



High Pressure Fuel Delivery Pipe/Tube Material

1 Scope

This standard covers the material and processing requirements for high pressure pipes and tubes used for gasoline fuel delivery.

1.1 Material Description. The material is a stainless steel tube manufactured by either seamless drawing or welded plus drawing. The drawing process must reduce tube wall cross-sectional area by a minimum of 40%.

1.2 Symbols. Not applicable.

1.3 Applicability. The material is to be used as a high-pressure fuel-carrying conduit. The conduit is exposed to various fuels including gasoline combined with various quantities of ethanol, methanol and several contaminants as specified by the GM Powertrain (GMPT) gasoline fuel system Subsystem Technical Specifications (SSTS).

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

ASTM A262	ASTM B117	ISO 6507	ISO 10088
ASTM A923	ASTM E384	ISO 9227	

2.2 GM Standards/Specifications.

GMW3059

2.3 Additional References.

GM Powertrain Gasoline Fuel System Subsystem Technical Specifications (SSTS).

3 Requirements

3.1 Chemistry. The following grades of stainless steels may be used, depending on fuel system design strength requirement:

- ISO 10088 grade X2CrNi18-9 (EN 1.4307)
- ISO 10088 grade X5CrNi18-10 (EN 1.4301) except carbon is mill certified to 0.05% or lower.
- ISO 10088 X2CrNiN23-4 (EN 1.4362)
- ISO 10088 X2CrNiMoN22-5-3 (EN 1.4462)

3.2 Hardness. Tubes, as delivered from the mill, shall have a hardness range within 30 points Vickers Pyramid Number (HV) in the entire circumference of the tube. The hardness range is determined by taking the maximum and minimum hardness measurements, converted to HV scale, and then subtract the minimum from the maximum. For welded tubes, the harness of the weld and heat affected zone shall be statistically indistinguishable from the rest of the tube per the test described in 3.2.1.

3.2.1 Using a mounted and polished cross section take, at a minimum, two (2) microhardness readings in each of the following areas (see Figure 1):

1. Center of the weld, near the Outer Diameter (OD).
2. Center of the weld, near the Inner Diameter (ID).

The heat affected zone, near the OD.

3. The heat affected zone, near the ID.
4. 90° away from the weld.
5. 180° away from the weld.

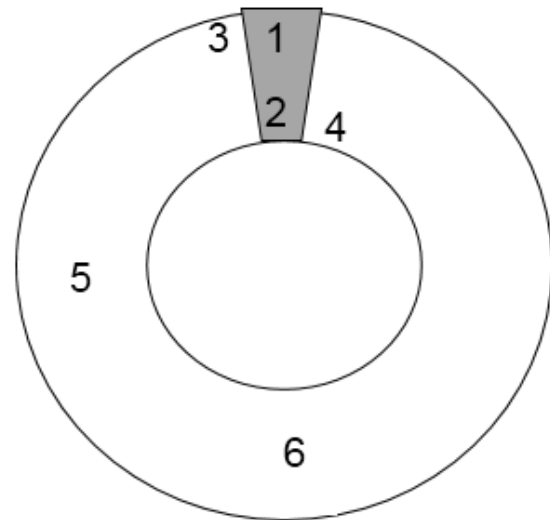


Figure 1: Microhardness Test Locations

Note: Perform micro hardness measurements per ASTM E384 or ISO 6507.

3.3 Sensitization. Tubes, as delivered to the fuel system assembly, shall not be sensitized when tested per ASTM A262 practice A for austenitic stainless steels (EN 1.4307 and EN 1.4301), or ASTM A923 for duplex stainless steels (EN 1.4362 and EN 1.4462).

3.3.1 Omit Section 3.4 of ASTM A262. In metallographic examination of the tube cross section after acid exposure, there shall be no full or partial grain boundaries ditching. Ditching is observable as semi-continuous thickening of the grain boundary in the microstructure from acid attack. If any grains are more than 50% surrounded by acid ditches, the tube material is deemed sensitized. Step, end grain I and end grain II microstructure, as described in ASTM A262 practice A are allowed.

Note: Using other practices per ASTM A262 are also allowed.

3.3.2 For ASTM A923, method A, B, or C are acceptable.

3.4 Corrosion Resistance. Tubes, as delivered to the fuel system assembly, shall not exhibit any red rust after exposure to neutral salt fog testing per ASTM B117 or ISO 9227 for 480 h. In this test, the ends of the tube shall not be plugged. The tubes can be angled to prevent fluid accumulation, but the ID of the tube shall be a part of the examined area. The presence of red rust after testing indicates surface contamination or sensitization.

4 Manufacturing Process

4.1 Welded Tube Manufacturing Process. The manufacturing process must include the following process steps:

- Tube welding: Welding is to be performed continuously with constant monitoring and control of tube speed, weld energy, gas flow and weld gap. In addition, a continuous thermal imaging system shall be used to monitor the temperature, width and position of the weld. All mentioned parameters shall have meaningful control ranges and alarms in place to reject defects and notify operators. Processing data shall be recorded and traceable to each production lot.
- Filler material shall not be used.
- A continuous eddy-current or ultrasonic check of the weld shall be performed at the welding operation to ensure welding defects are rejected.

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