## Introduction of Austenitic Stainless Steel

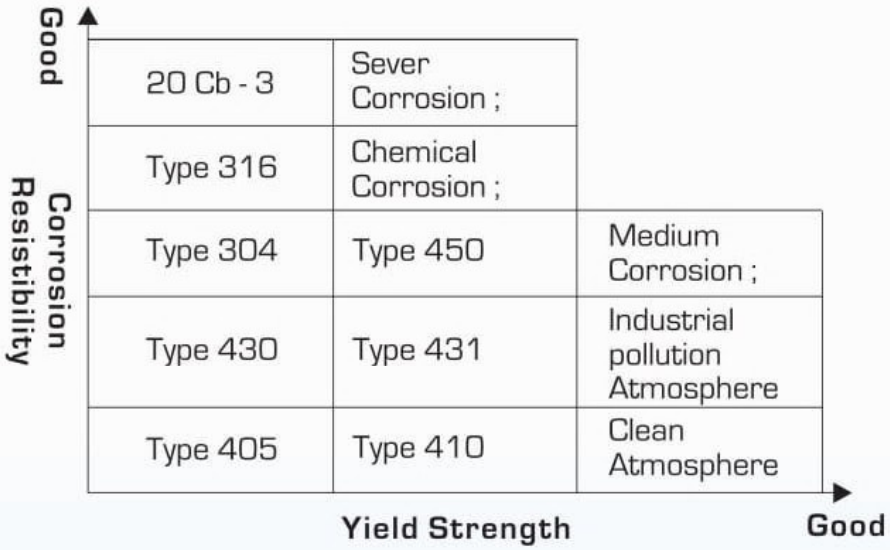
APL specializes in manufacturing Stainless Steel Fasteners which are mainly used 300 series Austenitic Stainless Steel as raw materials. The standard chemical composition of this type of Stainless steel is 18% (Cr) and 8% ($N_1$) thus it is also popularly know as 18 - 8 Stainless Steel- a kind of superior metal material which conforms to environmental protection.

### 1. 1. Physical Properties of Austenitic Stainless steel

The Austetenitic Stainless Steel possess excellent properties of corrosion resistability and cold-working ability. In low-temperature condition, it maintains the ability of extension and impact- resistability which prevent embrittlement and phase change from happening, even in high-temerature condition, the embrittlement is also seldom occurred. Besides, since the Austenitic Stainless Steel can't be hardened by heat treatment, it needs to be done through cold work to enhance its hardness and strength.

The Austenitic Stainless Steel is non magnetic under normal status, but it will turn to be slightly - magnetic after cold work.

### Application Index of Stainless Steel in Different Circumstance




## Designation ( ISO 3506 - 1979 (E) )

The steel grades and property classes are designation by a four- character Identifier consisting of a letter followed by three digits. The letter indicates the general composition groups of steels as follows :

- For austenitic steels
- For martensitic steels
- For ferritic steels

| Life Cycle of SS 304 Grade | |
|---|---|
| YEAR ESTIMATED FOR A PIT TO ENTER A 1 MM THICK SS SHEET | |
| LOCATION | SS 304 |
| SEA | 135 YRS. |
| INDUSTRIES | 145 YRS. |
| HOUSEHOLD | 770 YRS. |

| Life Cycle of SS 316 Grade | |
|---|---|
| YEAR ESTIMATED FOR A PIT TO ENTER A 1 MM THICK SS SHEET | |
| LOCATION | SS 316 |
| SEA | 260 YRS. |
| INDUSTRIES | 525 YRS. |
| HOUSEHOLD | 1200 YRS. |

| Life Cycle of SS 430 Grade | |
|---|---|
| YEAR ESTIMATED FOR A PIT TO ENTER A 1 MM THICK SS SHEET | |
| LOCATION | SS 430 |
| SEA | N/A |
| INDUSTRIES | 85 YRS. |
| HOUSEHOLD | 250 YRS. |

The first digit following the letter indicates the type of alloying elements presents for the particular group A, C or F, The last two digits indicate the property class (metallurgical condition); for example :

**1) A2-70 indicates :**

Austenitic steel, cold-worked, minimum 700 N/mm$^2$ tensile strength.

**2) A2-80 indicates :**

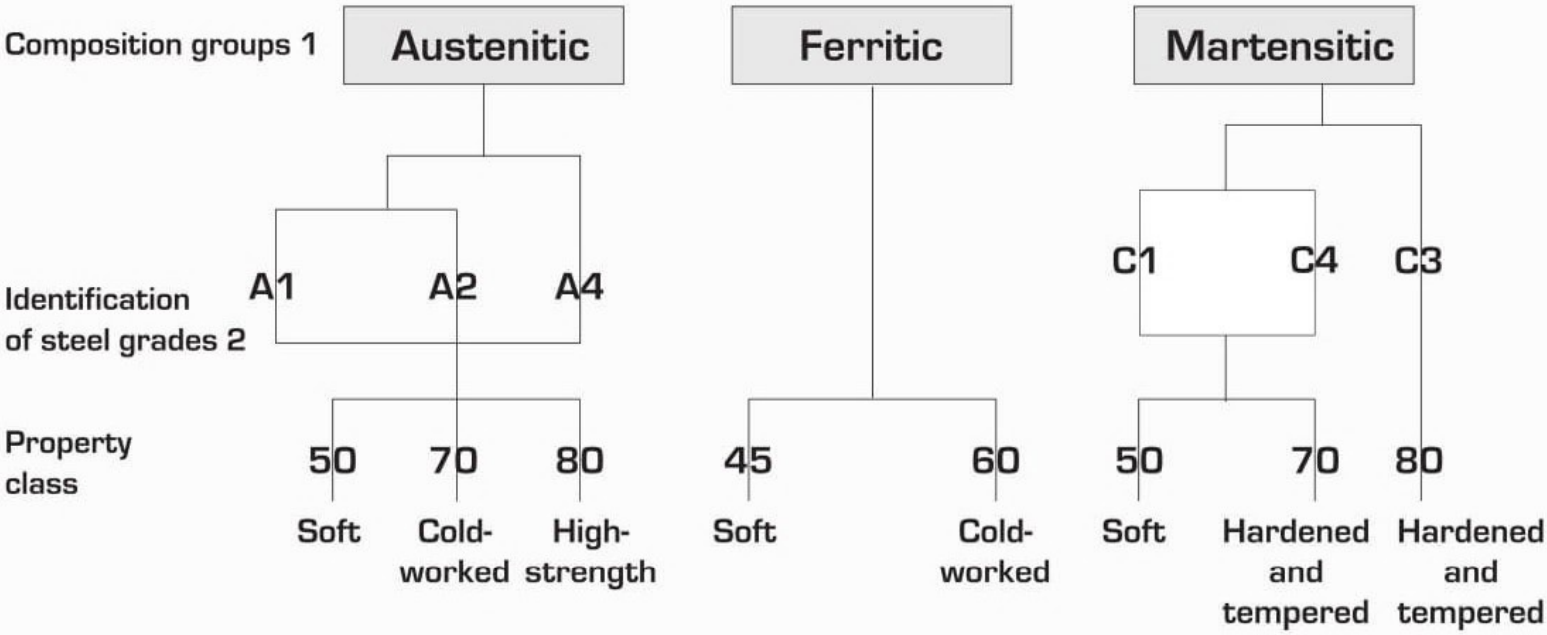
Austenitic steel, cold-worked, minimum 800 N/mm$^2$ tensile strength.

**3) C4-70 indicates :**

Martensitic 12 % Cr steel, hardened and tempered, minimum 700 N/mm$^2$ tensile strength.

## 1.2. Magnetic properties (Ref ISO 3506-1979)

All austenitic stainless steel fasteners are normally nonmagnetic; after cold working, some magnetic properties may be evident.




## 1.3. Chemical Requirements (ref. Asim A493)

| Alloy Group | UNS Designation | Alloy | Composition, % Maximum Except as Shown | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | C | Mn | P | S | Si | Cr | Ni | Cu | Mo | Others |
| 1 | S30400 | 304 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 17.0 to 20.0 | 8.0 to13.0 | 1.00 | | |
| 1 | S30403 | 302 | 0.03 | 2.00 | 0.045 | 0.030 | 1.00 | 17.0 to 19.0 | 8.0 to10.0 | 1.00 | | |
| 1 | S30430 | Xm7 | 0.10 | 2.00 | 0.045 | 0.030 | 1.00 | 17.0 to 19.0 | 8.0 to10.0 | 3.0 to 4.0 | | |
| 2 | S31600 | 316 | 0.08 | 2.00 | 0.045 | 0.030 | 1.00 | 16.0 to 18.0 | 10.0 to14.0 | – | 2.00 to 3.00 | |
| 2 | S31603 | 316L | 0.03 | 2.00 | 0.045 | 0.030 | 1.00 | 16.0 to 18.0 | 10.0 to14.0 | – | 2.00 to 3.00 | |

Note : Xm7 equal to 302HQ

## 2 Mechanical Property Requirements ( Ref. ASTM F593 )

| Stainless Alloy Group | Condition (b) | Alloy Mechanical property Marking | Nominal Diameter In Austonitic Alloys | Ionsllo Strength, Ksi (d) | Yield Strength, Ksi (c, d) | Rockwell Hardness |
|---|---|---|---|---|---|---|
| 1 (304, 304 L, Xm7 (302HQ) | CW1 | F593C | 1/4 to 5/8, incl. | 100 to 150 | 65 | B95 to C32 |
| | CW2 | F593D | 3/4 to 1-1/2, incl. | 85 to 140 | 45 | B80 to C32 |
| 2 (316, 316L) | CW1 | F593G | 1/4 to 5/8, incl. | 100 to 150 | 65 | B95 to C32 |
| | CW2 | F593H | 3/4 to 1-1/2, incl. | 85 to 140 | 45 | B80 to C32 |

Notes:

- Minimum values except where shows as maximum or as a range.
- Legend of conditions: Cw-Headed and rolled from annealed stock thus acquiring a degree of cold work; sizes 0.75 in and larger may be hot worked and solution-annoaled.
- All tensile stress values are calculated and reported in terms of the nominal tensile stress area of the thread .
- The extension measurements are determined in accordance with the test procedure and are on the actual screw or bolt length and not on a prepared test piece gauge length of 5d of the test piece.
- Above M20 the higher strength properly classes should have the properly values specially agreed upon between user and manufacturer because at the tensile strength values given in alternative values of stress at 0.2% permanent strain may occur.
- The yield and tensile strength values for full-size products shall be computed by dividing the yield and maximum tensile load Values by the stress area for the product size and thread series determined in accordance with test methods

## 3. The Requirements of Chemical Composition and Mechanical Properties for items

### 3.1. Chemical Requirements (ref DIN en iso 3506)

| Alloy Group | Grade | Chemical Composition in (mm) | | | | | | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | C | Si | Mn | P | S | Cr | Mo | Ni | Cu | |
| Austenitic | A2 | 0.1 | 1 | 2 | 0.05 | 0.03 | 15 to 20 | A | 8 to 19 | 4 | B. C. |
| | A4 | 0.08 | 1 | 2 | 0.045 | 0.03 | 16 to 18.5 | 2 to 3 | 10 to 15 | 1 | C. D. |

A. Molybdenum may be present at the discretion of the manufacturer. However, if for some applications limiting of the molybdenum Contents is essential this must be stated at the time of ordering by the purchaser.

B. If the Chromium content is below 17%, the minium nickel content should be 12%.

C. For Austenitic Stainless Steel having a maximum carbon content of 0.03% nitrogen may be present to a maximum of 0.22%.

D. At the discretion of the manufacturer the carbon content may be higher where required to obtain the specified mechanical Properties at larger diameters but shall not exceed 0.12% for Austenitic Steels.

E. **May contain copper up to 4.0 per cent maximum as per IS : 1367 (Part 14) 1984**

## 3.2 Mechanical Properties Requirements (Ref. DIN EN ISO 3506)

| Group | Grade | Property Class | Thread Diameter Range | Tensile Strength Rm (1) min N/mm | Stores at 0.2% Permanent strain Rp 0.2 (1) min N/mm | Elongation after fraction A (2) min mm |
|---|---|---|---|---|---|---|
| Austenitic | A2, A4 | 50 | < M39 | 500 | 210 | 0.6d |
| | | 70 | < M24 (3) | 700 | 450 | 0.4d |
| | | 80 | < M24 (3) | 800 | 600 | 0.3d |

1. The tensile stress is calculated on the stress area.
2. To be determined according to test methods on actual screw length and on a prepared test piece is; the nominal thread Diameter.
3. All tensile stress values are calculated and reported in terms of the nominal tensile stress area of the thread.
4. The extension measurements are determined in accordance with the test procedure and are on the actual screw or bolt length and not on a prepared test piece gauge length of 5d of the test piece.
5. Above M20 the higher strength properly classes should have the properly values specially agreed upon between user and manufacturer because at the tensile strength values given in the table alternative values of stress at 0.2% permanent strain may occur.

| Group | Grade | Property Class | Diameter Range | Tensile Strength Rm (1) $N/mm^2$ min. | Stores at 0.2% Permanent strain Rp 0.2 $N/mm^2$ min. | Extension $A_L$ (2) min. | Proof load stress $S_p$ $N/mm^2$ |
|---|---|---|---|---|---|---|---|
| Austenitic | A 1, A 2 and A 4 | 50 | < M39 | 500 | 210 | 0.6d | 500 |
| | | 70 | < M20 (3) | 700 | 450 | 0.4d | 700 |
| | | 80 | < M20 (3) | 800 | 600 | 0.3d | 800 |

## 3.3 Mechanical Properties Requirements (Ref. DIN EN ISO 3506)

| Size Standard Pitch | Minimum Breaking Torque | | | Proof load on Nuts Kg/min. |
|---|---|---|---|---|
| | 50 N - M | 70 N - M | 80 N - M | - |
| M 1.6 | 0.15 | 0.20 | 0.27 | - |
| M 2 | 0. 30 | 0.40 | 0.56 | 150.00 |
| M 2.5 | 0. 60 | 0.90 | 1.20 | 242.86 |
| M 3 | 1.10 | 1.60 | 2.10 | 356.77 |
| M 4 | 2.70 | 3.80 | 4.90 | 627.93 |
| M 5 | 5.50 | 7.80 | 10.00 | 1013.25 |
| M 6 | 9.30 | 13.00 | 15.00 | 1434.25 |
| M 8 | 23.00 | 32.00 | 37.00 | 2611.62 |
| M 10 | 46.00 | 65.00 | 74.00 | 44138.63 |
| M 12 | 80.00 | 110.00 | 130.00 | 6015.29 |
| M 14 | - | 157.00 | - | 8214.28 |
| M 16 | 210.00 | 290.00 | 330.00 | 11202.85 |
| M 18 | | | | 13714.29 |
| M 20 | | | | 17580.00 |

### 3.4. Mechanical properties at elevated temperature ; Applications at Low Temperature.

The values given in these tables are for guidance only. User should understand that the actual chemistry ,load of the installed fasteners and the environment, may cause significant variation. If loads are fluctuating and operating at elevated Temperatures the possibility of stress corrosion is high, user should consult the manufacture

### 3.4.1 Influence of temperature on ReL and Rp 0.2 (Ref. DIN EN ISO 3506)

| Steel grade | ReL. & Repo 2 % temperature | | | |
|---|---|---|---|---|
| - | + 100° C | + 200° C | + 300° C | + 400° C |
| A2 A4 | 85 | 80 | 75 | 70 |
| C1 | 95 | 90 | 80 | 65 |
| C3 | 90 | 85 | 80 | 60 |

### 3.4.2 Application at low temperatures (Ref. DIN EN ISO 3506)

| Steel grade | Lower limits of operational temp. at continuous operation | | | |
|---|---|---|---|---|
| A2 | - 200 C | | | |
| A4 | 95 | 90 | 80 | 65 |
| | 90 | 85 | 80 | 60 |

A. In connections with the alloying element the stability of the Austenitic is reduced and the transition temperature is shifted to higher values if a high degree of deformation during manufacturing of the fastener is applied.