# DAYE JINGCHENG MOULD CO., LTD
# TOOL STEEL PRODUCT

## 1.2343 Hot Work Tool Steel

### Identification

Designation by Standards

| Mat. No. | DIN | EN | AISI |
|---|---|---|---|
| 1.2343 | X38CrMoV51 | X38CrMoV51 | H11 |

### Chemical Composition

| C | Si | Mn | Cr | Mo | V | P | S |
|---|---|---|---|---|---|---|---|
| 0.36 | 0.90 | 0.30 | 4.80 | 1.10 | 0.25 | 0.030 | 0.030 |
| 0.42 | 1.20 | 0.50 | 5.80 | 1.40 | 0.50 | MAX | MAX |

### General Information

**Description**

This is supreme steel grade in the group of hot work tool steels. Special production methods ensure optimal parameters in all phases of steelmaking, providing this steel grade with supreme characteristics resulting in a higher tool durability. This steel incorporates the knowledge and experience of many generations of tool steel specialists.

**Applications**

Above all, the grade is designed for die casting of light metals and alloys (aluminium and aluminium alloys), for die forging of steel and non-ferous metals (e.g. cupper) and their alloys, for extrusion of tubes, barrels and sections made of light metals and alloys, for casting and processing of various plastics, and for glass processing. Characterics: Excellent homogeneity, high cleanliness, high level of isotrophy, good workability, high impact toughness, good polishability. Advantages: Lower cost due to: Lower tool life, lower tool wear, less tool repair, less tool changes and consistent heat treatment results.

### Properties

Physical properties (avarage values) at ambient temperature:
Modulus of elasticity [103 x N/mm2]: Approx. 215
Density [g/cm3]: 7.85, 7.69 (500C), 7.65 (600C) Electric resistivity [Ohm mm2/m]: Apprx. 0.50
Specific heat capacity[J/g.K]: Approx. 0.46
Transformation points: Ac1=805C, Ac3=880C

Thermal Conductivity [W/m.K] vs. Temperature

| 100C | 200C | 300C | 400C | 500C | 600C | 700C |
|---|---|---|---|---|---|---|
| 28.4 | 29.7 | 30.2 | 30.1 | 30.0 | 29.7 | 30.0 |

Coefficient of Linear Thermal Expansion 10-6 oC-1

| 20-100C | 20-200C | 20-300C | 20-400C | 20-500C | 20-600C | 20-700C | 20-800C |
|---|---|---|---|---|---|---|---|
| 11.9 | 12.4 | 12.8 | 13.2 | 13.6 | 14.2 | 14.4 | 14.4 |

### Heat Treatment

**Soft Annealing**

Heat to 800-850C/ min. 4 hours at temperature then cool slowly in furnace. This will produce a maximum Brinell hardness of 209 HB.

**Stress Relieving**

Stress relieving to remove machining stresses should be carried out by heating to approx. 600-650C, holding for 3 hours at temperature, followed by slow cooling in furnace. This operation is performed to reduce distortion during heat treatment and to reduce stress after machining of tools prior to final heat treatment of tools.

**Hardening**

Harden from a temperature of 980-1000C/ 30 minutes at temperature, followed by oil, thermal bath, air, vacuum and protective atmosphere quenching.

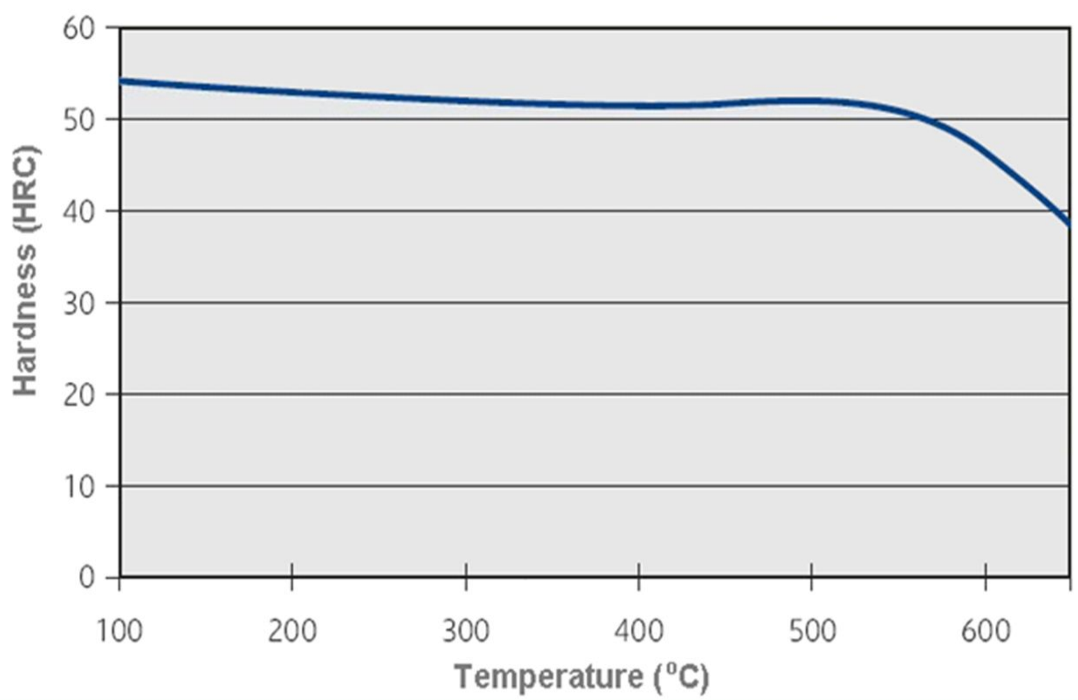
**Tempering**

1st tempering: 20-30C over secondary peak in the tempering diagram.
2nd tempering: Tempering to a working hardness of tool.
Recommendation: 3rd tempering from 20-50C down to bellow the temperature of 2nd tempering. Tempering: Slow heating up to tempering temperature is recommended, tempering times: min. 2 hours and/or 1 hour for 20-25 mm thickness for tool.

Tempering Temperature (C) vs. Hardness (HRC)

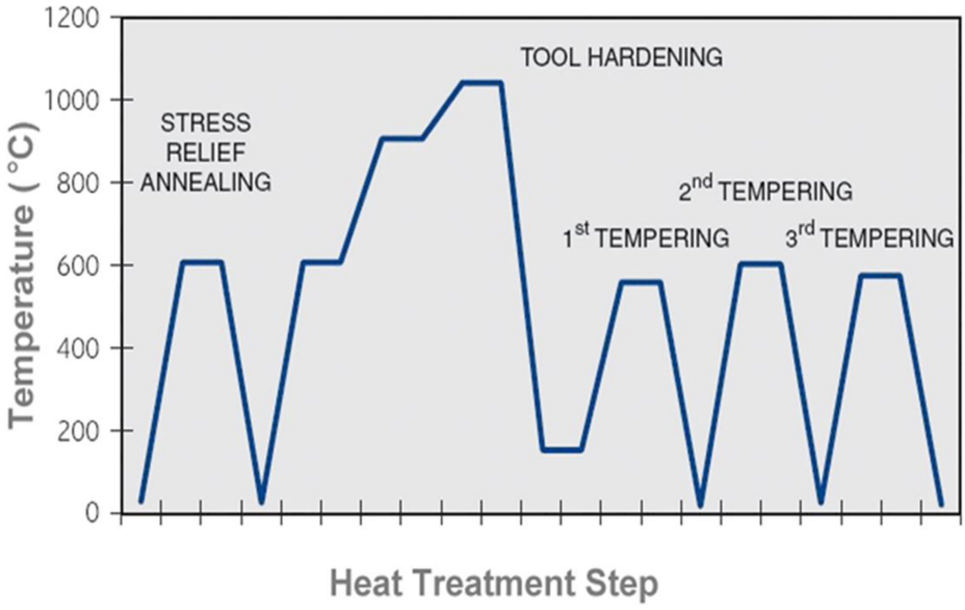
| 100C | 200C | 300C | 400C | 500C | 550C | 600C | 650C |
|---|---|---|---|---|---|---|---|
| 54 | 53 | 52 | 51.5 | 52 | 52 | 47 | 38 |

**Effect of Tempering Temperature on Hardness:**



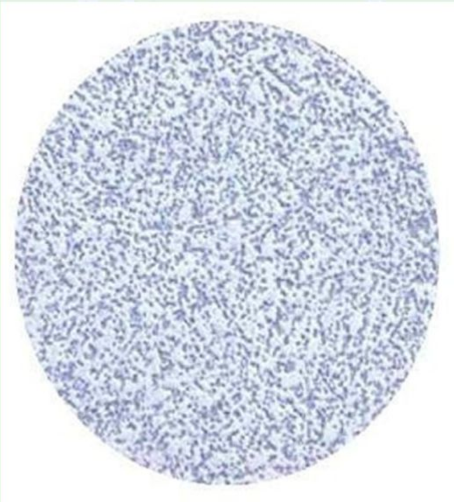
# DAYE JINGCHENG MOULD CO., LTD
# TOOL STEEL PRODUCT

**General Diagram of Heat Treatment**




**Microstructure**

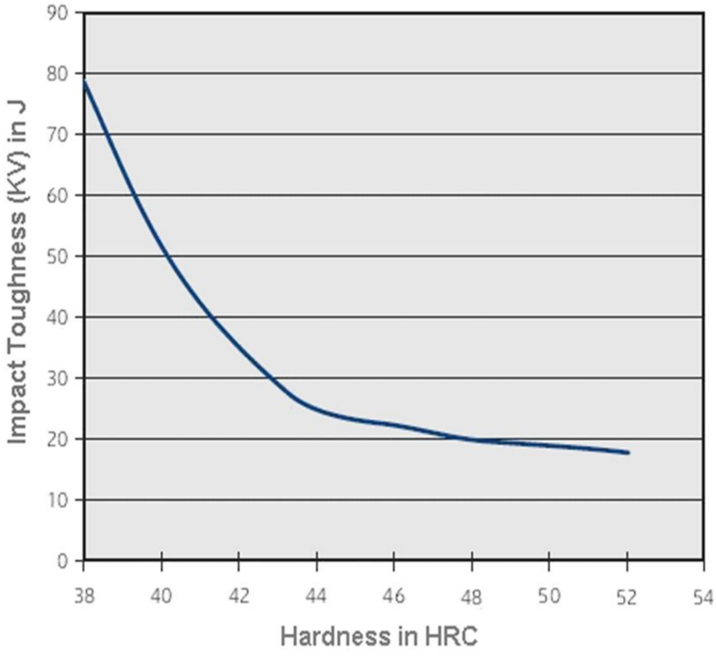
When annealed, the microstructure consists of equally distributed secondary carbides in the form of globules in a ferritic base along the whole section. To achieve such microstructure in an annealed condition, special advanced metallurgical methods are carried out in all phases of steel production. When annealed, hardness ranges between 170 and 209 HB. This grade provides a uniform hardness and toughness along the entire tool cross-section. This is achieved with a uniform distribution of secondary carbides in steel, even after hardening and tempering.



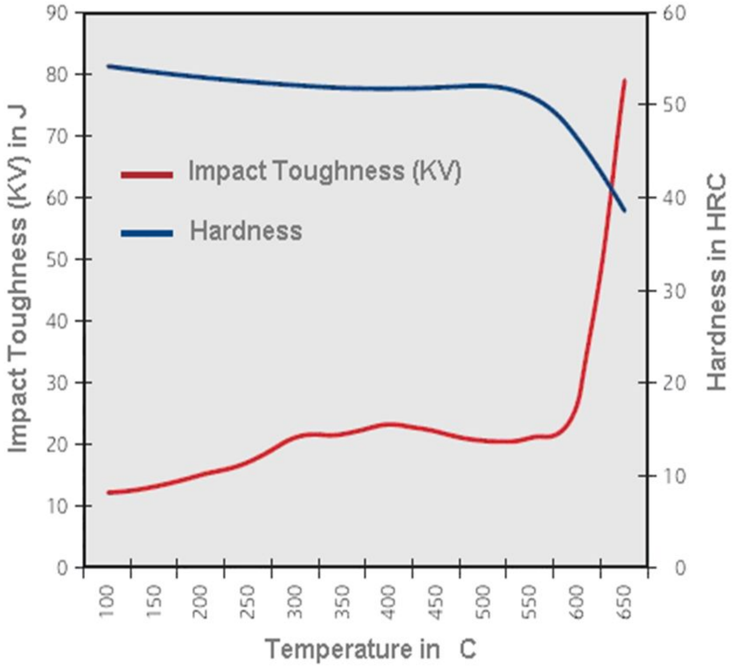
Microstructure of annealed
steel, SEP 1614:1916, Mag. 500 X.

## Mechanical Properties

### Impact Toughness (KV) vs. Hardness

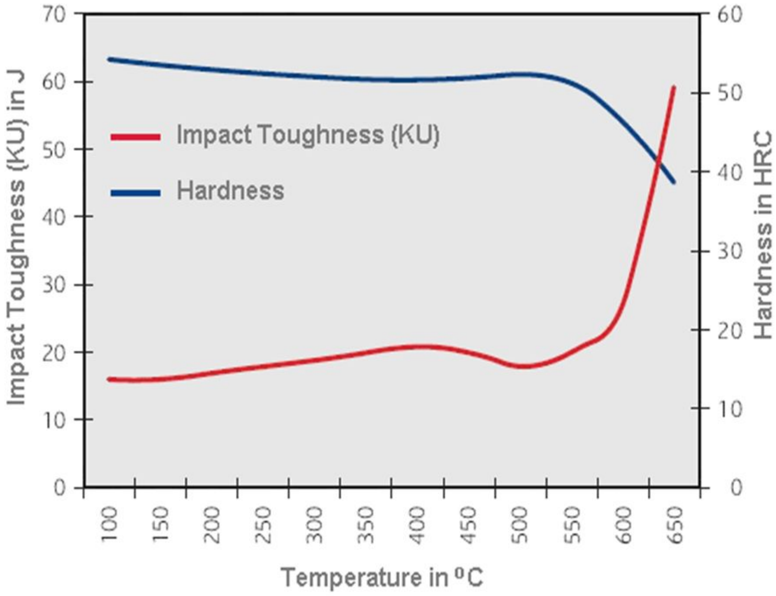



### Tempering Diagram and Impact Toughness



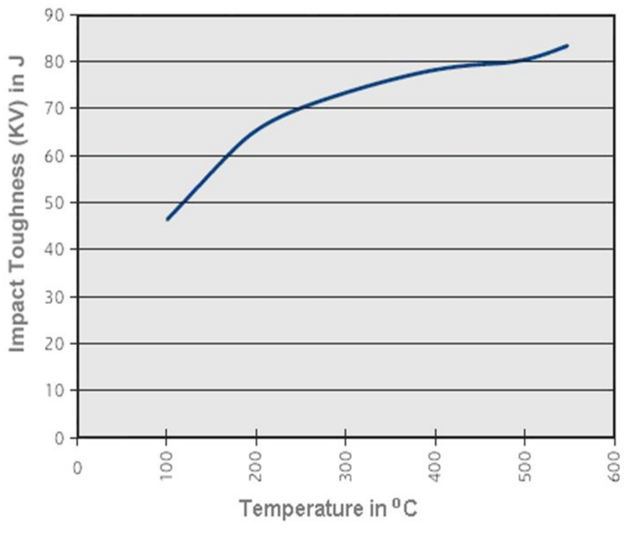

Note: Impact test pieces (KV and KU) are cut out of the core in transverse section of the forging. Heat treatment: Temperature of hardening: 1000 C/oil and double tempering 2 hours each in a temperature interval of 100 C to 650 C. EN 10045:-1, temperature of testing: 20 C.

**Diagram of Impact Toughness (KU) vs. Temperature**




Note: EN 10045:-1, temperature of testing: 20 C.

**Diagram of Impact Toughness (KV) vs. Temperatures**




Note: Impact test pieces (KV and KU) are cut out of the core in transverse section of the forging. Heat treatment: Temperature of hardening: 1000 C/oil and double tempering to the hardness of 45 +/- HRC.

## Workability

**Forging**
Hot forming temperature: Please ask.

**Machinability**
Please see the section bellow.

## Other Information

**Nitriding**
This grade is suitable for nitriding and nitrocarburizing. Surface hardness over 1000 HV0.3 can be achieved by gas, plasma, or salt processes. Nitriding must be performed 20-50 C below a previous tempering temperature, depending on the process time and temperature, to avoid loss of hardness, strength, and dimensional changes of the workpiece. Essential benefits of a hard nitrided or nitro Carburizingd surface lie in an improved.

**Welding**
The grade can be welded successfully by the MMA or GTA welding process, provided that proper precautions are taken before, during, and after welding. Laser weld repair of smaller cracks and edges is recommended to minimize negative effects of high residual stresses in weldments and heat affected zones. GTA welding is generally performed using AISI H11 consumables. Proper weld preparation is crucial; cracks are ground out to sound steel, correct joint slope and bottom radius shall be considered. Welding can be performed in soft annealed or hardened and tempered condition. In both cases, a preheat to 350 C is recommended. This temperature is to be maintained
throughout welding. After welding, soft annealed or hardened and tempered parts are slowly cooled down to between 70 and 100 C, then soft annealed or tempered 20 C below the last tempering temperature.

**Dimensional Changes During Hardening**
Temperature gradients in a workpiece during quenching often cause high stresses which cause distortion. Stress relief annealing between rough and semi-finish machining prior to hardening is recommended to limit distortion during quenching. Minimum machining allowance to account for grade distortion during a correctly performed rapid quench is

**Electrical Discharge Machnining**

Surfaces which are subjected to the Electrical Discharge Machnining (EDM) process must be ground or blanched ground to remove the brittle, resolidified surface layer. In addition, the material subjected to EDM must be tempered about 20 C bellow the previous tempering temperature to give a temper to the rehardened and untempered layer underneath. Both layers are very brittle and such detrimental to die performance.