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REPORT

OF

COMMITTEE FOR

IDENTIFYING ESTABLISHED VENDORS FOR SUPPLY OF TYPE APPROVED MATERIALS FOR AIRCRAFT AND AIR LAUNCHED WEAPONS

REGIONAL CENTRE FOR MILITARY AIRWORTHINESS (MATERIALS)

CEMILAC, DRDO

PO. KANCHANBAGH, HYDERBAD – 500 058.

March 2021

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IDENTIFYING ESTABLISHED VENDORS FOR SUPPLY OF TYPE APPROVED MATERIALS FOR AIRCRAFT AND AIR LAUNCHED WEAPONS

Prepared by

Biswanath Jana

(**BISWANATH JANA**), Sc 'G'
Member- Secretary
Addl. Regional Director
RCMA(Materials), CEMILAC

Approved & Issued by

(**B SAHA**)
Chairman
REGIONAL DIRECTOR
RCMA(Materials), CEMILAC

CONTENTS

COMMITTEE

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1.	**Shri B Saha** Regional Director, RCMA(Material), Hyd.
Member Secretary	
2.	**Shri Biswanath Jana**, Sc-G, RCMA(Material), Hyd.
Members	
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4.	**Shri Raju D Navindgi** Sc-G & Director(Admin), O/o DG(AERO), Bengaluru
5.	**Dr Shrish S Kale** Sc-G, GD(Materials)-CEMILAC & Regional Director-RCMA(F&F), Bengaluru
6.	**Shri KV Ramagopal** Deputy IFA, MSS Cluster, O/o DG –MSS, Hyd.
7	**Shri K Palani Muthu** PScO, RDAQA(GW & M), **DGAQA,** C/o DRDL, Hyd.
8	**Shri M Srinivas Rao** SSO-I, MSQAA, C/o DRDL, Hyd.
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9	**Shri S Gopinath** OS & Prog Leader ARM, RCI, Hyd.
10	**Dr. JVR Sagar** OS & Prog Leader Air Launch Systems, DRDL, Hyd
11	**Shri CVS Sai Prasad** Sc-G & Director(Q & R), O/o DG(MSS), Hyd.
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12	**Dr. R K Rayudu** Sc/Engr-G, Airframe Directorate, ADA, Bengaluru
13	**Shri D Subramanya Shastry** Deputy General Manager(P&P/MS), HAL(F&F), Bengaluru
14	**Shri S Madhavan** DGM(DLE & IND), HAL(Engines Division), Bengaluru
15	**Shri N C Satpathy** AGM(Design), HAL(Koraput Division), Sunabeda

16	**Shri Rajeev Kumar** Sr Manager (Design-Indigenisation), HAL(Nashik), Nashik
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17	**Dr. B Sahoo** Regional Director, RCMA(Koraput), Sunabeda
18.	**Shri BS Mandloi** Sc-F, RCMA(Nashik), C/o HAL(Nashik Division),Nashik
Co-Opted Special Invitees Air Launched Weapons (ALWs)	
19.	**Ms. AVS Perina Devi** Sc-F & PD (Astra Mk-II, DRDL)
Co-Opted Special Invitees for Aircraft/ Aero-Engines	
20.	**Shri Vasanthraju C** Chief Manager (DLE & Indign), HAL(LCA-Tejas Division), Bengaluru
21.	**Mr. Chandru Fernando** Sc-D, GTRE, Bengaluru

EXECUTIVE SUMMARY

The materials required for manufacture of military aircraft/ aero-engines and air-launched weapons (ALWs) are strategic in nature and these are not only of various types but mostly associated with requirements of low volumes and highest quality. Quality, Consistency and Reliability are the inherent characteristics of Type Certified/ Approved materials. However, availability of type certified/ approved materials indigenously in time and cost effective way often becomes bottleneck and the concerned Project resorts to import the required materials or make use of non-type approved/ non-aero grade/ general engineering grade/ commercial grade materials. Such a situation leads to delay in executing the Project due to extended qualification testing which is otherwise unavoidable in order to meet the intended goal with safety and reliability.

DG(MSS), DRDO constituted a committee under the Chairmanship of Regional Director, RCMA(Materials), Hyderabad having members from Aero Cluster, Missile Cluster, IFA(MSS Cluster), Airworthiness Agencies and Users (i.e., HAL, ADA, etc.) of Airworthy Materials with a mandate to identify, support, approve and create an indigenous supply chain mechanism to meet the requirement of Type Approved materials timely and economically for country's various strategic aircraft/ aero-engines/ ALWs Programs. The committee had extensive deliberations among the members addressing the term of references set by DG(MSS). Committee also deliberated in detail to evolve a comprehensive 'Approach to use non-type approved/ non-aero grade/ commercial grade materials for ALWs ONLY' as it was one of the major concerns of MSS Cluster for execution of Projects in time.

Chapter-1 of this report contains background, constitution and terms of references of the committee.

Chapter-2 briefly presents aspects on airworthiness certification highlighting significance of type certification of materials, attributes of aerospace materials and methodology practiced in India for airworthiness certification of materials.

The committee collected large number of data from the concerned organizations requiring airworthy materials for country's strategic defence programs. The data contains information on present and future requirements of various materials, their present sources, approval status, details of materials certified/ provisionally cleared

by CEMILAC/ RCMAs, etc. which were analysed and presented in Chapter-3, 4, 5 & 6.

The detailed minutes of meetings conducted by the meeting provided in Chapter-7.

Finally, Chapter-8 of this report concludes highlighting the recommendations made by the committee based on the discussions had on various occasions with regard to following Terms of References.

(i) Consolidated material requirements (Present and for Next 5 Years) of various projects based on bill of materials (Page No.17 &18 and Appendix-6 & 7)

(ii) Grading of materials required based on criticality of usage (Appendix-6 & 7)

(iii) Identification of approved status of the materials required by the projects (Page No. 8, 9,10 & 19 and Appendix-5a, 5b, 6 & 7)

(iv) Identification of established Indian vendors for supply of type approved materials (Appendix-5a, 5b & 8 and Page No. 13, 14 &19)

(v) Criteria for approaching established Vendors (Page No.20)

(vi) Firming up terms and conditions for placing purchase orders by the projects for supply of type approved materials to ensure safety of the airborne stores. (Page No.20 & 21)

(vii) Creation of Material Bank (for Indian Sourced Materials and Foreign Materials) (Page No.21 & 22)

(iii) Indian Potential Vendors for Sources of Type Approved Materials (Page No.13 & 14 and Appendix-8)

(iv) Indian Testing Facilities: Established Sources/ Potential Sources (Page No.15)

(v) Use of Commercial Grade Materials for Air Launched Weapons ONLY (Page No.23, 24, 25 & 26)

(vi) "SELF-CERTIFICATION" Approach (Page No.27)

(vii) Reduction of Certification Time Cycle: Without sacrificing Quality & Safety (Page No.27, 28, 29 & 30)

CHAPTER – 1

1.0 INTRODUCTION

A large variety of structural materials - metallic and non-metallic types are required for fabrication of sub-systems/systems of Air Launched Weapons (ALWs) and Aero-engines/ Aircraft developed/ being developed and produced for country's military applications. As these airborne strategic systems are mostly manned and operate in extremely hostile environment, its safety and reliability are of prime importance. The components of the sub-systems/systems are accordingly designed to meet the intended requirements and those are often of complex shapes and require high cutting edge technologies for their realization. Accordingly, the required materials and manufacturing/ fabrication technologies should have best attributes and those are to be guaranteed through Type Approval (TA)/ Type Certification Process. In addition, their sources are also to be Type Approved to ensure Airworthiness and Supply with consistent quality.

The materials being strategic in nature are required in low volumes. Hence, availability of Type Approved materials in time and cost effective way often becomes bottleneck and the concerned Project resorts to import the required materials or make use of non-type approved/ non-aero grade/ general engineering grade/ commercial grade materials. Such a situation leads to delay in executing the Project due to extended qualification testing which is otherwise unavoidable in order to meet the intended goal with safety and reliability.

Under this perspective, as per the Secretary & Chairman – DRDO's directive, DG(MSS) vide Lr. No. DG-MSS/DPM/DHQ/CEMILAC dt. 16.09.2020 (**Appendix-1**) has constituted a committee under the Chairmanship of Shri B Saha, Regional Director, RCMA(Materials), Hyderabad with a mandate to identify, support, approve and create supply chain mechanism to meet the requirement of Type Approved materials timely and economically for country's various strategic aircraft and ALW Programs.

1.1 COMMITTEE CONSTITUTION

Structure of the committee along with member name, designation and affiliation is detailed in **Appendix-2**. The committee has representations from following Offices/ Organisations:

1. DG-MSS, Hyderabad
2. DG-Aero, Bengaluru
3. IFA(Missile Cluster), Hyderabad
4. RCI, Hyderabad
5. DRDL, Hyderabad
6. ADA, Bengaluru
7. GTRE, Bengaluru
8. HAL(F&F), Bengaluru
9. HAL(Engine), Bengaluru
10. HAL(LCA-Tejas), Bengaluru
11. HAL(ARDC), Bengaluru
12. HAL(Nashik)
13. HAL(Koraput)
14. CEMILAC, Bengaluru
15. RCMA(Nashik)
16. RCMA(Koraput)
17. RCMA(F&F), Bengaluru
18. RCMA(Materials), Hyderabad

1.2 TERMS OF REFERENCES OF THE COMMITTEE

1.2.1 The Terms of References as per the directive of DG-MSS letter are listed below.

(i) Consolidating the material requirements of various projects based on bill of materials

(ii) Grading of materials required based on criticality of usage

(iii) Exploring identification of approved status of the materials required by the projects

(iv) Identification of established Indian vendors for supply of type approved materials

(v) Finalisation of suitable criteria for approaching established Vendors

(vi) Firming up terms and conditions for placing purchase orders by the projects for supply of type approved materials to ensure safety of the airborne stores.

1.2.2 The following Terms of References listed below are also augmented by the Committee

(i) Use of Commercial Grade Materials for Air Launched Weapons ONLY

(ii) Material Requirements for next 5 Years by various Projects as per Proforma

(iii) Creation of Material Bank with Established Vendors of TA Materials

(iv) Identification of Potential Vendors who can be considered for Sources for Type Approved Materials

(v) (v)Identification of Testing Facilities: Established Sources/ Potential Sources

(vi) Use of Commercial Grade Materials for Air Launched Weapons ONLY

(vii) Initiation of "SELF-CERTIFICATION" Approach involving Internal R&QA for Class-II & Class-III components:

(viii) Mechanism to reduce Certification Time Cycle: Without sacrificing Quality & Safety

CHAPTER – 2

2.0 AIRWORTHINESS CERTIFICATION

2.1 Airworthiness

Airworthiness is defined as "The continued capability of the Air Systems and Airborne Stores to perform satisfactorily and fulfill mission requirements, throughout the specified life in the specified environments with acceptable levels of safety and reliability". The acceptable levels are mutually agreed between Users, Main Contractor/ Designer and Airworthiness Agencies.

2.2 Airworthiness Certification of Systems/ Components/ Materials

The requirement of low probability of failure versus a hostile service environment, very high stresses, restrictions on weight and size indicated by users/designers, and stringent operational requirements necessitate a high degree of consistency in the behavior of an aerospace system/ component/ material. A systematic approach/method is adopted and practiced in order to minimize variability and maintain a high degree of consistency within a narrow range of property requirements in a particular type of Aerospace System/ Component/ Process/ Material. This approach is called as "Airworthiness Certification/ Type Testing/ Type Evaluation".

Once a system, material, manufacturing process and component fabrication technique has undergone airworthiness certification, it can be assured that such System/ Component/ Process/ Material will always perform in similar way as per the requirements under the intended operational conditions and fulfill the desired purpose for the specified period of time.

2.3 Significance of Type Certification/ Evaluation of Materials

Type certification of materials implies establishing supply of airworthy materials (i.e. feedstock such as bars, plates, sheets, etc., near-net parts using casting, closed die forgings, etc.) manufactured as per the "Documented Frozen Process" route ensuring *consistency in the required properties within a product itself, among the products in a batch and also between the batches*. When a PRODUCT is Type Certified/ Approved, the PROCESS used to manufacture that product, the

PLANT facilities (i.e., Equipment and Personnel) used for manufacturing the product are also CERTIFIED along with that product. *Concurrent Certification/ Approval of 3Ps in combination i.e., PRODUCT – PROCESS - PLANT* ensures supply of a particular product type with required quality *consistently*. This approach is GOLBALLY practiced for certification of materials for strategic applications and thus the 'FORGIVENESS' property of aerospace materials is enhanced by overcoming possible design and manufacturing inadequacies through their defect tolerance.

Material or Metallurgical Evaluation is the first step in airworthiness type certification of airborne systems. The success of certification therefore mostly depends on the consistency in material properties (within a narrow band) that determine the safety limits when designing a component. Value-wise, the cost of a complete material/ metallurgical evaluation is relatively inexpensive compared to the testing of components. Further, full-scale testing of a system is much more expensive than component testing.

Since each stage of evaluation during certification is progressively costly, it is vital that repetition of type certification be kept to a minimum to the extent possible. In this context, it is observed that material/ metallurgical evaluation and its documentation is of primary importance in certification, since it is the first quality deciding factor at a significantly lower cost.

2.4 Attributes of Aerospace Materials

In contrast to materials of general engineering grade, Aerospace materials have tighter ranges of constituent alloying elements, better control of a large number of impurity and trace elements, lower acceptance limits of detrimental elements, higher mechanical property limits, stringent metallographic acceptance norms, and comprehensive checks on real time (both static and dynamic) properties (tensile, fracture toughness, fatigue, etc.). As stringent control over quality of raw materials used and processing parameters are exercised during manufacturing/production, the scatter band in the properties of aerospace materials is significantly low compared to non-type approved/ general engineering/ commercial/ non-aero grade materials.

2.5 Methodology for Airworthiness Certification of Materials practices in India for Military Applications

During development of a new material or indigenization of an existing material for aerospace applications, certification is a necessarily complex and thorough procedure, consisting of many steps and stages. Whenever there is (or appears to be) a new material requirement for the Indian Air Force or any aerospace development agency, the general procedure is as follows:

(i) The aircraft operator/agency approaches an RCMA/ CEMILAC, and based on the RCMA's advice or any other appropriate criteria the operator selects a potential supplier or manufacturer. After assessing their capabilities by CEMILAC/ DGAQA and based on the feedback of aircraft operator/ agency, the RCMA circulates a "Development Test Schedule(DTS) / Type Test Schedule (TTS)" for a Local Type Certification Committee (LTCC) meeting chaired by the Regional Director of the RCMA. Members of the LTCC include the relevant agencies and the supplier or manufacturer and operator. After the LTCC meeting the RCMA finalizes the DTS/TTS, which is the final qualification document for the material/component.

(ii) There are two stages involved in the approval of a supplier or manufacturer: approval of the supplier or manufacturer itself, and approval of the material. Both tasks are carried out by teams from CEMILAC and the DGAQA. Approval of the material requires satisfactory conformance to tests typically from three heats/ batches of material and verification of compliance with the DTS/TTS. The RCMA then issues Provisional Clearances (PCs) for each batch. Under Concurrent Development/ Indigenization and Certification, each batch is cleared under PC mode to enhance the progress of the project.

(iii) After the issuance of a suitable number of PCs, depending upon RCMA requirements, the supplier or manufacturer prepare the Type Record (TR) in consultation with RCMA. The RCMA then forwards the TR along with a recommendation to CEMILAC, in order to obtain Type Approval (TA). Once the TA is issued, the DGAQA prepare the Release Specification (RS)

taking inputs from RCMA and issue it to the supplier or manufacturer for regular production. The production route is also sealed by the RCMA.

(iv) During regular production, all materials and components processed according to the sealed production route are released by the DGAQA, as per RS, and copies of the Test Certificates are forwarded to the RCMA.

(v) Any deviations encountered during series production are to be referred by the supplier or manufacturer to the DGAQA, and via the DGAQA to the RCMA. Based on the RCMA's advice on production modifications, the supplier or manufacturer prepares Revised Process Sheet (RPS) for approval by the RCMA.

(vi) The TA issued to the supplier or manufacturer is renewed periodically by CEMILAC, contingent upon a mandatory re-application from the supplier or manufacturer and a subsequent recommendation from the concerned RCMA.

For aerospace usage the approval of materials to aid the designers is carried out to provide the following categories of properties, even for known materials produced at a second source:

- Zero-Time Quantitative Evaluation of materials based on available national/international standards, mainly to evaluate mechanical properties: tensile strength, impact strength, fracture toughness.
- Real time static properties: creep strength, rupture strength, structural stability.
- Real time dynamic properties: high- and low-cycle fatigue, crack propagation behavior.

A detailed illustration of the certification methodology is given in **Appendix-3**.

A copy of the ppt slides highlighting the presentation made on "About airworthiness certification of materials" in 1st meeting of the committee by the Member-Secretary is placed at **Appendix-4**.

CHAPTER – 3

3.0 AIRWORTHINESS CERTIFICATION ACTIVITIES OF MATERIALS AT CEMILAC

Certification of materials for airborne applications are coordinated by the Material RCMAs under umbrella of CEMILAC, Bengaluru. There are two RCMAs, namely RCMA(Materials), Hyderabad and RCMA(F&F), Bengaluru who provide airworthiness certification supports on material requirements to all kinds of country's military aircraft/ aero-engines and air launched weapon programs. CEMILAC allocate material related tasks to both RCMAs depending on expertise and geographical feasibility.

RCMA(Materials) is currently involved in certifying metallic millforms, metallic components such as castings, forgings, tubes, weld joints, components made of composites such as carbon-carbon aircraft brake discs, CFRP wings & fins and ceramic radomes of air launched weapons, coatings of different kinds, etc. Whereas RCMA(F&F) is dealing with un/semi/finished metallic components, non-metallic materials and components, consumables and standard parts.

Till date, TYPE APPROVALS issued by CEMILAC for various airborne materials are depicted in **Fig.1a** and detailed **in Appendix-5a.** The details of TYPE APPROVALS coordinated by RCMA(F&F) are given in Appendix-5a and depicted in **Fig.1b**. TYPE APPROVALS and PROVISIONAL CLEARANCES coordinated by RCMA(Materials) are also depicted in **Fig.1c & Fig.1d** respectively and those are also detailed in **Appendix-5b** which contains information on material, form & size, manufacturing firm and approval status.

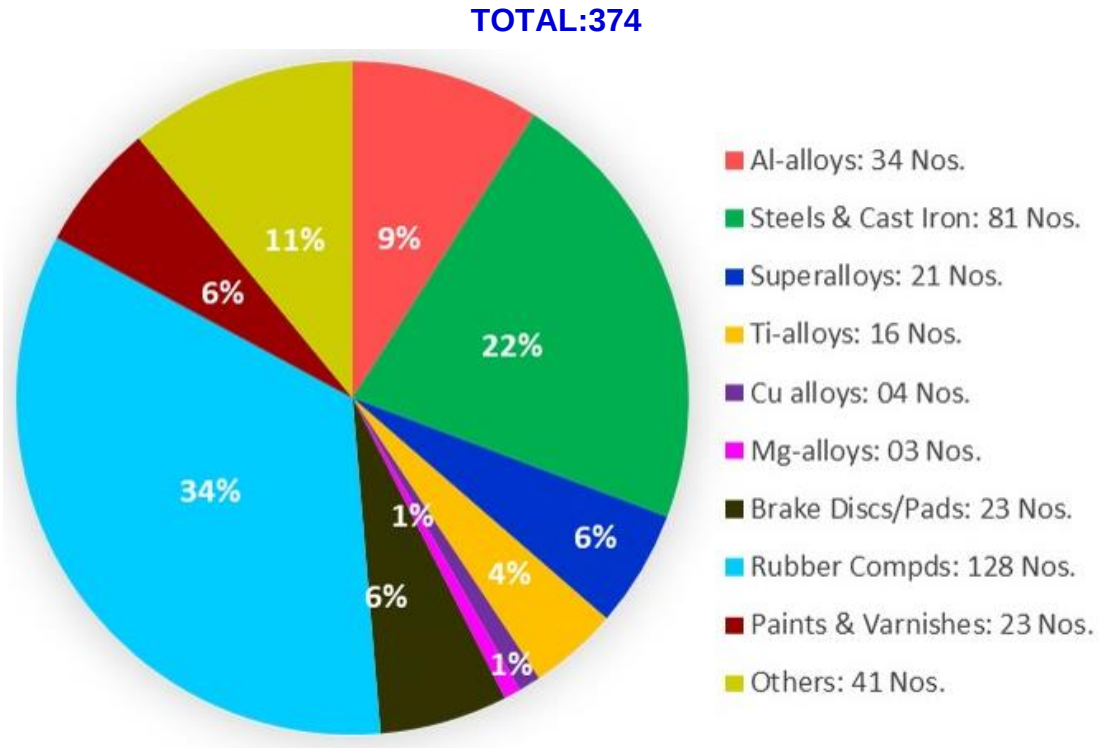


Fig.1a **Type Approvals issued by CEMILAC for various Air-borne Materials**

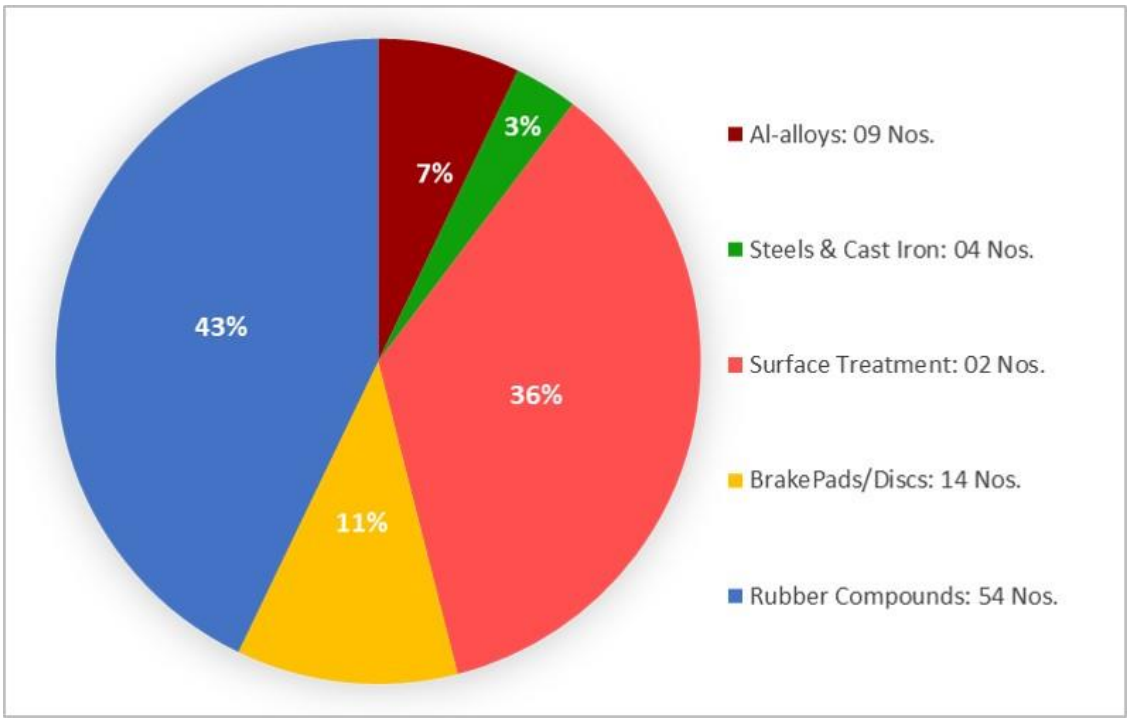


Fig.1b **Type Approvals coordinated by RCMA(F&F)**

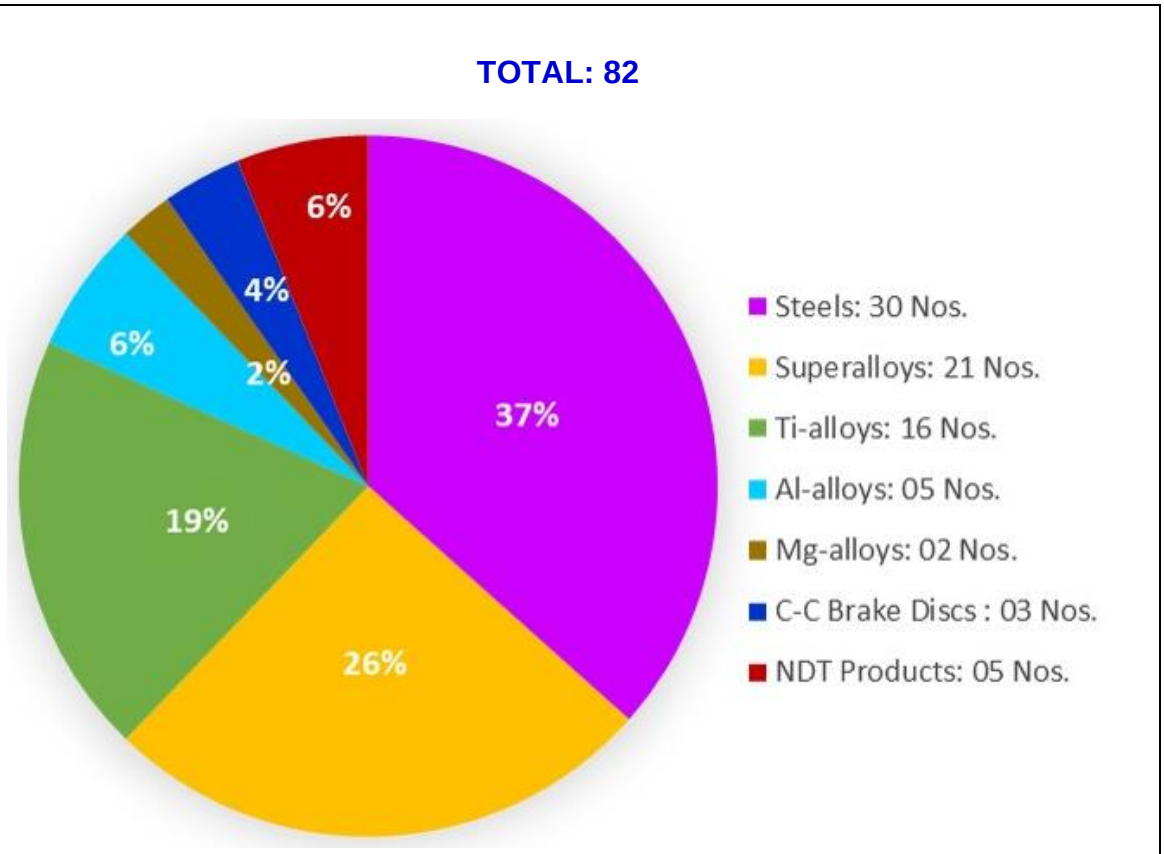


Fig.1c **Type Approvals coordinated by RCMA(Materials)**

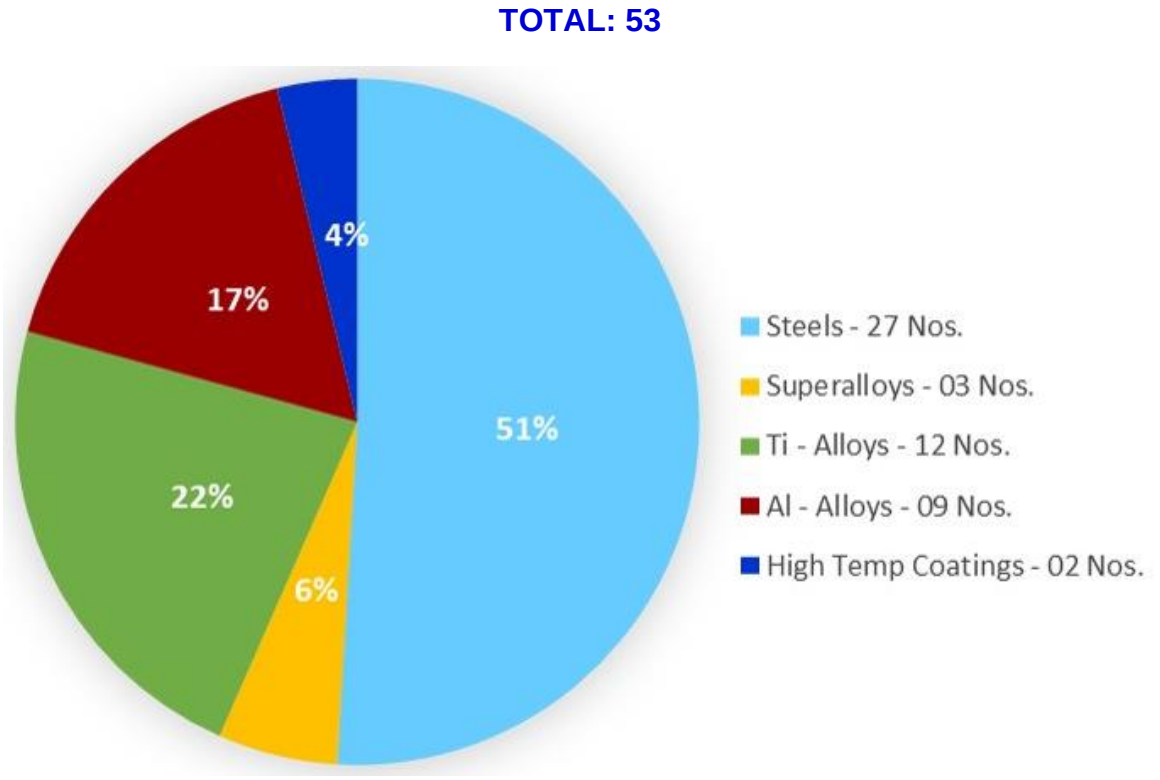


Fig.1d **Provisional Clearances issued by RCMA(Materials)**

CHAPTER – 4

4.0 MATERIAL REQUIREMENTS FOR VARIOUS PROJECTS

4.1 AIRCRAFT/ AERO-ENGINES

Requirements of materials projected by the Labs/ Organizations such as GTRE, HAL(F&F), HAL(Engines), HAL(LCA-Tejas), HAL(ARDC), HAL(Koraput), HAL(Nashik), CABS, ADE are detailed in **Appendix-6** which contains information on material, form & size, present requirements (Qty) & source, requirements for next 5 years and their approval status. Number of metallic materials/ alloys of various type required for country's various aero-engines/ aircraft programs are summarized in Fig.2.

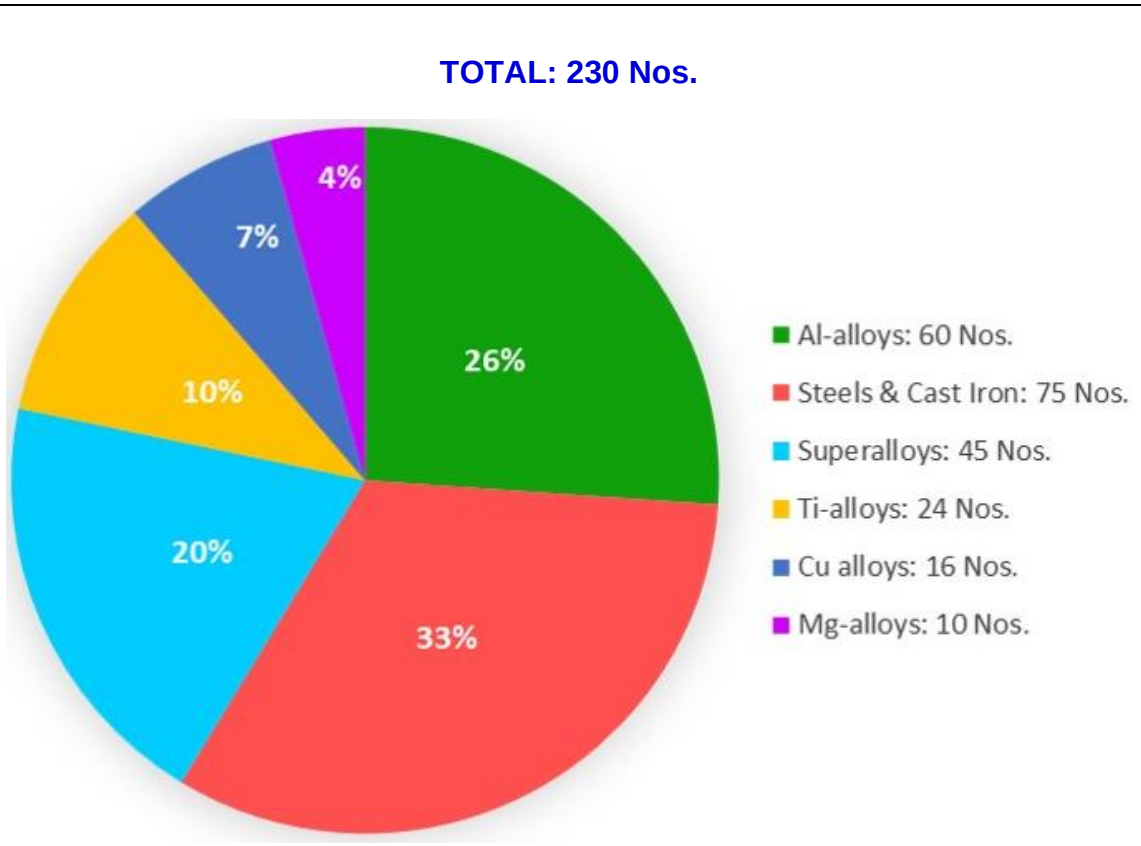


Fig.2 **Type and Number of Metallic Materials required for Country's various Aero-engines/ Aircraft Programs**

4.2 AIR LAUNCHED WEAPONS

Requirements of materials projected by various projects of ALWs such as ASTRA Mk-II, Rudram-II, RudraM-III, NGARM, LRGB & SAWW are detailed in **Appendix-7** which contains information on material, form & size, present requirements (Qty) & source, requirements for next 5 years and their approval status. Number of metallic materials/ alloys of various types required for country's various ALW programs are summarized in **Fig.3**.

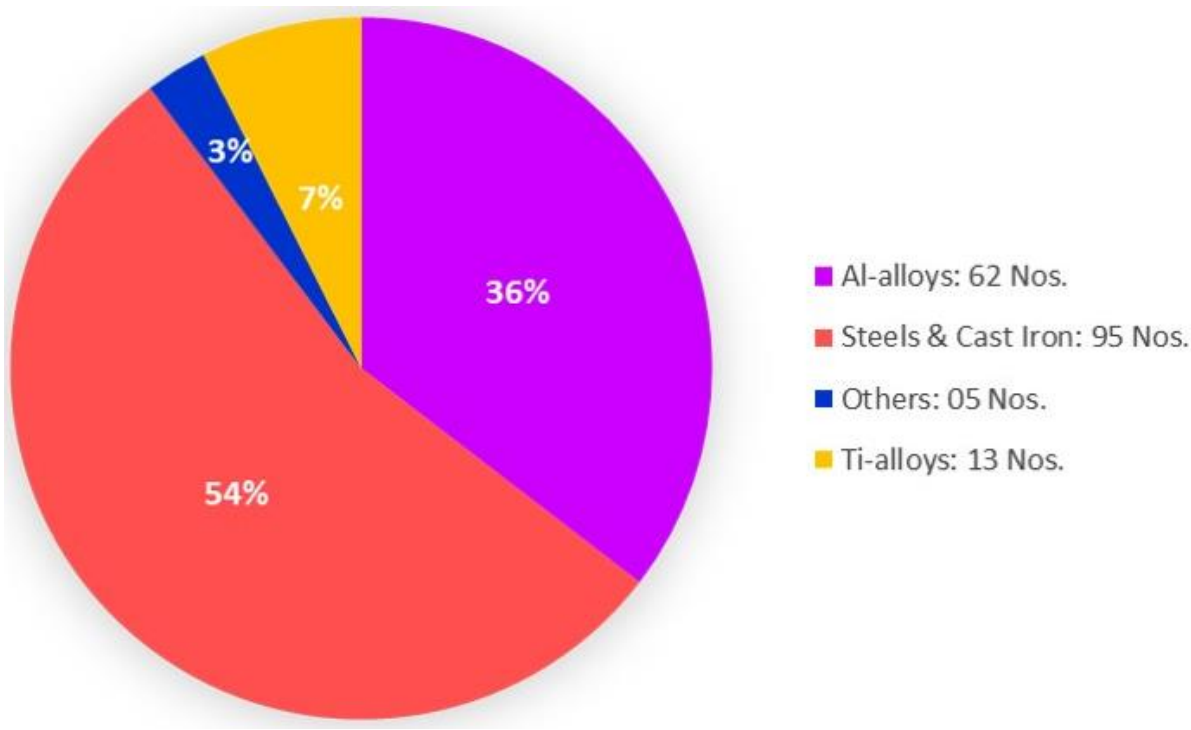


Fig.3 **Type and Number of Metallic Materials required for Country's various ALW Programs**

CHAPTER – 5

5.0 EXISTING INDIAN MANUFACTURING FACILITIES

(Type Approved/ Potential Non-Type Approved Manufacturing Facilities)

5.1 MILLFORMS (Bars, Plates, Sheets, Rods, Wires, Cast Sticks, etc.)

Details are given at Appendix-8.

5.2 FORGINGS

A list of Potential Forging Plants in India is given below.

	Plant/Location		Press/Hammer Capacity(Ton)
1.	L & T, Hazira	-	7000T/ 9000T
2.	Sarghri Forge	-	4000T/ 4500T
3.	Bay Forge	-	3000T
4.	Bharat Forge, Pune	-	4000T
5.	Saarlona, Pune	-	1600T
6.	CHW	-	3100T/ 3650T
7.	MVSCO	-	1000T
8.	Saurabh	-	2000T
9.	Western India	-	1600T
10.	Hindustan Forge	-	1200T
11.	Sunil Forge	-	2500T
12.	Vipras	-	1000T
13.	Vikranth	-	10T-(Hammer)
14.	Mackeil	-	3500T
15.	Star Wire	-	2000T
16.	Viraj	-	2500T
17.	Metal Forge	-	2500T
18.	Prabath Forge	-	1250T
	Government Sector		
19.	FGF, Kanpur	-	1600T
20.	MSF, Ishapore	-	1600T
21.	VISL, Bhadravathi	-	1600T

22.	MIDHANI, Hyderabad	-	1500T, 6000T
23.	BHEL, Haridawar	-	2650T, 7500T
24.	HEC, Ranchi	-	1000T
25.	SIFL, Kerala	-	1200T
New Project (Working in Process)			
26.	PGF, Kanpur	-	3000T
27.	NFC, Hyderabad	-	1600T

5.3 CASTINGS

A list of facilities in India for Investment Casting for aerospace applications is given below.

Sl.No	Vendor Name	Location
1.	DMRL	Kanchanbagh, Hyderabad
2.	MIDHANI	Kanchanbagh, Hyderabad
3.	HAL(F&F)	Vimanapura, Bengaluru
4.	HAL(Koraput)	Sunabeda, Koraput
5.	Investment & Precision Casting Ltd.	Bhavnagar, Gujrat
6.	PTC Industries Ltd.	Lucknow
7.	Dabir Precitech Pvt Ltd.,	Ambernath, Maharashtra
8.	Tamboli Casting Ltd.	Bhavnagar, Gujrat
9.	Turbo Cast (India) Pvt. Ltd.	Rajkot
10.	Captain Technocast Ltd.	Rajkot
11.	MPH Precision Castings Ltd.	Gujrat

5.4 FLOW FORMING

A list of Flow Forming facilities available in India is given below.

Sl. No	Vendor Name	Location	Max. Dia
1.	Bharat Dynamics Ltd.	Kanchanbagh, Hyderabad	600 mm Ø 750 mm Ø
2.	Bharat Dynamics Ltd.	Bhanur, Hyderabad	750 mm Ø
3.	Valeth Hightech Composites Pvt. Ltd.	Chennai & Hyderabad	650 mm Ø
4.	DRDL	Hyderabad	650 mm Ø
5.	HYT Engineering Company Pvt. Ltd.	Pimpri Chinchwad, Maharashtra	650 mm Ø 450 mm Ø 500 mm Ø 350 mm Ø
6.	Paras Defense & Space Technology Ltd.	Mumbai	500 mm Ø

CHAPTER – 6

6.0 EXISTING INDIAN TEST FACILITIES

A List of Vendors/ Laboratories RCMA(Materials) is associated with for Certification Testing Activities is given below.

1.	M/s Midhani, Hyderabad	25.	M/s Rachamallu Forgings (P) Ltd Hyd.
2.	M/s Kalyani Carpenter, Pune	26.	M/s Deccan Smith (P) Ltd, Hyd.
3.	M/s. Rohit Super Forgings (P) Ltd, Hyd.	27.	M/s IPCL, Bharnagar, Gujarat
4.	M/s Manjira Machine Builders (P) Ltd, Hyd.	28.	M/s HINDAL Co, Aurangabad
5.`	Nuclear Fuel Complex, Hyderabad	29.	M/s HINDAL Co, Renukoot
6.	M/s PTC Industries Ltd, Lucknow	30.	M/s HINDAL Co, Heerakud
7.	M/s SEC Industries Ltd, Hyderabad.	31.	M/s Fine Forge (P) Ltd Hyderabad
8.	M/s VEM Technology, Hyderabad.	32.	M/s. Team, Chennai
9.	M/s High Tech Hydraulics Ltd, Hyderabad.	33.	M/s. KMML, Kerala
10.	M/s L & T, Coimbatore	34.	ARCI, Hyderabad.
11.	M/s Walchand Nagar Industries Ltd.	35.	M/s. Bharat Forge Limited, Pune
12.	M/s Star Wire India Ltd, New Delhi	36.	M/s. BISS, Bengaluru
13.	M/s Valeth High Tech Compisites(P) Ltd, Hyd.	37.	M/s. Element Com, Mumbai
14.	DMRL, Hyderabad	38.	M/s. Subodh Technology, Mumbai
15.	DRDL, Hyderabad	39.	M/s. NCCCM, Hyderabad
16.	HTCC, ASL, Hyderabad	40.	M/s. HAL, Koraput
17.	M/s. Graphite India Limited, Nasik.	41.	M/s. HAL, Nashik
18.	M/s. Sri Asha Forgings (P) Ltd Hyderabad	42.	AMTL, Hyderabad
19.	M/s. Mailam India Ltd.	43.	M/s. Honavar Electrodes Pvt Ltd.
20.	M/s. D & H Secheron Electrodes Pvt Ltd.	44.	M/s. Gee Ltd.
21.	M/s. KAIPL	45.	M/s. LTSSHF
22.	M/s. YHEPL	46.	M/s. Essar Steel (AMNSI)
23.	M/s. SAIL (RSP, Bhilai, Durgapur)	47.	M/s. JSPL
24.	NMRL Ambernath	48.	

CHAPTER – 7

7.0 DETAILS OF INTERACTIONS AMONG COMMITTEE MEMBERS

The committee had three interaction meetings among the members. The 1st meeting was on 9th November 2020, 2nd meeting on 3rd December 2020 and 3rd meeting on 22nd December 2020.

The minutes of 1st meeting is enclosed at Appendix-9a & 9b. The minutes of 2nd & 3rd meetings is enclosed at Appendix-10.

CHAPTER – 8

8.0 CONCLUSIONS/ RECOMMENDATIONS OF THE COMMITTEE

8.1 With respect to the Terms of References (TOR-1 to TOR-6) as per the directive of DG-MSS

8.1.1 Material Requirements for Country's Aircraft/Aero-engine and ALW Programs

Material requirements as furnished by various organisations for their respective projects has been consolidated in this report for metallic alloys only. Table-1 given below provides at a glance the summary of present and future (i.e. next 5 years) tonnage requirements of Steels, Titanium alloys, Superalloys, Aluminium alloys, Copper alloys and other alloys (such as Aluminium Bronze, Lead Bronze & Phospho Bronze) for country's various projects of aircraft/ aero-engines and air launched weapons.

Table-1 Quantity of various types of metallic materials required presently and in next 5 years for country's aircraft/ aero-engines and air launched weapon programs

S. No.	*Metallic Alloys*	*Requirements in Quantity (Ton)*			
		Aircraft/ Aero-engines		***Air Launched Weapons***	
		Present	**Next 5 Yrs**	**Present**	**Next 5 Yrs**
1.	Steels	**110**	**810**	**83**	**314**
2.	Titanium Alloys	**64**	**307**	**12**	**20**
3.	Superalloys	**27**	**261**	**-**	**-**
4.	Aluminium Alloys	**64**	**727**	**25**	**99**
5.	Copper Alloys	**0.4**	**9**	**0.5**	**2**
6.	Other Alloys • Al-Bronze • Pb-Bronze • P- Bronze	 **0.013** **0.018** **0.03**	 **0.10** **0.24** **0.075**		

Project-wise break-up for requirement of metallic materials is illustrated in Table-2 below.

Varieties of steels, superalloys, titanium alloys, aluminium alloys, copper alloys and other metallic alloys being used along with their present sources for various aircraft/ aero-engines and air launched weapon programs are detailed in Appendix- 6 & 7 respectively.

Table-2 Project wise break-up on quantity of various types of metallic materials required presently and in next 5 years for country's aircraft/ aero-engines and air launched weapon programs

S. No.	Material	Quantity, kg					
		Aircraft/ Aero-engines			Air Launched Weapons		
		Project	Present	Future (Next 5 Yrs)	Project	Present	Future (Next 5 Yrs)
1	**Steels**	HAL(F&F)	54125	116875	ASTRA Mk-II	13228	39683
		HAL(Koraput)	-	159	SAAW	-	13468
		HAL(LCA)	2921	242443	NGARM	1204	74476
		HAL(Engines)	208	-	RudraM-III	61200	183500
		HAL(Nashik)	8086	40442	RudraM-II	7195	# (Vendor Scope)
		CABS	64	130	LRGB	-	2888
		GTRE-MG	1200	1079			
		GTRE-STFE	26538	367533			
		GTRE-KDE	16496	41242			
	Total		**1,09,638**	**8,09,903**		**82,827**	**3,14,015**
2	**Titanium Alloys**	HAL(F&F)	17950	81350	ASTRA Mk-II	2709	10679
		HAL(Koraput)	-	162	SAAW	-	-
		HAL(LCA)	732	60728	NGARM	-	-
		HAL(Nashik)	3988	19940	RudraM-III	3000	9000
		CABS	13	5223	RudraM-II	5970	# (Vendor Scope)
		GTRE-MG	7033	3108	LRGB	-	210
		GTRE-STFE	4612	61515			
		GTRE-KDE	29671	74178			
	Total		**63,999**	**3,06,204**		**11,679**	**19,889**
3	**Ni-base/ Co-base/ Fe-base Superalloys**	HAL(F&F)	2500	8500			
		HAL(Koraput)	-	8688			
		HAL(LCA)	42	3449			
		HAL(Engines)	158	-			
		GTRE-MG	3676	11052			
		GTRE-STFE	2397	183034			
		GTRE-KDE	18300	45750			
	Total		**27,073**	**2,60,473**			
4	**Aluminium Alloys**	HAL(F&F)	36750	181950	ASTRA Mk-II	7835	15911
		HAL(LCA)	504	288350	SAAW	-	15763
		HAL(Engines)	58	-	NGARM	4243	39995
		HAL(Nashik)	22505	112530	RudraM-III	8000	18000
		CABS	2617	95754	RudraM-II	4000	# (Vendor Scope)
		GTRE-MG	0	150	LRGB	447	9116
		GTRE-STFE	975	47796			
	Total		**63,409**	**7,26,530**		**24,525**	**98,785**
5	**Copper Alloys**	HAL(LCA)	7	595	RudraM-III Cu-W alloy	500	2000
		HAL(Engines	0.1				
		HAL(Nashik)	341	1705			
		GTRE-STFE	46	6407			
	Total		**394.1**	**8,707**		**500**	**2000**
5	**Other Alloys**	HAL(LCA) • Al-Bronze	 11	 900			
		GTRE-STFE • Lead Bronze	 18	 237			
		GTRE-KDE • Al-Bronze • P-Bronze	 2 30	 5 75			

8.1.2 *Grading of materials required based on criticality of usage*

The required materials have been graded based on criticality of end use of the components made out of these materials and it is as per the information provided by respective organisations/ projects. (Refer **Appendix – 6 & 7**).

8.1.3 *Exploring Identification of approval status of the materials required by the projects*

The number of Type Approvals issued by CEMILAC and co-ordinated by concerned RCMAs for various kinds of aeronautical materials is summarised below in Table-3. The approval status of the metallic materials required for various aircraft/ aeroengines and air launched projects are also detailed in Appendix-**6 & 7** respectively.

Table-3 *No. of Type Approvals Co-ordinated by RCMAs for various kinds of Aeronautical Materials*
[Grand Total: 374]

RCMA(Materials)			**RCMA(Aircraft)**			**RCMA(Nashik)**			**RCMA(Koraput)**		
Steels	:	30	Steels	:	02	Steels	:	43	Steels	:	02
Ti-Alloys	:	16	Al-Alloys	:	02	Al-Alloys	:	14	Al-Alloys	:	04
Superalloys	:	21	Brake Pads	:	02	Cu-Alloys	:	02	Cu-Alloys	:	02
Al-Alloys	:	05	Rubber Compounds	:	02	Rubber Compounds	:	34	Mg-Alloy	:	01
Mg-Alloys	:	02	Paint & Varnishes	:	13	Brake Pads	:	03	Rubber Compounds	:	26
C-C Brake Discs	:	03	Non-metallic	:	10	Non-metallic	:	10	Non-metallic	:	05
NDT Products	:	05				Paint & Varnishes	:	03	Paint & Varnishes	:	06
						Others	:	03			
Total	*:*	*82*	*Total*	*:*	*31*	*Total*	*:*	*112*	*Total*	*:*	*46*
RCMA(F&F)			**RCMA(Kanpur)**			**RCMA(Helicopter)**			**RCMA(Lucknow)**		
Rubber Compounds	:	55	Rubber Compounds	:	06	Rubber Compounds	:	01	Brake Pads	:	01
Steels	:	04	Paint & Varnishes	:	01	Non-metallic	:	03	Rubber Compounds	:	03
Al-Alloys	:	09	Non-metallic	:	01						
Brake Pads	:	14									
Others	:	02	*Total*	*:*	*08*	*Total*	*:*	*04*	*Total*	*:*	*04*
			RCMA(Hyd)			**RCMA(Engines)**			**RCMA(Chandigarh)**		
			Non-metallic	:	01	Non-metallic	:	01	Rubber Compounds	:	01
Total	*:*	*84*	*Total*	*:*	*01*	*Total*	*:*	*01*	*Total*	*:*	*01*

8.1.4 *Identification of established Indian vendors for supply of type approved materials*

The details of established Indian vendors for supply of metallic materials (Type approved/ Provisionally Cleared) have been provided in **Appendix-8**. Further, information on potential Indian vendors have been compiled in **Chapter-5 & 6**.

8.1.5 *Criteria for Approaching Established Vendors*

The following criteria are recommended.

(a) Single Tender if there is only one source

(b) Limited Tender if there are more than one source

(c) Time Schedule for Delivery

(d) Capability of undertaking long term and dynamic testing such as Fatigue, Creep, Stress Rupture, SCC, etc.

(e) Cost

8.1.6 *Terms and Conditions for Placing Purchase Orders by Projects for Supply of Type Approved Materials to Ensure Safety of Airborne Stores*

It is recommended that Expression of Interest (EOI) is to be published for sourcing Indian Vendors (for supply of Indigenous materials) – with an objective to have Rate Contract (RC) i.e., multiple vendors for supply of same category type approved material on L1 rate. In order to do so, following are suggested.

a) Obtain in-principle approval from Secretary-DRDO (since many labs across clusters involved or getting benefited from this outcome)

b) A list of materials [Category wise (Metals/ Non-metals/ Composites)] is to be prepared

c) Obtain firm commitments from Labs (Project wise) and work out the total quantity (material category wise) required to be purchased

d) EOI for each category of materials is to be published

e) Strict vendor qualification criteria (Technical grounds and Financial grounds as per CVC guidelines) to be used for filtering the vendors. CEMILAC/ RCMAs is to extend supports for such vendor qualification criteria as per requirement of certification

f) These EOIs will be used for establishing vendors with Rates for such tendered materials (rate for first year, rate for 2nd year with fixed/ floating/ escalation, etc.) - thereby Rate Contract is established. Labs with this RC can place their orders directly quoting this RC.

g) RCMAs is to provide certification services for the selected vendors along with RC. RCMAs is also to extend re-certification process based on necessity for the same vendors who are all in the RC list.

8.2 With respect to Additional Points deliberated by the Committee

8.2.1 Material requirements for next 5 Years by various programs

Consolidated requirements of various metallic materials required for next 5 years as furnished by respective organisations/ projects have been summarised in Table-1 & 2 referred above and detailed in Appendix **- 6 & 7**.

8.2.2 Creation of material bank with established vendors of Type Approved (TA) materials

The proposal of vendor such as M/s MIDHANI, Hyd and anticipated audit related issues were deliberated. Accordingly, following guidelines were arrived at in order create material bank for Foreign sourced and Indian sourced materials.

8.2.2.1 Material Bank for Indian Sourced materials

8.2.2.1.1 Obtain in-principle approval from Secretary-DRDO (since many labs across clusters involved or getting benefited from this outcome)

8.2.2.1.2 List out the Indian sourced materials of each category (Metals/ Non-Metals/ Composites etc.)

8.2.2.1.3 Obtain firm commitments from Labs (Project wise) and work out the total quantity required to be purchased

8.2.2.1.4 Publish EOI for obtaining responses from Indian Vendors (with an objective to filter the vendors)

8.2.2.1.5 Identify an owner for this material bank (the lab which uses most of the material sourced from India – may be identified)

8.2.2.1.6 The identified lab to make procurement under LBM-Limited Bidding Mode (with list of vendors qualified in the above EOI).

8.2.2.1.7 The identified lab will distribute the materials to the other labs based on their original projection.

8.2.2.1.8 The projects to deduct the cost of material being taken from material bank in their respective project's cost (AUDIT point of view).

8.2.2.2 Material Bank for Foreign materials

8.2.2.2.1 Obtain in-principle approval from Secretary-DRDO (since many labs across clusters involved or getting benefited from this outcome)

8.2.2.2.2 List out Foreign materials

8.2.2.2.3 Obtain firm commitments from Labs (Project wise) and work out the total quantity required to be purchased

8.2.2.2.4 First, publish EOI for obtaining any responses from Indian Vendors

8.2.2.2.5 If NIL response from Indian Vendors in the above EOI, obtain permission from Dept of Expenditure, MoF for floating GTE (Global Tender Enquiry).

8.2.2.2.6 Identify an owner for this material bank (the lab which uses most of the material sourced from Foreign – may be identified)

8.2.2.2.7 The identified lab to make procurement under GTE.

8.2.2.2.8 The identified lab will distribute the materials to the other labs based on their original projection.

8.2.2.2.9 The projects to deduct the cost of material being taken from material bank in their respective project's cost ((AUDIT point of view).

8.2.3 Identification of Potential Vendors for Type Approved Materials

A list of probable vendors who can manufacture materials meeting airworthiness requirements is detailed in **Chapter-5**. However, those vendors should be selected based on Strict vendor qualification criteria (Technical grounds and Financial grounds as per CVC guidelines). The vendor's technical capability to produce aero-quality products shall be judged giving main emphasis on

a) Production Facilities
b) Performance & Reliability of the Equipment
c) System of Monitoring Operations
d) Control check systems viz., leak rate of vacuum induction furnace etc.

e) Test Laboratory Facilities

f) Quality Control System

g) Discipline of Checks on Equipments & Control Systems

h) Handling of non-conformity in Production

i) System of studying of Specification

j) Filing & documentation practices

8.2.4 *Identification of Testing Facilities: Established Sources/ Potential Sources*

A list of established/probable testing facilities is detailed in **Chapter-6**. The technical capability of potential test facilities shall be judged giving main emphasis on

(a) Accreditation (NABL, NADCAP, etc.) or Approval by DGAQA

(b) Use of qualified skilled manpower

(c) Test facilities

(d) Familiarity to National and International Test Methods

(e) Calibration

(f) Data Interpretation

(g) Record Maintenance

(h) Knowledge on preserving test specimens before and after test, etc.

8.2.5 *Use of Non-Type Approved/ Non-Aero Grade/ General Engineering Grade/ Commercial Grade Materials in Air Launched Weapons ONLY*

Use of non-type approved/non-aero grade/ general engineering grade/ commercial grade materials is not recommended for applications in Aircraft and Aero-Engines. However, **the same is recommended for Air Launched Weapons (ALWs) only** under the category as detailed below.

8.2.5.1 Materials for Flight Safety Critical(C1) Class Components of ALWs:

It is preferable & highly recommended to use Type Approved materials for C1 class components. On the event of unavailability/ unacceptable delivery schedule, the ALW projects may use non-type approved/ non-aero grade/ general engineering grade/ commercial grade materials fulfilling the conditions detailed below.

8.2.5.1.1 Material shall be obtained against generic engineering grade specifications (AMS, ASTM, BS, etc.) and it should meet the design requirements of ALW projects (as per design criteria proforma countersigned by platform RCMA) and also the requirements of the Type Test Schedule(TTS) issued by RCMA(Materials) which covers Quality Assurance Plan (QAP) also.

8.2.5.1.2 The TTS shall be evolved conducting Local Type Certification Committee (LTCC) involving all the stake holders namely Project, Designer, User and R&QA of ALW Projects, DGAQA/MSQAA, Material Manufacturer (if known), Material RCMA, Platform RCMA, etc.

8.2.5.1.3 *Material manufactured against General Engineering Specification by Indian Firm (Non-Type Approved Source) and it is purchased directly from the manufacturing Firm*

8.2.5.1.3.1 Material properties should meet the design requirements of ALW projects (as per design criteria proforma certified by platform RCMA) and also the requirements of the Type Test Schedule(TTS) issued by RCMA(Materials) which covers Quality Assurance Plan (QAP) also.

8.2.5.1.3.2 If the firm meets the requirements of DGAQA/ MSQAA for ensuring quality and meet the requirements of TTS issued by RCMA(MAT) and supply the material consistently for 3 batches, the firm will be considered formally for Type Approval for that particular grade. Otherwise, batch clearance will be accorded.

8.2.5.1.4 *Material sourced through Traders/Agents (Foreign/ Indian Materials) holding valid License only from OEM*

8.2.5.1.4.1 Approval by name to the Trader/ Agent to supply materials manufactured by Indian Firm/ Foreign Firm will NOT be considered by CEMILAC.

8.2.5.1.4.2 ONETIME CLEARANCE/ APPROVAL will be accorded by RCMA(Materials) on vetting from DGAQA & MSQAA for the

particular batch/lot of a material purchased through Trader having a valid license of the OEM.

8.2.5.1.4.3 Clearance will be given to use for C1 class components/ items if traceability of the materials purchased exists in all respects such as Test Release Certificate, COC, Product Identification Tag, etc. as per the requirements of airworthiness agencies. If no traceability exists, the total material lot put up for clearance will be subjected to 100% testing and evaluation and after satisfactory meeting the complete requirements of the TTS of RCMA(Materials) the concerned lot/ batch/ heat can be used for C1 components.

8.2.5.1.4.4 *'100% testing and evaluation' means***:** Testing as per the TTS on each batch/ lot procured:

8.2.5.1.4.4.1 The products of each heat (if heat traceability exists); No. of products will be as required for testing as per TTS.

8.2.5.1.4.4.2 Each product (if no heat traceability exists) of the batch/ lot.

8.2.5.1.4.5 Testing will be carried out as per the TTS issued by RCMA(Materials).

8.2.5.1.4.6 Frequency of testing from each lot (Number of products and test specimens from each lot to be tested) will be mutually decided between the Project/ User and Airworthiness Agencies [i.e., RCMA(MAT) & DGAQA/MSQAA)].

8.2.5.1.5 *Applicability for use of non-type approved/ non-aero grade/ general engineering grade/ commercial grade materials for Flight Safety Critical(C1) Class Components of ALWs*

8.2.5.1.5.1 The material can be used for R&D phase/ development phase/user flight trials of ALWs provided the material meets the requirements of TTS issued by Material RCMA and the TTS has been evolved considering the full scope of user flight trials. After successful completion of user flight trials of ALWs, usage of the same material will be extended subsequently for production phase of concerned ALWs.

8.2.5.1.5.2 *If such materials are obtained from a non-type approved Indian manufacturing firm (procured directly or sourced through trader)*, the ALW projects shall make parallel efforts to get the concerned Indian firm type approved for regular supply during production phase of ALWs. However, till the time the concerned Indian firm is type approved, the practice of ONE TIME CLEARANCE (lot/batch/heat wise) shall be continued during production phase of ALWs fulfilling the conditions detailed under Para Nos. 8.2.5.1 to 8.2.5.1.5 and its sub-paragraphs.

8.2.5.1.5.3 Further, *in absence of non-availability of Indian manufacturing source/ supplier if such materials are obtained through Foreign Source (procured directly from OEM or sourced through Trader),* the ALW Projects shall make parallel efforts for its indigenization at potential Indian manufacturers and getting them type approved for regular supply during production phase of ALWs. However, till the time the particular material is indigenized and the concerned Indian firm is type approved, the practice of obtaining the material from Foreign source and ONETIME CLEARANCE (lot/batch/heat wise) shall be continued during production phase of ALWs fulfilling the conditions detailed under Para Nos. 8.2.5.1 to 8.2.5.1.5 and its sub-paragraphs.

8.2.5.2 Materials for Mission Critical (C2) Class Components of ALWs

The ALW projects may use non-type approved/ general engineering grade/commercial grade materials fulfilling the criteria mentioned in Para Nos. 8.2.5.1 to 8.2.5.1.5 and its sub-paragraphs. Notwithstanding these criteria the ALW projects can use Type Approved materials.

8.2.5.3 Materials for Non-Critical (C3) Class Components of ALWs

No separate type testing is required on materials meant for C3 components. The material conforming to the applicable specification is considered fit for use along with systems/sub-systems cleared by the concerned RCMAs. However, the concerned ALW project shall

prepare Quality Assurance Plan (QAP) indicating the tests to be carried out to accept the materials for C3 components.

8.2.6 *Initiation of "SELF-CERTIFICATION" Approach involving Internal R&QA for Class-II & Class-III Components*

It is recommended to study and explore the 'Self-Certification' approach/ procedure which is currently being followed with concurrence of DGAQA for HAL activities for implementation across all kinds of material certification activities.

8.2.7 *Mechanism to Reduce Certification Time Cycle without Sacrificing Quality & Safety*

Possible options for Reduction in CERTIFICATION TIMELINES during Indigenisation/ Certification of Materials/ Components are detailed below:

8.2.7.1 Concurrent Development-cum-Certification Approach:

Concurrent mode of development, testing for certification, release of materials on completion of short term tests (as 'PART-A') for component fabrication in parallel to completion of long term tests (as 'PART-B') will reduce the overall time required for indigenisation and certification of any product. *[Already being practiced at RCMA(Mat)].*

8.2.7.2 Creation of Material Bank:

There are number of alloys / materials which are common and required in different forms and sizes by various projects for similar applications. If such requirements are combined together alloy wise for all projects, manufacturing of these alloys can be carried out up to a certain intermediate stage which can be subsequently processed to realise the actual size required/ ordered by the individual projects. This way the manufacturing time can be reduced by 3-4 months or substantially. In addition, certification testing time can be substantially reduced provided the products from the same alloy/heat/intermediate size are supplied to more than one project. This approach will also result in reducing testing of large number of test specimens and also the time in turn, which will be otherwise required if testing is separately done for each project. To do this, the detailed requirements of any alloy (specifically alloy grade name,

form and size, heat treatment, quantity and governing specification) for all kinds of projects needs to be consolidated.

In this context, the present timelines followed for concurrent development and certification and supply of certified materials have been provided by M/s MIDHANI-Hyd. – one of the major suppliers of aerospace materials in the Country, vide Lr. No. MDN/CMD/CEMILAC/0121-6 dt. 19.01.2021 which is reproduced below.

MIDHANI

MDN/CMD/CEMILAC/0121-6
19.01.2021

To
Regional Director
Regional Centre for Military Airworthiness (Materials)
Ministry of Defence (R & D)
CEMILAC, DRDO
P.O. Kachanbagh
Hyderabad-500058

Dear Sir,

Sub: Supply of Aeronautical Materials by M/s MIDHANI for Air Launched Weapons and Aero-Engine/ Aircraft

This is reference to your letter dated 14.12.2020 on the above-mentioned subject. Firstly, I appreciate the interest shown by your office for smooth and unhindered supply of Aero grade materials from MIDHANI. We have type approvals issued for more than 55 grades in various forms and sizes by your office. On the timelines you sought, for manufacture and supply of various categories, we have the following subcategorized by form of supply. The data is based on supplies made over several years.

A) **Without RCMA(Mat)/DGAQA/MSQAA: After Placement of P.O.**
Melted Ingots/Cast sticks: 1-2Months.
Forged and Machined Bars: 2-4Months.
Hot rolled and Machined/Pickled Bars/Plates: 6-8Months.
Cold rolled Sheets and wires: 8-10Months.

B) **With Concurrence Certification from RCMA(Mat)/DGAQA/MSQAA: After placement of P.O. for First Supply:**
Melted Ingots/Cast sticks: 3-6Months.
Forged and Machined Bars: -6-8Months.
Hot rolled and Machined/Pickled Bars/Plates: 8-10Months.
Cold rolled Sheets and wires: 10-12Months.

Cont'd.....2

मिश्र धातु निगम लिमिटेड
(भारत सरकार का उद्यम)
पंजीकृत कार्यालयः पी.ओ. कंचनबाग, हैदराबाद, तेलंगाना -500058
MISHRA DHATU NIGAM LIMITED
(A Govt. of India Enterprise)
Registered Office: P.O. Kanchanbagh, Hyderabad, Telangana-500058
फोन Telephone: 040-24184000, फैक्स Fax: 040-24340039
निगमित पहचान सं. CIN: L14292TG1973GOI001660
वेबसाइट Website: www.midhani-india.in

MISHRA DHATU NIGAM LIMITED
KANCHANBAGH, HYDERABAD.

Continuation Sheet

:: 02 ::

C) **TA Material with Clearance only from DGAQA/MSQAA : After placement of P.O. for First Supply:**
Melted Ingots/Cast sticks: 2-3Months.
Forged and Machined Bars: 3-4Months.
Hot rolled and Machined/Pickled Bars/Plates: 6-8Months.
Cold rolled Sheets and wires: 8-10Months.

It may be noted that, MIDHANI many a times has made emergency supplies to Projects of National importance and strategic requirements with surveillance of Air worthiness Agencies in a noticeably short time utilizing available stocks. The instances of longer supply times are largely due to unclear requirements by the user/designers, merged or beyond standard specifications, multitude and very small quantities, developmental alloys, etc.

Thanking you,

Yours faithfully,
For MISHRA DHATU NIGAM LIMITED

(Dr. S K Jha)
Chairman & Managing Director

8.2.7.3 Qualification based on Tailored Specification:

Technical Specifications/ Qualification Test Requirements need to be re-worked/ tailored based on the design criteria and/or end applications in order to avoid superfluous testing**.** *[Already practiced at RCMA (Mat)].*

8.2.7.4 No Exclusive Certification for Materials for Non-Critical (Class-3) Items for ALWs:

For a 'One Time Use Air-Launched Weapon System', materials for Class-3 (i.e., Non-Critical) Components/Sub- systems need not to be certified separately/independently provided Class-3 Components/ Sub – systems qualify the required functional test. This way - these materials get proven concurrently and qualified. [**Already practiced at RCMA (Mat)**].

8.2.7.5 Declaration by Designer/ User for Mission-Critical (Class-2) Items for ALWs:

For Mission Critical (Class-2) Components/ Sub-systems used in 'One Time Use Air-Launched Weapon System', if designer/user issues a DECLARATION that failure/ malfunctioning of Mission Critical Components will not affect the "Fight Safety" of the platform aircraft, then the materials used stands qualified concurrently provided components/sub-systems complies with functional requirements and cleared. This will reduce the certification time to clear such materials; In this case the safety aspects depend fully on the declaration and assurance of the Project & its R&QA department. *[A Bold Proposal ONLY]*.

8.2.7.6 "SELF CERTIFICATION" approach for Mission-Critical (Class-2) and Non-Critical (Class-3) Items for Use of Non-Type Approved/ Non-aero grade/ General Engineering Grade/ Commercial Grade Material for ALWs

For Class-3 (Non-Critical) & Class-2 (Mission Critical) Sub-system/system, "Commercial Materials" can be used based on clearance of Internal R&QA department of the Project/Lab, and following the "SELF CERTIFICATION" approach exclusively for 'One Time Use Air-Launched Weapon System' PROVIDED the declaration given by project/user that failure due to usage of commercial materials shall not affect safety of the platform Aircraft. The onus of this practice remains with the projects/Lab under the scope of 'Self certification' procedure, if adopted.

8.2.7.7 Upgradation/ Augmentation of Existing Testing Facilities or Creation of New Testing Centres

During certification testing, varieties of tests and number of test specimens to be tested are very large. Therefore, a sincere effort should be made to upgrade the exiting test centres by augmenting test equipments or to create new test centres in order to complete certification testing in stipulated time.

8.2.7.8 Logistic Supports to Airworthiness Agencies

While taking up the indigenisation program, the concerned Project Directors should consider the logistic requirements of the Airworthiness Certification Agencies which also includes the manpower for timely response on certification related matters.

Appendix-1

RESTRICTED

Office of the Director General of Missiles & Strategic Systems

Kanchanbagh, Hyderabad-500058

No. DG-MSS/DPM/DHQ/CEMILAC Date: 16th September 2020

Sub: **Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons**

1. The following Committee is constituted for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons.

Shri B Saha, Sc 'G' & Regional Director, RCMA (Materials)	-	Chairman
Shri R Venugopal, Sc 'G' & Director Admin, O/o DG-MSS	-	Member
Shri Raju D Navindgi, Sc 'G', O/o DG-AERO	-	Member
Dr Shirish S Kale, Sc 'G', Regional Director RCMA (F&F)	-	Member
Rep DGAQA, MIDHANI	-	Member
Rep MSQAA	-	Member
Rep IFA (MSS Cluster)	-	Member
Shri B Jana, Sc 'G', RCMA (Materials)	-	Member Secretary
Special Invitees for Air Launched Weapons:		
Shri S Gopinath, OS & Prog Leader ARM, RCI	-	Special Invitee
Dr JVR Sagar, OS & Prog Leader Air Launch Systems, DRDL	-	Special Invitee
Shri CVS Sai Prasad, Sc 'G' & Director Q&R, O/o DG-MSS	-	Special Invitee
Special Invitees for Aircraft & Aero Engines:		
Rep HAL (F&F/Engines/Nashik/Koraput)	-	Special Invitee
Rep ADA	-	Special Invitee

Chairman may co-opt / nominate other members as and when necessary

2. Terms of Reference:
   - (i) Consolidating the material requirements of various projects based on bill of materials.
   - (ii) Grading of materials required based on criticality of usage.
   - (iii) Exploring identification of approval status of the materials required by the projects.
   - (iv) Identification of established Indian vendors for supply of type approved materials.
   - (v) Finalisation of suitable criteria for approaching established Vendors.
   - (vi) Firming up terms and conditions for placing purchase orders by the projects for supply of type approved materials to ensure safety of the airborne store.

3. This committee shall met periodically and submit their achievements to DG(MSS) and Chief Executive (Airworthiness).

(MSR Prasad)
DS & DG(MSS)

To:
The Chairman, all Members and all Special Invitees of Committee

RESTRICTED

Appendix-2

COMMITTEE FOR IDENTIFYING ESTABLISHED VENDORS FOR SUPPLY OF TYPE APPROVAL MATERIALS FOR AIRCRAFT AND AIR LAUNCHED WEAPONS

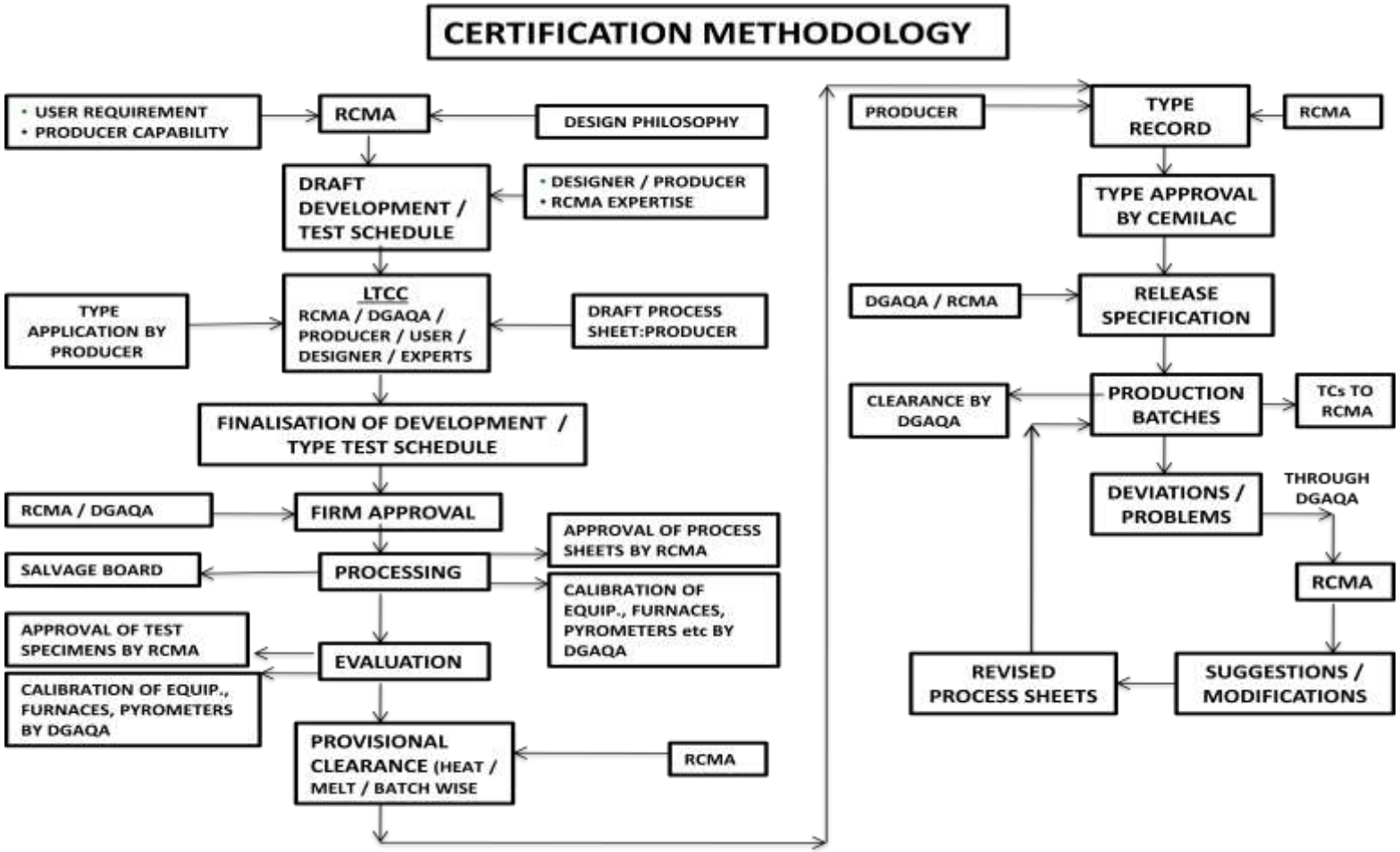
Committee Details

Sl.No	Name, Designation & Organization	Contract Details
Chairman		
1.	***Shri B Saha*** Sc-G & Regional Director, RCMA(Material)	Mobile: 9949956601 Phone: 040-24006601 Fax: 040- 24341827 Email Id: bsaha@cemilac.drdo.in DRONA Mail ID: b.saha@cmac.bandom
Member Secretary		
2.	***Shri Biswanath Jana*** Sc-G, RCMA(Material)	Mobile: 7680810909, 9985489437 Phone: 040-24006604 Fax: 040-24341827 Email Id: bjana@cemilac.drdo.in DRONA Mail ID: b.jana@cmac.bandom
Members		
3	***Shri R Venugopal*** Sc-G & Director Admin O/o DG -MSS	Mobile: 8247729968, 9441476453 Phone: 040-24584710, 24584720 (Off) Fax: 040-29705268 Email Id: DRONA Mail ID:
4	***Shri Raju D Navindgi*** Sc-G & Director(Admin) O/o DG-AERO	Mobile: 9740655556 Phone: 080-22511438 Fax: 080-25283028/ 25283022 Email Id: navindgi@hqr.drdo.in DRONA Mail ID: navindgi@dgaero.bandom
5	***Dr Shrish S Kale*** Sc-G GD(Materials)-CEMILAC & Regional Director-RCMA(F&F)	Mobile: 9483523033 Phone: 080-25121016 Fax: 080-25230856 Email Id: rdrcma.ff@cemilac.drdo.in DRONA Mail ID: ss.kale@cmac.bandom
6	***Rep DGAQA, MIDHANI*** ***Shri K Palani Muthu*** PScO RDAQA(GW & M) C/o DRDL, Kanchanbagh PO, Hyd-058	Mobile: 9441695425 Phone: 040-24346695 Fax: 040-29551447 (Telefax) Email Id: ocrigw.dgaqa.nic.in Web: www.dgaeroqa.gov.in

7	***ReP MSQAA*** ***Shri M Srinivas Rao*** SSO-I	Mobile: 9100871475 Phone: 24340207 (DRDL); 24184561 (Midhani) Fax: 040-24341887 Email Id: msqaahyd.dgaqa@nic.in
8	***Rep IFA (MSS Cluster)*** ***Shri KV Ramagopal*** Deputy IFA	Mobile: 9908727061 Phone: 040-24584732(Dir); 24584727 (PA to IFA) Fax: 040-29705263 Email Id:kvrg61@gmail.com DRONA Mail ID:
Special Invitees		
9	***Shri S Gopinath*** OS & Prog Leader ARM RCI	Mobile: 9490475403 Phone:24306419 Fax: 24306354, 24306000/001 Email Id: DRONA Mail ID: gopi_rcihyd@rci.hyddom
10	***Dr. JVR Sagar*** OS & Prog Leader Air Launch Systems DRDL	Mobile: 9440960426 Phone: Fax: 040-24345523 Email Id: DRONA Mail ID: JVR SAGAR/DRDL/HYD/DRDO@DRDO
11	***Shri CVS Sai Prasad*** Sc'G' & Director Q & R O/o DG –MSS	Mobile: 9849637019 Phone: 040-24584708 Fax: 040-29705270 Email Id: cvssaiprasad@hqr.drdo.in DRONA Mail ID:
12	***Rep HAL (F&F)*** Shri D Subramanya Shastry Deputy General Manager(P&P/MS) Foundry & Forge Division Bangalore Cpmplex HAL, P B No. 1791, Bengaluru – 560 017.	Mobile: 9449156438 Phone: 080-22323419 Fax: 080-22315521 Email Id: shastry.ds@hal-india.co.in
13	**Rep HAL (Engines)** Shri S Madhavan DGM(DLE & IND) Engines Division Bangalore Complex HAL, P B No. 1791, Bengaluru – 560 017.	Mobile: Phone: Fax: 080-22311180 Email Id: gm.engines@hal-india.com
14	***Rep HAL (Nasik)*** Shri Rajeev Kumar Sr Manager (Design-Indigenisation) AURDC, HAL, Ojhar PO, Nasik - 422 207.	Mobile: 7588980668 Phone: 02550-275846/ 47/ 48, 02550-271061 Fax: 02550-271965 Email Id: designdi.nsk@hal-india.com

15	***Rep HAL (Koraput)*** Shri N C Satpathy AGM(Design) HAL, Koraput Division Sunabeda-2, Dist- Koraput(Odisha) -763002	Mobile: 7978869833 Phone: Fax: 06853-220004/ 220217 Email Id: nabin.satpathy@hal-india.com
16	***Rep ADA*** Dr. R K Rayudu Sc/Engr 'G' Airframe Directorate Aeronautical development agency PB No. 1718, Vimanapura Post, Bengaluru-560 017.	Mobile: 9945178627 Phone: 080-25087144 Fax: 080-25238493 Email Id: rayudu@jetmail.ada.gov.in DRONA Mail ID:
Co-Opted Members		
17	Dr. B Sahoo Sc-F & Regional Director RCMA(Koraput) P B No. 15, Sunabeda – 763002 Koraput, Orissa	Mobile: 9668121177, 9437062226 Phone: 06853-221677 Fax: 06853-220382 Email Id: rdrcma.kpt@cemilac.drdo.in DRONA Mail ID:
18.	Shri BS Mandloi, Sc-F RCMA(Nashik) C/o HAL(Nashik Division) Ojhar Township, Nashik-422207	Mobile: 9422245190 Phone: 02550-275819 Fax: 02550-275912 Email Id: bs.mandloi@cemilac.drdo.in DRONA Mail ID: bs.mandloi@cmac.bandom
Co-Opted Special Invitees		
19.	Rep GTRE Mr. Chandru Fernando, Sc-D GTRE CV Raman Nagar Post Box No. 9302, Bengaluru-560 093.	Mobile: Phone: Fax: 080-25241507 Email Id: chandrufernando@gtre.drdo.in; sureshkumar@gtre.drdo.in DRONA Mail ID:
20.	Ms. AVS Perina Devi, Sc-F & PD (Astra Mk-II, DRDL)	Mobile: 9490755413 Phone: 9390925054 Fax: Email Id: DRONA Mail ID:
21.	Vasanthraju. C Chief Manager (DLE & Indgn) Marathahalli Post Bengaluru – 560037	Mobile: 9449631541 Phone: 080-22323627 Fax: 080-22323827 Email Id: dle.lca@hal-india.com DRONA Mail ID:

Appendix-3


CERTIFICATION METHODOLOGY
• USER REQUIREMENT
• PRODUCER CAPABILITY
RCMA
DESIGN PHILOSOPHY
DRAFT DEVELOPMENT / TEST SCHEDULE
• DESIGNER / PRODUCER
• RCMA EXPERTISE
TYPE APPLICATION BY PRODUCER
LTCC
RCMA / DGAQA / PRODUCER / USER / DESIGNER / EXPERTS
DRAFT PROCESS SHEET:PRODUCER
FINALISATION OF DEVELOPMENT / TYPE TEST SCHEDULE
RCMA / DGAQA
FIRM APPROVAL
APPROVAL OF PROCESS SHEETS BY RCMA
SALVAGE BOARD
PROCESSING
CALIBRATION OF EQUIP., FURNACES, PYROMETERS etc BY DGAQA
APPROVAL OF TEST SPECIMENS BY RCMA
EVALUATION
CALIBRATION OF EQUIP., FURNACES, PYROMETERS BY DGAQA
PROVISIONAL CLEARANCE (HEAT / MELT / BATCH WISE
RCMA
PRODUCER
TYPE RECORD
RCMA
TYPE APPROVAL BY CEMILAC
DGAQA / RCMA
RELEASE SPECIFICATION
CLEARANCE BY DGAQA
PRODUCTION BATCHES
TCs TO RCMA
DEVIATIONS / PROBLEMS
THROUGH DGAQA
RCMA
REVISED PROCESS SHEETS
SUGGESTIONS / MODIFICATIONS

About Airworthiness Certification of Materials

Airworthiness means

- Continued capability of an aircraft / equipment to perform satisfactorily and fulfill its mission requirements within the expected life under given atmospheric conditions with acceptable levels of safety and reliability.

Acceptable Levels to be mutually agreed between Users, Designers and Certification Authority

Type Certification of Materials/ Type Approved Materials: What it means?

- To establish supply of airworthy materials (i.e., Feedstock viz. bars, plates, sheets, etc., Near-net Parts using Casting, Close-Die Forgings, etc) manufactured as per Documented Process Route ensuring Consistency in the required properties within a Product/ Batch and Batch-to-Batch
- When a "Product is Type Approved" the PROCESS used to manufacture that product, the PLANT FACILITIES (i.e., Equipments and Personnel) used for manufacturing the product are also CERTIFIED along with that PRODUCT.

Certification/ Approval of Product-Process-Plant (3Ps combination)

ensures

Supply of a particular product type with required quality CONSISTENTLY

Contd/….

Type Certification of Materials/ Type Approved Materials: What it means?

- TYPE APPROVAL of any material is done under TWO Categories to meet:
  - Specific Requirements of Designer/ User - Universally Practiced
  - Generic Requirements (all possible properties are evaluated) - Generally not followed
- Extent of Testing and Evaluation during Type Certification of a Product is based on Criticality of the End Use (Design Criteria) of a Product.
- The criticality is defined based on the failure mode and risk analysis and accordingly aeronautical components are classified into THREE Classes.

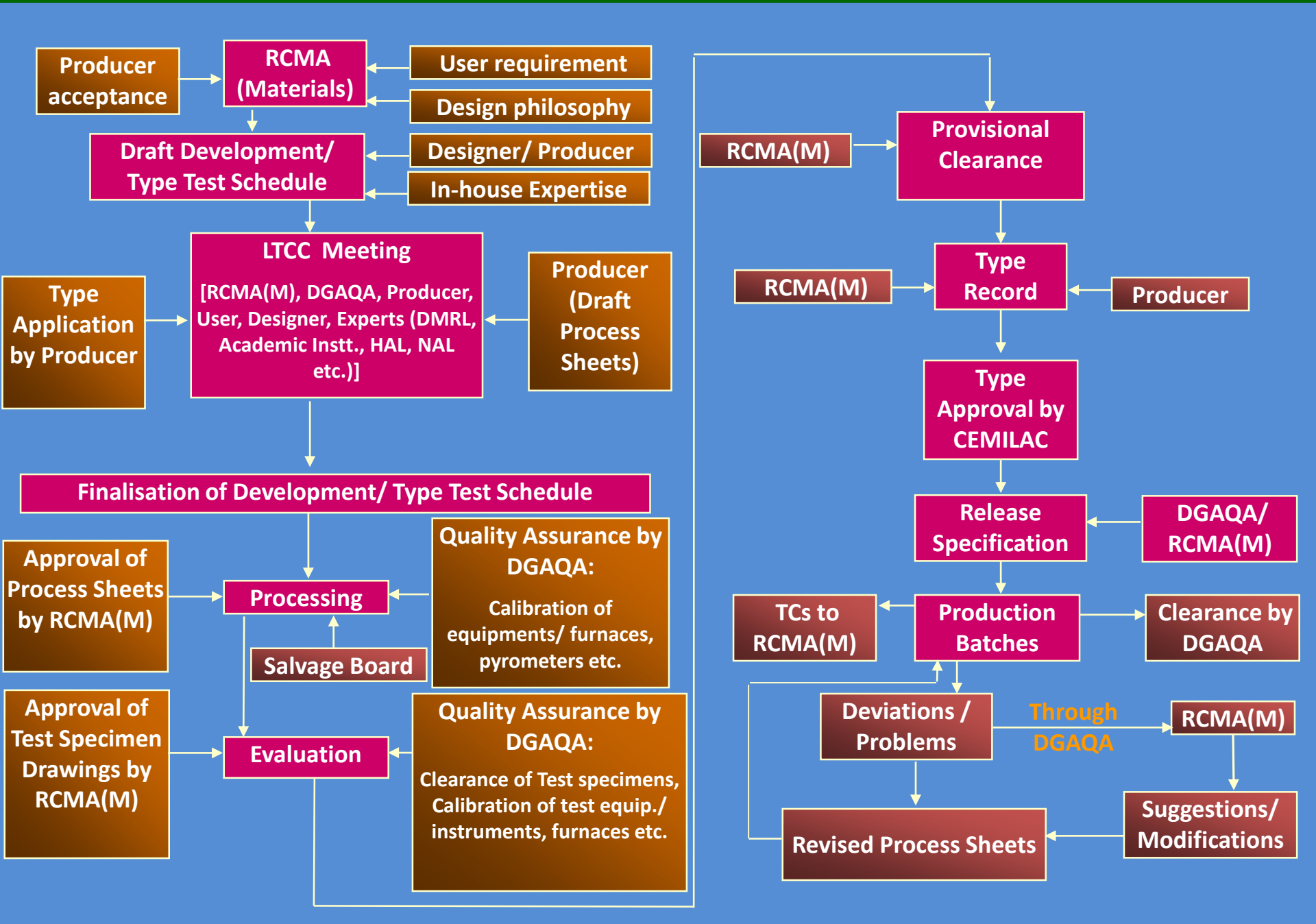
❑ Highly Critical	- Class 1	- Flight Safety Critical
❑ Moderately Critical	- Class 2	- Mission Critical
❑ Non-Critical	- Class 3	- Non-Critical

CLASSIFICATION OF AERONAUTICAL MATERIALS

DDPMAS 2002	Simple Classification
Flight Safety Critical Failure of components, systems or items endangers the safety of the aircraft or crew	**Class 1** Failure expected to cause structural collapse, personal injury or unacceptable malfunctioning
Mission Critical Failure of Components , systems or items results in aborting the mission	**Class 2** High or medium stressed parts not covered by Class 1
Non-Critical Failure of components does not endanger the safety of the aircraft and crew nor does it result in aborting the mission	**Class 3** Unstressed or lightly stressed parts

Designer assigns Classification CATEGORY based on
Significance of Component's Functionality and Failure Consequences

Certification Methodology followed at RCMA(Mat) for Certification of Materials / Components



PROFORMA FOR DESIGN CRITERIA

Project : _____

Name of Inspection Agency : _____

Name of Developing/ Manufacturing Agency: _____

Manufacturing Process Route: _____

Material Grade & Mill Form: _____

Heat Treatment Condition: _____

Size (mm): _____

Supply Condition: _____

Sl. No.	Component	Classification	Stress Condition			Environmental Conditions	Temperature Conditions	Weldability requirements*	Any other information
			Primary	Secondary	Static/ Dynamic loading conditions				
		Flight Safety Critical/ Mission Critical/ Non-Critical	Eg. Fracture Toughness, Fatigue, YS, UTS	Eg. Fracture Toughness, Fatigue, YS, UTS				*Type of Welding, No. of joints, Components details which are to be welded, Material type, WPS & PQR Status approved or not? Vendor details	

Enclosures:

1. Brief write-up about the Project
2. End use of the Components along with justification for classification
3. Drawings, photographs of components
4. QA Plan

Signature
Name & Designation
Name of Organisation (with Seal)

Countersigned by Platform/User RCMA

Aeronautical Vs Engineering Materials

S.No	Nomenclature	Aeronautical	General Engg.
1.	Design philosophy	– Safe life design – Fail safe design – Damage tolerant design	Infinite life design
	Reliability	Periodic Inspection	Not practiced
2.	Specifications		
	Alloying elements	Tighter range	Broad range
	Trace elements	Better control	No limit
	Impurity elements	Better control	No limit
	Injurious elements	Lower limits	Higher limits
	Mechanical properties	Higher side	Lower side
	Metallography acceptance	Stringent	Liberal
	Dimensional Tolerances	Closer	Broad range

GENERAL ENGINEERING Vs AEROSPACE MATERIALS SPECIFICATIONS

Examples of few alloys which have almost similar alloying elements and in use both for general engineering as well as for aerospace, but covered under separate category of specifications, have been compared individually. The difference in characteristics are highlighted by showing them in shaded region.

1. Comparison of a low alloy steel.

		General engineering grade	Aeronautical grade
Sl. No.	**Mechanical Properties**	BS 970 En24	BS S95/S119
	Hardness (HB)	293/341	293/341
	UTS , MPa	896	896
	0.2% PS, MPa	689	758
	% EI	16	12
	Impact Strength; Izod (ft.lbf)	35	35

Contd/...

GENERAL ENGINEERING Vs AEROSPACE MATERIALS SPECIFICATIONS

1. Comparison of a low alloy steel

		General engineering grade	Aeronautical grade
Sl. No.	Chemical composition	BS 970 En24	BS S95/S119
	C	0.35-0.45	0.36-0.44
	Si	0.10-0.35	0.15-0.35
	Mn	0.45-0.70	0.45-0.70
	Ni	1.30-1.80	1.30-1.70
	Cr	0.90-1.40	1.10-1.40
	Mo	0.20-0.35	0.20-0.35
	S	0.020 Max.	0.020 Max.
	P	0.050 Max.	0.025 Max.

Summary: Low alloy Steel

- ❑ Narrow range of alloying elements
- ❑ Significant reduction in impurity elements viz. S & P
- ❑ Better 0.2% PS

2. Comparison of Maraging Steel-250

Sl. No.		General Engineering grade	Aeronautical grade
		ASTM A579	AMS 6512 A
1	**H Condition**		
	(a) Mechanical Properties		
	UTS (MPa)	Not Mentioned	1103
	(a) Metallography		
	Grain Size Thickness		
	<63.5 mm	Not Mentioned	Predominantly 6 or finer with occasional 4
	63.5-254 mm	Not Mentioned	Predominantly 4 or finer with occasional 2
	>254mm	Not Mentioned	As a agreed by purchaser & vendor
	(c) Hardness (HB)	321 Max.	321 Max.
2	**HX Condition**		
	(a) Mechanical Properties	Size not mentioned	**Thickness size upto 101.6mm excl**
	RT Tensile	Direction not mentioned	L T
	UTS (MPa)	1760	1758 1758
	0.2% YS (MPa)	1720	1724 1724
	%EI (4D)	10	6 4
	%RA	45	45 35
			101.6-254.0mm
	UTS (MPa)	Not mentioned	1689 1689
	0.2%YS (MPa)	Not mentioned	1655 1655
	%EI (4D)	Not mentioned	5 3
	%RA	Not mentioned	30 20

Contd/...

2. Comparison of Maraging Steel-250

Sl. No.		General engineering grade	Aeronautical grade
		ASTM A579	AMS 6512 A
	(b) Cryogenic & elevated temperature tensile test	Called for	Not mentioned
	(c)) Hardness	Called for	Rc 48 Min.
	(d) Fracture Toughness	Called for	Called for
	(e) Metallography Micro inclusion Rating	As per ASTM E-45	Type Thin heavy A 1.5 1.0 B 1.5 1.0 C 1.5 1.0 D 2.0 1.5 E* 3.0 1.5 *Titanium Nitride test as type B
3	Macrostructure	Macro etching top & bottom of each ingot	Class / Condition / Severity 1 Freckles A 2 Whitespots B 3 Radial Segregation B 4 Ring pattern C
4	Size & Tolerances	Not Mentioned	As per AMS 2251
5	Non-destructive Testing	Magnetic particle, Liquid penetration, Ultrasonic inspection	Not mentioned

Contd/...

2. Comparison of Maraging Steel-250

Sl. No.		General engineering grade	Aeronautical grade
6	**Chemical Composition**	ASTM A579	AMS 6512 A
	C	0.03 Max	0.03 Max
	Mn	0.10 Max.	0.10 Max.
	Si	0.10 Max.	0.10 Max.
	P	0.01 Max.	0.01 Max.
	S	0.01 Max	0.01 Max
	Ni	17.0-19.0	17.0-19.0
	Co	7.0-8.5	7.0-8.5
	Mo	4.6-5.2	4.6-5.2
	Ti	0.3-0.5	0.3-0.5
	Al	0.05-0.15	0.05-0.15
	Cr	-	0.50
	Cu	-	0.50
	Ca	0.06	0.05
	Zr	0.02	0.02
	B	0.003	0.003
	Fe	Base	Base
7	**Heat Treatment**	Solution Annealing + Ageing	[815-925˚C ±15˚C/1-2hrs/ AC-(H)] + [480˚C±5˚C /4-6hrs/ AC-(X)]

Contd.../

Summary: Maraging Steel 250

- Trace elements viz Ca, Cu, & Cr are controlled better
- Mechanical properties tested are significantly higher in both HT conditions & in L&T directions
- Metallographic standards are stringent(viz grain size)
- Control of various inclusion counts has been specified
- Control of microstructure for freckles, white spots, radial segregation & ring pattern have been specified.

3. Comparison of Titanium Alloy Ti-6Al-4V

Sl. No.		General engineering grade	Aeronautical grade
	Properties	*LA 111*	*LA 166*
1	**Mechanical Properties At RT**		
	UTS (MPa)	830-1130	930 Min.
	0.2% YS (MPa)	820 Min.	830 Min.
	% El	8 Min.	9 Min.
	% RA	20 Min.	25 Min
	At 300˚C		
	UTS (MPa)	640 Min.	650 Min.
	0.2% YS (MPa)	530 Min.	530 Min.
	% EI % RA	9 Min 35 Min.	9 Min 35 Min.
	Notch tensile at RT (Notch-UTS/Smooth-UTS)	1.3 Min	1.3 Min
	Fracture Toughness K↑C	Not Specified	50 MPa √m Min.
	Low Cycle Fatigue At RT	Not Specified	830 MPa/1 x 104 Cycles
	β-Transus	Not specified	980-1010˚C

Contd.../

3. Comparison of Titanium Alloy Ti-6Al-4V

Sl. No.		General engineering grade	Aeronautical grade
2	*Properties*	*LA 111*	*LA 166*
	Chemical composition		
	Al	5.5-6.75	5.5-6.75
	V C	3.5-4.5 0.08 Max.	3.5-4.5 0.08 Max.
	Fe	0.3. Max.	0.30 Max.
	B	-	0.005 Max
	H	0.01 Max.	0.01 Max.
	N	0.05 Max.	0.05 Max.
	O	0.12-0.2	0.15-0.2
	Y	-	0.005 Max.
	Residual Element (each)	0.1 Max.	0.1 Max.
	Residual Element (total)	0.4 Max.	0.4 Max.
	Ti	Base	Base

Summary: Titanium alloy Ti-6Al-4V

- Impurity elements are controlled better both in numbers & amounts
- Mechanical properties are significantly superior
- Important properties like K_{IC} & LCF are checked & controlled

4. Comparison of Aluminum Alloy 24345

Sl. No.		General engineering grade	Aeronautical grade
1	***Chemical Composition***	*BS 1472 (IS : 737–74)*	*BS L72/73 (IS : 3436-66)*
	Cu	3.8-5.0	3.80-4.80
	Mg	0.2-0.8	0.55-0.85
	Si	0.5-1.2	0.60-0.90
	Mn	0.3-1.2	0.40-1.20
	Fe	0.7 Max.	0.7 Max.
	Ni	…	0.2 Max.
	Zn	0.2 Max	0.2 Max.
	Pb	…	0.05 Max.
	Sn	…	0.05 Max.
	Ti + Cr	0.3 Max.	0.30 Max
	Cr	0.3 Max.	-
	Al	Base	Base
2	**Mechanical Properties**		
	UTS, MPa	425	420
	0.2%PS, MPa	345	360
	%El	6	8

Summary: Aluminum alloy 24345

- ❑ Alloying elements are within narrow range
- ❑ Impurity elements are controlled more closely
- ❑ Better o.2% PS

Comparison of Nickel Base Superalloy Nimonic 80A

Chemical Composition	General engineering grade	Aeronautical grade
Element	*HW 19391*	*BS 2HR1*
Si	1.0 Max.	1.0 Max.
C	0.1 Max.	0.04-0.1
Mn	1.0 Max.	1.0 Max.
S	0.015 Max.	0.015 Max.
Ag	-	0.0005 Max
Al	1.0-1.8	1.0-1.8
B	0.008 Max.	0.008 Max.
P	0.03 Max.	-
Bi	-	0.0001 Max
Co	2.0 Max.	2.0 Max.
Cr	18.0-21.0	18.0-21.0
Cu	-	0.2 Max
Fe	3.0 Max.	1.5 Max.
Pb	-	0.002 Max
Ti	1.8-2.7	1.8-2.7
Ni	65 Min	Base

Summary: Superalloy Nimonic 80A

- ❑ Carbon range specified for better property control
- ❑ Impurity elements are controlled better both in numbers & amount

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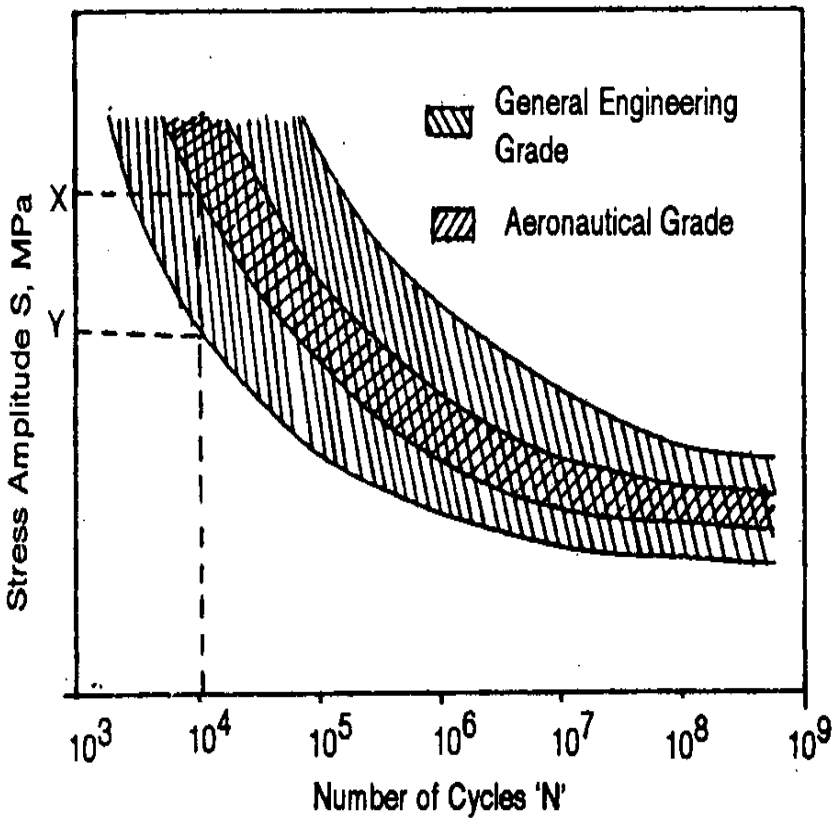


Reasons are both internal and External to Material

External Factors

- **Dimensional Accuracy & Surface Finish Test Samples**
- **Accuracy of Test Machines**
- **Operators' Skill etc.**

Stringent quality control, Control by Periodic Calibration, Use of Skilled Manpower are *Mandatory in Aerospace Material Testing*

Internal Factors

- **Presence of Unwanted Impurity Elements (Crack Initiation Sites and Faster Propagation)**
  - **Residual Gases (O, H, N, Ar, He)**
  - **Non-Metallic Impurities (S, P)**
  - **Metal & Metalloid Impurities (Pb, Bi, Sb, As, Se, Ag, Cu, Ti, Te, Fe, Ni)**
- **Macro & Microstructural Inconsistencies**

Aeronautical Materials

- Aeroengine demands materials at their best

Efficiency of An Aeroengine

$$\acute{\eta} \propto 1 - T_2 / T_1$$

Where T_1 is Turbine Entry Temperature &
T_2 is Turbine Outlet Temperature

- Low factor of safety used in design
- High quality, consistency and low scatter
- Quality at its best and quantity at its lowest

Property Scatter

- **More the scatter, more the weight**
- **More the weight, lesser the power to weight ratio**

Why Documented Manufacturing Route!

- Basic mechanical properties of a material not only exceed material and process specification minima but do so in a consistent manner.
- All components of a given type will respond to service imposed stresses and environments in similar fashion.
- Minimises the likelihood of undetected stress remaining in the finished components and limits the size of defects.
- In the remote case of component malfunction, the entire material history can be rapidly traced, thereby facilitating failure mode identification.

What RCMA(Materials) Does!

- Co-ordinates activities for Approval of Airworthy Materials for Applications in
  - Air-Launched Weapons
  - Aero Systems (Aero-Engines & Aircraft)
- Follows Concurrent Development and Certification Approach for Type Approval
  - Qualification Test Requirements (QTRs) in the form of DTS/ TTS (Through LTCC)
  - Approval of Manufacturing Process
  - Batch wise Clearance (Through PC Mode)
  - Testing in Phased Manner
    - Mandatory Tests (Short-term and Long-term Properties)
    - Tests for Data Generation
  - Clearance of Materials to facilitate fabrication of components/ other works pending certain Long-term properties
  - “One-Time Clearance” - Materials for ALWs

Appendix-5a

List of Type Approvals for Materials for Airborne Applications

Sl. No.	Nomenclature	Issued to	Coordinating RCMA	TA No.
	METALLIC MATERIALS			
	Aluminium Alloys			
1.	Al - alloy Sheet B51S in Condition 'W' & 'WP'	M/s Indian AL Co. Ltd., Belur, West Bengal	A/C	491
2.	Al-alloy with 5% Magnesium	M/s Hindustan AL Corp. U.P	A/C	47
3.	Al - alloy AU4G1, Extruded flats in T351 Condition	M/s Ordnance Factory, Nagpur	F&F	1327
4.	Al - alloy 5086 Extruded Bars in H-111 Condition	M/s Ordnance Factory, Nagpur	F&F	1330
5.	Al – alloy AA 2219 extruded flat & profile in T8511	Ordnance Factory, Nagpur	F&F	1729
6.	Al - alloy AG5MC Extruded Bars	Ordnance Factory, Nagpur	F&F	751
7.	Al - alloy Extruded Bars 7010A ST	M/s Ordnance Factory, Nagpur	F&F	987
8.	Al - alloy Forgings of HE-15A	M/s HAL F&F Division, Bengaluru	F&F	950
9.	Al – alloy HE 15A-ST (Stretched)	Ordnance Factory, Nagpur	F&F	724
10.	Al - alloy HE 20A (Extruded Bars)	Ordnance Factory, Nagpur	F&F	736
11.	Al-alloy HE-15A Extruded Bars (Forging Stock)	Ordnance Factory, Nagpur	F&F	617
12.	Al – alloy: Dornier control column casting, Pt No. HA-420211A01G	M/s HAL, Sunabeda	KPT	1732
13.	Al-alloy (I) AL-19	M/s HAL, Koraput	KPT	444
14.	Al-alloy AK-6 Stampings Pt.No.76-4903-13 & 75-4903-05	M/s HAL, Koraput	KPT	588
15.	Al-alloy AL-5	M/s HAL, Koraput	KPT	142
16.	Al – alloy AL-356 Investment Casting (Pedestal unit & Gimbal box)	M/s Investment & Precision, Gujarat	MAT	1517
17.	Al - alloy HF 15 Forgings in T652 Condition	M/s Deccan Smiths Pvt ltd., Hyderabad	MAT	1705
18.	Al - alloy HF 15 forgings in T652 condition	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	MAT	1872
19.	Al - alloy HF15 Forgings in T652 Condition	M/s Manjira Machine Builders Pvt Ltd, Telangana.	MAT	1833
20.	Al – alloy HF15 forgings in T652 condition	M/s Deccan Smiths Pvt. Ltd., Hyderabad	MAT	1728
21.	Al - alloy Extruded Rods AK-4-1	M/s Indian AL Co., Kerala	NSK	689

22.	Al - alloy 2S in Condition 'O' & 'HZ'	M/s Indian AL Co. Ltd., Belur, West Bengal	NSK	492
23.	Al - alloy Bronze Extruded Tube Gr BRZHN-I0-4.4	M/s IndosweEngg. Ltd., Pune	NSK	692
24.	Al – alloy Bronze Extruded Tube Gr(I) BRAZHMTS-I0-3-1.5	M/s IndosweEngg. Pvt. Ltd., Pune	NSK	398
25.	Al – alloy Bronze Rod Gr. BRAZHMIS 10-3-1.5	M/s IndosweEngg. Ltd., Pune	NSK	690
26.	Al - alloy Extruded lNDAL-B26SW	M/s Indian AL Co., Kolkata	NSK	367
27.	Al – alloy Extruded Rod 'INDAL-3S-0'	M/s Indian AL Co., Kolkata	NSK	371
28.	Al - alloy Extruded Rods 'INDAL-24SW'	M/s Indian AL Co., Kolkata	NSK	399
29.	Al - alloy Extruded Rods 'lNDAL-M57S-O'	M/s Indian AL Co., Kolkata	NSK	396
30.	Al – alloy Extruded Rods AK-8	M/s Indian AL Co., Kerala	NSK	691
31.	Al - alloy Extruded Rods AMG-2	M/s Indian AL Co., Kerala	NSK	688
32.	Al - alloy High Strength Duralumin Rivet Wire Grade V-65	Indian Ordnance Factory, Nasik M/s HAL, Nasik	NSK	348
33.	Al Sheet Grade INDAL "IS"	M/s Indian AL Co. Ltd., Kolkata	NSK	347
34.	Al-alloy Bars 5052 (ASM)	M/s Hindustan AL Corporation Ltd., U.P	NSK	420
	Copper Alloys			
35.	Copper alloy: Bronze 5 POC-5-25	M/s HAL, Koraput	KPT	180
36.	Copper alloy: Copper Tubes Gr. M-3	M/s Alcobex Metals (P) Ltd., Jodhpur	KPT	499
37.	Copper Locking Wires as per GOST 2112-79 (Grade MM)	M/s Bharat Wire, Mumbai	NSK	1493
38.	Copper alloy: Cold Rolled Cu Sheet Gr ETP To IS:191/67 & 1S:1972/61	M/s Rashtriya Metal Indus. Ltd., Mumbai	NSK	345
	Magnesium Alloys			
39.	Mg – alloy: Cast Alloy ML-10	M/s HAL Koraput Division, Sunbeda	KPT	803
40.	Mg – alloy: ZM21A Cast Blocks	M/s Super Inducto Castings Pvt Ltd, Hyderabad	MAT	765
41.	Mg – alloy: ZM21A HR Plates	M/s MIDHANI, Hyderabad	MAT	766
	Steels & Cast Iron			
42.	Steel: 2.5% Ni-Cr-Mo Steel Bar Forgings to BS-2S-98-1964	M/s Firth India Steel, Nagpur	A/C	423
43.	Steel: Chrome Molybdenum Steel SAE/ALSI4130	M/s Mysore Iron & Steel, Bhadravathi	A/C	88
44.	Steel: Low Alloy Steel Bars (Forging Stock)	M/s Firth India Steel, Nagpur	F&F	737
45.	Steel: 25CD4S Alloy Steel Bars	M/s Firth India Steel, Nagpur	F&F	670

46.	Steel: Steel 30CD12 Alloy Steel Bars (Forging stock)	M/s Firth India Steel, Nagpur	F&F	671
47.	Steel: XC 18S Alloy Steel Bars	M/s Firth India Steel, Nagpur	F&F	672
48.	Steel Forgings- 30X/CA Pt.No. 76-5555-971, 75-4906-05 & EL-4910-01	M/s HAL. Koraput	KPT	589
49.	Steel: Cast Iron-XM Sealing Rings	M/s HAL Koraput	KPT	160
50.	Steel: 18%Cr-10%Ni, Ti-Stabilised Austenitic Stainless Steel 12X18H10T	M/s MIDHANI, Hyderabad	MAT	626
51.	Steel: High Strength Low Alloy Steel 30XGCN2A	M/s MIDHANI, Hyderabad	MAT	642
52.	Steel: Low Alloy Steel E16NCD13, Forged Bars	M/s MIDHANI, Hyderabad	MAT	1294
53.	Steel: Low alloy Structural Steel Gd.-30 KHGSA. H.R.bars	M/s MIDHANI, Hyderabad	MAT	1165
54.	Steel: Maraging steel MDN 300A (HR strips)	M/s MIDHANI, Hyderabad	MAT	1710
55.	Steel: MDN 127A (HR Plates & CR Strips)	M/s MIDHANI, Hyderabad	MAT	1453
56.	Steel: MDN 250A (Forged Bars And Flats)	M/s MIDHANI, Hyderabad	MAT	1816
57.	Steel: MDN 250A Maraging Steel Forged Bars	M/s MIDHANI, Hyderabad	MAT	694
58.	Steel: MDN 321A Ti-Stabilised Austenitic Stainless Steels HR Bars	M/s MIDHANI, Hyderabad	MAT	732
59.	Steel: MDN 321A Ti stabilised Austenitic Stainless Steel C.D Wires	M/s MIDHANI, Hyderabad	MAT	991
60.	Steel: MDN 321A Ti-stabilised Austenitic Stainless Steel Billets and Forged Bars	M/s MIDHANI, Hyderabad	MAT	322
61.	Steel: MDN 321-A Ti-stabilised Austenitic Stainless Steel CR Sheets	M/s MIDHANI, Hyderabad	MAT	693
62.	Steel: MDN 321A Ti-Stabilised Austenitic Stainless Steels: Annealed Wires	M/s MIDHANI, Hyderabad	MAT	619
63.	Steel: MDN 347A Nb-Stabilised Stainless Steel Sheets	M/s MIDHANI, Hyderabad	MAT	713
64.	Steel: MDN 431A Martensitic Stainless Steel	M/s MIDHANI, Hyderabad	MAT	903
65.	Steel: MDN 440C Corrosion Resistant Steel HR bars (for non-weldable application only)	M/s MIDHANI, Hyderabad	MAT	1926
66.	Steel: MDN 9201 A Case Carburising Steel (Forged Bars)	M/s MIDHANI, Hyderabad	MAT	1973
67.	Steel: MDN LA1 (12X2H4AW) Case carburising Low Alloy Steel HR Bars	M/s MIDHANI, Hyderabad	MAT	640

68.	Steel: MDN LA1(12X2H4AW)Case Carburising Steel Forged Bars	M/s MIDHANI, Hyderabad	MAT	992
69.	Steel: MDN LA2 (16XCH) Low Carbon Alloy Steel CD Wires	M/s MIDHANI, Hyderabad	MAT	682
70.	Steel: MDN-132A Co-MO-V Nitriding Steel (Forged Bars)	M/s MIDHANI, Hyderabad	MAT	927
71.	Steel: MDN-15-5 PH Stainless Steel (Forged and HR bars)	M/s MIDHANI, Hyderabad	MAT	1166
72.	Steel: MDN250A Maraging Steel (Extruded Tubes)	M/s MIDHANI, Hyderabad	MAT	1975
73.	Steel: MDN347A Nb-Stabilised Stainless Steel F & HR Bars	M/s MIDHANI, Hyderabad	MAT	556
74.	Steel: MDN-431A Martensitic Stainless Steels HR Bars	M/s MIDHANI, Hyderabad	MAT	928
75.	Steel: Stainless Steel 12%Cr-Martensitic SS AE-961W	M/s MIDHANI, Hyderabad	MAT	614
76.	Steel: Brake Piston Insulator	M/s MIDHANI, Hyderabad	MAT	1648
77.	MDN 250 A Hot Rolled Plates	M/s MIDHANI, Hyderabad	MAT	2006
78.	MDN 250 A Rings Forgings	M/s MIDHANI, Hyderabad	MAT	2025
79.	MDN M50 A Hot Rolled Bars	M/s MIDHANI, Hyderabad	MAT	2028
80.	Steel Gr (I) 38KHA	M/s Firth India Steel, Mumbai	NSK	384
81.	Steel: 30 KHGSA Low Alloy Steel HR bar	M/s Mahindra Ugine Steel, Mumbai	NSK	782
82.	Steel: 15CDV6 Low Alloy Steel Bars	M/s Firth India Steel, Nagpur	NSK	641
83.	Steel: 16NCD13 Alloy Bars	M/s Firth India Steel, Nagpur	NSK	649
84.	Steel: 2.5% Ni-Cr-Mo (High Carbon) Steel Bar to BS-4S-99-I976	M/s Firth India Steel, Nagpur	NSK	424
85.	Steel: 30 KHGSA Low alloy Structural Steel -3 Types	M/s Rampra Steel, Mumbai	NSK	1147
86.	Steel: 30KHGSA HR Bar	M/s Firth India Steel, Nagpur	NSK	634
87.	Steel: 30KHGSNA-SSH CD&HR Steel Round Bar	M/s Firth India Steel, Nagpur	NSK	628
88.	Steel: 30NCD16 Alloy Bars	M/s Firth India Steel, Nagpur	NSK	648
89.	Steel: Alloy Steel Spring Wire Grade 65 S-2 VASH	M/s Firth India Steel, Nagpur	NSK	623
90.	Steel: Alloy Steel Wire for Cold Upsetting Gr Steel -16KHSN	M/s Firth India Steel, Nagpur	NSK	627
91.	Steel: C-25 Carbon Steel Rods Hot Rolled and Annealed	M/s Mahindra Ugine Steel, Mumbai	NSK	372
92.	Steel: Carbon Steel Wire Gr Steel-15	M/s Firth India Steel, Nagpur	NSK	629

93.	Steel: Carbon Steel Wire Gr Steel-25	M/s Firth India Steel, Nagpur	NSK	633
94.	Steel: Carbon Steel Wire Grade Steel 45	M/s Firth India Steel, Nagpur	NSK	616
95.	Steel: Carbon Steel Wire rope Galvanized Gr-V Dia-1.8, 2.5, & 3.6 mm	M/s Prakash Engineering, Mumbai	NSK	1129
96.	Steel: Carbon Structural Steel Grade C-45-Sizes 45 & 70mm	M/s AV Alloys Ltd, Nandigaon	NSK	1118
97.	Steel: Carbon Structural Steel Rods Gr(I) C-45 Hot Rolled & Annealed	M/s Mahindra Ugine Steel, Mumbai	NSK	393
98.	Steel: Carbon Structural Steel Rods to A/c quality Cold drawn & Annealed Gr(I) C-45	M/s Firth India Steel, Mumbai	NSK	412
99.	Steel: CD & Annealed Hexagon From SS Steel Grade 14KH17N2	M/s Firth India Steel, Nagpur	NSK	620
100.	Steel: CD & Annealed Hexagon Gr Steel-45	M/s Firth India Steel, Nagpur	NSK	637
101.	Steel: CD & Annealed Structural Steel Bars Gr Steel-45	M/s Firth India Steel, Nagpur	NSK	636
102.	Steel: CD Bar from Carbon Steel Gr Steel-25	M/s Firth India Steel, Nagpur	NSK	632
103.	Steel: CD Hexagon from low alloy Steel Grade 30KHGSA-SSH	M/s Firth India Steel, Nagpur	NSK	622
104.	Steel: CD Hexagon Rod from Steel Gr 30KHGSA	M/s Firth India Steel, Nagpur	NSK	631
105.	Steel: CD Round Bars from Steel Gr 30KHGSA	M/s Firth India Steel, Nagpur	NSK	635
106.	Steel: CD Wire for Cold Upsetting From Steel Grade 20G2	M/s Firth India Steel, Nagpur	NSK	621
107.	Steel: Cold Heading Wire from Steel Grade 30KHGSA-SSH	M/s Firth India Steel, Nagpur	NSK	624
108.	Steel: ESR Quality Alloy Steel Rod Gr(I) 12 KHN-3A	M/s Firth India Steel, Mumbai	NSK	392
109.	Steel: ESR Quality Chrome-Vanadium Steel Wire Cold Draw Gr (I) 50KHFA	M/s Firth India Steel, Mumbai	NSK	449
110.	Steel: ESR Quality Cold Drawn Carbon Steel Gr (I) C-25	M/s Firth India Steel, Mumbai	NSK	455
111.	Steel: Galvanized Low Carbon Steel Locking Wire as per GOST 792-67 (KO type)	M/s Bharat Wire, Mumbai	NSK	1495
112.	Steel: Hot forged Round Bar from Steel Gr 20KH13	M/s Firth India Steel, Nagpur	NSK	630
113.	Steel: HR & Annealed Bar SS Steel Grade14KH17N2	M/s Firth India Stee,l Nagpur	NSK	615
114.	Steel: Low Alloy Steel Gr(I) 30KHGSNA	M/s Mahindra Ugine, Mumbai	NSK	438
115.	Steel: Low Alloy Structural Steel Gr(I) 40KH	M/s Firth India Steel, Mumbai	NSK	397

116.	Steel: Ni-Chrome-Steel Wire Gr Steel(I) 16KHSN	M/s Firth India Steel, Mumbai	NSK	400
117.	Steel: Raw Forgings WGI-1257, 1258 & 1259 using Steel (I) 30KHGSNA	M/s W.G.Forge& Allied Indus. Ltd., Mumbai	NSK	440
118.	Steel: ROD Pt No.11BRD/ISC/644800	D&D by:11 BRD, Nasik; Mfd by: M/s RPM, Nasik	NSK	1874
119.	Steel: Seamless SS Tubes 3 types, Size OD 10XWT 1.0 mm	M/s Ratnamani Metals, Ahmedabad	NSK	1136
120.	Steel: Seamless Stainless Steel Tubes 7 Sizes of ASTM A-269, TP-321	M/s Ratnamani Metals, Ahmedabad	NSK	1135
121.	Steel: Stainless Steel Locking Wires Grade ALSI -321	M/s Bharat Wire, Mumbai	NSK	1494
122.	Steel: Wheel Axel Grade 30 KHGSN2A Pt. No. N429-4101-0003	M/s. HAL, Nasik	NSK	1286
	SUPERALLOYS			
123.	SUPERNI 75 A Bars	DMRL, Hyd.	MAT	173
124.	SUPERNI 75 A Billets & Bars	M/s MIDHANI, Hyd.	MAT	495
125.	SUPERNI75 A Forged Bars	M/s MIDHANI, Hyd.	MAT	546
126.	AE 435 All forms	M/s MIDHANI, Hyd.	MAT	566
127.	AE 868 All forms	M/s MIDHANI, Hyd.	MAT	762
128.	SUPERNI 263 A Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	904
129.	SUPERNI718 A Forged and Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	905
130.	SUPERNI718 A Feed Stock (Compressor Blades)	M/s MIDHANI, Hyd.	MAT	922
131.	SUPERNI263 A Cold Rolled Sheets	M/s MIDHANI, Hyd.	MAT	929
132.	CM247LC FPTR	DMRL, Hyd.	MAT	970
133.	CM247LC GGTS	DMRL, Hyd.	MAT	971
134.	CM247LC FPTS	DMRL, Hyd.	MAT	972
135.	CM247LC GGTR	DMRL, Hyd.	MAT	973
136.	SUPERFER 696 M Hot Rolled Bars & billets	M/s MIDHANI, Hyd.	MAT	1005
137.	AE 602 HR & CR Sheets	M/s MIDHANI, Hyd.	MAT	1006
138.	AE 437 A Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	1007
139.	AE 437 B Forged HR & CR Sheets	M/s MIDHANI, Hyd.	MAT	1008

140.	SUPERNI718A Cold Rolled Sheets	M/s MIDHANI, Hyd.	MAT	1291
141.	ZS6Y-VI Re–melt Stock	M/s MIDHANI, Hyd.	MAT	1292
142.	BZLI2Y-VI Re–melt Stock	M/s MIDHANI, Hyd.	MAT	1416
143.	Supercast 247 A Re–melt Stock	M/s MIDHANI, Hyd.	MAT	1489
	TITANIUM ALLOYS			
144.	OT 4-1 Forged and Hot Rolled Bars	DMRL, Hyd.	MAT	508
145.	OT 4-1 Forged and Hot Rolled Bars	DMRL, Hyd.	MAT	509
146.	BT-3-1 Forged and Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	639
147.	BT-9 All forms	M/s MIDHANI, Hyd.	MAT	646
148.	BT-5-1 Forged and Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	733
149.	Titan 23 A (OT 4-1) Cold Rolled sheets	M/s MIDHANI, Hyd.	MAT	906
150.	Titan 31A (Ti-6-4) Forged and Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	907
151.	Titan 31A (TM) Forged and Machined Bars	M/s MIDHANI, Hyd.	MAT	908
152.	Titan 31 A (DM) Feed Stock for Forging	M/s MIDHANI, Hyd.	MAT	909
153.	Titan 23A (OT4-1) Forged and Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	910
154.	Titan 26 A Forged and Machined Bars	M/s MIDHANI, Hyd.	MAT	1293
155.	Titan 29 A Forged Bars	M/s MIDHANI, Hyd.	MAT	1782
156.	Titan 29 A Hot Rolled Bars	M/s MIDHANI, Hyd.	MAT	1783
157.	Titanium Sponge	M/s KMML, Kerala	MAT	2008
158.	Ti-6Al-4V Hot Rolled Plates	M/s MIDHANI, Hyd	MAT	2020
159.	Titan 31 A (Double Melted) Forged Bars	M/s MIDHANI, Hyd	MAT	2010
	Surface Treatment			
160.	Surface Treatment: Cadmium plating of Maraging Steel Components using Fluoroborate bath	M/s HAL, ARDC, Bangalore	F&F	1826
161.	Surface Treatment: Ion Nitriding process for surface hardening of Maraging steel (MDN-250A or MIL-S-466508 Type-IV Gde 250)	M/s HAL, ARDC, Bangalore	F&F	1827
	Weld Consumables			
162.	Weld Consumables: ESR Quality (Welding Filler Wire) GR(I) 20KH4GMA	M/s Firth India Steel, Mumbai	NSK	385

163.	Weld Consumables: Flux coated Welding Electrode Tenacito-I8KHMA	M/s Advani Oerlikon, Mumbai	NSK	395
164.	Weld Consumables: Welding Filler Wire, Steel Gr(I) 18KHMA	M/s Firth India Steel, Mumbai	NSK	394
	Brake Pads/ Discs			
165.	HPT-32 Organic Brake Pad PT.No.HAL 88874 &: 88875	M/s. HAL (F&F), Bengaluru	A/C	587
166.	Inorganic Brake Pads PT.No.HF-S9028/2 For Kiran	M/s HAL (F&F), Bengaluru	A/C	717
167.	Brake Disc Pt No. HF-500 2062 for Dornier	M/s HAL (F&F), Bengaluru	F&F	845
168.	Brake Pads for Islander HF 138 006-06500	M/s HAL (F&F), Bengaluru	F&F	847
169.	Insulator Pads Pt No. HAL 84538	M/s HAL (F&F), Bengaluru	F&F	943
170.	Insulator Pad Pt No. HAL-83149	M/s HAL (F&F), Bengaluru	F&F	983
171.	Brake Lining Pt No. 155P-324D-2020-202A	M/s HAL (F&F), Bengaluru	F&F	1000
172.	Brake Pad / Lining Pt No.95215921-1	M/s HAL (F&F), Bengaluru	F&F	1001
173.	Organic Brake Pads Pt.No.HAL 83741 & HAL 83742	M/s Rane Brake Linings, Chennai	F&F	1138
174.	Brake Pads 3 Types - Rotor Brake Pads	M/s HAL (F&F), Bengaluru	F&F	1206
175.	Brake Pads of 4 Types - Main wheel for MiG-27	M/s HAL (F&F), Bengaluru	F&F	1208
176.	Brake Pads for MiG Nose Wheel of MiG-21	M/s HAL (F&F), Bengaluru	F&F	1214
177.	Brake Pads for Main wheel & Nose Wheel of MiG-21	M/s HAL (F&F), Bengaluru	F&F	1216
178.	Brake Pads for Pt No.15801000-113(HF-85859/1)	M/s HAL (F&F), Bengaluru	F&F	1341
179.	Modified Organic Brake Pads for HPT-32	M/s HAL (F&F), Bengaluru	F&F	1348
180.	MiG-29 Brake Pads – 3 Types	M/s HAL (F&F), Bengaluru	F&F	1896
181.	Locating Pads Pt. No. 25627	M/s HAL, Lucknow Division, Lucknow	LKO	864
182.	Carbon-Carbon Brake Discs (MARK-III) Components (Tejas – Airforce)	M/s Graphite India Ltd., Bengaluru	MAT	1712
183.	Carbon-Carbon Brake Discs (MARK-III) Components (Navy version)	M/s Graphite India Ltd., Bengaluru	MAT	1734
184.	Brake Discs (MARK-II) Components (Airforce version)	HTCC, ASL, Hyd	MAT	1407
185.	Metal Ceramic: Sectors (1) KT 102-42	M/s Mahindra Sintered Products Ltd, Pune	NSK	401

186.	Metal Ceramic: Sectors (I). KT-S9-S1-1M	M/s HALHyderabad	NSK	402
187.	Metal Ceramic Sectors (Sponge Iron)	M/s HAL, Nasik	NSK	664
	Rubber Compounds			
188.	Swastik Rubber Compound 724, 802, 1026 & 1046	M/s Swastik Rubber Products, Pune	A/C	89
189.	Rubber Compound Haltrille-0l	M/s HAL, (F&F), Bengaluru	A/C	558
190.	Silicon Rubber Compound SI-I09	M/s Swastik Rubber Products Ltd., Pune	CHA	258
191.	Rubber Compound Haltrile-05 to HM 4885	M/s HAL, F&F, Bengaluru	F&F	738
192.	Rubber Compound Haltrile-19 to HM 4886	M/s HAL, F&F, Bengaluru	F&F	739
193.	Rubber Compound Haltrile-02 to NFL-17-101A-23B7	M/s HAL, F&F, Bengaluru	F&F	740
194.	Rubber Compound Haltrile-07 to. HM-4888	M/s HAL, F&F, Bengaluru	F&F	741
195.	Rubber Compound Haltrile -03 to. NFL-17-101A-2IA7	M/s HAL, F&F, Bengaluru	F&F	742
196.	Rubber Compound Haltrile-16 to. NFL-16-101A-21B4	M/s HAL, F&F, Bengaluru	F&F	743
197.	Rubber Compound Haltrile-13 to NFL-17-120B-20A9	M/s HAL, F&F, Bengaluru	F&F	752
198.	Rubber Compound Haltrile-06	M/s HAL, F&F, Bengaluru	F&F	753
199.	Rubber Compound Haltrile-17	M/s HAL, F&F, Bengaluru	F&F	754
200.	Rubber Compound Haltrile-09	M/s HAL, F&F, Bengaluru	F&F	755
201.	Rubber Compound Haltrile-0l.	M/s HAL, F&F, Bengaluru	F&F	756
202.	Rubber Compound Haltrile-08	M/s HAL, F&F, Bengaluru	F&F	759
203.	Rubber Compound Haltrile-10	M/s HAL, F&F, Bengaluru	F&F	760
204.	Rubber Compound Halprene-01	M/s HAL, F&F, Bengaluru	F&F	768
205.	Rubber Compound Haltrile-15	M/s HAL, F&F, Bengaluru	F&F	769
206.	Rubber Compound Haltrile-20	M/s HAL, F&F, Bengaluru	F&F	770
207.	Rubber Compound Halprene-03	M/s HAL, F&F, Bengaluru	F&F	771
208.	Rubber Compound Haltrile-21	M/s HAL, F&F, Bengaluru	F&F	772
209.	Silicone Rubber Compound SH 70±5 to HM 4924	M/s Veekay Rubber Products, Mumbai	F&F	785
210.	Silicone Rubber Compound SH 60±5 to HM 4923	M/s HAL, F&F, Bengaluru	F&F	786
211.	Silicone Rubber Compound SH 50±5 to HM 4922	M/s HAL, F&F, Bengaluru	F&F	787
212.	Fluoro Carbon Base R.C - SH 75±5 to HM 4921	M/s Speciality Elastomers, Mumbai	F&F	788
213.	Rubber Compound Haltrile-11 Grade 65	M/s HAL, F&F, Bengaluru	F&F	796
214.	Rubber Compound Haltrilo-22 Grade 45	M/s HAL, F&F, Bengaluru	F&F	797
215.	Fluro Silicone Rubber Compound Grade 60	M/s Bangalore Rubber Industries, Bengaluru	F&F	981

216.	Fluro Silicone Rubber Compound Grade 70	M/s Bangalore Rubber Industries, Bengaluru	F&F	982
217.	Nitrile Base R.C Haltrile-23 NFL 17.121A.2138	M/s HAL, F&F Division, Bengaluru	F&F	1151
218.	Nitrile Base R.C Haltrile-12 Spec: DTD-560 Gde B, Quality P	M/s HAL, F&F Division, Bengaluru	F&F	1153
219.	Neoprene base R.C Halprene 02 Spec HM-4929 issue „A"	M/s HAL, F&F Division, Bengaluru	F&F	1154
220.	Neoprene Base R.C Halprene 04 to NFl-17-131A-31B4	M/s HAL, F&F Division, Bengaluru	F&F	1155
221.	Natutral Base R.C Halnat-01 to HM4931-Issue A	M/s HAL, F&F Division, Bengaluru	F&F	1157
222.	Silicone Base R.C EE-4923 to HM 4923	M/s Elastomeric Engineers, Salem	F&F	1167
223.	Silicone Base R.C EE-5531 to DTD 5531 Gr-70	M/s Elastomeric Engineers, Salem	F&F	1168
224.	Fluro carbon Base rubber Compound EE-4920	M/s Elastomeric Engineers, Salem	F&F	1169
225.	Fluro carbon Base rubber Compound EE-61D6	M/s Elastomeric Engineers, Salem	F&F	1170
226.	Silicone Base R.C EE-4922	M/s Elastomeric Engineers, Salem	F&F	1171
227.	Nitrile Base R.C EE 560 Gr B Quality P	M/s Elastomeric Engineers, Salem	F&F	1172
228.	Poly Chloroprene Base R.C EE-31-B4	M/s Elastomeric Engineers, Salem	F&F	1173
229.	Nitrile Base R.C EE 458A-Gr-A Gr-1	M/s Elastomeric Engineers, Salem	F&F	1174
230.	Chloroprene base R.C EE 31B6 to NFL-17-131A-31B6	M/s Elastomeric Engineers, Salem	F&F	1175
231.	Nitrile Base R.C EE 4885 to HM 4885 Issue-C	M/s Elastomeric Engineers, Salem	F&F	1176
232.	Nitrile Base R.C Elastonitrile-01 to DTD 560 Gr-C Qly P	M/s Elastomeric Engineers, Salem	F&F	1177
233.	Nitrile Base R.C Elastonitrile-02 to MiL R-6855 class 1 Gr 60	M/s Elastomeric Engineers, Salem	F&F	1178
234.	Styrene Butadyne base R. C Elast SBR-01	M/s Elastomeric Engineers, Salem	F&F	1179
235.	Rubber Compound EE-24 B7,	M/s Elastomeric Engineers, Salem	F&F	1274
236.	Rubber Compoun EE-21 A7,	M/s Elastomeric Engineers, Salem	F&F	1275
237.	Fluoro Silicone Base Rubber Compound	M/s Elastomeric Engineers, Salem	F&F	1276
238.	Polychloroprene Base Rubber Compound EE-31 B5	M/s Elastomeric Engineers, Salem	F&F	1277
239.	Fluoro Silicone Base Rubber Compound AMS-33 26C	M/s. Sujan Industries, Mumbai	F&F	1284
240.	Neoprene Base Rubber Compound HM-4930	M/s. Sujan Industries, Mumbai	F&F	1285

241.	Nitrile Base Rubber Compound Summrub-01-603	M/s. Summit-Tech (P) Ltd. Bengaluru	F&F	1304
242.	Nitrile Base Rubber Compound Summrub-01-580	M/s. Summit-Tech (P) Ltd. Bengaluru	F&F	1305
243.	Nitrile Base Rubber Compound Summrub-01-601	M/s. Summit-Tech (P) Ltd. Bengaluru	F&F	1306
244.	Nitile Base Rubber Compound Summrub-01-602	M/s. Summit-Tech (P) Ltd. Bengaluru	F&F	1307
245.	2.6 DI Tertiary Butyl 4-Methyl Phenol	M/s Quality Industries, Maharastra	FOL	1210
246.	Ethylene Propylene Diene Monomer (EPDM)	M/s HAL (F&F) Division, Bengaluru	H/C	995
247.	Rubber Compound DRL (M) IPN-3 Butadine Styrene	DRL(M), Kanpur	KNP	54
248.	Rubber Compound DRL (M) Compound "A" Nitrile Base	DRL(M), Kanpur	KNP	55
249.	Swastik Rubber Compound SMB-l007 Nitrile Base	M/s Swastik Rubber Products, Pune	KNP	60
250.	Rubber Compound DRLM-A4 Nitrile Base	M/s Ailga Rubber Works, Kanpur	KNP	227
251.	Rubber Compound DRL(M) A6	M/s Ailga Rubber Works, kanpur	KNP	999
252.	Rubber Compound DMS FE-75 (Fluoro Elastormer base RC)	M/s Ailga Rubber Works, Kanpur	KNP	1260
253.	DRL (M) Compound "A" Issue-2	M/s Ailga Rubber Works, Kanpur	KPT	200
254.	VT -I Fluro Carbon Rubber Compound	M/s Swastik Rubber Products Ltd., Pune	KPT	247
255.	Rubber Compound MV-3075 LC66	M/s Machard Industrial & Engg Corpn. Mumbai	KPT	389
256.	Rubber Compound (Viton-1305)	M/s Speciality Elastomers, Mumbai	KPT	531
257.	Rubber Compound SEN-1001 (Nitrile Base)	M/s Speciality Elastomers, Mumbai	KPT	532
258.	Nitrile Base Rubber Compound SEN 1010	M/s Speciality Elastomers, Mumbai	KPT	560
259.	Silicone Base Rubber Compound VKS-2004	M/s Vee-Kay Rubber Products, Mumbai	KPT	561
260.	Silicon Rubber Compound VKS-2005	M/s Vee-Kay Rubber Products, Mumbai	KPT	562
261.	Silicon Rubber Compound VKS-2002	M/s Vee-Kay Rubber Products, Mumbai	KPT	594
262.	Silicon Rubber Compound VKS-2003	M/s Vee-Kay Rubber Products, Mumbai	KPT	595
263.	Silicon Rubber Compound VKS-2001	M/s Vee-Kay Rubber Products, Mumbai	KPT	596
264.	Rubber Compound SEN-1683	M/s Speciality Elastomers, Mumbai	KPT	806
265.	Silicone Base Rubber Compound Polysil-1	M/s Polymer Enterprises, Nasik	KPT	837

266.	Silicone Base Rubber Compound Polysil-2	M/s Polymer Enterprises, Nasik	KPT	838
267.	Silicone Base Rubber Compound Polysil-4	M/s Polymer Enterprises, Nasik	KPT	839
268.	Fluorocarbon base Rubber Compound PV-1	M/s Polymer Enterprises, Nasik	KPT	840
269.	Rubber Compound Viton-1316 (Brown)	M/s Speciality Elastomers, Mumbai	KPT	856
270.	Nitrile Base Rubber Compound SENV-500(Green)	M/s Speciality Elastomers, Mumbai	KPT	871
271.	Rubber Compound-Hypalon	M/s HAL (F&F) Division, Bengaluru	KPT	902
272.	Rubber Compound NPE-1	M/s Polymer Enterprises, Nasik	KPT	945
273.	Rubber Compound KPT/ST/201	M/s HAL Koraput Division, Sunabeda	KPT	946
274.	Silicone Base Rubber Compound KPT/SR/201	M/s HAL Koraput Division, Sunabeda	KPT	949
275.	Silicone Base Rubber Compound VKS-1338	M/s Veekay Rubber products, Mumbai	KPT	988
276.	Silicone base Rubber Compound Polysil-6	M/s Polymer Enterprises, Nasik	KPT	1029
277.	Fluro Silicon Base R.C PFS-1	M/s Polymer Enterprises, Nasik	KPT	1231
278.	Nitrile Base R.C NPE-2 to TY38-005-1166-73	M/s Polymer Enterprises, Nasik	KPT	1249
279.	Rubber Compound BP-V-50	M/s B.P Engineers Pvt Ltd, Lucknow	LKO	859
280.	Rubber Compound BP-1 (Nitrile Base)	M/s B.P Engineers Pvt Ltd, Lucknow	LKO	861
281.	Rubber Compound BP-12 (Nitrile Base)	M/s B.P Engineers Pvt Ltd, Lucknow	LKO	862
282.	Rubber Compound –1078	M/s Hilton Rubbers Pvt. Ltd., Harayana	NSK	186
283.	Di Butyl Phthalate (DBP)	M/s Indo Nippon Chemicals Co. Ltd., Mumbai	NSK	235
284.	Nitrile Rubber Compound SMD 1813	M/s Swastik Rubber Products Ltd., Pune	NSK	341
285.	Rubber Compound HA-I609 (Nitrile Base Rubber Compound)	M/s HAL, Nasik	NSK	608
286.	Rubber Compound HA-7614 Nitrile Base	M/s HAL, Nasik	NSK	609
287.	Rubber Compound HA-4411	M/s HAL, Nasik	NSK	610
288.	Rubber Compound HA-2513 Polychloroprene	M/s HAL, Nasik	NSK	611
289.	Rubber Compound HA-4417	M/s HAL, Nasik	NSK	612
290.	Rubber Compound HA -4501	M/s HAL, Nasik	NSK	613
291.	Rubber Compound SPN-6-(Nitrile Base)	M/s Polymer Enterprises, Nasik	NSK	659

292.	Rubber Compound (Polysil-05)	M/s Polymer Enterprises, Nasik	NSK	663
293.	Rubber Compound HA-1818 (Nitrile Base)	M/s HAL, Nasik	NSK	700
294.	Rubber Compound HA-1821(Nitrile Base)	M/s HAL, Nasik	NSK	701
295.	Rubber Compound HA-1620C (Chloroprene R.C)	M/s HAL, Nasik	NSK	702
296.	Rubber HA-1819 (Nitrile base)	M/s HAL, Nasik	NSK	703
297.	Rubber HA-1825- (Nitrile base)	M/s HAL, Nasik	NSK	704
298.	Rubber HA-1805 (Nitrile Base)	M/s HAL, Nasik	NSK	705
299.	Rubber Compound HA-4415 (Natural Base)	M/s HAL, Nasik	NSK	714
300.	Rubber Compound HAL-203B(Nitrile Base)	M/s HAL, Nasik	NSK	715
301.	Rubber Compound TAPS-01(Nitrile Base)	M/s HAL, Nasik	NSK	716
302.	Rubber Compound HA-7610 (Butadine Styrine Base)	M/s HAL, Nasik	NSK	719
303.	Rubber Compound HA-2607(Chloroprene R.C)	M/s HAL, Nasik	NSK	720
304.	Rubber HA-I608 (Nitrile Base)	M/s HAL, Nasik	NSK	721
305.	NPE-3 Nitrile Base Rubber Compound	M/s Polymer Enterprises, Nasik	NSK	764
306.	Rubber Compound RA 594 against Russian Rubber 3853	M/s Blaze Enterprises, Nasik	NSK	1108
307.	Rubber Compound Polysulphide Sealant (RDL-945)	M/s Chocksey Chemicals Pvt Ltd, Mumbai	NSK	1109
308.	Rubber Compound NPE-1 against Rubber IRP-1353	M/s Polymer Enterprises, Nasik	NSK	1110
309.	Rubber Compound NPE-3,	M/s Polymer Enterprises, Nasik	NSK	1115
310.	Rubber Compound EE-3826 (Calendar Rubber Sheet)	M/s Elastomeric Engineers, Salem	NSK	1116
311.	Nitrile Base Rubber Products Calender Rubbers	M/s Unirub Techno India Pvt Ltd, Pune	NSK	1212
312.	Natural Base R.C HA-4712 to TUMKH-P-1428 54 R	M/s HAL, Nasik Division, Ojhar	NSK	1217
313.	Fluro Silicon Base R.C FS 14	M/s Filtrum Polymer Pvt Ltd, Pune	NSK	1221
314.	Fluro carbon Base rubber Compound PV-2	M/s Polymer Enterprises, Nasik	NSK	1236
315.	Rubber Compound HA -1824 USSR Gd- IRP-1054	M/s HAL, Nasik Division, Ojhar	NSK	1262
	Paints & Varnishes			
316.	Ardrox 690 Heavy Duty Carbon (ORlON -516)	M/s Oriental Chemical Works Pvt Ltd.,	A/C	3
317.	Ardrox 996 Penetrant -Dye, Remover & Developer	M/s Oriental Chemical Works Pvt Ltd.,	A/C	4
318.	Aerolite 306 & GBM-X Hardener (WITHDRAWN)	M/s Ciba of India Ltd., Mumbai	A/C	6

319.	Ardrox : 6005 Liquid Cleaning Compound	M/s Oriental Chemical Works Pvt Ltd.,	A/C	8
320.	Rain Repellant Chemical	DRL (M), Kanpur	A/C	107
321.	High Heat Resisting Enamel DR0C4/1517/78	DRL (M), Kanpur	A/C	129
322.	Duel Mix Cement PT A & B	DRL (M), Kanpur	A/C	139
323.	Southlac Antichill thinner	M/s. Southfield Paints Ltd, Bengaluru	A/C	417
324.	Southlac thinner	M/s. Southfield Paints Ltd, Bengaluru	A/C	427
325.	Etch Primer	M/s. Southfield Paints Ltd, Bengaluru	A/C	454
326.	Southlack finish coat paint materials	M/s. Southfield Paints Ltd, Bengaluru	A/C	520
327.	Epoxy primer (Yellow)	M/s. Southfield Paints Ltd, Bengaluru	A/C	569
328.	Alucoat Process	M/s Srinivasa Industrial. Chemicals, B"luru	AlC	185
329.	Duel Mix Cement PT A & B	M/s Ailga Rubber Works Kanpur	KAP	176
330.	High Temperature Vitreous Enamel CG-B-55A	M/s Central Glass & Ceramic Res. & Institute	KPT	143
331.	Shalimar Ertosion resitaent enamel	M/s Shalimar Paints Ltd. Kolkatta	KPT	383
332.	Silicone base varnish	M/s Star Paint & Oil Industries, Mumbai	KPT	414
333.	Silicone base varnish	M/s Star Paint & Oil Industries, Mumbai	KPT	415
334.	Star Tripplex Insulation Varnish	M/s Star Paint & Oil Industries, Mumbai	KPT	505
335.	Star Heatex Varnish	M/s Star Paint & Oil Industries, Mumbai	KPT	559
336.	Pentaphthalic Varnish RDL-919	M/s Asian Paints (India) Ltd., Mumbai	NSK	242
337.	Apcolite redoxide	M/s Asian Paints (India) Ltd., Mumbai	NSK	243
338.	Insulating Warnish	M/s Hardcastle &: Waud Mfg. Co. Ltd.,	NSK	246
	Non – Metallic Materials			
339.	Nylon Cardage 400 lbs Type BR / Ny /10	M/s Best Cotton Ropes Mfg. Co. Mumbai	A/C	43
340.	Fibre Glass Cloth "Glass King"	M/s INDO Glass Pvt. Ltd., Mumbai	A/C	84
341.	Wooden Propeller HT-2(A/c) Pt No.121-56002	M/s HAL, A/C, Bangalore	A/C	170
342.	Glass Cloth	M/s Montex Industries, Mumbai	A/C	177
343.	Silica Glass Tube as per CAT H13	M/s Borosil Glass Works Ltd., Mumbai	A/C	226

344.	Maltoprene Blocks „REGITHERM“	M/s U Foam Ltd., Hyderabad	A/C	248
345.	Insulator Bush, Sleeve and Washer	M/s Plastic Products Engg.Co.	A/C	439
346.	FRP Heat Shield to DRG .No. PRP-0l-08 (W/D)	M/s Applied Synthetics, Bengaluru	A/C	467
347.	Rigid Polyurethane Foam DRG.No. PRP-02-00	M/s Industrial Foam Pvt Ltd., New Delhi	A/C	497
348.	Cooling Hoses for Cheetah & Chetak Helicopters	M/s Fenner (India) Ltd, Madurai, T.N	A/C	800
349.	Enamel FRIT CG-ABK-I3 of USSR FRIT BK-13	M/s Central Glass & Ceramic Res. Institute	ENG	557
350.	Fiber Glass Cloth Trade Name ‘INSUGLASS’	M/s Hatim Dielectric Ltd., Kolkatta	H/C	302
351.	Moltoprene Blocks (Rigid Polyurethane Foam)	M/s U Foam, Hyderabad	H/C	1097
352.	Moltoprene Blocks (Rigid Polyurethane Foam)	M/s U Foam, Hyderabad	H/C	1098
353.	Phenolic Molding Powder Hylak HX-5551	M/s Bakelite Hylam Ltd., Hyderabad	HYD	157
354.	‘Power Grip’ Brand PVC Tube	M/s Bells Engg Corporation., Kolkatta	KNP	275
355.	Champion Super Metallic Stlye-54	M/s Asbestos & Jointing P. Ltd Mumbai	KPT	161
356.	Champion Style 59-Oil Special Asbestos	M/s Asbestos & Jointing P. Ltd Mumbai	KPT	274
357.	Heat Insulator K-400/Coating	M/s HAL, Koraput	KPT	584
358.	Graphite Sealing Ring Pt No. 470450164 & Bush	M/s Assam Carbon Products Limited, Patancheru	KPT	808
359.	Metal Ceramic Insert H.No. 950450-02	M/s ATS Tools, Hyderabad	KPT	1026
360.	Elastic Cotton Fabric as Quality T 4524 Grey 18” Dia	M/s Borosil Glass Works Ltd., Mumbai	NSK	237
361.	Muraka Fibre Glass Tape Unvarnished	M/s Murka Pvt. Ltd., Ahmedabad	NSK	241
362.	Leather Full Chrome, Black Goat	M/s Gordon Woodroffe Co. Ltd., Madras	NSK	252
363.	Hose Sleeve PT.No.86-7806-85-3ND	M/s HAL, Nasik	NSK	346
364.	Indigenous Flux “Tapadia” GR-80	M/s Tapadia Eng & Traders Pvt.Ltd.,	NSK	391
365.	Fused Flux INDARE-BRD-1	M/s Indian Oxygen Ltd., Mumbai	NSK	441
366.	Antimony Free Tin Lead Solder (I) Posk 50-18 DIA 1.6 mm	M/s Saru Smelting Pvt.Ltd., U.P	NSK	451
367.	Acrylic Cement ISRO MM7	M/s HAL, Nasik	NSK	453
368.	Plexiglas GS-249	M/s ROHM Chemische Fabrik, Germany	NSK	1111
369.	Acrylic Sheet (55”X53”X0.472”)	M/s Spartech Poly Cast, USA	NSK	1113

	NDT Products			
370.	Magnaglo 14 AM	ITW Signode (I) Ltd. Hyd	MAT	1072
371.	Magnaflux 8 A	ITW Signode (I) Ltd. Hyd	MAT	1073
372.	Magnaglo 2410	ITW Signode (I) Ltd. Hyd	MAT	1074
373.	Magnaglo 20 B	ITW Signode (I) Ltd. Hyd	MAT	1075
374.	Magnaflux WA -2B	ITW Signode (I) Ltd. Hyd	MAT	1076

Appendix-5b

Status of Type Approvals for Airborne Materials Coordinated Till Date by RCMA(Materials)

Sl. No.	Material	Millform	Size (mm)	Manufacturing Firm	Approval Status (TA/PC)	TA No./ PC No.	Valid upto
	Aluminium Alloys						
1.	Al-alloy AL-356	Investment Casting	Pedestal unit & Gimbal box	M/s Investment & Precision, Gujarat	TA	1517	31.12.2021
2.	Al-alloy HF 15	Forgings in T652 Condition	190 OD x 470 190 OD x 500 190 OD x 130 ID x 850	M/s Deccan Smiths Pvt ltd., Hyderabad	TA	1705	28.02.2022
3.	Al-alloy HF 15	Forgings in T652 condition	Ø190 x 900	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	TA	1872	31.12.2025
4.	Al-alloy HF15	Forgings in T652 Condition	Ø190 x 900 Ø190 x 500	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	TA	1833	30.06.2024
5.	Al-alloy HF15	Forgings in T652 condition	20 x 95 x315 20 x 80 x 135 20 x 85 x 152 75 x 135 x 170 95 x 150 x 175 95 x 215 x 315	M/s Deccan Smiths Pvt. Ltd., Hyderabad	TA	1728	30.06.2022
6.	Al-alloy AA2014	Forgings in T652 condition	OD 325 x ID 150 x L320	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1255	Active
7.	Al-alloy AA2014	Forgings in T652 condition	OD 325 x ID 250 x L760	M/s Rachamallu Forgings Pvt.Ltd.,Gandhi nagar, Balanaagr,Hyd-500037	PC	1256	Active
8.	Al-alloy AA2014	Forgings in T652 condition	340 x 200 x150	M/s Rohit Super Forge PvtLtd.,Gaddapotharam(V),jinnaram Mandakl,Kazipally Medak Dist-502319	PC	1257	Active
9.	Al-alloy AA2014	Forgings in T652 condition	855 x 330 x 20	M/s Sri Asha Forgings Pvt.Ltd.,Cherlapally,hyd-500051	PC	1258	Active
10.	Al-alloy AA6061-O	Sheets	2000L x 1500W x 4T	M/s Hindalco Industries Pvt. Ltd Hirakud Odisha-768016	PC	1274	Active
11.	Al-alloy AA2014	Forgings in T652 condition	64 x 425 x 760 (HELINA)	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1277	Active
12.	Al-alloy AA2014	Forgings in T652 condition	64 x 425 x 760 (RudraM-II)	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1292	Active
13.	Al-alloy AA2014	Forgings in T652 condition	220 x 220 x 110	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1297	Active

14.	Al-alloy AA2014	Forgings in T652 condition	250 x 250 x 150	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1296	Active
15.	Al-alloy AA2014	Forgings in T652 condition	120 x 700 x 1200	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1298	Active
16.	Al-alloy AA6061	T6 Forgings	Ø 60 x 1500	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1299	Active
17.	Al-alloy AA2014	Forgings in T652 condition	Ø 440 x 85	M/s Deccan Smiths Pvt. Ltd., Hyderabad	PC	1300	Active
18.	Al-alloy AA2014	Forgings in T652 condition	90 x 500 x 750	M/s Deccan Smiths Pvt. Ltd., Hyderabad	PC	1301	Active
19.	Al-alloy AA2014	Forgings in T652 condition	Ø 440 x 85	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1302	Active
20.	Al-alloy AA2014	Forgings in T652 condition	90 x 500 x 750	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1303	Active
21.	Al-alloy AA2014	Forgings in T652 condition	OD 205 x ID 120 x 300	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1304	Active
22.	Al-alloy AA2014	Forgings in T652 condition	OD 170 x ID 130 x 200	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1308	Active
23.	Al-alloy AA2014	Forgings in T652 condition	OD 170 x ID 130 x 300	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1309	Active
24.	Al-alloy AA2014	Forgings in T652 condition	OD 180 x ID 140 x 200	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1310	Active
25.	Al-alloy AA2014	Forgings in T652 condition	OD 465 x ID 375 x 55	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1311	Active
26.	Al-alloy AA2014	Forgings in T652 condition	75 x 170 x 500	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1312	Active
27.	Al-alloy AA2014	Forgings in T652 condition	120 x 700 x 1200	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1314	Active
28.	Al-alloy AA6061	T6 Forgings	Ø 60 x 1500	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1315	Active
29.	Al-alloy AA2014	Forgings in T652 condition	150 x 200 x 1500	M/s Rachamallu Forgings Pvt.Ltd.,Gandhi nagar, Balanaagr,Hyd-500037	PC	1316	Active
30.	Al-alloy AA2014	Forgings in T652 condition	80 x 200 x 550	M/s Rachamallu Forgings Pvt.Ltd.,Gandhi nagar, Balanaagr,Hyd-500037	PC	1317	Active
31.	Al-alloy AA2014	Forgings in T652 condition	20 x 200 x 650	M/s Rachamallu Forgings Pvt.Ltd., Gandhi nagar, Balanaagr,Hyd-500037	PC	1318	Active
32.	Al-alloy AA2014	Forgings in T652 condition	OD 220 x ID 95 x 85	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1321	Active
33.	Al-alloy AA2014	Forgings in T652 condition	OD 370 x ID 180 x 120	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1322	Active

34.	Al-alloy AA2014	Forgings in T652 condition	OD 550 x ID 230 x 140	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1323	Active
35.	Al-alloy AA2014	Forgings in T652 condition	OD 600 x ID 280 x 215	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1324	Active
36.	Al-alloy AA2014	Forgings in T652 condition	OD 640 x ID 320 x 150	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1325	Active
37.	Al-alloy AA2014	Forgings in T652 condition	OD 530 x ID 230 x 205	M/s. Deccan Smiths Pvt.Ltd, Hyderabad	PC	1326	Active
38.	Al-alloy AA2014	Forgings in T652 condition	OD 180 x 240L Id 130 x 178 Depth	M/s Manjira Machine Builders Pvt Ltd, Patiganapur, Patancheru, Telangana	PC	1327	Active
	Steels						
39.	Steel: 18%Cr-10%Ni, Ti-Stabilised Austenitic Stainless Steel 12X18H10T	Bars, Sheets & Wires	1.5 Thick & Ø 15	M/s MIDHANI, Hyderabad	TA	626	Indefinite
40.	Steel: High Strength Low Alloy Steel 30XGCN2A	Bars & Sheets	Ø 26, 36, 24, 40, 50, 56, 60, 65, 90, 110, 170	M/s MIDHANI, Hyderabad	TA	642	Indefinite
41.	Steel: Low Alloy Steel E16NCD13,	Forged Bars	Ø 125	M/s MIDHANI, Hyderabad	TA	1294	30.06.2021
42.	Steel: Low alloy Structural Steel Gd.-30 KHGSA.	H.R.bars	Ø 24, 42, 65	M/s MIDHANI, Hyderabad	TA	1165	31.12.2016
43.	Steel: Maraging steel MDN 300A	HR strips	Ø 10, 250	M/s MIDHANI, Hyderabad	TA	1710	31.12.2016
44.	Steel: MDN 127A	HR Plates & CR Strips	15, 10, 9.5, 3.5 Thick	M/s MIDHANI, Hyderabad	TA	1453	30.06.2021
45.	Steel: MDN 250A	Forged Bars And Flats	Ø 50, 60, 95, 190	M/s MIDHANI, Hyderabad	TA	1816	31.03.2024
46.	Steel: MDN 250A Maraging	Steel Forged Bars	Ø 215	M/s MIDHANI, Hyderabad	TA	694	Indefinite
47.	Steel: MDN 321A Ti-Stabilised Austenitic Stainless Steels	HR Bars		M/s MIDHANI, Hyderabad	TA	732	30.06.2021
48.	Steel: MDN 321A Ti stabilised Austenitic Stainless Steel	C.D Wires	Ø 0.6, 0.7, 0.8, 1.2, 2.0, 3.0, 5.0	M/s MIDHANI, Hyderabad	TA	991	30.06.2021
49.	Steel: MDN 321A Ti-stabilised Austenitic Stainless Steel	Billets and Forged Bars		M/s MIDHANI, Hyderabad	TA	322	30.06.2021

50.	Steel: MDN 321-A Ti-stabilised Austenitic Stainless Steel	CR Sheets	1.0, 1.6, 2.0, 2.6, 3.0 Thick	M/s MIDHANI, Hyderabad	TA	693	30.06.2021
51.	Steel: MDN 321A Ti-Stabilised Austenitic Stainless Steels:	Annealed Wires	Ø 0.7, 0.8, 1.5	M/s MIDHANI, Hyderabad	TA	619	30.06.2018
52.	Steel: MDN 347A Nb-Stabilised Stainless Steel	Sheets	1.2, 1.6, 2.0, 2.5, 3.2 Thick	M/s MIDHANI, Hyderabad	TA	713	Indefinite
53.	Steel: MDN 431A Martensitic Stainless Steel	Forged & Hot Rolled Bars	Ø 15, 35, 50, 60, 80, 90	M/s MIDHANI, Hyderabad	TA	903	31.12.2019
54.	Steel: MDN 440C Corrosion Resistant Steel HR bars (for non-weldable application only)	Hot Rolled Bars	Ø 15, 35, 50	M/s MIDHANI, Hyderabad	TA	1926	30.09.2022
55.	Steel: MDN 9201 A Case Carburising Steel	Forged Bars	Ø 300, 125	M/s MIDHANI, Hyderabad	TA	1973	31.10.2023
56.	Steel: MDN LA1 (12X2H4AW) Case carburising Low Alloy Steel	HR Bars	Ø 80, 100, 110	M/s MIDHANI, Hyderabad	TA	640	Indefinite
57.	Steel: MDN LA1(12X2H4AW)Case Carburising Steel	Forged Bars	Ø 60, 65, 125	M/s MIDHANI, Hyderabad	TA	992	31.2.2018
58.	Steel: MDN LA2 (16XCH) Low Carbon Alloy Steel	CD Wires	Ø 3.4, 4.8, 5.0, 5.2, 6.0, 6.2	M/s MIDHANI, Hyderabad	TA	682	Indefinite
59.	Steel: MDN-132A Co-MO-V Nitriding Steel	Forged Bars	Ø 90, 180	M/s MIDHANI, Hyderabad	TA	927	30.06.2016
60.	Steel: MDN-15-5 PH Stainless Steel	Forged and HR bars	Ø 25, 45, 50, 65, 85, 90, 95, 120	M/s MIDHANI, Hyderabad	TA	1166	30.06.2021
61.	Steel: MDN250A Maraging Steel	Extruded Tubes	OD 205 x ID 171, OD 200 x ID 108	M/s MIDHANI, Hyderabad	TA	1975	31.12.2023
62.	Steel: MDN347A Nb-Stabilised Stainless Steel	F & HR Bars	Ø 25, 30, 35, 40, 45, 50, 65, 70, 75, 90, 100, 110, 115, 125, 140, 150	M/s MIDHANI, Hyderabad	TA	556	Indefinite
63.	Steel: MDN-431A Martensitic Stainless Steels	HR Flats	Ø 260 x 50	M/s MIDHANI, Hyderabad	TA	928	31.12.2016

64.	Steel: Stainless Steel 12%Cr- Martensitic SS AE-961W	All Forms	Ø 65, 75, 130	M/s MIDHANI, Hyderabad	TA	614	Indefinite
65.	MDN 250 A	Hot Rolled Plates	25, 20, 7 Thick	M/s MIDHANI, Hyderabad	TA	2006	30.11.2024
66.	MDN 250 A	Rings Forgings	Wall Thickness upto 60mm & OD upto 342mm	M/s MIDHANI, Hyderabad	TA	2025	31.08.2025
67.	MDN 174A	Forged & Hot Rolled Bars	30, 90Ømm	M/s Midhani	PC	010 & 012	Active
68.	AE 962W	Hot Rolled & Cold Rolled Sheets	0.8, 1, 1.5, 3.3, 3.5mm thick	M/s Midhani	PC	22 & 23	Active
69.	MDN 132A	Hot Rolled Bars	30, 65Ømm	M/s Midhani	PC	1266	Active
70.	AE 69	Hot Rolled Bars	18, 38Ømm	M/s Midhani	PC	1033 & 1034	Active
71.	MDN 6758A	Forged & Hot Rolled Bars and Flats	40, 125,165, 50 x 155Ømm, 85mm x 310 x 2000-2500	M/s Midhani	PC	1307 & 1049	Active
72.	Softcomag 49AA	Forged & Hot Rolled Bars	50, 85Ømm	M/s Midhani	PC	1252, 1202, 1201, 1115, 1091	Active
73.	Softcomag 49AA	Cold Rolled strip	0.3mm thick x 140 mm	M/s Midhani	PC	1253	Active
74.	MDN 250A	Cast Ingot	----	M/s Midhani	PC	Nearly 60 Nos	Active
75.	15CDV6	Forged & Hot Rolled Bars	60, 70, 100, 160Ømm	M/s Midhani	PC	1142, 1108	Active
76.	MDN 250A	Flow Formed Tube	1.5mm wall thick	M/s Midhani	PC	1267	Active
77.	MDN 250A	Hot Rolled Plates	07, 19, 20, 25mm thickness	M/s Midhani	PC	1232, 1168, 1169, 1137	Active
78.	MDN 52100A	Forged & Hot Rolled Bars	15, 20, 32, 40, 80Ømm	M/s Midhani	PC	1198, 1197, 1196, 1195, 1194, 1193, 1192	Active
79.	MDN M50A	Hot Rolled Bars	40Ømm	M/s Midhani	PC	1178, 1177, 1176	Active
80.	MDN M50 NiLA	Forged & Hot Rolled Bars	40, 80,100Ømm	M/s Midhani	PC	1184, 1183, 1182, 1181, 1180, 1179	Active

81.	MDN 4340A	Forged & Hot Rolled Bars	20, 40, 80Ømm	M/s Midhani	PC	1188, 1187, 1186, 1185	Active
82.	MDN 440C A	Forged & Hot Rolled Bars	15, 40,80Ømm	M/s Midhani	PC	1191, 1190, 1189	Active
83.	MDN 304A	Forged Bars	175, 80Ømm	M/s Midhani	PC	1225, 1213, 1212, 1211	Active
84.	MDN 250W2	Filler wire	1.2, 1.6, 2.6Ømm	M/s Midhani	PC	1246, 1244, 1242, 1239, 1129, 1290, 1291-1	Active
85.	MDN 11-10 PH	Rings	685 OD x 550 ID x 125HT, 685OD x 550 ID X 145HT	M/s Midhani	PC	1144	Active
86.	MDN 465A	Forged & Hot Rolled Bars	10, 50, 100Ømm	M/s Midhani	PC	1245	Active
87.	MDN 15-5 PH	Hot Rolled Plates	25, 110, 150Ømm	M/s Midhani	PC	1247	Active
88.	15CDV6 Rings	Machined from Forged Bars	OD 180mm x ID 110mm x HT 350mm, (190 X 360Ømm)	M/s Rohit Super Forge Pvt Ltd, Telangana	PC	1264	Active
89.	15-5 PH	Hot Rolled Plates	10, 20, 40mm thick	M/s Star wire India Ltd, Haryana	PC	1263	Active
90.	MDN9201A	Forged Bars	125, 300Ømm	M/s Midhani	PC	1280	Active
91.	MDN 250A	Cold Rolled Sheets	1.5mm thick	M/s Midhani	PC	1275	Active
92.	MDN 250A	Hot Rolled Bars	45, 50Ømm	M/s Midhani	PC	1262	Active
93.	30CD12	Hot Rolled Bar	140Ømm	M/s Kalyani Carpenter Special Steels Ltd, Pune	PC	1062	Active
94.	MDN 99A	Forged, Hot Rolled Bars & Forged Flats	70x 230x 1800-2000mm, 75 x 270 x 2000-2500mm, 55 x 200 x 2000-2500mm, 100x 310 x 1500-2000mm, 100 x 310 x 15002000mm, 60mm Dia,	M/s Midhani	PC	1288	Active

95.	MDN 11-10PHA	Forged Rings	490 OD x 185 ID x 170 HT, 510 OD x 320 ID x 440 HT, 583 OD x 534 ID x 665 HT, 625 OD x 445 ID x 230 HT,	M/s Midhani	PC	1293	Active
96.	MDN 11-10PHA	Hot Rolled Plates	14 x 650 x 650mm	M/s Midhani	PC	1295	Active
97.	MDN 11-10PHA	Forged Bars	Dia 260mm x 1300mmL	M/s Midhani		1313	Active
	SUPERALLOYS						
98.	SUPERNI 75 A	Billets & Bars	F Bar – Ø100 HR Bars – Ø50 Sheets – 3 mm	M/s MIDHANI, Hyd.	TA	495	Indefinite
99.	SUPERNI75 A	Forged Bars	F Bar – Ø 100 HR Bars – Ø50 Sheets – 3 mm	M/s MIDHANI, Hyd.	TA	546	Indefinite
100.	AE 435	All forms	F Bar – Ø160 HR Bars – Ø60 Billets – 100 mm Sq	M/s MIDHANI, Hyd.	TA	566	Indefinite
101.	AE 868	All forms	F Bar – Ø100 HR Bars – Ø32, 60 Sheets – 1.8 mm	M/s MIDHANI, Hyd.	TA	762	30.06.2018
102.	SUPERNI 263 A	Hot Rolled Bars	HR Bars – Ø20, 70, 180	M/s MIDHANI, Hyd.	TA	904	30.05.2022
103.	SUPERNI718 A	Forged and Hot Rolled Bars	Ø160	M/s MIDHANI, Hyd.	TA	905	30.05.2022
104.	SUPERNI718 A Feed Stock	Compressor Blades	Ø20	M/s MIDHANI, Hyd.	TA	922	30.05.2022
105.	SUPERNI263 A	Cold Rolled Sheets	Sheets – 1.2, 2.0 Thick	M/s MIDHANI, Hyd.	TA	929	30.05.2022
106.	SUPERFER 696 M	Hot Rolled Bars & billets	Ø14, 27, 40	M/s MIDHANI, Hyd.	TA	1005	30.05.2022
107.	AE 602	HR & CR Sheets	0.9, 1.2 Thick	M/s MIDHANI, Hyd.	TA	1006	30.05.2022
108.	AE 437 A	Hot Rolled Bars	Ø20 & 30	M/s MIDHANI, Hyd.	TA	1007	30.05.2022
109.	AE 437 B	Forged HR & CR Sheets	Ø15 & 32	M/s MIDHANI, Hyd.	TA	1008	30.05.2022

110.	SUPERNI718A	Cold Rolled Sheets	2 Thick	M/s MIDHANI, Hyd.	TA	1291	30.05.2022
111.	ZS6Y-VI	Re–melt Stock	Ø80	M/s MIDHANI, Hyd.	TA	1292	30.05.2022
112.	BZLI2Y-VI	Re–melt Stock	Ø80	M/s MIDHANI, Hyd.	TA	1416	30.06.2014
113.	Supercast 247 A	Re–melt Stock	Ø80	M/s MIDHANI, Hyd.	TA	1489	30.05.2022
	TITANIUM ALLOYS						
114.	BT-3-1	Forged and Hot Rolled Bars	Ø 30	M/s MIDHANI, Hyd.	TA	639	Indefinite
115.	BT-9	Forged and Hot Rolled Bars	Ø 100, Ø 28	M/s MIDHANI, Hyd.	TA	646	Indefinite
116.	BT-5-1	Forged and Hot Rolled Bars	Ø 100, Ø 20	M/s MIDHANI, Hyd.	TA	733	Indefinite
117.	Titan 23 A (OT 4-1)	Cold Rolled sheets	0.8, 2.0 Thick	M/s MIDHANI, Hyd.	TA	906	30.05.2022
118.	Titan 31A (Ti-6-4)	Forged and Hot Rolled Bars	Ø 180, Ø 180	M/s MIDHANI, Hyd.	TA	907	30.06.2014
119.	Titan 31A (TM)	Forged and Machined Bars	Ø 180	M/s MIDHANI, Hyd.	TA	908	30.05.2022
120.	Titan 31 A (DM)	Feed Stock for Forging	Ø 180	M/s MIDHANI, Hyd.	TA	909	30.05.2020
121.	Titan 23A (OT4-1)	Forged and Hot Rolled Bars	Ø 50	M/s MIDHANI, Hyd.	TA	910	30.05.2022
122.	Titan 26 A	Forged and Machined Bars	Ø 180	M/s MIDHANI, Hyd.	TA	1293	31.12.2012
123.	Titan 29 A	Forged Bars	Ø 180	M/s MIDHANI, Hyd.	TA	1782	30.08.2018
124.	Titan 29 A	Hot Rolled Bars	Ø 60	M/s MIDHANI, Hyd.	TA	1783	30.08.2018
125.	Titanium Sponge	Sponge Granules	6-12	M/s KMML, Kerala	TA	2008	11.12.2024
126.	Ti-6Al-4V	Hot Rolled & Pickled Plates	12 & 25	M/s MIDHANI, Hyd	TA	2020	23.07.2025
127.	Titan 31 A (Double Melted)	Forged Bars	Ø 270	M/s MIDHANI, Hyd	TA	2010	14.01.2025
128.	Titan 32 (Half Alloy)	Forged Bars	Ø 148 X 500-520L	M/s MIDHANI, Hyd.	PC	1205	27.02.2018
129.	Ti-6Al-4V(ELI Grade)	Forged Bars	Ø 100	M/s MIDHANI, Hyd.	PC	1237	30.09.2018

130.	Ti-6Al-4V	Sheets (Imported)	1.5 x 200 x 650	TEAM , Chennai	PC	1254	30.09.2017
131.	Titan 1023	HR Bars	Ø 60	ADA, Bengaluru	PC	1261	28.08.2021
132.	Titan 26A	Adour HPC Disc	Stage-I	M/s MIDHANI, Hyd	PC	1282	26.09.2021
133.	Titan 26A	Adour HPC Disc	Stage-II	M/s MIDHANI, Hyd	PC	1283	30.12.2021
134.	Titan 26A	Adour HPC Disc	Stage-III	M/s MIDHANI, Hyd	PC	1286	30.12.2021
135.	Titan 26A	Adour HPC Disc	Stage-IV	M/s MIDHANI, Hyd	PC	1284	30.12.2021
136.	Titan 26A	Adour HPC Disc	Stage-V	M/s MIDHANI, Hyd	PC	1289	30.12.2021
137.	Titan 44A	Cold Rolled Sheets	2, 1.2, 0.8 Thick	M/s MIDHANI, Hyd	PC	1285	28.05.2021
138.	Titan 33A	Forged Slabs	55 x 1000 x 2600-2700, 100 x 800 x 1500-2000, 500 x 1000 x 2000-2500	M/s MIDHANI, Hyd	PC	1287	27.08.2021, 26.09.2021, 26.02.2022

Requirements of Materials Projected by various Projects of Aircraft and Aero-Engines

Alloy Name	Class of Components	Form	Size	Present Source	Requirements in kgs		Approval Status (TA-Type Approved; PC-Provisionally Cleared)
					Present	Next 5 Yrs	
Project: HAL-F&F							
Steels							
BS S154		Bar	100	Thyssenkrupp, UK.	500	2500	
MIL S 46850B IV GR250		Bar	127	Liberty Specialty	1975	5925	
MIL S 5000		Bar	200	Liberty Specialty	3000	15000	
BS S 143		Bar	50	CN Alloys, UK	100	500	
BS S 143 C		Bar	100	Norton Aluminium, UK	300	1500	
BS S 144		Bar	100	Thyssenkrupp, UK.	300	1500	
BS S15		Bar	50	Liberty Specialty	50	200	
BS S80		Bar	50	Gould Alloys Ltd.	50	1000	
BS S82		Bar	50	CN Alloys, UK	50	250	
BS S98		Bar	45	CN Alloys, UK	50	250	
BS S99		Bar	125	Liberty Specialty	1400	5000	
BS S99		Bar	150	Liberty Specialty	2600	10000	
ZFNL 9201		Bar	125	Norton Aluminium, UK	15000	28000	TA for Indigenous Material
ZFNL 9201		Bar	300	Midhani	25000	30000	TA
ZFNL 9201		Bar	100	Midhani	1000	5000	TA
ZFNL 9201		Bar	75	Norton Aluminium, UK	250	1250	
MIL-S-46850 B		Bar	175	T W Metals, USA	300	1500	
AMS 5362		Ingot	-	Norton Aluminium, UK	800	3000	
25CD4 to AIR 9160C		Bar	-	Norton Aluminium, UK	400	1050	
16NCD13 to AIR 9160C		Ingot	-	Midhani	300	850	PC
AMS 5355		Ingot	-	ABS alloys & Metals, UK	200	600	
HC 10		Bar	-	Ross & Cathetal, Uk	200	1000	
35CD4 to AIR 9160C		Ingot	-	Norton Aluminium, UK	300	1000	
				TOTAL	**54125**	**116875**	

Aluminium Alloys							
L77/2L77/ AMS 4133		Extuded Bar	75	Kalapuran	650	3250	
AA 7050		Extuded Bar	200	Kalapuran	650	3250	
AA 7075		Extuded Bar	125	Kalapuran	1000	5000	
AU2GN / AMS 4132		Extuded Bar	50	Kalapuran	1000	5000	
AU2GN / AMS 4132		Extuded Bar	150	Kalapuran	1500	7500	
AU4G1		Extuded Bar	65	Kalapuran	650	3250	
AG5MC / 5056A		Extuded Bar	200	Kalapuran	1000	5000	
A7U4SG		Extuded Bar	150	Kalapuran	1500	7000	
L77/2L77/ AMS 4133		Extuded Bar	50	Kalapuran	650	3250	
L77/2L77/ AMS 4133		Extuded Bar	65	Kalapuran	650	3250	
L77/2L77/ AMS 4133		Extuded Bar	100	Kalapuran	2000	10000	
L77/2L77/ AMS 4133		Extuded Bar	125	Kalapuran	3000	15000	
L77/2L77/ AMS 4133		Extuded Bar	150	Kalapuran	3000	15000	
L77/2L77/ AMS 4133		Extuded Bar	200	Kalapuran	3000	15000	
AA 7075		Extuded Bar	100	Kalapuran	3000	15000	
AA 7075		Extuded Bar	225	Kalapuran	3000	15000	
AK4-1 to GOST 21488..		Extuded Bar	250	Kalapuran	2000	10000	
AG5MC) / (5056)/(DIN 1747 3.3547)/ (IS-733 : 54300) /(IOF 5083A-'O') /(AMS-QQ-A-200/4C)/ 5083		Extuded Bar	150	Kalapuran	2000	10000	
AU2GN / AMS 4132		Extuded Bar	100	Kalapuran	1000	4100	
AU2GN / AMS 4132		Extuded Bar	120	Kalapuran	1000	4600	
AU2GN / AMS 4132		Extuded Bar	125	Kalapuran	1500	7500	
AU2GN / AMS 4132		Extuded Bar	150	Kalapuran	1500	7500	
AU2GN / AMS 4132		Extuded Bar	200	Kalapuran	1500	7500	
				TOTAL	**36750**	**181950**	
Titanium Alloys							
AMS 4928		Bar	275	Aubert & Duval	3500	17500	TA for Indigenous Material
AMS 4928		Bar	200	Aubert & Duval	2000	10000	TA for Indigenous Material
AMS 4928		Bar	150	TIMET UK LTD	1000	5000	TA for Indigenous Material
AMS 4928		Bar	90	Aubert & Duval	1300	6500	TA for Indigenous Material
AMS 4928		Bar	50	VSMPO Tirus GmbH	250	1250	TA for Indigenous Material

TA8DV AS PER AMS 4972		Bar	30	Stork International	2600	13000	PC for Indigenous Material
TA8DV AS PER AMS 4972		Bar	60	Stork International	700	3500	PC for Indigenous Material
2TA12		Bar	70	Stork International	800	4000	
TA6ZRD		Bar	150	Timet Savoie, France	2500	12500	TA for Indigenous Material
TA6VPQ		Bar	125	ATI Specialty, USA	500	2500	
TA6VPQ		Bar	175	Timet Savoie, France	2800	5600	
				TOTAL	**17950**	**81350**	
Ni-base Alloys/ Superalloys							
AMS 5707		Bar	150	Carpenter, USA	500	2500	
AMS 5662		Bar	150	Kalapuran	400	2000	
AMS 5666		Bar	200	ATI Specialty, USA	1000	1000	
AMS 5388		Ingot	-	ABS alloys & Metals, UK	200	1000	
AMS 5383		Ingot	-	Midhani	200	1000	
AMS 5401		Ingot	-	Midhani	200	1000	
				TOTAL	**2500**	**8500**	
Project: HAL-Koraput							
Ni Base SX		Bar	Bar Dia 90	Imported Russia		**8477**	
Ni Base		Sheet	Sheet 2.5 x 710 x 1420	Imported Russia		**178**	
Ni Base		Strip	Strip 1.0 x 230	Imported Russia		**33**	
Ti Alloys casting		Ingot	Ingot Dia 280	Imported Russia		**162**	
Steel		Pipe	Pipe Dia 18 x 0.8	Imported Russia		**42**	
Steel		Bar	Bar Dia 100	Imported Russia		**117**	
Project: HAL-LCA (For 83 Nos Aircraft)							
Steels							
Steel 316L		SHEET	0.05-3 Thick 7-380W		29	2385	
Steel 321		SHEET	1-3.5 Thick 12-240W		9	732	TA
Steel 347		SHEET	1-2.5 Thick 25-50W		1	49	TA
Steel 321		TUBE	0.8-0.9 WT OD 6.35-25		1	86	

Steel 316L		TUBE	0.8-1 WT OD 25-63		5	391	
Steel 321		BAR	ø 15-50		24	1981	TA
Steel 316L		BAR	ø 15-85		26	2127	
Steel 316L		BAR	12-45 Thick 15-300W		60	4972	
Steel 15-5 PH		BAR	ø 10-115		244	20252	PC
Steel 15-5 PH		BAR	6-55 Thick 15-175W		131	10872	PC
Steel A286		BAR	1.5 Thick 44W		2	200	
Steel 4130		SHEET	0.8-5 Thick 10-450W		92	7659	
Steel 4130		BAR	ø 6-170		498	41371	
Steel 4130		BAR	8-85 Thick 10-220W		262	21739	
Steel 4130		TUBE	1-3 WT OD 12.7-63.5		30	2490	
Steel 4130		TUBE	2 WT OD 16		0	6	
Steel 304L		TUBE	0.5 WT OD 6-8		0	0	
Steel 347		BAR	ø 5-110		18	1461	TA
Steel 347		BAR	10-125 Thick 15-240W		107	8911	TA
NCM Steel		BAR	ø 26		1	76	
Steel 347		TUBE	0.5-2.5 WT OD 6-50		2	188	
Nitriding Steel		BAR	ø 22-25		1	43	
NCM Steel		BAR	ø 5-130		369	30615	
NCM Steel		BAR	10-100 Thick 20-300W		506	42010	
CR Steel		BAR	ø 15-30		0	40	
Steel		BAR	ø 25		2	152	
Carburising Steel		BAR	ø 20		0	11	
Spring Steel		SHEET	0.5-1 Thick 16-70W		1	42	
Steel 347		SHEET	1-5 Thick 20-350W		15	1204	TA
Steel		BAR	ø 10		0	11	
NCM Steel		BAR	ø 14-15		0	8	
Steel 321		SHEET	0.3-1.6 Thick 20-120W		0	40	TA
Steel 321		SHEET	0.8-2.5 Thick 55-350W		8	666	TA
Maraging Steel		BAR	ø 6-100		98	8128	TA
Maraging Steel		BAR	60-65 Thick 140-160W		377	31327	TA
Steel wire		WIRE	ø 0.5-6		2	179	
Steel 321		SHEET	1.2 Thick 40-60W		0	18	TA

			TOTAL		**2921**	**242443**	
Al Alloys							
Al Alloys 6061		TUBE	0.6-1.2WT OD 06-80		0	8	
Al Alloys 2124		PLATE	08-152 Thick 35-1300 W		0	40	
Al Alloys 2014		FORGING STOCK	110-255 Thick 230-325W		8	666	
Al Alloys 7010		PLATE	15-140 Thick 100-1460W		98	8128	
Al Alloys 5251		TUBE	0.7-1 WT OD 6.3-16		377	31327	
Al Alloys 3103		SHEET	1 Thick 23-130W		2	179	
Al Alloys 6082		BAR	ø12-140		0	18	
Al Alloys 6082		BAR	10-115 Thick 20-325W		0	245892	
Al Alloys 6082		SHEET	0.8-4 Thick 7.2-1000W		0	0	
Al Alloys 2014		SHEET	0.5-6 Thick 10-1960W		0	0	
Al Alloys 2014		BAR	ø 8-180		0	0	TA (ø 190)
Al Alloys 2014		BAR	6-175 Thick 18-400W		0	0	
Al Alloys 2014		TUBE	1.6-2 WT OD 12.7-16		6	457	
Al Alloys 2014		EXT	3960L		2	139	
Al Alloys 2014		EXT	9990L		0	595	
Al Alloys 2014		EXT	240L		0	0	
Al Alloys 2014		EXT	288LL		0	0	
Al Alloys 2014		EXT	610L		11	900	
Al Alloys 2014		EXT	4850L		0	0	
Al Alloys 2014		EXT	1460L		0	0	
Al Alloys 2014		EXT	6950L		0	0	
Al Alloys 2014		EXT	311L		0	0	
Al Alloys 2014		EXT	1870L		0	0	
Al Alloys 2014		EXT	4260L		0	0	
Al Alloys 2014		EXT	3430L		0	0	
Al Alloys 2014		EXT	2320L		0	0	
Al Alloys 2014		EXT	1230L		0	0	
Al Alloys 2014		EXT	570L		0	0	
Al Alloys 2014		EXT	610L		0	0	
Al Alloys 2014		EXT	6990L		0	0	

Al Alloys 6061		BAR	ø 60		0	0	PC
Al Alloys 3100		SHEET	1.2 Thick 200-700W		0	0	
Al Alloys 6061		TUBE	0.8-1 WT OD 16-63		0	0	
			TOTAL		**504**	**288350**	
Ni-base Alloys/ Superalloys							
Inconel 625		TUBE	0.8-1.2 WT OD 20-63		11	921	
Inconel 625		SHEET	0.05-2 Thick 55-350W		30	2492	
Inconel 625		BAR	ø 17-25		0	37	
			TOTAL		**42**	**3449**	
Ti Alloys							
Ti Alloys 6Al4V		SHEET	1 Thick 110W		0	23	
Ti Alloys 3Al2.5V		TUBE	0.5-1.2 WT OD 06-16		24	2014	
Ti Alloys 6Al4V		BAR	ø 18		0	13	TA
Ti Alloys 6Al4V		BAR	ø 55		1	65	TA
Ti Alloys 6Al4V		BAR	35-40 Thick 40W		1	53	TA
Ti Alloys 6Al4V		BAR	ø 16		1	83	TA
Ti Alloys		SHEET	0.8 Thick 250W		3	213	
Ti Alloys 6Al4V		BAR	ø 8-65		6	531	TA
Ti Alloys 6Al4V		BAR	10-100 Thick 30-325W		696	57733	TA
			TOTAL		**732**	**60728**	
Copper Alloys							
Pure Copper		SHEET	1.5-3 Thick 30-70W		6	457	
Pure Copper		BAR	ø 20		2	139	
			TOTAL		**7**	**595**	
Al bronze							
Al bronze		BAR	ø 10-60		10.84	899.72	
			TOTAL		**11**	**900**	
Project: CABS							
Steels							

SS304	C2	Block	25 x 25 x 50 All Dimensions are in mm	Sri Durga sales, Bangalore (OEM is from USA)	1	5	TA for Indigenous Material
15-5PH	C1	Rod	i)Dia 63mm,2m Length	Sri Durga sales, Bangalore (OEM is from USA)	48	97	PC for Indigenous Material
15-5PH	C1	Rod	ii) Dia 24mm,1m Length	Sri Durga sales, Bangalore (OEM is from USA)	4	7	PC for Indigenous Material
15-5PH	C1	Rod	iii) Dia 42mm,1m Length	Sri Durga sales, Bangalore (OEM is from USA)	11	21	PC for Indigenous Material
				TOTAL	**64**	**130**	
Aluminium Alloys							
2024 T351	C2	Bar	i.40 x 40 x 1500 All Dimensions are in mm	SALCO extrusions(P) Ltd, Thane,Maharastra	672	672	
2024 T351	C2	Bar	ii.40 x 40 x 650	SALCO extrusions(P) Ltd, Thane,Maharastra	336	336	
2024 T4	C2	Sheet	8 feet x 4 feet,2mm thick	M/s Steel Age(India), Mumbai	333	333	
5052H32	C2	Sheet	8 feet x 4 feet,2mm thick	M/s Akash Aluminium company,Mysore road,Banglore	638	638	
5052H32	C2	Sheet	8feet x 4 feet,1.6mm thick	M/s Akash Aluminium company,Mysore road,Banglore	511	511	
6061 T6	C2	Bar	60 x 60 x 650 All Dimensions are in mm	SALCO extrusions(P) Ltd, Thane,Maharastra	126	126	
Al2024-T351	C1	Billets	6200 x 225 x 175mm	Constellium, Singapore		16405	
Al2024-T351	C1	Billets	6200 x 225 x 175mm	Constellium, Singapore		73823	
Al2024-T351	C1	Billets	6200 x 225 x 175mm	AMI Metals USA		2058	
Al2024-T351	C1	Billets	6200 x 225 x 175mm	AMI Metals USA		851	
				TOTAL	**2617**	**95754**	
Titanium Alloys							
Ti6Al4V	C2		8 feet x 4 feet, 1mm thick	M/s Steel Age(India), Mumbai	13	132	
Ti6Al4V	C1		1200 x 200 x 200mm	Dynamic Metals, UK		5092	
				TOTAL	**13**	**5223**	

Others							
C51000H02 OE Equivalent	C2	block	40x40mm,1m length	Sri Durga sales, Bangalore (OEM is from USA)			
4581AQIII/BTCy-1A	C1	Cyanate Ester Prepreg	Roll: 250mm()Dia x 1820mm(width) Length: 20000mm	IT Globe, USA (OEM: Toray Advanced Composites, USA)			
5.0F50 HRH-10	C1		1200 x 1820 mm x 36mm	Hexcel,USA			
E761-7781	C1	PrePegs	1000 width,100m length	Nelecote, Singapur			
Style EU92111 OR us7628	C2	Glass frabic, Plain weave	1m wide,100m length(1 Roll)	Mark Tech, Bengalore(OEM is ECC, Germany)			
M21/37%/7581	C1		Roll: 250mm()Dia x 1200mm(width) Length: 50000mm	Hexcel India Hexcel,USA			
Style 450-5	C2	Plain weave	1000 width,100m length	Mark Tech, Bengalore(OEM is ECC, Germany)			
Project : GTRE-MG							
Steels							
AE961W	C1			Midhani	0	281	
AE962W	C1			Midhani	0	30	
M50	C1	Bar	Dia 120	Midhani	300	150	
M50Nil	C1	Bar	Dia 120	Midhani	300	150	
AISI 440C	C1	Bar	Dia 120	Midhani	300	150	
A286	C3	Bar	Dia 120	Midhani	150	150	
E16NCD13	C1			Midhani	0	18	
M250 forging	C3	Bar	Dia 120	Midhani	150	150	
			TOTAL		**1200**	**1079**	
Titanium Alloys							
Ti -64	C1	Bar	Dia 180	Midhani	7000	1300	
Ti-64	C1			Midhani	11	273	
Ti 685	C1			Midhani	11	334	
Ti-900	C1			Midhani	0	412	
Ti 6242	C1			Midhani	0	296	
Ti 17	C1			Midhani	0	40	
BT3-1	C1			Midhani	0	426	TA

Ti-834	C1				11	27	
			TOTAL		**7033**	**3108**	
Super Alloys							
CM 247 DS	C1	Bar	Dia 60- 80	Abroad/ Midhani	1058	2163	
CM 247 EA	C1	Bar	Dia 60- 80	Abroad/ Midhani	1158	2043	TA for Indigenous Material
CM SX-4	C1			Abroad	549	1813	
Hastelloy X sheet	C3	Sheet	3 thick	Haynes International	10	10	
AE868				Midhani	12	18	TA
MARM509	C1			Abroad	500	500	
BZL12Y	C1			Abroad	129	398	
H 188	C1			Midhani	10	95	
H 230	C1			Midhani	23	114	
SU 718	C1			Midhani	0	1850	
SU 718	C1			Midhani	170	972	
SU 720	C1			Midhani	28	739	
SU263	C1			Midhani	29	337	
			TOTAL		**3676**	**11052**	
Al-Alloy							
Au-2GN	C1			Midhani	0	150	
			TOTAL		**0**	**150**	
Project :GTRE-STFE							
Steels							
17-7-PH	C1	Bar	Dia 45mm	Aviation Metals(England), Supreme Steels	153	2,034	
		Plate/Sheet	Thick 0.127mm,0.254mm				
15-5 PH	C1	Bar	Dia 45mm	Talley Metal Technology Inc., FRY Steel co. (California)	101	1,347	TA
E16NCD13 (Case Carburizing Steel)	C1	Bar	Dia 8mm	MIDHANI	3	100	TA
AMS5364C / CF-8C	C1		CASTING	Abroad	20	7,944	
2T66	C1	Bar	Dia 3.175, 4.75, 6.35mm Dia 6, 8, 10, 12 mm	Abroad	52	684	
		Plate/Sheet	Thick 0.91,0.8				

GTM-S-80 / AISI-431	C1	Bar	Dia 5,20, 30, 50,150, 250mm	MIDHANI	11101	1,48,089	TA
		Plate/Sheet	Thick 20.25mm				
GTM-S-130	C1		15, 20, 25, 30, 35, 40, 50, 65, 70, 75, 100	MIDHANI	1365	18,209	
GTM-S-132 (Nitriding Steel)	C1		25,35,50,75	Abroad	889	11,859	PC
S 526 / AISI - 321-A	C1	Bar	Dia25,35,40,60mm	MIDHANI	1351	18,017	TA
			Thick 0.5, 0.8, 0.85, 0.91, 1.22, 2, 3, 15, 25				TA
MDN 440C / AISI-440C	C1	Bar	Dia 20,25,30,50, 70,80, 110mm	MIDHANI	502	6,697	TA
AE961W	C1	Bar	Dia5,15,25,35,40,50,60,70, 80 ,85,100,125,150,160,250mm	MIDHANI	9221	1,23,009	TA
AE962W	C1		Thickness 1.2,5,10,15, 25mm	MIDHANI	1765	23,544	
CB-30/AMS-535D	C1		CASTING	Abroad	15	6,000	
			TOTAL		**26538**	**3,67,533**	
Ni-base Superalloys							
AE 868	C1	Bar	Dia 1.22,10mm	MIDHANI	456	6,083	TA
BZL12Y	C1		CASTING	Abroad	277	1,10,820	TA
Ni 80A	C1	Bar	Dia 100mm	MIDHANI, Special Metals(England)	65	860	TA
INCO-718/ Su - 718	C1	Bar	Dia 11.1,15, 35 mm	MIDHANI, ATI ALLVAC(Richburg), Enpar(germany), M C	273	3,638	TA
		Plate/Sheet	Thickness 0.56,0.71, 0.91,1.22,3,15, 25mm				TA (Sheet)
GTM-SU-263	C1	Bar	Dia 10, 25,30, 4.76 mm	MIDHANI	649	8,653	TA
		Plate/Sheet	Thickness 0.457,0.56, 0.71,0.91,10,15mm				TA
SU-720 / UDIMET 720	C1		FORGING	AEQUES/Abroad	90	1,201	
Ni 75	C1	Sheet	Thickness 0.51mm	Abroad	5	60	TA for Indigenous Material
Inco X-750	C1		VENDOR MATERIAL		-	-	
IC 247LC / CM 247	C1		CASTING	MIDHANI	114	45,480	TA
			TOTAL		**1929**	**176795**	
Co Based super Alloys							
H 188	C1	Bar	Dia 10, 100, 125 mm	Haynes International	301	4,011	

L605	C1	Plate/Sheet	Thickness 0.457,0.91mm	Haynes International	20	267	
			TOTAL		**321**	**4278**	
Ferrous based super Alloys							
A286	C1	Bar	Dia 12.7,40 mm	FRY STEEL COMPANY (CALIFORNIA); Aerodyne Alloys LLC	**147**	**1,961**	
		Plate/Sheet	Thickness 15 mm				
			TOTAL		**147**	**1961**	
Ti Alloys							
BT 3-1	C1	Bar	Dia 8,52,00,220 mm	MIDHANI	3915	52,226	TA
OT 4-1	C1	Bar	Dia 50 mm	MIDHANI	595	7,937	TA
OT 4-1	C1	Plate/Sheet	Thick 0.91, 15, 20	MIDHANI			TA (Up to 5mm Thick)
GTM-Ti-64	C1	Bar	Dia 35,60 mm	MIDHANI	102	1,352	TA
GTM-Ti-64	C1	Plate/Sheet	Thick 0.5,15	MIDHANI			TA
			TOTAL		**4612**	**61515**	
Al Alloys							
Al-3003	C1	Bar	Dia 12.7	Jindal Aluminium LTD, Kaiser Aluminium	162	2,158	
		Plate/Sheet	Thickness 1.22,1.63mm				
Al-6082	C1	Plate/Sheet	Thickness 5,19.05,25.4,	Amari Metals LTD (Amari Aerospace), Kamensk Uralsky Metalurgical Works(Russia)	652	8,698	
BS-L-168	C1	Plate/Sheet	Dia 15,50,65,75 mm	Abroad	65	865	
Al-6061	C1		CASTING	Abroad	90	36,000	
		Plate/Sheet	Thickness 1.27mm	Yarde Metals Inc, Alens Rolled ProductsLLC, Am Euro(Netherlands), Virat Aluminium	6	75	
			TOTAL		**975**	**47,796**	
Cu Alloys							
MONEL 400	C1		VENDOR MATERIAL				
COPPER	C1	Bar	Dia 15,25,35 mm	abroad	22	287	
		Plate/Sheet	Thickness 0.1mm				
COPPER OFE	C1	Bar	Dia 50 mm	abroad	9	120	
W80CU20	C1	Bar	Dia 40 mm	abroad	15	6,000	
			TOTAL		**46**	**6407**	

Bronze based							
LEAD BRONZE / L131	C1	Bar	Dia 10,15,20 mm	abroad	18	237	
			TOTAL		**18**	**237**	
Project: GTRE-KDE							
Steels							
S 130 Round Bars	C2	Bar	10,15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 70, 75, 80, 85, 90, 100	MIDHANI	6534	16335	
S132 Round Bars	C2	Bar	25, 30, 35, 40, 50, 65, 75, 90, 100, 125, 150, 180	MIDHANI	3265	8163	TA (ø 90-180), PC (ø 25-75)
S80 Round Bars	C2	Bar	10,15, 20, 25, 30, 35, 40, 50, 60, 75, 80, 90,100, 25,150	MIDHANI	3815	9538	
E16NCD13 Round Bars	C2	Bar	15, 25, 30, 40, 50, 60, 70, 75, 100, 125, 150	MIDHANI	340	850	TA (ø 125)
A286 Round Bars	C2	Bar	20	MIDHANI	65	163	
S 526 Sheet & Plate	C2	Sheets&Plate	0.25, 0.6, 0.91, 1.2, 1.6, 2, 3, 4, 6, 7, 10, 12, 15, 30, 35, 70	MIDHANI	1500	3750	
S 80 Sheet & Plate	C2	Sheets&Plate	3, 6, 15, 20	MIDHANI	200	500	
L168 Round Bars	C2	Bar	10, 15, 20, 30, 50, 70, 80, 90, 110, 150, 175, 200, 225, 250	IMPORT	600	1500	
L93 Sheet & Plates	C2	Sheets&Plate	3, 4, 7, 8, 10, 12, 15, 20, 25, 30	IMPORT	162	405	
S130 TUBES	C2	Tubes	6 OD, 8 OD, 10 OD, 12 OD, 16OD	IMPORT	15	38	
			TOTAL		**16496**	**41242**	
Bronze							
Aluminium Bronze	C2		50	IMPORT	2	5	
Phosphorous Bronze	C2		10,30,40	IMPORT	30	75	
			TOTAL		**32**	**80**	
Titanium Alloys							
Ti 64 Sheet & Plate	C2	Sheets& Plate	1.2, 1.6, 2, 4, 5, 6, 10, 12, 15, 20, 25, 30, 35, 45	MIDHANI	4364	10910	
Ti 64 Rectangular Bars	C1	Bars	95 X 140, 45 X 95, 75 X 110, 45 X 75, 30 X 110	MIDHANI	20307	50768	TA
Ti 900 Rectangular Bars	C1	Bars	40x75,30x60, 25x45	MIDHANI	2700	6750	TA

Ti 64 Round Bars	C2	Bars	10, 15, 20, 25, 30, 35, 40, 50, 75, 100, 125, 180, 230, 250	MIDHANI	2300	5750	TA
			TOTAL		**29671**	**74178**	
Super Alloys							
Su 263 Round Bars	C2	Bars	10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 125	MIDHANI	1100	2750	TA
Su 718 Round Bars	C2	Bars	5, 10, 15, 20, 25, 30, 35, 40, 50, 60, 70, 75, 80, 100,125,160	MIDHANI	5700	14250	TA
SU263 Sheet & Plate	C2	Sheets& Plate	0.45, 0.65, 0.71, 0.91, 1.2, 1.6, 2, 3.5, 10, 20, 25		2100	5250	TA
SU 718 Sheet & Plate	C2	Sheets& Plate	0.32, 0.55, 0.71, 0.91, 1, 1.2, 1.63, 2, 3, 4, 5, 6, 8, 10, 12, 15, 25	MIDHANI	3000	7500	TA
Su 718 Rectangular Bars	C1	Bars	25X45, 25X35, 30X30, 25X25, 25X40,15X30	MIDHANI	6400	16000	TA
			TOTAL		**18300**	**45750**	
HAL-Nashik							
Copper & Its Alloys							
DKRNP LS59-1	C1	Bar	36.0 mm L=3000	India	20	100	
LS59-1T	C1	Bar	HEX 10 L=3000	India	25	125	
DKRNP LS59-1	C1	Bar	14.0 MM L=3000	India	25	125	
BRAZHMTS 10-3-1.5	C1	Bar	75 X 12,5 MM L=3000	Russia	25	125	
BRAZHMTS 10-3-1.5	C1	Bar	GKRKHKH 120 X 15 L=2000	Russia	25	125	
LS59-1	C1	Wire	A/F 12MM L=3000	India	17	85	
M1M	C1	Wire	0.2X200	Russia	17	85	
M2T	C1	Wire	4X0.8 L=3000	Russia	17	85	
M3M	C1	Wire	DIA 6X0.6 L=3000	Russia	17	85	
DKRNP -L63M	C1	Wire	14.0 MM	Russia	17	85	
DKRNP -L63M	C1	Bar	40.0 MM L=3000	Russia	17	85	
DKRNM L63	C1	Wire	6x0.5 MM L=4000	Russia	17	85	
DKRNP LS59-1	C1	Bar	16.0 MM L=3000	India	17	85	
DKRNP LS59-1	C1	Bar	22.0 MM L=3000	India	17	85	
DKRNT BRKMTS3-1	C1	Bar	21 mm L=3000	Russia	17	85	
DPRLM/DPRNM M2 M	C1	Wire	0,5 MM L=3000	Russia	17	85	
DPRLM/DPRNM M2M	C1	Wire	0,6 MM L=3000	Russia	17	85	

DPRNM M2M	C1	Wire	M2M 0.3 X 300	Russia	17	85	
			Total		**341**	**1705**	
Titanium Alloys							
BT20	C1	Plate	100 X800x2000	Russia	500	2500	
BT16	C1	Bar	DIA 12.0 MM L=3000	Russia	100	500	
BT20	C1	Plate	40.0X1000 X 2500	Russia	300	1500	
BT20	C1	Plate	70.0X1000 X 2000	Russia	300	1500	
BT16	C1	Bar	DIA 10.0 MM L=3000	Russia	100	500	
BT20	C1	Sheet	1.5 X 600 X 2000 MM	Russia	200	1000	
BT20	C1	Sheet	2.5x800x2200 mm	Russia	200	1000	
BT20	C1	Bar	BT20 DIA 55 L=3000	Russia	100	500	
BT20	C1	Bar	60x1000X 2000	Russia	300	1500	
BT20	C1	Sheet	3.5 X900X2200MM	Russia	100	500	
BT20	C1	Sheet	4 X 600 X 2300 MM	Russia	100	500	
BT20	C1	Sheet	5 X600X2500MM	Russia	100	500	
BT6-C	C1	Bar	DIA 110.0 MM L=2000	Russia	50	250	
BT16	C1	Bar	DIA 15 mm L=3000	Russia	50	250	
BT16	C1	Bar	DIA 18.0MM L=3000	Russia	50	250	
BT20	C1	Plate	50 X1000X2000MM	India	200	1000	
OT4	C1	Sheet	1.8X800x2000/800X1500 mm	Russia	100	500	
BT20	C1		2.0X800X1500	Russia	100	500	
OT4	C1	Sheet	1.2 x 800 x 2000	Russia	100	500	
OT4	C1	Sheet	1.5 x800 x 2000 MM	Russia	100	500	
OT4	C1	Sheet	0.8X 600 X 1500 MM	Russia	100	500	
OT4	C1	Sheet	1.2X 600X 2000 MM	Russia	83	415	
OT4	C1	Bar	DIA 40 MM L=3000	Russia	67	335	
OT4	C1	Sheet	1.8 x 600 x 2000	Russia	67	335	
OT4	C1	Sheet	2.0X800X2000mm	Russia	67	335	
BT20M	C1		PT9-6k L=3000	Russia	20	100	
OT4	C1	Bar	DIA 25.0 MM L=3000	Russia	20	100	
OT4	C1	Sheet	1.5X 600X 2000 MM	Russia	20	100	

BT20	C1	Sheet	T=3 X600X2000 MM	Russia	25	125	
BT20M	C1		PT11-11 L L=3000	Russia	25	125	
BT20M	C1		PT2-54K L=2500	Russia	25	125	
OT4	C1	Bar	DIA 18.0MM L=3000	Russia	25	125	
OT4	C1	Bar	DIA 38 L=3000	Russia	25	125	
OT4	C1	Bar	DIA 50 MM L=3000	Russia	25	125	
OT4	C1	Sheet	0.6X600X2000 MM	Russia	25	125	
OT4	C1	Sheet	1.0 X 600 X 2000MM	Russia	25	125	
BT20M	C1		PT3-37K L=2600	Russia	17	85	
BT16	C1	Bar	DIA 35 L=3000	Russia	17	85	
OT4	C1	Bar	DIA 12.0MM L=3000	Russia	17	85	
OT4	C1	Bar	DIA 14.0MM L=3000	Russia	17	85	
OT4	C1	Bar	DIA 35 MM L=3000	Russia	17	85	
OT4	C1	Tube	OT4 DIA 45.0 MM L=3000	Russia	17	85	
OT4	C1	Bar	DIA 55 L=3000	Russia	17	85	
OT4	C1	Bar	DIA 60 L=3000	Russia	17	85	
OT4	C1	Bar	DIA 35 X 1.5 MM L=3000	Russia	17	85	
OT4-1	C1	Bar	DIA 40 L=3000	India	10	50	
PT7M	C1	Bar	10 X 2 L=3000	Russia	10	50	
OT4	C1	Plate	3 mm 600X1500	Russia	7	35	
OT4-0	C1	Sheet	0 12 X 1,5 L=1500	Russia	7	35	
OT4-0	C1	Sheet	0 14 X 1 L=2000	Russia	7	35	
			Total		**3988**	**19940**	
Aluminium Alloys							
AK4-1CHT	C1	Plate	30X1200X4800	Russia	500	2500	
B95PCHT1	C1	Plate	80 X1200X3000	Russia	400	2000	
B95PCHT2	C1	Plate	70,0 X1500x4000	Russia	500	2500	
B95PCHT2	C1	Plate	80,0X1200x3000	Russia	500	2500	
AK4-1CHT	C1	Plate	25X1200X3000	Russia	500	2500	
AK4-1 CHT	C1	Plate	80 X1500X4000 MM	Russia	500	2500	
AK4-1CHT	C1	Plate	40 X1000X3500	Russia	500	2500	
AK4-1CHT	C1	Plate	45X1200X3000	Russia	500	2500	

AK4-1CHT	C1	Plate	30 1200x3500	Russia	200	1000	
AK4-1CHT	C1	Plate	35X 1500 x 3000	Russia	500	2500	
AK4-1CHT	C1	Plate	40 X1500x3000	Russia	300	1500	
AK4-1 CHT	C1	Plate	70 X1500X4000 MM	Russia	500	2500	
B95PCHT2	C1	Plate	30,X1500 x 4000	Russia	500	2500	
AK4-1CHT	C1	Plate	60 X1500X4000 MM	Russia	350	1750	
B95PCHT2	C1	Plate	80 MM 1200X3000	Russia	500	2500	
B95PCHT1	C1	Plate	55 x 1200 x 6000 mm	Russia	300	1500	
AK4-1CHT	C1	Plate	40X 1200X2500	Russia	300	1500	
D19CHAMB	C1	Plate	1,8 X1500X3000	Russia	200	1000	
1420T	C1	Plate	2 X1200 X 3000	Russia	200	1000	
AK4-1CHT1	C1		444878 (PK-19886) L=3000	Russia	200	1000	
AK4-1CHT	C1	Plate	50X1500 X 3200 mm	Russia	300	1500	
B95PCHAMV	C1	Sheet	1.2 X2000 X 5000	Russia	500	2500	
B95PCHAT2B	C1	Plate	2,5 X1200 X 3000	Russia	500	2500	
B95PCHT1	C1	Plate	70X1500X5000	Russia	300	1500	
B95PCHAMV	C1	Plate	3X1200X3000	Russia	200	1000	
B95PCHAT2B	C1	Plate	2 X1200X3000	Russia	200	1000	
B95PCHT2	C1	Plate	40,0X1000x5000	Russia	400	2000	
D16CHT	C1	Bar	DIA70 L=3000	Russia	300	1500	
D19CHT	C1		552110 (PK 19527 - 1) L=4500	Russia	300	1500	
AK4-1CHT	C1	Plate	12X1000X4000	Russia	100	500	
AK4-1CHT	C1	Plate	20X1200X3000	Russia	150	750	
B95PCHAMV	C1	Sheet	1.5X1500X3000	Russia	200	1000	
B95PCHAMV	C1	Sheet	1.5X(2000X3000)	Russia	200	1000	
D16CHT	C1		80 L=2200	Russia	100	500	
D16CHT	C1	Bar	DIA 90 L=2000	Russia	100	500	
D19 CHATB	C1	Sheet	2.0X1200 X 3000	Russia	100	500	
B95PCHT2	C1	Plate	60 X1400 X 4000	Russia	400	2000	
B95PCHAMV	C1	Sheet	2.5X1500X3000	Russia	200	1000	
B95PCHAT2	C1	Sheet	T= 3X1200X3000	Russia	200	1000	
B95PCHT2	C1		420502 (PK301 -106) L=2400	Russia	50	250	

B65	C1	Bar	DIA 4.0	Russia	100	500	
B95PCHAM	C1	Wire	1.50MM	Russia	200	1000	
B95PCHAMV	C1	Sheet	1.5X1200X4000	Russia	200	1000	
D16CHT	C1	Bar	DIA 50 L=3000	Russia	100	500	
D19CHT	C1		400845. PK 801-127 L=5000	Russia	100	500	
B95PCHT3	C1	Plate	35 X1200 X 3000	Russia	250	1250	
B95PCHAT2B	C1	Plate	10 X1200 x 4500	Russia	100	500	
B95PCHAM	C1	Sheet	2X1200X3000	Russia	200	1000	
D19CHAT	C1	Sheet	1.50X1200 X 3000	Russia	100	500	
D19CHAMB	C1	Bar	2.00 MM L=3000	Russia	100	500	
B95PCHT2	C1		430656 (PK 18418) L=4000	Russia	50	250	
B95PCHT1	C1	Plate	35,0 X1400x5000	Russia	200	1000	
B95PCHAMV	C1	Sheet	1.5 X2000X2500	Russia	200	1000	
B95PCHT3	C1	Plate	30X1200X3000	Russia	100	500	
B95PCHT1	C1	Plate	40 X1400X4000	Russia	100	500	
D19CHT	C1		502002.(PK4247) L=3000	Russia	100	500	
B65	C1	bar	DIA 5.0	Russia	100	500	
1420T	C1	Sheet	3 X1200 X 3000	Russia	100	500	
B95PCH	C1		421152 (PK 355) L=4000	Russia	50	250	
B95PCHAMB	C1	Sheet	1.2 X1200 X 4000	Russia	100	500	
B95PCHAM	C1	Sheet	6 X1200 X 4000	Russia	100	500	
B95PCHAMB	C1	Sheet	1.2 X1500X3000	Russia	100	500	
B95PCHAM	C1	Sheet	1.5X1500X3000	Russia	100	500	
B95PCHAMV	C1	Sheet	2,0X1500X4000	Russia	100	500	
B95PCHAMV	C1	Sheet	2 x1500 x 4500/1425X4500	Russia	100	500	
B95PCHAMV	C1	Sheet	2,5MM 2000X2500	Russia	100	500	
D19CHATB	C1	Sheet	2.5 X1200 X 3000	Russia	100	500	
B95PCHAT2B	C1	Sheet	8 X1200X3000	Russia	100	500	
B95PCHT3	C1	Plate	45 X1200X3000	Russia	100	500	
AMTSM	C1	Sheet	1,8 X1200 x 3000	Russia	50	250	
B95PCHAMB	C1	Sheet	1,2X1200X3000	Russia	100	500	
B95PCHAMV	C1	Sheet	1,8X1500x2500(3000)	Russia	100	500	

D16CHT	C1	Bar	DIA 95 L=2000	Russia	100	500	
D19CHT	C1		661167(PK 19526) L=3000	Russia	100	500	
B95PCHT2	C1	Plate	20X1500X3000	Russia	100	500	
D19P	C1	Wire	4 MM	Russia	100	500	
D19P	C1	Wire	3 MM	Russia	100	500	
D19CHT	C1		522109. PK 19527 - 2 L=4500	Russia	100	500	
B95PCHT2	C1		B95PCHT2 420547 (PK301 -43) L=3000	Russia	50	250	
AK4-1	C1	Bar	DIA 160 L=2000	Russia	100	500	
D18P	C1	Wire	5.0MM	Russia	100	500	
DIA	C1	Bar	52.0X10.0 MM L=3000	Russia	100	500	
1420T	C1	Sheet	1.2 X 1200 X 3000	Russia	70	350	
1420T	C1	Sheet	1.5 X 1300X3000	Russia	100	500	
AMTSM	C1	Sheet	1.5 X1200X3000	Russia	50	250	
B95PCHAM	C1	Sheet	1.2X1200 X 3000	Russia	100	500	
D19CHAMB	C1	wire	1.20MM L=3000	Russia	100	500	
D19CHT	C1		440383 (PK 601 - 58) L=2500	Russia	100	500	
B95PCHT2	C1		420349 (PR 315-6) L=3000	Russia	50	250	
D18P	C1	Wire	4.0MM	Russia	83	415	
B95PCHAT1B	C1	Sheet	4.5MM 1200X4000	Russia	50	250	
AK4-1	C1	Bar	45 MM L=3000	Russia	50	250	
AK4-1	C1	Bar	85.0MM L=3000	Russia	50	250	
D19B	C1	Plate	20X1500X3000	Russia	67	335	
DIA	C1	Plate	58X10.0 MM L=3000	Russia	67	335	
AK4-1	C1	Bar	L=2000	Russia	50	250	
AK4-1CHT1	C1	Bar	L=2000	Russia	50	250	
AK4-1CHT1	C1	Bar	L=2000	Russia	50	250	
AMG2M	C1	Bar	32X1.00 MM L=3000	Russia	20	100	
B95PCH	C1		710014 (PK-17623) L=4000	Russia	30	150	
B95PCH	C1		710025 (PR 102-7) L=4000	Russia	30	150	
B95PCHAM	C1	Sheet	1.8X1200X4000	Russia	50	250	

D16-VT1-0	C1	Sheet	1.5X 600X3000	Russia	67	335	
D19CHT	C1		710036 (PR 102-34) L=4600	Russia	67	335	
B95PCHAT2	C1	Sheet	4 X1200X3000	Russia	50	250	
B95PCHT2	C1	Plate	14X1500X3200	Russia	50	250	
AK4-1CHT1	C1	bar	50.0MM L=3000	Russia	50	250	
AK4-1CHT1	C1	Bar	DIA60 L=3000	Russia	50	250	
AK4-1CHT1	C1	Bar	DIA65 L=3000	Russia	50	250	
AMG3M	C1	Bar	80MM L=2000	Russia	20	100	
AMG3M	C1	Bar	40X10 L=2000	Russia	20	100	
AMG3M	C1	Bar	45 X 10 MM L=2000	Russia	20	100	
D16T	C1	Bar	A/F 17 mm L=3000	Russia	50	250	
D16CHT	C1	Bar	DIA60 L=3000	Russia	50	250	
D19CHT	C1		PK19526 L=3000	Russia	50	250	
B95PCHT2	C1		450017 (PR 105-17) L=3000	Russia	50	250	
AMG5P	C1	Wire	5.0MM	Russia	40	200	
D18P	C1	Wire	2.6MM	Russia	25	125	
D18P	C1	Wire	3.5MM	Russia	25	125	
D19P	C1	Wire	2.6MM	Russia	25	125	
AMG5P	C1	Wire	4.0MM	Russia	33	165	
D18P	C1	Wire	3.00MM	Russia	25	125	
1420T	C1		710017 (PR102-31) L=3000	Russia	20	100	
1420T	C1		410025 (PR 100-53) L=3000	Russia	20	100	
1420T	C1		410049 (PR100-8) L=3000	Russia	20	100	
1420T	C1		410112 (PR100-60) L=3000	Russia	20	100	
1420T	C1		410760 (PR101-38) L=3000	Russia	20	100	
1420T	C1		411015 (PR101-45)	Russia	20	100	
1420T	C1		420320(PR113-6) L=3000	Russia	20	100	
1420T	C1		450037 (PR 105 - 11)	Russia	20	100	
AK4-1T1	C1	Bar	65 X 20MM L=3500	Russia	20	100	
AK4-1T1	C1	Bar	80 X 20MM L=3000	Russia	20	100	

AK4-1T1	C1	Bar	90 X 15MM L=3000	Russia	20	100	
AK4-1T1	C1	Bar	95 X 12,5 L=3500	Russia	20	100	
AK4-1CHT1	C1	bar	16.0 MM L=3000	Russia	20	100	
AK4-1CHT1	C1	Bar	DIA28 L=3000	Russia	20	100	
AK4-1CHT1	C1	Bar	DIA30 L=3000	Russia	20	100	
AK4-1CHT1	C1	Bar	DIA35 L=3000	Russia	20	100	
AK4-1CHT1	C1	Bar	DIA40 L=3000	Russia	20	100	
AK4-1CHT1	C1	Bar	46.0MM L=3000	Russia	20	100	
AK4-1CHT1	C1	Bar	DIA55 L=3000	Russia	20	100	
AMG2M	C1	Bar	12X1 MM L=4000	Russia	20	100	
AMG2M	C1	Bar	28 X 1 L=3000	Russia	20	100	
AMG3M	C1	Bar	42MM L=3000	Russia	33	167	
AMG3M	C1	Bar	DIA 65 L=2000	Russia	25	126	
B95PCH	C1		710017 (PR 102-31) L=4000	Russia	30	150	
B95PCH	C1		710022 (PR102-5)L=4000	Russia	30	150	
B95PCH	C1		710027 (PR102-32) L=4000	Russia	30	150	
B95PCH	C1		410038 (PR100-6)L=4000	Russia	30	150	
B95PCH	C1		410112 (PR100-60) L=3000	Russia	30	150	
B95PCH	C1		420407 (PR109-12) L=3000	Russia	30	150	
B95PCH	C1		440128 (PR 106-20)L=4000	Russia	30	150	
B95PCH	C1		450017 (PR 105-17)L=4000	Russia	30	150	
D16T	C1	bar	100 X 10 mm L=2000	Russia	25	125	
D16CH	C1	bar	DIA120 L=3000	Russia	25	125	
D16CHT	C1	bar	25 mm L=3000	Russia	25	125	
D16CHT	C1	bar	DIA40 L=3000	Russia	25	125	
D16CHT	C1	Bar	55MM L=3000	Russia	25	125	
D16CHT	C1	Bar	DIA65 L=3000	Russia	25	125	
D18P	C1	Wire	DIA 4 mm	Russia	25	125	
D19CHAT	C1	Wire	0.50MM L=3000	Russia	25	125	
D19CHAT	C1	Wire	4 mm L=3000	Russia	25	125	
D19CH	C1		KR110 L=2000	Russia	25	125	

D19CHT	C1		410112(PR 100-60) L=3000	Russia	25	125	
D19CHT	C1		411292(PR 101-49) L=3000	Russia	25	125	
D19CHT	C1		420377 (PK 16016) L=2500	Russia	25	125	
D19CHT	C1		563790 (PK1 9885) L=3400	Russia	25	125	
B95PCHAT1	C1		1 0,5	Russia	30	150	
B95PCHAT1B	C1	Wire	1B 1.2 X1200X3000	Russia	30	150	
B95PCHAT1	C1	Wire	1 1.5 X 1200 X 3000	Russia	30	150	
B95PCHAT1	C1	Wire	2 X1200X3000	Russia	30	150	
B95PCHT1	C1		410062 (PR 100-34) L=3000	Russia	30	150	
B95PCHAT1B	C1	Wire	B 1.5 MM 1500X3000	Russia	30	150	
B95PCHAT2	C1	Wire	1,5X1200X3000	Russia	30	150	
B95PCHT2	C1		710022 (PR102-5) L=3000	Russia	30	150	
B95PCHT2	C1		410112 (PR100-60) L=3000	Russia	30	150	
B95PCHT2	C1		410806 (PR 111-7) L=3000	Russia	30	150	
B95PCHT2	C1		410878(PR 101-43) L=3000	Russia	30	150	
B95PCHT2	C1		411126 (PR 111- 9) L=3000	Russia	30	150	
B95PCHT2	C1		411207 L=4000	Russia	30	150	
B95PCHT2	C1		420192 (PR1 13-1 8) L=3000	Russia	30	150	
B95PCHT2	C1		420407 (PR109-12) L=3000	Russia	30	150	
B95PCHT2	C1		450013(PR1 05-1) L=3000	Russia	30	150	
B95PCHT2	C1		450014 (PR 105-2) L=3000	Russia	30	150	
B95PCHAT2	C1		V-1.5 X1500X3000	Russia	30	150	
D16T	C1	Bar	70 X 10 L=2000	Russia	23	115	
AMG5P	C1	Wire	3.5 MM	Russia	17	85	
D1P	C1	wire	DIA 3.8 MM	Russia	17	85	
D16CHT	C1		PR335-7(P7048-14) L=3000	Russia	17	85	
D19P	C1	Wire	5 MM	Russia	17	85	

AMG5P	C1	Wire	2.6MM	Russia	17	85	
AMG2M	C1	Bar	30 X 1 L=3000	Russia	10	50	
AMG2M	C1	Bar	75 X 1,5 MM L=3000	Russia	10	50	
AMG3M	C1	Bar	DIA 15MM L=3000	Russia	17	85	
AMG3M	C1	Bar	DIA 20MM L=3000	Russia	17	85	
AMG3M	C1	bar	DIA26 L=3000	Russia	17	85	
AMG3M	C1	bar	DIA 30MM L=3000	Russia	17	85	
AMG3M	C1	bar	DIA 35 MM L=3000	Russia	17	85	
AMG3M	C1	bar	45MM L=3000	Russia	17	85	
AMG3M	C1	bar	42X8 L=2000	Russia	17	85	
AMG3M	C1	bar	58X12,5 L=2000	Russia	17	85	
AMG3M	C1	bar	60 X 12,5MM L=2000	Russia	17	85	
AMG3M	C1	bar	70X10 L=2000	Russia	17	85	
AMG3M	C1	bar	75X10 L=2000	Russia	17	85	
AMG3M	C1	bar	75X12.5 L=2000	Russia	17	85	
AMG3M	C1	bar	85 X 10 MM L=2000	Russia	17	85	
AMG6M	C1	bar	75 X 7,5 L=2000	Russia	17	85	
AMG6M	C1	Bar	80 X 5 L=3000	Russia	17	85	
D16T	C1	Bar	HEX 12 L=3000	Russia	17	85	
D16T	C1	Bar	HEX 32 L=3000	Russia	17	85	
D16T	C1	Bar	HEX 46 L=3000	Russia	17	85	
D16T	C1	Bar	12X3 L=3000	Russia	17	85	
D16T	C1	Bar	13 X 2 MM L=3000	Russia	17	85	
D16T	C1	Wire	20 X 1.5 MM L=3000	Russia	17	85	
D16T	C1	Wire	22 X 1,5 L=3000	Russia	17	85	
D16T	C1	Wire	25X1.5 MM L=3000	Russia	17	85	
D16T	C1	Wire	28X1.5 L=3000	Russia	17	85	
D16T	C1	Wire	30 X 6 L=2000	Russia	17	85	
D16T	C1	Wire	35X6 MM L=2000	Russia	17	85	
D16T	C1	Bar	38 X 10 L=3000	Russia	17	85	
D16T	C1	Wire	38X8.0 MM L=2000	Russia	17	85	
D16T	C1	Bar	40X2 L=3000	Russia	17	85	
D16T	C1	Bar	40 X 6 MM L=3000	Russia	17	85	

D16T	C1	Bar	40 X 7 L=2000	Russia	17	85	
D16T	C1	Bar	42 X 7 L=2000	Russia	17	85	
D16T	C1	Bar	55X8 L=2000	Russia	17	85	
D16T	C1	Bar	80X15 L=2000	Russia	17	85	
D16T	C1	Bar	105 X 10 MM L=2000	Russia	17	85	
D16T	C1	Bar	105 X 25 MM L=2000	Russia	17	85	
D16T	C1	Bar	105X6 L=2000	Russia	17	85	
D16T	C1	Bar	125 X 15 MM L=2000, L=2500	Russia	17	85	
D16T	C1	Bar	140X10 L=2000	Russia	17	85	
D16CHT	C1	Bar	DIA10 mm L=3000	Russia	17	85	
D16CHT	C1	Bar	15.0MM DIA L=3000	Russia	17	85	
D16CHT	C1	Bar	DIA 30.0 MM L=3000	Russia	17	85	
D16CHT	C1	Bar	DIA38 L=3000	Russia	17	85	
D16CHT	C1	Bar	HEX A/F14 mm L=3000	Russia	17	85	
D16CHT	C1	Bar	HEX 19 L=3000	Russia	17	85	
D16CHT	C1	Bar	HEX 27 L=3000	Russia	17	85	
D16CHT	C1	Bar	410547 (PK 2-118) L=3000	Russia	17	85	
D16CHT	C1	Bar	45 X 2,5MM L=3000 L=3000	Russia	17	85	
D19CHAT	C1	Wire	0.30MM L=3000	Russia	17	85	
D19 CHT	C1	Bar	DIA 12 L=3000	Russia	17	85	
D19CHT	C1	Bar	DIA22 L=3000	Russia	17	85	
D19CHT	C1	Bar	30MM L=3000	Russia	17	85	
D19 CHT	C1	bar	DIA36 L=3000	Russia	17	85	
D19CHT	C1	bar	700233 (PR215-2) L=2000	Russia	17	85	
D19CHT	C1		700256 (PR215-3) L=3000	Russia	17	85	
D19CHT	C1		410013 (PR-100-3) L=3000	Russia	17	85	
D19CHT	C1		710017 (PR 102-31) L=3000	Russia	17	85	
D19CHT	C1		410075 (PR 100-57) L=3000	Russia	17	85	
D19CHT	C1		410113 (PR 100-61) L=3000	Russia	17	85	
D19CHT	C1		410117 (PR 100-12) L=3000	Russia	17	85	

D19CHT	C1		410121 (PR 100-13) L=3000	Russia	17	85	
D19CHT	C1		410760 (PR 101-38) L=3000	Russia	17	85	
D19CHT	C1		410763 (PR 101-16) L=3000	Russia	17	85	
D19CHT	C1		510819 (PK 13008) L=3000	Russia	17	85	
D19CHT	C1		410986 (PR 111-37) L=2300	Russia	17	85	
D19CHT	C1		# 411110# (PK2-28) L=3000	Russia	17	85	
D19CHT	C1		411280 (PK 17872) L=3000	Russia	17	85	
D19CHT	C1		# 116399 # PK 14382 # L=3500	Russia	17	85	
D19CHT	C1		116425 (PR 335-5) L=2400	Russia	17	85	
D19CHT	C1		116445 (PR 336-7) L=2000	Russia	17	85	
D19CHT	C1		420500 [S 1526] NP2 768 L=3000	Russia	17	85	
D19CHT	C1		440058 (PR 106-18) L=3000	Russia	17	85	
D19CHT	C1		440130 (PR 106-33) L=3000	Russia	17	85	
D19CHT	C1		450013 (PR-105-1) L=4000	Russia	17	85	
D19CHT	C1		450060 (PR1 05-6) L=3000	Russia	17	85	
B95PCHT2	C1		410760 (PR101 -38) L=3000	Russia	20	100	
B95PCHT2	C1		411292(PR101-49) L=3000	Russia	20	100	
D16T	C1	Bar	D16T 100X5 L=1200	Russia	13	67	
AMG5P	C1	Wire	2.0 MM	Russia	7	35	
				Total	**22505**	**112530**	
Steels							
30KHGSA	C1	Bar	A/F 10 MM L=3000	India	500	2500	
30KHGSA	C1	Bar	B-TO A/F 12 MM L=3000	India	500	2500	
30KHGSA	C1	Bar	A/F 8 MM L=3000	India	500	2500	
30KHGSN2A -VD	C1	Bar	A -VD 140 X 20 MM L=3000	Russia	200	1000	
ZH	C1	Wire	ZH 1.8	Russia	500	2500	

30KHGSA-VD	C1	Bar	VD - X 36 MM L=3000	Russia	100	500	
C45	C1	Bar	A/F 24mm L=3000	Russia	100	500	
08KH15N5D2TU-SH	C1	Bar	110MM L=3000	Russia	200	1000	
30KHGSA	C1	Wire	A/F 7 MM L=3000	India	200	1000	
30KHGSA	C1	Bar	14 MM L=3000	India	200	1000	
14KH17N2	C1	Bar	32.0 MM L=3000	India	100	500	
C10	C1	Wire	3.4MM	Russia	100	500	
30KHGCA	C1	Bar	20X1000X2000	Russia	100	500	
30KHGSA	C1	Bar	25.X1000X2000	Russia	100	500	
30KHGCA	C1	Bar	5 MM	Russia	100	500	
30KHGCA	C1	Bar	5.8 MM	Russia	100	500	
30KHGCA	C1	Bar	6 MM	Russia	100	500	
08KH15N5D2TU-SH	C1	Bar	105-V L=3000	Russia	167	835	
12KH18N10T	C1	Wire	6 x 1 MM L=3000	Russia	24	119	
13KH15N4AM3-SH	C1	Bar	65.0 MM L=3000	Russia	100	500	
13KH15N4AM3-SH	C1	Bar	85 MM L=3000	Russia	100	500	
14KH17N2	C1	bar	A/F 17MM L=3000	India	50	250	
30KHGSA	C1	bar	16.0X 1000X2000	Russia	100	500	
C10	C1	Bar	5MM	Russia	100	500	
30KHGCA	C1	Wire	4.8MM	Russia	100	500	
ZH	C1	Wire	3.6	Russia	100	500	
14KH17N2	C1	Bar	A/F 10 MM L=3000	India	50	250	
07KH16N6-SH	C1	Bar	A/F 10 MM L=3000	Russia	50	250	
12KH18N10T	C1	Wire	8 x 0.6 L=3000	Russia	11	57	
12KH18N10T	C1	Wire	8 x 1 MM L=3000	Russia	19	95	
13KH11N2V2MFSH	C1	Bar	DIA60 MM L=3000	Russia	60	300	
14KH17N2	C1	Bar	A/F 27 MM L=3000	India	50	250	
18KH2N4VA-3-TO	C1	Bar	135 MM L=2000	Russia	50	250	
30KHGSA	C1	Bar	A/F 27 MM L=3000	India	50	250	
30KHGSA	C1	Plate	40X1000X2000	Russia	200	1000	
14KH17N2	C1	Bar	30.0 MM L=3000	India	50	250	
12KH18N10T	C1	Bar	32 x 1.5MM L=3000	Russia	9	48	
13KH15N4AM3-SH	C1	Bar	18MM L=3000	Russia	50	250	

13KH15N4AM3-SH	C1	Bar	DIA 26.0 MM L=3000	Russia	30	150	
13KH15N4AM3-SH	C1	Bar	DIA 70.0 MM L=3000	Russia	50	250	
13KH15N4AM3-SH	C1	Bar	130 MM L=3000	Russia	50	250	
C10	C1	Bar	DIA 8.0 MM L=3000	Russia	50	250	
07KH16N6-SH	C1	Bar	DIA 38MM L=3000	Russia	40	200	
07KH16N6-SH	C1	Bar	A/F 14.00 L=3000	Russia	40	200	
10KH11N23T3MR-VD	C1	Bar	B-28 L=3000	Russia	67	333	
13KH15N4AM3-SH	C1	Bar	DIA 20.0 MM L=3000	Russia	20	100	
13KH15N4AM3-SH	C1	Bar	DIA 22.0 MM L=3000	Russia	70	350	
13KH15N4AM3-SH	C1	Bar	DIA 80.0 MM L=3000	Russia	50	250	
13KH15N4AM3-SH	C1	Bar	100.0MM L=3000	Russia	50	250	
30KHGSA	C1	Sheet	2 X1000X2000	Russia	67	333	
30KHGSA	C1	Wire	4.4MM	Russia	50	250	
30KHGCA	C1	Bar	A/F 5.5MM L=3000	Russia	50	250	
07KH16N6-SH	C1		B-22 L=3000	Russia	40	200	
08KH15N5D2TU-SH	C1	Bar	75MM L=3000	Russia	50	250	
12KH18N10T	C1	Wire	9 X 1.4 L=3000	Russia	1	7	
C10	C1	Wire	2.6MM	Russia	25	126	
C15	C1	Wire	DIA 3.4 MM	Russia	25	126	
C20	C1	Bar	DIA 8.0 MM L=3000	Russia	25	126	
C20	C1	Wire	0.8mm 1000X2000	India	25	126	
C20	C1	Wire	1.0mm 1000X2000	India	25	126	
C20	C1	Wire	1.2mm 1000X2000	India	25	126	
C10	C1	Bar	DIA 5.0 MM L=3000	Russia	25	126	
C20A	C1	Bar	4.0X0.5 MM L=3000	Russia	1	6	
30KHGCA	C1	Bar	4.35MM	Russia	33	167	
07X16H6-SH	C1	Bar	A/F 12.0 MM L=3000	Russia	30	150	
12KH18N10T	C1	Bar	A/F 17.0 MM L=3000	India	25	125	
07KH16N6-SH	C1	Bar	50MM L=3000	Russia	30	150	
07KH16N6-SH	C1	Bar	60MM L=3000	Russia	30	150	
07KH16N6-SH	C1	Bar	A/F 19 MM L=3000	Russia	30	150	
08KH15N5D2TU-SH	C1	Bar	22.0 MM L=3000	Russia	33	167	
08KH15N5D2TU-SH	C1	Bar	25.0 MM L=3000	Russia	33	167	

08KH15N5D2TU-SH	C1	bar	30.0 MM L=3000	Russia	25	125	
08KH15N5D2TU-SH	C1	bar	40 MM L=3000	Russia	33	165	
08KH15N5D2TU-SH	C1	Bar	5.0 MM 1000X2000	Russia	30	150	
08KH15N5D2TU-SH	C1	Bar	6,0MM 1000X2000	Russia	20	100	
08KH15N5D2TU-SH	C1	Sheet	1.0 MM 1000X2000	Russia	25	125	
10KH11N23T3MR-VD	C1	Bar	30-V L=3000	Russia	33	167	
12KH18N10T	C1	Bar	A/F 14 MM L=3000	India	30	150	
12KH18N10T	C1	Bar	A/F 22 MM. L=3000	India	25	125	
12KH18N10T	C1	Bar	A/F 27-h11 L=3000	India	25	125	
12KH18N10T	C1	Bar	4 X 0,5 MM L=3000	Russia	0	1	
12KH18N10T	C1	Bar	22 x 1,0 L=4000	Russia	23	115	
12KH18N9T	C1	Bar	A/F 5 MM L=3000	India	20	100	
13KH11N2V2MFSH	C1	Bar	24 MM L=3000	Russia	20	100	
13KH11N2V2MFSH	C1	Bar	28MM L=3000	Russia	20	100	
13KH11N2V2MFSH	C1	Bar	32 MM L=3000	Russia	20	100	
13KH15N4AM3-SH	C1	Bar	12MM L=3000	Russia	20	100	
13KH15N4AM3-SH	C1	Bar	14MM L=3000	Russia	20	100	
14KH17N2	C1	Bar	L=3000	India	20	100	
14KH17N2	C1	Bar	A/F 8 MM L=3000	India	20	100	
18KH2N4VA	C1	Bar	3-TO 42 MM L=3000	Russia	20	100	
20A	C1	Bar	20A 5 X 1,0MM L=3000	Russia	1	5	
		Bar					
20KH13	C1	Bar	12 MM L=3000	Russia	20	100	
20KH13	C1	Bar	15 MM L=3000	Russia	20	100	
20KH13	C1	Bar	28MM L=3000	Russia	20	100	
20KH13	C1	Bar	35MM L=3000	Russia	20	100	
20KH13	C1	Bar	DIA 65 L=3000	Russia	20	100	
C-25	C1	Bar	10 MM L=3000	Russia	25	125	
30KHGSA	C1	Sheet	1.2 X1000X2000	Russia	33	165	
30KHGSA	C1	Bar	22 X 2.0 L=3000	Russia	34	171	
30KHGSN2A-VD	C1	Bar	36 MM L=3000	India	33	165	
30KHGSN2A-VD-V-NG	C1	Bar	A/F 46 MM L=3000	India	33	165	
40KHN2SMA-VD	C1	Bar	35-V L=3000	Russia	33	165	

40KHN2SMA-VD	C1	Bar	38-V L=3000	Russia	33	165	
40KHN2MA-V	C1	Bar	24 MM L=3000	Russia	33	165	
C-45	C1	Bar	14 - MM L=3000	Russia	25	125	
C-45	C1	Bar	V-24 L=3000	Russia	25	125	
50KHFA-B	C1	Bar	25-B L=3000	Russia	20	100	
65S2VA-SH	C1	Bar	N-P-2-2 MM L=5000	Russia	33	165	
65S2VA-G	C1	Bar	1-KHN 3.5 MM L=5000	Russia	33	165	
65S2VA-SH	C1	Bar	B-1 4 MM L=3500	Russia	33	165	
65S2VA-G	C1	Bar	1-KHN 8L=5000	Russia	33	165	
65S2VA-SH-G	C1	Bar	1 10 MM L=5000	Russia	33	165	
K350V/C-20	C1	Sheet	0.5mm 1000X2000	India	25	125	
C10	C1	Bar	12.0 MM L=3000	Russia	17	85	
C20	C1	Bar	DIA 12.0 MM L=3000	Russia	17	85	
C20	C1	Bar	DIA 20.0 MM L=3000	Russia	17	85	
C20	C1	Bar	3.0mm 1000X2000	India	17	85	
C20	C1	Bar	4.0mm 1000X2000	India	17	85	
C25	C1	Bar	DIA 3.0 MM	Russia	17	85	
C45	C1	Bar	DIA 18.0 MM L=3000	Russia	17	85	
CLIIA/C70	C1	Bar	DIA 0.3 MM	Russia	17	85	
CLIIA/C70	C1	Bar	DIA 0.8 MM	Russia	17	85	
CLIIA/C70	C1	Bar	DIA 1.2 MM	Russia	17	85	
CLIIA/C70	C1	Bar	DIA 1.6 MM	Russia	17	85	
CLIIA/C70	C1	Bar	DIA 4.0 MM	Russia	17	85	
CLIIA/C70	C1	Bar	DIA 3.0 MM	Russia	17	85	
C25	C1	Bar	2.6MM	Russia	17	85	
C20	C1	Sheet	1.5mm 1000X2000	India	17	85	
C20	C1	Sheet	2.0mm 1000X2000	India	17	85	
C20A	C1	Bar	8.0X1.0 MM L=3000	Russia	1	4	
CLIIA/C70	C1	Sheet	DIA 1.0 MM	Russia	17	85	
07KH16N6-SH	C1	Bar	6 MM L=3000	Russia	20	100	
07KH16N6-SH	C1	Bar	DIA 16.0 MM L=3000	Russia	20	100	
08KH15N5D2TU-SH	C1	Bar	12.0 MM L=3000	Russia	15	75	
12KH18N10T	C1	Bar	10 x 2,0MM L=3000	Russia	8	40	

12KH18N10T	C1	Bar	0,5 x 400	Russia	10	50	
20A	C1	Bar	8 X 1MM L=3000	Russia	1	4	
20A	C1	Bar	8 X 1,5MM L=3000	Russia	1	4	
20KH13	C1	Bar	8 MM . L=3000	Russia	10	50	
20KH13	C1	Bar	25MM L=3000	Russia	10	50	
C-25	C1	Bar	3.4-P-1 L=3000	Russia	17	85	
C-45	C1	Bar	10-V L=3000	Russia	17	85	
C-45	C1	Bar	V-12 L=3000	Russia	17	85	
C-45	C1	Bar	22 MM L=3000	Russia	17	85	
C-45	C1	Bar	9 - MM L=3000	Russia	17	85	
B-2A	C1	Bar	1 MM	Russia	17	85	
B-2A	C1	Bar	1,8	Russia	17	85	
B-2A	C1	Bar	5.0 MM	Russia	17	85	
20A	C1	Bar	8 X 1,6 L=3000	Russia	0	2	
20A	C1	Bar	8 X 2,0MM L=3000	Russia	1	4	
36NKHTYU-PN	C1	Bar	0,8 MM	Russia	7	35	
U10A-S	C1	Bar	0,6 X100	Russia	7	35	
U10A-S	C1	Bar	0,7 X 100	Russia	7	35	
U10A-S-N	C1	Wire	0.8 X 100	Russia	7	35	
U10A	C1	Wire	2,0 X 100	Russia	7	35	
12KH18N10T	C1	Wire	2-3,2-0,5	Russia	2	11	
30KHGSA	C1	Bar	B-10 X 3MM L=3000	Russia	2	11	
30KHGSA	C1	Bar	14 X 4.0MM L=3000	Russia	4	20	
12KH18N10T	C1	Bar	57 X 6.0 MM L=3000	Russia	8	41	
12KH18N10T	C1	Bar	63 x 2,0 L=3000	Russia	12	60	
12KH18N10T	C1	Bar	63 X 8,5 L=3000	Russia	7	37	
10KH11N23T3MR-VD	C1	Bar	45MM L=3000	Russia	40	200	
				Total	**8086**	**40442**	

Alloy	**Class**	**Form**	**SIZE**	**Present Source**	**Present Qty**	**Next 5 Yrs Qty**	

HAL-Engine Division Per SHAKTHI Engine							
Aluminium Alloy							
2024		Bar	ø15, 15L	M/s Safran FRANCE	0.0		
2024		Bar	ø20, 784L	M/s Safran FRANCE	0.7		
2024		Bar	ø30, 30L	M/s Safran FRANCE	0.1		
2024		Bar	ø35, 20L	M/s Safran FRANCE	0.1		
2024		Bar	ø40, 100L	M/s Safran FRANCE	0.3		
2024		Bar	ø45, 45L	M/s Safran FRANCE	0.2		
2024		Bar	ø50, 50L	M/s Safran FRANCE	0.3		
2024		Bar	ø52, 25L	M/s Safran FRANCE	0.1		
2024		Bar	ø55, 25L	M/s Safran FRANCE	0.2		
2024		Bar	ø70, 338L	M/s Safran FRANCE	3.5		
2024		Bar	ø76, 50l	M/s Safran FRANCE	0.6		
2024		Bar	ø 80, 50L	M/s Safran FRANCE	0.7		
2024		Bar	ø 105, 65L	M/s Safran FRANCE	1.5		
2024		Bar	ø 105, 65L	M/s Safran FRANCE	1.5		
2024		Bar	ø 115, 75L	M/s Safran FRANCE	2.1		
2024		Bar	ø 26, 442L	M/s Safran FRANCE	3.1		
2024		Wire	ø 3, 750L	M/s Safran FRANCE	0.6		
2024		Wire	ø 4, 1426L	M/s Safran FRANCE	3.1		
5086		Bar	ø 20, 35L	M/s Safran FRANCE	0.0		
5086		Wire	ø 1.2, 1600L	M/s Safran FRANCE	0.5		
6061		Bar	ø 10, 37L	M/s Safran FRANCE	0.0		
6061		Bar	ø 15, 20L	M/s Safran FRANCE	0.0		
6061		Bar	ø 20, 25L	M/s Safran FRANCE	0.0		
6061		Bar	ø 45, 70L	M/s Safran FRANCE	0.3		
6061		Bar	ø 50, 80L	M/s Safran FRANCE	0.4		
6061		Bar	ø 60, 70L	M/s Safran FRANCE	0.5		
6061		Bar	ø 86, 20L	M/s Safran FRANCE	0.3		
6061		Bar	ø 90, 30L	M/s Safran FRANCE	0.5		
6061		Bar	ø 150, 130L	M/s Safran FRANCE	6.2		

6061		Bar	ø 190, 180L	M/s Safran FRANCE	13.8		
A7-U4SG		Bar	ø 10, 100L	M/s Safran FRANCE	0.0		
AU2GN		Bar	ø 15, 45L	M/s Safran FRANCE	0.0		
AU2GN		Bar	ø 20, 25L	M/s Safran FRANCE	0.0		
AU2GN		Bar	ø 25, 50L	M/s Safran FRANCE	0.1		
AU2GN		Bar	ø 40, 15L	M/s Safran FRANCE	0.1		
AU2GN		Bar	ø 45, 25L	M/s Safran FRANCE	0.1		
AU2GN		Bar	ø 60, 35L	M/s Safran FRANCE	0.3		
AU2GN		Bar	ø 80, 117L	M/s Safran FRANCE	1.6		
AU2GN		Bar	ø 90, 45L	M/s Safran FRANCE	0.8		
AU2GN		Bar	ø 110, 267L	M/s Safran FRANCE	6.8		
AU2GN		Bar	ø 150, 102L	M/s Safran FRANCE	4.9		
AS7G06		Bar	ø 110, 15L	M/s Safran FRANCE	0.4		
AS7G06		Bar	ø 60, 99L	M/s Safran FRANCE	1.6		
				Total	**57.9**		
STEELS							
XC80		Wire	ø 0.8, 160L	M/s Safran FRANCE	0.0		
Z12CN1810		Wire	ø 0.8, 240L	M/s Safran FRANCE	0.0		
Z12CN1810		Wire	ø 0.8, 740L	M/s Safran FRANCE	0.0		
Z15CN1703		Bar	ø 18, 30L	M/s Safran FRANCE	0.1		
Z15CN1703		Bar	ø 85, 85L	M/s Safran FRANCE	3.8		
15CDV6		Bar	ø 50, 30L	M/s Safran FRANCE	0.5		
15CDV6		Bar	ø 90, 97L	M/s Safran FRANCE	4.9		
30CD12		Bar	ø 15, 180L	M/s Safran FRANCE	0.3		
30CD12		Bar	ø 18, 80L	M/s Safran FRANCE	0.2		
30CD12		Bar	ø 20, 20L	M/s Safran FRANCE	0.1		
30CD12		Bar	ø 40, 20L	M/s Safran FRANCE	0.2		
30CD12		Bar	ø 60, 240L	M/s Safran FRANCE	5.4		
30CD12		Bar	ø 75, 45L	M/s Safran FRANCE	1.6		
30CD12		Bar	ø 110, 331L	M/s Safran FRANCE	24.8		
30CD12		Bar	ø 115, 50L	M/s Safran FRANCE	4.1		
30CD12		Bar	ø 12, 245L	M/s Safran FRANCE	21.9		

30CD12		Bar	ø 125, 85L	M/s Safran FRANCE	8.2		
30CD12		Bar	ø 140, 94L	M/s Safran FRANCE	11.4		
E16NCD13		Bar	ø 65, 320L	M/s Safran FRANCE	8.4		
E32CDV13		Bar	ø 112, 115L	M/s Safran FRANCE	8.9		
EZ6CNT25		Bar	ø 10, 15L	M/s Safran FRANCE	0.0		
EZ6CNT25		Bar	ø 15, 180L	M/s Safran FRANCE	0.3		
EZ6NCT25		Bar	ø 10, 20L	M/s Safran FRANCE	0.0		
Z100CD17		Bar	ø 5, 60L	M/s Safran FRANCE	0.0		
Z100CD17		Bar	ø 8, 80L	M/s Safran FRANCE	0.0		
Z100CD17		Bar	ø 15, 35L	M/s Safran FRANCE	0.0		
Z100CD17		Bar	ø 25, 65L	M/s Safran FRANCE	0.3		
Z100CD17		Bar	ø 35, 65L	M/s Safran FRANCE	0.5		
Z10CNT18-11		Bar	ø 10, 80L	M/s Safran FRANCE	0.1		
Z10CNT18-11		Bar	ø 15, 10L	M/s Safran FRANCE	0.0		
Z10CNT18-11		Bar	ø 16, 20L	M/s Safran FRANCE	0.0		
Z10CNT18-11		Bar	ø 20, 160L	M/s Safran FRANCE	0.4		
Z10CNT18-11		Bar	ø 22, 100L	M/s Safran FRANCE	0.3		
Z10CNT18-11		Bar	ø 25, 75L	M/s Safran FRANCE	0.3		
Z10CNT18-11		Bar	ø 30, 75L	M/s Safran FRANCE	0.4		
Z10CNT18-11		Bar	ø 32, 65L	M/s Safran FRANCE	0.4		
Z10CNT18-11		Bar	ø 35, 325L	M/s Safran FRANCE	2.5		
Z10CNT18-11		Bar	ø 40, 310L	M/s Safran FRANCE	3.1		
Z10CNT18-11		Bar	ø 50, 1260L	M/s Safran FRANCE	19.5		
Z10CNT18-11		Bar	ø 55, 40L	M/s Safran FRANCE	0.8		
Z10CNT18-11		Bar	ø 60, 400L	M/s Safran FRANCE	8.9		
Z10CNT18-11		Bar	ø 70, 110L	M/s Safran FRANCE	3.3		
Z10CNT18-11		Bar	ø 120, 25L	M/s Safran FRANCE	2.2		
Z10CNT18-11		Wire	ø 0.2, 100L	M/s Safran FRANCE	0.0		
Z10CNT18-11		Wire	ø 0.5, 217L	M/s Safran FRANCE	0.1		
Z10CNT18-11		Wire	ø 0.6, 70.25L	M/s Safran FRANCE	0.0		
Z10CNT18-11		Wire	ø 0.8, 90L	M/s Safran FRANCE	0.1		
Z10CNT18-11		Wire	ø 1, 433.7L	M/s Safran FRANCE	0.3		
Z10CNT18-11		Wire	ø 1.1, 1L	M/s Safran FRANCE	0.0		

Z10CNT18-11		Wire	ø 1.5, 12L	M/s Safran FRANCE	0.0		
Z10CNT18-11		Bar	ø 10, 350L	M/s Safran FRANCE	0.1		
Z10CNT18-11		Bar	ø 16, 820L	M/s Safran FRANCE	0.2		
Z10CNT18-11		Bar	ø 22, 1100L	M/s Safran FRANCE	0.5		
Z10CNT18-11		Bar	ø 6, 6105L	M/s Safran FRANCE	0.6		
Z10CNT18-11		Bar	ø 8, 2500L	M/s Safran FRANCE	0.3		
Z12CN1810		Wire	ø 0.2, 2L	M/s Safran FRANCE	0.0		
Z12CN1810		Wire	ø 0.3, 2L	M/s Safran FRANCE	0.0		
Z12CN1810		Wire	ø 0.5, 2L	M/s Safran FRANCE	0.0		
Z12CN1810		Wire	ø 0.7, 314L	M/s Safran FRANCE	0.2		
Z12CN1810		Wire	ø 0.8, 45L	M/s Safran FRANCE	0.0		
Z12CNDV12		Bar	ø 20, 390L	M/s Safran FRANCE	1.0		
Z12CNDV12		Bar	ø 60, 71L	M/s Safran FRANCE	1.6		
Z12CNDV12		Bar	ø 70, 25L	M/s Safran FRANCE	0.8		
Z12CNDV12		Bar	ø 80, 25L	M/s Safran FRANCE	1.0		
Z12CNDV12		Wire	ø 1, 30L	M/s Safran FRANCE	0.0		
Z12CNDV12		Wire	ø 2, 91L	M/s Safran FRANCE	0.1		
Z12CNDV12		Wire	ø 2.5, 64L	M/s Safran FRANCE	0.1		
Z12CNDV12		Wire	ø 3, 653L	M/s Safran FRANCE	1.5		
Z12CNDV12		Wire	ø 3.5, 240.2L	M/s Safran FRANCE	0.7		
Z12CNDV12		Wire	ø 4, 2778L	M/s Safran FRANCE	8.8		
Z15CN1703		Bar	ø 7, 18L	M/s Safran FRANCE	0.0		
Z15CN1703		Bar	ø 8, 105L	M/s Safran FRANCE	0.0		
Z15CN1703		Bar	ø 10, 245L	M/s Safran FRANCE	0.2		
Z15CN1703		Bar	ø 12, 140L	M/s Safran FRANCE	0.1		
Z15CN1703		Bar	ø 15, 413L	M/s Safran FRANCE	0.6		
Z15CN1703		Bar	ø 16, 36L	M/s Safran FRANCE	0.1		
Z15CN1703		Bar	ø 18, 120L	M/s Safran FRANCE	0.2		
Z15CN1703		Bar	ø 20, 246L	M/s Safran FRANCE	0.6		
Z15CN1703		Bar	ø 25, 50L	M/s Safran FRANCE	0.2		
Z15CN1703		Bar	ø 28, 20L	M/s Safran FRANCE	0.1		
Z15CN1703		Bar	ø 30, 72L	M/s Safran FRANCE	0.4		
Z15CN1703		Bar	ø 32, 72L	M/s Safran FRANCE	0.5		

Z15CN1703		Bar	ø 42, 55L	M/s Safran FRANCE	0.6		
Z15CN1703		Bar	ø 50, 99L	M/s Safran FRANCE	4.9		
Z15CN1703		Bar	ø 55, 45L	M/s Safran FRANCE	0.8		
Z15CN1703		Bar	ø 60, 45L	M/s Safran FRANCE	1.0		
Z25CNWS22		Bar	ø 8, 20L	M/s Safran FRANCE	0.0		
Z25CNWS22		Bar	ø 55, 60L	M/s Safran FRANCE	1.1		
Z2CN1810		Bar	ø 10, 46L	M/s Safran FRANCE	0.0		
Z30C13		Bar	ø 5, 15L	M/s Safran FRANCE	0.0		
Z30C13		Bar	ø 6, 76L	M/s Safran FRANCE	0.0		
Z50NMC12		Bar	ø 20, 40L	M/s Safran FRANCE	0.1		
Z50NMC12		Bar	ø 45, 20L	M/s Safran FRANCE	0.3		
Z50NMC12		Bar	ø 50, 25L	M/s Safran FRANCE	0.4		
Z50NMC12		Bar	ø 84, 40L	M/s Safran FRANCE	1.8		
Z50NMC12		Bar	ø 85, 46L	M/s Safran FRANCE	2.1		
Z50NMC12		Bar	ø 94, 22L	M/s Safran FRANCE	1.2		
Z50NMC12		Bar	ø 95, 26L	M/s Safran FRANCE	1.5		
Z50NMC12		Bar	ø 102, 25L	M/s Safran FRANCE	1.6		
Z50NMC12		Bar	ø 103, 26L	M/s Safran FRANCE	1.7		
Z5CNU1704		Bar	ø 52, 25L	M/s Safran FRANCE	0.4		
Z5CNU1704		Bar	ø 60, 160L	M/s Safran FRANCE	3.6		
Z5CNU1704		Bar	ø 65, 320L	M/s Safran FRANCE	8.4		
Z8CND1704		Bar	ø 90, 40L	M/s Safran FRANCE	2.0		
Z8CND1704		Bar	ø 120, 60L	M/s Safran FRANCE	5.4		
				Total	**207.8**		
NICKEL ALLOY							
NC19FENB		Bar	ø 8, 528L	M/s Safran FRANCE	0.2		
NC19FENB		Bar	ø 10, 689L	M/s Safran FRANCE	0.5		
NC19FENB		Bar	ø 12, 500L	M/s Safran FRANCE	0.5		
NC19FENB		Bar	ø 15, 80L	M/s Safran FRANCE	0.1		
NC19FENB		Bar	ø 18, 495L	M/s Safran FRANCE	1.1		
NC19FENB		Bar	ø 24, 700L	M/s Safran FRANCE	2.7		

NC19FENB		Bar	ø 25, 60L	M/s Safran FRANCE	0.2		
NC19FENB		Bar	ø 40, 85L	M/s Safran FRANCE	0.9		
NC19FENB		Bar	ø 50, 65L	M/s Safran FRANCE	1.1		
NC20K14		Bar	ø 16, 120L	M/s Safran FRANCE	0.2		
NC20T		Bar	ø 10, 40L	M/s Safran FRANCE	0.0		
NC20T		Wire	ø 0.5, 37.5L	M/s Safran FRANCE	0.0		
NC20T		Wire	ø 04, 122500L	M/s Safran FRANCE	4.1		
NC22DNB		Bar	ø 10, 70L	M/s Safran FRANCE	0.0		
NC22DNB		Bar	ø 15, 11L	M/s Safran FRANCE	0.0		
NC22DNB		Bar	ø 15, 20L	M/s Safran FRANCE	0.0		
NC22DNB		Bar	ø 30, 260L	M/s Safran FRANCE	1.5		
NC22DNB		Bar	ø 45, 160L	M/s Safran FRANCE	2.1		
NC22DNB		Bar	ø 50, 212L	M/s Safran FRANCE	3.5		
NC22DNB		Bar	ø 110, 40L	M/s Safran FRANCE	3.2		
NC22DNB		Bar	ø 140, 50L	M/s Safran FRANCE	6.5		
NC22DNB		Bar	ø 200, 180L	M/s Safran FRANCE	47.5		
NC22DNB		Bar	ø 250, 110L	M/s Safran FRANCE	45.3		
NC22DNB		Wire	ø 0.6, 2609L	M/s Safran FRANCE	1.3		
NC22DNB		Wire	ø 0.8, 10890L	M/s Safran FRANCE	7.3		
NC22DNB		Wire	ø 1, 106L	M/s Safran FRANCE	0.1		
NC22DNB		Wire	ø 1.25, 27.5L	M/s Safran FRANCE	0.0		
NC22DNB		Wire	ø 2, 3163L	M/s Safran FRANCE	5.3		
NC22DNB		Wire	ø 3, 1246L	M/s Safran FRANCE	3.1		
NC22DNB		Wire	ø 4, 5700L	M/s Safran FRANCE	19.2		
NCK20TA		Wire	ø 0.5, 341.25 L	M/s Safran FRANCE	0.1		
				Total	**157.782**		
COPPER ALLOY							
CUCO0.2		Wire	ø 0.3, 65L	M/s Safran FRANCE	0.02		
CUCO0.2		Wire	ø 0.5, 52L	M/s Safran FRANCE	0.02		
CUCO0.2		Wire	ø 0.6, 75L	M/s Safran FRANCE	0.04		
				Total	**0.08**		

							Appendix-7
Requirements of Materials Projected by various Projects of ALWs							
Alloy	**Form**	**Class**	**Size**	**Present Source**	**Requirements in KG**		**Approval Status**
					Present	**Next 5 Yrs Qty**	
Project: ASTRA MK-II							
Steels							
MDN250A	Bar	C1	Ø 190x1000	Midhani	5512	16535	TA
MDN250A	Ring	C1	OD205xID171xL370	Midhani	993	2979	TA
MDN250A	Ring	C1	OD190xID130xL550	Midhani	1814	5442	TA
MDN250A	Bar	C2	Ø95x 800	Midhani	1102	3307	TA
MDN250A	Flat	C1	Flat 60x 85 x 800	Midhani	892	2677	TA
MDN 465A	Bar	C2	Ø100x 1000	Midhani	1111	3334	PC
MDN 465A	Bar	C2	Ø50x1000	Midhani	262	787	PC
MDN 465A	Bar	C2	Ø10x1000	Midhani	11	33	PC
SOFTCOMAG 49AA	Bar	C2	Ø 40x1000	Midhani	51	154	PC
SOFT COMAG 49AA	Strip	C2	0.3 Thk x 150x2000	Midhani	8	24	PC
MDN 15-5PH A	Plate	C1	Flat 25x150x110	Midhani	336	1007	PC
MDN 15-5PH A	Bar	C1	Ø25x1000	Midhani	57	171	TA
MDN 17-4 PH A	Bar	C2	Ø 22x1000	Midhani	44	133	PC
MDN 321A	Slab	C2	Slab 50x200x700	Midhani	942	2827	TA
MDN 321A	Bar	C2	Ø 18x3000	Midhani	91	272	TA
			Total		**13228**	**39683**	
Titanium Alloys							
TITAN31A (Ti-6Al-4V)	Plate	C1	12x225x1000	Midhani	1253	3759	TA
TITAN31A (Ti-6Al-4V)	Sheet	C1	1.5x200x650	Midhani	181	543	Under Development
TTITAN 31A	Flat/Slab	C1	150x140x1000	Midhani	928	4641	TA
TITAN 31A ELI Grade	Bar	C1	Ø100x1000	Midhani	347	1736	PC
			Total		**2709**	**10679**	
Aluminum Alloys							
AA2014 T652	Bar	C1	Ø 190x500	Deccan Smith	1985	3969	TA
	Bar	C1	Ø 190x900	Deccan Smith	3572	7145	TA
AA2014 T652	Ring	C1	OD190xID130x850 L	Deccan Smith	1794	3589	TA
AA2014 T652	Slab	C1	250x250x150	M/s Manjirra Machine Builders	263	656	PC
AA2014 T652	Slab	C2	315x250x100	Deccan Smith	221	551	Yet to be taken up
			Total		**7835**	**15911**	
Project: SAAW							
Steel							
PH 15-5 PH St. Steel, H 1025	Bar	C1	Ø 25 X1000	Midhani/ Imported by M/s Kalapur	Nil	76	TA
PH 15-5 PH St. Steel, H 1026	Bar	C2	Ø 60 X1000	Midhani/ Imported by M/s Kalapur	Nil	438	TA
PH 15-5 PH St. Steel, H 1027	Bar	C2	Ø 170X250	Midhani/ Imported by M/s Kalapur	Nil	1099	OTC
PH 15-5 PH St. Steel, H 1028	Bar	C2	Ø 180X 920	Midhani/ Imported by M/s Kalapur	Nil	4536	OTC
PH 15-5 PH St. Steel, H 1029	Bar	C2	Ø 210X 230	Midhani/ Imported by M/s Kalapur	Nil	1852	OTC
PH 15-5 PH St. Steel, H 1030	Bar	C2	Ø 250X 860	Midhani/ Imported by M/s Kalapur	Nil	49	OTC
PH 15-5 PH St. Steel, H 1031	Bar	C2	Ø 250X 120	Midhani/ Imported by M/s Kalapur	Nil	913	OTC
PH 15-5 PH St. Steel, H 1032	Bar	C2	Ø 250X 3000	Midhani/ Imported by M/s Kalapur	Nil	171	OTC
Custom 465 St. Steel, H950	Bar	C2	Ø 50X1070	Midhani/ Imported by M/s Kalapur	Nil	463	PC
Custom 465 St. Steel, H951	Bar	C2	Ø 110X500	Midhani/ Imported by M/s Kalapur	Nil	560	PC
MDN 250/ AISI 4330	Bar	C3	Ø 170x600	Midhani/ Imported by M/s Kalapur	Nil	3309	TA

			TOTAL		**Nil**	**13468**	
Aluminum Alloys							
AA2014 T652	Bar	C2	Ø 190 x 1000	Manjira/Deccan Smith	Nil	1191	TA
AA2014 T652	Bar	C2	Ø 170 x 1000	Manjira/Deccan Smith	Nil	953	TA
AA2014 T652	Square	C2	200 SQ, 480L	Manjira/Deccan Smith	Nil	1344	TA
AA2014 T652	Square	C2	200 SQ, 350L	Manjira/Deccan Smith	Nil	980	TA
AA2014 T652	Square	C2	200 SQ, 210L	Manjira/Deccan Smith	Nil	588	TA
AA2014 T652	Plate	C2	1000 x 200 x 20	Manjira/Deccan Smith	Nil	224	Yet to be taken up
AA2014 T652	Plate	C2	1000 x 200 x 30	Manjira/Deccan Smith	Nil	336	Yet to be taken up
AA2014 T652	Plate	C2	650 x 200 x 20	Manjira/Deccan Smith	Nil	182	PC
AA2014 T652	Plate	C2	550 x 200 x 80	Manjira/Deccan Smith	Nil	616	PC
AA2014 T652	Slab	C2	1500 x 200 x150	Manjira/Deccan Smith	Nil	2520	Yet to be taken up
AA2014 T652	Plate	C2	1000 x 200 x 50	Manjira/Deccan Smith	Nil	560	Yet to be taken up
AA2014 T652	Plate	C2	1300 x 1000 x 25	Manjira/Deccan Smith	Nil	1365	Yet to be taken up
AA2014 T652	Plate	C2	1260 x 1000 x 25	Manjira/Deccan Smith	Nil	1323	Yet to be taken up
AA2014 T652	Slab	C2	1500 x 200 x 200	Manjira/Deccan Smith	Nil	3360	Yet to be taken up
AA2014 T6 (ALCLAD)	Sheet	C2	2000 x 1000 x 1.5	Imported by M/s Kalapurna	Nil	126	Yet to be taken up
AA2014 T6 (ALCLAD)	Sheet	C2	1500 x 1000 x1.5	Imported by M/s Kalapurna	Nil	95	Yet to be taken up
			TOTAL		**Nil**	**15763**	
Project: NGARM							
Steel							
15-5 PH steel H1025 condition	Bar	C1	Ø 20 mm X 120 mm	-	36	150	OTC
15-5 PH steel H1025 condition	Bar	C1	Ø 40 mm X 80 mm	-	348	1450	OTC
17-4 PH steel H925 condition	Bar	C1	Ø 20 mm X 120 mm	-	18	75	OTC
17-4 PH steel H925 condition	Bar	C1	Ø 60 mm X 80 mm	-	84	350	OTC
AISI SS 304	Sheet	C1	0.2 thk	-	36	150	OTC
AISI SS 304	Sheet	C1	0.5 thk	-	96	400	OTC
AISI SS 420	Bar	C1	Ø 40 mm X 60 mm	-	30	125	OTC
Permendur- 49/ASTM A801 Type 1 UNSR30005 Alloy Annealed at 845'C	Bar	C1	Ø 40 mm X 60 mm	-	52	215	OTC
Custom 465(AMS5936C) H1000 condition	Bar	C1	Ø 25 mm X 100 mm	-	20	85	OTC
Custom 465(AMS5936C) H1000 condition	Bar	C1	Ø 60 mm X 70 mm	-	98	410	OTC
Custom 465(AMS5936C) H1000 condition	Bar	C1	Ø 75 mm X 70 mm	-	156	650	OTC
Permendur- 49/ASTM A801 Type 1 UNSR30005 Alloy Annealed at 845”C	Sheets	C1	70 X 70 X 0.3	-	96	400	OTC
PTFE ASTM D 1710-08, Type III, Ørade 2, Class A	Bar	C1	Ø 10 mm X 100 mm	-	24	100	OTC
Spring Steel IS 4454 part 4 Ørade-2	Bar	C1	Ø 0.6 mm	-	0	0	OTC
MDN 250A Annealed	Rings	C1	OD280 X ID245 X 20L mm	M/s Midhani	0	117	TA
MDN 250A Annealed	Rings	C1	OD320 X ID245 X 90L mm	M/s Midhani	0	1213	TA
MDN 250A Annealed	Rings	C1	OD342 X ID305 X 260L mm	M/s Midhani	0	2772	TA
MDN 250A Annealed	Rings	C1	OD320 X ID230 X 90L mm	M/s Midhani	0	1417	TA
MDN 250A Annealed	Rings	C1	OD320 X ID200 X 125L mm	M/s Midhani	0	2481	TA
MDN 250A Annealed	Rings	C1	OD342 X ID305 X 355L mm	M/s Midhani	0	3784	TA
MDN 250A Annealed	Rings	C1	OD320 X ID270 X 170L mm	M/s Midhani	0	1595	TA
MDN 250A Annealed	Bar	C1	Ø 170 X 25	M/s Midhani	0	115	TA
MDN 250A Annealed	Bar	C1	Ø 135 X 150	M/s Midhani	0	435	TA
MDN 250A Annealed	Bar	C1	Ø 100 X 1000 L	M/s Midhani	0	636	TA
MDN 250A Annealed	Bar	C1	Ø 70 X 1000 L	M/s Midhani	0	623	TA

MDN 250A Annealed	Bar	C1	Ø 160 X 320 L	M/s Midhani	0	1042	TA
MDN 250A Annealed	Bar	C1	Ø 200 X 1000 L	M/s Midhani	0	5089	TA
MDN 250A Annealed	Square	C1	60 Square X 50	M/s Midhani	0	58	TA
MDN 250A Annealed	Plate	C1	225 X 100 X 80 Thick	M/s Midhani	0	583	TA
MDN 250A Annealed	Rings	C1	OD310 X ID120 X 130 L	M/s Midhani	0	6757	TA
MDN 250A Annealed	Bar	C1	Ø 280 X 1000	M/s Midhani	0	2494	TA
MDN 250A Annealed	Bar	C1	Ø 270 X 90L	M/s Midhani	0	2087	TA
MDN 250A Annealed	Bar	C1	Ø 320 X 1000 L	M/s Midhani	0	16286	TA
MDN 250A Annealed	Bar	C1	Ø 280 X 1000	M/s Midhani	0	19950	TA
15CD V6 Annealed	Rings	C1	OD180 X ID110 X 355 L	Rohit Super Forge	40	80	TA
MDN 250A Annealed	Sheet	C1	0.5 X 100 X 620	M/s Midhani	70	300	TA
			TOTAL		**1204**	**74476**	
Aluminum Alloys							
AA2014 T-652	Plate	C2	855 X 330 X 30 mm	Manjira	474	2370	Yet to be taken up
AA2014 T-652	Rings	C2	OD325 X ID250 X 760L mm	Rachamallu	0	7208	PC
AA2014 T-652	Rings	C2	OD325 X ID280 X 450L mm	Rachamallu	0	1347	Yet to be taken up
AA2014 T-652	Rings	C2	OD325 X ID150 X 320L mm	Manjira	2340	7020	PC
AA2014 T-652	plate	C2	340 X 200 X 150 mm	Rohit Super Forge	0	4284	PC
AA2014 T-652	plate	C2	855 X 330 X 20 mm	Manjira	0	9193	Yet to be taken up
AA2014 T-652	Bar	C2	Ø 190 mm X 900L mm	Manjira	1429	8574	PC
HF-15/AA2014 T-652	Bar	C2	Ø 120 mm *	-	0	0	TA
HF-15/AA2014 T-652	Bar	C2	Ø 320 mm*	-	0	0	Yet to be taken up
HF-15/AA2014 T-652	Bar	C2	Ø 90 mm*	-	0	0	TA
HF-15/AA2014 T-652	Bar	C2	Ø 40 mm*	-	0	0	TA
			TOTAL		**4243**	**39995**	
Project: RudraM III							
Steel							
15CD6	Plates	C1	Plates up to 20mm thick	1. Midhani 2. Manjira 3. Rohit	2000	6000	OTC
15-5 PH	Rods	C1 & 2	Rods up to Dia 100mm	1. Midhani 2. Kalapurna	2000	12000	OTC
Custom 465	Rods	C1 & 2	Rods up to Dia 150mm	1. Midhani 2. Kalapurna	3000	16000	OTC
Steel 321	Sheet	C1	Sheet up to 2mm thick	Midhani	200	500	OTC
ESR grade En24	Bar	C1 & 2	Dia up to 120mm	Midhani	2000	12000	OTC
11-10 PH	Plates	C1	Plates up to 14mm thick	Midhani	10000	30000	OTC
11-10 PH	Ring	C1	Ring Forgings up to 200mm thick	Midhani	30000	80000	OTC
11-10 PH	Rods	C1	Rods up to Dia 150mm	Midhani	10000	20000	OTC
Invar	Sheet/Plate	C1	Sheet/Plate	Midhani	500	1000	OTC
SoftcoMag	Bar	C1	Dia up to 50mm	Midhani	1000	4000	OTC
SoftcoMag	Sheet	C1	Sheet up to 2.2mm thick	Midhani	500	2000	up alloy
			Total		**61200**	**183500**	
Aluminum Alloys							
2014	Plates	C1, 2 & 3	Plates up to 20mm thick	1. Rachamallu 2. Manjira 3. HAL 4. Asha	3000	9000	Yet to be taken up

2014	Rods	C1, 2 & 3	Rods up to Dia 150mm	1. Rachamallu 2. Manjira 3. HAL 4. Asha	3000	9000	TA
7050 T 7451	Ring	C1	Ring Forgings up to 150mm thick	1. Rachamallu 2. Manjira 3. HAL 4. Asha	2000	0	Yet to be taken up
			Total		**8000**	**18000**	
Titanium Alloys							
Ti6A4V	Plates	C1	Plates up to 20mm thick	1. Midhani 2. Kalapurna	1000	3000	TA
Titan 44	Plates	C1	Plates up to 20mm thick	Midhani	2000	6000	PC
			Total		**3000**	**9000**	
Tungsten							
Cu + W	Plates	C2	Plates up to 10mm thick	ARCI	**500**	2000	Not yet started
			Total		**500**	**2000**	
Project: RudraM II							
Steel							
Invar 39/36	Ring	C1	Dia 400 mm	Midhani	1000	#	Type certification under process
30 KhGSa / En 24	Bar	C1	Dia 2 mm to 20 mm	Midhani	500	#	OTC
11-10 Ph . 15-5 PH Steel	Rod	C1	Dia 100 mm	Midhani	#	#	OTC
MDN 174 (14-4 PH Steel)	Bar	C1	Dia 50 And Dia 20	Midhani	1000	#	OTC
SS 304		C2	SS 304	Trader	1500	#	OTC
SS 316L		C2	SS 316L	Trader	1500	#	OTC
15 CdV6	Sheet	C2	Sheet	Midhani	#	#	OTC
Custom 465	Rod	C2	Rod	Import,Midhani	#	#	PC
Permendur	Sheet and R	C2	Sheet and Rod	Import,Midhani	500	#	PC
MDN 250A	Bar	C1	Dia 80 * 130	Midhani	476	#	TA
MDN 250A	Ring	C1	460*330*100	Midhani	719	#	TA
11 – 10 Ph Steel		C1	Rod	Midhani	#	#	PC
			Total		**7195**		
Aluminum Alloys							
Al Alloy 24345	Ring	C1	Dia 500 mm	Deccan smith	1000	#	Yet to be taken up
Al. Alloy 65032	Bar	C2	Dia 180	Deccan smith, Manjira	1500	#	Yet to be taken up
Al Alloy 24345	Plate	C2	40 mm thick plate	Trader	1500	#	Yet to be taken up
			Total		**4000**		
Titanium Alloys							
Ti6A4V	Bar	C1	Dia 272	Midhani	5137	#	TA
Ti 6A14V (ELI)	Bar	C1	Dia 90 * 500	Midhani	25	#	PC
Ti 6A14V (ELI)	Bar	C1	Dia 60 * 85	Midhani	74	#	PC
Titanium Gr V Plate	Plate	C1	2000*800*6	Midhani	424	#	TA
Ti Grade - II	Sheet	C1	3.5*1000*2500	Import,Midhani	309	#	OTC
Ti 5Ch Alloy	Wire	C2	Dia 4.4	Import	Vendor Sco	#	OTC
			Total		**5970**		

Tungsten							
Tungsten alloy	Cuboid	C2	6*6*4.5	NFTDC	2000	#	
			Total		**2000**		
Brass							
Brass	Assorted	C3	Assorted	Trader			Not yet started
Non-Metallic Materials							
Silicon Nitride Si3N4) / Fused Silica Ceramic	Powder	C1	Powder	M/s Chettinad, Pondichery	5300	#	
Quartz / Fused Sillica	Assorted	C2	Assorted	Trader		#	
Spinel		C2	--	ARCI	3640	#	
Graphite	Rod	C1	Rod	Graphite India Limited	2260	#	
			Total		**11200**		
Phenolic							
Carbon Phenolic		C1			Vendor Scope		
Silica – Phenolic		C1			Vendor Scope		
ERDM Rubber		C3			Vendor Scope		
NOTE: (#) In Future all raw Materials Procurement will be vendors scope							
Project: LRGB							
STEELS							
MDN 250 A	Sheet	C1	1500 X 500 X 8 mm	M/S Midhani	0	213	
MDN 250 A	Sheet	C1	500 X 400 X 15 mm	M/S Midhani	0	120	
MDN 250 A	Sheet	C1	1000 X 500 X 10 mm	M/S Midhani	0	125	TA
MDN 250 A	Bar	C1	DIA 440 X 85 L	M/S Midhani	0	220	
MDN 250 A	Bar	C1	DIA 200 X 85 L	M/S Midhani	0	330	
MDN 250 A	Bar	C1	DIA 150 X 60 L	M/S Midhani	0	330	
MDN 250 A	Bar	C1	DIA 60 X 100 L	M/S Midhani	0	220	
MDN 15 – 5PH	Bar	C1	DIA 100 X 200 L	M/S Midhani	0	875	PC
MDN 15 – 5PH	Bar	C1	DIA 160 X 200 L	M/S Midhani	0	420	PC
SS304	Bar	C3	Dia 170 X 1000	M/s Midhani/Supreme Steel/ Sunflag Industries	0	35	OTC
			TOTAL		**0**	**2888**	
ALUMINIUM ALLOYS							
AA2014-T652	Bar	C1	DIA 440 X 85 L	M/S Deccan Smiths	0	220	PC
AA2014-T652	Bar	C1	DIA 90 X 560 L	M/S Deccan Smiths	0	95	Yet to be taken up
AA2014-T652	Bar	C1	DIA 200 X 1000 L	M/S Deccan Smiths	0	194	Yet to be taken up
AA2014-T652	Bar	C1	DIA 60 X 1500 L	M/S Deccan Smiths	0	125	Yet to be taken up
AA2014-T652	Slab	C1	750 X 500 X 90	M/S Deccan Smiths	0	105	Yet to be taken up
AA2014-T652	Slab	C1	1200 X 700 X 120	M/S Deccan Smiths	0	63	Yet to be taken up
AA2014-T652	Ring	C1	OD220 X ID95 X L85	M/S Deccan Smiths	0	440	PC
AA2014-T652	Ring	C1	OD370 X ID180 X L120	M/S Deccan Smiths	0	1000	PC
AA2014-T652	Ring	C1	OD550 X ID230 X L140	M/S Deccan Smiths	0	875	PC
AA2014-T652	Ring	C1	OD600 X ID280 X L215	M/S Deccan Smiths	0	125	PC
AA2014-T652	Ring	C1	OD640 X ID320 X L150	M/S Deccan Smiths	0	1220	PC
AA2014-T652	Ring	C1	OD530 X ID230 X L205	M/S Deccan Smiths	0	1250	PC
AA2014-T6	Sheet	C1	2500 X 1250 X 1.5 mm	M/s Virat AL Mumbai	40	160	Yet to be taken up

AA2014-O	Sheet	C1	2000 X 1000 X 1.5 mm	M/s Virat AL Mumbai	280	875	Yet to be taken up
AA2014-T6	Sheet	C1	2000 X 1000 X 2 mm	M/s Virat AL Mumbai	1	400	Yet to be taken up
AA2014-T6	Sheet	C1	2000 X 1000 X 2.5 mm	M/s Virat AL Mumbai	20	10	Yet to be taken up
AA2014-T6	Sheet	C1	2000 X 1000 X 4 mm	M/s Virat AL Mumbai	100	440	Yet to be taken up
AA2014-T6	Sheet	C1	2000 X 1000 X 4 mm	M/s Virat AL Mumbai	0	150	Yet to be taken up
AA2014-T6	Sheet	C1	30480 X 1524 X 6 mm	M/s Virat AL Mumbai	6	35	Yet to be taken up
AA2014-T6	Plate	C1	3048 X 1524 X 20 mm	M/s Virat AL Mumbai	0	80	Yet to be taken up
AA2014-T6	Plate	C1	700 X 400 X 40 mm	M/s Virat AL Mumbai	0	940	Yet to be taken up
AA2014-T6	Plate	C1	1500 X 400 X 50 mm	M/s Virat AL Mumbai	0	210	Yet to be taken up
AA2014-T6	Plate	C1	2000 X 1000 X 10 mm	M/s Virat AL Mumbai	0	32	Yet to be taken up
AA2014-T6	Plate	C1	2000 X 1000 X 10 mm	M/s Virat AL Mumbai	0	32	Yet to be taken up
AA2014-T6	Plate	C1	2000 X 1000 X 10 mm	M/s Virat AL Mumbai	0	40	Yet to be taken up
			TOTAL		**447**	**9116**	
Titanium Alloys							
Ti 6AL4V	Plate	C1	L350 X W300 X 50mm	M/S Midhani	0	210	TA
			TOTAL		**0**	**210**	

LIST OF APPROVED / POTENTIAL VENDORS FOR AERO / MISSILE / NAVAL MATERIALS Coordinated by RCMA(Materials), CEMILAC, Hyderabad

TITANIUM ALLOYS:

- **M/s. Midhani, Hyderabad:** BT3-1, BT-9 (IMI 550), BT5-1 (IMI 317), Titan 23 (IMI 315), Titan 31A (IMI 318), Titan 26A (IMI 685), Titan 29A (IMI 834), Titan 44A (S 21), Titan 1023 (Ti-10V-2Fe-3Al), Ti-half alloy (Ti-3Al-2.5V), Titan 20A (IMI 115), Titan 22A (Ti-8Al-1MO-1V), PT-1M, PT-7M, PT-3B, BT 1-0.
- **M/s. PTC Industries, Lucknow:** Titanium casting and Hipping (Ti6Al4V)
- **M/s. TEAM, Chennai:** Ti 6Al4V Sheets (Imported), Titanium welding (Ti6Al4V ELI grade welding)
- **M/s. KMML, Kerala:** Ti-sponge for Aero / Naval applications
- **NUCLEAR FUEL COMPLEX, Hyderabad:** Titanium Half alloy Tubes, PT1 M & P7M pipes

NICKEL BASE SUPERALLOYS:

- **M/s. Midhani, Hyderabad:** Superni 75A, AE 435, AE 868, Superni 718A, Superni 263A, AE 602, AE 437 A, AE 437B, ZS6YVI, BZL 12Y-VI, ZS6KPVI, ZS6KVI, Supercast 247A, Superni 80AA, Superni 60A, AE 602, Superfer 696M
- **DMRL, Hyderabad:** Jet Fuel Starter (JFS) Components using CM247LC

SPECIAL STEELS:

- **M/s. Midhani, Hyderabad:** 16KhSN, MDN 347A, MDN 321A, 12X18H10T, MDN 59A, MDN 60A, MDN 431A, MDN 40A, MDN 250A, MDN 250W2, MDN 122A, Grade 304, MDN 132A, AE 69, 15CDV6, MDN 127A, MDN 13-8MoPH A, MDN15-5PH A, MDN174A, MDN 440C A, MDN 99A, MDN 6758A, MDN 300A, E16NCD13, SoftCoMag 49AA, MDN 9201A, MDN 465A, MDN 52100A, MDN M50A, MDN M50 NiLA, MDN 4340A, MDN 11-10 PHA, MDN 304A, 30KhGSA, 30XGCN2A, 12X2H4AW, AE 961W, 14 Kh17N2, 16XCH, AE 962W, MDNLA2, MDN LA1, MDN 268LA, MDN 25-20LA
- **M/s. Kalyani Carpenter, Pune, Maharastra:** ZFNL 9201
- **M/s. Star Wire India (Pvt.) Ltd., Ballabgarh:** 15-5 PH steel
- **M/s. Rohit Super Forgings (Pvt) Ltd., Medak Dist:** 15CDV6 Rings
- **DMRL, Hyderabad:** Brake Piston Insulator

ALUMINIUM ALLOYS:

- **M/s. Sri Asha Forgings Private Limited, Hyderabad:** AA 2014 - T652 Forgings
- **M/s. Rachamallu Forgings Private Limited, Hyderabad :** AA 2014 - T652 Forgings
- **M/s. Rohit Super Forge Private Limited, Hyderabad:** AA 2014 - T652 Forgings
- **M/s. Deccan Smith Private Limited, Hyderabad:** HF 15 - T 652 Forgings
- **M/s. Manjira Machine Builders Private Limited, Hyderabad :** HF 15 - T 652 Forgings
- **M/s. MIDHANI, Hyderabad :** AA 2014 -T6 Closed die Forgings
- **M/s. Investment & Precision Castings Limited, Bhavnagar, Gujarat :** Al-356A Investment Castings
- **M/s. Rachamallu Forgings Private Limited, Hyderabad :** AA 7075 - T7352 Forgings

COMPOSITES & CERAMICS:

- **HTCC, Advanced Systems Laboratory, Hyderabad & M/s. Graphite India Limited, Bengaluru :** Carbon-Carbon Brake Discs for Aircraft
- **DMRL, Hyderabad:** Fused Silica Radomes (CIP Technology) for ALWs
- **ARCI, Hyderabad:** Spinel and Zinc Silphide Domes for ALWs
- **R&DE(E), Pune:** CFRP Wings for ALWs

NAVAL STEELS & WELD CONSUMABLES:

- **Defence Metallurgical Research Limited, Hyderabad & M/s. SAIL (BSP-Bhilai, ASP-Durgapur, BSL- Bokaro and RSP-Rourkela) :** DMR–249 & DMR–301 Grade Steel Plates
- **Defence Metallurgical Research Limited, Hyderabad, M/s. SAIL (ASP- Durgapur) & M/s. Krishna Allied Industries. Limited, Pune & Halol :** DMR–249 & DMR–301 Grade Steel Bulb Bars
- **Naval Materials Research Laboratory-Ambernath, M/s. Gee Ltd., Thane, M/s. Honavar Electrodes, M/s. Dwekam Electrodes Limited., Indore, M/s. D&H Secheron Electrode Limited, Indore, M/s. Starwire India Private Limited., Ballabgarh, M/s. Mailam India Ltd., Puduchery, M/s. L&T (HW), Surat, M/s. MIDHANI, Hyderabad:** Weld Consumables and Weld Technologies for DMR–249 & DMR–301 grade steels
- **M/s. MIDHANI, Hyderabad & M/s. L&T-SSHF, Surat :** DMR– Grade Steel Forgings:

List of Potential Vendor having Re-Melting / Refining Facilities in India

Sl.No.	Plant/Vendor	ESR	VSR	VD/VOD	AOD	VIM
1.	L & T	×	×	✓	×	×
2.	Bharat Forge	✓	✓	✓	×	×
3.	MVSCO	×	×	✓	×	×
4.	VIPRAS	×	×	✓	✓	×
5.	Remi melt	×	×	✓	×	×
6.	Ambica Metals	×	×	×	✓	×
7.	Vikranth	×	×	✓	×	×
8.	Star Wire	✓	✓	✓	✓	Planned
9.	Viraj	×	×	×	✓	×
10.	Sun Flag Steels	✓	✓	✓	✓	✓
11.	FGF, Kanpur	×	×	✓	×	×
12.	MSF	×	×	✓	×	×
13.	VISL	×	×	✓	×	×
14.	BHEL	×	×	✓	×	×
15.	HEC	×	×	✓	×	×

Alloy Steels & Stainless Steels Manufacturer (Wrought Product) in India

Sl.No.	Company	Location	Product	Grades
1.	America Steels Ltd.	New Delhi	Long Products	Only SS
2.	Avtar Steels Ltd.	Haryana	Long Products	Only SS
3.	BRN Iron & Steel Co. Pvt Ltd.	Kolkata	Flat Products	SS + AS
4.	Chandan Steels Ltd.	Mumbai	Long Products	Only SS
5.	India Steel Works Ltd.	Mumbai	Long Products	Only SS
6.	Jindal Stainless Steel Ltd.	Hissar	Flat Products	Only SS
7.	Laxcon Steels Limited	Ahmedabad	Long Products	SS + AS
8.	Mukand Ltd.	Thane	Long Products	SS + AS
9.	Panchmahal Steels Ltd.	Baroda	Long Products	Only SS
10.	Rimjheim Steels Ltd.	Kanpur	Long Products	Only SS
11.	Shah Alloys Ltd	Gandhinagar	Flat/Long Products	SS + AS
12.	Sunflag iron & steel Ltd.	Nagpur	Long Products	Only SS
13.	Viraj Profiles Ltd.	Thane	Long Products	
14.	Hel spum Speciality Sol.Ltd	Mumbai	Long Products Ingots	SS + AS
15.	Kalyani Saarlona	Pune	Long Products Ingots	SS + AS
16.	Mahindra Sanyo	Khopoli	Long Products Ingots	SS + AS
17.	Star Wire India Ltd.	Delhi	Long Products Ingots	SS + AS
18.	Vardhaman Special Steels	Ludhiana	Long Products	AS
19.	ISMT	Pune	Long Products	AS
* SS-Stainless Steel; AS-Alloy Steel.				

Telephone : (91) (040) 24340750
दूरभाष : (91) (040) 24006650
फैक्स / Fax : (91) (040) 24341827
ई-मेल / E-mail : rdrcma.mat@cemilac.drdo.in

सभी पत्रादि क्षेत्रीय निदेशक के पते पर भेजे जाने चाहिए, किसी अधिकारी के व्यक्तिगत नाम से नही ।
All correspondence to be addressed to the Regional Director and not to any person by name.

भारत सरकार, रक्षा मंत्रालय (आर एण्ड डी)
GOVERNMENT OF INDIA
MINISTRY OF DEFENCE (R&D)
क्षेत्रीय सेना उड़नयोग्यता केंद्र (पदार्थ), सेमिलैक
REGIONAL CENTRE FOR MILITARY AIRWORTHINESS (MATERIALS), CEMILAC, DRDO
डा. कंचनबाग
P.O. Kanchanbagh
हैदराबाद - ५०००५८.टी.एस., भारत.
HYDERABAD - 500 058,T.S., INDIA.

No. RCMA(MAT)/04/TA/MAT/Vendors

Date: 16.11.2020

To
Members/ Special Invitees/ Co-opted Nominees
(As per the enclosed list)

Sub: **Forwarding Minutes of 1st Meeting of the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons**

Reference is made to the 1st meeting of the subject committee held on 9th November 2020 at Conference Hall of Director-DRDL, Hyderabad and through VC (on DRONA)

2. Enclosed herewith please find the minutes of the subject meeting, issued vide lr. no. RCMA(MAT)/04/TA/MAT/Vendors/ 1st MOM dt. 16.11.2020, for your kind perusal and further necessary actions.

Biswanath Jana

(BISWANATH JANA), Sc-G
Member Secretary

Copy to: For kind information please

DG (MSS), Kanchanbagh, Hyderabad-058. **Fax no. 040-29705265.**
DG (Aero), Bengaluru-093. **Fax no. 080-25283028/25283022.**
CE (Airworthiness), CEMILAC, Bengaluru-037. **Fax 080-25230856.**
Director (Aircraft), CEMILAC, Bengaluru-037. **Fax 080-25235131.**

LIST OF MEMBERS/ SPECIAL INVITEES/ CO-OPTED NOMINEES

Members

1.	***Shri R Venugopal,*** Sc-G & Director Admin O/o DG –MSS	Fax: 040-29705268
2.	***Shri Raju D Navindgi,*** Sc-G & Director(Admin) O/o DG-AERO	Fax: 080-25283028/ 25283022
3.	***Dr Shrish S Kale,*** Sc-G, GD(Materials)-CEMILAC & Regional Director-RCMA(F&F)	Fax: 080-25230856
4	***Shri K Palani Muthu,*** PScO, RDAQA(GW & M) C/o DRDL, Kanchanbagh PO, Hyd-058	Fax: 040-29551447
5	***Shri M Srinivas Rao,*** SSO-I *Rep MSQAA*	Fax: 040-24341477
6.	***Shri KV Rama Gopal,*** Deputy IFA ***Rep IFA (MSS Cluster),***	Fax: 040-29705263

Special Invitees

7.	***Shri S Gopinath,*** OS & Prog Leader ARM, RCI	Fax: 24306354, 24306002
8.	***Dr. JVR Sagar*** OS & Prog Leader Air Launch Systems, DRDL	Fax: 040-24345523
9.	***Shri CVS Sai Prasad*** Sc'G' & Director Q & R, O/o DG –MSS	Fax: 040-29705270
10.	**Shri D Subramanya Shastry** DGM(P&P/MS), Foundry & Forge Division Bangalore Complex HAL, P B No. 1791, Bengaluru – 560 017.	Fax: 080-22315521
11.	**Shri S Madhavan** DGM(DLE & IND) HAL - Engines Division,Bangalore Complex HAL, P B No. 1791, Bengaluru – 560 017.	Fax: 080-22311180
12.	**Shri Rajeev Kumar** Sr Manager (Design-Indigenisation) AURDC, HAL, Ojhar PO, Nasik - 422 207.	Fax: 02550-271965
13.	**Shri N C Satpathy** AGM(Design), *HAL (Koraput)*	Fax: 06853-220004/ 220217
14.	**Dr. R K Rayudu** Sc/Engr 'G', ADA, Bengaluru	Fax: 080-25238493

Co-Opted Special Invitees

15.	***Ms. AVS Perina Devi,*** *Sc-F & PD(Astra Mk-II, DRDL*	Fax: 040-24583701/ 24345523

16.	**Shri Vasanthraju C** Chief Mgr (DLE & Indgn) **Rep of HAL(LCA Tejas Division)** Bengaluru-560017.	Fax: 080-22323827
17.	**Mr. Chandru Fernando,** Sc-D GTRE, Bengaluru	Fax: 080-25241507
18.	**Shri Rahul Prasad** Mgr (M&P) HAL(ARDC), Bengaluru	

Co-Opted Members

19.	**Dr. B Sahoo** Sc-F & Regional Director, RCMA(Koraput)	Fax: 06853-220382
20.	**Shri BS Mandloi,** Sc-F RCMA(Nashik), C/o HAL(Nashik Division)	Fax: 02550-275912

Minutes of 1st Meeting of the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons(ALWs)

Date: 09 Nov 2020 at 1430hrs

Mode of Meeting: Through Video Conference on DRONA

Venue: Conference Hall of Director - DRDL, HYDERABAD

1. The 1st Meeting of the **"Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons"** constituted by DG-MSS, vide Lr. No. DG-MSS/DPM/DHQ/CEMILAC dated 16th September 2020 was conducted under the **Chairmanship of Sri B Saha, Sc-G & Regional Director,** RCMA(Materials), CEMILAC, Hyderabad.

2. The list of participants is enclosed at **Appendix-I** of this MOM.

3. Chairman welcomed all the members, special invitees and other participants attended the meeting physically and through VC. He made a special welcome to Sri S Gopinath, Outstanding Scientist & ARM of RCI who joined physically for the meeting as one of the special invitees in respect of Air Launched Weapons.

4. He briefed all the participants the background behind the formation of the subject committee stating that the Secretary & Chairman, DRDO had emphasized the formation of a committee with a mandate to identify, support, approve and create supply chain mechanism for the requirement of type approved materials for aircraft/aeroengines and air launched weapons. Accordingly, the subject committee has been constituted by DG-MSS drawing members/ special invitees specifically from Certification agencies and Users including O/o DG(MSS), DG(Aero) and IFA(MSS Cluster) with a set of Terms of Reference to address the issues regarding material requirements for aircraft/aeroengines and air launched weapons.

5. Chairman emphasized that while fulfilling the objectives of this committee with reference to the Terms of Reference set by the directive of DG-MSS the following 3 specific issues are also to be addressed and requested the representative of IFA(MSS Cluster) to provide their valuable suggestions/ inputs.

5.1 Establishing multiple type approved sources for various materials

5.2 Exploring the possibility for reducing time cycle of type approval procedure without affecting flight safety, quality and reliability

5.3 Reducing the time cycle required for placing supply/ purchase orders on established approved sources/ other sources

6. Chairman informed the committee that the first (kick-start) meeting was planned around 15th October 2020; however it was postponed to today due to certain unavoidable reasons including non-receipt of inputs from some organizations which was sought as pre-meet action points. However, this time delay has been effectively utilized to carry out following activities.

6.1 To receive nominations from the organizations who are listed as members/ special invitees as per DG-MSS directive

6.2 To receive nominations from the organizations who have been co-opted by the Chairman

6.3 To compile the data available with RCMA(Mat) and other data received from various sources.

The same were presented by **Sri B Jana, Member-Secretary** in this meeting.

7. Chairman also informed the committee that, as per the letter issued by DG(MSS), this committee shall meet periodically as and when required and submit the achievements to DG(MSS) and Chief Executive (Airworthiness) for their further necessary advices and actions. Hence, after this meeting an interim report will be prepared with committee's feedback and recommendations and submit to the higher managements by end of November 2020.

8. Chairman also mentioned that in future separate meetings will be conducted to address the material requirements of aircraft/aeroengines and air launched weapons involving the concerned members/ special invitees respectively.

9. **Sri B Jana, Member-Secretary,** at the outset during his presentation, introduced the members, special invitees and co-opted nominees with each other participating physically as well through VC. He informed the committee that representatives from HAL(Nashik) and RCMA(Nashik) could not join the meeting as DRONA facility of RCMA(Nashik) was non-functional.

10. Sri B Jana made presentation on the following.

10.1 Brief on about airworthiness certification of materials for aircraft/aero-engines and air launched weapons highlighting airworthiness certification philosophy, material certification methodology, classification of components based on its criticality, attributes of aeronautical grade materials in comparison with general engineering grade materials with examples and certification practice at RCMA(Materials). Hard copy of the *.ppt slides are enclosed at **Appendix-II**.

10.2 Terms of reference as per the directive of DG-MSS letter

10.3 Additional points proposed by Chairman for deliberations

10.4 Actions taken and status as- on- date with respect to the Para 10.2 and 10.3 mentioned above.

11. Sri Jana during his presentation sought views/ comments/ suggestions from all the participants highlighting the specific points on which deliberations are to be made.

11.1 Hard copy of the *.ppt slides on Points emerged for Discussions during the meeting is enclosed at **Appendix-III**.

11.2 The Terms of Reference as per the directive of DG-MSS letter are listed below.

(i) Consolidating the material requirements of various projects based on bill of materials

(ii) Grading of materials required based on criticality of usage

(iii) Exploring identification of approved status of the materials required by the projects

(iv) Identification of established Indian vendors for supply of type approved materials

(v) Finalisation of suitable criteria for approaching established Vendors

(vi) Firming up terms and conditions for placing purchase orders by the projects for supply of type approved materials to ensure safety of the airborne stores.

11.3 Additional points proposed by Chairman for deliberations are listed below.

(i) Material Requirements for next 5 Years by various Projects as per Proforma

(ii) Creation of Material Bank with Established Vendors of TA Materials

(iii) Identification of Potential Vendors who can be considered for Sources for Type Approved Materials

(iv) Identification of Testing Facilities: Established Sources/ Potential Sources

(v) Inclusion of Organisations requiring Type Approved Materials

(vi) Use of Commercial Grade Materials for Air Launched Weapons Only

(vii) Initiation of "SELF-CERTIFICATION" Approach involving Internal R&QA for Class-II & Class-III components:

(viii) Mechanism to reduce Certification Time Cycle: Without sacrificing Quality & Safety

12. Summary of the deliberations/ discussions and decisions taken are enumerated below.

12.1 **Terms of Reference as per the Directive of DG-MSS letter**

12.1.1 ***Consolidating the material requirements of various projects based on bill of materials***

12.1.1.1 Proforma-1 and Proforma-2 (enclosed at **Appendix-IV**) were circulated to all the representatives of the concerned organizations to provide material requirements for air launched weapons and aircraft/ aero-engines respectively. The data were received from:

Air Launched Weapons (ALWs):	Rudram-II, Rudram-III & Astra Mark-II
Aircraft/ Aeroengines:	GTRE, ADE, CABS, HAL(Nashik), HAL(Koraput),

Although Rep. HAL(F&F) confirmed sharing the information over email, but information is not yet received by Member-Secretary. Rep. HAL(F&F) was informed about the same and was requested to forward the mail again.

Action by: Rep. HAL(F&F)/ Dr. S Kale

PDC: 23 Nov 2020

12.1.1.2 Required information is to be provided immediately by other projects of ALWs and aircraft/ aero-engines for compilation by the Member Secretary.

Action by: Reps of ALWs and Aircraft/ Aeroengines [ADA, HAL(LCA-Tejas), HAL(F&F), HAL(Engines), HAL(ARDC), Dr S Kale]

PDC: 23 Nov 2020

12.1.1.3 While forwarding the material requirements data as per the format, Material forms and sizes are to be clearly indicated. Material quantity is to be expressed in 'kg' in place of 'Nos'. The column of 'Present Source' is also to be filled.

Action by: Reps of ALWs and Aircraft/ Aero-engines

PDC: 23 Nov 2020

12.1.1.4 For consolidation of data for preparation of report, it was decided that mill forms for metallic components, products for ceramics/ composites and rubber compounds for Rubber products are to be considered.

Action by: Member-Secretary

12.1.2 ***Grading of materials required based on criticality of usage***

12.1.2.1 It will be consolidated as per the filled-in Proforma received from the concerned organisations.

12.1.3 ***Exploring identification of approved status of the materials required by the projects***

12.1.3.1 It will be consolidated as per the filled-in Proforma received from the concerned organisations and the data base available at RCMA(Materials, F&F, Nashik and Koraput).

Action by: Member-Secretary, RCMA(Materials, F&F, Nashik and Koraput), Dr. S Kale

PDC: 23 Nov 2020

12.1.4 ***Identification of established Indian vendors for supply of type approved materials***

12.1.4.1 Data for Type approved and Provisionally Cleared materials presently available at RCMA(Materials and F&F) was compiled and presented in the meeting. However, it will be further updated/ refined as per the filled-in Proforma received from the concerned organisations and the data base available at RCMA(Materials, F&F, Nashik and Koraput).

Action by: Member-Secretary, RCMA(Materials, F&F, Nashik and Koraput), Dr. S Kale

PDC: 23 Nov 2020

12.1.5 ***Finalisation of suitable criteria for approaching established Vendors***

12.1.5.1 Based on deliberations following criteria are emerged.

(i) Single Tender if only one source

(ii) Limited Tender if more than one source

(iii) Time Schedule for Delivery

(iv) Capability of undertaking long term and dynamic testing such as Fatigue

(v) Cost

12.1.6 ***Firming up terms and conditions for placing purchase orders by the projects for supply of type approved materials to ensure safety of the airborne store***

12.1.6.1 After detailed deliberation following were suggested by the representatives of DG(MSS), DG(Aero) and IFA(MSS Cluster).

12.1.6.1.1 Expression of Interest (EOI) is to be published for sourcing Indian Vendors (for supply of Indigenous materials) – with an objective to have Rate Contract(RC) i.e., multiple vendors for supply of same category type approved material on L1 rate.

(i) Obtain in-principle approval from Secretary-DRDO (since many labs across clusters involved or getting benefited from this outcome)

(ii) List of materials category wise (Metals/ Non-metals/ Composites)

(iii) Obtain firm commitments from Labs (Project wise) and work out the total quantity (Category wise) required to be purchased

(iv) EOI for each category to be published

(v) Strict vendor qualification criteria (Technical grounds and Financial grounds as per CVC guidelines) to be used for filtering the vendors. RCMA to extend support for such vendor qualification criteria as per requirement of certification

(vi) These EOIs will be used for establishing vendors with Rates for such tendered materials (rate for first year, rate for 2nd year with fixed/ floating escalation, etc.) - thereby Rate Contract is established. Labs with this RC can place their orders directly quoting this RC.

(vii) RCMA to provide certification services for the selected vendors along with RC. RCMA also to extend re-certification process based on necessity for the same vendors who are all in the RC list.

12.2 **Additional points proposed by Chairman to the committee for deliberation**

12.2.1 ***Material Requirements for next 5 Years by various Projects as per Proforma***

12.2.1.1 Chairman requested all the participants of concerned organizations to share the information immediately to consolidate the data which will help in preparing recommendations by the committee towards creation of material bank and others.

Action by: Reps of ALWs and Aircraft/ Aeroengines [ADA, HAL(LCA-Tejas), HAL(F&F), HAL(Engines), HAL(ARDC), Dr S Kale]

PDC: 23 Nov 2020

12.2.2 ***Creation of Material Bank with Established Vendors of TA Materials***

12.2.2.1 The proposal (enclosed at **Appendix-V**) of C&MD, M/s Midhani, Hyd (who already created a material bank for supply of Maraging Steel MDN 250A for DRDL Missile Projects) was discussed. Reps of O/o DG(MSS) and IFA(MSS Cluster) indicated the audit related issues which were encountered for that model. After detailed deliberation, following were suggested by the representatives of DG(MSS), DG(Aero) and IFA(MSS Cluster) in order to avoid audit related issues.

12.2.2.1.1 Material Bank (Category wise) may be worked out for Indian Sourced materials

(i) Obtain in-principle approval from Secretary-DRDO (since many labs across clusters involved or getting benefited from this outcome)

(ii) List out the Indian sourced materials

(iii) Obtain firm commitments from Labs (Project wise) and work out the total quantity required to be purchased

(iv) Publish EOI for obtaining responses from Indian Vendors (with an objective to filter the vendors)

(v) Identify a owner for this material bank (the lab which uses most of the material sourced from India – may be identified)

(vi) The identified lab to make procurement under LBM-Limited Bidding Mode (with list of vendors qualified in the above EOI).

(vii) The identified lab will distribute the materials to the other labs based on their original projection.

(viii) The projects to deduct the cost of material being taken from material bank in their respective project's cost – audit point of view.

12.2.2.1.2 Material Bank is suggested for Foreign materials

(i) Obtain in-principle approval from Secretary-DRDO (since many labs across clusters involved or getting benefited from this outcome)

(ii) List out Foreign materials

(iii) Obtain firm commitments from Labs (Project wise) and work out the total quantity required to be purchased

(iv) First, publish EOI for obtaining any responses from Indian Vendors

(v) If NIL response from Indian Vendors in the above EOI, obtain permission from Dept of Expenditure, MOF for floating GTE (Global Tender Enquiry).

(vi) Identify a owner for this material bank (the lab which uses most of the material sourced from Foreign – may be identified)

(vii) The identified lab to make procurement under GTE.

(viii) The identified lab will distribute the materials to the other labs based on their original projection.

(ix) The projects to deduct the cost of material being taken from material bank in their respective project's cost – audit point of view.

12.2.3 ***Identification of Potential Vendors who can be considered for Sources for Type Approved Materials***

12.2.3.1 The data available at RCMA(Materials) regarding probable vendors along with criteria to qualify were presented.

12.2.3.2 All other representatives were requested to share the data regarding probable vendors (can be considered for Sources for Type Approved Materials), if available with them.

Action by: All Special Invitees/ Members/ Co-opted Nominees

PDC: 23 Nov 2020

12.2.3.3 The representatives of DG(MSS), DG(Aero) emphasised strict criteria to be evolved to qualify the vendors.

12.2.4 ***Identification of Testing Facilities: Established Sources/ Potential Sources***

12.2.4.1 The data available at RCMA(Materials) regarding established and probable testing sources along with criteria to qualify were presented.

12.2.4.2 All other representatives were requested to share the data regarding probable vendors (can be considered for Sources for testing), if available with them.

Action by: All Special Invitees/ Members/ Co-opted Nominees

PDC: 23 Nov 2020

12.2.4.3 The representatives of DG(MSS), DG(Aero) emphasised strict criteria to be evolved to qualify the testing facilities.

12.2.5 ***Inclusion of Organisations requiring Type Approved Materials***

12.2.5.1 HAL(ARDC) representative has already joined for this meeting. The details of the representative (Name, Designation, Contact details) to be forwarded formally to Member-Secretary.

Action by: Dr. S Kale and Rep. of HAL(ARDC)

PDC: 23 Nov 2020

12.2.5.2 M/s BDL is to be included as they are taking up various production activities with respect to the projects of ADA, ASTRA, etc.

Action by: Rep. ADA & Dr. S Kale and Rep. DRDL

PDC: 23 Nov 2020

12.2.6 ***Use of Commercial Grade Materials for Air Launched Weapons Only***

12.2.6.1 It was decided to have separate meeting with concerned reps of Air Launched Weapons.

12.2.6.2 As indicated by CEMILAC Rep Dr. S Kale ppt. slides regarding approach to use commercial materials for ALWs only is to be shared with Reps of ALWs who are requested to provide their views/ comments in turn.

Action by: Member-Secretary and Reps of ALWs

PDC: 23 Nov 2020

12.2.7 ***Initiation of "SELF-CERTIFICATION" Approach involving Internal R&QA for Class-II & Class-III components:***

12.2.7.1 The option of SELF-CERTIFICATION approach and its associated obligations/ onus on Projects/ Labs (Legal/ Moral) was put forth for discussions. The views of all the representatives are to be forwarded to Member-Secretary.

Action by: All Special Invitees/ Members/ Co-opted Nominees

PDC: 23 Nov 2020

12.2.7.2 DGAQA rep mentioned that HAL is following SELF-CERTIFICATION approach with concurrence from DGAQA. Chairman requested DGAQA rep to provide the details on the approach being followed.

Action by: Rep DGAQA

PDC: 23 Nov 2020

12.2.8 Mechanism to reduce Certification Time Cycle: Without sacrificing Quality & Safety

12.2.8.1 Sri B Jana proposed the possible options (detailed below) which may be considered to reduce certification time cycle. Many of those options are in vogue at RCMA(Materials).

Possible options for Reduction in CERTIFICATION TIMELINES during Indigenisation/ Certification of Materials/ Components:

(i) Concurrent mode of development, testing for certification, release of materials on completion of short term test for component fabrication in parallel to completion of long term tests will reduce the overall time required for indigenisation and certification of any product. **[Already practiced at RCMA(Mat)]**.

(ii) There are number of alloys / materials which are common and required in different forms and sizes by various projects for similar applications. If such requirements are combined together alloy wise for all projects, manufacturing of these alloys can be carried out up to a certain intermediate stage which can be subsequently processed to realise the actual size required/ ordered by the individual projects. This way the manufacturing time can be reduced by 2-3 months. In addition, certification testing time can be substantially reduced provided the products from the same alloy/heat/intermediate size are supplied to more than one project. This approach will also result in reducing testing of large number of test specimens and also the time in turn, which will be otherwise required if testing is separately done for each project. To do this, the detailed requirements of any alloy (specifically alloy grade name, form and size, heat treatment, quantity and governing specification) for all kinds of projects needs to be consolidated.

(iii) Technical Specifications/ Qualification Test Requirements need to be re-worked/ tailored based on the design criteria and/or end applications in order to avoid superfluous testing. [**Already practiced at RCMA (Mat)**].

(iv) For a 'One Time Use Air-Launched Weapon System', materials for Class-3 (i.e., Non-Critical) Components/Sub- systems need not to be certified separately/independently provided Class-3 Components/ Sub – systems qualify the required functional test - the materials gets proven concurrently & are qualified. [**Already practiced at RCMA (Mat)**].

(v) For Mission Critical (Class-2) Components/ Sub-systems used in 'One Time Use Air-Launched Weapon System', if designer/user issues a DECLARATION that failure/ malfunctioning of Mission Critical Components will not affect the "Fight Safety" of the platform aircraft, then the materials used stands qualified concurrently provided components/sub-systems complies with functional requirements and cleared. This will reduce the certification time to clear such materials; In this case the safety aspects depend fully on the declaration and assurance of the Project & its R&QA department. [**A Bold Proposal ONLY**].

(vi) For Class-3 (Non-Critical) & Class-2 (Mission Critical) Sub-system/system, "Commercial Materials" can be used based on clearance of Internal R&QA department of the Project/Lab, and following the "SELF CERTIFICATION" approach exclusively for 'One Time Use Air-Launched Weapon System'

PROVIDED the declaration given by project/user that failure due to usage of commercial materials shall not affect safety of the platform Aircraft. The onus of this practice remains with the projects/Lab under the scope of 'Self certification' procedure, if adopted.

(vii) While taking up the indigenisation program, the concerned PD should consider the manpower and other logistic requirements of the Certification Agency in order to have certification related response in time.

12.2.8.2 Representative of O/o DG-AERO concurred the options for creating material bank.

13. Chairman in his concluding remarks stated that the points for discussions (which were deliberated in this meeting) will be circulated along with the minutes of meeting and feedback will be obtained in parallel with collecting and consolidating the data for preparation of a preliminary report. The content of the report before release will be discussed in a meeting with members of ALWs and Aircraft/ Aeroengines separately. The date will be communicated in due course of time.

14. There being no other points, Chairman thanked all participants for active deliberations. The meeting is ended at 1815hrs.

The minutes is issued with concurrence of the Chairman.

Biswanath Jana

(BISWANATH JANA), Sc-G
Member Secretary

Encl: Appendix-I, II, III, IV & V

RCMA(MAT)/ 04/TA/MAT/Vendors/1st MOM dated 16.11.2020

Copy to: **For kind information please**

DG(MSS), Kanchanbagh, Hyderabad
DG(Aero), Bengaluru
CE(Airworthiness), CEMILAC, Bengaluru
Director(Aircraft), CEMILAC, Bengaluru
Chairman of the Committee

Distributions:

All Special Invitees, Members, Co-opted Nominees

Appendix - I

Minutes of 1st Meeting of the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons(ALWs)

List of Participants

Members

1.	***Shri R Venugopal,*** Sc-G & Director Admin O/o DG –MSS	Fax: 040-29705268
2.	***Shri Raju D Navindgi,*** Sc-G & Director(Admin) O/o DG-AERO	Fax: 080-25283028/ 25283022
3.	***Dr Shrish S Kale,*** Sc-G, GD(Materials)-CEMILAC & Regional Director-RCMA(F&F)	Fax: 080-25230856/ 25236516
4	***Shri K Palani Muthu,*** PScO, RDAQA(GW & M) C/o DRDL, Kanchanbagh PO, Hyd-058 Rep DGAQA	Fax: 040-29551447/ 24346695
5	***Shri M Srinivas Rao,*** SSO-I *Rep MSQAA*	Fax: 040-24341477
6.	***Shri KV Rama Gopal,*** Deputy IFA ***Rep IFA (MSS Cluster),***	Fax: 040-29705263

Special Invitees

7.	***Shri S Gopinath,*** OS & Prog Leader ARM, RCI	Fax: 24306354, 24306002
8.	***Dr. JVR Sagar*** OS & Prog Leader Air Launch Systems, DRDL	Fax: 040-24345523
9.	***Shri CVS Sai Prasad*** Sc'G' & Director Q & R, O/o DG –MSS	Fax: 040-29705270
10.	**Shri D Subramanya Shastry** DGM(P&P/MS), Foundry & Forge Division Bangalore Complex HAL, P B No. 1791, Bengaluru – 560 017.	Fax: 080-22315521
11.	**Shri S Madhavan** DGM(DLE & IND) HAL - Engines Division Bangalore Complex HAL, P B No. 1791, Bengaluru – 560 017.	Fax: 080-22311180

12.	**Shri Rajeev Kumar** Sr Manager (Design-Indigenisation) AURDC, HAL, Ojhar PO, Nasik - 422 207.	Fax: 02550-271965
13.	**Shri N C Satpathy** AGM(Design), *HAL (Koraput)*	Fax: 06853-220004/ 220217
14.	**Dr. R K Rayudu** Sc/Engr 'G', ADA, Bengaluru	Fax: 080-25238493

Co-Opted Special Invitees

15.	***Ms. AVS Perina Devi,*** *Sc-F & PD(Astra Mk-II, DRDL*	Fax: 040-24583701/ 24345523
16.	**Shri Vasanthraju C** Chief Mgr (DLE & Indgn) **Rep of HAL(LCA Tejas Division)** Bengaluru-560017.	Fax: 080-22323827
17.	**Mr. Chandru Fernando,** Sc-D GTRE, Bengaluru	Fax: 080-25241507
18.	**Shri Rahul Prasad** Mgr (M&P) HAL(ARDC), Bengaluru	

Co-Opted Members

19.	**Dr. B Sahoo** Sc-F & Regional Director, RCMA(Koraput)	Fax: 06853-220382
20.	**Shri BS Mandloi,** Sc-F RCMA(Nashik), C/o HAL(Nashik Division)	Fax: 02550-275912

Other Invitees

21. Shri D Pradeesh Kumar, Sc-F, RCMA(F&F), Bengaluru
22. Smt CM Bhubaneswari, Sc-F, RCMA(F&F), Bengaluru
23. Dr. T Ramprabhu, Sc-D, RCMA(F&F), Bengaluru
24. Shri Venkateshwar Kosgi, Sc-E, RCMA(Materials), Hyderabad

About Airworthiness Certification of Materials

Airworthiness means

- **Continued capability of an aircraft / equipment to perform satisfactorily and fulfill its mission requirements within the expected life under given atmospheric conditions with acceptable levels of safety and reliability.**

Acceptable Levels to be mutually agreed between Users, Designers and Certification Authority

Type Certification of Materials/ Type Approved Materials: What it means?

- To establish supply of airworthy materials (i.e., Feedstock viz. bars, plates, sheets, etc., Near-net Parts using Casting, Close-Die Forgings, etc) manufactured as per Documented Process Route ensuring Consistency in the required properties within a Product/ Batch and Batch-to-Batch
- When a "Product is Type Approved" the PROCESS used to manufacture that product, the PLANT FACILITIES (i.e., Equipments and Personnel) used for manufacturing the product are also CERTIFIED along with that PRODUCT.

Certification/ Approval of Product-Process-Plant (3Ps combination)

ensures

Supply of a particular product type with required quality CONSISTENTLY

Contd/....

Type Certification of Materials/ Type Approved Materials: What it means?

➢TYPE APPROVAL of any material is done under TWO Categories to meet:

- Specific Requirements of Designer/ User - Universally Practiced
- Generic Requirements (all possible properties are evaluated) - Generally not followed

➢Extent of Testing and Evaluation during Type Certification of a Product is based on Criticality of the End Use (Design Criteria) of a Product.

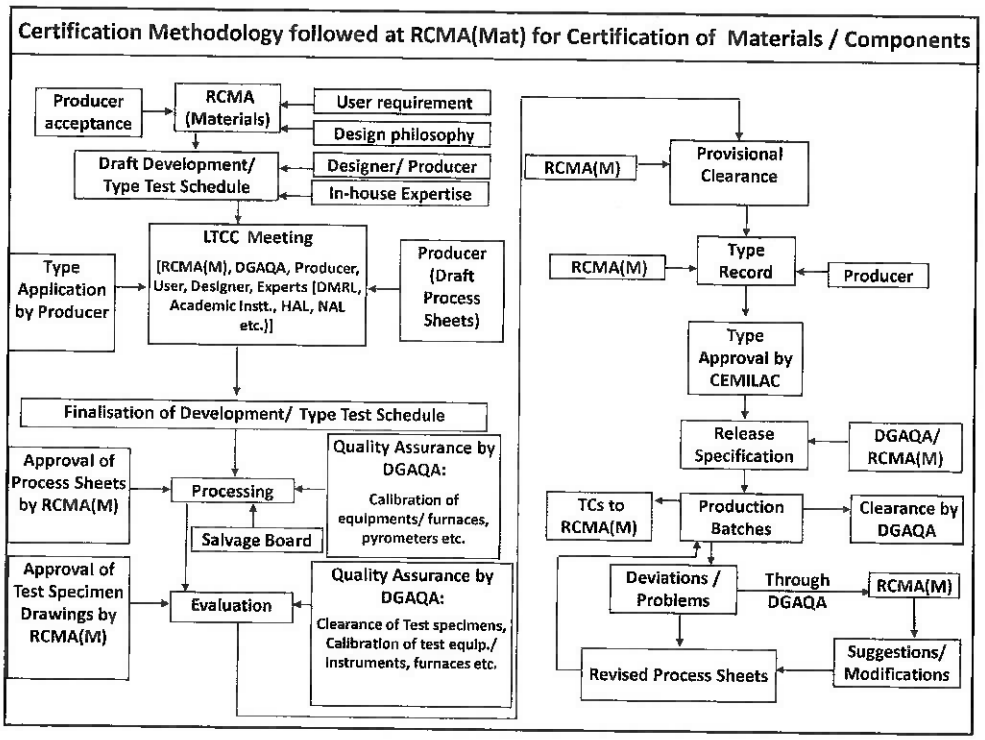
➢The criticality is defined based on the failure mode and risk analysis and accordingly aeronautical components are classified into THREE Classes.

❑ Highly Critical	- Class 1	- Flight Safety Critical
❑ Moderately Critical	- Class 2	- Mission Critical
❑ Non-Critical	- Class 3	- Non-Critical

CLASSIFICATION OF AERONAUTICAL MATERIALS

DDPMAS 2002	Simple Classification
Flight Safety Critical Failure of components, systems or items endangers the safety of the aircraft or crew	**Class 1** Failure expected to cause structural collapse, personal injury or unacceptable malfunctioning
Mission Critical Failure of Components , systems or items results in aborting the mission	**Class 2** High or medium stressed parts not covered by Class 1
Non-Critical Failure of components does not endanger the safety of the aircraft and crew nor does it result in aborting the mission	**Class 3** Unstressed or lightly stressed parts

Designer assigns Classification CATEGORY based on Significance of Component's Functionality and Failure Consequences



PROFORMA FOR DESIGN CRITERIA

Project : _____

Name of Inspection Agency : _____

Name of Developing/ Manufacturing Agency: _____

Manufacturing Process Route: _____

Material Grade & Mill Form: _____

Heat Treatment Condition: _____

Size (mm): _____

Supply Condition: _____

Sl. No.	Component	Classification	Stress Condition			Environmental Conditions	Temperature Conditions	Weldability requirements*	Any other information
			Primary	Secondary	Static/ Dynamic loading conditions				
		Flight Safety Critical/ Mission Critical/ Non-Critical	Eg. Fracture Toughness, Fatigue, YS, UTS	Eg. Fracture Toughness, Fatigue, YS, UTS				*Type of Welding, No. of joints, Components details which are to be welded, Material type, WPS & PQR Status approved or not? Vendor details	

Enclosures:

1. Brief write-up about the Project
2. End use of the Components along with justification for classification
3. Drawings, photographs of components
4. QA Plan

Signature
Name & Designation
Name of Organisation (with Seal)

Countersigned by Platform/User RCMA

Aeronautical Vs Engineering Materials

S.No	Nomenclature	Aeronautical	General Engg.
1.	Design philosophy	- Safe life design - Fail safe design - Damage tolerant design Dynamic mechanical properties	Infinite life design Static mechanical properties
	Reliability	Periodic Inspection	Not practiced
2.	Specifications		
	Alloying elements	Tighter range	Broad range
	Trace elements	Better control	No limit
	Impurity elements	Better control	No limit
	Injurious elements	Lower limits	Higher limits
	Mechanical properties	Higher side	Lower side
	Metallography acceptance	Stringent	Liberal
	Dimensional Tolerances	Closer	Broad range

GENERAL ENGINEERING Vs AEROSPACE MATERIALS SPECIFICATIONS

Examples of few alloys which have almost similar alloying elements and in use both for general engineering as well as for aerospace, but covered under separate category of specifications, have been compared individually. The difference in characteristics are highlighted by showing them in shaded region.

1. Comparison of a low alloy steel.

Sl. No.	Mechanical Properties	General engineering grade BS 970 En24	Aeronautical grade BS S95/S119
	Hardness (HB)	293/341	293/341
	UTS , MPa	896	896
	0.2% PS, MPa	689	758
	% El	16	12
	Impact Strength; Izod (ft.lbf)	35	35

Contd/...

GENERAL ENGINEERING Vs AEROSPACE MATERIALS SPECIFICATIONS

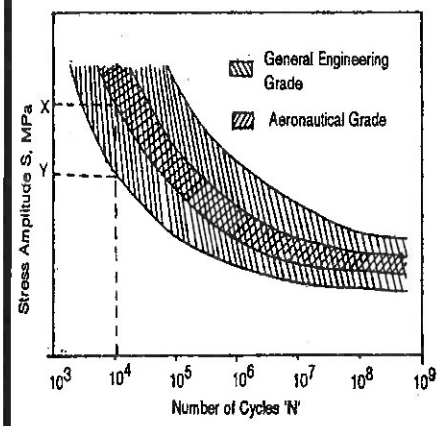
1. Comparison of a low alloy steel

		General engineering grade	Aeronautical grade
Sl. No.	Chemical composition	BS 970 En24	BS S95/S119
	C	0.35-0.45	0.36-0.44
	Si	0.10-0.35	0.15-0.35
	Mn	0.45-0.70	0.45-0.70
	Ni	1.30-1.80	1.30-1.70
	Cr	0.90-1.40	1.10-1.40
	Mo	0.20-0.35	0.20-0.35
	S	0.020 Max.	0.020 Max.
	P	0.050 Max.	0.025 Max.

Summary: Low alloy Steel

- ❑ Narrow range of alloying elements
- ❑ Significant reduction in impurity elements viz. S & P
- ❑ Better 0.2% PS

SCATTER BAND



Reasons are both internal and External to Material

External Factors

- Dimensional Accuracy & Surface Finish Test Samples
- Accuracy of Test Machines
- Operators' Skill etc.

Stringent quality control, Control by Periodic Calibration, Use of Skilled Manpower are ***Mandatory in Aerospace Material Testing***

Internal Factors

- Presence of Unwanted Impurity Elements (Crack Initiation Sites and Faster Propagation)
  - Residual Gases (O, H, N, Ar, He)
  - Non-Metallic Impurities (S, P)
  - Metal & Metalloid Impurities (Pb, Bi, Sb, As, Se, Ag, Cu, Ti, Te, Fe, Ni)
- Macro & Microstructural Inconsistencies

Aeronautical Materials

- Aeroengine demands materials at their best

Efficiency of An Aeroengine

$\dot{\eta} \propto 1 - T_2 / T_1$

Where T_1 is Turbine Entry Temperature &
T_2 is Turbine Outlet Temperature

- Low factor of safety used in design
- High quality, consistency and low scatter
- Quality at its best and quantity at its lowest

Property Scatter

- **More the scatter, more the weight**
- **More the weight, lesser the power to weight ratio**

Why Documented Manufacturing Route!

- **Basic mechanical properties of a material not only exceed material and process specification minima but do so in a consistent manner.**
- **All components of a given type will respond to service imposed stresses and environments in similar fashion.**
- **Minimises the likelihood of undetected stress remaining in the finished components and limits the size of defects.**
- **In the remote case of component malfunction, the entire material history can be rapidly traced, thereby facilitating failure mode identification.**

What RCMA(Materials) Does!

- Co-ordinates activities for Approval of Airworthy Materials for Applications in
  - Air-Launched Weapons
  - Aero Systems (Aero-Engines & Aircraft)
- Follows Concurrent Development and Certification Approach for Type Approval
  - Qualification Test Requirements (QTRs) in the form of DTS/ TTS (Through LTCC)
  - Approval of Manufacturing Process
  - Batch wise Clearance (Through PC Mode)
  - Testing in Phased Manner
    - Mandatory Tests (Short-term and Long-term Properties)
    - Tests for Data Generation
  - Clearance of Materials to facilitate fabrication of components/ other works pending certain Long-term properties
  - "One-Time Clearance" - Materials for ALWs

Appendix – III

Points for Discussions			
1	Material Quantity **Comments!**	Needs to indicate in 'kg' **? Proforma to be modified**	
2	Type of Materials	Metallic Alloys (Mill Forms, Castings, Forgings)	Steel, Super Alloys, Ti-Alloys, Al-Alloys, Cu-Alloys, etc.
		Composites/ Ceramics (Product)	Carbon-Carbon Brake Discs, Carbon-Phenolic, Glass-Epoxy, etc.
		Raw Materials for Composite/Ceramic Products	Fused Silica Powder, Prepregs(Glass or Carbon-Epoxy, etc), etc
		Rubber, other non-metallic materials/ items, etc. **Shall we restrict to** **? Metallic Alloys (Mill Forms, Castings, Forgings)** **? Composites/ Ceramics (Product)**	
	Comments!		

Points for Discussions			
3	Source of Materials	Indian Vendors	Established Not Established
		Import **Shall we restrict to** **? Indian Vendors** **? Indian Vendors – Not Established**	OEM Trader
	Comments!		
4	Finalisation of Suitable Criteria for Approaching Established Vendors - **Time Schedule** - **Costing** - **Only one Source** - **More than one source (2, 3, more)** - **Any other criteria!** **Comments!**		

Page 1 of 2

	Points for Discussions
5	Firming up Terms and Conditions for Placing Purchase Orders by Projects for Supply of Type Approved Materials to Ensure Safety of Airborne Stores **Comments from:** - Rep IFA - Rep DG(MSS), DG(Aero) - Reps of HAL - Others
6	Creation of Material Bank with Established Vendor of TA Materials **Comments!**
7	Identification of Potential Vendors for Sources for Type Approved Materials **Comments!**
8	Identification of Testing Facilities: Established Sources/ Potential Sources **Comments!**

	Points for Discussions
9	Inclusion of Organisations requiring Type Approved Materials: HAL(Aircraft), HAL(Helicopter), etc.! **Comments!**
10	Usage of Commercial Grade Materials for Air Launched Weapons **Comments!**
11	Initiation of "SELF-CERTIFICATION" Approach involving Internal R&QA for Class-II & Class-III components: What are the obligation/ onus on Projects/ Labs: Legal/ Moral ! **Comments!**
12	Mechanism to reduce Certification Time Cycle: Without sacrificing Quality & Safety **Comments!**

Page 2/2

Enclosure to Lr. No. RCMA(MAT)/04/TA/MAT/Vendors dated 01.10.2020

Proforma-1

MATERIAL REQUIREMENTS: AIR LAUNCHED WEAPONS

Project Name:

S. No.	Material Nomenclature	Tentative Sizes (if known)	Specification	Classification[@] (Class-1/ Class-2/ Class-3)	Present Requirements (Quantity in kgs.,/ meters/ Nos.)	Present Source	Tentative Cost	Future Requirements for next 5 years		Remarks
								Quantity	Sizes	

@ Class-1: Flight Safety Critical
Class-2: Mission Critical
Class-3: Non-Critical

Signature

Name:

Designation:

Organisation:

Appendix - IV

Page 1/2

Enclosure to Lr. No. RCMA(MAT)/04/TA/MAT/Vendors dated 01.10.2020

Proforma-2

MATERIAL REQUIREMENTS: AIRCRAFT AND AEROENGINES

Project Name:

S. No.	Material Nomenclature	Tentative Sizes (if known)	Specification	Classification[@] (Class-1/ Class-2/ Class-3)	Present Requirements (Quantity in kgs.,/ meters/ Nos.)	Present Source	Tentative Cost	Future Requirements for next 5 years		Remarks
								Quantity	Sizes	

@ Class-1: Flight Safety Critical
Class-2: Mission Critical
Class-3: Non-Critical

Signature

Name:

Designation:

Organisation:

Page 2/2

Appendix-V

डॉ. एस. के. झा
अध्यक्ष एवं प्रबंध निदेशक

MIDHANI

Dr. S. K. Jha
Chairman and Managing Director

MDN/CMD/NPCIL/102020-85
31.10.2020

Dear Shri Saha

Sub: Supply of Aeronautical Grade Materials for Air Launched Weapons and Aero-engines/ Aircraft

1. Please refer to the discussions we had with you on 27th October 2020in my office.

2. As per the discussions, it is understood that a committee under your chairmanship is looking into the future requirements of aeronautical grade alloys (viz. Steels, Titanium, Superalloys, Aluminum alloys, composites etc.) and their timely supply for country's various indigenous programs of Air Launched Weapons and Aero-engines/ Aircraft.

3. As you are aware that MDHANI is a Premium PSU supplying strategic materials to various programs of the country including Ministry of Defense. We have more than 50 alloys type approved through CEMILAC.

4. In this context, the undersigned wishes to convey that MIDHANI will be pleased to create a material bank for all the required alloys meeting our manufacturing scopes PROVIDED the consolidated tonnage requirements for these alloys are projected to us. Creation of MDN-250 metal bank in past has helped in meeting the major materials requirements of various DRDL projects on time.

5. MIDHANI being a public sector unit will be expecting certain commitments in the form of Letter of Intent (LOI) and other formal requirements as per the existing norms and policy of the Company in order to plan the resources like the raw materials for taking melts/ heats/ ingots of sufficient numbers. These ingots will be subsequently processed to the required forms and size as and when ordered by the concerned Projects. This approach will not only help MIDHANI to cut down manufacturing schedules by 3 to 4 months but also reduce testing and certification requirements, cost and time – resulting in cut short the overall delivery schedules.

6. We look forward to be associated with all the prestigious programs of DRDO and MoD for contributing towards the growth of India under 'Make in India' and 'Atmanirbhar' Bharat policy of Govt. of India.

Best Regards,

Yours Sincerely,

Sri B Saha
Regional Director
RCMA(Materials), CEMILAC, DRDO
Kanchanbagh PO, Hyderabad-500058.

RCMA (MAT) CEMILAC DRDO Govt. of India, Min. of Defence
283
06/11/20

मिश्र धातु निगम लिमिटेड **MISHRA DHATU NIGAM LIMITED**
भारत सरकार का उद्यम (A Govt. of India Enterprise)
पंजीकृत कार्यालय: पी.ओ. कंचनबाग, हैदराबाद, तेलंगाना-500058. Registered Office: P.O. Kanchanbagh, Hyderabad, Telangana-500058.
फोन Telephone: 040-24184000, फैक्स Fax: 040-24340039
निगमित पहचान सं. CIN: L14292TG1973GO100166
वेबसाइट Website: www.midhani-india.in

Shri BJ.
Pls. note
06.11.20

Telephone : (91) (040) 24340750
दूरभाष : (91) (040) 24006650
फैक्स / Fax : (91) (040) 24341827
ई-मेल / E-mail : rdrcma.mat@cemilac.drdo.in

सभी पत्रादि क्षेत्रीय निदेशक के पते पर भेजे जाने चाहिए, किसी अधिकारी के व्यक्तिगत नाम से नही ।
All correspondence to be addressed to the Regional Director and not to any person by name.

स्वच्छ भारत
एक कदम स्वच्छता की ओर

भारत सरकार, रक्षा मंत्रालय (आर एण्ड डी)
GOVERNMENT OF INDIA
MINISTRY OF DEFENCE (R&D)
क्षेत्रीय सेना उड़नयोग्यता केंद्र (पदार्थ), सेमिलैक
REGIONAL CENTRE FOR MILITARY AIRWORTHINESS (MATERIALS), CEMILAC, DRDO
डा. कंचनबाग
P.O. Kanchanbagh
हैदराबाद - ५०००५८.टी.एस., भारत.
HYDERABAD - 500 058,T.S., INDIA.

No. RCMA(MAT)/04/TA/MAT/Vendors Date: 20.11.2020

To
Members/ Special Invitees/ Co-opted Nominees
(As per the enclosed list)

Sub: **Addendum to Minutes of 1st Meeting of the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons**

Reference is made to this centre letter of even number dated 16.11.2020 forwarding the minutes of 1st meeting of the subject committee.

2. Following addendum is made to the minutes of the above mentioned meeting issued vide letter no RCMA (MAT) /04/TA/MAT/Vendors/1st MoM dated 16.11.2020.

ADD under Para No 12.2.8 :Mechanism to reduce Certification Time Cycle: without sacrificing Quality & Safety

12.2.8.3 The representative of HAL(F&F) mentioned that generic qualification of materials as per international specifications such as AMS, etc. are followed by HAL(F&F) for procurement of materials from abroad through traders. He further indicated that after forging those materials, the forged products are qualified as per the test schedule issued by the concerned RCMAs for end applications. In response, the Chairman proposed that the same approach (i.e. qualification against generic specifications like AMS) shall be followed for material procurement from Indian manufacturers (such as MIDHANI, etc.) also. This will reduce certification time to bare minimum duration as materials will be cleared as per AMS. Chairman further requested the rep of HAL(F&F) and other members to provide their feedback.

Action by: Rep(HAL(F&F)/ All Other special Invitees and Members

PDC: 23 Nov 2020

3. All the Members/ Special Invitees/ Co-opted Nominees are requested to make a note of this addendum and do the needful.

4. This has concurrence of the Chairman.

Biswanath Jana

(BISWANATH JANA), Sc-G
Member Secretary

Copy to: For kind information please

DG (MSS), Kanchanbagh, Hyderabad-058. **Fax no. 040-29705265.**
DG (Aero), Bengaluru-093. **Fax no. 080-25283028/25283022.**
CE (Airworthiness), CEMILAC, Bengaluru-037. **Fax 080-25230856.**
Director (Aircraft), CEMILAC, Bengaluru-037. **Fax 080-25235131.**

Telephone : (91) (040) 24340750
दूरभाष : (91) (040) 24006650
फैक्स / Fax : (91) (040) 24341827
ई-मेल / E-mail : rdrcma.mat@cemilac.drdo.in

सभी पत्रादि क्षेत्रीय निदेशक के पते पर भेजे जाने चाहिए, किसी अधिकारी के व्यक्तिगत नाम से नही ।
All correspondence to be addressed to the Regional Director and not to any person by name.

भारत सरकार, रक्षा मंत्रालय (आर एण्ड डी)
GOVERNMENT OF INDIA
MINISTRY OF DEFENCE (R&D)
क्षेत्रीय सेना उड़नयोग्यता केंद्र (पदार्थ), सेमिलैक
REGIONAL CENTRE FOR MILITARY AIRWORTHINESS (MATERIALS), CEMILAC, DRDO
डा. कंचनबाग
P.O. Kanchanbagh
हैदराबाद - ५०००५८.टी.एस., भारत.
HYDERABAD - 500 058,T.S., INDIA.

No. RCMA(MAT)/04/TA/MAT/Vendors

Date: 30.12.2020

To
Members/ Special Invitees/ Co-opted Nominees
(As per the enclosed list)

Sub: **Forwarding Minutes of 2nd and 3rd Meeting of the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons**

Reference is made to the 2nd and 3rd meeting of the subject committee held on 3rd December 2020 and 22nd December 2020 respectively at Conference Hall of Project ASTRA of DRDL, Hyderabad and through VC (on DRONA) involving Special Invitees and Members dealing with Air Launched Weapons only including representatives of CEMILAC, DGAQA and MSQAA.

2. Enclosed herewith please find the minutes of the subject meetings, issued vide lr. no. RCMA(MAT)/04/TA/MAT/Vendors/ 2nd & 3rd MOM dt. 29.12.2020, for your kind perusal and further necessary actions.

Biswanath Jana
(BISWANATH JANA), Sc-G
Member Secretary

Encl: As above

Copy to: For kind information please

DG (MSS), Kanchanbagh, Hyderabad-058. **Fax no. 040-29705265.**
DG (Aero), Bengaluru-093. **Fax no. 080-25283028/25283022.**
CE (Airworthiness), CEMILAC, Bengaluru-037. **Fax 080-25230856.**

Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons

List of Addressees of Lr No. No. RCMA(MAT)/04/TA/MAT/Vendors dt. 30.12.2020

Members		
1.	***Shri R Venugopal,*** Sc-G & Director Admin O/o DG –MSS	Fax: 040-29705268
2.	***Dr Shrish S Kale,*** Sc-G, GD(Materials)-CEMILAC & Regional Director-RCMA(F&F), Bengaluru	Fax: 080-25230856/ 25236516
3.	***Shri K Palani Muthu,*** PScO Rep of RDAQA(GW & M), DGAQA C/o DRDL,Hyderabad	Fax: 040-29551447/ 24346695
4	***Shri M Srinivas Rao,*** SSO-I *Rep MSQAA* *C/o DRDL, Hyderabad*	Fax: 040-24341477
Special Invitees		
5.	***Shri S Gopinath*** OS & Prog Leader ARM, RCI, Hyderabad	Fax: 24306354, 24306002
6.	***Shri CVS Sai Prasad*** Sc 'G' & Director Q & R, O/o DG –MSS, Hyderabad	Fax: 040-29705270
7.	***Ms. AVS Perina Devi*** PD (Astra Mk-II), DRDL, Hyderabad	Fax: 040-24583701/ 24345523
Other Invitees		
8.	***Shri S Ravi Krishna*** PD (RudraM-II) RCI, Hyderabad	Fax: 040-24306404
10.	***Shri D Venugopal*** PD (RudraM-III), RCI, Hyderabad	Fax: 040-24306175

Minutes of 2nd & 3rd Meeting of the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons(ALWs)

Date: 3rd December 2020 at 1500hrs (2nd Meeting) & 22nd December 2020 (3rd Meeting)
Mode of Meeting: Through Video Conference on DRONA
Venue: Conference Hall of PROJECT ASTRA, DRDL, HYDERABAD

1. The 2nd Meeting of the **"Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons"**, vide Member-Secretary letter no. RCMA(MAT)/04/TA/MAT/Vendors dated 27.11.2020 was conducted under the **Chairmanship of Sri B Saha, Sc-G & Regional Director**, RCMA(Materials), CEMILAC, Hyderabad. The main agenda point for the meeting was to deliberate on 'Approach for use of commercial grade materials for Air Launched Weapons Only'.

3. The draft minutes of 2nd meeting was circulated to all the participants. As the comments with difference of opinions were received particularly with respect to use of non-type approved/ general engineering/commercial/non-aero grade materials for Flight Safety Critical (C1) components and their clearance for R&D/ development/ user flight trials/ production phase ALWs. Hence, the 3rd Meeting of the committee was conducted in order to finalize the draft minutes of 2nd meeting. Accordingly, this minutes is issued consolidating the deliberations of both 2nd and 3rd meetings of the committee.

2. The lists of participants for 2nd and 3rd meeting are enclosed at **Appendix-I** and **Appendix-II** respectively of this MOM.

3. Chairman welcomed all the members, special invitees and other invitees attended the meeting physically and through VC. He stated that this meeting is being convened as one of the follow up action points of the 1st meeting to discuss mainly on two aspects listed below. As these issues are of concerns to projects of Air Launched Weapons (ALWs), Special invitees/ members specifically from Missile clusters including reps from CEMILAC, DGAQA [ORDAQA(GW&M) and MSQAA] are involved in this meeting.

   3.1 Approach to use non-type approved/ general engineering grade materials or in other words commercial grade materials for applications in Air Launched Weapons only. This

particular aspect has been stressed upon by CE(A)-CEMILAC and are being discussed vigorously in recent times between CEMILAC and RCMA(Materials) to find way forward; hence this issue is taken up separately by the committee for deliberations in order to identify comprehensive guidelines which will amicably meet the timelines/PDC/requirements of various Missile projects as well as requirements of Certification agencies without compromising on quality and safety of the items.

3.2 The information/data (as per the format and follow-up action points of the 1st and 2nd meeting) have been received so far for Astra Mk-II, RudraM-II, RudraM-III and NGARM Projects and the same are awaited with regard to other ALW projects such as LRGB, SAAW, NASM, HELINA, etc. As the committee plans to submit its report by end December 2020, Chairman requested special invitees from Missile clusters to expedite the same in order to complete the compilation and also formulate the recommendations of the committee.

Action by: Special Invitees and Members from ALWs

4. Chairman then requested Dr. S. Kale, GD(Materials), CEMILAC to express his views on use of non-type approved/ general engineering grade/commercial grade materials. He stated that feasibility of use of commercial/ non-aero-grade grade materials shall be considered for Systems/Sub-systems/Components of ALWs only, not for Aircraft/ Aero-engine applications and also for the components/items with increased safety margin/ enough reserve factor and having multiple load paths with additional tests as per design criteria for R&D phase (including user flight trials) of ALW Projects), as clarified during 3rd meeting.

5. Sri B Jana, Member-Secretary presented the slides (which were already shared for comments/feedback to special invitees/members participated in this meeting) detailing the approach to be deliberated on 'Use of non-type approved/ general engineering grade/commercial grade materials for ALWs only'. Sri Jana re-called his presentation of 1st meeting and briefed the members about the classification of components based on criticality [i.e., **Flight Safety Critical(C1), Mission Critical(C2) and Non-Critical(C3)**]. He also indicated with an example that for a same material, there exists a specification for general engineering applications and a separate specification for aero application and highlighted the main differences.

5.1 Sri Jana brought out that the materials purchased against general engineering grade specifications can be used provided its properties fulfills design requirements of the

concerned ALW projects and also the requirements of Type Test Schedule (TTS) issued by RCMA(Materials). The ALW projects should consider the category of sources from where the particular material is obtained, which are detailed below.

5.1.1 ***Type Approved Source (Indian Firm):***

Under this category, the **Product-Process-Plant** all are critically verified and certified for supply of a particular material; Consistent quality supply is ensured with respect to process and properties. These materials can be utilized for realization of C1 components and also C2/C3 components if the project desires.

5.1.2 ***Non-Type Approved Source (Indian Firm):***

The firm can be Type approved through verification of Product-Process-Plant over a period of supply/ procurement. The firm shall be capable of producing 3 heats fulfilling consistently the requirements of TTS of RCMA(Materials).

Otherwise, Test Release Certificate, COC along with Traceability, Product Identification Tag and other relevant information (It is assumed that all these documents will be available from the Indian Firm) will be verified and ONETIME CLEARANCE for the concerned lot/ heat/ batch can be given for realization of C1 components and also C2/C3 components based on testing, evaluation and meeting the TTS requirements.

5.1.3 **Trader/Agent (for supply of items made by Indian Firm or Foreign Firm):**

In this case, consistency in the quality will be at stake if proper documents such as Test Release Certificate, COC along with Traceability, Product Identification Tag and other relevant information are not available. These materials can be utilized for realization of C1 components provided all these documents from manufacturer are available. Otherwise, all the tests are to be repeated as per TTS and accordingly ONETIME CLEARANCE for the concerned lot/ heat/ batch can be given.

5.2 Sri Jana also mentioned that that even though general engineering specification (in lieu of aero-grade specification) meets the design requirements, the source from which material is obtained plays vital role for achieving ultimate quality of the end product.

6. After detailed deliberations in both 2nd & 3rd meeting, the following recommendations were arrived at regarding use of non-type approved/ general engineering grade/commercial grade materials.

6.1 Approval to the Trader/ Agent to supply materials manufactured by Indian Firm/ Foreign Firm will not be considered by CEMILAC. However, Traders having valid license of OEM for supply of a particular material, then ONETIME CLEARANCE can be considered for that material for the selected lot/batch only.

6.2 **Materials for Flight Safety Critical(C1) Class Components/ Items of ALWs:**

It is preferable to use Type Approved materials for C1 class item. However, the ALW projects may use non-type approved/ general engineering grade/commercial grade/ non-aero grade materials fulfilling the conditions detailed below.

6.2.1 Material shall be obtained against generic engineering grade specifications (AMS, ASTM, BS, etc.) and it should meet the design requirements of ALW projects (as per design criteria proforma certified by platform RCMA) and also the requirements of the Type Test Schedule(TTS) issued by RCMA(Materials).

6.2.2 The TTS shall be evolved conducting Local Type Certification Committee (LTCC) involving all the stake holders namely Project, Designer, User and R&QA of ALW Projects, DGAQA/MSQAA, Material Manufacturer/Producer (if known), Material RCMA, Platform RCMA, etc.

6.2.3 ***Material manufactured against General Engineering Specification by Indian Firm (Non-Type Approved Source) and it is purchased directly from the manufacturing Firm***

6.2.3.1 Material properties should meet the design requirements of ALW projects (as per design criteria proforma certified by platform RCMA) and also the requirements of the Type Test Schedule(TTS) issued by RCMA(Materials).

6.2.3.2 If the firm meets the requirements of DGAQA/ MSQAA for ensuring quality and meet the requirements of TTS issued by RCMA(MAT) and

supply the material consistently for 3 batches, the firm will be considered formally for Type Approval for that particular grade.

6.2.4 ***Material sourced through Traders/Agents (Foreign/ Indian Materials) holding valid License from OEM***

6.2.4.1 Approval to the Trader/ Agent to supply materials manufactured by Indian Firm/ Foreign Firm will not considered by CEMILAC.

6.2.4.2 ONETIME CLEARANCE/APPROVAL will be accorded by RCMA(Mat) for the particular batch/lot purchased through Trader having a valid license of the OEM.

6.2.4.3 Clearance will be given to use for C1 class components/ items if traceability of the materials purchased exists in all respects such as Test Release Certificate, COC, Product Identification Tag, etc. as per the requirements of airworthiness agencies. If no traceability exists, the materials will be subjected to 100% testing and evaluation and meeting the complete requirements of the TTS of RCMA(Materials) the concerned lot/ batch/ heat can be used for C1 components.

6.2.4.4 ***'100% testing and evaluation' means***: Testing as per the TTS on each batch/ lot procured:

- the products of each heat (if heat traceability exists); No. of products as required for testing.

- Each product (if no heat traceability exists) of the batch/ lot

6.2.4.5 Testing will be carried out as per the TTS issued by RCMA(Materials).

6.2.4.6 Frequency of testing from each lot (Number of products and test specimens from each lot to be tested) will be mutually decided between the Project/ User and Airworthiness Agencies [i.e., RCMA(MAT) & DGAQA/MSQAA)].

6.2.5 ***Use of non-type approved/ general engineering grade/commercial grade materials for Flight Safety Critical(C1) Class Components/ Items of ALWs***

6.2.5.1 The material can be used for R&D phase/ development phase/user flight trials of ALWs provided the material meets the requirements of TTS (The TTS shall be evolved considering the full scope of user flight trials). After successful completion of user flight trials of ALWs, subsequent use of the same material will be extended for production phase of concerned ALWs.

6.2.5.2 *If such materials are obtained from a non-type approved Indian manufacturing firm (procured directly or sourced through trader),* the ALW projects shall make parallel efforts to get the concerned Indian firm type approved for regular supply during production phase of ALWs. However, till the time the concerned Indian firm is type approved, the practice of ONETIME CLEARANCE (lot/batch/heat wise) shall be continued during production phase of ALWs fulfilling Para Nos. 6.2.1 to 6.2.5.

6.2.5.3 Further, *in absence of non-availability of Indian manufacturing source/ supplier if such materials are obtained through Foreign Source (procured directly from OEM or sourced through Trader),* the ALW Projects shall make parallel efforts for its indigenization at potential Indian manufacturers and getting them type approved for regular supply during production phase of ALWs. However, till the time the particular material is indigenized and the concerned Indian firm is type approved, the practice of obtaining the material from Foreign source and ONETIME CLEARANCE (lot/batch/heat wise) shall be continued during production phase of ALWs fulfilling Para Nos. 6.2.1 to 6.2.5.

6.3 **Materials for Mission Critical(C2) Class Components/ Items of ALWs:**

The ALW projects may use non-type approved/ general engineering grade/commercial grade materials fulfilling the criteria mentioned in Para Nos. 6.2.1 to 6.2.5 and their sub-paragraphs. Notwithstanding these criteria the ALW projects can use Type Approved materials.

6.4 **Materials for Non-Critical(C3) Class Components/ Items of ALWs:**

No separate type testing is required on materials meant for C3 items. The material conforming to the applicable specification is considered fit for use along with systems/sub-systems cleared by the concerned RCMAs. However, the concerned ALW project shall prepare Quality Assurance Plan (QAP) indicating the tests to be carried out to accept the materials for C3 components.

7. **Other Points:** Following were also discussed.

7.1 ***Quality Assurance Plan-cum- Type Test Schedule (QAP-TTS) Document***

7.1.1 Missile Project rep indicated that RCMA(Materials) issued TTS is a duplicate of their master QAP document. RD-RCMA(Materials) disagreed to this statement.

7.1.2 'Missile cluster's rep stated that based on Design Requirements Quality Assurance Plan (QAP) is generated by R&QA of ALW Projects and duly countersigned by Designer & Project. This master QAP is then forwarded to RCMA(Materials) to serve as Input for the preparation of TTS. He requested that this QAP which formed the basis of the TTS, may be referred in the TTS, for which RCMA(Materials) clarified that QAP is being referred in the TTS.

7.1.3 RCMA(Materials) clarified to the members of Missile cluster that the TTS document is evolved based the design criteria and the QAP for a particular item submitted by the project and the same is discussed in the LTCC meeting involving all the stake holders namely ALW Project, Designer, User, R&QA of ALW Project, DGAQA/MSQAA, Manufacturer/ Producer (if known), Material RCMA, Platform RCMA, etc. before issuance of TTS by RCMA(Materials). Further, it was clarified that the TTS is a comprehensive document which covers the manufacturing process to be followed, tests to be conducted for qualification, test methods, number test specimens and their extraction/ location plan, acceptance and rejection criteria, batch definition, repeat testing criteria, etc. The master QAP document submitted by the project is also considered for preparation of the draft TTS and also referred in the final TTS.

7.1.4 Regarding signing of QAP-TTS document by RCMA(Materials), the following were decided after deliberation.

7.1.4.1 RCMA(Materials) will issue the TTS within 2 weeks time after receipt of valid design criteria and QAP documents from the project and conducting LTCC meeting involving all the stakeholders.

7.1.4.2 The TTS shall be used by the project for floating tender enquiry and placing the Supply Order since it covers all aspects regarding processing, testing including number of test specimens, acceptance criteria, etc. The TTS is a comprehensive document which will enable a prospective vendor to quote appropriately addressing all the requirements.

7.2 **Issuance of TTS by RCMA(Mat) to facilitate tender enquiry by the Project**

7.2.1 RCMA(Materials) confirmed that if the design criteria in prescribed Proforma duly countersigned by the platform RCMA and the QAP document are submitted to RCMA(Materials), LTCC meeting will be conducted and the TTS will be issued within two weeks' time and the same TTS can be used by the Project for floating tender enquiry.

7.3 **Factor of Safety and Reserve Factor**

7.3.1 After detailed deliberation, it was concluded that

- *Factor of Safety (FOS)* = Yield Strength/ Design Limit; (both are expressed in same unit)

- *Reserve Factor (also called as Margin of Safety):*
  = Factor of Safety (FOS) – 1

7.3.2 FOS is design related parameter and Project of ALWs should take concurrence of platform RCMA.

7.4 **Delay supply by M/s Midhani for Materials as per TTS**

7.4.1 The Missile Project reps indicated that when M/s MIDHANI is approached for supply of materials as per the TTS issued by RCMA(Materials), they respond that

the supply of said material will take around 3 years, otherwise it takes only 6-9 months. The Chairman i.e., RD(Materials) did not agree with this statement and he indicated that he will discuss this issue with C&MD of M/s MIDHANI to have clarifications.

8. There being no other points, Chairman thanked all participants for active deliberations. The meeting is ended at 1830hrs on 3rd December 2020 and 1615hrs on 22 December 2020.

The minutes is issued with concurrence of the Chairman.

Biswanath Jana

(**BISWANATH JANA**), Sc-G
Member Secretary
RCMA(Materials), Hyderabad

Encl: Appendix-I & II

RCMA(MAT)/ 04/TA/MAT/Vendors/2nd & 3rd MOM dated 29.12.2020

Copy to: **For kind information please**

DG(MSS), Kanchanbagh, Hyderabad
DG(Aero), Bengaluru
CE(Airworthiness), CEMILAC, Bengaluru
Chairman of the Committee

Distributions:
All the Participants

Appendix-I

Minutes of 2nd Meeting of the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons(ALWs)

List of Participants

1.	***Shri B Saha,*** Regional Director-RCMA(Materials)	**Chairman**
2.	***Shri Biswanath Jana,*** Sc-G, RCMA(Materials)	**Member-Secretary**
Members		
3.	***Dr Shrish S Kale,*** Sc-G, GD(Materials)-CEMILAC & Regional Director-RCMA(F&F)	Fax No. 080-25236516
4.	***Shri K Palani Muthu,*** PScO, RDAQA(GW&M) C/o DRDL, Kanchanbagh PO, Hyd-058 Rep DGAQA	Fax: 040-29551447/ 24346695
5.	***Shri M Srinivas Rao,*** SSO-I *Rep MSQAA*	Fax: 040-24341477
Special Invitees		
6.	***Shri S Gopinath,*** OS & Prog Leader ARM, RCI	Fax: 24306354, 24306002
7.	***Ms. AVS Perina Devi,*** Sc-F & PD(Astra Mk-II, DRDL	Fax: 040-24583701/ 24345523
8.	***Shri CVS Sai Prasad*** Sc'G' & Director Q & R, O/o DG –MSS	Fax: 040-29705270
Other Invitees		
9.	***Shri S Ravi Krishna*** PD, RudraM-II, RCI, Hyderabad	Fax: 040-24306404
10.	***Shri D Venugopal*** PD, RudraM-III, RCI, Hyderabad	Fax: 040-24306175

Appendix-II

List of Participants

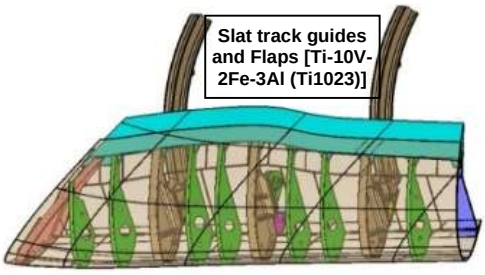
3rd Meeting of

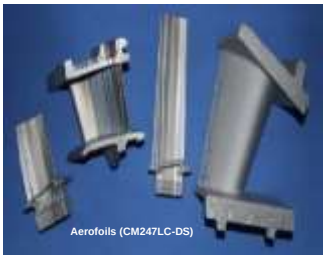
the Committee for Identifying Established Vendors for Supply of Type Approved Materials for Aircraft and Air Launched Weapons(ALWs)

1.	***Shri B Saha,*** Regional Director-RCMA(Materials)	**Chairman**
2.	***Shri Biswanath Jana,*** Sc-G, RCMA(Materials)	**Member-Secretary**
Members		
3.	***Dr Shrish S Kale,*** Sc-G, GD(Materials)-CEMILAC & Regional Director-RCMA(F&F)	Fax No. 080-25236516
4.	***Shri Karthikeyan,*** SSO-I, RDAQA(GW&M) C/o DRDL, Kanchanbagh PO, Hyd-058 Rep DGAQA	Fax: 040-29551447/ 24346695
5.	***Shri M Srinivas Rao,*** SSO-I *Rep MSQAA*	Fax: 040-24341477
Special Invitees		
6.	***Shri S Gopinath,*** OS & Prog Leader ARM, RCI	Fax: 24306354, 24306002
7.	***Ms. AVS Perina Devi,*** Sc-F & PD(Astra Mk-II, DRDL	Fax: 040-24583701/ 24345523

Materials & Components of Aero-engines & Aircraft Coordinated by RCMA(Materials)

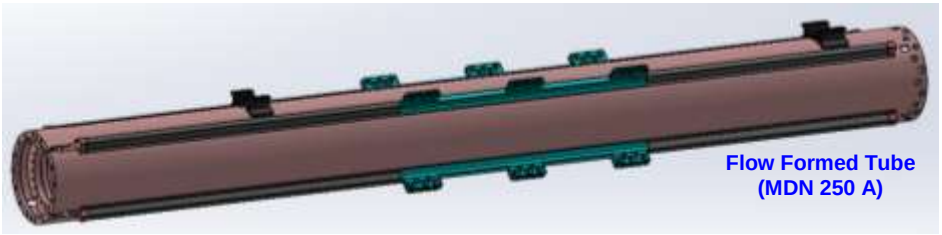
High Pressure Compressor Discs (Titan 26A)





Materials & Components of Air-Launched Weapons Coordinated by RCMA(Materials)

Launching Shoe (MDN 250 A)



Flow Formed Tube (MDN 250 A)