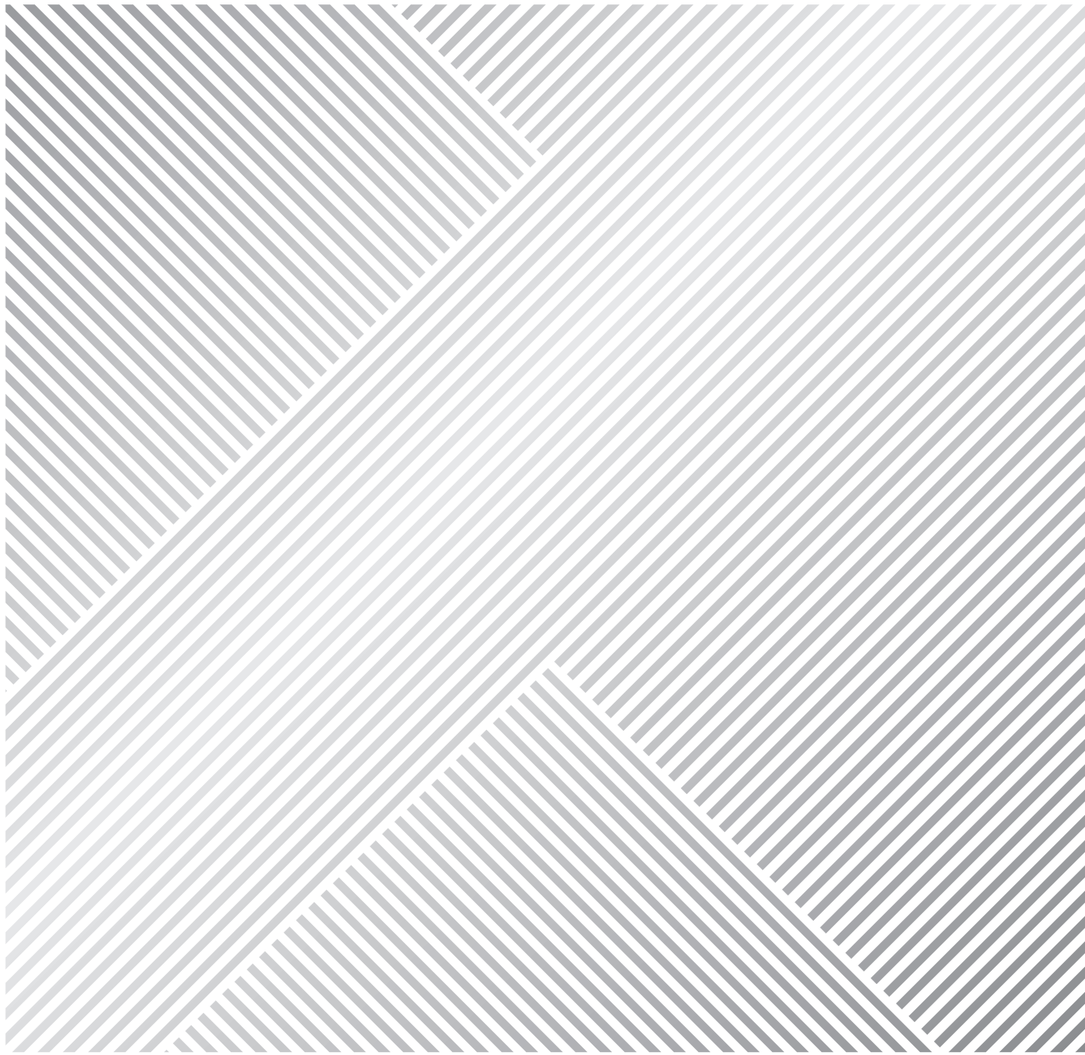
SeAH CSS



1) Material properties shown in this catalog are of standard data and may differ from guaranteed properties.
· The data in this catalog are representative values based on SeAH CSS's test data and may differ depending on conditions and equipment.
The data in this catalog are for technical reference and do not guarantee product quality.
2) The contents of this catalog are subject to change without notice. 3) Unauthorized reproduction of the contents of this catalog is prohibited.
4) Please consult with one of our service representatives for greater clarity on any topics covered herein. 5) This catalog is up-to-date as of July 2021.

TOOL & MOULD STEEL

Contents

For the past half century, SeAH CSS has grown alongside with South Korea and became the only integrated special steel maker in Korea which produces tool steel, mould steel, stainless steel, carbon alloy steel and Ni -alloys.

COMPANY HISTORY

1966.04	Established Samyang Special Steel Co., Ltd.
1977.12	Completed construction of Korea Integrated Special Steel Factory (bars, steel pipes, plates)
1982.06	Changed company name to Sammi Integrated Special Steel Co., Ltd.
1991.04	Completed 2nd special steel plant (steel making, rolling, machining)
1997.02	Incorporated into POSCO Group (bar and steel pipe business lines)
2006.10	Completed first stage facility rationalization (AOD, HV Mill, 2nd pickling plant, etc.)
2007.11	Awarded 700 million USD export tower on Trade Day
2007.11	Completed large forging plant (9,000-ton press)
2012.04	Completed second stage facility rationalization (60-ton electric furnace, bloom caster, SBM, etc.)
2015.03	Incorporated into SeAH Group
2015.03	Changed company name to SeAH Changwon Integrated Special Steel Co., Ltd. (SeAH CSS)
2017.03	Completed large-diameter steel pipe, special steel plant

TOOL STEEL HISTORY

1977.12	Started production/sales of tool steel
2011.12	Developed TW27 (DuMAC RD) cold work tool steel for thread rolling dies
2012.11	Started a national development project to develop a long-life cold mould material for press forming of 1GPa-grade ultra-high-strength steel sheets
2013.08	Received approval for tool steel supply specification for Honda Motor parts
2014.01	Started development of premium hot work tool steel for die casting/hot stamping
2015.12	Developed **TD1**(DuMAC PRO) **cold work tool steel for high-tensile steel sheet forming** and **DC1**(DuRAH PRO) **hot work tool steel for die casting**
2017.12	Developed **TD5**(DuMAC MAX) **long-life cold work tool steel for press forming of ultra-high strength steel sheet**
2019.11	**Developed DuRAH FX hot work tool steel for hot forging and aluminum extrusion**
2020.01	**Launched of next-generation tool steel brands DuRAH and DuMAC**

PLASTIC MOULD TOOL STEEL HISTORY

1977.12	Started production/sales of plastic mould steel rolled products
2007.12	Released TP1, TP4, TP4M, plastic mould steel forgings
2019.06	Acquired approval from Hyundai Mobis for plastic mould tool steel TP series
2019.07	**Acquired approval from Samsung Electronics for SMAT E and TP series and from LG Electronics for SMAT E and TP series of precision plastic mould steel**
2020.04	**Acquired approval from SL for SMAT E precision plastic steel grade** **Acquired approval from KOITO (in Japan) for SMAT E precision plastic steel grade**

SeAH CSS **Manufacturing Process/Major Equipment**

01

SeAH CSS provides **customized production** based on an intergrated production system which is from steel making to product stage.

02

SeAH CSS provides customized products for customers by the **only rolling/forging facility in Korea**

03

SeAH CSS's **advanced manufacturing practices** are able to produce subdivided and precisely sized products.

04

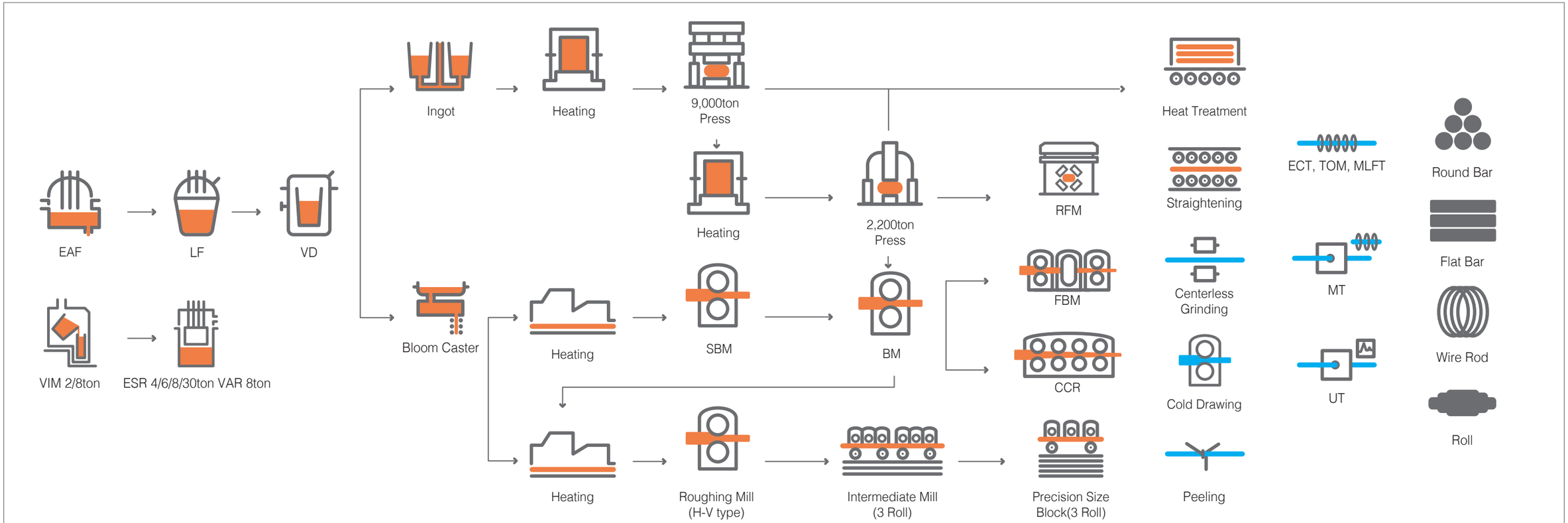
Through an **extensive distribution network,** SeAH CSS supplies the products its customers want at the right time and place.

05

With its **"Quality First"** business philosophy, SeAH CSS's thorough quality control and quick-response customer service system have been recognized by customers over the long haul.

06

SeAH CSS pursuits shared growth with customers by **"R&D of optimized materials"** for various environments and uses.



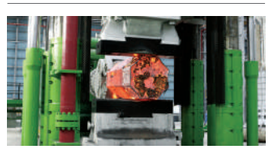
EAF

Ingot Casting

ESR

RFM

9,000ton Press



FBM

CCR

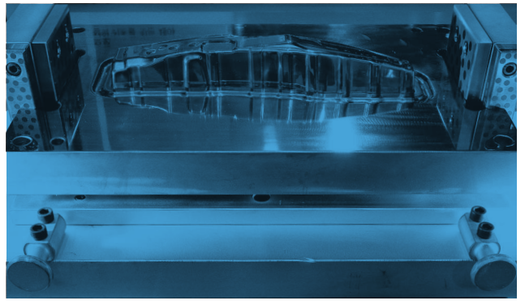
Furnace

* **Electric furnace/Refining furnace** : With decades of steelmaking know-how and accumulated technology, SeAH CSS provides the chemical composition and characteristics required by its customers.
* **Special refining** : SeAH CSS supplies uniform products of equal quality to customers by minimizing impurities and segregation through the latest manufacturing facilities and technologies.
* **Forging machine/Rolling machine** : SeAH CSS produces various products (wire rod, round bar, flat steel, free forging), into a diverse range of dimensions (round bar 5.5~850Ø, flat steel 10~1100T, by 1mm increments), to ensure an optimal range of choice for customers

* **Heat treatment** : Through optimal heat treatment, SeAH CSS ensures microstructural stability and outstanding mechanical properties.
* **Post-processing** : SeAH CSS supplies the best products through precision machining, calibration and thorough inspection.
* **Technical services** : SeAH CSS fulfills customer satisfaction by providing prompt technical support for customer usage environments such as heat treatment and welding.

SeAH CSS's **Product Lineup**

DuMAC Durability Maximized Advanced Cold tool steel



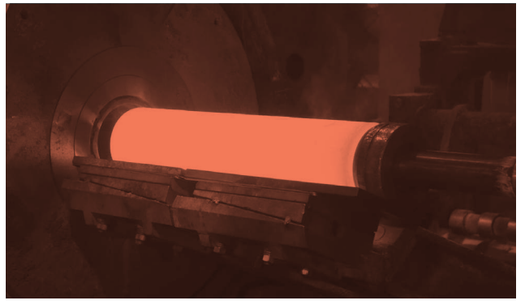
The DuMAC series is a tool steel which is suitable for a wide range of harsh environments. SeAH CSS provides a wide range of choices, from ESR based products for cutting ultra-high-strength steel sheets to Matrix HSS type tool steels.

DuMAC MAX	Cold work tool steel for trimming 1.5GPa grade advanced high-strength steel with extremely improved impact toughness and fatigue strength
DuMAC PRO	Premium yet economical cold work tool steel by minimized deformation from heat treatment, meanwhile capable to form high-strength steel.
DuMAC 11	All-purpose high-quality cold work tool steel with SeAH CSS's specialized technology
DuMAC DT	Cold work tool steel with improved wear resistance
DuMAC WF	Specially designed for punching moulds with the attributes not only with the high wear resistance of cold work tool steel but also with the toughness of hot work tool steel.
DuMAC RD	Cold work tool steel for thread rolling dies with greater hardness and better wear resistance
DuMAC DK	The best solution for industrial knives with extreme toughness

OTHER COLD WORK TOOL STEEL PRODUCTS

TA23F85	Cold work tool steel specialized in flame quenching heat treatment
TR12/TR2/ TR3505C/TR5	Cold work tool steel for rolling rolls for cold roll sheets & secondary batteries

DuRAH Durability Reinforced Advanced Hot tool steel



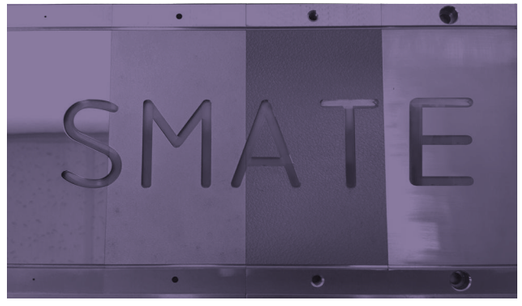
The DuRAH series has advanced material properties to improve mould lifespan. With the only forging and rolling facility in Korea, SeAH CSS provides DuRAH in various shapes and sizes to suit the environment of use.

DuRAH MAX	Superior hot work tool steel with extremely high cleanliness, high temperature strength and toughness
DuRAH PRO	Premium hot work tool steel for die casting and hot stamping produced by optimal design and advanced manufacturing process
DuRAH 61	All-purpose, market leading hot work tool steel by SeAH CSS's specialized technology
DuRAH FX	Specialized hot work tool steel with improved impact toughness for forging and extrusion

OTHER HOT WORK TOOL STEEL PRODUCTS

SKT4/SKT4V	Hot work tool steel for die forging and hammers

SMAT SeAH's Mould steel by Advanced Technologies



The SMAT series has secured a high degree of cleanliness and outstanding characteristics through the ESR process and boasts uniform quality even in large sizes. SMAT is recognized by its value and has been officially approved by global home appliance/automobile manufacturers in Korea.

SMAT E	A product with a hardness of 40 HRC, excellent in various fields such as machinability and weldability
SMAT F	Next generation high-precision precipitation hardening product with easy corrosion and electric discharge machining
SMAT G	High-gloss, high-precision mould steel with improved productivity based on high thermal conductivity
SMAT V	Premium mould steel for lens moulding with superior corrosion resistance and wear resistance

TP Tool steel for Plastic moulds

The TP series is a high-quality series of mould steel crafted with an optimal alloy design, high cleanliness refining technology, and the latest forging/heat treatment methods derived from long-term technological expertise. SeAH CSS provides customized products in diverse range and shapes to fulfill customer's environment and financial circumstances.

TP1	A S55C series tool steel with uniform material properties and minimal impurities
TP4/TP4M	Optimally designed, alloy steel-base high-performance tool steel which is certified by global home appliance and automobile manufacturers
TP4MS	High-efficiency tool steel that maximizes machinability and reduces the time and cost required for mould manufacturing
TP4M HH	Next-generation all-round tool steel with superior hard finish and corrosion processability

DuMAC

The DuMAC Series is an exclusive brand developed by SeAH CSS for the best performance in environments requiring stronger materials and more complicated shapes. DuMAC provides superior quality by special chemical compositions for it uses and production by advanced techniques and know-how of SeAH CSS.

Strong Points

Excellent mechanical properties

DuMAC is a well-balanced, developed product which has good toughness, hardness, hardenability, and wear resistance, which is optimized for various uses.

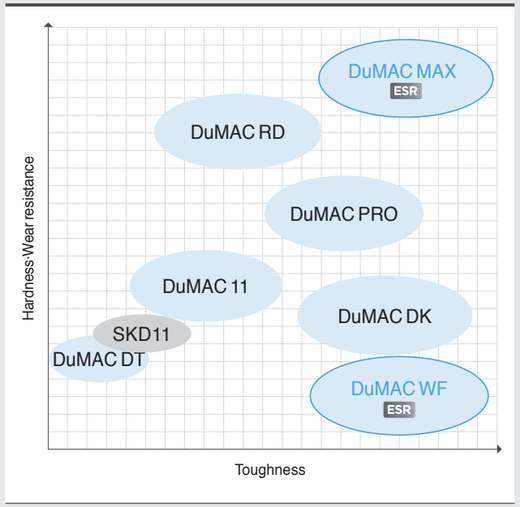
Outstanding purity

The DuMAC series provides stable quality and performance and boasts excellent lifespan.

Diverse product lineup

From advanced-high strength steel for moulding to Matrix HSS types, DuMAC series provide a wide range of products for our customers.

Feature Positioning



Feature comparison

SeAH CSS	Wear resistance	Toughness	Hardness	Machinability	Hardenability
DuMAC MAX ESR	A++	S	A++	A	A+
DuMAC PRO	A+	A	A+	A++	A+
DuMAC 11	B+	B+	B+	B	A
DuMAC DT [Specialized purpose]	A	B-	B	B	B
DuMAC WF [Specialized purpose] ESR	B	S	B+	A+	B+
DuMAC RD [Specialized purpose]	A+	A	A++	B	A+
DuMAC DK [Specialized purpose]	B+	A++	A+	A	A+

Product Lineup

Product name			Major characteristics	Applications	Chemical composition(wt%)						Physical characteristics			
SeAH CSS	KS / JIS	AISI / DIN			C	Si	Mn	Cr	Mo	V	Thermal expansion coefficient (x 10^{-6}/°C)	Specific gravity (g/cm³)	Thermal conductivity (W/mK)	Young's modulus (GPa)
DuMAC MAX ESR	8Cr	-	Suitable for advanced high-strength steel moulds by enhancing heat treatment hardness and chipping suppression capability	Specialized in trimming and fine blanking of 1.5GPa-grade steel sheets	0.90 1.10	0.90 1.20	0.30 0.60	7.70 8.50	Special element		11.8	7.68	17.8	220
DuMAC PRO	8Cr	-	Low deformation from heat treatment and improved machinability which reduce production costs and increase product lifespan.	Cold forming of advanced high-strength steel	0.90 1.10	0.95 1.10	0.50 0.80	7.80 8.20	Special element		12.2	7.70	16.7	220
DuMAC 11	STD11 SKD11	D2 WNr 1.2379	Cold work tool steel with stable wear resistance	General moulds	1.40 1.60	0.40	0.60	11.0 13.0	0.80 1.20	0.20 0.50	11.2	7.73	20.6	225
DuMAC DT [Specialized purpose]	SKD11 Modified	-	Cold work tool steel with enhanced wear resistance	Cold work moulds	1.60 1.80	0.70 1.00	0.40 0.80	11.0 13.0	Special element		12.2	7.67	20.0	220
DuMAC WF [Specialized purpose] ESR	Matrix HSS	-	ESR applied materials Matrix HSS with high toughness	Cold/warm punching	0.61 0.67	1.30 1.80	0.40 0.50	4.30 4.90	Special element		11.3	7.71	18.7	210
DuMAC RD [Specialized purpose]	7Cr	-	Steel grade specifically designed for high hardness and toughness of 64 HRC	Thread rolling dies	0.90 1.10	0.80 1.10	0.30 0.60	6.80 7.50	Special element		11.5	7.76	18.5	220
DuMAC DK [Specialized purpose]	8Cr	-	A specifically designed, chipping resistant steel grade with high toughness	Industrial knives	0.65 0.80	0.90 1.20	0.30 0.60	7.00 8.00	Special element		12.2	7.75	17.7	220

• RD : Rolling Dies • DK : Dies & Knife • WF : Warm Forging • DT : Dies & Trimming

• SeAH CSS uses its superior production technology to keep P, S and other impurities at levels lower than required by official standards.

DuMAC MAX ESR

The best solution for advanced 1.5GPa grade high-strength steel

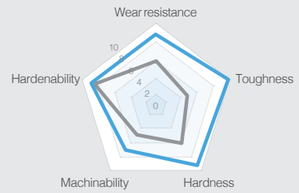
DuMAC MAX is a premium cold work tool steel grade specially developed for reduced weight and thickness of the materials. With **ESR (electroslag remelting)** and advanced manufacturing methods, **chipping and cracking have been reduced** while **hardness and wear resistance greatly improved.** Also homogeneity and fatigue strength have been secured which increases mould lifespan in extreme environments.

• Inclusions are removed from the substance used in the ESR process, while that substance undergoes rapid solidification using the slag to curb the forming of segregation in the high-alloy steel, thereby effectively increasing mould lifespan.

Applications

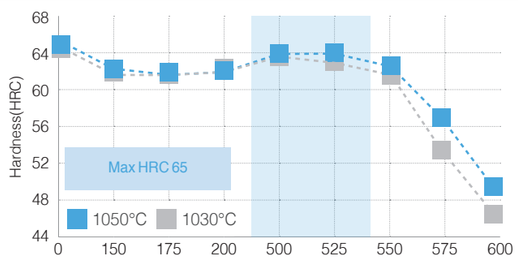
Optimized for cold working (trimming, cutting, and stamping) advanced high-strength steel

DuMAC MAX
SKD11

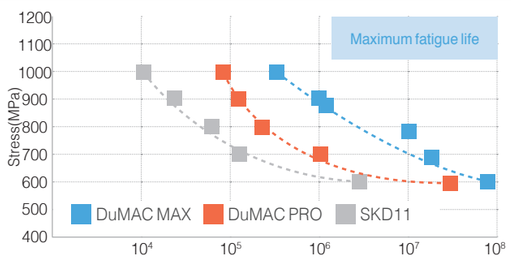


Mechanical Properties

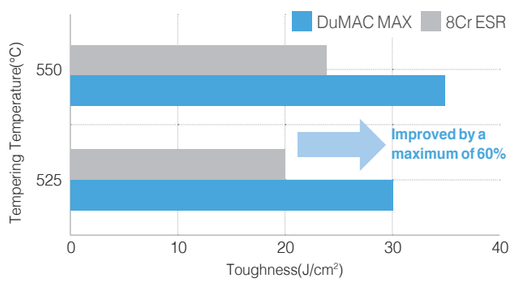
Heat Treatment Hardness



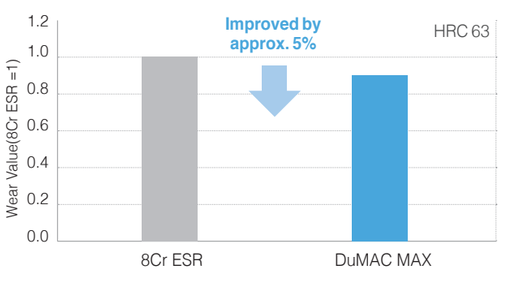
Fatigue Strength



Impact Toughness



Material Wear(Wear resistance)



Cases of Increased Mould Lifespan

Type	Application Evaluation Results (vs. Conventional Material)	Evaluated Companies(Mould)	Heat and Surface Treatment
Trimming mould (Driver side underbody parts)	1,470MPa Hot stamping material Cold trimming	Company M	High-temperature tempering
Drawing mould (Automotive seat products)	30% improved (vs. SKD11)	Company I	High-temperature tempering + PVD

DuMAC PRO

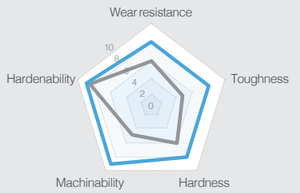
A premium solution for giga steel moulding

DuMAC PRO is a **cold work tool steel** made with SeAH CSS's knowhow and optimal chemical composition which shows improved impact toughness, hardness, and wear resistance. This product is not only well known by its improved machinablility and reduced heat deformation, but also well known for its efficiency as it reduces time and money for producing a mould product.

Applications

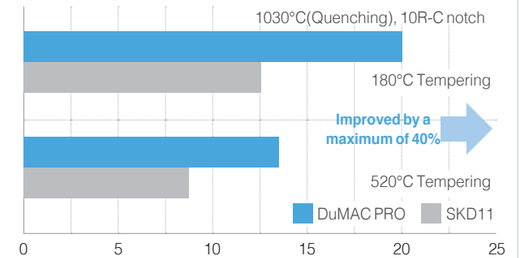
For cold forming moulds using high-strength steel and other high-strength materials

DuMAC PRO
SKD11

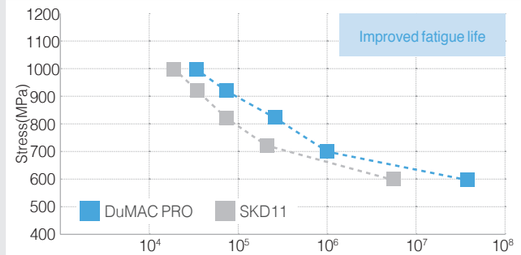


Mechanical Properties

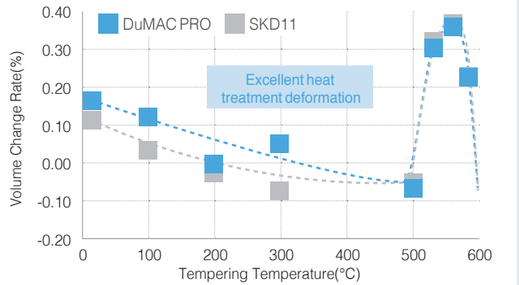
Impact Toughness



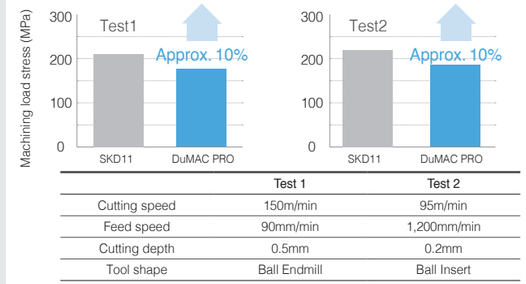
Fatigue Strength



Characteristics of Heat Treatment Deformation



Machinability



	Test 1	Test 2
Cutting speed	150m/min	95m/min
Feed speed	90mm/min	1,200mm/min
Cutting depth	0.5mm	0.2mm
Tool shape	Ball Endmill	Ball Insert

Cases of Increased Mould Lifespan

Type	Application Evaluation Results (vs. SKD11)	Evaluated Companies(Mould)	Hardness / Heat Treatment (Coating)
Drawing mould (Center Pillar)	▲ 35% improved	Company S DP 980 / 1.6t	HRC 58~61 High temperature tempering + PVD
Drawing mould (Steel Wheel)	▲ 65% improved	Company K HR 580 / 3.8t	HRC 58~61 Cold temperature tempering + TD
Drawing mould (Door Hinge)	▲ 12% improved	Company C HR 340LA / 4.0t	HRC 58~61 High temperature tempering + TD
Trimming mould (Side Sill)	▲ 75% improved	Company S CP 1180 / 1.2t	HRC 58~60 Cold temperature tempering

DuMAC 11

An all-in-one cold work solution with comparative advantage

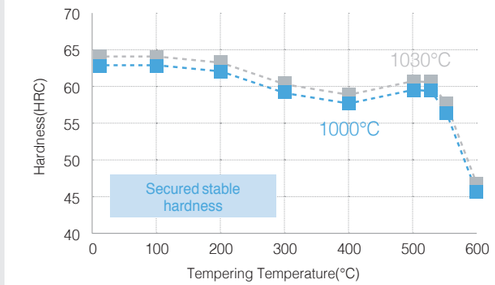
SeAH CSS's DuMAC 11 introduces **a new set of standards in cold work tool steel**. With SeAH CSS's empirical data and technology, Comparing to the standard grade SKD11, DuMAC 11 shows a better result in all purposes. Wear resistance has been improved by adding Carbon-Chromium and the damage rate has been reduced by improving impact toughness through advanced steel making technology. These improvements have satisfied our customers and enabled us to become **a leader in the domestic market**.

Applications

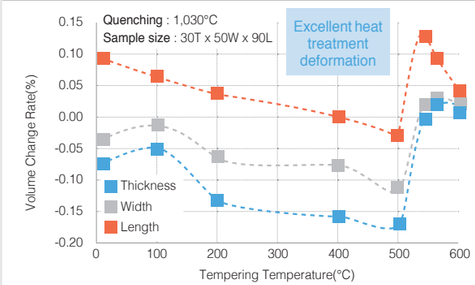
**Cold press moulds, forming rolls,
industrial shears/slitter knives,
cold trimming moulds, TBM cutters, blanking moulds**

Mechanical Properties

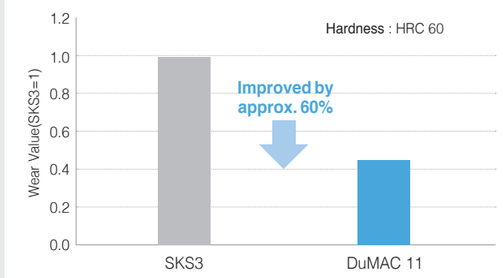
Heat Treatment Hardness



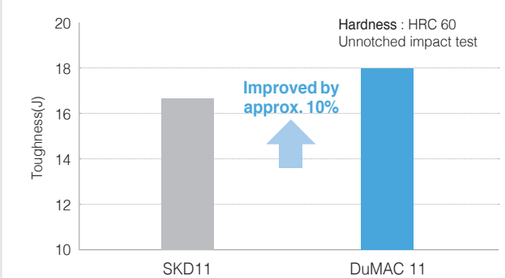
Heat Treatment Dimensional Change



Material Wear(Wear Resistance)



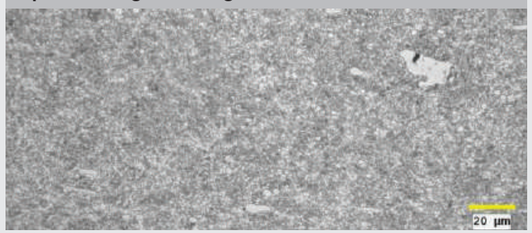
Impact Toughness



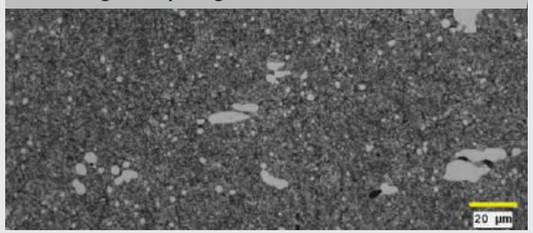
Microstructure

Improved machinability and wear resistance through uniform spheroidization / eutectic carbide distribution

Spheroidizing Annealing



Hardening & Tempering



DuMAC DT

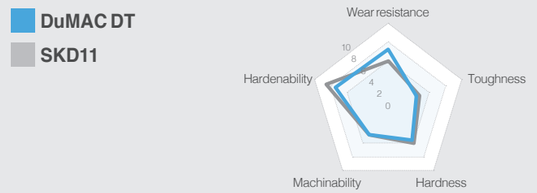
Specialized purpose

The best alternative for cold press moulds

DuMAC DT is a specialized cold work tool steel developed by SeAH CSS in line with the trend of shortened replacement cycles of cold press moulds, the diversification of quality and lifespan requirements. Based on more than half a century of knowhow, we have added high levels of Carbon-Chromium and optimal chemical elements to improve mould efficiency for reinforced wear resistance and hardness greater or equal compared to HRC 58.

Applications

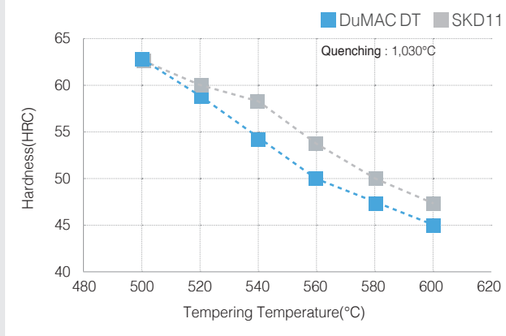
**Low-strength cold press mould, shear knives,
cold trimming, etc.**



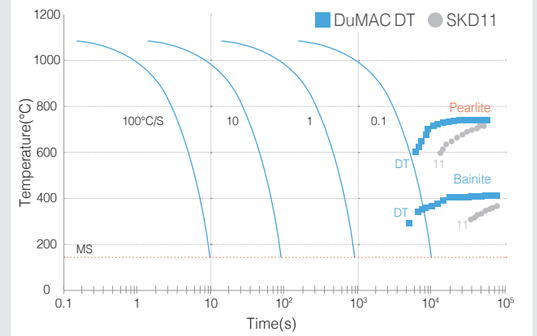
Mechanical Properties

- Hardness of HRC 58 or higher is obtained during high temperature tempering. In order to secure optimal hardness, heat treatment conditions suggested by SeAH CSS is recommended. (Adding N_2 gas over 0.3 bar during quenching)

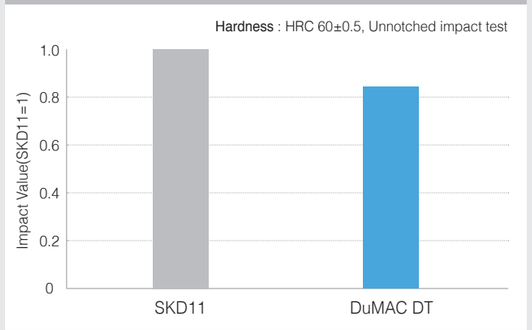
Heat Treatment Hardness



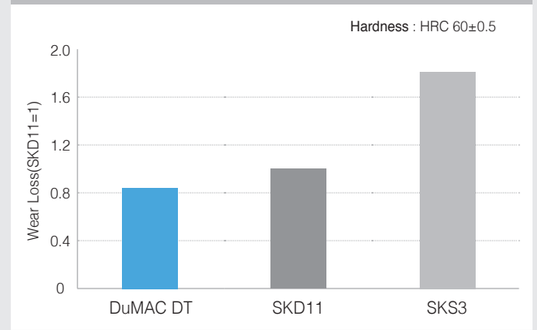
CCT Curve



Impact Toughness



Material Wear(Wear Resistance)



DuMAC WF ESR Specialized purpose

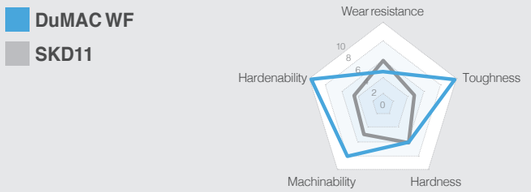
The best choice for cold and warm forging

DuMAC WF is a newly developed special-purpose cold tool steel from SeAH CSS, designed for **unparalleled performance in both cold and warm forging**. With optimized chemical compositions, DuMAC WF shows high wear resistance and toughness, characteristics of both the cold work tool steel and hot work tool steel. Furthermore, it ensures material cleanliness and homogeneous performance through an ESR process.

• WF: Warm Forging

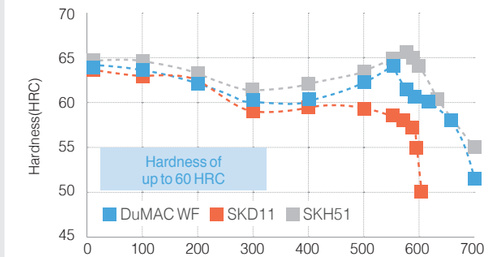
Applications

Recommended for cold and warm punching moulds that require high toughness and stable wear resistance

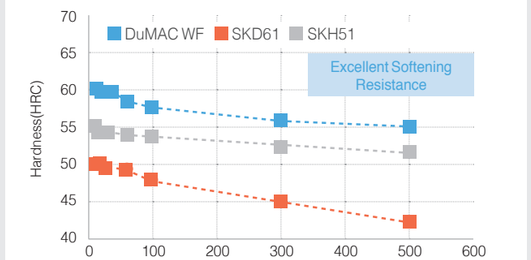


Mechanical Properties

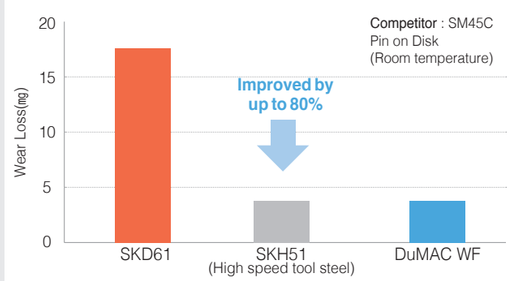
Heat Treatment Hardness



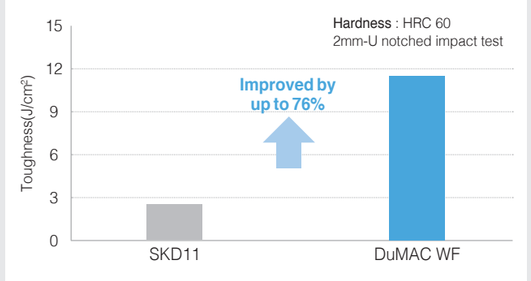
Softening Resistance(600°C)



Material Wear(Wear Resistance)



Impact Toughness



DuMAC RD Specialized purpose

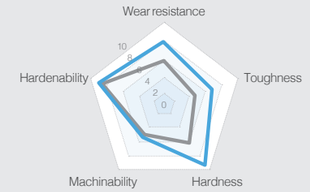
A byword for cold work tool steel for rolling dies

DuMAC RD is a special purpose **cold work tool steel** developed for diverse usage environments especially for **rolling dies**. This product maintains outstanding hardness at 64 HRC after QT heat treatment by finely dispersing eutectic carbide (M_7C_3), ensuring greater predictability for mould lifetime.

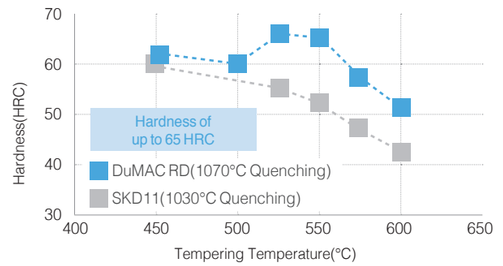
• RD : Rolling Dies
• QT : Quenching & Tempering

Applications

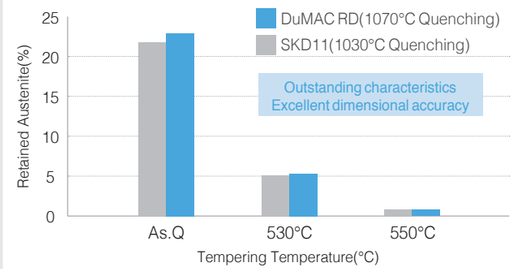
Suitable for roll dies that require high hardness



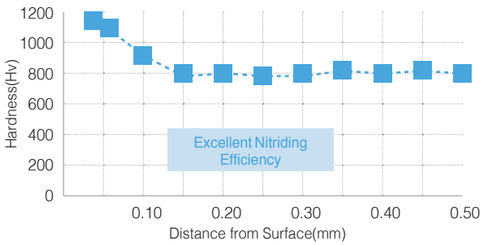
Heat Treatment Hardness



Residual Austenite Content(%)

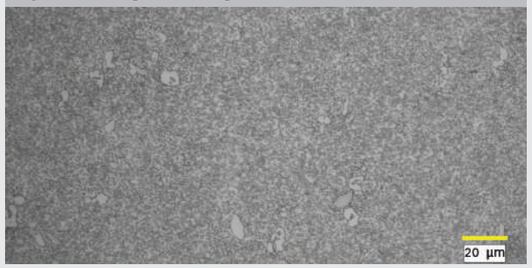


Nitriding Hardness



Microstructure

Spheroidizing Annealing



DuMAC DK Specialized purpose

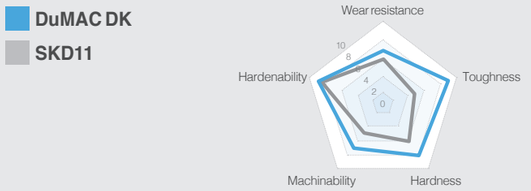
The best solution for industrial knives

DuMAC DK is a special-purpose cold work tool steel developed for products where impact toughness is especially important, especially for dies and industrial knives. Carbon-Chromium composition has been lowered, Molybdenum and special alloys have been added, and eutectic carbides are **refined to reduce damage while the cutting areas which has high hardness.**

• DK: Dies & Knives

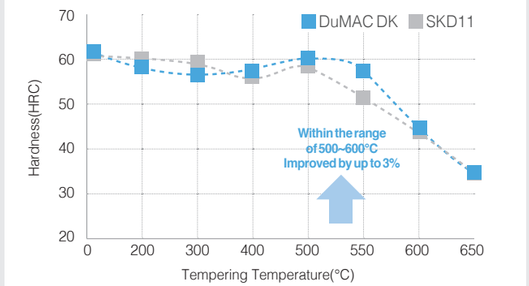
Applications

Suitable for slitter knives, cold presses, and blanking mould applications which require cold working of high-strength materials

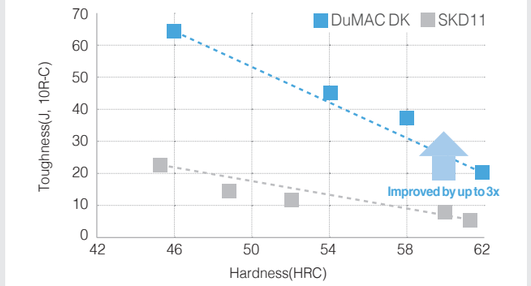


Mechanical Properties

Heat Treatment Hardness

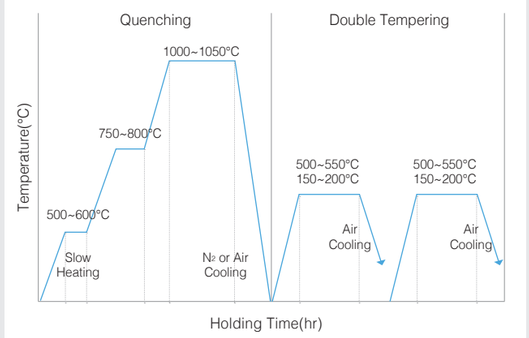


Impact Toughness

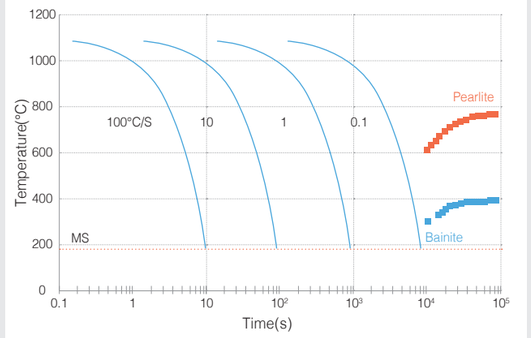


Heat Treatment Conditions

Heat Treatment



CCT Curve



TA23F85

A cold work tool steel suited for flame quenching heat treatment

TA23F85 is a low-alloy cold work tool steel that uses flame to secure **high levels of hardness and a hardened surface layer**. Hardenability is improved by by adding Si, and high strength by adding C.

Chemical Composition

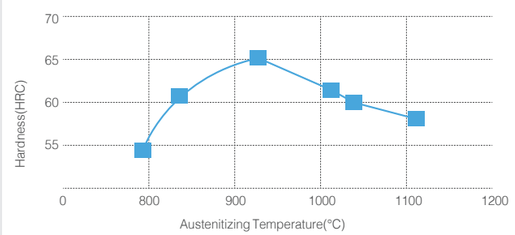
Type	Chemical composition(wt%)						
	C	Si	Mn	Cr	Mo	V	Al
TA23F85	0.80 0.90	0.80 1.20	0.70 1.10	1.80 2.20	0.20 0.30	0.07	0.02

Applications

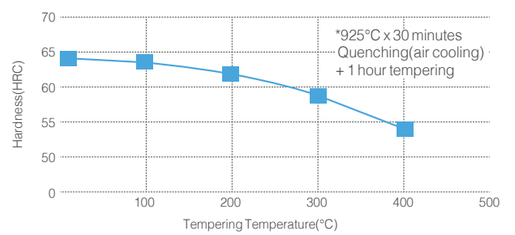
Automotive Part Moulds / Blanking Dies / Forming Dies / Trimming Dies / Shear Blades

Quenching and Tempering Heat Treatment Characteristics

Quenching Hardness

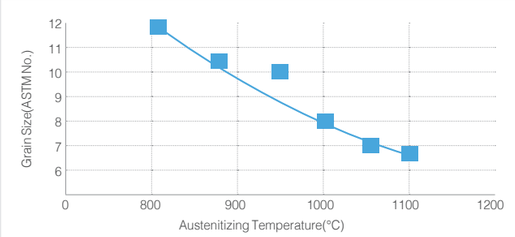


Quenching & Tempering Hardness

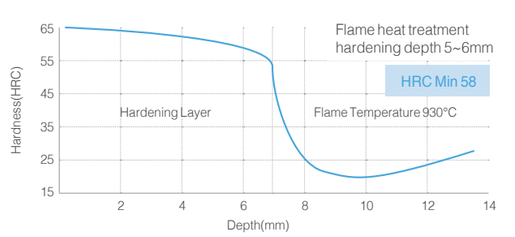


Mechanical Properties

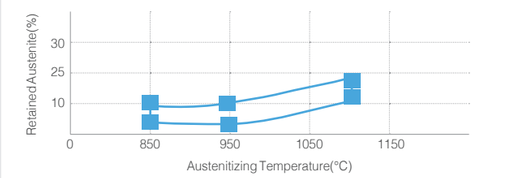
Grain Size



Hardening Depth

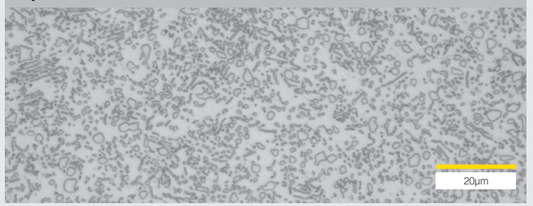


Residual Austenite



Microstructure

Spherical Carbide in Ferrite Matrix



TR12/TR2/TR3505C/TR5

High cleanliness roll material for hot/cold rolling

SeAH CSS produce roll materials from work rolls for cold rolling to back-up rolls with a **uniform structure and superior processability.** By producing specialized product groups for each application, we fulfill various customer needs.

Chemical Composition

Type	Chemical composition(wt%)						
	C	Si	Mn	Ni	Cr	Mo	V
TR12	1.50	0.50	0.50	0.20	12.0	1.00	0.80
TR2	0.50	1.10	0.40	0.20	5.00	1.30	0.60
TR3505C	0.90	0.65	0.35	-	3.20	0.20	-
TR5	0.90	0.30	0.45	Add	5.00	0.45	Add

Applications

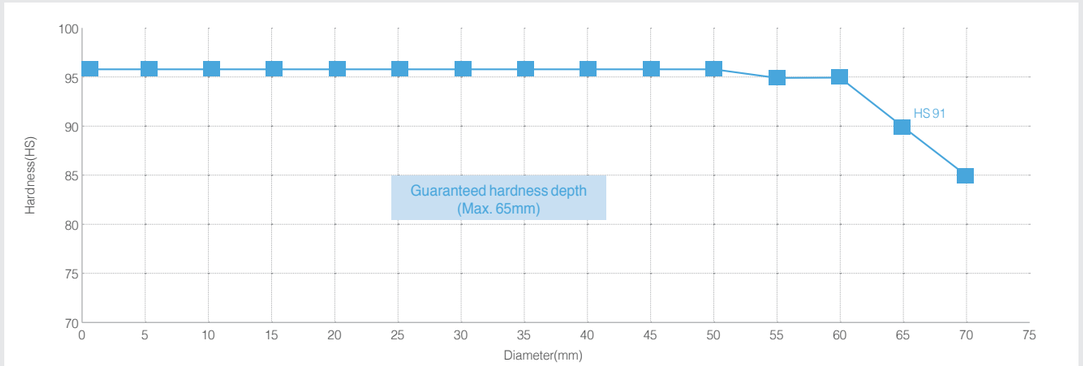
- TR12(SKD11 Modify) : Z/Mill Work Roll
- TR2(SKD62 Modify) : Z/Mill 1st / 2nd Roll
- TR3505C : 3% Cr Steel(General)
- TR5 : 5% Cr Steel(Electrical Plate Mill WR, Cold Rolled Mill WR/IMR)

*WR : Work Roll, IMR : Intermediate Roll

Work roll

Deep Hardness Distribution

- Uniform surface hardness secured: HS 96±1



Supply Performance

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 Steel		CR Shop	5% Cr Steel(ESR) W/R
BNG STEEL		STS CR Shop	Z/Mill
SeAH STEEL		CR Shop	3% Cr Intermediate Roll

TR12/TR2/TR3505C/TR5

DuRAH

The DuRAH Series is an exclusive brand of hot work tool steel developed by SeAH CSS for optimal performance in a variety of hot working environments. Designed with varying chemical compositions to suit a variety of working environments, the DuRAH series has been produced with advanced manufacturing processes and techniques, ensuring superior quality.

Strong Points

Excellent mechanical properties

A tool steel that is highly durable and possesses superior properties, including high temperature strength, toughness, hardness, hardenability, and wear resistance, designed to satisfy any consumer demand.

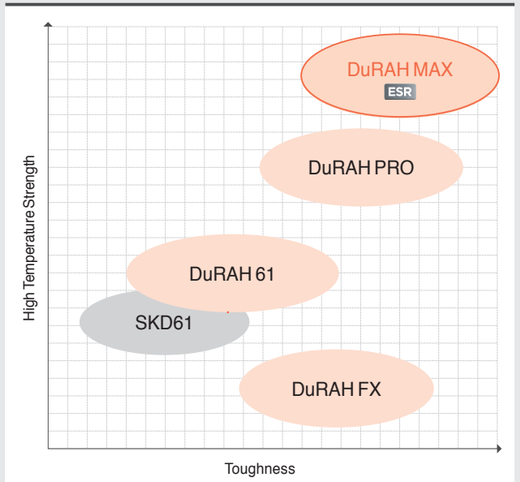
Heat check resistance

Optimized for large scale, high-pressure, high temperature, and complicated environments, thus improving the lifespan of moulds and increasing productivity.

Diverse product lineup

Our diverse products from hot stamping to extrusion, provides the best possible options for our customers in any environment.

Feature Positioning



Feature comparison

SeAH CSS	High-temperature strength	Toughness	Softening resistance	Wear resistance	Harden-ability
DuRAH MAX ESR	A+	S	A+	A+	A+
DuRAH PRO	A	A++	A	A	A+
DuRAH 61	B+	A	B+	B+	A
DuRAH FX [Specialized purpose]	B+	A+	B+	B+	A

Product Lineup

Product name			Major characteristics	Applications	Chemical composition(wt%)						Physical characteristics			
SeAH CSS	KS / JIS	AISI / DIN			C	Si	Mn	Cr	Mo	V	Thermal expansion coefficient (x 10^{-6}/°C)	Specific gravity (g/cm^3)	Thermal conductivity (W/mK)	Young's modulus (GPa)
DuRAH MAX ESR	-	-	Extended mould life span by extremly increased temperature strength, toughness and heat check resistance.	General and precision die casting moulds, etc.	0.35 0.40	0.30 0.60	0.60 0.90	4.80 5.30	Special element		11.3	7.82	25.0	220
DuRAH PRO	-	-	Improved high temperature strength, toughness, and mould lifespan compared to DuRAH 61	Die casting, hot stamping, hot forging moulds, etc.	0.35 0.40	0.50 0.80	0.40 0.70	5.00 5.50	Special element		11.3	7.78	25.5	215
DuRAH 61	STD61 SKD61	H13 WNr 1.2344	Hot work tool steel with stable high temperature strength and toughness	General moulds	0.35 0.42	0.80 1.20	0.25 0.50	4.80 5.50	1.00 1.50	0.80 1.15	11.3	7.75	24.6	210
DuRAH FX [Specialized purpose]	-	H11	Reduced cracking through improved toughness	Specialized for forging and extrusion	0.36 0.46	0.55 0.80	0.30 0.60	4.80 5.50	Special element		11.4	7.80	27.9	215

• SeAH CSS uses its superior production technology to keep P, S and other impurities at levels lower than required by official standards.

DuRAH MAX ESR

An optimal solution that surpasses all limits

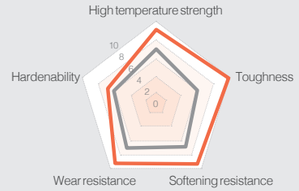
DuRAH MAX has been developed by SeAH CSS in accordance with the industrial trend for high-quality mould materials due to lightened end-products. DuRAH MAX provdes greater product lifespan even in extreme user environments by vastly improved **high temperature strength, impact toughness and heat check resistance.** Also the **ESR process ensures high cleanliness of this product.**

• Inclusions are removed from the substance used in the ESR process, while that substance undergoes rapid solidification using the slag to curb the forming of segregation in the high-alloy steel during the remelting and solidification stages, thereby effectively increasing mould lifespan.

Applications

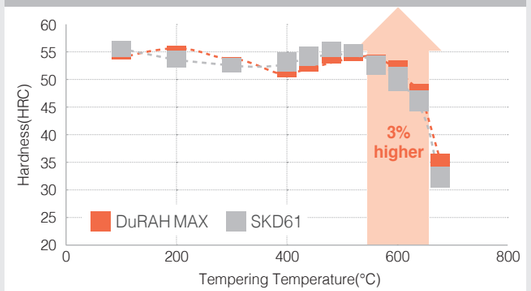
Recommended for large die-casting moulds that require the use of high-strength materials and large complex shape

DuRAH MAX
SKD61

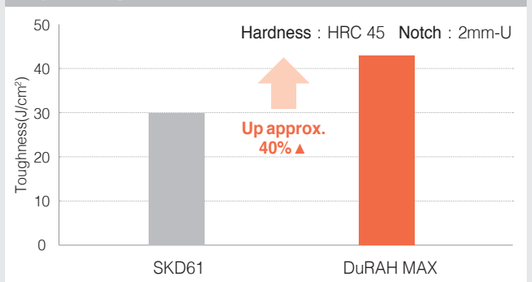


Mechanical Properties

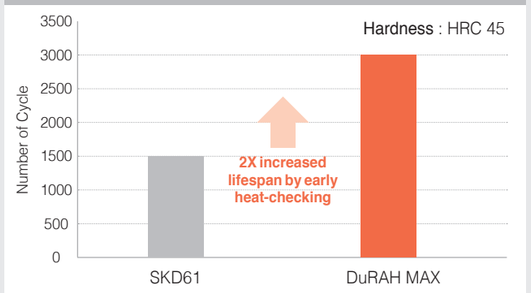
Heat Treatment Hardness



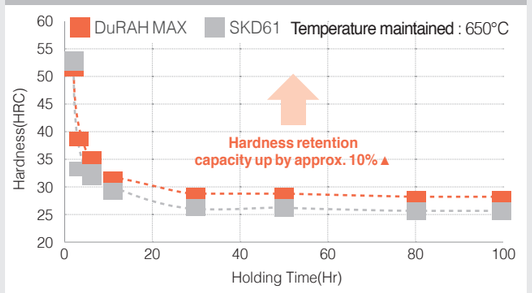
Impact Toughness



Heat Check Resistance



Softening Resistance



Applications

Category	Properties
Al Extrusion Mould	Recommended as high-strength aluminum extrusion mould
Results	Lifespan up 40%▲ vs. SKD61

Category	Properties
Steel pipe extrusion Mandrel/ Stem	Recommended for materials requiring high wear resistance and strength at high temperatures
Results	Lifespan up 40%▲ vs. SKD61

DuRAH PRO

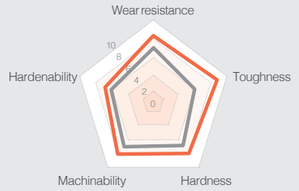
A highly efficient, premium solution for die casting and hot stamping

DuRAH PRO is a next-generation premium mould material that significantly improves the performance of standard SKD61 steel grade and extends mould lifespan even in extreme user environments. With superior impact toughness and high temperature strength through advanced manufacturing and optimum design, DuRAH PRO minimizes the occurrence of aluminum moulten metal erosion and heat-checking, **while providing stable performance even in extreme conditions**.

Applications

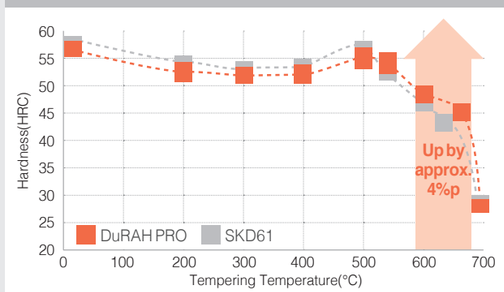
Hot forging moulds, extrusion moulds, die casting moulds requiring greater lifespan

DuRAH PRO
SKD61

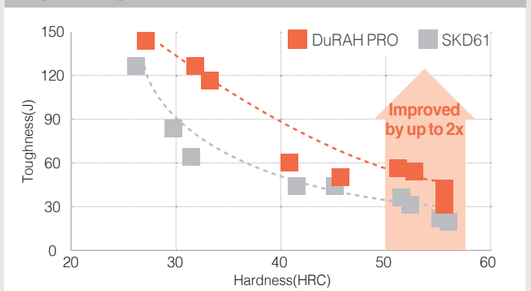


Mechanical Properties

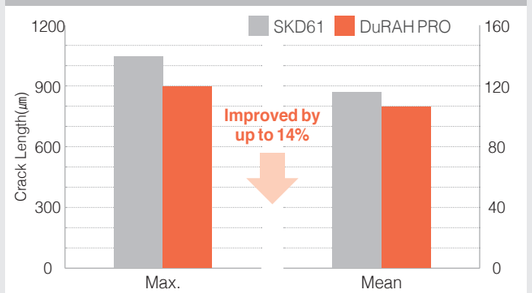
Heat Treatment Hardness



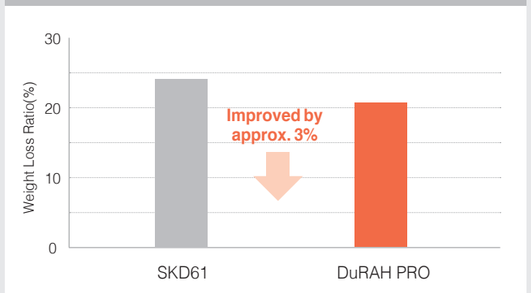
Impact Toughness



Heat Check



Al Molten Metal Erosion Properties



Applications

• DuRAH PRO is used as a mould material for production of automotive parts and proven to have longer mould lifespan than SKD61.

Type	Application Evaluation Results(vs. SKD61)	Evaluated Companies(mould)
Hot Forging	4,900 shots(▲60%)	Company K(Non-Driven)
	2,400 shots(▲40%)	Company K(Outer Race)
	5,030 shots(▲25%)	Company K(RR HUB)

DuRAH 61

Market proven hot work tool steel with advanced standards

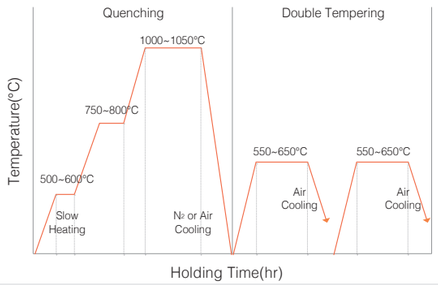
DuRAH 61 is an **all-rounded hot work tool steel** developed by SeAH CSS' empirical data and technology that has greater stability and performance than the standard steel grade, SKD61. More specifically, the product delivers greater applicability with higher red hardness and improved heat check resistance, which makes it well suited for any industry or environment. DuRAH 61 has demonstrated its excellence and set a new set of standards, resulting in the biggest Korean domestic market share.

Applications

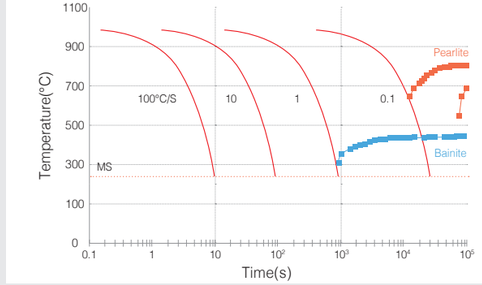
Suitable for most hot work, such as hot forging moulds, Al/Cu extrusion moulds and die casting moulds

Mechanical Properties

Heat Treatment

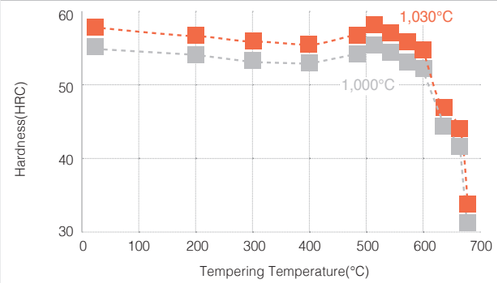


CCT Curve

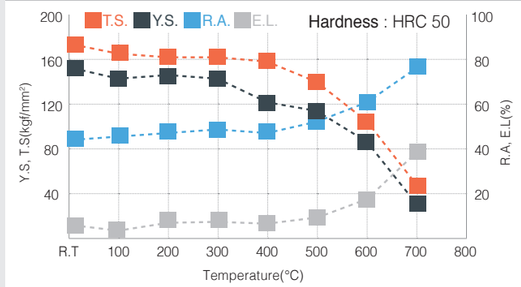


Heat Treatment Conditions

Heat Treatment Hardness

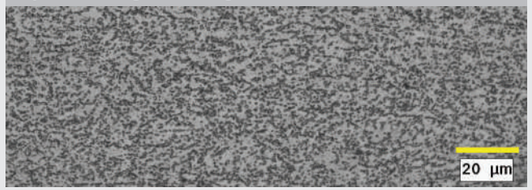


High Temperature Characteristics

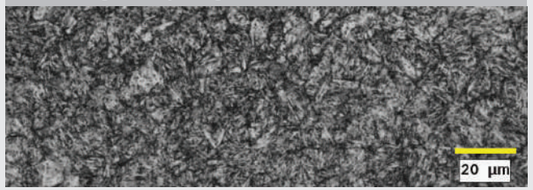


Microstructural Characteristics

Spheroidizing Annealing



Hardening & Tempering



DuRAH FX Specialized purpose

The best solution for forging and extrusion

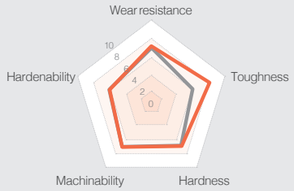
DuRAH FX is a hot work tool steel specially developed for **hot forging and extrusion moulds**. A rational specialized use product, which offers improved product lifespan by **significantly enhancing impact toughness** through the reduction of the risk of cracks or damage likely to occur in vulnerable sections due to external loads.

• FX: Forging & extrusion

Applications

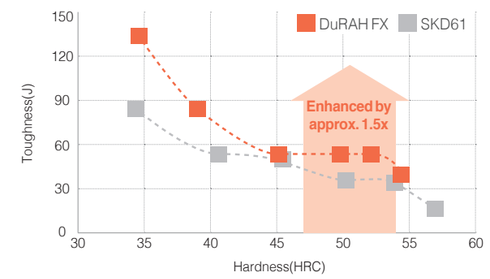
Suitable for hot forging moulds, hot extrusion moulds, etc. where there is a high risk of mould damage due to impact

DuRAH FX
SKD61

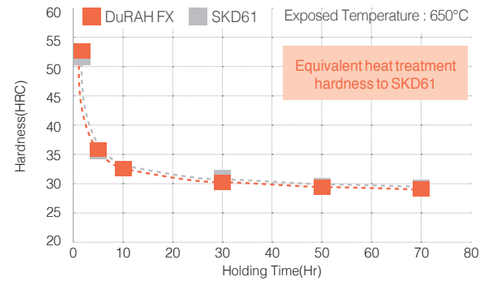


Mechanical Properties

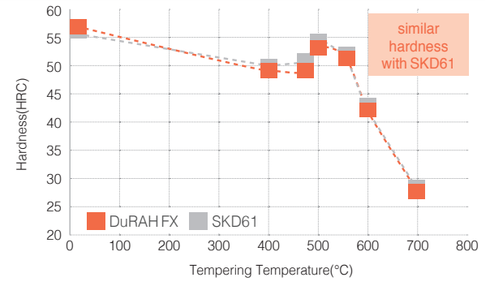
Impact Toughness



Softening Resistance



Heat Treatment Hardness



SKT4/SKT4V

Hot work tool steel for die forging and hammers with improved mould lifespan

SKT4/SKT4V is one of the most widely used steel grade for hot forging, which has improved mould lifespan by optimizing the chemical composition. SKT4V features increased Ni content for greater durability against impacts applied during the moulding process.

Chemical Composition

Type	Chemical composition(wt%)						
	C	Si	Mn	Ni	Cr	Mo	V
SKT4	0.50 0.60	0.10 0.40	0.60 0.90	1.50 1.80	0.80 1.20	0.35 0.55	0.05 0.15
SKT4V*	0.55	-	1.10	1.90	1.10	0.33	0.13

Applications

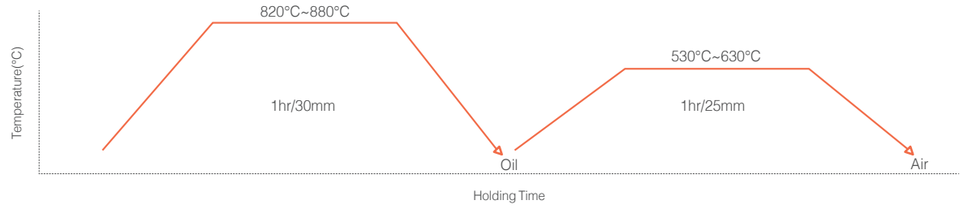
Tool steel for forming materials in a hot work state

- (Mould) forging mould, extrusion mould, die casting mould

Hot Forging Mould

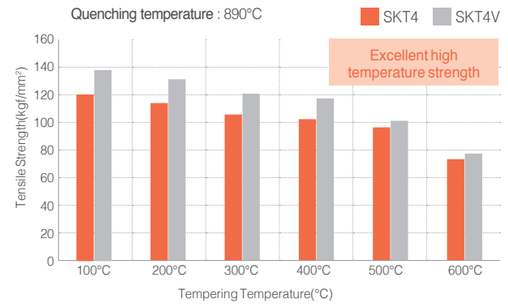
Quenching & Tempering Heat Treatment Conditions

- Tempering temperature varies according to the customer's required degree of hardness

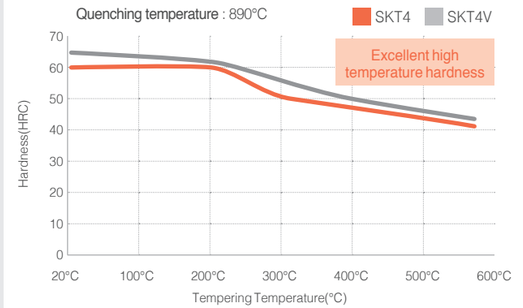


Changes in Physical Properties According to Tempering Temperature

Tensile Strength Changes According to Tempering Temperature

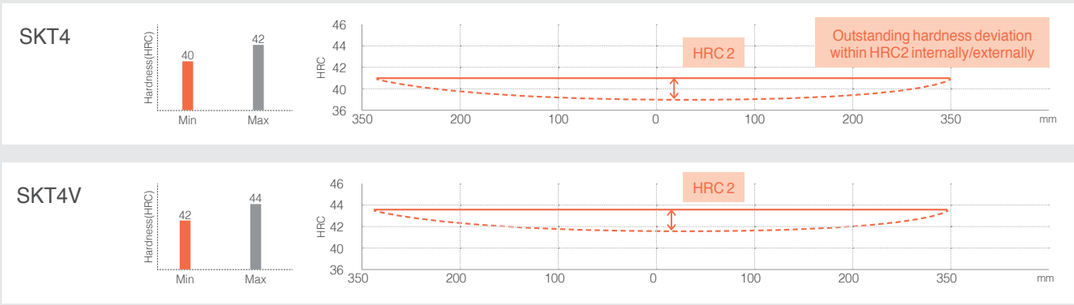


High Temperature Hardness



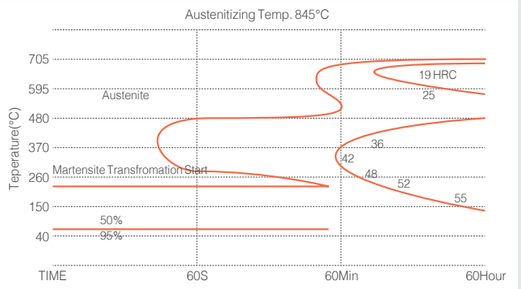
- The data above is from lab results and may differ by actual mould size and heat treatment environment.

Hardness Distribution

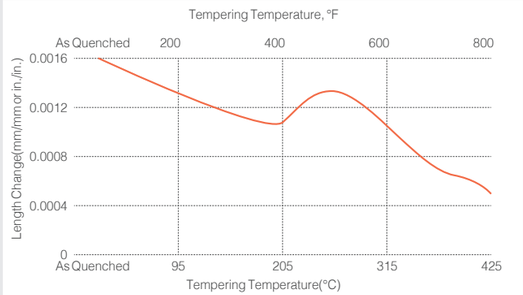


Heat Treatment Conditions

TTT Curve



Dimensional Changes



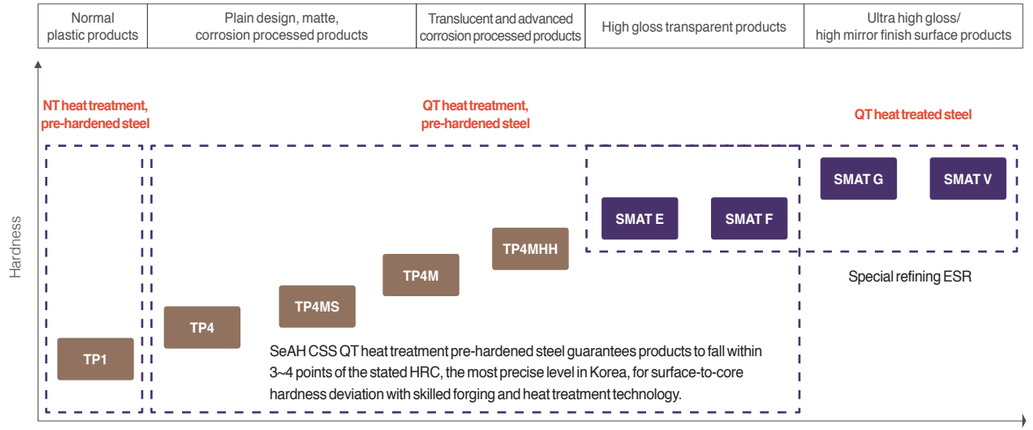
SMAT

The SMAT series is a brand of precision plastic mould steel developed by SeAH CSS based on an increase in the size and quality of products such as automobile lamps and TVs. SMAT has been officially approved for use by global home appliance/automobile manufacturers in Korea.
SeAH CSS is growing together with its customers by providing excellent affordability, quality, delivery time and after-sales service differentiation at both of domestic & global market.

Strong Points

Excellent machinability and weldability	Easier mould making and modification.
Wide range of dimensions and shapes	Cost reductions by minimizing machining loss.
Improved mirror surfacing and thermal conductivity	Contributes to high-quality injection moulding and productivity improvements.
Diverse product lineup	Offering a wide range of choices depending on the application and use environment of the mould.

Feature Positioning



*The precision plastic mould steel SMAT series is supplied in the form of pre-hardened steel or QT heat-treated steel depending on hardness.

Product Lineup

Product name	Characteristics	Applications	Hardness (HRC)	Mirror finish	Impact toughness (J/cm²)	Tensile characteristics(MPa,%)				Thermal expansion Coefficient(10^{-6}/℃)			Thermal conductivity(W/mK)			
						Y.S	T.S	El.	R.A	100°C	200°C	300°C	room temperature	100°C	200°C	300°C
SMAT E (ASTM P20+Ni ESR Modified)	Ni-Cr-Mo-based pre-hardened steel with mirror finish, weldability, and corrosion machining	Products with a high level mirror finish such as automobile lamp lenses, plating parts, and high-gloss TV bezels	37~41	#8,000 ~#12,000	45	1,050	1,200	14	45	12.0	12.9	13.5	36.7	31.8	30.5	29.5
SMAT F (ASTM P21 ESR Modified)	Ni-Al-Cu-based precipitation hardening precision machining with an outstanding mirror finish	Suitable for small moulds for transparent lenses used in automobiles, home appliances, plating and corrosion products	37~41	#8,000 ~#12,000	20	1,060	1,220	17	51	12.2	13.6	13.6	38.9	39.3	41.9	42.7
SMAT G (WNr1.2343 ESR Modified)	5% Cr-based QT heat-treated steel with excellent thermal conductivity and wear resistance	High-grade transparent lens resin with high fiber glass content	*46~52	#10,000 ~#14,000	110	325	640	31	70	11.3	12.4	12.9	36.6	34.1	31.9	30.5
SMAT V (WNr1.2083 ESR Modified)	STS 400 series QT heat-treated steel with excellent corrosion and wear resistance	Corrosive gas generating resin such as reflectors and optical lens BMC	*50~55	#10,000 ~#14,000	65	330	630	27	50	10.4	11.4	11.9	20.1	20.8	21.5	24.3

*Available in a wide range of hardness levels to meet customer heat treatment conditions
*QT : Hardening &Tempering

* QT heat-treated steel is the value measured under SA heat treatment conditions in addition to working-level hardness.
- The above data consist of measured values measured using KOLAS-certified equipment.

SMAT E ESR

Precision plastic mould steel with outstanding all-around properties

SMAT E is the first Korean precision plastic mould steel developed to solve problems related to material supply and cost, as well as the problems of mirror finish and workability of imported materials with a hardness of HRC 40. SMAT E boasts **excellent machinability, electric discharge machinability, and nitriding properties**, meanwhile it is **easy to mould and has excellent mirror finish properties**, as well as outstanding injection mould quality.

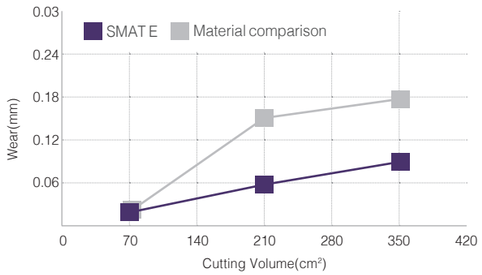
Applications

Mould for creating high-gloss precision injection mould products

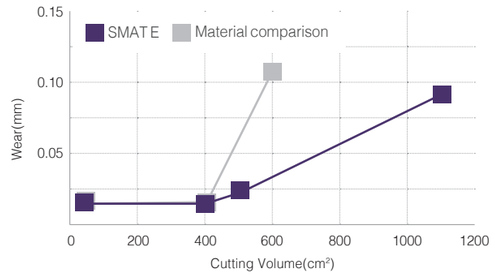
Hardness	Mirror finish
HRC 37~41	#8,000~12,000

Mechanical Properties

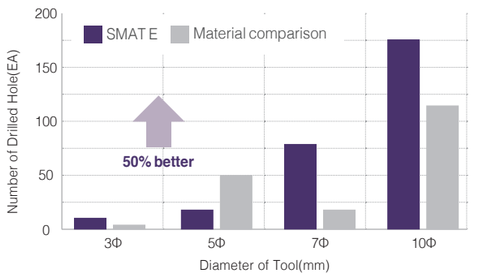
End-Mill(HSS material, diameter of 16Φ)



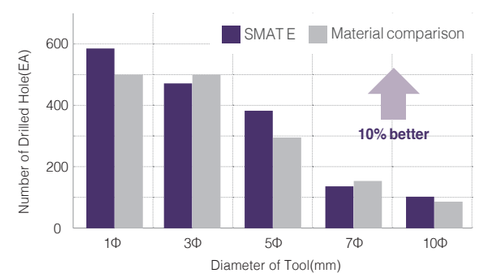
End-Mill((WC material, diameter of 16Φ)



Drill(HSS material)



Drill(WC material)

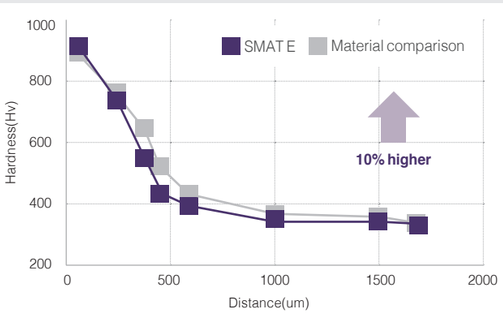


Gun Drilling

Tool diameter		Φ30	Φ18	Φ10	Φ5
Test conditions	PRM	389	800	1,400	3,000
	FEED (mm)	30	40	50	40
Maximum machining hole umber [EA]	SMAT E	9	6	6	27
	Com-parison material	0	1	1	1

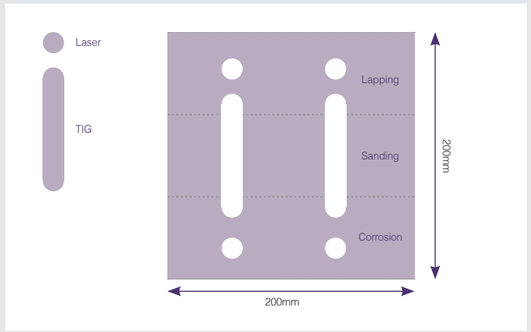
*Recommended machining conditions - 10Φ 1200rpm Feed 25~35mm/min - 8Φ 1400rpm, 27~35mm/min

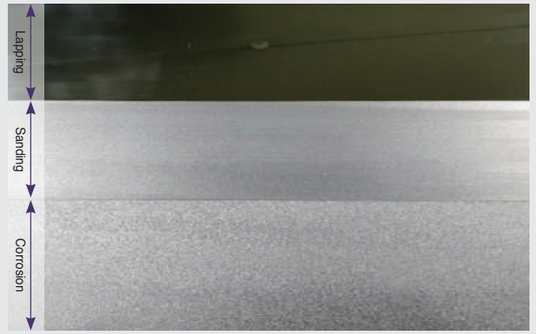
Nitriding Properties



Weldability

Welding type	Recommended welding rod	Welding conditions	Pre-heating temperature	Post-heating temperature
GTAW	SMAT E-TIG	Ø2.0~2.4, 200~270A	250~300°C	400~500°C
Laser	SMAT E_Laser	Ø0.6, 250V, 6.0ms, 25Hz		

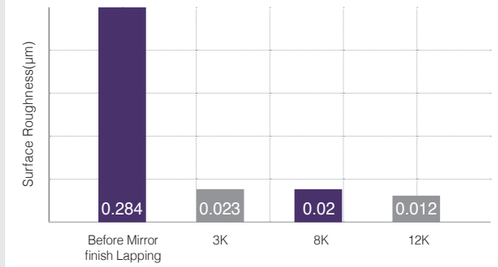




Mirror finish

First coating [Oil-stone]	Paper machining	Gloss [Compound]	Finishing [Absorbent cotton]
#600	Sandpaper #1,500	#3,000	#10,000
#1,200	Blackstone #2,000	#8,000	#12,000
#1,500 - #2,000		#12,000	

Surface Roughness



SMAT F ESR

Precipitation hardening high gloss precision plastic mould steel

SMAT F is a Ni-Al-Cu-based precipitation hardening **pre-hardened precision plastic steel** grade, with **a hardness of 40 HRC**.
Unlike SMAT E, SMAT F steel grade is produced with a thickness of 500 mm or less.

Applications

High-gloss precision plastic injection mould with excellent mirror finish, corrosion workability, and electric discharge workability. As a mould used for creating moulds, it is suited for use in various fields, and it is particularly appropriate for injection moulds with complex and sophisticated shapes due to its small dimensional deformation.

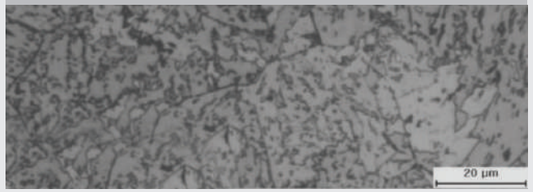
Hardness	Mirror finish
HRC 37~41	#8,000~#12,000

Cleanliness ASTM E 45 A Method

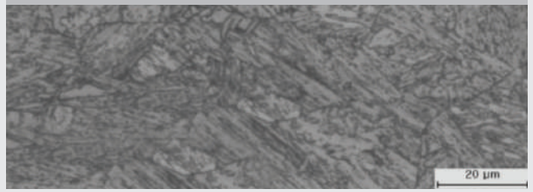
Type	Thin				Heavy			
	Sulfide	Alumina	Silicate	Globular Oxide	Sulfide	Alumina	Silicate	Globular Oxide
SMAT F	-	1.0	-	1.0	-	-	-	-

Structural Comparison

SMAT F (magnified ×500)



Comparison Material (magnified ×500)



Band-Saw Cuttability

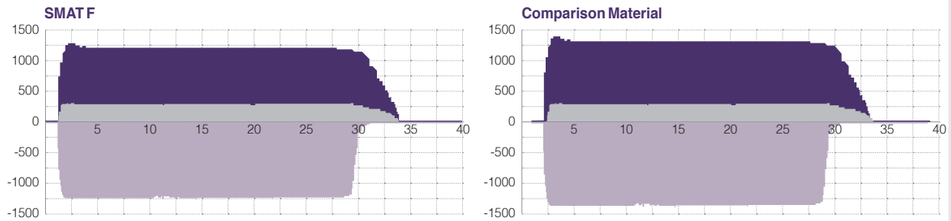
Type	Evaluation of band saw cuttability			
	Cuttability		Time required	Noise
SMAT F	Speed : 4.5	Pressure : 1	23 minutes 25 seconds	Good
Comparison material			23 minutes 22 seconds	Good

*Test method: Measure the time required for cutting specimens of the same dimensions (45T×405W) under the same conditions

End Mill Machinability

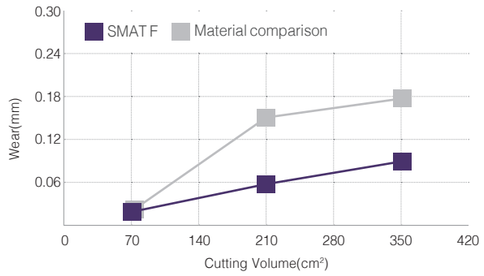
- The load on the cutting tool is lower than that of the comparison material and the cutting pattern is uniform
- Rotational speed: RPM 1320, depth of cut: 2mm, feed rate: 0.7m/min

Maximum cutting force	1,222 N	1,303 N
Cutting force graph	SMAT F	Comparison Material

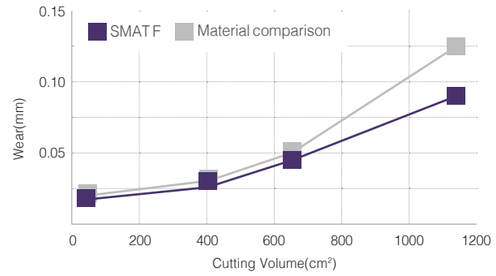


Machinability

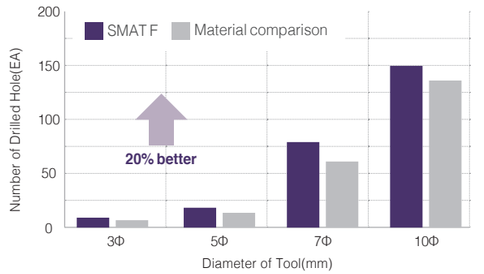
End-Mill(HSS material, diameter of Φ16)



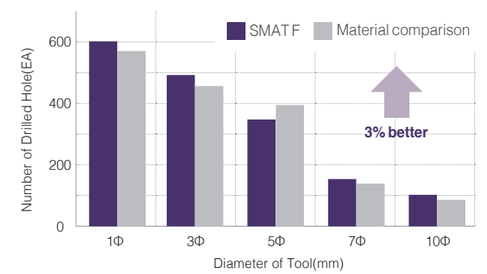
End-Mill(WC material, diameter of Φ16)



Drill(HSS material)



Drill(WC material)



SMAT G ESR

5% Cr-based high-gloss, high-precision plastic mould steel

SMAT G steel grade is a Q/T heat-treated steel, which enables diverse levels of hardness and has **excellent thermal conductivity compared to current materials**. As a precision plastic mould steel, **it is expected to shorten the injection moulding cycle and improve productivity**.

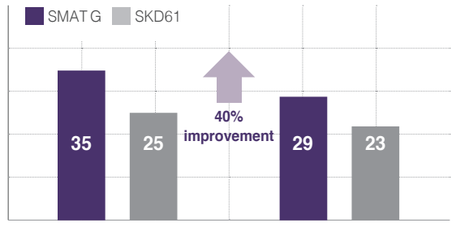
Applications

A precision plastic mould steel suitable for moulds that require high mirror surfacing / wear resistance, such as resins containing high fiber glass content or thermoset resin moulding.

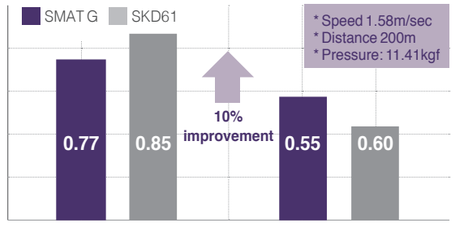
Hardness	Mirror finish
HRC 46~52	#10,000~#14,000

Mechanical Properties

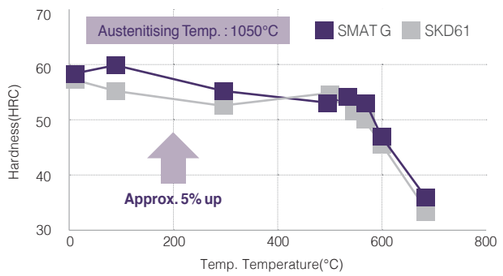
Thermal Conductivity



Wear Resistance



Hardness



SMAT V ESR

Premium precision plastic mould steel for lens moulding

SMAT V is a modified steel grade based pm STS420J2 which show great corrosion resistance and shows excellent wear resistance, corrosion resistance and mirror surfacing properties. In addition, it features excellent Ni plating and peelability, making it suitable for use as an aspherical lens mould.

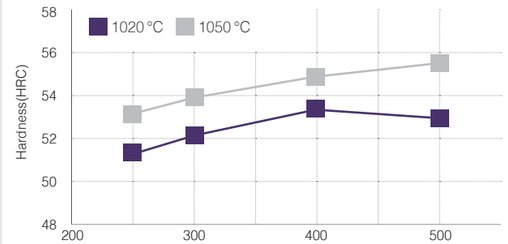
Applications

Ideal for use as a resin injection mould in a harsh corrosive environment, thermoset resin and high fiber glass content, and can be used as aspherical lens injection mould because of its excellent mirror surfacing and Ni plating properties.

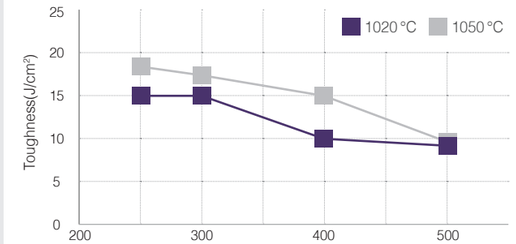
Hardness	Mirror finish
HRC 50~55	#10,000~#14,000

Mechanical Properties

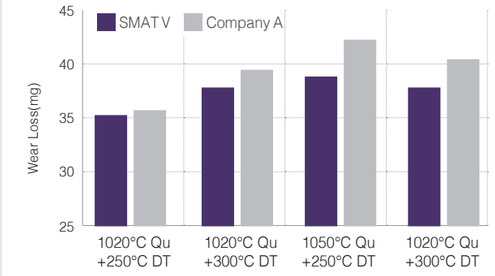
Heat Treatment Hardness



Impact Toughness



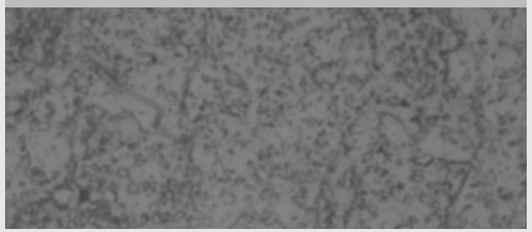
Wear Resistance



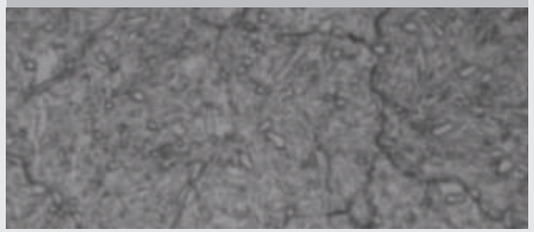
Equipment	OGOSHI Type
Material	WC
Hardness	HRC 77
Diameter	30mm
Thickness	3.2mm
Rotation speed	1.58m/sec
Machining length	200m

Structural Comparison

Before Q/T Heat Treatment



After Q/T Heat Treatment



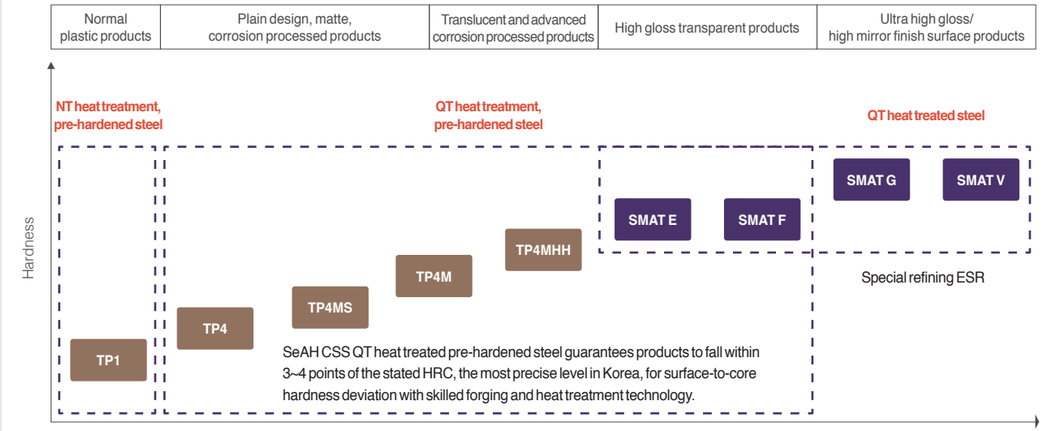
TP

The TP series is a high-quality plastic mould steel brand produced through high cleanliness refining and state-of-the-art forging/heat treatment methods, optimally designed with the accumulated technological knowhow of SeAH CSS. Customers can always choose a wide variety of products suitable for diverse use environments.

Strong Points

Corrosion workability	Stable quality with excellent uniform characteristics
Machinability	Reduced machining costs thanks to the outstanding design of optimal alloy
Minimized hardness deviation	Uniform internal/external hardness even in cross-section products (within an HRC of 3-4 points)
Outstanding external appearance	Ensure quality external appearance through oxidation scale removal and careful inspections

Feature Positioning



*The precision plastic mould steel SMAT series is supplied in the form of pre-hardened steel or QT heat-treated steel depending on hardness.

Product Lineup

Product name	Characteristics	Applications	Hardness (HRC,* HB)	Mirror finish	Impact toughness (J/cm²)	Tensile characteristics(MPa,%)				Thermal expansion coefficient(10^{-6}/℃)			Thermal conductivity(W/mK)			
						Y.S	T.S	El.	R.A	100°C	200°C	300°C	room temperature	100°C	200°C	300°C
TP1 / S55CP (S55C Modified)	Carbon steel-type mould steel	General-purpose mould base for general miscellaneous goods	175~215	~#1,000	45	350	710	24	49	11.9	12.5	13.8	47.2	45.6	42.4	38.3
TP4 (WNr1.2311 Modified)	Cr-Mo based mould steel with corrosion machining and impressive weldability	Lower mould for automobile interior and exterior materials, bumpers, home appliance parts, etc.	26~32	~#3,000	40	730	900	15	50	12.3	12.9	13.8	40.8	37.1	35.1	33.0
TP4M (WNr1.2738 Modified)	Ni-Cr-Mo mould steel Higher quality mirror finish vs. TP4, with corrosion machining and impressive weldability	Automotive interior and exterior materials, bumpers, home appliance parts, etc. A more advanced upper mould vs. TP4	30~35	~#5,000	40	880	1,040	20	56	12.0	13.1	13.7	39.5	36.5	34.9	32.3
TP4MS (WNr1.2312 Modified)	S added, Free-cutting mould steel with outstanding machin-ablility	Automotive interior and exterior materials, lamp housings, bezels, etc.	28~31	~#5,000	20	930	1,050	15	37	11.6	12.2	12.8	34.3	38.3	39.8	40.4
TP4MHH (WNr1.2738 HH Modified)	Higher-quality mirror finish vs. TP4M	TV back covers, automobile polishing parts mould	35~38	#5,000 ~#8,000	30	1,030	1,190	16	51	12.2	13.2	13.7	36.2	33.8	33.3	30.3

TP1/TP4/TP4M

A new standard for general-purpose mould steel created with advanced technology

TP1, TP4, and TP4M are common steel grades used for over 90% of the plastic mould steel market. SeAH CSS's quality-oriented chemical composition and manufacturing process has **significantly lower segregation defects, resulting in reduced risk of quality defects when used as corrosion moulds**.

• TP4, TP4M, rolled products under 150T are available in TP4R and TP4MR steel grades.

Applications

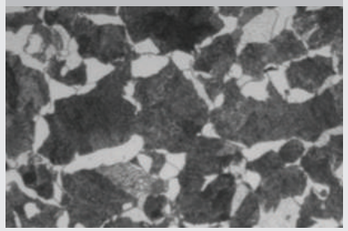
TP1, TP4, and TP4M are used as moulds for injection moulding of glossy and corrosion patterns in diverse fields such as mould base, miscellaneous good moulds, automobiles, home appliances, OA equipment, and in other fields

	Hardness	Mirror finish
TP1	HB 175~215	~#1,000
TP4	HRC 26~32	~#3,000
TP4M	HRC 30~35	~#5,000

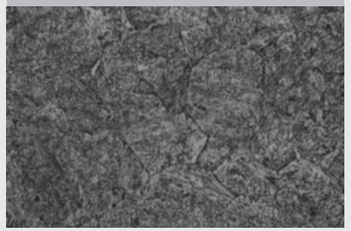
Microstructure

• Uniform characteristics secured through technology-intensive steelmaking and refining technology.

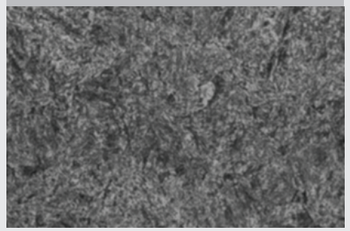
TP1



TP4



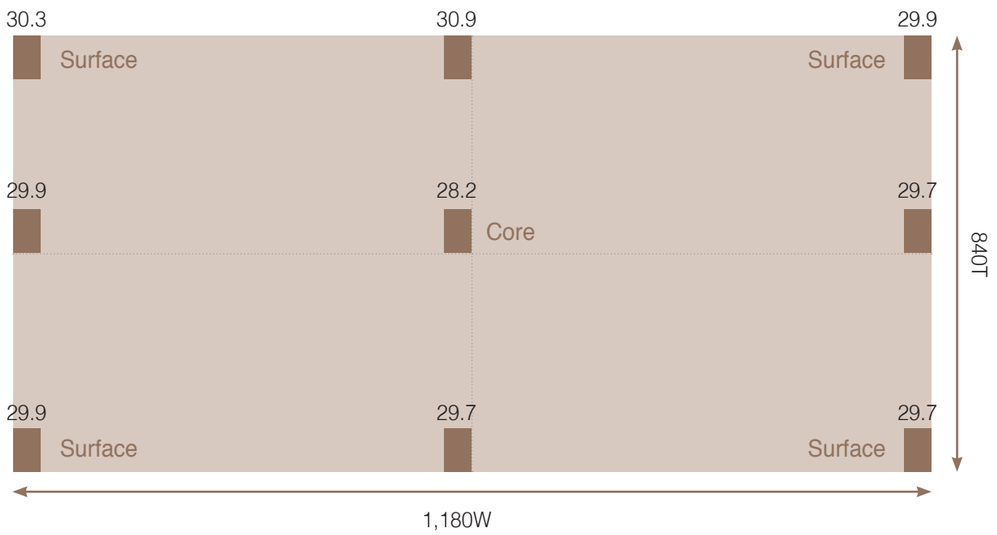
TP4M



Hardness Distribution

• TP series QT heat-treated pre-hardened steel features uniform properties with hardness variation within 3 HRC points.

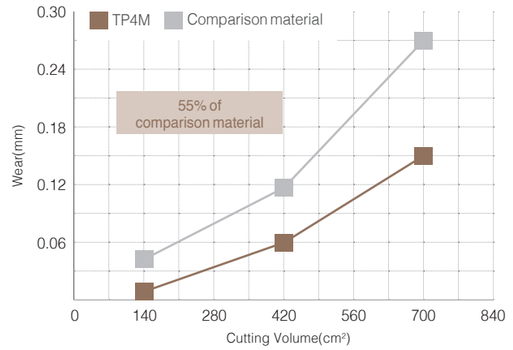
* T X W cut surface hardness distribution(Example)



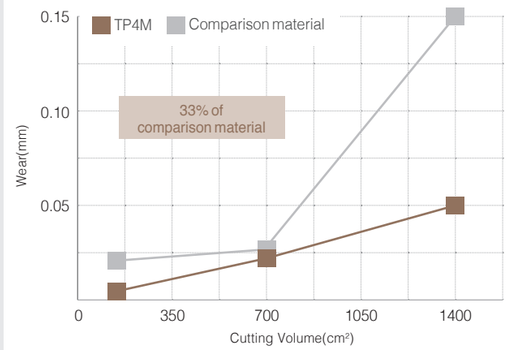
Machinability

• Steel grade TP4M •Based on tool life: HSS 0.3mm, WC 0.15mm

HSS Material, Diameter of 16Φ



WC Material, Diameter of 16Φ



Gun Drilling

Maximum number of machining holes: average of 28% better(up to 6x)

Type	Maximum number of machining holes(EA)			
	Φ30	Φ18	Φ10	Φ5
TP4	12	26	82	156
Comparison material 1	9	5	66	133
TP4M	9	6	80	150
Comparison material 2	9	1	50	133

• Machining conditions : Machining length (30D), cross-section machining, measuring the maximum number of machining holes at the point of tool breakage

Φ30		Φ18		Φ10		Φ5	
RPM	FEED (mm/min)	RPM	FEED (mm/min)	RPM	FEED (mm/min)	RPM	FEED (mm/min)
584	42	1100	70	1900	70	4000	50

TP4MS

Cutting-optimized mould steel with significantly improved machinability

In order to **significantly improve the machinability** of the existing SNCM alloy mould steel, TP4M, a pre-hardened mould steel with a hardness of HRC 28~31 that can **reduce mould manufacturing costs and shorten manufacturing time** through the formation of MnS non-metallic inclusions was utilized.

Applications

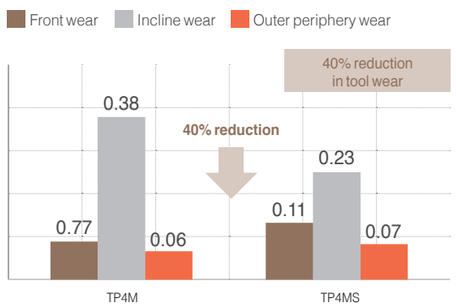
Due to its impressive mirror surfacing properties, TP4MS can be used in automobile lamp lenses and instrument panels, in-panel moulds, etc. Thanks to its excellent machinability, it can be used in moulds for moulding injection products with complex and sophisticated shapes

Hardness	Mirror finish
HRC 28~31	~#5,000

Mechanical Properties

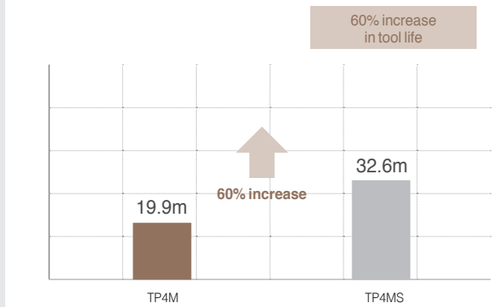
- Machining conditions: Tool 10Ø(4t), carbide, dry / ap 15mm, ae 1mm
- Cutting speed 80m/min, spindle rotation 2550min-1, feed speed: 820mm/min

End Mill Machining [Comparison of Tool Wear]



- Machining conditions: Tool 10Ø, carbide, wet / 510mm depth
- Cutting speed 60.3m/min, spindle rotation 1920min-1, feed rate: 38mm/min

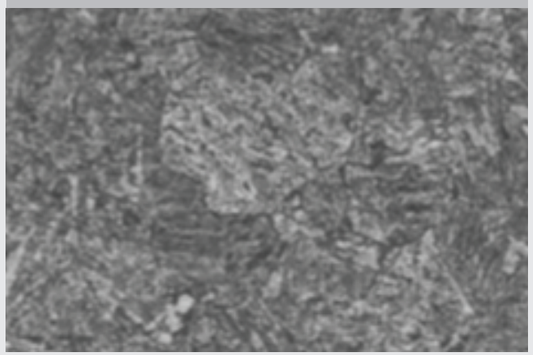
Gun Drill Machining [Gun Drill Machining Length]



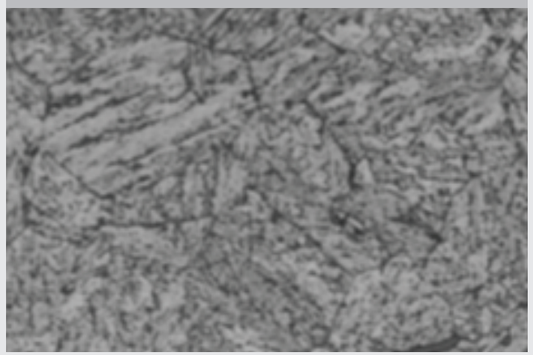
Microstructure

- Uniform tempered martensite structure and MnS non-metallic inclusions are distributed, so machinability is significantly superior to that of TP4M.

TP4M



TP4MS



TP4M HH

The best choice for surface mirror finishing and corrosion workability

Appropriate for use as a high-hardness mould material with mirror finishing and **high gloss with a hardness of HRC 35-38** thanks to the adjustment of hardenability elements in TP4M, an SNCM alloy mould steel.

Applications

Can be used in high gloss precision moulds and moulds with uniform corrosion on a cross-section surface such as hairline corrosion used for automobile interior and exterior trim, TV rear covers, Cr/Al plating, refrigerators, transparent containers, washing machines, air conditioners, electric rice cookers, vacuum cleaners, etc.

Hardness	Mirror finish
HRC 35~38	#5,000~#8,000

Machinability

- Outstanding machinability and minimal tool wear through optimal alloy design.

Type	Material	Spindle speed RPM	Feed rate /min	Machining length mm	Machining number of holes	Wear µm	Tool diameter	Specimen measurements mm	Conditions
Gun drill		192	38	2650	5	-			
		1440	32	5300	10	-	Φ10	400*150*530	
		1440	28	14840	28	-			
End mill	HSS	280	45	8	-	0.68	Φ16	70*120*190	After 3 passes Wear
	WC	3020	190	2.5	-	0.05	Φ5		
		1090	110	8	-	0.13	Φ16		
Drill	HSS	1880	94	7D	181	Breakage	Φ3	70*120*190	
		730	94.9	7D	27	Breakage	Φ7		
	WC	6000	780	6D	851	0.09	Φ3		
		4800	912	6D	322	0.05	Φ16		

Manufactureable Standard

Classification	Standard	Steel grade	Chemical composition(Wt, %)										Annealing		Heat treatment temperature(°C)		Hardness	Applications
			C	Si	Mn	P	S	Ni	Cr	Mo	V	Other	Temperature(°C)	Hardness	Quenching	Tempering		
General purpose plastic mould steel	SeAH CSS	TP1	0.50 0.55	0.20 0.40	0.75 0.90	0.025		0.20	0.20			Added	Prehardened steel		850~890 Air cooling	540~590 Air cooling	HB 215	General miscellaneous good moulds and mould bases
		TP4R	0.38 0.43	0.20 0.40	0.90 1.10	0.035	0.035		0.90 1.10	0.20 0.30	0.02 0.05	Added			850~890 Oil cooling	540~620 Air cooling	HRC 25~32	Automobile bumpers, interior and exterior material moulds Moulds for TV rear covers/stands, washing machines, refrigerators, OA equipment, etc.
		TP4MR	0.35 0.40	0.20 0.40	0.90 1.10	0.030	0.030		1.30 1.70	0.10 0.30	0.020 0.050	Added			850~890 Oil cooling	540~620 Air cooling	HRC 30~35	
		TP4	0.26 0.43	0.20 0.40	0.80 1.40	0.025	0.020	0.45	0.90 1.60	0.20 0.30	0.02 0.04	Added			850~890 Oil cooling	540~620 Air cooling	HS 38~44	
		TP4M	0.26 0.37	0.20 0.40	0.80 1.30	0.025	0.02	0.30 0.55	1.65 2.10	0.40 0.50	0.02 0.04	Added			850~890 Oil cooling	540~620 Air cooling	HS 42~48	
		TP4MS	0.13 0.20	0.10 0.30	1.75 1.90	0.025	0.020 0.035	0.20	1.75 1.85	0.35 0.45	0.09 0.13	Added			850~890 Oil cooling	540~620 Air cooling	HRC 28~31	
		TP4MHH	0.25 0.32	0.20 0.40	1.15 1.30	0.012	0.010	0.25 0.35	1.80 2.00	0.35 0.50	0.35 0.50	Added			850~890 Oil cooling	540~620 Air cooling	HRC 35~38	
	DIN	WNr 1.2311	0.35 0.45	0.20 0.40	1.30 1.60	0.035	0.035		2.00 2.10	0.15 0.25		Added			850~890 Oil cooling	540~620 Air cooling	HRC 28~32	
		WNr 1.2312	0.35 0.45	0.30 0.50	1.40 1.60	0.03	0.050 0.100		1.80 2.00	0.15 0.25		Added			850~890 Oil cooling	540~620 Air cooling	HB 280~325	
		WNr 1.2738	0.35 0.45	0.20 0.40	1.30 1.60	0.035	0.035		0.90 1.20	1.80 2.10	0.15 0.25	Added			850~890 Oil cooling	540~620 Air cooling	HRC 30~34	
Precision plastic mould steel	SeAH CSS	SMAT E	0.21 0.28	0.20 0.40	1.40 1.80	0.20	0.005	0.90 1.20	1.20 1.90	0.40 0.80	0.05 0.20	Added			850~890 Oil cooling	540~620 Air cooling	HRC 37~41	High gloss moulds such as automobile lamp lens moulds, TV front bezel moulds, and SMAT F washing machine and refrigerator moulds
		SMAT F	0.09 0.13			0.015	0.005	3.2	0.50	0.50		Added			850~890 Oil cooling	540~620 Air cooling	HRC 37~41	
		SMAT V	0.28 0.45	0.30 1.20	0.30 1.20	0.03	0.010	0.80	12.00 14.50	0.50	0.20 0.40	Added	760~870 Annealing	HB 200 Max	1,000~1,050 Oil cooling	250~600 Air cooling	Min HRC 50	Automotive reflector moulds, aspherical/ spherical lens moulds and SMAT G thermoset resin injection moulds
		SMAT G	0.30 0.60	0.40	0.30 0.60	0.015	0.015	0.60	4.00 6.00	0.80 2.00	0.20 1.00	Added	760~870 Annealing	HB 220 Max	1,000~1,050 Oil cooling	250~600 Air cooling	Min HRC 48	
Tool steel for cold moulds	KS	STD11	1.40 1.60	0.40	0.60	0.03	0.03		11.00 13.00	0.80 1.20	0.20 0.50		830~880 Annealing	HB 255 Max	1,030 Air cooling	180 Air cooling	HRC Min 58	Cold dies, presses, tools industrial knives
	JIS	SKD11	1.40 1.60	0.40	0.60	0.03	0.03		11.00 13.00	0.80 1.20	0.20 0.50		830~880 Annealing	HB 255 Max	1,030 Air cooling	180 Air cooling	HRC Min 58	
	ASTM	D2	1.40 1.60	0.10 0.60	0.10 0.60	0.03	0.03		11.00 13.00	0.70 1.20	0.50 1.10		830~880 Annealing	HB 255 Max	1,010 Air cooling	204 Air cooling	HRC Min 59	
		D3	2.00 2.35	0.10 0.60	0.10 0.60	0.03	0.03		11.00 13.00		1.00	W : Max1.0	830~880 Annealing	HB 255 Max	968 Oil cooling	204 Air cooling	HRC Min 61	
		D4	2.05 2.40	0.10 0.60	0.60	0.03	0.03		11.00 13.00	0.70 1.20	0.15 1.00		830~880 Annealing	HB 255 Max	996 Air cooling	204 Air cooling	HRC Min 62	
	DIN	WNr 1.2379	1.50 1.60	0.10 0.40	0.15 0.45	0.03	0.03		11.00 12.00	0.60 0.80	0.90 1.10		830~880 Annealing	HB 255 Max	1,010 Air cooling	204 Air cooling	HRC Min 58	
		WNr 1.2080	1.90 2.20	0.10 0.40	0.15 0.45	0.03	0.03		11.00 12.00				830~880 Annealing	HB 248 Max	996 Air cooling	204 Air cooling	HRC Min 60	
	SeAH CSS	DuMAC MAX	0.90 1.10	0.90 1.20	0.30 0.60				7.70 8.50			Added	830~880 Annealing	HB 255 Max	1,030~1,050 Air cooling	520 Air cooling	HRC Min 60	Trimming moulds
		DuMAC PRO	0.90 1.10	0.95 1.10	0.50 0.80				7.80 8.20			Added	830~880 Annealing	HB 255 Max	1030 Air cooling	520 Air cooling	HRC Min 58	Press moulds for forming high-tensile steel sheets
		DuMAC 11	1.40 1.60	0.40	0.60	0.03	0.03		11.00 13.00	0.80 1.20	0.20 0.50		830~880 Annealing	HB 255 Max	1,030 Air cooling	180 Air cooling	HRC Min 58	General purpose cold moulds
		DuMAC DT	1.60 1.80	0.70 1.00	0.40 0.80				11.0 13.0			Added	830~880 Annealing	HB 255 Max	1,030 Air cooling	180 Air cooling	HRC Min 58	Cold moulds
		DuMAC RD	0.90 1.10	0.80 1.10	0.30 0.60				6.80 7.50			Added	830~880 Annealing	HB 255 Max	1,030 Air cooling	520 Air cooling	HRC Min 60	Die forging
		DuMAC DK	0.65 0.80	0.90 1.20	0.30 0.60				7.00 8.00			Added	830~880 Annealing	HB 255 Max	1,030 Air cooling	520 Air cooling	HRC Min 58	Industrial knives, blanking moulds
		DuMAC WF	0.61 0.67	1.30 1.80	0.40 0.50				4.30 4.90			Added	830~880 Annealing	HB 229 Max	1,130 Salt bath treatment	560 Air cooling	HRC Min 58	Cold/hot punch moulds
Tool steel for hot moulds	KS	STF4	0.50 0.60	0.10 0.40	0.60 0.90	0.03	0.02	1.50 1.80	0.80 1.20	0.35 0.55	0.05 0.15		740~800 Annealing	HB 248 Max	850 Oil cooling	500 Air cooling	HRC Min 42	Extrusion moulds, die casting moulds, forging moulds, industrial knives
		STD61	0.35 0.42	0.80 1.20	0.25 0.50	0.03	0.02		4.80 5.50	1.00 1.50	0.80 1.15		820~870 Annealing	HB 229 Max	1,020 Air cooling	550 Air cooling	HRC Min 50	
		STD62	0.32 0.40	0.80 1.20	0.20 0.50	0.03	0.02		4.75 5.50	1.00 1.60	0.20 0.50	W : 1.0~1.6	820~870 Annealing	HB 229 Max	1,020 Air cooling	550 Air cooling	HRC Min 48	
		STD6	0.32 0.40	0.80 1.20	0.50	0.03	0.02		4.50 5.50	1.00 1.50	0.30 0.50		820~870 Annealing	HB 229 Max	1,050 Air cooling	550 Air cooling	HRC Min 48	
	JIS	SKT4	0.50 0.60	0.10 0.40	0.60 0.90	0.03	0.02	1.50 1.80	0.80 1.20	0.35 0.55	0.05 0.15		740~800 Annealing	HB 248 Max	850 Oil cooling	500 Air cooling	HRC Min 42	
		SKD61	0.35 0.42	0.80 1.20	0.25 0.50	0.03	0.02		4.80 5.50	1.00 1.50	0.80 1.15		820~870 Annealing	HB 229 Max	1,020 Air cooling	550 Air cooling	HRC Min 50	
		SKD62	0.32 0.40	0.80 1.20	0.20 0.50	0.03	0.02		4.75 5.50	1.00 1.60	0.20 0.50	W : 1.0~1.6	820~870 Annealing	HB 229 Max	1,020 Air cooling	550 Air cooling	HRC Min 48	
		SKD6	0.32 0.40	0.80 1.20	0.50	0.03	0.02		4.50 5.50	1.00 1.50	0.30 0.50		820~870 Annealing	HB 229 Max	1,050 Air cooling	550 Air cooling	HRC Min 48	
	ASTM	H13	0.32 0.45	0.80 1.25	0.20 0.60	0.03	0.03		4.75 5.50	1.10 1.75	0.80 1.20		820~870 Annealing	HB 235 Max	1,010 Air cooling	552 Air cooling	HRC Min 52	
		H12	0.32 0.40	0.80 1.00	0.20 0.50	0.03	0.03		4.75 5.50	1.10 1.75	0.20 0.50	W : 1.0~1.5	820~870 Annealing	HB 235 Max	1,010 Air cooling	552 Air cooling	HRC Min 53	
		H11	0.33 0.43	0.80 1.25	0.20 0.60	0.03	0.03		4.75 5.50	1.00 1.50	0.30 0.60		820~870 Annealing	HB 235 Max	1,010 Air cooling	552 Air cooling	HRC Min 53	
	DIN	WNr 1.2344	0.37 0.43	0.90 1.20	0.30 0.50	0.03	0.03		4.80 5.50	1.20 1.50	0.90 1.10		820~870 Annealing	HB 229 Max	1,010~1,030 Air cooling	540~560 Air cooling	HRC Min 50	
		WNr 1.2343	0.36 0.42	0.90 1.20	0.30 0.50	0.03	0.03		4.80 5.50	1.10 1.40	0.25 0.50		820~870 Annealing	HB 229 Max	1,010~1,030 Air cooling	540~560 Air cooling	HRC Min 48	
		WNr 1.2767	0.40 0.50	0.10 0.40	0.15 0.45	0.03	0.03	3.80 4.30	1.20 1.50	0.15 0.35			610~650 Annealing	HB 285 Max	840~860 Oil cooling	170~190 Air cooling	HRC Min 52	
	SeAH CSS	SKT4V	0.50 0.60	0.35	0.70 1.30	0.025	0.025	1.30 2.00	1.00 1.40	0.25 0.50	0.10 0.30	Added	700~800 Annealing	HB 230 Max	850~890 Oil cooling	540~620 Air cooling	HRC Min 40	
		DuRAH MAX	0.35 0.40	0.30 0.60	0.60 0.90				4.80 5.30			Added	820~870 Annealing	HB 229 Max	1,030 Air cooling	550 Air cooling	HRC Min 50	Large die casting moulds
		DuRAH PRO	0.35 0.40	0.50 0.80	0.40 0.70				5.00 5.50			Added	820~870 Annealing	HB 210 Max	1,030 Air cooling	550 Air cooling	HRC Min 50	Hot stamping, hot forging moulds
		DuRAH 61	0.35 0.42	0.80 1.20	0.25 0.50	0.03	0.02		4.80 5.50	1.00 1.50	0.80 1.15		820~870 Annealing	HB 229 Max	1,020 Air cooling	550 Air cooling	HRC Min 50	Universal hot moulds
		DuRAH FX	0.36 0.46	0.55 0.80	0.30 0.60				4.80 5.50			Added	820~870 Annealing	HB 229 Max	1,030 Air cooling	550 Air cooling	HRC Min 50	Forging, extrusion moulds
		PST27K57V	0.55 0.60	1.00 1.20	0.50	0.03	0.03	0.80 1.20	4.50 5.50	1.40 1.60	0.80 1.20	Cu : max 0.25	860~870 Annealing	HB 241 Max	1,010 Oil cooling	550 Air cooling	HRC Min 55	Industrial knives

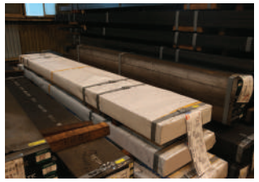
Manufactureable Standard

Classification	Standard	Steel grade	Chemical composition(Wt, %)										Annealing		Heat treatment temperature(°C)		Hardness	Applications
			C	Si	Mn	P	S	Ni	Cr	Mo	V	Other	Temperature(°C)	Hardness	Quenching	Tempering		
Carbon work tool steel	KS	STC3(STC105)	1.00 1.10	0.10 0.35	0.10 0.50	0.03	0.03						750~780 Annealing	HB 212 Max	780 Water cooling	180 Air cooling	HRC Min 61	Press form, figuring tools Chisel, drill, hammer
	JIS	SK3(SK105)	1.00 1.10	0.10 0.35	0.10 0.50	0.03	0.03						750~780 Annealing	HB 212 Max	780 Water cooling	180 Air cooling	HRC Min 61	
	ASTM	W1	0.95 1.05	0.10 0.40	0.10 0.40	0.03	0.03	0.20	0.15	0.10	0.10	Cu : max 0.20 W : Max 0.15	730~760 Annealing	HB 202 Max	760~820 Water cooling	150~200 Air cooling	HRC Min 61	
Air hardened tool steel	ASTM	A2	0.95 1.05	0.10 0.50	0.40 1.00	0.03	0.03		4.75 5.50	0.90 1.40	0.15 0.50		830~880 Annealing	HB 248 Max	954 Air cooling	204 Air cooling	HRC Min 60	Forming dies, punch
		A6	0.65 0.75	0.10 0.70	1.80 2.50	0.03	0.03		0.90 1.40	0.90 1.40	0.15 0.50		770~790 Annealing	HB 248 Max	843 Air cooling	204 Air cooling	HRC Min 58	
		A8	0.50 0.60	0.75 1.10	0.20 0.50	0.03	0.03		4.75 5.50	1.15 1.65		W : 1.0~1.5	770~790 Annealing	HB 241 Max	1,010 Air cooling	510 Air cooling	HRC Min 56	
	DIN	WNr 1.2363	0.90 1.05	0.20 0.40	0.40 0.70	0.035	0.035		4.80 5.50	0.90 1.20	0.10 0.30		770~790 Annealing	HB 230 Max	950 Air cooling	180 Air cooling	HRC Min 60	Forming dies, punch
Oil-hardened tool steel	KS	STS95	0.80 0.90	0.50	0.80 1.10	0.03	0.03		0.20 0.60				730~760 Annealing	HB 212 Max	820 Oil cooling	180 Air cooling	HRC Min 59	Ring gauge, drawing dies
		STS3	0.90 1.00	0.35	0.90 1.20	0.03	0.03		0.50 1.00			W : 0.5~1.0	750~800 Annealing	HB 217 Max	830 Oil cooling	180 Air cooling	HRC Min 60	Screw cutter, cutting knives
		STS93	1.00 1.10	0.50	0.80 1.10	0.03	0.03		0.20 0.60				750~780 Annealing	HB 217 Max	820 Oil cooling	180 Air cooling	HRC Min 63	Blade, press mould
	JIS	SKS95	0.80 0.90	0.50	0.80 1.10	0.03	0.03		0.20 0.60				730~760 Annealing	HB 212 Max	820 Oil cooling	180 Air cooling	HRC Min 59	Ring gauge, drawing dies
		SKS3	0.90 1.00	0.35	0.90 1.20	0.03	0.03		0.50 1.00			W : 0.5~1.0	750~800 Annealing	HB 217 Max	830 Oil cooling	180 Air cooling	HRC Min 60	Screw cutter, cutting knives
		SKS93	1.00 1.10	0.50	0.80 1.10	0.03	0.03		0.20 0.60				750~780 Annealing	HB 217 Max	820 Oil cooling	180 Air cooling	HRC Min 63	Blade, press mould
	ASTM	O1	0.85 1.00	0.10 0.50	1.00 1.40	0.03	0.03		0.40 0.70		0.30	W : 0.4~0.6	750~800 Annealing	HB 212 Max	802 Oil cooling	204 Air cooling	HRC Min 59	Cold forming dies, forming rolls
		O2	0.85 0.95	0.50	1.40 1.80	0.03	0.03		0.50	0.30	0.30		750~770 Annealing	HB 217 Max	802 Oil cooling	204 Air cooling	HRC Min 59	Cold forming dies, forming rolls
		O6	1.25 1.55	0.55 1.50	0.30 1.10	0.03	0.03		0.30	0.20 0.30			730~760 Annealing	HB 229 Max	802 Oil cooling	204 Air cooling	HRC Min 59	Ring gauge, drawing dies
	DIN	WNr 1.2510	0.90 1.05	0.15 0.35	1.00 1.20	0.035	0.035		0.50 0.70		0.05 0.15	W : 0.5~0.7	770~790 Annealing	HB 229 Max	780~820 Oil cooling	180~220 Air cooling	HRC Min 61	Cold forming dies, forming rolls
		WNr 1.2842	0.85 0.95	0.10 0.40	1.90 2.10	0.03	0.03		0.20 0.50		0.05 0.15		750~770 Annealing	HB 229 Max	790~820 Oil cooling	150~250 Air cooling	HRC Min 60	
Impact-resistant tool steel	KS	STS41	0.35 0.45	0.35	0.50	0.03	0.03		1.00 1.50			W : 2.5~3.5	760~820 Annealing	HB 217 Max	880 Oil cooling	180 Air cooling	HRC Min 53	Dies for hot forging
	JIS	SKS41	0.35 0.45	0.35	0.50	0.03	0.03		1.00 1.50			W : 2.5~3.5	760~820 Annealing	HB 217 Max	880 Oil cooling	180 Air cooling	HRC Min 53	Dies for hot forging
	ASTM	S1	0.40 0.55	0.15 1.20	0.10 0.40	0.03	0.03		1.00 1.80	0.50	0.15 0.30	W : 1.5~3.0	760~820 Annealing	HB 229 Max	954 Oil cooling	204 Air cooling	HRC Min 56	Dies for hot forging
		S5	0.50 0.65	1.75 2.25	0.60 1.00	0.03	0.03		0.10 0.50	0.20 1.35	0.15 0.35		830~850 Annealing	HB 229 Max	899 Oil cooling	204 Air cooling	HRC Min 58	Cutter blade punch
		S7	0.45 0.55	0.20 1.00	0.20 0.90	0.03	0.03		3.00 3.50	1.30 1.80	0.35		830~850 Annealing	HB 229 Max	954 Oil cooling	204 Air cooling	HRC Min 56	
Flame hardening tool steel	SeAH CSS	TA23F85	0.80 0.90	0.80 1.20	0.70 1.10	0.025	0.025		1.80 2.20	0.20 0.30	0.05 0.10		810~830 Annealing	HB 235 Max	900-1,000 flames		HRC Min 60	For cold moulds
Forging roll	SeAH CSS	TR2	0.30 0.60	1.00 1.30	0.30 0.70	0.030	0.030	0.50	4.00 6.00	0.80 1.70	0.40 0.80	W : 1.0~1.5	860~880 Annealing	HB 229 Max	Low, medium and high frequency heat treatment *Varies according to customer requirements		HS Min 90	Rolls for Z-Mill and Cold rolling rolls
		TR5	0.75 0.95	0.20 0.50	0.20 0.50	0.025	0.015	0.50	4.50 5.50	0.40 0.65	Add		860~880 Annealing	HB 229 Max			HS Min 90	
		TR12	1.30 1.70	0.30 0.70	0.30 0.70	0.030	0.030	0.50	11.00 13.00	0.70 1.30	0.50 1.00	Co : 0.2~0.5 Cu : max 0.30	860~880 Annealing	HB 245 Max			HS Min 90	
		TR3504	0.85 0.95	0.50 0.70	0.20 0.40	0.015	0.015	0.15	2.50 3.50	0.20 0.40								

Packaging Specifications

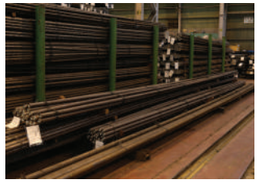
Flat Steel

Bare Packing



Hessian Packing

Round Bars



Bare Packing

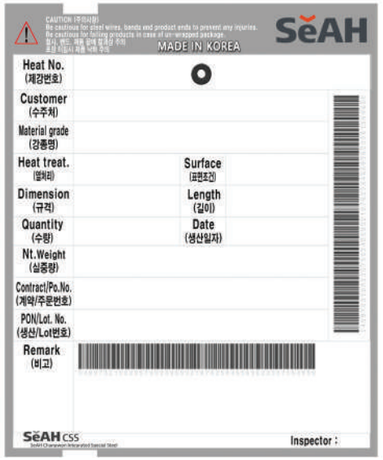
Hessian Packing

Wooden Slate Packing

Wooden Box Packing

Tags & Labels

Tag



Label

Certification Status

ISO 9001:2015
International Organization for Standardization

Quality management system

IATF16949:2016
International Automotive Task Force

Quality management system

ISO 14001:2015
International Organization for Standardization

Environmental management system

KOSHA18001
Korea Occupational & Safety Health Agency

Safety and health management system

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Warranty for mechanical and structural materials used in the nuclear power industry

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3) Quantity, delivery time 4) Application, machining method 5) Special requirements(if necessary)

SeAH CSS

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