SECTION 15067

SPECIAL PIPING MATERIALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.2 SUMMARY

A. This Section includes Stainless Steel piping systems intended for severe service applications with 32 °F (0 °C) to 366 °F (186 °C) temperature range and 150-psig maximum pressures.

B. Piping material Specifications included herein have requirements that exceed industrial standards. The following Material Specifications attachments are to supplement this section:
1. Material Specification MS-07-SS-4 (Stainless Steel Pipe, Schedule 10S).
2. Material Specification MS-07-SS-6 (Stainless Steel Pipe, Schedule 40S).
3. Material Specification MS-07-SS-8 (Stainless Steel Fittings, Schedule 10S).
4. Material Specification MS-07-SS-10 (Stainless Steel Fittings, Schedule 40S).
5. Material Specification MS-07-SS-12 (Stainless Steel Flange, Schedule 40S).
6. Material Specification MS-07-SS-13 (Stainless Steel Flange, Schedule 10S).
7. Material Specification MS-07-SS-14 (Stainless Steel Tubing).
8. Material Specification MS-07-SS-15 (Stainless Steel Tube Fittings).
9. Material Specification MS-04-SS-5 (Stainless Steel Bar).
10. Material Specification MS-04-SS-25 (Stainless Steel Plate).
11. Material Specification MS-04-SS-50 (Stainless Steel Sheet and Strip).
12. Gaskets: non-asbestos reinforced Teflon PTFE, ASTM D4894, 1/8-inch-thick, and flat ring, ASME B16.21.
13. Bolts: AISI Type 304 Stainless Steel, ASTM A193 Grade B8 Class 1, semi-finished heavy hex head, UNC threads.
14. Nuts: AISI Type 303 Stainless Steel, ASTM A194 Grade 8F, semi-finished heavy hex, UNC threads.

1.3 REFERENCES

A. The American Society of Mechanical Engineers (ASME).
1. ASME B16.21-92, “Nonmetallic Flat gaskets for Pipe Flanges”.
2. ASME B31.3-96, “Process Piping” .
3. ASME SA-182-92, “Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service” .
4. ASME SA-213-92, “Specification for Seamless Ferritic and Austenitic Alloy-Steel Boiler, Super-heater, and Heat-Exchanger Tubes”.
5. ASME SA-240-92, “Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels”.
6. ASME SA-249-92, “Specification for Welded Austenitic Steel Boiler, Super-heater, Heat-Exchanger, and Condenser Tubes”.
7. ASME SA-312-92, “Specification for Seamless and Welded Austenitic Stainless Steel Pipes”.
8. ASME SA-358-92, “Specification for Electric-Fusion-Welded Austenitic Chromium-Nickel Alloy Steel Pipe for High-Temperature Service”.

9. ASME SA-403-92, “Specification for Wrought Austenitic Stainless Steel Piping Fittings”.
10. ASME SA-479-92, “Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels”.
11. ASME SB-165-92, “Specification for Nickel-Copper Alloy (UNS N04400) Seamless Pipe and Tube”.
12. ASME SB-366-92, “Specification for Factory-Made Wrought Nickel and Nickel Alloy Welding Fittings”..
13. ASME SB-564-92, “Specification for Nickel Alloy Forgings”.
14. ASTM A262-93a, “Standard Practices for Detecting Susceptibility to Inter-granular Attack in Austenitic Stainless Steels”.
15. ASTM A450-92a, “Standard Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes”.

B. American Society for Testing and Materials (ASTM)
   1. ANSI B16.5-88, “Pipe Flanges and Flanged Fittings; Addenda B16.5A-92”.
   2. ANSI B16.9-93, “Factory-Made Wrought Steel Butt welding Fittings”.
   3. ANSI B16.11-91, “Forged Fittings, Socket-Welding, and Threaded”.

C. FED-STD-182B-79, “Federal Standard - Continuous Identification Marking of Nickel and Nickel Base Alloys”.

D. FED-STD-183C-84, “Federal Standard - Continuous Identification Marking of Iron and Steel Products”.

E. MIL-T-1368C-65 (Amendement 3 - 1980), Military Specification – “Tube and Pipe, Nickel Alloy, Seamless and Welded”.

F. QQ-N-281D-74 (Amendement 2 - 1985), Federal Specification – “Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections”.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use attached Material Specifications to procure these materials.

MATERIAL SPECIFICATION MS-07-SS-4

A. **DESCRIPTION**: pipe, AISI Type 304L stainless steel, UNS S30403; ASME SA-312 Grade TP304L or ASME SA-358 Grade 304L Class 1; seamless to 5-in., welded 6-in. and larger; cold finished, Schedule 10S.

B. **SUBMITTALS FOR APPROVAL**:

1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition as per ASME SA-312 or ASME SA-358 except 0.030% maximum carbon content.

D **CORROSION TESTING**: Test material for susceptibility to inter-granular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean pipe by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

G. **IDENTIFICATION**: Mark lengths of pipe per ASME SA-312 or ASME SA-358. Continuously mark lengths per FED-STD-183. Tags are not allowed. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on lengths of pipe at 3-ft intervals.

H. **PACKING**: Wrap pipe with polyethylene plastic sheet to protect from wetting. Protect ends with polyethylene plastic caps. Polyethylene plastic sheet and caps: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like sizes in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item numbers.

MATERIAL SPECIFICATION MS-07-SS-6

A. **DESCRIPTION**: pipe, AISI Type 304L stainless steel, UNS S30403; ASME SA-312 Grade TP304L; seamless, cold finished, Schedule 40S.

B. **SUBMITTALS FOR APPROVAL**:
1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-312, except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to inter-granular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean pipe by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

G **IDENTIFICATION**: Mark lengths of pipe per ASME SA-312. Continuously mark lengths per FED-STD-183. Tags are not allowed. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on lengths of pipe at 3-ft intervals.

H. **PACKING**: Wrap pipe with polyethylene plastic sheet to protect from wetting. Protect ends with polyethylene plastic caps. Polyethylene plastic sheet and caps: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like sizes in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item numbers.

MATERIAL SPECIFICATION MS-07-SS-8

A. **DESCRIPTION**: pipe fittings, AISI Type 304L stainless steel, UNS S30403; ASME SA-403 Grade WP-S304L or WP-W304L, butt weld, ANSI B16.9, matching Schedule 10S pipe. Fittings with taper or counter bores are unacceptable without prior approval from Facilities Manager.

B. **SUBMITTALS FOR APPROVAL**:
1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-403 except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to inter-granular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean pipe fittings by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

G. **IDENTIFICATION**: Mark fittings per ASME SA-403. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on fittings.

H. **PACKING**: Wrap fittings individually in polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like parts in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item numbers.

MATERIAL SPECIFICATION MS-07-SS-10

A. **DESCRIPTION**: pipe fittings, AISI Type 304L stainless steel, UNS S30403; ASME SA-403 Grade WP-S304L or WP-W304L, butt weld, ANSI B16.9, matching Schedule 40S pipe; ASME SA-182 Grade F 304L, socket weld or threaded, ANSI B16.11 Class 3000. Fittings with taper or counter bores are unacceptable without prior approval from Facilities Manager.

B. **SUBMITTALS FOR APPROVAL**:

1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-403 or ASME SA-182 except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean pipe fittings by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

G. **IDENTIFICATION**: Mark fittings per ASME SA-403 or ASME SA-182. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on fittings.

H. **PACKING**: Wrap fittings individually in polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like parts in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item number.

MATERIAL SPECIFICATION MS-07-SS-12

A. **DESCRIPTION**: flange, AISI Type 304L stainless steel, UNS S30403; ASME SA-182 Grade F 304L, weld neck, ANSI B16.5 Class 150, Schedule 40S bore.

B. **SUBMITTALS FOR APPROVAL**:
1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-182 except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean flanges by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 M Ohm-cm at tap.

G. **IDENTIFICATION**: Mark flanges per ASME SA-182. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on flanges.

H. **PACKING**: Wrap flanges individually in polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like sizes in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item number.

MATERIAL SPECIFICATION MS-07-SS-13

A. **DESCRIPTION**: flange, AISI Type 304L stainless steel, UNS S30403; ASME SA-182 Grade F 304L, weld neck, ANSI B16.5 Class 150, Schedule 10S bore

B. **SUBMITTALS FOR APPROVAL**:
1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition per ASME SA-182 except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean flanges by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

G. **IDENTIFICATION**: Mark flanges per ASME SA-182. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on flanges.

H. **PACKING**: Wrap flanges individually in polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like sizes in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item number.

MATERIAL SPECIFICATION MS-07-SS-14

A. **DESCRIPTION**: tubing; AISI Type 304L stainless steel, UNS S30403; ASME SA-213 Grade TP304L, cold drawn; ASME SA-249 Grade TP304L; seamless to 2-in. OD, welded 2½-in. OD and larger; cold finished.

B. **SUBMITTALS FOR APPROVAL**:

1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **FABRICATION**: Fabricate welded tubing from flat-rolled steel by automatic welding process with no addition of filler metal. Cold finish tubing. Visually inspect 100% of weld seams. Remove defects such as surface porosity, pin holes, undercut, overlap, lack of fusion, and/or cracks by grinding. Do not decrease wall thickness to less than permitted in ASTM A450. Facilities Manager Field Quality Representative may exercise option to further examine questionable weld seams by dye-penetrant inspection.

D. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-213 or ASME SA-249, except 0.030% maximum carbon content for tubing greater than 0.500-in. OD or 0.049-in. wall thickness and 0.040% maximum carbon content for tubing less than 0.500-in. OD or 0.049-in. wall thickness.

E. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

F. **REPAIR**: Repairs by welding are not permitted.

G. **CLEANING**: Clean tubing by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

H. **IDENTIFICATION**: Mark lengths of tubing per ASME SA-213 or ASME SA-249. Continuously mark tubing per FED-STD-183. Tags are not allowed. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on lengths of tubing at 3-ft intervals.

I. **PACKING**: Wrap tubing with polyethylene plastic sheet to protect from wetting. Protect ends with polyethylene plastic caps. Polyethylene plastic sheet and caps: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like sizes in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item number.

MATERIAL SPECIFICATION MS-07-SS-15

A. **DESCRIPTION**: tube fittings; AISI Type 304L or AISI Type 316L stainless steel, UNS S30403 or UNS 31603; ASME SA-182 Grade F 304L or F 316L or ASME SA-403 Grade WP-S304L, WP-W304L, WP-S316L, or WP-W316L. Fittings with taper or counter bores are unacceptable without prior approval from Facilities Manager.

B. **SUBMITTALS FOR APPROVAL**:

1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-182 or ASME SA-403 except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean tube fittings by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

G **IDENTIFICATION**: Mark tube fittings per ASME SA-182 or ASME SA-403. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on fittings.

H. **PACKING**: Wrap tube fittings individually in polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like parts in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item number.

MATERIAL SPECIFICATION MS-04-SS-5

A. **DESCRIPTION**: bar stock, AISI Type 304L stainless steel, UNS S30403; ASME SA-479; hot-rolled, annealed, pickled.

B. **SUBMITTALS FOR APPROVAL**:
1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-479 except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean bar stock by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

G. **IDENTIFICATION**: Mark lengths of tubing per ASME SA-479. Continuously mark tubing per FED-STD-183. Tags are not allowed. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on lengths of tubing at 3-ft intervals.

H. **PACKING**: Wrap bar stock with polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Pack like sizes in wooden boxes for shipment. Mark shipping containers with Facilities Manager purchase order number and item number.

MATERIAL SPECIFICATION MS-04-SS-25

A. **DESCRIPTION**: plate, AISI Type 304L stainless steel, UNS S30403; ASME SA-240; hot-rolled, annealed, pickled.

B. **SUBMITTALS FOR APPROVAL**:
1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-240 except 0.030% maximum carbon content.

D. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

E. **REPAIR**: Repairs by welding are not permitted.

F. **CLEANING**: Clean plate by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

IG **IDENTIFICATION**: Mark plates per ASME SA-240. Continuously mark plates per FED-STD-183. Tags are not allowed. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on plates at 3-ft intervals.

H. **PACKING**: Wrap plates with polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Band like sizes with nonmetallic banding on wooden pallets for shipment. Mark shipping pallets with Facilities Manager purchase order number and item number.

MATERIAL SPECIFICATION MS-04-SS-50

A. **DESCRIPTION**: sheet and strip, AISI Type 304L stainless steel, UNS 30403; ASME SA-240.

B. **SUBMITTALS FOR APPROVAL**:
1. Certificate of Compliance (COC) to requirements of this material specification for each lot of material.
2. Certified Material Test Report (CMTR) including results of heat analysis tests for each heat of finished product.
3. Corrosion Test Reports including corrosion rates for each specimen for each 48-h period.
4. Nondestructive Examination Procedures and Reports.

C. **FINISHES**: Furnish sheet material with a No. 2B surface finish. Furnish strip material with a No. 2 surface finish and a Square 1 or 5 edge.

D. **CHEMICAL COMPOSITION ANALYSIS**: Perform heat analysis to determine chemical composition of material. Chemical composition: ASME SA-240 except 0.030% maximum carbon content.

E. **CORROSION TESTING**: Test material for susceptibility to intergranular attack per ASTM A262 Practice A (Oxalic Acid Etch Test). Use Table 4 to screen materials. Test samples passing Practice A Test by ASTM A262 Practice C (Nitric Acid Test). For Practice A and Practice C requirements, test two specimens taken from representative samples from each size and heat of finished product. Prepare specimens as required, sensitize specimens by heating for 1 h at 1250°F ± 10°F and quench with water. Practice C test consists of five boiling periods of 48 h each. Ensure that corrosion rate for each specimen does not exceed 0.0020 in. per month for full five 48-h periods. Ensure that corrosion rate for final specimen does not exceed corrosion rate of any of the previous specimens by more than 0.0002 in. per month.

F. **REPAIR**: Repairs by welding are not permitted.

G. **CLEANING**: Clean sheet and strip by pickling, bright annealing, machining, or degreasing to ensure that surfaces are clean and free of scale. Ensure that no contamination is visible with unaided eye corrected to 20/20 vision when surface being inspected is illuminated by minimum 100 ft-c. Avoid use of halide-bearing materials (i.e., oils and cleaning fluids). If use of halide-bearing materials is required, remove residual halides from surfaces by washing with halide-free water of resistivity greater than 1.5 Mohm-cm at tap.

H **IDENTIFICATION**: Mark sheet and strip per ASME SA-240. Continuously mark sheet and strip per FED-STD-183. Tags are not allowed. Marking fluids: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. After approval for shipment, Facilities Manager Field Quality Representative will electro-etch additional marking, including IR number and heat number, on sheets and strips on a 2-ft X 2-ft grid pattern.

J. **PACKING**: Wrap sheet and strip with polyethylene plastic sheet to protect from wetting. Polyethylene plastic sheet: maximum 50 ppm water-soluble halides, maximum 50 ppm water-soluble sulfates. Band like sizes with nonmetallic banding on wooden pallets for shipment. Mark shipping pallets with Facilities Manager purchase order number and item number.

END OF SECTION 15067