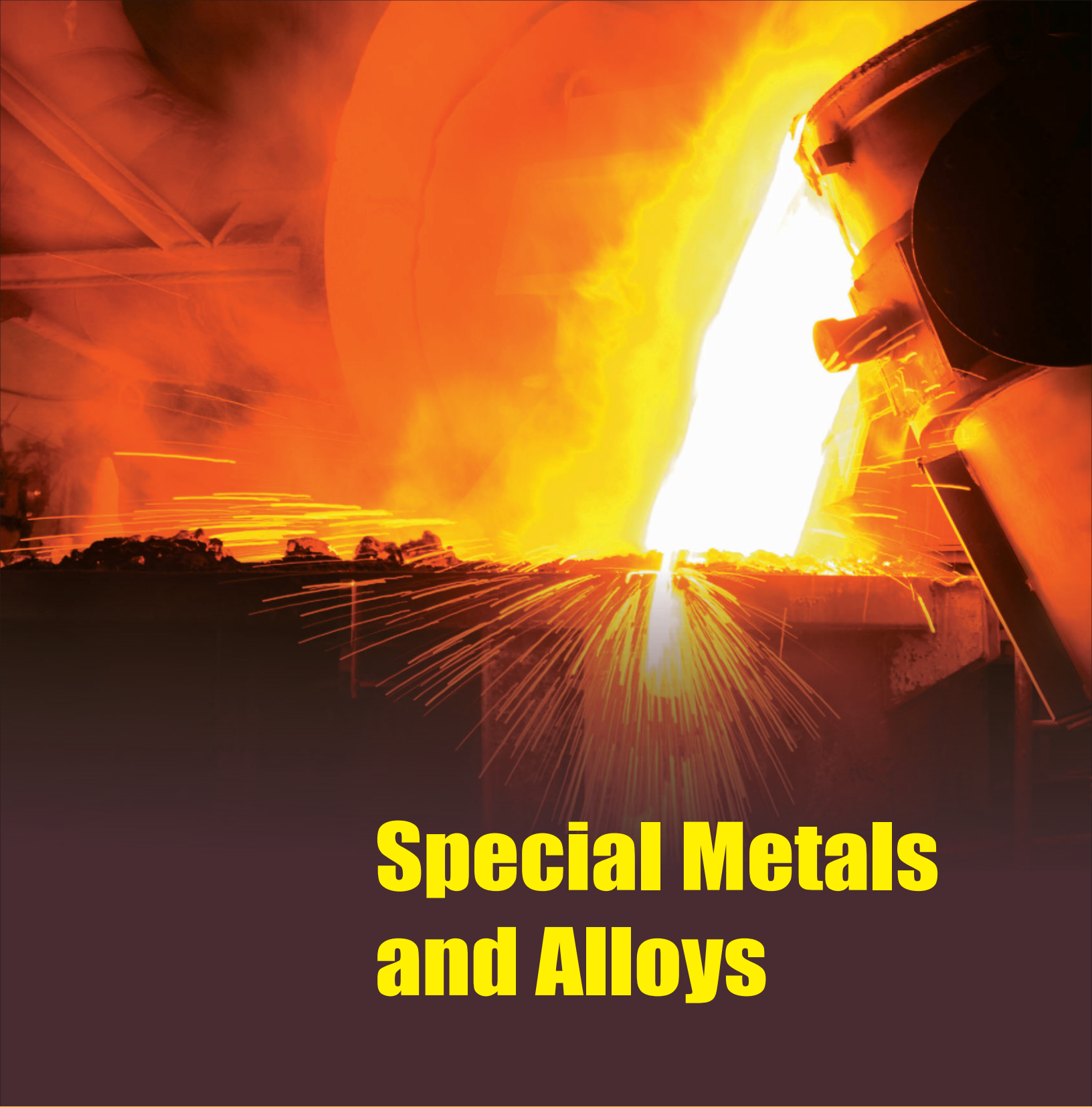


# Special Metals and Alloys

MIDHANI

A Mini Ratna Company

मिश्र धातु निगम लिमिटेड

**MISHRA DHATU NIGAM LIMITED**

**SUPERALLOY PROJECT**


MILL FORMS TO NEAR NET SHAPES

# About MIDHANI

Growth of high technology industries is invariably interlinked with availability of special materials. Aeronautics, Space, Atomic Energy, Armament, Power & General Engineering Industries have attained a high level of technical perfection which has in turn dictated stringent quality requirements on the raw materials.

Mishra Dhatu Nigam Limited (MIDHANI) a Govt of India Enterprises, was set up in 1976 at Hyderabad with the objective of providing the nation self reliance in strategic materials. For over three decades now, MIDHANI has been handling challenging tasks of developing alloys, taking a lead position in indigenization of critical technologies and products to render support to several programmes of National importance and hi-tech segments of Indian industry. MIDHANI has now started offering its core competence of developing and manufacturing custom made alloys to suit the specific requirements of customers for their critical applications.

MIDHANI's Product range includes Superalloys, Titanium & Titanium Alloys, Special Purpose Steels, Controlled Expansion Alloys, Electrical Resistance Alloys, Molybdenum and other Special Alloys. The products include a variety of mill forms ranging from forged rounds to wires and strips. MIDHANI, keeping up with the requirements, has moved from supply of semi finished products to supply of finished products like forged rings, near net shapes and titanium tubes. With its many years of engineering expertise, MIDHANI has diversified into the manufacture of Biomedical Implants, Armour products, Investment Castings, Closed Die Forgings and Aerospace quality fasteners.

## Unique Manufacturing Facilities

MIDHANI is equipped with highly integrated and flexible manufacturing facilities to produce a wide variety of special metals and alloys in various mill forms such as forged bars/ flats, Rings; near net shapes and closed die forgings, hot rolled bars/ sheets, cold rolled sheets, strips and foils; wires, castings, tubes and fasteners.

## Melting

With the help of an impressive array of melting and refining furnaces such as 5 T Arc Furnace, 2.2 T Air Induction Melting Furnace, 5 T Vacuum Induction Refining Furnace. 50kg, 600 kg, 2.5T & 6.5 T Vacum Induction Melting Furnaces, 4 T/10T Vacuum Arc Remelting Furnace, 5 T/10T Electroslag Refining Furnaces. MIDHANI produces alloys with close compositional control, metallurgical cleanliness and homogeneity.


# Forging

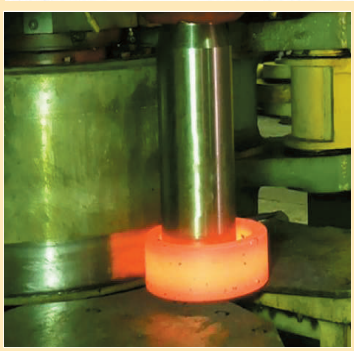
MIDHANI has a 1500 T capacity CNC hydraulic press operating with two rail bound manipulators for forging ingots to various shapes with close tolerances.

## 6000 T Forge Press:

6000 T Hydraulic Forge press with 20T manipulator, 4 Column push down type with 6000T Forge force and 4500 X 1800 mm clearance.

## Ring Rolling Mill

| | | |
|---|---|---|
| Mill Type | : | Radial Axial Ring Rolling Mill |
| Radial Force | : | 330T |
| Axial Force | : | 215T |
| Pressure | : | 300 Bar |
| Max OD | : | 3540mm |
| Min OD | : | 320mm |
| Max Height | : | 625mm |
| Min Height | : | 50mm |
| Wall Thickness | : | 40mm (min) |
| Weight | : | 3500kg (maximum) |



## Precision cold rolling

For cold rolling, 4-hi strip mill, 6-hi sheet mill, 12-hi strip mill and 20-hi foil mill are available, besides facilities like continuous annealing line, bell annealing furnaces, along with finishing lines for slitting and strip grinding.

## Bar and wire drawing

The shop is equipped with wire drawing machine, annealing lines, polishing, straightening and cutting machine etc., to draw wires upto a minimum of 0.02dia.

## Titanium Melting

MIDHANI has Vacuum Arc Remelting furnace for the production of Titanium ingots upto 6.5 T. For electrode preparation, a 3000 T capacity Compacting press and a Plasma arc welding unit are available. A high vacuum furnace is used for annealing.

## Tube Plant

MIDHANI has welded tubes manufacturing facility to produce Titanium, Stainless Steel, and Superalloy. There tubes welded tubes being are used in Power, Chemical, Petro - Chemical industries and for Marine applications where a highly corrosive environment is encountered.

### Titanium Tubes:

| | |
|---|---|
| Governing specification | : ASTM B 338 |
| Grades | : ASTM grade 1, 2 |
| Outer Diameter | : 12-60 mm |
| Wall thickness | : 0.5 - 2.5 mm |
| Length | : 2000 - 18000 mm |

### Nickel Tubes:

| | |
|---|---|
| Grades | : Superni 600 & Superfer 800 |
| Outer diameter | : 20 - 60 mm |
| Wall thickness | : 05 - 1.5 mm |
| Length | : 2000 - 18000 mm |

## Hot Rolling

2-hi, 2-stand and 3-hi strip mills, 3-hi, 3 stand bar mill and 7 stand wire rod mill make up the hot rolling facilities along with heat treatment, levelling and straightening and shearing of sheets and strips

## Fasteners Facilities

- Superni 80 A
- Ti 6Al 4V
- MDN 431
- Superni 718
- MDN 4130
- MDN 420
- Superfer 286
- MDN 321
- MDN 15-5

Hexagonal bolts, Hexagonal socket, Head cap screws, Cheese Head screws, Countersunk screws, Locking washers, and Plates, Wire locking screws and Nuts, Studs, Specialised and Custom made fasteners, Lock nuts, Locking plates and Split bushes. etc.,

## Investment casting facility

Vacuum investment casting facility enables MIDHANI to supply near-net-shape castings of Nickel, Iron & Cobalt base Superalloys and Titanium & Titanium alloys.

| | |
|---|---|
| Length (mm) | : 350 max |
| Diameter (mm) | : 250 max. |
| Weight (kg) | : 20 max. |

## Support facilities

These impressive production facilities are backed by heat treatment furnaces, pickling tanks etc., MIDHANI also has facilities for the manufacture of toroidal cores and lamination of different shapes.

# Superalloys

- Iron base SUPERFER
- Nickel base SUPERNI
- Cobalt base SUPERCO

Superalloys find extensive application in aeronautics, space, nuclear, chemical, petrochemical, power generation and furnace industries, where extreme temperatures, mechanical stresses and corrosive environments are encountered.

| GRADE | UNS NO. | CONFORMITY TO INTERNATIONAL SPECN. | KNOWN NEAR EQUIVALENT |
|---|---|---|---|
| Superfer MDS | | | INCOLOY DS |
| Superfer 800/800H | N 08800/08810 | ASTMB163, B407, B408, B 409 | INCOLOY 800/800H |
| Superni 600 | N 06600 | ASTMB166, B168,DTD 328A | INCONEL600 |
| Superni 76 | N 06002 | ASTMB 435 & B572 | HASTELLOY, X |
| Superni 80A | N 07080 | ASTMB637, BSHR 201 | NIMONIC 80A |
| Superni 90 | N 07090 | BS2HR 2 | NIMONIC 90 |
| Superni 718 | N 07718 | AMS5662, 5663, ASTM B637, B670 | INCONEL718 |
| Superni 750 | N 07750 | ASTMA461 | INCONEL X-750 |
| Superni 825 | N 08825 | ASTMB 163, B 426, B424, B 425 | INCOLOY 825 |
| Supper weld 82 | N 06082 | AWSERNiCr-3 | INCONEL 82 |
| Superni C276 | N 10276 | ASTMB574 & B575 | HASTELLOY C276 |
| Superni 690M | N 6690 | ASTMB166, B167 & B168 | INCONEL 690 |
| Superni 617 | N 06617 | ASTMB 166 & B168 | INCONEL 617 |
| Superni 625 | N00625 | ASTMB 443, B446 & B564 | INCONEL 625 |
| Superni 740 | | | INCONEL 740 |
| Superni 706M | N09706 | | INCONEL 706 |

| GRADE | PRODUCT CHARACTERISTICS | APPLICATIONS |
|---|---|---|
| Superfer MDS | - Good heat resisting property<br>- Resistant to green rot which occurs when atmosphere varies between oxidizing and reducing.<br>- Resistant to corrosion process. | - Furnace parts and heat treatment jigs in carburising and nitriding furnaces. |
| Superfer 800 | - Resistant to oxidation and carburisation<br>- Resists stress-corrosion cracking and a variety of industrial atmospheres. | - Furnace equipment, steam boilers, heat exchangers and piping in chemical /petro chemical and nuclear industries, reformer baffle plates / tubes in fertilizer plants. |
| Superni 600 | - Nickel-Chromium-Iron alloy having high temperature corrosion and oxidation resistance upto $1050^{0}$ C<br>- Good to excellent resistance to various corrosive media both organic and inorganic.<br>- Excellent mechanical properties with workability. | - Furnace muffles in oxidizing atmosphere<br>- High temperature springs.<br>- Heat exchanger tubings<br>- Chemical and food processing equipment<br>- Nuclear parts viz. feed valves, combustion chambers etc. |

| GRADE | PRODUCT CHARACTERISTICS | APPLICATIONS |
|---|---|---|
| Superni 76 | - Good strength and oxidation resistance<br>- Good forming and welding properties. | - Gas turbine parts. |
| Superni 80A | - Heat treatable $80^0$-$20^0$ Ni-Cr alloy with outstanding creep resistant properties.<br>- High strength upto $800^0$C<br>- High oxidation resistance.<br>- High fatigue properties under arduous conditions. | - Gas turbine components such as rotor and stator blades, combustion chamber and other parts.<br>- Exhaust valves in diesel engines.<br>- HTfasteners operating under continuous stressed condition. |
| Superni 90 | - Nickel based Superalloy containing chromium and cobalt with aluminum as hardening agents.<br>- High strength upto $850^0$ C<br>- Excellent creep resistance upto $800^0$ C<br>- High resistance to oxidation, scaling and corrosion in various atmospheric conditions | - Die inserts and mandrels for forging bolts, fasteners, hot shear blades. |
| Superni 718 | - Precipitation hardenable nickel base alloys.<br>- High yield strength upto $650^0$ C<br>- Excellent cryogenic properties upto - $217^0$ C<br>- Good weldability even in aged condition.<br>- Excellent oxidation resistance upto $980^0$ C<br>- Ease of formability. | - Jet engines, pump bodies and parts |
| Superni 750 | - Age hardenable alloy used for its corrosion and oxidation resistance and high creep strength at temperature upto $800^0$ C | - Gas turbine parts, aviation and indl. Springs, bolts, bellows. |
| Superni 825 | - Used aggressive & corrosive environments.<br>- Resistant to chloride-ion stress-corrosion cracking.<br>- Resistant to reducing acids and oxidizing chemicals. | - Phosphoric acid evaporators, chemical process equipment. |
| Superweld 82 | - Used for gas shielding arc welding of Superni's etc., to steel or other dissimilar combination of nickel-base and iron-base alloys. | - Welding electrodes. |
| Superni C276 | - Resistant to various acids like hydrochloric etc. | - Tanks, vessels, handling wet chlorine acids. Gas, hypochlorite, ferric &cupric chlorides, etc., |
| Superni 690M | - Excellent resistance to stress corrosion cracking | - Coal gasification furnaces, petrochemical industries |
| Superni 617 | - High temperature strength and oxidation resistance | - Combustion cans, air craft and land based gas turbines, nuclear power plants. |
| Superni 625 | - High temperature resistance and good corrosion resistance | - Chemical processing industries, aero space, gas turbine components |
| Super 740 | - Excellent resistance to corrosion attack, strength at high temperatures | - High temperature applications in power industries |
| Superni 706M | - High strength combined with ease of fabrication, Excellent resistance to post weld strain age cracking. | - Aero space industry, industrial gas turbines |

# Titanium and its alloys

- Commercially pure Titanium
- Titanium Alloys

Titanium by virtue of its excellent corrosion resistance and high strength-to-weight ratio finds application in the aerospace, chemical, petrochemical, marine, paper pulp, textile, food and dairy industries. Titanium alloy is also used for bio-medical implants.

| GRADE | UNS. NO. | CONFORMITY TO INTERNATIONAL SPECN. | KNOWN NEAR EQUIVALENT |
|---|---|---|---|
| Titan 12 | R 50250 | ASTM B 265/B 348 GRADE 1 | IMI 115 |
| Titan 15 | R 50400 | ASTM B 265/B 348 GRADE 2 | IMI 125 |
| Titan 31 | R 56400 | ASTM B 265/B 348 GRADE 5 | IMI 318 |
| Titan 26 | - | TA6ZD | IMI 685 |
| Halfalloy | R 56320 | ASTM B 265/B 348 GRADE 9 | - |

| GRADE | PRINCIPAL CHARACTERISTICS | APPLICATIONS |
|---|---|---|
| **Titan 12/15** | - Excellent resistance to corrosion by a wide range of natural and artificial environment. to weight ratio in view low density and high strength. | Airframes, aircraft engine parts, gas compression, chemical desalination, marine components, plate heat of exchangers, platinized anodes, surgicals implants, anodes for chlor-alkali cells, jigs, fixtures and baskets for electro plating. |
| **Titan 31** | - High strength to weight ratio.<br>- High specific strength at elevated temperatures.<br>- Excellent resistance at temperatures upto $520^0$ C<br>- High fatigue strength and toughness. | Rocket motor, structural forgings and fasteners, pressure vessels, gas and chemical pumps, cryogenic parts, ordnance equipment, marine components, steam turbine blades. |
| **Titan 26** | - Excellent High Temp. Strength & Creep Resistance, Good Weldability & Formability, Good Corrosion Resistance | Blades and other Aero engine Components |
| **Ti Half Alloy** | - High strength to weight ratio, excellent corrosion resistance | Marine applications, Bio implants, chemical processing industries |

MIDHANI

# TYPICAL PROPERTIES OF SOME GRADES

## SUPERALLOYS

| GRADE | NOMINAL COMPOSITION | MECHANICAL PROPERTIES 0.2%P.S (kg/mn$^2$) | UTS | %El |
|---|---|---|---|---|
| Superfer MDS | Fe Bal, Ni 37, Cr 18, Cu 0.5, Ti 0.2, Si 2.1, C 0.1 | 36.0 | 68.0 | 37 |
| Super800/800H | Fe Bal, Ni 32, Cr 21, Al 0.3, Mn 1.5max, Ti 0.3, Si 1max, C 0.1max | 32.6 | 70.0 | 40 |
| Superni 600 | Fe 10max, Ni Bal, Cr 15.5, Mn 0.5, | 24.6 | 56.0 | 30 |
| Superni 76 | Fe 18.5, Ni Bal, Cr 21.0, Co 2.5max, Cu 0.2, Mo 9.0, Mn1.0, C 0.1 Others W-0.5 | 27.5 | 80.0 | 30 |
| Superni 80A | Fe 1max, Ni Bal, Cr 19, Co 2.0max, Al 1.5 Ti 2.5, C 0.07 | 70.5 | 105.0 | 20 |
| Superni 90 | Fe 1max, Ni Bal, Cr 19, Co 19, Al 1.5, Ti 2.5, C 0.08 | 68.0 | 108.0 | 20 |
| Superni 718 | Fe 18.5, Ni Bal, Cr19.0, Cu 0.15, Al 0.50, Mo 3.05, Mn 0.18, Ti 0.90, Si 0.18, C 0.04, Others Cb+Ta-5.13 | 83.0 | 103.0 | 12 |
| Superni 750 | Fe 7.0, Ni Bal, Cr 15.5, Cu 0.25, Al 0.70, Mn 0.50, Ti 2.50, Si 0.25, C 0.04, Others Cb+Ta-0.95 | 63.0 | 98.0 | 8 |
| Superni 825 | Fe 30.0, Ni 42.0, Cr 21.5, Cu 2.25, Al 0.10, Mo 3.0, Mn 0.50, Ti 0.90, Si 0.25, C 0.03, | | | |
| Superweld 82 | Fe 3.0, Ni Bal, Cr 20.0, Mn 3.0, Ti 0.55, Others Nb-2.5 | 95.0 | 42.0 | |
| Superni C276 | Fe 6.0 Ni Bal, Cr 15.0, Mo 16.0, Mn 1.0, Si 0.08, C 0.02, Others W-3.5 | | | |
| Superni 690M | Ni 58 min, Cr 27-31, Fe 7 to 11, C 0.05 , S 0.015 , Mn 0.5, Si 0.5, Cu 0.5, Ti 0.6, B 0.006 | 240 | 585 | 30 |
| Superni 617 | Ni 44.5min, Cr 20-24, Co 10-15, Mo 8-10, Al 0.8-1.5, B 0.006 C 0.05-0.15, Fe 3.0, Mn 1.0, Si 1.0, S 0.015, Ti 0.6, Cu 0.5. | 322 | 734 | 62 |
| Superni 625 | Ni 58, Cr 20-23, Fe 5, Mo 8- 10, Nb + Ta 3.15-4.15, Co 1.00 | 270 | 600 | 30 |
| Superni 740 | C 0.03, Cr 25, Mo 0.5, Co 20, Al 0.9, Ti 1.8, Nb 2.0, Mn 0.30, Fe 0.7, Si 0.5, Ni bal | 720 | 1150 | 50 |
| Superni 706M | Ni + Co 39.0-44.0, Cr 14.5-17.5, Nb+Ta 2.5-3.3,Ti 1.5-2.0, Al 0.40, C 0.06, Cu 0.30,Mn 0.35, Si 0.35, S 0.015, P 0.020, B 0.006, Co 1.00 | 993 | 1282 | 18 |

## TITANIUM & TITANIUM ALLOYS

| GRADE | NOMINAL COMPOSITION | MECHANICAL PROPERTIES 0.2%P.S (kg/mn$^2$) | UTS | %Elonganation |
|---|---|---|---|---|
| Titan 12 | Fe 0.20, O 0.15, N 0.05, C 0.08, H 0.013, Ti Bal, | 18 | 32 | 25 |
| Titan 15 | Fe 0.25, O 0.25, N 0.06, C 0.08, H 0.013, Ti Bal | 25 | 47 | 20 |
| Titan 31 | Fe 0.30, O 0.20, N 0.07, C 0.08, H 0.013, Ti Bal, Al 6, V 4 | 85 | 92 | 10 |
| Titan 26 | AL 6.0, Zr 5.0, Mo 0.5, Si 0.25, Ti bal | 850 | 990 | 6 |
| Half Alloy | 3.0 Al , 2.5 V, Ti-bal | 700 | 900 | 15 |



## SPECIAL STEELS

| GRADE | NOMINAL COMPOSITION | MECHANICAL PROPERTIES 0.2%P.S (kg/mn$^2$) | UTS | %Elongen |
|---|---|---|---|---|
| MDN 174 | C 0.07, Ni 4.0, Cu 4.00, Cr 16.5, Fe Bal, Others Nb-0.3 Condition H1 100. | 72 | 93 | 16 50ft lb(cvm) |
| MDN 250 | C 0.01, Ni 18.5, Co 8.5, Fe Bal, Condition 480$^0$C Others Mo-4.8, Ti -0.4, Al-4.17 Condition Aged | 178 | 185 | 100 MPa$\sqrt{m}$ |
| MDN 904L | C 0.02, Ni 25.0, Cu 1.5, Cr 19.5, Fe Bal, Others Mo-4.5 | 22 | 50 | 36 |
| MDN 15-5PH | C 0.07, Mn 1.0,P 0.040,S 0.030, Si 1.0,Cr 14.0-15.0, Ni 3.50-5.50, Cu 2.50-4.50, Cb + ta 0.15-0.45,Ti 0.6-1.0, Al 0.2, Nb 0.15,Cu 0.3 Fe-bal | 795 | 965 | 14 |
| MDN 11-10PH | C 0.03, Si 0.15, Mn 0.1, P 0.01, S 0.01, Cr 10.0-11.0, Ni 9.0-10.3, Mo 1.8-2.3 | 1270 | 1370 | 8 |

## CONTROLLED EXPANSION ALLOYS

| GRADE | NOMINAL COMPOSITION | MEAN COEFFICIENT OF THERMAL EXPANSION ($10^{-7}$) 0-100 $^0$C | 0-200$^0$C |
|---|---|---|---|
| Ferni 36 | Fe Bal, Ni 36 | 12 | 23 |
| Ferni 42 | Fe Bal, Ni 42 | 47 | 45 |

## RESISTANCE ALLOYS

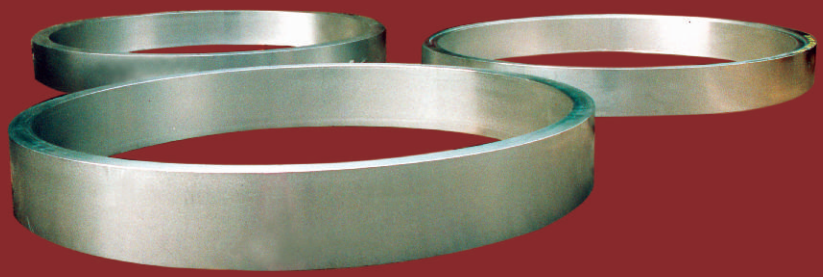
| GRADE | NOMINAL COMPOSITION | PHYSICAL PROPERTIES Resistivity at 20$^0$C micro-ohm-cm | Max working temp in air 1200$^0$C |
|---|---|---|---|
| Superheat 80 | Ni 80, Cr 20, R | 109 | 1200 |
| Superheat 60 | Fe Bal, Ni 60, Cr 15, | 112 | 1150 |
| Superheat 45 | Fe Bal, Ni 45, Cr 25 | 112 | 1150 |
| Superheat 30 | Fe Bal, Ni 30, Cr 20 | 104 | 1100 |

## SOFT MAGNETIC ALLOYS

| GRADE | NOMINAL COMPOSITION | TYPICAL MAGNETIC PROPERTIES Strip Thick (mm) | Bs Tesia | µmax | µ2max | Coercive force |
|---|---|---|---|---|---|---|
| Softmag 36B | Fe Bal, Ni 36, | 0.3 | 1.3 | 20000 | 17000 | 0.15 |
| Softmag 48B | Fe Bal, Ni 48 | 0.3 | 1.3 | 55000 | 35000 | 0.08 |
| Softmag 78B | Fe Bal, NI 78, Cr 0.05, Cu 5, Mo 4 | 0.1 | 0.7 | 160000 | 140000 | 0.012 |
| Softmag 78D | Cr -do | 0.1 | 0.7 | 390000 | 250000 | 0.006 |
| Softmag 78E | Cr -do- | 0.1 | 0.7 | 560000 | 280000 | -0.004 |

# Special Purpose Steels

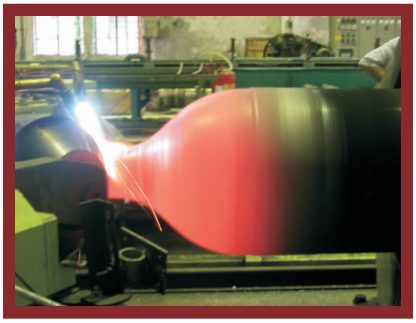
- Martensitic Steel
- Maraging Steels
- Austenitic Steel
- Precipitation hardening steels



These special steels have improved mechanical properties and better work ability which are essential for special applications in aerospace, power generation, nuclear, defence, cryogenic and other general engineering industries. These include precipitation hardening steels, nonmagnetic austenitic and martensitic stainless steels and above all maraging steels.

| GRADE | UNS. NO. | CONFORMITY TO INTERNATIONAL SPECN. | KNOWN NEAR EQUIVALENT | MAX SERVICE TEMP$^0$C |
|---|---|---|---|---|
| MDN 174 | S 17400 | ASTM A 564-TYPE 630 | Alloy 17-4 PH | 315 |
| MDN 250 | K 92890 | ASTM A 538/A 579 | Maraging 250 | 400 |
| MDN 904L | N 08904 | ASTM B 625, B 649 | AVESTA 904 L | - |
| MDN 15-5PH | S 15500 | ASTM A 567 | Alloy 15-5 PH | 350 |
| MDN 11-10PH | - | - | Alloy 11-10 PH | 400 |

| GRADE | PRINCIPAL CHARACTERISTICS | APPLICATIONS |
|---|---|---|
| **MDN 174** | - A precipitation hardening steel offering good corrosion resistance with high strength and hardness<br>- Used in application demanding high corrosion resistance upto 300$^0$ C | Nuclear power plants, nozzles for nylon fiber compressor parts |
| **MDN 250** | - High strength and toughness for service at cryogenic and ambient temperatures | Components for rockets, missiles and aircrafts, hot forging, dies, extrusion tooling etc. |
| **MDN 904 L** | - Used under severe corrosive conditions | Distillation columns, reaction vessels, pipes and tanks |
| **MDN 11- 10PH** | - High Strength, Toughness & Stress Corrosion Cracking resistance | Structural application in Aerospace industry |
| **MDN 15 - 5PH** | - High strength, good corrosion resistance, good mechanical properties up to 600$^0$ F (316$^0$ C),good toughness | Aerospace, chemical, petro chemical, food processing, paper and general metal working industries, |



# Heating Element Alloys

- Electrical resistance alloys (SUPERHEAT SERIES)

MIDHANI offers Nickel-Chromium and Iron-Nickel chromium alloys for heating elements in electric furnaces in various atmospheres. These alloys also find usage in iron heaters, dryers and other heating appliances.

| GRADE | UNS NO. | KNOWN NEAR EQUIVALENT |
|---|---|---|
| SUPERHEAT 80 | N0 6003 | NICHROME V |
| SUPERHEAT 60 | N0 6004 | NICHROME 3 |
| SUPERHEAT 45 | - | GILPHY 45 |
| SUPERHEAT 30 | - | NICHROME 1 |

| GRADE | PRINCIPAL CHARACTERISTICS | APPLICATIONS |
|---|---|---|
| SUPERHEAT 80 | Suitable for electrical resistance and electrical heating applications | Electric furnace in oxidizing or neutral atmosphere domestic heaters, wire wound resistors and potentiometers |
| SUPERHEAT 60 | - do - | Iron heaters, dryers |
| SUPERHEAT 45 | - do - | Electric furnace in reducing, carburizing or slightly sulphurising atmosphere |
| SUPERHEAT 30 | - do - | Medium temperature furnace, heaters, Rheostats, Shunts. |

# High Reliability Electrical & Electronic Alloys

- Soft magnetic alloys (Softmag series)
- Controlled expansion alloys (Ferni series)

MIDHANI manufactures a wide range of materials for electrical, electronic and telecommunications applications. They are soft magnetic alloys, soft iron high purity nickel and nickel-manganese alloys and controlled expansion alloys.

## SOFT MAGNETIC ALLOYS

| GRADE | KNOWN NEAR EQUIVALENT | PRINCIPAL CHARACTERISTICS | APPLICATIONS |
|---|---|---|---|
| Softmag 36B | Permalloy D | Very high electrical resistivity, good permeability and low electrical loss | Relays and pulse transformers |
| Softmag 48B | Permalloy B | High initial permeability | Relays, transformers, solenoids, current transformers |
| Softmag 78 | Mumetal | These alloys show very high initial and maximum permeability at low magnetic forces | Relay cores, current transformers, filters, inductances, magnetic amplifiers |

## CONTROLLED EXPANSION ALLOYS

| GRADE | UNS NO. | KNOWN NEAR EQUIVALENT |
|---|---|---|
| Ferni 36 | K93600 | INVAR |
| Ferni 42 | K94200 | N42 |

| GRADE | PRINCIPAL CHARACTERISTICS | APPLICATIONS |
|---|---|---|
| Ferni 36 | These alloys have controlled expansion co-efficients | Thermostats for geysers |
| Ferni 42 | These alloys are tough and ductile and can be strain hardened | Glass to Metal sealing |
| Ferconi | These alloys are having specific expansion property | Glass to Metal sealing |

# Powder Metallurgy Products

Molybdenum wire products are supplied for incandescent lamps and spray metallising; plates, strips, and fabricated Boats & Shrouds, heating elements for ultra-high temperature applications.

## MOLYBDENUM

Typical Properties of Pure Molybdenum

| | | |
|---|---|---|
| Melting Point | - | $2610^0$C |
| Density | - | 10.2 g/cm$^2$ |
| Yield Strength | - | 40 Kg/mm$^2$ |
| UTS | - | 70 Kg/mm$^2$ |
| Elongation | - | 8% |
| Hardness | - | 240-290 VPN |
| Unified Number | - | R03600 |

| GRADE | PRODUCT CHARACTERISTICS | APPLICATIONS |
|---|---|---|
| Molybdenum | Molybdenum is a refractory metal used for high temperature applications | Mandrel wire used in the process of manufacture of coiled coil of tungsten for filament application in incandescent lamps. Support wires for holding tungsten filament in lamps High temperature furnace electrical contacts, chemical processing equipment, incandescent temperature industry, electronic tubes, metal spraying, support for semiconductor devices, heat shields, electrodes for glass melting furnaces etc. |

## FORMS OF SUPPLY

(All dimensions are in mm)

| | | | |
|---|---|---|---|
| Bar | Forged | Dia | 75 - 300 |
| | Hot Rolled | Dia | 10 - 75 |
| Wire | Cold | Dia | 0.1 and above |
| Sheet / Plate | Hot Rolled | Thickness (min) | 4.0 and above |
| | | Width (max) | 1000 |
| | | Length | 1500 - 2000 |
| | Cold Rolled | Thickness (min) | 0.5 |
| | | Width (max) | 1000 |
| | | Length | 2000 - 2500 |
| Strip | Cold Rolled | Thickness (min) | 0.1 |
| | | Width (max) | 250 |
| Rings | Rolled | OD | 3540 |
| | | Wall Thickness (Min.) | 40 |
| | | Height (Max/Min) | 620/50 |

## Standard Products

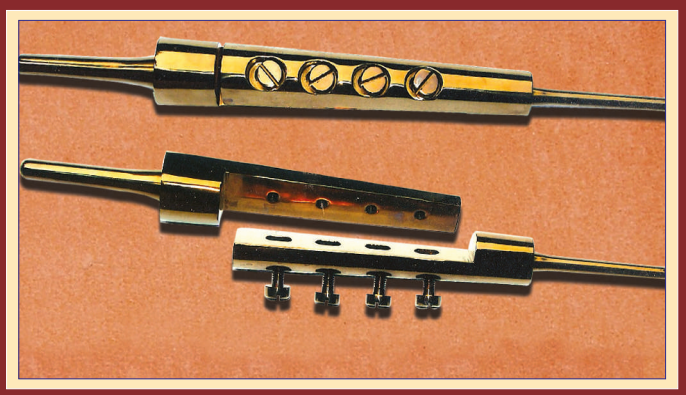
Grades and sizes indicated refer to our standard mill forms and products. We also take up production to customers' specifications.

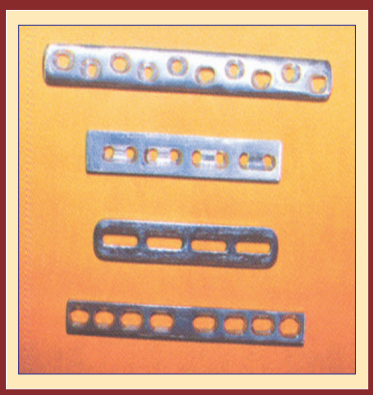
## Fabricated Finished Products

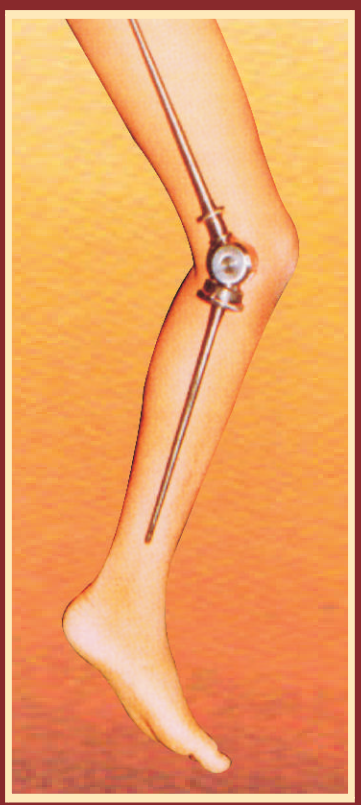
MIDHANI takes single-point responsibility for supply of finished components like large Rings & wide plates using in-house and external resources.

# Biomedical Implants & Devices

As a premier metallurgical establishment manufacturing Titanium and Titanium alloys for stringent aerospace and corrosion resistant applications, MIDHANI has diversified into development and manufacture of wide Spectrum of Bio-medical Products :







- Knee Hinge Joint
- Hip Prosthesis
- Compression Hip Screw
- Implants
- Screws
- Clamps and Plates
- Intra medullary Nails & Rush Nails

MIDHANI also manufactures custom made implants biomedical products to suit the specific requirements of the doctors for patients e.g. Hinge Knee Joint, Acetabular Cup with attached Iliac Wing, Lumbar Puncture Needle Device.

## Meeting Stringent international specifications:

MIDHANI conforms to ASTM, BS, ISO, IS, AMS, MIL, AFNOR, DIN & other standards for materials as well as biomedical products.

## Quality Assurance

MIDHANI is an ISO 9001:2008 and AS 9100C, certified NABL Accreditation as per IS-17025 for Chemical Testing Laboratory.

MIDHANI's quality systems are approved by more stringent standards of Director General of Aeronautical Quality Assurance, Director General of Civil Aviation, Director General of Quality Assurance, Department of Space, Department of Atomic Energy. "Source Approval" has been accorded by Boeing Aircraft Company, USA for titanium and Titanium alloys of MIDHANI for their C-17 transport and MD series of jet aircraft.

Apart from close control over chemistry and maintaining processing conditions, the intermediate as well as final products are subjected to various destructive and non-destructive tests to establish their suitability for high temperature, corrosion, vibration or stress conditions.

The central laboratory in MIDHANI, fully equipped with chemical, metallurgical, mechanical, non-destructive, magnetic and physical testing ensuring excellent quality of finished products.


## Quality & Process Control

Diverse types of metals and alloys required by avionics, space, nuclear power, communication & chemical sectors must meet their exact specifications.

Rigorous quality charts are done at each stage of manufacture to achieve quality, reliability and consistency of properties in all products. Centralized storage of technical information and data logging is also a part of the process.

## Aeronautical Materials Testing Laboratory

MIDHANI had set up and manages a state-of-art Aeronautical Materials Testing Laboratory (AMTL) for comprehensive testing and evaluation of aeroengine materials and components.

MIDHANI has been closely involved with development and supply of advanced superalloys, titanium alloys and special steels to the Gas Turbine Research Establishment (GTRE) for the Kaveri Engine to power the indigenously designed Light Combat Aircraft.

# Armour Products

MIDHANI has been supplying bulk quantities of armour steel products offering ballistic protection against a variety of weapon systems including 9mm SMG, AK - 47, 7.62mm SLR. The Company is poised to cater to the growing demand for a wide spectrum of sophisticated Body Armour Jackets, Headgear, and bullet-proof vehicles through inhouse technology initiatives.

- "Rakshak" Bullet-proof jackets
- "Patka" (Head band) for protection of head
- Bullet proof protection of personnel carriers for paramilitary forces & VVIP Cars
- Bullet proof Sentry Post

# Testing & Material Evaluation

A comprehensive range of testing and evaluation services covering chemical analysis, mechanical, non-destructive and magnetic testing are rendered by MIDHANI.

These include X-Ray, Atomic Absorption, Optical Emission & Ultra-voilet visible Spectrometry and gas analysis. Tensile, Creep & Fatigue testing, Fracture toughness evaluation, Ultrasonic, Eddy Current, Magnetic, Particle inspection, Dye-Penetrant, Radiography Hysteresis graph, Core Loss testing etc are also carried out.

Sophisticated services dedicated to testing and evaluation of aeronautical materials and components are also offered by MIDHANI. Mechanical testing services include Tensile & Compressive Testing at ambient, elevated and cryogenic temperatures, low cycle fatigue

testing upto $1000^{0}$ C, Stress Rupture Testing and Creep Strain Determination upto $1050^{0}$ C, Rotating Bending Fatigue Test at ambient and elevated temperatures, Plain Strain Fracture Toughness (KIC) and JIC Testing, measurement of Fatigue Crack Prop gation Rates, Impact and Hardness Testing. Metallography services include specimen preparation, Optical Microscopy, Scanning Electron Microscopy In-situ Metallography, Phase analysis by Microhardness testing. Chemical compotistional analysis is carried out using X-ray, Fluorescence Spectrometry, semi-quantitative analysis using Mobile Optical Emission Spectrometry. Other services include Electro discharge machining for sample blank extraction, Chevron Notch making, CNC machining.

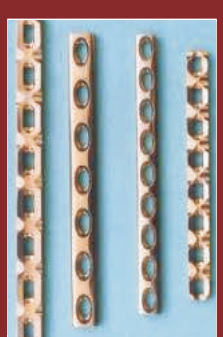
## Technical Services

### Job Works

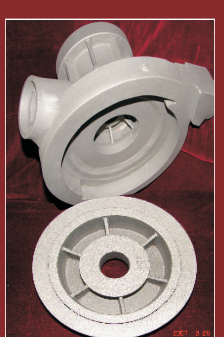
Forging, Rolling, Heat treatment, investment castings, and other conversion jobs are carried out by MIDHANI for its customers.

## Metallurgical Consultancy Services

MIDHANI offers failure analysis, selection and alloy design services on a consultancy basis to customers.



MIDHANI

A Mini Ratna Company

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