ASTM A688 TP304L (S30403) Engineering Technical Datasheet

Prepared from ASTM A688/A688M-15

1. Basic designation

Standard	Grade	UNS	Product form	Scope
ASTM A688/A688M-15	TP304L	S30403	Seamless or welded feedwater heater tube; U-bend if specified	Austenitic stainless steel feedwater heater tubes

2. Chemical composition (%)

C	Mn	P	S	Si	Ni	Cr	Mo	N	Cu	Ti	Al	Other
≤0.035	≤2.00	≤0.040	≤0.030	≤0.75	8.00–13.00	18.00–20.00	—	—	—	—	—	—

Chemistry note: For small diameter or thin walls or both, where many drawing passes are required, carbon maximum is 0.040%.

3. Mechanical properties

Condition / thickness range	Tensile strength, min	Yield strength, min	Elongation in 2 in. or 50 mm, min %
Standard	70 [485]	25 [175]	35

4. Heat treatment requirements

General condition	Heat treating temperature	Cooling requirement
All finished straight tubing or straight tubing ready for U-bending shall be furnished solution annealed.	1900 °F [1040 °C] min	Rapid cooling to below 700 °F [370 °C], sufficient to prevent harmful carbide precipitation

If heat treatment of U-bends is specified, it applies to the U-bend area plus approximately 6 in. [150 mm] of each leg beyond the tangent point. Inside surface shall be purged with protective or inert gas during heating and cooling to below 700 °F [370 °C].

5. Standard required inspection and testing

Requirement	Details
Tension test	1 specimen for lots of not more than 50 tubes; 2 tubes for lots of more than 50 tubes.
Hardness test	Specimens from 2 tubes from each lot.
Reverse bend test (welded)	1 test specimen from each 1500 ft [460 m] of finished tubing; not applicable for specified wall ≥10% OD, wall ≥0.134 in. [3.4 mm], or OD <0.375 in. [9.5 mm], where reverse flattening per A1016/A1016M applies.
Flattening test	From each end of one finished tube, not the one used for flange / flaring, from each lot.
Flange test (welded)	From each end of one finished tube, not the one used for flattening, from each lot.
Flaring test (seamless)	From each end of one finished tube, not the one used for flattening, from each lot.
Pressure test	Each straight tube or each U-tube after bending and post-bending heat treatment: hydrostatic or pneumatic, as specified by purchaser.
Nondestructive electric test	Each straight tube after finish heat treatment shall be tested in accordance with A1016/A1016M.
Corrosion test	One 1 in. full-section sample from the smallest radius heat-treated bend, and one 1 in. full-section sample from each lot of straight tubes, in accordance with ASTM A262.
Hardness limit	≤90 HRB or equivalent; no separate grain size requirement listed for this grade

6. Supplementary requirements (when specified in purchase order)

Supplementary requirement	Summary
S1 Nondestructive eddy-current test	Each finished tube, except bending if required, shall be tested by eddy current over full cross-section.
S2 Additional eddy-current test option	Purchaser may specify supplementary eddy current examination per standard supplementary requirements.
S3 Special test reports	Purchaser may request special reports on PO.

7. Permissible variations in dimensions

Dimension item	Requirement
Outside diameter tolerance	Per ASTM A1016/A1016M for straight tubes; bent U-tube portion excluded.
U-bend OD tolerance, R ≥ 2×D	Major or minor diameter at bent portion shall not deviate more than 10% from nominal diameter prior to bending.
Minimum wall tubing	+20% / -0 from specified minimum wall thickness.
Average wall tubing	±10% of nominal wall thickness.
U-bent section wall thickness	Not less than tf = 4RT / (4R + D), where T is required wall thickness, R is centerline bend radius, D is nominal OD.
Straight lengths up to 24 ft [7.3 m]	+1/8 in. [3 mm], -0.
Straight lengths over 24 ft [7.3 m]	Additional +1/8 in. [3 mm] for each 10 ft [3 m] or fraction thereof, up to +1/2 in. [13 mm] max.
U-bend leg length difference	Not greater than 1/8 in. unless otherwise specified.
Leg spacing at tangent points	Shall not vary from (2R - specified tube OD) by more than 1/16 in. [1.5 mm].
Plane of bend deviation	Shall not exceed 1/16 in. [1.5 mm].

8. Table 3 U-bend leg length over-tolerance

Specified leg length	Permissible over-tolerance
Up to 20 ft [6 m], incl.	1/8 in. [3.2 mm]
Over 20 to 30 ft [6 to 9 m], incl.	5/32 in. [4.0 mm]
Over 30 to 40 ft [9 to 12.2 m], incl.	3/16 in. [4.8 mm]

9. Table 4 Squareness of ends tolerance

Tube OD	Tolerance
Tube OD up to 5/8 in. [15.9 mm], incl.	0.010 in. [0.25 mm]
Tube OD over 5/8 to 1 in. [15.9 to 25.4 mm], incl.	0.016 in. [0.4 mm]

10. Filler metal / welding note

Item	Requirement / note
Filler metal	Not applicable for manufacture: ASTM A688 welded tubing shall be made by automatic welding process with no addition of filler metal.

11. Purchase order description example

Example wording
ASTM A688/A688M TP304L Tube, UNS S30403, seamless or welded, OD 19.05 mm × WT 1.24 mm × Length 12000 mm, average wall (or minimum wall as specified), solution annealed, straight or U-bent as specified, hydrostatic test or pneumatic test as specified, supplementary requirements as specified, test report required.

12. Notes

Surface condition: straight tubes after final annealing shall be pickled in nitric + hydrofluoric acid and then flushed/rinsed in water; not required if bright annealed.

Marking: all tubes shall be marked with the heat number; containers/packages shall show purchaser order number, manufacturer order number, specification, seamless or welded, grade, size and wall thickness, minimum or average, number of pieces, and item number if appropriate.