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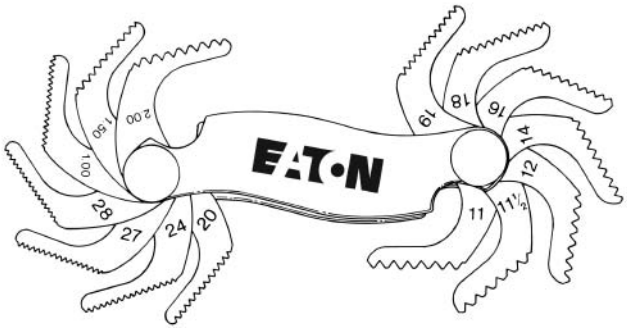

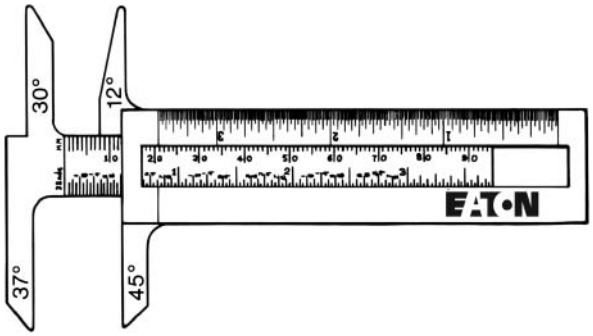

Hose Dash Size to Maximum Operating Pressure

See pages 349-355 for Fluid Compatibility

Hose tube identification chart

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

Pressures expressed in psi/bar.

HOSE TO FITTING PAGE REFERENCE CHART

Hose Part Number	Page	Tube	Hose -02	-03	-04	-05	-06	-08	-10	-12	-16	-20	-24	-32	-40	-48
FC252	0	5					50/3	50/3	40/3	40/3	35/2					
FC352*	0	5						100/7	100/7	100/7	90/6	85/6	85/6	75/5	60/4	50/3
2550	0	5					225/16									
2554	0	5					225/16									
2570	0	5					225/16	225/16	225/16							
FC829	0	6						225/16								
FC629	0	1					225/16	225/16								
2575	0	1			250/17		250/17	250/17	200/14	200/12						
FC647	0	1			360/25		300/21	300/21	250/17	250/17						
2556	0	1			360/25		300/21	300/21	250/17	250/17						
FC332	0	4			250/17		250/17	250/17	250/17	250/17						
2565	0	1			300/21		250/17	200/14	175/12	125/9						
1531	0	5							300/21	300/21	300/21	300/21				
1531A	0	5											300/21			
2661*	0	4								300/21††	250/17††	200/14††	150/10††	100/7††	62/4	56/4
FC619	0	1								300/21††	250/17††	200/14††	150/10††	100/7††	62/4	56/4
CR170	0	5			350/24		350/24	350/24		350/24						
FC321	0	5			350/24	350/24	350/24	350/24	350/24	350/24	350/24					
FC498	0	4			400/28		400/28	400/28	350/24	350/24						
FC598	0	4			400/28		400/28	400/28	350/24	350/24						
FC466	0	1			400/28		400/28	400/28	350/24	350/24						
FC699	0	5			400/28		400/28	400/28	350/24	350/24	250/17					
302A	0	1									800/55	600/41	500/34	350/24		
2580	0	1			1000/69	800/55	650/45	625/43	600/41	550/38	500/34	450/31	400/28	350/24		
2583	0	1			1250/86		1125/78	1000/69		750/52	565/39	375/26				
FC650	0	4			1000/69		1000/69	1000/69	1000/69	1000/69						
FC364	0	2						1250/86		1100/76	1000/69	1000/69	750/52	500/34	100/7	100/7
FC363	0	2						1250/86		1100/76	1000/69	1000/69	750/52	500/34		
FC355	0	4			1500/103	1500/103	1500/103	1250/86	1250/86	750/52	400/28	300/21	250/17	200/14		
FC234	0	5				1500/103	1500/103	1250/86	1250/86	750/52	400/28					
FC350	0	4			2000/138	1500/103	1500/103	1250/86	1250/86	750/52	400/28	300/21	250/17			
FC563	0	2						1250/86		1100/76	1000/69	1000/69	750/52	500/34		
2808	0	2						2750/190	2500/172	1750/121	1500/103	1125/78	800/55			
FC211	0	1			2750/190		2250/155	2000/138		1250/86	1000/69					
FC465	0	2		3000/207	3000/207	3000/207	2500/172	2000/138	1500/103	1200/83	1000/69	625/43				
2807	0	2		3000/207	3000/207	3000/207	2500/172	2000/138	1500/103	1200/83	1000/69	625/43				
FC807	0	2			3000/207	3000/207	2500/172	2000/138	1500/103	1200/83	1000/69					
FC300	0	4			3000/207	3000/207	2250/155	2000/138	1750/121	1500/103	800/55	625/43	500/34	300/21	300/21	
FC611	0	6			3000/207		2250/155	2000/138		1250/86	1000/69	625/43	500/34	375/26		
1503	0	1			3000/207	3000/207	2250/155	2000/138	1750/121	1500/103	800/55	625/43	500/34	350/24	350/24	
2651	0	1			3000/207	3000/207	2250/155	2000/138	1750/121	1500/103	800/55	625/43	500/34	350/24	350/24	
303	0	1			3000/207	3000/207	2000/138	2000/138	1750/121	1500/103						
FC639/ FC839B	0	1			3000/207		3000/207	3000/207	3000/207	3000/207	3000/207					

† Pressure rating with reusable style fittings.
‡ Pressure rating with Global crimp style fittings.
§ 10,000 psi for static jack hose applications. See hose page for details.
¥ 10,000 psi for water blast applications. See hose page for details.
* See hose page for dash sizes not listed.
†† 50 psi max with band clamp style fittings.

Hose Dash Size to Maximum Operating Pressure

Pressures expressed in psi/bar.

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 Corporation at 14615 Lone Oak Road, Eden Prairie, MN 55344 USA 952/937-9800.

HOSE TO FITTING PAGE REFERENCE CHART

Hose Part Number	Page	Tube	Hose -02	-03	-04	-05	-06	-08	-10	-12	-16	-20	-24	-32	-40	-48
GH681	0	1			3000/207		3000/207	3000/207								
FC194	0	4			3250/224		3000/207	2500/172	2000/138	1750/121	1250/86	900/62				
GH194	0	4			3250/224		3000/207	2500/172	2000/138	1800/124	1300/90	900/62				
GH663	0	1			3250/224		3000/207	2500/172		1800/124	1300/90	950/66	725/50	580/40		
					2750/190†		2250/155†	2000/138†		1250/86†	1000/69†					
2681	0	1		4000/276	3250/224	3250/224	3000/207	2500/172	2000/138	1800/124	1300/90	900/62	700/48	600		
GH493	0	1					4000/276	4000/276	4000/276	4000/276	4000/276	3000/207	2500/172	2500/172		
FC323	0	4								3000/207	3000/207	3000/207	3000/207	3000/207		
FC324	0	4						4000/276		4000/276	4000/276					
FC469	0	2						4000/276	4000/276	3500/241						
FC849/ FC849B	0	0			4000/276		4000/276	4000/276	4000/276	4000/276						
FC212	0	1			5000/345		4000/276	3500/241		2250/155	2000/138	1625/112	1250/86	1125/78		
FC310	0	1			5000/345		4000/276	3500/241	2750/190	2250/155	2000/138	1625/112				
FC693	0	6			5000/345		4000/276	3500/241								
GH120	0	1			5000/345		4000/276	3500/241	2750/190	2250/155	2000/138	1625/112	1250/86	1125/78		
FC510	0	4			5000/345		4000/276	3500/241	2750/190	2250/155	2000/138	1625/112				
FC325	0	4								5000/345	5000/345					
FC273/ FC273B	0	1								5000/345	5000/345	5000/345	5000/345	5000/345		
FC659	0	1					4000/276	4000/276	4000/276	4000/276	4000/276	3000/207	2500/172	2500/172		
FC136	0	1					5500/379§ 4000/276‡	5000/345 4000/276‡	5000/345 4000/276‡	4000/276	4000/276	3000/207	2500/172	2500/172		
FC636	0	6								4000/276	4000/276	3000/207	2500/172			
FC735	0	1			5000/345		5000/345	4250/293	3625/250	3125/216	2500/172	2250/155				
FC736	0	1					5500/379	5000/345	5000/345	4000/276	4000/276	3000/207	2500/172	2500/172		
							4000/276‡	4000/276‡	4000/276‡							
2766	0	1			5000/345		4000/276	3500/241		2250/155	2000/138	1625/112	1250/86	1000/69		
2781	0	1			5000/345		4000/276	3500/241	3250/224	3000/207	2000/138	1625/112	1750/121	1250/86		
					5750/397‡		5000/345‡	4250/293‡	3625/250‡	3125/216‡	2500/172‡	2250/155‡	1800/124‡	1500/103‡		
FC195	0	4			5000/345		4000/276	3500/241	2750/190	3000/207	2000/138	1625/112	1750/121	1250/86		
					5750/397‡		5000/345‡	4250/293‡	3250/224‡	3125/216‡	2500/172‡	2250/155‡	1800/124‡	1500/103‡		
GH195	0	4			5750/397		5000/345	4250/293	3250/224	3000/207	2500/172	2250/155	1750/121	1500/103		
GH781	0	1			5750/400		5000/345	4250/293	3625/250	3125/216	2500/172	2250/155	1800/124	1300/90		
GH793	0	1			5750/397		5000/345	4250/293	3625/250	3125/216	2500/172	2250/155	1800/124	1300/90		
					5000/345†		4000/276†	3500/241†	2750/190†	2250/155†	2000/138†					
GH506	0	1								6090/420	5510/380	5075/350	4250/293	3625/250		
FC254	0	1						7500/517¥		6250/431	5000/345	4000/276	3000/207	3000/207		
GH466	0	1										5510/380				
FC606/ FC606B	0	1									6000/414	6000/414	6000/414			
FC579***	0	1			10000/690§		10000/690§									

† Pressure rating with reusable style fittings.

‡ Pressure rating with Global crimp style fittings.

§ 10,000 psi for static jack hose applications. See hose page for details.

¥ 10,000 psi for water blast applications. See hose page for details.

* See hose page for dash sizes not listed.

†† 50 psi max with band clamp style fittings.

Agency Listings

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.

Industry Agencies

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

ISO – International Standards Organization

★ = Approved details available from Eaton

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

		GOVERNMENT							INDUSTRY						
Hose Part Number	Page	DOT/ FMVSS	CGA	DNV	FDA*	MIL/ DOD	MSHA	USCG/ MMT*	ISO	EN	DIN	AAR	ABS	SAE	UL
1503	0	106 Type All		★				★						100R5, J1402	
1531	0											M618			
1531A	0											M618			
2550	0	106 Type All						★						J1402	
2554															
2556	0			★			★								
2565	0					MIL-H-13444 Type I									
2570	0	106 Type All						★						J1402	
2580	0					MIL-H-24136/3	★	★							
2583	0			★			★			EN 854 Type R3				100R3	
2651	0			★			★	★					★		
2661	0						★	★					★+	100R4	
2681	0			★			★	★	1436 Type 1ST	EN 853 Type 1ST	20 022 Type 1ST			100R1A	
2781	0			★			★	★	1436 Type 1ST	EN 853 Type 2ST	20 022 Type 2ST			100R2A	
2807	0			★				★					★	100R14A	
2808	0							★					★		
302A	0					MIL-DTL-8794									
303	0					MIL-DTL-8794									
CR170	0		Type III												
FC136	0			★			★	★	3862 Type R12	EN 856 Type R12			★	100R12	
FC194	0			★+			★	★	1436 Type 1ST	EN 856 Type 1ST	20 022 Type 1ST			100R1A, J1019	
FC195	0						★	★	1436 Type 2ST	EN 856 Type 1ST	20 022 Type 1ST			100R2A	
FC211	0						★	★	1436 Type R1AT					100R2AT	
FC212	0						★	★	1436 Type R1AT					100R2AT	
FC234	0			★			★	★					★	J1527 Type A1	
FC252	0														

★ = Approved details available from Eaton
§ = In size -04 meets ISO 1436 Type R2AT
+ = Firesleeve required. Contact Eaton for details.
‡ = Does not meet in -04 size

Agency Listings

		GOVERNMENT							INDUSTRY						
Hose Part Number	**Page**	**DOT/ FMVSS**	**CGA**	**DNV**	**FDA***	**MIL/ DOD**	**MSHA**	**USCG/ MMT***	**ISO**	**EN**	**DIN**	**AAR**	**ABS**	**SAE**	**UL**
FC254	0			★			★	★					★	100R11	
FC273	0			★			★	★	3862 Type R13	EN 856 Type R13			★	100R13	
FC273B	0								3862 Type R13	EN 856 Type R13				100R13	
FC300	0	106 Type All		★				★					★	100R5, J1019, J1402	
FC310	0						★	★		EN 857 Type 1SC			★	100R16	
FC321	0														UL21
FC323	0						★	★					★	100R11, 100R12	
FC324	0							★	★	EN 856	Type R12		★	100R12	
FC325	0						★	★		EN 856 Type R13				100R13	
FC332	0												★+		
FC350	0	106 Type All		★+				★	★				★	J1402	
FC352	0													20R1	
FC355	0	106 Type All											★	J1402	
FC363	0				★			★							
FC364	0				★										
FC465	0													100R14B	
FC466	0									EN 854 Type R6				100R6	
FC469	0														
FC498	0						★			EN 854 Type R6				100R6	
FC510	0						★	★		EN 857 Type 1SC				100R2AT	
FC555	0														
FC558	0													J2064 Type B Class 1	
FC563	0														
FC579	0						★								
FC598	0													100R6	
FC606	0						★			3862 Type R15			★	100R15	
FC606B	0									3862 Type R15				100R15	
FC611	0														
FC619	0				★		★						★+	100R4	
FC629	0	106 Type All												J1402	
FC636	0														
FC639	0						★						★	100R17	
FC647	0														
FC650	0														

★ = Approved details available from Eaton.

+ Firesleeve required. Contact Eaton for details.

‡Applies only to hose that has suffered no damage, has been properly assembled with hose guards and tested to required proof test pressure.

Agency Listings

		GOVERNMENT							INDUSTRY						
Hose Part Number	**Page**	**DOT/ FMVSS**	**CGA**	**DNV**	**FDA***	**MIL/ DOD**	**MSHA**	**USCG/ MMT***	**ISO**	**EN**	**DIN**	**AAR**	**ABS**	**SAE**	**UL**
FC659	0			★			★	★		E3862 Type R12	EN 856 Type R12		★	100R12	
FC693	0														
FC699	0														
FC735	0									1436 Type 2SN§	20 022 Type 2SN	‡		100R16	
FC736	0									3862 Type R12	EN856 Type R12			100R12	
FC807	0													100R14A	
FC829	0	106 Type All											J1420		
FC839B	0													100R17	
FC849	0						★	★					★		
FC849B	0														
GH120	0						★							100R16	
GH194	0			★+			★		1436 Type 1SN	EN 853 Type 1SN	20 022 Type 1SN		★	100R1AT	
GH195	0						★	★	1436 Type 2SN	EN 853 Type 2SN	20 022 Type 2SN		★	100R2AT	
GH466	0						★								
GH493	0			★			★	★	3862 Type R12	EN 853 TypeR12			★	100R12	
GH506	0			★			★		3862 Type 4SH	EN856 Type 4SH	20 023 Type T2				
GH663	0			★			★	★††	1436 Type 1SN	EN 853 Type 1SN	20 022 Type 1SN		★	100R1AT	
GH681	0						★				DIN20022 Type 1				
GH781	0			★			★	★		EN 853 Type 2SC			★	100R16	
GH793	0			★			★	★	1436 Type 2SN	EN 853 Type 2SN	20 022 Type 2SN		★	100R2AT	

★ = Approved details available from Eaton.
+ Firesleeve required. Contact Eaton for details.
†† = -4 thru -16 only

Fluid Compatibility

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
14615 Lone Oak Road
Eden Prairie, MN 55344
USA
952/937-9800;
Fax: 952/974-7722
www.hydraulics.eaton.com

Resistance key rating

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.

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.

Hose tube identification chart

1. Nitrile

302A (p.26)	FC136 (p.52)	FC619 (p.34)	GH120 (p.45)
303 (p.26)	FC211 (p.38)	FC639/ (p.42)	GH466 (p.55)
1503 (p.26)	FC212 (p.44)	FC606 (p.56)	GH493 (p.51)
2556 (p.34)	FC254 (p.53)	FC647 (p.33)	GH506 (p.55)
2565 (p.34)	FC273/ (p.54)	FC659 (p.52)	GH663 (p.39)
2580 (p.37)	FC273B (p.54)	FC735 (p.46)	GH681 (p.42)
2583 (p.37)	FC310 (p.41)	FC736 (p.53)	GH781 (p.47)
2651 (p.25)	FC466 (p.35)	FC849/ (p.43)	GH793 (p.48)
2681 (p.38)	FC579 (p.57)	FC849B (p.44)	
2781 (p.47)		FC849B (p.43)	

2. PTFE

2807 (p.28)	FC363 (p.31)	FC465 (p.29)	FC563 (p.32)
2808 (p.30)	FC364 (p.31)	FC469 (p.30)	FC807 (p.29)

3. Thermoplastic Elastomer

4. AQP

2661 (p.35)	FC323 (p.50)	FC350 (p.23)	FC598 (p.36)
FC194 (p.40)	FC324 (p.50)	FC355 (p.23)	FC650 (p.24)
FC195 (p.49)	FC325 (p.51)	FC498 (p.36)	FC699 (p.24)
FC234 (p.25)	FC332 (p.33)	FC510 (p.41)	GH194 (p.39)
FC300 (p.27)		FC598 (p.36)	GH195 (p.48)

5. Special Application Hose (Not Included in Fluid Chart)

FC234	FC650			Fuel	(pp.25, 24)
CR170	FC321			LPG	(pp.27, 28)
1531	1531A			Railroad Air Brake	(p.22)
FC252	FC352	FC629	FC829	Silicone	(p.20)
2550	2554	2570	FC350	Truck Air Brake	(pp.21-23)

6. EPDM Rubber

FC611 (p.40)	FC636 (p.49)	FC693 (p.46)

SEAL ELASTOMER DATA

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

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

Fluid Compatibility

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

FLUID	HOSE 1 Nitrile	2 PTFE	3 Thermoplastic Elastomer	4 AQP	5 Special Application Hose	6 EPDM	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	E		E	U	U	E	G	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		C	U	U	U	E	U	U	C	C	C	U	E
Acetylene	E	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		E	G	G	E	E	G	G	E	E	E	E	E
Air, Hot (201°F – 300°F)	U	E	U	C		G	U	U	G	E	U	U	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	U		E	E	E	E	E	G	E	U	U	U	E	C
Aluminum Nitrate	E	E	E	C		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	E	G	U	U		E	E	E	E	U	–	–	E	U	E	E	E
Ammonia, Hot	U	G	U	U		G	U	G	G	U	–	–	E	U	E	E	E
Ammonia, Anhydrous	G	U	U	E		E	E	E	E	U	–	–	E	U	E	E	E
Ammonia, Aqueous	G	G	U	C		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	E		E	E	E	E	U	–	–	U	U	C	U	C
Ammonium Hydroxide	C	E	U	E		E	C	C	E	C	U	U	G	U	C	C	U
Ammonium Nitrate	E	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		G	U	U	G	U	U	U	E	E	E	E	E
Amyl Alcohol	E	E	E	C		E	G	C	E	G	C	E	G	G	E	U	G
Aniline, Aniline Oil	U	E	U	C		G	U	U	G	U	U	U	E	U	E	G	G
Aniline Dyes	C	E	U	U		U	U	G	G	G	U	U	U	C	G	C	G
Arsenic Acid	E	E	G	G		E	E	E	E	E	C	G	U	U	G	U	C
Asphalt	G	E	G	G		U	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	E	E	E	E		U	E	G	U	E	G	E	E	E	E	E	E
ASTM #3	E	E	E	E		U	E	G	U	E	G	E	E	E	E	E	E
Automatic Trans. Fluid	E	E	G	G		E	E	G	U	E	C	G	E	E	E	E	E
Barium Chloride	E	E	C	C		C	E	E	E	E	G	C	U	G	G	G	G
Barium Hydroxide	E	E	G	C		C	E	E	E	E	E	G	G	U	G	U	G
Barium Sulfide	E	E	C	C		C	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	E		C	U	U	U	E	C	C	U	G	G	G	G
Benzyl Alcohol	U	E	C	G		C	U	G	G	E	C	C	E	G	E	G	G
Black Sulfate Liquor	E	E	C	C		E	C	C	C	E	U	C	E	C	E	U	U
Blast Furnace Gas	C	U	C	G		C	U	U	U	E	U	C	E	C	E	U	U
Borax	E	E	G	G		E	G	G	E	E	G	G	E	E	E	G	–
Boric Acid	E	E	C	E		E	G	G	G	E	G	G	U	G	C	C	C
Brine	E	E	C	C		C	E	G	E	E	G	C	U	G	G	U	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	G		G	U	U	G	U	U	C	E	E	E	E	E
Butyl Alcohol	E	E	G	G		E	E	E	G	E	G	G	G	G	G	G	G
Butyl Cellosolve	C	E	C	C		E	U	U	G	U	U	C	E	E	E	E	E
Butylene	G	E	–	C		U	C	U	U	E	U	–	E	E	E	E	E
Butyl Stearate	G	E	–	G		G	G	U	U	E	–	–	G	G	G	G	G
Butyraldehyde	U	E	–	C		G	U	U	G	U	U	–	E	E	E	E	G
Calcium Acetate	E	E	C	E		G	G	G	E	U	U	C	G	G	C	G	G
Calcium Bisulfate	G	E	G	G		E	E	E	U	E	G	G	U	C	C	U	U
Calcium Chloride	E	E	E	C		E	E	E	E	E	E	E	G	G	G	C	G

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

FLUID	HOSE 1 Nitrile	2 PTFE	3 Thermoplastic Elastomer	4 AQP	5 Special Application Hose	6 EPDM	SEALS Buna-N	Neoprene	EPR	Viton*	Urethane	Hytrel	METAL Steel	Brass	Stainless Steel	Aluminum	Monel
Calcium Hydroxide	E	E	C	C		E	E	E	E	E	U	C	G	G	G	U	G
Calcium Hypochlorite	C	E	C	U		E	U	U	E	E	U	C	U	G	C	U	U
Calcium Nitrate	E	E	E	C		E	E	E	E	E	E	E	G	G	G	G	G
Cane Sugar Liquors	E	E	E	E		E	E	E	E	E	U	E	E	G	E	E	E
Carbitol	G	E	G	C		G	G	G	G	G	U	G	E	E	E	E	E
Carbolic Acid	E	E	U	E		C	U	U	G	E	U	U	U	E	E	–	–
Carbonic Acid	G	E	C	U		G	G	E	E	E	C	C	U	C	E	G	E
Carbon Dioxide	E	E	E	E		E	G	G	E	E	G	E	E	E	E	E	E
Carbon Disulfide	U	E	C	U		U	U	U	E	E	C	C	G	G	G	E	G
Carbon Monoxide	U	E	E	E		G	G	G	E	E	G	E	E	E	E	E	E
Carbon Tetrachloride	C	E	U	U		U	U	U	U	E	U	U	U	G	G	U	E
Castor Oil	E	E	G	E		G	E	E	G	E	G	G	E	E	E	E	E
Cellosolve Acetate	C	E	U	U		G	U	U	G	U	U	U	U	U	E	G	E
China Wood Oil (Tung Oil)	E	E	C	U		U	G	G	U	E	U	C	E	G	E	E	E
Chlorine	U	U	U	U		C	U	U	U	G	U	U	C	C	C	C	C
Chloroacetic Acid	U	E	U	U		G	U	U	G	U	U	U	U	U	U	U	G
Chloroacetone	U	E	U	U		C	U	U	E	U	U	U	G	G	G	U	G
Chlorobenzene	U	E	U	U		U	U	U	U	G	U	U	G	G	G	G	G
Chloroform	U	E	U	U		U	U	U	U	E	U	U	G	G	G	G	G
O-Chlorophenol	U	E	U	C		U	U	U	U	E	U	U	G	G	G	U	G
Chlosulfonic Acid	U	E	U	U		E	U	U	U	U	U	U	G	U	G	G	C
Chrome Plating Solution	U	E	–	U		U	U	U	G	E	U	–	C	U	U	U	U
Chromic Acid	U	E	–	U		G	U	U	C	E	U	–	C	U	U	U	U
Citric Acid	G	E	C	G		E	E	E	E	E	E	C	C	C	C	C	C
Coke Oven Gas	C	E	–	C		U	U	U	U	E	U	–	E	C	E	U	U
Copper Chloride	E	E	E	G		E	E	E	E	E	G	E	U	U	U	U	U
Copper Cyanide	E	E	–	E		E	E	E	E	E	E	–	E	U	G	U	G
Copper Sulfate	E	E	G	E		E	E	E	E	E	G	G	U	C	G	U	G
Cotton Seed Oil	E	E	E	G		G	E	G	C	E	E	E	E	E	E	E	E
Creosote (Coal Tar)	G	E	U	G		U	G	C	U	E	U	U	E	C	E	E	E
Crude Oil	G	E	C	E		U	E	G	U	E	G	C	G	U	G	U	U
Cyclohexanol	G	E	C	E		C	E	G	U	E	C	C	E	E	E	C	E
Cyclohexanone	U	E	G	U		G	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	U		E	U	U	E	U	C	C	E	E	E	E	E
Dibenzyl Ether	U	E	–	U		G	U	U	G	U	–	–	G	G	G	G	G
Diesel Oil	E	E	C	G		U	E	C	U	E	C	C	E	E	E	E	E
Diethylamine	C	E	–	C		G	G	G	G	U	–	–	E	U	E	–	E
Dioctyl Phthalate (DOP)	U	E	C	C		G	U	U	G	G	C	C	E	E	E	E	E
Dowtherm A&E	U	E	–	U		U	U	U	U	E	–	–	G	U	E	E	E
Dowtherm 209	C	E	–	C		E	C	G	E	U	–	–	–	–	–	–	–
Ester Blend	C	E	C	C		E	E	U	U	E	U	E	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	G		G	U	U	G	U	C	C	E	E	E	E	E
Ethyl Benzene	U	E	–	U		U	U	U	U	E	U	–	E	G	G	G	E
Ethyl Cellulose	E	E	C	G		G	G	G	G	U	C	C	E	G	G	G	G
Ethyl Chloride	C	E	U	C		C	U	U	U	E	U	U	E	E	E	G	G
Ethylene Dichloride	U	E	U	U		C	U	U	U	G	U	U	G	C	G	G	G
Ethylene Glycol	E	E	C	G		E	E	E	E	E	C	C	U	G	E	E	E
Ferric Chloride	E	E	–	G		E	E	G	E	E	–	–	U	U	U	U	U
Ferric Nitrate	E	E	C	E		E	E	E	E	E	C	C	U	U	G	U	U
Ferric Sulfate	E	E	C	E		E	G	G	E	E	C	C	U	U	E	U	U
Formaldehyde	G	E	C	G		E	C	C	G	G	C	C	E	E	E	G	G
Formic Acid	C	E	U	C		E	C	G	E	U	U	U	U	C	C	C	C
Fuel Oil	E	E	E	E		U	E	G	U	E	G	G	E	E	E	E	E
Furfural	U	E	–	G		G	C	C	G	U	U	–	G	G	G	G	G
Gallic Acid	U	E	–	C		G	G	G	E	U	U	–	U	–	G	C	G
Gasoline	E	E	E	G		U	E	C	U	E	E	E	E	E	E	E	E
Gasohol	C	E	G	C		U	G	G	U	E	E	E	E	E	E	G	E
Glycerine/Glycerol	E	E	E	E		E	E	E	E	E	G	E	E	G	E	E	E
Green Sulfate Liquor	G	E	–	U		E	G	G	E	E	–	–	U	U	E	U	U

*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.

Fluid Compatibility

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

FLUID	Nitrile 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
	HOSE						SEALS						METAL				
Helium	E	G	C	E		E	E	E	E	E	E	E	E	E	E	E	E
Heptane	E	E	E	C		U	E	G	U	E	G	G	E	E	E	E	E
Hexaldehyde	U	E	–	C		E	U	G	G	U	U	–	G	G	E	E	G
Hexane	E	E	E	E		U	E	G	U	E	G	G	E	E	E	E	E
Hydraulic Oils																	
Ester Blend	C	E	C	G		E	E	U	U	E	U	E	E	E	E	E	E
Phos. Ester/Petroleum Blend	U	E	C	G		–	U	U	U	C	U	G	E	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	G		E	E	E	E	E	C	C	E	E	E	G	E
Water Petroleum Emulsion	G	E	C	G		U	E	G	U	E	C	C	C	E	E	G	E
Hydrobromic Acid	U	E	U	E		E	U	U	E	E	U	U	E	U	E	E	U
Hydrochloric Acid	U	E	U	E		C	U	U	G	E	U	U	U	U	U	U	U
Hydrocyanic Acid	C	E	–	U		G	C	C	E	E	–	–	E	E	G	E	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	G	C	C	G		G	E	E	E	E	E	E	E	E	E	E	E
Hydrogen Peroxide	C	E	G	G		E	G	G	G	E	G	G	U	U	G	E	U
Hydrogen Sulfide, Dry	U	C	C	C		E	U	G	E	U	–	G	E	G	G	G	G
Isocyanate	U	E	U	U		U	U	U	G	E	U	U	G	–	G	–	–
Iso Octane	G	E	E	G		U	E	G	U	E	G	E	E	E	E	E	E
Isopropyl Acetate	U	E	C	U		G	U	U	G	U	U	C	E	–	E	E	E
Isopropyl Alcohol	G	E	C	G		E	G	G	E	E	U	C	E	E	E	G	E
Isopropyl Ether	G	E	–	C		U	G	U	U	U	C	–	G	G	G	–	–
JP-4, JP-5	E	E	G	E		U	E	U	U	E	U	G	E	E	E	E	E
Kerosene	E	E	G	E		U	E	U	U	E	U	G	E	E	E	E	E
Lacquer/Lacquer Solvents	U	E	C	U		U	U	U	U	U	U	G	U	E	E	E	E
Lime Sulfur	C	E	C	C		C	U	E	E	E	C	C	G	U	G	–	U
Linseed Oil	E	E	G	G		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	G		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	E	E	E	E
Maleic Acid	G	E	C	C		C	U	U	U	E	C	C	E	G	G	G	G
Maleic Anhydride	U	E	C	C		U	U	U	U	E	C	C	G	U	E	G	E
Malic Acid	G	E	–	G		U	G	G	U	G	–	–	U	–	E	G	E
Mercuric Chloride	G	E	E	G		G	E	E	E	E	E	E	U	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	G	E	U	C	C	G	G	E	C	E
Methyl Bromide	C	E	U	U		C	G	U	U	E	U	U	E	E	G	U	E
Methyl Chloride	U	E	U	U		C	U	U	U	E	U	U	E	E	E	U	G
Methyl Butyl Ketone	U	E	C	C		C	U	U	E	U	C	C	E	E	E	–	E
Methyl Ethyl Ketone	U	E	C	U		E	U	U	E	U	U	G	G	G	G	G	G
Methylene Chloride	U	E	U	U		U	U	U	U	G	U	U	G	G	G	G	G
Methyl Isobutyl Ketone	U	E	U	U		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	–	U		C	U	U	C	U	–	–	E	G	G	E	G
MIL-L-2104	E	E	E	E		U	E	G	U	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
MIL-L-7808	G	E	G	G		U	G	U	U	E	G	G	G	G	E	–	–
MIL-L-23699	G	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
MIL-H-83282	G	E	–	G		U	E	U	U	E	–	–	E	E	E	–	E
Mineral Oils	G	E	G	G		U	E	G	U	E	G	G	E	E	E	E	E
Naphtha	G	E	G	E		U	C	U	U	E	C	G	–	–	–	–	–
Naphthalene	U	E	G	G		U	U	U	U	E	C	G	E	G	E	G	G
Naphthenic Acid	G	E	–	E		U	C	U	U	E	–	–	–	G	E	G	G
Natural Gas	C	U	U	U		U	E	E	U	E	–	–	G	G	G	G	G

FLUID	Nitrile 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
	HOSE						SEALS						METAL				
Nickel Acetate	G	E	U	G		E	C	C	E	G	U	U	G	C	E	G	E
Nickel Chloride	E	E	U	E		E	E	G	E	E	U	U	U	U	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		G	U	U	U	E	U	C	U	U	E	U	U
Nitric Acid, over 10%	U	E	U	U		U	U	U	U	G	U	U	U	U	E	C	U
Nitrobenzene	U	E	U	U		U	E	G	E	E	E	E	E	G	E	E	E
Nitrogen	E	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Octyl Alcohol	G	E	E	E		E	E	E	E	E	E	E	E	E	E	E	E
Oleic Acid	G	E	G	E		G	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)	C	E	G	C		C	E	G	U	E	G	G	E	E	E	E	E
Ortho-Dichlorobenzene	U	E	–	U		U	U	U	U	E	–	–	G	G	G	G	G
Oxalic Acid	C	E	C	E		E	G	G	E	E	C	C	U	C	C	C	C
Oxygen	U	U	U	U		U	–	–	–	–	–	–	G	G	G	G	G
Palmitic Acid	G	E	E	E		G	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	U	E	U	C		G	E	G	G	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
Petroleum Base	E	E	E	G		U	E	G	U	E	E	E	E	E	E	E	E
Phenol (Carbolic Acid)	U	E	U	G		U	U	U	G	E	U	U	U	E	E	E	G
Phosphate Ester	U	E	C	U		C	U	U	G	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	E	E	U	U	C	U	C	E	E
Potassium Acetate	E	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	E	C	E	U	G
Potassium Cyanide	E	E	E	G		E	E	E	E	E	E	E	C	U	G	U	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	G		E	G	G	E	G	C	C	G	G	G	U	E
Potassium Hydroxide, over 10%	C	E	U	G		G	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 (Liquified)	C	–	–	–		U	C	–	–	–	–	–	E	E	E	E	E
Propyl Acetate	U	E	–	C		C	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	U	E	–	–	E	E	E	E	E
Refrigerant R-12	E	–	G	U		U	G	E	C	E	E	E	E	E	E	E	E
Refrigerant R-13	E	–	G	U		U	G	E	C	E	E	E	E	E	E	E	E
Refrigerant R-22	U	C	U	U		G	U	E	C	U	U	U	E	E	E	E	E
Refrigerant R-134a	U	C	U	U		E	E	C	U	U	U	E	E	E	E	E	E
Sewage	G	E	E	G		G	E	E	E	E	U	E	G	G	G	G	G
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	U	E
Sodium Acetate	G	E	–	G		E	G	G	E	U	–	–	E	E	G	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	E	U	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	G		E	U	G	E	G	G	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		G	C	C	E	C	C	C	U	U	U	U	C
Sodium Metaphosphate	E	E	E	E		E	E	E	E	E	E	E	E	G	G	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	–	G		G	G	G	E	E	U	–	U	U	C	C	C
Sodium Phosphates	E	E	E	C		E	E	E	E	E	E	E	U	E	G	U	E
Sodium Silicate	E	E	E	G		E	E	E	E	E	E	E	E	E	E	E	E
Sodium Sulfate	E	E	E	G		E	E	E	E	E	E	E	C	G	G	G	G
Sodium Sulfide	E	E	E	G		E	E	E	E	E	E	E	C	U	C	U	G
Sodium Thiosulfate	G	E	E	G		E	G	E	E	E	E	E	U	U	C	G	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.

Fluid Compatibility

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

FLUID	Nitrile 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
	HOSE						SEALS						METAL				
Soy Bean Oil	E	E	G	C		U	E	G	U	E	G	G	E	E	E	E	E
Stannic Chloride	G	E	C	E		E	E	G	E	E	C	C	U	U	U	U	U
Steam (up to 388°F)	U	E	U	U		G	U	U	C	C	U	U	E	E	E	G	E
Stearic Acid	G	E	G	G		G	G	G	G	E	G	G	C	C	E	C	E
Stoddard Solvent	G	E	U	E		U	E	G	U	E	U	U	E	E	E	E	E
Styrene	U	E	U	U		U	U	U	U	G	U	U	E	E	E	E	E
Sulfur	C	E	G	G		E	U	E	E	E	G	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	C	E	U	U		C	U	U	G	E	U	U	G	C	G	G	G
Sulfuric Acid, to 10%	U	E	U	U		E	U	G	U	E	C	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	U	E	U	G		G	C	C	U	U	U	U	U	C	C	C	U
Tannic Acid	G	E	G	E		G	E	E	E	E	G	G	E	E	E	C	E
Tar (Bituminous)	G	E	G	G		U	G	U	U	E	G	G	E	G	E	E	E
Tartaric Acid	E	E	G	E		G	E	G	G	E	G	G	U	C	C	E	E
Tertiary Butyl Alcohol	E	E	G	E		E	G	G	G	E	G	G	G	G	G	G	G
Titanium Tetrachloride	C	E	–	U		U	C	U	U	E	–	–	E	U	G	U	
Toluene (Toluol)	U	E	U	U		U	U	U	U	E	U	U	E	E	E	E	E
Trichlorethylene	U	E	U	U		U	U	U	U	E	U	U	E	G	E	E	E
Tricresyl Phosphate	U	E	U	U		E	U	U	E	G	U	U	E	–	C	–	G
Triethanolamine	G	E	U	G		G	E	U	E	U	U	U	E	U	E	E	E
Tung Oil	E	E	C	U		U	G	G	U	E	U	C	E	G	E	E	E
Turpentine	G	E	G	G		U	G	U	U	E	G	G	G	G	G	G	G
Varnish	C	E	G	G		U	G	U	U	E	G	G	E	G	E	E	E
Vinyl Chloride	U	E	U	U		C	U	U	U	E	U	U	E	U	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	U	U	C	G	E	G	E
Water (+201°F to +350°F)	U	E	U	U		E	U	U	U	G	U	U	C	G	E	G	E
Water Glycol	E	E	C	E		E	E	E	E	C	C		E	E	E	G	E
Water Petroleum Emulsion	E	E	C	E		U	E	G	U	E	C	C	C	E	E	G	E
Xylene	U	E	E	U		U	U	U	E	U	U	C	E	E	E	E	E
Zinc Chloride	E	E	E	E		E	E	E	E	E	E	E	E	U	U	C	G
Zinc Sulfate	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 namebrand 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.

Fluid Compatibility

STRAIGHT PETROLEUM-BASE

Maximum fluid temperature recommendation**

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

Fluid Compatibility

WATER AND PETROLEUM OIL EMULSION (FR)

Maximum fluid temperature recommendation**

Fluid Name

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 349 for maximum fluid temperatures and limiting ambient temperatures.*

WATER AND GLYCOL SOLUTION

Maximum fluid temperature recommendation**

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

Fluid Compatibility

STRAIGHT PHOSPHATE-ESTER (FR)

Maximum fluid temperature recommendation**

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**

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**

Fluid Name

Stauffer Jet I
Stauffer Jet II

SILICONE OILS

Maximum fluid temperature recommendation**

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**

Fluid Name

Quintolubric 822 Series

***See CAUTION on page 349 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

SAE Recomended Practices

Selection, installation and maintenance of hose and assemblies — SAE J1273 October 1996

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

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 straight edge.

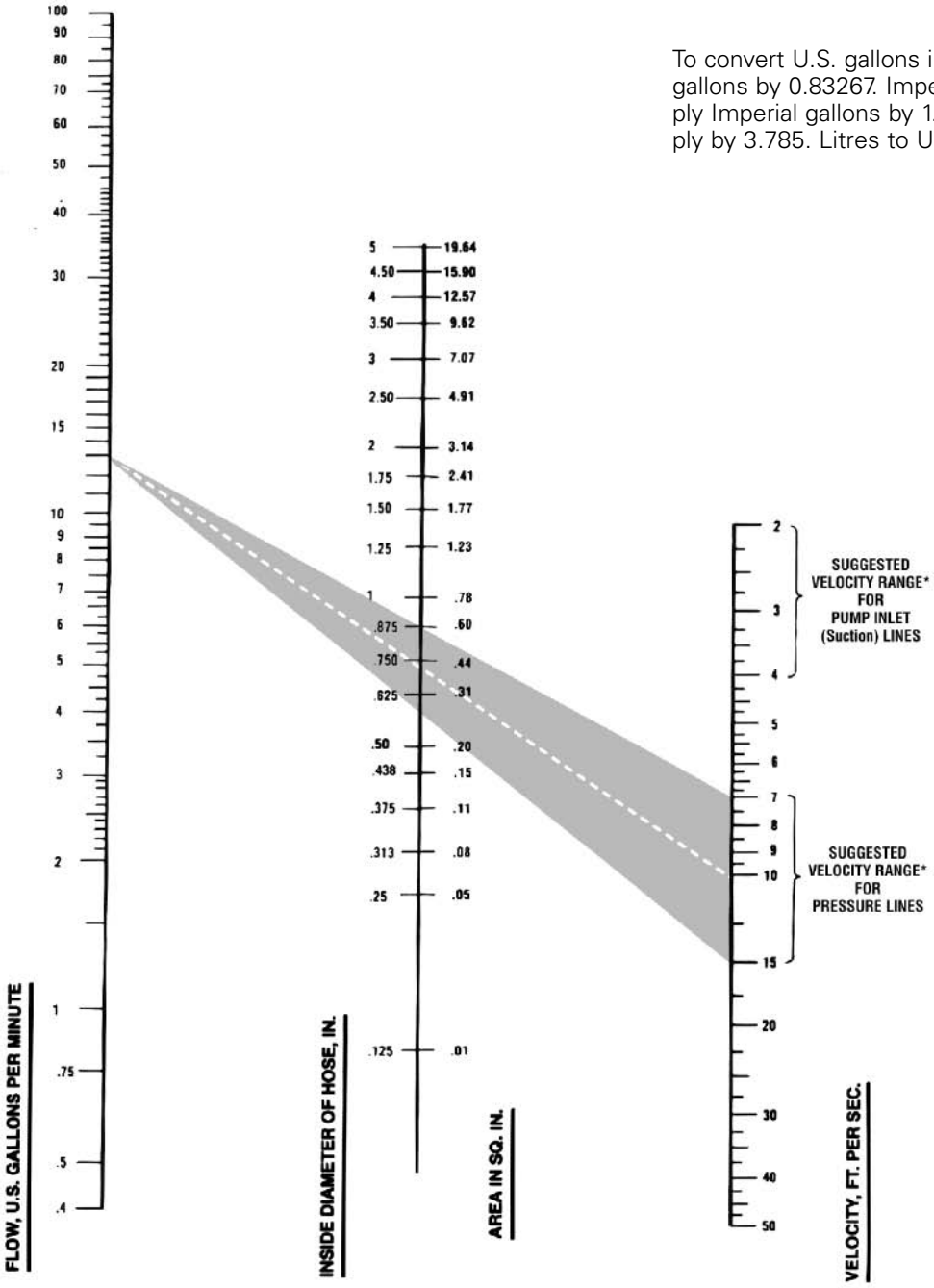
For suction hose, follow the same procedure except use suggested velocity range for pump inlet lines in the right hand column.

Based on Formula

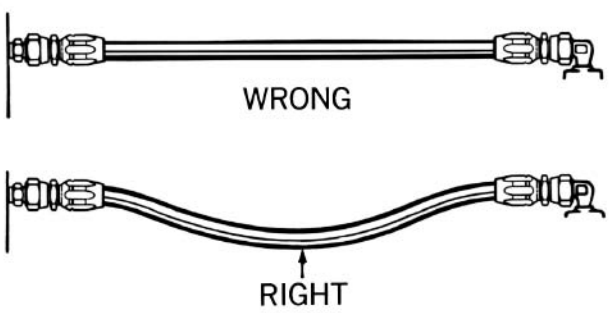
$$\text{AREA (SQ. IN.)} = \frac{\text{G.P.M.} \times 0.3208}{\text{VELOCITY (FT./SEC.)}}$$

*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.

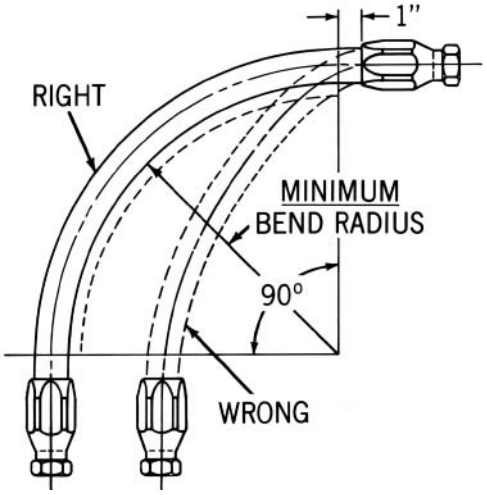
To convert U.S. gallons into Imperial gallons multiply U.S. gallons by 0.83267. Imperial gallons into U.S. gallons multiply Imperial gallons by 1.20095. U.S. gallons to litres multiply by 3.785. Litres to U.S. gallons, multiply by 0.2642.



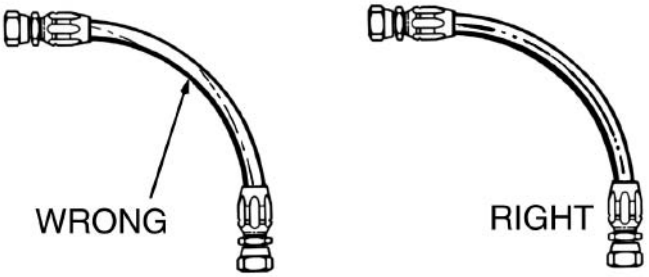
Hose Routing and Installation



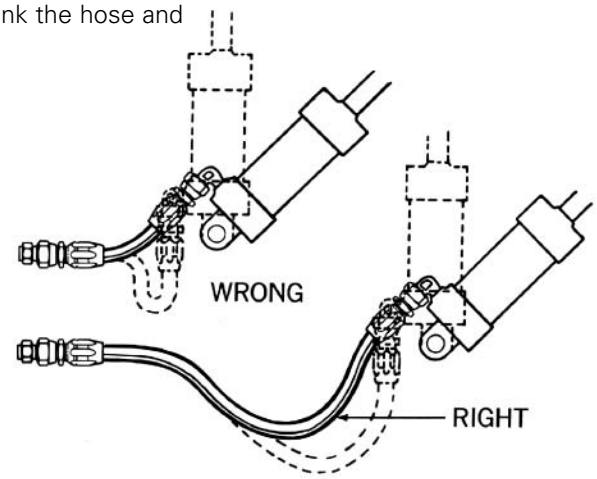
Under pressure, a hose may change in length. Always provide some slack in the hose to allow for this shortening or elongation. (However, excessive slack in hose lines may cause poor appearance.)



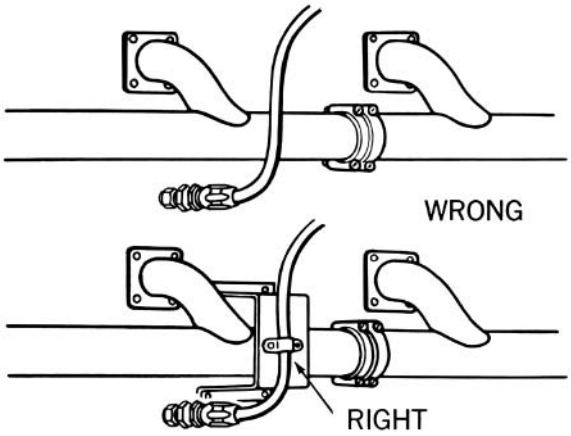
At bends, provide sufficient hose so that it does not have a bend radius less than its recommended minimum bend radius. Too tight a bend may kink the hose and restrict or stop the fluid flow. In many cases the proper use of adapters and hose fittings can eliminate tight bends or kinks.



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.

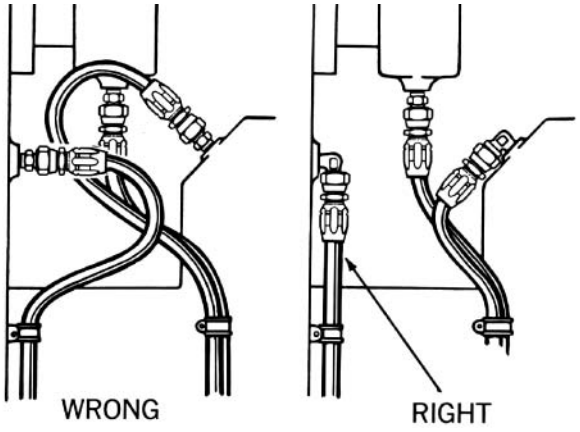


In applications where there is considerable vibration or flexing, allow additional hose length. The metal hose fittings, of course, are not flexible, and proper installation protects metal parts from undue stress, and avoids kinks in the hose.



When 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.



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

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'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'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 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 to improve your hose assembly and installation techniques.

This material is available free from
Eaton Corporation
14615 Lone Oak Road,
Eden Prairie, MN 55344
USA, 952/937-9800.

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

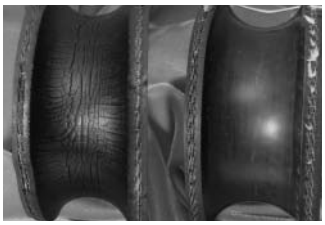
Too frequent or premature hose failure can be the symptom of a malfunction in your equipment. This is a factor that should be considered since prompt corrective action can sometimes avoid serious and costly equipment breakdown. Reprints of an article on "Troubleshooting Hydraulic Systems," which tells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

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 Everflex Polyon thermoplastic hoses are rated at –65°F (–54°C).

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 impulse 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 (100R12) are 500,000 cycles at 133% maximum operating and at +250°F (121°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 exam-ination 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.

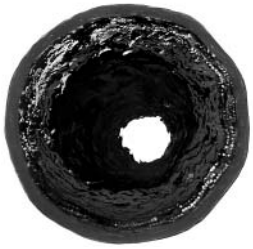
12. Symptom: Fitting blew off of the end of the hose.

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 "4Q01" which would mean that the hose was manufactured during the fourth quarter (October, November or December) of 2001.

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.

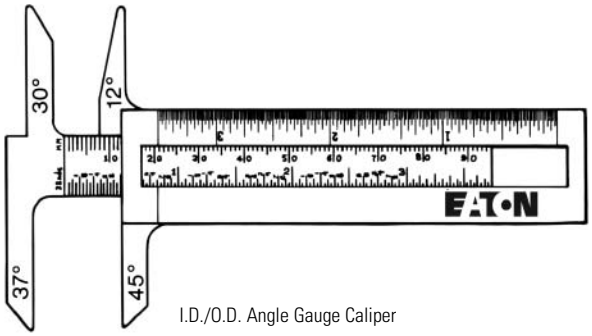
Cause: One of the most common causes for this is improper handling of the PTFE assembly. PTFE is a thermoplastic material which is not rubber-like. When bent sharply it simply collapses. This type of collapse is localized in one area and is radial. When the PTFE tube is folded longitudinally in one or 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 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.

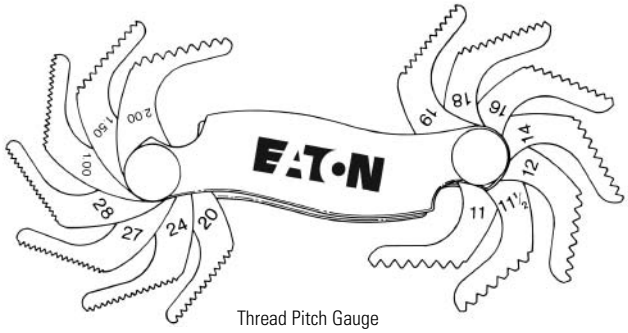
Cause: This situation occurs when a petroleum base fluid, with a low viscosity, is flowing at a high velocity. This condition can generate high voltage due to static electricity. The high voltage is seeking a ground connection and the only ground connection available is the braided stainless steel reinforcement. 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 The Indentification 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 offers a unique new caliper than offers the capabilities of both a caliper and a seat angle gauge in one unit.

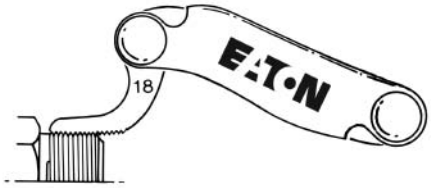


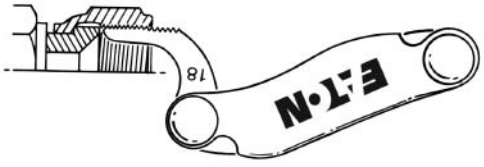
I.D./O.D. Angle Gauge Caliper



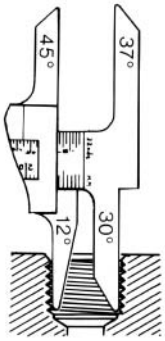
Thread Pitch Gauge

How to Measure Threads



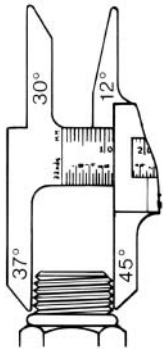


Use a thread pitch gauge to determine the number of threads per inch or the distance between threads in metric connections. Place the gauge on the threads until the fit is snug. Match the measurement to the charts.



I.D.

Measure the thread diameter with an I.D./O.D. caliper as shown.

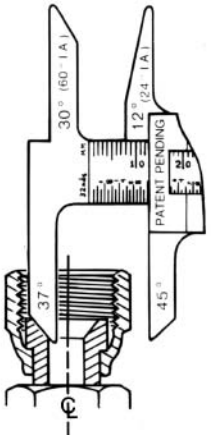


O.D.

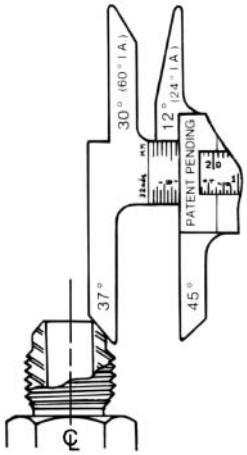
Match the measurements to the charts.

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.

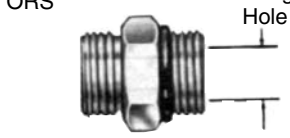
Dash size	N.P.T.F.	N.P.S.M. Approx. Dia.	SAE 45° Auto. Refrig.	SAE 37° (J.I.C.) Hydraulic	SAE O-Ring Boss	P.T.T. 30° Automotive	SAE Invert. Flare	ORS
–02	1/8–27	1/8–27	5/16–24	5/16–24	5/16–24		5/16–24	
–03			3/8–24	3/8–24	3/8–24		3/8–24	
–04	1/4–18	1/4–18	7/16–20	7/16–20	7/16–20		7/16–24	9/16–18
–05			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.

SAE 37°

ORS



Dash Size	E through hole SAE 37°		ORS	
	mm	in	mm	in
–03	3,0	0.12		
–04	4,3	0.17	4,3	0.17
–05	5,8	0.23		
–06	7,6	0.30	6,6	0.26
–08	9,9	0.39	9,7	0.38
–10	12,2	0.48	12,2	0.48
–12	15,5	0.61	15,5	0.61
–16	21,3	0.84	20,6	0.81
–20	25,8	1.08	26,7	1.05
–24	33,3	1.31	33,3	1.31
–32	45,2	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.

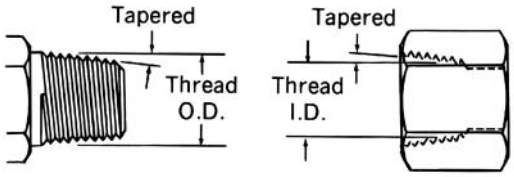
Staplok—Measure the male diameter with the O.D. portion of the caliper. Measure the female half by inserting the I.D. portion of the caliper into the through hole.

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.

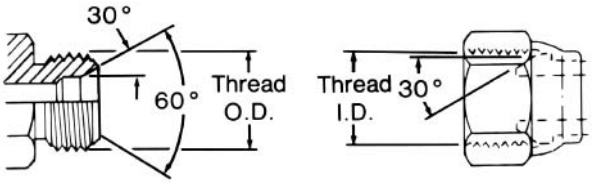
American Connections

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.

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.

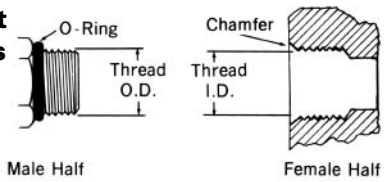
NPTF Threads

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	$1^{19}/_{32}$	.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

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	$1^{19}/_{32}$	.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

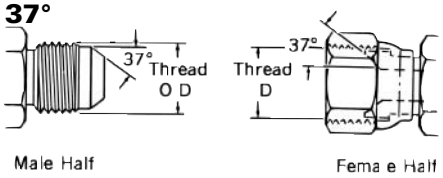
SAE J1926 Straight Thread O-Ring Boss (ORB)



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 O.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

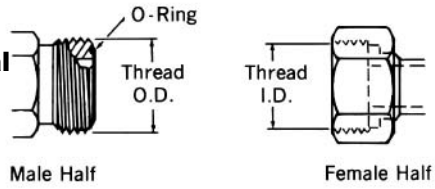
SAE J514 37° Hydraulic



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 O.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

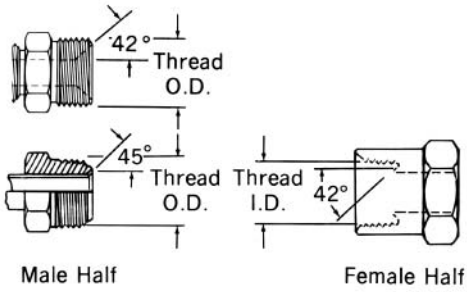
ORS SAE J1453 O-Ring Face Seal



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 O.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

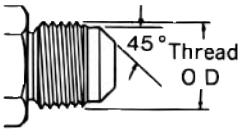
SAE J512 Inverted



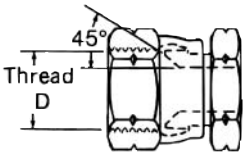
This connection is frequently used in automotive systems. The male connector can either be a 45° flare in the tube fitting form or a 42° seat in the machined adapter form. The female has a straight thread with a 42° inverted flare. The seal takes place on the flared surfaces. The threads hold the connection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

Inch Size	Dash size	Nominal Thread size	Male Thread O.D. inch		Female Thread O.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°



Male Half



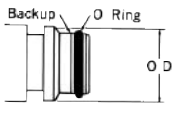
Female Half

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.

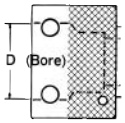
The threads hold the connection mechanically. CAUTION: In the –02, –03, –04, –05, –08 and –10 sizes, the threads of the SAE 45° flare and the SAE 37° flare are the same. However, the sealing surface angles are not the same.

Inch Size	Dash size	Nominal Thread size	Male Thread O.D. inch		Female Thread O.D. inch	
			fraction	decimal	fraction	decimal
1/8	02	5/16-24	5/16	0.31	9/32	0.27
3/16	03	3/8-24	3/8	0.38	11/32	0.34
1/4	04	7/16-20	7/16	0.44	13/32	0.39
5/16	05	1/2-20	1/2	0.50	15/32	0.45
3/8	06	5/8-18	5/8	0.63	9/16	0.57
1/2	08	3/4-16	3/4	0.75	11/16	0.69
5/8	10	7/8-14	7/8	0.88	13/16	0.81
3/4	12	1 1/16-14	1 1/16	1.06	1	0.99
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

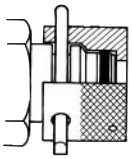
Staplok (SAE J1467)



Ma e Half



Female Half



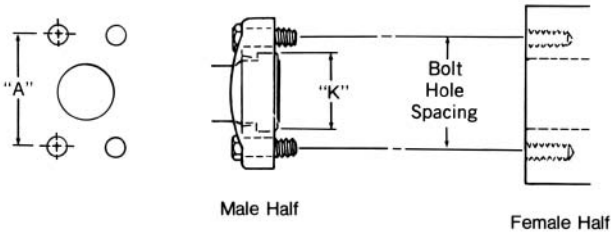
Staplok™ Connected

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	Nominal Thread size	Male Thread O.D. inch		Female Thread O.D. inch	
			fraction†	decimal	fraction	decimal
1/4	04		9/32	.586	1 9/32	.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*



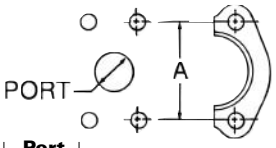
Male Half

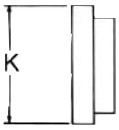
Female Half

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.





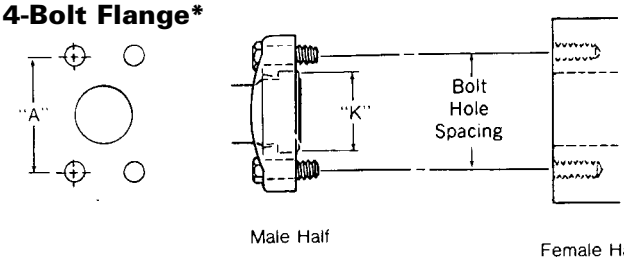
Inch Size (Dash size)	Port Hole I.D. inch fract. (deci.)	Bolt Dimension inch		Bolt Hole Spacing "A" inch (decimal)		Flanged Head Dia. "K" inch (dec)	
		Cd. 61	Cd. 62	Cd. 61	Cd.62	Cd. 61	Cd. 62
1/2 (08)	1/2 (.50)	5/16-18x1 1/4	5/16-18x1 1/4	1 1/2 (1.50)	1 19/32 (1.59)	1 3/16 (1.19)	1 1/4 (1.25)
3/4 (12)	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*



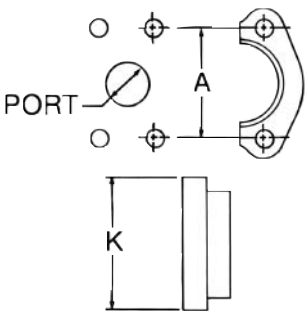
This connection is commonly used in fluid power systems. There are two pressure ratings. PN 35/350 bar (Code 61) is the "standard" series and PN 415 bar (Code 62) is the high pressure series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger 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.

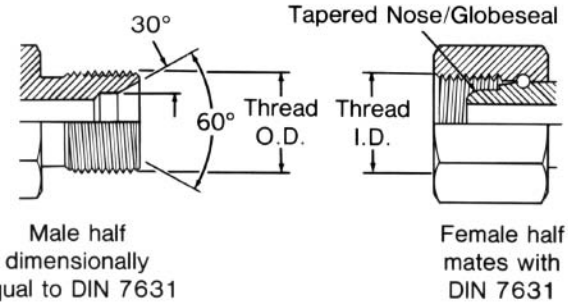
Size	Port Hole	Bolt Dimensions Spacing		Bolt Hole "A"	
		PN 35/350 Bar (Cd.61)	PN 415 Bar (Cd. 62)	PN 35/350 Bar (Cd. 61)	PN 415 Bar (Cd. 62)
mm in [dash]	mm [in]	mm [in]	mm [in]	mm [in]	mm [in]
13 (1/2) [08]	12,7 [.50]	M8 x 1.25 x 30 [5/16–18 x 1 1/4]	M8 x 1.25 x 30 [5/16–18 x 1 1/4]	38.10 [1.50]	40.49 [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)	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]	[2.75]	[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 Dia. "K"			
	PN 35/350 Bar (Cd.61)		PN 415 Bar (Cd. 62)	
	mm	in	mm	in
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

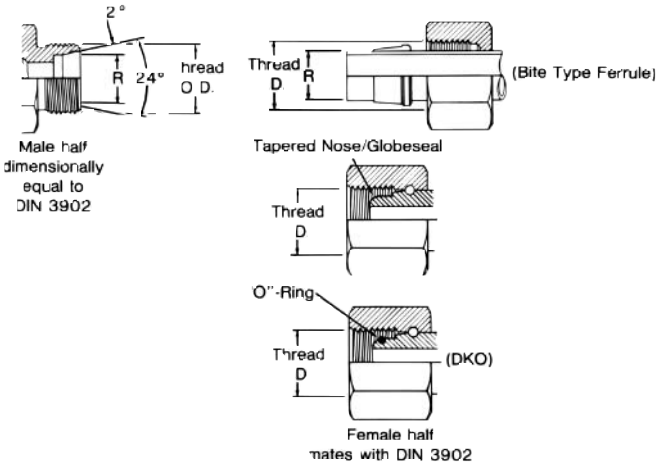
DIN 7631 Series



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	in		mm	in	mm	in
6	0.24	M12 x 1.5	12	0.47	10,5	0.41
8	0.32	M14 x 1.5	14	0.55	12,5	0.49
10	0.39	M16 x 1.5	16	0.63	14,5	0.57
12	0.47	M18 x 1.5	18	0.71	16,5	0.65
15	0.59	M22 x 1.5	22	0.87	20,5	0.81
18	0.71	M26 x 1.5	26	1.02	24,5	0.96
22	0.87	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

DIN 3902 Series



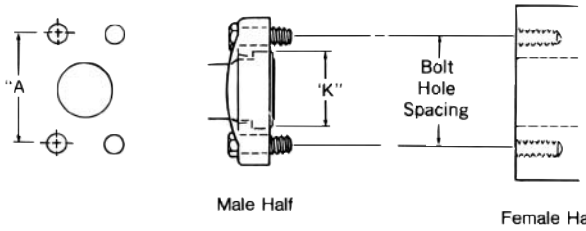
This connection style consists of a common male and three different female halves.

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.*		Tube O.D. "R" Dim. s.Rh.†		Metric Thread Size	Male Thread O.D.		Female Thread I.D.	
mm	in.	mm	in		mm	in	mm	in
6	0.24			M12 x 1.5	12	0.47	10.5	0.41
8	0.32	6	0.24	M14 x 1.5	14	0.55	12.5	0.49
10	0.39	8	0.32	M16 x 1.5	16	0.63	14.5	0.57
12	0.47	10	0.39	M18 x 1.5	18	0.71	16.5	0.65
12	0.47			M20 x 1.5	20	0.78	18.5	0.73
15	0.59	14	0.55	M22 x 1.5	22	0.87	20.5	0.81
16	0.63			M24 x 1.5	24	0.94	22.5	0.89
18	0.71			M26 x 1.5	26	1.02	24.5	0.96
22	0.87	20	0.78	M30 x 2.0	30	1.18	28	1.11
28	1.10	25	0.98	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

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

DIN 20066 4-Bolt Flange*



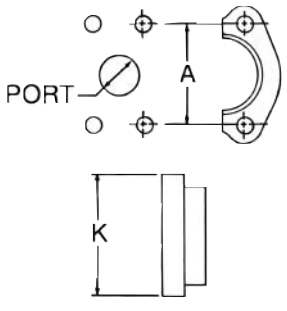
This connection is commonly used in fluid power systems. There are two pressure ratings. Form R (Code 61) is referred to as the "standard duty" series and Form S (Code 62) is the "heavy duty" series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters 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	Bolt Dimensions		Bolt Hole Spacing	
		Form R. (Cd. 61)	Form S (Cd. 62)	Form R (Cd. 61)	Form S (Cd. 62)
	mm (in)			mm (in)	mm (in)
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)

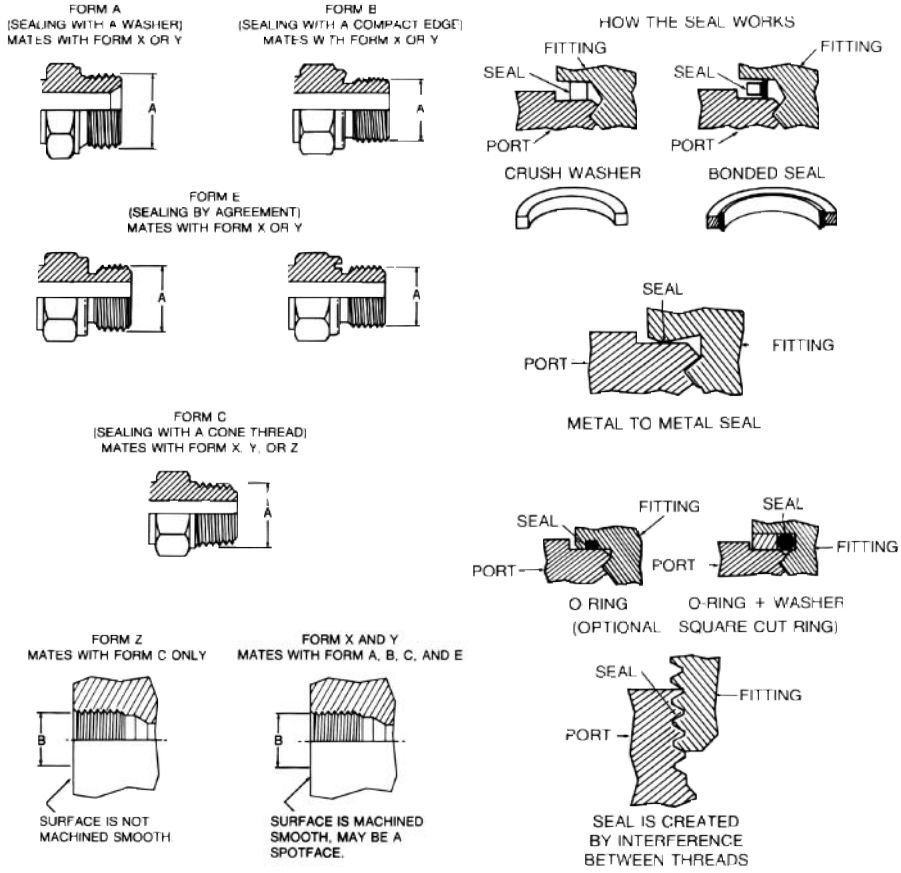
Inch Size	Flanged Head Dia. "K"			
	FORM R (Cd. 61)		FORM S (Cd. 62)	
	mm	in	mm	in
$1/2$	30.18	1.19	31.75	1.25
$3/4$	38.10	1.50	41.28	1.63
1	44.45	1.75	47.63	1.88
$1\,1/4$	50.80	2.00	53.98	2.13
$1\,1/2$	60.33	2.38	63.50	2.50
2	71.42	2.81	79.38	3.13



DIN 3852 Metric Threads

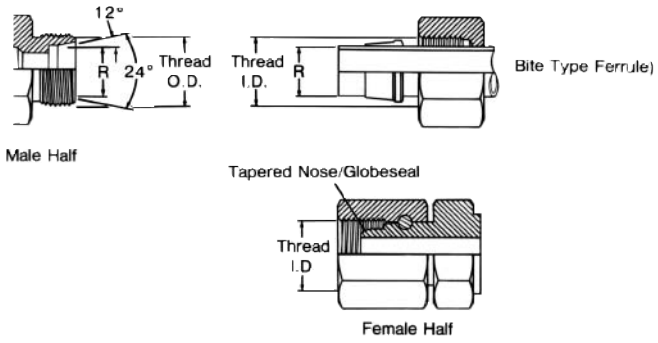
Metric Thread	Male Thread O.D. "A"		Female Thread I.D. "B"	
	mm	in.	mm	in.
M12 x 1.5	12	0.47	10,5	0.41
M14 x 1.5	14	0.55	12,5	0.49
M16 x 1.5	16	0.63	14,5	0.57
M18 x 1.5	18	0.71	16,5	0.65
M20 x 1.5	20	0.78	18,5	0.73
M22 x 1.5	22	0.87	20,5	0.81
M24 x 1.5	24	0.94	22,5	0.89
M26 x 1.5	26	1.02	24,5	0.96
M27 x 2	27	1.06	25	0.98
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



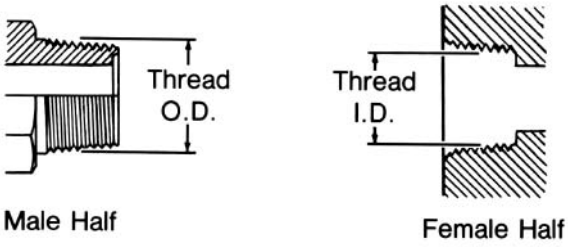
This connection consists of a common male and two different females. The Millimetrique Series is used with whole number metric O.D. tubing and the GAZ Series is used with fractional number metric O.D. pipe size tubing.

Millimetrique and GAZ Threads

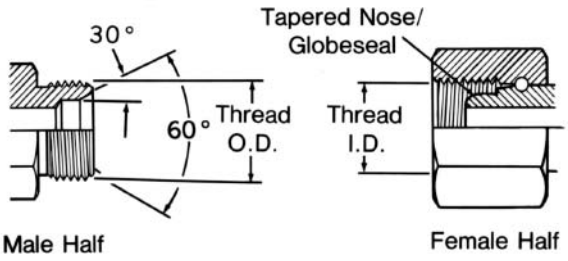
Tubing O.D. "R" dim.		"Gaz" Pipe O.D. "R" dim.		Metric Thread size	Male Thread O.D.		Female Thread I.D.	
mm	in	mm	in		mm	in	mm	in
6	0.24			M12 x 1.5	12	0.47	11	0.43
8	0.32			M14 x 1.5	14	0.55	12.5	0.49
10	0.39			M16 x 1.5	16	0.63	14.5	0.57
12	0.47			M18 x 1.5	18	0.71	16.5	0.65
14	0.55	13.25	0.52	M20 x 1.5	20	0.78	18.5	0.73
15	0.59			M22 x 1.5	22	0.87	20.5	0.81
16	0.63	16.75	0.66	M24 x 1.5	24	0.94	22.5	0.89
18	0.71			M27 x 1.5	27	1.06	25.5	1.00
22	0.87	21.25	0.83	M30 x 1.5	30	1.18	28.5	1.12
25	0.98			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.

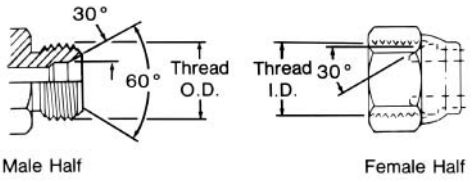
BSPT/BSPP Threads

Inch Size	Dash size	Nominal Thread size	Male Thread O.D. Inch		Female Thread O.D. Inch	
			fraction	decimal	fraction	decimal
1/8	02	1/8–28	3/8	0.38	11/32	0.35
1/4	04	1/4–19	33/64	0.52	15/32	0.47
3/8	06	3/8–19	21/32	0.65	19/32	0.60
1/2	08	1/2–14	1 13/16	0.82	3/4	0.75
5/8	10	5/8–14	7/8	0.88	13/16	0.80
3/4	12	3/4–14	11/32	1.04	31/32	0.97
1	16	1–11	15/16	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.

JIS 30° Male Inverted Seat, Parallel Pipe Threads

(Threads per JIS B 0202)

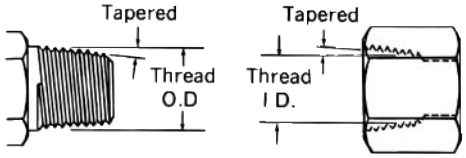


The JIS parallel is similar to the BSPP connection. The JIS parallel thread and the BSPP connection are interchangeable.

Size	Size (dash)	Nominal Thd. 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)

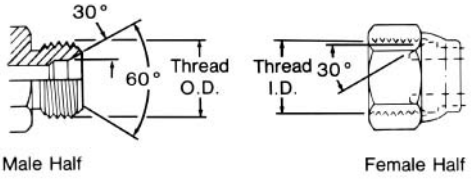


The JIS tapered thread is similar to the BSPT connection in design, appearance and dimensions. The JIS tapered thread and the BSPT connection are interchangeable.

Size	Size (dash)	Nominal Thd. 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)

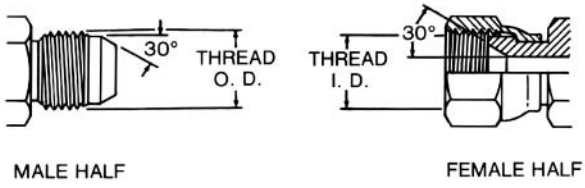


The JIS parallel (metric) is the same as the JIS parallel (PF), except for the thread difference.

Inch Size	Dash Size Equivalent	Thread Size	Male Thread O.D.		Female Thread I.D.	
			fraction	mm	fraction	mm
6	04	M14 x 1.5	14	0.55	12.5	0.49
9	06	M18 x 1.5	18	0.71	16.5	0.65
12	08	M22 x 1.5	22	0.87	20.5	0.81
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

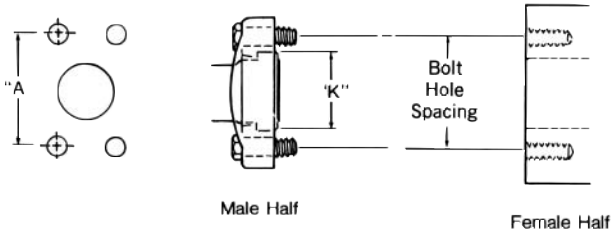
(Threads per JIS B 0202)

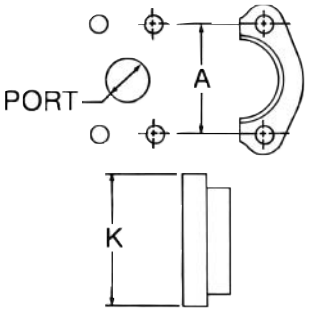


The Japanese JIS 30° flare is similar to the American SAE 37° flare connection in application as well as sealing principles. However, the flare angle and dimensions are different. The threads are similar to BSPP.

Size	Size (dash)	Nominal Thd. 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 B 8363 4-Bolt Flange*





Inch size	Flanged Head dia. "K"			
	Type I Bar (Cd.61)		Type II Bar (Cd. 62)	
	mm	in	mm	in
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

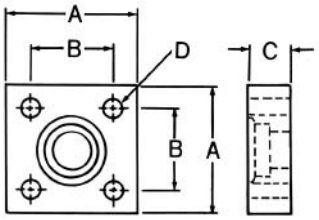
This connection is commonly used in fluid power systems. There are two pressure ratings. Type I (Code 61) is referred to as the "standard" series and Type II (Code 62) is the "6000 psi" series. The design concept for both series is the same, but the bolt hole spacing and flanged head diameters are larger 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 & 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 (0.50)	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 (0.75)	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)	M12 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)

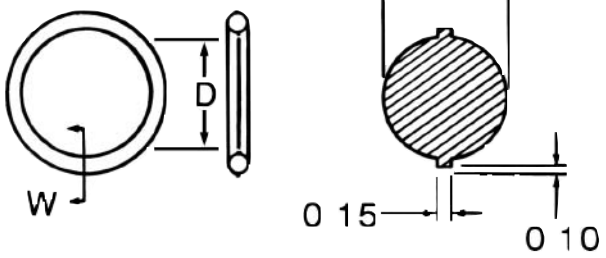
JIS 210 Kgf/cm² 4-Bolt Square Flange



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 (0.87)	11 (0.43)
19	3/4	M10 x 1.5 x 55 (80)	68 (2.67)	45 (1.77)	22 (0.87)	11 (0.43)
25	1	M12 x 1.75 x 70 (100)	80 (3.15)	53 (2.09)	28 (1.10)	13 (0.51)
32	1 1/4	M12 x 1.75 x 70 (100)	90 (3.54)	63 (2.48)	28 (1.10)	13 (0.51)
38	1 1/2	M16 x 2.0 x 90 (130)	100 (3.94)	70 (2.76)	36 (1.42)	18 (0.71)
50	2	M16 x 2.0 x 90 (130)	112 (4.41)	80 (3.15)	36 (1.42)	18 (0.71)

JIS 210 Kgf/cm² O-Ring



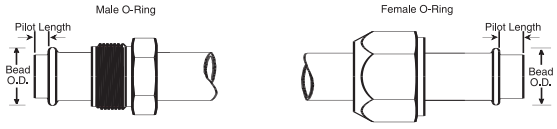
Nominal size mm	Dim. "D" mm	Dim. "W" mm
12	24.4 ± 0.15	3.1 ± 0.1
19	29.4 ± 0.15	3.1 ± 0.1
25	34.4 ± 0.15	3.1 ± 0.1
32	39.4 ± 0.15	3.1 ± 0.1
38	49.4 ± 0.15	3.1 ± 0.1
50	59.4 ± 0.15	3.1 ± 0.1

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.

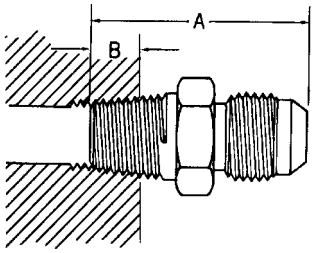
		Male Thread			Female Thread		
Inch Size	**Dash Size**	**O.D. (inch) Nominal Thread**	**O.D. (inch) Fraction**	**O.D. (inch) Decimal**	**I.D. (inch) Nominal Thread**	**I.D. (inch) Fraction**	**I.D. (inch) Decimal**
3/8	06	5/8 - 18	5/8	0.62	5/8 - 18	9/16	0.57
1/2	08	3/4 - 18	3/4	0.75	3/4 - 16	11/16	0.69
5/8	10	7/8 - 18	7/8	0.87	7/8 - 14	13/16	0.81
3/4	12	1 1/16 -16	1 1/16	1.06	1 1/16 - 14	1	0.99

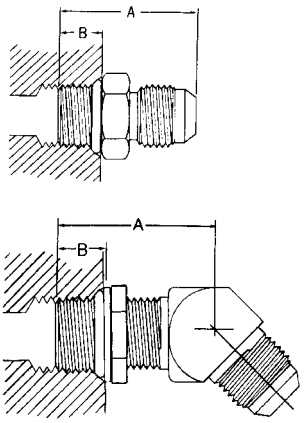
		Long Pilot		Short Pilot	
Inch Size	**Nominal Tube Size**	**Bead O.D. (inch)**	**Pilot Length**	**Bead O.D. (inch)**	**Pilot Length**
3/8	06	0.52	0.28	0.52	0.19
1/2	08	0.64	0.39	0.64	0.19
5/8	10	0.77	0.39	0.77	0.19
3/4	12	0.91	0.39	0.91	0.19

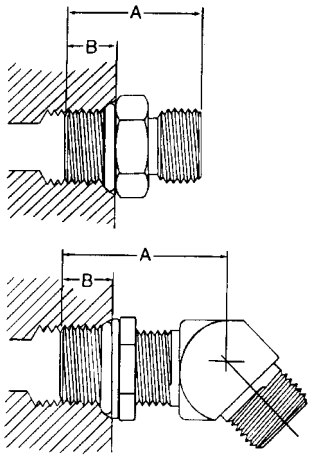


Thread Engagement Nominal Dimensions

Dimensions may vary due to tolerance conditions.
Listed below are the thread engagement dimensions (B) which must be taken into consideration when making connection 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		SAE O-ring Boss SAE J1926 with 37° Flare J514		SAE O-ring Boss SAE J1926 with ORS J1453	
	Straight and Angled Dimension "B"		Straight and Adjustable Dimension "B"		Straight and Adjustable Dimension "B"	
	mm	in	mm	in	mm	in
–02	6,4	0.25				
–04	9,7	0.38	9,1	0.36	10,9	0.43
–05			9,1	0.36	10,9	0.43
–06	9,7	0.38	9,1	0.39	11,9	0.47
–08	12,7	0.50	10,9	0.43	14,0	0.55
–10			12,7	0.50	16,0	0.63
–12	15,7	0.62	15,0	0.59	18,5	0.73
–14			15,0	0.59		
–16	17,5	0.69	15,0	0.59	18,5	0.73
–20	17,5	0.69	15,0	0.59	18,5	0.73
–24	17,5	0.69	15,0	0.59	18,5	0.73
–32	19,1	0.75	15,0	0.59		

Allowable bulkhead thickness for ORS:

Dash Size	Hole Diameter	ORS Bulkhead Thickness			
		MIN		MAX	
	in	mm	in	mm	in
–04	.575 +.015/–.000	5,1	0.20	12,7	0.50
–06	.700 +.015/–.000	5,1	0.20	15,0	0.59
–08	.825 +.015/–.000	5,6	0.22	15,0	0.59
–10	1.015 +.015/–.000	5,8	0.23	15,0	0.59
–12	1.200 +.015/–.000	6,4	0.25	15,0	0.59
–16	1.450 +.015/–.000	6,4	0.25	15,2	0.60
–20	1.715 +.015/–.000	6,4	0.25	15,2	0.60
–24	2.030 +.015/–.000	6,4	0.25	15,2	0.60

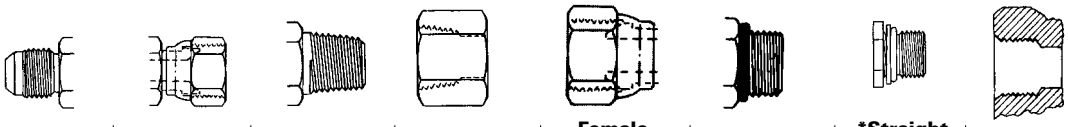
For 37° Flare:

Dash Size	Hole Diameter	37° Bulkhead Thickness Straights				37° Bulkhead Thickness Shapes			
		MIN		MAX		MIN		MAX	
	in	mm	in	mm	in	mm	in	mm	in
–03	.391 +.016/–.000	1,3	0.05	10,4	0.41	3,3	0.13	6,4	0.25
–04	.453 +.016/–.000	1,3	0.05	10,4	0.41	3,3	0.13	7,1	0.28
–05	.516 +.016/–.000	1,3	0.05	10,4	0.41	3,3	0.13	7,1	0.28
–06	.578 +.016/–.000	1,3	0.05	11,2	0.44	3,3	0.13	7,6	0.30
–08	.766 +.016/–.000	1,3	0.05	11,2	0.44	4,1	0.16	8,6	0.34
–10	.891 +.016/–.000	1,3	0.05	11,9	0.47	4,1	0.16	9,1	0.36
–12	1.076 +.016/–.000	1,3	0.05	11,9	0.47	4,1	0.16	9,7	0.38
–16	1.328 +.016/–.000	1,3	0.05	11,9	0.47	4,1	0.16	9,7	0.38
–20	1.656 +.031/–.000	1,3	0.05	11,9	0.47	4,1	0.16	9,7	0.38
–24	1.906 +.031/–.000	1,3	0.05	11,9	0.47	4,1	0.16	9,7	0.38

Dimensions may vary due to tolerance conditions.

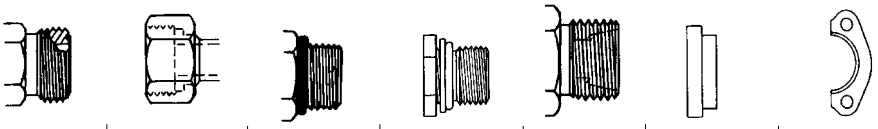
Thread Style Pressure Performance/ Maximum Operating Pressure

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 products. Figures shown are maximum operating pressures in BAR (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		*Male O-ring Boss		*Straight Thread O-ring Adjustable		Female O-ring Boss	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
–2	1/8							700,0	10000	350,0	5000	420,0	6000						
–4	1/4	350,0	5000	595,0	8500	385,0	5500	655,0	9500	315,0	4500	350,0	5000	525,0	7500	315,0	4500	315,0	4500
–5	5/16	297,0	4250	595,0	8500	350,0	5000							525,0	7500	245,0	3500	245,0	3500
–6	3/8	280,0	4000	490,0	7000	280,0	4000	560,0	8000	245,0	3500	280,0	4000	525,0	7500	280,0	4000	245,0	3500
–8	1/2	245,0	3500	20,0	6000	280,0	4000	420,0	6000	245,0	3500	245,0	3500	525,0	7500	280,0	4000	210,0	3000
–10	5/8	192,0	2750	385,0	5500	210,0	3000							525,0	7500	280,0	4000	175,0	2500
–12	3/4	157,0	2250	280,0	4000	210,0	3000	350,0	5000	210,0	3000	245,0	3500	350,0	5000	245,0	3500	124,1	1800
–14	7/8	140,0	2000	280,0	4000	210,0	3000							350,0	5000	210,0	3000	117,2	1700
–16	1	140,0	2000	245,0	3500	175,0	2500	280,0	4000	175,0	2500	210,0	3000	315,0	4500	175,0	2500	112,0	1600
–20	1 1/4	113,0	1625	245,0	3500	140,0	2000	210,0	3000	140,0	2000	140,0	2000	315,0	4500	140,0	2000	105,0	1500
–24	1 1/2	87,0	1250	140,0	2000	105,0	1500	140,0	2000	105,0	1500	105,0	1500	245,0	3500	140,0	2000	105,0	1500
–32	2	78,0	1125	87,0	1250	87,0	1250	140,0	2000	98,0	1400	105,0	1500	140,0	2000				

*For non "ORS" adapters



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	
		bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi	bar	psi
–2	1/8																
–4	1/4	350,0	5000	630,0	9000	630,0	9000	630,0	9000	420,0	6000	420,0	6000				
–5	5/16	297,0	4250														
–6	3/8	280,0	4000	630,0	9000	630,0	9000	630,0	9000	420,0	6000	420,0	6000				
–8	1/2	245,0	3500	630,0	9000	560,0	8000	630,0	9000	420,0	6000	420,0	6000	350,0	5000	420,0	6000
–10	5/8	192,0	2750	630,0	9000	560,0	8000	630,0	9000	420,0	6000	350,0	5000				
–12	3/4	157,0	2250	420,0	6000	420,0	6000	420,0	6000	420,0	6000	315,0	4500	350,0	5000	420,0	6000
–14	7/8	140,0	2000														
–16	1	140,0	2000	420,0	6000	420,0	6000	420,0	6000	350,0	5000	280,0	4000	350,0	5000	420,0	6000
–20	1 1/4	113,0	1625	315,0	4500	315,0	4500	315,0	4500	315,0	4500			280,0	4000	420,0	6000
–24	1 1/2	87,0	1250	280,0	4000	280,0	4000	280,0	4000	210,0	3000			210,0	3000	420,0	6000
–32	2	78,0	1125											210,0	3000	420,0	6000

Maximum Operating Pressures Bar/PSI for Hydraulic Tubing (SAEJ356, J524, J525, J526, J527)

Tube O.D.	Dash Size	Tubing Wall Thickness (in inches)											
		.028	.035	.049	.065	.083	.095	.109	.120	.134	.148	.156	.188
		bar psi	bar psi	bar psi	bar psi	bar psi	bar psi	bar psi	bar psi	bar psi	bar psi	bar psi	bar psi
.19	–03	297,0 4250	375,0 5450										
.25	–04	213,0 3100	272,0 3950	396,0 5750	420,0 6000								
.31	–05	169,0 2450	213,0 3100	315,0 4500	420,0 6000								
.38	–06	140,0 2000	175,0 2550	251,0 3650	350,0 5000	420,0 6000	420,0 6000						
.50	–08		127,0 1850	186,0 2700	251,0 3650	335,0 4800	388,0 5550	420,0 6000	420,0 6000				
.62	–10		105,0 1500	145,0 2100	196,0 2850	258,0 3750	299,0 4350	353,0 5050	392,0 5600				
.75	–12		84,0 1200	122,0 1750	162,0 2350	210,0 3050	248,0 3550	286,0 4150	322,0 4600				
1.00	–16		62,0 900	89,0 1300	122,0 1750	157,0 2250	182,0 2600	210,0 3000	231,0 3350	262,0 3800	294,0 4200		
1.25	–20			70,0 1000	93,0 1350	122,0 1750	143,0 2050	162,0 2350	182,0 2650	189,0 2700	203,0 2950	217,0 3100	259,0 3750
1.50	–24				79,0 1150	100,0 1450	119,0 1700	134,0 1950	148,0 2150	171,0 2450	171,0 2450	182,0 2600	220,0 3150
2.00	–32				58,0 850	77,0 1100	87,0 1250	100,0 1450	112,0 1600	126,0 1800	140,0 2000	147,0 2100	178,0 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 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 SAE 37° Flare	Versil-Flare SAE 37° Flareless	ORS-BR SAE O-Ring Face Seal	ORS-TF 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 SAE 37° Flare	Versil-Flare SAE 37° Flareless	ORS-BR SAE O-ring Face Seal	ORS-TF SAE O-ring Face Seal
SAEJ524	SAEJ356	SAEJ356	SAEJ356
SAEJ525	SAEJ524	SAEJ524	SAEJ524
	SAEJ525	SAEJ525	SAEJ525
	SAEJ527	SAEJ526	SAEJ526

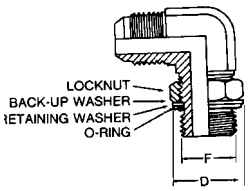
Hydraulic tubing material description: SAEJ356 electric resistance welded flash controlled low carbon steel, SAEJ524 seamless annealed low carbon steel, SAEJ525 electric resistance welded cold worked annealed, SAEJ526 single wall welded low carbon steel (automotive), SAEJ527 brazed double wall low carbon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

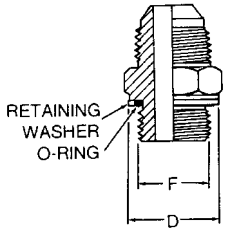
Metric Thread Dimensions

Conversion Adapters

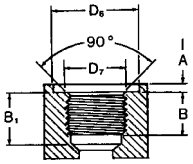
Sealing is achieved by means of an O-Ring, retaining washer and a properly machined port. The O-Ring is "captured" by the I.D. of the retaining washer. The port may be of the spot faced or a flat machined surface as long as the D6 dimension is met.

Assembly instructions for adjustable type adapters are presented on page 309.





DIN 3852 LARGE SPOTFACE



EQUIVALENT TODIN 3852 FORM X

Dimensions in mm

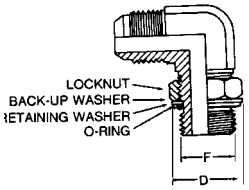
Thread Size	M 10 x 1	M 12 x 1.5	M 14 x 1.5	M 16 x 1.5	M 18 x 1.5	M 20 x 1.5	M 22 x 1.5	M 26 x 1.5	M 27 x 2	M 33 x 2	M 42 x 2	M 48 x 2
F Thread Dia.	10.0	12.0	14.0	16.0	18.0	20.0	22.0	26.0	27.0	33.0	42.0	48.0
A max	1.0	1.5	1.5	1.5	2.0	2.0	2.5	2.5	2.5	2.5	2.5	2.5
B min (full thread)	12.0	12.0	12.0	12.0	12.0	14.0	14.0	16.0	16.0	18.0	20.0	22.0
B1 min	13.5	18.5	18.5	18.5	18.5	20.5	20.5	22.5	24.0	26.0	28.0	30.0
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
D6 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
D7 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

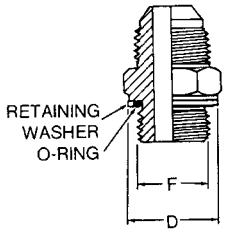
BSPP (Parallel) Threads

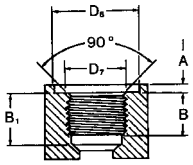
Sealing is achieved by means of an O-Ring, retaining washer and a properly machined port.

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.





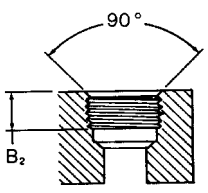


Thread Size	G 1/8"-28		G 1/4"-19		G 3/8"-19		G 1/2"-14		G 3/4"-14		G 1"-11		G 11/4"-11		G 11/2"-11	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
F Thread Dia.	9,7	0.38	13,2	0.50	16,7	0.66	20,9	0.83	26,4	1.04	33,3	1.31	41,9	1.65	47,8	1.88
A max	1,0	0.04	2,0	0.08	2,05	0.10	2,5	0.10	2,5	0.10	2,5	0.10	2,5	0.10	2,5	0.10
B min	8,0	0.31	12,0	0.47	12,0	0.47	14,0	0.63	16,0	0.63	18,0	0.71	20,0	0.79	22,0	0.87
B1 min (full thread)	13,0	0.51	18,5	0.73	18,5	0.73	22,0	0.94	24,0	0.94	27,0	1.06	29,0	1.14	31,0	1.22
D max	15,7	0.62	19,7	0.78	24,0	0.94	28,7	1.38	35,2	1.38	43,2	1.70	52,7	2.07	58,7	2.31
D6 min	16,2	0.64	20,2	0.81	24,9	0.98	29,4	1.43	36,4	1.43	44,4	1.75	53,4	2.10	59,9	2.36
D7 max	10,0	0.39	13,4	0.53	16,9	0.67	21,2	1.05	26,7	1.05	33,6	1.32	42,3	1.67	48,2	1.90

BSPT (Tapered) Threads

Port Sealing

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



Thread Size	R 1/8"-28		R 1/4"-19		R 3/8"-19		R 1/2"-14		R 3/4"-14		R 1"-11		R 11/4"-11		R 1 1/2"-11	
	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in	mm	in
B2 min (full thread)	5,5	0.22	8,5	0.33	8,5	0.33	10,5	0.41	13,0	0.51	14,5	0.57	17,0	0.67	17,0	0.67

Recommended Parallel Connection Assembly Torque

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

The values listed are for steel connections. Contact Eaton for torque values for other materials.

Straight Thread O-Ring Boss Low Pressure with 37° (SAEJ514)

Dash Size	Thread Size (inches)	Jam Nut or Straight Fitting Torque lb.-ft.	Jam Nut or Straight Fitting Torque Newton Meters
–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

Straight Thread O-Ring Boss High Pressure with ORS (J1453)

Dash Size	Thread Size (inches)	Jam Nut or Straight Fitting Torque lb.-ft.	Jam Nut or Straight Fitting Torque Newton Meters
–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

ORS

Dash Size	Thread Size (inches)	Swivel Nut Torque lb.-ft.	Swivel Nut Torque Newton Meters
–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

SAE 37° (JIC)

Dash Size	Thread Size (inches)	Swivel Nut Torque lb.-ft.	Swivel Nut Torque Newton Meters
–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

Metric

Thread Size	Straight Adapter or Locknut Torque	
mm	lb.-ft.	Newton Meters
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

BSPP

Nominal Thread Size	Straight Adapter or Locknut Torque	
inches**	lb.-ft.	Newton Meters
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

***"G" denotes parallel threads, other than ISO 6149. (Port connection only)*

Proper Tube Installation

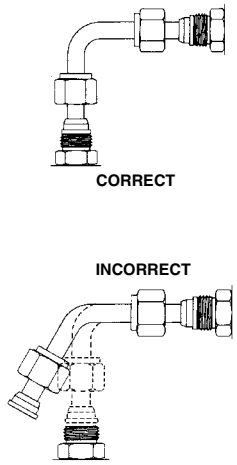


Figure 1

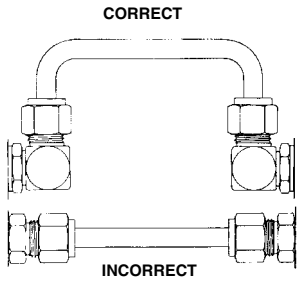


Figure 2

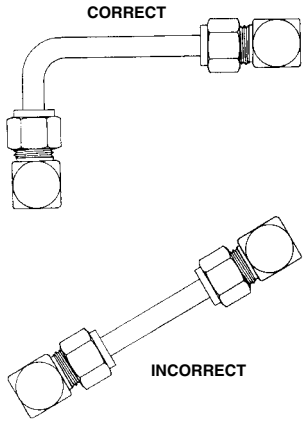


Figure 3

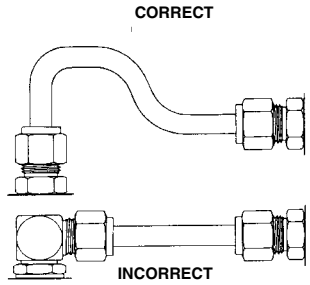


Figure 4

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 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 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.

Conversions

Inch/Millimeter Conversion Table

Multiply inches x 25.4 = Millimeters

Inches		Millimeters
fractions	decimals	decimals
1/64	.016	.397
1/32	.031	.794
3/64	.047	1.191
1/16	.063	1.588
5/64	.078	1.984
3/32	.094	2.381
7/64	.109	2.778
1/8	**.125**	**3.175**
9/64	.141	3.572
5/32	.156	3.969
11/64	.172	4.366
3/16	.188	4.763
13/64	.203	5.159
7/32	.219	5.556
15/64	.234	5.953
1/4	**.250**	**6.350**

Inches		Millimeters
fractions	decimals	decimals
17/64	.266	6.747
9/32	.281	7.144
19/64	.297	7.541
5/16	.313	7.938
21/64	.328	8.334
11/32	.344	8.731
23/64	.359	9.128
3/8	**.375**	**9.525**
25/64	.391	9.922
13/32	.406	10.319
27/64	.422	10.716
7/16	.438	11.113
29/64	.453	11.509
15/32	.469	11.906
31/64	.484	12.303
1/2	**.500**	**12.700**

Inches		Millimeters
fractions	decimals	decimals
33/64	.516	13.097
17/32	.531	13.494
35/64	.547	13.891
9/16	.563	14.288
37/64	.578	14.684
19/32	.594	15.081
39/64	.609	15.478
5/8	**.625**	**15.875**
41/64	.641	16.272
21/32	.656	16.669
43/64	.672	17.066
11/16	.688	17.463
45/64	.703	17.859
23/32	.719	18.256
47/64	.734	18.653
3/4	**.750**	**19.050**

Inches		Millimeters
fractions	decimals	decimals
49/64	.766	19.447
25/32	.781	19.844
51/64	.797	20.241
13/16	.813	20.638
53/64	.828	21.034
27/32	.844	21.431
55/64	.859	21.828
7/8	**.875**	**22.225**
57/64	.891	22.622
29/32	.906	23.019
59/64	.922	23.416
15/16	.938	23.813
61/64	.953	24.209
31/32	.969	24.606
63/64	.984	25.003
1	**1.000**	**25.400**

Pressure Conversion Table

(Per SAE J517 Appendix A)

Mpa	Bar	PSI
0.25	2.5	35
0.3	3	45
0.35	3.5	50
0.4	4	56
0.4	4	62
0.5	5	70
0.6	6	90
0.7	7	100
0.8	8	112
0.85	8.5	125
1	10	140
1.05	10.5	150
1.25	12.5	180
1.4	14	200
1.6	16	225
1.7	17	250
2.1	21	300
2.4	24	350
2.6	26	375
2.8	28	400
3.5	35	500
3.9	39	565

Mpa	Bar	PSI
4.2	42	600
4.3	43	625
4.9	49	700
5	50	725
5.2	52	750
5.6	56	800
6.1	61	875
7	70	1000
7.8	78	1125
8.4	84	1200
8.7	87	1250
9.8	98	1400
10	100	1450
10.5	105	1500
11.2	112	1600
11.3	113	1625
12.2	122	1750
14	140	2000
15.7	157	2250
16.8	168	2400
17.5	175	2500
19.2	192	2750

Mpa	Bar	PSI
20	200	2900
21	210	3000
22.4	224	3200
22.7	227	3250
24.5	245	3500
28	280	4000
29.7	297	4250
31.5	315	4500
33.5	335	4800
35	350	5000
38.5	385	5500
40	400	5800
42	420	6000
43.5	435	6250
45.5	455	6500
49	490	7000
52.5	525	7500
56	560	8000
59.5	595	8500
61	610	8750
63	630	9000
70	700	10000

Mpa	Bar	PSI
77	770	11000
78	780	11250
80	800	11600
84	840	12000
87	870	12500
98	980	14000
112	1120	16000
119	1190	17000
122	1220	17500
140	1400	20000
157	1570	22500
160	1600	23200
168	1680	24000
175	1750	25000
210	2100	30000
245	2450	35000
280	2800	40000
315	3150	45000
350	3500	50000

A new method for calculating the equivalent metric conversion to Mpa from psi was utilized. This method provides an extremely easy and consistent method of conversion to arrive at a rounded metric units using 7 Mpa for each 1000 psi. The resulting Mpa pressure in never more than 1.7% higher that the mathematically correct Mpa unit when the pressure in higher than 250 psi. All operating pressures of SAE J517 hoses are above 250 psi except for most of 100R4 and the 76mm (-48) and larger sizes of 100R5. Therefore all files of previous test results should not be compromised.