

SEA-CURE[®]

Stainless Steel Condenser, Evaporator, and Heat Exchanger Tubing*



MANUFACTURING & QUALITY CONTROL PROCEDURES 0TS-053 rev 04 December 12, 2006.

1.0 SCOPE:

This process control standard covers the processing and testing of SEA-CURE[®] super ferritic (UNS S44660) stainless steel tubing to meet or exceed the requirements of ASTM A-268/ASME SA-268 or special customer requirements.

2.0 RAW MATERIAL:

Electric furnace melted and cold rolled strip is procured to a Plymouth Tube specification to meet the requirements of A-268 and Plymouth's special requirements.

3.0 WELDING:

The strip is cold formed into a tubular shape and fusion welded by the tungsten inert gas method without the addition of filler material. Inspection samples are taken during setup and periodically thereafter for destructive testing and acid etching to insure a sound weld suitable to meet the flare, flange, and reverse flatten tests of A-268.

4.0 COLD WORKING:

After welding, the weld area is sufficiently cold worked to promote optimum corrosion resistance of the weld on subsequent annealing.

5.0 PRE-ANNEAL CLEANING:

The original clean strip finish is maintained on the tube ID no lubricants are used in forming, welding or cold working, therefore, no cleaning is necessary.

6.0 ANNEALING:

The tubes are solution annealed at 1500° F minimum, followed by water quench from the anneal temperature to prevent the formation of harmful carbide precipitation and to provide ductility to meet the mechanical properties, and manipulation test requirements of the specification.

7.0 STRAIGHTENING:

The tubes are machine straightened to a tolerance of .030" maximum camber in any 3 foot section. As tubing 1" OD and smaller is not stiff enough to accurately measure this, straightness will be demonstrated by having the ability to freely roll the tubes down a 5 degree incline.

8.0* AIR TEST:

The tubes will be air tested under water per QCS-108 at a minimum of 450 psi for tubing 1" OD and smaller, and 250 psi for tubing over 1 inch OD*, for not less than 5 seconds and long enough for the operator to inspect full length of tube.

9.0 CUT AND DEBURR:

Each tube end will be abrasive cut, thoroughly deburred, producing a square burr free end suitable for roller expanding and/or flaring.

10.0 PICKLE:

Each tube will be pickled in a mixture of nitric/H₂O/hydrofluoric acids to remove all oxide or scale and produce a smooth, clean, passivated, corrosion resistant surface for the optimum corrosion resistance of this grade.

11.0 RINSING:

Each pickled tube will be thoroughly rinsed by tank immersion, then hose rinsed with water. Demineralized water with 1 PPM maximum chloride will be used as a final rinse when requested by the customer.

12.0 NON-DESTRUCTIVE ELECTRIC TEST:

Each tube will be given a non-destructive electric test per Plymouth QCS-109 including applicable supplements.

13.0 FINAL INSPECTION:

Tubing will be examined per QCS-123 for straightness, length, OD size and wall thickness, and general surface appearance to insure specification conformance. An OD go ring gauge is used to check OD size on each end. To allow sliding clearance, it will be .002" larger than the maximum diameter allowed by the specification. To examine the inside surface, a light box will be placed on the opposite end.

14.0 IDENTIFICATION AND PACKAGING:

Immediately after eddy current test and final inspection on straight tubes, the tubes will be packed in wooden boxes lined with a water resistant material. The box covers will not be attached by nailing. This is to ensure that imperfections caused by additional handling, such as cutting, are eliminated.

14.1 Each box will be identified with customer order number, Plymouth mill order number, tube size and length, heat number, number of pieces and box number.

15.0 CUSTOMER INSPECTION:

Plymouth Tube – East Troy will allow entry and provide reasonable facilities for the customer's representative during testing or final inspection of the customer's order. Notification by Plymouth will be per the customer's purchase order requirements.

16.0 LABORATORY TESTS:

The following tests will be made per ASTM A-268/ASME SA 268 -

- 16.1 Tensile Test
- 16.2 Hardness Test
- 16.2 Flange Test
- 16.3 Reverse Flatten
- 16.4 Additional Tests per Customer Specification

17.0 TEST REPORTS:

Certified reports showing test results verifying specification conformance will be furnished.

* Denotes change/new since last revision

