



Mold Steel for Plastic with Corrosion Resistance and Mirror Finish-ability FM ALLOY® PROVA-400

High quality special stainless steel Best for molds on plastic molding

 FM ALLOY consists of : DURO: Die steels for cold work
 PROVA: Mold steels for plastic
 NPR: Special steels for plastic injection molding machine parts

Properties of FM ALLOY (DURO and PROVA)



Typical Nachi Steel Grades

C	Classification	Grade	Application	
		SKH9D	Pin, Punch	
		HSU2C	Plus Punch	
High Speed Steels	Conventional HSS	HS53M	Broach	
(HSS)		HS97R	Endmill	
		HMT12	Тар	
	Powder Metallugical HSS	FAX Series	Drill, Broach, Tap, Die	
Alloy Tool Steels	Dia Staala far Cald Wark	ICS22	Die for eye glass forming	
	Die Steels for Cold Work	MDS9	Die	
Martensitic Stainless Steel		13RA	Knife, Cutter	
Steels for Precise Die & Mold		DURO-F1, 3, 7, SP	Cold Work Die and Mold	
	(DURO Series)	DURO-F1, N1	Hot Work Die and Mold	
Plastic Mold Steel with				
FM ALLOY	Corrosion Resistance and	PROVA-400	Plastic Mold	
	Mirror Finish			
Corrosion and Wear Resistance Alloy Steel		NPR1	Injection Molding Machine Parts	

FM ALLOY is

A brand name for Nachi's newest material products: Made from Nachi's own technology to be high performance alloys with fine microstructure control.

PROVA is

Named from the Portuguese word which means "endure" or "prove". A description for a tough material with mirror surface under heavy corrosive environment.

Benefits of PROVA-400

PROVA-400 is a high quality stainless steel which is made with new alloy design and special melting technology.

It is the best for molds in plastic molding.

- Martensitic stainless steel with high corrosion resistance.
- Very clean steel with minimized non-metallic inclusion. Good for mirror finish.
- High hardness (53HRC) and good wear resistance.
- Good uniformity after heat treatment because of homogenizing.

Applications

- Corrosion Resistance Mold for plastic with fire-retarding material or PVC which are strongly corrosive.
- Wear Resistance Mold for heat-hardening resin or plastic with glass fiber.
- Mirror Finish-ability Mold for clear plastic which are used for optical devices or medical parts.

Plastic Material	Examples of finish product			
PVC, PS, PE, PF, PC, PMMA, PP, EP, etc.	Camera Lens, Case of DVD, CD, Injection Syringe, Eye glass lens, Enclosures for Electronics, Plastic Plates			

Condition and Chemical Composition of Material

Grade	Condition	Chemical Composition (wt%)					
		С	Si	Mn	Cr	Мо	V
PROVA-400 (AISI 420 - Modified)	Annealed (< 220HB)	0.4	0.9	0.4	13.5	trace	trace

Features of PROVA-400

Properties

Physical Properties

Coefficient of thermal expansion

	Coefficient of thermal expansion (×10-6/K)						
	30 to 100°C	30 to 200°C	30 to 300°C	30 to 400°C	30 to 500°C		
PROVA-400	10.9	11.4	11.8	12.2	12.5		
Other maker's grade A	11.0	11.7	11.9	12.3	12.8		
Other maker's grade B	10.9	11.5	11.9	12.2	12.6		

Coefficient of thermal conductivity

	Coefficient of thermal conductivity (W/m·K)						
	R.T.	100°C	200°C	300°C	400°C	500°C	
PROVA-400	20.6	21.6	23.2	24.5	25.4	26.0	
Other maker's grade A	19.6	20.5	21.9	23.2	24.2	25.3	
Other maker's grade B	20.6	21.5	23.1	24.0	24.9	25.6	

R.T.: 26 to 28°C

Sample hardness: 53HRC

 Specific heat 				
	Specific heat (J/kg·K)			
	R.T.			
PROVA-400	455			
Other maker's grade A	465			
Other maker's grade B	457			

R.T.: 26 to 28°C

Corrosion Resistance

PROVA-400 is superior for corrosion Resistance



Sample hardness: 53HRC



PROVA-400 shows less weight loss compared to other maker's grade A and B.



PROVA-400 shows excellent toughness.

Impact resistance



Drawability



Room Temp. Sample type: No.4 (JIS Z2202)

PROVA-400 shows higher impact resistance compared to other maker's grade A and B.

PROVA-400 has excellent drawability and ductility compared to other maker's grade A and B.

Mirror Finish ability

PROVA-400 has minimum non-metallic inclusions to show superior mirror like finish.





Surface of other maker's grade B

0.1mm

Other maker's grade A Other maker's grade B

All samples are made from \$20mm hot rolled bar. Hardness: 53HRC

1940

Elongation

PROVA-400

Tensile strength

1950

1930

• good 2000

1900

Tensile Strength (N/mm²) 1000 1200

1500



: non-metallic inclusion or pores

Features of PROVA-400

Properties

Machinability

PROVA-400 has excellent machinability.

Wear comparison of PROVA-400 and other maker's grades A, B for ball-endmill pocket cutting.

Test Condition

Cutting Tool (Ball-endmill): NACHI GS Mil-Ball R3 × 9 × 80 × 6dia 2GSR3 Cutting Speed at cutting point: 42m/min (7900RPM) Feed: 920mm/min (0.058mm/tooth) Cutting Depth: ap = 0.12mm × 2passes Pick feed Pf = 0.3mm Cutting Fluid: Water soluble emulsion Test machine: Matsuura FX-5 Work dimension: 40 × 40 × 200 hardened and tempered (53HRC)





Heat treatment

Heat treatment conditions

Hardening

- •Pre-heat: 600 to 850°C
- •Austenitizing: 1000 to 1050°CC (1020 to 1030°C: usually recommended)
- •Heat time: long enough to heat center of material

Tempering

- •The lowest tempering temperature: 180°C
- •Times: 2 times or more
- •200 to 400°C for high corrosion resistance and/or low age deformation
- •Sub-zero treatment is suggested for minimum age deformation
- 490 to 510°C is suggested to avoid breaking at electric discharging

Hardness

Max hardness: 53HRC



Austenitizing: 1030°C × 60min Vacuum furnace N₂ gas pressure quenching (130kPa)

Size deformation after heat treatment

PROVA-400 shows little size change after heat treatment because of its homogenizing.



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