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

鋼種		碳工具鋼				合金工具鋼								
鋼種記號		SK2	SK3	SK5	SK7	SKS2	SKS3	SKD1	SKD11	SKD12	SKD4	SKD6	SKD61	SKT4
退火溫度		770	790	800	800	780	790	850	850	850	820	850	850	770
淬火溫度		800	800	800	800	850	800	950	1030	970	1030	980	1020	850
Ms點(℃)		140	155	220	280	170	180	180	200	210	420	280	280	320
回火處理之硬度	150 ℃	65	65	64	63	63	65	64	63	63	53	55	52	60
	200 ℃	63	60	59	58	62	63	63	61	60	53	53	52	58
	250 ℃	62	58	57	55	60	62	62	59	58	53	53	52	58
	300 ℃	59	56	54	52	58	59	60	58	58	51	53	51	57
	350 ℃	57	55	53	50	56	56	58	57	57	49	53	53	54
	400 ℃	53	53	51	48	55	54	58	57	57	48	54	54	53
	450 ℃	47	47	46	45	52	51	56	58	57	48	55	54	51
	500 ℃	45	45	44	42	49	48	55	59	56	49	56	55	48
	550 ℃	37	38	37	35	46	46	50	56	54	51	54	54	45
	600 ℃	33	34	33	31	41	41	43	50	51	51	45	52	43
	650 ℃	29	28	27	26	35	33	34	45	43	48	36	42	38