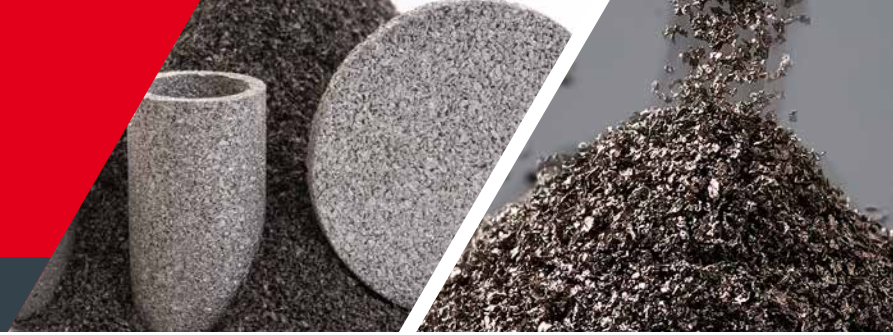


# HASTELLOY® X POWDER

## TECHNICAL DATA SHEET



## HASTELLOY® X POWDER

AMETEK offers several different Hastelloy® alloys in powder form, including but not limited to C-22, C-276, B, and X alloys. They are nickel based and used in applications where the corrosion resistance or service temperature of stainless steels is insufficient.

### HASTELLOY® X

Hastelloy® X (UNS N06002) (W86002) is one of the original nickel superalloys. It has excellent fabricability and weldability for a high temperature nickel alloy, and is used in sintered metal filters and coatings applications where prolonged exposure above roughly 1200°F / 650°C is expected.

Hastelloy® X is a nickel-chromium-iron-molybdenum alloy that possesses exceptional high- temperature strength and oxidation resistance. It also displays outstanding resistance to stress- corrosion cracking in petrochemical applications.

The alloy is ductile and has excellent formability properties after long exposure at temperatures above 1200°F / 650°C for 16,000 hours.

It can be hot-worked and is also easily formed by cold working. To restore the optimum balance of properties, all hot- or cold- worked parts should be annealed and cooled quickly.

### MARKETS

- Chemical Process
- Oil & Gas
- Geothermal
- LNG (Liquefied Natural Gas)
- Petrochemical
- Pharmaceutical
- Sea Water
- Nuclear Power

### CHEMICAL COMPOSITION %

| Alloy | Ni        | Co         | Cr | Mo | Fe | W   | Mn       | V | Si       | C   | Cu | Nb         | B            | Al         | Ti          | Ta | Zr |
|-------|-----------|------------|----|----|----|-----|----------|---|----------|-----|----|------------|--------------|------------|-------------|----|----|
| X     | 47<br>bal | 1.5<br>max | 22 | 9  | 18 | 0.6 | 1<br>max | - | 1<br>max | 0.1 | -  | 0.5<br>max | 0.008<br>max | 0.5<br>max | 0.15<br>max | -  | -  |

# HASTELLOY® X POWDER

## TECHNICAL DATA SHEET



## HASTELLOY® X BULK PROPERTIES

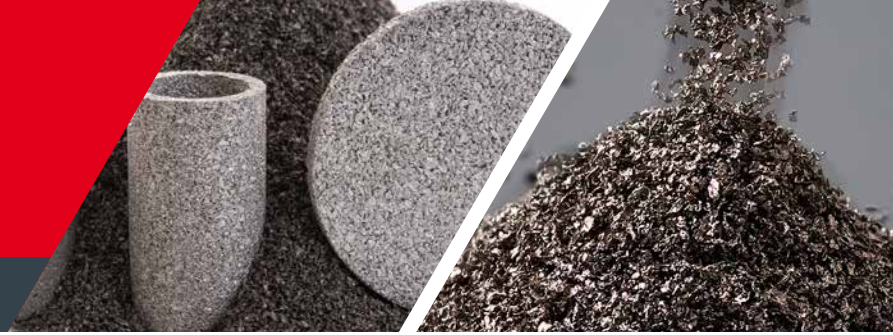
| PHYSICAL PROPERTIES           |                  |                                  |               |                        |
|-------------------------------|------------------|----------------------------------|---------------|------------------------|
| Physical Property             | Imperial units   |                                  | Metric Units  |                        |
| <b>Density</b>                | 72°F             | 0.297 lb/in <sup>3</sup>         | 22°C          | 8.22 g/cm <sup>3</sup> |
| <b>Melting Range</b>          | 2300 - 2470 °F   |                                  | 1260 - 1355°C |                        |
| <b>Electrical Resistivity</b> | -400°F           | 43.8 µohm-in                     | -250°C        | 16.86 µohm-cm          |
|                               | -300°F           | 43.2 µohm-in                     | -200°C        | 16.96 µohm-cm          |
|                               | -200°F           | 43.8 µohm-in                     | -150°C        | 17.14 µohm-cm          |
|                               | -100°F           | 44.3 µohm-in                     | -100°C        | 17.34 µohm-cm          |
|                               | 0°F              | 45.0 µohm-in                     | -50°C         | 17.55 µohm-cm          |
|                               | 75°F             | 45.4 µohm-in                     | 25°C          | 17.87 µohm-cm          |
| <b>Thermal Conductivity</b>   | 70°F             | 63 Btu-in/ft. <sup>2</sup> h-°F  | 25°C          | 9.2 W/m-°C             |
|                               | 200°F            | 76 Btu-in/ft. <sup>2</sup> h-°F  | 100°C         | 11.2 W/m-°C            |
|                               | 500°F            | 98 Btu-in/ft. <sup>2</sup> h-°F  | 200°C         | 14.1 W/m-°C            |
|                               | 1100°F           | 144 Btu-in/ft. <sup>2</sup> h-°F | 600°C         | 20.9 W/m-°C            |
|                               | 1200°F           | 151 Btu-in/ft. <sup>2</sup> h-°F | 650°C         | 21.9 W/m-°C            |
|                               | 1300°F           | 159 Btu-in/ft. <sup>2</sup> h-°F | 700°C         | 22.8 W/m-°C            |
|                               | 1400°F           | 166 Btu-in/ft. <sup>2</sup> h-°F | 750°C         | 23.8 W/m-°C            |
|                               | 1500°F           | 174 Btu-in/ft. <sup>2</sup> h-°F | 800°C         | 24.7 W/m-°C            |
|                               | 1600°F           | 182 Btu-in/ft. <sup>2</sup> h-°F | 850°C         | 25.7 W/m-°C            |
|                               | 1700°F           | 189 Btu-in/ft. <sup>2</sup> h-°F | 900°C         | 26.7 W/m-°C            |
| <b>Specific Heat</b>          | RT               | 0.116 Btu/lb.-°F                 | RT            | 486 J/kg-°C            |
|                               | 200°F            | 0.117 Btu/lb.-°F                 | 100°C         | 487 J/kg-°C            |
|                               | 400°F            | 0.118 Btu/lb.-°F                 | 200°C         | 484 J/kg-°C            |
|                               | 600°F            | 0.119 Btu/lb.-°F                 | 300°C         | 491 J/kg-°C            |
|                               | 800°F            | 0.123 Btu/lb.-°F                 | 400°C         | 507 J/kg-°C            |
|                               | 1000°F           | 0.130 Btu/lb.-°F                 | 500°C         | 531 J/kg-°C            |
|                               | 1200°F           | 0.139 Btu/lb.-°F                 | 600°C         | 564 J/kg-°C            |
|                               | 1400°F           | 0.151 Btu/lb.-°F                 | 700°C         | 606 J/kg-°C            |
|                               | 1600°F           | 0.167 Btu/lb.-°F                 | 800°C         | 657 J/kg-°C            |
|                               | 1800°F           | 0.186 Btu/lb.-°F                 | 900°C         | 716 J/kg-°C            |
| 2000°F                        | 0.205 Btu/lb.-°F | 1000°C                           | 784 J/kg-°C   |                        |

RT = Room Temperature

Data shown for Physical Properties sourced from Haynes International, Inc.

# HASTELLOY® X POWDER

## TECHNICAL DATA SHEET



## HASTELLOY® X BULK PROPERTIES (CONTINUED)

| PHYSICAL PROPERTIES                          |                   |  |              |  |
|--|-------------------|--|--------------|--|
| Physical Property                            | Imperial units    |  | Metric Units |  |
| <b>Mean Coefficient of Thermal Expansion</b> | 79 - 200°F        | 7.7 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 100°C   | 13.9 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1000°F       | 8.4 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 500°C   | 15.0 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1200°F       | 8.6 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 600°C   | 15.3 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1350°F       | 8.8 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 700°C   | 15.7 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1400°F       | 8.9 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 750°C   | 15.9 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1500°F       | 8.9 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 800°C   | 16.0 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1600°F       | 9.1 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 850°C   | 16.2 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1650°F       | 9.1 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 900°C   | 16.4 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
|  | 79 - 1800°F       | 9.2 $\mu\text{in}/\text{in.}\cdot^{\circ}\text{F}$ | 26 - 975°C   | 16.6 $10^{-6} \text{ m}/\text{m}\cdot^{\circ}\text{C}$ |
| <b>Dynamic Modulus of Elasticity</b>         | RT                | 29.8 x $10^6$ psi                                  | RT           | 205 GPa  |
|  | 200°F             | 29.4 x $10^6$ psi                                  | 100°C        | 202 GPa  |
|  | 400°F             | 28.6 x $10^6$ psi                                  | 200°C        | 198 GPa  |
|  | 600°F             | 27.8 x $10^6$ psi                                  | 300°C        | 192 GPa  |
|  | 800°F             | 26.7 x $10^6$ psi                                  | 400°C        | 187 GPa  |
|  | 1000°F            | 25.8 x $10^6$ psi                                  | 500°C        | 180 GPa  |
|  | 1200°F            | 24.7 x $10^6$ psi                                  | 600°C        | 173 GPa  |
|  | 1400°F            | 23.3 x $10^6$ psi                                  | 700°C        | 165 GPa  |
|  | 1600°F            | 22.2 x $10^6$ psi                                  | 800°C        | 157 GPa  |
| 1800°F                                       | 20.4 x $10^6$ psi | 900°C  | 148 GPa      |  |
| <b>Poisson's Ratio</b>                       | -108°F            | 0.328  | -78°C        | 0.328  |
|  | 72°F              | 0.32   | 22°C         | 0.32   |
| <b>Magnetic Permeability</b>                 | RT                | 1.002 at 200 oersteds (15,900 A/m)                 |              |  |

RT = Room Temperature

Data shown for Physical Properties sourced from Haynes International, Inc.



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