ATT 2083 ESR

VP420IM

SIMILAR STANDARDS

ATT 2083 ESR is similar to the following grades: AISI 420, DIN X42Cr13, W.Nr. 1.2083 and JIS SUS 420J2. This steel is produced in accord with ASTM A276.

GENERAL INFORMATION

ATT 2083 ESR is a martensitic stainless steel indicated for manufacturing of plastic molds. It is produced with special processes, including vacuum degassing and refining by ESR (Electro-Slag Remelting), ensuring a high homogeneity of its properties.

ATT 2083 ESR combines corrosion and wear resistance with excellent polishability, good machinability and stability in hardening. The combination of these properties gives ATT 2083 ESR good production performance when applied in plastics mold industry.

MAIN CHARACTERISTICS

ATT 2083 ESR exhibits the following properties:

⇒ Good corrosion resistance
⇒ Excellent polishability
⇒ High wear resistance
⇒ Good machinability
⇒ High mechanical strength, leading to hardness up to 52 HRC

MAIN APPLICATIONS

⇒ Mold inserts
⇒ Molds, cores and cavities for injection or extrusin of corrosive materials, such as PVC.
⇒ Molds subjected to humid environments or are storage conditions
⇒ Molds for glass production
⇒ Other applications that need high mechanical and corrosion resistance

CHEMICAL COMPOSITION

Typical Analysis (Weight Percent)

C	Si	Mn	Cr	V
0.40	1.0 max	1.0 max	13.5	0.3 max

STANDARD PRODUCTION RANGE

Production Route	Standard	Production Range	Finishing
Rolled Products	ASTM A276	Thickness between 8 to 152 mm with width between 38.10 to 320mm Round 12.70-152.40mm	Centerless ground Peeled Turned
Forged Products		Round 152.40 – 570 mm Thickness up to 300mm with width up to 760mm	Turned Peeled Milled

*Other dimensions and conditions are available upon inquiry.

DELIVERY CONDITION

ATT 2083 ESR is usually available annealed condition in round, square or flat bars with maximum hardness of 230 HB. This steel can also be supplied in the final heat treatment condition in accordance with ASTM A276.

HEAT TREATMENT

Soft Annealing

Soft annealing should be carried out by slow heating to 780 and 840°C for 1 hour for each inch of thickness, followed by slow cooling at 30°C per hour until 600°C and then, by air cooling.

In this treatment, the use of protective atmosphere is important to avoid surface oxidation and decarburization.

Stress Relief

In case of high removal during machining, a stress relief heat treatment shall be applied in order to avoid distortions during quenching and tempering heat treatments.

The indicated procedure is slow heating to 650°C or 50°C lower than the tempering temperature in case of hardened tool, holding until complete homogenization, and cooling inside the furnace at least down to 500°C, then freely in air.

Hardening

Preheated to 600-850°C and then to austenitization temperature.

The austenitizing temperature should be between 1000-1040°C, holding the temperature until complete homogenization of the part.

Surface decarburization cause decrease in hardness and may cause polishing problems named “overpolishing”. Therefore, the use of protective atmosphere (or vacuum) is important during heating to hardening.

After austenitization, quenching can be performed in the following cooling media:

⇒ Sufficient overpress gas (e.g.N_2)

⇒ Warm oil with a temperature between 40 - 70°C and appropriate stirring, until the piece reaches 100°C. Then cool in calm air up to 70°C

⇒ Fluidised bed or salt bath at 250-550°C, then cool in air blast.

Note: Inert gas quenching (vacuum furnace) at lower pressures (around 5 bar) may be recommended to minimize dimensional distortions, in the case of molds applied to the plastic processing industry and where the geometric complexity is very large.

Tempering

The parts shall be tempered immediately after quenching, i.e. as soon as they reach 60°C. It is necessary, at least, double tempering. After each tempering, parts shall be slowly cooled to room temperature.

Choose the tempering temperature according to the hardness required by reference to the tempering graph.

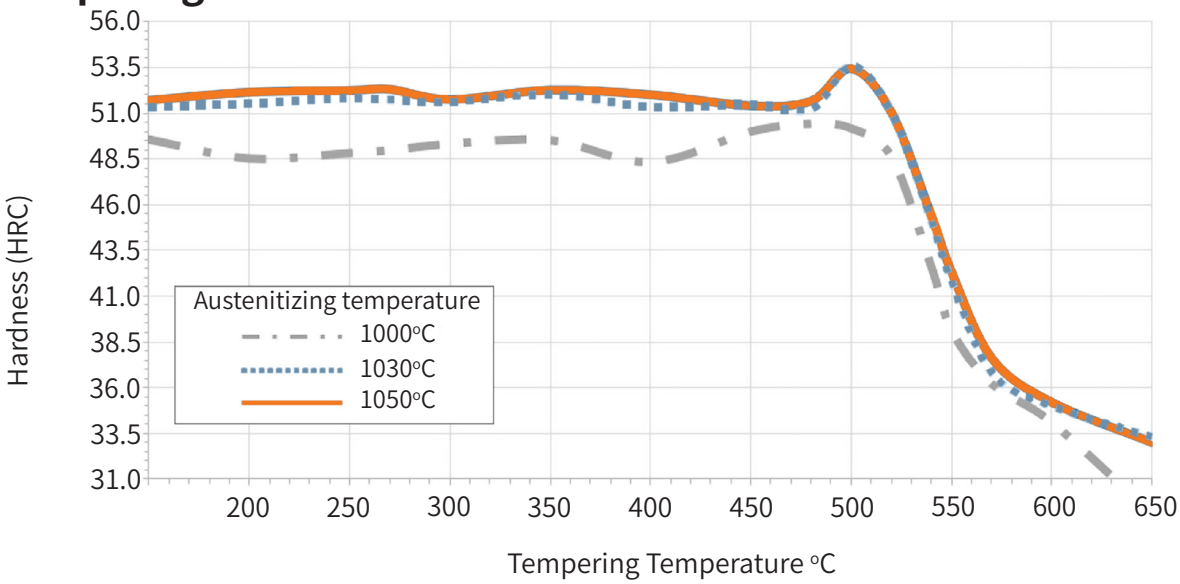
Tempering temperatures are generally between 200-300°C, depending upon the desired hardness. The time of each tempering cycle shall be at least 2 hours in temperature. The temperature range between 450 and 540°C shall be avoided because it can promote an excessive loss in toughness and corrosion resistance.

For parts with thickness larger than 70 mm, the time at temperature should be calculated according to their size, being a reference for calculation about one hour for each inch of thickness.

Surface Treatment

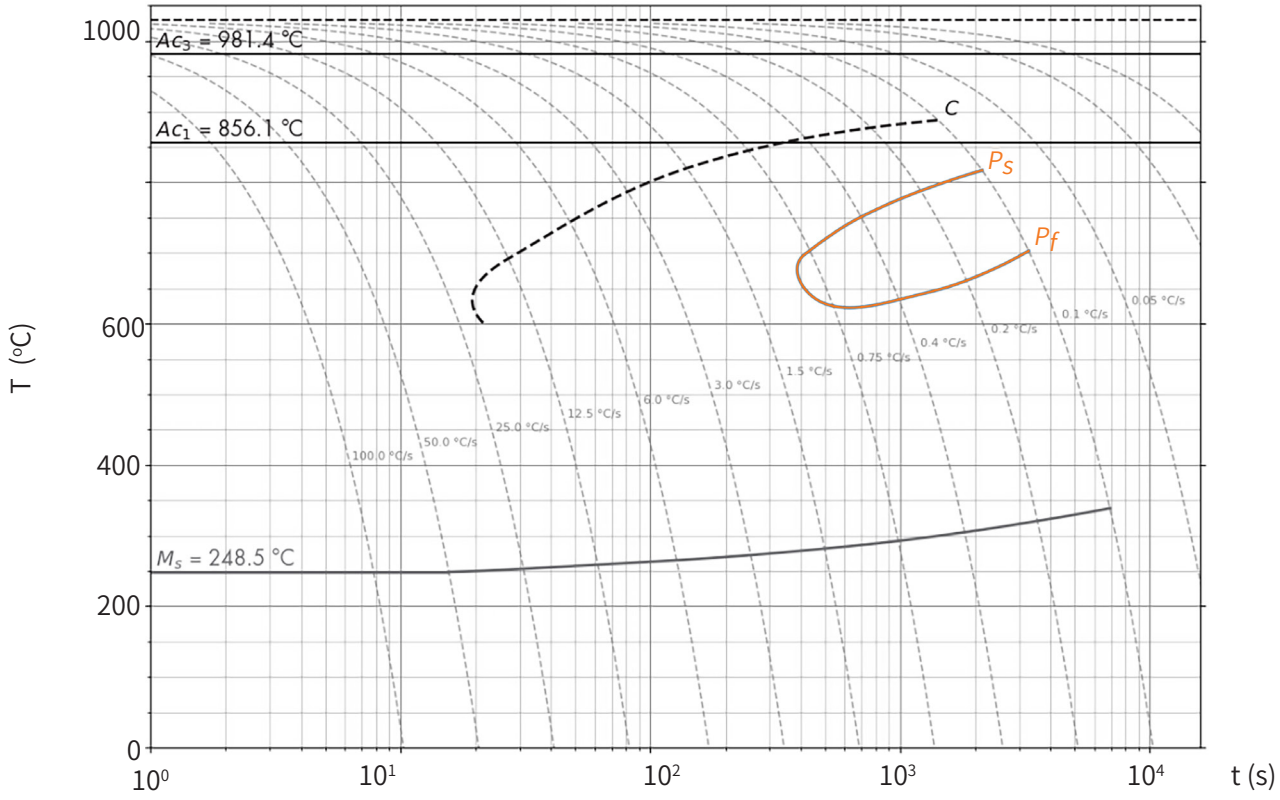
Depending on the temperature used during nitriding or PVD, corrosion resistance may decrease. They are usually only applied when there is a greater need for wear resistance.

Tempering curve



Tempering curve of ATT 2083 ESR after hardening at different austenitizing temperature.
Tempering time: 2 hours
Curve obtained from specimens with 20 mm x 20 mm x 20 mm.
Note: this graph is referential.
Actual hardness achieved after hardening and tempering depends on the mold size.

CCT diagrams



ATT 2083 ESR cooling chart. Austenitizing temperature 1020°C (1870°F)

MACHINABILITY

ATT 2083 ESR can be conventionally in the annealed or hardened condition. For a better machinability, it is recommended the use of coated carbide indexable insert. The recommendations for turning and milling processes in the following tables are valid for ATT 2083 ESR in annealed condition 160-220 HB as well as hardened and tempered to 48-52 HRC.

For drilling process up to diameter of 20 mm in annealed condition 160-220 HB is recommended to use solid carbide drill ISO P15 Class with a cutting speed of 60-100 m/min and feed of 0.1 to 0.4 mm/rev. or carbide indexable insert drill ISO P40 Class TiCN/TiN coated with a cutting speed of 180-250 m/min and feed of 0.10–0.25 mm/rev.

These cutting parameters should be considered as guidelines and must be adapted according to local machining conditions.

In order to avoid distortions on the part during hardening and tempering, it is recommended to perform a stress relief heat treatment before hardening if more than 30% of part weight is removed in machining operations.

Electro-erosion process can be employed in heat treated dies or molds. After electro-erosion machining it is recommended to remove the superficial layer through fine grinding wheel. After grinding it is recommended to perform a tempering heat treatment in temperature around 50°C lowerthan that of the last tempering.

Condition	Annealed		Hardened and Tempererd	
Hardness	160 - 220 HB		48 - 52 HRC	
Machining process	Rough Turning	Finish Turning	Rough Turning	Finish Turning
Cutting speed (m/min)	150 - 200	200 - 250	50 - 70	70 - 90
Feed (mm/rev)	0.2 - 0.4	0.05 - 0.2	0.2 - 0.5	0.05 - 0.3
Depth of cut (mm)	2 - 4	0.5 - 2	0.1 - 2	0.5 - 1
Carbide tool (ISO Class)	P20/25 TiCN+Al_2O_3+ TiN coated	P10/15 TiCN+Al_2O_3+ TiN coated	P20/25 TiCN+Al_2O_3+ TiN coated	P10/15 TiCN+Al_2O_3+ TiN coated

Condition	Annealed		Hardened and Tempererd		
Hardness	160 - 220 HB		48 - 52 HRC		
Machining process	Rough Milling	Finish Milling	Rough Milling	Finish Milling	Ball Nose End Milling
Cutting speed (m/min)	200 - 250	250 - 300	40 - 60	50 - 70	60 - 90
Feed (mm/rev)	0.2 - 0.4	0.1 - 0.2	0.2 - 0.5	0.1 - 0.2	0.1 - 0.2
Depth of cut (mm)	2 - 4	0 - 2	0.1 - 2	0.1 - 2	0.1 -2
Carbide tool (ISO Class)	P20/25 TiAlN coated	P10/15 TiAlN coated	P20/25 AlTiCrN coated	P10/15 AlTiCrN coated	P10/15 AlTiCrN coated

WELDING

In exceptional cases and always considering that welding would be a temporary solution, ATT 2083 ESR might be welded using special procedures to minimize the occurrence of cracks.

The instructions of the appropriate welding electrode manufacturer should be followed. The sequence of operations for repair welding ATT 2083 ESR depends upon its prior heat treatment.

As a general guideline, it is recommended to: (a) preheat, (b) weld with appropriate filler metal, (c) perform a stress relief heat treatment, (d) machine, (e) quench and temper if in the annealed condition or stress relief if already hardened and (f) grind to final dimensions.

The qualification of a specific welding procedure for repair is the key point to obtain the desired quality.

The skill and experience of the welder is also a vital factor in obtaining satisfactory results.

ELECTRICAL DISCHARGE MACHINING - EDM

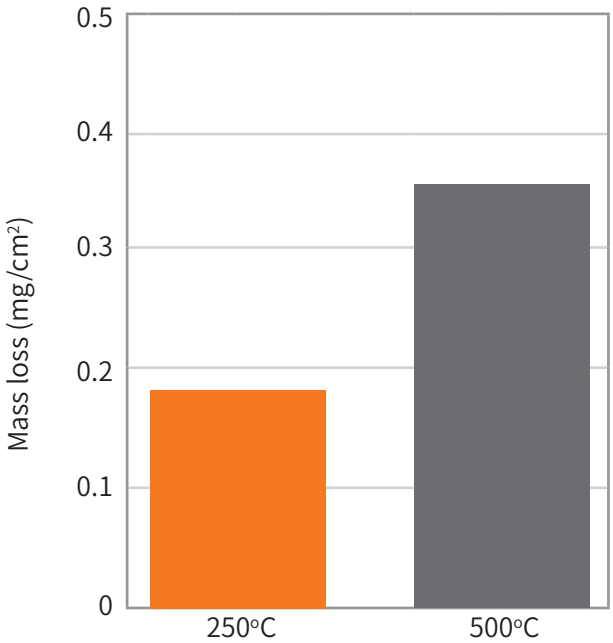
If spark erosion is performed in the hardened and tempered condition, the white recast layer should be removed mechanically, for example, by grinding or stoning. The tool should then be given an additional temper at approximately 25ºC below the highest previous tempering temperature.

PHOTO ETCHING

A special photoetching process might be necessary because due to the good corrosion resistance of ATT 2083 ESR. This steel has a good response to texturing and the companies responsible for this process are familiar with this material.

CORROSION RESISTANCE

ATT 2083 ESR steel when adequately heat treated presents good corrosion resistance to atmosphere, mild acids and alkalis and fresh water.



Graph of corrosion resistance of ATT 2083 ESR steel after hardening and tempering heat treatment.

PHYSICAL PROPERTIES

Density

Temperature	g/cm^3	lb/in^3
20°C (68°F)	7.70	0.278

Thermal Conductivity

Temperature	W/(m · K)	Btu.in/(h.ft^2.°F)
100°C (212°F)	24.8	171

Specific Heat

Temperature 20 °C to (68°F to)	J/kg.K	Btu/lb.°F
200°C (392°F)	460	0.110

Solidification

Temperature	°C	°F
Melting Range	1250 - 1510	2280 - 2750

Advanced Tooling Tek (Shanghai) Co. Ltd. (ATT), established in 2001, is a trusted supplier of premium mold steel for China' s manufacturing sector. With more than two decades of industry experience, ATT has built a strong reputation for reliability, technical expertise and customer-focused service.

Serving a wide range of industries, including automotive, electronics, home appliances and packaging, ATT offers a comprehensive portfolio of premium tool steels, including hot work tool steel, cold work tool steel and primarily plastic mold steel. To meet diverse customer requirements, ATT provide processing services such as sawing, milling, grinding, and heat treatment, ensuring efficient turnaround and consistent quality.

To further enhance its product range and technical strength, ATT collaborates closely with its group mill, Villares Metals. Headquartered in Sumaré, São Paulo, Brazil, Villares Metals has been a leader in specialty steels and alloys since 1944, supplying high-performance solutions to industries such as automotive, railway, energy, medical, oil and gas, aerospace and agriculture across the Americas and globally.

Through this collaboration, ATT offers customers access to world-class materials, international metallurgical expertise and innovative steel technologies. From mold manufacturers to component users and end product producers, ATT supports every stage of the value chain with dependable products, technical guidance and responsive service.

ATT is dedicated to being your preferred partner for high-performance tool steel solutions.

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