**SKD11 Steel Characters and Heat Treatment**

SKD11 (alloy tool steel): High-Carbon High-Chromium alloy steel with
high hardness (appropriate toughness) and tempering hardening effect.
Examples like stamping mold, plastic mold and other multi-function items.After quenching, residual austenite is about 13% to 20%. It can be
eliminated by cryogenic treatment or tempering process. For the molds
requiring both hardness and toughness, it is safer to use the hardness
of HRC58 with tempering process and secondary hardening.

To increase the abrasion resistance of SKD11, you can use
low-temperature tempering, and with the cryogenic treatment, life can be extended. It can also be prevented from being deformed at the same
time.

Generally speaking, SKD11 uses 550 ~ 530 degrees for tempering.
However, if you want to increase the abrasion resistance, you need to
use low-temperature tempering. Both have advantages and disadvantages.After tempering, it is with better toughness and increase the rupture
resistance. The low-tempering has good abrasion resistance and long
service life.

**Features：**
(1)    Good Wear-Resisting，Good Quenching，Less Deformation
(2)     Heat-Treated Steel，Hardness: HRC 58-62 Degree
(3)     Average Price, High Hardness, Most commonly Used Plate
(4)     Most Commonly Used on Molding
(5) High Carbon/Chromium Alloy Steel. High Hardness and Proper  Toughness w/Tempering Hardening Effect. It is the typical       wind-hardened steel and is currently the best wear resistance of alloy tool steel.
(6) Adding molybdenum, vanadium and other elements, it’s with     wear-resisting, non-deformation, impact-resistance and other      characteristics.
(7) Secondary Refining, Good Cleanliness, Fine Grain

Application Range: SKD11 is often used in the main template       (example: up, down templates, stripper plate and etc.) such as the steel plate for pad printing. Hardness falls at HRC60 ~ 62 degrees

SKD11 Status after Vacuum Heat-Treated:
(1)   Re-Heat-Treated :
SKD11 can stay at original hardness or reduce its hardness depending on what you require. The advantage is to reduce the residual Austenitein steel and make the whole structure stable. In short, it’s to make the steel toughness better.
(2)   Cooling :
Both methods will have the steel hardness back to the status before it’s heat-treated (about HRC15~20). Unless it’s re-modifying, people tend not to select cooling.

Which method is more appropriate for heat-treated?
SKD11 is mostly using vacuum heat-treated. Temperature above 1000 degree Celsius. Normally, cooling at 150~200 degree Celsius and hardness above HRC61.
Method: SKD11 Air-Hardening Steel. It’s hardened under the room temperature.
SKD11 Specification：JIS-SKD11/AISI-D2/BS-BD2。
SKD11Specification(%)：
C-1.40~1.60，Si<=0.40，Mn-<=0.60，P<=0.03，S<=0.03，Cu<=0.25，Ni<=0.50，Cr-11.0~13.0，Mo-0.80~1.20，V-0.20~0.50。

**Vocabulary：**
Quenching
Changing point of iron metal is heated to 723 degrees Celsius, subjected to rapid cooling, such as into water or into the oil cooling. The crystal grains become fine, the hardness becomes higher as a treatment, hardened, the steel material becomes hard. The term: hard and brittle – In order to prevent breakage, it needs tempering process.
**Usage**: Enhance Hardness
Re-Heat-Treated
Because iron metal is having residual problem during quenching, we cool reheating quenched parts at temperature below the transformation point to impose oil-cooling or air-cooled so that the residual austenitic organization can be transformed into martensite. To avoid ferrous metal materials by Nazi fire occurred residual stress embrittlement problem.
Parts with a long time, the applied energy (cold) will form a "strain energy" left in the metal. This process is called: Dislocations changes that will lead to deterioration of the metal rigidity and ductility.
**Usage**: Enhance Toughness

Cooling
Ferrous metal by casting or forging or cold molding process to produce hardness is not easy. So the iron metal is heated to abnormal points or more, average temperature after slow cooling in the furnace of an iron metal heat treatment method. Annealed iron metal crystal grains coarse, low hardness, easy processing.

Purpose of Re-Heating：
1. Adjust the steel hardness after heat-treated.
2. Elimination of the steel after quenching stress generated
3. Enhance Steel Toughness
4. The generation of secondary carbide precipitation hardening phenomenon
Re-heating：
(1) Tempering at 500 ° C to a temperature range A1, mainly to enhance the toughness of the material-based, this process is also known as modulation (quenching the fire temperature after treatment). And some steel, because of its alloying elements, in some tempering temperature range, it will further precipitation of carbides and makes further increase hardness, this phenomenon is called secondary hardening, such as SKD11, SKD61, such as mold steel, SKH series, etc., high-speed steel having this feature.
(2) Tempering: tempering temperature of 150 to 200 degrees C. Its main function is to adjust the hardness of the main, and virtually eliminate the internal stress generated by quenching. (The higher the residual stress tempering temperature less) In general, the tempering cooling method after removal from the furnace is mostly based industrial fan blowing to cool it to allow natural cooling.
Tempering, depending on its tempering temperature dependent, the general principle is that as long as the color of the fire disappeared (600 degrees C) at 500 degrees or less, can be placed in the water, oil, or with fan forced cooling.

Table of Steel Heat Treatment Temperature and Hardness