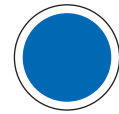


Ameralloy[®] Air

AIR HARDENING STEEL **AISI A-2**



Color Code:
BLUE



Ameralloy Air is an air-hardening tool steel possessing excellent non-deforming properties. Its wear resistance is midway between the high carbon/high chromium Ameralloy D, and the manganese oil hardening steel, Ameralloy Oil.

While Ameralloy Air may be hardened by quenching in either air or oil, air-quenching is recommended to virtually eliminate the risk of breakage. Ameralloy Air is particularly adapted to applications that demand toughness and high abrasion resistance.

Typical Analysis

- Carbon 1.00
- Chromium 5.75
- Vanadium .25
- Molybdenum 1.15
- Silicon .20
- Manganese .60

Heat Treatment

- **Forging** 1700°–1950°F, stop at 1750°F, cool slowly
- **Normalizing** Do not normalize
- **Annealing** 1650°F, furnace-cool. Brinell 212 max.
- **Preheating** 1200°F prior to hardening
- **Hardening** 1775°F, air-quench to 150°F
- **Tempering** 350°–400°F, resulting hardness Rockwell C 60–61

Features And Advantages

- Low distortion in heat treatment
- High abrasion resistance and hardness
- Good hardenability

Applications

- Cold forming
- Blanking
- Bending dies
- Forming rolls
- Broaches
- Knurling tools
- Gages

Characteristics

- **Machinability** If properly annealed to Brinell 212, Ameralloy Air has a machinability of 65, as compared with a 1% carbon tool steel rated at 100.
- **Dimensional stability** When air-quenched from the proper hardening temperature, this grade generally expands .001 in./in. of cross section.
- **Critical points** Critical point ranges obtained by dilatometer test when heating and cooling at a rate of 400°F/hour:

Heating – Ac range 1475° to 1540°F

Cooling – Ar range 1310° to 670°F

General Instructions

- **Forging** Before forging Ameralloy Air, preheat at 1250°F and soak thoroughly. Then raise temperature to 2000°–2050°F, and hold until the steel is uniformly heated. Forging should be discontinued at 1700°F. Reheat as often as necessary to complete the forging operation. Immediately after forging, bury in an insulating medium to avoid cooling cracks.
- **Annealing** Ameralloy Air should always be annealed after forging. To prevent decarburization, use a controlled atmosphere furnace or pack in a sealed container using inert material. To anneal for lowest hardness, heat slowly to 1650°F and hold at this temperature for approximately two hours per inch of greatest cross section. Cool at a rate of 20°F per hour to 1150°F and reheat to 1350°F. Hold three hours per inch of greatest cross section. Furnace-cool at 20°F per hour to 1100°F, then furnace-cool to 900°F, then air-cool. Resulting hardness from this treatment will be Brinell 212 max.
- **Hardening** To prevent decarburization, pack in inert material, or the treatment can be carried out in a salt bath or controlled atmosphere furnace. Preheat to 1200°F and hold at this temperature until thoroughly soaked. Heat to 1750°–1800°F, and hold for one hour per inch of greatest cross section. Remove from the furnace and cool in air. Although Ameralloy is primarily an air hardening grade, flash oil-quenching is occasionally used on large sections. However, tools must be removed from the oil when they reach 1000°F, then air-cooled to 150°F. Temper immediately to minimize the possibility of cracking.

Ameralloy-tested fracture grain size and Rockwell C hardness of specimens 1" square x 4" long, quenched in air and oil after holding one hour at 1600°–1900°F:

| Still Air Quenching Temperature (°F) | Fracture Grain Size | Rockwell C |
|--------------------------------------|---------------------|------------|
| 1600° | 7 | 48 |
| 1650° | 9½ | 54 |
| 1700° | 9¾ | 59.5 |
| 1750° | 9¾ | 64 |
| 1800° | 10 | 64 |
| 1850° | 9½ | 63 |
| 1900° | 9¼ | 62 |

| Oil Quenching Temperature (°F) | Fracture Grain Size | Rockwell C |
|--------------------------------|---------------------|------------|
| 1600° | 9¾ | 54 |
| 1650° | 9¾ | 55 |
| 1700° | 9¾ | 62 |
| 1750° | 9¾ | 65 |
| 1800° | 9¾ | 64 |
| 1850° | 9.625 | 63.5 |
| 1900° | 9¾ | 62 |

- **Tempering** After cooling in the quench to approximately 150°F, temper immediately. For most applications, Ameralloy Air should be tempered at 350°–400°F at a minimum holding time of 2 hours per inch of greatest cross section.

Rockwell C hardness of specimens 1" square when air-quenched from 1775°F or oil-quenched from 1750°F. Tempered at various temperatures:

| Tempering Temperature (°F) | Rockwell C | |
|----------------------------|-------------------|-------------------|
| | 1775°F Air-Quench | 1750°F Oil-Quench |
| None | 64 | 65 |
| 300°F | 62 | 62.5 |
| 400°F | 60 | 61 |
| 500°F | 56 | 57.5 |
| 600°F | 56 | 56 |
| 700°F | 56 | 56 |
| 800°F | 56 | 56 |
| 900°F | 56 | 56 |
| 1000°F | 56 | 55 |
| 1100°F | 50 | 50 |
| 1200°F | 43 | 45 |
| 1300°F | 34 | 34 |

Above results on 1" diameter specimens may be used as a guide in tempering tools to desired hardness. Tools of heavy section or mass may be several points lower in Rockwell hardness for a given treatment.

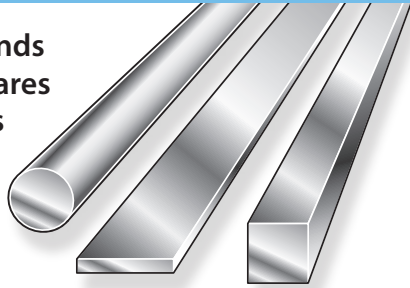
Effect Of Mass

Effectiveness of heat treatment on sections of increasing mass. Sample lengths of at least double the cross section were hardened as shown below. Rockwell C hardness obtained for 1" disc cut from the midsection of sample length:

| Size | Treatment | Hardness – (Rc) | |
|-------|--|-----------------|----------|
| | | Surface | Center |
| 1"sq. | Preheat 1200°F, austenitize 1775°F, air-cool to 150°F Temper at 400°F | 64 61 | 64 61 |
| 4"sq. | Preheat 1200°F austenitize 1775°F Air-cool to 150°F Temper at 400°F | 63 59 | 60 59 |
| 5"sq. | Preheat 1200°F, austenitize 1775°F, oil to 1000°F Air-cool to 150°F Double temper at 400°F | 63 59 | 60 59 |
| 6"sq. | Preheat 1200°F, austenitize 1775°F, oil to 1000°F Air-cool to 150°F Double temper at 400°F | 62 59 | 59 57 |
| 8"sq. | Preheat 1200°F, austenitize 1775°F, oil to 150°F Double temper at 400°F | 62 61 | 61 59 |

Available Shapes And Sizes

Rounds
Squares
Flats



ROUNDS: Lengths precut to any size desired, or 8'-10' R/L lengths. FLATS & SQUARES: Standard 10'-12' R/L lengths.

Rounds Decarb Free Or Hot Rolled Annealed

| | | | | |
|-------|--------|-------|-------|-------|
| 1/4 | 1 | 2 | 4 | 7 |
| 5/16 | 1-1/16 | 2-1/8 | 4-1/4 | 7-1/2 |
| 3/8 | 1-1/8 | 2-1/4 | 4-1/2 | 8 |
| 7/16 | 1-1/4 | 2-3/8 | 4-3/4 | 8-1/2 |
| 1/2 | 1-3/8 | 2-1/2 | 5 | 9 |
| 9/16 | 1-1/2 | 2-5/8 | 5-1/4 | 10 |
| 5/8 | 1-5/8 | 2-3/4 | 5-1/2 | 11 |
| 11/16 | 1-3/4 | 2-7/8 | 5-3/4 | 12 |
| 3/4 | 1-7/8 | 3 | 6 | |
| 13/16 | | 3-1/8 | 6-1/4 | |
| 7/8 | | 3-1/4 | 6-1/2 | |
| 15/16 | | 3-1/2 | | |
| | | 3-3/4 | | |

Flats & Squares Decarb-Free Plus .015/.035

| | | | | |
|---------|----------|---------|----------|---------|
| 1/2 | 5/8 | 3/4 | 7/8 | 1 |
| x 1/2 | x 5/8 | x 3/4 | x 7/8 | x 1 |
| x 3/4 | x 3/4 | x 7/8 | x 1 | x 1-1/4 |
| x 7/8 | x 7/8 | x 1 | x 1-1/8 | x 1-1/2 |
| x 1 | x 1 | x 1-1/8 | x 1-1/4 | x 1-3/4 |
| x 1-1/8 | x 1-1/8 | x 1-1/4 | x 1-1/2 | x 2 |
| x 1-1/4 | x 1-1/4 | x 1-3/8 | x 1-3/4 | x 2-1/4 |
| x 1-3/8 | x 1-3/8 | x 1-1/2 | x 2 | x 2-1/2 |
| x 1-1/2 | x 1-1/2 | x 1-3/4 | x 2-1/4 | x 2-3/4 |
| x 1-3/4 | x 1-3/4 | x 1-7/8 | x 2-1/2 | x 3 |
| x 1-7/8 | x 2 | x 2 | x 2-3/4 | x 3-1/2 |
| x 2 | x 2-1/4 | x 2-1/4 | x 3 | x 4 |
| x 2-1/4 | x 2-1/2 | x 2-1/2 | x 3-1/2 | x 4-1/2 |
| x 2-1/2 | x 2-3/4 | x 2-3/4 | x 4 | x 5 |
| x 2-3/4 | x 3 | x 3 | x 4-1/2 | x 6 |
| x 3 | x 3-1/2 | x 3-1/2 | x 5 | x 7 |
| x 3-1/2 | x 4 | x 4 | x 6 | x 8 |
| x 4 | x 4-1/2 | x 4-1/2 | x 7 | x 10 |
| x 4-1/2 | x 5 | x 5 | x 8 | x 12 |
| x 5 | x 6 | x 6 | x 10 | |
| x 6 | x 8 | x 8 | x 12 | |
| x 8 | x 10 | x 10 | | |
| x 10 | x 12 | x 12 | | |
| x 12 | | | | |
| 1-1/8 | 1-1/4 | 1-3/8 | 1-1/2 | 1-3/4 |
| x 1-1/8 | x 1-1/4 | x 1-3/8 | x 1-1/2 | x 1-3/4 |
| x 1-1/4 | x 1-1/2 | x 1-3/4 | x 1-3/4 | x 2 |
| x 1-1/2 | x 1-3/4 | x 2 | x 2 | x 2-1/4 |
| x 1-3/4 | x 2 | x 2-1/4 | x 2-1/4 | x 2-1/2 |
| x 2 | x 2-1/4 | x 2-1/2 | x 2-1/2 | x 2-3/4 |
| x 2-1/4 | x 2-1/2 | x 3 | x 3 | x 3 |
| x 2-1/2 | x 2-3/4 | x 3-1/2 | x 3 | x 3-1/2 |
| x 2-3/4 | x 3 | x 4 | x 3-1/2 | x 4 |
| x 3 | x 3-1/2 | x 4-1/2 | x 4 | x 4-1/2 |
| x 3-1/2 | x 4 | x 5 | x 4-1/2 | x 5 |
| x 4 | x 4-1/2 | x 6 | x 5 | x 6 |
| x 4-1/2 | x 5 | x 8 | x 6 | x 7 |
| x 5 | x 6 | x 10 | x 7 | x 8 |
| x 6 | x 7 | x 12 | x 8 | x 10 |
| x 8 | x 8 | | x 10 | x 12 |
| x 10 | x 10 | | x 12 | |
| x 12 | x 12 | | x 18-1/4 | |
| | x 18-1/4 | | | |
| 2 | 2-1/4 | 2-1/2 | 3 | 3-1/2 |
| x 2 | x 2-1/4 | x 2-1/2 | x 3 | x 3-1/2 |
| x 2-1/4 | x 2-1/2 | x 2-3/4 | x 3-1/2 | x 4 |
| x 2-1/2 | x 3 | x 3 | x 4 | x 4-1/2 |
| x 2-3/4 | x 3-1/2 | x 3-1/2 | x 4-1/2 | x 5 |
| x 3 | x 4 | x 4 | x 5 | x 6 |
| x 3-1/2 | x 4-1/2 | x 4-1/2 | x 6 | x 8 |
| x 4 | x 5 | x 5 | x 8 | x 10 |
| x 4-1/2 | x 6 | x 6 | x 10 | |
| x 5 | | x 8 | | |
| x 5-1/2 | | x 10 | | |
| x 6 | | x 12 | | |
| x 8 | | | | |
| x 10 | | | | |
| x 12 | | | | |
| 4 | 4-1/2 | 5 | 6 | |
| x 4 | x 4-1/2 | x 5 | x 6 | |
| x 4-1/2 | x 5 | x 6 | x 8 | |
| x 5 | x 6 | x 8 | x 10 | |
| x 6 | x 8 | x 10 | x 12 | |
| x 8 | x 10 | x 12 | | |
| x 10 | x 12 | | | |
| x 12 | | | | |