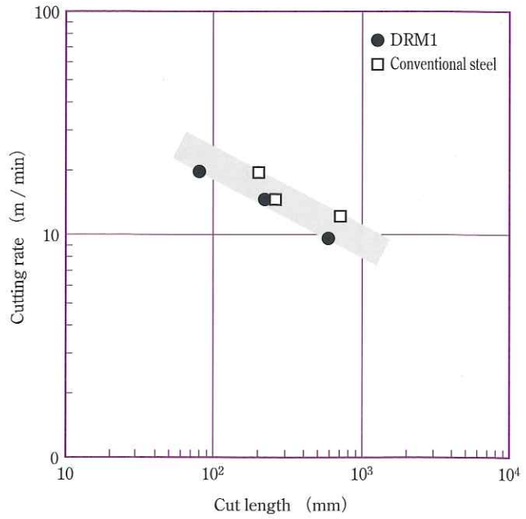
Drilling machinability



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

Physical Properties

◆Coefficient of expansion

	20~100℃	20~200℃	20~300℃	20~400℃	20~500℃	20~600℃	20~700℃	20~800℃
$\times 10^{-6}$/K	11.2	11.4	11.7	11.9	12.2	12.4	12.7	12.3

◆Thermal conductivity

	25℃	200℃	300℃	400℃	500℃	600℃	700℃
W/m·K [cal/cm·sec·℃]	22.4 [0.054]	26.3 [0.063]	27.3 [0.065]	28.6 [0.068]	28.4 [0.068]	29.1 [0.070]	28.8 [0.069]

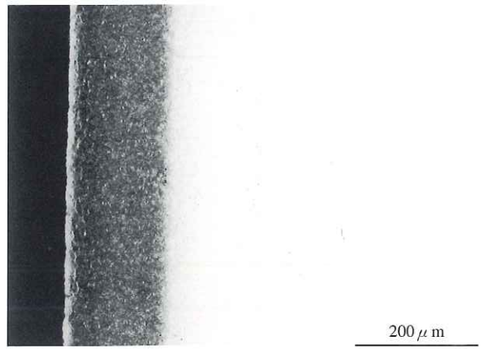
◆Specific heat

	25℃	200℃	300℃	400℃	500℃	600℃	700℃
J/kg·K [cal/g·℃]	413 [0.099]	487 [0.116]	519 [0.124]	562 [0.134]	616 [0.147]	705 [0.168]	840 [0.201]

◆Young's modulus 210 Gpa

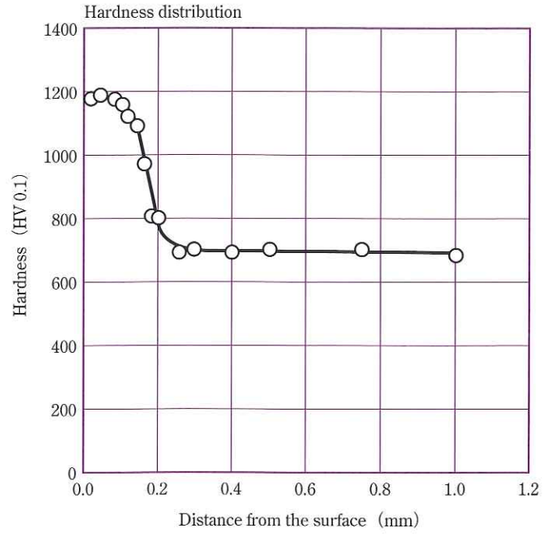
· Specimen condition : H : 1140℃ OQ T : 560℃ AC twice

Nitriding



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

Hardness distribution



DAIDO STEEL

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www.daido.co.jp

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05.02.2,0 (TRY)

Dream Series

Daido's DRM1

Hot and Warm Forging Die Steel

High tough matrix type high speed tool steel

Features

High hardness and high tough Matrix type high speed tool steel vastly surpassing hot work die steels. DRM1 improves hot and warm die life by its higher toughness than conventional grade.

①Applicable with the maximum hardness of 58HRC
②High hardness and tough grade with excellent heat checking resistance
③Fine microstructure as that of hot work die steels resulting in higher toughness than conventional high speed tool steels
④High softening resistance and hot hardness
⑤Double melting realizes clean and homogeneous steel with less non-metallic inclusions

Applications

· Hot forging dies and punches
· Warm forging dies and punches

Heat treatment

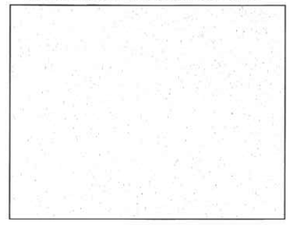
Re-forging Temperature	Heat treatment conditions (℃)			Hardness	
	Annealing	Quenching	Tempering	Annealed	Hardening / Tempering
Requested to inquire	800~880 Slow cooling	1100~1140 OQ , GC,Salt bath	550~620 AC, ≧twice	≦235HB	56~58HRC

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

Microstructure (As annealed)

●Fine and uniform microstructure with less coarse carbides

DRM1 (Middle of 100 dia. bar)



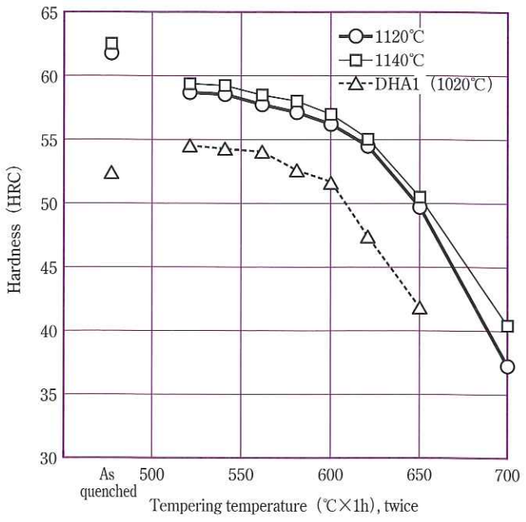
Conventional steel (Daido)

〈Cr_2O_3 Eletrically etching〉

DAIDO STEEL

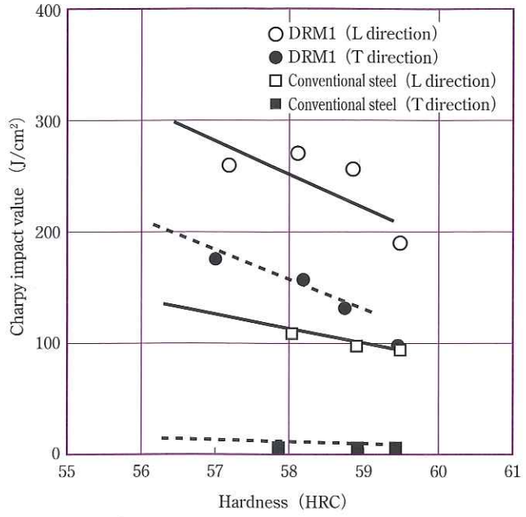
Characteristics

Tempering hardness



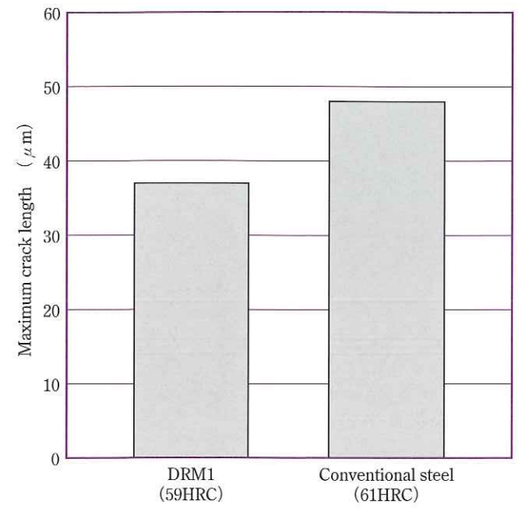
- Specimen : 15mm square
- Hardening : Oil quenching
- Tempering : Air cooling

Toughness : Charpy impact property



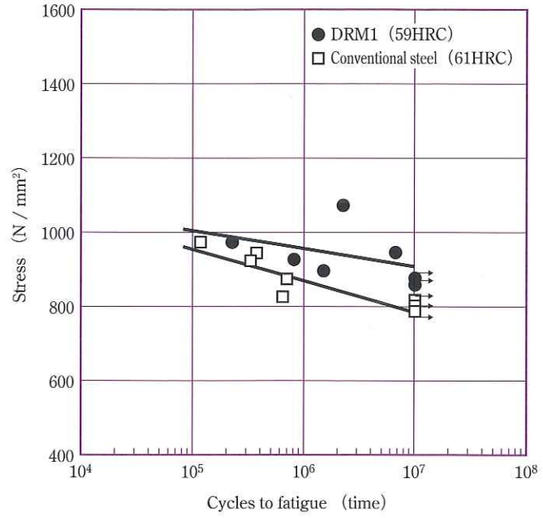
- Sampling : 100mm dia. Bar center
- Specimen : 10R notched
- Heat treatment : DRM1 ····· H : 1140℃ OQ
  T : 540～600℃ AC, twice
  Conventional Steel ··· H : 1120℃ OQ
  T : 540～600℃ AC, twice

Heat checking resistance



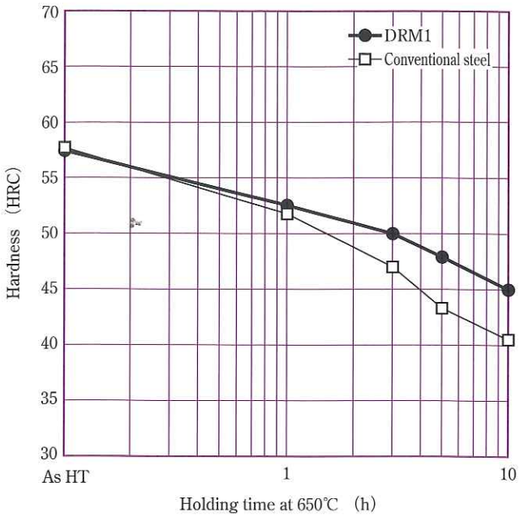
- Specimen : 15 mm dia. 10 mm thick
- Heat treatment : DRM1 ····· H : 1140℃ OQ
  T : 560℃ AC, twice
  Conventional Steel ··· H : 1140℃ OQ
  T : 560℃ AC, twice
- Test method : Induction heating 20←→700℃ (1000 times)

Fatigue strength



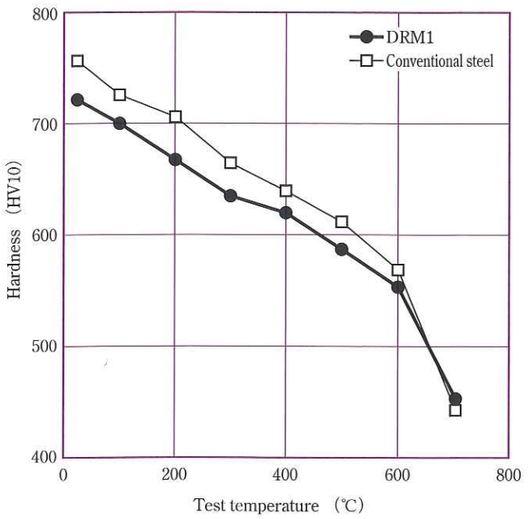
- Sampling : 100 mm dia. Bar center
- Heat treatment : DRM1 ····· H : 1140℃ OQ
  T : 560℃ AC, twice
  Conventional Steel ··· H : 1140℃ OQ
  T : 560℃ AC, twice
- Test method : Rotating bending fatigue test (20℃)

Temper softening resistance



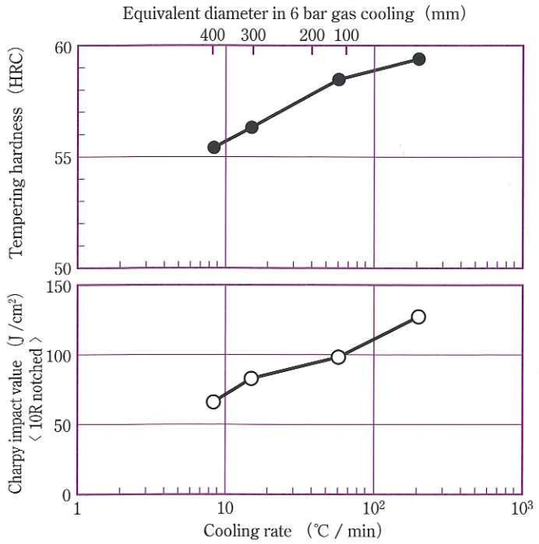
- Heat treatment : DRM1 ····· H : 1140℃ OQ
  T : 600℃ AC, twice
  Conventional Steel ··· H : 1120℃ OQ
  T : 610℃ AC, twice

Hot hardness



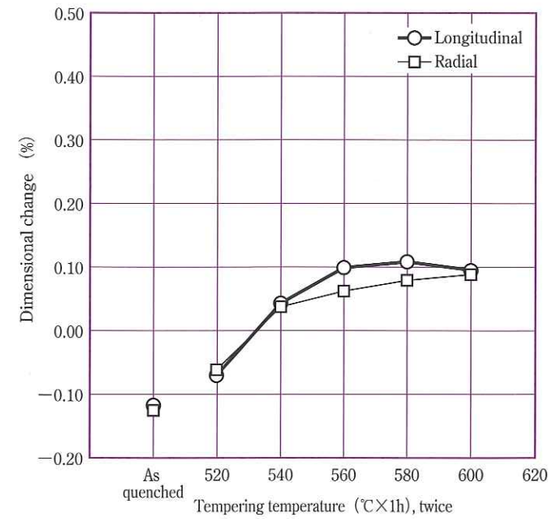
- Heat treatment : DRM1 ····· H : 1140℃ OQ
  T : 560℃ AC, twice
  Conventional Steel ··· H : 1140℃ OQ
  T : 560℃ AC, twice

Hardenability



- Sampling : 100mm dia. Bar center
- Heat treatment : H : 1140℃ (200℃ / min → equal to OQ)
  T : 560℃ AC, twice

Dimensional changes in heat treatment



- Specimen : 100mm dia. × 60 mm
- Hardening : 1140℃ salt bath quenching