

# AEROSPACE

## MATERIAL SPECIFICATIONS

**AMS 6412E**

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

Issued 1-23-40

Revised 1-31-64

### STEEL BARS AND FORGINGS

0.80Cr - 1.8Ni - 0.25Mo (0.35 - 0.40C) (4337)

1. **ACKNOWLEDGMENT:** A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. **FORM:** Bars, forgings, and forging stock.
3. **APPLICATION:** Parts with sections 0.875 in. or less in thickness at the time of heat treatment which require a through-hardening steel capable of developing hardness as high as Rockwell C 50 when properly hardened and tempered and also parts of greater thickness but requiring proportionately lower hardness. In appropriate section sizes, this material is capable of meeting the requirements of AMS 2310.

4. **COMPOSITION:**

|            | min  | max   |
|------------|------|-------|
| Carbon     | 0.35 | 0.40  |
| Manganese  | 0.65 | 0.85  |
| Silicon    | 0.20 | 0.35  |
| Phosphorus | --   | 0.040 |
| Sulfur     | --   | 0.040 |
| Chromium   | 0.70 | 0.90  |
| Nickel     | 1.65 | 2.00  |
| Molybdenum | 0.20 | 0.30  |

- 4.1 **Check Analysis:** Composition variations shall meet the requirements of the latest issue of AMS 2259, paragraph titled "Low Alloy Steels".

5. **CONDITION:**

- 5.1 **Bars:** In a machinable condition and hot finished, having hardness not higher than Brinell 229 or equivalent, except that bars ordered cold finished may have hardness as high as Brinell 248 or equivalent.

- 5.2 **Forgings:** As ordered.

- 5.3 **Forging Stock:** As ordered by the forging manufacturer.

6. **TECHNICAL REQUIREMENTS:** When ASTM methods are specified for determining conformance to the following requirements, tests shall be conducted in accordance with the issue of the ASTM method listed in the latest issue of AMS 2350.

- 6.1 Hardenability: The hardenability shall be J50=10 min and J44=18 min when determined on the standard end-quench test specimen in accordance with the SAE Method of Determining Hardenability published in the latest issue of the SAE Handbook, except that the steel shall be normalized at  $1700\text{ F} \pm 10$  ( $926.7\text{ C} \pm 5.6$ ) and the test specimen austenitized at  $1500\text{ F} \pm 10$  ( $815.5\text{ C} \pm 5.6$ ). The hardenability test is not required on a product which will not yield a suitable specimen but the steel from which the product is made shall conform to the hardenability specified.
- 6.2 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, determined in accordance with ASTM E112, Appendix III, Section A1, Treatment (1) (McQuaid-Ehn test).
- 6.3 Decarburization:
- 6.3.1 Bars ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces.
- 6.3.2 Allowable decarburization of bars or billets ordered for redrawing or forging, or to specified microstructural requirements, shall be as agreed upon by purchaser and vendor.
- 6.3.3 Decarburization of bars to which 6.3.1 or 6.3.2 is not applicable shall be not greater than the following:

| Ø | Nominal Diameter or Distance<br>Between Parallel Sides<br>Inches | Depth of<br>Decarburization<br>Inch |
|---|------------------------------------------------------------------|-------------------------------------|
|   | Up to 0.375, incl                                                | 0.010                               |
|   | Over 0.375 to 0.500, incl                                        | 0.012                               |
|   | Over 0.500 to 0.625, incl                                        | 0.014                               |
|   | Over 0.625 to 1.000, incl                                        | 0.017                               |
|   | Over 1.000 to 1.500, incl                                        | 0.020                               |
|   | Over 1.500 to 2.000, incl                                        | 0.025                               |
|   | Over 2.000 to 2.500, incl                                        | 0.030                               |
|   | Over 2.500 to 3.000, incl                                        | 0.035                               |
|   | Over 3.000 to 4.000, incl                                        | 0.045                               |

- 6.3.4 Unless otherwise agreed upon by purchaser and vendor, decarburization shall be measured by the microscopic method, or by Rockwell Superficial 30-N scale hardness method, or equivalent hardness testing method, on hardened but untempered specimens protected during heat treatment to prevent changes in surface carbon content.
- Ø Depth of decarburization, when measured by a hardness method, is defined as the perpendicular distance from the surface to the non-decarburized depth under that surface below which there is no further increase in hardness. Measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization or lack of decarburization thereon.