

# **Singapore Airworthiness Requirements**

Publication of the  
Civil Aviation Authority of Singapore  
60 Airport Boulevard, #04-01  
Changi Airport Terminal 2  
Singapore 819643

*Copies of this document may be obtained from the CAAS website at [www.caas.gov.sg](http://www.caas.gov.sg)*

# **CONTENTS**

EFFECTIVE DATE : 1 FEBRUARY 2026  
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## **Sections**

- 1        General
- 2        Aircraft Airworthiness
- 3        Component and Equipment Airworthiness
- 4        Engineering and Maintenance Administration
- 5        Aircraft Performance
- 6        Approval of Persons and Organisations

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# CONTENTS

EFFECTIVE DATE : 1 FEBRUARY 2026

REVISION NO : 31 (ISSUE 2)

---

## Contents

### **SECTION 1 - GENERAL**

Chapter 1.1 - Introduction

Chapter 1.2 - Definitions

Chapter 1.3 - *Reserved*

Chapter 1.4 - Issue of Noise Certificate

### **SECTION 2 - AIRCRAFT AIRWORTHINESS**

Chapter 2.1 - *Reserved*

Chapter 2.2 - Issue of Certificates of Airworthiness

Appendix 1 - General Requirements

Chapter 2.3 - Renewal of Certificates of Airworthiness

Chapter 2.4 - Export Certificate of Airworthiness

Chapter 2.5 - *Reserved*

### **SECTION 3 - COMPONENT AND EQUIPMENT AIRWORTHINESS**

Chapter 3.1 - *Reserved*

Chapter 3.2 - *Reserved*

Chapter 3.3 - *Reserved*

Chapter 3.4 - *Reserved*

Chapter 3.5 - *Reserved*

Chapter 3.6 - *Reserved*

Chapter 3.7 - Requirements for Compass Swing

Chapter 3.8 - *Reserved*

Chapter 3.9	-	<i>Reserved</i>
Chapter 3.10	-	<i>Reserved</i>
<b>SECTION 4</b>	-	<b>ENGINEERING AND MAINTENANCE ADMINISTRATION</b>
Chapter 4.1	-	General Requirements for Maintenance of Aircraft and Aircraft Components
Appendix 1	-	Certificate of Fitness for Flight
Chapter 4.1.1	-	Responsibilities of Licensed Aircraft Maintenance Engineers and Approved or Authorised Persons or Organisations
Chapter 4.2	-	<i>Reserved</i>
Chapter 4.3	-	Maintenance of Aircraft
Appendix 1	-	Certificate of Maintenance Review
Appendix 2	-	Reliability Control Programmes
Chapter 4.4	-	<i>Reserved</i>
Chapter 4.5	-	Technical Logs
Chapter 4.6	-	Aircraft Records System
Chapter 4.7	-	<i>Reserved</i>
Chapter 4.8	-	Required Inspections and Tests
Chapter 4.9	-	Reportable Safety Matter
Chapter 4.10	-	<i>Reserved</i>
Chapter 4.11	-	<i>Reserved</i>
Chapter 4.12	-	<i>Reserved</i>
<b>SECTION 5</b>	-	<b>AIRCRAFT PERFORMANCE</b>
Chapter 5.1	-	Weight Control of Aircraft
Appendix 1	-	Example of a Weight and Balance Report
Appendix 2	-	Example of a Basic Weight Schedule
Appendix 3	-	Conduct of Weighing

Chapter 5.2	-	Flight Manuals
Chapter 5.3	-	Test and Special Flights
<b>SECTION 6</b>	-	<b>APPROVAL OF PERSONS AND ORGANISATIONS</b>
Chapter 6.1	-	<i>Reserved</i>
Chapter 6.2	-	<i>Reserved</i>
Chapter 6.3	-	<i>Reserved</i>
Chapter 6.4	-	<i>Reserved</i>
Chapter 6.5	-	Approval of Welders
Appendix 1	-	Examination Requirements
Chapter 6.6	-	<i>Reserved</i>
Appendix 1	-	<i>Reserved</i>
Chapter 6.7	-	<i>Reserved</i>
Chapter 6.8	-	<i>Reserved</i>
Chapter 6.9	-	<i>Reserved</i>

INTENTIONALLY  
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# LIST OF EFFECTIVE PAGES

EFFECTIVE DATE : 1 FEBRUARY 2026

REVISION NO : 31 (ISSUE 2)

Page No.	Rev No.	Date
C-1	31	1 Feb 2026
C-2	31	1 Feb 2026
C-3	31	1 Feb 2026
C-4	31	1 Feb 2026
LEP-1	31	1 Feb 2026
LEP-2	31	1 Feb 2026
ROR-1	-	-
ROR-2	-	-
1.1-1	22	3 May 2016
1.1-2	22	3 May 2016
1.2-1	28	5 Oct 2018
1.2-2	28	5 Oct 2018
1.3-1 (deleted)	31	1 Feb 2026
1.3-2 (deleted)	31	1 Feb 2026
1.4-1	31	1 Feb 2026
1.4-2	31	1 Feb 2026
2.2-1	31	1 Feb 2026
2.2-2	31	1 Feb 2026
2.2-3	31	1 Feb 2026
2.2-4	31	1 Feb 2026
2.2-App1-1	18	15 Dec 2011
2.2-App1-2	18	15 Dec 2011
2.2-App1-3	18	15 Dec 2011
2.2-App1-4	18	15 Dec 2011
2.3-1	31	1 Feb 2026
2.3-2	31	1 Feb 2026
2.4-1	31	1 Feb 2026

Page No.	Rev No.	Date
2.4-2	31	1 Feb 2026
3.7-1	18	15 Dec 2011
3.7-2	18	15 Dec 2011
4.1-1	27	1 Aug 2018
4.1-2	27	1 Aug 2018
4.1-3	27	1 Aug 2018
4.1-4	27	1 Aug 2018
4.1-App1-1	12	15 Aug 2006
4.1-App1-2	12	15 Aug 2006
4.1.1-1	30	29 Mar 2022
4.1.1-2	30	29 Mar 2022
4.1.1-3 (deleted)	30	29 Mar 2022
4.1.1-4 (deleted)	30	29 Mar 2022
4.1.1-5 (deleted)	30	29 Mar 2022
4.1.1-6 (deleted)	30	29 Mar 2022
4.3-1	28	5 Oct 2018
4.3-2	28	5 Oct 2018
4.3-3	28	5 Oct 2018
4.3-4	28	5 Oct 2018
4.3-App1-1	30	29 Mar 2022
4.3-App1-2	30	29 Mar 2022
4.3-App1-3	30	29 Mar 2022
4.3-App1-4	30	29 Mar 2022
4.3-App2-1	28	5 Oct 2018
4.3-App2-2	28	5 Oct 2018
4.5-1	31	1 Feb 2026
4.5-2	31	1 Feb 2026
4.5-3	31	1 Feb 2026

Page No.	Rev No.	Date
4.5-4	31	1 Feb 2026
4.6-1	28	5 Oct 2018
4.6-2	28	5 Oct 2018
4.8-1	18	15 Dec 2011
4.8-2	18	15 Dec 2011
4.8-3	18	15 Dec 2011
4.8-4	18	15 Dec 2011
4.9-1	30	29 Mar 2022
4.9-2	30	29 Mar 2022
4.9-3	30	29 Mar 2022
4.9-4	30	29 Mar 2022
4.12 (deleted)	30	29 Mar 2022
5.1-1	28	5 Oct 2018
5.1-2	28	5 Oct 2018
5.1-3	28	5 Oct 2018
5.1-4	28	5 Oct 2018
5.1-5	28	5 Oct 2018
5.1-6	28	5 Oct 2018
5.1-App1-1	28	5 Oct 2018
5.1-App1-2	28	5 Oct 2018
5.1-App1-3	28	5 Oct 2018
5.1-App1-4	28	5 Oct 2018
5.1-App2-1	0	15 July 2000
5.1-App2-2	0	15 July 2000
5.1-App3-1	18	15 Dec 2011
5.1-App3-2	18	15 Dec 2011
5.2-1	30	29 Mar 2022
5.2-2	30	29 Mar 2022
5.3-1	18	15 Dec 2011
5.3-2	18	15 Dec 2011
5.3-3	18	15 Dec 2011
5.3-4	18	15 Dec 2011
6.5-1	18	15 Dec 2011
6.5-2	18	15 Dec 2011
6.5-3	18	15 Dec 2011

Page No.	Rev No.	Date
6.5-4	18	15 Dec 2011
6.5-App1-1	18	15 Dec 2011
6.5-App1-2	18	15 Dec 2011
6.5-App1-3	18	15 Dec 2011
6.5-App1-4	18	15 Dec 2011
6.5-App1-5	18	15 Dec 2011
6.5-App1-6	18	15 Dec 2011
6.5-App1-7	18	15 Dec 2011
6.5-App1-8	18	15 Dec 2011

## RECORD OF REVISIONS

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RECORD OF REVISIONS					
REV NO.	DATE	INSERTED BY	REV NO.	DATE	INSERTED BY
<b>Issue 1</b>	<b>01.01.1989</b>	<b>CAAS</b>	16	20.07.2010	CAAS
1	01.05.1990	CAAS	17	18.11.2010	CAAS
2	01.04.1991	CAAS	18	15.12.2011	CAAS
3	01.07.1993	CAAS	19	01.02.2013	CAAS
4	20.08.1996	CAAS	20	07.05.2013	CAAS
5	31.10.1997	CAAS	21	09.02.2015	CAAS
6	01.02.1998	CAAS	22	03.05.2016	CAAS
7	01.10.1999	CAAS	23	30.06.2016	CAAS
<b>Issue 2</b>	<b>15.07.2000</b>	<b>CAAS</b>	24	15.12.2016	CAAS
1	15.12.2000	CAAS	25	11.01.2017	CAAS
2	01.02.2002	CAAS	26	15.02.2017	CAAS
3	01.06.2002	CAAS	27	01.08.2018	CAAS
4	01.08.2002	CAAS	28	05.10.2018	CAAS
5	01.07.2003	CAAS	29	01.11.2018	CAAS
6	15.11.2003	CAAS	30	29.03.2022	CAAS
7	01.04.2004	CAAS	31	01.02.2026	CAAS
7	01.04.2004	CAAS			
8	01.11.2004	CAAS			
9	15.06.2005	CAAS			
10	15.11.2005	CAAS			
11	15.11.2005	CAAS			
12	15.08.2006	CAAS			
13	17.07.2008	CAAS			
14	19.11.2009	CAAS			
15	13.04.2010	CAAS			

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*SECTION 1*

***GENERAL***

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## CHAPTER 1.1

# INTRODUCTION

EFFECTIVE DATE : 3 MAY 2016

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- 1 This Singapore Airworthiness Requirements is issued pursuant to paragraph 17A of the Singapore Air Navigation Order. This Singapore Airworthiness Requirements (SAR) sets out the minimum requirements, in respect of airworthiness of aircraft, aircraft engineering and maintenance requirements, licensing of aircraft maintenance engineers and the approval of persons and organisations and must be complied with in addition to obligations imposed under the Air Navigation Order.
- 2 The requirements are effective from the date printed thereon and supersede any applicable requirements in force prior to that date. Certificates, approvals, licences or authorisations issued or granted previously by the DGCA will continue to be in force. Where the applicable requirements have been changed, and unless otherwise approved, compliance with the current Singapore Airworthiness Requirements will be necessary to retain the existing approval or to qualify for renewal of any certificate or document.
- 3 Failure to comply with any of these requirements may result in the suspension or revocation of the licence or approval and may be subject to the penalties provided under the Thirteenth Schedule of the ANO.

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## CHAPTER 1.2

# DEFINITIONS

EFFECTIVE DATE : 5 OCTOBER 2018

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- 1 For the purposes of the Singapore Airworthiness Requirements the following terms and their definitions apply in addition to the definitions prescribed in the Singapore Air Navigation Order:
  - 1.1 **“Aircraft Component”** means any assembly, instrument, mechanism, equipment, part, item, or accessory, including an airframe, aircraft engine, or propeller, that is used, or is intended to be used, in operating or controlling an aircraft in flight, or is installed in or attached to an aircraft.
  - 1.2 **“Aircraft Equipment”** means any equipment provided in accordance with the Schedules to the Singapore Air Navigation Order and limited to equipment required to be approved.
  - 1.3 **“Aircraft Material”** means material for use in components or equipment which could affect their airworthiness standard.
  - 1.4 – Reserved –
  - 1.5 **“Approved”** means approved by the Director-General of Civil Aviation (DGCA).
  - 1.6 – Reserved –
  - 1.7 **“Continuing airworthiness”** means the set of processes by which all aircraft comply with the applicable airworthiness requirements and remain in a condition for safe operation throughout their operating life
  - 1.7A **“Director-General of Civil Aviation (DGCA)”** refers to the ‘Chief Executive’ as defined in the Air Navigation Order. This will include any person authorised by him to act on his behalf and any person acting in that capacity.
  - 1.8 **“Time in service”** means the total time in service required to be recorded in the technical log by paragraph 9(7)(a) of the Air Navigation Order.
  - 1.9 **“Maintenance programme”** means the maintenance schedule and related procedures, such as a reliability programme necessary for the safe operation of those aircraft to which it applies.
  - 1.9A **“State of Manufacture”** means the State having jurisdiction over the organization responsible for the final assembly of the aircraft, engine or propeller.

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## CHAPTER 1.4

# ISSUE OF NOISE CERTIFICATE

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### 1 Introduction

- 1.1 Pursuant to paragraph 51(5) of the Air Navigation Order (ANO), this Chapter prescribes the requirements for the application for a Noise Certificate to be carried onboard a Singapore registered aircraft.
- 1.2 ICAO Annex 16, Volume 1, states that noise certification shall be granted or validated by the State of Registry on the basis of satisfactory evidence that the aircraft complies with the requirements that are at least equal to the applicable Standards specified in Annex. When the State of Registry is satisfied with the evidence provided, a document such as a noise certificate attesting to noise certification shall be approved by the State of Registry and shall be carried on board the aircraft. The noise certification standards adopted are those in ICAO Annex 16, Volume 1.
- 1.3 Application for a noise certificate is a one-time exercise done during the registration of the aircraft. A new application is required when the noise characteristics of the aircraft has changed such that either the noise level or the noise standard of the aircraft has changed.
- 1.4 In this Chapter, **Annex** means Volume I of Annex 16 to the Convention on International Civil Aviation entitled “Environmental Protection” and any amendment thereto.

### 2. Application for a Noise Certificate

- 2.1 Application shall be made on Form CAAS(AW)143 and submitted to:

Civil Aviation Authority of Singapore  
Flight Standards Division  
60 Airport Boulevard, #04-01  
Changi Airport Terminal 2  
Singapore 819643

### **3 Requirements**

3.1 - Reserved-

3.2 Application for a noise certificate shall be submitted via Form CAAS(AW)143 and information provided in the form must be supported by:

(a) Any relevant documents to show that the aircraft complies with the requirements that are at least equal to the applicable standards specified in Part II of the Annex. The supporting documents must contain, at the minimum, the following information,

1. The noise level achieved during type certification;
2. The noise certification standard to which the aircraft is certificated;
3. The noise certification procedures used; and
4. Any additional modifications that enable the aircraft to meet the relevant noise certification requirements of the Annex

Such documents may include the following;

- (i) a noise certificate issued by the State of Design; or
- (ii) a statement made in the Flight Manual or Type Certificate, that the aircraft type conforms with the applicable environment requirements in Annex Part II and the associated noise data in the Flight Manual or in the Type Certificate Data Sheet.

(b) Any other evidence as required by the DGCA for the consideration of the application.

3.3 Whenever the noise certification standard of an aircraft model has attained a more stringent level, an operator may submit a new application for a noise recertification together with documents to support the more stringent noise certification. A noise certificate may be issued by the DGCA upon satisfaction that the aircraft meets the applicable requirements of the more stringent noise standard.

### **4. Validity of Noise Certificate**

4.1 Subject to paragraph 4.2, when the ownership of an aircraft has changed but the aircraft remains on Singapore's aircraft register, the noise certificate shall remain valid.

4.2 A noise certificate of an aircraft may be suspended in accordance with section 17 of the Air Navigation Act or revoked in accordance with section 18 of the Air Navigation Act if the aircraft ceases to comply with the applicable noise certification standards

4.3 The noise certificate shall cease to be valid when an aircraft is de-registered from Singapore's aircraft register.

4.4 A noise certificate that is suspended or revoked under paragraph 4.2 or that ceases to be valid under paragraph 4.3 shall be returned to the DGCA as soon as reasonably practicable.

**SECTION 2**

***AIRCRAFT AIRWORTHINESS***

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**CHAPTER 2.2****ISSUE OF CERTIFICATES OF AIRWORTHINESS**

EFFECTIVE DATE : 1 FEBRUARY 2026

REVISION NO : 31 (ISSUE 2)

**1 Introduction**

- 1.1 Pursuant to paragraph 7 of the Singapore Air Navigation Order, this Chapter prescribes the requirements for the issue of a Singapore Certificate of Airworthiness.
- 1.2 An aircraft to which a certificate of airworthiness is issued shall be operated in compliance with the terms of that certificate and within the approved operating limitations in its flight manual.
- 1.3 The categories in which Certificates of Airworthiness may be issued are specified in the Singapore Air Navigation Order.
- 1.4 This Chapter spells out the general requirements for the issue of the Singapore Certificate of Airworthiness.

**2 Application for a Certificate of Airworthiness**

- 2.1 Application shall be made on Form CAAS(AW)29 and submitted to:

Civil Aviation Authority of Singapore  
Flight Standards Division  
60 Airport Boulevard, #04-01  
Changi Airport Terminal 2  
Singapore 819643

Note: The fees payable for this purpose are prescribed in the Twelfth Schedule of the Singapore Air Navigation Order.

**3 Requirements**

- 3.1 Prior to issuing any Certificate of Airworthiness, the DGCA may conduct an investigation to determine if the aircraft meets the Singapore airworthiness requirements. The applicant will have to furnish to the DGCA the information, data, reports, etc., prescribed in Chapter 2.2 Appendix 1 and to meet any additional requirements decided by the DGCA during the investigation.
- 3.2 The aircraft must have a type certificate that has been accepted by the DGCA, in accordance to SAR-21 Subpart A. Any Special Conditions imposed by the Airworthiness Authority of an exporting state must be acceptable to the DGCA.

3.3 The aircraft may be required to be made available for survey by the DGCA at suitable times and for such periods considered necessary. The owner shall prepare the aircraft to permit access as necessary and shall perform any checks and tests that may be requested.

3.4 - Reserved -

3.5 Each application for issue by the Chief Executive of a Certificate of Airworthiness must be accompanied by documents which:

- (a) state the type, model and manufacturer's serial number of the aircraft;
- (b) substantiate that the aircraft complies with the airworthiness requirements appropriate to the aircraft type and which are acceptable to the DGCA;
- (c) substantiate that all Singapore airworthiness requirements and special conditions applicable to the aircraft have been complied with;
- (d) certify in regard to a used aircraft, that the aircraft and its records have been inspected and as far as can be reasonably determined the aircraft is safe to fly subject to the requirements prescribed in the approved flight manual and the latest Certificate of Airworthiness issued by the foreign Civil Aviation Authority.

3.6 Upon being registered in Singapore, all work on the aircraft shall be undertaken by appropriately approved person or organisation or, when otherwise approved, a licensed aircraft maintenance engineer. A Certificate of Release to Service shall be issued and attached to the log book or other approved records together with full particulars of the work done.

Note: Requirements for the compilation of aircraft, engine and variable pitch propeller log book entries and engineering records are prescribed in Section 4 Chapter 4.6.

3.7 The flight test carried out under the exporting country's authority may be accepted for the issue of a Singapore Certificate of Airworthiness. When the flight test is required by the DGCA, the owner shall be responsible to ensure that :

- (a) the aircraft and its engine(s) have been certified as fit for flight by appropriately licensed aircraft maintenance engineers.

Note: A Certificate of Fitness for flight shall be issued in duplicate. One copy must be retained by the person issuing the Certificate.

- (b) a flight test schedule is prepared and is acceptable to the DGCA.
- (c) the handling characteristics are satisfactory and climb performance equals or exceeds the scheduled performance.
- (d) the flight tests are conducted by a person or organisation acceptable to the DGCA.

Note: The test may be witnessed by the DGCA.



- (e) a report on the flight tests in an acceptable format shall be submitted to the DGCA.

3.8 For new aircraft the owner shall arrange for the aircraft to be inspected during the course of construction to determine that it conforms in all essential aspects with the approved design and that its construction and assembly are satisfactory. The owner shall nominate a person, acceptable to the DGCA to carry such inspections. When necessary, the DGCA may also inspect the aircraft in addition to the abovementioned inspections.

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## CHAPTER 2.2 : ISSUE OF CERTIFICATE OF AIRWORTHINESS APPENDIX 1

### GENERAL REQUIREMENTS

EFFECTIVE DATE : 15 DECEMBER 2011

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#### 1 Introduction

- 1.1 The following identifies the general requirements which must be satisfied prior to the issue of a Singapore Certificate of Airworthiness.

#### 2 New Aircraft

- 2.1 The general requirements are as follows:

- (a) Export Certificates of Airworthiness for the aircraft, engines and propellers (as applicable).

The Certificates shall be endorsed with:

- (i) the national requirements with which the aircraft complies giving the title, issue numbers and effective date.
  - (ii) such deviations from the national requirements as may have been authorised in writing by the Airworthiness Authorities which issue the Certificates.
  - (iii) such additional special conditions that were required before the issue of the Certificates.
- (b) A list of applicable Airworthiness Directives together with:
- (i) A declaration of the Airworthiness Directives that had been complied with. Where alternate means of compliance are offered, the means chosen shall be stated.
  - (ii) Identification of Airworthiness Directives that require repetitive compliance. Information as to when the next compliance is due must also be provided.
- (c) A list of Service Bulletins, including Alert Service Bulletins, complied with on aircraft engines, propellers (as applicable) and equipment.
- (d) Statement of Modification Status which shall include:
- (i) Customer options incorporated.

- (ii) Equipment incorporated.
- (e) Statement of compliance with mandatory equipment and radio apparatus requirements specified in the Schedules of the Singapore Air Navigation Order.
- (f) Statement of compliance with requirements specified in the Singapore Airworthiness Notices.
- (g) A list of defects, if any, that is to be rectified by the applicant at the time of issue of the Export Certificate of Airworthiness.
- (h) Equipment list.
- (i) Weighing report.
- (j) Weight and centre-of-gravity schedule.
- (k) Time/life limitations.
- (l) Records of compass system and magnetic compass swing.
- (m) Noise Certificate.

### **3 First-of-type Aircraft**

3.1 In addition to the requirements in paragraph 2, the following is required for a first-of-type aircraft exported to Singapore, unless otherwise notified:

- (a) Statement of build standard which shall include the aircraft specification.
- (b) A copy of the aircraft and engine type certificates and applicable supplemental type certificates.
- (c) Type certificate data sheets or specifications for aircraft, engine and propeller, including any supplemental type specifications.
- (d) Wiring diagrams.
- (e) Electrical load analysis.
- (f) Maintenance Review Board Report where applicable.
- (g) Maintenance Planning Data (which should include corrosion prevention and control programme, and structural integrity programme, where applicable)
- (h) Master Minimum Equipment List, where applicable.
- (i) Noise certificate.
- (j) One copy each of the following manuals:

- (1) Flight Manual or Pilot Operating Handbook (in addition to the copy for each aircraft).
- (2) Operations Manual (in addition to the copy for each aircraft).
- (3) Aircraft Maintenance Manual.
- (4) Engine Maintenance Manual.
- (5) Propeller Maintenance Manual.
- (6) APU Maintenance Manual.
- (7) Parts Catalogue.
- (8) Standard Practices Manual.
- (9) Structural Repair Manual.
- (10) Structurally Significant Items.
- (11) Loading Procedures Manual.
- (12) Weight and Balance Manual.
- (13) Non-destructive Testing Manual.
- (k) Complete sets of Service Bulletins for aircraft, engine, propeller and APU. Amendment service for the above documents must be provided to the DGCA.

#### **4 Used Aircraft**

4.1 In addition to the requirements in paragraph 2 and, where applicable, in paragraph 3, the following is also required for a used aircraft:

- (a) A complete history of past operational uses of the aircraft.
- (b) A complete history of the aircraft, engines, propellers, components and equipment including:
  - (i) The number of landings and pressurisation cycles.
  - (ii) The maintenance schedule to which the aircraft has previously been maintained, including previous check cycle and future check cycle.

Note : The owner shall be required to show proof that the maintenance schedule is adequate based on the reliability programme of the previous operator or its equivalent.

- (c) The time in service since new of any components of the aircraft, engines, propellers or equipment which are subject to mandatory life limitations.
- (d) The time in service since new and since overhaul of any components of the aircraft, engines, propellers or equipment which are subject to an approved overhaul period.
- (e) Details of all changes of major structural components such as wings, tailplanes, helicopter rotors or transmission components and histories of the replacing components.
- (f) Details of major structural repairs including the nature of damage in each case.
- (g) The particulars and results of airworthiness acceptance tests.

**CHAPTER 2.3****RENEWAL OF CERTIFICATE OF AIRWORTHINESS**

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**1 Introduction**

- 1.1 Pursuant to paragraph 7(8) of the Singapore Air Navigation Order, this Chapter prescribes the requirements for renewal of a Certificate of Airworthiness.

Note: Singapore Certificates of Airworthiness are issued or renewed for periods not exceeding one year.

**2 Application for Renewal of Certificate of Airworthiness**

- 2.1 Application shall be made on Form CAAS(AW)29 and submitted to:

Civil Aviation Authority of Singapore  
Flight Standards Division  
60 Airport Boulevard, #04-01  
Changi Airport Terminal 2  
Singapore 819643

- Note:
- (1) The fees for renewal of a Certificate of Airworthiness are prescribed in the Schedules of the Singapore Air Navigation Order.
  - (2) The application and all documents required by this Chapter should be submitted at least two weeks prior to the expiry date of the Certificate.

**3 Requirements**

- 3.1 The renewal of a Certificate of Airworthiness is dependent on evidence being provided that the aircraft complies with the appropriate airworthiness requirements and is airworthy.
- 3.2 An inspection of the aircraft may be required but all relevant records shall be reviewed prior to the renewal of the Certificate of Airworthiness. The depth and extent of the inspection, if required, will depend on:
- (a) the age of the aircraft, areas and types of operation and conditions of storage.
  - (b) the extent of any unscheduled work that has been carried out on the aircraft since the last renewal following such events as serious or persistent defects, defects or damages requiring major repairs or modifications, inspections completed following hard or overweight landings or abnormal stresses during flight or on the ground, corrosion in major structure, etc.

- (c) evidence that the approved maintenance schedules or approved overhaul and/or replacement periods for the aircraft and its components have been fully observed.
- (d) evidence that airworthiness requirements or instructions, such as mandatory modifications and inspections, airworthiness directives, etc., prescribed or approved by the DGCA, for the aircraft and its components, have been complied with fully.
- (e) evidence of, observance of the aircraft or component manufacturers' recommendations, such as service bulletins, service letters, etc., which may affect the airworthiness of the aircraft.

3.3 Prior to renewal of the Certificate of Airworthiness the aircraft may be required to be made available for survey by the DGCA. If a survey is required, the owner shall have the aircraft prepared for inspection in an acceptable condition to enable tests and inspections to be made. Additional work may be required by the DGCA following a survey of the aircraft.

3.4 Unless there is a system of monitoring the weight and centre of gravity of the aircraft, the aircraft should be weighed prior to the initial issue of a Singapore Certificate of Airworthiness. For all aircraft, it should be re-weighed within two years after the date of manufacture and thereafter at intervals not exceeding five years. The weighing and centre of gravity report shall be submitted in a prescribed format to the DGCA.

3.5 If a flight test is required by the DGCA, the results of the test and related test information and data shall be submitted in an acceptable format, to the DGCA. In lieu of an annual flight test, a programme for aircraft performance and engine condition monitoring must be implemented.

#### **4 Records and Log Books**

4.1 The relevant log books, modification record book and maintenance records forming part of log books, and records permitted to be kept by other approved means shall be submitted to the DGCA prior to renewal of the Certificate of Airworthiness.

4.2 Full particulars of the work done relating to the renewal of the Certificate of Airworthiness shall be entered and certified in the log books or other approved records.

4.3 Copies of the valid Certificates of Releases to Service/Schedule Maintenance Inspection and Certificate of Maintenance Review should be submitted to the DGCA prior to the renewal of the Certificate of Airworthiness.

#### **5 Aircraft Documents**

5.1 Unless otherwise required, the aircraft flight manual and maintenance schedule shall be made available for survey if required by the DGCA. The owner shall ensure that these documents together with the maintenance, overhaul, repair manuals and crew manuals, etc., are up to date.



**CHAPTER 2.4****EXPORT CERTIFICATE OF AIRWORTHINESS**

EFFECTIVE DATE : 1 FEBRUARY 2026

REVISION NO : 31 (ISSUE 2)

**1 Introduction**

- 1.1 This Chapter prescribes the requirements to an Export Certificate of Airworthiness under paragraph 7A of the Air Navigation Order.
- 1.2 The Airworthiness Authority of the country of import usually requires evidence from the Airworthiness Authority of the country of export as to the airworthiness of the aircraft concerned. The evident of airworthiness adopted and accepted internationally is usually in the form of an Export Certificate of Airworthiness.
- 1.3 The Export Certificate of Airworthiness does not, by itself, give authority for the aircraft to be flown. Such authority will have to be obtained from the Airworthiness Authority of the country in which the aircraft is to be registered.

**2 Application**

- 2.1 An application for an Export Certificate of Airworthiness shall be made on Form CAAS(AW)36. The application shall be
- (a) accompanied by relevant documents and other evidence specified in Chapter 2.2 and Chapter 2.3 of this Section;
  - (b) accompanied by documents specifying the requirements or design standards with which the aircraft does not comply and a letter from CAAS to notify that an exemption from the Air Navigation Order or the Technical Requirements had been granted in respect of the non-compliance;
  - (c) accompanied by evidence that the importing state requires an Export Certificate of Airworthiness; and
  - (d) submitted to:  
  
Civil Aviation Authority of Singapore  
Flight Standards Division  
60 Airport Boulevard, #04-01  
Changi Airport Terminal 2  
Singapore 819643
- 2.2 The application and all required documents should be submitted at least one month prior to the date of the intended export of the aircraft.

**3 Requirements**

- 3.1 The aircraft concerned shall have a valid Certificate of Airworthiness to be eligible for the grant of an Export Certificate of Airworthiness.
- 3.2 For the purposes of the grant of an Export Certificate of Airworthiness, CAAS may consider an aircraft as “new” if it meets all of the following criteria:
- (a) The aircraft has only flown for any or all of the following purposes:
    - (i) testing the aircraft;
    - (ii) demonstrating the aircraft with a view to the sale of that aircraft;
    - (iii) proceeding to or from a place at which the aircraft is to be demonstrated; or
    - (iv) delivering the aircraft to a person who has agreed to buy or lease the aircraft.
  - (b) The aircraft has, from its date of manufacture to the date of application for an Export Certificate of Airworthiness, been under the sole ownership of the manufacturer or dealer authorised by the manufacturer; and
  - (c) The aircraft has not accumulated flight cycles or flying hours that requires its first maintenance inspection as defined in its approved Maintenance Schedule. Inspection and servicing tasks that are necessary for flight operations as identified in the approved Maintenance Schedule are not considered as ‘maintenance inspection’ for this purpose.
- 3.3 For the purpose of the grant of an Export Certificate of Airworthiness, CAAS may consider an aircraft that does not meet the criteria set out in paragraph 3.2 as “used”.
- 3.4 CAAS may record additional information in the Export Certificate of Airworthiness granted to a new aircraft. Such additional information may include cycles, hours and purposes of the flights conducted while the aircraft was registered in Singapore.
- 3.5 The aircraft concerned shall be de-registered from Singapore’s register prior to the issue of an Export Certificate of Airworthiness.

- Note:
- (1) CAAS does not require that an aircraft being exported from Singapore be issued with an Export Certificate of Airworthiness.
  - (2) An Export Certificate of Airworthiness is not a Certificate of Airworthiness for the purposes of the Singapore Air Navigation Order.
  - (3) The Singapore Export Certificate of Airworthiness will certify only to the eligibility of the aircraft to receive the Singapore Certificate of Airworthiness in a particular category and unless specifically endorsed will not certify compliance with the airworthiness requirements of the importing country.
  - (4) - Reserved-

SECTION 3

***COMPONENT AND EQUIPMENT  
AIRWORTHINESS***

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**CHAPTER 3.7****REQUIREMENT FOR COMPASS SWING**

EFFECTIVE DATE : 15 DECEMBER 2011

REVISION NO : 18 (ISSUE 2)

**1 General**

1.1 Pursuant to paragraph 12(4) of the Air Navigation Order, this Chapter prescribes the requirements for Singapore aircraft in respect of direct reading compasses, gyro-stabilised remote indicating compass systems and non gyro-stabilised remote indicating compass systems.

1.3 For the purpose of this Chapter, the following definitions shall apply.

**Calibration** means the measurement of residual deviations of a compass installed in an aircraft;

**Deviation** means the angle required to be added algebraically to the compass reading to obtain the aircraft magnetic heading; and

**Standby Compass** means a direct reading compass which is not used as the primary heading reference.

**2 Compass Swing**

2.1 The operator of a Singapore aircraft shall conduct a compass swing to calibrate each installed compass in accordance with the conditions and time intervals prescribed in the maintenance schedule. In the event the maintenance schedule does not prescribe a time interval, a compass swing shall be conducted at least once every twelve months.

2.2 The operator shall verify the accuracy of the compass when the accuracy of the compass is in doubt and shall carry out a compass swing when necessary.

2.3 A compass swing shall be performed in accordance with approved data and documents, unless otherwise permitted by the DGCA. The presence of magnetic interference shall also be taken into consideration during the compass swing.

2.4 Deviation of the compass at any heading shall be within a limit stipulated by the aircraft manufacturer. In the absence of such limits specified by the aircraft manufacturer, the deviation shall be within a limit acceptable to the DGCA.

**3      Recording**

- 3.1      A record of the compass swing shall be made in the aircraft log book or in any other manner acceptable to the DGCA.
- 3.2      A compass deviation card shall be made available for the primary standby compass, and shall contain at least the following information:
- (a)      the magnetic heading and the compass reading necessary to achieve the magnetic heading at the cardinal and intermediate 30-degree headings;
  - (b)      the date of the compass swing;
  - (c)      the type and serial number of the compass; and
  - (d)      the identity and signature of the person responsible for the compass swing.
- 3.3      The compass deviation card shall be protected against water or other damage and be positioned so that it can be easily read during flight.

*SECTION 4*

***ENGINEERING AND MAINTENANCE  
ADMINISTRATION***

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**CHAPTER 4.1****GENERAL REQUIREMENTS FOR MAINTENANCE  
OF AIRCRAFT AND AIRCRAFT COMPONENTS**

EFFECTIVE DATE : 1 AUGUST 2018

REVISION NO : 27 (ISSUE 2)

**1 General**

- 1.1 Pursuant to paragraphs 9 and 10 of the Air Navigation Order, this Chapter prescribes the requirements for Singapore aircraft in respect of:-

**Maintenance of aircraft.** This work must be conducted in accordance with a maintenance schedule prepared by the owner or operator of an aircraft and approved by the DGCA.

Note: The contents of a maintenance schedule are dependent on the category of an aircraft, its complexity and the system of control over maintenance by the owner or operator. Specific requirements are stated in Chapter 4.3.

**Overhaul, repair, inspection and modification of aircraft, components or equipment and replacements of components and equipment.** This work must be undertaken in accordance with approved conditions and procedures, approved components, parts or material must be used and a certificate of release to service must be issued on completion of the work.

**2 Responsibilities for Airworthiness****2.1 Owner's or Operator's Responsibilities**

The owner or operator of an aircraft is responsible that maintenance work on his aircraft is conducted in accordance with the Singapore airworthiness requirements and the aircraft is maintained in an airworthy condition. He shall ensure that:

- (a) All maintenance, mandatory modifications and inspections, overhauls or replacements on the aircraft, its engines, components or equipment are completed within any required periods and in accordance with the approved maintenance schedules, or other approved worksheets as applicable.
- (b) Unless otherwise agreed by the Chief Executive, all work is undertaken by a SAR-145 approved maintenance organisation.
- (c) The SAR-145 approved maintenance organisation is notified of the work to be undertaken at each scheduled check or inspection, including rectification of defects or damage and any mandatory work to be completed unless the maintenance schedules adequately specify such work as may be applicable.

- (d) The aircraft is not flown unless all work has been completed and certified on documents appropriate for the work and the pilot is notified of the status of the aircraft.
- (e) When an aircraft has had abnormal loads applied in flight, experienced hard or overweight landings, or been struck by lightning, it shall be inspected in accordance with the manufacturers requirements or other schedules approved by the DGCA and the results of the inspection plus details of repairs made are entered in the aircraft log book or other approved records and when appropriate the aircraft technical log.
- (f) Maintenance schedules and worksheets pertinent to his aircraft, components or equipment are revised whenever modifications to the aircraft or changes in maintenance practices or category of operation cause them to be inapplicable. Such revisions must be approved by the DGCA and distributed to all persons or organisations responsible for maintenance of his aircraft.
- (g) Particulars of all work completed on his aircraft are, as appropriate, entered in the technical log, or other appropriate log book or approved records system together with the applicable certification document.
- (h) Approved data and documents are revised as soon as possible after receipt of amendment advice from the manufacturer and appropriate staff are advised of amendments that affect airworthiness.

Note: The data and documents which may be approved for use in aircraft maintenance are specified in paragraph 3.2.

- (i) Where the flight or operating characteristics of the aircraft or its components may have been affected by maintenance or other work, the aircraft shall not be released to service until it has been certified as fit for flight and tested in flight in accordance with an approved test schedule, unless other procedures have been approved.

Note: Requirements for design of a certificate of fitness for flight under 'A' Conditions and specified in Appendix 1.

- (j) The effect of the work on the empty weight and centre of gravity position of the aircraft shall be calculated. Where significant changes have occurred the results shall be submitted to DGCA who will determine whether re-weighing and/or preparation of a new weight schedule is required.
- (k) The DGCA and authorised officers are permitted access to his aircraft and establishment to assess whether these requirements are being observed; and, to inspect documents, aircraft, components, equipment, or work in progress to assess the competence and diligence of staff engaged in aircraft maintenance and other work.

**2.2     Maintenance Organisation's Responsibilities**

A person or organisation responsible for maintenance or other work on aircraft shall carry out the work under and in accordance with the requirements stipulated in the SAR-145.

**3         General Requirements for the Conduct of Maintenance and Other Work****3.1     Aircraft Components, Equipment and Materials**

Aircraft components, equipment and materials shall not be used unless they comply with all mandatory airworthiness requirements specified by the DGCA or in the airworthiness directives as adopted under Singapore Airworthiness Requirements Part 39 and an Authorised Release Certificate or other acceptable document has been issued in accordance with paragraph 10 of the ANO. Replacement items must be either identical with those installed in the aircraft, component, equipment or approved alternatives.

**3.2     Approved Data and Documents**

3.2.1     The following data or documents are approved for use in the maintenance of Singapore-registered aircraft, except when the DGCA has directed or notified otherwise:

- (a)       The aircraft, component or equipment manufacturer's maintenance data as specified in SAR-145.
- (b)       data or design documents approved by the DGCA in accordance with SAR-21 Subpart C or Subpart F;
- (c)       data or design documents approved by the DGCA in accordance with SAR 21.117;
- (d)       Data or design documents issued by the approved signatories and within the scope of a design organisation approved by the DGCA in accordance with SAR-21 Subpart H.

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## CHAPTER 4.1 : GENERAL REQUIREMENTS FOR AIRCRAFT MAINTENANCE

### APPENDIX 1

## CERTIFICATE OF FITNESS FOR FLIGHT

EFFECTIVE DATE : 15 AUGUST 2006

REVISION NO : 12 (ISSUE 2)

The Certificate shall be as follows:

### CERTIFICATE OF FITNESS FOR FLIGHT

#### AIRCRAFT REGISTRATION

It is hereby certified that the aircraft defined hereon has been inspected and is fit for flight provided it is properly loaded.

This Certificate is valid until \_\_\_\_\_ or until the airworthiness condition of the aircraft is altered, whichever is earlier.

Signed \_\_\_\_\_ Authorisation No \_\_\_\_\_  
Airframe

Date \_\_\_\_\_

Signed \_\_\_\_\_ Authorisation No \_\_\_\_\_  
Engines

Date \_\_\_\_\_

- Note:
- (1) The maintenance organisation shall ensure that a Certificate of Fitness for Flight is issued after the aircraft's airframe and engine integrity are verified by the appropriately authorised certifying staff.
  - (2) A Certificate of Fitness for Flight shall be certified only by holder(s) of an appropriate aircraft maintenance licence with privileges in airframe, engine or both.
  - (3) The period of validity shall be stated but shall not exceed 7 days.
  - (4) The Certificate shall be issued in duplicate and one copy kept elsewhere than in the aircraft.
  - (5) If the original airworthiness condition of the aircraft is affected during the period of validity, the Certificate shall be re-issued.

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**CHAPTER 4.1.1****SCOPE OF RESPONSIBILITIES OF AIRCRAFT  
MAINTENANCE LICENCE HOLDERS AND  
APPROVED OR AUTHORISED PERSONS OR  
ORGANISATIONS**

EFFECTIVE DATE : 29 MARCH 2022

REVISION NO : 30 (ISSUE 2)

**1 General**

- 1.1 This Chapter prescribes the scope of responsibilities of licensed aircraft maintenance personnel pursuant to paragraphs 10 and 11 of the Air Navigation Order for the issue of certificates of Release to Service for the completion of overhauls, maintenance, modification, replacements, repairs and inspections.

Note: Persons authorised or approved to perform the functions of a licensed aircraft maintenance personnel shall also comply with the provisions of this Chapter.

- 1.2 A person who is appropriately licensed, authorised or approved shall not certify for the completion of work unless he has familiarised himself with all current information necessary for the work.

Note: When the work involves the assembly or any disturbance of a vital point or control system to which the SAR applies, any duplicate inspection required must be certified before the relevant Certificate of Release to Service is issued.

- 1.3 For the purpose of this Chapter, the following definitions shall apply:

- |              |  |
|--------------|--|
| Overhaul     | - is a major work operation which involves dismantling, inspection and replacement of any necessary parts, reassembly and complete functional testing to specifications and renewal of operational life. |
| Modification | - is any change made to an aircraft, engine, propeller, component, or equipment and their installation.  |
| Replacement  | - is the removal of a part or component and its replacement with an identical part or component or substitution of another approved part.  |
| Repair       | - is any rectification work which is not covered by any of the above definitions.  |

Inspection	- is any work necessary to determine the condition of a component, whether damage or defects exist, or work has been completed in an approved manner.
Maintenance	- is any scheduled maintenance inspection (SMI) or other work required by the approved maintenance schedule.
Condition	- is the physical state of a part or component.
Assembly	- means that items are put together, fitted, attached, installed, connected, secured, or adjusted correctly in the approved manner.
Functioning	- means ensuring that components or systems operate correctly and in the approved manner.
Electronic Component	- means a component which contains semi-conductor parts or microprocessors.
Primary structure	- means those parts of the structure which contribute significantly to carrying flight, ground or pressurisation loads, the failure of which could endanger the safety of the aircraft.

## **2 Privileges of an Aircraft Maintenance Licence**

- 2.1 The aircraft maintenance licence alone does not permit the holder to issue certificates of release to service (CRS). To issue a CRS, the licenced holder must in addition hold a certification authorisation issued by a CAAS approved organisation.
- 2.2 Subject to the rating and any limitations stated on an aircraft maintenance licence, the holder may be authorised to certify for the maintenance, modifications, replacements, repairs and inspections as appropriate.
- 2.3 There are many areas where work being carried out on an aircraft could affect other systems, equipment or components outside the licence holder's privileges. Where an overlap occurs the licence holder primarily responsible for the system must ensure such other work are certified by another licence holder with the appropriate privileges.

**3** - Reserved -

## **4 SAR-66 Aircraft Maintenance Licence Privileges**

- 4.1 Details of the SAR-66 licence privileges are found in SAR-66.20.

## **5 Responsibilities of Authorised or Approved Persons or Organisations**

- 5.1 The extent of any approval of a person to undertake and certify for maintenance, overhaul, modification, replacement, repair or inspection of components or parts will be in accordance with the terms of the approval.



## CHAPTER 4.3

# MAINTENANCE OF AIRCRAFT

EFFECTIVE DATE : 5 OCTOBER 2018

REVISION NO : 28 (ISSUE 2)

### 1 General

1.1 This chapter prescribes the requirements for the preparation of:

- (a) maintenance of schedules; and
- (b) systems of control over maintenance on aircraft.

### 2 Maintenance Schedules

2.1 Owners or operators of Singapore aircraft shall prepare and submit maintenance schedules, detailing the maintenance required at specific intervals on the aircraft, to the DGCA for approval.

2.2 Singapore operators operating foreign-registered aircraft shall provide, for the use and guidance of maintenance and operational personnel concerned, a maintenance schedule approved by the State of Registry. A copy of such a maintenance schedule shall be submitted to the DGCA when the operator applies to include or use a foreign-registered aircraft in his operation.

2.3 All maintenance schedules shall contain the following information:

- (a) The owner's or operator's registered name and address.
- (b) The makes, type and series reference of the aircraft, its engine(s) and propeller(s).
- (c) The nationality and registration marks of the aircraft to which the schedule is applicable.
- (d) The periods at which the aircraft, its components, equipment and their installations shall be inspected, the extent of each inspection, and practices and procedures to be followed.

Note: Specific references in the maintenance schedules to the aircraft, component or equipment manufacturers current maintenance and overhaul manuals may be acceptable, instead of including the complete information, provided any aspects of the work on aircraft which are additional to or vary from the manufacturer's information are detailed in the maintenance schedule.

- (e) The periods at which components or equipment are inspected, checked, tested, calibrated etc and cleaned, lubricated, adjusted etc. as applicable and the practices and procedures to be followed.

- (f) A statement specifying the procedures for recording aircraft time in service, the periods at which scheduled inspections and other work are to be done, the periods at which a Certificate of Maintenance Review is to be issued and procedures for its issue.
- (g) A schedule detailing components or equipment which are to be overhauled or retired from service at specified calendar (elapsed) time or flying time periods or other approved service life period.
- (h) Procedures and documentation for certification of all checks and inspections, issue of a Certificate of Maintenance Review and issue of a Certificate of Release to Service.

Note: The requirements for issue of Certificate of Maintenance Review are specified in Chapter 4.3 Appendix 1.

### **3 Systems of Control Over Maintenance on Aircraft**

3.1 An associated system of control over maintenance of aircraft is also required for aircraft operated in accordance with a Singapore Air Operator Certificate.

3.2 The operator shall provide for the use and guidance of maintenance and operational personnel concerned, a maintenance programme approved by the DGCA containing the information required below. The design and application of the operator's maintenance programme shall observe human factors principles. The maintenance programme shall include:

- (a) maintenance tasks and the intervals at which these are to be performed, taking into account the anticipated utilisation of the aeroplane;
- (b) when applicable, a continuing structural integrity programme;
- (c) procedures for changing and deviating from (a) and (b) above; and
- (d) when applicable condition monitoring and reliability programme descriptions for aircraft systems, components and powerplants. (Refer to Appendix 2).

Maintenance tasks and intervals that have been specified as mandatory in approval of the type design of the aircraft shall be identified as such.

3.3 The associated system of control over maintenance shall also include the following:

- (a) Servicing procedures for each aircraft type including:-
  - (i) Procedures for refuelling, defuelling and replenishment of oils, fluids and gases;
  - (ii) The approved specification and/or grade of fuel, oil, water methanol, hydraulic fluids, oxygen etc required for each aircraft type;

- (iii) The system of quality control to be observed by the operator in order that:
  - (A) petroleum products used in his aircraft conform with the approved specifications;
  - (B) work undertaken by other organisations and persons during the servicing of an aircraft is done correctly and safely; and
  - (C) adequate measures are taken by refuelling agencies to ensure the correct products are always supplied and that the likelihood of contamination and deterioration of petroleum products is minimal.

- (b) Policy for the use of manufacturers manuals and field service information.
- (c) Details of any reliability control programme or condition monitoring programme including a schedule of components or equipment subject to such programmes and the practices and procedures established for their use.

Note: Essential aspects are stated in Appendix 2 Chapter 4.3.

- (d) Rectification of an unserviceable or inoperative component or equipment and the class of person who may certify that an aircraft may continue in service with an unserviceable or inoperative component or equipment in accordance with the minimum equipment list.
- (e) Procedures for applying to the CAAS for a concession or approval, of a change or variation, in compliance with a mandatory requirement or an approved maintenance schedule requirement.
- (f) The procedures to be observed for work undertaken on behalf of the operator by other organisations in Singapore or other countries, and the procedures for certification of such work and issue of the necessary certificates.
- (g) The procedures for the use of aircraft components, equipment and materials in maintenance or other work when an aircraft is away from Singapore.

Note: Chapter 4.6 specifies the required records.

- (h) A list of all forms used in maintenance and other work plus a statement of their purposes and procedures for their use.

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**CHAPTER 4.3 : MAINTENANCE OF AIRCRAFT****APPENDIX 1****CERTIFICATE OF MAINTENANCE REVIEW**

EFFECTIVE DATE : 29 MARCH 2022

REVISION NO : 30 (ISSUE 2)

**1 General**

- 1.1 Pursuant to paragraph 9 of the ANO, the issue of a CMR provides evidence that, at the date of issue, the aircraft was in compliance with the requirements of the maintenance schedule approved by the CAAS, that all modifications and inspections classified as mandatory had been satisfied, that defects entered in the technical log had been rectified or deferred in accordance with approved procedures and that all CRS had been issued in accordance with the Singapore Airworthiness Requirements. A copy of the current CMR must be carried on board the aircraft to which it relates.
- 1.2 CMR signatories work on behalf of approved organisations and as such, approved organisations must have procedures established as to how the signatory will comply with the requirement. For instance it may be acceptable for the signatory to accept authorised reports from various sections and rely on “no adverse comments” from quality audits, but he must have the right of access, questions and query to any relevant information, including quality audits, in order to carry out his task. It would be untenable if the signatory accepted reports without question from a reliability group if there were critical quality audits on that group of which he was not aware. In the absence of specific procedures, full access to all records will be required.
- 1.3 The CMR signatory shall be given access to such information as is necessary in order that he may carry out his obligations. It is therefore incumbent on the CMR signatory that he does research the records to the extent necessary to confidently issue the CMR. Thus the following records must be at his disposal: the maintenance schedule, the technical log, technical records and mandatory information like Airworthiness Directives.

**2 Aircraft above 2730 MTWA**

In the case of aircraft above 2730 kg MTWA, the CMR shall be issued for a period of four calendar months unless a different period has been approved by the CAAS. Nothing prevents the CMR from being reissued as many times as necessary during each year, but its validity must never exceed four months or such period as approved by the CAAS. This flexibility of application of the CMR is intended to allow maintenance organisations to align its issue with an SMI if they wish to do so.

**3 Aircraft below 2730 MTWA**

In the case of aircraft below 2730 kg MTWA, the CMR shall be issued for a period of one year. Unless otherwise agreed or directed by the CAAS, the CMR must be aligned with the renewal of the Certificate of Airworthiness

**4 Conditions for Issue of CMR**

4.1 The signatory shall only issue a CMR when satisfied, at the time of the review, that the following aspects of maintenance have been carried out:

- (a) All maintenance requirements prescribed by the approved maintenance schedule, including requirements on all lifed items and out-of-phase checks or similar special checks, have been complied with.
- (b) All mandatory modifications and inspections have been complied with within the prescribed time periods.
- (c) All entries in the technical log have been rectified or deferred in accordance with procedures approved by the CAAS.
- (d) All required CRSs have been issued.

4.2 The CMR shall be signed by the holder of an appropriate aircraft maintenance licence or a suitably authorised person of a maintenance organisation approved by the CAAS.

**5 Requirements for Applicants**

5.1 Persons seeking authorisations/approvals to issue Certificates of Maintenance Review must hold:

- (a) - Reserved -
- (b) - Reserved -
- (c) a full SAR-66 Category B1 or B2 licence appropriate to the aircraft type for which authorisation/approval is sought; or
- (d) a foreign approved licence with equivalent privilege as the licence mentioned in paragraph 5.1(c), provided that the foreign requirements are determined by the DGCA to be acceptable.

5.2 Such person shall also:

- a) have at least eight years' experience of aircraft maintenance, which includes at least two years' recent experience involving the certification of maintenance; and

- b) hold a position within the Approved Organisation compatible with the responsibilities involved; and
- c) have successfully completed familiarisation training on the operator's requirements for which authorisation/approval is sought.

5.3 CMR certifying staff must be trained in the procedures of the Organisation, and on the following:

- (i) - Reserved -
- (ii) The status of the Certificate of Maintenance Review and the responsibilities of a signatory of the Certificate.
- (iii) The form and implementation of the Approved Maintenance Schedule for the type of aircraft concerned.
- (iv) The details of the systems and procedures contained in the Exposition and associated documents, together with the requirements of the Organisation for their implementation.
- (v) The maintenance support systems which are related to continuing airworthiness, e.g., reliability programmes, defect control, production control, development engineering, training, certification authority and modification control.
- (vi) The form and use of the aircraft technical log, deferred defect log, fuel and instrument log, and the minimum equipment list.
- (vii) The form and implementation of mandatory inspections/modifications as required by Airworthiness Directives (Mandatory Modification Inspections) for the type of aircraft concerned.

5.4 Persons seeking authorisation or approval to issue a Certificate of Maintenance Review for new aircraft must hold a SAR-66 Category B licence appropriate to the aircraft type for which an authorisation or approval is sought. In addition, the person must comply with the requirements in paragraphs 5.2 to 5.3

5.5 For the purpose of paragraph 5.4, 'new aircraft' means a Singapore aircraft delivered new from the manufacturer, which has not yet been registered or operated in Singapore. The CMR for such new aircraft must be issued before its first flight as a Singapore aircraft.

## **6 Validity of Authorisations/Approvals**

6.1 Authorisations/approvals granted in accordance with this Appendix shall only be used, subject to their conditions of validity, whilst the holder remains in the employ of the Approved Organisation and his licence remains valid.

**7 CERTIFICATE OF MAINTENANCE REVIEW**

A Certificate of Maintenance Review shall be issued at the times specified in the Approved Maintenance Schedule or the relevant Approval Document of the Maintenance Schedule, as appropriate. The certification shall be in the following format:

AIRCRAFT TYPE:	REGISTRATION:
INSPECTION RECORD REFERENCE:	
THIS MAINTENANCE REVIEW WAS CARRIED OUT ON:	
Certified that a maintenance review of this aircraft and such of its equipment as is necessary for its airworthiness has been carried out in accordance with the requirements of the Air Navigation Order for the time being in force.	
SIGNED:	
AUTHORISATION:	
DATE:	
The Next Maintenance Review is due on or before:	



## CHAPTER 4.3 : MAINTENANCE OF AIRCRAFT

### APPENDIX 2

## RELIABILITY CONTROL PROGRAMMES

EFFECTIVE DATE : 5 OCTOBER 2018

REVISION NO : 28 (ISSUE 2)

- 1 Approval for the establishment of a reliability control programme and/or condition monitoring programme will be dependent on the operator submitting adequate details of the company policies and for administering such programmes.
- 2 The following aspects are essential and must be included in the submission:
  - (a) Programmes and their associated control systems must be directed by a board consisting of senior members of the operator who are responsible for engineering quality and maintenance and who will be responsible to establish company policy and procedures to co-ordinate all action within the company and to liaise with the DGCA on the initial approval and subsequent revisions to the programme, and surveillance of the programme.
  - (b) Responsibilities of each board member and their departments, and the responsibilities for co-ordination between the departments.
  - (c) The Information to be utilised for assessment of reliability.
  - (d) Policies for the establishment of levels of acceptable reliability for all components and equipment controlled by the programme.
  - (e) Procedures for selection of items to be included in the programme and schedule of the items that are controlled by the programme.
  - (f) Policies for monitoring and analysis of operational data, investigation of unsatisfactory performance and appropriate rectification action.
  - (g) Provision of forms and exhibits to ensure that all action is formally documented and to facilitate monitoring and surveillance of the programme.
  - (h) Provision for an EDTO reliability programme.

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## CHAPTER 4.5

# TECHNICAL LOGS

EFFECTIVE DATE : 1 FEBRUARY 2026

REVISION NO : 31 (ISSUE 2)

### 1 General

This Chapter prescribes the requirements for Technical Logs required, pursuant to Regulation 101 of the Air Navigation (91 — General Operating Rules) Regulations 2018, to be carried in Singapore aircraft.

### 2 Technical logs shall be provided by the owner or operator of an aircraft and shall contain the following information:

- (a) An identification that the document is a technical log required pursuant to the Air Navigation Regulation (91 — General Operating Rules) Regulations 2018.
- (b) A list of the contents of the Log and directions for making the records unless such information is provided separately.
- (c) The name and address of the registered owner or operator.
- (d) The nationality and registration marks of the aircraft.
- (e) Instructions on how to defer defects. An aircraft or equipment defect can only be deferred in the following ways:
  - (i) The deferment is in accordance with the provision spelt out in the Minimum Equipment List (MEL).
  - (ii) The defect is related to a cabin item which is not safety related.
  - (iii) The defect is allowed in the Maintenance Manual or Structural Repair Manual.
  - (iv) The deferment is pursuant to a Despatch Authorisation granted by the DGCA.
  - (v) The defect has incorporated an approved repair in accordance with the operator's procedures.
  - (vi) The deferment is otherwise in accordance with procedures approved by DGCA.
- (f) A record which shall have serially numbered sheets with provision for the following entries:

- (i) The date and time at which each flight began and ended.
- (ii) Places and times of departure and arrival.
- (iii) Hours of flight.
- (iv) Certification for completion of all checks and inspections made in accordance with an approved maintenance schedule and which require certification by a nominated signatory.

Note: Such certifications must include the signature and licence, authorisation or approval reference of the persons and the date and time of certification.

- (v) Recording defects, failures, malfunctions or damage occurring to the aircraft, its components or equipment.
  - (vi) The certification on a certificate of release to service by an appropriately licensed aircraft maintenance engineer or other authorised/approved person in respect of any work completed to rectify defects, failures, malfunctions or damage.
  - (vii) In respect of the deferment of rectification of any defects, failures, malfunctions or allowable damage, a certification by an appropriately licensed aircraft maintenance engineer or other authorised/approved person recording the deferment and stating any conditions relevant to operation of the aircraft. The statement must refer to the relevant technical log entry.
- (g) The signature of the pilot-in-command of the aircraft.
- (h) A fuel and oil record which shall have serially numbered sheets with provision for the following entries:
- (i) Date, time and place of refuelling.
  - (ii) The quantities of fuel, oil, water-methanol etc. uplifted and the quantities available in each tank or combination of tanks.
  - (iii) The grade of fuel, or other fluids, uplifted and its proprietary name and type of specification.
  - (iv) The measuring means used to determine the quantities of fuel in the aircraft after refuelling.

Note: The fuel & oil record may be provided as a separate document.

2A - *deleted* -

2B - *deleted* -

- 3      Entries in the technical log shall be made in ink or indelible pencil.
- 4      The record sheets shall be in duplicate with provision for a copy of each entry made to be retained by the operator at the place where the entry was made.
- 5      The original copy of maintenance and defect records shall be retained by the owner or operator for a period of two years following the expiry of any period of validity or the date of an entry.
- 6      Appropriate data shall be extracted and entered in the aircraft and engine log books or other approved records system as soon as possible after the conclusion of each flight or scheduled series of flights.
- 7      Copies of all technical log page format must be submitted to the DGCA for acceptance.

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## CHAPTER 4.6

# AIRCRAFT RECORDS SYSTEM

EFFECTIVE DATE : 5 OCT 2018

REVISION NO : 28 (ISSUE 2)

### 1 General

Pursuant to paragraph 15 of the Singapore Air Navigation Order, log books are required to be kept for aircraft, engines and variable pitch propellers.

This Chapter prescribes the records to be maintained in log books or other approved records systems in respect of:

- (a) The engineering history of aircraft, engines and propellers including components and equipment as applicable.
- (b) The maintenance completed.
- (c) Other work completed.
- (d) Defects, damage, failures or malfunctions that have occurred.
- (e) Airworthiness data.

2 The owner or operator of aircraft operated in accordance with an Air Operator Certificate approval may obtain approval to use a records system instead of the prescribed log books provided the system includes the required data and records, and procedures are established which will ensure that accurate records are maintained. A record of all important modifications and major repairs shall also be kept for each aircraft in an approved Modification Record Book.

3 The operator shall ensure that the following records are maintained for aircraft, engines and variable pitch propellers including their components and equipment for the periods specified in paragraph 4:

- (a) The total time in service and number of landings of the aircraft daily.
- (b) All maintenance checks or inspections completed in accordance with an approved maintenance schedule including the date and total time in service when the certifications were made.
- (c) All overhauls, repairs, replacements or modifications completed and the date and total time in service when the certifications were made.
- (d) Particulars of any defects, failures, malfunctions or damage occurring to the aircraft, its components and equipment, the rectification action taken and a reference to any relevant technical log entries.

- (e) The approved data or documents observed for all work other than that completed in accordance with approved maintenance schedules or approved work sheets.
- (f) Details of any concession approved for maintenance or other work.
- (g) Details of mandatory inspections completed including the results of such inspections.
- (h) The total time in service of aircraft components which are subject to a mandatory life limitations.
- (i) The time in service since new or overhaul as appropriate of any components or equipment which are subject to an approved overhaul period, a special check or inspection within a specified period.
- (j) The total time in service of major airframe components of complex aircraft.
- (k) The total time in service since new and the flight time since last overhaul of major components that have been replaced in the engines or propellers.
- (l) In respect of engines on which performance checks have been made such data which may be required during subsequent maintenance or operation.
- (m) The current status of compliance with all mandatory continuing airworthiness information.
- (n) A continuous record of the changes in empty weight and centre of gravity position due to modifications, repairs, alterations etc.
- (o) Detailed maintenance records to show that all requirements for the signing of the certificate of release to service have been met.

**4** Records above are to be preserved for the following periods:

- (a) Paragraphs 3 (a) to (m) - a minimum period of 24 months after the date the aircraft or aircraft component has been destroyed or permanently withdrawn from service.
- (b) Paragraph 3 (n) - a period of time as per the requirement in paragraph 16(3) of the Air Navigation Order.
- (c) Paragraph 3 (o) - a minimum period of 2 years after the signing of the certificate of release to service. The certificate of release itself shall be preserved for a period of time as per the requirement in paragraph 10 (5) of the Air Navigation Order.

Note: (1) A person responsible for making an entry in a log book or other approved record may be required to substantiate any statements made in such records.

(2) - *deleted* -



**CHAPTER 4.8****REQUIRED INSPECTION AND TESTS**

EFFECTIVE DATE : 15 DECEMBER 2011

REVISION NO : 18 (ISSUE 2)

**1 General**

Pursuant to paragraph 7 of the Air Navigation Order the DGCA may require an inspection or test to be made on an aircraft to determine whether it is airworthy. This Chapter prescribes the requirements to establish the airworthiness condition of an aircraft following:

- (a) The completion of maintenance involving the adjustment, repair, modification or replacement of any part of a control system or units of the flight, engine and propeller controls, their related system controls, and associated operating mechanisms. Duplicate inspections are required of all work which, if not completed correctly, could affect the safety of an aircraft.
- (b) The application of abnormal loads in flight or on the ground.
- (c) Modifications, repairs or replacements of components which may affect the accuracy of a magnetic compass or compass system.

**2 Duplicate Inspection of Control Systems**

Note: A duplicate inspection is an inspection first made and certified by one qualified person and then repeated and certified by a second qualified person.

The requirements are as follows:

- (a) Duplicate inspections shall be made and certified by appropriately licensed aircraft maintenance engineers or persons approved or authorised to undertake work on the particular control system.  
  
In an emergency and when only minor adjustments are involved the second inspection may be made and certified by a flight engineer or pilot licensed for the aircraft type (except a student).
- (b) Duplicate inspections of all affected control systems in an aircraft shall: -
  - (i) Be made after its assembly and before the first flight, and
  - (ii) Before flight after overhaul, repair, replacement or adjustments. Inspections may be limited to a specific section or part of a system when only a minor adjustment or minor work has been done.

- (c) The inspections shall be of sufficient depth to determine that the control system(s) have been installed and adjusted in accordance with the manufacturers requirements or other approved data or documents. The procedures shall be specified in an approved maintenance schedule or worksheet (which for complex systems should include a check list of the necessary operations) and shall also ensure that full and correct movement of controls throughout the system(s) relative to movement of the flight crew's controls is obtained both prior to and after all covers and fairings are finally secured.
- (d) Control systems subject to duplicate inspections must not be disturbed or readjusted after the first inspection has been completed and certified. The second inspection must be made as early as practical after the first inspection but may be commenced before the first inspection is completed in areas where access is difficult or other similar problems exist.
- (e) Any disturbance of a control system after completion of a duplicate inspection will require further duplicate inspections and certifications of the part of the system that has been disturbed.
- (f) If a duplicate inspection is required, it shall be the final operation to establish the integrity of the system when all other work has been completed.
- (g) The approved worksheets or approved data for the overhaul and repair of sealed components shall, where appropriate, include procedures for: -
  - (i) Duplicate inspections and certifications of the sections/ parts which will be concealed during bench assembly and which cannot be proved to be functioning in accordance with the manufacturers requirements when subsequently installed on an aircraft; and
  - (ii) Duplicate inspections, of such units, after final assembly for functioning and correct relative movement.

The certification for these inspections shall be attached as part of the approved certificate for the component. The certifications shall be made by persons, whose names and duties are stated in the approved quality control system or company exposition.

- (h) Where it is not possible to make duplicate inspections of a complete system due to the routing of controls through inaccessible sections, the persons responsible for duplicate inspections may accept certifications for prior duplicate inspections of specific areas or for sealed units provided a certification of the earlier inspections is available and duplicate inspections of the accessible sections are made, the correct units are installed, the system functions in accordance with the manufacturer's requirements, and has full, free and correct directional movement. The certifications for all such duplicate inspections shall be attached as part of the final duplicate inspections.

**3 INSPECTION FOLLOWING ABNORMAL LOADS IN FLIGHT OR ON THE GROUND**

- 3.1 An aircraft that has been subject to abnormal loads or stresses in flight or on the ground shall be inspected in accordance with the requirements of the manufacturer or an approved maintenance schedule or worksheet prior to the next flight.
- 3.2 Such inspections shall be made by an appropriately licensed aircraft maintenance engineer. The results and a certification, of the inspections shall be entered in the log book or other approved records. A report of any damage and rectification action shall be submitted in accordance with Chapter 4.9.

**4 TESTING OF MAGNETIC COMPASSES**

- 4.1 Each magnetic compass on aircraft on which the undermentioned work has been completed shall be checked to determine whether the work has affected the accuracy of the compass(es). Where there is any indication of a change in accuracy a compass swing in accordance with an approved procedure in Chapter 3.7 shall be completed.
- (a) The replacement of an engine mounted in the forward fuselage or the installation, removal or replacement of any magnetic material which may affect the accuracy of a compass.
  - (b) The installation of a new electrical system or major modification to an existing system.
  - (c) The installation of geophysical survey equipment or other equipment likely to have a strong external magnetic field.
  - (d) The replacement of any component of a compass installation which may affect the accuracy of the installation.

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**CHAPTER 4.9****REPORTABLE SAFETY MATTER**

EFFECTIVE DATE : 29 MARCH 2022

REVISION NO : 30 (ISSUE 2)

**1 General**

- 1.1 Pursuant Section 4O of the Air Navigation Act, a responsible person shall notify the Authority of a reportable safety matter relating to the airworthiness condition of an aircraft.
- 1.2 This Chapter prescribes the requirements for reporting a safety matter that includes reporting the occurrence or detection of defects, failures or malfunctions in an aircraft, its components or equipment, which could jeopardize the safe operation of an aircraft or cause it to become a danger to persons or property.
- 2 Reports shall, as applicable, be submitted by:
- (a) The operator holding a certificate granted in accordance with Air Navigation (119 — Air Operator Certification) Regulations 2018, Air Navigation (125 — Complex General Aviation) Regulations 2018 or Air Navigation (137 — Aerial Work) Regulations 2018, or in all other cases involving a Singapore aircraft, the owner, following the occurrence to their aircraft of a potentially hazardous defect, failure or malfunction detected during maintenance or other work on an aircraft.
  - (b) Approved persons or organisations who during maintenance or other work become aware of serious or hazardous defects, failures or malfunctions on aircraft or aircraft components.
  - (c) - deleted -
  - (d) The holder of an Air Operator Certificate in the form of a periodical summary of technical delays, systems defects, failures or malfunctions, component premature removals, and investigations made by the holder into important technical problems.
- 3 Potentially hazardous occurrences referred to in Paragraph 2(a) are defects, failures or malfunctions of aircraft, components or equipment that result in:
- (a) Fire or operation of fire or smoke warning systems.
  - (b) Significant leakage of fuel, oil or other fluid.
  - (c) Smoke, vapour, toxic or noxious fumes inside the aircraft.
  - (d) Malfunction, stiffness, slackness or reduced range of movement of any controls.
  - (e) Incorrect assembly of components, causing possible malfunction.

- (f) Engine malfunction resulting in partial loss of power, engine shutdown.
  - (g) Failure or malfunction of the thrust reverser system.
  - (h) Failure of a propeller feathering system to shut down an engine or to control thrust.
  - (i) Use of incorrect fuel, oil or other fluid.
  - (j) Fuel system malfunction affecting fuel supply, distribution and jettison.
  - (k) Fuel spillage on ground.
  - (l) Significant failure or malfunction of electrical, instrument, hydraulic, pneumatic, flight control, pressurisation or ice protection systems or of the radio and navigation equipment.
  - (m) On a multi-engine rotorcraft, loss of drive of one engine.
  - (n) Operation of any rotorcraft transmission condition-warning system.
  - (o) Failure of any required emergency equipment to operate or inadvertent operation that causes a hazardous situation.
  - (p) Failure of aircraft primary structure.
  - (q) Cracks, permanent deformation or corrosion of aircraft structure or major aircraft components that exceed specified limits, defects found as the result of a mandatory inspection.
  - (r) Structural damage resulting from any cause which requires any permanent or temporary repair before the aircraft can fly.
  - (s) Failure or malfunction of ground equipment used for testing/checking aircraft systems or equipment.
  - (t) Any other occurrence that has jeopardised or may endanger the safe operation of an aircraft or cause a danger to persons or property.
- 4 Defects, failures or malfunctions shall be reported to the Authority in accordance with the following:
- (a) Potentially hazardous occurrences specified in paragraph 3, within 72 hours of the occurrence or its detection or such other period acceptable to the Authority.
  - (b) Statistical summaries of defects, failures, malfunctions and premature removals of components and equipment, within a period acceptable to the Authority.
- 5 The reports shall be provided in an acceptable format, except that initial report made in accordance with paragraph 4(a) may be telephoned to the Flight Standards

Division, Civil Aviation Authority of Singapore provided a written report is submitted within 72 hours. Reports shall include as much of the following data that is available at the time:

- (a) Aircraft type and registration marks.
- (b) Name of the operator or owner.
- (c) The date and the maintenance being performed when the defect, failure or malfunction occurred or was detected.
- (d) Any precautionary or emergency procedures used.
- (e) A description of the defect, failure or malfunction.
- (f) The identification of the component, equipment or system involved, including the make, serial number and part number(s) of the major component(s) involved.
- (g) The total time in service since new and/or overhaul and the time in service since the last maintenance on the items involved.
- (h) The apparent cause of the occurrence.
- (i) The action taken to rectify the defect, failure or malfunction and any action to preclude its recurrence.
- (j) Whether the aircraft was grounded.
- (k) Other pertinent information necessary for more complete identification, seriousness of the defect etc., corrective action taken etc.

6 Reports shall not be withheld because all the required information is not available.

7 When all the pertinent data is not available or the cause of the occurrence cannot be determined without further investigation a supplementary report shall be submitted detailing the missing data and any additional information that becomes available since the initial report such as:

- (a) The total number of flights since new if a primary structural component is affected.
- (b) Details of damage which indicates the pattern of sequence of failure.
- (c) A brief summary of any pertinent data that could assist in identification or determination of the seriousness, cause, associated effects of the occurrence.

8 Defective aircraft, components and equipment which are the subject of a report may be required to be available for investigation by the Authority. Any such components or equipment removed from an aircraft shall not be despatched from Singapore, nor have any work commenced on them if it would impede any investigation without the prior approval from the Authority.

**9 Occurrence reporting to design organisation**

- 9.1 An operator of aeroplane over 5700 kg or helicopters over 3175 kg maximum certificated take-off mass shall within 72 hours of the occurrence of a fault, malfunction, defect or other occurrences that cause or might cause adverse effect on the continuing airworthiness of the aircraft, submit a written report with information on the occurrence to the organisation responsible for the type design of that aircraft.
- 9.2 Where the information referred to in paragraph 9.1 relates to an engine or propeller, the operator shall transmit such information to: -
- (a) the organisation responsible for the type design of the engine or the propeller, as the case may be and
  - (b) the organisation responsible for the aircraft type design.
- 9.3 Where the occurrence referred to in paragraph 9.1 is associated with a modification, the operator shall, within 72 hours of the occurrence, submit a written report containing the information to the organisation responsible for the design of the modification.
- 9.4 For the purpose of this paragraph, an “operator” means –
- (a) in case involving an operator holding a certificate granted in accordance with ANR-119, ANR-125 or ANR-137, that operator; or
  - (b) in all other cases involving a Singapore registered aircraft, the owner.



**SECTION 5**

***AIRCRAFT PERFORMANCE***

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**CHAPTER 5.1****WEIGHT CONTROL OF AIRCRAFT**

EFFECTIVE DATE : 5 OCTOBER 2018

REVISION NO : 28 (ISSUE 2)

**1 General**

Pursuant to paragraph 16 of the Air Navigation Order, this Chapter prescribes the requirements for weighing Singapore aircraft including helicopters, the determination of the centre of gravity of such aircraft and preparation of Basic Weight Schedules and Weight and Balance Reports.

**2 Definitions****2.1 Basic Weight**

Basic Weight is the weight of the aircraft and all its basic equipment and that of the declared quantity of unusable fuel and unusable oil. In the case of turbine-engined aircraft and aircraft of 5700 kg maximum total weight authorised (MTWA) or less it may also include the weight of usable oil.

**2.2 Basic Equipment**

Basic Equipment is the unconsumable fluids, and equipment which is common to all roles in which the operator intends to use the aircraft.

**2.3 Variable Load**

Variable Load is the weight of the crew and of items such as the crew's baggage, removal units and other equipment the carriage of which depends upon the role for which the operator intends to use the aircraft for the flight.

**2.4 Aircraft Prepared for Service, or Operating Weight**

The sum of the Basic Weight and the total Variable Load required for the role in which the operator intends to use the aircraft.

**2.5 Disposable Load**

Disposable Load is the weight of all persons and items of load, including fuel and other consumable fluids, carried in the aircraft other than the Basic Equipment and Variable Load.

Note: To obtain the total loaded weight it is necessary to add to the Basic Weight the weights of the Variable and Disposable Load items to be carried for the particular role in which the aircraft is to be used.

**3 Weighing Requirements**

- 3.1 All aircraft shall be weighed in Singapore prior to the initial issue of a Singapore Certificate of Airworthiness.
- 3.1A Notwithstanding 3.1, the DGCA may allow an aircraft to be weighed at a place outside Singapore prior to their importation into Singapore and for which any subsequent changes in weight have been computed and recorded, provided all the necessary weight and balance data for the aircraft are furnished to the DGCA and such data are found to be accurate and adequate.
- 3.2 Aircraft shall be re-weighed within two years after the date of manufacture and thereafter at intervals not exceeding five years, and at such other times as the DGCA may require. Aircraft weighing shall be conducted in accordance with procedures acceptable to the DGCA. Essential aspects of the conduct of weighing are given in Appendix 3.
- 3.3 When an aircraft is weighed, the condition of the aircraft (i.e., the equipment, the position of movable items and other items of load such as fluids in tanks) shall be recorded. The equipment installed at the time of weighing should not differ from that in the declared Basic Equipment list associated with the Basic Weight Schedule (see paragraph 4). Otherwise, in determining the Basic Weight and the corresponding centre of gravity position, corrections will have to be made for items that have been weighed but that are not Basic Equipment items, and for Basic Equipment items not installed in the aircraft during the weighing.
- 3.4 Weighing results and related calculations shall be recorded in a weighing report which shall be retained by the operator. When the aircraft is again weighed the previous weighing records must be retained with the aircraft records.
- 3.5 The operator shall maintain records of all known weight and centre of gravity changes which occur after the aircraft has been weighed and such records shall be retained by the operator.

**4 Basic Weight Schedule**

- 4.1 A Basic Weight Schedule shall be provided for each aircraft. Each Schedule shall be identified by the aircraft type and model number, the nationality and registration marks and the aircraft serial number. The date of issue and the reference number of the Schedule shall be given, and the Schedule shall be signed by a person suitably qualified and acceptable to the DGCA. A statement shall be included stating that the Schedule supersedes all earlier issues.
- 4.2 The Schedule shall present the derivation of the Basic Weight and the centre of gravity from the most recent weighing report or Basic Weight Schedule or other acceptable information. The Schedule shall indicate the landing gear positions (retracted or extended) to which the derived centre of gravity position is related. The Schedule shall also include the current Basic Equipment list showing the weight and lever arm of each item or make reference to the document in which such a list is included.

- 4.3 The date and reference number of the most recent weighing report, Basic Weight Schedule or other acceptable information, upon which the Schedule is based, shall be given.
- 4.4 The Basic Weight Schedule may be in the form given in Appendix 2 to this Chapter. Variations in presentation are permitted but must be acceptable to the DGCA. In the case of helicopters, it may be necessary to present lever arms and moments about more than one axis, depending on the centre of gravity limits specified in the Flight Manual.
- 4.5 The datum which is defined in the Basic Weight Schedule may be different from the datum defined in the Certificate of Airworthiness or Flight Manual to which the centre of gravity limits relate. When a different datum is used it shall be adequately defined, its precise relationship to the datum in the Certificate of Airworthiness or Flight Manual shall be given, and any lever arms and moments which appear in any part of the Schedule shall be consistent with the datum so declared.
- 4.6 The Schedule shall be retained by the operator and where the Schedule has been revised the previous issue must be retained with the aircraft records.
- 4.7 Operators shall revise the Basic Weight Schedule when the weight and centre of gravity are known to have undergone changes in excess of a maximum figure, which has been agreed by the DGCA as applicable to a particular aircraft type.

Note: The following changes in basic weight or centre of gravity position are considered significant and must be reported to the DGCA:

- (a) Aeroplanes whose empty weight has changed by more than 0.5% of the maximum total weight authorised or whose basic centre of gravity position has changed by more than 0.5 % of the mean aerodynamic chord.
- (b) Helicopters whose empty weight has changed by more than 1% of the maximum total weight authorised or whose basic centre of gravity position has changed by more than 0.5 inch or 10% of the maximum permissible centre of gravity range whichever is the lesser.

## **5 Weight and Balance Report**

- 5.1 A Weight and Balance Report shall be produced for each Singapore aircraft. A copy of each report shall be supplied to the DGCA.
- 5.2 The Weight and Balance Report is intended to record the essential loading data to enable the particular aircraft to be correctly loaded and to include sufficient information for an operator to produce written loading instructions in accordance with the requirements in regulation 24 of the Air Navigation (91 – General Operating Rules) Regulations 2018
- 5.3 The Weight and Balance Report shall include the following items:
  - (a) Reference number and date of issue.

- (b) Type and model number of the aircraft and its nationality and registration mark.

(c) Basic Weight

The Basic Weight and centre of gravity of the aircraft as derived from the Basic Weight Schedule shall be presented. A copy of the Basic Weight Schedule, including the Basic Equipment list, and any referenced weighing report, shall be attached to the Report.

(d) Datum definition

A diagram or a description of the datums (e.g., in relation to the fuselage frame numbering system or other identifiable points) shall be included. See also paragraph 4.5.

(e) Variable Load

Information on the weight and lever arms appropriate to Variable Load items may be detailed for as many roles as the operator wishes and for every role the total weight and moment change shall be given.

(f) Loading Information

This shall include all relevant information so that, knowing the disposable load which is intended to be carried, the weight and the position of the centre of gravity of the aircraft can be calculated. At least the following shall be given:

- (1) The lever arm of the centre of gravity of an occupant of each seat.
- (2) The lever arm of each compartment or area in the aircraft where disposable load, such as luggage or freight, may be placed.
- (3) Any significant change in the centre of gravity of the aircraft (change in moment) which will result from a change in configuration, such as the retraction and extension of the landing gear.
- (4) The lever arm of the centre of gravity of fuel and oil in each tank including the variation of the lever arm with the quantity loaded if this variation is significant.
- (5) The maximum total usable capacities of the fuel and oil tanks and the weight of fuel and oil when the tanks are filled to their capacities assuming typical densities of these fluids.

- (g) A statement shall be given in the Schedule to the effect that pursuant to the Air Navigation (91 – General Operating Rules) Regulations 2018 the pilot-in-command shall satisfy himself before take-off that the load is of

such weight and is so distributed and secured that it may safely be carried on the intended flight.

(h) A statement that the Report supersedes all earlier issues.

- 5.4 The weights, distances, moments and quantities may be given in any units provided that these are used consistently and agree with the markings and placards on the aircraft.
- 5.5 A copy of the Report shall be included in the Flight Manual of all aircraft not exceeding 5 700 kg MTWA. If a Flight Manual is not applicable, the Report shall be displayed or retained in the aircraft in a suitably identified stowage.
- 5.6 Operators shall revise the Weight and Balance Report when there is a change to any of the items in paragraph 5.3.
- 5.7 The Weight and Balance Report may be in the form given in Appendix 1 to this Chapter. Variations in presentation are permitted but must be acceptable to the DGCA.

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## CHAPTER 5.1 : WEIGHT CONTROL OF AIRCRAFT APPENDIX 1

# EXAMPLE OF A WEIGHT AND BALANCE REPORT

EFFECTIVE DATE : 5 OCTOBER 2018

REVISION NO : 28 (ISSUE 2)

### SPECIMEN WEIGHT AND BALANCE REPORT

Reference Number	- NAL/WBR/123
Date of Issue	- 1 January 1989
Produced by	- New Aviation Ltd
Aircraft Type and Model	- Flynow 2E
Nationality and Registration Marks	- 9V-ABC
Constructor	- F.L.Y. Co Ltd.
Constructor's Serial Number	- 44
Maximum Total Weight Authorised	- 3320 kg
Centre-of-Gravity Limits	- Refer to Flight Manual reference Number FM/946

### PART A - BASIC WEIGHT

The basic weight of the aircraft as  
derived in the Basic Weight Schedule  
NAL/BWS/246 dated 31 December 1988 is - 2500 kg

The centre of gravity of the aircraft  
in the same condition at this weight  
and with the landing gear extended is - 127 in. aft of datum

The total moment about the datum in  
this condition in kg-in/100 is - 3175

Note:

- (1) The datum is at fuselage station 0 situated 114 inches forward of the wing leading edge. This is the datum defined in the Flight Manual. All lever arms are distances in inches aft of datum.
- (2) The basic weight includes the weight of 11 kg unusable fuel and 2.2 kg unusable oil.

**PART B - VARIABLE LOAD**

The weight, lever arm and moment of items of Variable Load are shown below. The Variable Load depends upon the equipment carried for the particular role.

Item	Weight (kg)	Lever Arm inches	Moment kg/inches 100
Pilot (one)	-	108	-
De-icing fluid 1½ gallon	5.5	140	8
Life-jackets (7)	6.4	135	9
Row 1 passenger seats (two)	27.2	173	47
Row 2 passenger seats (two)	27.2	215	58
Row 3 passenger seats (two)	27.2	248	68
Table	3.6	256	9
One stretcher and attachments (in place of seats rows 2 and 3)	20.5	223	46
Medical Stores	6.8	250	17

**PART C - LOADING INFORMATION (DISPOSABLE LOAD)**

The total moment change when the landing gear is retracted is 8.2 kg-in/100. The appropriate lever arms are:

Item	Weight (kg)	Lever Arm inches	Capacity Imp.Gallon
Fuel in tanks 1 and 2	620*	145	190
Engine oil	23*	70	5.6
Forward baggage		21	
Rear baggage		261	
Passengers in row 1 seats		171	
Passengers in row 2 seats		213	
Passengers in row 3 seats		246	
Patient in stretcher		223	

Fuel density 3.26 kg/gal and oil density 4.1 kg/gal.

In accordance with the Air Navigation (91 – General Operating Rules) Regulations 2018, it is a requirement that the pilot satisfies himself before take-off that the load is of such a weight, and is so distributed and secured, that it may safely be carried on the intended flight.

Note: To obtain the total loaded weight of aircraft, add to the Basic Weight the weights of the Variable and Disposable Load items to be carried for the particular role.

This Report was prepared on \_\_\_\_\_ (date) \_\_\_\_\_ and supersedes all previous issues.

Name and Designation \_\_\_\_\_

Signed: \_\_\_\_\_

—

On behalf of: \_\_\_\_\_

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## CHAPTER 5.1 : WEIGHT CONTROL OF AIRCRAFT

### APPENDIX 2

# EXAMPLE OF A BASIC WEIGHT SCHEDULE

EFFECTIVE DATE : 15 JULY 2000

REVISION NO : 0 (ISSUE 2)

## SPECIMEN BASIC WEIGHT SCHEDULE

Reference Number	- NAL/BWS/246
Date of Issue	- 31 December 1988
Aircraft Type and Model	- Flynow 2E
Nationality and Registration Marks	- 9V-ABC
Aircraft Serial Number	- 44

## COMPUTATION OF BASIC WEIGHT AND CENTRE-OF-GRAVITY POSITION

Description	Weight	Arm	Moment (kg-in)
Aircraft weight as per weighing report WR/789 dated 30 December 1988	2475	126	311850
Total of items weighed but not part of Basic Equipment (listed to be given)	-25	-	-650
Total of Basic Equipment items not weighed (list to be given)	+50	-	+5000
Basic Weight	2500	127	317500

Or

Description	Weight	Arm (in)	Moment (kg-in)
Aircraft basic weight as per Basic Weight Schedule NAL/BWS/245 dated 20 June 1988	2475	126	311850
Total of Basic Equipment items removed (list to be given)	-25	-	-650
Total of Basic Equipment items added (list to be given)	+50	-	+5000
New Basic Weight	2500	127	317500

**Note:** The datum is at fuselage station O situated 114 inches forward of the wing leading edge. This is the datum defined in the Flight Manual. All lever arms are distances in inches aft of datum.

Current Basic Equipment List (may be given on separate sheets and attached to Schedule)

Item	Weight	Arm (in)
Two Marzell propeller type BL – H3Z30	57.6 each	76
Two engine driven 100 ampere alternative type GE-361	12.2 each	117
One 13 AH Ni-Cd battery CB-7	14	153
Etc	etc	etc

This Schedule was prepared on \_\_\_\_\_ (date) and supersedes all previous issues.

Name and Designation: \_\_\_\_\_

Signed: \_\_\_\_\_

On behalf of: \_\_\_\_\_

## **CHAPTER 5.1 : WEIGHT CONTROL OF AIRCRAFT APPENDIX 3**

### **CONDUCT OF WEIGHING**

EFFECTIVE DATE : 15 DECEMBER 2011

REVISION NO : 18 (ISSUE 2)

- 1 The following aspects should be adhered to and included in company weighing procedures:
  - (a) All weighings shall be supervised by a suitably qualified person who is acceptable to the DGCA.
  - (b) Weighing equipment should be suitable for the purpose. Evidence should be available, if necessary, to show that the equipment is regularly inspected and calibrated and its errors are within the tolerances specified by the equipment manufacturer or local weights and measure authority requirements.
  - (c) The staff are trained and handling equipment is adequate to permit weighings to be made accurately and safely.
  - (d) Unless otherwise agreed to by the DGCA a weighing shall consist of two independent weighings made with the aircraft longitudinal datum horizontal. The load must be removed from the weighing equipment between the weighings. Any discrepancy in the weighings shall not exceed 0.2 per cent of the gross weight or 25 lbs whichever is greater. If this tolerance is exceeded further weighings should be performed until the results between two consecutive weighings agree within the tolerance.
  - (e) A weighing report should be produced to provide a record of all measurements and calculations pertinent to the weighing. The report should include a list of equipment installed on the aircraft at the time of weighing.

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## CHAPTER 5.2

# FLIGHT MANUALS

EFFECTIVE DATE : 29 MARCH 2022

REVISION NO : 30 (ISSUE 2)

### 1 General

- 1.1 Pursuant to the Singapore Air Navigation Order, the flight manual is part of the Certificate of Airworthiness and Singapore aircraft are required to be operated in accordance with the Flight Manual and other acceptable data. This Chapter prescribes the requirements for such manuals.

### 2 Contents

- 2.1 Only Flight Manuals approved in accordance with the requirements of the State of Design of the aircraft may be accepted.
- 2.2 Each Flight Manual shall contain the following information, including instructions where necessary, relating to:
- (a) Nationality and registration marks of the aircraft, together with its type and model number and the manufacturer's serial number.
  - (b) Except where other means of providing the information are approved, the operating procedures, operational limitations and loading of the aircraft.
  - (c) The performance data for the aircraft.
  - (d) The date of approval or the currentness of the document.

### 3 Amendment

- 3.1 Changes or amendments shall not be made to a Flight Manual without the approval of the DGCA.
- 3.2 The DGCA may direct the owner of operator of a Singapore aircraft to change or amend a Flight Manual, where necessary, to maintain the airworthiness or safety standard of an aircraft. Such action may result from either:

- (a) A proposed modification to the aircraft or its equipment.
  - (b) A proposal by the operator or owner which affects the operation of the aircraft.
  - (c) Other occurrences affecting the airworthiness or safety of the aircraft.
- 3.3 A copy of all proposed changes and amendments, including those approved by the State of Manufacture of the aircraft, shall be supplied for approval by the DGCA.
- 3.4 The Flight Manual shall be made available for examination by the DGCA before a Certificate of Airworthiness is renewed and on request at other times.

## CHAPTER 5.3

# TEST AND SPECIAL FLIGHTS

EFFECTIVE DATE : 15 DECEMBER 2011

REVISION NO : 18 (ISSUE 2)

### 1 General

1.1 The Singapore Air Navigation Order prescribes the requirements in respect of operation of an aircraft without a valid Certificate of Airworthiness. The conditions for approval and conduct of such flights are stated in the Schedules to the Air Navigation Order as 'A' Conditions, 'B' Conditions and 'C' Conditions.

1.2 This Chapter prescribes the requirements for:

- (a) The certification of aircraft and conduct of flights to be made as Condition 'A' flights; and
- (b) Airworthiness flight tests.

Note: Flights made in accordance with Conditions 'B' or 'C' will be approved separately.

### 2 Certification for Flight under 'A' Conditions

2.1 The aircraft shall be inspected by appropriately licensed aircraft maintenance engineers to determine whether it is fit for flight and a Certificate of Fitness for Flight as specified in paragraph 2.3 shall be issued on completion of the inspection.

2.2 The validity of the certificate shall not exceed seven days. It shall be issued in duplicate, the original shall be included with the technical log and the duplicate retained by the operator separately from the aircraft. The aircraft shall be re-inspected and the certificate re-issued if the airworthiness condition of the aircraft is affected during the period of validity.

2.3 The Certificate of Fitness for Flight shall include the following:

- (a) A certification to the effect that the aircraft has been inspected and is fit for flight provided it is loaded in accordance with the approved Weight and Balance Report.
- (b) The approved data or schedules, etc., used for the inspection.
- (c) A statement of the period of validity of the Certificate and that it ceases to be valid if the airworthiness condition of the aircraft is altered.
- (d) The name, licence number or approval designation of the person making the certification.

**3        Airworthiness Flight Tests**

3.1       Flight tests may be required in the following circumstances:

- (a)       Prior to the issue of a Singapore Certificate of Airworthiness.
- (b)       Periodically to determine whether the handling characteristics, functioning and performance of an aircraft continues to comply with the requirements that were acceptable to the DGCA when the aircraft was issued with a Singapore Certificate of Airworthiness.
- (c)       On completion of a modification or other work likely to affect the handling characteristics, functioning or performance of an aircraft.

3.2       Flight test schedules shall be prepared in conjunction with the DGCA and must be acceptable to the DGCA.

3.3       Schedules for flight tests required by paragraphs 3.1(a) and (b) shall, except where otherwise agreed, include tests to check:

- (a)       The performance of the aircraft.
- (b)       The handling characteristics of the aircraft. These tests will be based on the results of the test during type certification and the subsequent history of the type.
- (c)       The functioning of aircraft controls, major systems and components in flight.
- (d)       Other aspects required by the DGCA.

3.4       Schedules for flight tests required by paragraph 3.1(c) shall:

- (a)       in respect of modifications or other work outside the scope of manufacturer's documents, include tests to:
  - (i)       determine whether the aircraft continues to comply with the airworthiness requirements observed for its type certification.
  - (ii)      establish whether revision of the Flight Manual handling or performance data is necessary.
  - (iii)     determine the data for such revisions.
- (b)       in respect of modifications or other work made in accordance with manufacturer's documents, approved maintenance manuals or completed subsequently to the final approval of work as specified in paragraph 3.4(a):
  - (i)       state the flight tests required.
  - (ii)      specify the procedures and standards to be observed.

**4 Flight Test Reports**

- 4.1 A copy of flight test reports in an acceptable format shall be submitted to the DGCA on completion of all airworthiness flight tests except those made in accordance with paragraph 3.4(b). A copy of all flight test reports shall be retained by the operator with the aircraft records.

**5 Flight Test Personnel and Facilities**

- 5.1 The qualifications and experience of flying staff and other persons engaged in flight tests, together with the facilities and equipment provided for the tests shall be acceptable to the DGCA.

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*SECTION 6*

***APPROVAL OF PERSONS AND  
ORGANISATIONS***

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## CHAPTER 6.5

# APPROVAL OF WELDERS

EFFECTIVE DATE : 15 DECEMBER 2011

REVISION NO : 18 (ISSUE 2)

### 1 General

- 1.1 Pursuant to ANO paragraph 8 and paragraph 10. This Chapter is applicable to persons who weld parts which are essential to the airworthiness of an aircraft where the making of a sound joint by the welding process depends largely on the competency of the operator.
- 1.2 Welders will be approved in accordance with the requirements of this Chapter and Appendix 1.
- 1.3 This Chapter prescribes the procedures for approving welders, and also prescribe the responsibilities of the approved welders and of the Approved Organisations employing them.

### 2 Approval of Welders

- 2.1 An approved organisation may employ, train, qualify and grant approval to welders to perform work under its scope of approval, subject to the following:
  - (a) It has an established system of training, qualifying, testing, approving, re-approving and monitoring the welders in its employ.
  - (b) It has a system of maintaining the training records of welders, qualification, testing and issue of approval and re-approval.
  - (c) Such system shall be approved by the DGCA in the Approved organisation's exposition document.
- 2.2 Notwithstanding paragraph 2.1 (a), an Approved Organisation may be approved to utilise an external approved organisation for initial training, qualification and approval of welders. However, the re-approval of welder is the responsibility of the Approved Organisation and shall be in accordance with this Chapter.
- 2.3 Welder Approvals are granted with specific ratings of metal groups and welding processes and with restrictions prescribing the type of welding work that may be undertaken (e.g., sheet to sheet, tube to tube). The metal groups and welding processes are given in Appendix 1.
- 2.4 Welder Approvals are granted with a maximum validity period of twelve months. The approval granted to a welder in the employ of an Approved Organisation will be invalidated automatically if the welder leaves that Organisation.

- 2.5 An applicant for the issue or re-issue of a welder's approval shall:
- (a) Be employed by an Approved Organisation who shall ensure that the applicant is able to read, write and converse in the English language and not suffering from any disability likely to affect his technical skill or judgement.
  - (b) Provide evidence of his qualifications and practical experience in welding.
  - (c) Satisfactorily complete the appropriate test samples and meet the examination requirements specified in Appendix 1.
- 2.6 The holder of a welder's approval is approved to certify for completion of work provided:
- (a) the approval is valid and appropriate for the type of material and welding process used.
  - (b) the work consists solely of welding.
  - (c) that where necessary the welding process followed and the material used comply with approved data or design documents specified for the work.
  - (d) the certification is only made in respect of the quality of the welding and of the fact that an approved process has been followed.

Note: An approved welder is not permitted to certify the welded parts unless approved as a person competent to issue a Certificate of Release to Service.

### **3 Procedures for the Issue of Approval**

- 3.1 The Approved Organisation employing the welder shall make arrangements for the welder to prepare and weld test samples in accordance with the requirements specified in Appendix 1.
- 3.2 The Approved Organisation shall arrange to submit the test samples to an Approved Test Organisation for examination together with full particulars of the welder concerned, materials and welding processes used, test sample figure numbers and identification marks on the test samples.
- 3.3 When the welder has made an application and after the test results furnished by the Approved Test Organisation are found satisfactory, the Approved Organisation may then issue a welder's approval to the welder for the materials and welding processes used and prescribing any restrictions.

### **4 Procedures for the Renewal of Approval**

Note: Should approval be sought for a rating (material and welding process used) or restriction different from that already granted, the procedures for the issue of approval as detailed in paragraph 3 shall be followed.

- 4.1 The Approved Organisation employing the welder shall arrange for renewal examinations of the welder's competency for each of the approved rating/restriction combination.
- 4.2 To ensure continuity of a welder's approval the renewal examination should be carried out before the expiry date of the approval, but not more than two months before the expiry date. The examination should be scheduled so that the results can be known before the approval expires.
- 4.3 At each renewal examination, the Approved Organisation shall make arrangements for the welder to prepare and weld an appropriate test sample in accordance with the requirements specified in Appendix 1.
- 4.4 The Approved Organisation shall arrange to submit the test sample to an Approved Test Organisation for examination together with full particulars of the welder concerned, material and welding process used, test sample figure number and identification marks on the test sample.
- 4.5 When the welder has made an application and after the test results furnished by the Approved Test Organisation are found satisfactory, the Approved Organisation may then renew the welder's approval.
- 4.6 If the test results are unsatisfactory the Approved Organisation employing the welder shall arrange for the renewal examination to be repeated immediately and the test sample sent to an Approved Test Organisation for examination. After these unsatisfactory test results are known and before the results of the repeated renewal examination are known the welder shall not weld parts that are essential to the airworthiness of an aircraft. If the test results of the repeated renewal examination are satisfactory, the welder's approval may then be renewed.

Note: If, however, the test results of the repeated renewal examination are again unsatisfactory the welder's approval shall be suspended until further training and/or experience has been gained to the satisfaction of the Approved Organisation, and a further examination has been satisfactorily completed.

## **5 Test Reports from Approved Test Organisations**

- 5.1 The Approved Test Organisations examining the test samples shall send a copy of all test reports to the Approved Organisation. The test reports shall detailed the test results and indicate also the date of receipt of the test samples and the date when testing is completed.

## **6 Records**

- 6.1 An Approved Organisation employing approved welders shall maintain a register of the welders' approvals as well as the records required in paragraphs 6.2 and 6.3 and shall keep copies of all test reports.
- 6.2 In relation to each approval (rating/restriction combination) issued, records shall be kept to indicate:

- (a) the date of preparation of the test sample.
- (b) the name of the authorised person supervising the preparation.
- (c) the name of the Approved Test Organisation to which the test sample has been sent for examination.
- (d) the date the test sample has been sent to the Approved Test Organisation.
- (e) the date the test report was received.
- (f) the test report reference.

6.3 In relation to the renewal of approvals, records shall be kept for the information required in paragraph 6.2 and, in addition, to indicate:

- (a) the scheduled date for the next renewal examination.
- (b) the period of suspension of approval, if any.

Note: Records for all renewal examinations, whether satisfactory or unsatisfactory, shall be kept.

6.4 All records shall be made available to an authorised person on request.

## **7 Checks by the DGCA**

7.1 The DGCA may select samples of approved welders' work at any time for additional check examination purposes.

## CHAPTER 6.5 : APPROVAL OF WELDERS

### APPENDIX 1

## EXAMINATION REQUIREMENTS

EFFECTIVE DATE : 15 DECEMBER 2011

REVISION NO : 18 (ISSUE 2)

#### 1 Metal Groups and Welding Processes

- 1.1 Welder's approvals are granted for the following metal groups and welding processes:

##### Metal Group

- 1 - Aluminium alloys
- 2 - Magnesium alloys
- 3 - Low carbon steels
- 4 - Corrosion and heat resisting steels
- 5 - Nickel alloys
- 6 - Copper alloys
- 7 - Titanium alloys

##### Welding Processes

- 1 - Gas (oxy-acetylene, etc)
- 2 - Braze welding (oxy-gas)
- 3 - Metal-arc (flux coated consumable electrode)
- 4 - TIG (tungsten-arc inert gas shielded)
- 5 - MIG (metal-arc inert gas shielded - consumable electrode)
- 6 - Plasma-arc

- 1.2 Other metal groups and welding processes may be considered by the DGCA.

#### 2 Types of Test Samples

- 2.1 The standard test samples are shown in the following figures:

Figure 1 - Sheet to sheet butt weld

Figure 2 - Sheet to tube weld

Figure 3 - Tube to tube weld

The dimensions given in the figures are in millimetres and may be regarded as approximate.

Note :                      (1)                      Approval will be limited to welding material from the specified metal group using the specified process. The selection of test samples to be welded by the applicant

- (2) will further determine any restrictions to an approval in respect of the type of work to be undertaken.  
On application to the CAAS other test samples may be used if they would be more relevant to the work normally undertaken.

- 2.2 The test samples shall be prepared by the applicant under the direct supervision of a supervisor. The supervisor will examine the dimensions, preparation and fitting of the test samples, and ensure that the required materials and process are used and that the test samples are completed in accordance with the requirements of paragraph 3.

Note: The supervisor shall be a person authorised, in accordance with Chapter 6.1, by the Approved Organisation to supervise welders' preparation of test specimens.

- 2.3 Additional test samples may be used if the applicant is not satisfied with the quality of the weld. The test samples shall be submitted complete and suitably identified to an Approved Test Organisation for examination.

### **3 Welding of Test Samples**

Note: Irrespective of the type of test samples, completed welds shall not be dressed, hammered or sand blasted. Light tapping with a hammer to remove scale deposits is acceptable. Flux shall be removed by standard procedures.

#### **3.1 Figure 1 Test Sample**

The edges of the sheet to be welded may be chamfered when 1.5mm or thicker sheet is used. Edge preparation is not necessary for aluminium alloys thinner than 2.5mm. The welding shall be performed with the test piece flat and by forehand welding from one side only using the correct filler rod, flux or shielding gas as applicable.

#### **3.2 Figure 2 Test Sample**

A 12mm diameter hole shall be drilled in the centre of each end plate prior to welding. The end plates may be positioned by tack welds. The first weld shall be completed by working around the test piece with the end plate flat on the bench and the tube vertical. The second weld shall be completed by working under and over the test piece with the tube horizontal and not moved during the welding process.

#### **3.3 Figure 3 Test Sample**

The tubes shall be prepared, assembled in a jig and tack welded. The assembly is then to be removed from the jig and mounted in a vertical position with the 150mm long tube vertical and 75mm long tube (at 45 degrees) at the top. The assembly shall not be moved from this position until all welds are completed. The welding of the lower tube shall be made by working around the test piece and the other welds by overhead welding and working around the test piece.

#### **4 Cutting Test Specimens**

- 4.1 Test specimens shall be cut from test samples by an Approved Test Organisation in accordance with the details given in the appropriate figures.

#### **5 Specimen Examination**

- 5.1 Assessment of a weld shall be based on consideration of the sample weld as a whole, including the results obtained by visual, microscopical, and where applicable, mechanical testing. If any doubt exists regarding the quality of the weld, or any defect revealed is thought to be of a local character, further sections should be examined and final assessment shall be based on all the specimens examined.

Note: Figure 1 test specimens shall be subjected to tensile and bend tests.  
Figure 3 test specimens shall be subjected to tensile test.

- 5.2 The micro test specimen shall be examined at suitable magnifications in the unetched and etched conditions. A list of suitable etching reagents is given in Table 1.
- 5.3 The presence of intergranular oxide films is considered to be detrimental to the weld due to their embrittling effect, but the extent of these films is very difficult to determine in etched specimens. If the area of intergranular oxide is only very slight and satisfactory results are obtained by mechanical testing, further sections of the weld shall be examined before a decision is reached.
- 5.4 Where fillet welds are concerned, unless complete fusion is required by the drawing, a certain degree of lack of fusion is permissible at the roots: -
- (a) For fillet welds of 45° or more, the maximum lack of fusion which can normally be accepted is that revealed by a line of oxide extending from the root of the weld for a distance not greater than one-third of that between the root and the toes of the weld. Provided the amount of weld material used has been adequate, this method of assessment should ensure that the effective throat thickness of the weld is not less than the thickness of the sheets or tubes used for the specimens.
  - (b) For fillet welds at acute angles such as 30°, complete penetration in the root of tubular sections is difficult to achieve and there is a danger of collapse of the tube walls if excessive penetration is attempted. The presence of a fairly large cavity, or corresponding lack of fusion, is permissible at the root of such welds but there should be a bridge of weld metal and reasonable throat depth, showing satisfactory fusion to the basic metal.

**5.5      Sheet to Sheet Butt Welds**

The section must be free from excess oxidation, burning cracks, cavitation, porosity, scale and slag. The specimen must show adequate penetration when the underside of the weld is examined. If excessive penetration occurs along the entire length of the weld the specimen must be rejected, but isolated excrescence on the underside are permissible, provided the weld itself is free from cavities, oxide films, and other defects.

**5.6      Tube to Sheet and Tube to Tube Welds**

The specimen must show adequate penetration and freedom from excess oxidation, cracks, cavitation, porosity, scale and slag.

**6          Mechanical Testing of Specimens****6.1      Tensile Test**

6.1.1      Tensile test specimens shall be tested to destruction in direct tension. The ultimate stress (calculated on the minimum area of cross section of the specimen, i.e., ignoring the increase in thickness due to welding) and the location of the break shall be recorded. Tube to tube weld specimens shall be broken in a tensile test machine fitted with suitable shackles and pins, the pins being passed through the top and bottom cross tubes of the specimens, so that the tensile load may be applied without bending the specimens.

6.1.2      A weld will be considered satisfactory when the failure occurs in the parent metal. A test piece failing at the toe of the weld or in the weld material can only be considered satisfactory if the ultimate stress is found to exceed the minimum tensile strength of the parent metal as given in the appropriate material specification, and if the fracture surfaces are free from defects such as cracking, blow holes, excessive porosity or inclusions. No evidence of lack of adhesion such as the peeling away of the filler metal shall be apparent.

**6.2      Bend Test**

6.2.1      Bend test specimen shall be tested in bending so that the weld lies along the centre line of the bend and the weld face (the side from which the welding was performed) is on the outside of the bend.

6.2.2      To ensure the close contact of the specimen to the bar about which it is bent, the side of the specimen away from the weld face should be dressed down by filing or grinding until the weld is level with the parent metal. The edges of the specimen in the vicinity of the weld should be given reasonable radii.

6.2.3      Austenitic steel specimens must be given the "weld decay" pickling test prescribed in the relevant specification or in accordance with British Standard 5903 prior to the bend test.



6.2.4 The angle and radius of bend shall be as specified in the following table:

Material	Angle of Bend (degrees)	Radius of Bend (T=nominal thickness)
(a) Austenitic steels	90	3T
(b) Magnesium alloys	180	10T
(c) Aluminium alloys	180	5T
(d) Steels containing boron	180	3T
(e) Titanium alloys	180	5T
(f) Others	180	2T

Note : (1) In the event the bend test details exceed distortion limits of the parent material, the bend limitations of the parent material shall be used.

(2) Special test requirements may be specified by the DGCA.

6.2.5 A bend test will be considered satisfactory if the test specimen withstands the bending without developing cracks visible to the unaided eye.

Note: If interpretation of the bend test results is in doubt, comparison may be made with the bend test performance of a separate sample of the parent material from which the test specimens were prepared.

TABLE 1 - ETCHING REAGENTS

Material	Reagent
Carbon steels	Saturated solution of picric acid in ethyl alcohol (industrial spirit grade)
	Concentrated nitric acid 2%) Ethyl alcohol (industrial spirit grade) 98%) (V/V)
Corrosion-resisting steels and nickel base alloys	Ferric Chloride 5g Concentrated hydrochloric acid 50ml Distilled water 100ml
	Concentrated nitric acid (used electrolytically)
	Oxalic acid ) used 10g Distilled water ) electrolytically 90ml
	Phosphoric acid ) used electrolytically 85%) Glycerine ) at 85° 15%) (V/V)
Aluminium alloys	Concentrated nitric acid 20%) Hydrofluoric acid (40%) 2%) (V/V) Distilled water 78%)
	Hydrofluoric acid (40%) 0.5%) Distilled water 99.5%) (V/V)
Magnesium	Concentrated nitric acid 1%) Distilled water 99%) (V/V)
Copper base alloys	Ferric Chloride 5g Concentrated hydrochloric acid 50ml Distilled water 100ml
Titanium alloys	Nitric acid 19%) Hydrofluoric acid 1%) (V/V) Distilled water 80%)

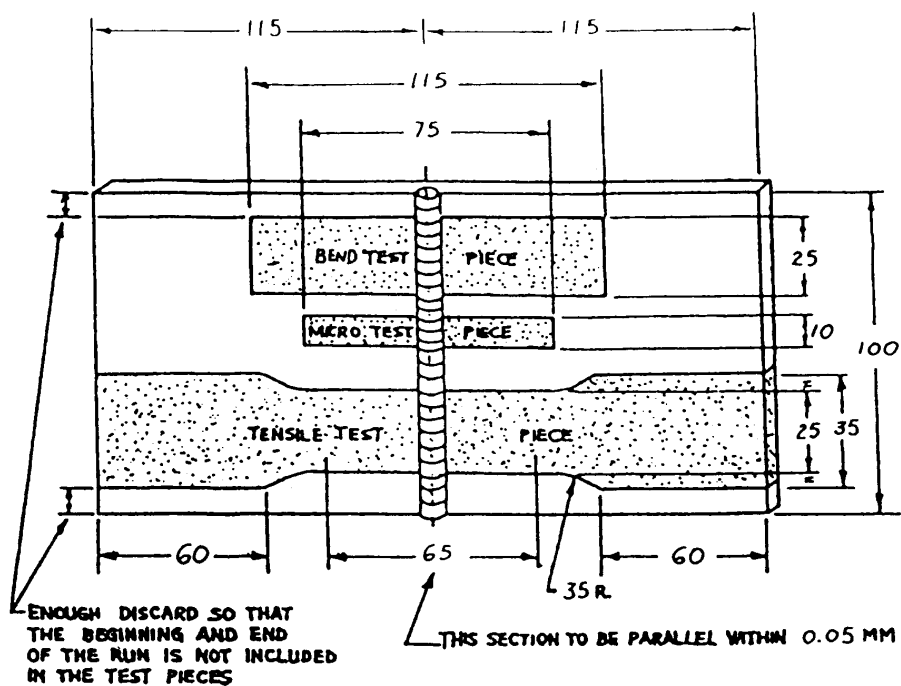


Figure 1 SHEET TO SHEET BUTT WELD

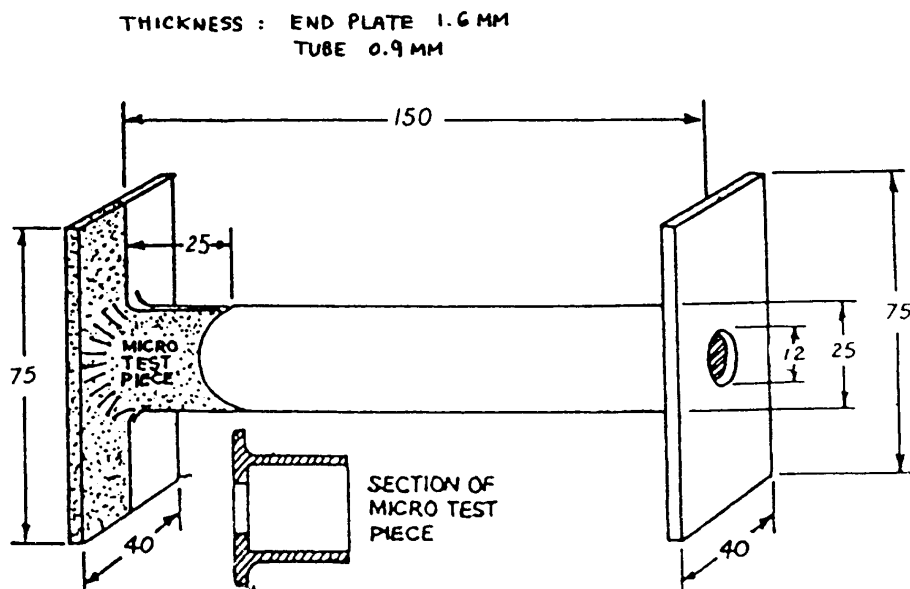


Figure 2 SHEET TO TUBE WELD

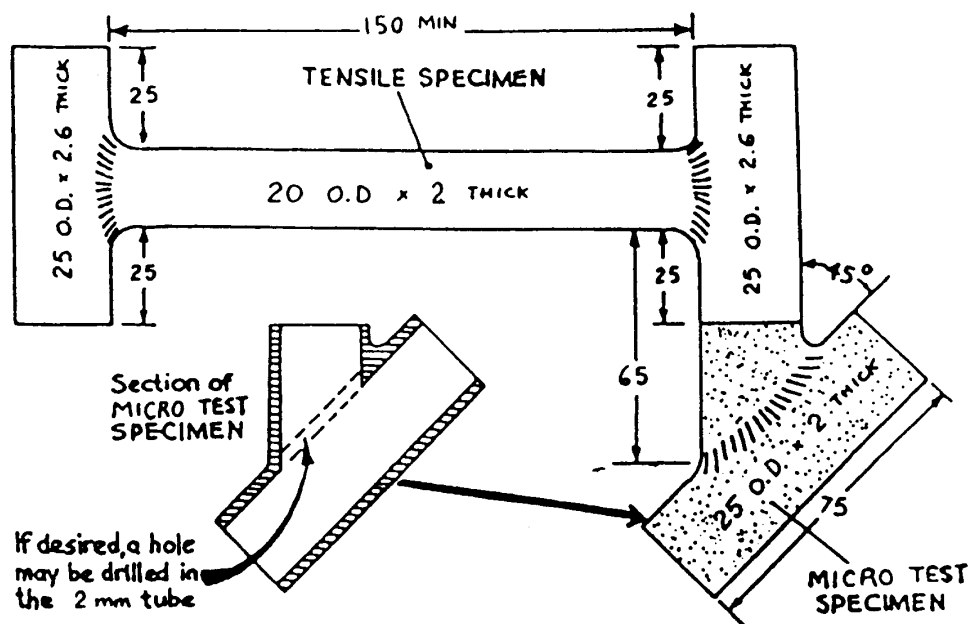


Figure 3 TUBE TO TUBE WELD