Contribution by MIDHANI
Towards
Atma Nirbhar Bharat

MIDHANI

MISHRA DHATU NIGAM LIMITED
Kanchanbagh, Hyderabad.

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PREFACE

Adversity is the greatest teacher; it pushes one to abandon conventional thinking and forge new paths. *Atma Nirbharta* (Self-reliance) is one of the many lessons that this current pandemic has taught the humankind. Global pandemic has taken a devastating toll on production, on movement of people, on transportation of goods & services which have resulted in closing down of organisations and complete collapse of supply-chain. It has also revealed the fallacies of over-dependency on the conventional development models. In such a scenario, "*Atma Nirbharta*" is the only way forward.

A new *Atma Nirbhar* India, as envisioned by Hon'ble Prime Minister, is to be built on five pillars :

- **Economy**, quantum jump
- **Infrastructure**, one that represents modern India
- A new **System** driven by technology and forward-looking policies
- Vibrant **Demography** of the largest democracy
- Economic **Demand,** full utilization of power of demand and supply

Based on these five pillars, India has to achieve self-reliance by uncovering the opportunities and exploring the potential that lie within this great nation. *Atma Nirbhar Abhiyan* not only aims to revive every sphere of Indian economy, but also build India into a self-reliant nation so that it can sustain and take care of any black swan event that might occur in future.

Mishra Dhatu Nigam Limited (MIDHANI) is proud to be a part of this *Atma Nirbhar Abhiyan* and fully dedicates itself towards achieving the goals this *Abhiyan* is set out to accomplish.

ABOUT MIDHANI

Mishra Dhatu Nigam Limited (MIDHANI) is one of the few integrated and modern metallurgical plants in the world manufacturing a wide range of superalloys, titanium and titanium alloys and special steels in various mill forms using state-of-the-art production facilities. Since its inception, MIDHANI has been playing a significant role in supply of materials to various strategic sectors like Space, Defence and Energy.

MIDHANI, incorporated under the companies act as a Public sector undertaking (PSU) in November 20, 1973, was conceived to help India achieve self-reliance in the manufacture of a wide spectrum of critical and complex alloys.

MIDHANI went into commercial production in stages, starting with the powder metallurgical products in the year of 1979, the integrated commercial production commenced in 1983. The manufacturing facilities of MIDHANI include some of the most sophisticated equipment such as Vacuum Induction, Vacuum Arc, Electro-Slag and Electronic Bean Melting Furnaces, Computer-Controlled Forge Presses, Ring Rolling Mill, Hot Rolling Mills, Precision Cold Strip, Sheet and Foil Rolling mills, Bar & Wire Drawing Equipment and Investment Casting Facilities. It has fully-equipped centralized laboratory which helps in maintaining high quality standards demanded of special grade alloys.

MIDHANI is always on the move and poised to take quantum leap, improving the 'Self-Reliance Index' of the strategic sectors. Indigenization efforts at MIDHANI started with raw materials for strategic sector and today have progressed to component level, sub-assembly-level parts for critical equipment/product as well.

In FY 2017-18, GoI divested its stake in MIDHANI to the extent of 26% through Initial Public Offering. The shares of the company got listed in BSE & NSE in April, 2018 and since then, it has continued to generate value for its shareholders.

MIDHANI is currently going through a major expansion & diversification phase. A state-of-the-art Wide Plate Mill dedicated for rolling wide plates of various alloys is being setup. A world class Armour Manufacturing Facility capable of manufacturing steel armour & ceramic armour products for personnel armour and vehicle armour will be commissioned shortly at IMT Rohtak. A Spring Manufacturing Facility for manufacturing of springs for metro coaches and wagons is under commissioning. To cater to the increasing demand of Special Steel, Superalloy & Titanium alloy, many advanced furnaces are being commissioned.

Also, MIDHANI is entering into new materials (High-end Aluminium Alloy for aerospace quality) with the setup of Utkarsha Aluminium Dhatu Nigam Limited (A Joint Venture with NALCO).

MIDHANI has travelled a long road through many ups and downs and slowly emerged as a 'National Centre for Excellence' in advanced metals and alloys. MIDHANI aspires to achieve greater heights by contributing more towards indigenization so that our nation becomes "Atma Nirbhar" in the truest sense of the term.

INTELLECTUAL PROPERTY RIGHTS

Trademark granted to MIDHANI is given below

Registered Trademark for MIDHANI Material	Material Type	Number
MDN300®, MDN310®, MDN316L®, MDN350®, MDN08X18H10T®, MDN11-10PH®, MDN15-5PH®, MDN174®, MDN177®, MDN250®, MDN9CRMO®, MDN12X18H10T®, MDN15CDV6®, MDN18X2H4MAW®, MDN59®, MDN60®, MDN172®, MDN321®, MDN321A®, MDN340L®, SOFTIRON1®, SOFTMAG48B®	Special Steel & Special Alloy	22
SUPERNI718®, SUPERNI750®, SUPERNI825®, SUPERCO 605®, SUPERNI 80A®	Superalloy	5
	Total :	27
Trademark filed for MIDHANI Material	**Material Type**	**Number**
MDN250W2™, MDN 321™, MDN330W™, MDN304L™ MDNDMR45™, MDN12-10PH™, MDNEN24™, MDN 316Ti™, MDN316W™, MDNN3SM™, MDN155™, MDN15-5T™	Special Steel	12
SUPERNI 617CC™, SUPERNI 625™	Superalloy	2
PT3B™,TITAN31ELI™	Titanium Alloy	2
	Total :	16

Note - Registered Trademark & Accepted Trademark details are as on 5th Aug 2020

Patent : 4 patents were granted to MIDHANI in Special Steel, Superalloy & Titanium alloy for respective application areas of Vehicle Armouring, Missile, PSLV Cryogenic Engine and Welding electrode.

Details are given below.

Patent - Air Hardening Alloy Steel
Application Area - Vehicle armouring

Patent - Precipitation Hardening Steel
Application Area – Missile

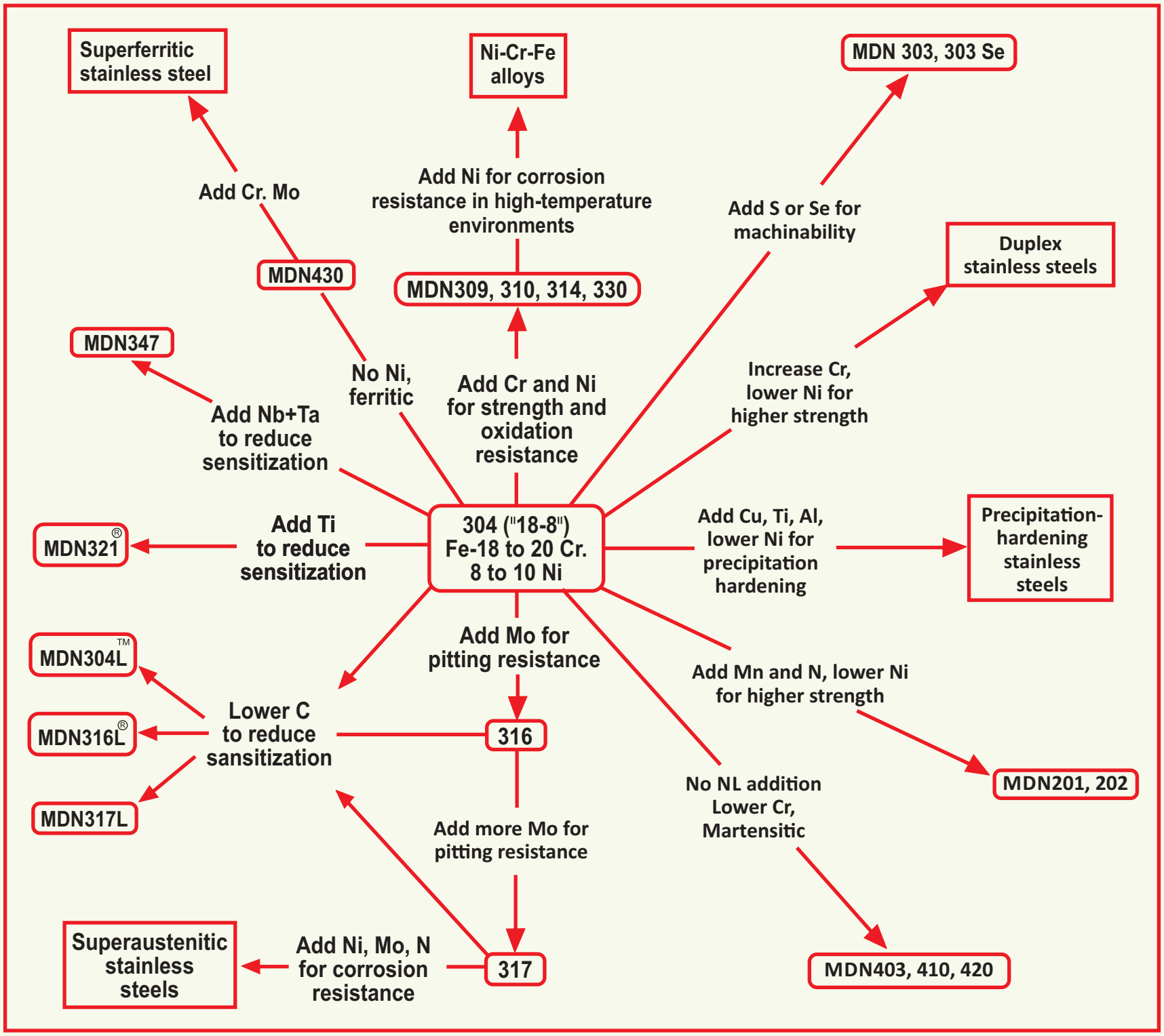
Patent - Cobalt Based Alloy
Application Area – PSLV Cryogenic Engine

Patent - Wire of Ti-6Al-4V
Application Area – Welding electrode

Special Steel

Over the last 45+ years, MIDHANI has played a stellar role in the development and manufacture of an array of advanced and premium quality steels such as High Fracture Toughness Special Steels, Special Purpose High Performance Stainless Steels and Ultra-High Strength Low Alloy steels, for strategic applications in Space, Aerospace, Ordnance and Nuclear engineering sectors.

Family Chart of Special Steel at MIDHANI



CONTRIBUTION IN DEFENCE

T-90/T-72 Gun Barrel – Improvement of mechanical properties by modifying the chemistry

MIDHANI has successfully indigenized gun barrels for Indian Field Gun, T72, Main Battle Tank Arjun, 155 mm Field Howitzer (Bofors) and T90. Nearly 2000 gun barrel forgings for T72 tank have been supplied to ordnance factories

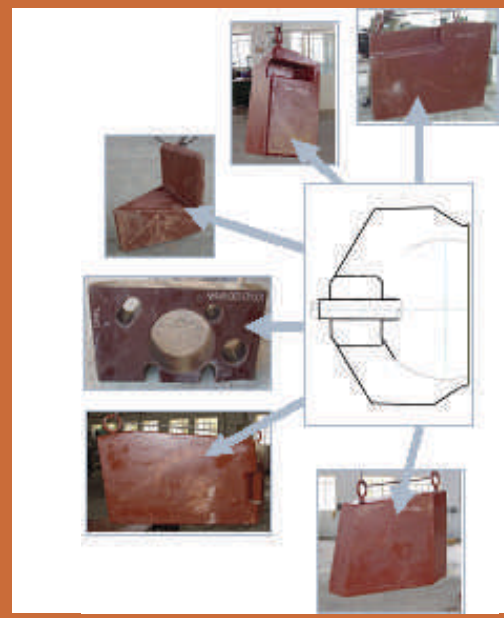
BATTLE TANK

Weapon/Equipment	Grade	Application
155mm Howitzer	MDN 155	Barrel, Breech Ring, Breech Screw & Muzzle Brake
T-72 Tank	MDN 172 45xH2MQA 18X2H4MA 85W	Barrel, Breech Ring, Block, Coupling Torsion Bar Crank Shaft Friction Disc
MBT (Arjun)	MDN 95 EN 25	Barrel, Breech Rings Driving Shaft
Vijayanta	C 55	Barrel
IFG MKII	MDN 59 MDN 60	Trail Tube Carriage Component

Development and production of Ultra high strength and high toughness low alloy steel MDN 173 plates and sheets for tank armouring:

MBT – ARJUN

ARMOUR MODULES

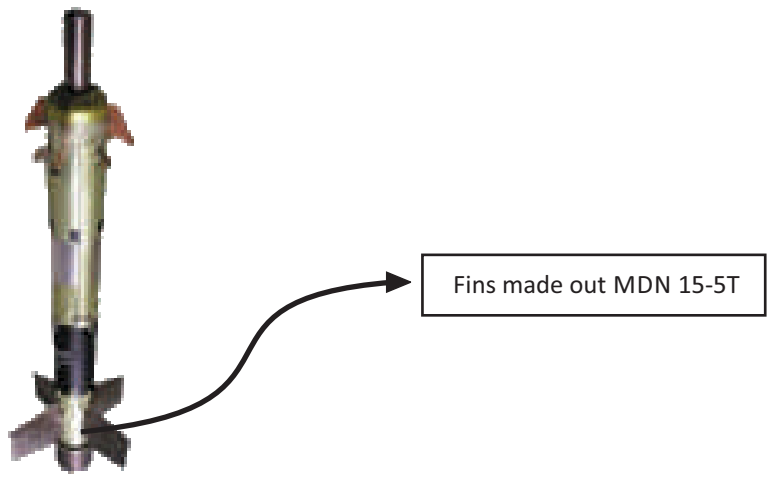


MDN 4130 Preforms for Pinaka Rocket Motor Casings:

MDN 4130 (0.3 C – 0.25 Si – 0.5 Mn – 1.0 Cr – 0.2 Mo balance iron) is a medium carbon, chromium-molybdenum steel. MIDHANI has been supplying MDN 4130 since early 1990's to BDL for manufacture of cold formed tubes for Pinaka missiles.

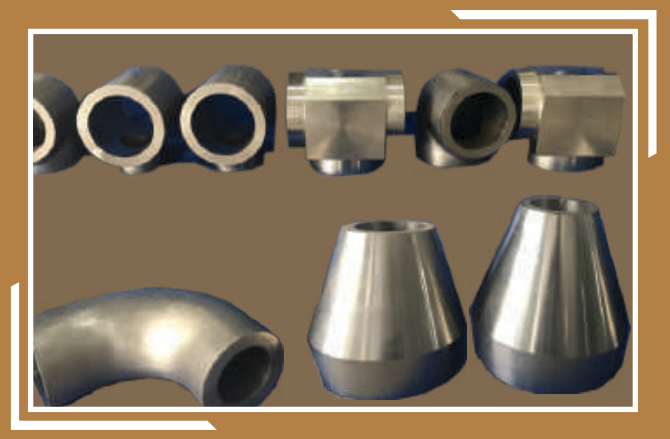
Precipitation Hardened 15-5T:

MDN 15 – 5 T is a precipitation hardening corrosion resistant steel – Stainless Steel **(**equivalent to 08Kh15N5D2T – W Russian specification). A combination of high ultimate tensile strength (1250 – 1400 MPa) and adequate impact toughness in case of bars is characteristics of this alloy. The material was developed forBDL for production of Konkur – M missile's wings.



MDN 59

This material is a 0.05%C, 14.5%Cr, 5.5%Ni, 1.5Nb, 0.5%Nb precipitation hardening stainless steel. This steel has exceptionally good combination of strength, toughness, corrosion resistance and weldability. It finds wide engineering applications such as compression disc, shafts, blades, fan impellers, pump parts, gun carriage parts etc.



Various close die forging components

CONTRIBUTION IN ENERGY

SS 316 Ti

MDN316Ti modified finds extensive use in reactor core application for clad and wrapper tubes of Fast Breeder Reactor. The specification calls for narrow range of chemical composition, low gas levels, stringent ultrasonic requirement (1mm FBH) and fine grains.

PFBR FUEL SUB ASSEMBLY

Modified SS 403 (MDN 403)

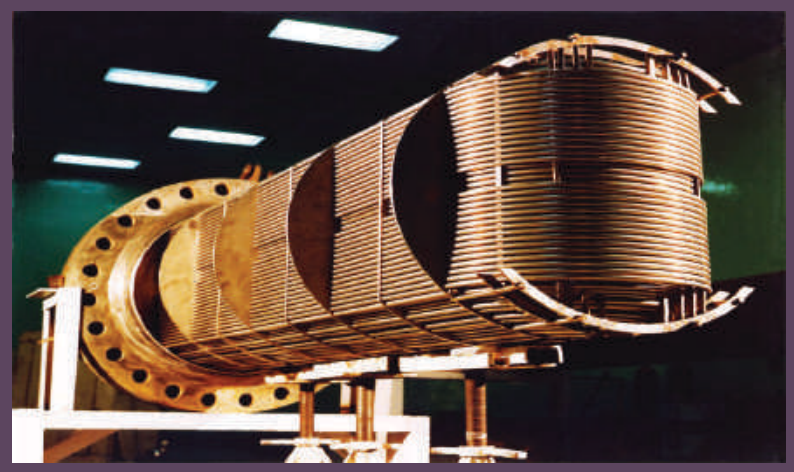
The steel used for end fitting is a modified version of SS 403 (MDN 403). MDN 403 modified is a low carbon martensitic stainless steel that finds applications as end fitting in Pressurized Heavy Water Reactor due to its high strength and impact toughness, adequate resistance to corrosion, wear, erosion and oxidation resistance; and of the thermal expansion coefficient close to zirconium alloy pressure tube.

SS 403 MODIFIED IN END FITTING IN FINISHED MACHINED CONDITION

Superfer 800 L

Superfer 800, 800H, and 800HT belong to nickel-iron-chromium alloys family. These have good strength and excellent resistance to oxidation and carburization in high-temperature exposure. These alloys are identical except for the higher level of carbon in alloy 800H and 800HT, plus a higher range of aluminum and titanium specified in alloy 800HT. MIDHANI has manufactured and supplied Superfer 800L for steam generator.

Heat Exchanger



Development of Austenitic stainless steel MDN 347MN for light water reactor.

This steel was developed for light water reactor with suitable modification of the composition of the alloy with molybdenum and balancing the composition by introducing controlled additions of nitrogen. These modifications have resulted in a new alloy with retention of strength up to 400°C.

Modified 9Cr1Mo - Innovative Processing Technology

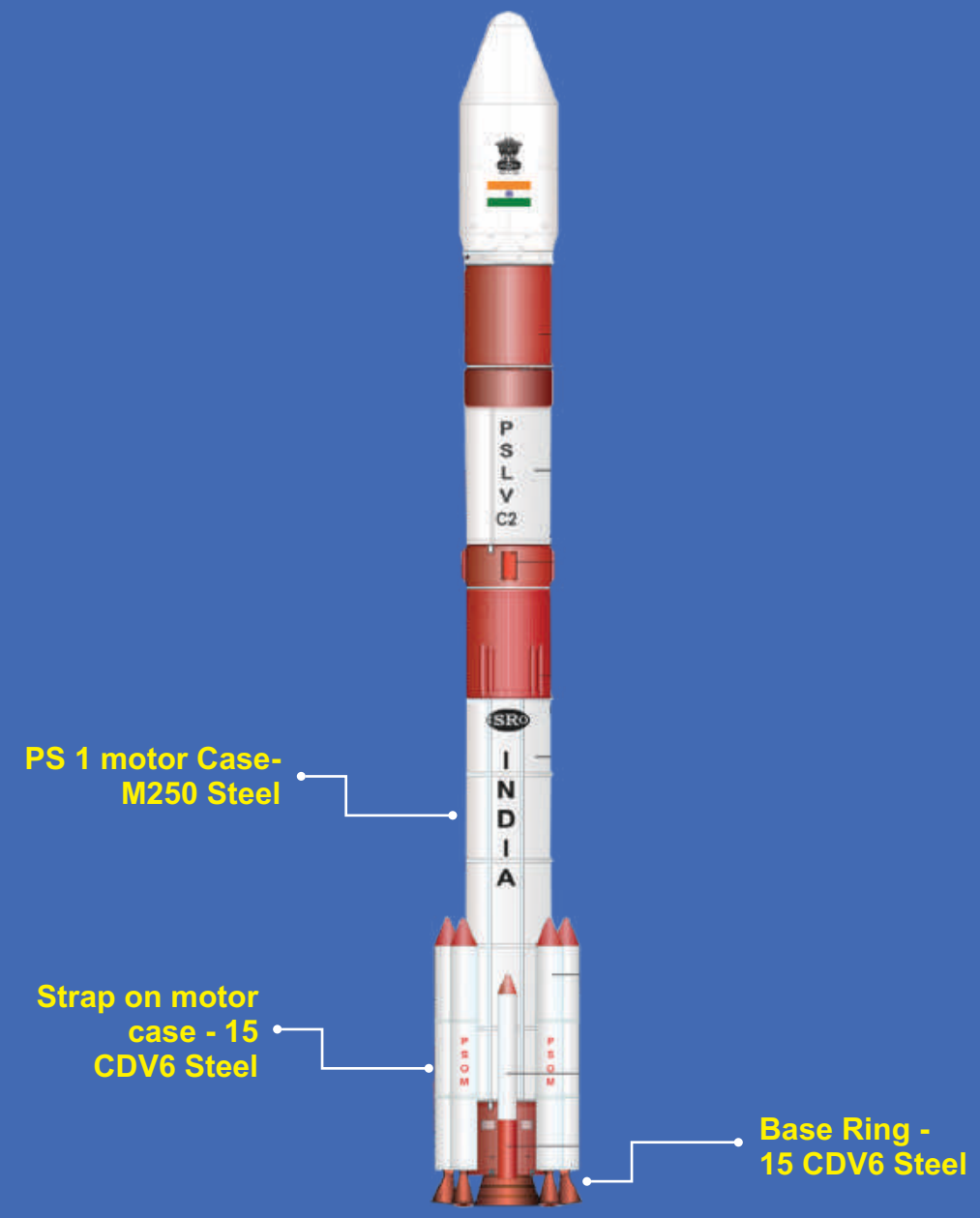
MIDHANI has manufactured a number of heavy forging of modified 9Cr -1Mo steel for steam generators in Prototype Fast Breeder Reactor (PFBR). PFBR material specifications have been exclusively formulated and are stringent compared to ASME requirements.

CONTRIBUTION IN SPACE AND AEROSPACE

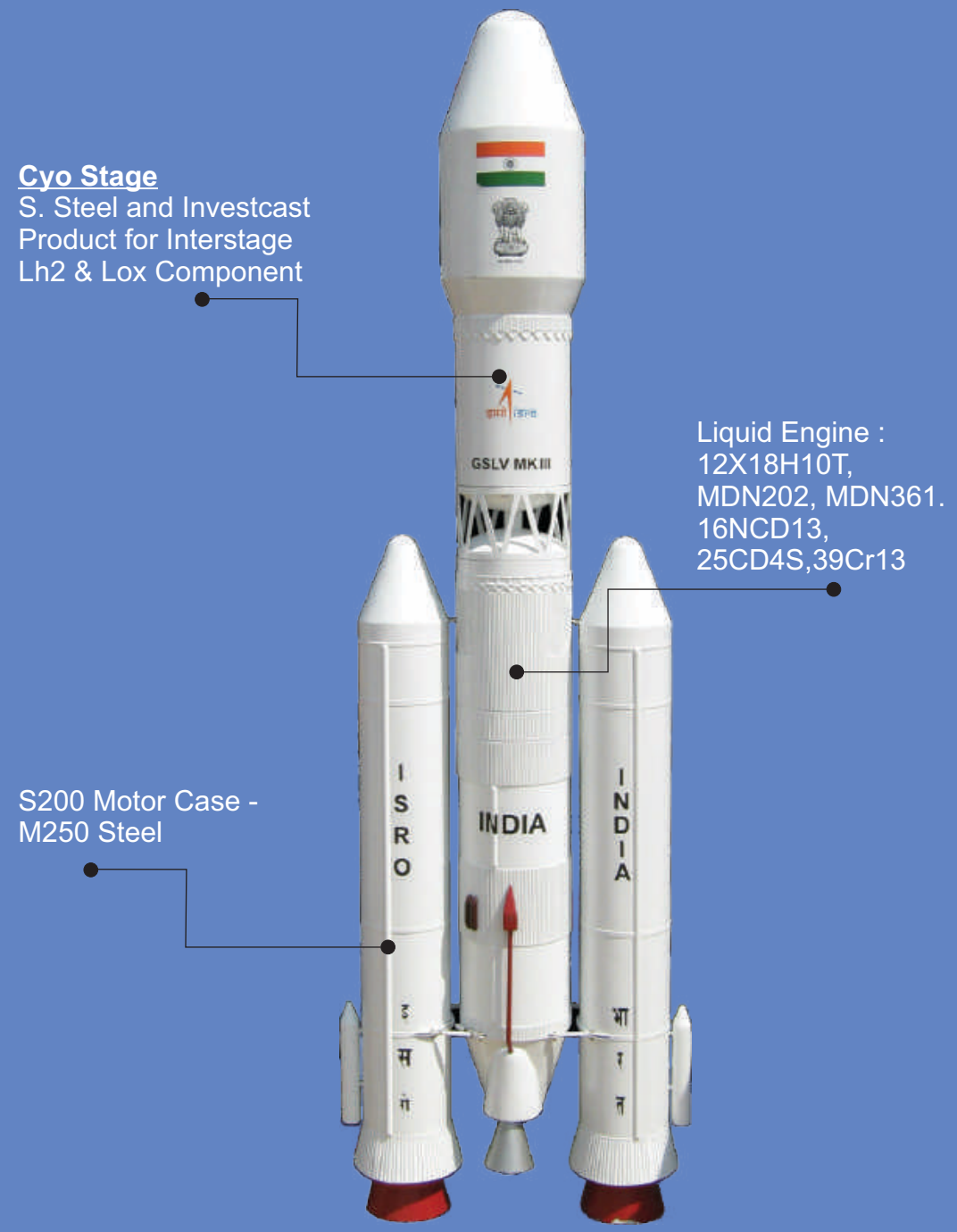
Over the years, MIDHANI has developed various high-performance stainless steel, special steel and ultra-high strength steel for space sector and contributed in various prestigious launch programs for ISRO like PSLV, GSLV, GSLV Mk-III, Chandrayaan-1, Chandrayaan-2, Mangalyaan and Gaganyaan. MIDHANI is the key supplier of material for all 50+ launches of ISRO.

Special Steel & Stainless steel for PSLV

MDN250	Rings, Plates, Wire, Rods, Strips, Blocks
S. Steels	Rings, Forgings, Rods, Plates, Sheets
15CDV6	Rings, Plates, Wire, Rods, Strips, Blocks



Special Steel and Stainless Steel for GSLV MKIII

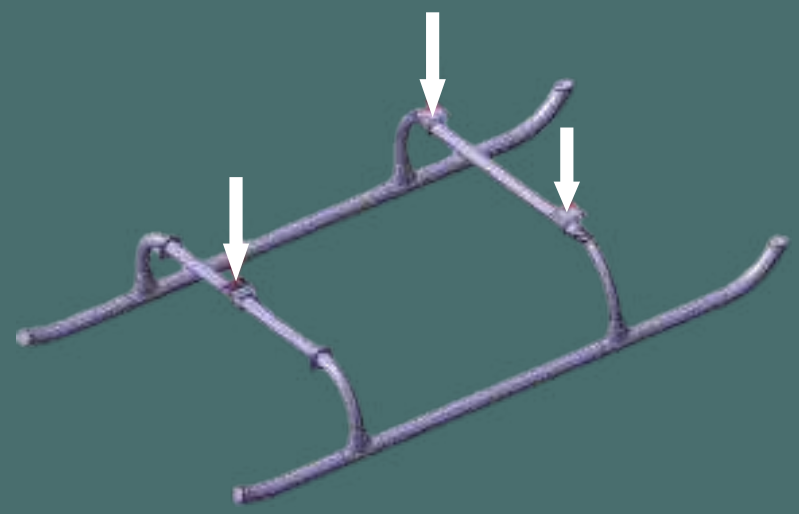


Stainless Steel alloy 465 development for ASTRA missile applications

MDN 465A is a double vacuum melted, martensitic, age hardenable steel. This 0.02C-12Cr-11Ni-1Mo-1.5Ti alloy was designed to have excellent notch tensile strength and fracture toughness over a wide range of section sizes.

MDN 9201 alloy development for Helicopter programs of HAL

MDN 9201 is a low carbon, low alloy (0.17C-1.5Cr-1.5Ni) steel. It is typically used for parts requiring a through-hardening capability up to 40 mm in nominal thickness and subject to rigid magnetic particle inspection standards. The alloy is used extensively in helicopter transmission assemblies (power transmission gears and pinions) in helicopter for different projects like ALH, LCH & LUH.



INNOVATIVE PRODUCTS DEVELOPED

Indigenization of large size tubes for NALCO

Large size tubes of alloy steels are required for various applications in the country. MIDHANI has identified alloy steel tubes (known as roll shells) being imported by NALCO. These have size of OD 1013 ID 889 and L 1867 mm.

View of Roll Shell

"Successful Trial run of Roll Shells supplied by M/s MIDHANI"
- Appreciation Received from NALCO

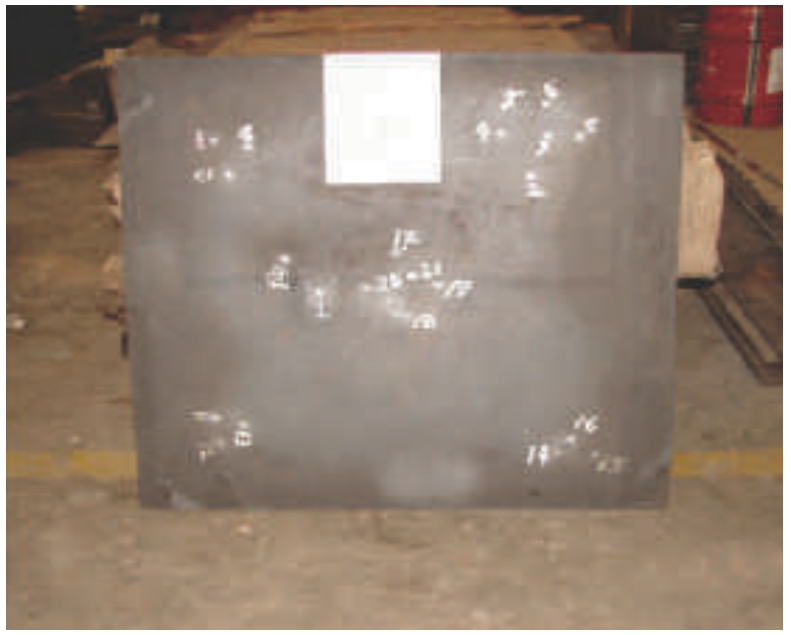
Development of forged crusher hammers with improved life for NTPC

The development of crusher hammer involves close die forging of MIDHANI material MDN 172M into the required shape and heat treating. The product has been developed with high hardness (>500 BHN) with adequate toughness.

Hammer for coal crushing

Development of air hardening Armour Steel Plates– MDN AS1

MIDHANI developed steel – AS1, which can obtain high hardness without need of quenching in oil or water. The air hardening steel can achieve hardness over 500 BHN. The plates met the specified hardness and have successfully found application in vehicle armouring.



BALLISTIC TESTING DETAILS OF ARMOUR PLATE
GRADE : AIR HARDENING STEEL

HEAT NO.	: H8490
SIZE (MM)	: 1000 x 1000
THICKNESS (MM)	: 6.30-6.50
NO OF ROUNDS FIRED	: 21
AMMUNITION	: Catridge SA 7.62 x 51 mm ball (OF-Kirky)
GUN	: 7.62 SLR
ANGLE OF ATTACK	: 0^0
DISTANCE	: 10 Mtrs
STRIKING VELOCITY (MIN)	: 841 Mtrs/s
(MAX)	: 856 Mtrs/s
RESULT	: PLATE PASSED PROOF

FIRING RANGE : SMALL ARMS RANGE, DMRL
Date: 12.03.2008

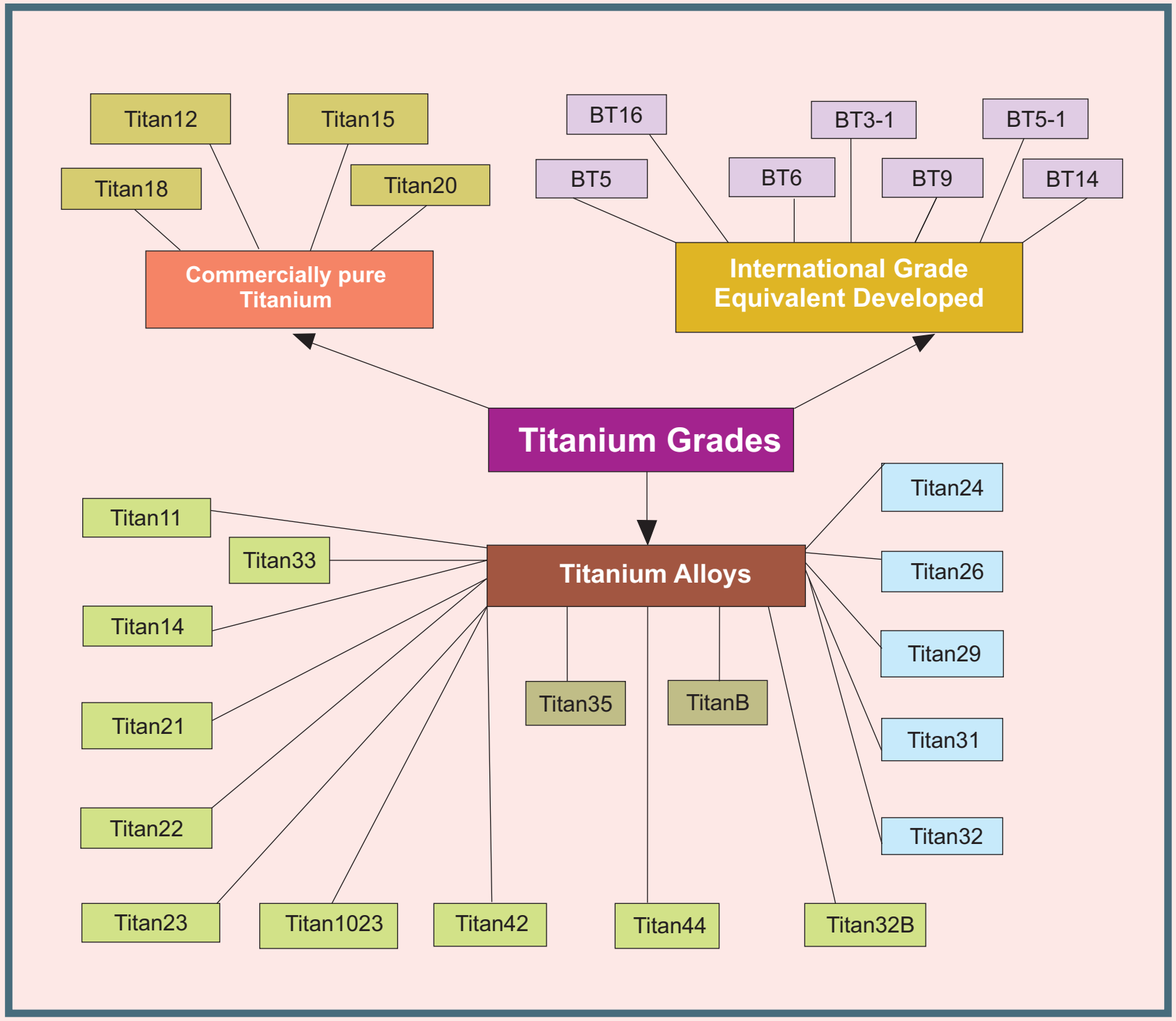
Development of Bomb shell assembly for Indian Air Force

Three types of Bomb Shell assemblies used by Indian Air force namely 1000 lbs, 450 kg. & 250 kg for Ordnance Factory were successfully developed, assembled and painted.

Titanium & Titanium Alloy

Over the last 45+ years, MIDHANI has been playing a significant role in the production of Titanium & Titanium alloys in strategic sectors like Space, Aerospace & Defence. MIDHANI is the only manufacturer of titanium alloys in India. Titanium and Titanium Alloys are produced in a wide variety of product forms. MIDHANI products includes: Ingot, Billet, Bar, Plate, Sheet, Strip, Tube, Ring and Investment Cast Product.

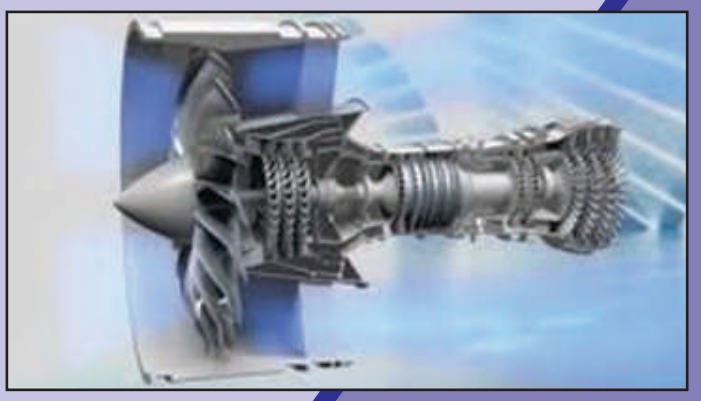
Family chart of Titanium & Titanium Alloys at MIDHANI



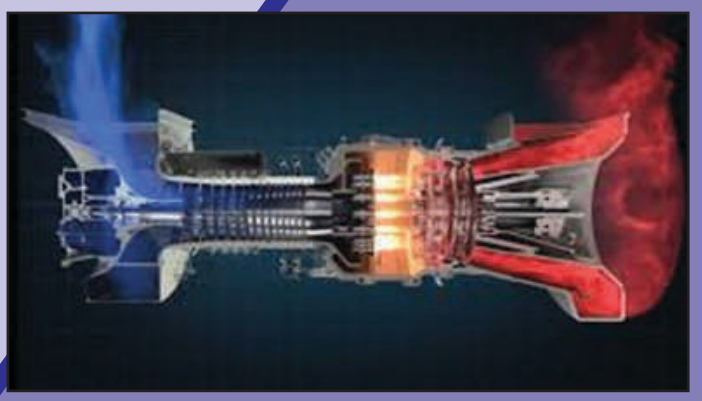
VARIOUS TITANIUM GRADES PRODUCED AT MIDHANI:

A. Commercially Pure Titanium		
1	Titan-12	Ti 99.8%
2	Titan-15	Ti 99.7%
3	Titan-18	Ti 99.6%
4	Titan-20	Ti 99.5%
B. Titanium alloys		
1	Titan 11 (PT-1M)	Ti-0.4 Al
2	Titan 14	Ti-1 Ni-0.5 Mo
3	Titan 21	Ti-5.3 Al-2.5 Sn
4	Titan 22	Ti-8 Al-1 Mo-1 V
5	Titan 23 (OT4-1)	Ti-2.3 Al-2.2 Mn-0.1 Fe
6	Titan 24 (PT-7M)	Ti-2.5 Al-2.5 Zr
7	Titan 26 (IMI 685)	Ti-6 Al-5 Zr-1 Mo-0.3 Si
8	Titan 29 (IMI 834)	Ti-5.5Al-0.5Mo-4.0Sn-0.7Nb-0.3Si-4Zr-0.06C
9	Titan 31	Ti-6 Al-4 V
10	Titan 31 ELI	Ti-6 Al-4 V
11	Titan 32	Ti-3 Al-2.5 V
12	Titan 32B (PT3B)	Ti-4 Al-2 V
13	Titan 33 (BT 20)	Ti-6 Al-1.5 Mo-1.5 V
14	Titan 35 (GTM 900)	Ti-6.5 Al-3.3 Mo-1 Zr-0.3 Si
15	Titan B	Ti-5Ta-2 Nb
16	Titan 1023	Ti-10 V-2 Fe-3 Al
17	Titan 42	Ti-15 V-3 Sn-3 Cr-3 Al
18	Titan 44 (Beta 21S)	Ti-15 Mo-2.7 Nb-3 Al-0.2 Si
C. International grade equivalent developed		
1	BT 3-1	Ti-6.5 Al-2.5 Mo-1.5 Cr
2	BT5	Ti-5 Al
3	BT 5-1	Ti-5.6 Al-2.6 Sn
4	BT 6	Ti-6 Al-5 V
5	BT 9	Ti-6.3 Al-3.3 Mo-1 Zr-0.3 Si
6	BT 14	Ti-6 Al-1.5 V-3.5 Mo-0.1 Fe
7	BT16	Ti-2.8 Al-5 Mo-5 V

CONTRIBUTION IN SPACE, AEROSPACE



Jet Engines



Gas turbines

Air Frame Components

Speciality of Titanium Alloys

Titanium is a low-density element (approximately 60% of the density of steel) which can be strengthened greatly by alloying and deformation processing. Titanium is nonmagnetic and has good heat-transfer properties. Its coefficient of thermal expansion is somewhat lower than that of steel's and less than half that of aluminium. Titanium has the ability to passivate and thereby to exhibit a high degree of immunity against attack by most mineral acids and chlorides. Commercial pure titanium and some titanium alloys generally are biologically compatible with human tissues and bones.

Compared to steels or aluminium alloys, titanium alloys must be considered a much younger structural material. The outstanding properties of titanium alloys include high specific strength and excellent corrosion resistance. Therefore, titanium alloys are found in aerospace application where the combination of weight, strength, corrosion resistance, and/or high temperature stability of aluminium alloys, high strength steels, or nickel-based superalloys are insufficient.

The main drivers for titanium's use in aerospace application are:

- Weight reduction (substitute for steels and Ni-based superalloys)
- Application temperature (substitute for Al alloys, and steels)
- Corrosion resistance (substitute for Al alloys, and low-alloyed steels)
- Galvanic compatibility with polymer matrix composites (substitute for Al alloys)
- Space limitation (substitute for Al alloys and steels)

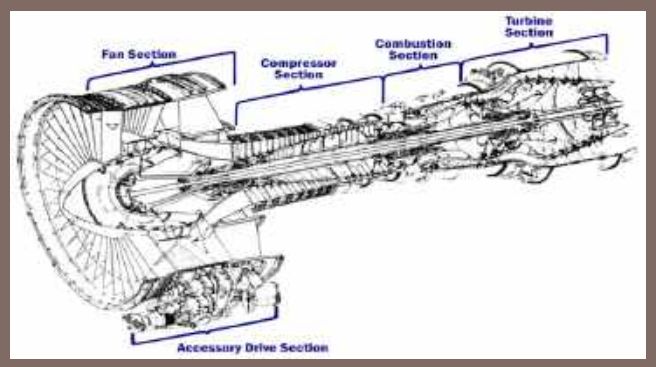
Titanium Alloys for MIG Aircraft

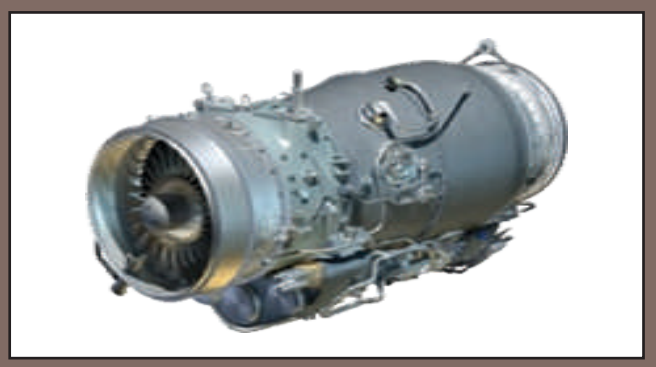
S.No	Alloy	Temp.°C (Max)	Typical Components
1.	BT9	500	Compressor rotor and stator blades, rotor discs
2.	BT3-1	450	Compressor rotor and stator blades, compressor rotor discs, brackets, flanges, adaptors, casings, nuts, sleeves
3.	BT5-1	450	Engine couplings, rings, fasteners, tail cones, tank lining
4.	OT4-1	400	Aeroengine exhaust shrouds, brackets, tail cones, lugs, covers, turbine nozzle covers

Titanium Alloys for Tejas & Jaguar Aircraft

S.No	Alloy	Temp.°C (Max)	Typical Components
1	Titan 31A (Double Melted)	300	Rings, casings, housing, etc.
2	Titan 31A (Triple melted)	300	Compressor stator & rotor blades & discs
3	Titan 23A	400	Exhaust Shrouds, Turbine Nozzle Cover, etc.
4	Titan 35A (GTM 900)	500	Gas turbine components
5	Titan 22A	520	HPC compressor rotor blades
6	Titan 26A	550	HPC compressor discs

MATERIAL FOR AERO ENGINE FOR MILITARY JAGUAR AIRCRAFT





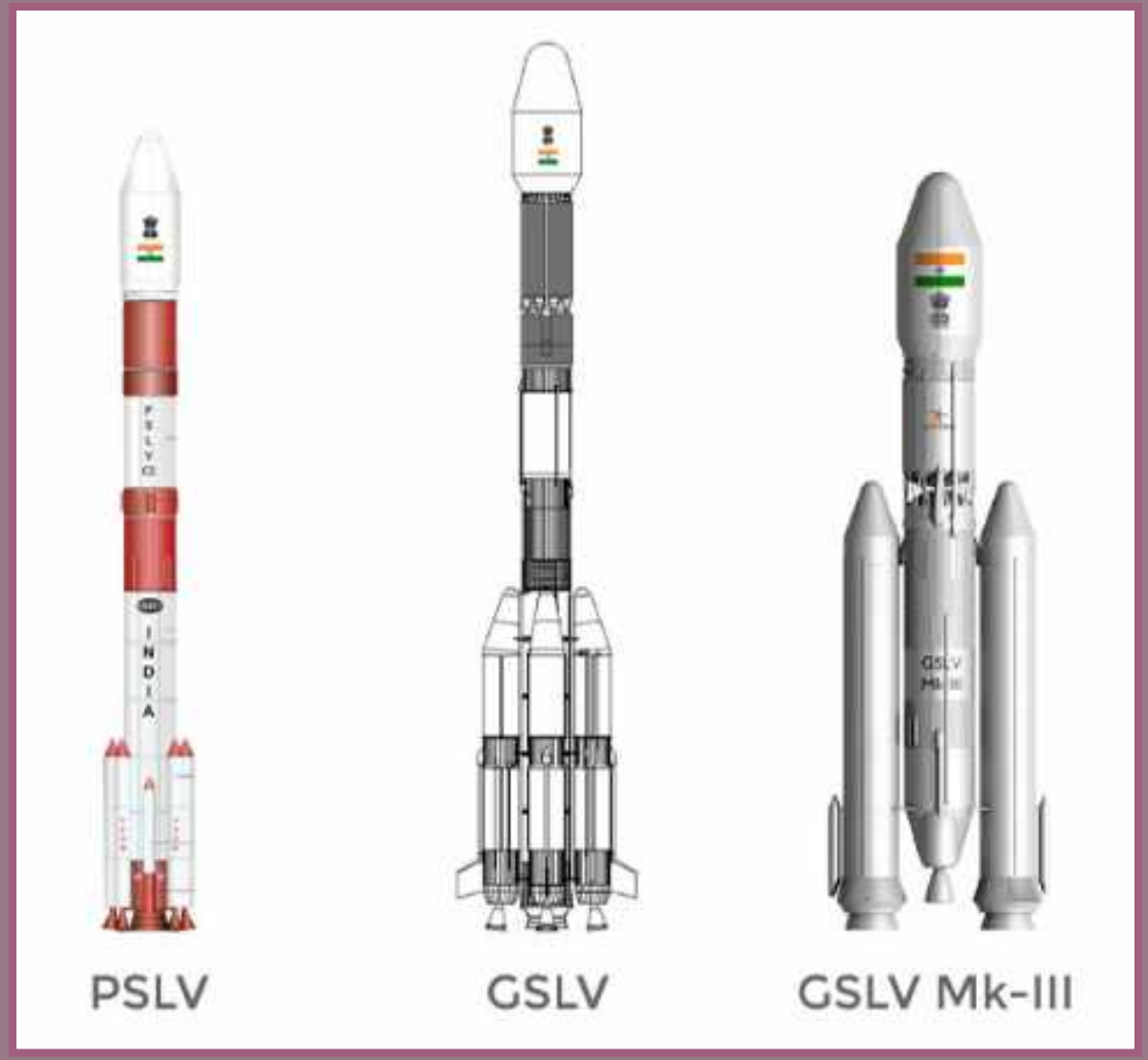
Stages 1 to 5 of ADOUR HP Compressor Discs (Ti-6 Al-5 Zr-0.5 Mo-0.25 Si)

MIDHANI has successfully delivered isothermally forged titanium alloy high pressure compressor discs for compressor of Adour MK 811 Engines used in jaguar military aircraft with completely indigenous technology. The discs were Isothermally forged to Near Net Shape (NNS), forged and heat treated to achieve desired properties

Alloys for Adour Engine	Application Area
Titanium 26 A	High Pressure Compressor Disc Stage 1 to 5

SEAMLESS RINGS DEVELOPED FOR PSLV & GSLV (RINGS FOR PS4 TANK)

VARIOUS TITANIUM ALLOYS FOR ISRO



Alloy Developed	Application Area
BT5-1	Gas Bottles
Titan31 Ti-6 Al-4V Ti6Al4V (ELI) Ti Half Alloy	Strap on motor casing, Fasteners Inter Tank Structure & Gas Bottles Gas bottles Pipes & fittings for hi-pressure systems Cryo components
Titan 42	Honeycombed aerospace structures Components in satellite launch system
C-103	Thruster Cone

VARIOUS INVESTMENT CAST PRODUCTS DEVELOPED FOR ISRO

Titanium Investment Cast Products for ISRO

VARIOUS INVESTMENT CAST PRODUCTS DEVELOPED FOR NUCLEAR SUBMARINE

Products for Nuclear Submarine Application

MIDHANI has indigenously developed several critical components for Naval applications such as:
1)Heaviest Titanium alloy (74kg) Casting
2)Titanium casting for pumps bodies and sea water filters

Superalloy

Over the last 45+ years, MIDHANI has played a significant role in the development and manufacture of Superalloys for strategic applications in Space, Aerospace, and Energy.

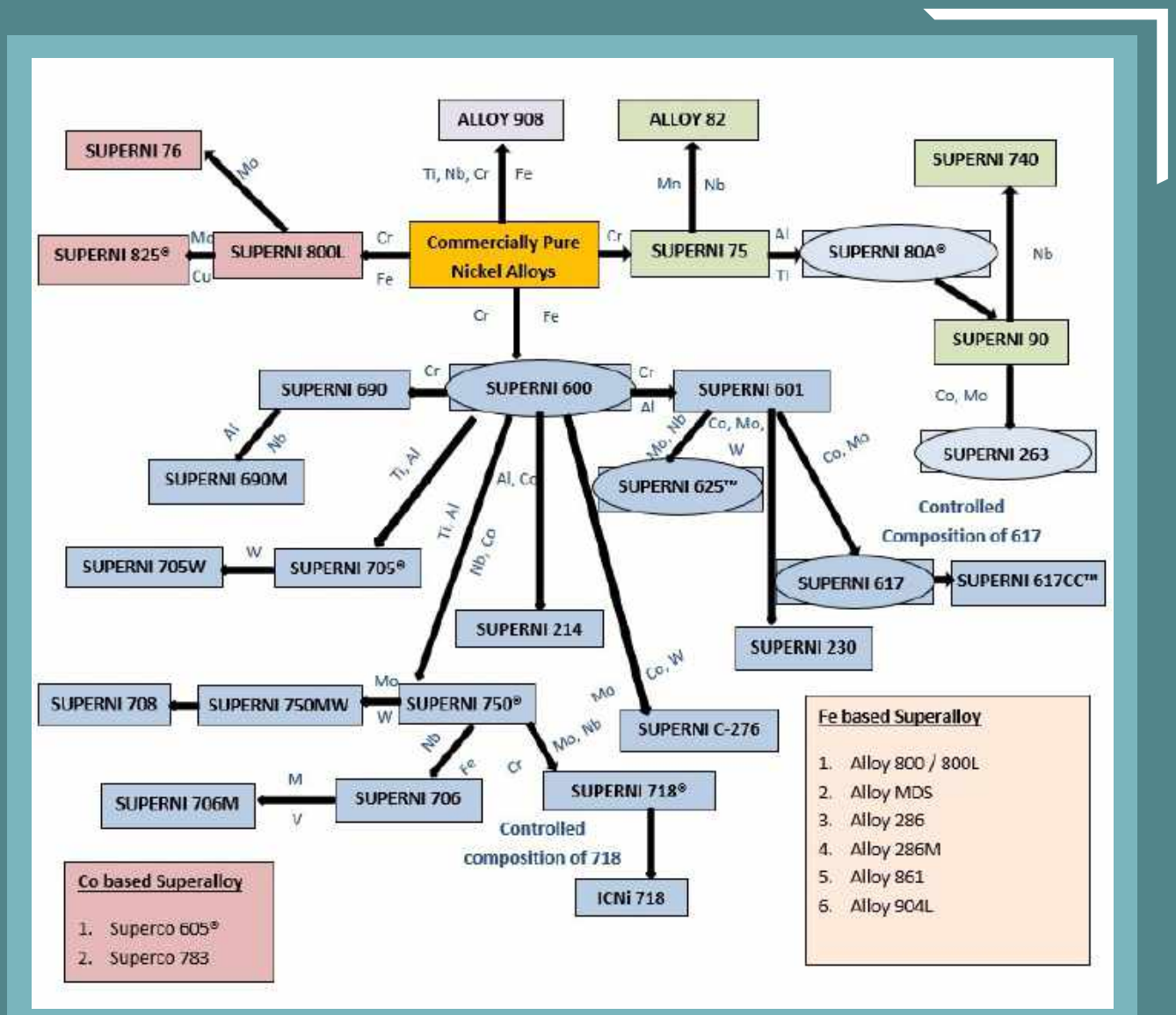
Speciality of Superalloy

Superalloys are group of alloys comprising of nickel, cobalt and iron along with other refractory metals to maintain higher strength even at high temperature and enhance their corrosion resistance. Superalloys are mainly used in Aerospace, Gas Turbine Engines, Nuclear Reactors, Petrochemical, Rocket Engines, Tools and Dies for hot-working of metals in Automotive and Chemical industries.

Main characteristics of superalloys over conventional alloys are

- Good strength at high temperature and across thick sections
- Ductile at cryogenic temperatures
- Excellent oxidation resistance at all temperatures
- Good corrosion and erosion resistance

Superalloys market is categorised by base material (Nickel-Based, Iron-Based and Cobalt-Based) and Application (Aerospace, Industrial Gas Turbine, Automotive, Oil & Gas, Industrial and Others).



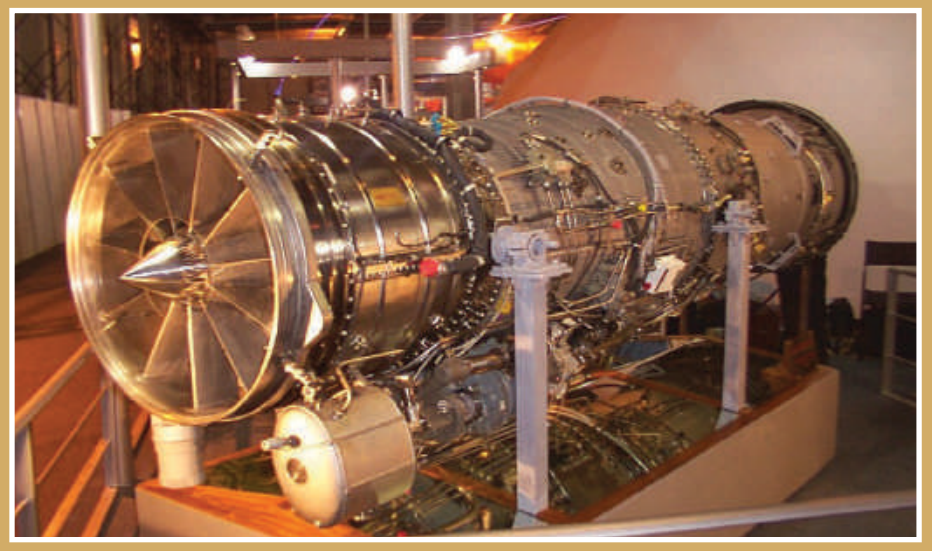
Family Chart of Superalloys at MIDHANI

CONTRIBUTION IN AEROSPACE AND SPACE

Nickel based Superalloy for Kaveri and Ghatak Engine:

Strategic Superalloys required for Kaveri Engine Programme were entirely developed through in -house R&D efforts. Large-sized ingots free from macro-segregation were processed using advanced re-melting practices to match stringent international standards.

Alloy Developed	Nominal Composition	Equivalent International Specification	Properties
SUPERNI 236A	20Cr-20Co-5.9 Mo-2.1 Ti-0.5Al-Bal Ni	GTM-SU-263/FS-1, MSRR 7035, MSRR 7036, BS HR 10, AMS 5886, AMS 5872	0.2 % PS (MPA), RT: 650+, UTS (MPA), RT: 1100+, % of elongation in 25 mm – 40+%
SUPERNI 718A	19Cr-18Fe-5Nb-3Mo-1 Ti-0.5Al-52Ni	AMS5662, AMS5663, MB637, B670, BS2H2	0.2 % PS (MPA), RT: 1150+, UTS (MPA), RT: 1400+, % of elongation in 4D – 20%, % RA – 35+%, Hardness, BHN: 400+

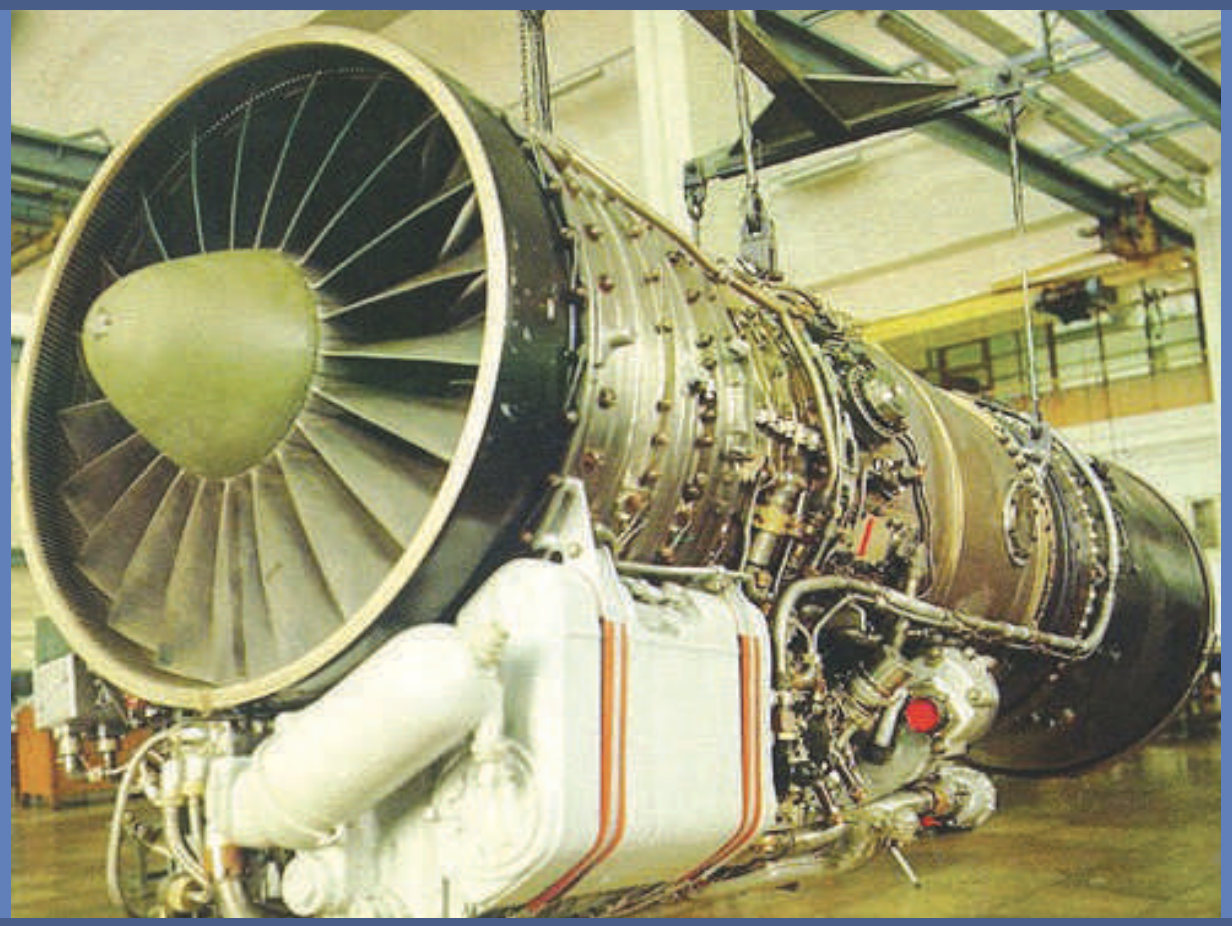


Typical Components for Kaveri and Ghatak engine:

Flame tube, combustion chamber, reheat system, thrust deflector system, casing, exhaust ducts, bearing housing, cooling rings, flanges

Superalloys for MIG Engine Programme

Significant advancements were made in production of large diameter ingots of complex Superalloys by double vacuum melting to achieve high degree of structural homogeneity.



Alloy	Nominal Composition	Equivalent International Specification	Application Temperature °C	Typical Components
AE435	20 Cr-0.3Ti -BalNi	TY14-1-1671-76, TY14-1-378-72, TY14-1-1747-76, TY14-1-975-74	700	Exhaust cones, Jet pipes, combustion chamber parts.
AE868	25Cr-14W-0.5Ti -Bal Ni	TY14-1-286-72, TY14-1-1747-76, TY14-997-76	800	Combustion chamber parts, pipelines in the hot zones, reheat chamber, diffusion end casing, nuts & bolts, etc.
AE696M	0.1C-11Cr -23Ni-2.9Ti-1.3Mo -Bal Fe	TY14-1-312-72, TY14-1-378-72	750	Adjustable nozzle, bolt, pin, reheat details, bush.
AE602	20.5Cr-2.1Mo -1.1Nb-0.55Ti-0.55 Al-Bal-Ni	TY14-1-1747-76, TY 14-1-146-71	700	Deflector, flame tube details, adjustable nozzle, flange, valve, reheat diffuser.
AE437A	20.5Cr-2.5Ti -0.75Al-Bal Ni	TY14-1-75-71, TY14-1-402.72	800	Flange, 9th stage compressor stator blade, bracket, bush for flame tube
AE437B	20.5Cr-2.6Ti -0.8Al-0.01B- Bal Ni	TY14-1-75-71, TY14-1-402-72, TY14-1-1747-76, TY14-1-684-73	800	Atomizer, nozzle, bush, pin, tie rod, pull rod, bracket, shackle

Superalloys for Su30MKI Aircraft – AL31FP ENGINES

Alloys for Indigenisation	Application
NICKEL BASE ALLOY	
SUPERNI 718ED	Covers, Flanges
SUPERNI 708ED	Rings, Bushes
SUPERNI 742ED	Rings, Flanges
ZS32BE	Turbine Rotor Blades

Cast Products & Rings for Space (SN750MW)

Superni 750MW is a Nickel–Chromium alloy precipitation strengthened superalloy equivalent to XH67MBTIO of Russian origin being used upto 800ºC in major subsystems of semidry engine like thrust chamber, pre burner, turbo pump and LPOT. Also, this alloy is solid solution hardened by additions of Molybdenum and Tungsten. The alloy has short term creep strength with very low creep elongation upto 750° C as well as oxidation resistance upto 1000°C.Additionally the alloy has very good weldability combined with high temperature strength which is stable upto 800°C.

MIDHANI has successfully developed spider casting indigenously with stringent aerospace requirements for Semi cryo-engine of satellite launch vehicle.

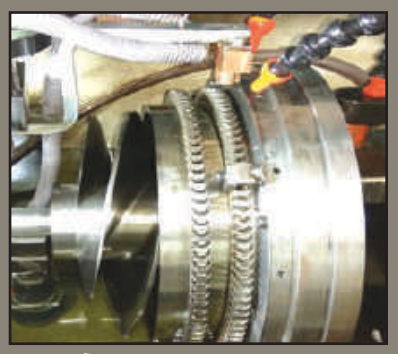
Alloy	Nominal Composition
SN750MW	Ni-18.5Cr-4.5Mo-4.5W-3.0Fe-2.5Ti- 1.2Al

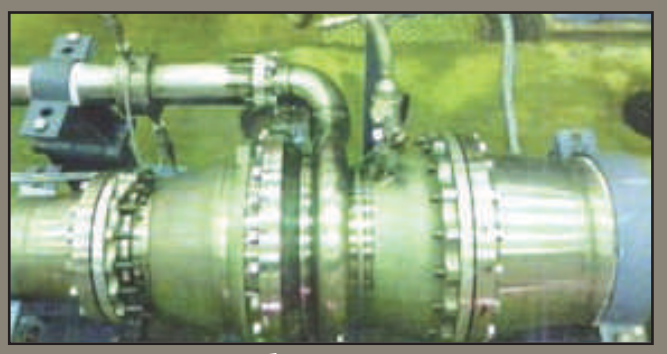
Castings for Cryo Engine (MDN 750Mw)

1 – Inter Stage Housing Body

2 - Second Stage Volute Body

3 - Exhaust Casing





Different rotor and stator part made of Superni 750MW rings in Low pressure oxidizer turbo pump,one of the major components in Semi cryo Engine

CONTRIBUTION IN ENERGY

Material Developed by MIDHANI

Grade	Application
SUPERNI 80 A/ SUPERNI 617	Used for gas turbine components (blades, rings and discs), bolts, tube supports in nuclear steam generators, die-casting inserts and cores, and exhaust valves in internal-combustion engines
SUPERNI 76	Jet engine tailpipes, afterburner Components, cabin heaters and other aircraft parts
SUPERNI 718	Applications include gas turbine hot section components and cryogenic storage tanks
SUPERNI 750	Structural members in hot sections of gas turbines such as discs, thrust reversers and ducts. Heat treat fixtures and cryogenic vessels, springs and fasteners
SUPERCO 605	Gas turbine, high temperature components, high temperature springs
SUPERFER A286	Jet engine, supercharger parts, high temperature application fasteners for aircraft

Advanced Ultra Super Critical (AUSC) Project

Advanced Ultra Super Critical (AUSC) technology refers to an advanced coal-based power generation system that works on higher temperatures (above 700^{o} C) and pressures for improved efficiency, reducing coal consumption and CO_2 generation.

Power generation from coal-fired power plants contributes to about 38% of CO_2 pollution in the atmosphere. AUSC technology would help in 20% reduction in CO_2 emission at source combined with 20% saving in coal consumption compared to sub-critical plants.

A consortium of Bharat Heavy Electricals Limited (BHEL), National Thermal Power Corporation (NTPC) and Indira Gandhi Centre of Atomic Research (IGCAR) was formed in 2010, under the aegis of the office of the Principal Scientific Advisor to work on the project.

Product for AUSC Project

Body Forging (617 cc)

Body Forging (617cc)

Superni 625 Casting

Stepped Shaft Forging

MIDHANI joins the fight against Covid-19

During COVID-19 crisis, MIDHANI has developed and supplied Nickel Wire (0.16 mm) with purity ~100% which was critically required for the manufacture of Oxygen sensor pertaining to the “Critical Core Ventilator”

An oxygen sensor monitors the oxygen concentration of the gas to be delivered to the patient – an important, essential function. The correct operation of the connected oxygen sensor is automatically checked at regular intervals by the ventilator's internal electronics.

Armouring Solutions

MIDHANI has extensive experience in design & manufacture of Steel Armour & Composite Armour Products for Personnel Protection & Vehicle Protection.

PERSONNEL PROTECTION

BULLET PROOF PATKA

DESCRIPTION - BP Patkas developed are as per BP(R&D) Specifications using special armour steel. Ergonomic features and trauma pad provided to absorb shocks.

CHARACTERISTICS

- BP Patka (Steel) without skull protection – 1.4 kg+10%
- BP Patka (Steel) with skull protection – 1.5 kg+10%

CAPABILITY

- Front Armour Protection: 7.62 x 39 mm HSC
- Rear Protection: 9 x 19 mm Ball

USERS : Defence Forces, CAPFs, Police Force & Security Agencies

BULLET PROOF HELMET

MIDHANI's Bulletproof Helmet are being used by Military Police and Special force to provide protection against ballistic threats to reduce head injuries and fatalities.

FEATURES:

- Made of Aramid (Kevlar) Composite material
- Light Weight, High Strength
- High-energy absorption-to-weight ratio
- Outstanding long-term stability
- Multi-Layer Construction
- Durable & Comfortable Suspension Straps
- Compatible with Chem/Bio hazard masks
- Leather & Foam Cushioned
- Offers the ideal Ballistic Helmets for Law Enforcement, Military and Private Security Contractors
- Sizes: M,L
- Weight: 1.2 kg, 3kg
- Colour; on customer's demand

PROTECTION LEVEL:

- Level IIIA NIJ, BFS: 13 mm max

BULLET PROOF JACKET

- Description – Light weight bullet resistant jacket. Latest technology of dispersing CNT on the Polyethyelene sheets and using ceramics on strike face is used.
- Characteristics
  - BIS Level 5 : 7.1 kgs (large size) – without 360° protection, BFS:25 mm
  - BIS Level 5 : 9.0 kgs (large size) – with 360° protection, BFS:25 mm
- Capability – Protection against BIS Level 5 and can be increased to BIS Level 6, depending upon user requirements
- Users : Defence Forces, CAPFs, Police Force & Security Agencies

BULLET PROOF MORCHA

- **Description – Provide protection to troops during surveillance and acts as a protection cover during exchange of fire. Position of the Morcha can be easily changed by mounting castor wheels under each BR Panel**

- **Variants**
  - **Large Morcha (750 mm x 1900 mm) – 260 kgs (without BR glass viewing port)**
  - **Large Morcha (750 mm x 1900 mm) – 278 kgs (with BR glass viewing port)**
  - **Small Morcha (700 mm x 1200 mm) – 154 kgs (without BR glass viewing port)**
  - **Small Morcha (700 mm x 1200 mm) – 172 kgs (with BR glass viewing port)**

- **Capability – Protection against 7.62 x 39 mm HSC and the same can be customised as per user requirement**

- **Users : Defence Forces, CAPFs, Police Force & Security Agencies**

SENTRY POST

- Description – Bullet resistant structures that can be customised based on the user requirement with the incorporation of various features like BR Glasses, Composites, Mobile Structures etc.
- Characteristics – Protection against 7.62 x 39 HSC
- Users : Defence Forces, CAPFs, Police Force & Security Agencies

VEHICLE PROTECTION

Armour Bus

Passenger Vehicle

Passenger Truck

BIS Level 5 & NIJ Level III A

Armouring Solution Provided

- Composite Solution: Light weight laminate to ensure high power to weight ratio
- BP Glass : No degradation of visibility up to five years
- Bullet Proof Tyres : 50 to 100 km safe running after a hit
- Firing Platform : Customised solution for each Weapon System
- Protection against secondary projectiles : By Spall Laminates
- Road Testing : VRDE or ARAI or ICAT
- Reconnaissance & Surveillance : Upgradation as per increased weight post armouring

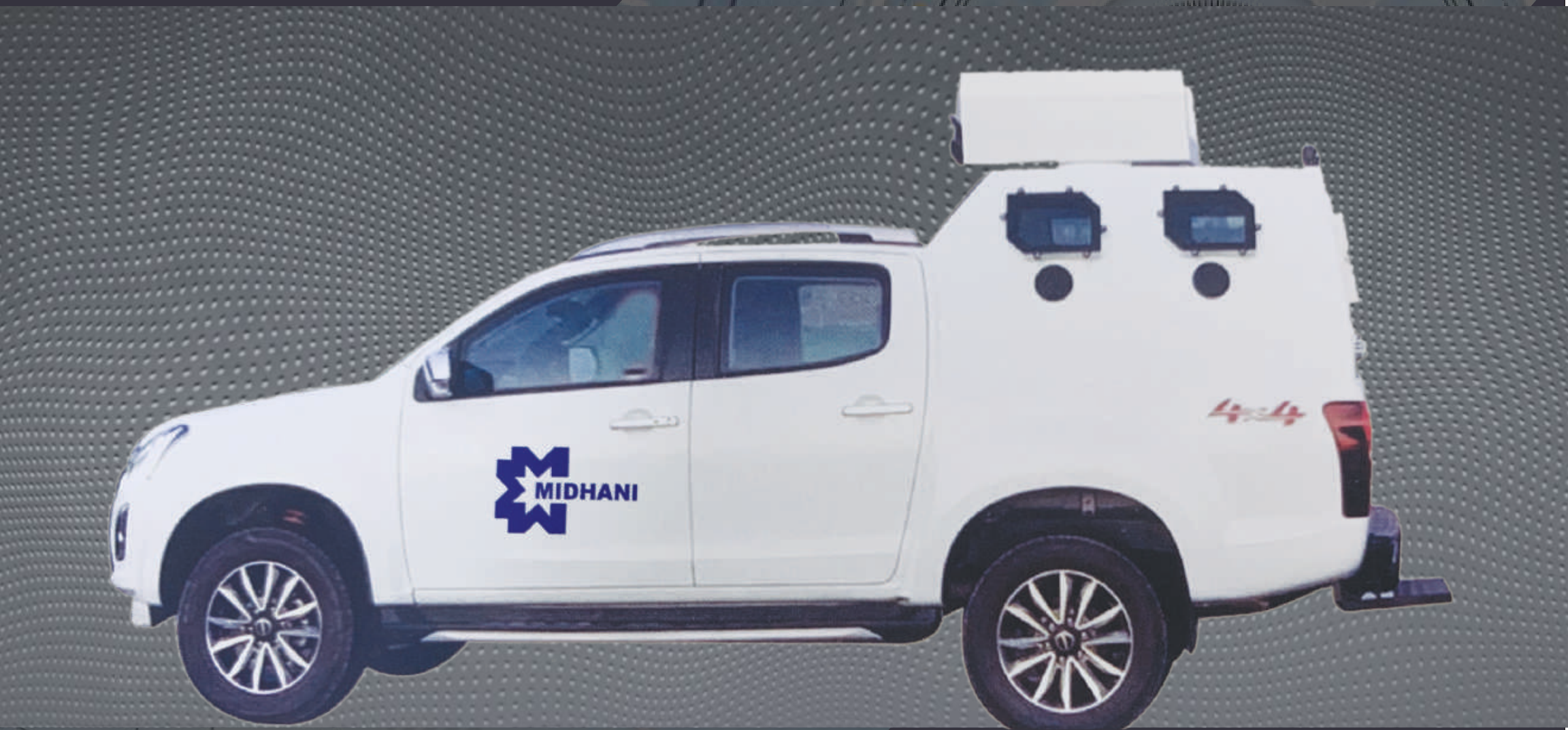
Users : Defence Forces, CAPFs, Police Force & Security Agencies

FIRST EVER ISUZU BASED: COMBAT VEHICLE

- **BALLISTIC PROTECTION:**
  - Roof and Body protected against 7.62x39 mm MSC and 7.62x39 mm HSC ammunition
  - Floor protected against 2 x HE36 Grenades
  - All ports are covered with different sizes of BP glass and protected against 7.62x39 mm MSC & 7.62x39 mm HSC
- Crew Carrying Capacity with Weapons: 07
- Runflat Tyres System: 100 kms
- Bullet Resistance Steel: Fabricated with reliable and tested MDN-45 Bullet Resistant Steel

- **BULLET RESISTANT GLASS:** Protection against 7.62x39 mm HSC ammunition 5 Years of warranty against any visibility defect
- **Revolving Turret:** Mounting of Large Calibre Support Weapon in 360° revolving Turret
- **ENHANCEMENT FEATURES :**
  - **Composite Up-Armouring:** Composite Armouring variant will provide power to weight ratio equal to 60 BHP/MT
  - **Surveillance and Reconnaissance:** Can be Equipped with 360 degree high resolution camera with FOV varies from 35 degree to 75 degree or customised

FIRST EVER ISUZU BASED: COMBAT VEHICLE



HELICOPTER ARMOURING

MIDHANI is providing Composite Armouring Solution for Helicopters engaged in Military operations & other missions. Indigenously developed panels by MIDHANI are cheaper by 35%

Key benefits

- **Provide protection to crew against Small Arms Fire**
- **Increased fuel efficiency, service ceiling and speed**

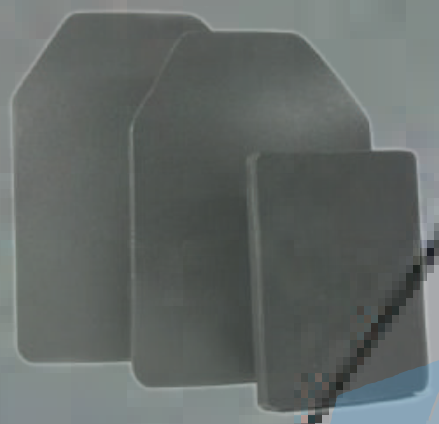
Users : Defence Forces, CAPFs, Police Force & Security Agencies

BALLISTIC STEELS

GRADE	PROPERTIES	APPLICATION
MDN45	Hardness : 480-520 HB	Blast & IED protection, bottom side of medium vehicles
MDN1700	Hardness : 480 – 520 HB, K1 c=80 MPa $m^{1/2}$	Flat part for whole vehicle, Heavy armour for MBT protection
MDNRHA	Charpy impact (J) = 80 at RT Hardness : 290 – 340 HB	Ammunition proofing, construction of submarine hull/structure and naval surface ships
Super Bainite Steel	Hardness : 600 HB, K1 c = 70 MPa $m^{1/2}$	Light & medium combat vehicle structures
High Nitrogen Steel	%EL = 35, CVN@RT=200	Infantry Combat vehicle, Helicopter, Naval boats etc.

BALLISTIC STANDARDS: BIS: 17051: 2018

Threat Level	Ammunition	Bullet Weight (G)	Bullet Type	Velocity (M/S)	Distance (M)	MIDHANI's Applicable Products
1	9 x 19 mm	7.4-8.2	FMJ/Pb	430±15	5±0.5	BR Vest, Spall Liner, Brief Case, BP Helmet
2	7.62 x 39 mm	7.45-8.05	FMJ/MSC	710±15	10±0.5	BRJ, BP Patka
3	7.62 x 51 mm	9.4-9.6	FMJ/Pb	840±15	10±0.5	BRJ, BP Morcha, BP Shield, BP Vehicle, Armoured Helicopter & Sentry Post
4	5.56 x 45 mm	3.5-4.0	FMJ / (SI+Pb)	890±15	10±0.5	
5	7.62 x 39 mm	7.45-8.05	HSC	700±15	10±0.5	
6	7.62 x 54R	10.3-10.5	API	830±15	10±0.5	



Over the years MIDHANI has immensely contributed towards

Self-Reliance

and the journey still continues...

Atma Nirbhar Bharat

आत्म निर्भर भारत