cycles at 133% maximum operating and at +200°F (93°C). If the extrapolated impulses in a system amount to over a million in a relatively short time a spiral reinforced hose would be the better choice.

4. Symptom: The hose has burst, but there is no indication of multiple broken wires the entire length of the hose. The hose may have burst in more than one place.

Cause: This would indicate that the pressure has exceeded the minimum burst strength of the hose. Either a stronger hose is needed or the hydraulic circuit has a malfunction which is causing unusually high pressure conditions.

5. Symptom: Hose has burst. An examination indicates the the wire braid is rusted and the cover has been cut, abraded or deteriorated badly.

Cause: The primary function of the cover is to protect the reinforcement. Elements that may destroy or remove the hose covers are:

1. Abrasion
2. Cutting
3. Battery Acid
4. Steam Cleaners
5. Chemical Cleaning Solutions
6. Muriatic Acid (for cement clean-up)
7. Salt Water
8. Heat
9. Extreme Cold

Once the cover protection is gone the wire reinforcement is susceptible to attack from moisture or other corrosive matter.

6. Symptom: Hose has burst on the outside bend and appears to be elliptical in the bent section. In the case of a pump supply line, the pump is noisy and very hot. The exhaust line on the pump is hard and brittle.

Cause: Violation of the minimum bend radius is most likely the problem in both cases. Check the minimum bend radius and make sure that the application is within specifications. In the case of the pump supply line partial collapse of the hose is causing the pump to cavitate creating both noise and heat. This is a most serious situation and will result in catastrophic pump failure if not corrected.

7. Symptom: Hose appears to be flattened out in one or two areas and appears to be kinked. It has burst in this area and also appears to be twisted.

Cause: Torquing of a hydraulic control hose will tear loose the reinforcement layers and allow the hose to burst through the enlarged gaps between the braided plaits of wire strands. Use swivel fittings or joints to be sure there is no twisting force on a hydraulic hose.

8. Symptom: Hose type has broken loose from the reinforcement and piled up at the end of the hose. In some cases it may protrude from the end of the hose fitting.

Cause: The probable cause is high vacuum or the wrong hose for vacuum service. No vacuum is recommended for double wire braid, 4 and 6 spiral wire hose unless some sort of internal coil support is used. Even though a hose is rated for vacuum service, if it is kinked, flattened out or bent too sharply this type of failure may occur.

9. Symptom: Hose has burst about six to eight inches away from the end fitting. The wire braid is rusted. There are no cuts or abrasions of the outer cover.

Cause: Improper assembly of the hose end fitting allowing moisture to enter around the edge of the fitting socket. The moisture will wick through the reinforcement. The heat generated by the system will drive it out around the fitting area but six to eight inches away it will be entrapped between the inner line and outer cover causing corrosion of the wire reinforcement.

10. Symptom: There are blisters in the cover of the hose. If one pricks the blisters, oil will be found in them.

Cause: A minute pin hole in the hose tube is allowing the high pressure oil to seep between it and the cover. Eventually it will form a blister wherever the cover adhesion is weakest. In the case of a screw together reusable fitting insufficient lubrication of the hose and fitting can cause this condition because the dry tube will adhere to the rotating nipple and tear enough to allow seepage. Faulty hose can also cause this condition.

11. Symptom: Blistering of the hose cover where a gaseous fluid is being used.

Cause: The high pressure gas is effusing through the hose tube, gathering under the cover and eventually forming a blister wherever the adhesion is weakest. Specially constructed hoses are available for high pressure gaseous applications. Your supplier can advise you on the proper hose to use in these cases.

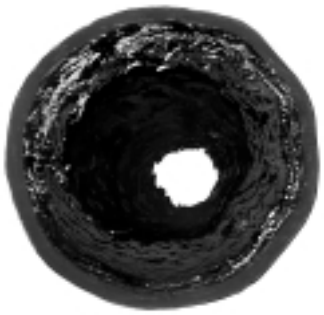
12. Symptom: Fitting blew off of the end of the hose.

Cause: It may be that the wrong fitting has been put on the hose. Recheck manufacturer's specifications and part numbers.

In the case of a crimped fitting the wrong machine setting may have been used resulting in over or undercrimping. The socket of a screw together fitting for multiple wire braided hose may be worn beyond its tolerance. The swaging dies in a swaged hose assembly may be worn beyond the manufacturer's tolerances.

The fitting may have been applied improperly to the hose. Check manufacturer's instructions. The hose may have been installed without leaving enough slack to compensate for the possible 4% shortening that may occur when the hose is pressurized. This will impose a great force on the fitting. The hose itself may be out of tolerance.

13. **Symptom:** The tube of the hose is badly deteriorated with evidences of extreme swelling. In some cases the hose tube may be partially "washed out."



Cause: Indications are that the hose tube is not compatible with the agent being carried. Even though the agent is normally compatible, the addition of heat can be the catalyst that can cause inner liner deterioration. Consult your hose supplier for a compatibility list or present him with a sample of the fluid being conducted by the hose for analysis. Make sure that the operating temperatures both internal and external do not exceed recommendations.

14. **Symptom:** Hose has burst. The hose cover is badly deteriorated and the surface of the rubber is crazed.

Cause: This could be simply old age. The crazed appearance is the effect of weathering and ozone over a period of time. Try to determine the age of the hose. Some manufacturers print or emboss the cure date on the outside of the hose. As an example, Aeroquip hose would show "4Q73" which would mean that the hose was manufactured during the fourth quarter (October, November or December) of 1973.

15. **Symptom:** Hose is leaking at the fitting because of a crack in the metal tube adjacent to the braze on a split flange head.

Cause: Because the crack is adjacent to the braze and not in the braze this is a stress failure brought on by a hose that is trying to shorten under pressure and has insufficient slack in it to do so. We have cured dozens of these problems by lengthening the hose assembly or changing the routing to relieve the forces on the fitting.

16. **Symptom:** A spiral reinforced hose has burst and literally split open with the wire exploded out and badly entangled.

Cause: The hose is too short to accommodate the change in length occurring while it is pressured.

17. **Symptom:** Hose is badly flattened out in the burst area. The tube is very hard down stream of the burst but appears normal up stream of the burst.

Cause: The hose has been kinked either by bending it too sharply or by squashing it in some way so that a major restriction was created. As the velocity of the fluid increases through the restriction the pressure decreases to the vaporization point of the fluid being conveyed. This is commonly called cavitation, and causes heat and rapid oxidation to take place which hardens the tube of the hose down stream of the restriction.

18. **Symptom:** Hose has not burst but it is leaking profusely. A bisection of the hose reveals that the tube has been gouged through to the wire braid for a distance of approximately two inches.

Cause: This failure would indicate that erosion of the hose tube has taken place. A high velocity needle like fluid stream being emitted from an orifice and impinging at a single point on the hose tube will hydraulically remove a section of it. Be sure that the hose is not bent close to a port that is orificed.

In some cases where high velocities are encountered particles in the fluid can cause considerable erosion in bent sections of the hose assembly.

19. **Symptom:** The hose fitting has been pulled out of the hose. The hose has been considerably stretched out in length. This may not be a high pressure application.

Cause: Insufficient support of the hose. It is very necessary to support very long lengths of hose, especially if they are vertical. The weight of the hose along with the weight of the fluid inside the hose in these cases is being imposed on the hose fitting. This force can be transmitted to a wire rope or chain by clamping the hose to it much like the utilities support bundles of wire from pole to pole. Be sure to leave sufficient slack in the hose between clamps to make up for the possible 4% shortening that could take place when the hose is pressurized.

20. **Symptom:** The hose has not burst but it is leaking profusely. An examination of the bisected hose reveals that the tube has burst inwardly.

Cause: This type of failure is commonly referred to as hose tube blow down. It is usually associated with very low viscosity fluids such as air, nitrogen, freon and other gases. What happens is that under high pressure conditions the gases will effuse into the pores of the hose tube charging them up like miniature accumulators. If the pressure is very suddenly reduced to zero the entrapped gases literally explode out of the tube often tearing holes in it. In some hose constructions a second hose tube made from a plastic such as nylon, is inserted into the hose.

A small leak will allow the gaseous fluid to seep between the two inner liners and when the pressure is reduced to zero the innermost liner will collapse because of the entrapped pressure around its outer diameter.

21. **Symptom:** PTFE hose assembly has collapsed internally in one or more places.

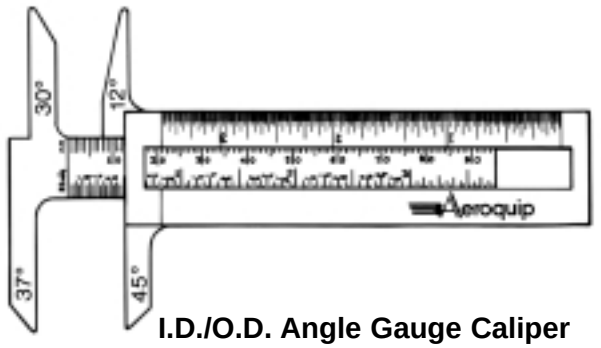
Cause: One of the most common causes for this is improper handling of the PTFE assembly. PTFE is a thermoplastic material which is not rubber-like. When bent sharply it simply collapses. This type of collapse is localized in one area and is radial. When the PTFE tube is folded longitudinally in one or more places this could be the result of heat (which softens the hose tube) along with vacuum conditions inside of it. Because of the additional tension of the wire braid reinforcement inherent with this type of hose, there is always a radial tension on the tube trying to push it in. Rapid cycling from a very hot agent in the hose to a very cold agent in the hose can produce the same type of failure. Eaton Aeroquip offers an internal support coil that will eliminate this problem.

22. **Symptom:** A PTFE hose assembly has developed a pin hole leak or several pin hole leaks.

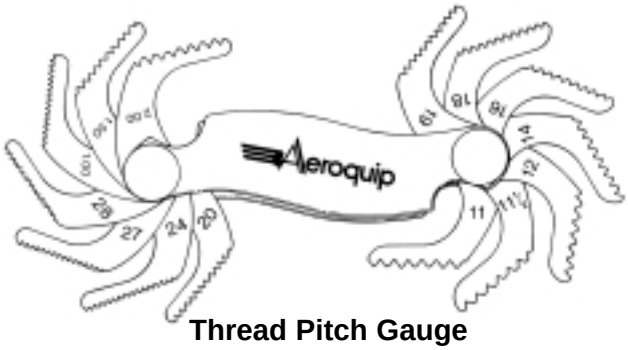
Cause: This situation occurs when a petroleum base fluid, with a low viscosity, is flowing at a high velocity. This condition can generate high voltage due to static electricity. The high voltage is seeking a ground connection and the only ground connection available is the braided stainless steel reinforcement. This causes an electric arc, which penetrates through the PTFE tube as it travels to the reinforcement. Specially constructed PTFE tubes are available that have enough carbon black in them so as to be conductive. They will "drain off" the static electricity and preclude this problem.

How to Identify Fluid Connectors

Measuring Tools—Order part number FT1341 for Aeroquip Tool Kit. A seat angle gauge, thread pitch gauge and an I.D./O.D. caliper are necessary to make accurate measurements of commonly used connectors. Eaton Aeroquip offers a unique new caliper than offers the capabilities of both a caliper and a seat angle gauge in one unit.

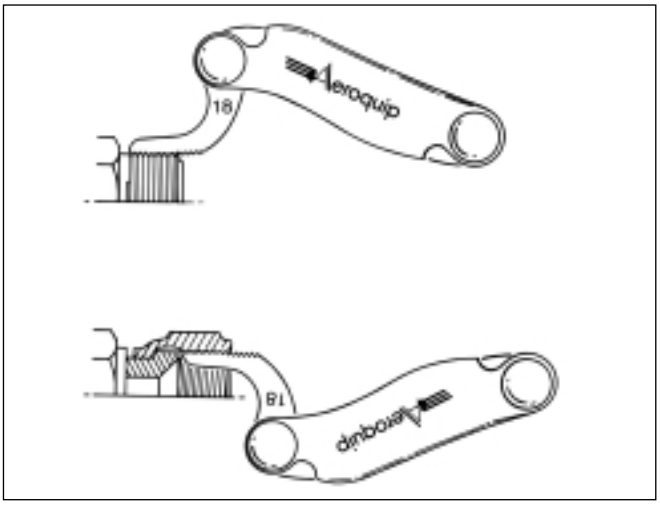


I.D./O.D. Angle Gauge Caliper

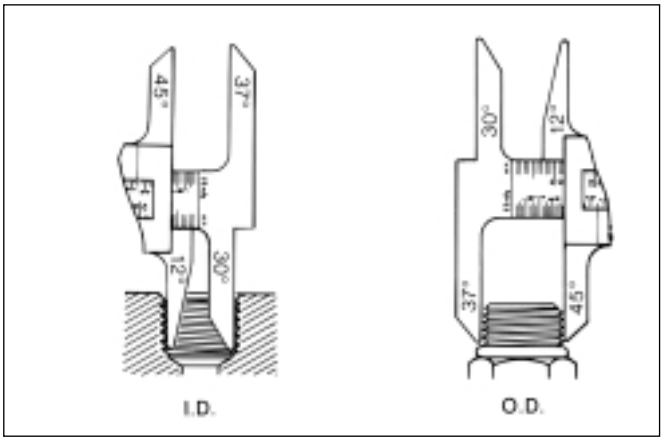


Thread Pitch Gauge

How to Measure Threads



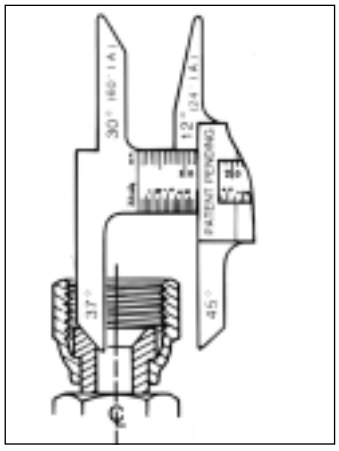
Use a thread pitch gauge to determine the number of threads per inch or the distance between threads in metric connections. Place the gauge on the threads until the fit is snug. Match the measurement to the charts.



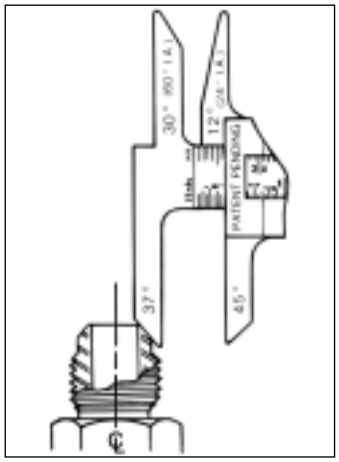
Measure the thread diameter with an I.D./O.D. caliper as shown. Match the measurements to the charts.

How to Measure Sealing Surface Angles

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

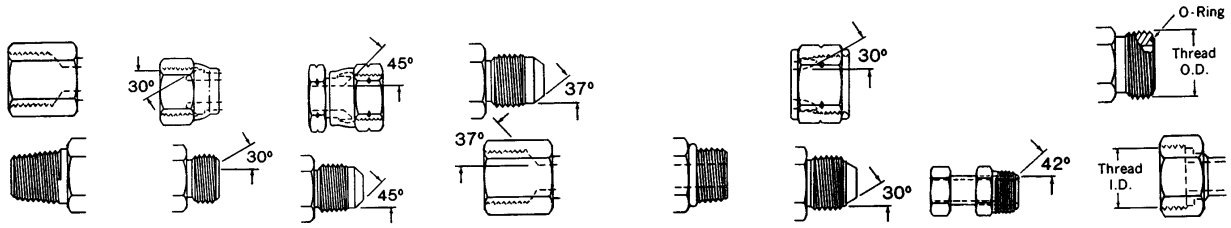


Male flare type connectors are usually measured by placing the gauge on the sealing surface. If the centerlines of the connection and gauge are parallel, the correct angle has been determined.



Thread size chart

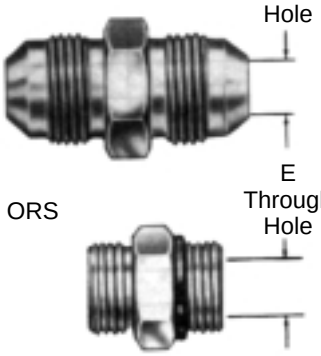
The following chart is intended as a quick reference guide for thread size by dash size.



Dash size	N.P.T.F.	N.P.S.M. approx. dia.	SAE 45° auto. refrig.	SAE 37° (J.I.C.) hydraulic	SAE O-Ring boss	P.T.T. 30° automotive	SAE invert. flare	ORS
–02	1/8–27	1/8–27	5/16–24	5/16–24	5/16–24		5/16–24	
–03			3/8–24	3/8–24	3/8–24		3/8–24	
–04	1/4–18	1/4–18	7/16–20	7/16–20	7/16–20		7/16–24	9/16–18
–05			1/2–20	1/2–20	1/2–20		1/2–20	
–06	3/8–18	3/8–18	5/8–18	9/16–18	9/16–18		5/8–18	11/16–16
–07			11/16–24				11/16–18	
–08	1/2–14	1/2–14	3/4–16	3/4–16	3/4–16		3/4–18	13/16–16
–10			7/8–14	7/8–14	7/8–14		7/8–18	1–14
–12	3/4–14	3/4–14	1 1/16–14	1 1/16–12	1 1/16–12		1 1/16–16	1 3/16–12
–14				1 3/16–12	1 3/16–12			
–16	1–11 1/2	1–11 1/2		1 5/16–12	1 5/16–12	1 5/16–14		1 7/16–12
–20	1 1/4–11 1/2	1 1/4–11 1/2		1 5/8–12	1 5/8–12	1 5/8–14		1 11/16–12
–24	1 1/2–11 1/2	1 1/2–11 1/2		1 7/8–12	1 7/8–12	1 7/8–14		2–12
–32	2–11 1/2	2–11 1/2		2 1/2–12	2 1/2–12	2 1/2–12		
–40	2 1/2–8	2 1/2–8		3–12	3–12			
–48	3–8	3–8		3 1/2–12	3 1/2–12			

Through hole dimensions

All dimensions are nominal. In jump size bodies, the minimum through hole dimensions will correspond to the smallest dash size.



Dash Size	E through Hole	
	SAE 37°	ORS
–03	.12	
–04	.17	.17
–05	.23	
–06	.30	.26
–08	.39	.38
–10	.48	.48
–12	.61	.61
–16	.84	.81
–20	1.08	1.05
–24	1.31	1.31
–32	1.78	

How to Measure Non-Threaded connections

Four Bolt Flange—First measure the port hole diameter using the caliper. Next, measure the longest bolt hole spacing from center-to-center or measure the flange head diameter.

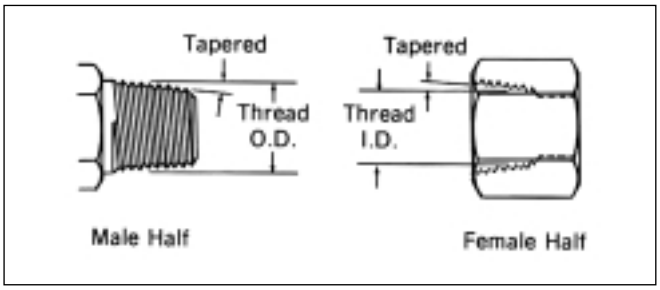
Staplok®—Measure the male diameter with the O.D. portion of the caliper. Measure the female half by inserting the I.D. portion of the caliper into the through hole.

Dash Numbers

Most fluid piping system sizes in the United States are measured by dash numbers. These are universally used abbreviations for the size of the component expressed as the numerator of the fraction with the denominator always being 16. For example, a –04 port is $^{4}/_{16}$ or $^{1}/_{4}$-inch. Dash numbers are usually nominal (in name only) and are abbreviations that make ordering of components easier.

American connections

NPTF (National Pipe Tapered Fuel)



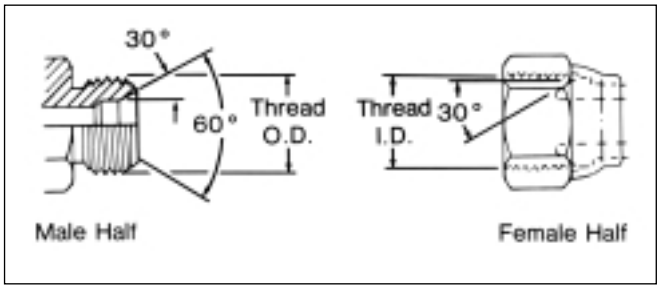
This connection is still widely used in fluid power systems, even though it is not recommended by the National Fluid Power Association (NFPA) for use in hydraulic applications. The thread is tapered and the seal takes place by deformation of the threads.

NPTF Threads

Measure thread diameter and subtract $^{1}/_{4}$-inch to find the nominal pipe size.

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

NPSM (National Pipe Straight Mechanical)



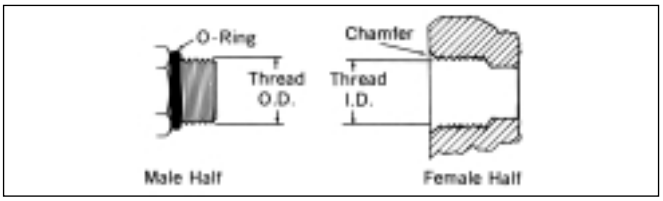
This connection is sometimes used in fluid power systems. The female half has a straight thread and an inverted 30° seat. The male half of the connection has a straight thread and a 30° internal chamfer. The seal takes place by compression of the 30° seat on the chamfer. The threads hold the connection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

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

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

American connections

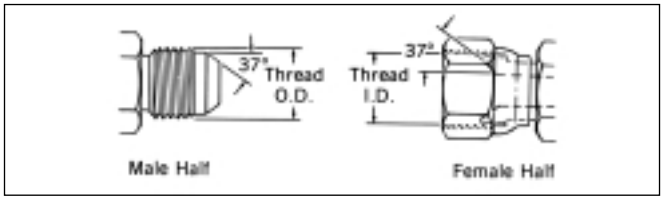
SAE J1926 Straight Thread O-Ring Boss (ORB)



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

Inch Size	Dash Size	Nominal Thread Size	Male Thread O.D. (Inch)		Female Thread I.D. (Inch)	
			Fraction	Decimal	Fraction	Decimal
1/8	02	5/16-24	5/16	.31	9/32	.27
3/16	03	3/8-24	3/8	.38	11/32	.34
1/4	04	7/16-20	7/16	.44	13/32	.39
5/16	05	1/2-20	1/2	.50	15/32	.45
3/8	06	9/16-18	9/16	.56	17/32	.51
1/2	08	3/4-16	3/4	.75	3/4	.69
5/8	10	7/8-14	7/8	.88	13/16	.81
3/4	12	1 1/16-12	1 1/16	1.06	1	.98
7/8	14	1 3/16-12	1 3/16	1.19	1 1/8	1.13
1	16	1 5/16-12	1 5/16	1.31	1 1/4	1.23
1 1/4	20	1 5/8-12	1 5/8	1.63	1 9/16	1.54
1 1/2	24	1 7/8-12	1 7/8	1.88	1 13/16	1.79
2	32	2 1/2-12	2 1/2	2.50	2 7/16	2.42

SAE J514 37°* Hydraulic

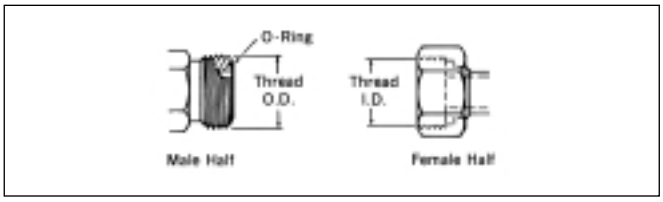


This connection is very common in fluid power systems. Both the male and female halves of the connections have 37° seats. The seal takes place by establishing a line contact between the male flare and the female cone seat. The threads hold the connection mechanically.
CAUTION: In the –02, –03, –04, –05, –08 and –10 sizes, the threads of the SAE 45° flare and the SAE 37° flare are the same. However, the sealing surface angles are not the same.

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

**This connection was formerly known as JIC.*

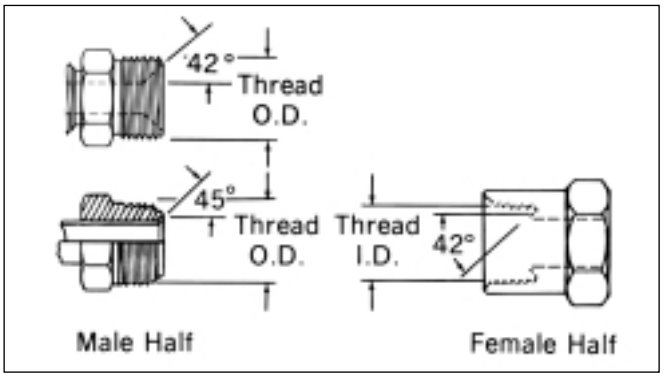
ORS® SAE J1453 O-Ring Face Seal



This connection offers the very best leakage control available today. The male connector has a straight thread and an O-Ring in the face. The female has a straight thread and a machined flat face. The seal takes place by compressing the O-Ring onto the flat face of the female, similar to the split flange type fitting. The threads hold the connection mechanically.

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

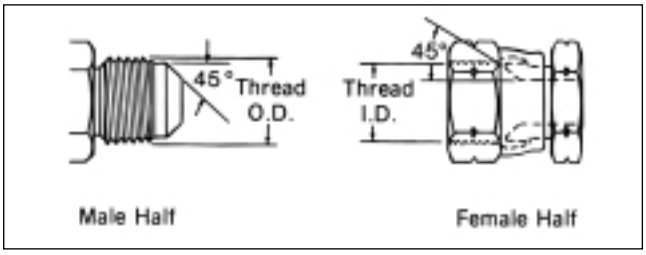
SAE J512 Inverted



This connection is frequently used in automotive systems. The male connector can either be a 45° flare in the tube fitting form or a 42° seat in the machined adapter form. The female has a straight thread with a 42° inverted flare. The seal takes place on the flared surfaces. The threads hold the connection mechanically.

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

SAE J512 45°

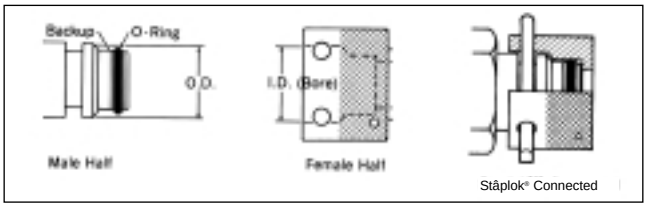


This connection is commonly used in refrigeration, automotive and truck piping systems. The connector is frequently made of brass. Both the male and female connectors have 45° seats. The seal takes place between the male flare the female cone seat. The threads hold the connection mechanically.

CAUTION: In the –02, –03, –04, –05, –08 and –10 sizes, the threads of the SAE 45° flare and the SAE 37° flare are the same. However, the sealing surface angles are not the same.

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

Staplok® (SAE J1467)

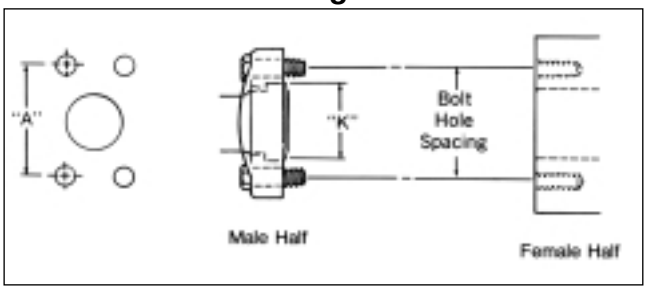


This is a radial O-Ring seal connection developed in Germany and commonly used for hydraulic application in underground mines. The male contains an exterior O-Ring and backup ring, plus a groove to accept the “staple”. The female has a smooth bore with two holes for the stable. A “U” shaped retaining clip or staple is inserted through the two holes, passing through the groove in the male to lock the connection together. The seal takes place by contact between the O-Ring in the male and the smooth bore of the female.

Inch Size	Dash Size	Male Thread O.D. (Inch)		Female Thread I.D. (Inch)	
		Fraction†	Decimal	Fraction†	Decimal
1/4	04	19/32	.586	19/32	.597
3/8	06	25/32	.783	51/64	.794
1/2	08	15/16	.940	61/64	.951
3/4	12	1 9/64	1.137	1 9/64	1.148
1	16	1 17/32	1.529	1 35/64	1.540
1 1/4	20	1 13/16	1.806	1 13/16	1.817
1 1/2	24	2 5/32	2.163	2 11/64	2.174
2	32	2 33/64	2.517	2 17/32	2.528

†Measure to the closest 1/64-inch.

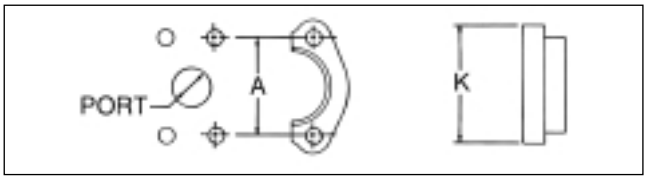
SAE J518 4-Bolt Flange*



This connection is commonly used in fluid power systems. There are two pressure ratings. Code 61 is referred to as the “standard” series and Code 62 is the “6000 psi” series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger for the higher pressure, Code 62 connection.

The female (port) is an unthreaded hole with four bolt holes in a rectangular pattern around the port. The male consists of a flanged head, grooved for an O-Ring, and either a captive flange or split flange halves with bolt holes to match the port. The seal takes place on the O-Ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.

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



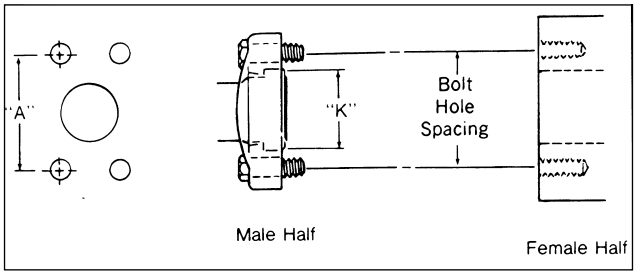
Inch Size (Dash Size)	Port Hole I.D. Inch Fraction (Decimal)	Bolt Dimensions Inch		Bolt Hole Spacing "A" Inch (Decimal)		Flanged Head Diameter "K" Inch (Decimal)	
		Cd. 61	Cd.62	Cd. 61	Cd. 62	Cd. 61	Cd. 62
1/2 (08)	1/2 (.50)	5/16-18x1 1/4	5/16-18x1 1/4	1 1/2 (1.50)	1 19/32 (1.59)	1 3/16 (1.19)	1 1/4 (1.25)
3/4 (12)	3/4 (.75)	3/8-16x1 1/4	3/8-16x1 1/2	1 7/8 (1.88)	2 (2.00)	1 1/2 (1.50)	1 5/8 (1.63)
1 (16)	1 (1.00)	3/8-16x1 1/4	7/16-14x1 3/4	2 1/16 (2.06)	2 1/4 (2.25)	1 3/4 (1.75)	1 7/8 (1.88)
1 1/4 (20)	1 1/4 (1.25)	7/16-14x1 1/2	1/2-13x1 3/4	2 5/16 (2.31)	2 5/8 (2.63)	2 (2.00)	2 1/8 (2.13)
1 1/2 (24)	1 1/2 (1.50)	1/2-13x1 1/2	5/8-11x2 1/4	2 3/4 (2.75)	3 1/8 (3.12)	2 3/8 (2.38)	2 1/2 (2.50)
2 (32)	2 (2.00)	1/2-13x1 1/2	3/4-10x2 3/4	3 1/16 (3.06)	3 13/16 (3.81)	2 13/16 (2.81)	3 1/8 (3.12)

How to Measure

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

ISO connections

ISO/DIS 6162 4-Bolt Flange*



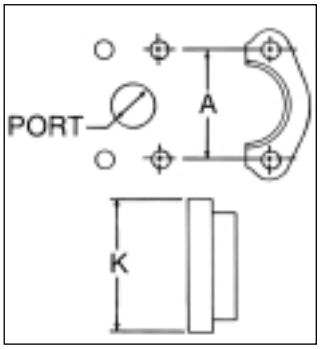
This connection is commonly used in fluid power systems. There are two pressure ratings. PN 35/350 bar (Code 61) is the "standard" series and PN 415 bar (Code 62) is the high pressure series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger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

The female (port) is an unthreaded hole with four bolt holes in a rectangular pattern around the port. The male consists of a flanged head, grooved for an O-Ring, and either a captive flange or split flange halves with bolt holes to match the port. The seal takes place on the O-Ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.

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

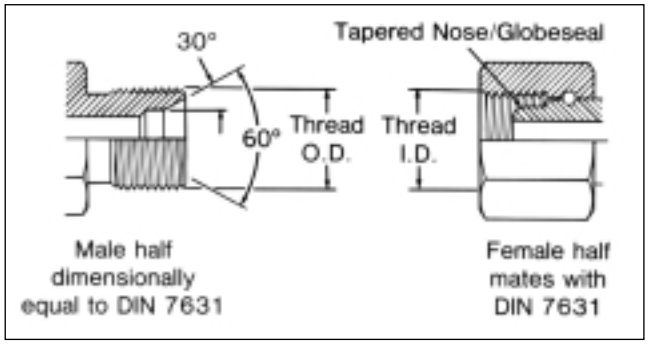
Size mm (Inch) [Dash]	Port Hole mm (Inch)	Bolt Dimensions mm and Inch		Bolt Hole Spacing "A" mm (Inch)	
		PN 35/350 Bar (Cd. 61)	PN 415 Bar (Cd. 62)	PN 35/350 Bar (Cd. 61)	PN 415 Bar (Cd. 62)
13 (1/2) [08]	12.7 (.50)	M8 x 1.25 x 30 5/16–18 x 1 1/4	M8 x 1.25 x 30 5/16–18 x 1 1/4	38.10 (1.50)	40.49 (1.57)
19 (3/4) [12]	19.1 (.75)	M10 x 1.5 x 35 3/8–16 x 1 1/4	M10 x 1.5 x 40 3/8–16 x 1 1/2	47.63 (1.88)	50.80 (2.00)
25 (1) [16]	25.4 (1.00)	M10 x 1.5 x 35 3/8–16 x 1 1/4	M12 x 1.75 x 45 7/16–14 x 1 3/4	52.37 (2.06)	57.15 (2.25)
32 (1 1/4) [20]	31.8 (1.25)	M12 x 1.75 x 40 7/16–14 x 1 1/2	M14 x 2 x 50 1/2–13 x 1 3/4	58.72 (2.31)	66.68 2.63)
38 (1 1/2) [24]	38.1 (1.50)	M14 x 2 x 40 1/2–13 x 1 1/2	M16 x 2 x 55 5/8–11 x 2 1/4	69.85 (2.75)	79.38 (3.13)
51 (2) [32]	50.8 (2.00)	M14 x 2 x 40 1/2–13 x 1 1/2	M20 x 2.5 x 70 3/4–10 x 2 3/4	77.77 (3.06)	96.82 (3.81)

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



German connections

DIN 7631 Series

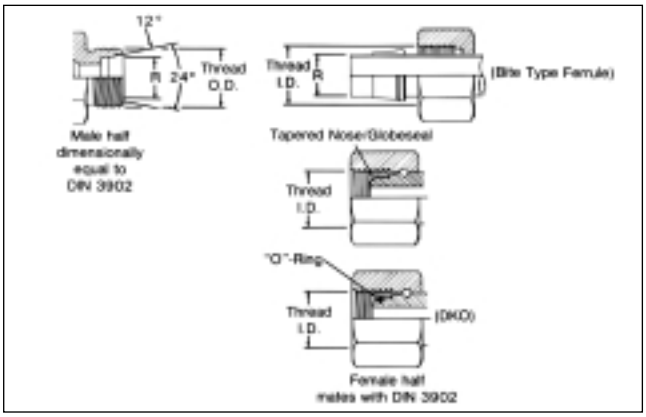


This connection is frequently used in hydraulic systems. The male has a straight metric thread and a 60° (included angle) recessed cone. The female has a straight thread and a tapered nose/Globeseal™ seat. The seal takes place by contact between the cone of the male and the nose of the tapered nose/Globeseal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

Use with Pipe/Tube O.D.		Metric Thread Size	Male Thread O.D.		Female Thread I.D.	
mm	Inch		mm	Inch	mm	Inch
6	.24	M12 x 1.5	12	.47	10.5	.41
8	.32	M14 x 1.5	14	.55	12.5	.49
10	.39	M16 x 1.5	16	.63	14.5	.57
12	.47	M18 x 1.5	18	.71	16.5	.65
15	.59	M22 x 1.5	22	.87	20.5	.81
18	.71	M26 x 1.5	26	1.02	24.5	.96
22	.87	M30 x 1.5	30	1.18	28.5	1.12
28	1.10	M38 x 1.5	38	1.50	36.5	1.44
35	1.38	M45 x 1.5	45	1.77	43.5	1.71
42	1.65	M52 x 1.5	52	2.04	50.5	1.99

German connections (cont.)

DIN 3902 Series

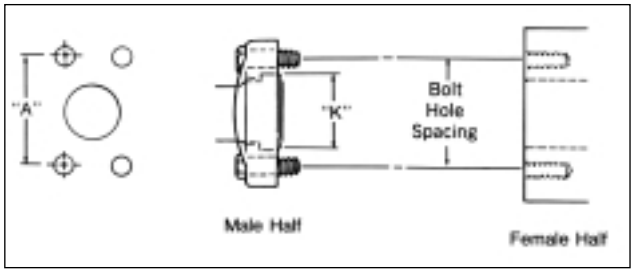


This connection style consists of a common male and three different female halves.
The male has a straight metric thread, a 24° included angle and a recessed counterbore that matches the tube O.D. used with it. The female may be a tube, nut and ferrule, a tapered nose/Globeseal flareless swivel or a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

Tube O.D. "R" Dim. l.Rh.* mm (Inch)	Tube O.D. "R" Dim. s.Rh† mm (Inch)	Metric Thread Size	Male Thread O.D.		Female Thread I.D.	
			mm	Inch	mm	Inch
6 (.24)		M12 x 1.5	12	.47	10.5	.41
8 (.32)	6 (.24)	M14 x 1.5	14	.55	12.5	.49
10 (.39)	8 (.32)	M16 x 1.5	16	.63	14.5	.57
12 (.47)	10 (.39)	M18 x 1.5	18	.71	16.5	.65
	12 (.47)	M20 x 1.5	20	.78	18.5	.73
15 (.59)	14 (.55)	M22 x 1.5	22	.87	20.5	.81
	16 (.63)	M24 x 1.5	24	.94	22.5	.89
18 (.71)		M26 x 1.5	26	1.02	24.5	.96
22 (.87)	20 (.78)	M30 x 2.0	30	1.18	28	1.11
28 (1.10)	25 (.98)	M36 x 2.0	36	1.41	34	1.34
	30 (1.18)	M42 x 2.0	42	1.65	40	1.57
35 (1.38)		M45 x 2.0	45	1.77	43	1.70
42 (1.65)	38 (1.50)	M52 x 2.0	52	2.04	50	1.97

**I.Rh. is a light duty system.*
†s.Rh. is a heavy duty system.

DIN 20066 4-Bolt Flange*



This connection is commonly used in fluid power systems. There are two pressure ratings. Form R (Code 61) is referred to as the "standard duty" series and Form S (Code 62) is the "heavy duty" series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger for the higher pressure, Form S connection. Both metric and inch bolts are used.

The female (port) is an unthreaded hole with four bolt holes in a rectangular pattern around the port. The male consists of a flanged head, grooved for an O-Ring, and either a captive flange or split flange halves with bolt holes to match the port. The seal takes place on the O-Ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.

**DIN 20066, IS/DIS 6166, JIS B 8363 and SAE J518 are interchangeable, except for bolt sizes.*

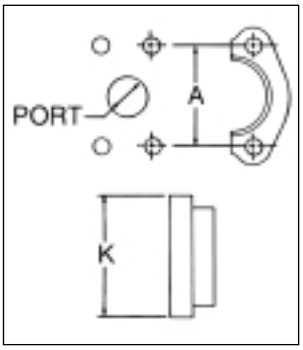
Size mm (Inch) [Dash]	Port Hole mm (Inch)	Bolt Dimensions mm and Inch		Bolt Hole Spacing "A" mm (Inch)	
		Form R (Cd. 61)	Form S (Cd. 62)	Form R (Cd. 61)	Form S (Cd. 62)
12 (1/2) [08]	12.7 (.50)	M8 x 1.25 x 30 5/16-18 x 1 1/4	M8 x 1.25 x 30 5/16-18 x 1 1/4	38.10 (1.50)	40.49 (1.57)
20 (3/4) [12]	19.1 (.75)	M10 x 1.5 x 30 3/8-16 x 1 1/4	M10 x 1.5 x 40 3/8-16 x 1 1/2	47.63 (1.88)	50.80 (2.00)
25 (1) [16]	25.4 (1.00)	M10 x 1.5 x 35 3/8-16 x 1 1/4	M12 x 1.75 x 45 7/16-14 x 1 3/4	52.37 (2.06)	57.15 (2.25)
32 (1 1/4) [20]	31.7 (1.25)	M10 x 1.75 x 40 7/16-14 x 1 1/2	M14 x 2 x 45 1/2-13 x 1 3/4	58.72 (2.31)	66.68 2.63)
40 (1 1/2) [24]	38.0 (1.50)	M12 x 1.75 x 40 1/2-13 x 1 1/2	M16 x 2 x 55 5/8-11 x 2 1/4	69.85 (2.75)	79.38 (3.13)
50 (2) [32]	50.8 (2.00)	M12 x 1.75 x 40 1/2-13 x 1 1/2	M20 x 2.5 x 70 3/4-10 x 2 3/4	77.77 (3.06)	96.82 (3.81)

DIN 20066 4-Bolt Flange continued on page 420.

German connections (cont.)

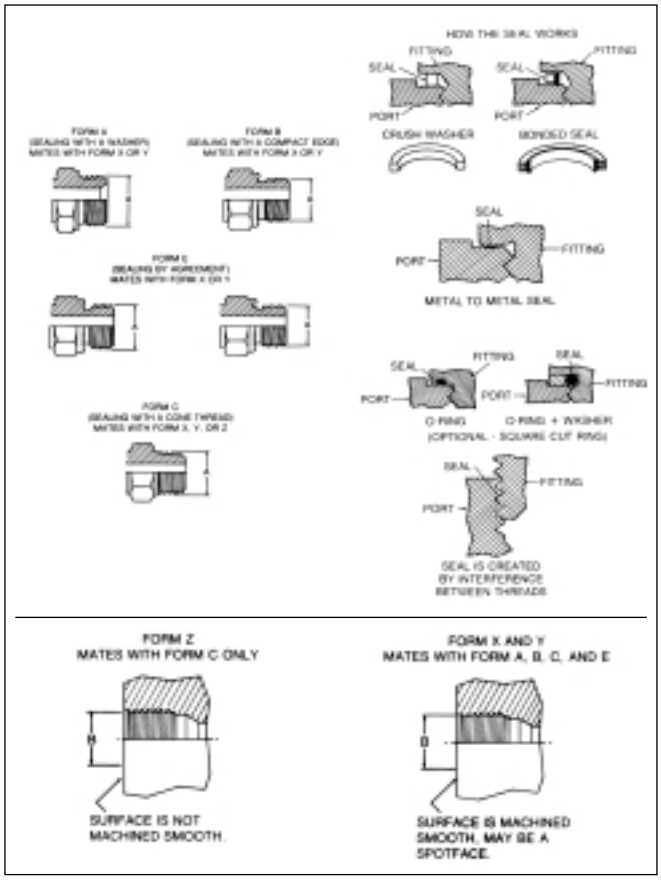
DIN 20066 4-Bolt Flange (cont.)

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



DIN 3852
Male Connectors and Female Ports

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



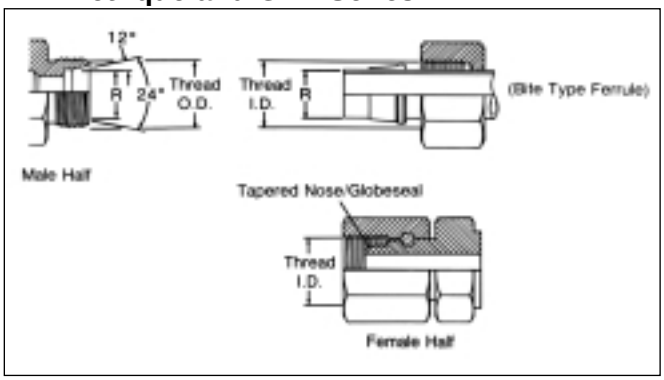
DIN 3852 Metric Threads

Metric Threads	Male Thread O.D. "A"		Female Thread I.D. "B"	
	mm	Inch	mm	Inch
M12 x 1.5	12	.47	10.5	.41
M14 x 1.5	14	.55	12.5	.49
M16 x 1.5	16	.63	14.5	.57
M18 x 1.5	18	.71	16.5	.65
M20 x 1.5	20	.78	18.5	.73
M22 x 1.5	22	.87	20.5	.81
M24 x 1.5	24	.94	22.5	.89
M26 x 1.5	26	1.02	24.5	.96
M27 x 2	27	1.06	25	.98
M30 x 1.5	30	1.18	28.5	1.12
M30 x 2	30	1.18	28	1.10
M33 x 2	33	1.30	31	1.22
M36 x 1.5	36	1.41	34.5	1.36
M36 x 2	36	1.41	34	1.33
M38 x 1.5	38	1.49	36.5	1.43
M38 x 2	38	1.49	36	1.41
M42 x 1.5	42	1.65	40.5	1.60
M42 x 2	42	1.65	40	1.57
M45 x 1.5	45	1.77	43.5	1.71
M45 x 2	45	1.77	43	1.69
M48 x 1.5	48	1.89	46.5	1.83
M48 x 2	48	1.89	46	1.81
M52 x 1.5	52	2.04	50.5	1.89
M52 x 2	52	2.04	50	1.97

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

French connections

Millimetrique and GAZ Series



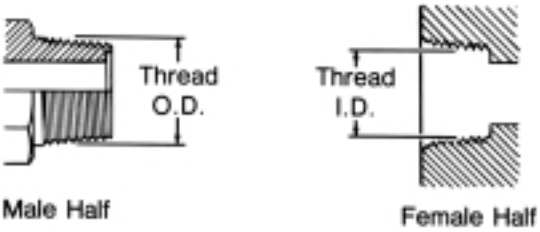
This connection consists of a common male and two different females. The Millimetrique Series is used with whole number metric O.D. tubing and the GAZ Series is used with fractional number metric O.D. pipe size tubing.

Millimetrique and GAZ Threads

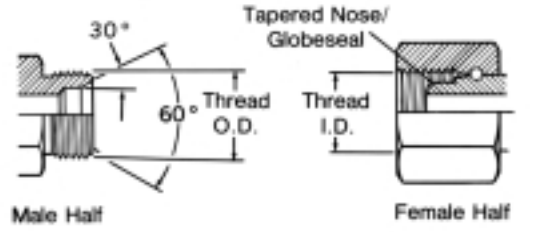
Tubing O.D. "R" Dim. mm (Inch)	"GAZ" Pipe O.D. "R" Dim. mm (Inch)	Metric Thread Size	Male Thread O.D.		Female Thread I.D.	
			mm	Inch	mm	Inch
6 (.24)		M12 x 1.5	12	.47	11	.43
8 (.32)		M14 x 1.5	14	.55	12.5	.49
10 (.39)		M16 x 1.5	16	.63	14.5	.57
12 (.47)		M18 x 1.5	18	.71	16.5	.65
14 (.55)	13.25 (.52)	M20 x 1.5	20	.78	18.5	.73
15 (.59)		M22 x 1.5	22	.87	20.5	.81
16 (.63)	16.75 (.66)	M24 x 1.5	24	.94	22.5	.89
18 (.71)		M26 x 1.5	27	1.06	25.5	1.00
22 (.87)	21.25 (.83)	M30 x 1.5	30	1.18	28.5	1.12
25 (.98)		M33 x 1.5	33	1.30	31.5	1.24
28 (1.10)	26.75 (1.05)	M36 x 1.5	36	1.41	34.5	1.36
30 (1.18)		M39 x 1.5	39	1.54	37.5	1.48
32 (1.25)		M42 x 1.5	42	1.65	40.5	1.60
35 (1.38)	33.50 (1.32)	M45 x 1.5	45	1.77	43.5	1.71
38 (1.50)		M48 x 1.5	48	1.89	46.5	1.83
40 (1.57)	42.25 (1.66)	M52 x 1.5	52	2.04	50.5	1.99
45 (1.77)		M54 x 2.0	54	2.12	52	2.05
	48.25 (1.90)	M58 x 2.0	58	2.28	55	2.16

British connections

British Standard Pipe (BSP)



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



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

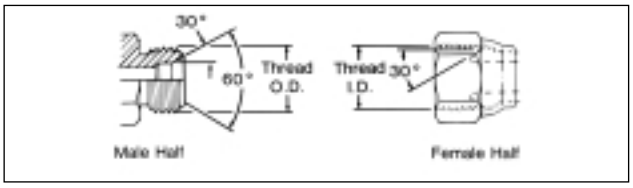
BSPT/BSPP Threads

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

**Frequently, the thread size is expressed as a fractional dimension preceded by the letter "G" or the letter "R". The "G" represents a parallel thread and the "R" indicates a tapered thread. For example, BSPP 3/8–19 may be expressed as G 3/8, and BSPT 3/8–19 may be expressed as R3/8.*

Japanese connections

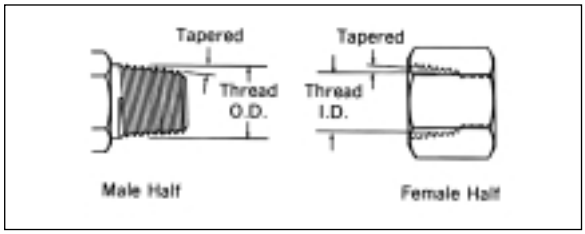
JIS 30° Male Inverted Seat, Parallel Pipe Threads (Threads per JIS B 0202)



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

Inch Size	Size mm (Dash)	Nominal Thread Size (Similar to BSPP)	Male Thread. O.D		Female Thread I.D.	
			Fraction	mm	Fraction	mm
1/4	6 (04)	1/4–19	33/64	13.2	15/32	11.9
3/8	9 (06)	3/8–19	21/32	16.7	19/32	15.3
1/2	12 (08)	1/2–14	13/16	21.0	3/4	19.2
3/4	19 (12)	3/4–14	1 1/32	26.4	31/32	24.6
1	25 (16)	1–11	1 5/16	33.3	1 7/32	30.9
1 1/4	32 (20)	1 1/4–11	1 21/32	41.9	1 9/16	39.6
1 1/2	38 (24)	1 1/2–11	1 7/8	47.8	1 25/32	45.5
2	50 (32)	2–11	2 11/32	59.7	2 1/4	57.4

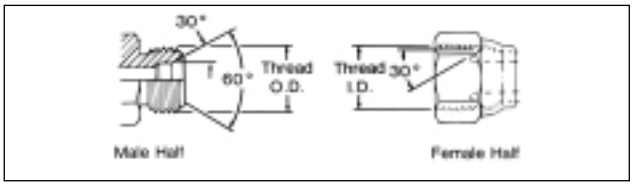
JIS Tapered Pipe (PT) (Threads per JIS B 0203)



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

Inch Size	Size mm (Dash)	Nominal Thread Size (Similar to BSPT)	Male Thread O.D.		Female Thread I.D.	
			Fraction	mm	Fraction	mm
1/4	6 (04)	1/4–19	33/64	13.2	15/32	11.9
3/8	9 (06)	3/8–19	21/32	16.7	19/32	15.3
1/2	12 (08)	1/2–14	13/16	21.0	3/4	19.2
3/4	19 (12)	3/4–14	1 1/32	26.4	31/32	24.6
1	25 (16)	1–11	1 5/16	33.3	1 7/32	30.9
1 1/4	32 (20)	1 1/4–11	1 21/32	41.9	1 9/16	39.6
1 1/2	38 (24)	1 1/2–11	1 7/8	47.8	1 25/32	45.5
2	50 (32)	2–11	2 11/32	59.7	2 1/4	57.4

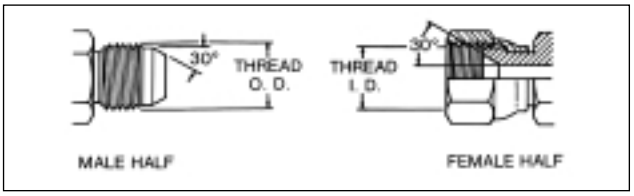
JIS 30° Male (Inverted) Seat, Metric Threads (Threads per JIS B 0207)



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

Size mm	Dash Size Equivalent	Thread Size	Male Thread O.D.		Female Thread I.D.	
			mm	Inch	mm	Inch
6	04	M14 x 1.5	14	.55	12.5	.49
9	06	M18 x 1.5	18	.71	16.5	.65
12	08	M22 x 1.5	22	.87	20.5	.81
19	12	M30 x 1.5	30	1.18	28.5	1.12
25	16	M33 x 1.5	33	1.30	31.5	1.24
32	20	M42 x 1.5	42	1.65	40.5	1.60

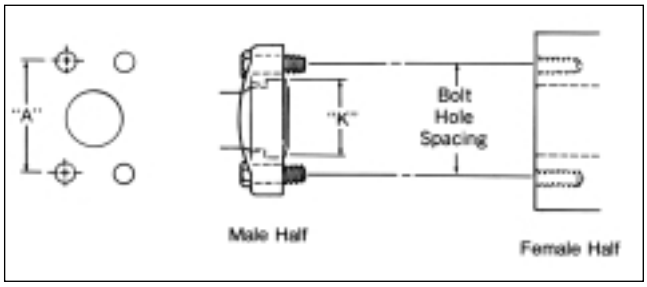
JIS 30° Female (Cone) Seat, Parallel Pipe Threads
(Threads per JIS B 0202)



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

Inch Size	Size mm (Dash)	Nominal Thread Size (Similar to BSPP)	Male Thread O.D. (Inch)		Female Thread I.D. (Inch)	
			Fraction	mm	Fraction	mm
1/4	6 (04)	1/4-19	33/64	13.2	15/32	11.9
3/8	9 (06)	3/8-19	21/32	16.7	19/32	15.3
1/2	12 (08)	1/2-14	13/16	21.0	3/4	19.2
3/4	19 (12)	3/4-14	1 1/32	26.4	31/32	24.6
1	25 (16)	1-11	1 5/16	33.3	1 7/32	30.9
1 1/4	32 (20)	1 1/4-11	1 21/32	41.9	1 9/16	39.6
1 1/2	38 (24)	1 1/2-11	1 7/8	47.8	1 25/32	45.5
2	50 (32)	2-11	2 11/32	59.7	2 1/4	57.4

JIS B 8363 4-Bolt Flange*



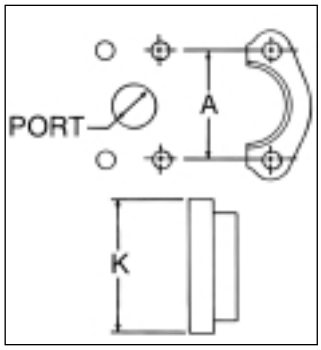
This connection is commonly used in fluid power systems. There are two pressure ratings. Type I (Code 61) is referred to as the "standard" series and Type II (Code 62) is the "6000 psi" series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger for the higher pressure, Type II connection. Both metric and inch bolts are used.

The female (port) is an unthreaded hole with four bolt holes in a rectangular pattern around the port. The male consists of a flanged head, grooved for an O-Ring, and either a captive flange or split flange halves with bolt holes to match the port. The seal takes place on the O-Ring, which is compressed between the flanged head and the flat surface surrounding the port. The threaded bolts hold the connection together.

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

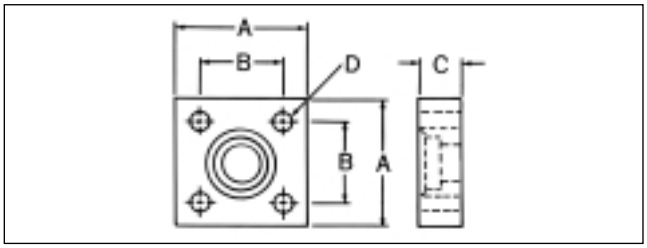
Size mm (Inch) [Dash]	Port Hole mm (Inch)	Bolt Dimensions mm and Inch		Bolt Hole Spacing "A" mm (Inch)	
		Type I (Cd. 61)	Type II (Cd. 62)	Type I (Cd. 61)	Type II (Cd. 62)
12 (1/2) [08]	12.7 (.50)	M8 x 1.25 x 30 5/16-18 x 1 1/4	M8 x 1.25 x 30 5/16-18 x 1 1/4	38.10 (1.50)	40.49 (1.57)
19 (3/4) [12]	19.1 (.75)	M10 x 1.5 x 30 3/8-16 x 1 1/4	M10 x 1.5 x 40 3/8-16 x 1 1/2	47.63 (1.88)	50.80 (2.00)
25 (1) [16]	25.4 (1.00)	M10 x 1.5 x 30 3/8-16 x 1 1/4	M12 x 1.75 x 45 7/16-14 x 1 3/4	52.37 (2.06)	57.15 (2.25)
32 (1 1/4) [20]	31.7 (1.25)	M10 x 1.5 x 40 7/16-14 x 1 1/2	M14 x 2 x 45 1/2-13 x 1 3/4	58.72 (2.31)	66.68 2.63)
38 (1 1/2) [24]	38.0 (1.50)	M12 x 1.75 x 40 1/2-13 x 1 1/2	M16 x 2 x 55 5/8-11 x 2 1/4	69.85 (2.75)	79.38 (3.13)
50 (2) [32]	50.8 (2.00)	M12 x 1.75 x 40 1/2-13 x 1 1/2	M20 x 2.5 x 70 3/4-10 x 2 3/4	77.77 (3.06)	96.82 (3.81)

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



Japanese connections (continued)

JIS 210 Kgf/cm²
4-Bolt Square Flange

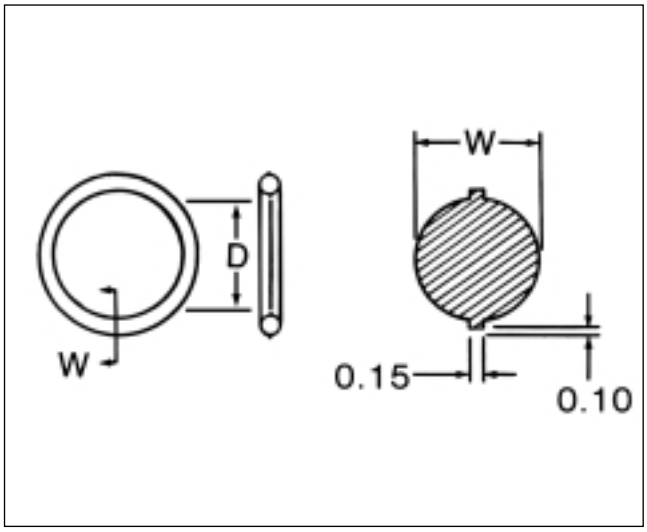


The JIS 4-Bolt square flange connection is similar in concept to the SAE 4-bolt flange connection, except that the JIS bolt pattern is square and the flange itself is different.

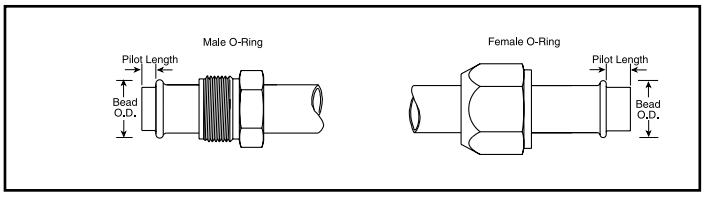
Size mm	Approx. Inch Size	Bolt Size mm (Bolt Length for Long Design)	Dim. "A" mm (Inch)	Dim. "B" mm (Inch)	Dim. "C" mm (Inch)	Bolt Hole Dia. "D" mm (Inch)
12	1/2	M10 x 1.5 x 55 (80)	63 (2.48)	40 (1.57)	22 (.87)	11 (.43)
19	3/4	M10 x 1.5 x 55 (80)	68 (2.67)	45 (1.77)	22 (.87)	11 (.43)
25	1	M12 x 1.75 x 70 (100)	80 (3.15)	53 (2.09)	28 (1.10)	13 (.51)
32	1 1/4	M12 x 1.75 x 70 (100)	90 (3.54)	63 (2.48)	28 (1.10)	13 (.51)
38	1 1/2	M16 x 2.0 x 90 (130)	100 (3.94)	70 (2.76)	36 (1.42)	18 (.71)
50	2	M16 x 2.0 x 90 (130)	112 (4.41)	80 (3.15)	36 (1.42)	18 (.71)

JIS 210 Kgf/cm² O-Ring

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



How to Identify O-Ring Pilot Thread Sizes

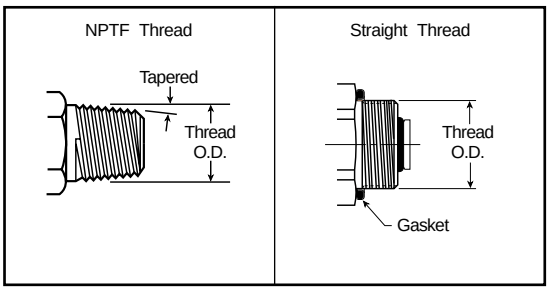


This connection is common to air conditioning systems, both in vehicle and commercial applications. Both the male and female halves of the connections have a pilot, either long or short. The seal takes place by compressing an O-ring adjacent to the bead of the tube. The threads hold the connection together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

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

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

How to Identify Oil Pan-Plug Thread Sizes



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

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

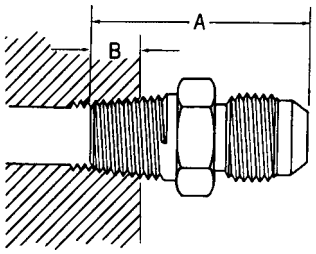
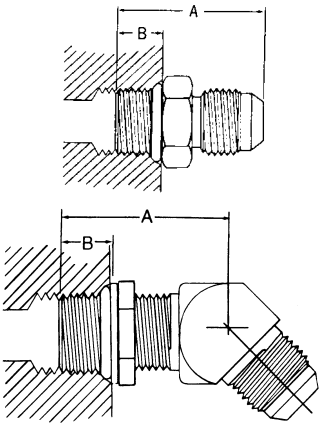
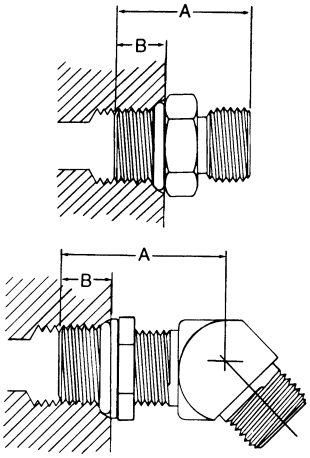
Thread Size	Male Thread O.D.		FD14 Drain Coupling	FF1187 90°Adapter
	Inch	mm	Part Number	Part Number
1/2-20 UNF	0.50	12.6	FD14-1002-01-06	FF1187-0801S
M18 x 1.5	0.70	18.0	FD14-1002-02-06	FF1187-0802S
M14 x 1.25	0.55	14.0	FD14-1002-03-06	FF1187-0803S
M10 x 1	0.39	10.0	N/A	FF1187-0804S
1 1/4-18 UNEF	1.24	31.6	FD14-1002-05-06	FF1187-0805S
1-18 UNS	0.99	25.2	FD14-1002-06-06	FF1187-0806S
7/8-18 UNS	0.87	22.1	FD14-1002-07-06	FF1187-0807S
5/8-18 UNF	0.62	15.7	FD14-1002-08-06	FF1187-0808S
3/4-16 UNF	0.74	18.9	FD14-1002-09-06	FF1187-0809S
7/8-14 UNF	0.87	22.0	FD14-1002-10-06	FF1187-0810S
M24 x 2	0.94	24.0	FD14-1002-11-06	FF1187-0811S
9/16-18 UNF	0.56	14.1	FD14-1002-12-06	FF1187-0812S
1 1/8-12 UNF	1.12	28.4	FD14-1002-14-06	FF1187-0814S
M20 x 1.5	0.78	20.0	FD14-1002-16-06	FF1187-0816S
M25 x 1.5	0.98	25.0	FD14-1002-17-06	FF1187-0817S
M22 x 1.5	0.86	22.0	FD14-1002-18-06	
M24 x 1.5	0.94	24.0	FD14-1002-19-06	
1 1/16-12 UN	1.06	26.8	FD14-1002-20-06	
M30 x 1.5	1.18	30.0	FD14-1002-21-06	
1/2-14 UNS	0.49	12.5	FD14-1002-22-06	
M12 x 1.5	0.47	12.0	FD14-1002-23-06	
M14 x 1.5	0.55	14.0	FD14-1002-24-06	
M12 x 1.75	0.47	12.0	FD14-1002-25-06	
3/4-14 Dryseal NPTF	1.05	26.7	FD14-1002-26-06	

Thread engagement dimensions—Nominal

Dimensions may vary due to tolerance conditions.

Listed below are the thread engagement dimensions (B) which must be taken into consideration when making connections with ports or appropriate female adapters.

The "B" dimension must be subtracted from the overall length (A) to insure proper connection.

Dash Size	Male pipe  Straight and Angled Dimension "B"	SAE O-Ring boss SAE J1926 with 37° Flare J514  Straight and Adjustable Dimension "B"	SAE O-Ring boss SAE J1926 with ORS J1453  Straight and Adjustable Dimension "B"
–02	.25		
–04	.38	.36	.43
–05		.36	.43
–06	.38	.39	.47
–08	.50	.43	.55
–10		.50	.63
–12	.62	.59	.73
–14		.59	
–16	.69	.59	.73
–20	.69	.59	.73
–24	.69	.59	.73
–32	.75	.59	

Allowable bulkhead thickness

For ORS:

Dash Size	Hole Diameter	ORS Bulkhead Thickness Min	Max
–04	.575 +.015/–.000	.195	.500
–06	.700 +.015/–.000	.200	.590
–08	.825 +.015/–.000	.220	.590
–10	1.015 +.015/–.000	.230	.590
–12	1.200 +.015/–.000	.245	.590
–16	1.450 +.015/–.000	.245	.600
–20	1.715 +.015/–.000	.245	.600
–24	2.030 +.015/–.000	.245	.600

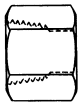
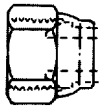
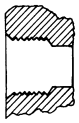
For 37° Flare:

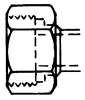
Dash Size	Hole Diameter	37° Bulkhead Thickness Straights Min	Straights Max	Shapes Min	Shapes Max
–03	.391 +.016/–.000	.047	.406	.125	.250
–04	.453 +.016/–.000	.047	.406	.125	.281
–05	.516 +.016/–.000	.047	.406	.125	.281
–06	.578 +.016/–.000	.047	.438	.125	.297
–08	.766 +.016/–.000	.047	.438	.156	.344
–10	.891 +.016/–.000	.047	.469	.156	.359
–12	1.076 +.016/–.000	.047	.469	.156	.375
–16	1.328 +.016/–.000	.047	.469	.156	.375
–20	1.656 +.031/–.000	.047	.469	.156	.375
–24	1.906 +.031/–.000	.047	.469	.156	.375

All dimensions in inches. Dimensions may vary due to tolerance conditions.

Thread Style Pressure Performance/Maximum Operating Pressure

The following table is a breakdown of hydraulic pressure performance by thread style and size for steel products. The table is based on limited laboratory test data and is intended only as an approximate guide to field performance of Eaton Aeroquip products. Figures shown are maximum operating pressures in psi, based upon a 4:1 safety factor relative to the connection minimum burst pressure. Testing was conducted at SAE recommended assembly torque in hardened test blocks. The pressure rating must be adjusted for any change in mating part material. The maximum operating pressure for the adapter or tube fitting body must be the lower of the chosen mating end types.

Dash Size	Inch Size	SAE100R2 Maximum Operating Pressure	 SAE 37° Flare Male (JIC)	 SAE 37° Flare Swivel (JIC)	 Male Pipe NPTF	 Female Pipe NPTF	 Female Pipe Swivel NPSM	For Non ORS Adapters  Male O-Ring Boss	For Non ORS Adapters  Straight Thread O-Ring Adjustable	 Female O-Ring Boss
–2	1/8				10000	5000	6000			
–4	1/4	5000	8500	5500	9500	4500	5000	7500	4500	4500
–5	5/16	4250	8500	5000				7500	3500	3500
–6	3/8	4000	7000	4000	8000	3500	4000	7500	4000	3500
–8	1/2	3500	6000	4000	6000	3500	3500	7500	4000	3000
–10	5/8	2750	5500	3000				7500	4000	2500
–12	3/4	2250	4000	3000	5000	3000	3500	5000	3500	1800
–14	7/8	2000	4000	3000				5000	3000	1700
–16	1	2000	3500	2500	4000	2500	3000	4500	2500	1600
–20	1 1/4	1625	3500	2000	3000	2000	2000	4500	2000	1500
–24	1 1/2	1250	2000	1500	2000	1500	1500	3500	2000	1500
–32	2	1125	1250	1250	2000	1400	1500	2000		

Dash Size	Inch Size	SAE100R2 Maximum Operating Pressure	 ORS Male	 ORS Female Swivel	For ORS Adapters  ORB/STR	For ORS Adapters  ORB/ADJ	 Male SAE Flareless	Flange  Code 61	Flange  Code 62	
–2	1/8									
–4	1/4	5000	9000	9000	9000	6000	6000			
–5	5/16	4250								
–6	3/8	4000	9000	9000	9000	6000	6000			
–8	1/2	3500	9000	8000	9000	6000	6000	5000	6000	
–10	5/8	2750	9000	8000	9000	6000	5000			
–12	3/4	2250	6000	6000	6000	6000	4500	5000	6000	
–14	7/8	2000								
–16	1	2000	6000	6000	6000	5000	4000	5000	6000	
–20	1 1/4	1625	4500	4500	4500	4500		4000	6000	
–24	1 1/2	1250	4000	4000	4000	3000		3000	6000	
–32	2	1125						3000	6000	

Maximum Operating Pressures (PSI) for Hydraulic Tubing

(SAEJ356, J524, J525, J526, J527)

Tube O.D.	Dash Size	Tubing Wall Thickness (in.)											
		.028	.035	.049	.065	.083	.095	.109	.120	.134	.148	.156	.188
.19	–03	4250	5450										
.25	–04	3100	3950	5750	6000								
.31	–05	2450	3100	4500	6000								
.38	–06	2000	2550	3650	5000	6000	6000						
.50	–08		1850	2700	3650	4800	5550	6000	6000				
.62	–10		1500	2100	2850	3750	4350	5050	5600				
.75	–12		1200	1750	2350	3050	3550	4150	4600				
1.00	–16		900	1300	1750	2250	2600	3000	3350	3800	4200		
1.25	–20			1000	1350	1750	2050	2350	2650	2700	2950	3100	3750
1.50	–24				1150	1450	1700	1950	2150	2450	2450	2600	3150
2.00	–32				850	1100	1250	1450	1600	1800	2000	2100	2550

Maximum operating pressure ratings at specified wall thickness are based upon recommended tubing ratings per SAEJ1065 as well as limited laboratory test data. Operating pressures are based upon a 4:1 safety factor relative to tube burst data. Eaton Aeroquip recommends a maximum operating pressure of the joint which is the lesser of the tubing rating or the mating connector rating.

Recommended Wall Thickness (Inches) for Tube Fitting Applications

Tube	Dash	Versil·Flare™		ORS-BR	ORS-TF
		SAE 37° Flare	SAE 37° Flareless	SAE O-Ring Face Seal	SAE O-Ring Face Seal
.19	–03	.028 – .035	.028 – .035		
.25	–04	.028 – .065	.028 – .065	.028 – .065	.028 – .065
.31	–05	.028 – .065	.028 – .065		
.38	–06	.028 – .065	.028 – .095	.035 – .083	.028 – .065
.50	–08	.035 – .083	.035 – .120	.035 – .109	.035 – .120
.62	–10	.035 – .095	.035 – .120	.035 – .120	.035 – .095
.75	–12	.035 – .109	.035 – .120	.035 – .120	.049 – .120
1.00	–16	.035 – .120	.035 – .134	.049 – .148	.049 – .134
1.25	–20	.049 – .120	.049 – .188	.049 – .188	.049 – .156
1.50	–24	.065 – .120	.065 – .188	.065 – .188	.065 – .188
2.00	–32	.065 – .134	.065 – .188		

Recommended Hydraulic Tubing Material Specifications

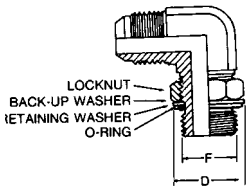
Hydraulic Tubing SAE Specifications	Versil·Flare™		ORS-BR	ORS-TF
	SAE 37° Flare	SAE 37° Flareless	SAE O-Ring Face Seal	SAE O-Ring Face Seal
	SAEJ524	SAEJ356	SAEJ356	SAEJ356
	SAEJ525	SAEJ524	SAEJ524	SAEJ524
		SAEJ525	SAEJ525	SAEJ525
		SAEJ527	SAEJ526	SAEJ526

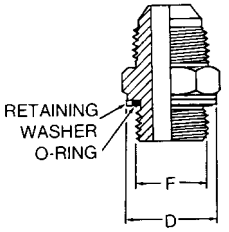
Hydraulic tubing material description: SAEJ356 electric resistance welded flash controlled low carbon steel, SAEJ524 seamless annealed low carbon steel, SAEJ525 electric resistance welded cold worked annealed, SAEJ526 single wall welded low carbon steel (automotive), SAEJ527 brazed double wall low carbon steel (automotive). **The maximum hardness of the above tubing should not exceed Rockwell B65.**

Conversion Adapters

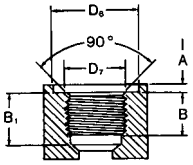
Metric Threads

Sealing is achieved by means of an O-Ring, retaining washer and a properly machined port. The O-Ring is "captured" by the I.D. of the retaining washer. The port may be of the spot faced or a flat machined surface as long as the D_6 dimension is met. Assembly instructions for adjustable type adapters are presented on page 368.





DIN 3852 LARGE SPOTFACE



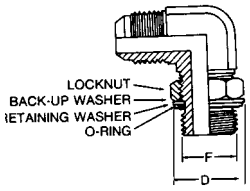
EQUIVALENT TO
DIN 3852 FORM X

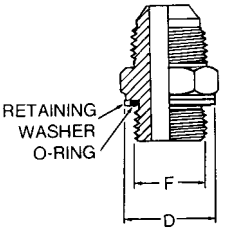
Dimensions (in mm)

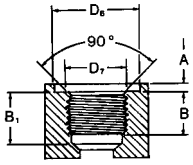
Thread Size	M 10 x 1	M 12 x 1.5	M 14 x 1.5	M 16 x 1.5	M 18 x 1.5	M 20 x 1.5	M 22 x 1.5	M 26 x 1.5	M 27 x 2	M 33 x 2	M 42 x 2	M 48 x 2
F Thread Dia.	10	12	14	16	18	20	22	26	27	33	42	48
A max	1	1.5	1.5	1.5	2	2	2.5	2.5	2.5	2.5	2.5	2.5
B min (full thread)	12	12	12	12	12	14	14	16	16	18	20	22
B_1 min	13.5	18.5	18.5	18.5	18.5	20.5	20.5	22.5	24	26	28	30
D max	15.7	18.7	19.7	23.2	26.2	28.2	30.2	35.2	36.2	43.2	52.7	58.7
D_6 min	16.2	19.2	20.2	23.7	26.9	28.9	30.7	35.7	36.7	44.4	53.4	59.9
D_7 max	10.2	12.2	14.2	16.2	18.2	20.2	22.2	26.2	27.2	33.3	42.3	48.3

BSPP (Parallel) Threads

Sealing is achieved by means of an O-Ring, retaining washer and a properly machined port. The O-Ring is "captured" by the I.D. of the retaining washer. The compression is controlled by the thickness of the retaining washer. The port may be of the spot faced or a flat machined surface as long as the D6 dimension is met. Assembly instructions for adjustable type adapters are presented on page 368.



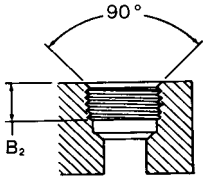




Dimensions (in mm)

Thread Size (in inches)	G 1/8"-28	G 1/4"-19	G 3/8"-19	G 1/2"-14	G 3/4"-14	G 1"-11	G 1 1/4"-11	G 1 1/2"-11
F Thread Dia.	9.73	13.16	16.66	20.96	26.44	33.25	41.91	47.8
A max	1	2	2.5	2.5	2.5	2.5	2.5	
B min	8	12	12	14	16	18	20	22
B_1 min (full thread)	13	18.5	18.5	22	24	27	29	31
D max	15.7	19.7	24.0	28.7	35.2	43.2	52.7	58.7
D_6 min	16.2	20.2	24.9	29.4	36.4	44.4	53.4	59.9
D_7 max	10.0	13.4	16.9	21.2	26.7	33.6	42.3	48.2

BSPT (Tapered) Threads



Port Sealing

Sealing is achieved by means of metal to metal deformation of the adapter and port threads.

Thread Size (in inches)	R 1/8"-28	R 1/4"-19	R 3/8"-19	R 1/2"-14	R 3/4"-14	R 1"-11	R 1 1/4"-11	R 1 1/2"-11
B_2 min (full thread)	5.5	8.5	8.5	10.5	13	14.5	17	17

Recommended parallel connection assembly torque

Eaton Aeroquip recommends that a torque wrench be used to assure proper fitting assembly of these connections.

	Dash Size	Thread Size (Inches)	Swivel Nut Torque	
			Ft./Lbs.	Newton Meters
ORS®	–04	9/16-18	10-12	14-16
	–06	11/16-16	18-20	24-27
	–08	13/16-16	32-35	43-47
	–10	1-14	46-50	62-68
	–12	1 3/16-12	65-70	88-95
	–16	1 7/16-12	92-100	125-136
	–20	1 11/16-12	125-140	170-190
	–24	2-12	150-165	204-224

	Dash Size	Thread Size (Inches)	Jam Nut or Straight Fitting Torque	
			Ft./Lbs.	Newton Meters
Straight Thread O-Ring Boss Low Pressure with 37° (SAEJ514)	–03	3/8-24	8-9	12-13
	–04	7/16-20	13-15	18-20
	–05	1/2-20	14-15	19-21
	–06	9/16-18	23-24	32-33
	–08	3/4-16	40-43	55-57
	–10	7/8-14	43-48	59-64
	–12	1 1/16-12	68-75	93-101
	–14	1 3/16-12	83-90	113-122
	–16	1 5/16-12	112-123	152-166
	–20	1 5/8-12	146-161	198-218
	–24	1 7/8-12	154-170	209-230
	–32	2 1/2-12	218-240	296-325

	Dash Size	Thread Size (Inches)	Jam Nut or Straight Fitting Torque	
			Ft./Lbs.	Newton Meters
Straight Thread O-Ring Boss High Pressure with ORS® (J1453)	–03	3/8-24	8-10	11-13
	–04	7/16-20	14-16	20-22
	–05	1/2-20	18-20	24-27
	–06	9/16-18	24-26	33-35
	–08	3/4-16	50-60	68-78
	–10	7/8-14	72-80	98-110
	–12	1 1/16-12	125-135	170-183
	–14	1 3/16-12	160-180	215-245
	–16	1 5/16-12	200-220	270-300
	–20	1 5/8-12	210-280	285-380
	–24	1 7/8-12	270-360	370-490

Recommended parallel connection assembly torque

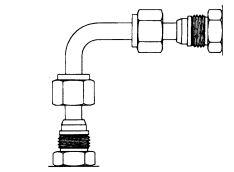
	Dash Size	Thread Size (Inches)	Swivel Nut Torque	
			Ft./Lbs.	Newton Meters
SAE 37° (JIC)	–04	7/16-20	11-12	15-16
	–05	1/2-20	15-16	20-22
	–06	9/16-18	18-20	24-28
	–08	3/4-16	38-42	52-58
	–10	7/8-14	57-62	77-85
	–12	1 1/16-12	79-87	108-119
	–16	1 5/16-12	108-113	148-154
	–20	1 5/8-12	127-133	173-182
	–24	1 7/8-12	158-167	216-227
	–32	2 1/2-12	245-258	334-352

	Thread Size mm	Straight Adapter or Locknut Torque	
		Ft./Lbs.	Newton Meters
Metric	M10 x 1	13-15	18-20
	M12 x 1.5	15-19	20-25
	M14 x 1.5	19-23	25-30
	M16 x 1.5	33-40	45-55
	M18 x 1.5	37-44	50-60
	M20 x 1.5	52-66	70-90
	M22 x 1.5	55-70	75-95
	M26 x 1.5	81-96	110-130
	M27 x 2	96-111	130-150
	M33 x 2	162-184	220-250
	M42 x 2	170-192	230-260
	M48 x 2	258-347	350-470

	Nominal Thread Size Inches**	Straight Adapter or Locknut Torque	
		Ft./Lbs.	Newton Meters
BSPP **"G" denotes parallel threads, other than ISO 6149. (Port connection only)	G 1/8-28	13-15	18-20
	G 1/4-19	19-23	25-30
	G 3/8-19	33-40	45-55
	G 1/2-14	55-70	75-95
	G 3/4-14	103-118	140-160
	G 1-11	162-184	220-250
	G 1 1/4-11	170-192	230-260
	G 1 1/2-11	258-347	350-470

Eaton Aeroquip recommends that a torque wrench be used to assure proper fitting assembly of these connections.

Proper tube installation



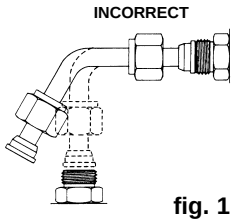


fig. 1

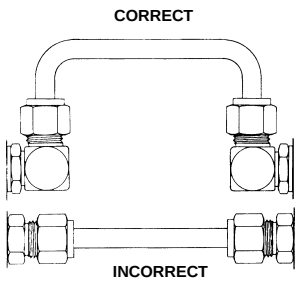


fig. 2

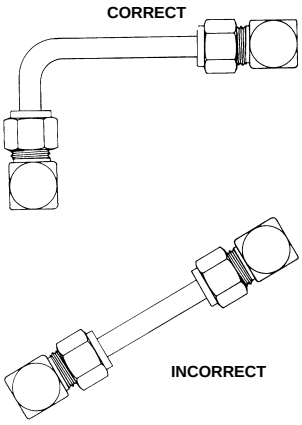


fig. 3

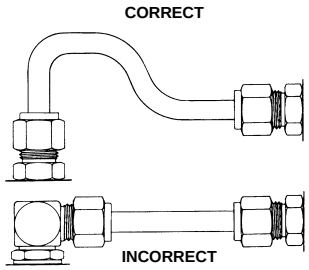


fig. 4

When compared to rigid pipe, hydraulic tubing offers the following advantages:

1. Size for size, tubing is lighter in weight, easier to handle and can be bent more easily than iron pipe.
2. Bent tubing reduces pressure drop and turbulence in the system because it eliminates sudden change in the direction of the fluid flow.
3. Hydraulic tubing reduces the number of connections required, thus reducing material and labor costs.
4. Fewer joints means lower costs and fewer points of potential leakage.
5. The use of tube fittings makes every joint a union which permits easier, faster maintenance and repair work.
6. The Aeroquip ORS-TF Tube Fitting eliminates the need for threading, brazing or welding.

Tube bending

To reduce the number of fittings in a tube assembly, bend the tubing whenever possible.

Steel tubing can be bent in many sizes by using a hand bender designed for steel tubing. For production quantities, or for larger sizes, a power bending tool is generally used. Contact Eaton Aeroquip for additional tube bending information.

Tube routing and installation

Tubing manufacturers will advise the correct radii for various types and wall thicknesses of tubing. Kinks, flattened bends, wrinkles and tube breakage can be avoided by the use of proper tube bending equipment.

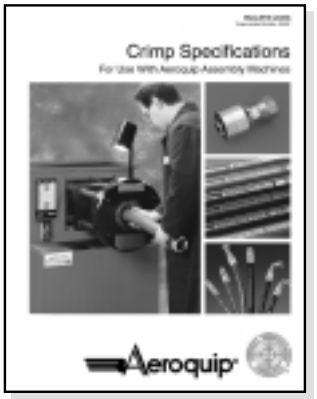
Avoid straight line connections whenever possible, especially in short runs.

Fluid conveying systems (see figures 2, 3 and 4) should be designed to follow the contour of the equipment. They are easier to install and present a neater appearance. Long runs should be supported by brackets or clamps. All heavy systems components should be bolted or clamped to eliminate tubing fatigue.

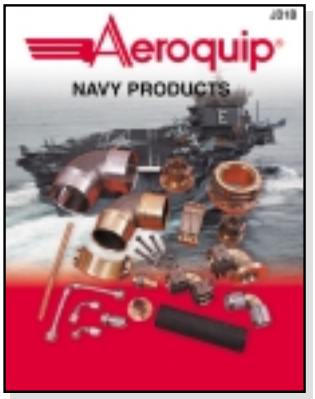
Inspect the tubing to see that it conforms to the required specifications before installation.

Tubes should align with the center line of the fittings, without distortion or tension. Tubing should not be sprung into position (see figure 1) to be assembled to the fitting. If this occurs the tubing has not been properly fabricated, and when installed and connected, places the tubing under stress.

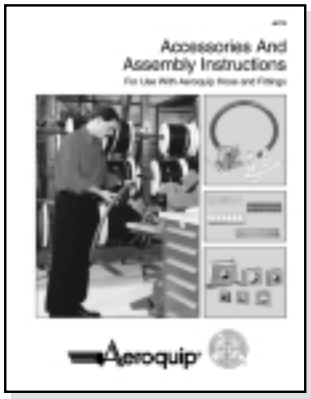
Other Aeroquip Product Literature



Crimp Specifications
Bulletin JA55

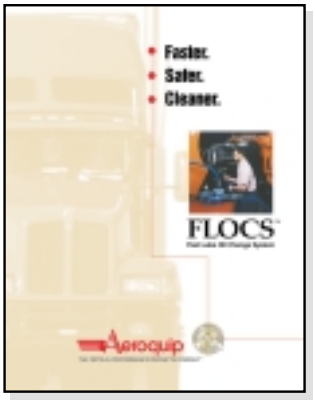


Marine Products
Catalog JD1



Accessories And Assembly
Instructions Catalog JA776

Flexmaster Joints
Catalog JA241



FLOCS
Bulletin JB13

MATCHMATE Plus
Bulletin JA592

Performance Products
Bulletin JC125

Aeroquip products are available from:

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