AUSTRALIAN PIPELINE VALVE®

ADELAIDE • BRISBANE • PERTH

# Valve Casting Material Metallurgical Chemical & Mechanical Specification

## Duplex Stainless Steel A890/A995

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| 255SS, UNS J93370, CD4MCu | A890 1A* | 25Cr-5Ni-Mo-Cu | Carbon | 0.04% Max | Nickel | 4.75 - 6.0% | Tensile Strength | 100,000 PSI Min |
| | | | Manganese | 1.00% Max | Chromium | 24.5 - 26.5% | Yield Strength | 70,000 PSI Min |
| | | | Silicon | 1.00% Max | Molybdenum | 1.75 - 2.25% | Elongation at 2in. | 16.0% Min |
| | | | Phosphorus | 0.04% Max | Copper | 2.75 - 3.25% | | |
| | | | Sulfur | 0.04% Max | Iron | Balance | | |
| UNS J93372, CD4MCuN | A890 1B†(A)<br>A995 1B | 25Cr-5Ni-Mo-Cu-N | Carbon | 0.04% Max | Nickel | 4.7 - 6.0% | Tensile Strength | 100,000 PSI Min |
| | | | Manganese | 1.0% Max | Chromium | 24.5 - 26.5% | Yield Strength | 70,000 PSI Min |
| | | | Silicon | 1.0 % Max | Molybdenum | 1.7 - 2.3% | Elongation at 2in. | 16.0% Min |
| | | | Phosphorus | 0.04% Max | Copper | 2.7 - 3.3% | | |
| | | | Sulfur | 0.04% Max | Nitrogen | 0.15 - 0.25% | | |
| UNS J93373, CD3MCuN | A890 1C*(B) | 25Cr-6Ni-Mo-Cu-N | Carbon | 0.03% Max | Nickel | 5.6 - 6.7% | Tensile Strength | 100,000 PSI Min |
| | | | Manganese | 1.20% Max | Chromium | 24.0 - 26.7% | Yield Strength | 65,000 PSI Min |
| | | | Silicon | 1.10% Max | Molybdenum | 2.9 - 3.8% | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.03% Max | Copper | 1.40 - 1.9% | | |
| | | | Sulfur | 0.03% Max | Nitrogen | 0.22 - 0.33% | | |
| UNS J93345, CE8MN | A890 2A†<br>A995 2A | 24Cr-10Ni-Mo-N | Carbon | 0.08% Max | Nickel | 8.0 - 11.0% | Tensile Strength | 95,000 PSI Min |
| | | | Manganese | 1.00% Max | Chromium | 22.5 - 25.5% | Yield Strength | 65,000 PSI Min |
| | | | Silicon | 1.50% Max | Molybdenum | 3.0 - 4.5% | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.04% Max | Nitrogen | 0.10 - 0.30% | | |
| | | | Sulfur | 0.04% Max | | | | |
| UNS J93371, CD6MN | A890 3A†<br>A995 3A | 25Cr-5Ni-Mo-N | Carbon | 0.06% Max | Nickel | 4.0 - 6.0% | Tensile Strength | 95,000 PSI Min |
| | | | Manganese | 1.00% Max | Chromium | 24.0 - 27.0% | Yield Strength | 65,000 PSI Min |
| | | | Silicon | 1.00% Max | Molybdenum | 1.75 - 2.5% | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.04% Max | Nitrogen | 0.15 - 0.25% | | |
| | | | Sulfur | 0.04% Max | | | | |
| 2205SS, UNS J92205, CD3MN | A890 4A†<br>A995 4A | 22Cr-5Ni-Mo-N | Carbon | 0.03% Max | Nickel | 4.5 - 6.5% | Tensile Strength | 90,000 PSI Min |
| | | | Manganese | 1.50% Max | Chromium | 21.0 - 23.5% | Yield Strength | 60,000 PSI Min |
| | | | Silicon | 1.00% Max | Molybdenum | 2.5 - 3.5% | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.04% Max | Copper | 1.00% Max | | |
| | | | Sulfur | 0.02% Max | Nitrogen | 0.10 - 0.30% | | |
| UNS J93404, CE3MN<br>(Super Duplex) | A890 5A† (B)<br>A995 5A (B) | 25Cr-7Ni-Mo-N | Carbon | 0.03% Max | Nickel | 6.0 - 8.0% | Tensile Strength | 100,000 PSI Min |
| | | | Manganese | 1.50% Max | Chromium | 24.0 - 26.0% | Yield Strength | 75,000 PSI Min |
| | | | Silicon | 1.00% Max | Molybdenum | 4.0 - 5.0% | Elongation at 2in. | 18.0% Min |
| | | | Phosphorus | 0.04% Max | Nitrogen | 0.10 - 0.30% | | |
| | | | Sulfur | 0.04% Max | | | | |
| UNS J93380, CD3MWCuN<br>(Super Duplex) | A890 6A† (B)<br>A995 6A (B) | 25CR-7Ni-Mo-N | Carbon | 0.03% Max | Chromium | 24.0 - 26.0% | Tensile Strength | 100,000 PSI Min |
| | | | Manganese | 1.00% Max | Molybdenum | 3.0 - 4.0 | Yield Strength | 65,000 PSI Min |
| | | | Silicon | 1.00% Max | Copper | 0.5 - 1.0% | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.03% Max | Tungsten | 0.5 - 1.0% | | |
| | | | Sulfur | 0.025% Max | Nitrogen | 0.20 - 0.30% | | |
| | | | Nickel | 6.5 - 8.5% | | | | |
| UNS J93379 (Zeron 100™)<br>(Super Austenitic/Duplex) | A890 7A† (B)<br>A995 7A (B) | 27Cr-Ni-Mo-Cu-N | Carbon | 0.03% Max | Molybdenum | 2.0 - 3.5% | Tensile Strength | 100,000 PSI Min |
| | | | Manganese | 1.00 - 3.00% | Copper | 1.00% Max | Yield Strength | 75,000 PSI Min |
| | | | Silicon | 1.00% Max | Tungsten | 3.0 - 4.0% | Elongation at 2in. | 20.0% Min |
| | | | Phosphorus | 0.03% Max | Nitrogen | 0.30 - 0.40% | | |
| | | | Sulfur | 0.02% Max | Barium | 0.0002 - 0.010% | | |
| | | | Nickel | 6.0 - 8.0% | Boron | 0.0010 - 0.010% | | |
| | | | Chromium | 26.0 - 28.0% | Ce + La | 0.005 - 0.03% | | |

* A890 1A No longer referenced by API, A990 1C is not referenced in A995.
† Still in use but optionally superceded by A995.
A995-13 Current edition as of January 2017.
(A) % Cr + 3.3% Mo + 16% N ≥ 40.
(B) % CR + 3.3 (% Mo + 0.5 % W) + 16 % N ≥ 45.

## Austenitic Stainless Steel A351/A743/A744

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| 304SS, UNS J92600 | A351 CF8<br>A743 CF8<br>A744 CF8 | 19Cr-9Ni | Carbon | 0.08% Max | Sulfur | 0.04% Max | Tensile Strength | 70,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 8.0 - 11.0% | Yield Strength | 30,000 PSI Min |
| | | | Silicon | 2.00% Max | Chromium | 18.0 - 21.0% | Elongation at 2in. | 35.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% Max | | |
| 304LSS, UNS J92500 | A351 CF3<br>A743 CF3<br>A744 CF3 | 19Cr-9Ni | Carbon | 0.03% Max | Sulfur | 0.04% Max | Tensile Strength | 70,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 8.0 - 12.0% | Yield Strength | 30,000 PSI Min |
| | | | Silicon | 2.00% Max | Chromium | 17.0 - 21.0% | Elongation at 2in. | 35.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% Max | | |
| 316SS, UNS J92900 | A351 CF8M<br>A743 CF8M<br>A744 CF8M | 19Cr-10Ni-2Mo | Carbon | 0.08% Max | Sulfur | 0.04% Max | Tensile Strength | 70,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 9.0 - 12.0% | Yield Strength | 30,000 PSI Min |
| | | | Silicon | 1.50% Max | Chromium | 18.0 - 21.0% | Elongation at 2in. | 30.0% Max |
| | | | Phosphorus | 0.04% Max | Molybdenum | 2.0 - 3.0% | | |
| 316LSS, UNS J92800 | A351 CF3M<br>A743 CF3M<br>A744 CF3M | 19Cr-10Ni-2Mo | Carbon | 0.03% Max | Sulfur | 0.04% Max | Tensile Strength | 70,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 9.0 - 13.0% | Yield Strength | 30,000 PSI Min |
| | | | Silicon | 1.50% Max | Chromium | 17.0 - 21.0% | Elongation at 2in. | 30.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 2.0 - 3.0% | | |
| 316ModSS, UNS J92804 | A351 CF3MN<br>A743 CF3MN | 19Cr-10Ni-2-Mo-N | Carbon | 0.03% Max | Nickel | 9.0 - 13.0% | Tensile Strength | 75,000 PSI Min |
| | | | Manganese | 1.50% Max | Chromium | 17.0 - 21.0% | Yield Strength | 37,000 PSI Min |
| | | | Silicon | 1.50% Max | Molybdenum | 2.0 - 3.0% | Elongation at 2in. | 35.0% Min |
| | | | Phosphorus | 0.04% Max | Nitrogen | 0.10 - 0.20% | | |
| | | | Sulfur | 0.04% Max | | | | |
| UNS J93401 | A351 CH10<br>A743 CH10 | | Carbon | 0.04 - 0.10% | Sulfur | 0.04% Max | Tensile Strength | 70,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 12.0 - 15.0% | Yield Strength | 30,000 PSI Min |
| | | | Silicon | 2.00% Max | Chromium | 22.0 - 26.0% | Elongation at 2in. | 30.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% Max | | |
| UNS J93402 | A351 CH20<br>A744 CH20 | 25Cr-13Ni | Carbon | 0.04 - 0.20% | Sulfur | 0.04% Max | Tensile Strength | 70,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 12.0 - 15.0% | Yield Strength | 30,000 PSI Min |
| | | | Silicon | 2.00% Max | Chromium | 22.0 - 26.0% | Elongation at 2in. | 30.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% Max | | |
| UNS J94204 | A351 HK40 | | Carbon | 0.35 - 0.45% | Sulfur | 0.04% Max | Tensile Strength | 62,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 19.0 - 22.0% | Yield Strength | 35,000 PSI Min |
| | | | Silicon | 1.75% Max | Chromium | 23.0 - 27.0% | Elongation at 2in. | 10.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% Max | | |
| Alloy 20, UNS J95150 | A351 CN7M<br>A743 CN7M<br>A744 CN7M | 20Cr-29Ni-3Cu-2Mo | Carbon | 0.07% Max | Nickel | 27.5 - 30.5% | Tensile Strength | 62,000 PSI Min |
| | | | Manganese | 1.50% Max | Chromium | 19.0 - 22.0% | Yield Strength | 25,000 PSI Min |
| | | | Silicon | 1.50% Max | Molybdenum | 2.0 - 3.0% | Elongation at 2in. | 35.0% Min |
| | | | Phosphorus | 0.04% Max | Copper | 3.0 - 4.0% | | |
| | | | Sulfur | 0.04% Max | | | | |
| 317LSS, UNS J92999 | A351 CG3M<br>A743 CG3M<br>A744 CG3M | 19Cr-11Ni-3Mo | Carbon | 0.03% Max | Sulfur | 0.04% Max | Tensile Strength | 75,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 9.0 - 13.0% Max | Yield Strength | 35,000 PSI Min |
| | | | Silicon | 1.50% Max | Chromium | 18.0 - 21.0% Max | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 3.0 - 4.0% Max | | |
| 317SS, UNS J93000 | A351 CG8M<br>A743 CG8M<br>A744 CG8M | 19Cr-11Ni-3Mo | Carbon | 0.08% Max | Sulfur | 0.04% Max | Tensile Strength | 75,000 PSI Min |
| | | | Manganese | 1.50% Max | Nickel | 9.0 - 13.0% | Yield Strength | 35,000 PSI Min |
| | | | Silicon | 1.50% Max | Chromium | 18.0 - 21.0% | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 3.0 - 4.0% | | |
| 218SS, UNS J92972, Nitronic 60 | A351 CF10SMnN<br>A742 CF10SMnN | 17Cr-8.5Ni-N | Carbon | 0.10% Max | Sulfur | 0.03% Max | Tensile Strength | 85,000 PSI Min |
| | | | Manganese | 7.00 - 9.00% | Nickel | 8.0 - 9.0% | Yield Strength | 42,500 PSI Min |
| | | | Silicon | 3.90 - 4.50% | Chromium | 16.0 - 18.0% | Elongation at 2in. | 30.0% Min |
| | | | Phosphorus | 0.06% Max | Nitrogen | 0.08 - 0.18% | | |
| Duplex, 254SMO, UNS J93254 | A351 CK3MCuN<br>A743 CK3MCuN<br>A744 CK3MCuN | 20Cr-18Ni-6Mo-Cu-N | Carbon | 0.025% Max | Nickel | 17.5 - 19.5% Max | Tensile Strength | 80,000 PSI Min |
| | | | Manganese | 1.20% Max | Chromium | 19.5 - 20.5% | Yield Strength | 38,000 PSI Min |
| | | | Silicon | 1.00% Max | Molybdenum | 6.0 - 7.0% | Elongation at 2in. | 35.0% Min |
| | | | Phosphorus | 0.045% Max | Copper | 0.50 - 1.00% | | |
| | | | Sulfur | 0.010% Max | Nitrogen | 0.18 - 0.24% | | |

## Martensitic Stainless Steel A217/A487/A743

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| UNS J91150 | A217 CA15<br>A487 CA15<br>A743 CA15 | Cr,<br>Martensitic Cr,<br>12Cr | Carbon | 0.15% Max | Sulfur | 0.04% Max | Tensile Strength | 90,000 PSI Min |
| | | | Manganese | 1.00% Max | Nickel | 1.00% Max | Yield Strength | 65,000 PSI Min |
| | | | Silicon | 1.50% Max | Chromium | 11.5 - 14.0% | Elongation at 2in. | 18.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.15 - 1.0% | Reduction of area | 30.0% Min |
| 410 Mod., UNS J91540 | A352 CA6NM<br>A486 CA6NM A&B<br>A743 CA6NM | 12.5Cr-4Ni-Mo,<br>Martensitic Cr-Ni | Carbon | 0.06% Max | Chromium | 11.5 - 14.0% | Tensile Strength | 100,000 PSI Min |
| | | | Manganese | 1.00% Max | Molybdenum | 0.4 - 1.0% | Yield Strength | 75,000 Psi Min |
| | | | Silicon | 1.00% Max | Copper | 0.50% Max | Elongation at 2in. | 17% Min |
| | | | Phosphorus | 0.04% Max | Vanadium | 0.05% Max | Reduction of area | 35% Min |
| | | | Sulfur | 0.03% Max | Tungsten | 0.05% Max | | |
| | | | Nickel | 3.5 - 4.5% | Total residual elements | 0.50% | | |

## Nickel Base Steel A494

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| Ni210, N02100 | A494 CZ100 | 95Ni | Carbon | 1.00% Max | Sulfur | 0.02% Max | Tensile Strength | 50,000 PSI Min |
| | | | Manganese | 1.5% Max | Nickel | 95.0% Max | Yield Strength | 18,000 PSI Min |
| | | | Silicon | 2.00% Max | Copper | 1.25% Max | Elongation at 2in. | 10.0% Min |
| | | | Phosphorus | 0.03% Max | Iron | 3.00% Max | | |
| Monel 400, N24130 | A494 M30C | 63Ni-29Cu-2Cb | Carbon | 0.30% Max | Nickel | Balance | Tensile Strength | 65,000 PSI Min |
| | | | Manganese | 1.50% Max | Copper | 26.0 - 33.0% | Yield Strength | 32,500 PSI Min |
| | | | Silicon | 1.0 - 2.0% | Columbium | 3.50% Max | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.03% Max | Iron | 1.0 - 3.0% | | |
| | | | Sulfur | 0.02% Max | | | | |
| Ni'B', N30007, Hastalloy B2 | A494 N7M | 65Ni-28Mo-2Fe | Carbon | 0.07% Max | Nickel | Balance | Tensile Strength | 76,000 PSI Min |
| | | | Manganese | 1.00% Max | Chromium | 1.0% Max | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 1.00% Max | Molybdenum | 30.0 - 33.0% | Elongation at 2in. | 20.0% Min |
| | | | Phosphorus | 0.03% Max | Iron | 3.00% Max | | |
| | | | Sulfur | 0.02% Max | | | | |
| Ni'C' Mod., N30002, Hastalloy C | A494 CW12MW | 55Ni-17Mo-16Cr-4W | Carbon | 0.12% Max | Chromium | 15.5 - 17.5% | Tensile Strength | 72,000 PSI Min |
| | | | Manganese | 1.00% Max | Molybdenum | 16.0 - 18.0% | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 1.00% Max | Vanadium | 0.20 - 0.40% | Elongation at 2in. | 4.0% Min |
| | | | Phosphorus | 0.03% Max | Tungsten | 3.75 - 5.25% | | |
| | | | Sulfur | 0.02% Max | Iron | 4.5 - 7.5% | | |
| | | | Nickel | Balance | | | | |
| Ni'C' Mod., N26455, Hastalloy 4 | A494 CW2M | 61Ni-16Cr-16Mo | Carbon | 0.02% Max | Nickel | Balance | Tensile Strength | 72,000 PSI Min |
| | | | Manganese | 1.00% Max | Chromium | 15.0 - 17.5% | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 0.80% Max | Molybdenum | 15.0 - 17.5% | Elongation at 2in. | 20.0% Min |
| | | | Phosphorus | 0.03% Max | Tungsten | 1.0% Max | | |
| | | | Sulfur | 0.02% Max | Iron | 2.0% Max | | |
| Inconel 625 | A494 CW6MC | 58Ni-21Cr-8.5Mo-3.4Cb-2Fe | Carbon | 0.06% Max | Nickel | Balance | Tensile Strength | 70,000 PSI Min |
| | | | Manganese | 1.00% Max | Chromium | 2.0 - 23.0% | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 1.00% Max | Molybdenum | 8.0 - 10.0% | Elongation at 2in. | 25.0% Min |
| | | | Phosphorus | 0.015% Max | Columbium | 3.15 - 4.50% | | |
| | | | Sulfur | 0.015% Max | Iron | 5.0% Max | | |

## Heat Resistant Steel A297

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| 309SS, UNS J93503 | A297 HH | 25Cr-12Ni | Carbon | 0.20 - 0.50% | Sulfur | 0.04% Max | Tensile Strength | 75,000 PSI Min |
| | | | Manganese | 2.00% Max | Nickel | 11.0 - 14.0% | Yield Strength | 35,000 PSI Min |
| | | | Silicon | 2.00% Max | Chromium | 24.0 - 28.0% | Elongation at 2in. | 10.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% | | |
| 310SS, UNS J94224 | A297 HK | 25Cr-20Ni | Carbon | 0.20 - 0.60% | Sulfur | 0.04% Max | Tensile Strength | 65,000 PSI Min |
| | | | Manganese | 2.00% Max | Nickel | 18.0 - 22.0% | Yield Strength | 35,000 PSI Min |
| | | | Silicon | 2.00% Max | Chromium | 24.0 - 28.0% | Elongation at 2in. | 10.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% | | |
| 312SS, UNS J93403 | A297 HE | 29Cr-9Ni | Carbon | 0.20 - 0.50% | Sulfur | 0.04% Max | Tensile Strength | 85,000 PSI Min |
| | | | Manganese | 2.00% Max | Nickel | 8.0 - 11.0% | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 2.00% Max | Chromium | 26.0 - 30.0% | Elongation at 2in. | 9.0% Min |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% Max | | |
| 330SS | A297 HT | 15Cr-35Ni | Carbon | 0.35 - 0.75% | Sulfur | 33.0 - 37.0% | Tensile Strength | 65,000 PSI Min |
| | | | Manganese | 2.00% Max | Nickel | 15.0 - 19.0% | Elongation at 2in. | 4.0% Min |
| | | | Silicon | 2.50% Max | Chromium | 15.0 - 19.0% | | |
| | | | Phosphorus | 0.04% Max | Molybdenum | 0.50% Max | | |

## Precipitation Hardened Steel A747

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| 17-4PH, UNS J92180, 5355 | A747 CB7Cu-1 | 16Cr-4Ni-3Cu | Carbon | 0.07% Max | Nickel | 3.60 - 4.60% | | |
| | | | Manganese | 0.70% Max | Chromium | 15.50 - 17.70% | | |
| | | | Silicon | 1.00% Max | Copper | 2.50 - 3.20% | | |
| | | | Phosphorus | 0.035% Max | Nitrogen | 0.05% Max | | |
| | | | Sulfur | 0.03% Max | Columbium | 0.15 - 0.35% | | |
| 15-5PH, UNS J92110, 5346 | A747 CB7Cu-2 | 16Cr-5Ni-3Cu | Carbon | 0.07% Max | Nickel | 4.50% Max | | |
| | | | Manganese | 0.70% Max | Chromium | 14.0 - 15.5% | | |
| | | | Silicon | 1.00% Max | Copper | 2.5 - 3.20% | | |
| | | | Phosphorus | 0.035% Max | Nitrogen | 0.05% Max | | |
| | | | Sulfur | 0.03% Max | Columbium | 0.15 - 0.35% | | |

## Alloy Steels (Chrome-Moly) A217

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| 4118 Mod., UNS J12072 | A217 WC6 | C-Mo | Carbon | 0.05 - 0.20% | Chromium | 1.00 - 1.50% | Tensile Strength | 70,000 - 95,000 PSI |
| | | | Manganese | 0.50 - 0.80% | Molybdenum | 0.45 - 0.65% | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 0.60% Max | Copper | 0.50% Max | Elongation at 2in. | 20% Min |
| | | | Phosphorus | 0.035% Max (C) | Tungsten | 0.10% Max | Reduction of area | 35% Min |
| | | | Sulfur | 0.035% Max (C) | Total of residual elements | 1.00% Max | | |
| | | | Nickel | 0.50% Max | | | | |
| 4115 Mod., UNS J21890 | A217 WC9 | Cr-Mo | Carbon | 0.05 - 0.18% | Chromium | 2.00 - 2.75% | Tensile Strength | 70,000 - 95,000 PSI |
| | | | Manganese | 0.40 - 0.70% | Molybdenum | 0.90 - 1.20% | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 0.60% Max | Copper | 0.50% Max | Elongation at 2in. | 20% Min |
| | | | Phosphorus | 0.035% Max | Tungsten | 0.10% Max | Reduction of area | 35% Min |
| | | | Sulfur | 0.035% Max (C) | Total of residual elements | 1.00% Max | | |
| | | | Nickel | 0.50% Max | | | | |
| UNS J42045 | A217 C5 | Cr-Mo | Carbon | 0.20% Max | Chromium | 4.00 - 6.50% | Tensile Strength | 90,000 - 115,000 PSI |
| | | | Manganese | 0.40 - 0.70% | Molybdenum | 0.45 - 0.65% | Yield Strength | 60,000 PSI Min |
| | | | Silicon | 0.75% Max | Copper | 0.50% Max | Elongation at 2in. | 18% Min |
| | | | Phosphorus | 0.04% Max (C) | Tungsten | 0.10% Max | Reduction of area | 35.0% Min |
| | | | Sulfur | 0.045% Max (C) | Total of residual elements | 1.00% Max | | |
| | | | Nickel | 0.50% Max | | | | |
| UNS J82090 | A217 C12 | | Carbon | 0.20% Max | Chromium | 8.00 - 10.00% | Tensile Strength | 90,000 - 115,000 PSI |
| | | | Manganese | 0.35 - 0.65% | Molybdenum | 0.90 - 1.20% | Yield Strength | 60,000 PSI Min |
| | | | Silicon | 1.00% Max | Copper | 0.50% Max | Elongation at 2in. | 18% Min |
| | | | Phosphorus | 0.035% Max (C) | Tungsten | 0.10% Max | Reduction of area | 35.0% Min |
| | | | Sulfur | 0.035% Max (C) | Columbium | 0.03% Max | | |
| | | | Nickel | 0.50% Max | Total of residual elements | 1.00% Max | | |
| | A217 C12A | | Carbon | 0.08 - 0.12% | Molybdenum | 0.85 - 1.05% | Tensile Strength | 85,000 - 110,000 PSI |
| | | | Manganese | 0.30 - 0.60% | Vanadium | 0.18 - 0.25% | Yield Strength | 60,000 PSI Min |
| | | | Silicon | 0.20 - 0.50% | Nitrogen | 0.030 - 0.07% | Elongation at 2in. | 18% Min |
| | | | Phosphorus | 0.25% Max | Aluminium | 0.02% Max | Reduction of area | 45% Min |
| | | | Sulfur | 0.01% Max | Columbium | 0.06 - 0.10% | | |
| | | | Nickel | 0.40% Max | Titanium | 0.01% Max | | |
| | | | Chromium | 8.0 - 9.5% | Zirconium | 0.01% Max | | |

(C) For lower maximum phosphorus or sulfur contents, see ASTM A217/ A217M-14 Supplementary Requirement S52.

## Carbon Steel A216

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| 1025 | A216 WCB | | Carbon | 0.30% Max | Chromium | 0.50% Max | Tensile Strength | 70,000 - 95,000 PSI |
| | | | Manganese | 1.00% Max | Molybdenum | 0.20% Max | Yield Strength | 36,000 PSI Min |
| | | | Silicon | 0.60% Max | Copper | 0.30% Max | Elongation at 2in. | 22.0% Min |
| | | | Phosphorus | 0.035% Max | Vanadium | 0.03% Max | Reduction of area | 35.0% Min |
| | | | Sulfur | 0.035% Max | Total of residual elements | 1.00% Max | | |
| | | | Nickel | 0.50% Max | | | | |
| 1020 | A216 WCC | | Carbon | 0.25% Max | Chromium | 0.50% Max | Tensile Strength | 70,000 - 95,000 PSI |
| | | | Manganese | 1.20% Max | Molybdenum | 0.20% | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 0.60% Max | Copper | 0.30 | Elongation at 2in. | 22.0% Min |
| | | | Phosphorus | 0.035% Max | Vanadium | 0.03% Max | Reduction of area | 35.0% Min |
| | | | Sulfur | 0.035% Max | Total of residual elements | 1.00% Max | | |
| | | | Nickel | 0.50% Max | | | | |

## Carbon Steel - Low Temp A352

| Alloy/ Common Name | ASTM | Type | Chemical Composition | | | | Physical Properties | |
|---|---|---|---|---|---|---|---|---|
| 1025 | A352 LCB | C | Carbon | 0.30% Max | Nickel | 0.50% Max | Tensile Strength | 65,000 - 90,000 PSI |
| | | | Manganese | 1.00% Max | Chromium | 0.50% Max | Yield Strength | 35,000 PSI Min |
| | | | Silicon | 0.60% Max | Molybdenum | 0.20% Max | Elongation at 2in. | 24.0% Min |
| | | | Phosphorus | 0.04% Max | Copper | 0.30% Max | Reduction of area | 35.0% Min |
| | | | Sulfur | 0.045% | Vanadium | 0.03% Max | | |
| 1020 | A352 LCC | C, Mn | Carbon | 0.25% Max | Nickel | 0.50% Max | Tensile Strength | 70,000 - 95,000 PSI |
| | | | Manganese | 1.20% Max | Chromium | 0.50% Max | Yield Strength | 40,000 PSI Min |
| | | | Silicon | 0.60% Max | Molybdenum | 0.20% Max | Elongation at 2in. | 22.0% Min |
| | | | Phosphorus | 0.04% Max | Copper | 0.30% Max | Reduction of area | 35.0% Min |
| | | | Sulfur | 0.045% | Vanadium | 0.03% Max | | |

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