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भारत सरकार, रक्षा मंत्रालय (आर एण्ड डी)
GOVERNMENT OF INDIA
MINISTRY OF DEFENCE (R & D)
सेना उड़ान - योग्यता और प्रमाणीकरण केन्द्र
**CENTRE FOR MILITARY
AIRWORTHINESS & CERTIFICATION**
मारतहल्ली कालोनी (पोस्ट)
Marathahalli Colony (Post)
बैंगलोर - 560 037. भारत
Bangalore - 560 037. INDIA

सभी पत्रादि मुख्य कार्यपालक (उड़ान-योग्यता) को
सम्बोधित किया जाए और न किसी अन्य अधिकारी के
उपनाम से

All Correspondence should be addressed to
the Chief Executive (Airworthiness)
and not to any officer by name.

CEMILAC/GDA/1001

24 Aug 2011

As per distribution list

AIRWORTHINESS DIRECTIVE ON TRANSFER OF TECHNOLOGY

1. An Airworthiness Directive no. 11 on Transfer of Technology (ToT) is issued vide CEMILAC/5390/2/TCS dt 11 Aug 2011. This is done to standardize the procedure of ToT and define the role of each agency associate with the product design, development and manufacturing. CEMILAC would like to thank all the participating agencies in improving this Airworthiness Directive. Most of the suggestions forwarded by various organisations are absorbed in one or the other form. However a few suggestions that could not be incorporated / absorbed are tabulated and attached as Appendix to this letter with rationale thereof.

2. It is requested to give wide publicity about this Directive to various Programmes / Projects running under your Directorate / Lab / PSU so that Transfer of Technology is done to production agency following standard method as brought out in this Airworthiness Directive.

Kanchan Biswas

(Kanchan Biswas), Sc-'G'
Associate Director (Aircraft)
for Chief Executive (Airworthiness)

Encl: As stated

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CEMILAC/5390/2/TCS

11 Aug 2011

AIRWORTHINESS DIRECTIVE No. 11

ON **TRANSFER OF TECHNOLOGY**

1. Introduction

Indigenous design and development of aircraft and airborne stores for Military application have increased many folds in the recent years. New projects are taken up by Defence laboratories, PSUs and other agencies. Design, Development, Testing and Flight Evaluation of Prototype are carried out by Design and Development (D&D) Agencies. On successful Ground and Flight Tests, Airworthiness Certificate is issued to the D&D Agencies by RCMA/CEMILAC in the form of Provisional Clearance (PC). Often the D&D Agency and Series Manufacturing Agency may not be the same. In such cases the D&D Agency identifies a Manufacturing Agency for the purpose of bulk production. It is essential that proper Transfer of Technology (ToT) is ensured from D&D Agency to Manufacturing Agency.

2. Aim

The aim of this Directive is to Regulate, Control and follows uniform procedure in ToT from a Development Agency to Production Agency identified by the Development Agency. The AW Directive aims at laying down step by step procedure to ensure

transfer of complete knowledge gained during product development by a D&D agency to the Production Agency.

3. Scope

The scope of this Directive is to lay guidelines for ToT from Design and Development Agency to the Production Agency with complete details of design, drawings, materials, process acceptance criteria etc.

4. Applicability

The Airworthiness (AW) Directive on ToT is applicable to all indigenously developed airborne stores for Military use which have been certified by CEMILAC and taken up for bulk production. This Directive is applicable only when D&D Agency and Bulk Manufacturing Agencies are different. This Directive is not applicable when:

- a) Design and Production Agency are same
- b) Product jointly developed by the Design and Production Agencies

The Production Agency at no stage should transfer the technology to any other agency without the written consent from the Design and Development agency.

5. Transfer of Technology (ToT)

For the purpose of this Directive the term 'Technology' covers; the products / hardware developed for military use, as well as all the technological processes developed for the manufacturing of a military hardware. New technology is used to improve manufacturing process and make a superior product. Military hardware is developed using advanced design/engineering methods, modern materials, new technological processes and assembly/testing techniques. Transfer of Technology is handing over of manufacturing processes and methods along with related engineering documents through an agreement from a D&D Agency to a Production Agency for product realization.

6. CEMILAC Certification

CEMILAC certifies airborne stores in a "Concurrent Certification" mode. This implies that CEMILAC is associated with the project right from the inception and accords stage

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by stage clearance to project during development phase. The concurrent certification route is as follows:

- (a) Approval of technical specification by CEMILAC based on Staff Requirements or company's product definition
- (b) Design and Development by the D&D agency. Design clearance by CEMILAC based on Design Documents
- (c) Fabrication of prototype by D&D agency. Inspection clearance by competent Quality Assurance Agency (QAA) based on approved design
DCAQA
- (d) Validation of design through qualification testing carried out as per test schedule approved by CEMILAC & Verified by QAA.
- (e) Analysis of critical test and flight test report forwarded by the development agency duly coordinated by QAA.
- (f) Issue of Airworthiness clearance based on qualification test results.

6.1 Provisional Clearance:

On successful completion of prototype development, ground and flight testing, RCMA/CEMILAC issues provisional clearance. At the same time freezing of design document and the master list of drawings is prepared and kept ready. Standard of Preparation (SOP), Bill of Material (BOM), and Drawing Applicability List (DAL) are prepared and finalized. Provisional Clearance (PC) could be issued to the D&D Agency by the concerned RCMA for a limited period.

6.2 Type Approval

Type Approval is a certificate issued by the Type Approving Authority (CE, CEMILAC) to the effect that the store under reference meets all design specifications and test requirements laid down by CEMILAC. The Type Approval is issued after the

Design and Development Authority/Main Contractor submits a full Type Record with all relevant documents, to the satisfaction of CEMILAC. DDPMAS-2002, DDPMAS Vol-II, and DDP UAV-2011 can be referred for detailed guidelines on certification.

7. Airworthiness Directive by CEMILAC on Transfer of Technology

In the present scenario, methods followed for ToT differs from case to case, as no guideline is available for transfer of technology of a certified product to an identified production agency. Further, due to non-availability of proper guidance, there is no means to confirm that all relevant information essential for quality production has been transferred.

Hence it is necessary to have an Airworthiness Directive on 'Transfer of Technology' issued by CEMILAC to ensure that proper transfer of know-how from the D&D agency to Production agency has been carried out.

8. Team for Transfer of Technology (TOT Team)

For Transfer of Technology it is advisable to have representatives of all concerned agencies. Suggested team composition for aero products is to have a member each from the following organisations:

- a) Design and Development Agency : **Team Leader**
- b) Manufacturing and Quality Control Representatives of Production Agency
- c) Certification Agency (CEMILAC/RCMA)
- d) Quality Assurance Agency (DGAQA)
- e) User Representative (preferably from Directorate issuing Staff Requirements)

8.1 Assessment of Production Partner by the composite team

The team should assess the organization and infrastructure of the production partner in respect of the following:

- a) Commitment of Top Management to acquire Technology and Know How
- b) Well defined organization and track record

- c) Adequacy of specified plant, machinery for production & Scope of expansion
- d) Adequacy of suitable testing & Scope of expansion of testing facilities
- e) Adequacy of qualified personnel in each departments
- f) Mechanism to carry design change, modification, design review etc
- g) Procedure for document and data control
- h) Sufficient and Experienced QC & QA personnel
- i) ISO/national accreditation & safety certification desirable

A report is to be submitted by the team indicating suitability of production agency for ToT.

8.2 Business Agreement

Once a firm is assessed and recommended for ToT, a business agreement may be made between D&D agency and Production agencies. Agreement must include role of each organisation, scope of ToT and period of alliance etc. Non disclosure agreement, commitment on continual improvement regarding quality cost and delivery are important aspects of the business agreement. The D&D agency can enter into a ToT agreement with more than one production partner for the same component or assembly depending on the criticality and volume of production. The list of documents for the ToT is discussed in the subsequent paragraph.

9. ToT Documents

At this stage, the D&D agency is ready to formally hand over documents to the Production agency. The list of documents is exhaustive however the D&D agency may forward the relevant document to the production agency. The Documents to be handed over by the D&D agency to production agency is listed below:

- a) Standard of Preparation (SOP)
- b) Standard of Equipment (SOE)
- c) Description Manual
- d) List of Raw materials (from approved source)

- e) Technical Specification
- f) Configuration documents
- g) Approved Drawing and Master Drawing Index
- h) Bill of Materials
- i) Method and process documents / Instruction Sheet
- j) Manufacturing and assembly process, associated jigs and fixtures
- k) Acceptance Test Plan/Test Schedules, Inspection plan and key characteristic list
- l) Embedded Software
- m) Technical Specification of Automated Test Equipment (ATE) & ATE Software
- n) Product Definition Dossier
- o) Operation and Maintenance Manual
- p) Product identification, vendor code and labeling details
 - i) Safety and operating instructions
 - ii) Trouble shooting.
 - iii) Do's and Don'ts
 - iv) Shelf life, Calendar life, Total Technical Life
 - v) Packaging Handling and storage instructions
 - vi) Guaranty/warranty of product

Note: These documents to be coordinated / vetted by the appropriate Regulatory Authority

9.1 Training and Technology Absorption by Production Agency

To facilitate faster technology absorption, production agency must organize training for the production team with the assistance from the D&D agency. The issues needs attention during training is:

- a) Guidance in identifying source of supply for raw materials/ equipment etc.
- b) Creation of new facilities like tools, jigs & fixtures, testing and calibration equipment
- c) Critical and advanced manufacturing process.
- d) Acceptance criteria of the product

10. First off Inspection

As production commences, first article produced is subjected to inspection as per First Article inspection report (FAIR) as per the requirements of AS-9102. Quality department of the production agency shall prepare the FAIR then inspected/ vetted by DGAQA for clearance. DGAQA uses approved ATP to check the acceptability of the first product. On clearance of FAIR by DGAQA the FAIR Document shall be preserved through the life cycle.

10.1 Repeat Type Test

In some cases it may be required to carry out Repeat Type Test as per the provisions of DDPMAS- 2002. Repeat Type Test is to be discussed and decided by a committee consisting of members from D&D, Production, Certification and QA Agencies. The Repeat Type Test may include only First off Inspection or additional tests as decided by the above committee. On completion of the Repeat Type Test CEMILAC will issue a Production Clearance.

11. Review by the ToT Team

Once the product has passed First Off Inspection and Re-qualification, the level of technology absorption and confidence level of personnel involved in production are judged by the ToT team. If satisfied, a certificate is to be issued by the team that ToT has been absorbed fully. However to see the consistency in product quality the following steps are to be ensured:

- On commencement of production, Inspection Record Sheet (IRS) of first five batches/products to be forwarded to-D&D agency, CEMILAC and QAA for monitoring.
- ToT will be reviewed once in five years before renewal of Type Approval.

12. Post Technology Transfer Issues

Issues like, design improvement, modifications, product upgrades, reduction in operating / maintenance cost, and life extensions etc. to be addressed by all involved agencies including the ToT team. This is to be ensured through regular interaction between the agencies.

12.1 Product Support to Users

It is an extremely important issue for the confidence of User in the Product and its success. The area in which the User expects Product support is listed below:

- a) Advise in finalizing various aspects of deviations in quality and safety aspects during usage, storage, handling and maintenance.
- b) Advise on the benefits and constraints of new technology.
- c) Minimizing operating and maintenance cost
- d) Assistance in defect/failure analysis of the finished products during usage.
- e) Closure of production notice to user.

13. Conclusion

ToT would be considered successful only when all relevant documents are transferred and production partner is able to absorb manufacturing details for realization of a quality product. CEMILAC will play an effective role in ensuring the ToT at the earliest after the successful qualification of prototype. This directive will help in maintaining uniform standards of process and production methodology to be followed for ToT. This procedure is to be adopted by all the D&D agencies whenever they Transfer Technology to the Production agency irrespective of the criticality of the airborne store.



(Dr. K. Tamilmani)
Distinguished Scientist
Chief Executive (Airworthiness)

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Suggestions Not Incorporated in AW Directive on Transfer of Technology for Aero Products

Sl. No	Sec & Chapter	Suggestion proposed to the AW Directive	Proposed by	Rationale for not incorporating suggestions
1.	General	Applicability of the guidelines for the ground systems (especially test equipment) which though are not airborne stores, form an integral part of the system	BDL, Hyderabad	This document is general guidance for ToT from D&D to Production agency thus it can be followed for any product. If required more than one specialist member can be taken in ToT team if process so demands.
2	General	TOT document for aero-engine and aircraft need to be different	RCMA (Koraput)	AW Directive is issued as guidance. More than one specialist member can be taken as member of ToT team to ensure process control.
3	Para - 8.	Design and Development consisting of team of	HAL (QA & CS) Bangalore	This much detail is not required in the AW Directive however, More than one member can be taken as member of ToT team if process demands.
4	Para - 8.1 (f)	For: Mechanism to carry design change, modification, design review etc.	HAL (QA & CS) Bangalore	Minor design change can be done with the concurrence of designer if safety and operating procedure so demand.
5	Para-9(a) & (b)	QTP and QTR documents to Production agency to be included.	DARE, Bangalore	ToT only authorize production agency to fabricate the product QTP and QTR documents will be different for different product
6	Para-11	Review by the ToT Team-annually	HAL (QA & CS) Bangalore	Annual review is too frequent.
7	ADRDE Letter 13 /7/ 11	D I ² T M, DRDO guidelines	ADRDE Agra	AW Directive is Technical in nature - outlines process and practices to be followed for Aero products. D I ² T M, DRDO guidelines are oriented to business/ contract agreement, ToT Fee, Royalty etc. D I ² T M Member can be taken in ToT team if process demands.

Encl-9

1. The following information was obtained from the records of the Department of the Interior, Bureau of Land Management, regarding the land owned by the United States in the State of California.

Section	Tract	Acres	Owner	Remarks
1	Section 1, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
2	Section 2, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
3	Section 3, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
4	Section 4, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
5	Section 5, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
6	Section 6, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
7	Section 7, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
8	Section 8, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
9	Section 9, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.
10	Section 10, Township 12N, Range 12E, Meridian 1E, County of San Diego, California	10.00	United States	Land owned by the United States, formerly owned by the California Land Company.

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फौंड्री व फोर्ज प्रभाग

बेंगलूर कॉम्प्लेक्स

हिन्दुस्तान एरोनाटिक्स लिमिटेड

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NO.F/DGM(D)/274 /2011

17th May 2011

✓ Chief Resident Engineer
RCMA(F&F - FOL), CEMILAC
C/o. Foundry & Forge Division
Hindustan Aeronautics Limited
Bangalore-560017

Dear Sir,

Sub : Amendment of CEMILAC Directive Nos. 04 & 07

F&F Division is engaged in development and manufacture of Castings, Forgings, Rolled Rings, Powder Metallurgy and Rubber Components for various customers such as HAL Divisions, DMRL, DRDL, NAL, Defense PSU's and Private Undertakings, etc.

2 Development / indigenisation of aeronautical components are carried out as per the guidelines / procedures laid down by CEMILAC Directive Nos. 04 and 07, DDPMAS 2002, etc. F&F Division develops first-off sample batch in co-ordination with RCMA(F&F) and DGAQA(F&F) and type tests are carried out by the User Division in co-ordination with their Airworthiness Agencies. As per the guidelines, F&F Division, being the development agency, applies for Provisional Clearance for critical items from RCMA(F&F) after receipt of performance report of the User and subsequently apply for Type Approval from CEMILAC, and applies for Production Clearance for non-critical items.

3 The above Directives provide coverage for Castings, Forgings and Powder Metallurgy Components except Rubber Components. You are requested to take steps to amend the Directives to extend their coverage to Rubber Components too so that uniform procedures can be followed across all types of products.

Thanking you,

Yours faithfully,
for HINDUSTAN AERONAUTICS LIMITED

N. S. Velari
(M.S. Velari)

Deputy General Manager (Development)



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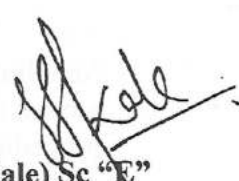
**CENTRE FOR MILITARY AIRWORTHINESS & CERTIFICATION
DEFENCE RESEARCH & DEVELOPMENT ORGANISATION
RCMA (F&F-FOL), CEMILAC, BANGALORE**

ION	
To: The Chief Executive (Airworthiness) CEMILAC, Bangalore - 37 KA: GD(TC&S)	From: Regional Director RCMA (F&F-FOL), CEMILAC, Bangalore-17
Copy to: GD (P), CEMILAC	Ref: RCMA(F&F)/107 Date: 23 /05/2011

Amendment of CEMILAC Directive No.07

Reference is made to the letter no. F/DGM (D)/274/2011 dated 17.05.2011 regarding the subject matter (enclosed for ready reference).

2. HAL (F&F) along with RCMA (F&F-FOL) is engaged in development and indigenization of castings, Forgings, Mill forms, Powder metallurgy and Rubber compounds/Components. Airworthiness guidelines are followed as per the CEMILAC Directive No.7 which covers only Castings, Forgings, Mill forms and Powder metallurgy except Rubber compound/components.
3. Hence It is requested to amend the subject mentioned directive for Rubber compounds/ components to follow the uniform procedure for all types of products.


(Shirish S Kale) Sc "E"
Chief resident Engineer (F&F-FOL)