



AIRWORTHINESS

ADVISORY

CIRCULAR

CIVIL AVIATION AUTHORITY OF BOTSWANA

CAAB Document AAC-013

**SPECIALIZED MAINTENANCE
ACTIVITIES: WELDING AND
NON DESTRUCTIVE TESTING OF
AERONAUTICAL PRODUCTS**

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1. PURPOSE

This Airworthiness Advisory Circular (AAC) provides information and guidance on CAAB requirements for the qualification of personnel on Welding and Non Destructive Testing (NDT).

2. STATUS OF THIS ADVISORY CIRCULAR

This Airworthiness Advisory Circular (AAC-013) Revision 1 supersedes the original version issued on 31 March 2013.

3. EFFECTIVE DATE

This AAC becomes effective immediately.

4. APPLICABILITY

This AAC is applicable to personnel intending or who are engaged in specialized maintenance activities such as Non-Destructive Testing methods and Aircraft Welding.

5. RELATED REGULATIONS

Copies may be obtained from the Government Printer.

- Civil Aviation (Approved Maintenance Organisations) Regulations, 2012
- Civil Aviation (Personnel Licensing) (Other Personnel) Regulations, 2013
- Civil Aviation (Personnel Licensing) (General) Regulations, 2013
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- Civil Aviation (Approved Training Organizations) Regulations, 2012
- Civil Aviation (Airworthiness) Regulations, 2012
- Civil Aviation (Air Operator Certification and Administration) Regulations

6. RELATED PUBLICATIONS

- ICAO Annex 1

Copies may be obtained from Document Sales Unit, ICAO, 999 University Street, Montreal, Quebec, Canada H3C 5H7.

7. DEFINITIONS AND ACRONYMS

7.1 The following definitions are used in this circular:

PEL (Other Personnel) Regulations means the Civil Aviation (Personnel Licensing) (Other Personnel) Regulations, 2013.

Primary Structure means a structure which contributes significantly to carrying flight, ground, or pressurization loads, and whose failure could result in catastrophic failure of the aircraft.

Note: Examples of a Primary Structure are: Tubular fuselage structure, wing or tail plane structure, control surfaces and their attachments, spar caps and webs, door frames, pressurized bulkheads, window frames and engine mountings.

7.2 The following acronyms are used in this circular

AAC Airworthiness Advisory Circular

AMO Approved Maintenance Organisation

ARSL Aviation Repair Specialist License

Advisory Circulars (ACs) are intended to provide advice and guidance to illustrate an acceptable means, but not necessarily the only means, of complying with the regulations, or to explain certain regulatory requirements by providing informative, interpretative and explanatory material. Where a regulation contains the words "prescribed by the Authority," the AC may be considered to prescribe a viable method of compliance, but status of that "prescription" is always "guidance" (never regulation).

- CAAB** Civil Aviation Authority of Botswana
- ICAO** International Civil Aviation Organization
- NDT** Non Destructive Testing
- PEL** Personnel Licensing

8. BACKGROUND

- 8.1 Regulation 21.(9) of the Civil Aviation (Approved Maintenance Organisations) Regulations, 2012 requires an approved maintenance organisation (AMO) to provide specialized training, including initial and recurrent, for employees whose duties require a specific skill.
- 8.2 Further to the above, Regulation 24 of the Civil Aviation (Personnel Licensing) (Other Personnel) Regulations, 2013 requires a person who performs specialized aircraft maintenance activities to be in possession of an Aviation Repair Specialist License (ARSL) issued by the CAAB. Specialized maintenance activities include, among others, welding and NDT of aircraft or aircraft components.
- 8.3 A person seeking approval to perform such activities should apply to the CAAB for issuance of an ARSL and rating(s) required for that particular maintenance activity. The applicant will be expected to comply with age, language, educational or experience requirements specified in Regulation 25 of PEL (Other Personnel) Regulations, 2013. Pursuant to Regulation 26 of those Regulations, the Authority may issue the holder of an ARSL with ratings specifying specialized maintenance activities that the license holder is authorized to perform.
- 8.4 The AAC provides guidelines only; however, the specific qualification requirements shall be as determined by respective test equipment and welding equipment manufacturers unless where other overriding instructions are given in this regard. The procedures shall include minimum requirements for professional qualification and for certifying personnel involved in such maintenance activities. Minimum requirements shall require the organization's quality system procedures to include Qualification procedure for specialized activities such as Non-Destructive Testing, Welding, etc. This will cover but not limited to the following:
- (a) Initial training,
 - (b) Skills & experience,
 - (c) Examinations,
 - (d) Medical examinations as applicable,
 - (e) Recurrent training.

9. NON DESTRUCTIVE TESTING (NDT) COMMON METHODS

- 9.1 NDT common methods include:

- (a) Liquid Penetrant
- (b) Magnetic Particle
- (c) Eddy Current
- (d) Ultra Sonic
- (e) Radiography (X-Ray)

- 9.2 **The terms 'Non Destructive Testing' and 'Non Destructive Inspection'**

These are sometimes used interchangeably but it is important to note that there is a slight difference between the two. The 'Testing' methods include those listed above and the 'Inspection' methods include processes like borescope inspection and coin tapping for delaminating inspection.

9.3 Qualification of NDT Personnel

9.3.1 The requirements for the training and qualification of NDT personnel involved in the manufacture and maintenance of aircraft or aircraft components, shall be in accordance with international recognized standards such as the European Standard EN4179 and the Approved Organization's written practice/procedures for the authorization of NDT personnel.

9.3.2 All approved organisations involved in any aspect of NDT shall develop and maintain procedures for the qualification and authorization of their NDT personnel in accordance with best international standards. The CAAB recognizes and accepts NDT qualifications from the following bodies:

- (1) Recommended Practice SNT-TC-1A: Personnel Qualification and Certification in Non-Destructive Testing (2006). This document provides guidelines for employers to establish in-house certification programs for the qualification and testing of NDT personnel.
- (2) **MIL-STD-410E**, Military Standard, Non-destructive Testing Personnel Qualification and Certification (acceptable, although now rescinded).
- (3) **AIA-NAS-410**, Aerospace Industries Association, National Aerospace Standard, NAS Certification & Qualification of Non-destructive Test Personnel. This document has superseded MIL-STD-410E.
- (4) **ATA Specification 105**, Air Transport Association, Guidelines for Training and Qualifying Personnel in Non-destructive Testing Methods.
- (5) Canadian National Regulations contained in **CAN/CGSB-48.9712-95**, Qualification and Certification of Non-destructive Testing Personnel.
- (6) International Organization for Standardization (ISO) document: **ISO 9172**, Non-destructive Testing – Qualification and Certification of Non-destructive Testing Personnel.
- (7) **EN473** – General Principles for Qualification and Certification of NDT Personnel.
- (8) **EN4179** – Qualification and approval of personnel for non-destructive testing.
- (9) American Society for Non-destructive Testing, Inc. (ASNT), Recommended Practice SNT-TC-1A, Personnel Qualification and Certification in Non-destructive Testing.

9.3.3 The Organization's procedures and written practice as defined shall be approved by the Nominated Level 3 Inspector. The procedures/written practice should normally be published as a separate document and cross referenced in the appropriate exposition, manual or quality management system as applicable.

9.4 Levels of Qualification

According to basic international practices, the following levels of qualification are used in the training and capacity building of NDT personnel:

(a) Trainee

Trainee is an individual who is at the early stages of skills acquisition in the trade. The individual shall be taken through a training program developed by the organisation and approved by the Authority. In addition to theoretical classroom work, the individual shall obtain work experience under the

guidance of Level 2 or 3 personnel in the same method studied in the theoretical part. Any guidance from level 1 personnel should be very limited and should be supervised by level 2 or 3 personnel.

(b) **Level 1**

The inspector shall have the skills and knowledge to prepare, process and perform limited tasks in accordance with written and approved instructions under the supervision of level 2 or 3 personnel. This level shall not have certification authority and should be taken through phases of the approved training program.

(c) **Level 2**

The inspector shall have the skills and knowledge to set up test equipment, conduct tests, interpret and evaluate results for acceptance or rejection of parts undergoing test. The individual shall be capable of providing necessary guidance and supervision to Level 1 and Trainee personnel. This level may perform tasks without direct supervision of Level 3 personnel. Unless other considerations are made and approved by the Authority in writing, Level 2 personnel may be granted limited certification authority on dye penetrant testing only.

(d) **Level 3**

The inspector shall be qualified to perform applicable processes to a high degree of accuracy. Level 3 personnel shall have certifying authority limited to methods qualified on. The individual should be capable of:

- i. Guiding and supervising all levels below level 3,
- ii. Providing direct training,
- iii. Practical examination of Level 2 and trainee staff,
- iv. Assisting in assessment of personnel for qualification purposes be capable of assisting in an audit of subcontracted organizations in the NDT methods of qualification.

(e) **Instructor (optional)**

The inspector shall have the skills and knowledge to perform the following:

- i. Plan and organize training,
- ii. Present classroom training,
- iii. Conduct practical exercises,
- iv. Perform On Job Training,
- v. Conduct theoretical and practical examinations,
- vi. Participate in the qualifying process for certifying personnel
- vii. Develop work instructions,
- viii. Be capable of conducting an audit of subcontracted organizations in the NDT methods qualified on.

9.5 **Other NDT Methods**

Other methods of NDT that can be used are, but not limited to:

- i. Acoustic Emission,
- ii. Neutron Radiography,
- iii. Penetrant Leak Testing,
- iv. Thermography,
- v. Holography, and
- vi. Computer Tomography.

10. AIRCRAFT WELDING

10.1 Welding of Aircraft

The approved individual can only carry out maintenance (manual welding), in accordance with approved maintenance data, within the scope of the authorization.

10.2 Welding of Aircraft Components/Materials

The approved individual can only carry out maintenance (manual welding), in accordance with the approved maintenance data, on aircraft components or aircraft material within the scope of the authorization.

10.3 Certification

Certification shall be carried out on the maintenance (manual welding) carried out in accordance with the approved maintenance data, in the documents kept for recording such maintenance under the requirements of the Authority.

10.4 Types of Manual Welding

These shall include but not limited to the following:

- i. Gas Welding,
- ii. Braze Welding,
- iii. Manual Metal Arc Fusion Welding,
 - (a) Manual metal-arc (MMA) welding
 - (b) Metal inert gas (MIG) welding, and
 - (c) Tungsten inert gas (TIG) welding
- iv. Gas Tungsten Arc Welding,
- v. Gas Metal Arc Welding,
- vi. Plasma Arc Welding

10.5 Acceptable Welding Standards

10.5.1 The Authority recognizes the following welding standards:

- (a) International Organization for Standardization (ISO) Standards;
- (b) American Welding Society (AWS) Standards;
- (c) British Standards (BS); and,
- (d) European Union (CEN) Standards.

10.5.2 Examples of recognized welding standards

- (a) **BS EN ISO 14343 : 2009** – Welding consumables. Wire electrodes, wires and rods for arc welding of stainless and heat resisting steels.
- (b) **BS EN ISO 10042 : 2005** – Arc welded joints in aluminum and its alloys.
- (c) **BS 5500** – Specifications for welded pressure vessels.
- (d) **BS 5135** – Specifications for structural steel.
- (e) **DEF STA 00-932** – Specifications for tensile steel.

10.6 Parent Metal Groups

Parent Metal Groups for which qualification may be sought include but are not limited to the following:

- i. Aluminum Alloys,
- ii. Magnesium Alloys,
- iii. Carbon Steel and Low Alloy Steels,
- iv. Corrosion and Heat Resisting Steels,
- v. Nickel Alloys,
- vi. Copper based Alloys,
- vii. Titanium Alloys.

10.7 Qualifications

Personnel intending to be, or engaged in aircraft welding shall receive professional training in both theoretical and practical training in the particular type of manual welding and parent metal group qualification sought. The training is expected to cover but not limited to the following subjects:

- i. Safety in Welding,
- ii. Welding Equipment,
- iii. Theory and Application of Welding Processes,
- iv. Welded Joints,
- v. Welding Metallurgy,
- vi. Welding Practice and Production

10.8 Training for Experts in Specialized Maintenance

Individuals intending to, or undertaking training in any type of the welding processes shall be provided with professional training at a facility acceptable to the Authority. Training provided shall be in accordance with a CAAB approved training program. Records of such training/associated examinations undertaken and certificate awarded shall be copied/submitted to the Authority as appropriate.

10.9 Grant of Approval

10.9.1 The procedures for the issue and control of welding approval are dependent on the employment conditions of the welder. Where a welder is in the employment of an organisation approved by the Authority, and where such approval includes the control of welders, the company will have the responsibility for the grant of welder's authorization. Welders not employed by an organization approved by the Authority will be granted authorization by the Authority in accordance with the procedure below:

10.9.2 The welders not employed by the CAAB approved Organisation, shall, under the supervision of a responsible person acceptable to the CAAB, prepare and weld appropriate test sample(s) in accordance with these requirements and also complete the application form. The test samples will be forwarded to CAAB for examination together with full particulars of the welder concerned, materials used, details of any post-welding treatment (e.g. heat treatment for stress relief) and identification marks on the test(s).

10.9.3 If the applicant was found to be successful, an approval will be granted to the applicant to enable him/her to exercise the privileges of a welder.

11. MAINTENANCE OF WELDING APPROVAL

11.1 The validity of a welder's approval may be maintained by the procedures detailed in paragraphs 11.1.1 or 11.1.2 as appropriate.

- 11.1.1 Where the welder is employed by an organisation approved by the CAAB, the approved organisation shall arrange for periodic check examinations of the welder's competency. At each periodic check examination an appropriate standard test sample or such other test samples to be decided by the approved organisation shall be completed by the welder using relevant techniques and materials, or by using techniques and material used in standard work practices appropriate to the maintenance of approval. For welders holding approval for more than one (1) configuration (i.e. sheet to sheet, sheet to tube or tube to tube) it will normally only be necessary to provide a single test sample provided that the CAAB is satisfied it is representative of the welder's main day-to-day work.

However, a separate initial test sample will be required for each technique and material group specified in the welder's approval. Test samples shall be sent to the CAAB under arrangements made by the approved Organisation. If the test results of this examination are satisfactory the welder's approval document shall be endorsed by the approved organisation. Complete records of the periodical check examinations shall be kept at the Organisation. The check test records for each welder must indicate the date for the next check test in advance so that the test can be completed and the results known within the period of approval of the welder. All records shall be held available to the CAAB.

- (a) The maximum period between check examinations shall be 12 months. Organisations shall arrange for the relevant test within the period of validity of the previous test period to ensure continuity of approval.
- (b) If the test results are unsatisfactory the approved Organisation shall arrange for the check examinations to be repeated immediately and the samples be re-examined. During the period between any check test which proved unsatisfactory and the result of the next check test, the welder shall not weld parts which are essential to the airworthiness of an aircraft. If the test results 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 test has been satisfactorily completed.

- 11.1.2 Welders who are not employed in accordance with the conditions of paragraph 11.1.1 shall arrange for a check examination to be carried out at periods not exceeding 12 months. The same procedure as for the issue of the welder's approval in paragraph 10.8.2 shall apply except that, for welders holding approval for more than one configuration (i.e. sheet to sheet, sheet to tube, tube to tube) it will normally only be necessary to provide a single test sample, provided that the CAAB is satisfied it is representative of the welder's main day-to-day work. However, a separate initial test sample will be required for each technique and material group specified in the welder's approval.

- (a) If the test results are unsatisfactory the Applicant shall prepare new test samples and arrange for the check examination to be repeated immediately. During the period between any check test which proves unsatisfactory and the result of the next check test, the welder shall not weld parts which are essential to the airworthiness of an aircraft. If the result of the re-test is again unsatisfactory, the welder shall notify the CAAB. The approval will be suspended from the date of the first unsatisfactory examination and remain so until further training and/or experience has been gained and a further test has been satisfactorily completed.

- (b) A check test record must be kept to indicate the date for the next check test in advance so that the test can be completed and the results known within the period of approval of the welder. All records shall be made available to the CAAB.

12. VISUAL ACUITY TESTS

Personnel engaged in NDT and Welding shall have annual periodic visual acuity tests performed by appropriately qualified medical practitioners. This is to ensure their vision and color perception meets the required criteria for the precision and accuracy demanded by the trades. The respective organizations (employers) shall maintain such medical records in confidence and will be subject to inspection by the Authority inspectors.

13. OTHER SPECIALIZED MAINTENANCE ACTIVITIES

Approved Maintenance Organizations engaged in '**Metal Plating** and **Borescope Inspections**' shall also be required to develop training and qualification procedures for personnel performing such functions. All training shall be as guided by equipment manufacturers and where applicable shall be tailored to include specific requirements of aircraft manufacturers.

14. TRAINING

- 14.1 The Authority shall recognize and accept training standards and qualifications approved or recognized by the European Aviation Safety Agency (EASA) and the Federal Aviation Administration (FAA).
- 14.2 The Authority may recognize and accept any other approved training and qualification on a case by case basis.


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For/Civil Aviation Authority of Botswana


Date: 10/06/2014

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