

ASTM-A312/A312M

SPECIFICATION FOR SEAMLESS, WELDED, AND HEAVILY COLD WORKED AUSTENITIC STAINLESS STEEL PIPES

This specification covers seamless, straight-seam welded, and heavily cold worked welded austenitic stainless steel pipe intended for high-temperature and general corrosive service.

❖ **Heat Treatment :-**

- All pipe shall be furnished in the heat-treated condition in accordance with the requirements of Table 1.
- Other than for Grades S33228, S30815, S31272, and the H Grades, seamless pipe immediately following hot forming may be individually quenched by water or rapidly cooled by other means, provided that the temperature of the pipes after hot forming is not less than the minimum specified solution treatment temperature in Table 1.
- For H Grades, as well as Grades S33228, S30815, and S31272, the pipes shall be reheated to the specified solution treatment temperature for the required time before quenching.

Table 1

| Grade or UNS Designation | Heat Treating Temperature | Cooling/Testing Requirements |
|---|-----------------------------|------------------------------|
| All grades not individually listed below: | 1900 °F [1040 °C] | C |
| TP321H, TP347H, TP348H: | | |
| Cold finished | 2000 °F [1100 °C] | D |
| Hot finished | 1925 °F [1050 °C] | D |
| TP304H, TP316H: | | |
| Cold finished | 1900 °F [1040 °C] | D |
| Hot finished | 1900 °F [1040 °C] | D |
| TP309H, TP309HCb, TP310H, TP310HCb | 1900 °F [1040 °C] | D |
| S30600 | 2010–2140 °F [1100–1170 °C] | D |
| S30601 | 2010–2140 °F [1100–1170 °C] | D |
| S30815, S31272 | 1920 °F [1050 °C] | D |
| S31035 | 2160–2280 °F [1180–1250 °C] | D |
| S31254, S32654 | 2100 °F [1150 °C] | D |

| | | |
|----------------|-----------------------------|---|
| S31266 | 2100 °F [1150 °C] | D |
| S31277 | 2050 °F [1120 °C] | D |
| S31727, S32053 | 1975–2155 °F [1080–1180 °C] | D |
| S33228 | 2050–2160 °F [1120–1180 °C] | D |
| S34565 | 2050–2140 °F [1120–1170 °C] | D |
| S35315 | 2010 °F [1100 °C] | D |
| S38815 | 1950 °F [1065 °C] | D |
| N08367 | 2025 °F [1110 °C] | D |
| N08020 | 1700–1850 °F [925–1010 °C] | D |
| N08810 | 2050 °F [1120 °C] | D |
| N08811 | 2100 °F [1150 °C] | D |
| N08904 | 2000 °F [1100 °C] | D |
| N08925, N08926 | 2010–2100 °F [1100–1150 °C] | D |

^A New designation established in accordance with Practice E527 and SAE J1086.

^B Minimum, unless otherwise stated.

^C Quenched in water or rapidly cooled by other means, at a rate sufficient to prevent re-precipitation of carbides, as demonstrable by the capability of pipes, heat treated by either separate solution annealing or by direct quenching, of passing Practices A262, Practice E. The manufacturer is not required to run the test unless it is specified on the purchase order. Note that Practices A262 requires the test to be performed on sensitized specimens in the low-carbon and stabilized types and on specimens representative of the as-shipped condition for other types. In the case of low-carbon types containing 3 % or more molybdenum, the applicability of the sensitizing treatment prior to testing shall be a matter for negotiation between the seller and the purchaser.

^D Quenched in water or rapidly cooled by other means.

❖ **Chemical Composition :-**

The steel shall conform to the requirements as to chemical composition prescribed in Table 2.

Table 2

| Grade | UNS Designation ^A | Composition, % ^B | | | | | | | | |
|---------|------------------------------|-----------------------------|-----------|------------|--------|---------|-----------|-----------|------------|--|
| | | Carbon | Manganese | Phosphorus | Sulfur | Silicon | Chromium | Nickel | Molybdenum | Other ^C |
| TP201 | S20100 | 0.15 | 5.5–7.5 | 0.06 | 0.03 | 1.00 | 16.0–18.0 | 3.5–5.5 | ... | N [0.25] |
| TP201LN | S20153 | 0.03 | 6.4–7.5 | 0.05 | 0.02 | 0.75 | 16.0–17.5 | 4.0–5.0 | ... | N [0.10–0.25], Cu [1] |
| ... | S20400 | 0.03 | 7.0–9 | 0.05 | 0.03 | 1.00 | 15.0–17.0 | 1.5–3.0 | ... | N [0.15–0.3] |
| TPXM-19 | S20910 | 0.06 | 4.0–6 | 0.05 | 0.03 | 1.00 | 20.5–23.5 | 11.5–13.5 | 1.5–3.0 | Cb [0.10–0.3], N [0.20–0.4], V [0.10–0.30] |
| TPXM-10 | S21900 | 0.08 | 8.0–10 | 0.05 | 0.03 | 1.00 | 19.0–21.5 | 5.5–7.5 | ... | N [0.15–0.4] |

| | | | | | | | | | | |
|----------------------|--------|--------------------|-----------|------|------|----------|-----------|-----------|---------|---|
| TPXM-11 | S21904 | 0.04 | 8.0–10 | 0.05 | 0.03 | 1.00 | 19.0–21.5 | 5.5–7.5 | ... | N [0.15–0.4] |
| TPXM-29 | S24000 | 0.08 | 11.5–14.5 | 0.06 | 0.03 | 1.00 | 17.0–19.0 | 2.3–3.7 | ... | N [0.20–0.4] |
| TP304 | S30400 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 18.0–20.0 | 8.0–11.0 | ... | ... |
| TP304L | S30403 | 0.035 ^D | 2.00 | 0.05 | 0.03 | 1.00 | 18.0–20.0 | 8.0–13.0 | ... | ... |
| TP304H | S30409 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 18.0–20.0 | 8.0–11.0 | ... | ... |
| ... | S30415 | 0.04–0.06 | 0.80 | 0.05 | 0.03 | 1.0–2.0 | 18.0–19.0 | 9.0–10.0 | ... | N [0.12–0.18], Ce [0.03–0.08] |
| TP304N | S30451 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 18.0–20.0 | 8.0–11.0 | ... | N [0.10–0.16] |
| TP304LN | S30453 | 0.04 | 2.00 | 0.05 | 0.03 | 1.00 | 18.0–20.0 | 8.0–12.0 | ... | N [0.10–0.16] |
| ... | S30600 | 0.02 | 2.00 | 0.02 | 0.02 | 3.7–4.3 | 17.0–18.5 | 14.0–15.5 | 0.20 | Cu [0.50 max] |
| ... | S30601 | 0.02 | 0.50–0.8 | 0.03 | 0.01 | 5.0–5.6 | 17.0–18.0 | 17.0–18.0 | 0.20 | N [0.05], Cu [0.35] |
| ... | S30615 | 0.16–0.24 | 2.00 | 0.03 | 0.03 | 3.2–4 | 17.0–19.5 | 13.5–16.0 | ... | Al [0.80–1.5] |
| ... | S30815 | 0.05–0.1 | 0.80 | 0.04 | 0.03 | 1.40–2.0 | 20.0–22.0 | 10.0–12.0 | ... | N [0.14–0.2], Ce [0.03–0.08] |
| TP309S | S30908 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 22.0–24.0 | 12.0–15.0 | 0.75 | ... |
| TP309H | S30909 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 22.0–24.0 | 12.0–15.0 | ... | ... |
| TP309Cb | S30940 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 22.0–24.0 | 12.0–16.0 | 0.75 | Cb [10×C min, 1.10 max] |
| TP309HC _b | S30941 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 22.0–24.0 | 12.0–16.0 | 0.75 | Cb [10×C min, 1.10 max] |
| | S31002 | 0.02 | 2.00 | 0.02 | 0.02 | 0.15 | 24.0–26.0 | 19.0–22.0 | 0.10 | N [0.1] |
| TP310S | S31008 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 24.0–26.0 | 19.0–22.0 | 0.75 | ... |
| TP310H | S31009 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 24.0–26.0 | 19.0–22.0 | ... | ... |
| | S31035 | 0.04–0.1 | 0.60 | 0.03 | 0.02 | 0.40 | 21.5–23.5 | 23.5–26.5 | | W [3.0–4.0], Co [1.0–2.0], Cb [0.40–0.6], N [0.20–0.3], Cu [2.5–3.5], B [0.002–0.008] |
| TP310Cb | S31040 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 24.0–26.0 | 19.0–22.0 | 0.75 | Cb [10×Cmin, 1.10max] |
| TP310HC _b | S31041 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 24.0–26.0 | 19.0–22.0 | 0.75 | Cb [10×Cmin, 1.10max] |
| ... | S31050 | 0.03 | 2.00 | 0.02 | 0.02 | 0.40 | 24.0–26.0 | 20.5–23.5 | 1.6–2.6 | N [0.09–0.15] |
| ... | S31254 | 0.02 | 1.00 | 0.03 | 0.01 | 0.80 | 19.5–20.5 | 17.5–18.5 | 6.0–6.5 | N [0.18–0.25], Cu [0.50–1] |
| ... | S31266 | 0.03 | 2.00–4 | 0.04 | 0.02 | 1.00 | 23.0–25.0 | 21.0–24.0 | 5.2–6.2 | W [1.50–2.5], N [0.35–0.6], Cu [1.00–2.5] |

| | | | | | | | | | | |
|---------|--------|--------------------|-------|--------------------|------|-----------|-----------|------------------------|----------|--|
| | S31272 | 0.08–12 | 1.5–2 | 0.03 | 0.02 | 0.25–0.75 | 14.0–16.0 | 14.0–16.0 | 1.00–1.4 | Ti [0.30–0.6], B [0.002–0.008] |
| | S31277 | 0.02 | 3.00 | 0.03 | 0.01 | 0.50 | 20.5–23.0 | 26.0–28.0 | 6.5–8.0 | N [0.30–0.4], Cu [0.50–1.5] |
| TP316 | S31600 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 16.0–18.0 | 11.0–14.0 ^E | 2.0–3.0 | ... |
| TP316L | S31603 | 0.035 ^D | 2.00 | 0.05 | 0.03 | 1.00 | 16.0–18.0 | 10.0–14.0 | 2.0–3.0 | ... |
| TP316H | S31609 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 16.0–18.0 | 11.0–14.0 ^E | 2.0–3.0 | ... |
| TP316Ti | S31635 | 0.08 | 2.00 | 0.05 | 0.03 | 0.75 | 16.0–18.0 | 10.0–14.0 | 2.0–3.0 | Ti [5×(C+N)–0.70], N [0.1] |
| TP316N | S31651 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 16.0–18.0 | 11.0–14.0 ^E | 2.0–3.0 | N [0.10–0.16] |
| TP316LN | S31653 | 0.04 | 2.00 | 0.05 | 0.03 | 1.00 | 16.0–18.0 | 11.0–14.0 ^E | 2.0–3.0 | N [0.10–0.16] |
| TP317 | S31700 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 18.0–20.0 | 11.0–15.0 | 3.0–4.0 | ... |
| TP317L | S31703 | 0.04 | 2.00 | 0.05 | 0.03 | 1.00 | 18.0–20.0 | 11.0–15.0 | 3.0–4.0 | ... |
| ... | S31725 | 0.03 | 2.00 | 0.040 ^F | 0.03 | 1.00 | 18.0–20.0 | 13.5–17.5 | 4.0–5.0 | N [0.1], Cu [0.75] |
| ... | S31726 | 0.03 | 2.00 | 0.040 ^F | 0.03 | 1.00 | 17.0–20.0 | 13.5–17.5 | 4.0–5.0 | N [0.10–0.2], Cu [0.75] |
| ... | S31727 | 0.03 | 1.00 | 0.03 | 0.03 | 1.00 | 17.5–19.0 | 14.5–16.5 | 3.8–4.5 | N [0.15–0.21], Cu [2.8–4] |
| ... | S31730 | 0.03 | 2.00 | 0.04 | 0.01 | 1.00 | 17.5–19.0 | 15.0–16.5 | 3.0–4.0 | N [0.045], Cu [4.0–5] |
| ... | S32053 | 0.03 | 1.00 | 0.03 | 0.01 | 1.00 | 22.0–24.0 | 24.0–26 | 5.0–6.0 | N [0.17–0.22] |
| TP321 | S32100 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 17.0–19.0 | 9.0–12.0 | ... | N [0.1], ^G |
| TP321H | S32109 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 17.0–19.0 | 9.0–12.0 | ... | Ti [4(C+N) min; 0.7 max], N [0.1] |
| ... | S32615 | 0.07 | 2.00 | 0.05 | 0.03 | 4.8–6.0 | 16.5–19.5 | 19.0–22 | 0.30–1.5 | Cu [1.50–2.5] |
| ... | S32654 | 0.02 | 2.0–4 | 0.03 | 0.01 | 0.50 | 24.0–25.0 | 21.0–23 | 7.0–8.0 | N [0.45–0.55], Cu [0.30–0.6] |
| ... | S33228 | 0.04–0.08 | 1.00 | 0.02 | 0.02 | 0.30 | 26.0–28.0 | 31.0–33 | ... | Cb [0.60–1], Ce [0.05–0.1], Al [0.025] |
| ... | S33228 | 0.04–0.08 | 1.00 | 0.02 | 0.02 | 0.30 | 26.0–28.0 | 31.0–33 | ... | Cb [0.60–1], Ce [0.05–0.1] |
| ... | S34565 | 0.03 | 5.0–7 | 0.03 | 0.01 | 1.00 | 23.0–25.0 | 16.0–18.0 | 4.0–5.0 | Cb [0.1], N [0.40–0.6] |
| TP347 | S34700 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 17.0–19.0 | 9.0–13.0 | ... | ^H |
| TP347H | S34709 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 17.0–19.0 | 9.0–13.0 | ... | ^I |
| TP347LN | S34751 | 0.005–0.02 | 2.00 | 0.05 | 0.03 | 1.00 | 17.0–19.0 | 9.0–13.0 | ... | Cb [0.20–0.50] ^J , N [0.06–0.1] |
| TP348 | S34800 | 0.08 | 2.00 | 0.05 | 0.03 | 1.00 | 17.0–19.0 | 9.0–13.0 | ... | Ta [0.10], ^H |

| | | | | | | | | | | |
|----------|--------|-----------|------|------|------|----------|-----------|-----------|----------|---|
| TP348H | S34809 | 0.04–0.1 | 2.00 | 0.05 | 0.03 | 1.00 | 17.0–19.0 | 9.0–13.0 | ... | Ta [0.10], ^I |
| ... | S35045 | 0.06–0.1 | 1.50 | ... | 0.02 | 1.00 | 25.0–29.0 | 32.0–37.0 | ... | Ti [0.15–0.6], Cu [0.75], Al [0.15–0.6] |
| ... | S35315 | 0.04–0.08 | 2.00 | 0.04 | 0.03 | 1.2–2.0 | 24.0–26.0 | 34.0–36.0 | ... | N [0.12–0.18], Ce [0.03–0.08] |
| TPXM-15 | S38100 | 0.08 | 2.00 | 0.03 | 0.03 | 1.50–2.5 | 17.0–19.0 | 17.5–18.5 | ... | ... |
| ... | S38815 | 0.03 | 2.00 | 0.04 | 0.02 | 5.5–6.5 | 13.0–15.0 | 15.0–17.0 | 0.75–1.5 | Cu [0.75–1.5], Al [0.3] |
| Alloy 20 | N08020 | 0.07 | 2.00 | 0.05 | 0.04 | 1.00 | 19.0–21.0 | 32.0–38.0 | 2.0–3.0 | Cu [3.0–4.0], ^M |
| ... | N08367 | 0.03 | 2.00 | 0.04 | 0.03 | 1.00 | 20.0–22.0 | 23.5–25.5 | 6.0–7.0 | N [0.18–0.25], Cu [0.75] |
| 800.00 | N08800 | 0.10 | 1.50 | 0.05 | 0.02 | 1.00 | 19.0–23.0 | 30.0–35.0 | ... | Fe ^K [39.5 min], Cu [0.75], Al [0.15–0.6] |
| 800H | N08810 | 0.05–0.1 | 1.50 | 0.05 | 0.02 | 1.00 | 19.0–23.0 | 30.0–35.0 | ... | Fe ^K [39.5 min], Ti [0.15–0.6] Cu [0.75], Al [0.15–0.6] |
| | N08811 | 0.06–0.1 | 1.50 | 0.05 | 0.02 | 1.00 | 19.0–23.0 | 30.0–35.0 | ... | Fe ^K [39.5 min], Ti [0.15– 0.60 ^L], Cu [0.75], Al [0.15–0.6 ^L] |
| ... | N08904 | 0.02 | 2.00 | 0.04 | 0.03 | 1.00 | 19.0–23.0 | 23.0–28.0 | 4.0–5.0 | N [0.1], Cu [1.0–2.0] |
| ... | N08925 | 0.02 | 1.00 | 0.05 | 0.03 | 0.50 | 19.0–21.0 | 24.0–26.0 | 6.0–7.0 | N [0.10–0.2], Cu [0.80–1.5] |
| ... | N08926 | 0.02 | 2.00 | 0.03 | 0.01 | 0.50 | 19.0–21.0 | 24.0–26.0 | 6.0–7.0 | N [0.15–0.25], Cu [0.50–1.5] |

^A New designation established in accordance with Practice E527 and SAE J1086.

^B Maximum, unless otherwise indicated. Where ellipses (...) appear in this table, there is no requirement and analysis for the element need not be determined or reported.

^C The method of analysis for nitrogen shall be a matter of agreement between the purchaser and manufacturer.

^D For small diameter or thin walls or both, where many drawing passes are required, a carbon maximum of 0.040 % is necessary in grades TP304L and TP316L. Small outside diameter tubes are defined as those less than 0.500 in. [12.7 mm] in outside diameter and light wall tubes as those less than 0.049 in. [1.20 mm] in average wall thickness (0.044 in. [1.10 mm] in minimum wall thickness).

^E For welded TP316, TP316N, TP316LN, and TP316H pipe, the nickel range shall be 10.0–14.0 %.

^F For welded pipe, the phosphorus maximum shall be 0.045 %.

^G $Ti \geq 5 \times (C+N)$ min, 0.70 max.

^H The columbium content shall be not less than ten times the carbon content and not more than 1.00 %.

^I The columbium content shall be not less than eight times the carbon content and not more than 1.0 %.

^J Grade S34751 shall have a columbium (niobium) content of not less than 15 times the carbon content.

^K Iron shall be determined arithmetically by difference of 100 minus the sum of the other specified elements.

^L (Al + Ti) 0.85 – 1.20.

^M Columbium (Nb) + Tantalum = 8 × Carbon min, 1.00 max.

❖ **Tensile Requirements :-**

The tensile properties of the material shall conform to the requirements prescribed in Table 3.

Table 3

| Grade | UNS Designation | Tensile Strength, min ksi [MPa] | Yield Strength, min ksi [MPa] |
|----------|-----------------|---------------------------------|-------------------------------|
| TP201 | S20100 | 75 [515] | 38 [260] |
| TP201LN | S20153 | 95 [655] | 45 [310] |
| ... | S20400 | 95 [635] | 48 [330] |
| TPXM-19 | S20910 | 100 [690] | 55 [380] |
| TPXM-10 | S21900 | 90 [620] | 50 [345] |
| TPXM-11 | S21904 | 90 [620] | 50 [345] |
| TPXM-29 | S24000 | 100 [690] | 55 [380] |
| TP304 | S30400 | 75 [515] | 30 [205] |
| TP304L | S30403 | 70 [485] | 25 [170] |
| TP304H | S30409 | 75 [515] | 30 [205] |
| ... | S30415 | 87 [600] | 42 [290] |
| TP304N | S30451 | 80 [550] | 35 [240] |
| TP304LN | S30453 | 75 [515] | 30 [205] |
| ... | S30600 | 78 [540] | 35 [240] |
| ... | S30601 | 78 [540] | 37 [255] |
| ... | S30615 | 90 [620] | 40 [275] |
| ... | S30815 | 87 [600] | 45 [310] |
| TP309S | S30908 | 75 [515] | 30 [205] |
| TP309H | S30909 | 75 [515] | 30 [205] |
| TP309Cb | S30940 | 75 [515] | 30 [205] |
| TP309HCb | S30941 | 75 [515] | 30 [205] |
| ... | S31002 | 73 [500] | 30 [205] |
| TP310S | S31008 | 75 [515] | 30 [205] |
| TP310H | S31009 | 75 [515] | 30 [205] |
| | S31035 | 95 [655] | 45 [310] |

| | | | |
|-----------|-------------------------|-----------|----------|
| TP310Cb | S31040 | 75 [515] | 30 [205] |
| TP310HCb | S31041 | 75 [515] | 30 [205] |
| ... | S31050: | | |
| | t ≤ 0.25 in. | 84 [580] | 39 [270] |
| | t > 0.25 in. | 78 [540] | 37 [255] |
| ... | S31254: | | |
| | t ≤ 0.187 in. [5.00 mm] | 98 [675] | 45 [310] |
| | t > 0.187 in. [5.00 mm] | 95 [655] | 45 [310] |
| ... | S31266 | 109 [750] | 61 [420] |
| ... | S31272 | 65 [450] | 29 [200] |
| ... | S31277 | 112 [770] | 52 [360] |
| TP316 | S31600 | 75 [515] | 30 [205] |
| TP316L | S31603 | 70 [485] | 25 [170] |
| TP316H | S31609 | 75 [515] | 30 [205] |
| ... | S31635 | 75 [515] | 30 [205] |
| TP316N | S31651 | 80 [550] | 35 [240] |
| TP316LN | S31653 | 75 [515] | 30 [205] |
| TP317 | S31700 | 75 [515] | 30 [205] |
| TP317L | S31703 | 75 [515] | 30 [205] |
| ... | S31725 | 75 [515] | 30 [205] |
| ... | S31726 | 80 [550] | 35 [240] |
| ... | S31727 | 80 [550] | 36 [245] |
| ... | S31730 | 70 [480] | 25 [175] |
| ... | S32053 | 93 [640] | 43 [295] |
| TP321 | S32100: | | |
| Welded | | 75 [515] | 30 [205] |
| Seamless: | ≤ 3/8 in. | 75 [515] | 30 [205] |
| | > 3/8 in. | 70 [485] | 25 [170] |
| TP321H | S32109: | | |
| Welded | | 75 [515] | 30 [205] |
| Seamless: | ≤ 3/8 in. | 75 [515] | 30 [205] |
| | > 3/8 in. | 70 [480] | 25 [170] |
| ... | S32615 | 80 [550] | 32 [220] |
| ... | S32654 | 109 [750] | 62 [430] |

| | | | |
|---|--|---------------------|-------------------|
| ... | S33228 | 73 [500] | 27 [185] |
| ... | S34565 | 115 [795] | 60 [415] |
| TP347 | S34700 | 75 [515] | 30 [205] |
| TP347H | S34709 | 75 [515] | 30 [205] |
| TP347LN | S34751 | 75 [515] | 30 [205] |
| TP348 | S34800 | 75 [515] | 30 [205] |
| TP348H | S34809 | 75 [515] | 30 [205] |
| ... | S35045 | 70 [485] | 25 [170] |
| ... | S35315: | | |
| | Welded | 94 [650] | 39 [270] |
| | Seamless | 87 [600] | 38 [260] |
| TPXM-15 | S38100 | 75 [515] | 30 [205] |
| ... | S38815 | 78 [540] | 37 [255] |
| Alloy 20 | N08020 | 80 [550] | 35 [240] |
| ... | N08367: | | |
| | t ≤ 0.187 | 100 [690] | 45 [310] |
| | t > 0.187 | 95 [655] | 45 [310] |
| 800 | N08800: | | |
| | cold-worked | 75 [515] | 30 [205] |
| | annealed | | |
| | hot finished annealed | 65 [450] | 25 [170] |
| 800H | N08810 | 65 [450] | 25 [170] |
| | N08811 | 65 [450] | 25 [170] |
| ... | N08904 | 71 [490] | 31 [215] |
| ... | N08925 | 87 [600] | 43 [295] |
| ... | N08926 | 94 [650] | 43 [295] |
| Elongation in 2 in. or 50 mm (or 4D), min, % | | | |
| | | Longitudinal | Transverse |
| | All Grades except S31050 and S32615 | 35 | 25 |
| | S32615, S31050 | 25 | ... |
| | S31277, N08925 | 40 | ... |
| | N08367, N08020, N08800, N08810, N08811 | 30 | ... |

❖ **Mechanical Tests :-**

- a. Transverse or Longitudinal Tension Test.
- b. Flattening Test.
- c. Hydrostatic or Non-destructive Electric Test :-
 - i. Each pipe shall be subjected to the non-destructive electric test or the hydrostatic test. The type of test to be used shall be at the option of the manufacturer, unless otherwise specified in the purchase order.
 - ii. The hydrostatic test shall be in accordance with Specification A999/A999M.
 - iii. The non-destructive electric test shall be in accordance with Specification A999/A999M.

❖ **Grain Size :-**

Grain size determinations, in accordance with Test Methods E112, shall be made on the grades listed in Table 4.

Table 4

| Grade | UNS Designation | Grain Size |
|--------------|------------------------|-------------------|
| ... | N08810 | 5 or coarser |
| ... | N08811 | 5 or coarser |
| TP304H | S30409 | 7 or coarser |
| TP309H | S30909 | 6 or coarser |
| TP309HCb | S30940 | 6 or coarser |
| TP310H | S31009 | 6 or coarser |
| ... | S31035 | 7 or coarser |
| TP310HCb | S31041 | 6 or coarser |
| TP316H | S31609 | 7 or coarser |
| TP321H | S32109 | 7 or coarser |
| ... | S32615 | 3 or finer |
| TP347H | S34709 | 7 or coarser |
| TP348H | S34809 | 7 or coarser |

❖ **Lengths :-**

- Unless otherwise agreed upon, all sizes from NPS 1/8 to and including NPS 8 are available in a length up to 24 ft with the permitted range of 15 to 24 ft. Short lengths are acceptable and the number and minimum length shall be agreed upon between the manufacturer and the purchaser.

❖ **Supplementary Tests :-**

- A. Transverse Tension Tests.
- B. Flattening Test.
- C. Etching Tests.
- D. Radiographic Examination.
- E. Stabilizing Heat Treatment :- Subsequent to the solution anneal required , Grades TP309HCb, TP310HCb, TP321, TP321H, TP347, TP347H, TP348, and TP348H shall be given a stabilization heat treatment at a temperature lower than that used for the initial solution annealing heat treatment. The temperature of stabilization heat treatment shall be as agreed upon between the purchaser and vendor.
- F. Intergranular Corrosion Test :- When specified, material shall pass intergranular corrosion tests conducted by the manufacturer in accordance with Practices A262, Practice E.
- G. Weld Decay Test.

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