DuRAH

Hot Work Tool Steel

SëAH CSS

SëAH CSS

Contents

Specially designed for hot working, **SeAH CSS's Hot Work Tool Steel**

DuRAH

Durability **R**einforced **A**dvanced **H**ot Work Tool Steel

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, it has been produced with advanced manufacturing processes and techniques, ensuring superior quality.

SeAH CSS is developing and producing advanced, next-generation mould materials and contributing to the development of hot working technology and extension of mould lifespan.

DuRAH Series Features

Excellent mechanical properties and wear resistance

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.

Improved resistance to heat and heat checking

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

A range of products designed for your needs

Our diverse products from hot stamping to extrusion, provide the best options possible for our customers.

South Korea's only special steel producer with the largest distribution network in country

Supplying the products clients want in various shapes and dimensions in a timely manner.

DuRAH Series Applications

① Hot forging moulds
② General/precision die casting moulds
③ Aluminum (Al), copper (Cu) extrusion moulds
④ Other moulds for plastic deformation temperatures

SeAH CSS' DuRAH Series is a brand of hot work tool steel that responds to customer needs changing with the development of hot plastic working technology. With improved mechanical properties, steel grades have been segmented and optimized according to its different uses to provide optimum performance. SeAH CSS is the one and only all-around special steel manufacturer that have special refining equipment and forging & rolling lines to reliably supply products the customers demand in different shapes and sizes.

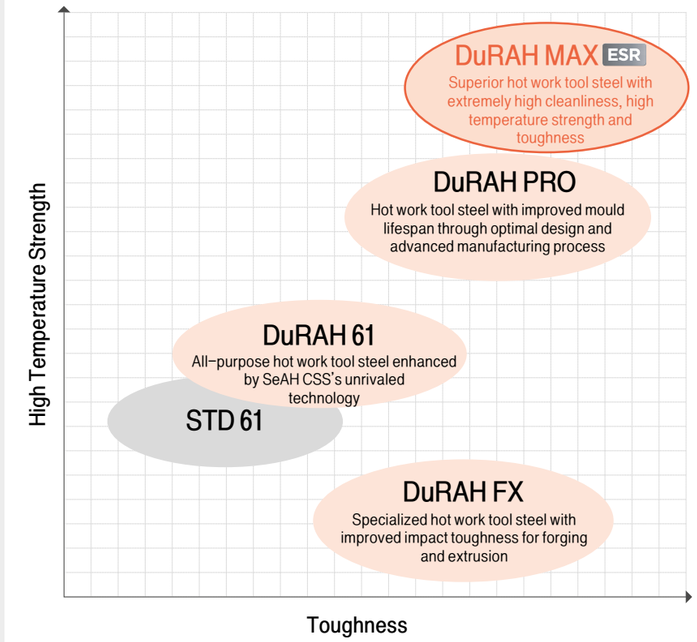
DuRAH

DuRAH Series Hot Work Tool Steel

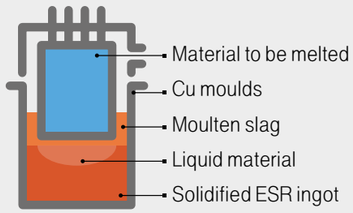
Products			Mechanical Property Comparisons					Major Characteristics	Usages							Hardness (HRC)
SeAH CSS	KS /JIS	AISI /DIN	High temperature Strength	Toughness	Softening Resistance	Wear Resistance	Hardenability			C	Si	Mn	Cr	Mo	V	
DuRAH MAX ESR	–	–	A+	S	A+	A+	A+	Extended mould lifespan through highly increased high temperature strength, toughness, and heat checking 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		HRC 42~52
DuRAH PRO	–	–	A	A++	A	A	A+	Improved high temperature strength, toughness, and mould lifespan compared to STD 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		
DuRAH 61	SKD 61 STD 61	H13 WNR 1.2344	B+	A	B+	B+	A	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	
DuRAH FX [Specialized Grade]	–	H11	B+	A+	B+	B+	A	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		

❖ Heat check: Micro-cracks formed on the surface due to repeated radical heating and cooling.
❖ FX: Forging & extrusion
❖ SeAH CSS uses its superior production technology to keep P, S and other impurities at levels lower than required by STD 61/SKD 61 standards.

DuRAH Series Product Positioning



ESR (Electroslag Remelting)

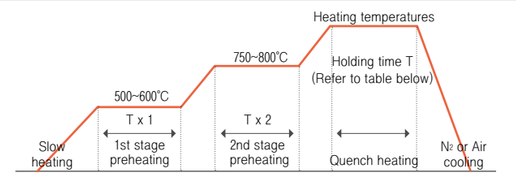


ESR applied material undergoes rapid coagulation and inclusion removal using slag.
This process effectively lengthens the mould lifespan by curbing segregations in high alloy steels.

Standard Heat Treatment

❖ For details on heat treatment conditions, refer to the standard heat treatment conditions for each steel grade.

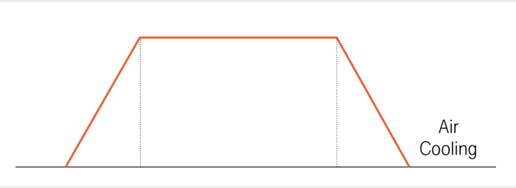
Quenching



❖ Preheating for quench hardening is performed in two stages: the first in the 500–600℃ section, the second in the 750–800℃ section.
• It is essential to prevent material decarburization and oxidation during quenching.

Thickness (mm)	15	20	50	75	100	125	150	200	300
Holding Time (min)	15	25	45	50	60	65	70	80	100

Tempering



❖ Tempering at least twice is recommended.

Thickness (mm)	25	26~35	36~64	65~84	85~124	125~174	175~249	250~349	350~499
Holding Time (hr)	1	1.5	2	3	4	5	6	7	8

DuRAH MAX ESR

An optimal solution that surpasses all limitations

DuRAH MAX has been developed by SeAH CSS in accordance with the industrial trend for high-quality mould materials due to lightened end-products. Moreover, ESR process ensures high cleanliness for greater product lifespan even in extreme user 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 during the remelting and solidification stages, thereby effectively increasing mould lifespan.

- Maximized high temperature toughness
- Excellent heat check resistance
- Superior wear resistance
- Excellent high temperature strength
- Unrivaled cleanliness

Applications

Recommended for large die-casting moulds that require the use of high-strength materials due to their size and complex shape.

Chemical Composition

- To improve mould lifespan the amount of Mo and V are controlled to achieve the optimal chemical composition and apply to the ESR process

Steel Grade		Chemical Composition (wt%)						
SeAH CSS	KS	C	Si	Mn	Cr	Mo	V	Other
DuRAH MAX	STD 61 Modified	0.35 0.40	0.30 0.60	0.30 0.90	4.80 5.30	Special Element		

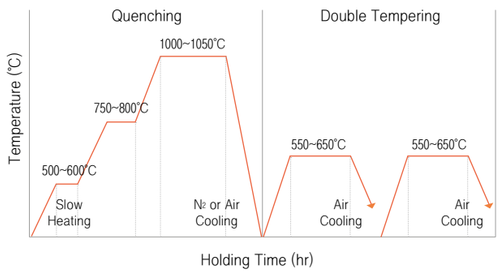
Physical Properties

Thermal Expansion Coefficient (x 10^{-6}/℃)	Specific Gravity (g/㎤)	Thermal Conductivity (W/m·K)	Young's Modulus (GPa)
11.3 (25~200℃)	7.82	25.0 (20℃)	220

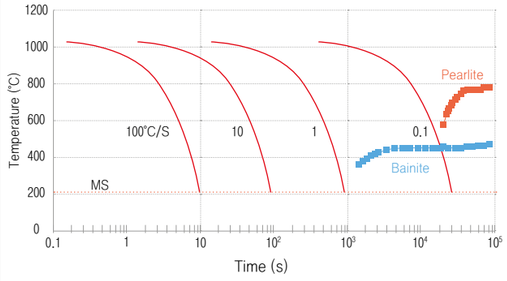
Heat Treatment Conditions

- Same Q/T heat treatment as STD 61 can be applied with no additional cost.
- CCT Curve: With optimal hardening elements added, it is best to obtain a high-strength full martensitic structure.

QT Heat Treatment



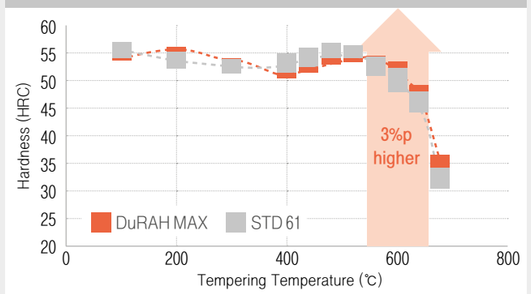
CCT Curve



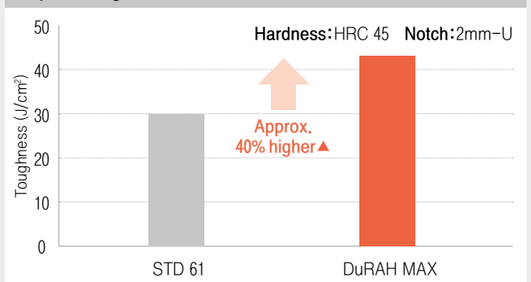
Mechanical Properties

- Heat treatment hardness: Even under same heat treatment as STD 61, greater hardness can be achieved.
- Impact toughness: Greater than all-purpose hot work tool steel.

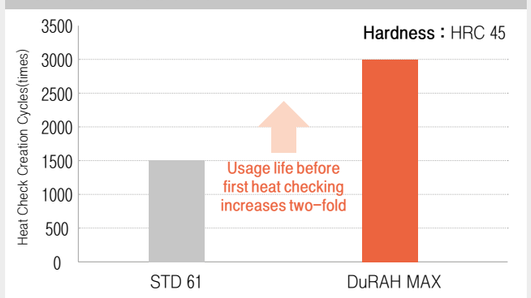
Heat Treatment Hardness



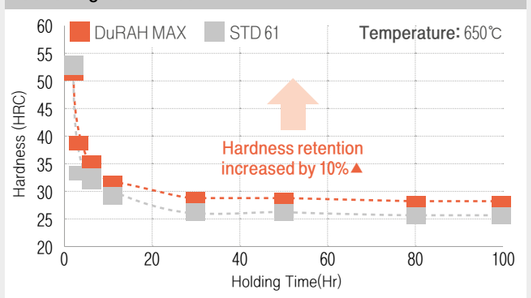
Impact Toughness



Heat Check Resistance



Softening Resistance



Applications

Type	Products
Aluminum Extrusion Mould	 Recommended for high strength aluminum extrusion moulds
Result	▲40% higher mould lifespan than STD 61

Type	Products
Steel Pipe Extrusion Mandrel/ Stem	 Recommended for materials that require high wear resistance and strength at high temperatures
Result	▲40% higher mould lifespan than STD 61

DuRAH PRO

Highly efficient, premium solution satisfying higher standards

DuRAH PRO is a next-generation premium mould material that significantly improves the performance of standard STD 61 steel 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-check, providing stable performance even in extreme conditions.

- Optimal wear resistance
- Improved erosion resistance
- Excellent high temperature strength
- Improved heat check resistance
- High cleanliness

Applications

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

Chemical Composition

Steel Grade		Chemical Composition (wt%)						
SeAH CSS	KS	C	Si	Mn	Cr	Mo	V	Other
DuRAH PRO	STD 61 Modified	0.35 0.40	0.50 0.80	0.40 0.70	5.00 5.50			Special Element

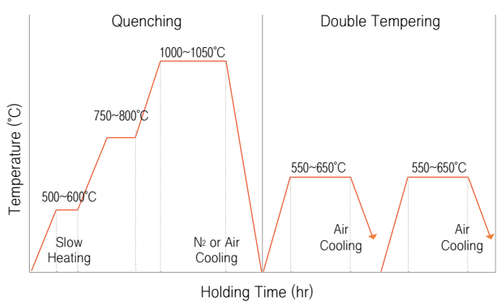
Physical Properties

Thermal Expansion Coefficient (x 10^{-6}/℃)	Specific Gravity (g/㎤)	Thermal Conductivity (W/m·K)	Young's Modulus (GPa)
11.3 (25~200℃)	7.78	25.5 (20℃)	215

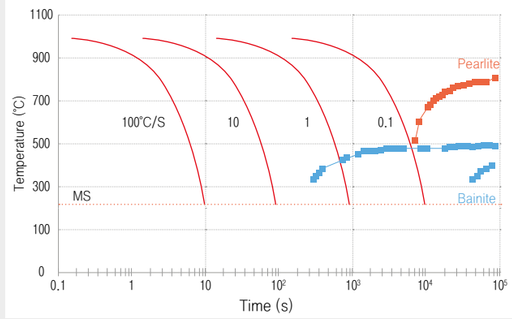
Heat Treatment

• Same Q/T heat treatment as STD 61 can be applied with no additional cost.

QT Heat Treatment



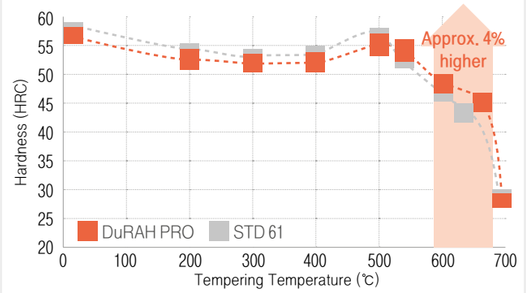
CCT Diagram



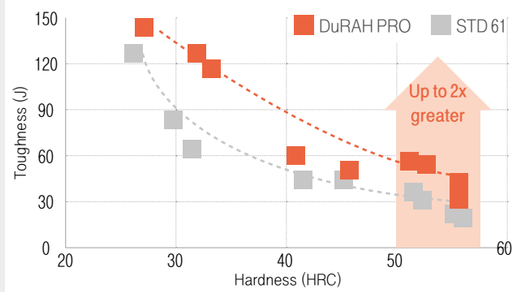
Mechanical Features

- Alloying element composition is optimized to secure greater hardness, toughness and other desired qualities than in STD 61, allowing longer practical use of the mould.
- Heat treatment hardness: higher than STD 61.
- Impact toughness: Superior toughness with the same hardness.

Heat Treatment Hardness

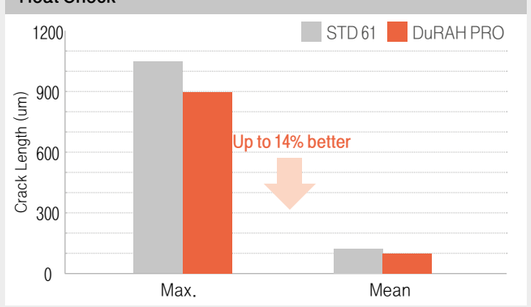


Impact Toughness

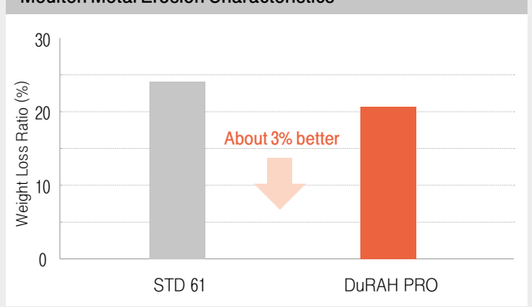


• With greater heat check resistance and erosion characteristics in Al moulten metal than STD 61, leading to greater likelihood of extending mould lifespan.

Heat Check



Moulten Metal Erosion Characteristics



Welding Conditions and Materials

Welding Conditions		Welding Methods
Diameter (Ø)	Current (A)	
3.2	85~110	– Preheat: Up to 350℃ (maintain mould temperature at 250℃ during welding) – Maintain 350℃ at mould center – Preheat after welding: Ensure 50℃ greater than preheating temperature and cool off slowly (to prevent creation of cracks due to rapid cooling)
4.0	120~160	
5.0	150~200	

❖ Welding rod: Spheroidized (STD 61 or equivalent welding rod), hardened (maraging steel welding rod)

Applications

• DuRAH Pro Series is used as mould material for production of automotive parts and proven to have longer mould lifespan than STD 61.

Type	Applications Evaluation Results (vs. STD 61)	Evaluated Companies (mould)
Hot Forging	4,900 shots (▲60%)	A***** (Non-driven)
	2,400 shots (▲40%)	B***** (Outer Race)
	5,030 shots (▲25%)	C***** (PR HUB)

DuRAH 61

Market proven, advanced standards

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

- Excellent red hardness
- Improved heat check resistance
- Heat treatment transformation resistance
- Improvement of anisotropy

Applications

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

Extrusion

Die Casting

Chemical Composition

Steel Grade		Chemical Composition (wt%)						
SeAH CSS	KS/JIS	C	Si	Mn	Cr	Mo	V	Other
DuRAH 61	STD 61	0.35	0.80	0.25	4.80	1.00	0.80	–
	SKD 61	0.42	1.20	0.50	5.50	1.50	1.15	

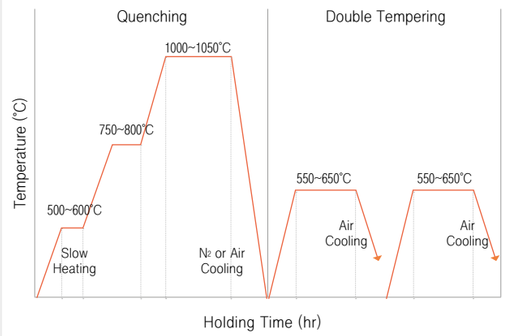
Physical Properties

Thermal Expansion Coefficient (x 10^{-6}/℃)	Specific Gravity (g/㎤)	Thermal Conductivity (W/m·K)	Young's Modulus (GPa)
11.3 (25~200℃)	7.75	24.6 (20℃)	210

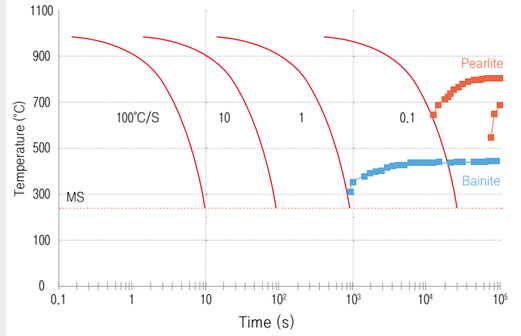
Heat Treatment

- Spheroidizing annealing: After gradually heating to 820~870˚C, the temperature is maintained for 1 hour per inch and then annealed slowly (15 to 30˚C/hour) to 500˚C, which is then followed by air cooling.
- Stress relief: Heating to 650˚C and maintaining this for a certain period of time before cooling slowly to 500˚C through annealing

QT Heat Treatment



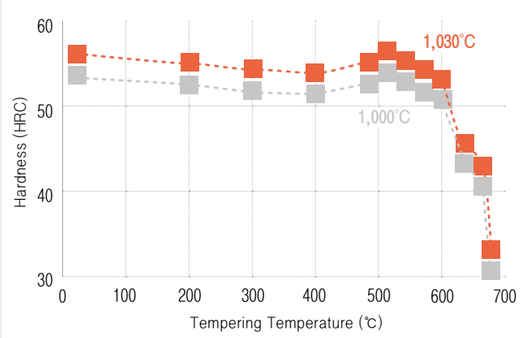
CCT Curve



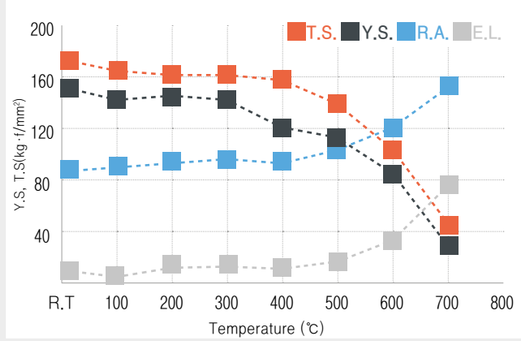
Mechanical Properties

- DuRAH 61 retains its strength at high temperatures due to the solid-solution strengthening of hardening elements and secondary hardening effect.

Heat Treatment Hardness

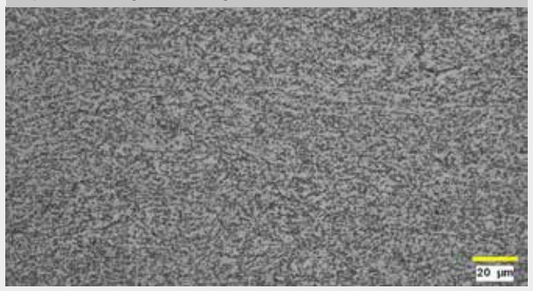


High Temperature Characteristics

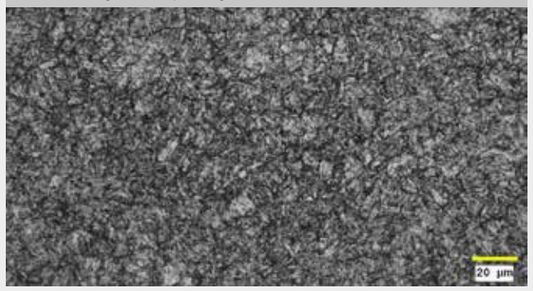


Microstructure

Spheroidizing Annealing



Quenching & Tempering



DuRAH 61

DuRAH FX Specialized Grade

The best solution for forging and extrusion

DuRAH PRO is a next-generation premium mould material that significantly improves the performance of standard STD 61 steel and extends mould lifespan even in extreme user environments. With superior impact toughness and high temperature strength through advanced construction and optimum design, DuRAH PRO minimizes the occurrence of aluminum moulten metal erosion and heat-check, providing stable performance even in extreme conditions.

- Specialized for hot forging extrusion moulds
- Excellent toughness
- Improved heat check resistance
- Excellent high temperature strength

Applications

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

Chemical Composition

• Optimized composition of alloy elements to improve mould lifespan.

Steel Grade		Chemical Composition (wt%)						
DuRAH	KS	C	Si	Mn	Cr	Mo	V	Other
DuRAH FX	STD 61 Modified	0.36 0.46	0.55 0.80	0.30 0.60	4.80 5.50		Special Element	

Physical Properties

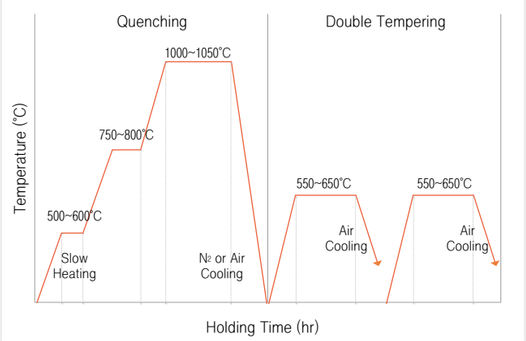
• DuRAH FX's improved thermal conductivity allows greater resistance to heat checking.

Thermal Expansion Coefficient (x 10^{-6}/℃)	Specific Gravity (g/㎤)	Thermal Conductivity (W/m·K)	Young's Modulus (GPa)
11.4 (25~200℃)	7.80	27.9 (20℃)	210

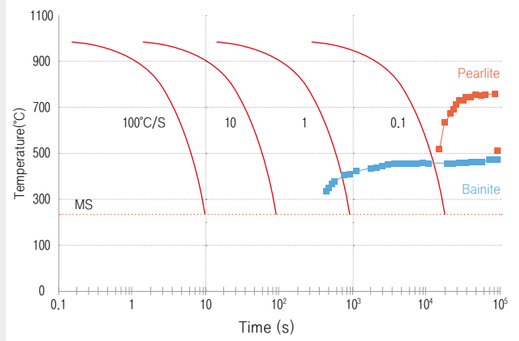
Heat Treatment

• QT heat treatment can be applied under the same conditions as STD 61 while incurring no additional cost.

QT Heat Treatment



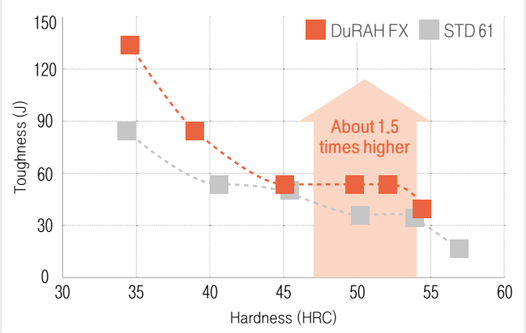
CCT Curve



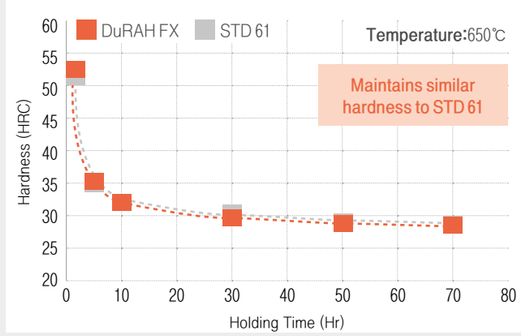
Mechanical Properties

- DuRAH FX has equivalent heat treatment hardness and softening resistance to STD 61 acquired through SeAH CSS' optimization of its manufacturing process.
- With improved impact toughness, formation of cracks is reduced thus mould lifespan can be increased in hot forging and extrusion.
- DuRAH FX's improved thermal conductivity allows greater resistance to heat checking as well.

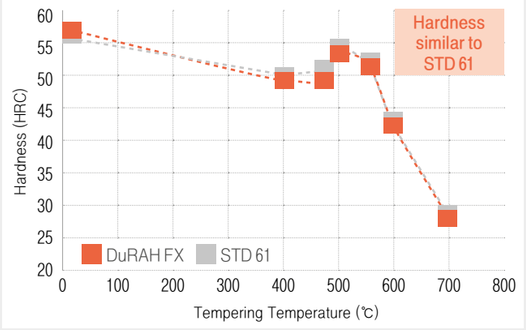
Impact Toughness



Softening Resistance



Heat Treatment Hardness



❖ **Impact toughness:** Optimized composition alloying elements ensures toughness at the same hardness level, suitable for hot forging and extrusion.

❖ **Softening resistance:** Equivalent to STD 61 and suitable for use at high temperatures.

❖ **Heat treatment hardness:** QT heat treatment can be performed under the same conditions as STD 61, with similar hardness achieved.

SeAH CSS

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