

NACE® MR0175/MR0103 and ISO 15156/17945 Compliant Swagelok® Fittings

Introduction

Swagelok® products made from 316/316L stainless steel, 6-Moly super austenitic stainless steel, alloy 2507 super duplex stainless steel, and nickel alloys 825, 625, C-276 and 400 are available for use in sour gas applications. The NACE® MR0175/ISO 15156 standard contains tables that describe metallurgical requirements and environmental limits for the use of materials in oil and gas production. The NACE® MR0103/ISO 17945 standard contains sections that describe metallurgical requirements for the use of materials in petroleum refineries. This document provides ordering requirements for products in compliance with NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945.

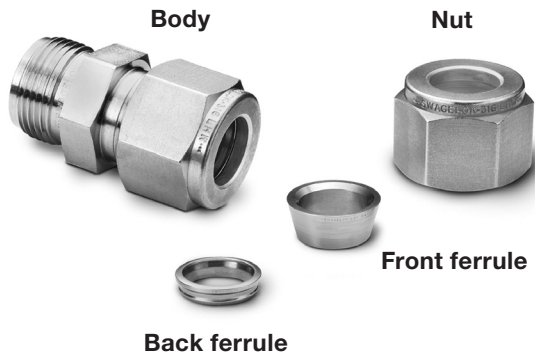


NACE MR0175/MR0103 and ISO 15156/17945 Compliant Swagelok Fittings

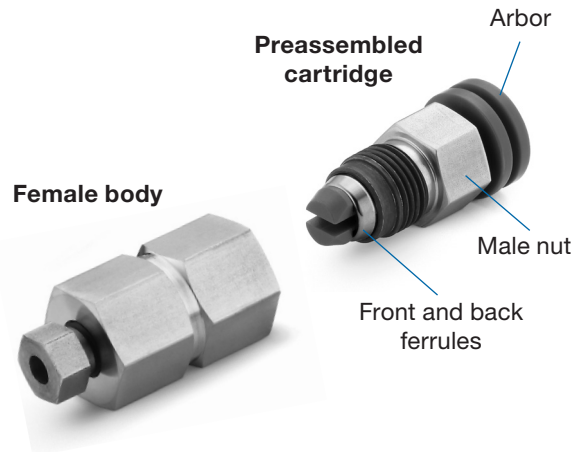
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Swagelok tube fitting



Swagelok medium-pressure, FK fitting



NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945 compliance of Swagelok manufactured fittings, internal exposure to sour gas

Body Material	Material Designator	Tube ^① , FK ^② , Threaded ^③ , or Weld ^④ Fittings
		NACE MR0175/ISO 15156 NACE MR0103/ISO 17945
316/316L SS	SS	See tables on pages 5 to 8
316L SS	316L	
6-Moly (254, 6HN)	6MO	
Alloy 2507	2507	
Alloy 625	625	
Alloy 825	825	
Alloy C-276	HC	
Alloy 400	M	

① Any tube fitting containing at least one Swagelok end connection, tube adapters, tube caps, tube plugs, and port connectors.

② Any medium-pressure FK fitting containing at least one FK end connection, FK tube adapters, FK caps, FK plugs, and FK port connectors.

③ Any fitting containing at least one threaded end connection that doesn't also contain a Swagelok or medium-pressure FK end connection.

④ Any fitting containing weld end connections only (no Swagelok, medium-pressure FK, or threaded end connections).

NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945 compliance of Swagelok manufactured fittings, external exposure to sour gas

Body Material	Material Designator	Tube ^① or FK ^② Fitting		Threaded ^③ or Weld ^④ Fittings
		NACE MR0175/ ISO 15156	NACE MR0103/ ISO 17945	NACE MR0175/ISO 15156 NACE MR0103/ISO 17945
316/316L SS	SS	— ^⑥	Section 18.4.1 ^⑤	See tables on pages 5 to 8
316L SS	316L			
6-Moly (254, 6HN)	6MO	Table A.11 ^⑤	Section 18.4.1 ^⑤	
Alloy 2507	2507	— ^⑦	— ^⑧	
Alloy 625	625	Table A.14 ^⑤	Table 14.1.1.5 ^⑤	
Alloy 825	825	Table A.14 ^⑤	Table 14.1.1.5 ^⑤	
Alloy C-276	HC	Table A.14 ^⑤	Table 14.1.1.5 ^⑤	
Alloy 400	M	Table A.13 ^⑤	Table 14.1.1.1 ^⑤	

① Any tube fitting containing at least one Swagelok end connection, tube adapters, tube caps, tube plugs, and port connectors.

② Any medium-pressure FK fitting containing at least one FK end connection, FK tube adapters, FK caps, FK plugs, and FK port connectors.

③ Any fitting containing at least one threaded end connection that doesn't also contain a Swagelok or medium-pressure FK end connection.

④ Any fitting containing weld end connections only (no Swagelok, medium-pressure FK, or threaded end connections).

⑤ NACE MR0175 / NACE MR103 table listed is valid for external exposure to sour gas regardless of whether "SG2" ordering designator is selected.

⑥ NACE MR0175 Table A.4 is only valid for surface applications.

⑦ Swagelok alloy 2507 tube and FK fittings meet the requirements of NACE MR0175/ISO 15156 for use in any equipment if the fitting is wetted internally, but not externally, to sour gas environments (i.e. H₂S-containing production fluids).

⑧ Swagelok alloy 2507 tube and FK fittings meet the requirements of NACE MR0103/ISO 17945 if the fitting is wetted internally, but not externally, to sour gas environments (i.e. H₂S-containing production fluids).

Compliance with NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945

Swagelok tube and medium-pressure FK fitting hardware compliance

To function correctly, the nut and ferrules of Swagelok tube fittings and medium-pressure FK fittings must be made from cold-drawn bar stock. This material has the strength necessary to grip the tubing, which has a high surface hardness, and to maintain leak free performance at the pressures listed in *Tubing Data* catalog, [MS-01-107](#), and Swagelok *Medium and High Pressure Fitting* catalogs, [MS-02-474](#) and [MS-02-472](#).

For internal exposure to sour gas

- Although the nuts and back ferrules are produced from cold-drawn bar stock, they are not wetted by the system fluid and therefore are not subject to the NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945 material requirements.
- Front ferrules are produced from cold-drawn bar stock, and the nose of the front ferrule comprises a wetted surface. However, the nose of the front ferrule is under compression and therefore is not subject to stress corrosion cracking or sour gas cracking as the NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945 standards state that a tensile stress component is required to enable these cracking modes.

For external exposure to sour gas

- The nuts and ferrules comply with NACE MR0175/ISO 15156 and NACE MR0103/ISO 17945 tables/sections which permit cold-drawn material.

Environmental Limits for NACE MR0175/ISO 15156 Compliant Alloys

Alloy	Material Designator	Condition of Alloy	NACE MR0175 / ISO 15156 Table	Application	Maximum Temperature C° (F°)	Maximum H ₂ S Partial Pressure ^① kPa (psi)
316/316L Stainless Steel (UNS S31600/ S31603)	SS and 316L	Solution-annealed and Cold-drawn	A.4	Surface applications only. Instrument tubing, control-line tubing, associated compression and threaded fittings, and screens ^③	no restrictions; see MR0175 for cautionary remarks	
		Solution-annealed	A.2	Any equipment or component	60 (140)	100 (15)
					60 (140)	1000 (145) ^②
90 (194)	1 (0.145) ^②					
6-Moly (254, 6HN) (UNS N08367)	6MO	Solution-annealed and Cold-drawn	A.11	Instrument tubing, control-line tubing, associated compression and threaded fittings, and surface and downhole screen devices ^③	no restrictions; see MR0175 for cautionary remarks	
		Solution-annealed	A.8	Any equipment or component	60 (140)	100 (15)
2507 (UNS 32507)	2507	Solution-annealed	A.24	Any equipment or component	232 (450)	20 (3)
625 (UNS N06625)	625	Annealed and Cold-drawn	A.14	Any equipment or component	232 (450)	200 (30)
		Solution-annealed or Annealed	A.13		218 (425)	2000 (300)
149 (300)	any					
					no restrictions; see MR0175 for cautionary remarks	
825 (UNS N08825)	825	Annealed and Cold-drawn	A.14	Any equipment or component	232 (450)	200 (30)
					218 (425)	700 (100)
		204 (400)	1000 (150)			
		177 (350)	1400 (200)			
					132 (270)	any
					no restrictions; see MR0175 for cautionary remarks	
C-276 (UNS N10276)	HC	Annealed and Cold-drawn	A.14	Any equipment or component	232 (450)	7000 (1000)
		Solution-annealed or annealed	A.13		204 (400)	any
					no restrictions; see MR0175 for cautionary remarks	
400 (UNS N04400)	M	Cold-worked condition permitted	A.13	Any equipment or component	no restrictions; see MR0175 for cautionary remarks	

① H₂S partial pressure is the pressure contribution of hydrogen sulfide gas to the total pressure. (Example for partial pressure: air consists of 21% oxygen; if the total air pressure is 1.00 atm, then the partial pressure of oxygen is 0.21 atm).

② For chloride concentration ≤50 g/l and pH>=4.5

③ Application per ISO 15156-3:2020 Technical Circular 1

Note: Consult NACE MR0175/ISO 15156 for additional permitted system conditions and detailed information on the environmental limits of alloys.

316/316L Stainless Steel Fittings

Configuration	Order Designator	Body Material		Body Marking		NACE MR0175/ISO 15156 Table (NACE MR0103/ISO 17945 Section)			
		Description	ASTM Specification	SS 316/316L Material Designator	316L Material Designator	Tube ^①	Threaded ^②	Weld ^③	FK ^④
Body Straight	—	Alloy 316/316L (UNS S31600/S31603) Cold-drawn	A479	“316”	“6L” or “316L”	A.4 (18.4.1)	A.4 ^⑥	Not NACE Compliant	A.4 (18.4.1)
	-SG	Alloy 316/316L (UNS S31600/S31603) Solution-annealed	A479	“316” and “SG”	“6L” and “SG” or “316L” and “SG”	—	A.2 (13.5.1)	A.2 (13.5.1)	—
	-SG2					—	—	—	A.2 (13.5.1) ^⑤
Body Shaped (Elbow, Tee, and Cross)	—	Alloy 316/316L (UNS S31600/S31603) Cold-drawn	A479	“316”	“6L” or “316L”	A.4 (18.4.1)	A.4 ^⑥	Not NACE Compliant	A.4 (18.4.1)
		Alloy 316/316L (UNS S31600/S31603) Solution-annealed	A182						
	-SG	Alloy 316/316L (UNS S31600/S31603) Solution-annealed	A479/A182	“316” and “SG”	“6L” and “SG” or “316L” and “SG”	—	A.2 (13.5.1)	A.2 (13.5.1)	—
	-SG2					—	—	—	A.2 (13.5.1) ^⑤

- ① Any fitting containing at least one Swagelok end connection, tube adapters, tube caps, tube plugs, and port connectors.
- ② Any fitting containing at least one threaded end connection that doesn't also contain a Swagelok or medium-pressure FK end connection.
- ③ Any fitting containing weld end connections only (no Swagelok, medium-pressure FK, or threaded end connections).
- ④ Any fitting containing at least one medium-pressure FK end connection, FK tube adapters, FK caps, FK plugs, and FK port connectors.
- ⑤ FK end connection sizes 1/4 in., 3/8 in., 1/2 in., 6 mm, 10 mm, 12 mm, and 16 mm.
- ⑥ Threaded fittings compliant to NACE MR0175/ISO 15156 Table A.4 per ISO 15156-3:2020 Technical Circular 1. Threaded fittings are not NACE MR103/ISO 17945 compliant.

6-Moly Fittings

Configuration	Order Designator	Body Material		Body Marking	NACE MR0175/ISO 15156 Table (NACE MR0103/ISO 17945 Section)		
		Description	ASTM Specification		Tube ^①	Threaded ^②	Weld ^③
Body Straight	—	Alloy 6HN (UNS N08367) Cold-drawn	A479	“6HN”	A.11 (18.4.1)	A.11 ^④	Not NACE Compliant
	-SG2	Alloy 6HN (UNS N08367) Solution-annealed		“6HN” and “SG”	A.8, type 3a and 3b (13.7)	A.8, type 3a and 3b (13.7)	A.8, type 3a and 3b (13.7)
Body Shaped (Elbow, Tee, and Cross)	—	Alloy 6HN (UNS N08367) Solution-annealed	A479/A182	“6HN”	A.11 (18.4.1)	A.11 ^④	Not NACE Compliant
	-SG2			“6HN” and “SG”	A.8, type 3a and 3b (13.7)	A.8, type 3a and 3b (13.7)	A.8, type 3a and 3b (13.7)

- ① Any fitting containing at least one Swagelok end connection, tube adapters, tube caps, tube plugs, and port connectors.
- ② Any fitting containing at least one threaded end connection that doesn't also contain a Swagelok end connection.
- ③ Any fitting containing weld end connections only (no Swagelok or threaded end connections).
- ④ Threaded fittings compliant to NACE MR0175/ISO 15156 Table A.11 per ISO 15156-3:2020 Technical Circular 1. Threaded fittings are not NACE MR103/ISO 17945 compliant.

Alloy 2507 Fittings

Configuration	Order Designator	Body Material		Body Marking	NACE MR0175/ISO 15156 Table (NACE MR0103/ISO 17945 Section)
		Description	ASTM Specification		
Body Straight	—	Alloy 2507 Super Duplex SS (UNS S32750) Cold-drawn	A479	"2507"	Not NACE Compliant
		Alloy 2507 Super Duplex SS (UNS S32750) Solution-annealed			
	-SG2	Alloy 2507 Super Duplex SS (UNS S32750) Solution-annealed	A479	"2507" and "SG"	A.24 (13.8.1)
Body Shaped (Elbow, Tee, and Cross)	—	Alloy 2507 Super Duplex SS (UNS S32750) Solution-annealed	A479/A182	"2507"	Not NACE Compliant
	-SG2		A479/A182	"2507" and "SG"	A.24 (13.8.1)

Alloy 625 Fittings

Configuration	Order Designator	Body Material		Body Marking	NACE MR0175/ISO 15156 Table (NACE MR0103/ISO 17945 Section)
		Description	ASTM Specification		
Body Straight	—	Alloy 625 (UNS N06625) Cold-drawn Hardness 35 HRC max ^④	B446 ^③	"625"	A.14, type 4d (14.1.1.5)
		Alloy 625 (UNS N06625) Annealed (Grade 1)			
	-SG2 ^{①②}	Alloy 625 (UNS N06625) Annealed (Grade 1)	B446	"625" and "SG"	A.13, type 4a (14.1.1.1)
Body Shaped (Elbow, Tee, and Cross)	—	Alloy 625 (UNS N06625) Annealed (Grade 1)	B564/B446	"625"	A.14, type 4d (14.1.1.5)
		Alloy 625 (UNS N06625) Cold-drawn, Hardness 35 HRC max ^④	B446 ^③		
	-SG2 ^{①②}	Alloy 625 (UNS N06625) Annealed (Grade 1)	B564/B446		

① SG2 designator is available for threaded fittings (any size), weld fittings (any size), and tube fittings (1/2 in. or 12 mm sizes only).

② SG2 designator is available for FK fittings with an FK end connection in combination with another FK, threaded, or weld end connection (any size) or tube fitting end connection (1/2 in. or 12 mm sizes only).

③ B446, except elongation.

④ Hardness limit is 35 HRC max. per Swagelok material specification and NACE MR0103/ISO 17945.

Alloy 825 Fittings

Configuration	Order Designator	Body Material		Body Marking	NACE MR0175/ISO 15156 Table (NACE MR0103/ISO 17945 Section)
		Description	ASTM Specification		
Body Straight	—	Alloy 825 (UNS N08825) Cold-drawn, Hardness 35 HRC max ^②	B425 ^①	“825”	A.14, type 4c (14.1.1.5)
	-SG2	Alloy 825 (UNS N08825) Annealed	B425	“825” and “SG”	A.13, type 4a (14.1.1.1)
Body Shaped (Elbow, Tee, and Cross)	—	Alloy 825 (UNS N08825) Annealed	B564/B425	“825”	A.14, type 4c (14.1.1.5)
		Alloy 825 (UNS N08825) Cold-drawn, Hardness 35 HRC max ^②	B425 ^①		
	-SG2	Alloy 825 (UNS N08825) Annealed	B564/B425	“825” and “SG”	A.13, type 4a (14.1.1.1)

① B425, except elongation

② Hardness limit is 35 HRC max. per Swagelok material specification and NACE MR0103/ISO 17945.

Alloy C-276 Fittings

Configuration	Order Designator	Body Material		Body Marking	NACE MR0175/ISO 15156 Table (NACE MR0103/ISO 17945 Section)
		Description	ASTM Specification		
Body Straight	—	Alloy C-276 (UNS N10276) Cold-drawn, Hardness 35 HRC max ^②	B574 ^①	“HC”	A.14, type 4e (14.1.1.5)
	-SG2	Alloy C-276 (UNS N10276) Solution-annealed	B574	“HC” and “SG”	A.13, type 4b (14.1.1.1)
Body Shaped (Elbow, Tee, and Cross)	—	Alloy C-276 (UNS N10276) Solution-annealed	B564/B574	“HC”	A.14, type 4e (14.1.1.5)
		Alloy C-276 (UNS N10276) Cold-drawn, Hardness 35 HRC max ^②	B574 ^①		
	-SG2	Alloy C-276 (UNS N10276) Solution-annealed	B564/B574	“HC” and “SG”	A.13, type 4b (14.1.1.1)

① B574, except elongation

② Hardness limit is 35 HRC max. per Swagelok material specification and NACE MR0103/ISO 17945.

Alloy 400 Fittings

Configuration	Order Designator	Body Material		Body Marking	NACE MR0175/ISO 15156 Table (NACE MR0103/ISO 17945 Section)
		Description	ASTM Specification		
Body Straight	—	Alloy 400 (UNS N04400) Cold-drawn, Hardness 35 HRC max ^①	B164	"M"	A.13 (14.1.1.6)
Body Shaped (Elbow, Tee, and Cross)	—	Alloy 400 (UNS N04400) Annealed, Hardness 35 HRC max ^①	B164/B564	"M"	A.13 (14.1.1.6)

① Hardness limit is 35 HRC max. per Swagelok material specification and NACE MR0103/ISO 17945.

Refer to the following product catalogs for additional information.

- *Gaugeable Tube Fittings and Adapters*, [MS-01-140](#)
- *Pipe Fittings*, [MS-01-147](#)
- *Medium- and High-Pressure Fittings, Tubing, Valves, and Accessories*, [MS-02-472](#)
- *Weld Fittings, Ultrahigh-Purity, Specially Cleaned, and Industrial*, [MS-01-149](#)
- *Gaugeable Alloy 2507 Super Duplex Tube Fittings*, [MS-01-174](#)
- *Alloy 2507 Super Duplex Weld Fittings*, [MS-01-173](#)

Safe Product Selection

When selecting a product, the total system design must be considered to ensure safe, trouble-free performance. Function, material compatibility, adequate ratings, proper installation, operation, and maintenance are the responsibilities of the system designer and user.

WARNING

Do not mix/interchange Swagelok products or components not governed by industrial design standards, including Swagelok tube fitting end connections, with those of other manufacturers.

Warranty Information

Swagelok products are backed by The Swagelok Limited Lifetime Warranty. For a copy, visit swagelok.com or contact your authorized Swagelok representative.