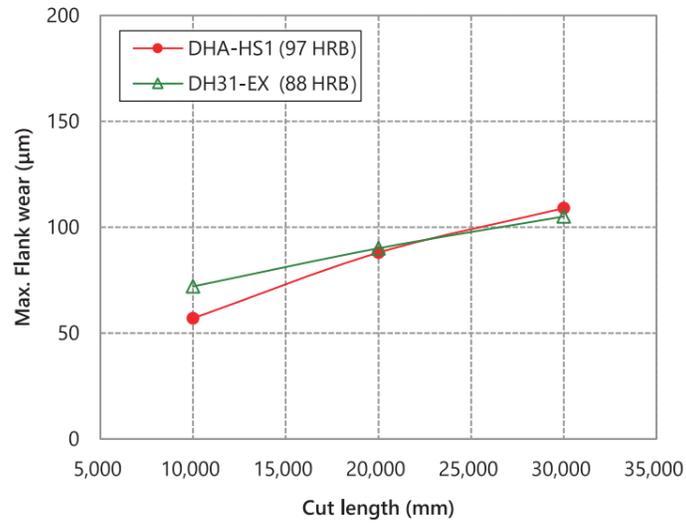


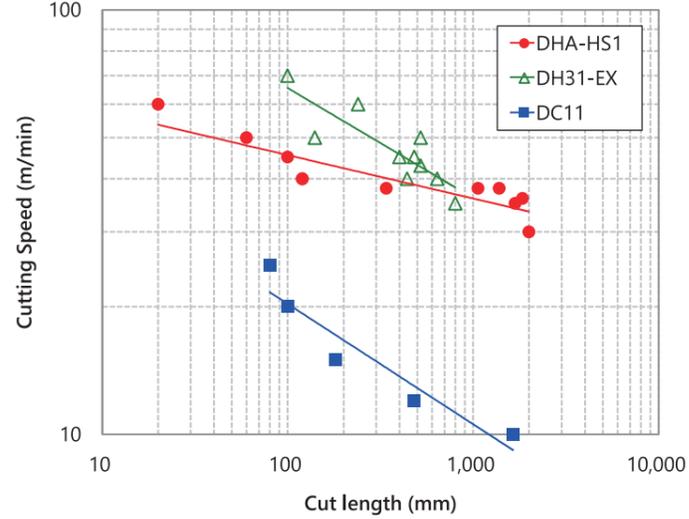
Machinability (Endmilling)

Tool : VP15TF (TiAlN coating) Depth of cut : 1 × 4 mm
 Speed : 100 m/min Cooling : Air blow
 Feed : 0.2 mm/rev Milling : Down cut



Machinability (drilling)

Tool : SKH51 Depth of hole : 20mm
 Shape : Φ5, Straight shank drill Lubricant : Yushiroken EZ30 (5% Soln.)
 Feed : 0.15 mm/rev Criteria : Breakage or corrosion



Daido's Hot Work Die Steel Series

DHA-HS1TM



**High thermal conductivity, High softening resistance
Hot Stamping Die Steel**

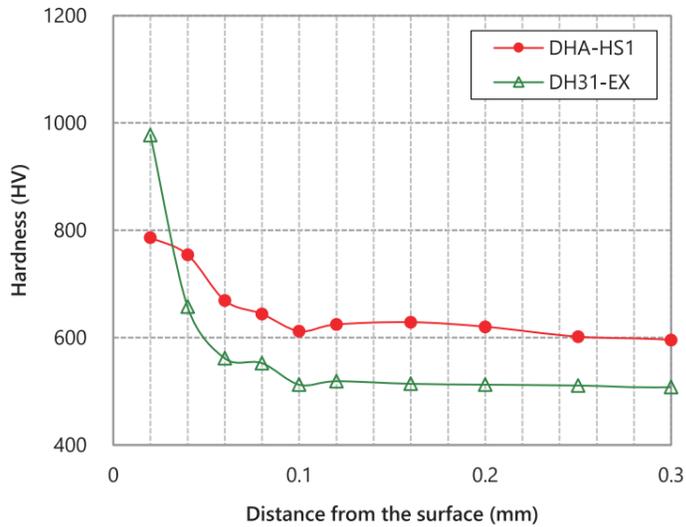
Features

DHA-HS1 is "Hot stamping die steel", which offers high thermal conductivity as well as excellent abrasion resistance at high temperatures. It contributes to increasing productivity and improving die life.

- ◆ **High thermal conductivity** : With high thermal conductivity of approx. **36 (W/m·K)** at room temperature, DHA-HS1 helps reducing cooling time of dies and steel sheets.
- ◆ **High hardness** : Practical hardness of up to **54 HRC** can be obtained at a wide range of tempering temperatures. Surface treatment can also be applied.
- ◆ **High softening resistance** : DHA-HS1 retains high hardness at elevated temperatures when in contact with hot steel sheets.

Nitriding characteristics

Specimen : 10 × 15 × 20mm Nitriding : Daido Die & Mold Steel Solutions Co., Ltd.
 Quenching : 1030°C × 1h, Gas cooling Radical nitriding
 Tempering : DHA-HS1 : 560°C × 1h, Twice
 DH31-EX : 600°C × 1h, Twice



Physical properties

Quenching : 1030°C × 1h, Gas cooling (6 bar)
 Tempering : 560°C × 1h, Twice
 Tempered to the hardness : 53 HRC

◆ Thermal expansion rate

Temp.	20~100°C	20~200°C	20~300°C	20~400°C	20~500°C	20~600°C
×10 ⁻⁶ /K	10.8	11.9	12.6	13.2	13.7	14.2

◆ Thermal conductivity

Temp.	25°C	100°C	200°C	300°C	400°C	500°C	600°C
W/m·K	36.3	40.5	40.6	39.0	38.6	36.1	35.1

※Accuracy of repeated measurements is about ±10%.

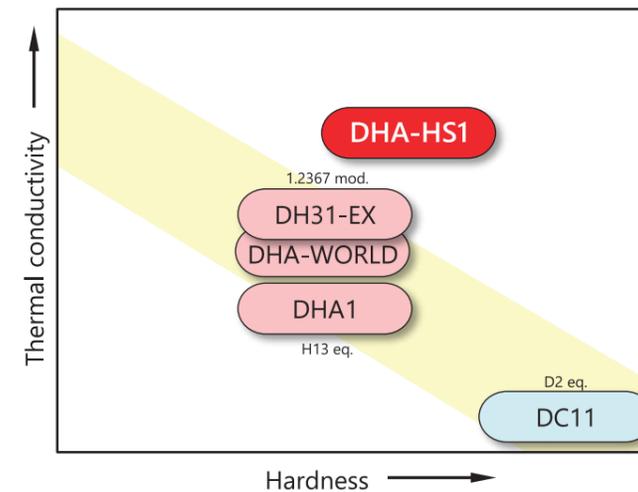
◆ Specific heat

Temp.	25°C	100°C	200°C	300°C	400°C	500°C	600°C
J/kg·K	495	561	599	626	692	757	854

◆ Young's modulus / Rigidity modulus / Poisson's ratio (25°C)

Young's modulus	Rigidity modulus	Poisson's ratio
208 GPa	82 GPa	0.27

Positioning diagram



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■ **Document Disclaimer**
 The product characteristics included in this brochure are the representative values based on the result of our measurements, and do not guarantee the performance in use of the products. Please inquire the latest information to our department in charge as the information of this brochure is updated without previous notice as needed.

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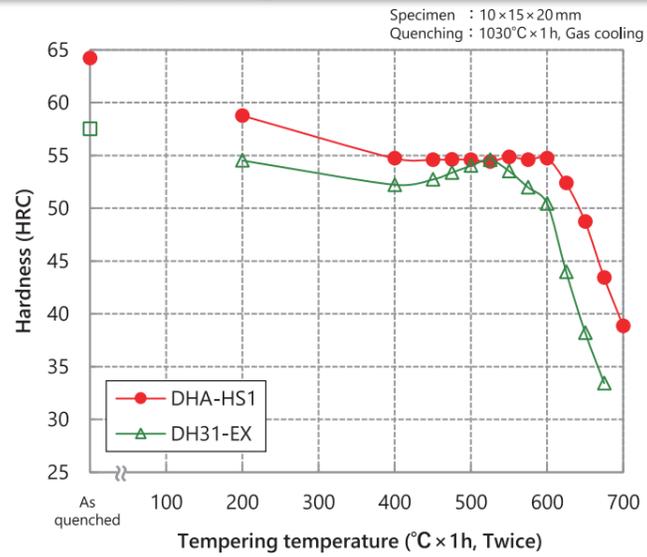
Heat treatment

Re-forging Temperature (°C)	Heat treatment (°C)			Hardness		Transformation Temp. (°C)	
	Annealing	Quenching	Tempering	Annealed	Quenched & Tempered	Ac	Ms
900~1200	820~870 Slow cooling + 650~700 Air cooling	1000~1030 Vacuum (≥ 6 bar)	550~670 Air cooling	≤ 235 HBW	45~54 HRC	725~790	230 (Austenitized at 1030°C)

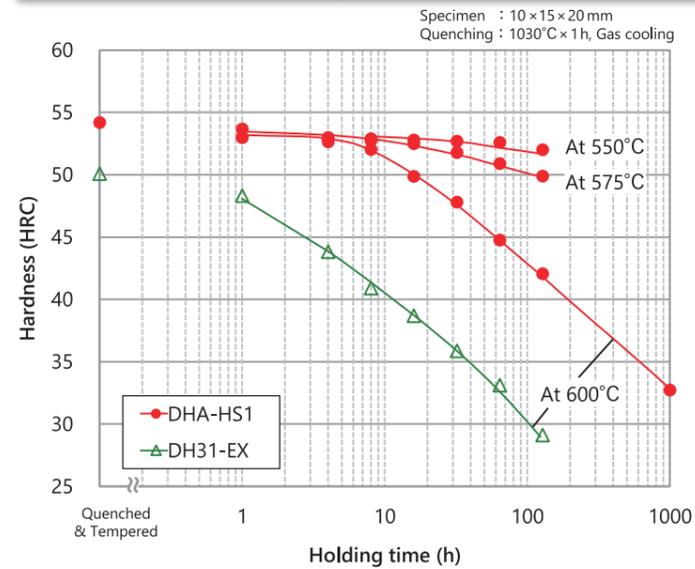
- ◆ **Notice**
 - Please be careful of quenching crack on the cooling.
 - Due to a limitation in hardenability, DHA-HS1 is best suited for rough machined dies lighter than 80 kg. Please ask for our advice if you plan to heat treat dies heavier than 80 kg in order to avoid unexpected trouble.



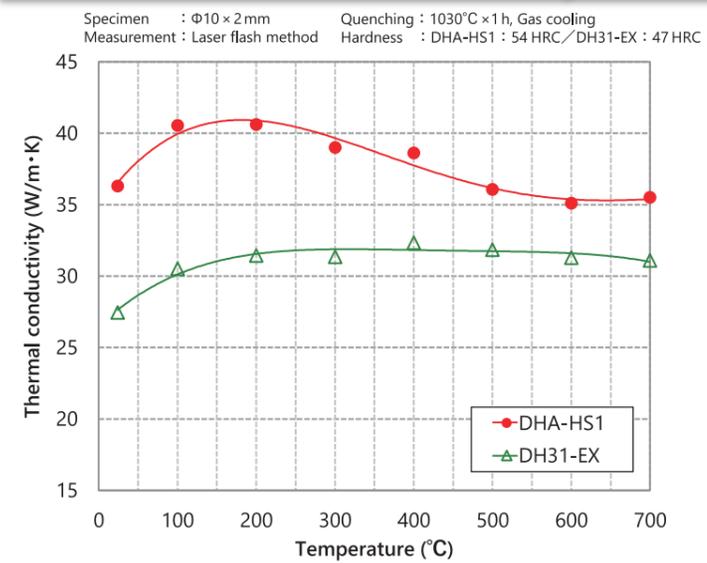
Tempering hardness



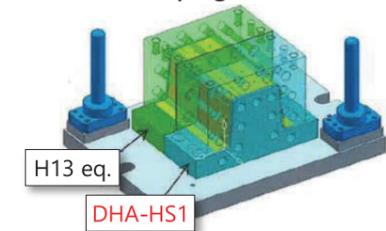
Softening resistance



Thermal conductivity and Hot stamping test results

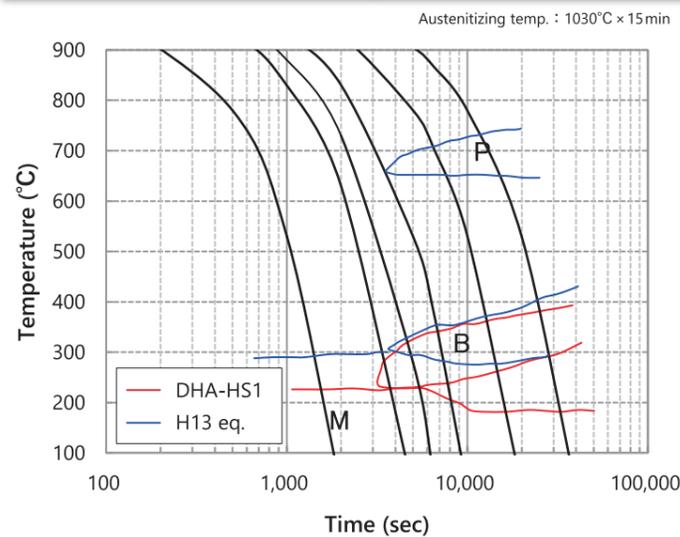


Test die and Hot stamping test method

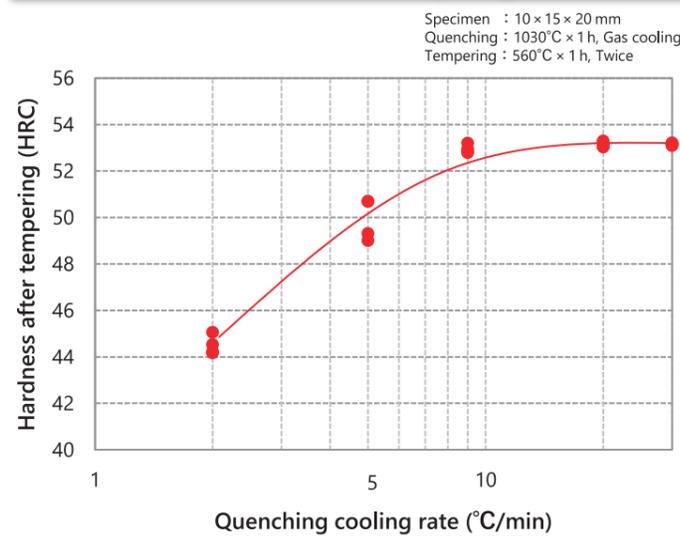


Press conditions	Cycle time	3.0spm
	Holding time at the bottom dead center	6.0 sec
Steel sheet temperature at the start of pressing		approx. 850°C
Cooling conditions	Coolant temperature	approx. 18°C
	Location of water line	approx. 10 mm from the die surface
Evaluation	Thermocouple position	lower die : approx. 5 mm from the die surface

CCT diagram

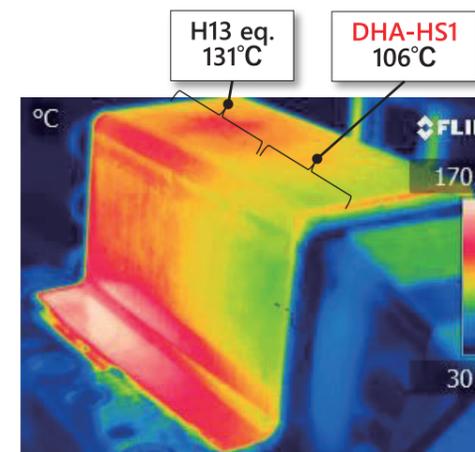


Relation between Quenching cooling rate and Hardness after tempering



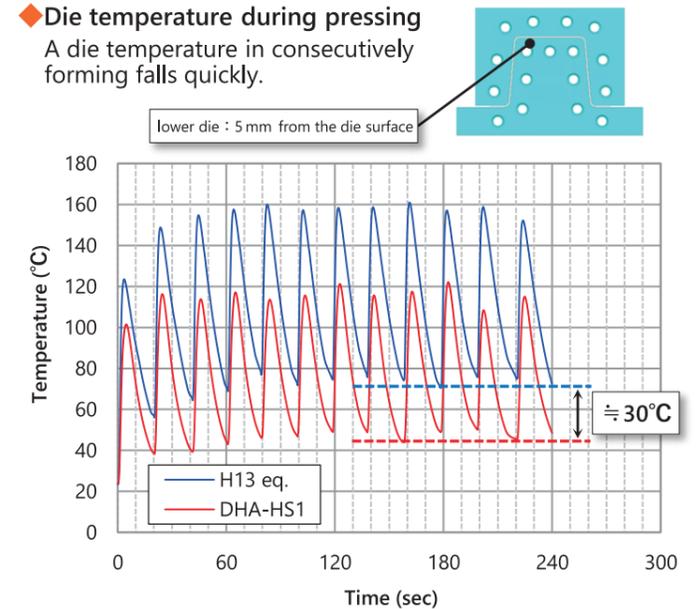
Sheet surface temperature immediately after opening die

A steel sheet cooling rates increase in quenching.



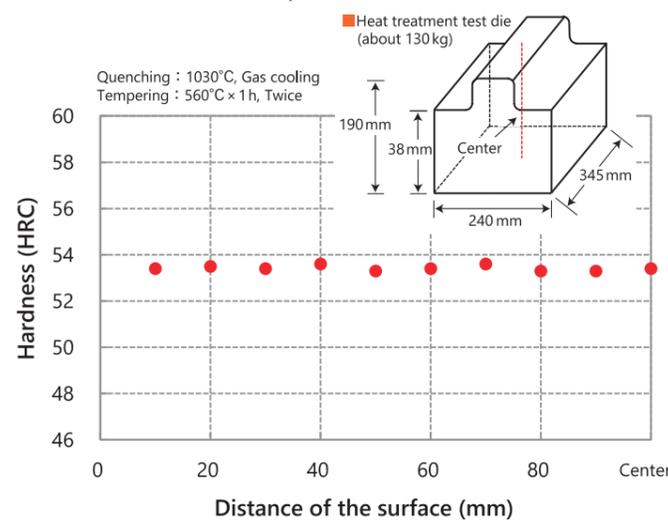
Die temperature during pressing

A die temperature in consecutively forming falls quickly.

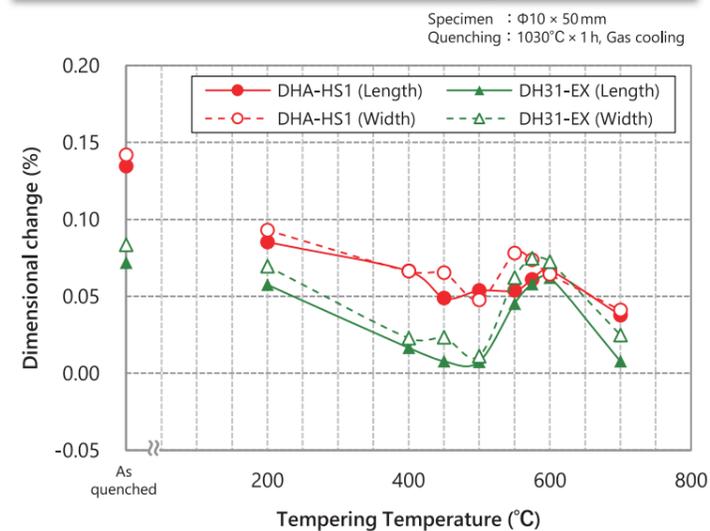


Hardness distribution

Hardness can be secured up to the center.



Dimensional change



Mechanical properties at R.T.

Hardness (HRC)	53
Tensile strength (MPa) Specimen : Φ8 × 90 mm	1,973
0.2% Yield strength (MPa)	1,787
Charpy Impact values (J/cm ²) Specimen : 10 × 10 × 55 mm, 2 mm U-notched	17
Fracture toughness (MPa · m ^{1/2}) Specimen : 2 × 2 × 0.5 in, Length of notch = 22.8 mm	35

Fatigue properties

