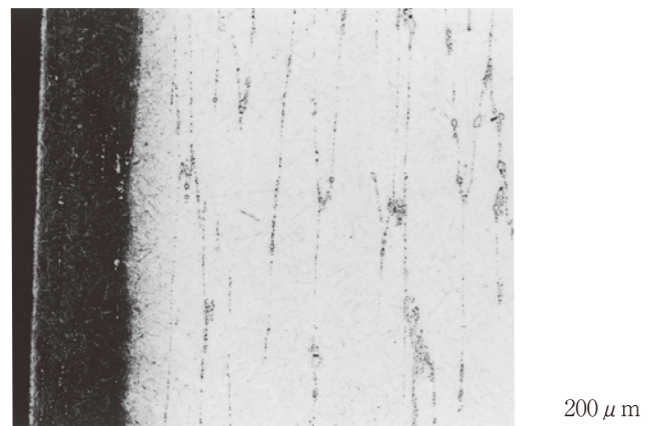


## Nitriding characteristics

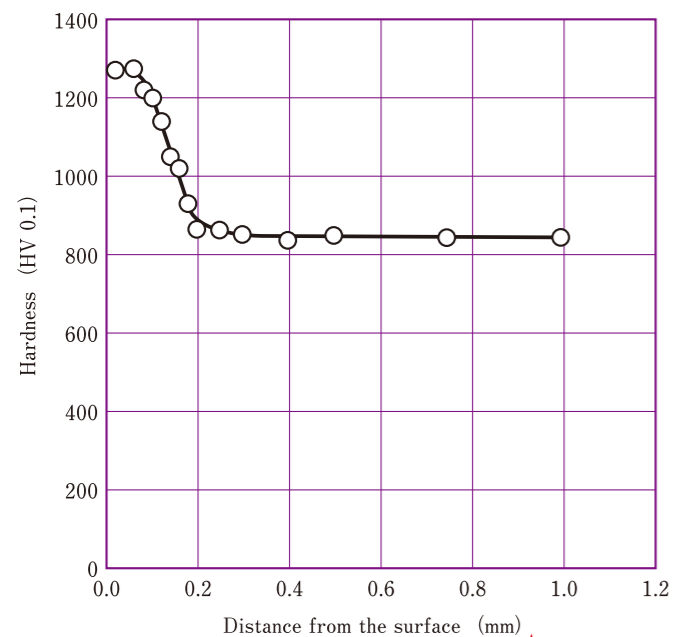
An example of micro structure nitrided by PS process

### ● PS process

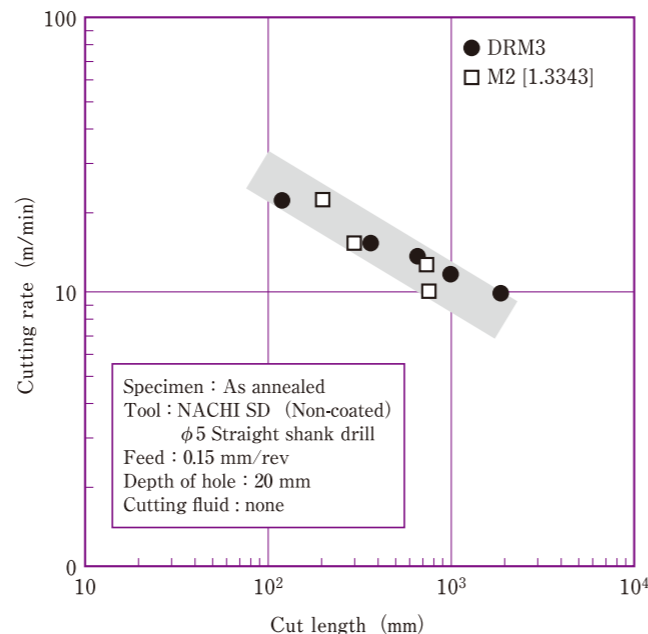
Daido Die & Mold Steel Solutions originally developed process featured by high scuffing and erosion resistance



### ● Hardness distribution



## Drilling machinability



## Physical properties

Quenching: 1140°C×1h, Oil cooling  
Tempering: 560°C×1h - Air cooling, Twice  
Hardness: 65HRC

### ◆ Thermal expansion rate

Temp.	20~100°C	20~200°C	20~300°C	20~400°C	20~500°C	20~600°C
×10 <sup>-6</sup> /K	10.5	11.1	11.5	11.9	12.3	12.6

### ◆ Thermal conductivity

Temp.	25°C	100°C	200°C	300°C	400°C	500°C	600°C
W/m·K	20.2	22.6	24.8	25.5	26.0	26.4	27.6

※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	465	505	545	568	603	658	758

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

Young's modulus	Rigidity modulus	Poisson's ratio
214GPa	82GPa	0.30



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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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No.SC0409a 24.03.0.5 (ZZZ)

# Dream Series Daido's DRM3™

## Cold Forging Die Steel

High hard and tough high speed tool steel with excellent hardenability

### Features

Conventional grade MH88 has been improved to DRM3. High hardness and tough DRM3 with excellent hardenability is suitable for high precision cold working tools.

- ①Applicable with the maximum hardness 66HRC
- ②Fine carbides contribute higher toughness and fatigue strength than those of M2 [1.3343]
- ③Greater hardenability results in high performance even in large dies and gas quenching in vacuum furnace.
- ④Double melting realizes clean and homogeneous steel with less non-metallic inclusions

### Applications

- Cold forging dies and punches
- Cold work roll, emboss roll
- Tools quenched by gas in vacuum furnace

### Heat treatment

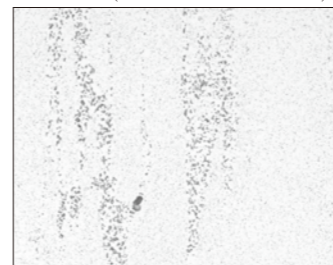
Re-forging Temperature	Heat treatment (°C)			Hardness	
	Annealing	Quenching	Tempering	Annealed	Quenched & Tempered
Requested to inquire	800~880 Slow cooling	1100~1140 OQ, GC, Salt bath	550~620 AC, ≥twice	≤235HBW	62~66HRC

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

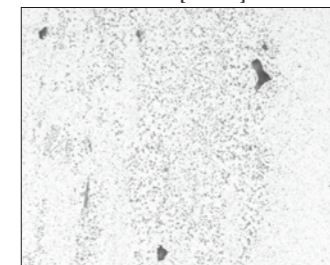
### Microstructure (As annealed)

● Finely distributed coarse carbides

DRM3 (Middle of 100 dia. bar)



M2 [1.3343]



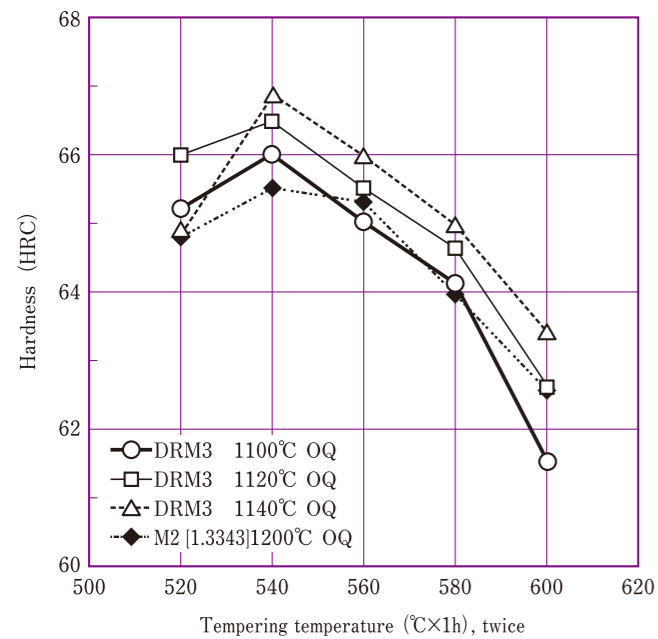
25 μm

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



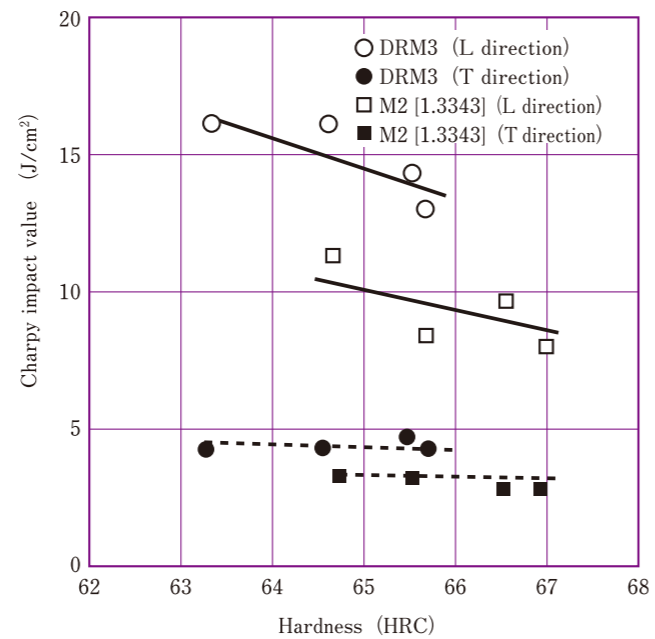
# Properties

## Tempered Hardness



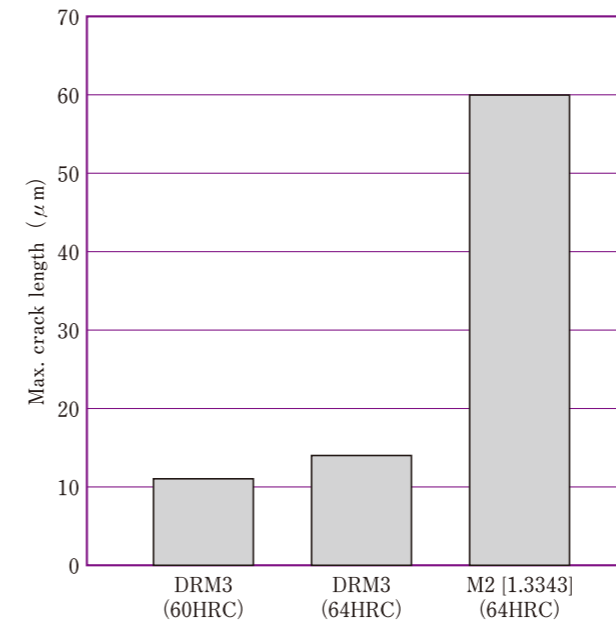
- Specimen : 15mm square
- Hardening : Oil quenching
- Tempering : Air cooling

## Toughness



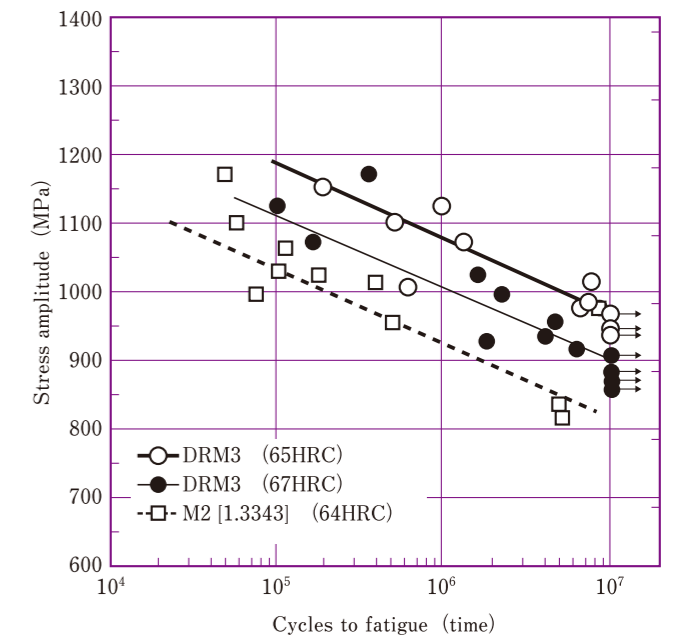
- Sampling : 100mm dia. Bar center
- Specimen : 10R notched
- Heat treatment : DRM3 ..... H : 1140°C OQ  
T : 540~600°C AC, twice
- Heat treatment : M2 [1.3343] ..... H : 1210°C OQ  
T : 540~600°C AC, twice

## Heat checking resistance



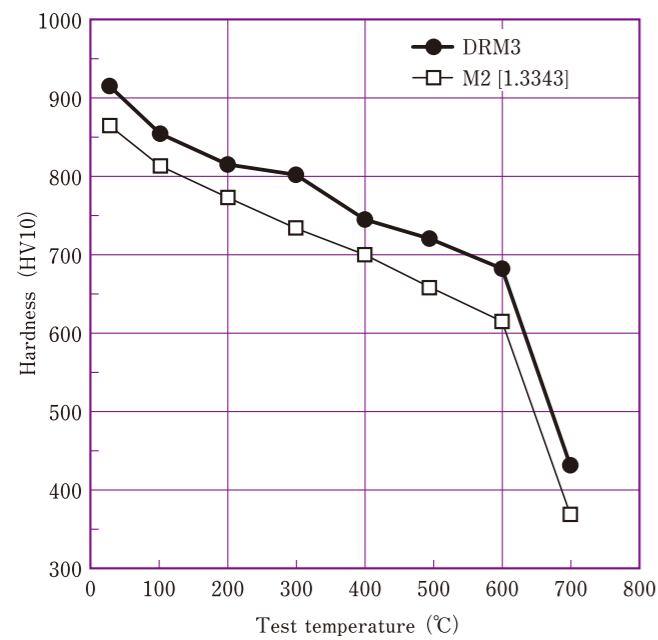
- Specimen : 15 mm dia. 10 mm thick
- Heat treatment : DRM3 ..... H : 1120°C OQ  
T : 560~620°C AC, twice
- Heat treatment : M2 [1.3343] ..... H : 1200°C OQ  
T : 560°C AC, twice
- Test method : Induction heating 20↔ 600°C (1000 times)

## Fatigue strength



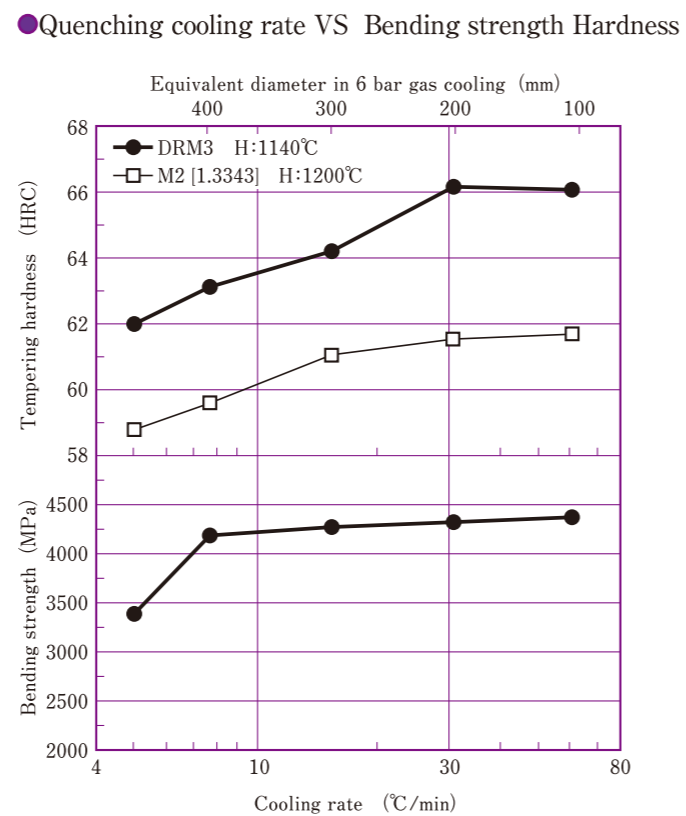
- Heat treatment : DRM3 (65HRC) ..... H : 1100°C OQ  
T : 560°C AC, twice
- Heat treatment : DRM3 (67HRC) ..... H : 1140°C OQ  
T : 550°C AC, twice
- Heat treatment : M2 [1.3343] ..... H : 1200°C OQ  
T : 560°C AC, twice
- Test method : Rotating bending fatigue test (20°C)

## Hot hardness



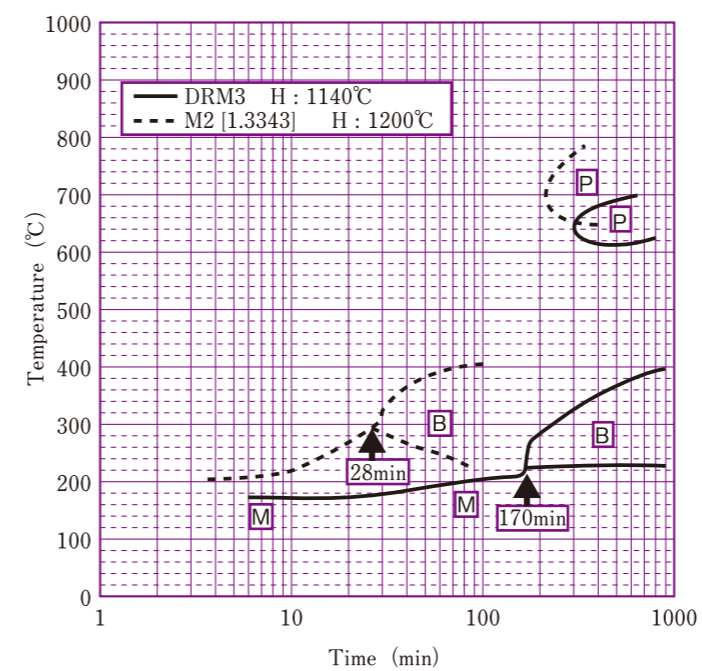
- Heat treatment : DRM3 ..... H : 1140°C OQ  
T : 560°C AC, twice
- Heat treatment : M2 [1.3343] ..... H : 1200°C OQ  
T : 580°C AC, twice

## Hardenability

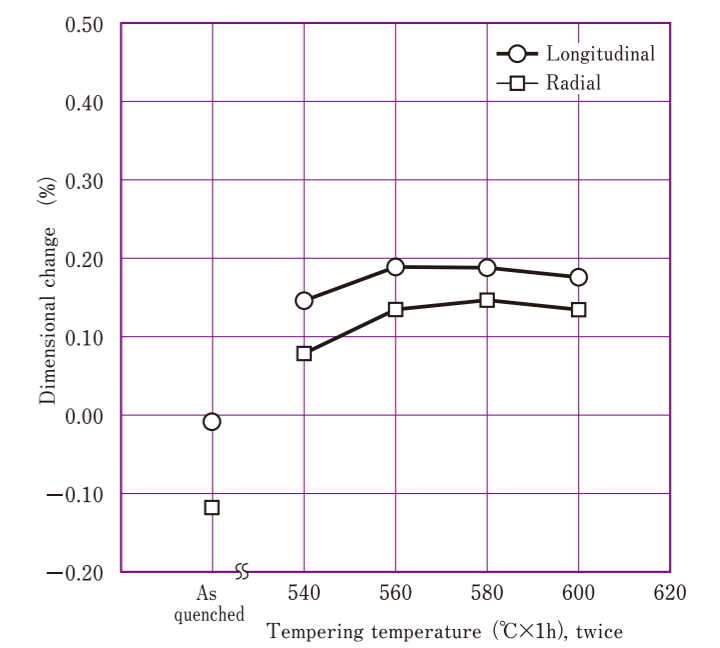


- Quenching cooling rate VS Bending strength Hardness

- CCT diagram



## Dimensional change



- Specimen : 100mm dia. x 60 mm
- Hardening : 1140°C salt bath quenching