



Double Wall Construction Steel Tubing

1 Scope

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose/Material Description. This standard covers double wall construction tubing wherein the two walls and the joints are copper brazed in a reducing atmosphere to produce tubing satisfactory for hydraulic brake lines, lubrication oil lines, vacuum lines, air brake lines, etc. There are requirements for the base metal, the optional coating materials, and the coated tubing. These requirements are applicable to the product coming out of the tube mills and the coating application lines, which are sometimes separate facilities. This tubing is used in the production of customized parts and assemblies. It is recommended that those parts and assemblies be validated for corrosion performance, conductivity and continuity, strength, appearance, and other critical properties unique to the particular application.

1.2 Symbols. Not applicable.

1.3 Applicability. Double wall steel tubing is typically used for automotive hydraulic brake lines.

1.4 Remarks. Double wall steel tubing should not be used for fuel lines because residual copper can contribute to the formation of sour gas.

2 References

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

2.1 External Standards/Specifications.

ASTM A254	ASTM B750	ISO 6892-1	SAE J403
ASTM A875	ASTM E8	ISO 8493	SAE J527

2.2 GM Standards/Specifications.

GMW3059	GMW3420	GMW14729	GMW15891
GMW3286	GMW14124	GMW14829	GMW18267
GMW3356	GMW14700	GMW15282	

2.3 Additional References.

- GMPT-5-036 Aggressive Bio Diesel
- GMPT-6-006 TF2 Gasoline
- GMPT-6-019 Oxidized Gasoline
- GMPT-6-023 E85 Low pHe
- GMPT-6-037 E100

3 Requirements

3.1 Properties. Basic tubing material shall be cold rolled mild steel strip to SAE J403 G10060, G10080 or G10100. Brazing material should be copper or copper alloy containing $\geq 93\%$ Cu by mass.

GMW14658 (I/II/III)

"I" = Outside diameter of as-brazed, millimeters (mm)

"II" = Wall thickness, millimeters (mm)

"III" = Manufacturing Process (*)

(*) Process Abbreviations:

G = Zinc-aluminum-alloy

Z = Electroplated Zinc

E = Aluminum Rich Epoxy Paint

N = Extruded Nylon 11 or 12

Y = Extruded Nylon 612

L = Polypropylene

3.1.1 Mechanical Properties. The following requirements shall apply only to the more common type of steel tubing; brazed-as manufactured. Properties of other classes of tubing, such as work hardened tubing, shall be as specified through special agreement between supplier and purchaser. Test pieces for mechanical test shall be taken at the end of the tube manufacturing process (after coiling, etc.,) without any additional cold working. All mechanical tests shall be performed at 23 °C ± 5 °C per ISO 6892-1 or ASTM E8.

Property	Minimum Requirements
• Tensile Strength R_m	290 MPa
• 0.2% Yield Strength $R_{p0.2}$	170 MPa
• Fracture Elongation A_{50}	14%

3.1.2 Drift Expanding Test (ISO 8493) Tubing shall be capable of being expanded over a tapered mandrel having an angle 60° until the internal diameter at expanded end is increased 20% without cracking or showing flaws (ASTM A254 Paragraph 6.3). Prior to expansion test, tubing shall be cut off square, edge crowned, and deburred. It shall be held firmly and squarely in the die, and punch must be guided on the axis of the tubing.

3.1.3 Bending Test Tubing shall be capable of being bent on a centerline radius of three times the tubing outside diameter without undue reduction of area of flatter when suitable bending fixtures used. The reduction of area shall be ≤ 6% for the diameters and wall thicknesses covered by this specification.

3.1.4 Static Burst Pressure. Tubing shall be capable of withstanding the following internal static hydraulic pressure, unless otherwise specified:

- Through 10.0 mm OD.....35 MPa
- Over 10.0 mm through 16.0 mm OD....15 MPa

3.2 Dimensions. Tubing shall conform to the dimensions and tolerances listed by the purchaser.

3.2.1 Brazed Tubing. Nominal diameter and wall thickness shall conform per Figure 1, and those listed in SAE J527 and Table 2.

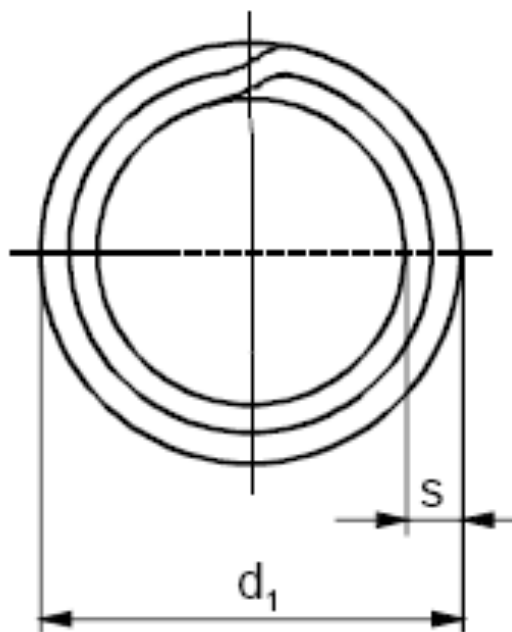


Figure 1: Dimensions for Diameter and Wall Thickness

3.2.2 Flared Ends. The pipe flare ends (inverted flare) shall conform to the Supplementary Requirements in ASTM A254, Section S1.

Table 1: External Finish Codes and Requirements

Finish	Finish Code	External Finish Description and Material Requirements
Zinc-Aluminum Alloy plus Aluminum Rich Epoxy Paint	GE	Hot dip zinc-aluminum alloy coating consisting of a 5% aluminum-balanced zinc alloy per ASTM B750 with a coating mass of 50 g/m ² per ASTM A875, Section 8 and a thickness of 3 μm minimum anywhere on the tube per Appendix A. The hot dip zinc-aluminum coating is then subsequently coated with an approved pretreatment process and an approved aluminum-rich epoxy coating. Film Thickness: The aluminum-rich epoxy paint of the GE finish shall have a minimum thickness of 3 μm anywhere on the tube as measured by the procedures in Appendix A. Actual thickness of the coatings in the GE finish shall be monitored circumferentially and longitudinally for each tube line. A sampling plan shall be referenced in the control plan.
Zinc-Aluminum Alloy plus Extruded Nylon 11 or 12	GN	Zinc-aluminum alloy as described in the preceding, followed by a conversion coating, an epoxy resin based primer, and a topcoat of Nylon 11 or 12. Appearance: The topcoat shall be uniform in color and free from discontinuities such as flow lines, pin holes, craters, or abnormal roughness. The topcoat shall be black in color unless otherwise specified on the engineering drawing. Film Thickness: The epoxy primer shall be 0.3 μm minimum and the Nylon 11 or 12 topcoat shall have a minimum thickness of 150 μm when tested by microscopic examination per Appendix A. Maximum thickness of the coating shall be controlled by the maximum OD (Table 2). Actual thickness of the coatings in the GN finish shall be monitored circumferentially and longitudinally for each tube line. A sampling plan shall be referenced in the control plan.

Finish	Finish Code	External Finish Description and Material Requirements
Zinc-Aluminum Alloy plus Extruded Nylon 612	GY	Zinc-aluminum alloy as described in the preceding, followed by a conversion coating, an epoxy resin based primer, and a topcoat of Nylon 612. Appearance: The topcoat shall be uniform in color and free from discontinuities such as flow lines, pin holes, craters, or abnormal roughness. The topcoat shall be black in color unless otherwise specified on the engineering drawing. Film Thickness: The epoxy primer shall be 0.3 μm minimum and the Nylon 612 topcoat shall have a minimum thickness of 150 μm when tested by microscopic examination per Appendix A. Maximum thickness of the coating shall be controlled by the maximum OD (Table 2). Actual thickness of the coatings in the GY finish shall be monitored circumferentially and longitudinally for each tube line. A sampling plan shall be referenced in the control plan.
Zinc Aluminum Alloy plus Extruded Nylon 11 or 12 plus Polypropylene	GNL	Zinc Aluminum Alloy plus Extruded Nylon 11 or 12 as described in the preceding, followed by an additional extruded layer of polypropylene. Appearance: The topcoat shall be uniform in color and free from discontinuities such as flow lines, pin holes, craters, or abnormal roughness. The topcoat shall be black in color unless otherwise specified on the engineering drawing. Film Thickness: The epoxy primer shall be 0.3 μm minimum and the Nylon 11 or 12 shall have a minimum thickness of 150 μm when tested by microscopic examination per Appendix A. The polypropylene topcoat shall have a minimum thickness of 700 μm. Maximum thickness of the coatings shall be controlled by the maximum OD (Table 2). Actual thickness of the coatings in the GNL finish shall be monitored circumferentially and longitudinally for each tube line. A sampling plan shall be referenced in the control plan.
Zinc Aluminum Alloy plus Extruded Nylon 612 plus Polypropylene	GYL	Zinc Aluminum Alloy plus Extruded Nylon 612 as described in the preceding, followed by an additional extruded layer of polypropylene. Appearance: The topcoat shall be uniform in color and free from discontinuities such as flow lines, pin holes, craters, or abnormal roughness. The topcoat shall be black in color unless otherwise specified on the engineering drawing. Film Thickness: The epoxy primer shall be 0.3 μm minimum and the Nylon 612 shall have a minimum thickness of 150 μm when tested by microscopic examination per Appendix A. The polypropylene topcoat shall have a minimum thickness of 700 μm. Maximum thickness of the coating shall be controlled by the maximum OD (Table 2). A sampling plan shall be referenced in the control plan.
Zinc Plate plus Extruded Nylon 11 or 12	ZN	Electroplated zinc, coated to a minimum thickness of 22 μm anywhere on the tube, followed by a conversion coating, an epoxy resin based primer, and a topcoat of Nylon 11 or 12. Appearance: The topcoat shall be uniform in color and free from discontinuities such as flow lines, pin holes, craters or abnormal roughness. The topcoat shall be black in color unless otherwise specified on the engineering drawing. Film Thickness: The epoxy primer shall be 0.3 μm minimum and the Nylon 11 or 12 topcoat shall have a minimum thickness of 150 μm when tested by microscopic examination per Appendix A. Maximum thickness of the coating shall be controlled by the maximum OD (Table 2). Actual thickness of the coatings in the ZN finish shall be monitored circumferentially and longitudinally for each tube line. A sampling plan shall be referenced in the control plan.
Zinc Plate plus Extruded Nylon 612	ZY	Electroplated zinc, coated to a minimum thickness of 22 μm anywhere on the tube, followed by a conversion coating, an epoxy resin based primer, and a topcoat of Nylon 612.