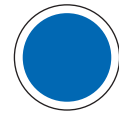


Ameralloy[®] Air

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.

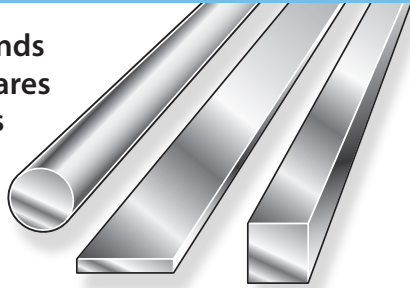
Effect Of Mass

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	64
		61	61
4"sq.	Preheat 1200°F austenitize 1775°F Air-cool to 150°F Temper at 400°F	63	60
		59	59
5"sq.	Preheat 1200°F, austenitize 1775°F, oil to 1000°F Air-cool to 150°F Double temper at 400°F	63	60
		59	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				