

# Daido's Matrix type Tool Steels Series

# DCMX

## Matrix type Cold Work Die Steel

### Features

DC-Matrix is a matrix type cold work tool steel: only fine carbides are distributed in matrix due to optimum alloy design and production process.

DC-Matrix shows high performance in service and ease in mold making as well.

#### < Die performance >

- ◆ **High hardness** such as 62HRC is available by high temperature tempering with good Dimensional stability, resulting in high wear resistance.
- ◆ **High toughness** contributes to prevent cracking and chipping.

#### < Ease in die making >

- ◆ **Isotropic** dimensional change works easy geometry control in heat treating.
- ◆ **Machinability** is improved by free machining additives and finely dispersed carbides.

### Main applications

- ◆ Punches, dies and working tools for cold pressing and cold forging, especially for Cold stamping dies for high strength steels  
Where galling and peel off of coated layer, TD and CVD, are main failure modes
- ◆ Insert blocks for composite stamping dies  
Where good dimensional stability is required in dies alignment
- ◆ Blanking punches and trimming edges  
Where main failures are cracking and chipping.

### Chemistry

Patent pending

### Heat treatment

Forging Temp. (°C)	Treating temperature (°C)				Hardness	
	Annealing	Quenching	Tempering	Stabilizing treatment	Annealed	Quenched & tempered
900—1160	920—980 Slow cooling	1000-1050 Air cooling	Low : 150 - 200 High: 480 - 560 Air cooling More than twice	400°C for longer than 1h	≤ 235HB	56~62HRC



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[www.lindquiststeels.com](http://www.lindquiststeels.com)

STRATFORD, CT

800-243-9637 • FAX 203-386-0132  
sales@lindquiststeels.com

NEW HAMPSHIRE

603-905-9042 • FAX 603-905-9072  
sales-nh@lindquiststeels.com

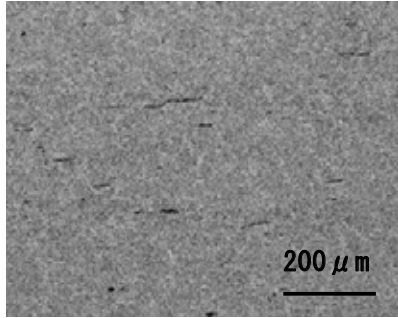


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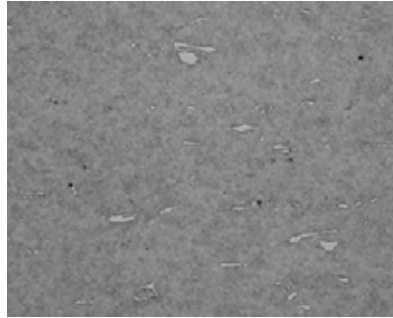
# Properties

## Optical micrographs (As annealed)

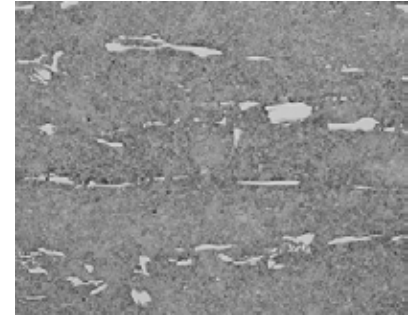
- DCMX shows fine microstructure almost free from coarse carbides



DCMX

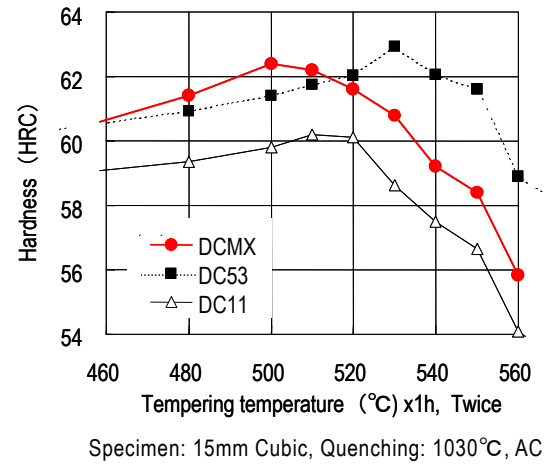
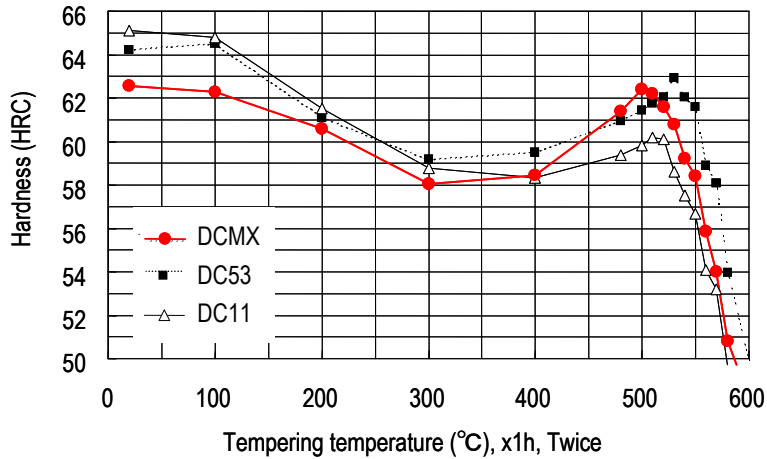


DC53

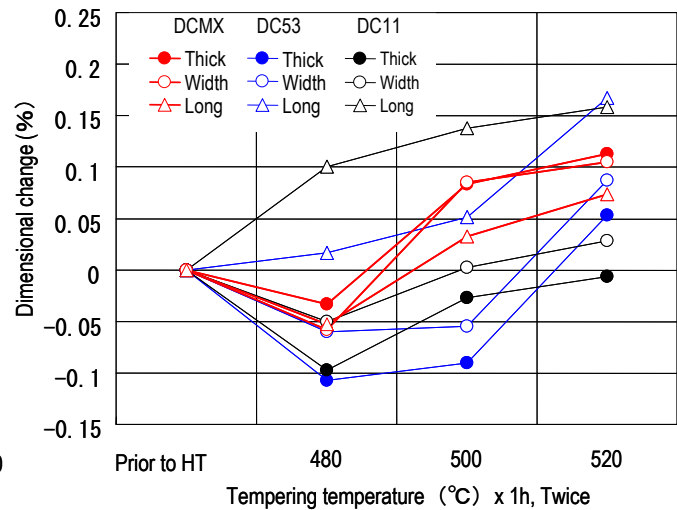
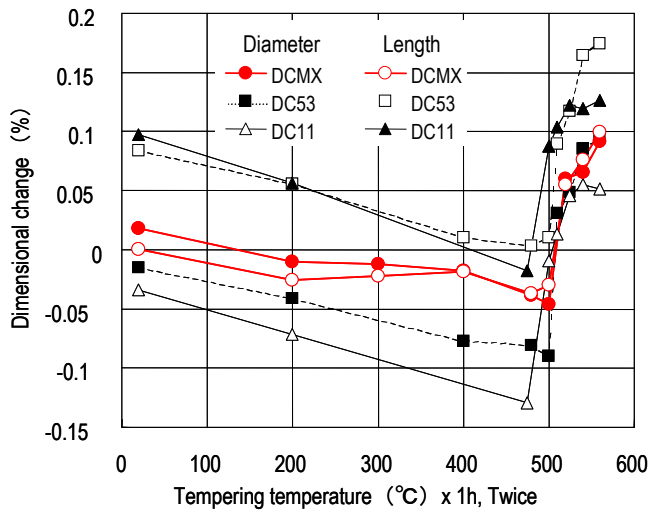


DC11 (Equivalent to D2)

## Tempering hardness

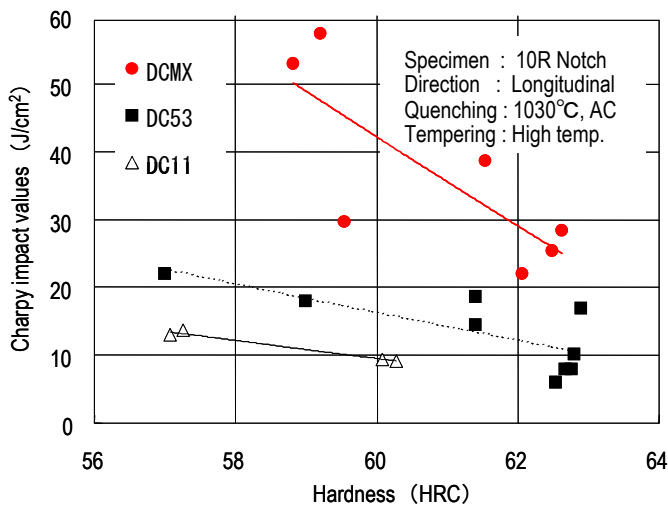


## Dimensional stability

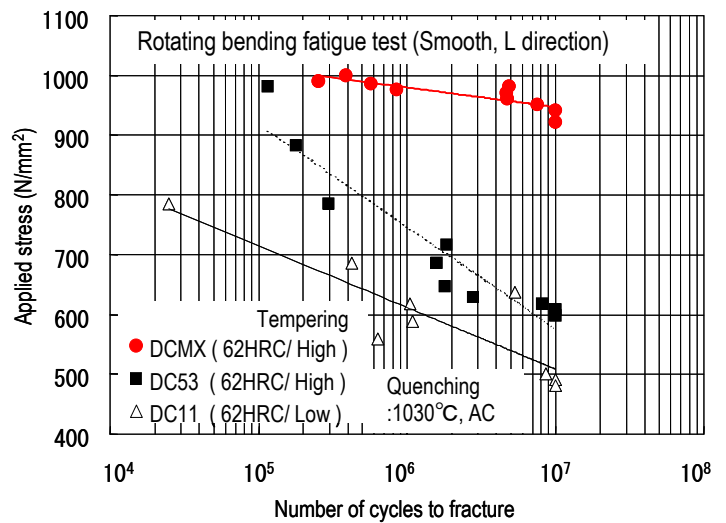


# Properties

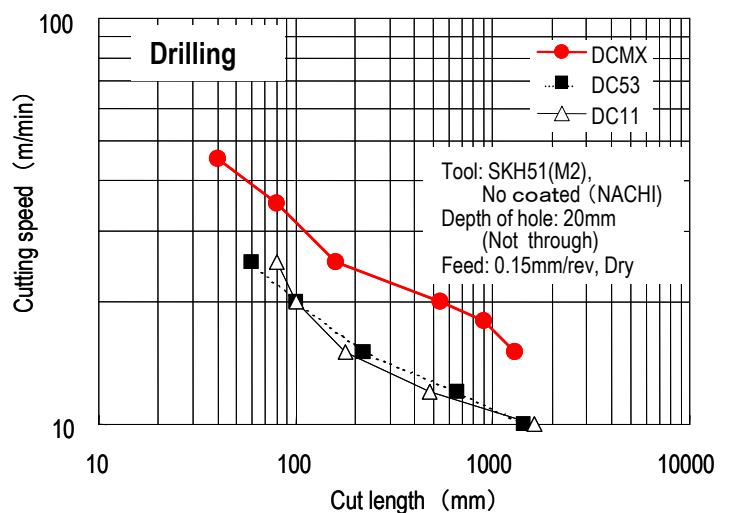
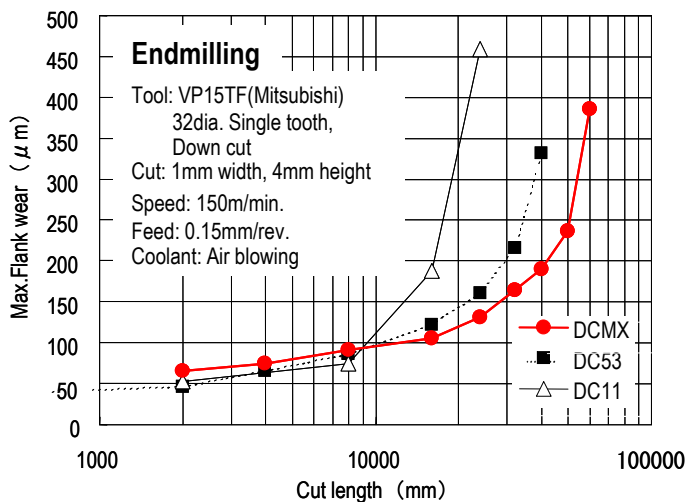
## Toughness



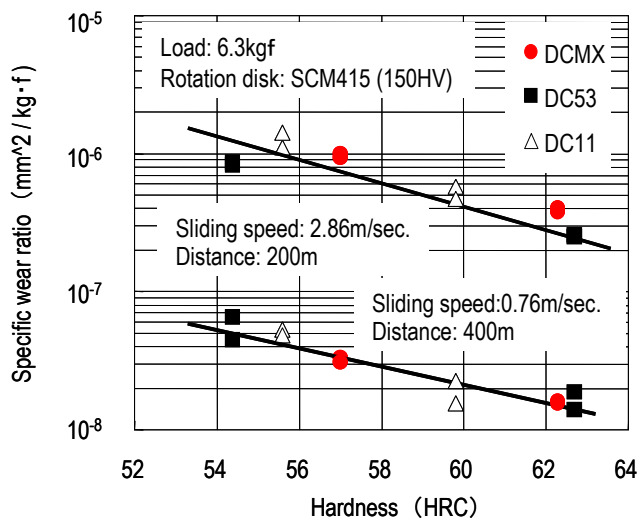
## Fatigue properties



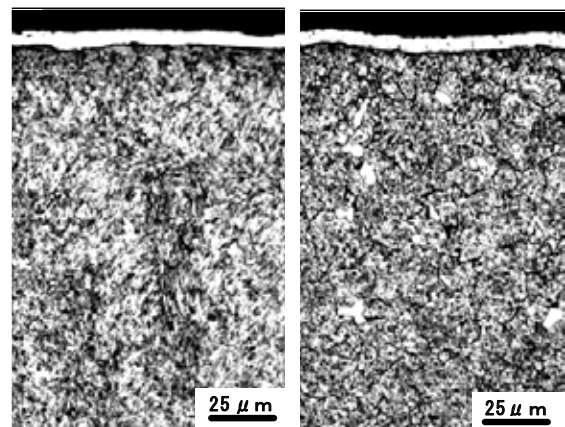
## Machinability (Annealed)



## Wear resistance (Ohkoshi-test)



## TD coating

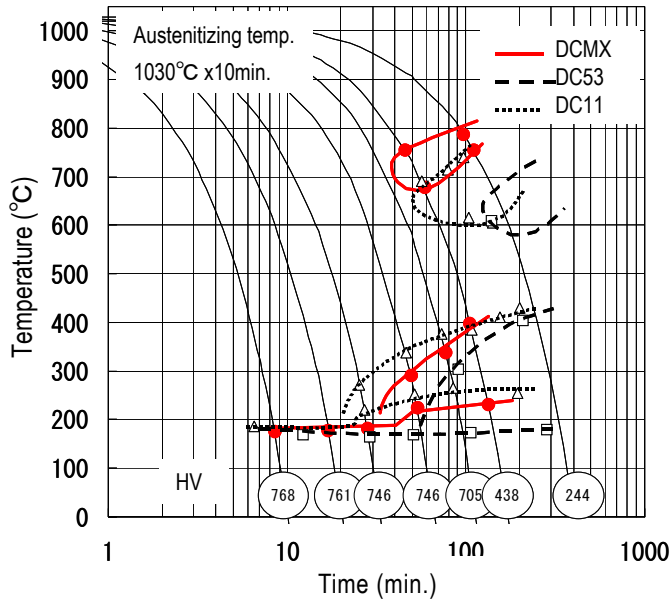


DCMX

DC11

TD coating: By courtesy of DOWA Thermo Engineering.

## CCT diagrams



## Physical properties

◆ Thermal expansion rate ( $\times 10^{-6}/K$ , Ave.value from 20°C)

100°C	200°C	300°C	400°C	500°C	600°C	700°C
13.3	13.7	14.0	14.4	14.7	14.9	14.9

◆ Thermal conductivity ( $W/m \cdot K$  [cal/cm·sec·°C])

RT	100°C	200°C	300°C	400°C	500°C
17.1	18.8	20.9	22.6	24.0	25.7
[0.0409]	[0.0449]	[0.0499]	[0.0540]	[0.0573]	[0.0614]

◆ Specific heat ( $J/kg \cdot K$ )

RT	100°C	200°C	300°C	400°C	500°C
507	535	570	611	654	719

◆ Young modulus = 202 GPa

◆ Specific weight = 7.67 g/cm<sup>3</sup>

※ Heat treating of specimens

Quenching: 1030°C, AC, Tempering: 500°C, Twice

## Comparison of properties among Daido cold work die steels

Properties		DCMX	DC53	DC11
Tempering hardness	Low temp.(200°C)	61 HRC	61 HRC	61 HRC
	High temp.(500°C)	62 HRC	60 HRC	58 HRC
	Hightemp.(520°C)	60 HRC	62 HRC	58 HRC
Isotropy		◎	○	△
Dimensional change with time*1		○(○)	△(○)	○(○)
Hardneability		○	◎	○
Toughness		◎	○	△
Fatigue properties		◎	○	△
Machinability		◎	○	△
Wear resistance		◎	◎	○
Wear resistance to sand		△	○	◎
Wire EDM *2		○	◎	○
Low temp. coating *2		○	◎	○

\*1 Comparison by dimensional change when stabilizing treated △: Average, ○: Good ◎: Excellent

Highlighted are especially featured properties

\*2 Comparison by the decrease in hardness when tempered at 520°C for wire EDM and PVD coating



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