

# 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.

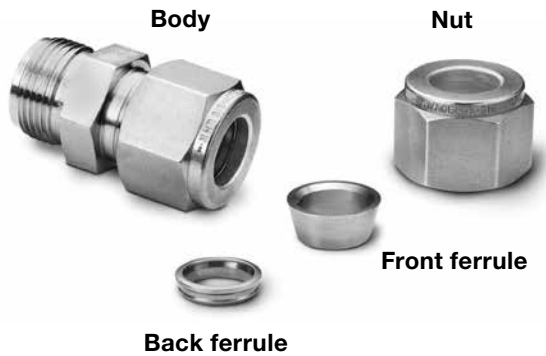


# NACE MR0175/MR0103 and ISO 15156/17945 Compliant Swagelok Fittings

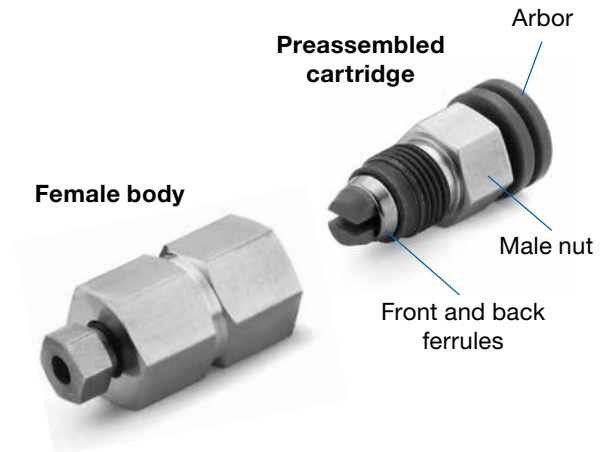
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### Swagelok tube fitting



### Swagelok medium-pressure, FK fitting



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

Body Material	Material Designator	External Exposure to Sour Gas		Internal Exposure to Sour Gas
		Tube <sup>①</sup> or FK <sup>②</sup> Fitting	Threaded <sup>③</sup> or Weld <sup>④</sup> Fittings	Tube <sup>①</sup> , FK <sup>②</sup> , Threaded <sup>③</sup> , or Weld <sup>④</sup> Fittings
316/316L SS	SS	Surface Applications Only	See tables on pages 5 to 8	See tables on pages 5 to 8
316L SS	316L			
6-Moly (254, 6HN)	6MO	Table A.11 <sup>⑤</sup>		
Alloy 2507	2507	Not Compliant		
Alloy 625	625	Table A.14 <sup>⑤</sup>		
Alloy 825	825	Table A.14 <sup>⑤</sup>		
Alloy C-276	HC	Table A.14 <sup>⑤</sup>		
Alloy 400	M	Table A.13		

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 table listed is valid for external exposure to sour gas regardless of whether "SG2" ordering designator is selected.

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

Body Material	Material Designator	External Exposure to Sour Gas		Internal Exposure to Sour Gas
		Tube <sup>①</sup> or FK <sup>②</sup> Fitting	Threaded <sup>③</sup> or Weld <sup>④</sup> Fittings	Tube <sup>①</sup> , FK <sup>②</sup> , Threaded <sup>③</sup> , or Weld <sup>④</sup> Fittings
316/316L SS	SS	Surface Applications Only	See tables on pages 5 to 8	See tables on pages 5 to 8
316L SS	316L			
6-Moly (254, 6HN)	6MO	Section 18.4.1 <sup>⑤</sup>		
Alloy 2507	2507	Not Compliant		
Alloy 625	625	Section 14.1.1.5 <sup>⑤</sup>		
Alloy 825	825	Section 14.1.1.5 <sup>⑤</sup>		
Alloy C-276	HC	Section 14.1.1.5 <sup>⑤</sup>		
Alloy 400	M	Section 14.1.1.1		

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 table listed is valid for external exposure to sour gas regardless of whether "SG2" ordering designator is selected.

## 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 <sub>2</sub> S Partial Pressure <sup>①</sup> 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 <sup>③</sup>	no restrictions; see MR0175 for cautionary remarks	
		Solution-annealed	A.2	Any equipment or component	60 (140)	100 (15)
					60 (140)	1000 (145) <sup>②</sup>
90 (194)	1 (0.145) <sup>②</sup>					
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 <sup>③</sup>	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 H<sub>2</sub>S 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 <sup>①</sup>	Threaded <sup>②</sup>	Weld <sup>③</sup>	FK <sup>④</sup>
Body Straight	—	Alloy 316/316L (UNS S31600/S31603) Cold-drawn	A479	“316”	“6L” or “316L”	A.4 (18.4.1)	A.4 <sup>⑥</sup>	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) <sup>⑤</sup>
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 <sup>⑥</sup>	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) <sup>⑤</sup>

- 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 <sup>①</sup>	Threaded <sup>②</sup>	Weld <sup>③</sup>
Body Straight	—	Alloy 6HN (UNS N08367) Cold-drawn	A479	“6HN”	A.11 (18.4.1)	A.11 <sup>④</sup>	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 <sup>④</sup>	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 <sup>④</sup>	B446 <sup>③</sup>	"625"	A.14, type 4d (14.1.1.5)
		Alloy 625 (UNS N06625) Annealed (Grade 1)			
	-SG2 <sup>①②</sup>	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 <sup>④</sup>	B446 <sup>③</sup>		
	-SG2 <sup>①②</sup>	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 <sup>②</sup>	B425 <sup>①</sup>	“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 <sup>②</sup>	B425 <sup>①</sup>		
	-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 <sup>②</sup>	B574 <sup>①</sup>	“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 <sup>②</sup>	B574 <sup>①</sup>		
	-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 <sup>①</sup>	B164	"M"	A.13 (14.1.1.6)
Body Shaped (Elbow, Tee, and Cross)	—	Alloy 400 (UNS N04400) Annealed, Hardness 35 HRC max <sup>①</sup>	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](http://swagelok.com) or contact your authorized Swagelok representative.