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

<table>
<thead>
<tr>
<th>Classification</th>
<th>Grade</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Speed Steels (HSS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conventional HSS</td>
<td>SKH9D</td>
<td>Pin, Punch</td>
</tr>
<tr>
<td></td>
<td>HSU2C</td>
<td>Plus Punch</td>
</tr>
<tr>
<td></td>
<td>HS53M</td>
<td>Broach</td>
</tr>
<tr>
<td></td>
<td>HS97R</td>
<td>Endmill</td>
</tr>
<tr>
<td></td>
<td>HMT12</td>
<td>Tap</td>
</tr>
<tr>
<td>Powder Metallurgical HSS</td>
<td>FAX Series</td>
<td>Drill, Broach, Tap, Die</td>
</tr>
<tr>
<td>Alloy Tool Steels</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Die Steels for Cold Work</td>
<td>ICS22</td>
<td>Die for glass forming</td>
</tr>
<tr>
<td></td>
<td>MDS9</td>
<td>Die</td>
</tr>
<tr>
<td>Martensitic Stainless Steel</td>
<td>13RA</td>
<td>Knife, Cutter</td>
</tr>
<tr>
<td>FM ALLOY</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steels for Precise Die &amp; Mold (DURO Series)</td>
<td>DURO-F1, 3, 7, SP</td>
<td>Cold Work Die and Mold</td>
</tr>
<tr>
<td></td>
<td>DURO-F1, N1</td>
<td>Hot Work Die and Mold</td>
</tr>
<tr>
<td>Plastic Mold Steel with Corrosion Resistance and Mirror Finish</td>
<td>PROVA-400</td>
<td>Plastic Mold</td>
</tr>
<tr>
<td>Corrosion and Wear Resistance Alloy Steel</td>
<td>NPR1</td>
<td>Injection Molding Machine Parts</td>
</tr>
</tbody>
</table>
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.

<table>
<thead>
<tr>
<th>Plastic Material</th>
<th>Examples of finish product</th>
</tr>
</thead>
<tbody>
<tr>
<td>PVC, PS, PE, PF, PC, PMMA, PP, EP, etc.</td>
<td>Camera Lens, Case of DVD, CD, Injection Syringe, Eye glass lens, Enclosures for Electronics, Plastic Plates</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade</th>
<th>Condition</th>
<th>Chemical Composition (wt%)</th>
</tr>
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<tbody>
<tr>
<td>PROVA-400 (AISI 420 - Modified)</td>
<td>Annealed (&lt; 220HB)</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.4</td>
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</table>
Features of PROVA-400

Properties

Physical Properties

◆ Coefficient of thermal expansion

<table>
<thead>
<tr>
<th></th>
<th>PROVA-400</th>
<th>Other maker’s grade A</th>
<th>Other maker’s grade B</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 to 100°C</td>
<td>10.9</td>
<td>11.0</td>
<td>10.9</td>
</tr>
<tr>
<td>30 to 200°C</td>
<td>11.4</td>
<td>11.7</td>
<td>11.5</td>
</tr>
<tr>
<td>30 to 300°C</td>
<td>11.8</td>
<td>11.9</td>
<td>11.9</td>
</tr>
<tr>
<td>30 to 400°C</td>
<td>12.2</td>
<td>12.3</td>
<td>12.2</td>
</tr>
<tr>
<td>30 to 500°C</td>
<td>12.5</td>
<td>12.8</td>
<td>12.6</td>
</tr>
</tbody>
</table>

◆ Coefficient of thermal conductivity

<table>
<thead>
<tr>
<th></th>
<th>PROVA-400</th>
<th>Other maker’s grade A</th>
<th>Other maker’s grade B</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.T.</td>
<td>20.6</td>
<td>19.6</td>
<td>20.6</td>
</tr>
<tr>
<td>100°C</td>
<td>21.6</td>
<td>20.5</td>
<td>21.5</td>
</tr>
<tr>
<td>200°C</td>
<td>23.2</td>
<td>21.9</td>
<td>23.1</td>
</tr>
<tr>
<td>300°C</td>
<td>24.5</td>
<td>23.2</td>
<td>24.0</td>
</tr>
<tr>
<td>400°C</td>
<td>25.4</td>
<td>24.2</td>
<td>24.9</td>
</tr>
<tr>
<td>500°C</td>
<td>26.0</td>
<td>25.3</td>
<td>25.6</td>
</tr>
</tbody>
</table>

◆ Specific heat

<table>
<thead>
<tr>
<th></th>
<th>PROVA-400</th>
<th>Other maker’s grade A</th>
<th>Other maker’s grade B</th>
</tr>
</thead>
<tbody>
<tr>
<td>R.T.</td>
<td>455</td>
<td>465</td>
<td>457</td>
</tr>
</tbody>
</table>

Corrosion Resistance

◆ PROVA-400 is superior for corrosion Resistance

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

**Impact resistance**

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

**Tensile strength**

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.
Features of PROVA-400

Properties

PROVA-400 has excellent machinability.

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)

Result

PROVA-400 shows less wear of ball endmill compared to other maker’s grades A and B.
Heat treatment

Heat treatment conditions

Hardening
- Pre-heat: 600 to 850°C
- Austenitizing: 1000 to 1050°C (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

Size deformation after heat treatment

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

AMERICA
- NACHI AMERICA INC. HEADQUARTERS
  17500 Twenty-Three Mile Road, Macomb, Michigan, 48044, U.S.A.
  Tel: +1-586-226-5115 Fax: +1-888-383-8665
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  URL: http://www.nachirobotics.com/
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  URL: http://www.nachicanada.com/
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  URL: http://www.nachi.de/

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  URL: http://www.nachimtc.com/
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  NORTH CAROLINA INC.
  1826 Lindbergh Street Suite 400, Charlotte, North Carolina, 28208, USA.
  Tel: +1-704-391-1511 Fax: +1-704-391-1648
- NACHI BRASIL LTDA
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  Tel: +55-11-4793-8800 Fax: +55-11-4793-8870
  URL: http://www.nachim.com.br/

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