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# Material Specification

## HPA-MS-105 Rev. B

## HPA N60, Level 5 Cold-Worked Bar

### 1 SCOPE

This specification establishes the requirements to obtain Level 5 mechanically-strengthened, corrosion resistant HPA N60 (S21800) steel bars from High Performance Alloys, Inc (HPA).

### 2 APPLICABLE DOCUMENTS

- ❒ AMS 5848: *Steel, Corrosion Resistant, Bars, Wire, Forgings, Extrusions, Tubing, and Rings, Wear and Galling Resistant 8.0mn 4.0si 17cr 8.5ni 0.13n Solution Heat Treated*
- ❒ AMS 2248: *Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys*
- ❒ AMS 2371: *Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock*
- ❒ ASTM E8: *Standard Test Methods for Tension Testing of Metallic Materials*
- ❒ ASTM A370: *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*
- ❒ ASTM E18: *Standard Test Methods for Rockwell Hardness of Metallic Materials*
- ❒ ASTM E140: *Standard Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, and Scleroscope Hardness*
- ❒ ASTM E45: *Standard Test Methods for Determining the Inclusion Content of Steel*
- ❒ ASTM A262: *Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels*

### 3 REQUIREMENTS

#### 3.1 MATERIAL

The material produced per this specification shall be mechanically-strengthened as defined herein and is corrosion resistant steel, UNS S21800, 8.0Mn – 4.0Si – 17Cr – 8.5Ni – 0.13N. HPA N60 conforms to this chemistry.

3.2 CONDITION

Before processing, the material per 3.1 shall be of commercial quality and meet the chemical requirements of AMS 5848. Material shall then be processed per 3.3 to meet the mechanical properties per 3.5.

3.3 PROCESSING

Material shall be cold worked (mechanically strengthened) in accordance with HPA-approved processes to attain the properties of 3.5.

3.4 SIZE

Bars produced per 3.3 shall not exceed 1.5” diameter after finishing.

3.5 MECHANICAL PROPERTIES

The material shall meet the following Level 5 mechanical requirements:

| | |
|---|---|
| Tensile Strength: | 200 KSI (1379 MPA) |
| Yield Strength @0.2% Offset: | 180 KSI (1241 MPA) |
| Elongation in 4XD: | 10% |
| Reduction of Area: | 45% |

3.6 HARDNESS

Hardness testing shall be performed per 4.2.3.

3.7 SUPPLEMENTAL (OPTIONAL)

The purchaser may elect to apply one or more of the following non-standard supplemental options. The purchaser shall request options at the time of quotation as additional charges shall apply.

S1 – ultrasonic testing
S2 – intergranular corrosion test
S3 – mechanical testing of two or more bars per heat-lot
S4 – serialization of each bar
S5 – magnetic permeability
S6 – melt cleanliness

## 4 SAMPLING AND TESTING

4.1 SAMPLING

One (standard) or more (S3) randomly selected sample(s) from each process heat-lot shall be submitted to an HPA-approved independent test laboratory. The sample(s) shall qualify the entire heat-lot.

4.2 TESTING

4.2.1 CHEMICAL COMPOSITION

Melting mill chemistry shall be transcribed to the HPA certificate and checked for accuracy and conformance to composition check limits per AMS 2248. Material shall meet the chemical requirements of AMS 5848.

4.2.2 MECHANICAL

Mechanical testing shall be performed in accordance with ASTM A370 and ASTM E8. Material shall meet the mechanical properties of 3.5.

4.2.3 HARDNESS

Rockwell hardness testing shall be performed in accordance with ASTM E18. Conversion of hardness readings is allowed per ASTM E140 and may be applied as necessary. Product shall not be rejected on the basis of hardness provided the mechanical properties of 3.5 are met. Hardness sample shall be taken from and thereby matched to the tensile sample from which it was taken.

4.2.4 ULTRASONIC TESTING (S1)

Each bar shall be submitted to an HPA-approved independent test laboratory for ultrasonic testing. The specification and pass/fail criteria shall be mutually-determined and agreed upon between purchaser and HPA.

4.2.5 DETECTING SUSCEPTIBILITY TO INTERGRANULAR ATTACK (S2)

One sample per heat-lot shall be submitted to an HPA-approved independent test laboratory to determine the material's susceptibility to intergranular attack in accordance with ASTM A262 Practice E. Material shall meet all requirements of ASTM A262 Practice E.

4.2.6 MAGNETIC PERMEABILITY (S5)

One sample per heat-lot of shall be submitted to an HPA-approved independent test laboratory for magnetic permeability testing. The purchaser shall provide acceptance criteria.

4.2.7 MELT CLEANLINESS (S6)

One sample per heat-lot of shall be submitted to an HPA-approved independent test laboratory for micro-inclusion testing in accordance with ASTM E45. The method and pass/fail criteria shall be mutually-determined and agreed upon between purchaser and HPA.

4.3 REJECTION/ACCEPTANCE OF PROCESS LOT

A lot is defined as one heat of material processed in same manner during a consecutive time period. One mechanical retest is allowed for sample/testing error in accordance with AMS 2371. Any lot that fails to meet the ordered strength level even after retest shall be graded and certified to the level at which it qualifies. HPA shall not ship any lot that fails to meet the requirements of this specification without proper authorization from the purchaser. Such authorization shall consist of written documentation stating the purchaser's acceptance of the nonconformance identified.

## 5 PREPARATION FOR DELIVERY

Upon authorization to release the final product for shipment, HPA shall bundle and tag.

5.1 PRODUCT MARKING

HPA shall use a permanent marker or product ID tag to mark the product with the customer purchase order number, alloy, heat, lot, strength level, dimensions, and quantity. If the purchaser selects Supplemental (S4), HPA shall serialize each bar in accordance with the method mutually-determined and agreed upon between purchaser and HPA.

5.2 PACKAGING

Product that has received final inspection must be safely packaged in order to protect the product from damage during shipment. A packing slip and material test certification shall accompany the material, affixed to the outside of the package.