

SeAH Changwon  
Integrated Special Steel



**SeAH** CSS



**TOOL &  
MOLD STEEL**



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SeAH CSS’s constant mission:  
Creating new value from steel  
for the world

Our constant mission is to open a door to the future of the global special steel industry.

From high-tech industries including power generation, petrochemicals and semiconductors to futuristic industries such as nuclear power and aerospace, SeAH CSS is growing into a leader in Stainless steel, Tool steel, and Ni-alloys.

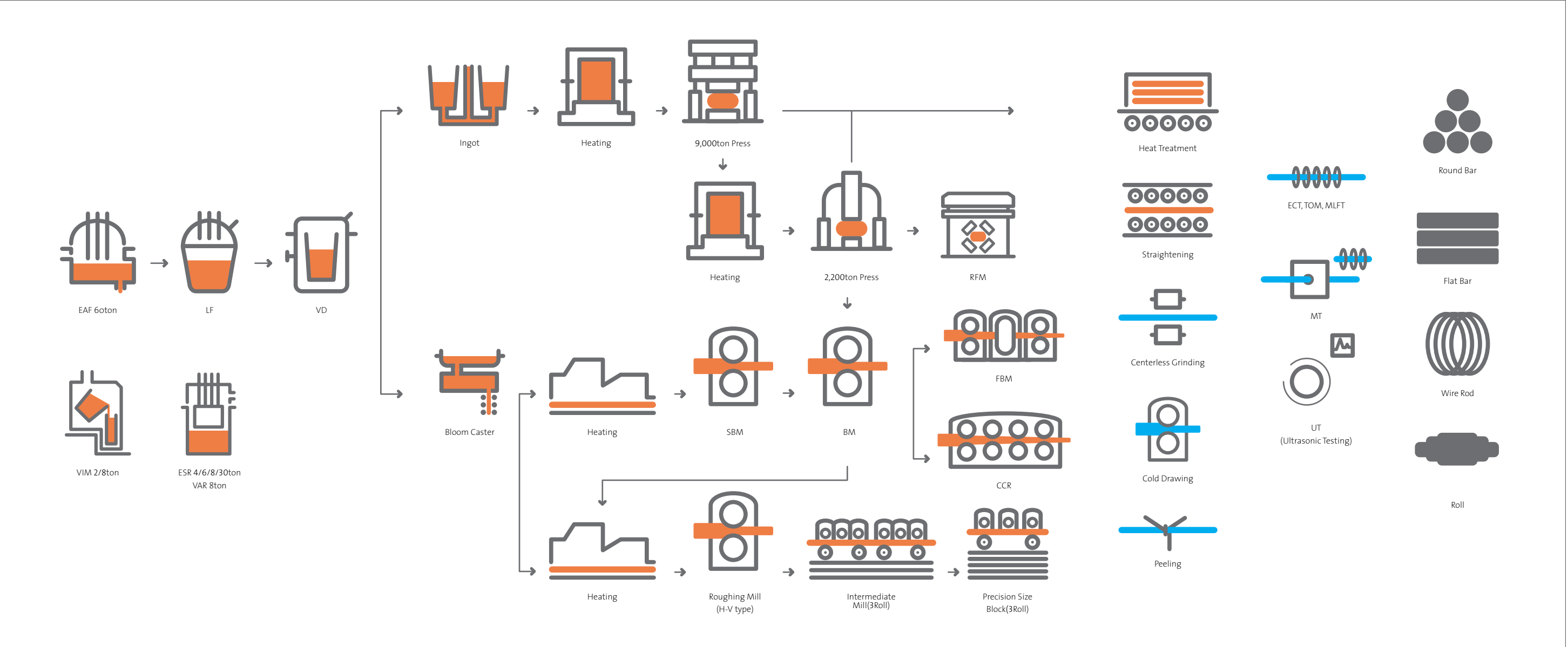
With our products, we aim to raise the level of customer satisfaction and set up the new industry standard by constantly challenging ourselves.



History

|         |                                                                                                                       |
|---------|-----------------------------------------------------------------------------------------------------------------------|
| 04/1966 | Founded as Samyang Special Steel Co., Ltd.                                                                            |
| 12/1977 | Completed a general special steel plant as Korea Specialty Steel Co., Ltd<br>(for round bars, steel pipes and plates) |
| 06/1982 | Changed its name to SAMMI General Special Steel Co., Ltd                                                              |
| 04/1991 | Opened its second special steel plant<br>(for steelmaking, rolling, processing)                                       |
| 02/1997 | Annexed to POSCO Group<br>(for round bars and pipe business)                                                          |
| 10/2006 | Completed the 1st phase of its facility rationalization<br>(AOD, HV Mill, Second acid cleaning plant and more)        |
| 02/2007 | Renamed Changed its name to POSCO Specialty Steel Co., Ltd                                                            |
| 04/2012 | Completed the 2nd phase of its facility rationalization<br>(6oton EAF, Bloom Caster, SBM and more)                    |
| 03/2015 | Acquired by SeAH Group and changed its name to SeAH Changwon Integrated Special Steel Co., Ltd                        |

# Manufacturing Process



EA



Ingot Casting



ESR



RFM



9,000ton Press



FBM



CCR



Furnace



# Cold Work Tool Steel\_STD11/SKD11[Equivalent to D2 (ASTM)& WNR1.2379 (DIN)]

H-Carbon and H-Chrome Steel provide extra hardness,excellent wear resistance and low dimensional change.

### Product Characteristics

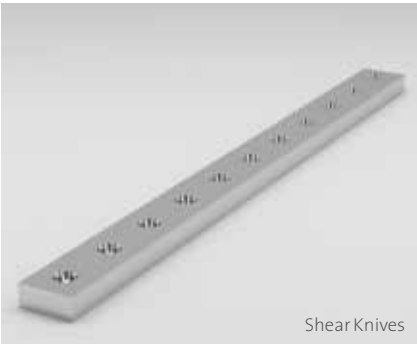
|                  |                             |                        |                  |                |
|------------------|-----------------------------|------------------------|------------------|----------------|
| High Cleanliness | Exceptional wear resistance | Uniform Microstructure | Uniform hardness | Extra hardness |
|------------------|-----------------------------|------------------------|------------------|----------------|

### Chemical Composition

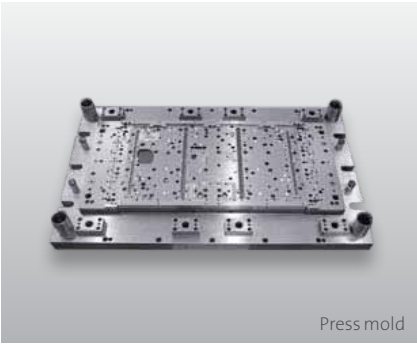
| Grade | Chemical composition rate (Wt, %) |      |      |      |      |      |      |      |
|-------|-----------------------------------|------|------|------|------|------|------|------|
|       | C                                 | Si   | Mn   | P    | S    | Cr   | Mo   | V    |
| STD11 | 1.40                              |      |      |      |      | 11.0 | 0.80 | 0.20 |
|       | 1.60                              | 0.40 | 0.60 | 0.03 | 0.03 | 13.0 | 1.20 | 0.50 |

### Applications

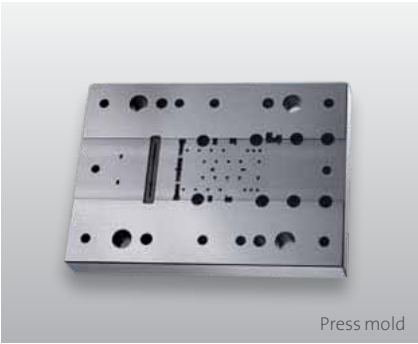
Applied to tool materials manufactured in a cold state.



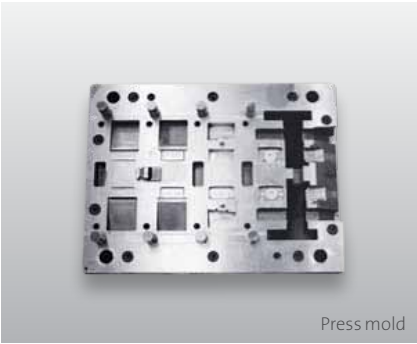
Shear Knives



Press mold



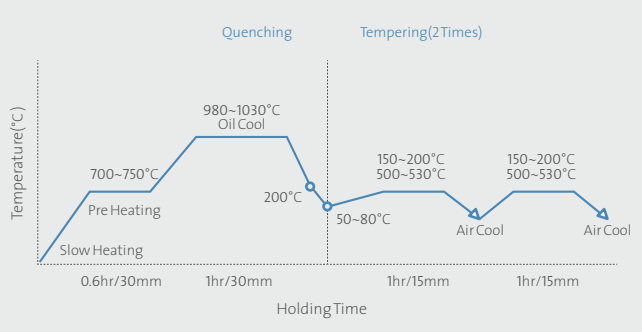
Press mold



Press mold

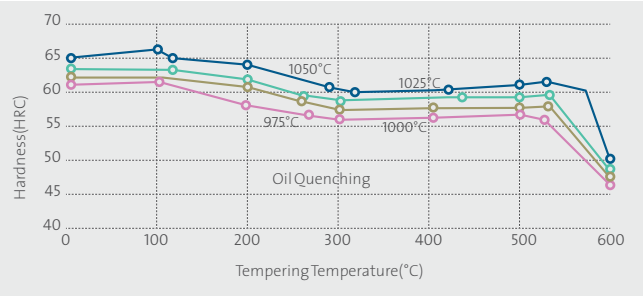
### Heat Treatment Conditions

#### Quenching and Tempering Heat Treatment Cycle



#### Distribution of Heat Treatment Hardness

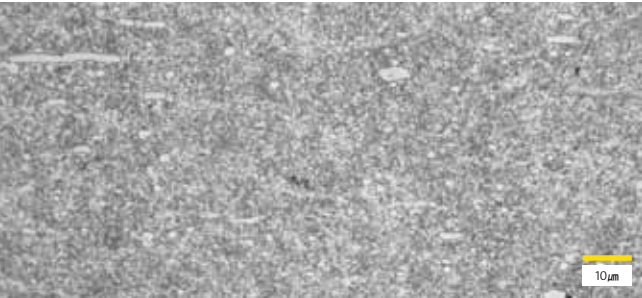
Quenching hardness:HRC 61 ~ 65 /2nd hardening occurs in the range of 400~530°C.



### Microstructures

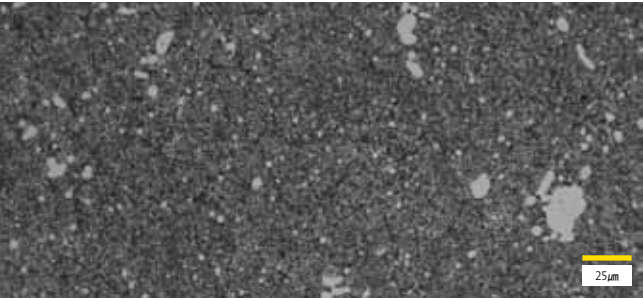
#### Spheroidizing Annealing

Spherical cementites and eutectic carbides in ferrite matrix

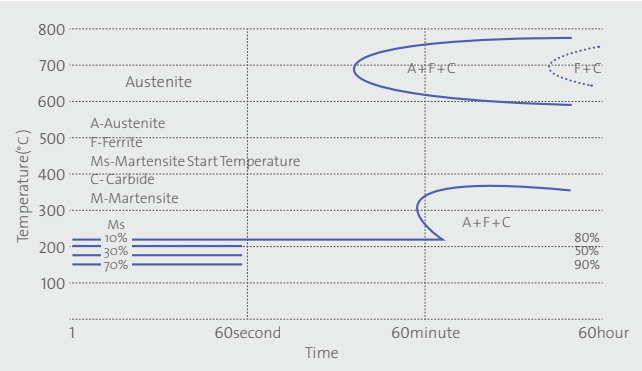


#### Quenching&Tempering

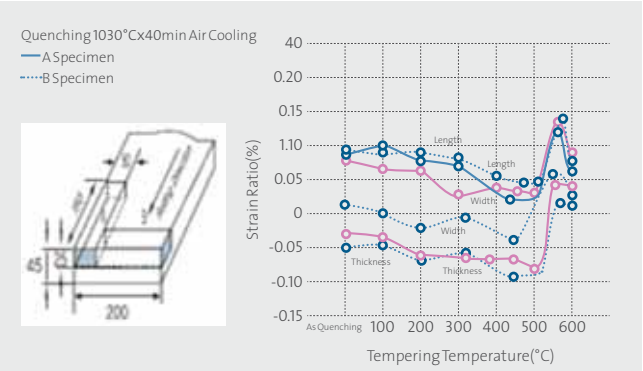
Tempered martensites and carbides



### TTT Curve



### Dimensional Change after Heat Treatment



# Cold Work Tool Steel for High Tension Steel Plate Processing\_TD1

Special elements are added for high tension steel plate processing. It provides extra hardness and wear resistance through Q/T heat treatment.

## Chemical Composition

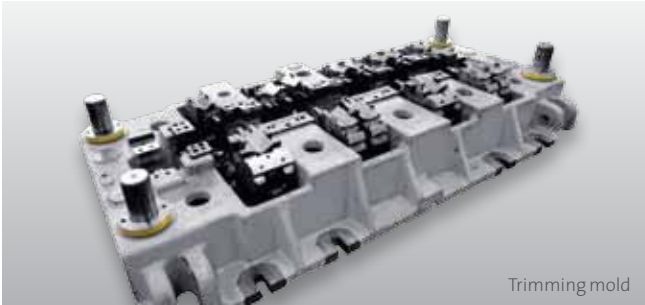
| Grade       | Chemical composition (Wt, %) |     |     |   |   |              |              |              |        |
|-------------|------------------------------|-----|-----|---|---|--------------|--------------|--------------|--------|
|             | C                            | Si  | Mn  | P | S | Cr           | Mo           | V            | Others |
| STD11       | 1.40<br>1.60                 |     |     |   |   | 11.0<br>13.0 | 0.80<br>1.20 | 0.20<br>0.50 | -      |
| TD1(Target) | 1.0                          | 1.0 | 0.6 |   |   | 8.0          | 1.3          | 0.2          | Add.   |

## Physical Properties

| Thermal expansion co-efficient(X 10 <sup>-6</sup> /°C) | Specific gravity (g/cm³) | Heat conductivity (W/m·K) | Elastic co-efficient |
|--------------------------------------------------------|--------------------------|---------------------------|----------------------|
| 11.6(27~100°C)<br>12.7(100~200°C)                      | 7.65                     | 26.7                      | 220                  |

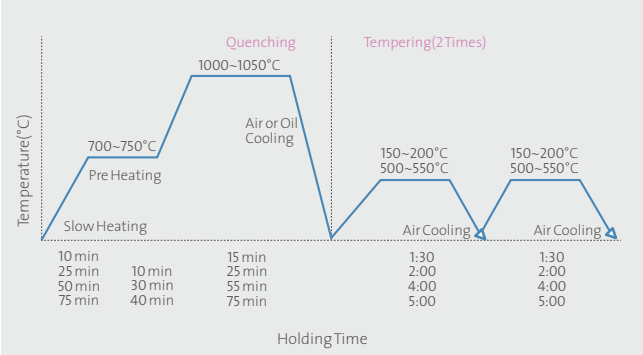
## Applications

Molds for manufacturing materials in cold state (Drawing / trimming mold for high tension steel plate).

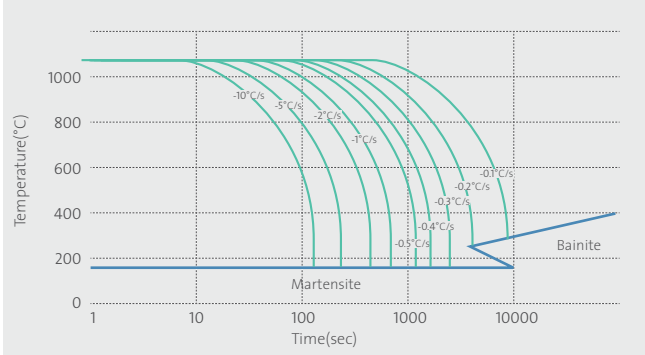


## QT heat treatment cycle

The same heat treatment applied to STD11 available.

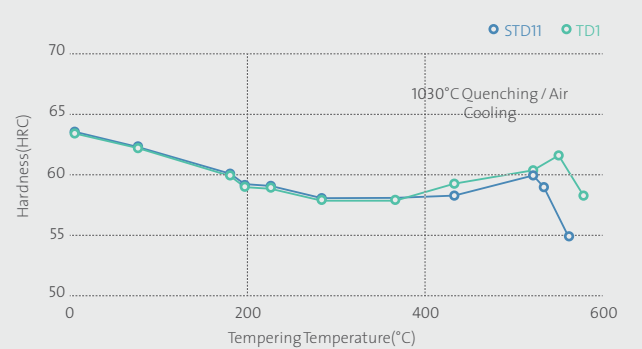


## CCT Curve



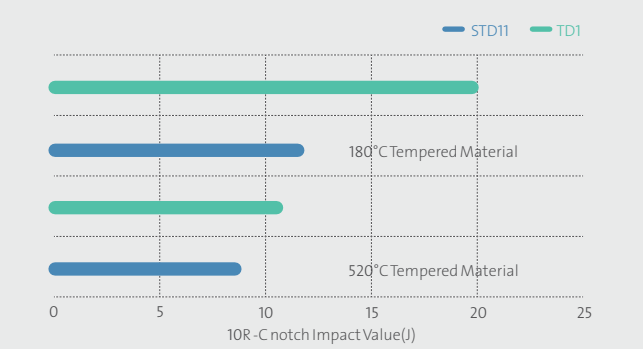
## Hardness Curves

Enhances its hardness with below 600°C tempering condition.



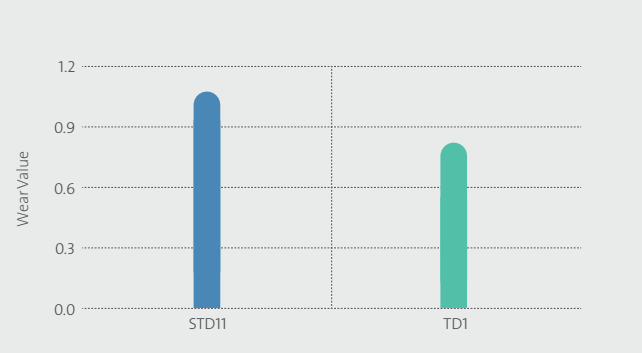
## Impact Toughness

- Enhances its impact toughness by reducing carbide extrusion.



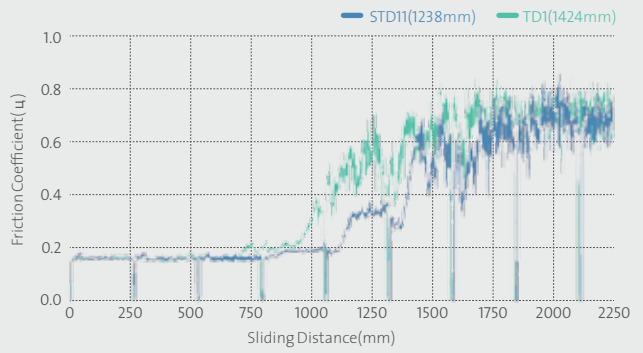
## Wear Resistance

Enhances its wear resistance performance by adding special alloy.



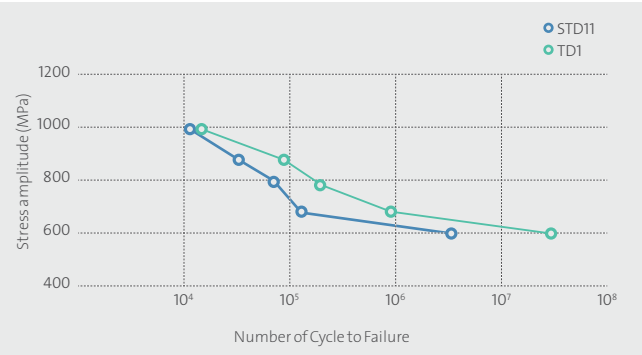
## Galling Resistance

Enhances its durability by restraining scratch on mold surface and galling.



## Fatigue Strength

Keeps the product durable by enhancing its fatigue strength.



## Applications

A test result provided by one of vehicle component manufacturers.

| Applicable molds    | STD11 durability enhancement rate | Work material |
|---------------------|-----------------------------------|---------------|
| Center Pillar Outer | 135%                              | DP980 1.6t    |
| Steel Wheel         | 165%                              | HR580/330Y-DP |
| Door Hinge          | 110%                              | HR340LA, 4.0t |

# Hot Work Tool Steel STD61/SKD61[Equivalent to H13 (ASTM), WNR1.2344 (DIN)]

Tools with extra red hardness and heat crack resistance, used for die casting and extrusion molds.

### Product Characteristics

|                                        |                                |                                    |                                                                   |                                                   |
|----------------------------------------|--------------------------------|------------------------------------|-------------------------------------------------------------------|---------------------------------------------------|
| Exceptional toughness and red hardness | Heat crack and wear resistance | Anti-heat treatment transformation | Suitable for hot die casting molds with its high Vanadium content | Suitable for Aluminum and Magnesium Pressing Dies |
|----------------------------------------|--------------------------------|------------------------------------|-------------------------------------------------------------------|---------------------------------------------------|

### Chemical Composition

| Grade | Chemical composition (Wt, %) |      |      |      |      |      |      |      |
|-------|------------------------------|------|------|------|------|------|------|------|
|       | C                            | Si   | Mn   | P    | S    | Cr   | Mo   | V    |
| STD61 | 0.35                         | 0.80 | 0.25 |      |      | 4.80 | 1.00 | 0.80 |
|       | 0.42                         | 1.20 | 0.50 | 0.03 | 0.02 | 5.50 | 1.50 | 1.15 |

### Physical Properties

| Thermal expansion co-efficient (X 10 <sup>-6</sup> /°C) | Specific gravity (g/cm <sup>2</sup> ) | Heat conductivity (W/m·K) | Young's modulus (GPa) |
|---------------------------------------------------------|---------------------------------------|---------------------------|-----------------------|
| 12.5(25~200°C)                                          | 7.8                                   | 24(20°C)                  | 205                   |

### Applications

Molds for manufacturing materials in a hot state.



Extrusion mold



Extrusion mold

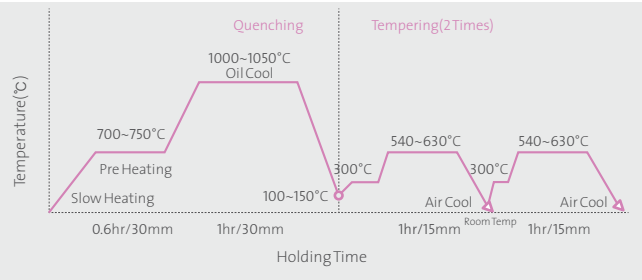


Die-casting mold

### Heat Treatment Conditions

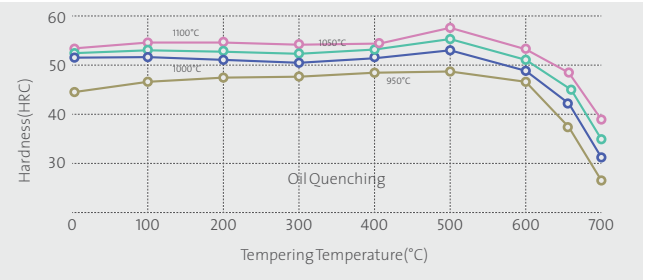
#### Quenching and Tempering Heat Treatment Cycle

A tempering temperature is set higher (+25 to 50°C) than the operative temperature.



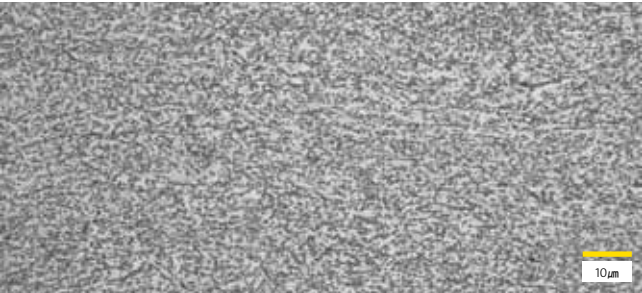
#### Distribution of Heat Treatment Hardness

When the temperature of a solid solution rises, its hardness increases as well. The 2ndhardening occurs in the range from 400 to 530°C



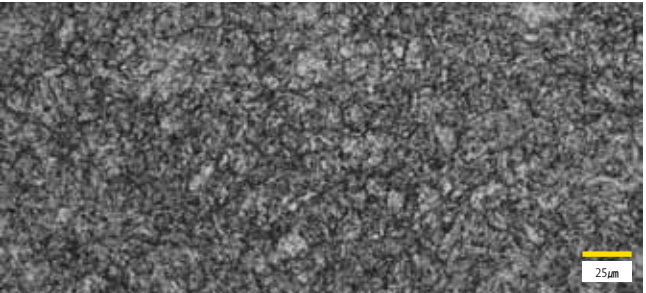
### Microstructure

#### Spheroidizing Annealing



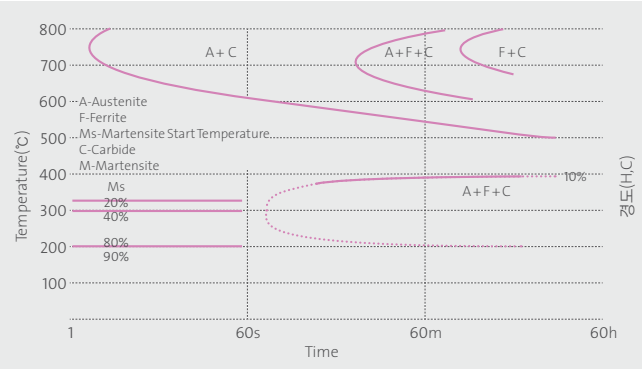
Spherical cementites in ferrite matrix

#### Quenching & Tempering

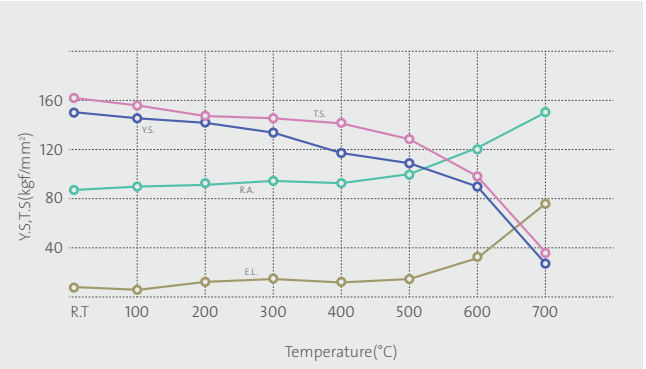


Tempered martensites

### TTT Curve



### High Temperature Material Properties



# Hot Work Tool Steel for Die Casting\_DC1

Durable tool steels with added special elements help enhance productivity.They can be applied to large molds as well.

## Chemical Composition

| Grade       | Chemical composition (Wt, %) |      |      |      |      |      |      |        |
|-------------|------------------------------|------|------|------|------|------|------|--------|
|             | C                            | Si   | Mn   | P    | S    | Cr   | Mo   | Others |
| STD61       | 0.35                         | 0.80 | 0.25 | 0.03 | 0.02 | 4.80 | 1.00 | -      |
|             | 0.42                         | 1.20 | 0.50 |      |      | 5.50 | 1.50 |        |
| DC1(target) | 0.4                          | 0.6  | 0.6  |      |      | 5.0  | 1.3  | Add.   |

## Physical Properties

| Temperature | Thermal expansion co-efficient (X 10 <sup>-6</sup> /°C) | Heat conductivity (W/m·K) |
|-------------|---------------------------------------------------------|---------------------------|
| 25°C        | 11.5                                                    | 30.7                      |
| 700°C       | 14.1                                                    | 29.1                      |

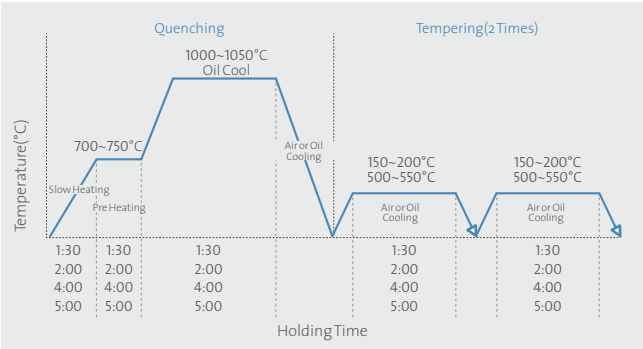
## Applications

Hot tool steels for large scale die casting with extra toughness.



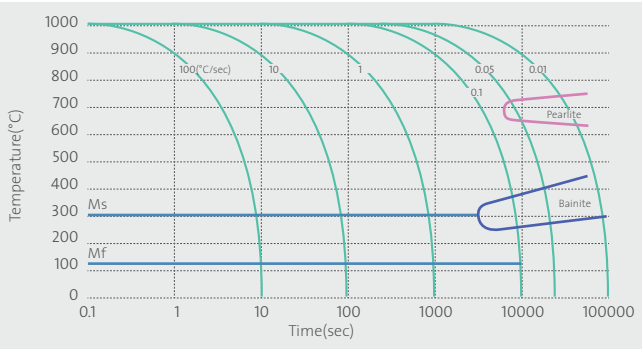
## Heat Treatment Conditions

The same heat treatment applied to STD61 available.



## CCT Curve

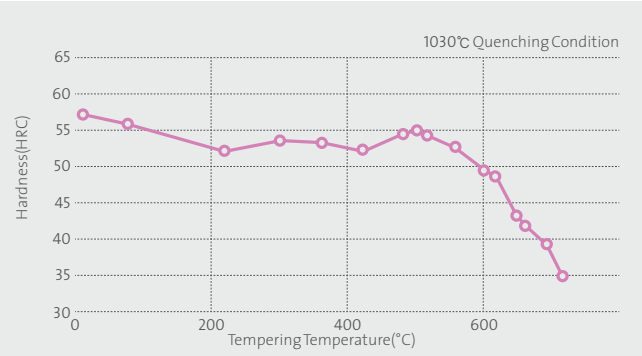
Quenching Temperature :1030°C



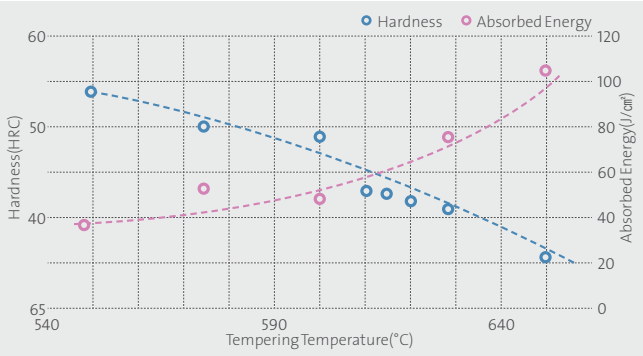
## Mechanical Properties

- Extra hardness guaranteed during heat treatment.
- Excellent balance between hardness and impact toughness

### Hardness Curve(HRC)

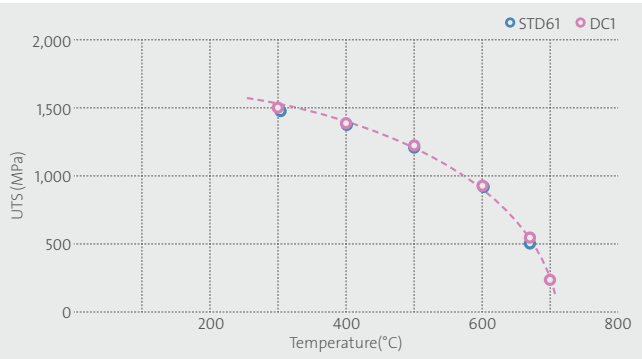


### Impact Toughness



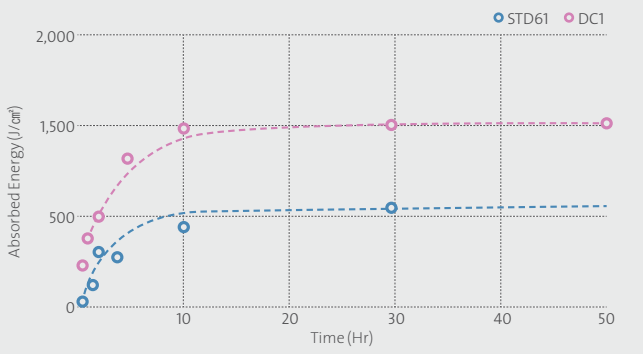
## High Temperature Strength

- Enhances RA(Reduction of Area) rate.



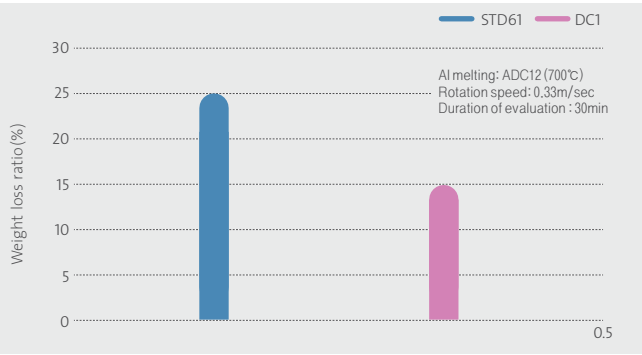
## Temper Softening Resistance (Exposed to a temperature of 650°C)

- Enhances impact toughness and temper softening resistance through grain refinement at 650°C(die casting Al molten metal requirement).



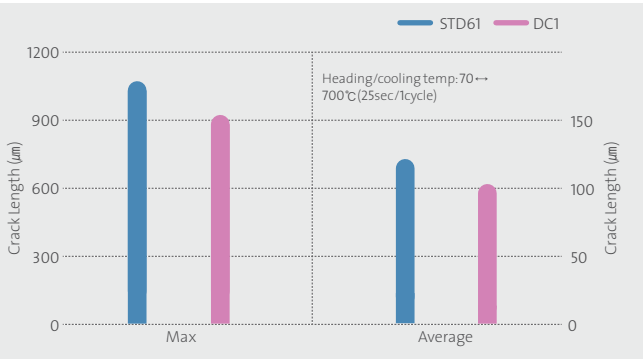
## Erosion Properties

- Enhances anti-erosion Properties by optimizing alloying elements with Al molten metal.



## Heat Crack Properties

- Reduces cracks through thermal stress.



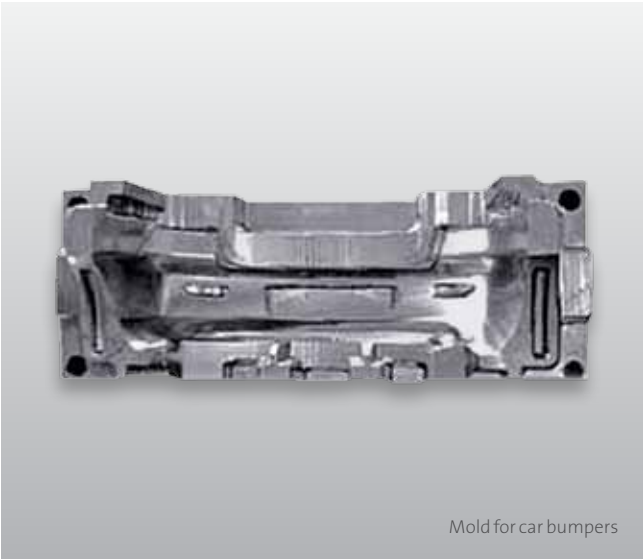
# Plastic Mold Steel\_TP1,TP4,TP4M

Steel materials used for molds that are utilized to inject molds.

## Chemical Composition

| SeAH<br>CSS | JIS           | AISI          | DIN             | Chemical composition (Wt, %) |              |              |       |       |              |              |              | Applications                                                                                                                            |
|-------------|---------------|---------------|-----------------|------------------------------|--------------|--------------|-------|-------|--------------|--------------|--------------|-----------------------------------------------------------------------------------------------------------------------------------------|
|             |               |               |                 | C                            | Si           | Mn           | P     | S     | Ni           | Cr           | Mo           |                                                                                                                                         |
| TP1         |               |               |                 | 0.50<br>0.55                 | 0.35         | 0.90         | 0.03  | 0.02  | -            | -            | -            | Molds for general merchandise, base materials for precision parts                                                                       |
| TP4         | SCM improved  | 4140 improved | 1.2311 improved | 0.26<br>0.43                 | 0.15<br>0.35 | 0.80<br>1.15 | 0.025 | 0.020 | 0.45         | 0.90<br>1.50 | 0.20<br>0.30 | Car bumper molds, radiator grills, OA equipment, cabinets, back covers of TVs and PCs, molds for consumer electronics and more          |
| TP4M        | SNCM improved | P20 improved  | 1.2738 improved | 0.26<br>0.37                 | 0.15<br>0.35 | 0.80<br>1.00 | 0.025 | 0.020 | 0.55         | 1.65<br>2.10 | 0.40<br>0.50 | High end car bumper molds, radiator grills, OA equipment, cabinets, back covers of TVs and PCs, molds for consumer electronics and more |
|             |               |               | 1.2311          | 0.35<br>0.45                 | 0.20<br>0.40 | 1.30<br>1.60 | 0.035 | 0.035 | -            | 1.80<br>2.10 | 0.15<br>0.25 |                                                                                                                                         |
|             |               |               | 1.2738          | 0.35<br>0.45                 | 0.20<br>0.40 | 1.30<br>1.60 | 0.035 | 0.035 | 0.90<br>1.20 | 1.80<br>2.10 | 0.15<br>0.25 |                                                                                                                                         |
|             |               |               | 1.2312          | 0.35<br>0.45                 | 0.30<br>0.50 | 1.40<br>1.60 | 0.030 | 0.100 | -            | 1.80<br>2.00 | 0.15<br>0.25 |                                                                                                                                         |
|             |               |               | 1.2714          | 0.50<br>0.60                 | 0.10<br>0.40 | 0.65<br>0.95 | 0.030 | 0.030 | 1.50<br>1.80 | 1.00<br>1.20 | 0.45<br>0.55 |                                                                                                                                         |

## Applications

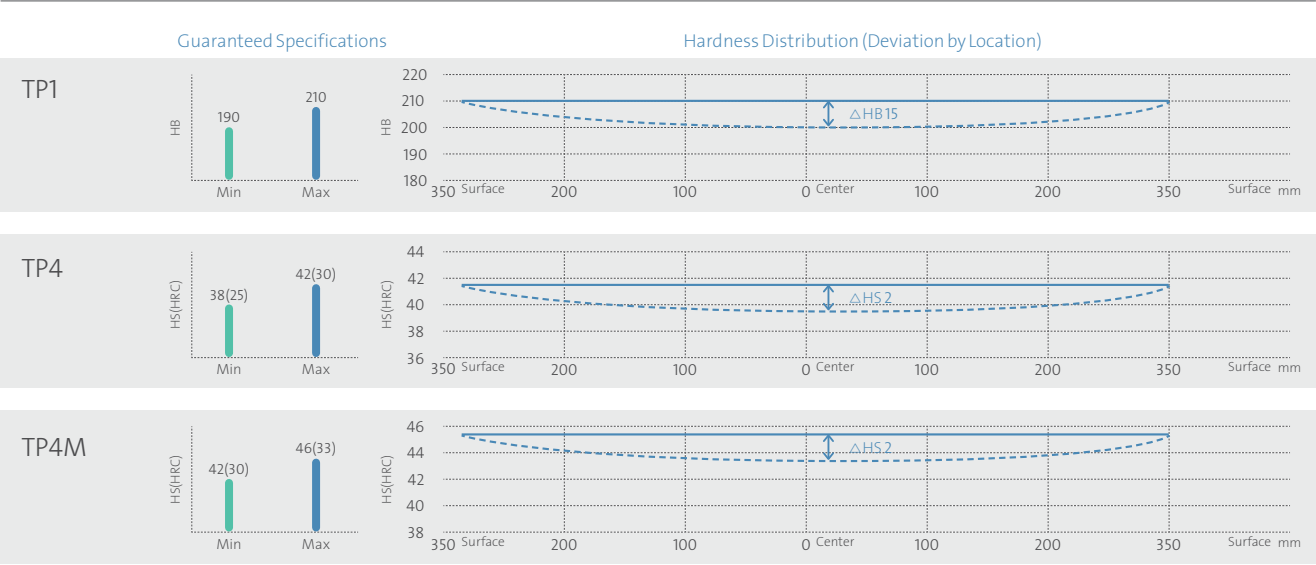


Mold for car bumpers



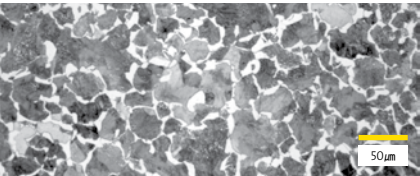
Mold for car head lamps

## Hardness Distribution



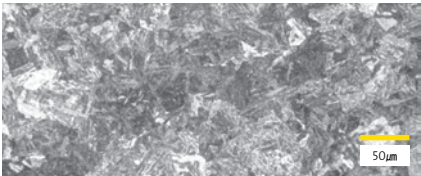
## Microstructures

TP1 [Nor.+Temp]



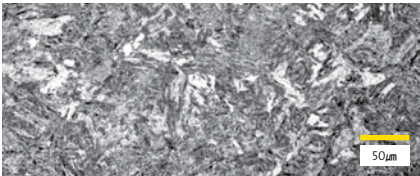
Pearlite+Ferrite

TP4 [Nor.+Qu.+Double Temp.]



Tempered Martensite

TP4M [Nor.+Qu.+Double Temp.]



Tempered Martensite

## Thermal Expansion Co-efficient

| (Unit: 10 <sup>-6</sup> /°C) |      |      |      |
|------------------------------|------|------|------|
| Temperature                  | TP1  | TP4  | TP4M |
| 20~100°C                     | 7.4  | 11.2 | 11.8 |
| 20~200°C                     | 10.9 | 11.8 | 12.3 |
| 20~300°C                     | 12.1 | 12.4 | 12.9 |
| 20~400°C                     | 13.0 | 13.0 | 13.4 |
| 20~500°C                     | 13.7 | 13.6 | 14.0 |
| 20~600°C                     | 14.3 | 13.8 | 14.2 |

# High Gloss Precision Plastic Mold Steel\_ SMAT1

High gloss precision plastic mold material with high cleanliness and uniform structure.

## Product Characteristics

| Polishability | Impact toughness | Machinability | High cleanliness |
|---------------|------------------|---------------|------------------|
|---------------|------------------|---------------|------------------|

## Chemical Composition

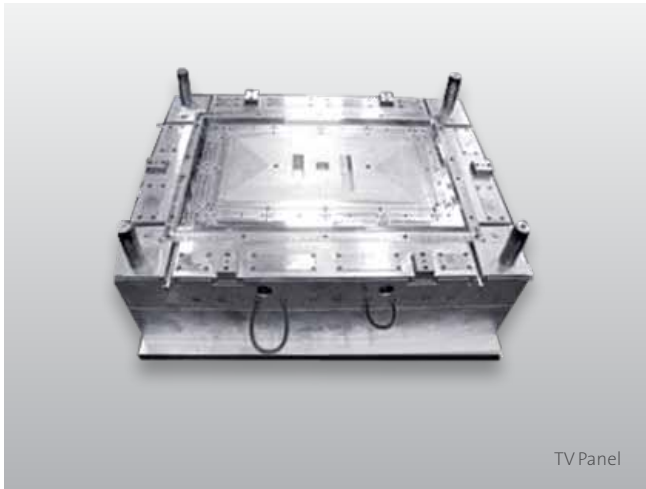
| Grade         | Chemical composition (Wt, %) |              |              |              |              |              |              |        |
|---------------|------------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------|
|               | C                            | Si           | Mn           | Cr           | Ni           | Al           | V            | Others |
| P21           | 0.18<br>0.22                 | 0.20<br>0.40 | 0.20<br>0.40 | 0.20<br>0.30 | 3.90<br>4.25 | 1.05<br>1.25 | 0.15<br>0.25 | -      |
| SMAT1(target) | 0.1                          | 0.3          | 1.5          | 0.8          | 3.0          | 1.0          | -            | Add.   |

## Mechanical Properties

| Grade | Yield strength<br>[N/mm²] | Tensile strength<br>[N/mm²] | Elongation<br>[%] | Cross-section reduc-<br>tion[%] | Hardness<br>[HRC] | Impact toughness<br>[J/cm²] |
|-------|---------------------------|-----------------------------|-------------------|---------------------------------|-------------------|-----------------------------|
| SMAT1 | 1,000~1,200               | 1,100~1,300                 | >14               | >45                             | 37~41             | >45                         |

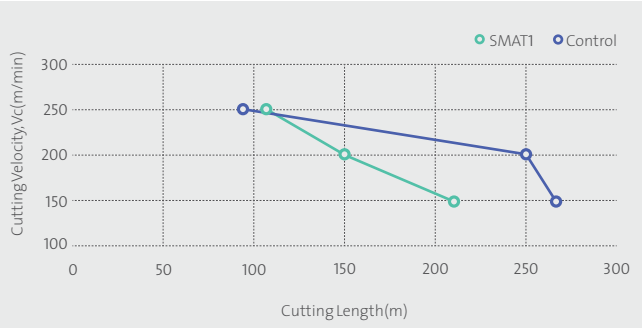
## Applications

- High gloss molds for mobile phone cases, consumer electronics, OA machines, automobile parts (headlamps, fog lights).
- High gloss TV front panels and high precision plastics.

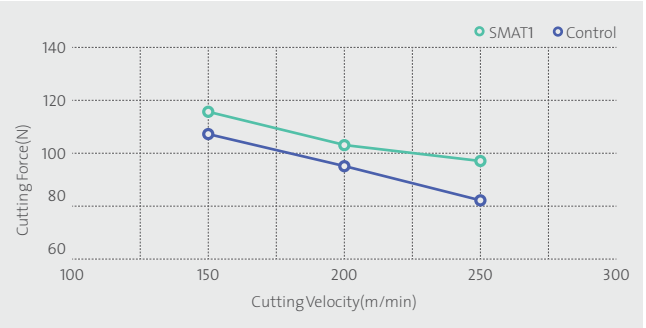


## Machinability

- Excellent end-mill Machinability
- Through put Based on Cutting Speed



## Cutting Force Measurement Result

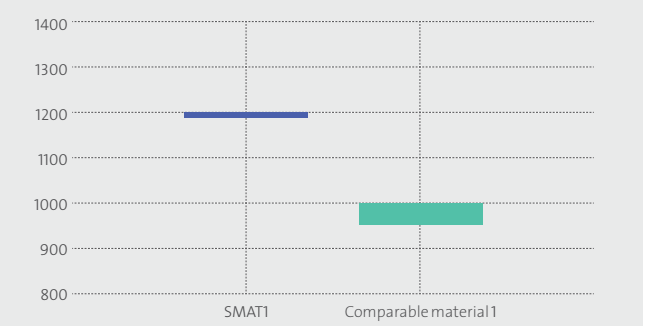


## Polishability

- No pit or wave mark formed after lapping (#1200).
- SMAT1's Polishability

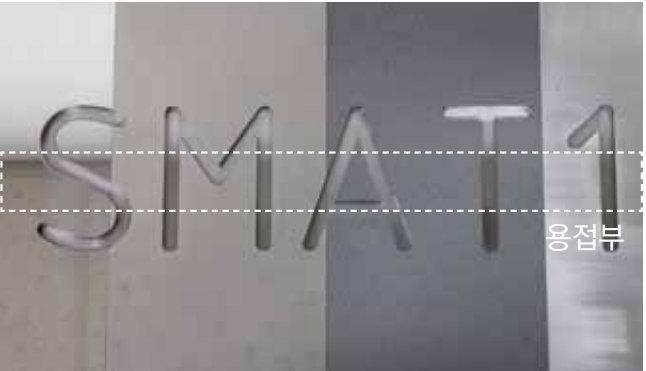
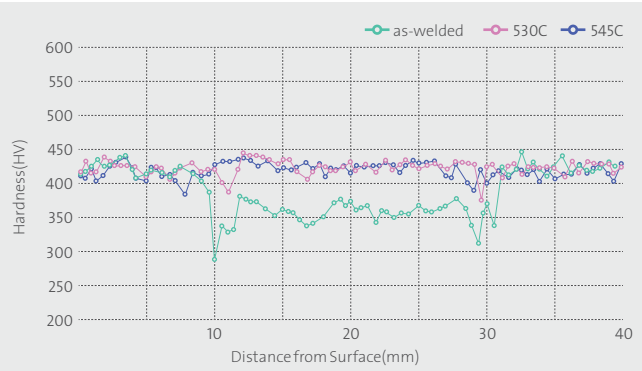


## Glossiness Measurement Result



## Weldability

- No weld line formed after lapping due to its outstanding recovering ability.



# Precision Plastic Mold Steel with Excellent Machinability\_SMAT E

High gloss precision plastic mold materials that have excellent workability and polishability through special refining and heat treatment technics.

## Product Characteristics

|                         |               |                  |                  |
|-------------------------|---------------|------------------|------------------|
| Excellent Machinability | Polishability | Impact toughness | High cleanliness |
|-------------------------|---------------|------------------|------------------|

## Chemical Composition

| Grade  | Chemical composition (Wt, %) |              |              |              |              |        |
|--------|------------------------------|--------------|--------------|--------------|--------------|--------|
|        | C                            | Si           | Mn           | Cr           | Mo           | Others |
| P20    | 0.28<br>0.40                 | 0.20<br>0.80 | 0.60<br>1.00 | 1.40<br>2.00 | 0.30<br>0.55 | -      |
| SMAT E | 0.25                         | 0.25         | 1.5          | 1.4          | 0.6          | Add.   |

## Mechanical Properties

| Grade  | Yield strength<br>[N/mm²] | Tensile strength<br>[N/mm²] | Elongation<br>[%] | Cross-section reduc-<br>tion[%] | Hardness<br>[HRC] | Impact toughness<br>[J/cm²] |
|--------|---------------------------|-----------------------------|-------------------|---------------------------------|-------------------|-----------------------------|
| SMAT E | 1,000~1,200               | 1,100~1,300                 | >14               | >45                             | 37~41             | >45                         |

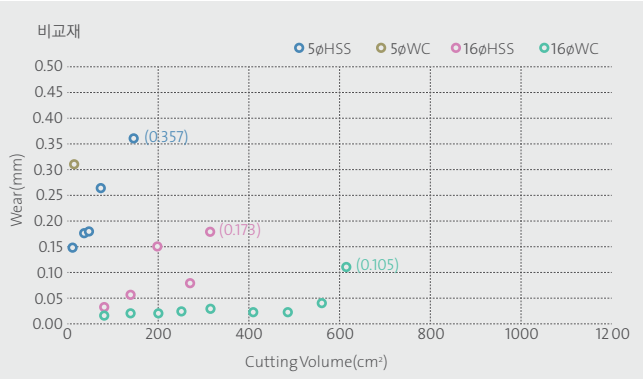
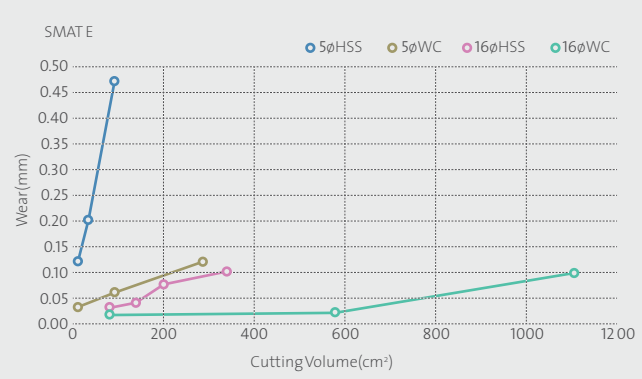
## Applications

Molds for high polishability/gloss injection(i.e.TV panels),molds for precision injection requiring complicated shaping process,and rubber molds requiring numerous machine processing operations(electric/electronic parts).



## Machinability

End Mill  
-Excellent in End-mill Machinability

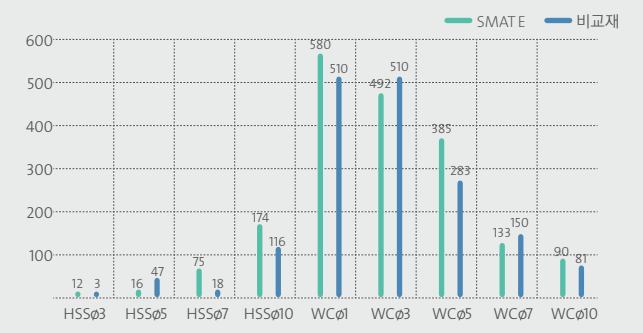


Gun Drill Drilling  
-Excellent in gun-drill machinability.

| 구분     | φ30 |      |      | φ18 |      |      | φ10   |      |      | φ5    |      |      |
|--------|-----|------|------|-----|------|------|-------|------|------|-------|------|------|
|        | RPM | FEED | 가공율수 | RPM | FEED | 가공율수 | RPM   | FEED | 가공율수 | RPM   | FEED | 가공율수 |
| SMAT E | 389 | 30   | 9EA  | 800 | 40   | 6EA  | 1,400 | 50   | 6EA  | 3,000 | 24   | 27EA |
| 비교재    | 389 | 30   | 0EA  | 800 | 40   | 1EA  | 1,400 | 50   | 1EA  | 3,000 | 12   | 1EA  |

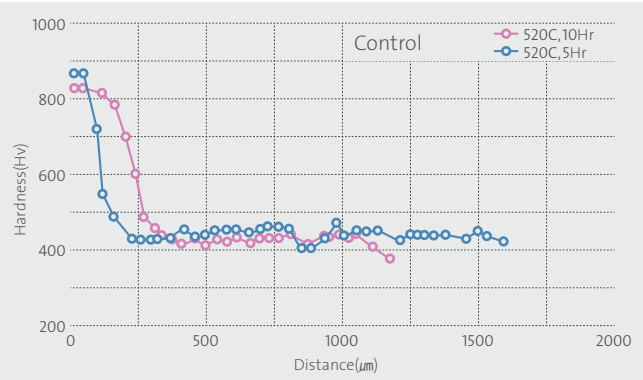
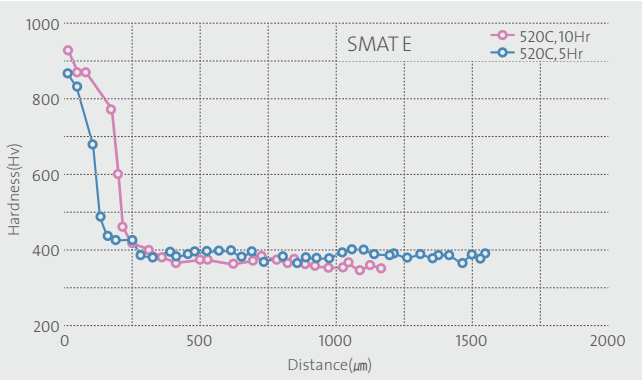
(단위 rpm, m/min, ea)

After measuring processed holes based on the tool's quality and size, SMAT E stays at about the same or the higher level than the control material shown in the figure.



## Nitriding Properties

As shown in the figure, '520°C, 5Hr' values prove that they have an outstanding nitriding quality. Their nitriding depth is about 0.2μm and initial hardness is about 880Hv.



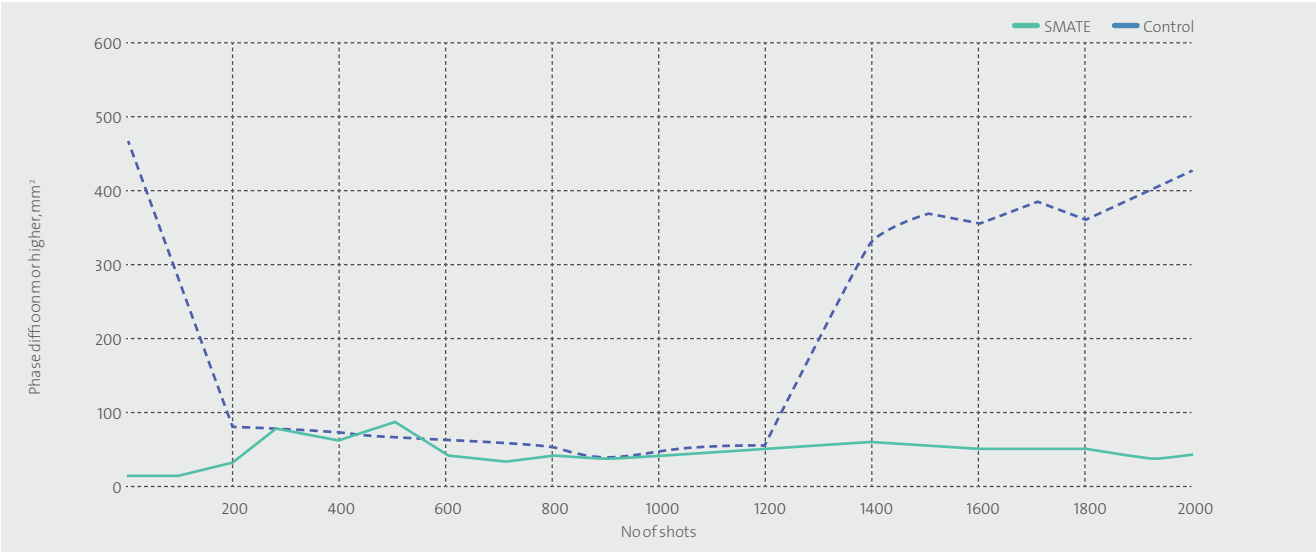
# Precision Plastic Mold Steel with Excellent Machinability\_ SMAT E

### Applications

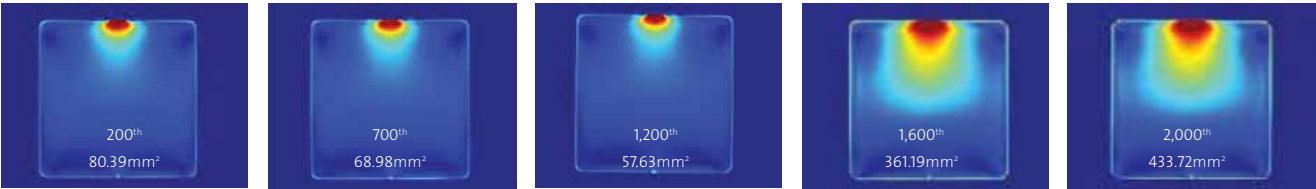
| Application area | Measurement items                                                                                                             |
|------------------|-------------------------------------------------------------------------------------------------------------------------------|
| Lens core mold   | - Injection mold (double refraction analysis and measurement)<br>- Core damage measurement after giving shots for 2,000 times |

### Measurement of Double Refraction after Injection

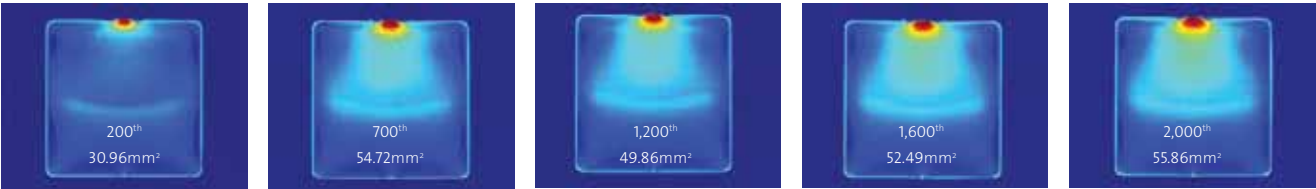
- SMAT E’s double refraction rate is more constant and shows less deviation than the control material.



Control Material



SMAT E

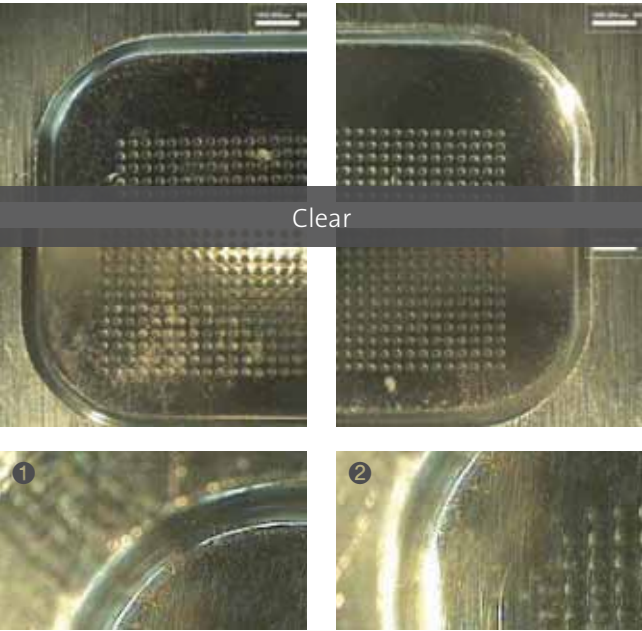


\* Measurement Range: More than 110 nm. A range from red to yellow.

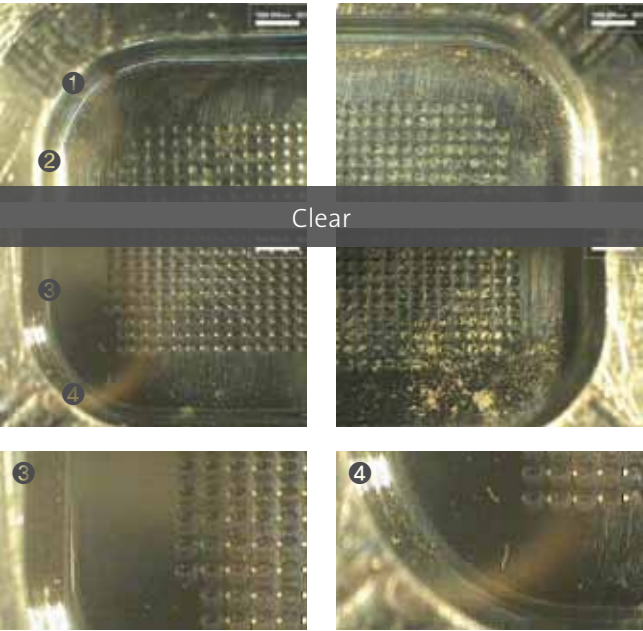
### Mold Damage Observation

- SMAT E’s surface still shows satisfactory condition after giving shots for 2,000 times.

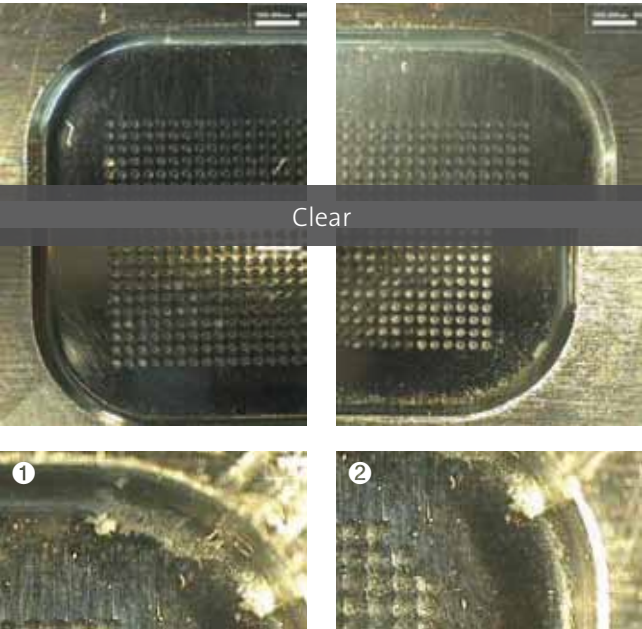
SMAT E’s Upper Core



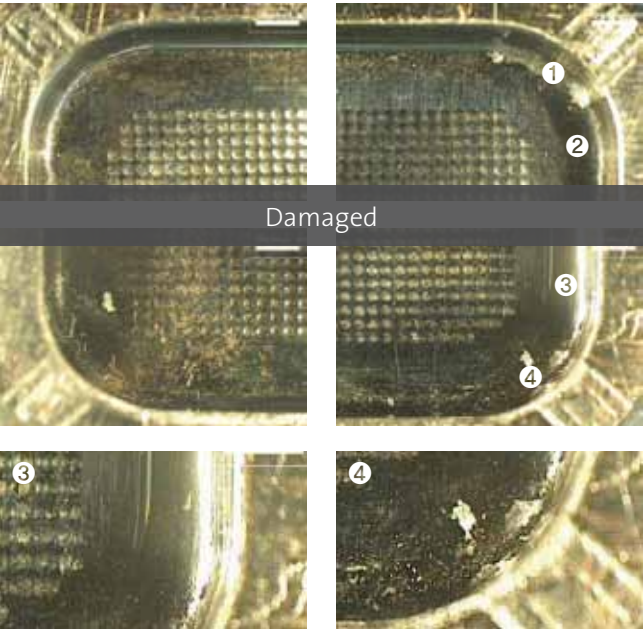
SMAT E’s Bottom Core



Control Material’s Upper Core



Control Material’s Bottom Core



# Flame Hardened Tool Steel\_ PST23F85

By utilizing flame, the flame hardened tool steel is produced through surface hardening heat treatment. This tool steel's hardenability can be increased by adding Cr and Mn.The addition of Si also leads to enhance its hardenability.Furthermore, the portion of the C is a factor to control its hardness.

## Product Characteristics

|                                                        |                                                  |
|--------------------------------------------------------|--------------------------------------------------|
| Cost can be saved through flame surface heat treatment | High strength and wear resistance at the surface |
|--------------------------------------------------------|--------------------------------------------------|

## Chemical Composition

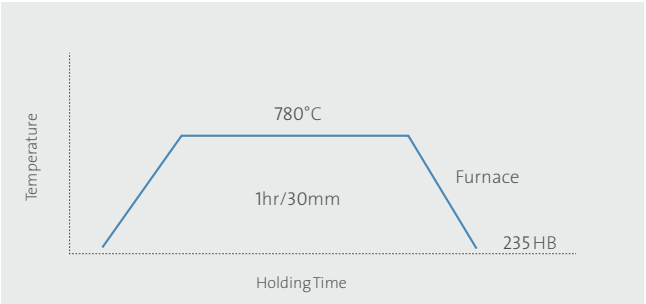
| Grade    | Chemical Composition (Wt, %) |      |      |      |      |
|----------|------------------------------|------|------|------|------|
|          | C                            | Si   | Mn   | Cr   | Mo   |
| PST23F85 | 0.80                         | 0.80 | 0.70 | 1.80 | 0.20 |
|          | 0.90                         | 1.20 | 1.10 | 2.20 | 0.30 |

## Applications

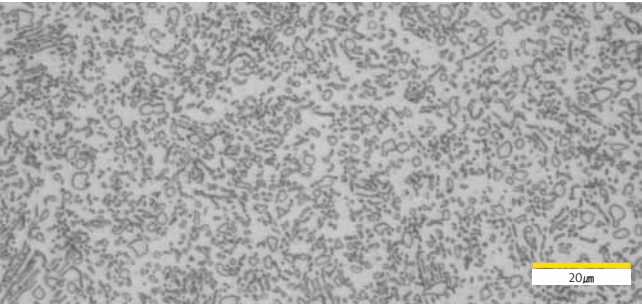
Molds for automobile parts,blanking dies,forming dies,trimming dies,and shear blades



## Spheroidizing Annealing

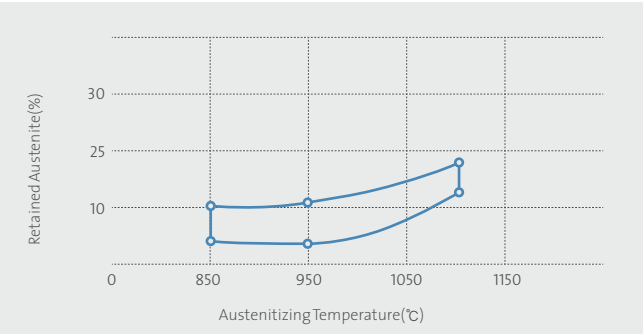
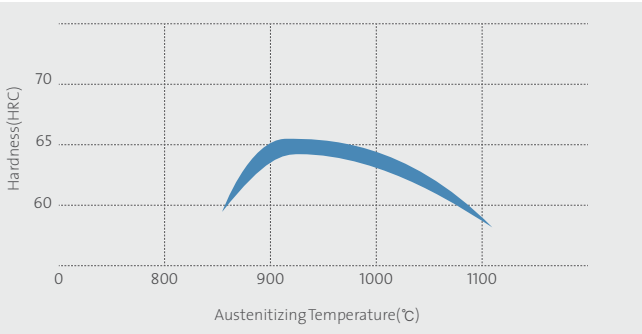


## Microstructure

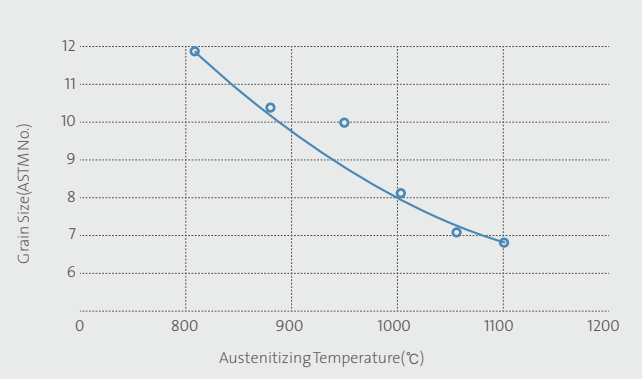


## Hardness and Retained Austenite Distribution Based on the Flame Temperature

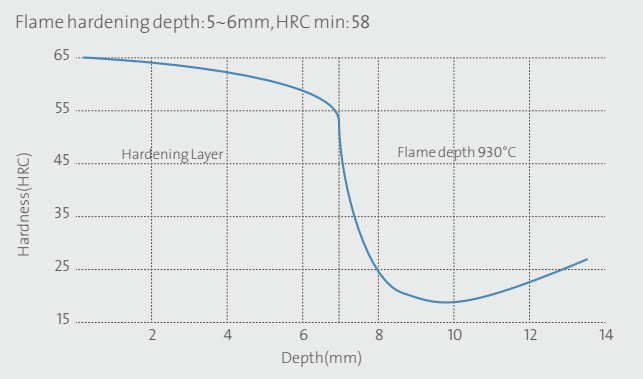
HRC distribution ranges from 62 to 65 in the temperature of 900~950°C. Hardness lowered between 1,000~1,100°C due to increasing retained Austenite content.



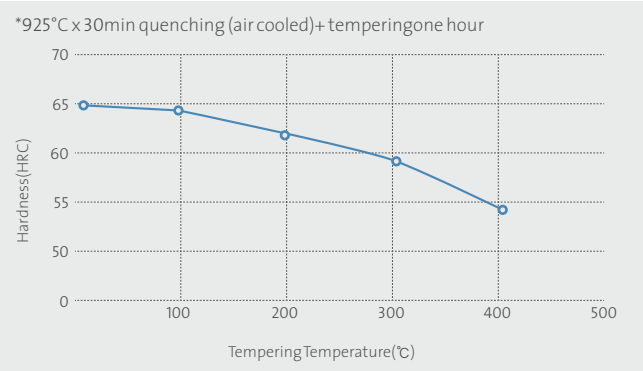
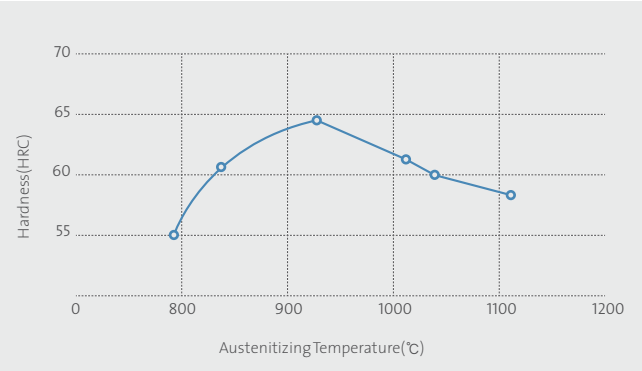
## Grain Size Based on Flame Temperature



## Hardening Depth



## Quenching and Tempering Heat Treatment Properties



# Pre-hardened Tool Steel\_ SKT4(V)

Provided as in the condition of Q/T heat treated. Mold machining customer can use material as mold without additional heat treatment.

## Product Characteristics

|                         |                                |                            |                  |
|-------------------------|--------------------------------|----------------------------|------------------|
| Excellent Machinability | Outstanding thermal resistance | Impressive wear resistance | Uniform hardness |
|-------------------------|--------------------------------|----------------------------|------------------|

## Chemical Composition

| Grade  | Chemical composition (Wt,%) |      |      |      |      |      |      |
|--------|-----------------------------|------|------|------|------|------|------|
|        | C                           | Si   | Mn   | Ni   | Cr   | Mo   | V    |
| SKT4   | 0.50                        | 0.10 | 0.60 | 1.50 | 0.80 | 0.35 | 0.05 |
|        | 0.60                        | 0.40 | 0.90 | 1.80 | 1.20 | 0.55 | 0.15 |
| SKT4V* | 0.55                        | 0.35 | 0.80 | 1.50 | 1.10 | 0.33 | 0.18 |

(\*) Upgraded version of SKT4: Higher resistance to abrasion and heat

## Applications

Tools for shaping materials in a hot state.



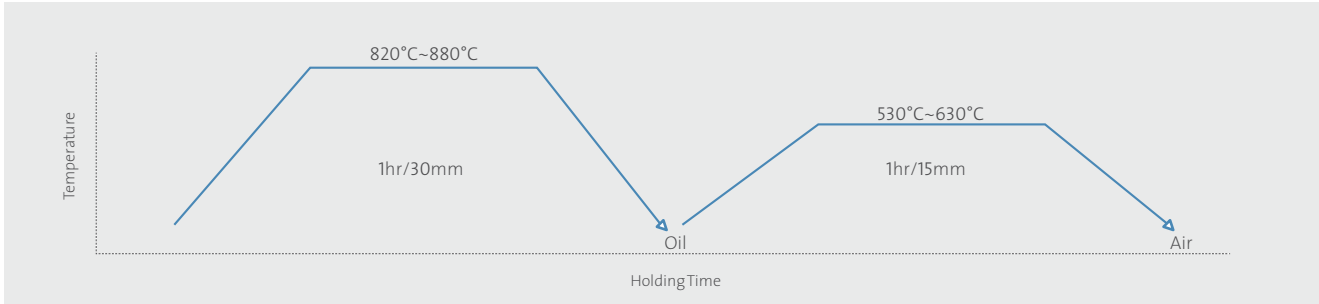
Hot Pressing Dies



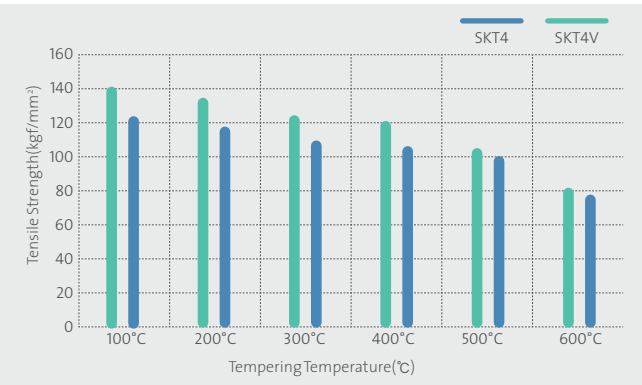
Hot Pressing Dies

- \* Dies for form forging
- \* Extrusion dies
- \* Press molds
- \* Die casting dies

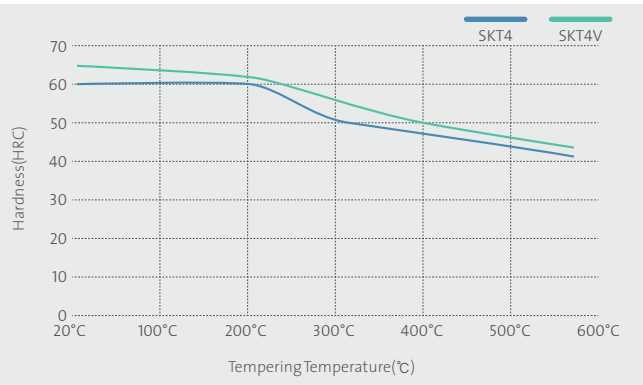
## Heat Treatment Conditions for Quenching & Tempering



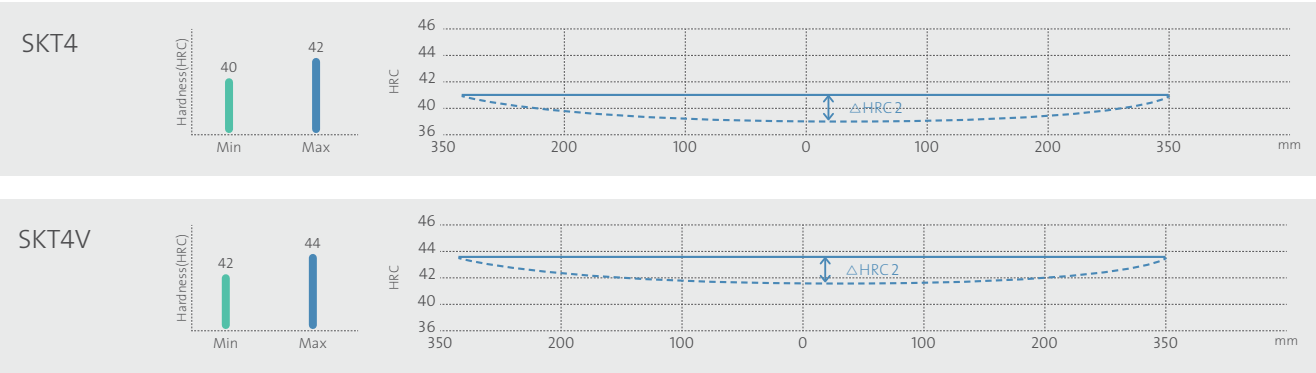
## Tensile Strength Based on Tempering temperatures



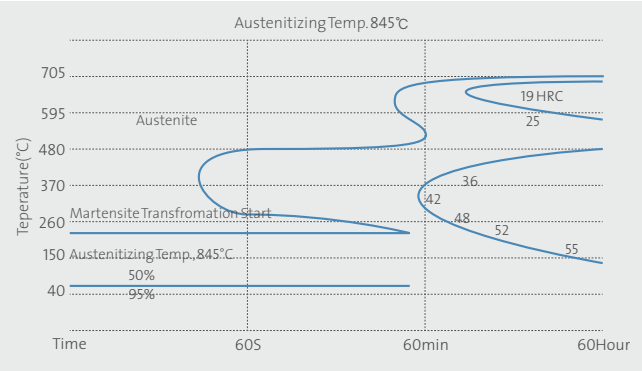
## Determining Hardness at High Temperatures



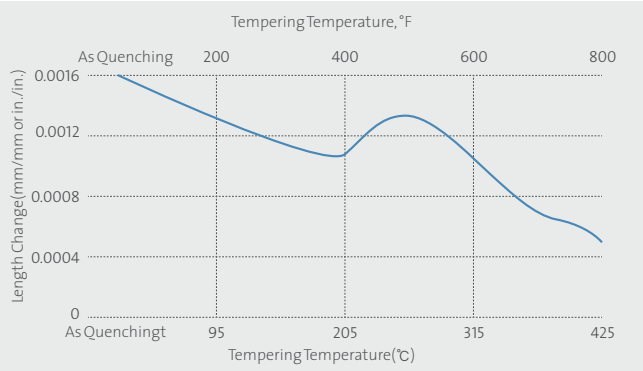
## Hardness Distribution



## TTT Curve



## Dimension Change



# Forged Rolls

Work rolls used for cold rolling mills that press steel plates applied to automobiles and electronic products.

## Chemical Composition

| Grade     | Chemical composition (Wt, %) |      |      |      |      |      |      |
|-----------|------------------------------|------|------|------|------|------|------|
|           | C                            | Si   | Mn   | Ni   | Cr   | Mo   | V    |
| PSTR-12   | 1.50                         | 0.50 | 0.50 | 0.20 | 12.0 | 1.00 | 0.80 |
| PSTR-2    | 0.50                         | 1.10 | 0.40 | 0.20 | 5.00 | 1.30 | 0.60 |
| PSTR3505C | 0.90                         | 0.65 | 0.35 | -    | 3.20 | 0.20 | -    |
| PSTR-5    | 0.90                         | 0.30 | 0.45 | Add  | 5.00 | 0.45 | Add  |

## Applications

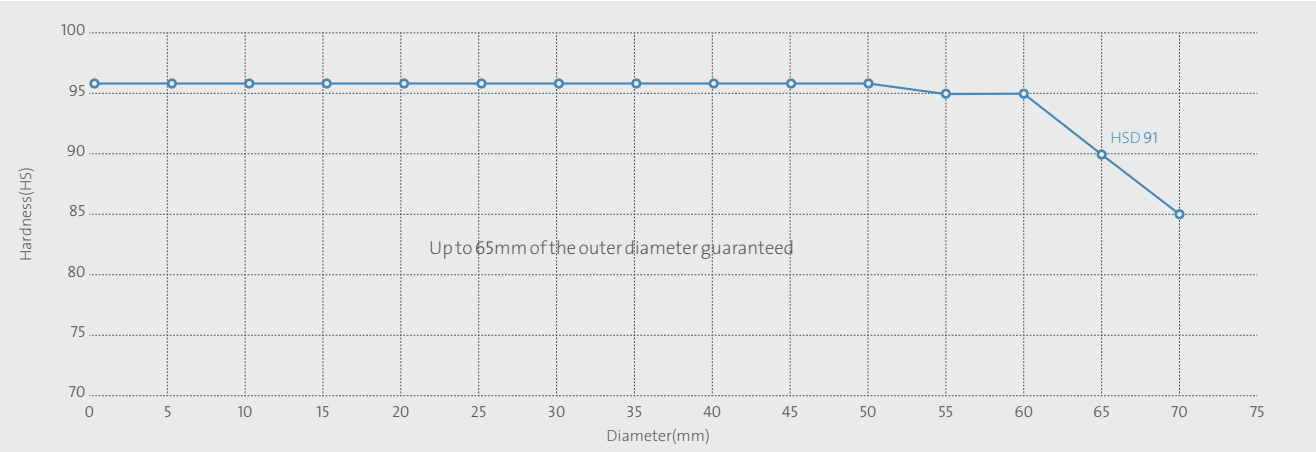
- PSTR-12(SKD11 Modify) : Z/Mill Work Roll
  - PSTR-2(SKD62 Modify) : Z/Mill 1st / 2nd Roll

\*WR : Work Roll, IMR : Intermediate Roll
- PSTR3505C : 3% Cr Steel(General)
  - PSTR-5 : 5% Cr Steel(Electrical Plate Mill WR, Cold Rolled Mill WR/IMR)



## Depth Hardness Distribution

\* Hardness of work rolls for cold rolling steel plates applied to automobiles:HSD 96±1(HSD 91Up)



## Applications

|               |           |                       |                              |
|---------------|-----------|-----------------------|------------------------------|
| POSCO         | Pohang    | No.1 CR Shop          | 5% Cr Steel (ESR) W/R        |
|               |           | No.2 CR Shop          | 5% Cr Steel (ESR) W/R        |
|               |           | Electrical Plate Shop | 5% Cr Steel (ESR) W/R, Z/Mil |
|               |           | STS CR Shop           | Z/Mill                       |
|               | Gwangyang | No.1 CR Shop          | 5% Cr Steel (ESR) W/R        |
|               |           | No.2 CR Shop          | 5% Cr Steel (ESR) W/R        |
|               |           | No.3 CR Shop          | 5% Cr Steel (ESR) W/R        |
|               |           | No.4 CR Shop          | 5% Cr Steel (ESR) W/R        |
| India         | CR Shop   | 5% Cr Steel (ESR) W/R |                              |
| DHF           | Japan     | CR Shop               | 3% Cr Intermediate Roll      |
| HYUNDAI HYSCO |           | CR Shop               | 5% Cr Steel (ESR) W/R        |
| BNG STEEL     |           | STS CR Shop           | Z/Mill                       |
| SeAH STEEL    |           | CR Shop               | 3% Cr Intermediate Roll      |

Specifiactions

| Type                | Standard           | Grade        | Chemical composition (Wt, %) |              |              |              |      |              |                |              |              |                                  | Annealing temp.(°C)        | Annealing hardness         | Heat treatment temp. (°C) |                          | Hardness               | Applications                                                                |            |                                                                                  |
|---------------------|--------------------|--------------|------------------------------|--------------|--------------|--------------|------|--------------|----------------|--------------|--------------|----------------------------------|----------------------------|----------------------------|---------------------------|--------------------------|------------------------|-----------------------------------------------------------------------------|------------|----------------------------------------------------------------------------------|
|                     |                    |              | C                            | Si           | Mn           | P            | S    | Ni           | Cr             | Mo           | V            | Others                           |                            |                            | Quenching                 | Tempering                |                        |                                                                             |            |                                                                                  |
| Carbon Toolsteel    | KS                 | STC3(STC105) | 1.00<br>1.10                 | 0.10<br>0.35 | 0.10<br>0.50 | 0.03         | 0.03 |              |                |              |              |                                  | 750~780<br>Furnace cooling | HB 212 Max                 | 780<br>Water Cooling      | 180<br>Air cooling       | HRC Min 61             | Press frames, clamping tools<br>chisels, drills, hammers                    |            |                                                                                  |
|                     | JIS                | SK3(SK105)   | 1.00<br>1.10                 | 0.10<br>0.35 | 0.10<br>0.50 | 0.03         | 0.03 |              |                |              |              |                                  | 750~780<br>Furnace cooling | HB 212 Max                 | 780<br>Water Cooling      | 180<br>Air cooling       | HRC Min 61             |                                                                             |            |                                                                                  |
|                     | ASTM               | W1           | 0.95<br>1.05                 | 0.10<br>0.40 | 0.10<br>0.40 | 0.03         | 0.03 | 0.20         | 0.15           | 0.10         | 0.10         | Cu : Max 0.20<br>W : Max 0.15    | 730~760<br>Furnace cooling | HB 202 Max                 | 760~820<br>Water Cooling  | 150~200<br>Air cooling   | HRC Min 61             |                                                                             |            |                                                                                  |
| Cold workTool steel | KS                 | STD11        | 1.40<br>1.60                 | 0.40         | 0.60         | 0.03         | 0.03 | 0.50         | 11.00<br>13.00 | 0.80<br>1.20 | 0.20<br>0.50 |                                  | 830~880<br>Furnace cooling | HB 255 Max                 | 1030<br>Air cooling       | 180<br>Air cooling       | HRC Min 58             | Cold dies, presses, tools, press<br>dies                                    |            |                                                                                  |
|                     | JIS                | SKD11        | 1.40<br>1.60                 | 0.40         | 0.60         | 0.03         | 0.03 |              | 11.00<br>13.00 | 0.80<br>1.20 | 0.20<br>0.50 |                                  | 830~880<br>Furnace cooling | HB 255 Max                 | 1030<br>Air cooling       | 180<br>Air cooling       | HRC Min 58             |                                                                             |            |                                                                                  |
|                     | ASTM               | D2           | 1.40<br>1.60                 | 0.10<br>0.60 | 0.10<br>0.60 | 0.03         | 0.03 | 0.40         | 11.00<br>13.00 | 0.70<br>1.20 | 0.50<br>1.10 |                                  | 830~880<br>Furnace cooling | HB 255 Max                 | 1010<br>Air cooling       | 204<br>Air cooling       | HRC Min 59             |                                                                             |            |                                                                                  |
|                     |                    | D3           | 2.00<br>2.35                 | 0.10<br>0.60 | 0.10<br>0.60 | 0.03         | 0.03 | 0.50         | 11.00<br>13.50 |              |              | W : Max1.0                       | 830~880<br>Furnace cooling | HB 255 Max                 | 968<br>Oil cooling        | 204<br>Air cooling       | HRC Min 61             |                                                                             |            |                                                                                  |
|                     |                    | D4           | 2.05<br>2.40                 | 0.10<br>0.60 | 0.60         | 0.03         | 0.03 |              | 11.00<br>13.00 | 0.70<br>1.20 | 0.15<br>1.00 |                                  | 830~880<br>Furnace cooling | HB 255 Max                 | 996<br>Air cooling        | 204<br>Air cooling       | HRC Min 62             |                                                                             |            |                                                                                  |
|                     | DIN                | WNR1. 2379   | 1.50<br>1.60                 | 0.10<br>0.40 | 0.15<br>0.45 | 0.03         | 0.03 |              | 11.00<br>12.00 | 0.60<br>0.80 | 0.90<br>1.10 |                                  | 830~880<br>Furnace cooling | HB 255 Max                 | 1010<br>Air cooling       | 204<br>Air cooling       | HRC Min 58             |                                                                             |            |                                                                                  |
|                     |                    | WNR1. 2080   | 1.90<br>2.20                 | 0.10<br>0.40 | 0.15<br>0.45 | 0.03         | 0.03 |              | 11.00<br>12.00 |              |              |                                  | 830~880<br>Furnace cooling | HB 248 Max                 | 996<br>Air cooling        | 204<br>Air cooling       | HRC Min 60             |                                                                             |            |                                                                                  |
|                     | SeAH CSS           | TD1          | Patent                       |              |              |              |      |              |                |              |              |                                  | 180~520<br>Air cooling     | HB 255 Max                 | 1030<br>Air cooling       | 180/520<br>Air cooling   | HRC Min 58             |                                                                             |            |                                                                                  |
|                     | Hot work Toolsteel | KS           | STF4                         | 0.50<br>0.60 | 0.10<br>0.40 | 0.60<br>0.90 | 0.03 | 0.02         | 1.50<br>1.80   | 0.80<br>1.20 | 0.35<br>0.55 | 0.05<br>0.15                     |                            | 740~800<br>Furnace cooling | HB 248 Max                | 850<br>Oil cooling       | 500<br>Air cooling     |                                                                             | HRC Min 42 | Extrusion dies,<br>Die casting dies, forging dies,<br>head dies, shearing knives |
| STD61               |                    |              | 0.35<br>0.42                 | 0.80<br>1.20 | 0.25<br>0.50 | 0.03         | 0.02 | 0.25         | 4.80<br>5.50   | 1.00<br>1.50 | 0.80<br>1.15 |                                  | 820~870<br>Furnace cooling | HB 229 Max                 | 1020<br>Air cooling       | 550<br>Air cooling       | HRC Max 50             |                                                                             |            |                                                                                  |
| STD62               |                    |              | 0.32<br>0.40                 | 0.80<br>1.20 | 0.20<br>0.50 | 0.03         | 0.02 |              | 4.75<br>5.50   | 1.00<br>1.60 | 0.20<br>0.50 | W : 1.0~1.6                      | 820~870<br>Furnace cooling | HB 229 Max                 | 1020<br>Air cooling       | 550<br>Air cooling       | HRC Max 48             |                                                                             |            |                                                                                  |
| STD6                |                    |              | 0.32<br>0.42                 | 0.80<br>1.20 | 0.20<br>0.50 | 0.03         | 0.02 |              | 4.50<br>5.50   | 1.00<br>1.50 | 0.30<br>0.50 |                                  | 820~870<br>Furnace cooling | HB 229 Max                 | 1050<br>Air cooling       | 550<br>Air cooling       | HRC Max 48             |                                                                             |            |                                                                                  |
| JIS                 |                    | SKT4         | 0.50<br>0.60                 | 0.10<br>0.40 | 0.60<br>0.90 | 0.03         | 0.02 | 1.50<br>1.80 | 0.80<br>1.20   | 0.35<br>0.55 | 0.05<br>0.15 |                                  | 740~800<br>Furnace cooling | HB 248 Max                 | 850<br>Oil cooling        | 500<br>Air cooling       | HRC Min 42             |                                                                             |            |                                                                                  |
|                     |                    | SKD61        | 0.35<br>0.42                 | 0.80<br>1.20 | 0.25<br>0.50 | 0.03         | 0.02 |              | 4.80<br>5.50   | 1.00<br>1.50 | 0.80<br>1.15 | W : 1.0~1.5                      | 820~870<br>Furnace cooling | HB 229 Max                 | 1020<br>Air cooling       | 550<br>Air cooling       | HRC Min 50             |                                                                             |            |                                                                                  |
|                     |                    | SKD62        | 0.32<br>0.40                 | 0.80<br>1.00 | 0.20<br>0.50 | 0.03         | 0.03 |              | 4.75<br>5.50   | 1.00<br>1.50 | 0.20<br>0.60 | W : 1.0~1.5                      | 820~870<br>Furnace cooling | HB 229 Max                 | 1020<br>Air cooling       | 550<br>Air cooling       | HRC Min 48             |                                                                             |            |                                                                                  |
|                     |                    | SKD6         | 0.33<br>0.43                 | 0.80<br>1.25 | 0.20<br>0.60 | 0.03         | 0.03 |              | 4.75<br>5.50   | 1.10<br>1.60 | 0.30<br>0.60 |                                  | 820~870<br>Furnace cooling | HB 229 Max                 | 1050<br>Air cooling       | 550<br>Air cooling       | HRC Min 48             |                                                                             |            |                                                                                  |
| ASTM                |                    | H13          | 0.32<br>0.45                 | 0.80<br>1.25 | 0.20<br>0.60 | 0.03         | 0.03 |              | 4.75<br>5.50   | 1.10<br>1.75 | 0.80<br>1.20 |                                  | 820~870<br>Furnace cooling | HB 235 Max                 | 1010<br>Air cooling       | 552<br>Air cooling       | HRC Min 52             |                                                                             |            |                                                                                  |
|                     |                    | H12          | 0.32<br>0.40                 | 0.80<br>1.00 | 0.20<br>0.50 | 0.03         | 0.03 |              | 4.75<br>5.50   | 1.00<br>1.50 |              | W : 1.0~1.5                      | 820~870<br>Furnace cooling | HB 235 Max                 | 1010<br>Air cooling       | 552<br>Air cooling       | HRC Min 53             |                                                                             |            |                                                                                  |
|                     |                    | H11          | 0.33<br>0.43                 | 0.80<br>1.25 | 0.20<br>0.60 | 0.03         | 0.03 |              | 4.75<br>5.50   | 1.10<br>1.60 | 0.30<br>0.60 |                                  | 820~870<br>Furnace cooling | HB 235 Max                 | 1010<br>Air cooling       | 552<br>Air cooling       | HRC Min 53             |                                                                             |            |                                                                                  |
|                     |                    | DIN          | WNR1. 2344                   | 0.37<br>0.43 | 0.90<br>1.20 | 0.30<br>0.50 | 0.03 | 0.03         |                | 4.80<br>5.50 | 1.20<br>1.50 | 0.90<br>1.10                     |                            | 750~780<br>Furnace cooling | HB 229 Max                | 1010~1030<br>Oil cooling | 540~560<br>Air cooling | HRC Min 50                                                                  |            |                                                                                  |
| WNR1. 2343          |                    |              | 0.36<br>0.42                 | 0.90<br>1.20 | 0.30<br>0.50 | 0.03         | 0.03 |              | 48.0<br>5.50   | 1.10<br>1.40 | 0.25<br>0.50 |                                  | 750~780<br>Furnace cooling | HB 229 Max                 | 1010~1030<br>Oil cooling  | 540~560<br>Air cooling   | HRC Min 48             |                                                                             |            |                                                                                  |
| WNR1.2767           |                    |              | 0.40<br>0.50                 | 0.10<br>0.40 | 0.15<br>0.45 | 0.03         | 0.03 | 3.80<br>4.30 | 1.20<br>1.50   | 0.15<br>0.35 |              |                                  | 610~650<br>Furnace cooling | HB 285 Max                 | 840~860<br>Oil cooling    | 170~190<br>Air cooling   | HRC Min 52             |                                                                             |            |                                                                                  |
| SeAH CSS            |                    | SKT4V        | 0.50<br>0.60                 | 0.35         | 0.70<br>1.00 | 0.025        | 0.02 | 1.30<br>2.00 | 1.00<br>1.40   | 0.25<br>0.50 | 0.10<br>0.30 | Al : 0.02~0.03<br>Nb : 0.03~0.04 | 760~780<br>Furnace cooling | HB 241 Max                 | 850<br>Oil cooling        | 550<br>Air cooling       | HRC Min 40             |                                                                             |            |                                                                                  |
|                     |                    | PST27K57V    | 0.55<br>0.60                 | 1.00<br>1.20 | 0.50         | 0.03         | 0.03 | 0.80<br>1.20 | 4.50<br>5.50   | 1.40<br>1.60 | 0.80<br>1.20 | Cu : Max 0.25                    | 860~870<br>Furnace cooling | HB 241 Max                 | 1010<br>Oil cooling       | 550<br>Air cooling       | HRC Min 55             |                                                                             |            |                                                                                  |
|                     |                    | DC1          | Patent                       |              |              |              |      |              |                |              |              |                                  | 820~870<br>Furnace cooling | HB 229 Max                 | 1020<br>Air cooling       | 550<br>Air cooling       | HRC Min 50             |                                                                             |            |                                                                                  |
| Plastic Mold steel  | SeAH CSS           | TP1          | 0.50<br>0.55                 | 0.35         | 0.90         | 0.03         | 0.02 |              |                |              |              |                                  | Prehardened steel          |                            |                           | 540~590<br>Air cooling   | HB Max 215             | Molds for general merchan-<br>dise, base materials for preci-<br>sion parts |            |                                                                                  |
|                     |                    | TP4          | 0.26<br>0.43                 | 0.15<br>0.35 | 0.80<br>1.15 | 0.025        | 0.02 | 0.45         | 0.90<br>1.50   | 0.20<br>0.30 | 0.02<br>0.04 | special Alloy added              |                            |                            | 850~890<br>Oil cooling    | 540~620<br>Air cooling   | HS Min 38              | Molds for auto bumpers,<br>OA machines, TV & PC back<br>covers              |            |                                                                                  |
|                     |                    | TP4M         | 0.26<br>0.37                 | 0.15<br>0.35 | 0.80<br>1.00 | 0.025        | 0.02 | 0.30<br>0.55 | 1.65<br>2.10   | 0.40<br>0.50 |              |                                  |                            |                            | 850~890<br>Oil cooling    | 540~620<br>Air cooling   | HS Min 40              |                                                                             |            |                                                                                  |
|                     |                    | SMAT1        | Patent                       |              |              |              |      |              |                |              |              |                                  |                            |                            |                           |                          |                        |                                                                             |            |                                                                                  |
|                     |                    | SMAT E       | Patent                       |              |              |              |      |              |                |              |              |                                  |                            |                            |                           |                          |                        |                                                                             |            |                                                                                  |

Specifiactions

| Type                       | Standard | Grade        | Chemical composition (Wt, %) |              |              |       |              |              |                |              |              |                               | Annealing temp.(°C)        | Annealing hardness | Heat treatment temp. (°C)                                                           |                        | Hardness   | Applications                                             |
|----------------------------|----------|--------------|------------------------------|--------------|--------------|-------|--------------|--------------|----------------|--------------|--------------|-------------------------------|----------------------------|--------------------|-------------------------------------------------------------------------------------|------------------------|------------|----------------------------------------------------------|
|                            |          |              | C                            | Si           | Mn           | P     | S            | Ni           | Cr             | Mo           | V            | Others                        |                            |                    | Quenching                                                                           | Tempering              |            |                                                          |
| Plastic Mold Steel         | DIN      | WNR1.2311    | 0.35<br>0.45                 | 0.20<br>0.40 | 1.30<br>1.60 | 0.04  | 0.04         |              | 1.80<br>2.10   | 0.15<br>0.25 |              |                               | 850~890<br>Air cooling     | HB 230 Max         | 850~890<br>Oil cooling                                                              | 540~620<br>Air cooling | HS Min 38  | Molds for high end auto bumpers and consumer electronics |
|                            |          | WNR1.2312    | 0.35<br>0.45                 | 0.30<br>0.50 | 1.40<br>1.60 | 0.03  | 0.05<br>0.10 |              | 1.80<br>2.00   | 0.15<br>0.25 |              |                               | 850~890<br>Oil cooling     | HB 230 Max         | 850~890<br>Oil cooling                                                              | 540~620<br>Air cooling | HS Min 38  |                                                          |
|                            |          | WNR1.2714    | 0.50<br>0.60                 | 0.10<br>0.40 | 0.65<br>0.90 | 0.03  | 0.03         | 1.50<br>1.80 | 1.00<br>1.20   | 0.45<br>0.55 | 0.07<br>0.12 |                               | 850~890<br>Air cooling     | HB 245 Max         | 850~890<br>Oil cooling                                                              | 540~620<br>Air cooling | HS Min 38  |                                                          |
|                            |          | WNR1.2738    | 0.35<br>0.45                 | 0.20<br>0.40 | 1.30<br>1.60 | 0.04  | 0.04         | 0.90<br>1.20 | 1.80<br>2.10   | 0.15<br>0.25 |              |                               | 850~890<br>Air cooling     | HB 240 Max         | 850~890<br>Oil cooling                                                              | 540~620<br>Air cooling | HS Min 42  |                                                          |
| Air hardened Tool Steel    | ASTM     | A2           | 0.95<br>1.05                 | 0.10<br>0.50 | 0.40<br>1.00 | 0.03  | 0.03         |              | 4.75<br>5.50   | 0.90<br>1.40 | 0.15<br>0.50 |                               | 830~880<br>Furnace cooling | HB 255 Max         | 954<br>Air cooling                                                                  | 204<br>Air cooling     | HRC Min 60 | Forming dies, punches                                    |
|                            |          | A6           | 0.65<br>0.75                 | 0.10<br>0.70 | 1.80<br>2.50 | 0.03  | 0.03         |              | 0.90<br>1.40   | 0.90<br>1.40 | 0.15<br>0.50 |                               | 770~790<br>Furnace cooling | HB 248 Max         | 843<br>Air cooling                                                                  | 204<br>Air cooling     | HRC Min 58 |                                                          |
|                            |          | A8           | 0.50<br>0.60                 | 0.75<br>1.10 | 0.20<br>0.50 | 0.03  | 0.3          |              | 4.75<br>5.50   | 1.15<br>1.65 |              | W : 1.0~1.5                   | 770~790<br>Furnace cooling | HB 241 Max         | 1010<br>Air cooling                                                                 | 510<br>Air cooling     | HRC Min 56 |                                                          |
|                            | DIN      | WNR1.2363    | 0.90<br>1.05                 | 0.20<br>0.40 | 0.40<br>0.70 | 0.035 | 0.035        |              | 4.80<br>5.50   | 0.90<br>1.20 | 0.10<br>0.30 |                               | 770~790<br>Furnace cooling | HB 230 Max         | 950<br>Air cooling                                                                  | 180<br>Air cooling     | HRC Min 60 | Forming dies, punches                                    |
| Oil hardened Tool Steel    | KS       | STS95        | 0.80<br>0.90                 | 0.50         | 0.80<br>1.10 | 0.03  | 0.03         |              | 0.20<br>0.60   |              |              |                               | 730~760<br>Furnace cooling | HB 212 Max         | 820<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 59 | Ring gauges, pulling dies                                |
|                            |          | STS3         | 0.90<br>1.00                 | 0.35         | 0.90<br>1.20 | 0.03  | 0.03         |              | 0.50<br>1.00   |              |              | W : 0.5~1.0                   | 750~800<br>Furnace cooling | HB 217 Max         | 830<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 60 | Screw cutters, cutting knives                            |
|                            |          | STS93        | 1.00<br>1.10                 | 0.50         | 0.80<br>1.10 | 0.03  | 0.03         |              | 0.20<br>0.60   |              |              |                               | 750~780<br>Furnace cooling | HB 217 Max         | 820<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 63 | Blades, press frames                                     |
|                            | JIS      | SKS95        | 0.80<br>0.90                 | 0.50         | 0.80<br>1.10 | 0.03  | 0.03         |              | 0.20<br>0.60   |              |              |                               | 730~760<br>Furnace cooling | HB 212 Max         | 820<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 59 | Ring gauges, pulling dies                                |
|                            |          | SKS3         | 0.90<br>1.00                 | 0.35         | 0.90<br>1.20 | 0.03  | 0.03         |              | 0.50<br>1.00   |              |              | W : 0.5~1.0                   | 750~800<br>Furnace cooling | HB 217 Max         | 830<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 60 | Screw cutters, cutting knives                            |
|                            |          | SKS93        | 1.00<br>1.10                 | 0.50         | 0.80<br>1.10 | 0.03  | 0.03         |              | 0.20<br>0.60   |              |              |                               | 750~780<br>Furnace cooling | HB 217 Max         | 820<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 63 | Blades, press frames                                     |
|                            | ASTM     | O1           | 0.85<br>1.00                 | 0.10<br>0.50 | 1.00<br>1.40 | 0.03  | 0.03         |              | 0.40<br>0.70   |              | 0.30         | W : 0.4~0.6                   | 750~800<br>Furnace cooling | HB 212 Max         | 802<br>Oil cooling                                                                  | 204<br>Air cooling     | HRC Min 59 | Cold molding dies, forming rolls                         |
|                            |          | O6           | 1.25<br>1.55                 | 0.55<br>1.50 | 0.30<br>1.10 | 0.03  | 0.03         |              | 0.30           | 0.20<br>0.30 |              |                               | 730~760<br>Furnace cooling | HB 212 Max         | 802<br>Oil cooling                                                                  | 204<br>Air cooling     | HRC Min 59 | Ring gauges, pulling dies                                |
|                            |          | O2           | 0.85<br>0.95                 | 0.50         | 1.40<br>1.80 | 0.03  | 0.03         |              | 0.50           | 0.30         | 0.30         |                               | 750~770<br>Furnace cooling | HB 217 Max         | 802<br>Oil cooling                                                                  | 204<br>Air cooling     | HRC Min 59 | Cold molding dies, forming rolls                         |
|                            | DIN      | WNR1.2510    | 0.90<br>1.05                 | 0.15<br>0.35 | 1.00<br>1.20 | 0.035 | 0.035        |              | 0.50<br>0.70   |              | 0.05<br>0.15 | W : 0.5~0.7                   | 770~790<br>Furnace cooling | HB 229 Max         | 780~820<br>Oil cooling                                                              | 180~220<br>Air cooling | HRC Min 61 | Cold molding dies, forming rolls                         |
|                            |          | WNR1.2842    | 0.85<br>0.95                 | 0.10<br>0.40 | 1.90<br>2.10 | 0.03  | 0.03         |              | 0.20<br>0.50   |              | 0.05<br>0.15 |                               | 750~770<br>Furnace cooling | HB 229 Max         | 790~820<br>Oil cooling                                                              | 150~250<br>Air cooling | HRC Min 60 |                                                          |
| Shock resisting Tool steel | KS       | STS41        | 0.35<br>0.45                 | 0.35         | 0.50         | 0.03  | 0.03         |              | 1.00<br>1.50   |              |              | W : 2.5~3.5                   | 760~820<br>Furnace cooling | HB 217 Max         | 880<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 53 | Dies for hot forging                                     |
|                            | JIS      | SKS41        | 0.35<br>0.45                 | 0.35         | 0.50         | 0.03  | 0.03         |              | 1.00<br>1.50   |              |              | W : 2.5~3.5                   | 760~820<br>Furnace cooling | HB 217 Max         | 880<br>Oil cooling                                                                  | 180<br>Air cooling     | HRC Min 53 | Dies for hot forging                                     |
|                            | ASTM     | S1           | 0.40<br>0.55                 | 0.15<br>1.20 | 0.10<br>0.40 | 0.03  | 0.03         |              | 1.00<br>1.80   | 0.50         | 0.15<br>0.30 | W : 1.5~3.0                   | 760~820<br>Furnace cooling | HB 217 Max         | 954<br>Oil cooling                                                                  | 204<br>Air cooling     | HRC Min 56 | Dies for hot forging                                     |
|                            |          | S5           | 0.50<br>0.65                 | 1.75<br>2.25 | 0.60<br>1.00 | 0.03  | 0.03         |              | 0.10<br>0.50   | 0.20<br>1.35 | 0.15<br>0.35 |                               | 830~850<br>Furnace cooling | HB 229 Max         | 899<br>Oil cooling                                                                  | 204<br>Air cooling     | HRC Min 58 | Cutter blades, punches                                   |
|                            | S7       | 0.45<br>0.55 | 0.20<br>1.00                 | 0.20<br>0.90 | 0.03         | 0.03  |              | 3.00<br>3.50 | 1.30<br>1.80   | 0.35         |              | 830~850<br>Furnace cooling    | HB 229 Max                 | 954<br>Air cooling | 204<br>Air cooling                                                                  | HRC Min 56             |            |                                                          |
| Forged Rolls               | SeAH CSS | PSTR-1       | 1.30<br>1.70                 | 0.70         | 0.70         | 0.03  | 0.03         | 0.50         | 11.00<br>13.00 | 0.70<br>1.30 | 0.50<br>1.00 | Co : 0.2~0.5                  | 860~880<br>Furnace cooling | HB 225 Max         | Heat treatment at low, medium or high frequency<br>* As per customer's requirements |                        | HS Min 90  | Z-mills and cold rollers                                 |
|                            |          | PST23R11     | 1.40<br>1.55                 | 0.40         | 0.60         | 0.03  | 0.03         | 0.50         | 11.00<br>12.50 | 1.55<br>1.70 | 0.70<br>0.95 | Co : 0.3~0.5                  | 860~880<br>Furnace cooling | HB 225 Max         |                                                                                     |                        | HS Min 90  |                                                          |
|                            |          | PSTR-2       | 0.30<br>0.60                 | 1.30         | 0.70         | 0.03  | 0.03         | 0.50         | 4.00<br>6.00   | 0.80<br>1.70 | 0.82         | W : Max 1.5                   | 860~880<br>Furnace cooling | HB 229 Max         |                                                                                     |                        | HS Min 90  |                                                          |
|                            |          | PSTR-5       | 0.75<br>0.95                 | 0.20<br>0.50 | 0.20<br>0.50 | 0.025 | 0.015        | 0.50         | 4.50<br>5.50   | 0.40<br>0.65 | -            | -                             | 860~880<br>Furnace cooling | HB 229 Max         |                                                                                     |                        | HS Min 90  |                                                          |
|                            |          | PSTR-12      | 1.30<br>1.70                 | 0.70         | 0.70         | 0.03  | 0.03         | 0.50         | 11.00<br>13.00 | 0.70<br>1.30 | 0.50<br>1.00 | Co : 0.2~0.5<br>Cu : max 0.30 | 860~880<br>Furnace cooling | HB 245 Max         |                                                                                     |                        | HS Min 90  |                                                          |
| Flame hardened Tool steel  | SeAH CSS | PST23F85     | 0.80<br>0.90                 | 0.80<br>1.20 | 0.70<br>1.10 | 0.025 | 0.025        |              | 1.80<br>2.20   | 0.20<br>0.30 | 0.05<br>0.10 |                               | 810~830<br>Furnace cooling | HB 235 Max         | 900~1000°C<br>Flame                                                                 |                        | HRC Min 60 | Cold molds                                               |

# Classification of Tool Steel

|     |                   |     |                     |       |                                           |
|-----|-------------------|-----|---------------------|-------|-------------------------------------------|
| SK3 | Wear resistance   | SK1 | Wear resistance     | SKD1  | Cold work tool steel                      |
|     |                   |     |                     | SKD11 |                                           |
|     |                   | SK2 | Wear resistance     | SKH3  | High speed tool steel                     |
|     |                   |     | High temp. hardness | SKH55 |                                           |
|     |                   |     | Machinability       | SKS2  |                                           |
|     |                   |     |                     |       |                                           |
|     | Impact resistance | SK5 | Machinability       | SKH2  | High speed tool steel                     |
|     |                   |     | High temp. hardness | SKH51 |                                           |
|     |                   |     |                     |       |                                           |
|     |                   |     |                     |       |                                           |
|     |                   |     | Wear resistance     | SKS3  | Cutting tool steel with Impact resistance |
|     |                   |     | Impact resistance   | SKS31 |                                           |
|     |                   |     | Impact resistance   | SKS41 | Hot work tool steel                       |
|     |                   |     | High temp. hardness | SKD4  |                                           |
|     |                   |     | Impact resistance   | SKD61 |                                           |

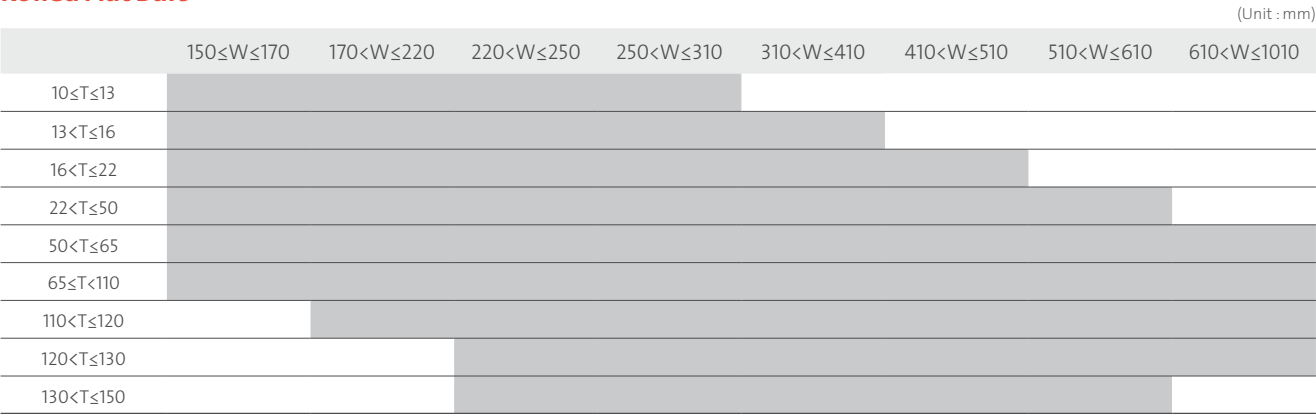
| Requirement                                     | Substantial Alloy Elements                         |
|-------------------------------------------------|----------------------------------------------------|
| High temperature strength                       | W, Mo, Co (in combination with W or Mo), V, Cr, Mn |
| Wear resistance                                 | V, W, Mo, Cr, Mn                                   |
| Hardenability                                   | Mn, Mo, Cr, Si, Ni, V                              |
| Transformation resistance                       | Mo (in combination with Cr), Cr, Mn                |
| Toughness (grain refinement)                    | V, W, Mo, Mn, Cr (Al adjusted for others)          |
| Resistance to oxidation for hot work tool steel | Cr, Si, Al                                         |

# Product Size

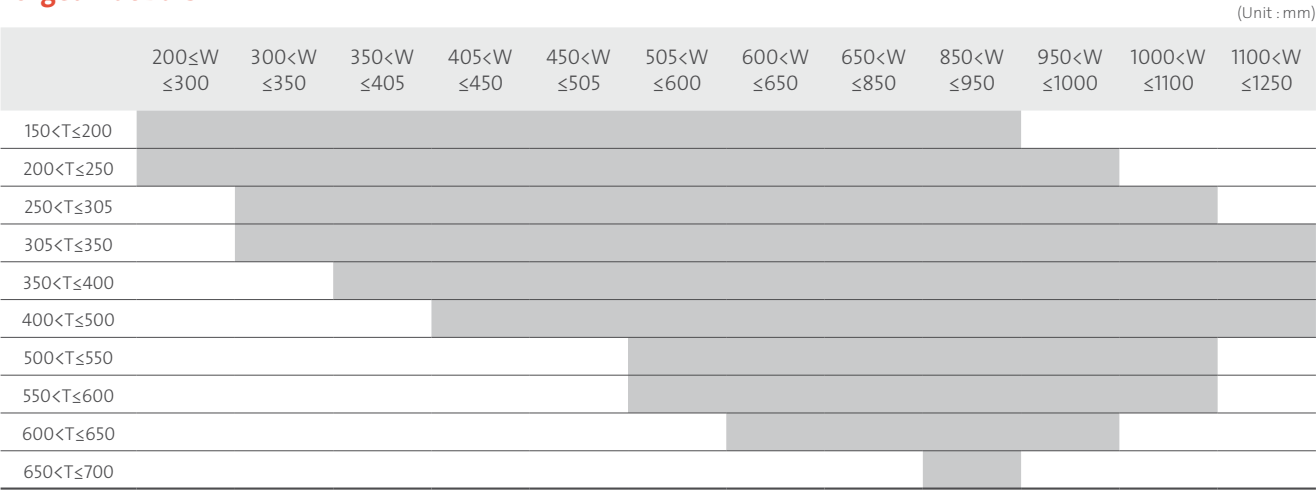
## Round Bars

• Rolled (5.7~340φ) • Forged (206~850φ)

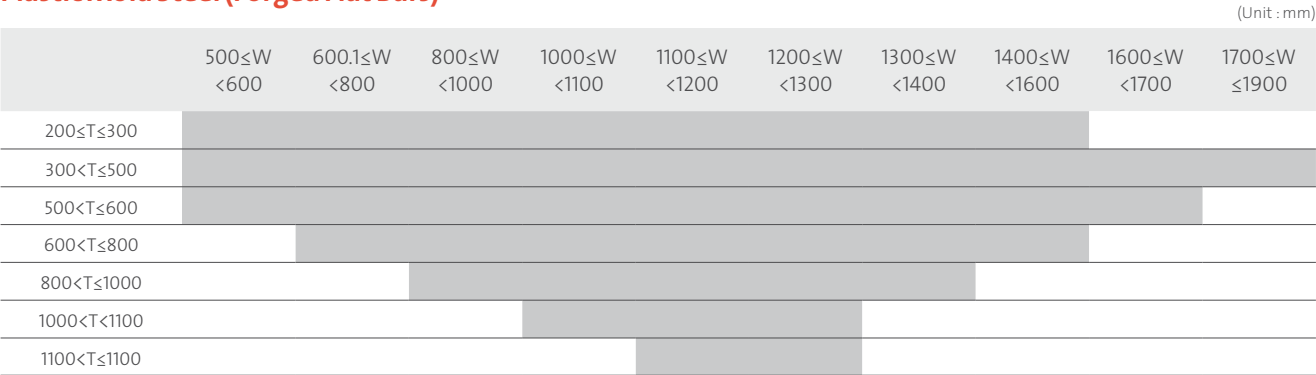
## Rolled Flat Bars



## Forged Flat Bars



## Plastic Mold Steel (Forged Flat Bars)



Contact us for any order outside the dimensions above.

[T: Thickness, W: Width]

Packing Types

Flat bars



Bare



Hessian



Wooden Slate



Wooden Box

Round bars



Bare



Hessian



Wooden Slate

Tag & Label



Tag (for Domestic)



Tag (for Export)



Label (for Domestic)



Label (for Export)

Certificates of Approval



ISO 9001:2008  
ISO QUAL-  
ITY MANAGE-  
MENT SYSTEM



ISO/TS  
16949:2009  
ISO QUAL-  
ITY MANAGE-  
MENT SYSTEM



ISO  
14001:2004  
ENVIRON-  
MENTAL MAN-  
AGEMENT  
SYSTEM



KOSHA18001  
KOSHA SAFE  
AND HEALTH  
MANAGE-  
MENT SYSTEM



KOREAN  
INDUSTRIAL  
STANDARDS



JAPANESE  
INDUSTRIAL  
STANDARDS



KOREA  
ELECTRIC  
POWER  
INDUSTRY  
CODE

Order Requirements

We can only provide the right product for you when you fully specify what you need.

Be sure to provide detailed information for the line items below.

E-mail : trade@seah.co.kr / Website : www.seahss.co.kr/eng / Tel : +82 2 6970 2369 for questions

<sup>1)</sup>Applicable standards: ASTM, JIS, DIN, etc.   <sup>2)</sup>Steel grade, Surface, Heat Treatment, Dimension

<sup>3)</sup>Quantity and Delivery   <sup>4)</sup>Applications, method of processing   <sup>5)</sup>Special requirements (if applicable)