NAK55
NAK80

40 HRC Pre-hardened Type
High Performance, High Precision Plastic Mold Steel

Features

NAK 55

1 It is solution-treated and age-hardened to 37 - 43 HRC.

- It is ready to be machined into molds, and no further heat treatment is necessary.

2 It is a Ni-Al-Cu precipitation hardening steel.

- It has high machinability.
- It has high polishability after Electrical Discharge Machining (EDM).
- It can easily be subjected to build-up welding.
- It keeps high preciseness during use.
- It has uniform hardness (40 HRC) between surface and interior.

3 We use a special melting method.

- It has extremely good mirror surface polishability and provides full brightness.
- It provides highly uniformed texture etching performance.

NAK 80 **(Improved NAK 55 on mirror surface, EDM surface, and toughness.)**

NAK 80 has the following features in addition to those noted for NAK 55.

- It has better mirror surface polishability.
- It can be used in place of aventurine etching due to better EDM surface.

Applications

NAK 55

- High precision plastic molds.
- Rubber molds
- Press dies (for benders, etc.)
- Parts used in industrial equipments and the like

NAK 80

Plastic molds for the following:

- Transparent products and others for which mirror finished surface are particularly important
- Products for which electrical discharge machined surfaces are very important

DAIDO STEEL

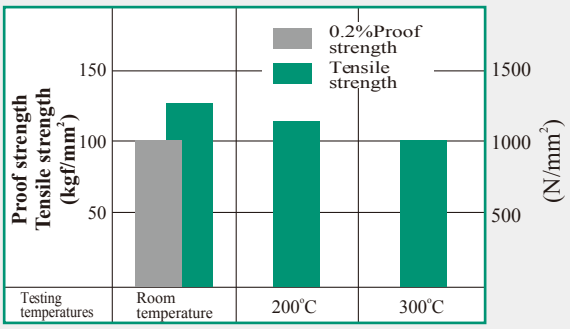
Chemical Composition

Daido Brand	Equivalent to JIS and /or others	Chemical Composition (%)							
		C	Si	Mn	Ni	Cu	Mo	Al	Free cutting elements
NAK55	---	0.15	0.3	Proper amount	3.0	1.0	0.3	1.0	Additives
NAK80	---	Improved NAK 55							

Quality Characteristics I

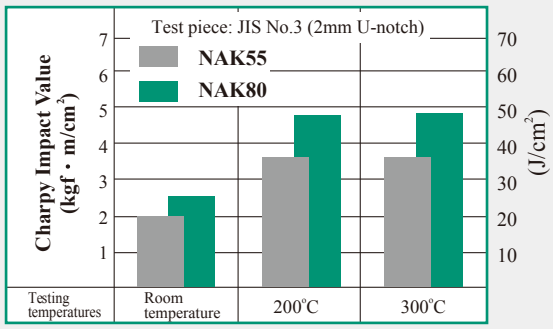
[Typical Mechanical Properties of Rolled Bars]

● Tensile strength (initial hardness 40 HRC) ... NAK 55, NAK 80



(25D, L)

● Toughness (initial hardness 40 HRC)

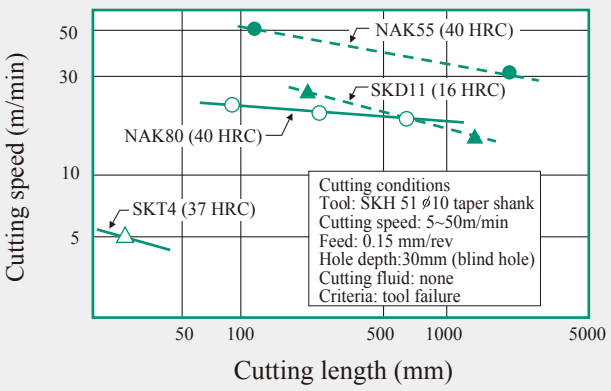


(25D, L)

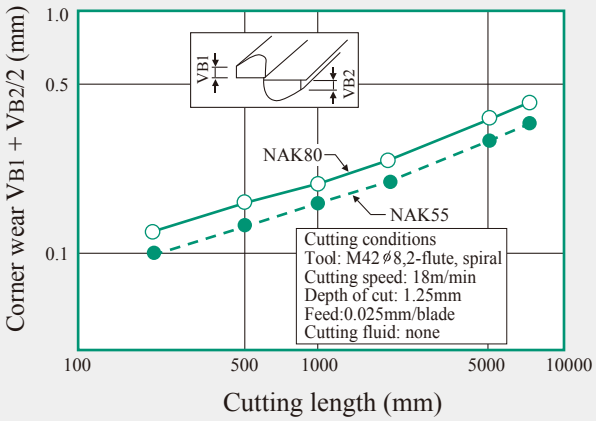
[Machinability]

- **Though both are easily machined, the properties of NAK 80 are slightly inferior to those of NAK 55.**

● Typical drill tool life



● Typical tool wear by end mill

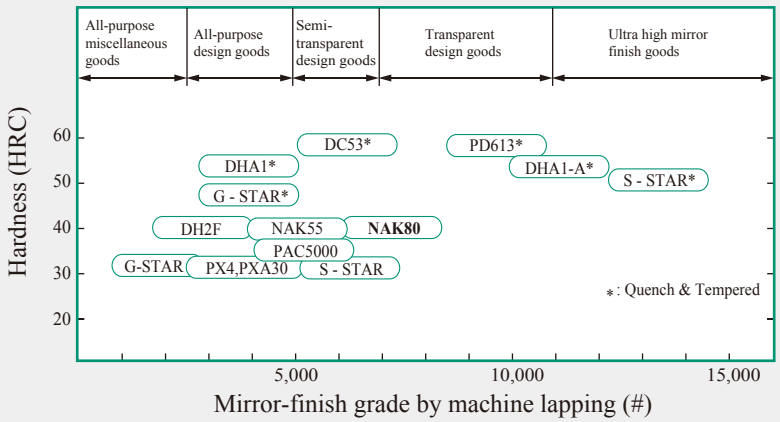


Quality Characteristics II

[Mirror Finish Properties]

- **It provides good mirror finished surface and full brightness.**

● Mirror finished grade (concept diagram)



(Normal polishing procedures)

Turning
Milling
→ Grinding（～#220 → #320 → #400）

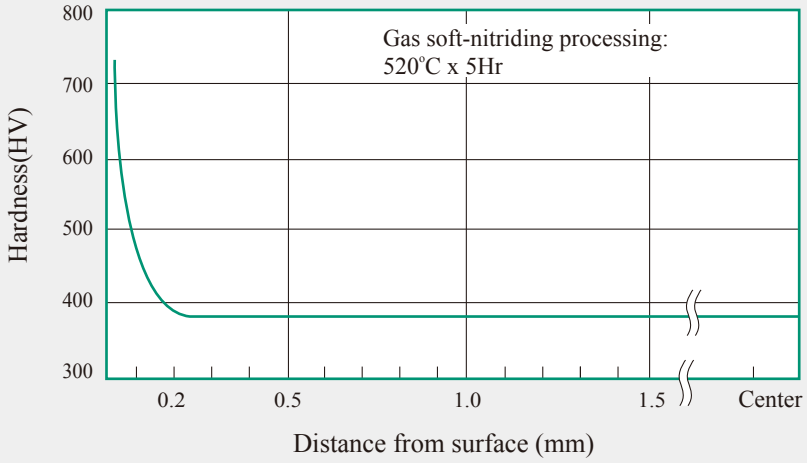
-Emery paper polishing （#320 → #400 → #600 → #800 → #1000 → #1200 → #1500）→

Diamond paste finishing （#1200 → #1800 → #3000 → #8000 → #14000）

With NAK 55, surface might be roughed to aventurine finish surface when the method of polishing of #5000 or finer polishing is attempted.

[Gas Soft-Nitriding Capability]

● Typical hardness distribution: NAK 55, NAK 80



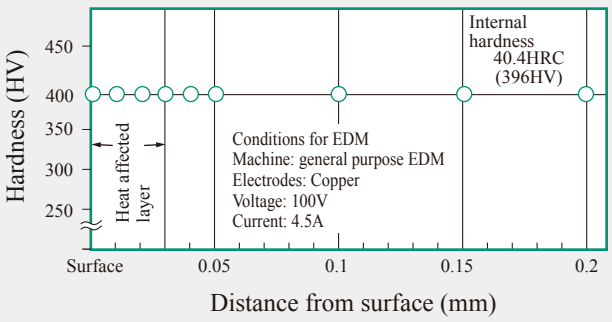
Dimensional changes may occur during any type of surface hardening treatment if temperature exceeds 520°C.

Quality Characteristics III

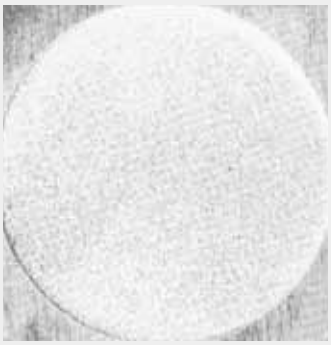
[Electrical Discharge Machinability]

- **There is no increase in hardness of EDM surface. So fine machining can be easily carried out.**

● Typical hardness distribution after EDM: NAK 55, NAK 80



● Electrical discharge machined surface of NAK 80



Conditions for EDM
Machine tool: Makino EDNC-22
Electrodes: Copper (ø20)
Voltage: 100V
Current: 3.5A
Electrode Consumption: under 1%

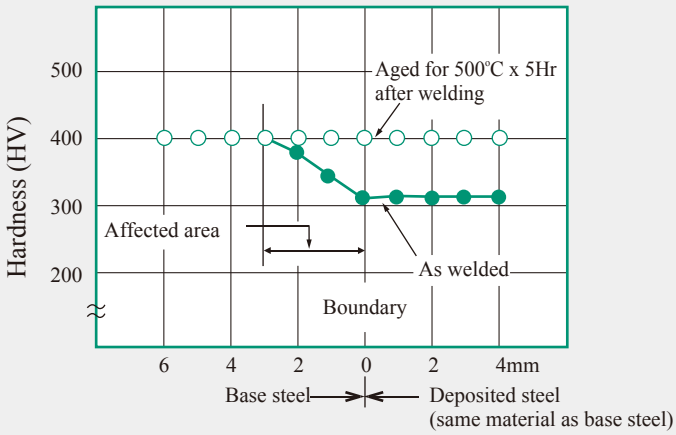
EDM surface roughness:16µm

The surface of NAK 80 after electrical discharge machining is extremely fine and attractive. However, stripe patterns may develop on the surface of NAK 55.

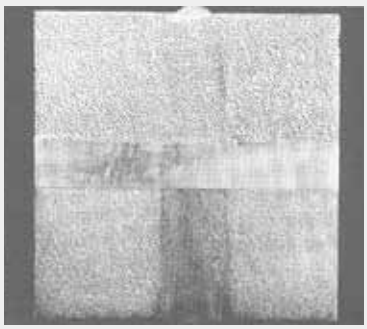
[Build-up Welding Properties]

- **There is no increase in hardness of welded sections. If aging is performed after welding, uneven etching structure will be improved.**

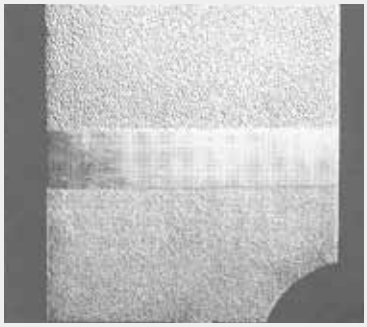
● Typical hardness distribution after Welded: NAK 55, NAK 80



Welding conditions
Welding method: TIG welding (argon shield)
Preheating: 300 to 400°C
Current: 150 to 170A
Welding rod: Same material as base steel



As welded



Aged after welded
(air cooled at 500°C x 5 Hr)

Quality Characteristics IV

[Physical Properties]

● Thermal expansion coefficient (x 10^{-6}/ °C)

Daido Brand	20~100°C	20~200°C	20~300°C
NAK55 NAK80	11.3	12.5	13.4

● Thermal conductivity (w/m・K)

Daido Brand	20°C	100°C	200°C	300°C
NAK55 NAK80	38.9	39.3	41.9	42.7

● Magnetic properties

Daido Brand (JIS)	Maximum magnetic permeability	Saturated magnetism (T)	Residual magnetism (T)	Coercive force (A/m)
NAK55 NAK80	380	1.635	0.850	1100
(S55C)	---	---	1.380	1200

[Build-up Welding Method]

Build-up welding should be conducted according to the procedures and methods noted below:

1. Preparation
- Fully clean all oils, foreign material, and scales
- Remove all cracks and surface treatment layers
- Beveling: corner sections 3R or above

2. Build-up Welding Rod
- NAK-W (for both NAK 55 and NAK 80)

3. Pre-heating
- 300 to 400°C
- Gradually heat with furnace , propane, or natural gas burner

4. Welding
- DC normal polarity, backward welding
- Conditions:

Rod diameter	Electrode diameter	Current	Argon
1.6 mm	1.6 mm	70-150A	6~9ℓ/min.
2.4	2.4	150-250	7-10

5. Post-heating
- 450-500°C x 1 H

[Precautions]
- If pre-heating and post-heating are conducted with a propane or natural gas burner, the entire body should be heated to prevent cracking.
- When repairing cracks which have occurred during build-up wilding or during use, large deposits often appear. In such cases, even though there may be slight sacrificing of dimensional changes, it is still often necessary to relieve strain immediately after welding (at 870°C) and to conduct aging processing (from 500 to 520°C).

[Precautions for Use]

Both NAK 55 and NAK 80 have a variety of features for use as materials for plastic molds. However, it should be noted that NAK 55, in particular, is slightly inferior to alloy steel in toughness.
Thus, to use the special characteristics of NAK 55 to their maximum effect, it is a good idea to consider measures such as the use of other types of steel inserted at the thin rising sections, or the addition of an arc to the corners of the rising sections from the initial design stages.
All technical and engineering data and suggested procedures, specifications and applications contained in this publication are for general information only.

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