Indian Air Force

Confederation of Indian Industry

Indigenisation Roadmap Indian Air Force (2016-2025)

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एक कदम स्वच्छता की ओर

Message

India is one of the largest importers of defence equipment with almost seventy percent of its requirements being imported. Even for the defence equipment and systems that are produced within the country, there is a sizeable dependency on foreign OEMs for their sub-systems and components. This is primarily due to non-availability of required technologies within the country and inadequate participation of private industry in defence production in the past. There is a huge potential in our industry that needs to be tapped for meeting the indigenisation requirements of our defence forces with an aim to reduce our dependence on foreign OEMs.

A number of measures have been taken by the Govt of India to promote indigenous development and manufacture of defence equipment. The DPP 2016, revised offset policy and enhanced FDI in defence sector are some such measures which offer several incentives to the private industry to participate in defence production.

I am glad that IAF has prepared its indigenisation requirements for future technologies and new weapon system capabilities that they plan to induct, in the form of this booklet. This booklet would provide useful inputs to the industry to map their potential with the requirements of Indian Air Force.

Dated: 08 April, 2016

New Delhi

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MESSAGE

IAF is in the process of modernising and expanding its inventory to keep up with the changing geo-political scenario and emerging threat perceptions. Acquisition of new weapon platforms and systems to boost our operational capability is being pursued at an accelerated pace. However, many of the cutting edge technologies desired in these platforms are not indigenously available. As a result we rely extensively on foreign vendors for many of our weapon systems.

There is an urgent need to minimise dependency on foreign OEMs both for our legacy equipment as well as for the newly inducted systems. Towards achieving this goal, we need to develop in house expertise to ensure unhindered maintenance support for all the equipment operated by the IAF. Indigenisation of LRUs and their repair facilities is currently an important focus area for the IAF.

There exists a huge potential for indigenisation in the manufacturing of capital equipment and their maintenance spares. Economical and optimal exploitation of such a potential by the Indian Industry would lead to greater self-reliance.

Indigenisation requirements for the IAF and future technologies that IAF intends to induct over the next ten years have been collated in the form of this booklet on 'Indigenisation Roadmap for the IAF'. I am sure this information would prove useful in enabling the industry to participate with the IAF in furthering its indigenisation drive.

Jai Hind!

Air Chief Marshal
Chief of the Air Staff

16 **Mar 16**

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MESSAGE

Indian Air Force operates a mix of legacy as well as new generation weapon platforms and systems. Maintenance of this wide range of systems is a huge challenge due to technological obsolescence coupled with rapidly diminishing product support from the OEM.

Indigenisation has been a focus area of Indian Air Force for the last few decades. Indigenisation in the IAF is primarily a Base Repair Depot (BRD) oriented activity and our initial thrust was to indigenise simple but critically required items. We have indigenised a few spares along with HAL and private vendors. We have achieved satisfactory level of indigenisation with respect to low technology high volume spares required for maintenance of various aircraft fleets and systems. However, we are yet to achieve desired level of indigenisation of complex high technology items, sub systems and systems as a whole.

IAF plans to go along with Indian Industry and achieve higher level of indigenisation. This will result in a win-win situation for all. MoD has already taken steps to ensure greater participation of Indian Industry to ensure 'Make in India' programme a success.

'Indigenisation Roadmap for IAF' is an effort to provide a ready reckoner to the industry of the indigenisation requirements of IAF and technologies that the IAF is planning to induct in the next ten years. This booklet would provide useful inputs to interested enterprises in the private sector and would encourage the private industry to be a part of indigenisation process of Indian Air Force.

Jai Hind!

VK Khanna

Air Marshal
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14 April 2016

MESSAGE

Indian Air Force is the fourth largest and is regarded as one of the best in the world. Wide range of weapon platforms and systems, gives it the much needed upper hand. In the emerging security environment, role of Indian Air Force varies from combat to humanitarian missions. Indian Air Force has established itself as the first choice in case of emergencies. Some of the most recent incidents have brought out the unique capabilities that aerospace power brings to the decision maker; may it be evacuation of our diaspora from Yemen or providing relief to the victims of the deadly earthquake in Nepal.

IAF is currently working towards replacing and upgrading a large part of its ageing and obsolete weapon platforms and equipment. Currently, nearly 57% of Air Force's capital procurements are done through the import route. With the current Government's push for Make in India, with a special focus on defence sector, there lies a huge opportunity for the Indian industry, to partner with the Indian Air Force. For several years, Indian Air Force has been focused on Indigenisation & has a well-established indigenisation organization in place.

I am happy to know that IAF in association with CII is coming up this publication titled **INDIGENISATION ROAD MAP Indian Air force (2016-2025)** which will act as a ready reckoner for the industry. By putting the road map in public domain, it will further strengthen the partnership between IAF and the Indian Industry. I congratulate the Indian Air Force for such a wonderful initiative and earnestly hope that such industry friendly initiatives continue in the day to come.

Sd/-
Baba Kalyani
Chairman, National Committee on Defence

FOREWORD

1. Indian Air Force is the fourth largest and one of the most formidable and professionally acclaimed Air Forces in the world. The IAF has a wide variety of weapon platforms and systems in its inventory, ranging from the legacy MiG 21 class of aircraft to the latest and state of the art new generation SU 30 MKI aircraft. IAF has a mix of Russian, Western and a few indigenous platforms and systems, and this wide variety of inventory coupled with depleting product support from OEMs for legacy aircraft fleets and systems poses a huge challenge in maintenance and sustenance of these assets. IAF is also in the process of replacing and upgrading some of its ageing and obsolete weapon platforms and equipment to advanced standards.

2. Procurement of new equipment, and maintenance and sustenance of legacy fleets and systems operated by the IAF offers a huge opportunity for indigenous development in the country. Some of the areas where the IAF is looking up to the private industry is setting up of MRO facilities, indigenisation of complex high end technology items, sub systems and systems as a whole, indigenisation of aircraft spares, of tools, testers and ground equipment, etc. There are private industries in the country with adequate expertise and potential, who can support the IAF in its quest for indigenisation towards achieving self reliance.

3. In pursuance of Govt of India's 'Make in India' initiative and to reduce dependence on foreign OEMs, IAF is very keen to engage private industry to meet its requirements. This booklet is aimed at providing an insight into the IAF's indigenisation requirements for the next ten years and the opportunities it offers to the industry. An effort has been made to collate the critical requirements of spares required by IAF for sustenance of its fleets and it is expected that release of this booklet would enable the industry to map its capabilities and potential with the requirements of IAF and encourage the industry to be a part of indigenisation process of IAF.

CHAPTER-1

INTRODUCTION

1. India is one of the largest importers of defence equipment with almost seventy percent of our requirements being procured from foreign OEMs. Even for the defence equipment and systems that are produced within the country, there is a sizeable dependency on foreign OEMs for their sub systems and components.

2. The Indian Air Force constantly endeavours to modernise and expand to effectively address emerging threat perception. The technologies and capability that the nation needs in the next 15 years have been summarized in the 'Technology Perspective and Capability Roadmap' (TPCR) published by HQ Integrated Defence Staff (IDS). On the anvil are acquisition projects worth more than Rupees Two Lakh Fifty Thousand Crore. Unfortunately, only 10-15% of these are expected to be from indigenous sources as the technologies needed are not available indigenously.

3. The IAF spent about Rs.36,900 crores on capital procurement in the year 2013-14, of which approximately Rs.21,000 crores (57%) worth of equipment and stores were directly imported. Similarly, in the year 2014-15 approximately Rs.14,655 crores worth of capital equipment was imported. On the revenue side also approximately Rs.1595 crores in the year 2013-14 and Rs.1678 crores in the year 2014-15 worth of spares and stores were imported for maintenance of the existing aircraft fleets and systems. As can be seen, a significant proportion of the IAF's capital and revenue budgets is being used for procurement from foreign OEMs. One of the primary reasons for this has been the limited participation of Indian industry in defence production in the past.

4. Indigenisation and self-reliance has remained a Key Result Area (KRA) of IAF for the last few decades. Indigenisation is typically attempted at three distinct levels of complexity viz. System level, subsystem level and MRO spares. These are elaborated below:-

(a) **System Level**. This level typically includes aircraft, engines and systems as a whole. These requirements flow from our Long Term Perspective Plans (LTPP) and are primarily based on the Air Staff Qualitative Requirements (ASQR). Tejas aircraft, Dhruv helicopter and Kaveri engine projects are a few examples at this level.

(b) **Sub-System Level.** At the second level we have sub systems which can be designed, developed and manufactured in house. At this level, IAF has been able to successfully develop and integrate a large number of sub systems on our aircraft fleets with the active

participation of DPSUs, DRDO labs, CEMILAC and a few Indian industries. Some shining examples in this category are the Radar Warning Receivers, Counter Measure Dispensing System and Mission Computers which have been successfully integrated onto a few of our weapon platforms and are performing satisfactorily.

(c) **MRO Spares**. The third and very important aspect of 'Make in India' for IAF is sustenance of aircraft fleets and systems by means of Maintenance, Repair and Overhaul, i.e. MRO. Maintenance of wide range of combat systems of IAF is a huge challenge primarily due to technological obsolescence coupled with rapidly diminishing product support from the OEM. New inductions have also posed challenges for maintenance staff for timely supply of various spares, tools, testers and ground handling equipment. Ever increasing costs of spares, dependence on foreign vendors and declining support from various OEMs have led to a more rigorous pursuit of indigenisation of maintenance infrastructure and spares.

5. IAF has a well-established indigenisation organization in place with the Directorate of Indigenisation as the nodal agency for all aspects related to indigenisation. HQ Maintenance Command at Nagpur spearheads most of our indigenisation activities through various Base Repair Depots (BRDs) spread across the country. The focus of indigenisation in the IAF has so far been limited to addressing the requirement of spares for first line to fourth line maintenance of aircraft and systems. As a result of concerted efforts over the last decade or so, IAF has been able to achieve indigenisation of more than 90% mandatory and Automatic Replenishment System (ARS) spares for a significant proportion of its fleets.

6. Having achieved a satisfactory level of indigenisation of spares required for first line to fourth line maintenance of aircraft, IAF has shifted its focus to indigenisation of complex and high end spares to achieve the desired serviceability of various weapon platforms and systems. There is a huge potential in Indian private industry that needs to be tapped for meeting the indigenisation requirements of IAF with an aim to reduce our dependence on foreign OEMs.

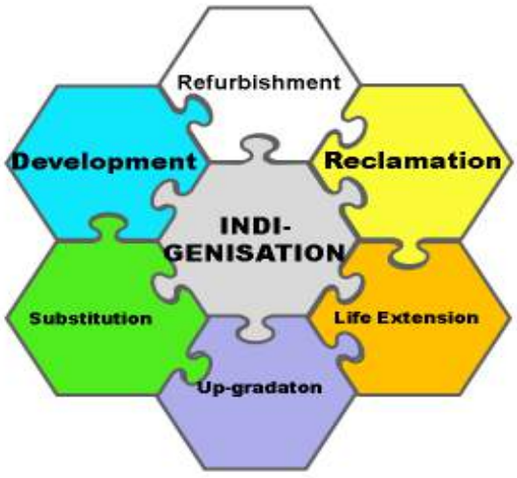
7. This booklet lays down a broad roadmap for indigenisation requirements of IAF and is expected to aid the Indian industry to make useful business decisions for participative collaboration with IAF.

CHAPTER-2

INDIGENISATION IN IAF

1. The definition of indigenisation in IAF has changed over a period of time and today indigenisation includes various facets like reclamation, refurbishment, up gradation, life extension, etc. though the focus remains on addressing maintenance related issues. The entire gambit of indigenisation in the IAF is aptly described by the diagram below:-

FACETS OF INDIGENISATION



Organisation Structure

2. The organization structure in the IAF for indigenous development activities is in three levels as given below:-

(a) **Air HQ.** Broad policies, higher-level coordination with other agencies to facilitate indigenisation activities is done by Directorate of Indigenisation which functions under ACAS (MP). The IAF is represented by ACAS (MP) in the apex indigenisation committee.

(b) **HQ Maintenance Command.** HQ Maintenance Command is the key agency for all aspects related to indigenisation activities. Facilitation, coordination and control of indigenisation activities undertaken by BRDs are done by Command Indigenisation Officer at HQ MC.

(c) **Base Repair Depots (BRDs).** BRDs are the execution agencies leading the development activities to a logical and conclusive end through direct interaction with various agencies. Indigenisation officers at Depots handle all indigenous development related cases.

Role and Responsibility

3. The broad role and responsibilities of various agencies in the organisation are as given below:

(a) **Air HQ (Directorate of Indigenisation)**

(i) Formulation of policy on indigenisation.

(ii) To be associated with Plans branch during the process of new acquisitions to advise on areas in which indigenisation should be taken up through joint development and Make in India.

(iii) Maintain a central database for all vendors along with the range of products indigenised.

(iv) To ensure availability of required funds for indigenisation at BRDs.

(v) Suggest technologies/ areas which need to be obtained under Offsets for the IAF.

(vi) Provide interface with Indian industry for indigenous development.

(vii) Provide support for development and registration of vendors.

(b) **HQ Maintenance Command, Nagpur**

(i) Formulate processes and procedures on indigenisation in the form of Manual of Indigenisation and review the same to maintain authenticity on introduction of policy changes in techno-commercial aspects.

(ii) Approval of annual indigenisation task for each Depot and monitor progress.

(iii) Facilitate Depots to progress indigenisation task through higher level coordination with DPSUs, PSUs, DRDO Labs and major Indian aviation industries.

(iv) Assign specific tasks to an appropriate BRD/1CIMD for indigenisation of items for OEM and HAL supported fleets.

(v) Fund allocation and management.

(vi) Participate and organize indigenisation seminars, conference and workshops to enhance expertise and assimilate technology.

(vii) Expansion of vendor base.

(c) **Base Repair Depots**

(i) Prioritise, plan and undertake indigenous development of all range of items as applicable to their assigned role.

(ii) Undertake indigenisation tasks for OEM/ HAL supported aircraft fleets as and when tasked by HQ MC.

(iii) Project requirements of funds for indigenisation to HQ MC.

(iv) Maintain technical and commercial documents and data related to indigenous development.

(d) **No. 1 Central Indigenisation and Manufacturing Depot, Nasik.** This depot functions as the growing Central Repository of knowledge base and as an advisory body to BRDs on engineering issues and work towards conversion of items in Not Indigenised Not Feasible (NINF) category of BRDs to Not Indigenised Feasible category. 1 CIMD also caters to the requirement of indigenisation of aviation grade raw material, bearings, tyres/tubes, batteries, ASVs and any other complex items that have commonality in terms of technology and application. The focus of 1 CIMD is on rationalization and standardization for universal utility.

Indigenisation Procedure

5. Indigenisation activity involves research and development, making it vulnerable to longer time frame and uncertainties. The failure in the process of indigenisation is a possibility but avoidable. It is a proven fact that any well-planned project has met the time frames and succeeded. Similarly, the indigenisation efforts should commence with detailed planning envisaging uncertainties and needs to be progressed in logical and systematic manner. Chapter 15 of Defence Procurement Manual (DPM) 2009 deals with design, development and fabrication contracts. Detailed guidelines and procedure for undertaking indigenisation in the IAF are explicitly laid down in the Manual of Indigenisation (edition 2012) issued by HQ MC. Some of the important steps involved in processing of development contracts of an item are given below:-

(a) Selection of an item for indigenous development.
(b) Obtaining in principle approval of the CFA for indigenous development of identified item.
(c) Generation of Tech Specs, drawing and design parameters.
(d) Identification of potential vendors/ firms capable of undertaking the development project.
(e) Obtaining Acceptance of Necessity (AON) sanction from the CFA in consultation with the Integrated Financial Advisor (IFA).
(f) Formulation of Request for Proposal (RFP) in consultation with IFA and issue of RFP.
(g) Technical evaluation of bids.
(h) Opening of commercial bids of technically qualified vendors.
(i) Holding of commercial negotiations with L1 vendor.
(j) Conclusion of contract/ supply order.
(k) Post contract management including qualification tests, user trials and certification.

6. Certification of airborne indigenous products is to be undertaken as per Design Development and Production of Military Aircraft and Airborne Stores (DDPMAS) 2002.

CHAPTER-3

INDIGENOUS DEVELOPMENTS ACHIEVED

1. **Spares for First to Fourth Line Maintenance of Aircraft.** The major thrust of BRDs in the past has been to maximize indigenisation of mandatory spares and Automatic Replenishment Spares (ARS) for all aircraft fleets supported by BRDs. Mandatory spares includes all those spares which are required to be changed mandatorily irrespective of their condition during scheduled servicing, repair or overhaul. ARS spares include all those spares which are consumed regularly at field units and are supplied every month as per authorized scale to meet the requirements of the units. In addition, a large number of Tools, Testers and Ground Equipment (TTGE) required for maintenance of aircraft and systems, and spares required for these TTGE have also been indigenised successfully. More than 45000 lines of spares have been indigenised so far by various Depots, which accounts for more than 90% of mandatory and ARS spares for ac fleets. Further, the range of indigenisation is also no more limited to aircraft general spares but includes various systems including radar spares which have been developed purely on black box concept.

2. **Major Systems/ sub-systems and Equipment Indigenised.** Some of the major systems, sub-systems, testers, simulators, ground handling equipment and other airborne equipment developed indigenously so far in house by the IAF or with the assistance of DPSUs and private vendors are listed below:-

(a) **Airborne Systems/ Equipment**

Sl No.	System/ Equipment	Developed By
(i)	Radar Warning Receiver for various ac fleets	DARE
(ii)	Counter Measuring Dispensing system	M/s BDL
(iii)	Mission Computer for SU 30 MKI ac	DARE
(iv)	Core avionics computer for MiG 27 Upg	DARE
(v)	Power supply modules for various systems of different aircraft fleets	Private vendors
(vi)	Aircraft batteries	M/s HBL
(vii)	Aircraft tyres for SU 30 MKI aircraft	M/s MRF
(viii)	Tubes for main wheel tyres of IL 76 ac	M/s Agrawal Rubber Ltd
(ix)	Retreading technology for main wheel tyres of IL 76 ac	M/s Elgi Aviation Tyres
(x)	Aviation grade oil and lubricants for different aircraft fleets operated by IAF	M/s Avi Oil Ltd

(xi)	Various types of ejection seat and power cartridges for different aircraft fleets	Developed by ARDE and manufactured by Ordnance factories
(xii)	EW systems like Trap, Trumpet,Tempest, Tusker for MiG 27 aircraft fleet	DARE
(xiii)	Solid state flight data recorder for Jaguar and Mig 27 Upg aircraft	HAL Korwa
(xiv)	Radio sets,INCOM and COM	HAL(Hyd)
(xv)	IFF system for various aircraft fleets	HAL(Hyd)
(xvi)	TACAN for Hawk	HAL(Hyd)
(xvii)	Fibre optic rate gyro for Avro aircraft	RCI
(xviii)	VOR/ILS/TACAN	HAL
(xix)	Display Processor for SU 30 MKI ac	DARE
(xx)	Radar Computer for SU 30 MKI	DARE
(xxi)	Multi-Function Displays for SU 30 MKI aircraft	M/s SAMTEL

(b) **Test Equipment/ Simulators/ Specialist Vehicles and Ground Equipment**

Sl No.	System/ Equipment	Developed By
(i)	Indigenised Pechora Combat Simulator (IPCS) for Pechora system	2211 Sqn, AF
(ii)	Testers for various systems of different aircraft fleets including the following:- (a) Armament testers (b) FDR milking and analysis tester (c) EW testers (d) Pitot static system testers (e) Auto pilot testers	Various units of IAF and private vendors
(iii)	Arrester barriers	ADRDE and M/s ESCO
(iv)	Cockpit ladders, aircraft lifting jacks, aircraft towing bars, transportation trolleys and other ground equipment for various aircraft fleets	BRDs and HAL through private vendors

(c) **Aircraft Specialist Vehicles (ASV)**

Sl No.	System/ Equipment	Developed By
(i)	Ground Power Unit for providing AC and DC supplies to aircraft on ground	MAK Controls AVISH STATCON
(ii)	Universal Hydraulic Servicing Trolley	DANTAL Neometrix KPCL
(iii)	Air Conditioning Trolley for MiG 27, MiG 29, Jaguar and Mirage 2000 aircraft	KPCL MAK Controls
(iv)	Air Conditioning Trolley for SU 30 MKI aircraft	KPCL Leonardo(under field trial)
(v)	Mobile Air Field Compressor	KPCL
(vi)	Mobile Air Charging Vehicle	KPCL
(vii)	Nitrogen Generating, Storage and Delivery Station	KPCL SERVO
(viii)	Oxygen Storage and Delivery Cart	KPCL Neometrix
(ix)	Weapon Loading Trolley(Bheema)	BEML TPS Infrastructure Ltd

CHAPTER-4

INDIGENISATION REQUIREMENTS OF IAF

1. As covered in earlier chapter, more than 90% of mandatory and ARS spares for aircraft fleets of IAF supported by BRDs have been indigenised. However, some spares have not yet been indigenised due to either complexity of the item or non-availability of technology. In addition, substantial number of spares required for maintenance of aircraft fleets supported directly by HAL or the OEM are yet to be indigenised. Details of items required to be indigenised for IAF are discussed in succeeding paragraphs.

2. **Spares for First to Fourth Line Maintenance of Aircraft/ other Systems.** Fleet wise details of spares/ground support equipment required to be indigenised for first to fourth line maintenance of various ac fleets/systems are placed at Appendix 'A'.

3. **Tools Testers and Ground Equipment (TTGE).**Another area of concern for IAF today is the upkeep and maintenance of TTGE, especially for legacy aircraft fleets and systems. Over a period of time, TTGE supplied by the OEM has become difficult to maintain primarily due to obsolescence issues and non-availability of spares, coupled with diminishing support from the OEM. Therefore, indigenisation of existing TTGE and development of new TTGE offer a great opportunity for the Indian industry. The complete range of TTGE includes general purpose and specific to aircraft type tools and test equipment, ground support and handling equipment like towing bars, ladders, ac lifting jacks, transportation trolleys etc. On a case to case basis, a few test and ground support equipment have been successfully indigenised through DPSUs as well as Indian industry, but a lot more needs to be achieved. The complete range of TTGE needs to be indigenised for the new inductions also so as to reduce dependency on the OEM. The offset clause as given in DPP 2013 needs to be effectively used for procurement of indigenous TTGE. Some of the test equipment which the IAF is looking to upgrade/ develop are:-

(l) Design and development of test equipment for Russian and Ukranian origin Air Launched missiles.
(m) Development of centre for telecom testing and interoperability lab.
(n) Testers for MiG 29 aircraft.
(o) Digitisation of Plan Position Indicator of OSA-AK-M combat vehicle.
(p) Up gradation of ATE to facilitate diagnosis, repair and testing of complex PCBs with RF components.
(q) Development of night vision for TV cameras of OSA-AK-M combat vehicle.
(r) Design and development of bomb assembly conveyer for preparation of armament stores.

4. **Development of Simulators.** The IAF had procured simulators for imparting practical training to its air warriors for some of the aircraft fleets and ground based systems. Some of these simulators have become difficult to maintain due to obsolescence and non-availability of spares support from the foreign OEMs. Further, in certain cases the simulators were not procured. IAF is now looking to develop new simulators for some of its aircraft fleets and ground based systems. Some of the aircraft fleets and systems for which there is a requirement to develop simulators are:-

(a) Maintenance Simulator for THD 1955 Radar.
(b) DARIN II Simulator for Jaguar aircraft.
(c) Universal training simulator for man portable shoulder fired IGLA missiles.
(d) Training simulator for BAZ combat vehicle of OSA-AK-M missile system.

5. **Aircraft Tyres.** Main wheel tyre for SU 30 MKI ac has already been developed by M/s MRF and is in service use. Similarly nose wheel tyres for SU 30 MKI ac has also been developed by M/s MRF and field trials of the indigenous tyres have been successfully completed by ASTE. The tyres will be inducted into service shortly. The IAF intends to indigenise tyres of all aircraft fleets in the near future and towards this an Expression of Interest (EoI) was floated in Aug 15 to identify potential vendors. Case has been initiated for development of tyres for IL-76 and MiG 29 UPG aircraft fleets. This would be followed by development of tyres of other aircraft fleets operated by the IAF.

6. **Aircraft Crash Fire Tender.** The Aircraft Crash Fire Tender (ACFT) is intended to provide rapid response and protection to counter aircraft fire as well as fire protection in the vicinity of airfield area. The IAF is looking up to the Indian industry to supply indigenous ACFT for its flying bases and Directorate of Mechanical Transport is in the process of floating an Expression of Interest to identify potential vendors for the same.

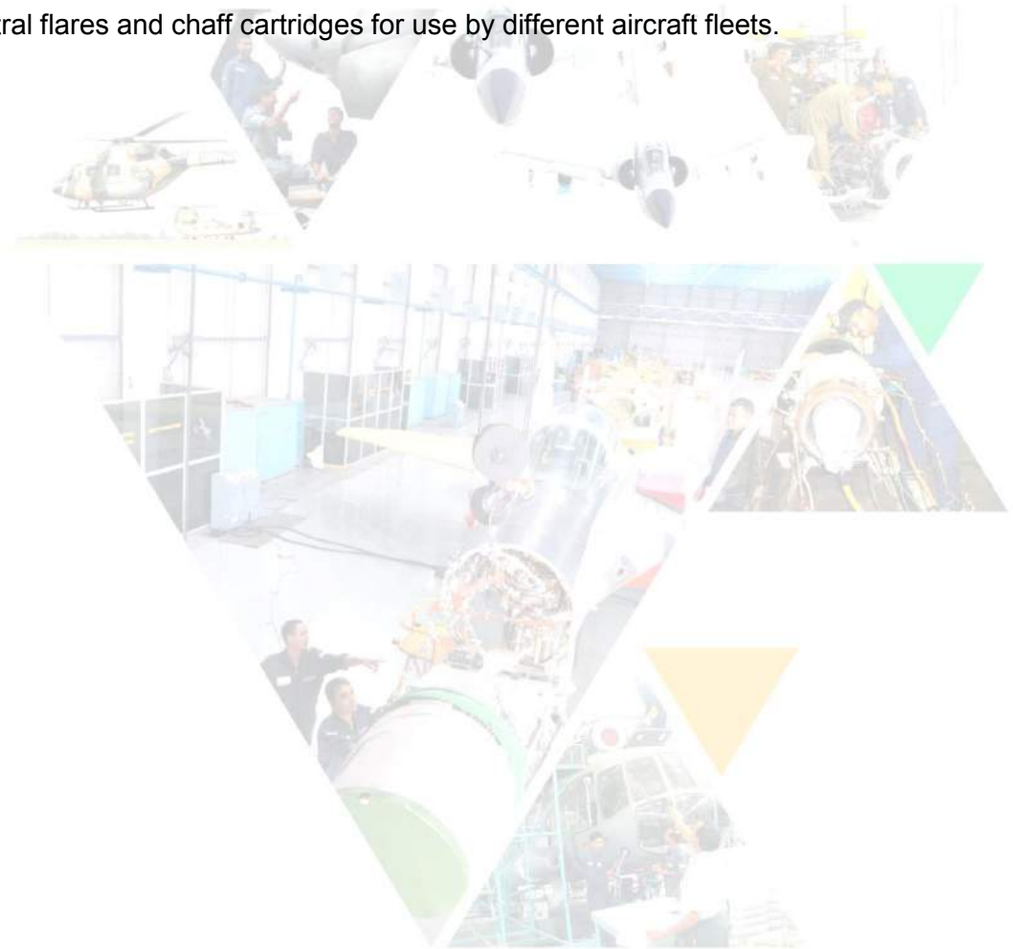
7. **Retreading Technology for Transport Aircraft Tyres.** Retreading technology for main wheel tyre of IL 76 aircraft operated by the IAF has been successfully developed by M/s Elgi Aviation Tyres Ltd with active support from CEMILAC. Retreaded main wheel tyres of IL 76 ac are in use and their performance has been reported to be good. The IAF is now looking forward to developing retreading technology for nose wheel tyre of IL 76 aircraft and main & nose wheel tyres for AN 32 aircraft fleets and case has been initiated for the same. Retreading of remaining transport aircraft operated by the IAF would be taken up subsequently.

8. **Indigenisation of Items like Aircraft Batteries, Bulbs, Filters, Fuel Oil and Lubricants (FOL) etc**. Another area where the Indian industry has enough potential and expertise to contribute is indigenisation of items like bulbs, batteries, different types of fuel, oil and hydraulic filters, various types of fuels oils and lubricants. Many of the aircraft batteries in use today have been indigenised

and the same needs to be extended to all fleets. A large number of fuel, oil and lubricants used by IAF aircraft have been indigenised by M/s Avi Oil Ltd and these items used by our latest inductions can also be developed within the country. Similarly items like fuel, oil and hydraulic filters, aircraft bulbs and fuses used by our various aircraft fleets can all be developed and produced within the country.

9. **Manufacture and Repair of Main and Tail Rotor Blades.** IAF operates different variants of Mi series helicopters. As on date, facility for manufacture and repair of rotor blades of these helicopters is not available in the country and needs to be developed to provide unhindered support to these helicopters.

10. **Flares and Chaff Cartridges.** Flares and Chaff cartridges are primarily meant to deceive enemy sensors. Presently entire requirement of IAF is imported. IAF is looking to indigenise multi spectral flares and chaff cartridges for use by different aircraft fleets.



CHAPTER-5

MAINTENANCE REPAIR AND OVERHAUL (MRO) POTENTIAL IN MILITARY AVIATION

1. The concept of MRO is not new to IAF or any defence service. IAF has BRDs, Army has Base Workshops and Navy has dockyards, which perform the full range of MRO functions. These captive MROs were created for the following reasons;

(a) In earlier years, defence technology was exclusive and enough expertise was not available in private sector.

(b) Low volumes could not attract Indian industries to invest in MRO infrastructure.

(c) Services were bound by contracts with OEMs and ToT to Indian industry was constrained.

2. However, now the situation has totally changed and creating a defence MRO in private sector has not only become a reality but it is also well facilitated by liberal Govt. policies. As covered earlier in Chapter 1, the concept of MRO is a very important area for IAF for sustenance and maintenance of aircraft fleets and systems.

3. Strong MRO industry is the need of the hour if India is to reduce dependence on foreign companies and become self-reliant in defence sector. India with its growing aircraft fleet size, backed by rich pool of engineering work force and low labour costs has tremendous potential to be a global MRO player in aviation sector. A strong and effective MRO in aviation would also produce employment, bring in revenue, save foreign exchange, reduce lead times in repair and maintenance of aircraft fleets and in turn enhance tarmac availability of aircraft. However, as on date, defence MROs in India are in an infant stage and need to grow at a much faster pace in the coming years.

4. The prospects of MRO in defence aviation sector can be gauged by weighing the drivers and its challenges. The drivers are:-

(a) Defence budget has been steadily increasing over the last few years, wherein we saw an increase of about 9% from 2013-14 to 2014-15 and about 11% from 2014-15 to 2015-16. Increased defence budget augurs well for the defence industry in the country and is a driver for Indian industry to invest in defence sector.

(b) Defence offset policy was formulated in 2005 to contribute to our goal of developing domestic defence industry. However, despite various amendments to the offset policy, India has actually not been able to absorb offsets to its advantage. India has signed five billion USD worth of defence offset contracts, while ten billion USD worth of additional offset contracts are in the pipeline. This is an area we really need to look into seriously if we have to develop our domestic defence industry. MRO is one area where offsets can be effectively executed.

(c) The revised DPP which is likely to be issued any time now has a host of improvements that can be advantageous to private sector. A new category called IDDM (Indigenously Designed Developed and Manufactured) has been introduced in the new DPP which would give a huge boost to our Indian industry in defence sector. Certain other features like level playing field, fast tracking of procurement and giving preference to procurement from indigenous sources will give a boost to the 'Make in India' initiative and enhance involvement of Indian industry.

(d) The Govt. has permitted 49% FDI in defence sector through automatic route from the earlier Govt. approved route where prior Govt. approval was required and the proposals were considered by FIPB (Foreign Investment Promotion Board). Recently in Nov 2015, TATA Advance Systems and Boeing announced a JV to make aero structures for Apache helicopters. It is expected that FDI reforms such as these would definitely result in more JVs in future.

(e) Another driver for defence MRO is economic growth and political stability. The environment which is associated with a stable Govt tends to increase investments and also positively impacts the pace of economic growth. Economic growth delivers larger dividends when the stability of the Govt. translates into good governance.

(f) India is the fastest growing economy in the world today and we are expected to record a five year high growth rate of 7.6% in 2015-16. As per one of the surveys, Indian aerospace market is one of the fastest growing in the world, driven by continued economic growth. India today boasts of young and skilled work force, engineering work force and to top it labour costs in India are amongst the lowest in the world. Backed by all these factors, India is emerging as a potential international hub for MRO.

5. As against these drivers, we have difficult challenges that need to be overcome.

(a) **Technology Absorption.** Defence sector, especially the field of aviation, is technology intensive. One of the biggest challenges for MRO industries would be absorption of high end niche technology with which the aviation sector is associated. The industry would have to develop these capabilities in terms of required infrastructure, skilled and trained manpower.

(b) **R&D Infrastructure.** India is fast emerging as a major force in global R&D arena. However while the domestic R&D output and investment has shown a steady growth over the last few years, public investment still accounts for more than three fourths of the total R&D spending and boosting Indian industry investment in R&D continues to be a challenge. If we are to become self-reliant in defence sector we have to develop R&D capability in the country and have to create requisite R&D infrastructure.

(c) **Material and Manufacturing Technology.** Another challenge for MRO in defence sector is non-availability of the required material and manufacturing technology in the country, especially for airborne products. A large number of metallic and rubber raw materials used in production of airborne spares are still being imported. Similarly, some of the manufacturing technologies required for production of defence goods, especially airborne products, are still not available in the country. To cite an example, we have not been able to develop aviation grade bearings for our aircraft fleets despite continued efforts of DPSUs and Indian industry. Unless we develop these technologies within the country, we would remain dependent on foreign sources.

(d) **Industry Capability.** Today, there are Indian industries in the country with adequate expertise and knowledge who can meet the requirements of defence services. However, certain capabilities which are specific to defence, especially in the aviation sector need to be developed by the industry, with the active support of DRDO, Academia and other Scientific organisations in the country.

(e) **Economic Order Quantities.** One of the biggest challenges for defence MROs would be economy of scale. Most of the spares/ components used by the three services are specific to military use and does not have any use in civil sectors. Further, in certain cases the order quantities are so low that a private player may not find it economically viable to invest for such products or services. An altogether different model for manufacturing low MOQ items is required to be evolved. Perhaps our MSMEs can join hands to form a ‘Matrix’ type of organisation to overcome this hurdle.

(f) **Airworthiness & Quality Assurance.** Due to its very nature of usage, defence equipment in general and equipment for IAF in particular, has to meet highly exacting standards and accordingly very stringent airworthiness requirements have been laid down. There can be virtually no failures and the need for stringent quality control measures and proper certification of indigenous products needs no emphasis. We have a fairly well laid down procedure in place with CEMILAC being the certification agency for all indigenous military aviation products. Stringent airworthiness requirements also call for high standards of quality assurance at various stages of MRO of aviation products/ platforms. DGAQA is entrusted with the responsibility of Quality Assurance functions at production agencies for IAF. Requisite QA infrastructure would also have to be created by defence MRO to meet the highly exacting standards.

(g) **'Black Box' Design.** In certain cases, especially pertaining to Russian systems and components, detailed technical information is not available to facilitate development of indigenous substitutes. For such cases, we have to resort to 'Black Box' development methodology wherein input and output of the component/ systems are known and the item is developed based on this information. Development of such items remains a challenge.

6. There are still a large number of rotables and LRUs for different aircraft fleets and systems operated by the IAF, for which repair and overhaul facilities have not yet been set up in the country. The broad areas where Indian industry can explore setting up MRO facilities for IAF are:-

(a) Airframe and Aero engines
(b) Mechanical Rotables
(c) Electronic Rotables
(d) Test Equipment and Ground Support Equipment
(e) Airfield Safety Systems like Aircraft Crash Fire Tender, Arrester Barrier etc.

7. This aspect needs to be exploited by the Indian industry and detailed discussions on the subject can be arranged at Air HQ by Directorate of Indigenisation.

Repair and Reclamation

8. Another strategy that the IAF has adopted to ensure better availability of spare parts for improving serviceability of various aircraft fleets is by way of restoration of engine and airframe parts through Repair and Reclamation. In case we can Repair or Reclaim, then why replace? The following steps are typically involved in the process of reclamation:-

(a) **Identification of Parts for Reclamation.** The first challenge in the process of reclamation is identification of parts for reclamation. Various factors that are considered in the process of identification of parts for reclamation are non-availability or shortage of spare, cost and consumption, cost benefit analysis etc.

(b) **Identification of Technology.** Reclamation of spares require identification of technologies available in the country and their customization to suit the requirement. National research institutes, laboratories and domain experts in the field of technology such as ARCI, IICT, NAL, DMRL, GTRE, IITs etc are approached and consulted for assessment and selection of most suitable technology for undertaking reclamation of identified parts.

(c) **Identifying Source.** Once the parts are identified and reclamation technology to be adopted for the same is finalized, a decision is made whether the reclamation process is to be established in-house at the BRDs or is to be carried out through outsourcing to industry.

(d) **Testing and Certification.** The component has to undergo testing and certification for validation of reclamation process. Testing is done in- house at the concerned BRD, in DRDO Labs or in any NABL accredited labs. RCMA, being the airworthiness certification agency, is involved at each step right from the proposal stage to avoid problems in certification at a later stage.

9. Some of the technologies that have already been utilised by BRDs for reclamation of aero engine and airframe parts are given below:-

(a) TIG welding of compressor casing and assembly guide vane of AN-32 aero engine
(b) Chrome plating of gears of front casing of AN-32 aero engine.
(c) Plasma coating of stage rings and AGV of AN-32 aero engine and stage rings of Mi-8 aero engines.
(d) Copper coating of driving gear of Mi-8 aero engine and 5&7 pin carriers of Mi-8 and Mi-17 aero engines.
(e) Laser cladding of turbine blades of Mi-17 aero engines.
(f) Titanium Nitride coating using Cathodic Arc Physical Vapour Deposition Technique (CAPVD) on compressor blades of Mi-17 aero engines.
(g) KNA coating using thermal spray process on nozzle guide vanes of AN -32 aero engines.

10. Some of the reclamation partners of IAF are given below:-

(a) ARCI, Hyderabad with specialisation in power metallurgy, laser cladding, CVD/PVD.
(b) IICT, Hyderabad with specialisation in coatings, chemicals and paints.
(c) MEC Jodhpur with specialisation in thermal spray coatings of all types.
(e) Irusha India Chandigarh with specialisation in hard chrome plating and machining.
(f) CTR, Ludhiana with specialisation in machining.
(g) Taurus Agile Technology, Chandigarh with specialisation in manufacturing and machining.
(h) Sabooritech International Inc, Faridabad with specialisation in machining.
(j) VTC Surface Technologies, Vishakhapatnam with specialisation in plasma spray coating.

11. Some of the reclamation efforts taken up by IAF so far are depicted below:-

(a) **Titanium Nitride coating**

(b) **Replacement of Copper Coating with Laser Cladding**

(c) **Plasma Coating**

(d) **Hard Alumina Coating**

12. Though significant progress has been made with respect to restoration of parts through reclamation in the last few years, a lot more needs to be done. The IAF plans to extend the reclamation process for all our aircraft and helicopter fleets in the future with active participation of Govt. agencies, DPSUs, CEMILAC and Indian industry.

CHAPTER-6

FUTURE TECHNOLOGIES REQUIRED

Technology Perspective and Capability Roadmap (TPCR-2013)

1. TPCR, issued by HQ Integrated Defence Staff, MoD in April 2013 provides the industry a 15 year technology road map with an intention to drive the technology in development process. This document is based on the Long Term Integrated Perspective Plan (LTIPP) of the Armed Forces. The LTIPP identifies the shape and size of the Forces over the designated time period based on the foreseeable strategic trends. Some of the future technology imperatives in the field of aviation as indicated in the TPCR are given below:-

(a) **Aircraft Structures.** Platform design capability and employment of advanced CFD and FEM tools for structural optimisation are required to be developed indigenously.

(b) **Propulsion Technology.** There has been a gap between indigenous developments and the capabilities of aeronautically advanced nations in the field of air-breathing engines. The industry needs to intensify its collaborative ventures to leapfrog and catch-up in this field. The next generation fighter aircraft should invariably have three dimensional thrust vectored nozzles. Development of variable bypass engine would need to be commenced within the next ten years. Fundamental engine technologies such as single crystal blade design, high temperature materials, combustion chamber design and CFD programs should evolve between the short and medium-term.

(c) **Engine Systems.** All the aircraft engines must incorporate Full Authority Digital Engine Control (FADEC) systems, with full manual back up to facilitate more fuel efficient and surge resistant engine operations.

(d) **Avionics.** Technology of core avionics display systems and their software has been witnessing a rate of growth higher than the other related fields. Indigenous capabilities in the field of avionics such as mission computer, display processors etc. have already been demonstrated and all efforts need to be made to ensure that India remains contemporary in this field. Some of the specific areas under Avionics that need to be developed in the future are:-

(i) **Display Systems.** There would be a requirement to impart greater impetus to the development of display technologies such as optical thin films, thin TFTs,

collimators for wide angle holographic HUDs etc. All aircraft must incorporate smart electronic displays which can be easily re-configured, if required.

(ii) **Navigation Capabilities.** All platforms should have an independent, jam proof, reliable and redundant navigation capability. Navigation systems must incorporate the ability for feeding the mission from a portable data loader and within the next decade must be capable of uploading the mission directly from the ground via the data link.

(iii) **Auto Pilot.** All aircraft must incorporate advanced auto pilots, which must include all modes of horizontal and vertical navigation and aircraft recovery linked to the aircraft Flight Management System(FMS).

(iv) **Airborne Sensors.** Airborne sensors including UAVs operating at high and medium altitudes with extended endurance periods, capable of withstanding adverse conditions like high winds or jet stream phenomenon need to be developed.

(v) **Night and All Weather Capability.** All aerial platforms must possess suitable night vision and all weather capabilities.

(e) **Flight Control Systems.** All aircraft of the future will necessarily have fly by wire/ fly by optics technologies. Presently, already incorporated on most fighter aircraft, they must be full authority, multiple redundant systems and battle hardy, enabling recovery even in the event of multiple channel failure.

(f) **Aircraft Safety Systems.** Aircraft safety systems akin to Traffic Collision Avoidance System (TCAS) and Enhanced Ground Proximity Warning Systems (EGPWS) must be incorporated, with the facility being available to the pilot to disable the system for any specific mission. All aircraft would also need to incorporate Reduced Vertical Separation Minima (RVSM) capability, as all aircraft operating above FL 150 need to be RVSM compliant.

(g) **Aircraft Survivability.** There is a need to develop technologies to enhance aircraft survivability including multi-spectral signature control, active/ passive vulnerability reduction technologies, damage tolerant aircraft structures, defensive avionics and counter SAM capabilities, including missile and laser warning systems.

(h) **Information Electronic Warfare (IEW) Systems.** Modern day RWRs with high detection ranges of up to 200 km need to be inducted on all aircraft. For platforms capable of undertaking the hard kill option against ground emitters, the technology of HADF (High Accuracy Direction Finder) must be incorporated. All airborne platforms need to be integrated with MAWS (Missile Approach Warning System) and LWS (Laser Warning Systems).

(i) **Communication and Networks.** There is a need to develop technologies to improve aircraft communications and network connectivity performance throughout the battle space. Communications should cover a large band width and provide high data rate for voice, data and imagery and video transmissions. There should be a high level of network security with encryption/ decryption capability.

(j) **UAVs.** The future UAVs need to be smaller and easier to transport. Size as well as stealth technology must make them difficult to detect. There is a need to develop technologies to enable unmanned, highly autonomous strike capabilities against the full spectrum of potential targets. Payload and sensors need to be upgraded with changing technology.

Other Technologies Required

2. Indigenisation of defence technologies to achieve strategic independence has been one of the KRAs of the Raksha Mantri Production Committee (RMPC). In this context a study has been carried out by the IAF to identify core technologies that need to be developed to meet the present and future requirements of the IAF and the same are discussed in succeeding paragraphs.

3. **Aviation Grade Bearings.** BRDs have been pursuing indigenisation of aero engine bearings, and other aviation grade bearings used in different parts of an aircraft with civil firms for the last few decades. However, most of the aviation grade bearings in use by various aircraft fleets of IAF today are still being imported. One of the primary reasons for this is non availability of test facilities required for qualification of aviation grade bearings. Thus, there is a requirement to develop test facilities for qualification of aviation grade bearings in consultation with Centre for Military Airworthiness and Certification (CEMILAC), which is the certifying agency for all indigenous aviation products.

4. **Aviation Grade Glues.** Different types of glues are used during the process of repair and overhaul of aircraft, aero engines and their components. Most of these aviation grade glues are still being imported and need to be indigenously developed in the country to achieve self reliance and reduce dependency on foreign OEMs.

5. **Aircraft Canopies and Wind Shields.** Aircraft canopies and wind shields deteriorate and become opaque over a period of time due to fair wear and tear or at times get damaged due to bird hits, and are required to be replaced. Canopies and wind shields of most of the aircraft fleets are still being imported. Thus, development of technology for manufacture of aircraft canopies and wind shields is another area where IAF is looking up to DPSUs and Indian industry.

6. **Application of Nano Technology for Repair and Rejuvenation of Aircraft Canopies.** Aircraft canopies exhibit wear and tear and minor damages in the form of nicks and cuts. Though these damages can be rectified by polishing, the canopies are rejected if the damage is beyond permissible limits. Sol gel coating technology is a versatile surface engineering technique which has shown promise in recovering canopies which otherwise would have been rejected. There is a need to develop this technology for reclamation of damaged canopies.

7. **Test Facilities for Aircraft Tyres.** Significant progress has been made in the last few years in indigenous development of aircraft tyres and main and nose wheel tyres for SU 30 MKI aircraft have been successfully developed by M/s MRF. The IAF is looking at indigenising tyres for all its aircraft fleets in the future. However, a few test facilities required for qualification test of indigenous tyres, like the dynamometer test, are not available in the country and are being undertaken abroad. There is a need to develop all such test facilities in consultation with CEMILAC to reduce dependence on foreign OEMs.

8. **Protective Coating on Aero Engine Compressor Blades through Vapour Deposition Technique.** Helicopters of IAF operate in varied climatic conditions wherein the aero engines are exposed to sandy, dusty and saline weather conditions. Continued operations in these conditions wear out the stator vanes and rotor blades of the compressor. Worn out blades results in degraded performance of the engine and at times the blades are also rejected during micrometry checks at BRD. Thus, there is a need to develop protective coatings for compressor blades.

9. **Aviation Grade Rubber Compounds for all Applications.** Different types of rubber compounds are used for manufacture of seals, gaskets etc. for use at various locations on the aircraft/ aero engine and also for various components of aircraft/ aero engines. The type of rubber compound to be used depends upon the medium in which the item is intended to be used, the operating conditions including temperature and humidity etc. Even though most of the rubber seals/ gaskets are being indigenously produced at BRDs or HAL or through private vendors, some of the rubber compounds are still being imported. There is a need to develop rubber compounds for all aviation applications to reduce dependency on foreign OEMs.

10. **Development of New NDE techniques for Life Extension Studies.** BRDs have been established in the IAF for undertaking repair and overhaul of aircraft, aero engines, aircraft and aero engine components, ground based systems and their components. In addition the BRDs are also involved in life extension of aircraft/ aero engines and other parts. As of now only conventional NDE techniques, are being used for defect analysis and these have limitations as far as their use for life extension is considered. In order to enhance the existing defecation capability at BRDs it is proposed to develop new NDE techniques, like phased array system for undertaking defect analysis and assessing condition of airframe and its parts for further exploitation.

11. **3 D Printing for Manufacture of Aircraft Parts.** Another technology that the IAF is looking to develop in the near future is 3 D printing process for manufacturing aircraft parts. 3 D printing process, also called Additive Layer Manufacturing (ALM) offers a completely new approach to production. Instead of obtaining a part by cutting away a solid block of material, it works from the inside out, building the part, layer by layer. The process repeatedly prints very thin layers of material on top of each other until the layers form a solid object, in material ranging from high grade titanium alloys to glass and concrete. 3 D printing makes it simpler to produce very complex shapes. An electron or laser beam is used to model the desired material according to a computer generated design. Such parts are lighter, faster to produce and ultimately less expensive than conventional ones. ALM technique is already in use by the Airbus group for tooling, prototyping, making parts for test flights and parts for commercial aircraft. UAV Atlante has a 3D printed air intake onboard. 3 D printing is an imminent change and would soon be utilised world over to shape the future of aircraft component manufacturing.

12. Some of the other technologies which IAF requires in the next ten years are:-

(a) Development of AESA Radar technology for Air to Air or Air to Ground.

(b) Active and Passive {Radio Frequency (RF) and Imaging Infra –red(IIR)} Seeker and Sensor Technology for missiles.

(c) Electro Optical (EO)/ Infra-red (IR) payload for Intelligence, Surveillance and Reconnaissance (ISR).

(d) Smart materials.

(e) On board prognostic and real time health monitoring technologies.

(f) Low Observable Technology.

New Weapon System Capabilities

13. In addition to the above, some of the future technologies that IAF is seeking, either embedded in a weapon system or as a standalone system are given in succeeding paragraphs.

14. **Airborne Platforms and Pods**

(a) Advance Multi Role Combat Aircraft (AMCA) Programme/ Fighter aircraft.
(b) Unmanned Combat Aerial Vehicle (UCAV).
(c) Navigation and Targeting pods.

15. **Surface to Air Guided Weapons**

(a) Short Range Surface to Air Missile (SRSAM).
(b) Medium Range Surface to Air Missile (MRSAM).
(c) Close in Weapon System (CIWS).
(d) Long Range Surface to Air Missile (LRSAM)

16. **Weapons**

(a) Stand Off Long Range (SOLR) Homing (H) Anti-Radiation Missile (ARM).
(b) Runway Penetration Bomb (RPB).
(c) Long Range Glide Bomb (LRGB).
(d) Smart Anti-Airfield Weapons (SAAW).
(e) Anti-Ballistic Missile
(f) New Gen Beyond Visual Range (NGBVR) Missile
(g) New-Gen Within Visual Range (NGWVR) Missile
(h) Air to Ground Stand -off Weapons (including PGMs)
(i) Air Launched Missiles
(j) Fuzes for Air Launched weapons
(k) Smart weapons
(l) Directed Energy Weapons

17. **EW Systems**

(a) Airborne Self Protection Jammers
(b) Directed IR Counter Measure (DIRCM)
(c) Multi Sensor Warning System (MSWS) for Transport and Heptrs
(d) Towed decoy
(e) Tactical Air Launched Decoy
(f) Missile Approach and Warning System (MAWS)

18. **Radars and Sensors**

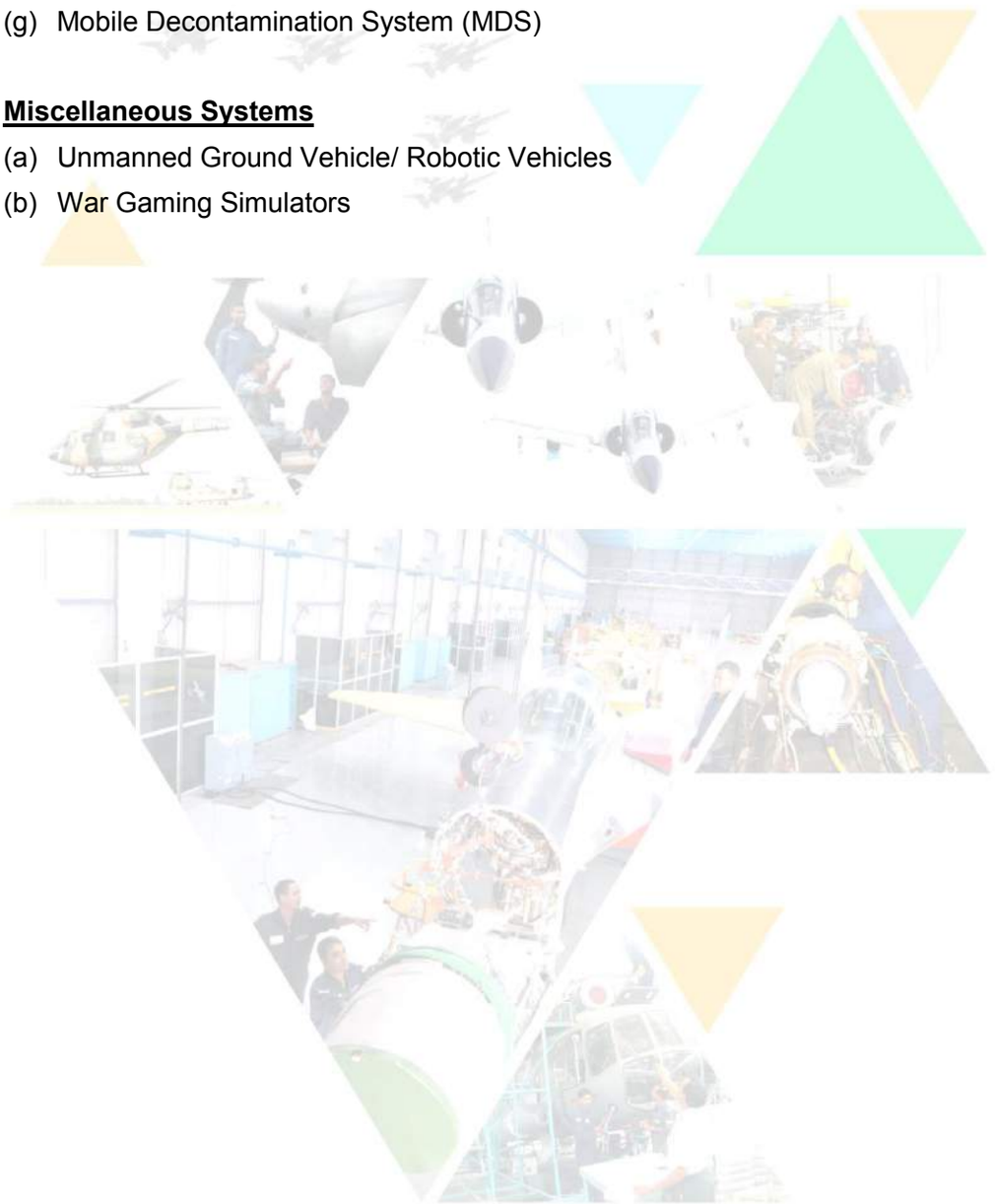
(a) Long Range Surveillance Radar (LRSR)
(b) High Power Radar (HPR)
(c) Passive Surveillance System (PSS)
(d) Aerostats
(e) Elevated Radar Network

19. **NBC Equipment**

(a) Chemical Agent Monitor
(b) Multi- purpose Decontamination System
(c) NBC Inflatable Shelter
(d) NBC Recce Vehicle
(e) NBC Water Purification System
(f) Automatic Chemical Agent Detector and Alarm (ACADA)
(g) Mobile Decontamination System (MDS)

20. **Miscellaneous Systems**

(a) Unmanned Ground Vehicle/ Robotic Vehicles
(b) War Gaming Simulators



CHAPTER-7

RECOMMENDATIONS TO ENHANCE PARTICIPATION OF INDIAN INDUSTRY IN INDIGENISATION OF DEFENCE PRODUCTS

1. One of the primary reasons for not achieving the desired level of indigenisation in the past has been the lack of involvement of Indian industry in the process. Today, there are Indian industries in the country with adequate expertise and knowledge who, with active support of DPSUs and DRDO establishments, can support the IAF in its quest for development of complete systems, sub systems and complex high technology items. There is an inescapable requirement to take the Indian industry on board in order to achieve self-reliance in defence production. A few suggestions have been made in the succeeding paragraphs to enhance involvement of Indian industry in indigenisation of defence products and to reduce dependence on foreign OEMs.

2. **Effective Use of Offset Policy.** DPP 2013 lays down permissible avenues for discharge of offset obligations for leveraging capital acquisitions to develop Indian industry. The industry needs to identify suitable industry oriented avenues for effective exploitation of the offsets in various categories like technology, production, support services etc. with an aim to boost indigenisation, reduce imports in the long run and to achieve self-reliance. As far as the IAF is concerned, we would like to identify specific indigenisation requirements at induction stage itself and include them in the RFP to avoid IPR violation at a later stage. Similarly, TTGE associated with all new acquisitions may be sourced from within the country by the OEM through partnership, and the same may be included in the RFP. The provisions for defence offsets need to be leveraged for setting up necessary Joint Ventures to provide life time maintenance and logistics support.

3. **Proactive Approach by DPSUs/ Industry.** As of now the requirements spelt out by the Armed Forces in the form of SQRs are driving the DPSUs and the Indian industry. This needs to reverse and the Indian Industry needs to become proactive and tell the armed forces about what is available in the market that suits the requirements of the Armed Forces. Towards this, the concept of “Cluster of Industries”, especially cluster of MSMEs, in the defence sector needs to be encouraged and it is this cluster that needs to identify and meet the requirements of the armed forces. An Industry cluster has to be industry driven and the industry needs to take the lead in addressing issues and opportunities, while Government and other agencies would play a supportive role.

4. **Maintenance, Repair and Overhaul.** Another area which offers a huge opportunity to the Indian industry in the context of IAF is sustenance of aircraft fleets and systems by means of Maintenance, Repair and Overhaul, i.e. MRO. The IAF inventory is wide and varied in terms of

technology and origin and maintenance of such an inventory is a huge challenge primarily due to technological obsolescence coupled with rapidly diminishing product support from the OEM. The concept of MRO (Maintenance Repair and Overhaul) is not new to IAF since BRDs perform the full range of MRO functions for some of the aircraft fleets and systems operated by IAF. For a few of the aircraft fleets and systems, MRO is provided by DPSUs, however, IAF is still dependent on foreign OEMs for some of the legacy equipment as well as recently inducted weapon platforms and systems. There are still a number of LRUs, especially for the recently inducted aircraft fleets and systems, for which Repair and Overhaul facilities are yet to be established within the country. Creation of a MRO in military aviation in private sector in the country today is a reality and it is well facilitated by liberal Govt policies. However, it is presently in an infant stage and needs to grow at a much faster pace in the coming few years.

5. **Long Term Maintenance Agreement (LTMA)/ Long Term Repair Agreement (LTRA).** Another area where the IAF has recently ventured into is LTMA for a few weapon platforms and systems. LTMA is primarily an agreement between the IAF and vendor for the vendor to meet all maintenance requirements of a particular weapon platform/ system for a specified period of time (say five years) in terms of provisioning of spares and undertaking repair of unserviceable components, at specified costs. On similar lines, IAF has also entered into LTRA with a few OEMs for some of the aircraft fleets. LTRA is primarily an agreement between the IAF and the vendor for the vendor to undertake repairs of specified components at a specified cost for a specified period of time. Thus, the vendor is assured of recurring requirements for the period specified in the LTMA/LTRA and IAF is also assured of requisite support from the vendor for sustenance of its fleets/ systems.

Conclusion

6. With the changing times, the concept of indigenisation in IAF has been transformed into a broader idea that enables participative collaboration with Indian industry. There is a huge potential for indigenisation of capital equipment as well as maintenance spares in IAF. Economic and optimal exploitation of this potential by Indian Industry can lead to greater self-reliance. This booklet provides broad inputs to the interested enterprises in the private sector to take a step forward and be a part of indigenisation process in IAF. We encourage the members of the Indian industry to get in touch with Directorate of Indigenisation, Air HQ, HQ Maintenance Command, Nagpur and any of the Base Repair Depots. Useful contact particulars are given on the back cover of this booklet.

Appendix 'A'

(Refers to para 2 of chapter 4)

INDIGENISATION REQUIREMENTS FOR MAINTENANCE OF AIRCRAFT FLEETS AND SYSTEMS

1. Indigenisation requirements of IAF are given in succeeding paragraphs.

2.

Part Number	76-3160018E ETU 100/3
Description	Ball Bearing
Weapon Platform	AN 32
Main system	Electric motor
Annual Requirement	10

3.

Part Number	34100 DTU 100/3
Description	Ball Bearing
Weapon Platform	AN 32
Main system	Turbo cooler
Annual Requirement	20

4.

Part Number	NU1200U ETU 100/5
Description	Ball Bearing
Weapon Platform/	AN 32
Main system	Aileron control mechanism
Annual Requirement	20

5.

Part Number	981067UU, ETU100/5
Description	Ball Bearing
Weapon Platform	AN 32
Main system	Control linkage assembly
Annual Requirement	50

6.

Part Number	1584A-2-7
Description	Filler neck plug
Weapon Platform	AN 32
Main system	Refuelling system
Annual Requirement	40

7.

Part Number	AD 4A 1.5-3.0kg
Description	Shock mount
Weapon Platform	AN 32
Main system	Tray FDS coupler
Annual Requirement	40

8.

Part Number	AD 5A 3.5 kg
Description	Shock mount for AP control unit
Weapon Platform	AN 32
Main system	Auto pilot control unit tray
Annual Requirement	20

9.

Part Number	24-3022.120
Description	Rudder control unit
Weapon Platform	AN 32
Main system	Rudder control unit
Annual Requirement	10

10.

Part Number	AGD 1C 458 MKS
Description	Gyro transmitter
Weapon Platform	AN 32
Main system	Self
Annual Requirement	29

11.

Part Number	BKU-17R
Description	Stall sensor
Weapon Platform	AN 32
Main system	Angle of attack
Annual Requirement	29

12.

Part Number	USHU-2K
Description	Nav indicator
Weapon Platform	AN 32
Main system	Compass system
Annual Requirement	20

13.

Part Number	BI 12-2
Description	Measuring unit
Weapon Platform	AN 32
Main system	Fuel system
Annual Requirement	10

14.

Part Number	GA-6
Description	Directional gyro
Weapon Platform	AN 32
Main system	Compass system
Annual Requirement	38

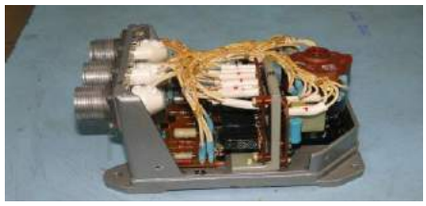
15.

Part Number	ITE 2T
Description	RPM indicator
Weapon Platform	AN 32
Main system	Engine instrument
Annual Requirement	25

16.

Part Number	BI-33
Description	Measuring unit
Weapon Platform	AN 32
Main system	Oil system
Annual Requirement	22

17.



Part Number	AZP-A1
Description	Over voltage protection unit
Weapon Platform	AN 32
Main system	Self
Annual Requirement	10

18.

Part Number	PO-1500
Description	Inverter
Weapon Platform	AN 32
Main system	Self
Annual Requirement	15

19.

Part Number	PO-1000
Description	Inverter
Weapon Platform	AN 32
Main system	Self
Annual Requirement	12

20.

Part Number	PZ 11M
Description	Electronic transducer
Weapon Platform	AN 32
Main system	Self
Annual Requirement	10

21.

Part Number	RUT 4000TV
Description	Current regulator
Weapon Platform	AN 32
Main system	APU starting panel
Annual Requirement	25

22.

Part Number	32.02.6800.251.000
Description	Bracket exhaust
Weapon Platform	AN 32
Main system	Jet pipe
Annual Requirement	20

23.

Part Number	32.01.6800.140.002
Description	Bracket KH exhaust
Weapon Platform	AN 32
Main system	Jet pipe
Annual Requirement	20

24.

Part Number	472C50507
Description	Pulley
Weapon Platform	AN 32
Main system	Engine control
Annual Requirement	60

25.

Part Number	32.02.4100.411.000
Description	Sleeve
Weapon Platform	AN 32
Main system	Main landing gear
Annual Requirement	04

26.

Part Number	32.02.7602.115.000
Description	Funnel RH
Weapon Platform	AN 32
Main system	Air conditioning
Annual Requirement	40

27.

Part Number	STA/32-01-4108-565-000 STA/32-01-4108-570-000
Description	Cables
Weapon Platform	AN 32
Main system	MLG component door lock mechanism
Annual Requirement	40 each

28.

Part Number	32-02-6100-265-000
Description	Hose swaged
Weapon Platform	AN 32
Main system	Engine fuel system
Annual Requirement	10

29.

Part Number	KSH-24
Description	Oxygen hose
Weapon Platform	AN 32
Main system	Oxygen system
Annual Requirement	30

30.

Part Number	RP-6-86 TK 7859-1760-01
Description	Oxygen supply hose
Weapon Platform	AN 32
Main system	Oxygen system
Annual Requirement	50

31.

Part Number	SSP-21-RM
Description	Fire detector connector
Weapon Platform	AN 32
Main system	Fire system
Annual Requirement	360

32.

Part Number	N3-3
Description	FDS system
Weapon Platform	AN 32
Main system	FDS system
Annual Requirement	10

33.

Part Number	32.02.3210.000.001
Description	Elevator trim tab
Weapon Platform	AN 32
Main system	Aircraft control surface
Annual Requirement	10

34.

Part Number	32.01.3310.000.000
Description	Rudder gear tab
Weapon Platform	AN 32
Main system	Control surface
Annual Requirement	10

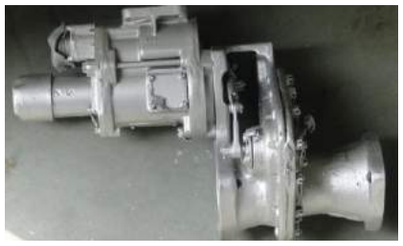
35.

Part Number	24.3706.0.1
Description	Aileron balance tab
Weapon Platform	AN 32
Main system	Control surface
Annual Requirement	10

36.

Part Number	24.3705.0
Description	Aileron trim tab
Weapon Platform	AN 32
Main system	Control surface
Annual Requirement	10

37.



Part Number	34-7603-1100
Description	Cut off valve
Weapon Platform	AN 32
Main system	Air conditioning and anti icing system
Annual Requirement	10

38.

Part Number	KT-192-010
Description	Wheel for tyres
Weapon Platform	AN 32
Main system	Self
Annual Requirement	10

39.

Part Number	K 2105
Description	Nose wheel assembly
Weapon Platform	AN 32
Main system	Self
Annual Requirement	10

40.

Part Number	3263
Description	Turbo cooler
Weapon Platform	AN 32
Main system	Air conditioning system
Annual Requirement	10

41.

Part Number	340079A
Description	Fuel filter element
Weapon Platform	AN 32
Main system	Fuel system
Annual Requirement	20

42.

Part Number	8D2-966-015-2
Description	Hydraulic filter
Weapon Platform	AN 32
Main system	Hydraulic system
Annual Requirement	10

43.

Part Number	AA 3
Description	Pilot Junction Box
Weapon Platform	AN 32
Main system	SPU 8 communication system
Annual Requirement	12

44.

Part Number	PPD-1
Description	Pitot head
Weapon Platform	AN 32
Main system	Self
Annual Requirement	10

45.

Part Number	ME 1866T
Description	Hydraulic oil qty indicator
Weapon Platform	AN 32
Main system	Self
Annual Requirement	08

46.

Part Number	NPP DKE
Description	Combined course indicator
Weapon Platform	AN 32
Main system	FDS
Annual Requirement	10

47.

Part Number	GA 6
Description	Gyro unit
Weapon Platform	AN 32
Main system	Compass system
Annual Requirement	30

48.

Part Number	TKE-52 PODG
Description	Relay
Weapon Platform	Mi-17 helicopter
Main system	Electrical system
Annual Requirement	64

49.

Part Number	Champion CH 34630
Description	Spark plug
Weapon Platform	Mi-17 helicopter
Main system	APU
Annual Requirement	270

50.

Part Number	DPS
Description	Fire detector
Weapon Platform	Mi-17 helicopter
Main system	Fire fighting system
Annual Requirement	65

51.

Part Number	680027T2S2
Description	Ball Bearing
Weapon Platform	AN 32
Main system	Generators
Annual Requirement	211

52.

Part Number	26-7000110B
Description	Ball Bearing
Weapon Platform	Mi-17 helicopter
Main system	Intermediate casing
Annual Requirement	42

53.

Part Number	76-160508E2
Description	Ball Bearing
Weapon Platform	Mi-17 helicopter
Main system	Generators
Annual Requirement	171

54.

Part Number	704902K2
Description	Bearing needle roller
Weapon Platform	Mi-17 helicopter
Main system	Engine
Annual Requirement	12

55.

Part Number	8-1932-330
Description	Nut feathering hinge
Weapon Platform	Mi-17 helicopter
Main system	Main rotor hub
Annual Requirement	50

56.

Part Number	330-090-902
Description	Retainer nut
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	13

57.

Part Number	303-128-705-0
Description	Ball bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

58.

Part Number	303-128-707-0
Description	Ball bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

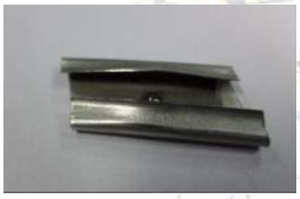
59.

Part Number	303-129-205-0
Description	Ball bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

60.

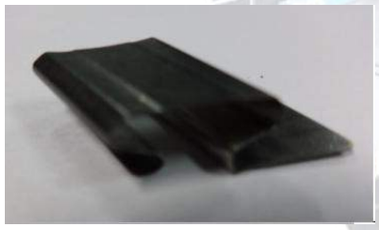
Part Number	303-141-902-0
Description	Ball bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

61.



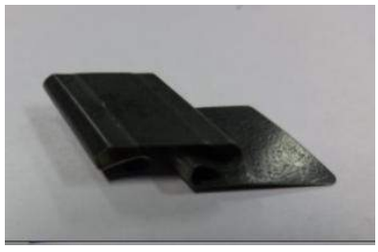
Part Number	303-151-071-0
Description	Damper blade stage IV and V
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	06

62.



Part Number	303-151-102-0
Description	Damper blade stage VII
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	06

63.

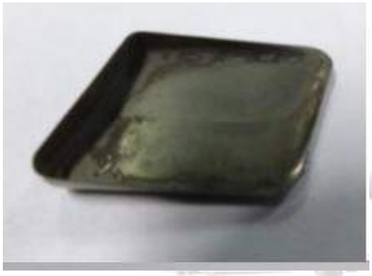


Part Number	303-151-202-0
Description	Damper blade stage VIII
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	06

64.

Part Number	303-151-405-0
Description	Ball bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

65.



Part Number	303-282-402-0
Description	Plate damper stage IV and V
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	06

66.

Part Number	403-702-215-0
Description	Shim laminated
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	15

67.

Part Number	403-712-622-0
Description	Body assembled
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

68.

Part Number	607ZZT65G81
Description	Ball bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

69.

Part Number	650-560-108-0
Description	Ball bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

70.

Part Number	3501-003-0
Description	Grommet
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	10

71.

Part Number	23202AM0360T
Description	Ring retainer inner
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	06

72.

Part Number	213334
Description	Shaft assembly
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	06

73.

Part Number	602369
Description	Ball bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

74.

Part Number	602370
Description	Ball bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

75.

Part Number	978792-100
Description	Filter
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

76.

Part Number	EN3049A1060
Description	Packing preformed
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	18

77.

Part Number	213346
Description	Shaft long
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	06

78.

Part Number	S32-328Z
Description	Bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

79.

Part Number	S32-330Z
Description	Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

80.

Part Number	S32-331Z
Description	Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

81.

Part Number	S32-333Z
Description	Bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

82.

Part Number	S32-334Z
Description	Bearing flanged
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

83.

Part Number	SS693-003P5C5/13G
Description	Ball Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

84.

Part Number	SSF68/2.5P5C5/10G
Description	Ball Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

85.

Part Number	ULKB8016XJ782/1
Description	Ball Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

86.

Part Number	VS225/12BO5RH3
Description	Ball Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

87.

Part Number	VS 225/19A
Description	Ball Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

88.

Part Number	WAY 105T
Description	Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

89.

Part Number	WFSP12109BT5
Description	Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

90.

Part Number	WFY1/4T53CH21
Description	Bearing race deep groove
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

91.

Part Number	WX3-16T53H47
Description	Ball Bearing
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

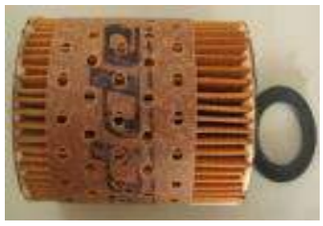
92.

Part Number	WY1-4T53C21
Description	Bearing race deep groove
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

93.

Part Number	Z 43050
Description	Bearing ball annular
Weapon Platform	Mirage 2000
Main system	M-53 engine
Annual Requirement	02

94.



Part Number	226AV/MFHA/317
Description	Element filter
Weapon Platform	Avro
Main system	Hydraulic system
Annual Requirement	12

95.

Part Number	226AV/MFHA/151
Description	Element filter
Weapon Platform	Avro
Main system	Hydraulic system
Annual Requirement	12

96.

Part Number	27V/501/4/05423
Description	Bearing
Weapon Platform	Avro
Main system	Temp control valve
Annual Requirement	11

97.

Part Number	20CZT/A984
Description	Fuse gravinier
Weapon Platform	Avro
Main system	Fire Extinguishing system
Annual Requirement	18

98.

Part Number	225M/601022839
Description	Hub switch brush
Weapon Platform	Avro
Main system	Propeller feathering system
Annual Requirement	25

99.

Part Number	27V/501/4/05651
Description	Bearing
Weapon Platform	Avro
Main system	Temp control valve
Annual Requirement	12

100.

Part Number	ST3.301.006TU
Description	Valve 6N1P-EB
Weapon Platform	Pechora
Main system	Self
Annual Requirement	5200

101.

Part Number	310D/N-101176
Description	PRB Base Band comp assy BE-586
Weapon Platform	SARBE-8
Main system	Self
Annual Requirement	25

102.

Part Number	310MOT/L-1095 GP 328
Description	Scrambler card
Weapon Platform	Radio
Main system	Motorola GP 328
Annual Requirement	150

103.

Part Number	385M-11101-68
Description	Pin
Weapon Platform	MiG 29
Main system	Ejection seat
Annual Requirement	36

104.

Part Number	5.12.0422.1010.91
Description	Angle RH
Weapon Platform	MiG 29
Main system	Aircraft fuselage
Annual Requirement	10

105.

Part Number	5.12.0422.1010.92
Description	Angle LH
Weapon Platform	MiG 29
Main system	Aircraft fuselage
Annual Requirement	10

106.

Part Number	7G-ZAB-7221-30
Description	Cable number 3
Weapon Platform	MiG 29
Main system	Ejection seat
Annual Requirement	12

107.

Part Number	7G-ZAB-7221-40
Description	Cable number 4
Weapon Platform	MiG 29
Main system	Ejection seat
Annual Requirement	12

108.

Part Number	7G-ZAB-7221-50
Description	Cable number 5
Weapon Platform	MiG 29
Main system	Ejection seat
Annual Requirement	12

109.

Part Number	7G-ZAB-7224-10-01
Description	Cable number 1
Weapon Platform	MiG 29
Main system	Ejection seat
Annual Requirement	12

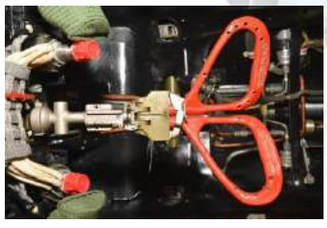
110.

Part Number	7G-ZAB-9200-170
Description	Rope
Weapon Platform	MiG 29
Main system	Signal joint
Annual Requirement	12

111.

Part Number	7G-ZAB-9201-75
Description	Cable number 2
Weapon Platform	MiG 29
Main system	Ejection seat
Annual Requirement	12

112.



Part Number	7G-ZAB-9208-2090M-01
Description	Ejection hand grip
Weapon Platform	MiG 29
Main system	Ejection seat
Annual Requirement	12

113.

Part Number	7G-ZAB-9228-2080
Description	Unit of micro switches
Weapon Platform	MiG 29
Main system	Blocking mechanism
Annual Requirement	12

114.

Part Number	P1M10-4BOUO.360.05
Description	Micro switch
Weapon Platform	MiG 29
Main system	Blocking mechanism
Annual Requirement	24

115.

Part Number	082000083TU100/3 I/L52000083ETU100/3
Description	Bearing
Weapon Platform	MiG 23UB
Main system	Throttle
Annual Requirement	48

116.

Part Number	4-46202B1T2ETU100/3
Description	Bearing
Weapon Platform	MiG 29
Main system	Turbo cooler
Annual Requirement	05

117.

Part Number	4-76101BT ETU 3900-A
Description	Bearing
Weapon Platform	MiG 29
Main system	Turbo cooler
Annual Requirement	4

118.

Part Number	8D2.966.706
Description	Filter element
Weapon Platform	MiG 29
Main system	Cockpit pressurisation system
Annual Requirement	20

119.

Part Number	ES 100D ETU100/3
Description	Ball bearing
Weapon Platform	MiG 29
Main system	Turbo cooler
Annual Requirement	23

120.

Part Number	KT 100-50
Description	Ceramic disc
Weapon Platform	MiG 29
Main system	Aircraft wheel
Annual Requirement	15

121.

Part Number	SB 2013-3-0
Description	Diaphragm
Weapon Platform	MiG 29
Main system	Cabin pressurisation system
Annual Requirement	08

122.

Part Number	24506
Description	Spring brake
Weapon Platform	MiG 29
Main system	Inertia pick up
Annual Requirement	17

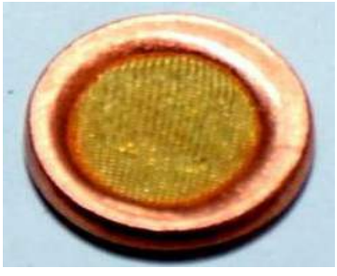
123.

Part Number	75.180.504.ETS 15
Description	Bearing
Weapon Platform	MiG 29
Main system	Electrical system
Annual Requirement	28

124.

Part Number	7A80027S1ETU100/3
Description	Bearing
Weapon Platform	MiG 29
Main system	Electrical system
Annual Requirement	17

125.



Part Number	9G5-886-503
Description	Filter
Weapon Platform	MiG 29
Main system	Oxygen system
Annual Requirement	185

126.

Part Number	D711
Description	Micro switch
Weapon Platform	MiG 29
Main system	Electrical system
Annual Requirement	55

127.

Part Number	EP-298
Description	Magnetic tape
Weapon Platform	MiG 29
Main system	Flight data Recorder
Annual Requirement	2175 mtrs

128.

Part Number	PML 6x10
Description	Metal braiding
Weapon Platform	MiG 29
Main system	Lock drop tank
Annual Requirement	52 mtrs

129.

Part Number	6-60027 ETU 100/3
Description	Bearing
Weapon Platform	MiG 29
Main system	Electrical system
Annual Requirement	197

130.

Part Number	340098A
Description	Filter element
Weapon Platform	MiG 29
Main system	Hydro boosters
Annual Requirement	414

131.

Part Number	4551
Description	Lamp Taxying
Weapon Platform	Jaguar
Main system	Lighting(external)
Annual Requirement	39

132.

Part Number	4580
Description	Lamp Landing
Weapon Platform	Jaguar
Main system	Lighting(external)
Annual Requirement	34

133.

Part Number	1022504B
Description	UV Light Assy LH
Weapon Platform	Jaguar
Main system	Lighting(internal)
Annual Requirement	14

134.

Part Number	1022504T
Description	UV Light Assy (RH)
Weapon Platform	Jaguar
Main system	Lighting(internal)
Annual Requirement	10

135.

Part Number	102BV2BW
Description	Total temperature probe
Weapon Platform	Jaguar
Main system	Gen Instruments
Annual Requirement	3

136.

Part Number	33435-01
Description	Pitot Pressure Head
Weapon Platform	Jaguar
Main system	Pitot Static System
Annual Requirement	11

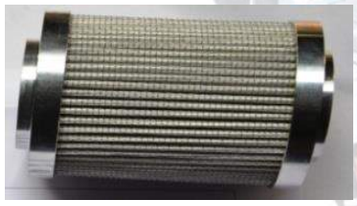
137.

Part Number	1740-01-031-5868
Description	MHU-141 Trailor
Weapon Platform	Jaguar
Main system	Transportation of missiles and bombs
Annual Requirement	36

38.

Part Number	4GC-4232153
Description	Hoist Type ‘C‘
Weapon Platform	Jaguar
Main system	Weapon lifting system
Annual Requirement	100

139.



Part Number	C38135H1
Description	Element Assy
Weapon Platform	Jaguar
Main system	LP Filter
Annual Requirement	138

140.

Part Number	C11604-10B
Description	Gasket
Weapon Platform	Jaguar
Main system	P2 Flexible pipe
Annual Requirement	633

141.

Part Number	116230SL1011FA
Description	Packing Performed
Weapon Platform	Jaguar
Main system	Alt and Air Starter
Annual Requirement	859

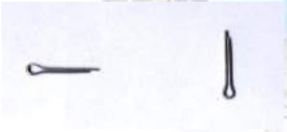
142.

Part Number	MBEU23502
Description	Pin Special
Weapon Platform	Jaguar
Main system	Ejection Seat
Annual Requirement	150

143.

Part Number	SP90G7
Description	Split Pin
Weapon Platform	Jaguar
Main system	EBD
Annual Requirement	27

144.



Part Number	SP90B3
Description	Split Pin
Weapon Platform	Jaguar
Main system	Additional Air intake Door
Annual Requirement	623

145.

Part Number	SP90C5
Description	Split Pin
Weapon Platform	Jaguar
Main system	Throttle
Annual Requirement	2325

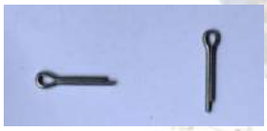
146.

Part Number	SP90G8
Description	Split Pin
Weapon Platform	Jaguar
Main system	Spoiler
Annual Requirement	152

147.

Part Number	SP90E7
Description	Split Pin
Weapon Platform	Jaguar
Main system	Spoiler
Annual Requirement	160

148.



Part Number	SP90E4
Description	Split Pin
Weapon Platform	Jaguar
Main system	Additional Air intake doors
Annual Requirement	278

149.

Part Number	SP90H8
Description	Split Pin
Weapon Platform	Jaguar
Main system	Spoilers
Annual Requirement	28

150.

Part Number	SP90C7
Description	Split Pin
Weapon Platform	Jaguar
Main system	Air Brake
Annual Requirement	585

151.

Part Number	SP90G10
Description	Split Pin
Weapon Platform	Jaguar
Main system	Flap Control Unit
Annual Requirement	986

152.

Part Number	SP90E8
Description	Split Pin
Weapon Platform	Jaguar
Main system	Spoiler and Air Brake
Annual Requirement	1790

153.

Part Number	SP90C8
Description	Split Pin
Weapon Platform	Jaguar
Main system	Spine Bend Potmeter
Annual Requirement	1840

154.

Part Number	SP90C3
Description	Split Pin
Weapon Platform	Jaguar
Main system	Controls
Annual Requirement	362

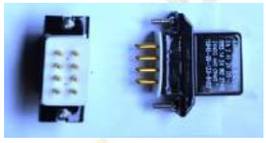
155.

Part Number	SP90C4
Description	Split Pin
Weapon Platform	Jaguar
Main system	Main Undercarriage
Annual Requirement	3281

156.

Part Number	SP90C6
Description	Split Pin
Weapon Platform	Jaguar
Main system	Door Assy
Annual Requirement	2240

157.



Part Number	XA2412400
Description	Relay
Weapon Platform	Jaguar
Main system	Electrical
Annual Requirement	175

158.

Part Number	R04382X533A50D7
Description	O Ring
Weapon Platform	Jaguar
Main system	Cold Air Unit
Annual Requirement	154

159.

Part Number	R13310
Description	Seal
Weapon Platform	Jaguar
Main system	Fuel System
Annual Requirement	15

160.

Part Number	C11604-20B
Description	Seal
Weapon Platform	Jaguar
Main system	Flexible Pipe
Annual Requirement	1106

161.

Part Number	JETDN6V
Description	Seal
Weapon Platform	Jaguar
Main system	Air Starter Drain Plug
Annual Requirement	338

162.

Part Number	DN8V
Description	Seal
Weapon Platform	Jaguar
Main system	Supply Filter
Annual Requirement	66

163.

Part Number	74526
Description	Seal
Weapon Platform	Jaguar
Main system	Alternator
Annual Requirement	743

164.

Part Number	74609
Description	Seal
Weapon Platform	Jaguar
Main system	Alternator
Annual Requirement	716

165.

Part Number	R13308
Description	Seal
Weapon Platform	Jaguar
Main system	Supply Filter
Annual Requirement	124

166.

Part Number	AGS1186-4
Description	Seal Bonded
Weapon Platform	Jaguar
Main system	Shut Off Valve
Annual Requirement	227

167.

Part Number	HDS1171-3-13
Description	Seal Bowl
Weapon Platform	Jaguar
Main system	LP Filter
Annual Requirement	152

168.

Part Number	HTE1400-001
Description	Sealing Ring
Weapon Platform	Jaguar
Main system	Fuel Valve
Annual Requirement	852

169.

Part Number	C11604-18B
Description	Seal
Weapon Platform	Jaguar
Main system	P3 NRV
Annual Requirement	46

170.

Part Number	R14PC-851A
Description	Seal O Ring
Weapon Platform	Jaguar
Main system	Fuel Filter
Annual Requirement	15

171.

Part Number	1322Z-MK4
Description	Switch Limit
Weapon Platform	Jaguar
Main system	Gun System
Annual Requirement	14

172.

Part Number	460-03T2
Description	Valve Drain
Weapon Platform	Jaguar
Main system	Air Gene Drain Plug
Annual Requirement	17

173.

Part Number	S3860-4ACL
Description	Washer Lock
Weapon Platform	Jaguar
Main system	Air Gen Ignitor Plug
Annual Requirement	593

174.

Part Number	SP107G
Description	Washer Tab
Weapon Platform	Jaguar
Main system	Air Brake
Annual Requirement	61

ABBREVIATIONS

ACFT	Aircraft Crash Fire Tender
ALM	Additive Layer Manufacturing
AON	Acceptance of Necessity
ARS	Automatic Replenishment Spares
ASQR	Air Staff Qualitative Requirements
ASV	Aircraft Specialist Vehicles
BRD	Base Repair Depot
CEMILAC	Centre for Military Airworthiness Certification
CFA	Competent Financial Authority
CIMD	Central Indigenisation and Manufacturing Depot
DDPMAS	Design Development and Production of Military Aircraft and Airborne Stores
DGAQA	Directorate General of Aeronautical Quality Assurance
DPM	Defence Procurement Manual
DPP	Defence Procurement Procedure
DPSU	Defence Public Sector Undertaking
DRDO	Defence Research and Development Organisation
FADEC	Full Authority Digital Engine Control
FIPB	Foreign Investment Promotion Board
FOL	Fuel Oil Lubricants
HQ MC	Headquarters Maintenance Command
IFA	Integrated Financial Advisor
JV	Joint Venture
KRA	Key Result Area
LRU	Line Replaceable Unit
LTIPP	Long Term Integrated Perspective Plan
LTMA	Long Term Maintenance Agreement
LTRA	Long Term Repair Agreement
MRO	Maintenance Repair and Overhaul
MSME	Micro Small and Medium Enterprise
NINF	Not Indigenised Not Feasible
OEM	Original Equipment Manufacturer
RCMA	Regional Centre for Military Airworthiness
R&D	Research and Development
RFP	Request for Proposal
TPCR	Technology Perspective and Capability Roadmap
TTGE	Tools Testers and Ground Equipment

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