



## ATT 2344 ESR

### CHEMICAL ANALYSIS (PERCENTAGE BY MASS)

	C	Si	Cr	Mn	Mo	V
Guide analysis	0.40	0.95	5.20	0.35	1.50	0.90

### CHARACTERISTICS

ATT 2344 ESR is a hot work tool steel that has a good combination of properties such as high toughness and heat resistance. Its alloy design makes ATT 2344 ESR a very versatile tool steel, employed in several application in hot work tooling and also in plastic molds. In service, ATT 2344 ESR presents the following behavior:

- Excellent homogeneity of properties in all directions (isotropy)
- High resistance to heat-checking and gross cracking
- Good machinability and polishability
- High hardenability and good dimensional stability during heat treatment
- Good heat conductivity

DIN	X40CrMoV5-1
AFNOR	Z40CDV5
AISI	H13
BS	BH13
JIS	SKD61
EN	X40CrMoV5-1-1
WNR.	1.2344
NADCA 207-2003	H13

### APPLICATIONS

The physical and mechanical properties of ATT 2344 ESR make possible its use in many applications, being classified as a general purpose hot work tool steel. Some typical applications are presented below:

- Dies for die casting of aluminum or other light metals
- Extrusion dies for aluminum or other non ferrous alloys
- Forging dies and die holders for steel or other ferrous and nonferrous alloys
- Hot shearing blades
- Wear resistance parts, when nitrided
- Injection or other molds for plastic

### DELIVERED CONDITION

Available in round, square or flat , annealed to maximum hardness of 235HB.

### PHYSICAL PROPERTIES

Density, kg/dm <sup>3</sup> at	20°C					
	7.85					
Thermal Conductivity (W/m.K) at	20°C	350°C	700°C			
	25.0	28.3	29.3			
Thermal Expansion (µm/m) from 20°C to	100°C	200°C	300°C	400°C	500°C	600°C
	11.5	12.0	12.2	12.5	12.9	13.0

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### HEAT TREATMENT

**Annealing :** soft annealing should be carried out by heating between 840 and 860°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 :** important in case of high removal during machining, in order to avoid distortions during heat treatment. The indicated procedure is slow heating to 500/600°C (or 50°C lower than the tempering temperature in case of hardened tool), holding until complete homogenization, and cooling (air or furnace) at least down to 200°C.

**Hardening and Tempering :**

The indicated heat treatment temperatures

Pre-heating  
780 - 820°C

Hardening  
1000-1040°C

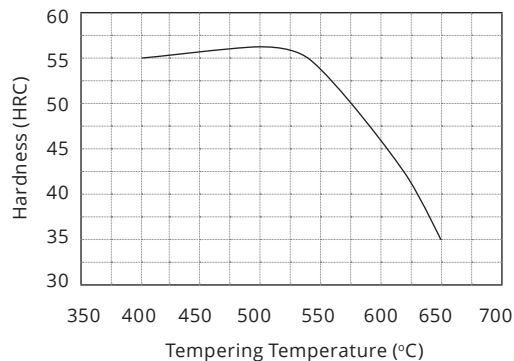
Tempering  
540 -650°C

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 :

- Salt bath at 500/550°C
- Warm quenching oil
- Vacuum, with high pressure circulated gas
- Air blast

Tempering temperatures should be suitable to the working condition, but 450/540°C range should be avoided because can cause excessive loss in toughness. Double tempering is required and after each one tool must cool down to room temperature. After soaking, holding time of at least 2 hr is necessary.



### SURFACE TREATMENT

ATT 2344 ESR is an adequate substrate for nitriding, leading to surface hardness around 1100 Hv. Nitriding temperature should be at least 50°C lower than that of the tempering. Surface must be in an adequate condition. PVD and CVD coatings are also possible to be applied in ATT 2344 ESR if desired.

### PROCESSING OPERATIONS

The following processes can be applied for producing tools with ATT 2344 ESR:

**Machining :** grinding, turning or milling. The general parameter should be adequate to the tool steel condition, if annealed or hardened.

**Welding :** special care is necessary in procedure and choice of consumables. After welding of hardened tool, another tempering treatment should be applied in 50°C lower temperature than the previous tempering. If tool is in the annealed condition, soft annealing is necessary before final heat treatment.

**Electrical discharge machining (EDM):** 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.

**Polishing and Photo-etching :** After electroslog remelting treatment, the steel has higher purity and it is suitable for plastic mould that requires high polishability and photo-etching requirements.