Industeel

ArcelorMittal

W 1.2343 EFS – AISI H11 EFS

2343 EFS – H11 EFS: Hot work tool steel with extra Fine Structure (EFS)

MATERIAL PROPERTIES

EFS 5% Chromium hot work tool steel grade is suitable for die casting, dies, mold-cavities and forging applications.

Good softening resistance, good polishing properties after hardening. Good coating adaptability (PVD-CVD), easy nitriding (Gas, Ionic or salt bath).
Good toughness and good dimensional stability during heat treatment.

2343 EFS – H11 EFS is having a very high thermal conductibility and is recommanded for hot working applications with high cycles.

PROPERTIES

STANDARDS

- **> JIS** SKD6
- **> EURONORM** X37CrMoV5.1
- **> WERKSTOFF** W1.2343
- **> SDK6**
- **> GB 4Cr5MoSiV**

CHEMICAL ANALYSIS

	C	S	Si	Cr	Mo	V	Mn	P
Min	0.33	-	0.80	4.80	1.10	0.30	0.20	0.10
Typ	0.38	≤ 0.005	1.10	5.00	1.30	0.40	0.30	≤0.015
Max	0.41	-	1.20	5.50	1.50	0.50	0.40	0.30

Typical Industeel analysis is in accordance with international standards

MECHANICAL PROPERTIES

2343 EFS -H11 EFS grade is delivered in annealed condition with a hardness around 220HB. Is has to be heat treated after rough machining.
Typical mechanical performances of W1.2343 EFS/AISI H11EFS after hardening are :

Hardness (HRC)	Rm (MPa)	Rp0,2 (Mpa)	KV in J at 20°C
52	1 800	1 540	>15
48	1 600	1 380	>16
44	1 450	1 200	>18

PHYSICAL PROPERTIES

Typical values of 2343 EFS after hardening

Thermal conductivity W.m-1.K-1	Thermal expansion Coefficient (10-6.K-1)				
20°C	20-100°C	20-200°C	20-300°C	20-400°C	Specific heat J/kg.°C
25	11.8	12.4	12.5	12.7	460

METALLURGICAL PROPERTIES

Internal soundness

All plates & blocks are 100% UT tested and meet following standards:

> Euronorm EN 10228-3 class 4

> ASTM A681 S1.1

> SEP1921 D/d

Grain size

Very fine and homogeneous without precipitations or carbide alignments at the grain bondaries ensurineg a longer tool life along with a good fatigue resistance.

At annealed stage 2343 EFS -H11 EFS is conformed with CNOMO E 117222N, SEP 1614 -1 and NADCA ≠207

Cleanliness

Due to the steelmaking process, the content of nonmetallic inclusions is reduced to an extremely low level.
Nonmetallic inclusions content is measured in accordance with ASTM E45 - 95 A method.

A (sulfide)		B (alumina)		C (silicate)		D (Globular oxides)	
Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy
2	1	1.5	1	1.0	0.5	1.5	1

2343 EFS -H11 EFS grade is delivered in a soft annealed condition for easier machining.
When machining is completed, it can be hardened with a heat treatment procedure including preheating, austenitizing, quenching and double tempering.
Heat treatment should be done under vacuum or under gas protection to avoid surface oxidation and decarburization.
Surface and core temperature (Ts/Tc) should be controlled by thermocouples.

Soft annealing

- Heating at 750°C - 800 °C (1382°F - 1472 °F) One hour + one hour per 25 mm thickness
- Slow cool down at 10°C (20°F)
- Oven atmosphere must be reducing to avoid decarburization of the steel.

Stress relieving

After rough machining, stress in the tool can be released by heating at 650°C during minimum 2 hours followed by slow cooli down to 450°C and then air cooling.

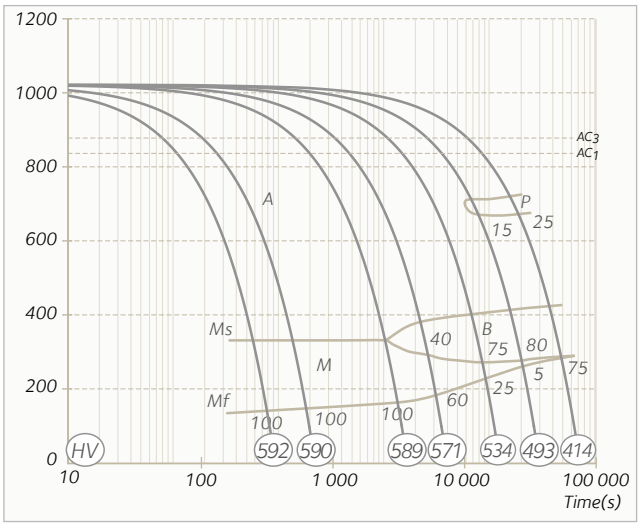
Preheating (before austenitizing)

Heating rate should be limited to 220°C /h (400°F/h), measured in the core of cavity. First preheating has to be done at Ts≈620°C (1150°F) and hold until
Ts-Tc < 110°C (200°F) Second preheating has to be done at Ts≈830°(1530°F) and hold until Ts-Tc < 15°C (25°F).

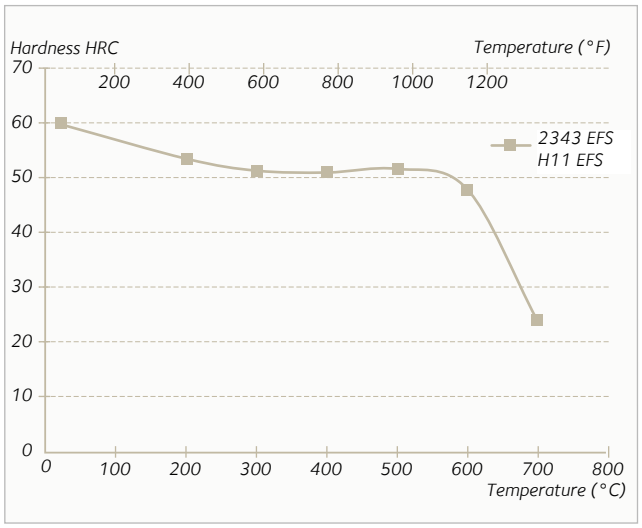
Austenitizing

After second preheating, austenitizing should be rapidly increased up to 1010°C - 1030°C (1850°F - 1886°F) and holding time should not be too long to avoid increasing grain size. It is recommended to hold 30 mn after austenitisation temperature has been reached et the heart of the piece.

CCT DIAGRAM



TEMPERING CURVE



Typical values for hardness in regards of tempering temperature							
Temperature	200°C	300°C	400°C	500°C	550°C	600°C	700°C
HRC Hardness	52	52	52	54	53	48	31

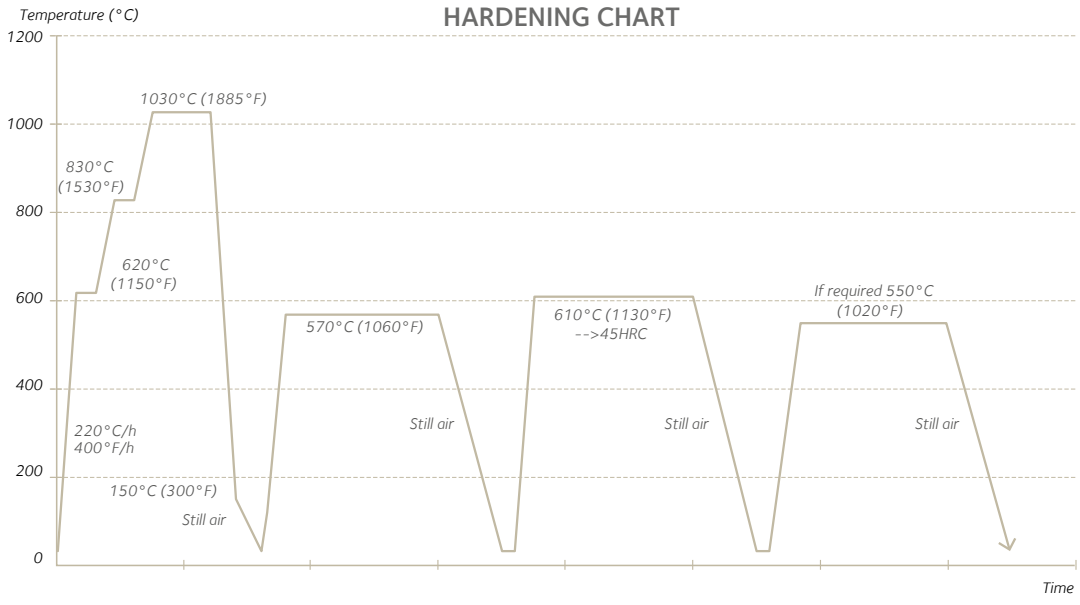
Quenching

Quenching shall be performed in oil at 80°C, . vacuum (pressure>6 bars), salt bath 500°C- 550°C.

Tempering

To ensure a minimum residual austenite rate as well as greater tool stability, it is essential to perform a double tempering. First temper can be performed et a temperature of 570°C to ensure a good precipitation of carbides.
Second tempering must be done according final hardness required.
Minimum time for each tempering session must be equal et 1H + 1H per every 25 mm thickness and it must be done under athmosphere and not under vacuum.

HARDENING CHART



SURFACE TREATMENT

Nitriding
Nitriding temperature should always be 20°C lower than last tempering.
Gas nitriding can be performed at 520°C during 25 hrs. A 2 mm layer at 1070 HV1 should be obtained.
Plasma nitriding can be done at 520°C during 15 hrs. A 1 mm layer at 1050 HV1 should be obtained.

Hard Chrome plating
It can be done as long as surface is free from oil and clean. Roughness below Ra 0.8 µm (Ra 0,2 µm is advisable)
Voltage 6-8V/20-50 Amps/dm^2/bath temp 40-60°C/Chromic and sulfuric acids.
Because of Hydrogen absorption we recommend to make a degassing treatment (20°C below temperating temperature for 4 hrs) This treatment will avoid later-on cracks in 2343 EFS- H11EFS.

PVD and CVD
All kind of PVD or CVD coating are suitable.

Welding
Laser, TIG or GTAW are acceptable.
Material filler should be H11 material
Pre-heating at 350°C is recommended
Post heating, let cool it down very slowly at rate of 20°C/h.

DIMENSIONAL PROGRAM

Thickness	Width
15 -350 mm	1000 - 2 100 mm

YOUR CONTACTS

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