

Ameralloy[®] D-2

AIR HARDENING STEEL **AISI D-2**



Color Code:
GREEN



Ameralloy D-2 is a premium quality, high carbon/high chrome air hardening steel for use in high volume production applications. It is recommended for dies with production quotas in the hundreds, thousands, or millions of pieces at minimum cost. Ameralloy D-2 resists edge chipping, sometimes experienced with other types of die steel. This decreases both the number and depth of grinds necessary to maintain the die.

Ameralloy D-2 hardens with a minimum amount of distortion and is perfectly suited for dies where close size tolerance is critical. Ameralloy D-2 is easier to machine than other high carbon/high chrome die steels.

Typical Analysis

- Carbon 1.55
- Silicon .35
- Chromium 12.50
- Vanadium 1.00
- Molybdenum 1.00
- Manganese .55

Features And Advantages

- Maximum die life
- Maximum resistance to edge wear and chipping
- Minimum dimensional change during hardening
- Air hardening/deep hardening
- High compressions strength
- Non-scaling properties with fair resistance to corrosion
- Good machinability for a high alloy steel

Applications

- Ring gauges
- Swaging dies
- Plug gauges
- Coining dies
- Shear knives
- Blanking dies
- Trimming dies
- Slitting dies
- Forming dies
- Drawing dies
- Lamination dies
- Thread rolling dies
- Forming rolls
- Lathe centers
- Seaming rolls
- Punches

Heat Treatment

- **Forging** 1950°–2050°F, stop at 1700°F, cool slowly
- **Normalizing** Do not normalize
- **Annealing** 1650°F, furnace-cool. Brinell 217 max.
- **Preheating** 1200°–1250°F, prior to hardening
- **Hardening** 1850°F, air-quench to 150°F
- **Tempering** 900°F, minimum (see Tempering under General Instructions)

Characteristics

- **Machinability** Ameralloy D-2 has a machinability rating of 65, as compared with a rating of 100 for a 1% carbon steel tool.
- **Dimensional stability** Tests on this grade normally show a slight amount of contraction after hardening with a piece in the as-quenched condition or tempered below 900°F. Tempering at approximately 925°F usually eliminates the contraction and virtually brings the part back to its original size. Ameralloy D-2 has the minimum distortion in heat treatment as compared with other tool steels.
- **Critical points** Critical point ranges obtained by dilatometer test when heating and cooling at a rate of 400°F/hour:

Heating – Ac range 1520° to 1600°F

Cooling – Ar range 1390° to 1300°F

- **Decarburization** To prevent decarburization, pack in an inert material or heat for hardening in a salt bath or controlled-atmosphere atmosphere furnace, or a vacuum furnace.
- **Grinding** Ameralloy D-2 is somewhat sensitive to grinding stresses resulting from improper practice. Oversize allowance for machining should be held to a minimum to avoid excessive grinding for finishing. The superior abrasion resistance of this grade makes it necessary to use a soft wheel with the coarsest grit commensurate with the finish required. Use a generous amount of coolant to cover the work at all times. Light cut must be made to avoid danger of cracking. For specific grinding operations, consult your grinding wheel representative for aid in selecting the proper grain and grade of wheel.

General Instructions

- **Forging** Due to a combination of high carbon/high chromium, take special care when hot working. Heat slowly and uniformly to 10 approximately 1250°F, and hold temperature sufficiently long to thoroughly soak the piece. For forging, heat to 1950°–2050°F. Discontinue forging at 1700°F and reheat. When forging is complete, cool slowly, preferably burying in dry insulating material.
- **Annealing** To prevent decarburization, use a controlled-atmosphere furnace or pack in inert material in a sealed container. Heat slowly to approximately 1600°–1650°F and hold at temperature for 1½ hours per inch of greatest thickness. Cool slowly at 20° per hour to 900°F, then allow steel to cool down with the furnace. Resulting hardness will be Brinell 217 max.
- **Hardening** When heating, protect the steel by packing or wrapping in inert material. When available, use a well-regulated salt bath, a controlled-atmosphere furnace, or a vacuum

furnace. Preheat to 1200°F and hold at this temperature until thoroughly soaked. Heat to 1850°F and hold at this temperature 1 hour per inch of greatest cross section. The piece may then be removed and cooled in still air to 150°F and tempered immediately. Oil-quenching is required on pieces 6" and larger.

Ameralloy-tested hardness and fracture grain ratings for various air-quenching temperatures:

Quenching Temperature (°F)	Fracture Grain Size	Rockwell C
1700°	8¾	62
1750°	9¼	64
1800°	9¼	65
1850°	9½	65
1900°	9¼	63

- **Tempering** Double tempering is preferable with the second temper 50°F lower than the first. The tool type and service requirements determine the temperature. For most applications, the tempering range is 900°–960°F. Use a minimum holding time of 2 hours for each inch of greatest cross section. To minimize cracking, temper immediately after hardening, and heat slowly to desired tempering temperature.

In the as-quenched condition, Ameralloy-D2 normally shows a slight amount of contraction in size. Tempering at 900°F or slightly higher usually neutralizes the original shrinkage produced in the quench, and brings the part virtually back to its original size. If the first temper does not completely neutralize the shrinkage, then a second or even a third temper may be used, with each temper raised 10°F over the previous. This produces a hardness in the range of Rockwell C 58 to 60.

After the shrinkage of the part has been neutralized, it is advisable to give the part a final temper to temper any newly formed martensite. This final temper should be done at 25°–50°F below the previous temper.

Rockwell hardness from various heats of steel, air-quenched from 1850°F and tempered a minimum or 2 hours per inch of cross section.

Tempering Temperature (°F)	Rockwell C
None	64
400°	60
500°	58
600°	58
700°	58
800°	57
900°*	58/60
960°	
1000°	56
1100°	48
1200°	40

*See Tempering

Above results may be used as a guide in tempering tools to desired hardness, however, tempering below 900°F is not recommended. Tools of heavy section or mass may be several points lower in Rockwell hardness for a given treatment.

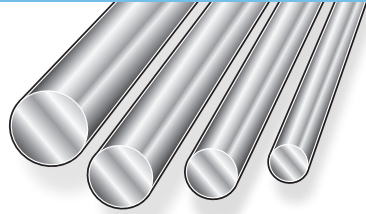
Ameralloy® D-2

AIR HARDENING STEEL

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Available Shapes And Sizes

Rounds



Flats



Squares



ROUNDS: Lengths precut to any size desired, or 10'-12' R/L lengths. FLATS & SQUARES: Standard 8'-10' R/L lengths. Wider widths and non-standards available upon request. Prompt forging service available.

Rounds Decarb Free Or Hot Rolled Annealed

1/4	1	2	4	8
5/16	1-1/8	2-1/8	4-1/4	8-1/2
3/8	1-1/4	2-1/4	4-1/2	9
7/16	1-3/8	2-3/8	4-3/4	9-1/2
1/2	1-1/2	2-1/2	5	10
9/16	1-5/8	2-5/8	5-1/4	10-1/2
5/8	1-3/4	2-3/4	5-1/2	11
11/16	1-7/8	2-7/8	5-3/4	11-1/2
3/4		3	6	12
13/16		3-1/8	6-1/4	12-1/2
7/8		3-1/4	6-1/2	13
15/16		3-1/2	7	14
		3-3/4	7-1/2	16

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

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 6	x 4-1/2	x 6	x 8
x 4	x 8	x 5	x 8	x 10
x 4-1/2	x 10	x 6	x 10	x 12
x 5	x 12	x 8	x 12	
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			