VILLARES METALS

COLD WORK TOOL STEEL VF800-AT

Brief Description

VF800-AT is a cold work tool steel, with excellent arrange of properties. In relation AISI D series tool steels, VF800-AT presents finer structure, which leads to comparative or higher wear resistance and toughness substantially higher. In service, presents the following behaviour:

- Much higher resistance to cracking or chipping and much better machinability/grindability than the higher-carbon (1,5% or more) AISI D types, such as D2, D3, D6 and D7.
- High resistance to adhesive wear, which is the main mechanism in cold work tooling.
- High dimensional stability, even if heat treated to hardness as high as 62 HRC.
- High hardenability, leading to minimum distortion and very high safety and resistance to cracking during hardening.

Chemical Composition

C	Si	Cr	Mo	V	Nb
0.85	0.90	8.40	2.00	0.50	0.15

Standard Specifications

None.

Physical Property

Density at 20 ºC: 7.7 kg/dm^3.

Delivery Conditions

Standard Identification colors:
white – blue – white.

Forms and hardness: annealed material is available in round, square or flat bars: 250 HB max.

Production Process

VF800-AT presents very homogeneous microstructure and mechanical properties (isotropy through the bars cross section).

Round and flat bars with diameter or thickness larger than 76.20 mm (3 inches) are produced via Electro Slag Re-melting (ESR) process.

Typical Applications

VF800-AT can be largely employed in several cold work tools, including that where both high wear resistance and toughness are necessary. Some typical applications are:

- Blanking and piercing dies, including punches and dies used to cold form metals in an stamping press.
- Tools for press forming dies.
- Deep drawing dies.
- **Thread rolling dies.**
- Blades for cold shearing flat materials, with thickness up to 13 mm (1/2 inches). Also for cold slitting up to 6,5 mm (1/4 inches).
- Coining dies.
- Cold rolling mill rolls.
- Cold heading dies.
- Punches and dies for cold extrusion.

Processing operations

The following processes can be applied for producing tools with VF800-AT:

- Machining: grinding, turning or milling. Due to its refined structured, VF800-AT good behaviour in grinding operations, considerably better than D2, D6 and D7 steels. This contributes to reduce the risk to surface overheating and cracking.

- Welding: only indicated if a special procedure of pre-heating is employed and if the filler material is from the same grade.

- Electrical discharge machining: the white layer should be mechanically removed, by grinding or sanding. It is also important to re-temper tools in a temperature 50 °C lower than that of the previous tempering.

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Heat treatment

Annealing: soft annealing should be carried out by heating between 870 and 900 °C for 2 hours, followed by slow cooling at 10/20 °C per hour until 650 °C and, then, by air cooling. In this treatment, the use of protective atmosphere is important to avoid surface oxidation and decarburization.

Stress relieving: Intense material removal during machining of tools can induce considerable stress, which may cause distortions after end heat treatment. In order to avoid this, a stress reliving is recommended to be applied after machining and before heat treatment. The indicated procedure is slow heating to 500/600 °C, holding until complete homogenisation, and cooling (air or furnace) at least down to 200 °C.

Hardening and Tempering: the indicated heat treatment temperatures are:

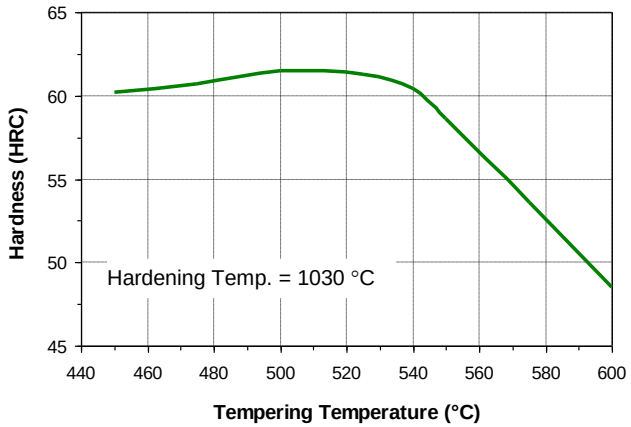
Pre-heating	*Hardening*	*Tempering*
790 – 830 °C	1020 - 1050 °C	500 - 600 ºC (see diagram below)

After preheating, tools must be carried to another furnace, holding 30 min after soaking (after tool is fully heated throughout).

Quenching may be done in:

a) Salt bath at 500/550 °C.
b) Warm quenching oil.
c) Vacuum, with high pressure circulated gas.
d) Air blast.

Tempering temperatures should be suitable to the required hardness (see diagram), being always higher than 500 °C. Double tempering is required and after each one tools must cool down to room temperature. After soaking, holding time of at least 2h is necessary.

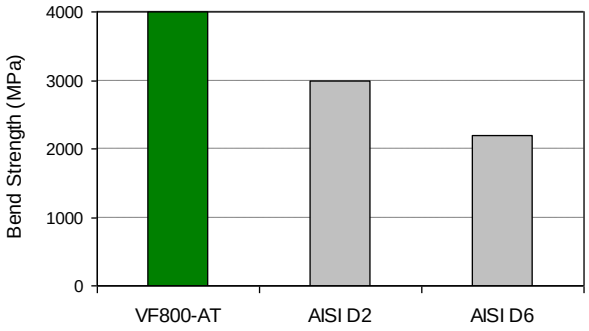


Surface treatments: VF800-AT is an adequate substrate for nitriding. As tempering temperatures are higher than 500 ºC, VF800-AT have no risk of decrease in core hardness during nitriding. This is another advantage in relation to AISI D grades.

PVD or CVD coatings are also available to be applied in VF800-AT if desired, without decrease in core hardness.

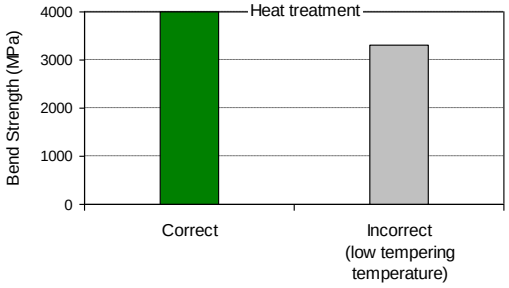
Mechanical Properties

Typical bend test properties of VF800-AT are presented below, compared to AISI D2 and D6, being toughness related to bend strength. VF800-AT presents much higher toughness and is therefore able to reduce the tendency to failures by cracking, chipping or spalling. Besides, its higher toughness contribute to improve adhesive wear resistance, which in many application, is better than that for D2.



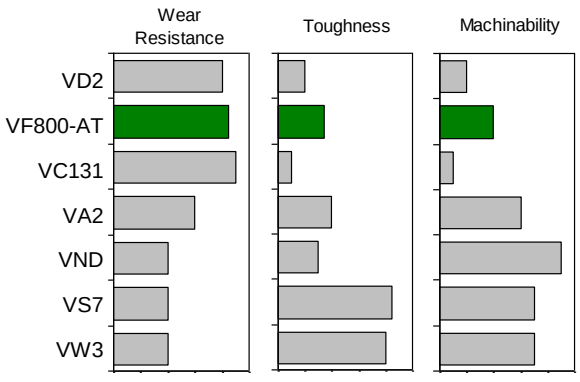
Values for specimens taken from the core of a 60 mm round bar, in longitudinal orientation. Hardness of 60 HRC.

For optimizing tool life, a proper heat treatment is absolutely necessary (see item before). As shown in Figure below, incorrect heat hardening or tempering temperatures lead to considerable decrease in toughness and substantially reduce tool life.



Results for specimens taken from the core of a 60 mm round bar, in longitudinal orientation, correctly and incorrectly tempered to of 60 HRC.

Relative Comparison of Villares Metals Cold Work Tool Steels



Note: All information presented are intended to provide guidelines of material use. They do not have relation to warranty of specific properties or contractual obligations.