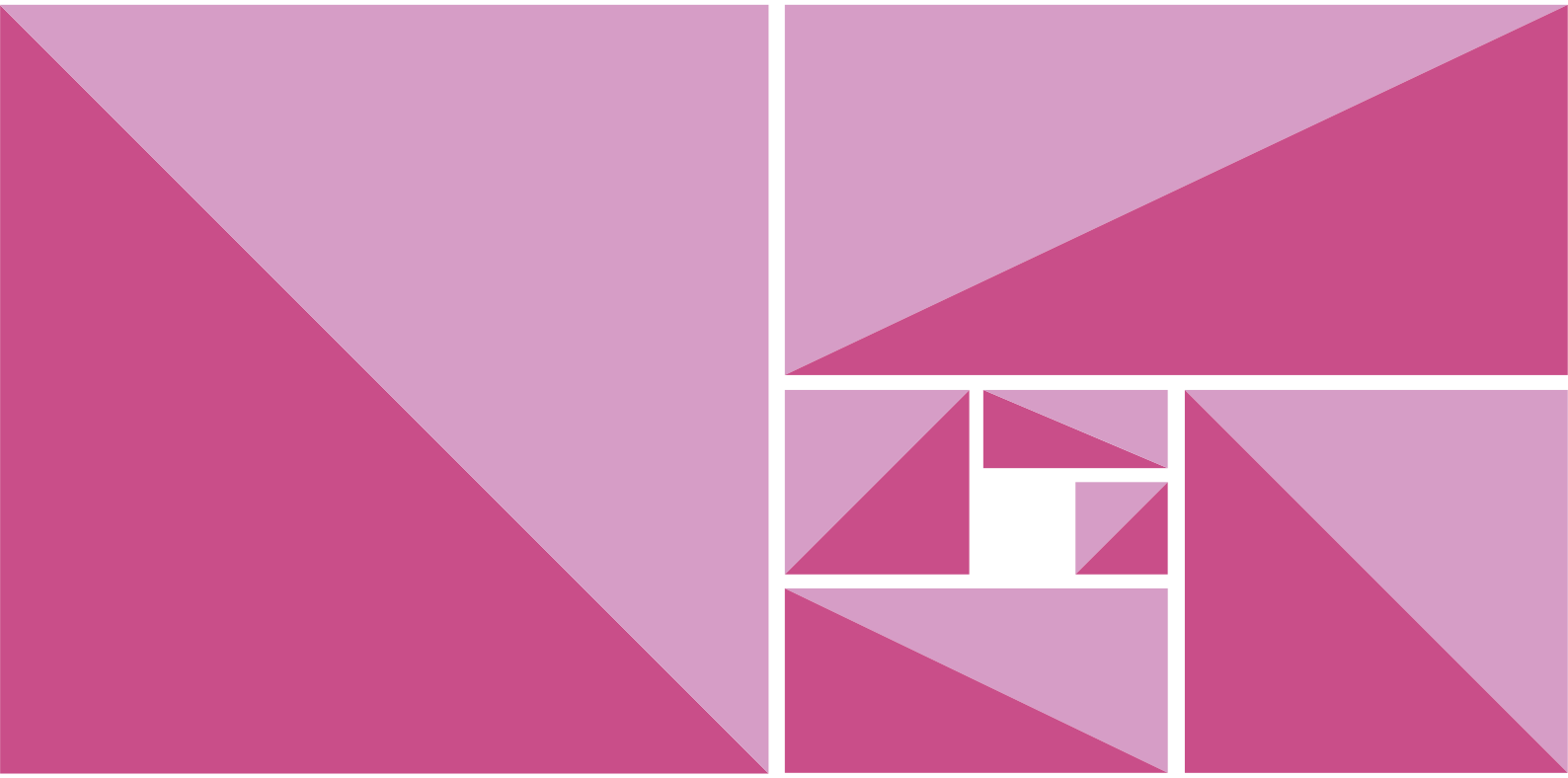
Materials Mag!c

HITACHI

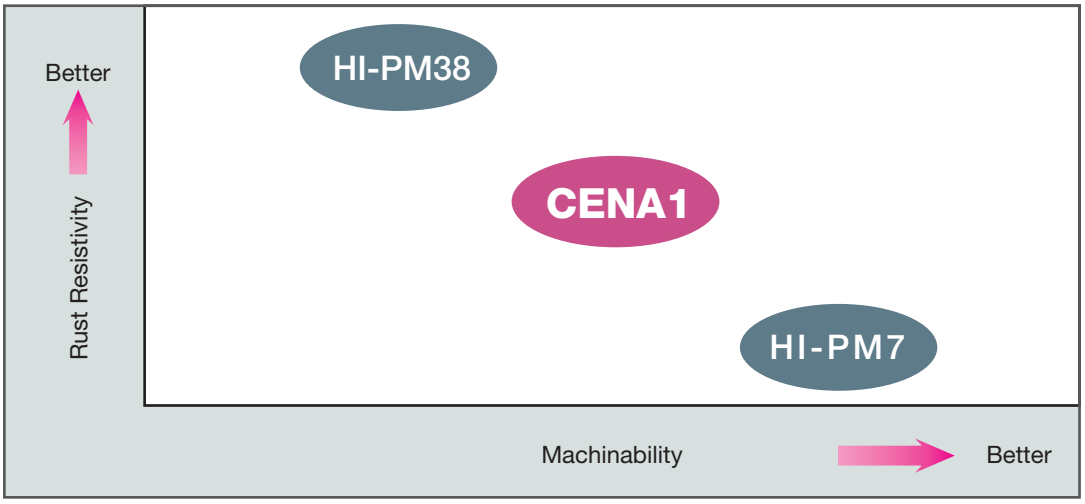
YSS
Plastic Mold Steel
CENA1



Hitachi Metals, Ltd.

Concept of CENA1®

CENA1 is a high performance plastic mold with rust resistivity and excellent machinability. CENA1 has excellent purity and suit for critical surface finish.



Properties Comparison

Grade	Hardness (HRC)	Machinability	Rust Resistivity	Mirror Polishability	Crepability	EDM Finishability
CENA1	37-42	B	B	A	A	A
HI-PMPRO	37-41	B	C	A	A	A
HI-PM7	29-33	A	D	C	C	C
HI-PM38	50-55	C	A	A	B	A

(excellent "A" ⇔ poor "D")

Application

- Weldless molds, Heat & cool molds (Molds that rust preventing)
  e.g. Glossy molding of TV bezel, Glossy molding , Molding for products with high quality surface of mobile equipments parts, OA equipments parts, auto parts. thick transparent parts for game machine , etc.
- Mold requiring sensitive surface as mirror polishing, creping and EDM
  e.g. Mold of housing of mobile equipments, video camera, home electronics (ex. Vacuum cleaner, Air conditioner), auto parts (ex. Inner panel, Transparent cover), cosmetics case, bottle
- General molds for long life: Making the maintenance easy by rust resistance increase
- Mold of food container
- Rubber mold

Rust Resistivity

CENA1 has improved rust resistivity compared with conventional 40HRC prehardened grade.

- Improvement of corrosion problem on mold surface by resins.
- Decreased rust formation at cooling water hole makes cooling effect stable.
- Fewer rust problem in storage, transportadion, or usage of mold
- Much less rust formation on WEDM surface

Rust Resistivity of Polished Surface

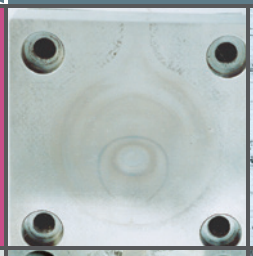
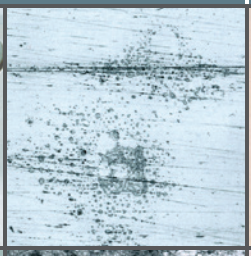
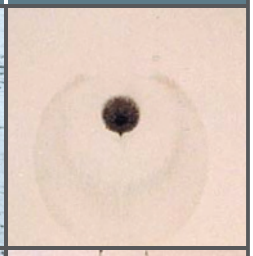
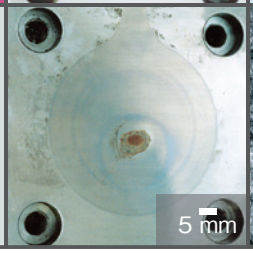
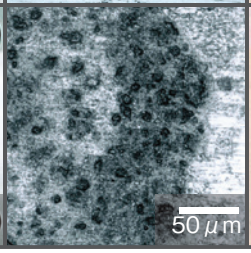
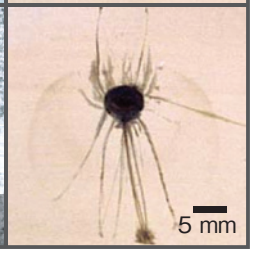
CENA1	HI-PM MAGIC	P20Ni	Conventional P21 Improved Grade
			

【Condition】
Finished by #800 emery paper,
Temperature: 80℃
Humidity: 90%
2 hour hold

CENA1 increases mold durability against corrosion by gas generated from resin.

Gas generated from resin often becomes high temperature by injection pressure and corrode the mold. It brings cloudiness of mirror surface and burr of injected parts. CENA1 improves above gas-corrosion resistance by alloy combination.

Accelerated Gas-corrosion Tests:
Change on Mirror-Finished Mold Surface after Injection Molding Tests

Steel Grade \ Resin	POM		Flame Retardant ABS
CENA1			
Conventional P21 Improved Grade			

<Figure>
Accelerated gas-corrosion tests by a mold that is made to shut gas intentionally.
Observation results of mirror-finished mold surface after 3000 shots of POM and ABS flame retardant grade.

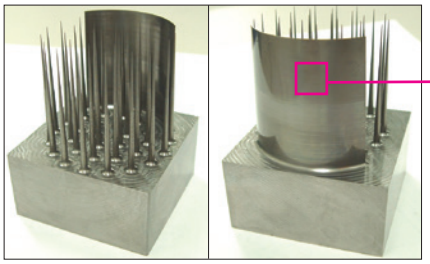
Machinability

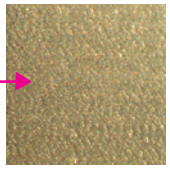
CENA1 decrease tool wear in endmilling and promote cutting efficiency.

- CENA1 can promote cutting efficiency
- CENA1 can decrease tool-change frequency drastically.
- Smooth cut surface of CENA1 makes after-polishing easier.

Endmilling Example

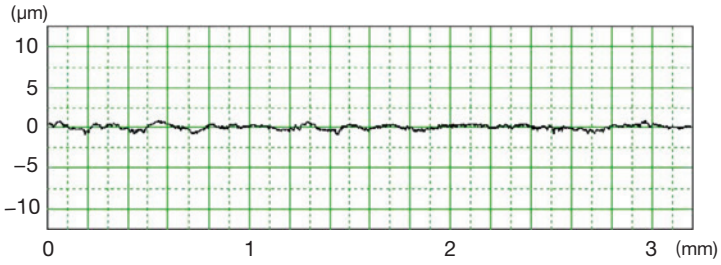
This sample was machined by one endmill for 22 hours.
Machined surface roughness is very smooth.





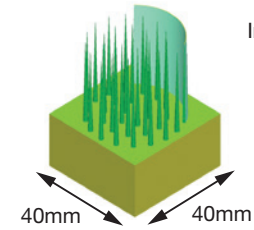
Rz = 2.3 mm
Ra75 = 0.26 mm

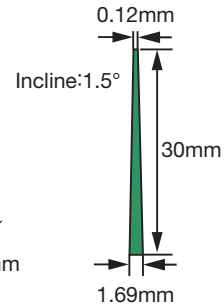
Roughness curve (Longitudinal: × 2,000, Horizontal × 50)



Same condition cutting on conventional P21 steel needs 2 endmills.

L/D=250



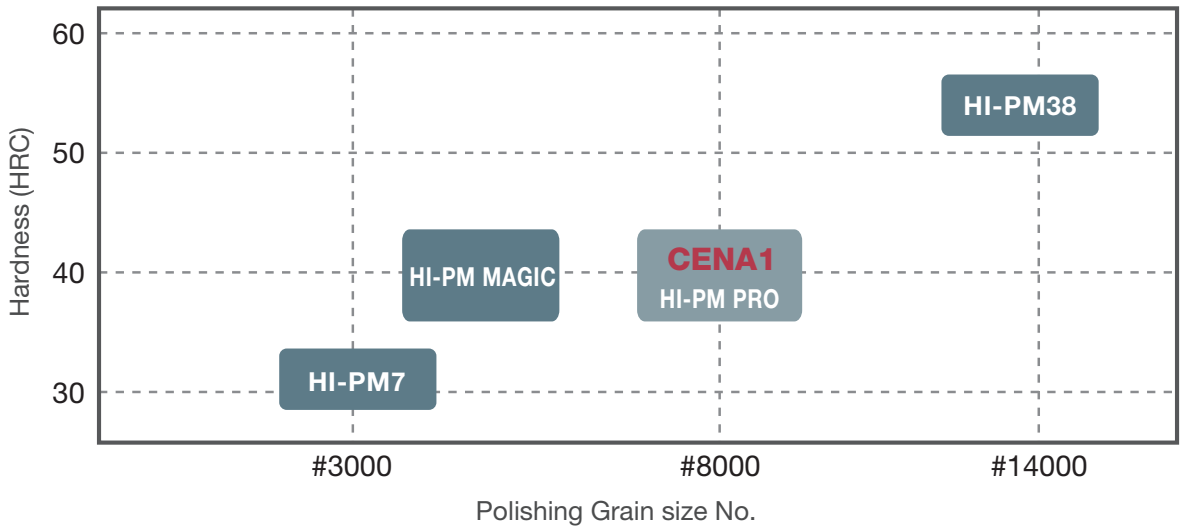


Tool: ϕ 3.0 2 teeth,
EPDR2030-30-05-TH (Hitachi Tool)
Machine: MAKINO V33
Cutting Verocity: 50 m/min (5300 min^{-1})
Feed: 0.06 mm/tooth (640 mm/min)
Cutting Depth: 0.06 mm
Pick Feed: 0.12 mm
Dry (Air Blow)
Cutting time: 22 Hr
Number of tool use: 1

Mirror Polishability

CENA1 has very low non-metallic inclusion content and excellent mirror polishability.

Mirror Polishability Comparison



Crepability

CENA1 has homogenized micro structure and good crepability. CENA1 is suitable for precise creping.

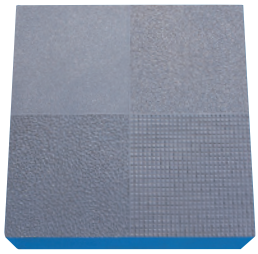
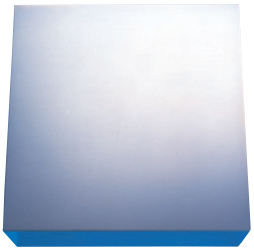


Photo Etching Sample



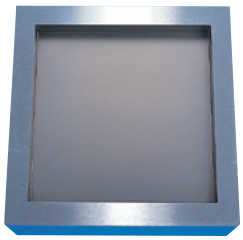
Non-glare Treatment Sample

*EDM surface Etching ... Sand blasting treatment is needed before etching.

*Welded Surface Etching ... Post-heating (≧200℃) after welding is needed before etching.

EDM Finishability

CENA1 has good EDM Finishability. As surface hardened layer is much less than conventional grades, CENA1 is able to be polished easier after EDM machining.



CENA1
100×100×50 (mm)

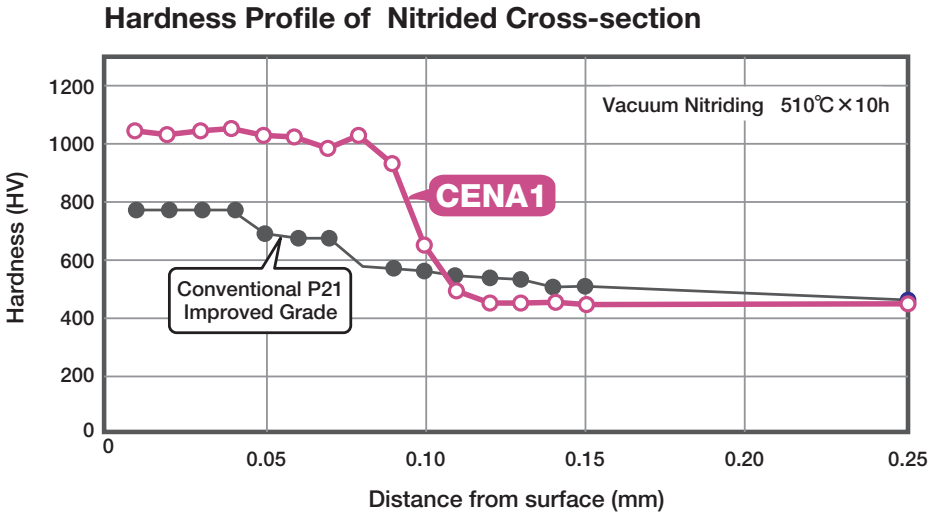
EDM Finished

【Condition】

Machine : HQSF(MAKINO), EDGE2S #108
Solution : Paraol 250
Additive : μSC (0.8-1.0g/L)
Electrode : Gr 78.0mm (EDM depth 1.0mm)
Cu 79.2mm (EDM depth 0.4mm)
Cu 79.7mm (EDM depth 0.15mm)

Nitriding Property

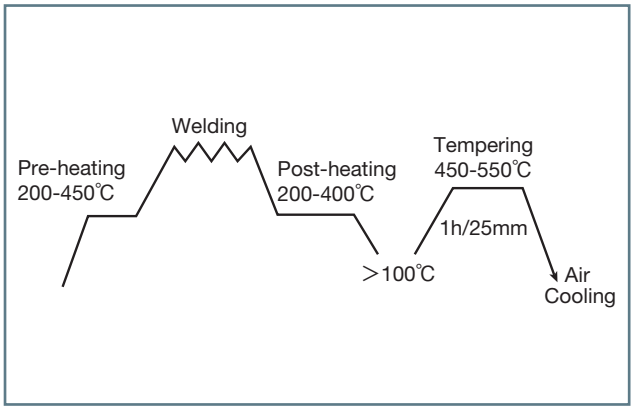
By nitriding, 1000HV surface hardness is obtained easily on CENA1, that is effctive against wearing of slide core or reinforced resin mold.



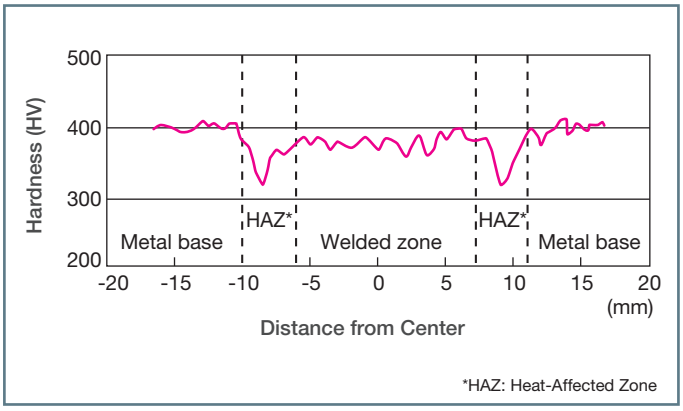
*The care is necessary to avoid breakage by over-hardening especially for small dia. pin or sharp edge part. It is recommended to apply lower nitriding temperature or weak nitriding condition.

Weldability

As welded area hardness variety of CENA1 is less than conventional grades, mold is able to be repaired and finished easily.



Welding Procedure Example



Measured Surface Hardness of Welded Area

Welding repair is recommended to be done by TIG welding with CENA1-W rod.

Mechanical Properties

Representative value of flat bar 50t×400W.

Grade	Hardness (HRC)	Tensile Strength (N/mm^2)	0.2%Yield Strength (N/mm^2)	Elongation (%)	Reduction of Area (%)	2U Charpy impact value (J/cm^2)
CENA1	40	1,225	1,150	15	50	20

Physical Properties

Specific Gravity 7.78

Thermal Conductivity

W/(m·K)

Grade	20℃	100℃	200℃	300℃	400℃
CENA1	20.5	22.9	25.9	28.2	30.5

Thermal Expansion Coefficient

Average value from 30℃, $\times 10^{-6}$/℃

Grade	100℃	200℃	300℃	400℃
CENA1	10.8	11.5	12.0	12.4

Young's Modulus 205GPa

Actual Performance

Rust Resistivity

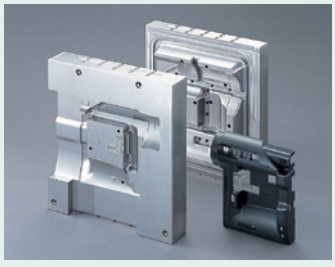
Application	Comparison of Actual Performance with Conventional Grade by Customers
Electronics Parts	Least rusting during WEDM for 1 week. Rust removing process becomes unnecessary.
Mechanical Parts	Resistant to corrosive gas generated by advanced engineering resins. Mold durability is improved.

Machinability and EDM Finishability

Acrylic Lens	• Carbide endmill tool life is doubled. • Easy to mirror polish EDM surface.
TV Speaker	• Many small pins were made by EDM machining. Better EDM surface has been obtained compared with conventional grade.
Auto Head-light Lens	• Good machinability in ball endmilling. • Smooth surface machined with 0.4R ball endmill makes polishing easy.

CENA1 and Weldless Molds

CENA1 is most suitable for weldless molds for which temperature control is required, because surface condition of heating and cooling holes comes to be less corrosive and more stable. **CENA1** is widely used for the products such as TV frame and video camera for better surface condition.



Weldless Molds

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