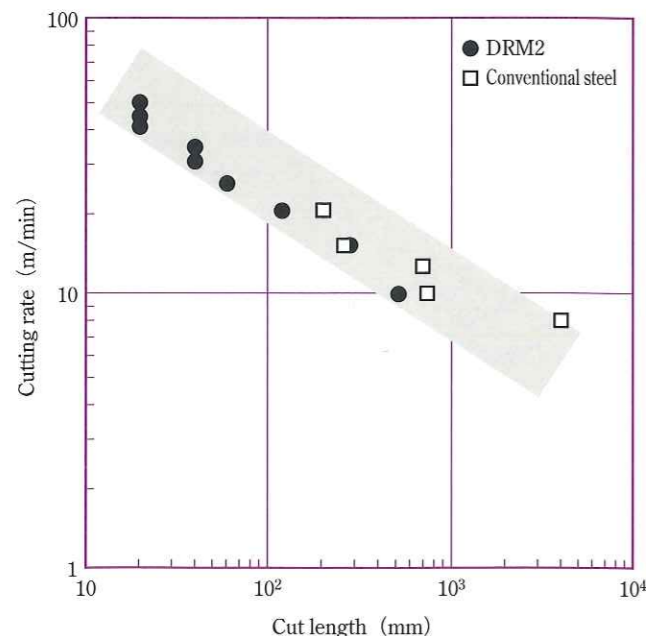


## Drilling machinability



- Specimen : As annealed
- Tool : NACHI SD  $\phi$  5mm (non-coated)
- Test condition : Feed : 0.15mm/rev · Hole depth : 20mm  
· Cutting fluid : none

## Physical Properties

### ◆ Coefficient of expansion

	20~100°C	20~200°C	20~300°C	20~400°C	20~500°C	20~600°C	20~700°C	20~800°C
$\times 10^{-6}/K$	11.0	11.4	11.8	12.1	12.3	12.6	12.4	12.9

### ◆ Thermal conductivity

	25°C	200°C	300°C	400°C	500°C	600°C	700°C
W/m·K [cal/cm·sec·°C]	23.2 [0.055]	26.9 [0.064]	27.9 [0.067]	29.0 [0.069]	28.8 [0.069]	29.2 [0.070]	29.6 [0.071]

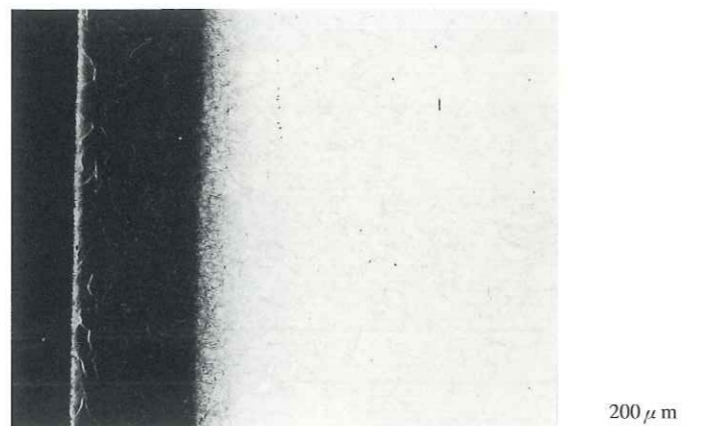
### ◆ Specific heat

	25°C	200°C	300°C	400°C	500°C	600°C	700°C
J/kg·K [cal/g·°C]	458 [0.109]	518 [0.124]	555 [0.133]	598 [0.143]	659 [0.158]	756 [0.181]	910 [0.217]

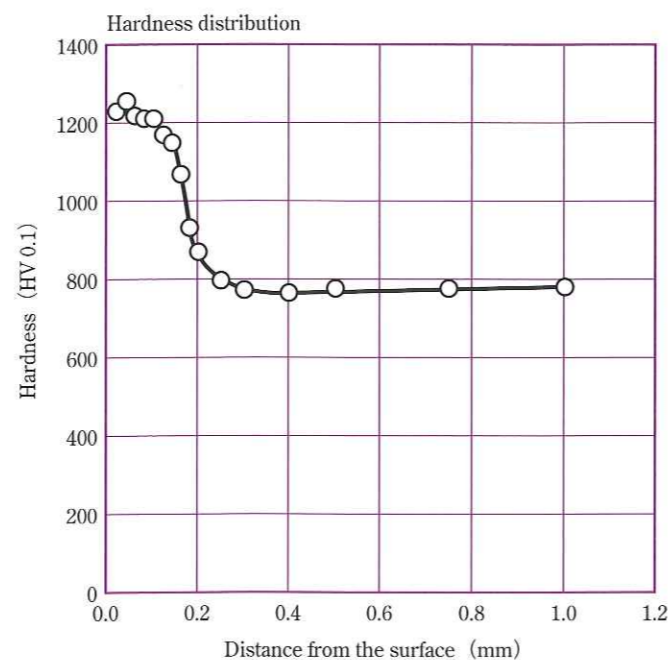
### ◆ Young's modulus 210 Gpa

◆ Specimen condition : H : 1120°C OQ T : 560°C AC twice

## Nitriding



An example of micro structure nitrided by PS process  
 ● PS process  
 · Daido Amistar's originally developed process featured by high scuffing and erosion resistance



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### ■ IMPORTANT NOTE

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# Dream Series Daido's DRM2

## Warm and Cold Forging Die Steel

High hard and tough matrix type high speed tool steel

### Features

Matrix type high speed tool steel available for warm and cold forging tools where critical performance is required.

DRM2 prolongs service life due to its higher hardness and toughness than those of conventional grades.

- ① Applicable with the maximum hardness 62HRC
- ② Fine microstructure contributes to high toughness and fatigue strength
- ③ Greater hardenability results in high performance even in large dies and gas quenching in vacuum furnace.
- ④ Double melting realizes clean and homogeneous steel with less non-metallic inclusions

### Applications

- Warm forging dies and punches
- Cold forging dies and punches

### Heat treatment

Re-forging Temperature	Heat treatment conditions (°C)			Hardness	
	Annealing	Quenching	Tempering	Annealed	Hardening / Tempering
Requested to inquire	800~880 Slow cooling	1050~1120 OQ, GC, Salt bath	550~620 AC, $\geq$ twice	$\leq$ 235HB	58~62HRC

OQ : Oil quenching , GC : Gas quenching in vacuum furnace, AC : Air cooling

### Microstructure (As annealed)

- Fine and uniform microstructure with less coarse carbides

DRM2 (Middle of 100 dia. bar)



Conventional steel (Daido)

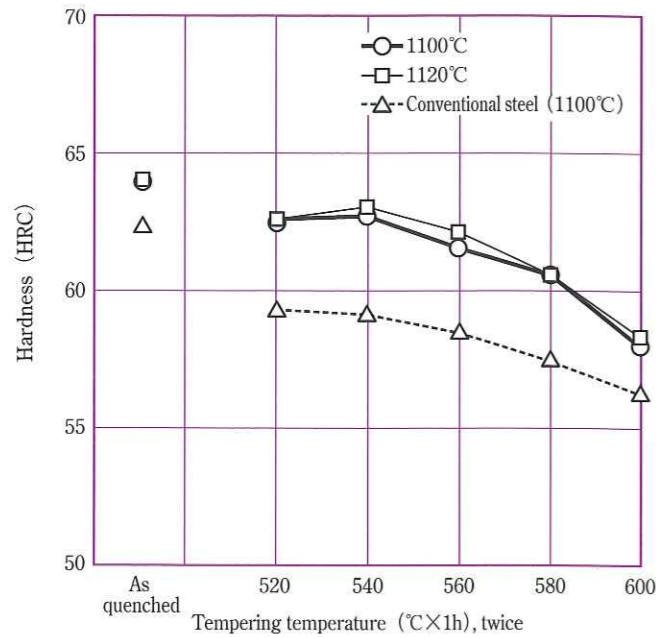


(Cr<sub>2</sub>O<sub>3</sub> Electrically etching)



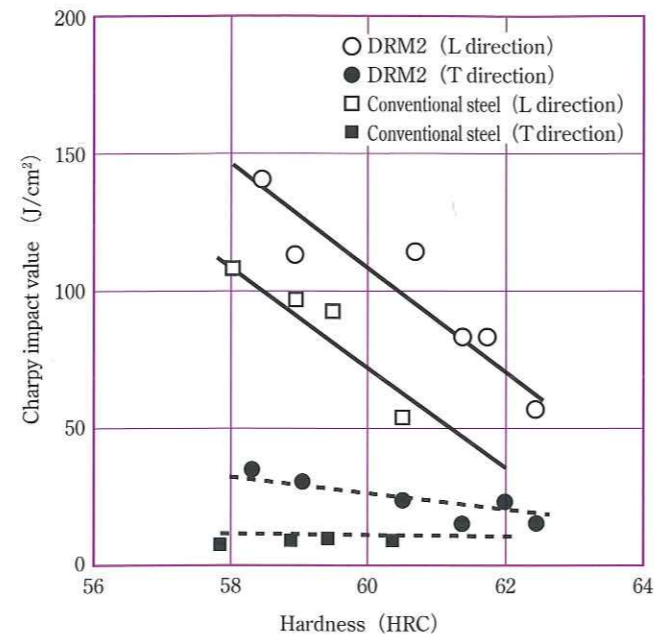
# Characteristics

## Tempering hardness



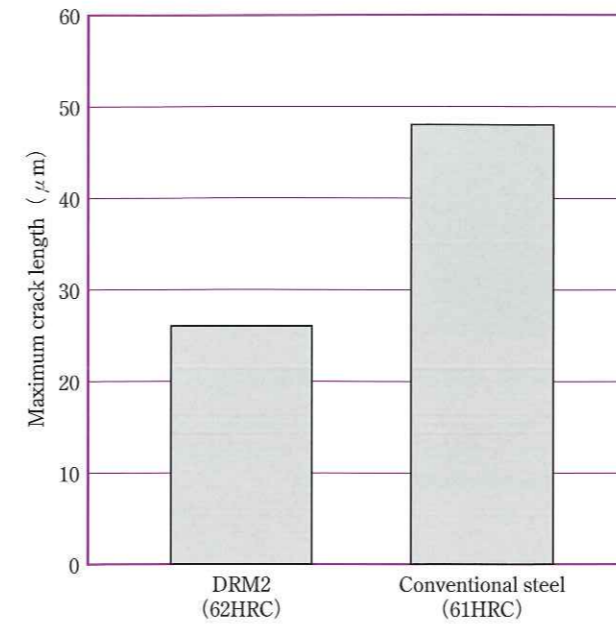
- Specimen : 15mm square
- Hardening : Oil quenching
- Tempering : Air cooling

## Toughness : Charpy impact property



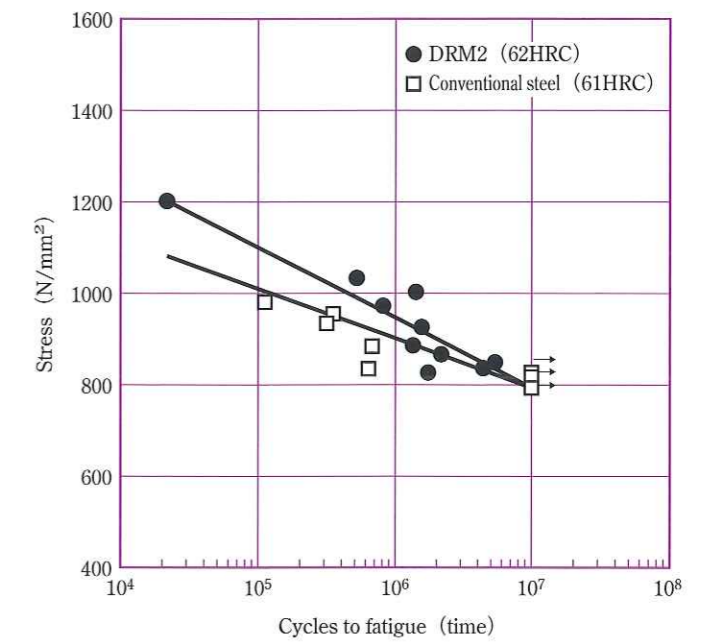
- Sampling : 100mm dia. Bar center
- Specimen : 10R notched
- Heat treatment : DRM2..... H : 1120°C OQ  
T : 540~600°C AC, twice
- Heat treatment : Conventional Steel... H : 1120°C OQ  
T : 540~600°C AC, twice

## Heat checking resistance



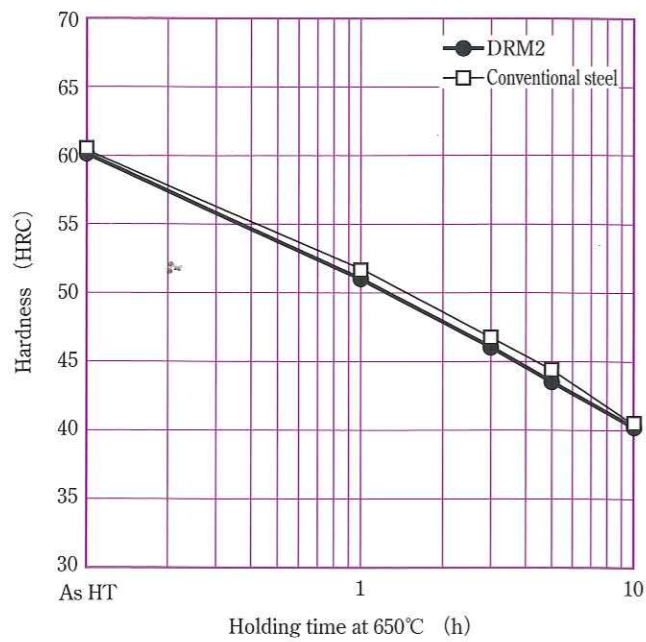
- Specimen : 15 mm dia. 10 mm thick
- Heat treatment : DRM2..... H : 1120°C OQ  
T : 560°C AC, twice
- Heat treatment : Conventional Steel... H : 1140°C OQ  
T : 560°C AC, twice
- Test method : Induction heating 20 ↔ 700°C (1000 times)

## Fatigue strength



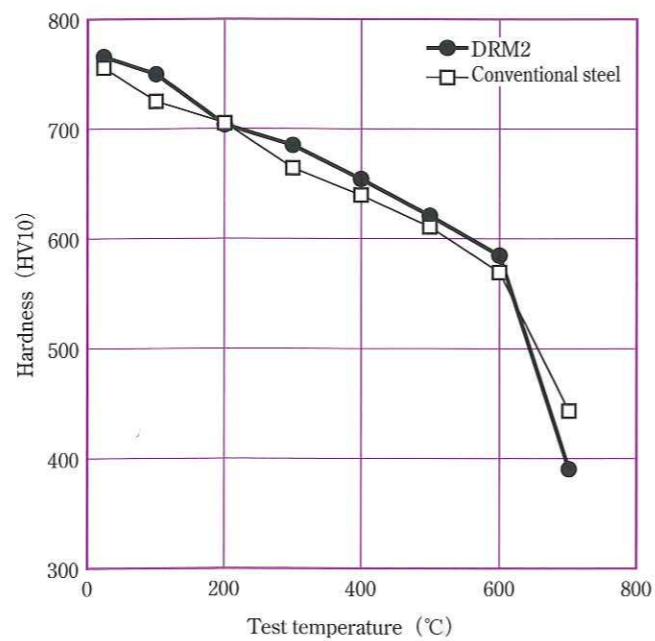
- Sampling : 100 mm dia. Bar center
- Heat treatment : DRM2..... H : 1120°C OQ  
T : 560°C AC, twice
- Heat treatment : Conventional Steel... H : 1140°C OQ  
T : 560°C AC, twice
- Test method : Rotating bending fatigue test (20°C)

## Temper softening resistance



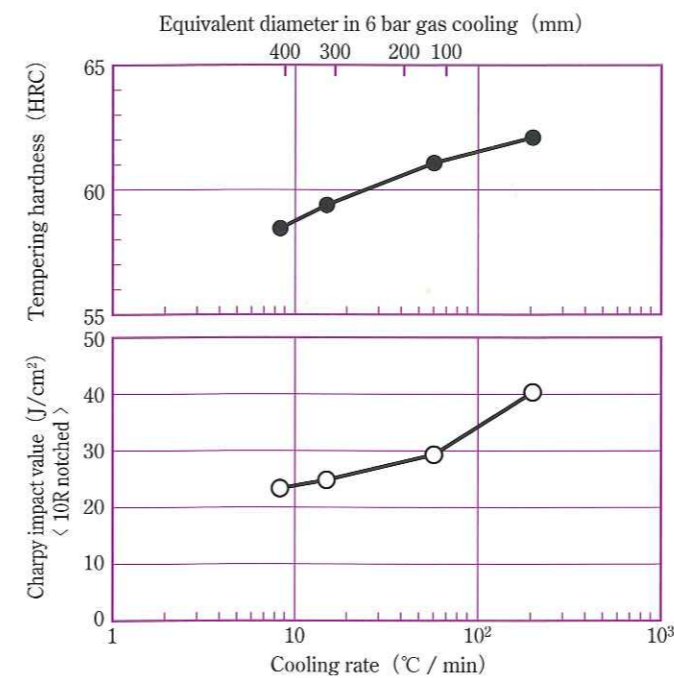
- Heat treatment : DRM2..... H : 1120°C OQ  
T : 580°C AC, twice
- Heat treatment : Conventional Steel... H : 1120°C OQ  
T : 540°C AC, twice

## Hot hardness



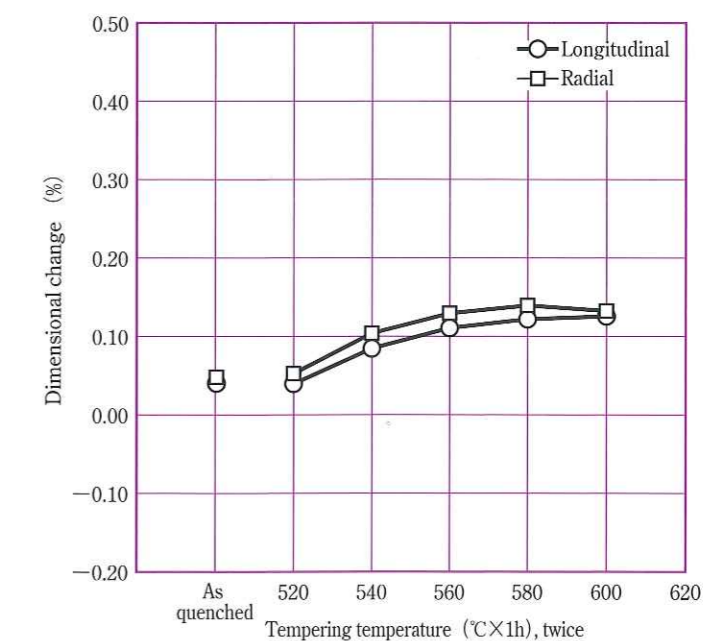
- Heat treatment : DRM2..... H : 1120°C OQ  
T : 560°C AC, twice
- Heat treatment : Conventional Steel... H : 1120°C OQ  
T : 560°C AC, twice

## Hardenability



- Sampling : 100mm dia. Bar center
- Heat treatment : H : 1120°C (200°C / min → equal to OQ)  
T : 560°C AC, twice

## Dimensional changes in heat treatment



- Specimen : 36mm dia. × 60 mm
- Hardening : 1120°C salt bath quenching