CHAPTER 6

MAINTENANCE AND INSPECTION PROCEDURES

6.0 MAINTENANCE AND INSPECTION PROCEDURES

This chapter describes Philippine Aerospace Development Corporation (PADC) maintenance and inspections procedures, to ensure good maintenance practices and compliance with the rules and regulations as stated in PCAR Part 6 Series

6.1 NOTIFICATION TO THE CIVIL AVIATION AUTHORITY OF THE PHILIPPINES REGARDING CHANGES TO THE ORGANOZATION

Officer-In-Charge, Quality Assurance Department will notify CAAP within 30 days of any of the following changes:

A. Name of the Organization
B. Location of the Organization
C. Additional locations of the Organization
D. Accountable manager
E. Any of the Management personnel specified in MPM Sec. 5.1

Officer-In-Charge – Quality Assurance Department will also be responsible for notification of any change in the Organizations activities to the CAAP. These changes such as amendments in the capabilities and approvals shall be reflected in the manual.

Each Department Head shall be informed by the Officer-In-Charge, Quality Assurance Department of any revision requirement that arises.

Upon acceptance by the CAAP, sufficient copies will be provided and distributed to each manual holder.

MAINTENANCE AND INSPECTION PROCEDURES

6.2 CIVIL AVIATION AUTHORITY INSPECTIONS

Philippine Aerospace Development Corporation permits the Authority or its representative to inspect the Organization and any of its contract maintenance facilities at any time to determine compliance to PCAR Part 6 Series of June 23, 2008

MAINTENANCE AND INSPECTION PROCEDURES

6.3 MAINTENANCE PROCEDURE MANUAL AMENDMENT PROCEDURES

Each page is provided with a Section, Page No. and Revision No. located at the upper right corner of the page. When referring to any policy or procedures, use these numbers and information as reference number

1. The Officer-In-Charge, Quality Assurance Department of Philippine Aerospace Development Corporation is responsible for the revision, control and distribution of this manual.
2. All revision is submitted to CAAP for approval prior to incorporation into the Maintenance procedures Manual (MPM) and for distribution to the holders. Approval of changes by CAAP is through acceptance signature and/or stamp on the list of effective pages.
3. Each revision contains the revision number, the reason for the revision and the instructions for filing the revised pages. This will trace the history of revision of the manual and rationale behind the revision.
4. The manual is provided with a Record of Revision. This record determines the current revision status of the manual, identifies the person who inserted the revision and the date the revision is inserted. The manual holder shall be responsible for inserting revised pages and updating of these manuals.
5. After receipt of a revision, the manual holder shall acknowledge the receipt by signing, and then detaching and returning the acknowledgement slip to the office of the Quality Assurance within five (5) working days from the receipt. A follow-up shall be made by the office of the Quality Assurance to manual holders whose acknowledgement slip is not returned after the said period.
6. To check the currency of the manual, a List of effective pages is provided. The list has the revision dates of very page of the manual and is revised for every revision made in the manual.
7. Before using any provisions in the manual, check if it is current. It will be the responsibility of the manual holder to read, fully understand and be familiar with the contents of this manual.
8. Correction of errors and recommendations should be directed to Officer-In-Charge, Quality Assurance Department.

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6.4 MAINTENANCE PERSONNEL

Maintenance personnel are required to be thoroughly familiar with all inspection and methods, techniques and equipment used in their area of responsibility to determine the quality of airworthiness of an article undergoing maintenance repair or alterations. All personnel must also maintain proficiency in the used of the various types of inspection and maintenance aids to be used for inspection of the particular items undergoing inspection. Available to all maintenance personnel are current specifications involving. Inspection tolerances, limits and procedures as set forth by the manufacturer of the product undergoing inspection and other forms of inspection information such as CAAP/FAA Airworthiness Directives, current manufacturer's manual, bulletin, service letters etc. To allow the personnel concerned to perform their duties and responsibilities with a high degree of safety. A file of maintenance manuals, engineering letters, service letters, CAAP/FAA regulations, etc., is available to inspectors assigned to the different shops

Maintenance personnel assigned to Approved Maintenance Organization operations are required to familiarize themselves with CAAP regulations applicable to such operations with particular emphasis on the following:

Philippine Civil Aviation Regulation – Part – 6, Series June 23, 2008	Civil Aviation Regulations Issuance of Approved Maintenance Organization Certificate

MAINTENANCE AND INSPECTION PROCEDURES

6.5 PROCEDURE FOR UPDATING PERSONNEL RECORDS

All personnel records shall be kept current by the Production, Planning and Control. Individual records of each Maintenance and Engineering Department and Quality Assurance Department are kept in the Administrative and Records Section. Individual Records should contain all the training records, certificates, and licenses. Each file should have the list of their qualification and authorizations, type of trainings, location, and duration of training, recurrence training, and certificate issued examination control.

Records of staff will be archived for two (2) years once the staff is no longer serve the company. Certifying staff will be furnished on request with a copy of their record on leaving the organization.

MAINTENANCE AND INSPECTION PROCEDURES

6.6 INSPECTORS, MECHANICS AND SUPERVISORS

All supervisors, inspectors, and mechanics are required to be thoroughly familiar with the requirements of this manual, CAAP regulations, airworthiness directives and advisory circulars, manufacturer's service letters and bulletins and engineering orders. The basic inspection system required mechanics to sign their last name for work performed by them prior to submitting the item to inspectors for final acceptance. Inspectors will indicate their acceptance of work performed with the application of the inspectors' acceptance stamp next to the items on the appropriate box. See section VI of this manual for sample forms and instructions for their use.

MAINTENANCE AND INSPECTION PROCEDURES

6.7 PROCEDURE TO ESTABLISH CURRENT ROSTERS OF CERTIFYING STAFF

PADC shall maintain a roster of all certifying staff, which includes details of the scope of their authorization.

The following minimum information shall be kept on record in respect of each certifying person:

1) Name
2) Date of Birth
3) Basic training
4) Type of training
5) Continuation training
6) Experience
7) Qualification relevant to the approval
8) Scope of authorization
9) Date of 1st issue of the authorization
10) Expiration (if appropriate)
11) Identification No. of the authorization

MAINTENANCE AND INSPECTION PROCEDURES

6.8 LIMITATIONS ON THE AMO

PADC shall maintain an aircraft or aeronautical product for which it is approved only when necessary housing facilities, equipment, tools, material, approved technical data and certifying staff are available. (*Ref. PCAR 6.5.1.5 series of June 23, 2008)*

MAINTENANCE AND INSPECTION PROCEDURES

6.9 AMO SELF EVALUATTION

PADC shall conduct self-evaluation of the organization once a year and results shall be reported the Accountable Manager for review and action.

Acting Head – Maintenance & Engineering Department is responsible to perform the self-evaluations and ensures that the capability list is kept current. The record(s) of self-evaluation shall include the person (by title), date, and the results and/or corrections made as appropriate.

The self-evaluation along with the capability list shall be reviewed and signed by the PCEO/ Accountable Manager. Procedures identifying that the maintenance organization shall not perform such maintenance on any article until such time the PCEO/Accountable Manager has accepted and signed the self-evaluation sheet(s) and capability list (*ref. PCAR Part 6 Series of June 23, 2008)*

MAINTENANCE AND INSPECTION PROCEDURES

6.10 INSPECTION PROCEDURES

6.10.1 GENERAL

The Officer-In-Charge Quality Assurance is responsible for the complete and efficient performance of inspectors assigned to the Approved Maintenance Organization to assure inspection acceptance in accordance with manual specifications or other approved technical data.

Shop supervisors are responsible for the accomplishment of all work in accordance with manual specifications or other approved technical data. The work done under the Approved Maintenance Organization's Limited Rating - Specialized Services will be accomplished in accordance with the Philippine Aerospace Development Corporation CAAP approved process specification.

Alterations and repair will be subjected to progressive inspection by the Inspection

Department discrepancies generated during the process of accomplishing the work involved will be recorded on the Snag Sheet QA Form 002. Discrepancies will be corrected before the unit is submitted for final inspection. Upon completion of this progressive inspection, the area affected is given a shakedown inspection and after all rework is accomplished and accepted, the Inspection Department will clear the unit for final acceptance.

After completion of specific operation, the mechanic will sign off the records using his signature indicating that the item is complete and ready for inspection. The necessary corrective action will be noted opposite the discrepancy generated during accomplishing the work on the Snag Sheet QA Form 002. The inspector will then inspect the item to assure conformance to specifications and established workmanship standards. Functional checks of any system affected by the work involved will be performed before final acceptance. The inspector's stamps will indicate acceptance.

See sample form in Section VI of this manual.

MAINTENANCE AND INSPECTION PROCEDURES

INSPECTION PROCEDURES

6.10.2 CONTINUITY OF INSPECTION RESPONSIBILITY

Through a "Line of Succession" list maintained by the Chief Inspector, his duties are assured of performance through the next in line as "Officer-In-Charge Quality Assurance".

A status book will be provided in the hangar and each shop in which a status report will be left by each of the inspectors leaving the job, before completion of a project, for information to the succeeding inspector. Its purpose is to assure a continuing inspection responsibility for in-progress work inspections.

All forms upon which work performed is listed have been designed to show the name of the mechanic, or repairman who performs the work (or supervises it) and the name of the inspector inspecting that work.

A project involving work other than inspection only, may not be approved for return to service unless it has been cleared by the Officer-In-Charge, Quality Assurance as satisfying the requirements of PCAR - Part - 6, Series of June 23, 2008.

Samples of work forms and inspection forms are contained in Section Xi - B of this manual.

MAINTENANCE AND INSPECTION PROCEDURES

INSPECTION PROCEDURES

6.10.3 PRELIMINARY INSPECTION

The Quality Officer-In-Charge of the Approved Maintenance Organization is responsible for the performance of appropriate inspection including functional and non-destructive tests to assure that all units delivered to the Approved Maintenance Organization for maintenance, alteration or repair under the privileges of the Approved Maintenance Organization certificate are subjected to a preliminary inspection to determine the state of preservation and any defects on the items involved. This inspection will be recorded on the QA Form No. 005 (Preliminary Inspection) with any discrepancies noted and the form must be attached to the Work Order identified with the unit involved. It will remain with the applicable inspection records until the unit is released for service. Appropriate supplemental forms will be used to record the results of functional and non-destructive tests. Those forms will show the work order number and will be routed attached to the Work Order.

See copy of Preliminary Inspection Form on Section VI of this manual.

MAINTENANCE AND INSPECTION PROCEDURES

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6.10.4 INSPECTION FOR HIDDEN DAMAGE

The preliminary inspection is not limited to the area of obvious damage or deterioration but includes a thorough and searching inspection for hidden damage in areas adjacent to the damaged area and/or in the case of deterioration, a thorough review of all similar materials or equipment in a given system or structural area. The scope of this inspection will be governed by the type of unit involved with special consideration accorded previous operating history, Malfunction or Defect Reports, Service Bulletins and AD notes applicable to the unit involved. The inspector is responsible for listing all discrepancies noted during inspection on the Snag Sheet – QA Form 002 for rectification or corrective actions

6.10.5 PROGRESSIVE INSPECTION

Authorized inspectors will be assigned to make inspections at various stages of teardown, overhaul and repair of all units or components received by the Approved Maintenance Organization for service. Progressive inspections are accomplished with a frequency determined by applicable manual recommendation and/or Approved Maintenance Organization originated work forms.

MAINTENANCE AND INSPECTION PROCEDURES

INSPECTION PROCEDURES

6.10.6 PERFORMANCE RULES - INSPECTION

1. Each person performing an inspection required by the Authority shall—

a) Perform the inspection so as to determine whether the aircraft, or portion(s) thereof under inspection, meets all applicable airworthiness requirements; and

b) If there is an inspection program required or accepted for the specific aircraft being inspected perform the inspection in accordance with the instructions and procedures set forth in the inspection program.

2. Annual and 100-hour inspections.

a) Each person performing an annual or 100-hour inspection shall use a checklist while performing the inspection. The checklist may be of the person's own design, one provided by the manufacturer of the equipment being inspected, or one obtained from another source. This checklist shall include the scope and detail of the items prescribed by the Authority.

Implementing Standard: See IS: 5.6.1.7 for components to be included in an annual or 100-hour inspection.

b) Each person approving a reciprocating-engine-powered aircraft for return to service after an annual or 100-hour inspection shall, before that approval, run the aircraft engine or engines to determine satisfactory performance in accordance with the current manufacturer's recommendations of—

(i) Power output (static and idle rpm);

(ii) Magnetos;

(iii) Fuel and oil pressure; and

(iv) Cylinder and oil temperature.

3. Each person approving a turbine-engine-powered aircraft for return to service after an annual or 100-hour inspection shall, before that approval, run the aircraft engine or engines to determine satisfactory performance in accordance with the current manufacturer's recommendations

INSPECTION PROCEDURE

6.10.7 CONTROL OF INSPECTION STAMPS

1. This procedure prescribes the control and safeguarding of inspection stamps issued to authorized inspectors directly involved in the maintenance operations.

2. The Quality Officer-In-Charge is responsible for the control of inspection stamps and shall:

   2.1 Maintain adequate records of all inspection stamps used in his department. This record will reflect the inspector's name, signature, initial, stamp number, impression of stamp, date of issue, and/or cancellation

   2.2 Check monthly, all inspection stamps used in his area of responsibility and ensure that:

      2.2.1 Worn-out or eligible stamps are withdrawn from service and replaced by new stamps.

      2.2.2 Lost stamp is immediately reported to the Inspection Department.

      2.2.3 Stamps no longer required are removed from service and returned to Inspection Department.

      2.2.4 Adequate security measures are being taken by inspectors in the safeguarding of their stamps.

      2.2.5 Stamps are not loaned, left on desks or in unlocked drawers.

      2.2.6 Stamps are properly used for its intended purposes.

      2.2.7 All stamps withdrawn from use or cancelled are not to be re-issued within a specified period.

3 The Inspector is directly responsible for the stamps issued to him and shall:

   3.1 Immediately notify his superior when a stamp is lost or has become illegible.

   3.2 Take all necessary precautions for safeguarding his stamp.

   3.3 Use the stamp only for official purposes.

MAINTENANCE AND INSPECTION PROCEDURES

6.11 MAINTENANCE PROCEDURES

6.11.1 PERFORMANCE RULES – MAINTENANCE PROCEDURES

a. PADC who performs any maintenance, preventive maintenance, modifications for an air operator certificated under CAR Part 9 having an approved maintenance program under CAR Part 9, Subpart 9.4.1.11 and approved continuous maintenance program under Subpart CAR Part 5, 5.6.1.8 (e) shall perform that work in accordance with the air operator's manuals.

b. Except as provided in paragraph (a), PADC shall perform its maintenance and modification operations in accordance with the applicable standards in Part 5. It shall maintain, in current condition, all manufacturer's service manuals, instructions, and service bulletins that relate to the articles that it maintains or modifies.

c. In addition, PADC having an avionics rating shall comply with those sections in Part 5 that apply to electronic systems, and shall use materials that conform to approved specifications for equipment appropriate to its rating. It shall use test apparatus, shop equipment, performance standards, test methods, modifications, and calibrations that conform to the manufacturer's specifications or instructions, approved specification, and if not otherwise specified, to accept good practices of the aircraft avionics industry.

MAINTENANCE PROCEDURE

6.11.2 LIST OF CUSTOMER/OPERATOR PADC PROVIDE MAINTENANCE SERVICES

Updated Master List of Customer/Operators (Flying Schools, Private /Civilian and Government) and its locations will be provided as other documents to be presented by PADC during the CAAP Facility Audit Inspection. Refer on the PADC MPM Appendices.

1. Luzon Areas
2. Visayas Areas (Iloilo City, Cebu & Lapu-Lapu City)
3. Mindanao Areas: (Cagayan de Oro & Davao)

MAINTENANCE PROCEDURE

6.11.3 SCHEDULES MAINTENANCE/PROGRESSIVE INSPECTION

Scheduled inspections e.g. 50, 100, etc. and progressive inspections will be accomplished in accordance with the inspection cards or inspection schedule provided for each specific model aircraft/engine component. The inspection paperwork will be supplemented as necessary to cover items to be replaced for time special inspection items, discrepancies and airworthiness directives. All scheduled and annual inspection paperwork will comply with PCAR - Part - 6, Series of June 23, 2008, Chapter V - Performance Rules.

No aircraft/engine will be returned to service following an inspection as outline above until all discrepancies affecting airworthiness have been corrected.

Maintenance supervisors are responsible for screening completed work orders covering work performed in their assigned area to assure that there are no open discrepancies and all major works are accomplished. Inspection will recheck to assure compliance to the Work Order. No aircraft/engine will be returned to service until discrepancies affecting airworthiness have been corrected.

After Work Order has been screened for completeness and accuracy, they are submitted to the Administrative & Records Section and will be retained in active file for a period of not less than two (2) years and then transferred to dead storage for five (5) additional years.

MAINTENANCE PROCEDURE

6.11.4 CONTINUITY OF MAINTENANCE RESPONSIBILITY

A status book will be provided in the hangar and each shop in which a status report will be entered by each of the lead mechanics informing the next shift of the status of each job not completed in case of work shifting. Its purpose is to assure a continuing maintenance responsibility for work in progress

MAINTENANCE PROCEDURES

6.11.5 MAJOR REPAIR AND ALTERATION , AIRCRAFT AND COMPONENT

Following the preliminary inspection, additional records may be prepared by the Inspection Department to provide a comprehensive historical record of the work performed. These records will contain Work Orders, Service Bulletins, AD notes, Service Letters, type of inspection, detailed figures related to functional tests and special non-destructive tests to be accomplished. The approved engineering or other approved technical data authorizing the repair or alteration will be clearly indicated. Where special drawings are made to cover specific repair conditions, a copy of the drawing will be included in the aircraft records.

Units removed from the aircraft will be tagged with the appropriate inspection identification tag, listing the aircraft serial number, unit serial number and reason for removal. No item removed and tagged as above described will be reinstalled unless the unit is cleared as "serviceable" by inspection.

During the process of handling major repair /alteration, technical personnel concerned are informed and instructed to perform their duties and responsibilities with utmost and high degree of safety as per PCAR- Part 6.5.1.1 (c) (1) of June 23, 2008.

The AMO shall be in receipt of all airworthiness data appropriate to support the work performed from the Civil Aviation Authority of the Philippines (CAAP), the aircraft aeronautical product design organization, and any other approved design organization in the State of Manufacture or State of Design as per PCAR- Part 6.5.1.8 and PCAR IS 6.5.1.8 of June 23, 2008.

Major repair and modification/alteration are done in accordance with the capabilities granted and in accordance with approved and current standards and technical data, acceptable to the Authority, which have been developed and documented by the State of Design/Manufacturer.

MAINTENANCE PROCEDURE

6.11.6 OPTIONAL MODIFICATION PROCEDURES

1 All modifications must be approved by the customer airlines prior incorporation.

2 All modifications to aircraft, aircraft engines and parts must be performed in accordance with approved documents.

3 The customers/aircraft operator is responsible for evaluation of Regulatory Directives, manufacturer's Service bulletins and other technical publications.

4 The customers/aircraft operator schedules the incorporation of all modifications at convenient maintenance checks. Such scheduling must ensure regulatory time limits imposed for such modifications, where applicable, are not exceeded.

5 Modifications, once accomplished and certified by appropriately licensed personnel or authorization holders, are incorporated into the records of the aircraft, aircraft engine or component by the customer /aircraft operator.

6 All modifications must be within the scope of PADC capabilities. Modifications scope included and limited to minor modification, service bulletin, aircraft maintenance manual, structural repair manual and component maintenance manual.

7 Major modification shall require CAAP approval.

MAINTENANCE PROCEDURE

6.11.7 REPAIR ALTERATION AND OVERHAUL, ACCESSORIES AND APPLIANCES

Self-contained accessory and appliance units such as actuators, pumps, valves, generator, etc., which, after preliminary inspection, have been established as eligible for overhaul or repair, will be identified with a green reparable part tag with appropriate repair instructions entered on the face of the tag, as authorized by the Work Order. No such unit shall be approved for return to service without a maintenance release tag authorizing its return to service.

MAINTENANCE PROCEDURE

6.11.8 PROCEDURE FOR HANDLING AOC HOLDERS

PADC shall carry out the following tasks as permitted by and in accordance with the maintenance procedures manual:

(1) In support of a specific activities where AOC holder has requested the services of AMO at a location other than the location identified on the AMO Certificate and the AMO has been rated to maintain the aircraft of that specific AOC holder at the requested location in the AMO operating provisions approved by the Authority; and

(2) Issue an approval for return to service or a maintenance release in respect of subparagraphs AOC has requested aircraft of that specific AOC holder at the requested location in the AMO operating provisions approved by the Authority; and for which it is rated at any location subject to the need for such maintenance arising from unserviceability of the aircraft upon completion of maintenance in accordance with applicable limitations.

All AOC procedures and paperwork will be accomplished in accordance with the relevant operator procedures manual.

The procedure for handling customers would vary according to the needs and contractual agreement, thus diligence must be taken to ensure cross-fertilization of other operator procedures does not occur. Maintenance records will be accomplished as per procedures given by customer. The operator may contract Philippine Aerospace Development Corp. (PADC) to retain some maintenance records required by the Civil Aviation Authority of the Philippines (CAAP)

MAINTENANCE PROCEDURE

6.11.9 RECORDS FOR THE AIR OPERATOR CERTIFICATE

All maintenance records shall be maintained according to contractual and airworthiness requirements.

Work records may be paper format and/or electronically scanned and filed. Copies of records shall be kept in a secure place and can be retrieved for printing if necessary. All record keeping for third party work will be per contractual and airworthiness requirements. A copy of the maintenance records and their associated approved data must be kept for two years from the date the aircraft which the work relates was release from the organization.

The original records are returned to the Customer after completion of the check.

Respective shop shall also file and keep maintenance records of work done at PADC.

MAINTENANCE PROCEDURE

6.11.10 TECHNICAL RECORDS

Records of work done on the aircraft include:

1) Routine maintenance records
2) Non- routine maintenance within the scope of capability
3) Component Changes (Part Number and Serial Number)
4) Maintenance record related to release to service.

These records are filed and kept in the Administrative & Records Section. Administrative & Records officer is responsible for the correct maintenance records which will provide a history of aircraft.

MAINTENANCE PROCEDURE

6.11.11 REPORTING OF DEFECT TO THE OPERATOR

1 Any condition that could seriously hazard the aircraft must be reported to the relevant Authority and the aircraft operator as applicable

2 Reports must be made on prescribed forms and must contain all pertinent information about condition known to the approved maintenance organization.

3 Report must be made as soon as practicable but in any case within three days after discovery of the malfunction /defect.

4 The Quality Assurance Department is responsible for preparing and submitting the DEFECT REPORT to the relevant authorities/organizations.

5 Subsequent investigation and recommendation to prevent recurrence of the defect is performed by Quality Assurance Department.

6 Any defect, failure or malfunction whose condition conforms to that stipulated in the PCAR Part 6.5.1.9 is reported to operator within three (3) working days of the AMO identifying the condition to which the report relates.

6.1 On report of the defect, Quality Assurance Department will provide a copy of the SNAG SHEET (QA Form -002) Certifying Staff of QA Inspector will complete details of the aircraft components/systems involved, station and date of occurrence and nature of defect.

6.2 Copy of the report is then sent to CAAP Operator in compliance to CAAP CAR PART 6.5.1.9

6.3 Should there be further information or data not available at the time of reporting to operator, a supplementary report will be raised. The supplementary report will be submitted to Operator through the Quality Assurance Department.

6.4 For all reportable defects found in Line Maintenance the defect is reported thru the Snag Sheet for (QA-Form-002) and transmitted to Quality Assurance Department within **72 Hours of the discovery** of the defect. The Quality Assurance Officer-In-Charge shall report the defect to the relevant customer or to the regulatory authority having jurisdiction as applicable.

MAINTENANCE PROCEDURE

6.11.11 REPORTING OF DEFECT TO THE OPERATOR

6.5 PADC Certifying staff or QA Inspector supporting customer must accomplish SNAG SHEET immediately after handling reportable incidents or occurrence, as stated in PCAR Par 5.5.1.4.

6.6 A sample and description of the SNAG SHEET form can be found in Section VI of MPM.

MAINTENANCE PROCEDURE

6.11.12 GENERAL TEST REQUIREMENTS

1. New components manufactured under a type or production certificate, or in accordance with the Technical Standard Order (or similar CAAP/FAA approved technical data), or components, which have been rebuilt by the manufacturer to production specifications, require a visual receiving inspection.

2. Any repaired or overhauled components received from a CAAP certificated Approved Maintenance Organization do not normally require more than a visual receiving inspection before being returned to service. Repaired or overhauled components that are received from other that a CAAP inspection will be functionally checked before being returned to service.

3. All components requiring a functional check are routed to the proper repair station shop for the accomplishment of this check.

NOTE: Functional checks are performed in accordance with instructions contained in the appropriate manufacturer's publications. However, if such specific instructions are not available, functional check requirements will be determined by the Officer-In-Charge Quality Assurance, and issued on a form to provide a means of recording compliance therewith. If suitable test facilities are not available in Approved Maintenance Organization, components may be functionally checked in the aircraft. In any case, all conditional checks must be monitored and recorded by the Quality Officer-In-Charge or designee.

4. The Supervisor - Quality Control may request a functional check of any component overhauled or repaired by any agency, when of the opinion that such a check is required in order to return the component to service.

5. All adhesives, sealers, primers, finishing and other materials having limited shelf-life are identified by material control labels showing the expiration date of the shelf-life as established by applicable specifications. Inspectors and mechanic will dispose of any materials found in the shop or storerooms without such identification or with expired shelf-life.

6. The detailed functions or material inspection are covered by the manufacturer's quality assurance directive and inspection bulletins which will be used to implement the operation of the Approved Maintenance Organization with respect to the control and identification of materials, parts and equipment received for direct use in the Approved Maintenance Organization. All parts new or overhauled purchased from vendors will be checked for proper approval documentation prior to release for installation by the Approved Maintenance Organization.

MAINTENANNCE PROCEDURE

6.11.13 FINAL INSPECTION AND RETURN TO SERVICE

Certificate of Return to Service is a document signed by an authorized representative of an AMO in respect of an inspection, repair, and modification on a complete aircraft, engine or propeller after it has received a Maintenance Release for the maintenance performed by an AMO.

A Certificate of Return to Service shall be issued by appropriately authorized certifying staff when satisfied that all required maintenance of the aircraft or aeronautical product has been properly carried out by the AMO in accordance with the Maintenance Procedure Manual.

Certifying staff authorized to sign maintenance releases/CRS shall meet the following criteria:

1. holder of a valid Phil. Civil AMT license
2. had relevant training on the MPM
3. had training as describe in the MPM
4. had relevant/specialized training on the aircraft type
5. knowledgeable

A Certificate of Return to Service shall contain the following:

1) Basic details of the maintenance carried out;
2) The date such maintenance was completed
3) The identity, including authorization reference of the AMO and certifying staff issuing the certificate
4) The authorized signature and stamp, the AMO certificate number, including their certifying stamps.

Maintenance Release is a certification confirming that maintenance work to which it relates has been complied with in accordance with the applicable standards of airworthiness, using approved data.

Prior to approval for return to service, irrespective of the method to be used to indicate such approval, the Quality Assurance Officer-In-Charge will audit the records package as identified by the Work Order, to determine that all work has been performed as required for compliance with this maintenance procedures and PCAR - Part - 6, Series of June 23, 2008. He will indicate affirmative findings approving form per Section VI of this manual.

MAINTENANCE PROCEDURE

6.11.13 FINAL INSPECTION AND RETURN TO SERVICE

When approval has been given to the above audit, either the Chief inspector or the individual authorized in the official roster, will approve the Certificate of Return to Service.

This approval will be accomplished as appropriate to the work done, the article involved, the records available with the article, and the instruction of the customer. Care will be exercised to comply with PCAR - Part - 6, Series of June 23, 2008 in every case.

Whenever the aircraft records (log) are available, record of work accomplished is expected to be made therein. This does not waive any PCAR - Part - 6, Series of June 23, 2008 records requirements. Neither will PCAR - Part - 6, Series of June 23, 2008 be considered waived by PCAR - Part - 6, Series of June 23, 2008 records requirements.

Articles such as appliances, accessories, and individual parts or components will not have an individual record to which an entry may be added. However, the installation of these items on an aircraft constitutes an aircraft maintenance or alteration, and record must be made accordingly.

Routinely, major repair approvals will be handled in accordance with PCAR - Part - 6, Series of June 23, 2008. A maintenance release is completed as a part of the Work Order form at the time of approval of the Certificate of Return to Service. A separate maintenance release certificate will be completed and shipped on an article that is shipped to a customer. At the request of the customer (to be indicated on the Work Order when originated

The authorized supervisor in whose area the repair or alteration is accomplished will be responsible for establishing that the repair or alteration was made in accordance with the requirements of PCAR - Part - 6, Series of June 23, 2008 and will sign the conformity statement on Maintenance Release. . Personnel responsible for the approval for return to service of aircraft will indicate such approval by signing the approval for return to service .Appropriate entries will be made in the aircraft/engine record pertinent to the repairs and alterations accomplished by the Approved Maintenance Organization.

MAINTENANCE PROCEDURE

6.11.13 FINAL INSPECTION AND RETURN TO SERVICE

Specific reference will be made by calendar date to the applicable CAA MR/M Form. The original CAA MR/ M Form will be inserted in the aircraft record with the copy forwarded to the Assistant Secretary, Civil Aviation Authority of the Philippines and one copy retained with the copy of the item Work Order.

It is the responsibility of the person authorizing aircraft return to service to assure that the aircraft logbooks is properly revised following any alteration or modification on the aircraft and that the weight and balance record has been amended as approved by the CAAP.

Aircraft components, appliances, and other items, other than completed aircraft repaired and overhauled as authorized by the Approved Maintenance Organization specifications, will be returned to service through the use of a maintenance release pre-printed on the serviceable parts tag described in this section of this manual. The authorized supervisor under whose jurisdiction the work is accomplished will be responsible for the release of units in the category.

No aircraft or unit may be released for return to service until Work Order and other records have been reviewed for completeness and final acceptance cleared by inspection. Particular attention shall be accorded the status of applicable airworthiness directives.

MAINTENANCE PROCEDURE

6.11.14 MAINTENANCE RELEASE STATEMENT

A maintenance release statement stamp and/or reprinted tag, prepared in accordance with PCAR - Part - 6, Series of June 23, 2008, will be used to release to service major repairs which have been accomplished by this station in accordance with PCAR - Part - 6, Series of June 23, 2008. Other records required by PCAR - Part - 6, Series of June 23, 2008 will be executed, as required, regardless of whether a CAAP Form No. 1051 or maintenance release has been used to return the article to service. In any event, the Approved Maintenance Organization will indicate on their copy of the Work Order whether or not a maintenance release was used, including the signature of the authorized representative

MAINTENANCE PROCEDURE

6.11.15 RESPONSIBILITY FOR SUBMITTING REPORTS

The Maintenance & Engineering Officer-In-Charge and Quality Assurance Officer-In-Charge are responsible for preparing and submitting a Malfunction or Defect Report to the following:

DIRECTOR GENERAL
Civil Aviation Authority of the Philippines
Ninoy Aquino, International Airport,
Pasay City , Metro Manila

BRITTEN NORMAN GROUP LIMITED
Bembridge
Isle of Wight, England

CESSNA AIRCRAFT COMPANY
Wichita, Kansas, USA

HARTZELL PROPELLER INC.
Piqua, Ohio, USA

McCAULEY PROPELLER SYSTEM
3535 McCauley Drive
Vandalia, Ohio 45377, USA

SENSENICH PROPELLER MANUFACTURING CO., INC.
14 Citation Lane
Lititz, PA 17543

LYCOMING ENGINE
652 Oliver Street
Williamsport, PA 17701

TELEDYNE CONTINENTAL MOTORS INC.
Aircraft Products Division
P.O. Box 90
Alabama 36601

AP PRECISION HYDRAULICS LTD
A BBA Group Company
P.O. Box 1 Shaw Road, Speke, Liverpool L24 9JY , England

FAIREY
FHL Division, Claverham Ltd, Claverham , Bristol, BS49 4NF
England

MAINTENANCE PROCEDURE

6.11.16 SERVICE DIFFICULTY REPORTING (REPORTING OF UN-AIRWORTHY CONDITION)

PADC shall report to the Authority and the aircraft design organization of the State of Design any identified condition that could present a serious hazard to the aircraft. Reports shall be made on a form and in a manner prescribed by the Authority and contain all pertinent information about the condition known to the AMO. Where the AMO is contracted by an AOC holder to carry out maintenance, that AMO shall report to the AOC holder any condition affecting the aircraft or aeronautical product. Reports shall be made as soon as practicable, but in any case within three (3) working days of the AMO identifying the condition to which the report relates. *(Ref. PCAR 6.5.1.9 series June 23, 2008)*

A copy of the SDR should distribute to the following:

a) AMO (Maintenance Engineering Department)

b) AOC holder

c) CAAP

d) Manufacturer

MAINTENANCE PROCEDURE

6.11.17 SUBCONTRACTED MAINTENANCE

The subcontractor must be an agent rated/approved by CAAP for a particular job. The work performed by this agency for this Approved Maintenance Organization will be inspected by the Officer-In-Charge Quality Assurance or an inspector delegated for such inspection. This inspection will verify that the work was performed in an airworthy manner that parts and materials used were of such a quality to be airworthy, and the paperwork received with the material verifies the authenticity of the part and work performed. At no time shall the Material Facilities Manager release any parts made by, or parts having work performed on them by a subcontractor until the Officer-In-Charge Qaulity Assurance or an inspector delegated has approved the materials as being airworthy.

All subcontracted work shall be kept separate from regular stock until inspection has been performed and the material is accepted for use.

If for any reason subcontracted material is rejected as being unairworthy, it will immediately be reported to CAAP and identified as unairworthy. The proper disposition will be promptly established such as to scrap or return to vendor

MAINTENANCE PROCEDURE

6.11.18 LIST OF SUBCONTRACTED WORKS

1. Metal plating or anodizing.

Subcontractors are evaluated yearly based on their quality of workmanship, delivery period, and cost of services, warranty and attitude of their representative.

MAINTENANCE PROCEDURE

6.11.19 LIST OF SUBCONTRACTORS

When the following outside contractors will be required to provide the records as performs test and/or calibration outlined in Section 6.11.18.

AGENCY	EQUIPMENT
1. MIRDC/DOST ITDI/DOST	- Master Gauges, Length Measuring Instruments
2. Aviation Support Inc. (ASI) Melchers Int'l & Co. – Singapore	- Electronic Test Equipment
3. Global Defense Technology, Inc. Building 4020 Centennial Road, CSEZ, Pampanga	- Aircraft Weigh & Balance Kit and Magnaflux MPI Machine
4. Philippine Geoanalytics Calibration and measurement Laboratory Corporation 85 Kamuning Road, Quezon City 1103	- Dead Weight Test Ball Arm and Set of Counter Weights
5. GE Inspection Technologies 892 Charter Avenue, Canley, Coventry West Midlands CV4 8AF United Kingdom	- Phasec 3D Eddy Current Equipment
6. NDT Instruments Pte Ltd 50 Ubi Avenue 3, #05-20 Frontier, Singapore 408866	- Gauss Meter and UV Light Meter Equipment

MAINTENANCE PROCEDURE

6.11.20 PERFORMANCE OF MAINTENANCE AT A LOCATION OTHER THAN THE APPROVED MAINTENANCE ORGANIZATION

Philippine Aerospace Development Corporation (PADC) will provide maintenance service for its customer on an emergency on-call basis, at a place away from the Approved Maintenance Organization. PADC will only provide this service for work for which the Approved Maintenance Organization is rated. The Director for Marketing will authorize the initiation of a Service Order for such Work Order. The M&E Dept. Acting Head will inform CAAP of the proposed out station maintenance work.

The M&E Acting Head will be responsible for assigning the personnel necessary to perform the work and appoint a person to be in-charge of the work force. The Chief Inspector will assign the inspector(s) responsible to inspect the work and assure that all required forms and work are completed as necessary. The Officer-In-Charge Quality Assurance will assign one inspector with the responsibility for returning the article to service.

The M&E Dept. Acting Head will ensure that the article to undergo maintenance and the work force will be in an area safe for the work to be performed. The M & E Dept. Acting Head will be responsible for providing all necessary forms, technical data, tools and equipment needed for the accomplishment of the maintenance. The M&E Dept. Acting Head will establish a system of communication between the field force and the Approved Maintenance Organization.

The Logistic Manager will be responsible for assigning a stock-person who will provide parts and supply support between the Approved Maintenance Organization and the field force. All articles removed by the field force from a product undergoing maintenance at a location away from the Approved Maintenance Organization will be routed through the stockroom parts receiving section.

The article(s) will be inspected in accordance with the Approved Maintenance Organization inspection procedures and either routed to the Approved Maintenance Organization shops or to contract repair agencies as appropriate.

All personnel assigned to accomplished work away from the Approved Maintenance Organization shall accomplish specific function of work in the same manner as when performed at the Approved Maintenance Organization and in accordance with PCAR - Part - 6, Series of June 23, 2008, Chapter III.

MAINTENANCE PROCEDURE

6.11.21 AIRCRAFT MAINTENANCE PROGRAM COMPLIANCE

1. The Customer /AOC holders is responsible for scheduling of aircraft and engines for engineering maintenance, in accordance with its approved maintenance program.

2. Compliance responsibilities rest with the customer/AOC holders, PADC will perform the work as scheduled by the customer/AOC holders, within the scope of its capabilities.

MAINTENANCE PROCEDURE

6.11.22 AIRWORTHINESS DIRECTIVES PROCEDURE

1. Airworthiness Directives, Service Bulletins and other Airworthiness publications as provided by customer will be received and recorded by Technical Librarian where applicable.

2. All inspection items and modifications pertaining to AD are carried out through customer's special request.

3. Customer shall be responsible for keeping records of AD compliance for their aircraft. PADC will perform work to meet the requirements of the AD is the work is within the scope of company's rating.

6.12 MAINTENANCE RECORDS

6.12.1 MAINTENANCE RECORDS AND ENTRIES

PADC shall record, in a form acceptable to the Authority, all details for maintenance work performed. The AMO shall provide a copy of each certificate of return to service to the aircraft operator, together with a copy of any specific airworthiness data used for repairs/modifications performed. **The AMO shall retain a copy of all detailed maintenance records and any associated airworthiness data for two years from the date the aircraft or aeronautical product to which the work relates was released from the AMO.**

Each person who maintains, performs preventive maintenance, rebuilds, or modifies an aircraft/aeronautical product shall make an entry in the maintenance record of that equipment:

(1) A description and reference to data acceptable to the Authority of work performed.

(2) The date of completion of the work performed.

(3) The name of the person performing the work if other than the person specified in this subsection.

(4) If the work performed on the aircraft/aeronautical product has been performed satisfactorily, the signature, certificate number, and kind of certificate held by the person approving the work.

(5) The authorized signature, the AMO certificate number, and kind of certificate held by the person approving or disapproving for return to service the aircraft, airframe, aircraft engine, propeller, appliance, component part, or portions thereof;

(6) The signature constitutes the approval for return to service only for the work performed.

(7) In addition to the entry required by this paragraph, major repairs and major modifications shall be entered on a form, and the form disposed of by the person performing the work, in the manner prescribed by the Authority.

(8) If the aircraft is found to be airworthy and approved for return to service, the following or a similarly worded statement—I certify that this aircraft has been inspected in accordance with (insert type) inspection and was determined to be in airworthy condition;

MAINTENANCE RECORDS

6.12.1 MAINTENANCE RECORDS AND ENTRIES

(9) If the aircraft is not approved for return to service because of needed maintenance, non-compliance with the applicable specifications, airworthiness directives, or other approved data, the following or a similarly worded statement—/ *certify that this aircraft has been inspected in accordance with (insert type) inspection and a list of discrepancies and unairworthy items dated (date) has been provided for the aircraft owner or operator;* and

(10) If an inspection is conducted under an inspection program provided for in this regulation, the entry shall identify the inspection program accomplished, and contains a statement that the inspection was performed in accordance with the inspections and procedures for that particular program. (ref. PCAR Part 6, PCAR 8.3)

(11) Listing of discrepancies. If the person performing any inspection required by this regulation finds that the aircraft is not airworthy or does not meet the applicable type certificate data sheet, airworthiness directives, or other approved data upon which its airworthiness depends, that person shall give the owner or lessee a signed and dated list of those discrepancies.

A Copy of each certificate of return to service shall be provided to the aircraft operator and a copy of each Work Order ME Form 001 with all attached supplementary forms will be maintained in the Approved Maintenance Organization records section. Separate files are provided for all paper works associated with the Approved Maintenance Organization's work activities. An inspector checks each work record for work accomplished, parts used, signature of mechanic and inspectors who performed maintenance. **Records are maintained in active file for two (2) years then transferred to dead storage for five (5) additional years.**

MAINTENANCE RECORDS

6.12.2 WORK ORDER

Upon receipt of a Service Order for maintenance or alteration on an airframe, engine, accessory, propeller, instrument, radio or a product requiring a specialized service covered by the repair station certificate, the Production, Planning & Control of Maintenance and Engineering will issue a PADC Approved Maintenance Organization Work Order ME Form 001 to authorize that work to be accomplished. The form will have a control number as a basic reference for the product's maintenance record. The Work Order will specify the work to be supplemented as necessary with detailed inspection during work progress with applicable form to assure proper inspection and repair of the product involved. The original Work Order form will be retained in the Production, Planning & Control of the Maintenance Engineering Department.

A logbook will be maintained in the Production, Planning & Control for recording each work order in numerical order, identifying the customer, the product particulars, (e.g. part number, serial number, part name) special instruction and the work accomplished. The accomplished Work Order will have their separate file folder per work center in the Production, Planning & Control.

It is the responsibility of the respective shop supervisor and Officer-In-Charge Quality Assurance to assure that proper supplemental instructions are furnished to assure proper progressive servicing, inspection and testing of the unit involved.

Mechanics or shop supervisors will enter work accomplished and use last names to sign off that work on form. Inspectors will use their inspection stamp to sign off inspection. A list of inspectors and stamp numbers are contained in this manual under Section II, page 4 and 5.

See copy of work order and supplemental forms in Section VI of this manual.

MAINTENANCE RECORDS

6.12.3 AIRWORTHINESS DATA

PADC shall be in receipt of all airworthiness data appropriate to support the work performed from the Authority, the aircraft/aeronautical product design organization and any other approved design organization in the State of Manufacture or State of Design, as appropriate. The Authority may classify data from another authority or organization as mandatory and may require the AMO to hold such data. Where the AMO modifies airworthiness data to a format or presentation more useful for its maintenance activities, the AMO shall submit to the Authority an amendment to the maintenance procedure manual for any such proposed modifications for acceptance. All airworthiness data used by the AMO shall be kept current and made available to all personnel who require access to that data to perform their duties.

The following are examples of maintenance related documents:

1) Civil Air Regulations
2) Associated Advisory Materials
3) Airworthiness Directives
4) Manufacturer's Maintenance Manual
5) Overhaul Manual
6) Illustrated Parts Catalog
7) Maintenance Schedule
8) Repair Manuals
9) Service Bulletins, Service Letters, Service Instructions
10) Modification Leaflets
11) Aircraft Maintenance Program
12) NDT Manuals , etc

6.12.4 RECORD OF SPECIALIZED INSPECTION, TEST AND/OR CALIBRATION

Specific notations, attesting accomplishment, will be made on appropriate printed company forms for recording specialized inspection, testing and/or calibration of a component of aircraft.

MAINTENANCE RECORDS

6.12.5 RECORD OF INSPECTION

Where a record of the inspection by dimensions, tests or calibration is required by the manufacturer's technical data such record shall be made on an appropriate form properly identified with the Work Order; it must also be dated and signed by the mechanic performing the inspection, tests or calibration and/or the inspector as appropriate.

6.12.6 MAINTENANCE INSTRUCTIONS AND DOCUMENTATION CONTROL

6.12.6.1 PUBLICATION AND DOCUMENTATON CONTROL

All Line Maintenance requirements of aircraft, engines and associated components shall be performed in accordance with the approved data as well as approved worksheets as applicable. PADC Technical Library is responsible for distribution and control of all technical publication in use. Customer/ AOC holders shall provide all required aircraft technical manuals and publications (e.g. AMM, IPC, etc)

For such customer provided approved data, the customer shall confirm that such data, and any temporary revisions as applicable, are up-to–date. The requirement for attesting to the currency of all customer provided data and maintenance instructions is included in contracts signed with the customer.

SCOPE:

1. The Technical Library, under the charge of a Technical Librarian serves as the receipt and dissemination point for technical literature, manuals and drawings received from aircraft manufacturers, component vendors.
2. The Library is also the centre through which orders from procurement of technical literature and manuals are referred to and registered before processing
3. The Library maintains manuals for aircraft operated by customers, including engines and major components as approved.
4. All revision to technical manual issued by the aircraft manufacturer, component vendor or Technical Services of Customer are registered and distributed by Technical Librarian to holders of such manuals for amendment action by the respective holders, with the exception of the individual aircraft Operations Manual.

MAINTENANCE INSTRUCTIONS AND DOCUMENTATION CONTROL

PUBLICATION AND DOCUMENTATION CONTROL

6.12.6.2 TECHNICAL PUBLICATION

GENERAL:

1) All incoming Technical Publications received from Manufacturer, Customer, Air Regulatory Bodies and others shall be recorded in the Incoming Logbook. It shall be reviewed by the Officer-In-Charge, Quality Assurance Department so that appropriate action can be taken as required by the document.

2) The Librarian should provide a Tech Publication Verification Form to the Library to the library on a semi –annual basis to verify currentness of their individual manuals.

3) A Revision status of all controlled Technical Manuals" shall be issued to manual holder and posted inside the Library, for users/holders to validate the currentness of the available manuals.

4) A complete and updated Component Maintenance Manual for items with in-house capability shall be provided to concerned areas.

5) General Reference material that doesn't have revisions shall be stamped with "UNCONTROLLED COPY" for training purposes only" in the List of Effective Pages.

6) All Technical manuals that comes from the Library and issued by the librarian to be used as a reference shall bear the UNCONTROLLED COPY for reference only, will not be revised

7) All out of date/historical publications will be shall be returned to the Technical library for proper verification and disposition.

8) Company manuals (e.g.. MPM) reproduced from Master Copy and will be given to the holder shall be stamped with "CONTROLLED COPY" in the List of Effective Pages.

9) Officer-In-Charge - Quality Assurance Department or his designee will take responsibility of the Library in the absence of the Librarian.

10) Reproduced Technical hard copy that is not issued by the Technical Librarian (e.g. from computer) and will be used as a reference copy shall be stamped and signed by the concerned/responsible person with the provided "UNCONTROLLED COPY for reference only, will not be revised" stamp. Responsible person should take the responsibility for the disposition of such documents.

MAINTENANCE INSTRUCTIONS AND DOCUMENTATION CONTROL

PUBLICATION AND DOCUMENTATION CONTROL

6.12.6.3 HANDLING OF COMPANY CONTROLLED MANUALS

1. Revision of Company Controlled Manual (e.g. MPM) will be done on a quarterly basis (March –June- September- December) or as required.
2. The final draft of MPM revision/s together with a Document Change Request Form is forwarded to the Officer-In-Charge, Quality Assurance Department for pre-final evaluation and approval.
3. Original copy of the approved manual revision/s will be forwarded to CAAP for final review and approval.
4. CAAP approved revision/s shall be distributed to all holders listed in the Distribution List within 2 weeks from the date of receipt
5. Reproduced copy shall be dry sealed and the List of Effective pages should be stamped with "CONTROLLED COPY" and signed by the Librarian
6. Acknowledgement Receipt shall be provided by the Librarian to the Manual holder for proper documentation.
7. The distribution and receipt of manual revisions shall be document using a Document Receipt and Retrieval form
8. It shall be the responsibility of ALL MANUAL HOLDER to insert provided revisions and return obsolete pages to Technical Library.
9. Returned OBSOLETE pages shall be verified and disposed by the Librarian

MAINTENANCE INSTRUCTIONS AND DOCUMENTATION CONTROL

PUBLICATION AND DOCUMENTATION CONTROL

6.12.6.4 BORROWING OF TECHNICAL PUBLICATIONS

1. Prior borrowing Publications, the user must fill up a borrower's logbook
2. Users are not allowed to bring the borrowed publications outside the Library. But in instances that the publications need to be borrowed for several days, the user must:
    a) Advise the Librarian.
    b) Must fill up borrower's logbook.
    c) Borrowed Manuals due date will be 3 working days only.
    d) Make sure that the borrowers will return the manual before its due date.
3. Computer access. Prior using the computer the user must log-in to the provided logbook. Computer is for official Business purposes only. Please be reminded of the following guidelines:
    a) No reconfiguring of software is allowed. Please do not change the programs/setting installed in the computer
    b) No downloading of programs
    c) Viewing of unnecessary documents/websites is not permitted unless with prior approval from the librarian
    d) The use of computer is limited for 30 minutes only to give way to other users.

IMPORTANT REMINDERS REGARDING THE RULES IN THE LIBRARY:

1. Observe courtesy by returning and arranging the manuals in their respective places.

MAINTENANCE INSTRUCTIONS AND DOCUMENTATION CONTROL

PUBLICATION AND DOCUMENTATION CONTROL

6.12.6.5 TECHNICAL RECORDS CONTROL

1) The Quality Assurance Department shall be responsible to maintain the Aircraft Maintenance records in accordance with the conditions of the relevant authorities' regulations, and AOC holders.

2) Such records shall comprise records of work done by Philippine Aerospace Development Corp. (PADC) and kept in paper format as appropriate. The original worksheets will be returned to the AOC Holders while a copy is kept by PADC.

3) The records shall be retained for at least (2) years of a period requires by the AOC holders/airworthiness authorities, after which they will be disposed.

4) All records will appropriately be kept such that they remain legible throughout the required retention period. They should be kept in cabinets with positive locking in a fireproof and flood proof environment. No one except authorized by the Acting Head, QA can make access to these maintenance.

MAINTENANCE INSTRUCTIONS AND DOCUMENTATION CONTROL

PUBLICATION AND DOCUMENTATION CONTROL

6.12.6.6 COMPUTER MAINTENANCE RECORDS SYSTEM

AMO shall have any electronic or automated system capable of receiving, storing, and processing external data, and transmitting and presenting such data in a usable form for the accomplishment of specific functions.

Maintenance releases /CRS and other maintenance forms action by electronic methods maintain a back-up file at the Administrative and Records Section at Maintenance Engineering Department to protect the electronic computer system.

MAINTENANCE AND INSPECTION PROCEDURE

6.13 PERFORMANCE RULES- AIRWORTHINESS LIMITATIONS

Each person performing an inspection or other maintenance specified in an airworthiness limitations section of a current manufacturer's maintenance manual, or instructions for Continued Airworthiness, shall perform the inspection or other maintenance in accordance with that section, or in accordance with specifications approved by the Authority. (*Ref. PCAR 5.6.1.8 Series of June 23, 2008)*

MAINTENANCE AND INSPECTION PROCEDURE

6.14 EQUIPMENT TOOLS AND MATERIALS

1. PADC shall have available the necessary equipment, tools, and material to perform the approved scope of work and these items shall be under full control of the AMO. The availability of equipment and tools means permanent availability except in the case of any tool or equipment that is so rarely needed that its permanent availability is not necessary.
2. PADC shall control all applicable tools, equipment, and test equipment used for product acceptance and/or for making a finding of airworthiness.
3. PADC shall ensure that all applicable tools, equipment, and test equipment used for product acceptance and/or for making a finding of airworthiness are calibrated to ensure correct calibration to a standard acceptable to the Authority and traceable to the State National Standards
4. PADC shall keep all records of calibrations and the standards used for calibration.
5. PADC shall ensure temperature and humidity of accessories and calibration shops were properly monitored. Shop Supervisor or his/her designated person is responsible in monitoring the temperature and humidity.
6. PADC Shop Supervisor and his designated representative is responsible the maintenance and serviceability of all the equipment and tools of his assigned area.

EQUIPMENT TOOLS AND MATERIALS

6.14.1 TEST EQUIPMENT CALIBRATION REQUIREMENTS

Test equipment shall be calibrated at periodic intervals established on the basis of stability, purpose and degree of usage. One year shall be the maximum calibration interval or in accordance with manufacturer's recommendation.

Each piece of test equipment will be labeled. The label will identify the unit by manufacturer, model and serial number. The attached label must indicate the last calibration date and next calibration due date.

During the first week of each month the Officer-In-Charge Qaulity Assurance (or designee) will review the test equipment calibration history card file and give cards for test equipment requiring calibration to the Maintenance Acting Head and each shop supervisor as appropriate. It will be the responsibility of those persons to issue Work Orders to Approved Maintenance Organization shops or outside contractors as necessary for the calibration of the units and attachment of updated calibration labels. After calibration, the test unit will be checked for proper labeling and the equipment calibration history card will be updated and returned to the Inspection Department active file.

At no time will any person be permitted to perform work on aircraft or components using test equipment that is out of calibration. Inspectors or supervisors at random to assure that equipment in use is in calibration will check the test equipment labels. If at any time a piece of test equipment inadvertently exceeds its calibration due date, it will immediately be removed from service until a calibration check has been performed.

Standards used to calibrate test equipment must be traceable to the National Standards Laboratory or an approved foreign country's standard by certificate from the testing facility. Frequency for calibration standards may vary from different units but must never exceed a 24-month interval or equipment manufacturer's recommendation.

EQUIPMENT, TOOLS AND MATERIALS

6.14.2 ALTERNATIVE /LOCALLY MANUFACTURED TOOLS AND EQUIPMENT

PURPOSE:

To ensure alternative or locally manufactured tools and equipment used in aircraft maintenance, component maintenance and aircraft ground support are controller through approved procedures and documentation.

PROCEDURES:

1. MAINTENANCE OPERATION
   a. Ensure availability of a design drawing/document of the equipment for review of specifications to ascertain that requirements are met and satisfied.

   b. Tools and equipment passed the specified data and design; a control number shall be issued. The issued control number will become the tools and equipment identification number.

   c. Route the approved design document to Logistics Department for proper acquisition or local fabrication.

   d. The received design document after the completion and acceptance of that particular tool and equipment for use should be filed for ready references.

   Note: Instructional use/training on the complex tools and equipment should be held first to end user prior to use.

2. PURCHASING
   a. Request contracted supplier/entity to submit the design drawing/documents for the specific tools and equipment to be produced as alternate for Technical Service evaluation /approval.

   b. Based on the approved design documents, expedite the completion/purchase of the said tools and equipment from the contracted supplier/entity.

   c. When the specific tooling is already available/completed, ensure that pertinent documents are complete and available for final inspection and acceptance. Then turn it over to the assigned QA inspector.

EQUIPMENTS, TOOLS AND MATERIALS

6.14.2 ALTERNATIVE /LOCALLY MANUFACTURED TOOLS AND EQUIPMENT

3. QA INSPECTOR

   a. Check /inspect the tool or equipment if in conformance with the approved design documents and for damage /defect.

   b. If damage/defect is found or if there is non-conformance with the design documents, report of the findings should be submitted to the Officer-In-Charge, Quality Assurance Department for final disposition

   c. The approved/accepted tool or equipment shall be provided with serviceable tag and the design documents stamped prior to submission to the tool keeper.

4. TOOLKEEPER

   a. Notify end user of the availability of the tool or equipment
   b. Update the master list of tools & equipment for inventory/monitoring purposes.

EQUIPMENT, TOOLS AND MATERIALS

6.14.3 USE OF TOOLING AND EQUIPMENT (ISSUANCE OF TOOLS)

USE OF TOOLING AND EQUIPMENT (ISSUANCE OF TOOLS)

POLICY

It is a policy of the Company to make available precision, special tools and equipment for use by concerned personnel in the maintenance, inspections and checks or customer's aircraft.

GUIDELINES:

1) Present the Company ID to the tool keeper and log on the provided logbook. Please take note that all transactions are made through the tool room window counter. The borrower is only allowed to enter the tool room if the need arises.

2) Make sure that the quantity, part number, serial number (if available), description, name and signature of the borrower and aircraft registration number is properly indicated.

3) Log all tools borrowed in the appropriate logbook for proper monitoring. Always indicate the name of the borrower, date, time, part number, description of the tools borrowed and aircraft registration or reference Work Order wherein the borrowed tools will be used.

4) Let the borrower sign in the logbook.

5) After checking, issue tool to the mechanic.

6) See to it that all tools borrowed on a particular day will be returned on the same day.

7) Make sure that all tools returned are clean and serviceable before acceptance.

EQUIPMENT, TOOLS AND MATERIALS

6.14.4 CONTROL OF PRECISION MEASURING EQUIPMENT

1 All inspection measuring equipment used in the maintenance shall be under the control of the Quality Assurance Officer-In-Charge and Chief Inspector.

2 All precision measuring equipment will be controlled as follows.

2.1 Measuring equipment shall be serial numbered.
2.2 Measuring equipment shall bear a calibrated decal.
2.3 The working condition of equipment will be the responsibility of Inspector assigned in the area. He will report any suspected unserviceable equipment to the Quality Assurance Officer-In-Charge and Chief Inspector.
2.4 Measuring equipment shall be checked and calibrated in accordance with the established calibration frequency or schedule.

3 The Quality Assurance Officer-In-Charge and Chief Inspector will be responsible for:

3.1 Keeping test records of all measuring equipment.
3.2 Informing the Department concerned of any measuring equipment due for test/calibration.

4 All measuring equipment due for testing shall be turned-in to the Stores Supervisor, who will be responsible for sending these to the nearest test facility.

EQUIPMENT, TOOLS AND MATERIALS

6.14.5 CALIBRATION PROGRAM AND MEASURING EQUIPMENT

The established calibration intervals of measuring equipment are as follows:

Nomenclature	Calibration Intervals (mos.)	Method
Micrometer	12	Gauge block
Vernier Caliper	12	Gauge block
Height Gauge	12	Gauge block
Dial Gauge	12	Gauge block
Surface Plate	12	Level and condition check
Protractor	12	Optical
Feeler Gauge	12	Micrometer
Inclinometer	12	Sine Bar
Cable Tensiometer	12	Cable Tension Meter Tester
Electronic Weighing Kit	*24	Dead Weight
Weighing Scale	12	Standard Weights
Spring Tester	12	Standard Weights
Torque Wrench Tester	12	Dead Weight Test Bar
Torque Wrench	12	Torque Wrench Tester
Crimping Tool	12	Limit Gauge
Spring Pocket Balance	12	Standard Weights
Spring Tension meter	12	Standard Weights
Tachometer	12	Electronic Counter
Flow meter	12	Master Flow Meter
Pressure Gauge	12	Pressure Gauge Tester
Pressure Gauge Tester	12	Pressure Gauge Tester
Pressure Gauge Tester	12	Dead Weight
Vacuum Tester	12	McCleod Gauge
Pitot Static Tester	12	Condition Check
D.C. Voltmeter/Ammeter	12	AC/DC Standard
A.C. Voltmeter/Ammeter	12	AC/DC Standard
Watt Meter	12	National Standard Lab.
Meg.Ohmmeter Tester	12	Standard Resistance
ADF Signal Simulator	12	Freq. Counter Oscillator
AM-FM Signal Generator	12	Frequency Counter
Digital Counter	12	Frequency Standard
Field Strength Meter	12	Master Oscillator
Frequency Counter	12	Frequency Standard
RF Millivoltmeter	12	Signal Generator/ AC Standard
Eddy Current	12	
Ultrasonic	12	

- Manufacturer's recommendation

EQUIPMENT, TOOLS AND MATERIALS

6.14.6 RECORD OF TESTS AND CALIBRATION OF PRECISION EQUIPMENT

A system is maintained on all precision test equipment that will properly identify each piece of equipment. A file system is maintained to properly identify the equipment and record the date and person testing or calibrating each individual piece of precision equipment. Records of test reports will be kept in the Inspection Department.

EQUIPMENT, TOOLS AND MATERIALS

6.14.7 ACCEPTANCE OF TOOLS AND EQUIPMENT

User departments recommend the procurement of tools and equipment necessary to fulfill the tasks undertaken by their respective departments. PADC Logistics Department is responsible for the procurement of new tools and equipment, loan of tools and equipment to and from other operators, repair of defective items and the disposal of obsolete parts.

Upon acceptance of new tools and equipment user departments must ensure that all new instruments are registered with tool keeping section for monitoring and control. Copy of operating and service manuals must be available with Tool Keeping section for reference.

Following the various maintenance policies and standards which are in accordance with the Manufacturer's specifications as well as the rules and regulations set forth for the Aircraft Airworthiness, maintenance and handling procedures of tools and equipment that differs from one aircraft type to another, one operator to another or one place of operation to another are laid down by each and every company.

Use of non-manufacturer recommended (i.e. alternative) tools and equipment should always be restricted unless there is written authorization from OEM, aircraft manufacturer or customer engineering.

For the brand new tools or equipment which are being used for the first time in service, the next due for re-calibration should be base upon the date of those tools/equipment put into service provided calibration compliance certificate from manufacturer can be obtained. After that tools/equipment shelf life expired, they must be recalibrated and the interval of calibration follows normal procedure.

These procedures encompass personnel assigned for the maintenance and upkeep as well as other tasks in ensuring their serviceability at all times.

6.15 INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.1 SUPPLIER EVALUATION & SUBCONTRACT CONTROL PROCEDURE

All parts, materials, equipment and services for airworthiness purposes must be obtained from sources approved by relevant regulatory authorities.

Approved Parts will be checked for the following:

1) Correct documentation and compliance with regulatory requirements.

2) Certification of Approved Status

3) Compliance with Quality and Technical Specifications.

Items not meeting required acceptance criteria will be rejected and suppliers of such item maybe barred or subjected to quality audits or other special qualification requirements.

Evaluation of supplier's performance is carried out by Logistics Department conjunction with the Quality Assurance Department which conducts quality airworthiness verification and quality audits when required to verify compliance with airworthiness, regulatory or quality standards.

Suppliers who are not OEMs or OEMs recommended or no CAAP approved organizations shall require approval from PADC Quality Assurance Department who will perform supplier evaluation before acceptance.

Parts will be procured in accordance with the established company policy and procedure

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.2 PROCUREMENT PROCEDURE

The procurement of aeronautical supplies shall only be from sources approved by the regulatory authorities having jurisdiction. These will normally be sources approved and/or recommended by aircraft/engine/component manufacturers. Suppliers who are not OEMs or OEMs recommended or non-CAAP approved organizations shall require approval from PADC Quality Assurance Department office that will perform supplier's evaluation before acceptance.

Separate lists of approved vendors are maintained and updated by Logistics Department office and Quality Assurance Department Office.

6.15.2a. Repair parts NOT IN STOCK shall be recommended by the Shop Supervisor for procurement through a Purchase Requisition.

6.15.2b. Purchase Requisition shall be submitted by the Shop Supervisor to the M&E procurement officer who shall source out the parts from at least three (3) known and credible suppliers.

6.15.2c. M&E procurement officer shall prepare the Abstract of Canvass after receipt of quotation.

6.15.2d. Upon selection of the lowest responsive supplier, the M&E procurement officer shall secure the final confirmation of the Shop Supervisor and QA Inspector of the parts to be procured.

6.15.2e. The M&E procurement officer shall thereafter submit to the Buyer/Purchaser the Abstract of Canvass together with the Quotations, RIS and Purchase Requisition for the preparation of the Purchase Order.

6.15.2f. Upon receipt of delivered items, the Buyer/Purchaser shall cause the inspection and acceptance by the committee and thereafter deposit all delivered items to the storeroom.

6.15.2g. Storekeeper shall issue items only upon presentation of RIS by the Shop Supervisor.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.3 INCOMING PARTS AND MATERIALS

1. Quality Assurance Department is responsible for ensuring that all airworthiness materials, parts and supplies, including customer supplied parts and materials, meet the requirements of the regulatory authorities having jurisdiction.
2. Every shipment, package, article or part received will be inspected by the Quality Inspectors before it is routed to stores for future release, or directly to a work area. The following general policy will govern:
   a. New parts, tools and equipment received directly from manufacturers, or approved vendors and suppliers will be subject to inspection for conformity with incoming documentation, and specifications in the relevant Purchase Order.
   b. When status cannot be determined by records or visual inspection, used or surplus parts will be subject to overhaul prior to use.
   c. Overhauled and repaired parts purchased from contractors and vendors will be subject to individual inspection. All contractor and vendors are responsible to ensure that all work is performed in accordance with the requirements of the regulatory authority having jurisdiction. In cases, where vendors do not possesses a quality assurance system in their organization, and then PADC inspects such work for quality before the article is entered into service.
   d. All incoming new components, and customer supplied parts are inspected by Quality Assurance Inspectors.

Quality Inspectors will verify that all incoming aircraft parts and materials have been supplied by approved vendors as listed in the list of approved vendors. Customer supplied parts and materials are checked to ensure that they are received directly from the customer of from a customer approved vendor or sub-contractor. They then perform their acceptance inspection/checks in accordance with the following criteria.

1. For new aircraft and engine components obtained from manufacturing sources, the components should be accompanied by a Release Document authorized by the regulatory Authority of the originating country.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.3 INCOMING PARTS AND MATERIALS

2. For new aircraft and engine components obtained from a parts distributor, the component should be accompanied by the original release document traceable to the original manufacturer document.

3. For used components returned after maintenance or overhaul and intended for use on an aircraft or engine that is under the jurisdiction of the CAAP, the component should be accompanied by an Authorized Release Certificate.

4. For parts that are defined as Standard Parts by the Type Certificate Holder, the part should accompanied by a certificate of conformity certifying that the parts are manufactured to industry or national specifications.

5. For raw material and consumable material such as sealants intended for aircraft use, the material should be accompanied by documentation clearly relating to the particular material and containing conformity to specification statement plus identification of both the manufacturing and supplier source.

6. All components, parts and materials received from suppliers and vendors under a Customer's Purchase Order or Repair Order will be inspected and examined for physical damage and the presence of the appropriate Authorized Release Certificate or manufacturer's Certificate of Conformance.

7. Items hand carried by customer or shipped on board Customer aircraft will be examined for physical damage and the presence of the Customer's Serviceable Tag or other traceability tag in accordance with Customer's Standard Procedures. Aircraft parts and components without Customer's Tag or other traceability tags must be accompanied by an Authorized Release Certificate, while consumables and standard parts must have the manufacturer's certificate of compliance.

8. All incoming parts and materials will be inspected for conformity with the requirements of the aircraft, engine or component manufacturer, and the regulatory authority having jurisdiction. Any Suspected Unapproved Parts or materials will be quarantined, and reported in accordance with established procedures.

9. Parts/materials that do not pass the above checks, or are suspected to be unapproved parts will be segregated and moved to the Quarantine racks in the Receiving Stores. The Quality Inspectors, in rejecting such items, will stamp "QUALITY REJECT" on the purchase order invoice, and raise a Stores Inspection Discrepancy Report specifying all relevant details and the reasons for rejection. Where suspected unapproved parts/materials are detected, the Quality Assurance Department will notify the regulatory authority jurisdiction.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.4 ACCEPTANCE OF APROVED PARTS

Quality Assurance Department will carry out the necessary checks and inspections to ensure that:

1. Correct documentation and compliance with Airworthiness regulations are being maintained;

2. The quality of approved parts received meets the required standards for use in aircraft maintenance and repair ; and

3. The appropriate rejection action is taken when necessary.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.5 IDENTIFICATION OF APPROVED PARTS

The proper identification of approved parts is necessary at all times in order to ensure that:

1. Only approved parts are to be used for aircraft maintenance and repair, and

2. Any item or batch of items which are suspected as unapproved shall be isolated so that appropriate action can be taken.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.6 LABELLING OF APPROVED PARTS

To ensure compliance with the relevant Airworthiness Regulations all materials or parts released by an approved firm should be accompanied by approved documents.

All relevant certification must certify that such item comply/conform to the applicable specifications and conditions

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.7 HANDLING OF PARTS

All items of components undergoing maintenance repair and/or alterations in the Approved Maintenance Organization shall have the component parts segregated and in containers in order to assure that all parts of the same units (s) are kept together. Suitable trays, racks, standard protective covering (as required) are to be provided in shop area to ensure maximum protection of all parts. Rejected parts will be identified by the use of a red tag (condemned) and final disposition will be the responsibility of the Officer-In-Charge - Quality Assurance.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.8 TAGGING AND IDENTIFICATION OF PARTS

All units, for which this Approved Maintenance Organization is rated, will be properly identified by tags during their process through the shop. Tags contain information such manufacturer of unit, model, part number, serial number, part name and customer/owner.

The following is our four-tag system:

White tag - used for identification of unit and customer only. To be completed by shop supervisor or a designated employee.

Green tag - will be attached to unit or parts requiring tests or repair and will include work to be performed. To be executed and signed by inspector.

Yellow tag - To be attached to completed units that have received final inspection and are approved for return to service. The maintenance release statement is printed on the tag and signed by the technician and the inspector.

Red tag - Will be attached to rejected parts, pending final disposition. If rejected parts are in large quantities, they can be placed in a special container marked "rejected parts". This tag is to be completed by an inspector.

The red, white and green tags will be made part of the record file. If the rejected part is returned to the customer, the red tag will remain attached and a record will be made showing the part was returned to the customer.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.9 PART FINISHING

Painting and spraying is accomplished in an area segregated from the assembly areas.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.10 PRESERVATION OF PARTS (STORAGE)

Components are preserved in accordance with manufacturer's recommendations or other acceptable industry standards. To afford protection against humidity, extreme temperatures, dust, rough handling or other damage. Wrapping in suitable containers, plastic bags, and/or rigid boxes containing suitable shock absorption material will preserve the component.

Storage of "Approved Maintenance Organization" preserved components will be accomplished by storing in a separate "Approved Maintenance Organization" location maintained by the "Stores" department. The location should provide maximum protection from physical damage.

In case, wherein PADC decided to stock only consumables parts, parts or components purchased on per need basis, a designated quarantine area should be made available as the receiving and inspection area for all the parts received prior issuance to the end users.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.11 STORAGE LIMIT PERIOD

The manufacturers of certain aircraft parts/materials impose storage limiting periods after which time they will not guarantee the efficient functioning of the items. On expiry of recommended storage periods the item should be withdrawn from stores for evaluation or overhaul as recommended by the manufacturer. The effective storage limiting periods of some items may be considerably reduced it suitable conditions or storage are not provided. Therefore, storage limiting periods quoted by manufacturers will only apply if prescribed conditions of storage are in operation.

Where a storage limiting period is not specified by the manufacturer the limiting period laid down in the requirements of the relevant regulatory authorities will apply.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.12 HARDWARE AND EQUIPMENT STORAGE

The Sr. Property Officer (Storekeeper) is responsible to the Logistics Manager for operation of the stockroom and is responsible for controlling, segregating and maintaining all stock and tools as to serviceable or unserviceable category approved by the Chief Inspector.

In addition, the Material Facilities Manager is required to:

1) Properly store, maintain, segregate and protect materials, parts and supplies.

2) Provide suitable storage facilities for storing standard parts, spare parts, and assure that raw materials are separated from the shop and working areas.

3) Provide for the preservation of all articles or parts while in inventory, that the subject to deterioration and shelf life specifications.

4) Only acceptable parts and supplies will be issued for any job. Acceptable industry practices shall be followed for the proper protection and storage of materials.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.13 CONTROL OF AIRCRAFT COMPONENTS, PARTS AND MATERIALS (STORAGE AND SHELF LIFE)

1. This procedure prescribes the guidelines for storage of aircraft components, parts and materials which have specified shelf-life that are subject to certain conditions and limitations.

2. During inspection of incoming items, the Intake/Receiving Inspector shall:

   2.1 Verify whether the items are shelf-life limited.

   2.2 Check if the shelf-life is indicated in both item and container.

   2.3 Reject items which have expired shelf-life and place them in the Quarantine Room.

3. The Storekeeper shall monitor the stock of shelf-life items and ensures that:

   3.1 All items contained in the Store are identified with "Shelf-Life" and "Test Due" labels.

   3.2 Items which have expired shelf-life are removed from stock and place in the Quarantine Room.

   3.3 Items are issued in strict rotation, i.e. First in, First out (FIFO) system.

4. As all storage limiting period (shelf-life) are based upon items being stored under correct conditions, the following guidelines should be strictly adhered to:

   4.1 All items must be placed in appropriate racks and bins.

   4.2 The storage area must be kept clean and maintained at an even dry temperature (bet 15-20 deg. Celsius)

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.13 CONTROL OF AIRCRAFT COMPONENTS, PARTS AND MATERIALS (STORAGE AND SHELF LIFE)

4.3 Items should be stored in such a way as to follow for a free circulation of air where possible.

4.4 Strict rotation must be observed in the issuance of all parts.

4.5 Paints, thinners, sealants and flammable materials must be kept in a separate building.

4.6 Stocks likely to have adverse effects on other materials must be segregated.

4.7 High pressure cylinders must be kept in a separate area.

4.8 Life jackets/rafts shall be stored out of direct sunlight at a temperature between 15-20 deg. Celsius.

4.9 Pipes and hoses shall have blank plugs fitted to prevent ingress of moisture or foreign materials. All hoses shall be identified with test date.

4.10 Inner tubes shall be stored in their original cartons.

4.11 Tires should be stored vertically, supported at two (2) points with approximately one-third (1/3) of the lower part of the tire below the support points. Tires shall be rotated to a new position every three (3) months.

4.12 Windscreen/windows flexi glass panels shall have the protective coating intact and be stored away from direct sunlight and excessive heat.

4.13 Batteries containing electrolytes shall not be kept in the store areas.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.14 SHELF LIFE OF SEALANTS, ADHESIVES AND SPECIAL FLUIDS

At the incoming Inspection, the manufacturer's shelf life is to be noted on receipt and expiry date must be indicated. Storekeeper shall affix life stickers and regular checks shall be done to remove life expired items for disposal.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.15 RELEASE OF COMPONENTS AND MATERIALS FROM STORES

Where applicable and practical, all components and materials shall be issued from stores on a "FIRST IN FIRST OUT "(FIFO)" basis. Shelf Life controlled and storage life limited items shall also be subject to this system of control.

This is to ensure that components and materials which have been stored for longer period are released for service first.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.16 RETURN OF DEFECTIVE COMPONENTS AND MATERIALS ISSUED FROM STORE

Any products that fail to meet applicable specification will be tagged as unserviceable, listing the discrepancies using the Property Turn In Slip (PTIS) PADC Form -002 will be use to return the item to store. To preclude those parts from being used, the storekeeper will place such items in the locked holding area until they are repacked for shipping back to vendor.

INSPECTION AND ACCEPTANCE OF AIRCRAFT COMPONENT AND MATERIALS

6.15.17 RETURN OF DEFECTIVE COMPONENTS TO OUTSIDE CONTRACTORS

3. Defective components shall be sent to approve contractors/manufacturers for repair.

4. Such components shall be identified with the appropriate labels and repair order.

5. Proper packaging should be used per IATA requirements if applicable in dispatching components and then route them to store for temporary storage if immediate transportation means not available.

6. On receiving of the return component, storekeeper before re-binning the item visually inspects the component to ensure that it is satisfactorily, and that its accompanying documentation is in good order.

7. Storekeeper shall arrange for the dispatch of the component and monitor its return after repair.

6.16 PROCEDURES FOR LINE MAINTENANCE

6.16.1 GROUND HANDLING PROCEDURE (TOWING)

GENERAL

1. Provision is made for affecting all ground handling operations using various items of equipment according to option.
2. A ground steering bar is available for maneuvering the airplane while on the ground and this bar can be attached to the nose wheel retaining fork. Fig. 1 shows the minimum turning cycle required by the airplane. To release the brakes, before maneuvering the airplane, first depress the brake pedals to relieve the pressure and then move the parking brake selector lever to the OFF position.

POWER TOWING

3. Mod NB/M/1460 (previous Pilatus Britten Norman Service Bulletin BN-2/SB.197) introduces an improved nose undercarriage mounting structure. Incorporation of this modification is recommended on BN-2A/B short nose Islanders and enables these Islanders to be power towed from the nose gear when the following conditions are satisfied.

4. The aircraft must have one of the following Modifications embodied:

   Mod NB/M/463 Castoring Nose Gear
   Mod NB/M/503 AP Precision Hydraulics (Lockheed) Gear Steering Disconnect
   Mod NB/M/733 FHL (Fairey) Gear Steering Disconnect

   Aircraft with permanently engaged (rudder interconnected) nose gears are not eligible for towing with a rigid link.

5. For aircraft in compliance with (1), towing is permitted up to a gross weight of 7000 lbs by means of a rigid tow bar attached to the steering arm spools on the nose wheels.

6. In the event of a spring release or shear pin tow bar being used, it is recommended to set the pin, or release, to 1500 lbs.

7. Precautions should be taken to ensure the towing angle remains within the nose gear swivel angle of 70 degrees from the centerline as, otherwise, stop damage if possible.

PROCEDURES FOR LINE MAINTENANCE

6.16.2 RAMP SAFETY PROCEDURE

Ramp Safety Rules

The following rules apply to all operations on the ramp:

- Always be aware of your surroundings.
- Always wear personal protective equipment (PPE).
- No smoking.
- No alcoholic drinks or any drugs, legal or illegal, that are likely to impair performance or judgment.
- No rough or boisterous play; practical jokes may lead to injury or damage.
- Report all injuries, equipment damage and near-collisions to a supervisor.
- Do not operate any equipment that has been declared unserviceable.
- Keep the ramp area clear of foreign object debris (FOD).
- Only a trained operator may drive a vehicle or operate its controls.
- Always obey speed limits.
- Never try to get on or off a moving vehicle; wait until it stops.
- Never carry co-workers on vehicles unless seats are available. "No seat, no ride."
- Do not operate vehicles or equipment in the no-drive zone under the aircraft's fuselage and wings. Loading/unloading of some containerized narrow body aircraft may require
- Vehicles or equipment to be operated between the inboard engine and fuselage; great care must be taken to avoid contact with the engine or fuselage.
- Never drive over fuel hoses or static leads

PROCEDURES FOR LINE MAINTENANCE

6.16.2 RAMP SAFETY PROCEDURE

- Minimize the distance a high-lift vehicle is driven with the rear van body raised.
- Never back a vehicle toward an aircraft unless a marshaller is present and the view is clear.
- Be very careful near moving aircraft; they have the right-of-way.
- Avoid the intake and exhaust areas of aircraft engines.
- Use extreme caution when walking under any part of an aircraft.
- Wait until the aircraft's anti-collision beacon is off before approaching the aircraft.
- Never try to load late-arriving baggage if the aircraft's anti-collision beacon is on.

The following general rules apply to ramp operations near propeller-driven aircraft:

- Do not approach the aircraft until the propellers have stopped turning and the anti-collision beacon is off.
- Never walk close to or between propellers or between propeller blades, even if they are motionless.
- Never touch a propeller blade.

PROCEDURES FOR LINE MAINTENANCE (RAMP SAFETY PROCEDURE)

6.16.2.1 Positioning Ground Service Equipment

Movement of aircraft into and out of the parking area is done in an area called the aircraft clearance zone. Keep this zone free of obstructions and protect it from any intrusion while the aircraft is moving.

Illustrations of the aircraft clearance zone and aircraft clearance zone markings are provided in the appendix (pages A-1 and A-2).

Follow these general guidelines for positioning ground service equipment (GSE):

- Place GSE outside the aircraft clearance zone equipment limit lines for ready access to the aircraft after it stops and the anti-collision beacon is off.
- Before positioning GSE near the aircraft, check that all buffers are serviceable and handrails are retracted.
- After positioning GSE near the aircraft, check that stabilizers, if fitted, are down and handrails are extended correctly.

Keep loading platforms lowered when placing them near the aircraft; ensure enough clearance for cargo doors to be opened.

Note: The arc prescribed by the unhinged end of a cargo door when it is opened or closed is not continuous, and care must be taken to avoid injury (see the illustration provided in the appendix, page A-11).

- Position GSE in an organized way so that all equipment has access to the aircraft.

PROCEDURES FOR LINE MAINTENANCE(RAMP SAFETY PROCEDURE)

6.16.2.2 _APPROACHING AN ARRIVING AIRCRAFT

Approaching an Arriving Aircraft

Before approaching the aircraft, make sure that:

- The aircraft has stopped.
- The nose wheels are chocked.
- The anti-collision beacon is off.
- The marshaller has given the "safe to approach" signal.

When working around an aircraft, be alert for protrusions that could cause injury, such as antennas, pitot tubes, vortex generators and air-conditioning pack exhaust ports.

Aircraft servicing involves several types of vehicles. General guidelines for positioning vehicles at the aircraft include:

- Baggage-handling vehicles (belt loaders and pallet loaders) are normally the first to approach, followed by catering and cabin-cleaning vehicles.
- When positioning catering and cleaning vehicles, ensure that the leading edge of the platform is as perpendicular as possible to the side of the aircraft, taking into account the curvature of the fuselage.
- After the baggage-handling vehicles are in position, tow vehicles pulling carts, trolleys, carts (barrows), container dollies or other equipment carrying baggage, cargo and mail may approach.
- Provide clear access and egress to the refueling vehicle.

PROCEDURES FOR LINE MAINTENANCE (RAMP SAFETY PROCEDURE)

6.16.2.3 CIRCLES OF SAFETY

Each parked aircraft has unmarked protection zones called the "circles of safety" that are designed to prevent damage from GSE. The outer circle of safety extends 5 meters (16 feet) from the aircraft. Vehicle drivers must test their brakes before crossing this imaginary boundary. The inner circle of safety is 2 meters (7 feet) from the aircraft and indicates where drivers must stop their vehicles before resuming their approach to the aircraft at a slow speed.

An illustration of the circles of safety is provided in the appendix (page A-3).

PROCEDURES FOR LINE MAINTENANCE (RAMP SAFETY PROCEDURE)

6.16.2.4 POSITIONING SAFETY CONES

Safety cones are used to create protective zones around specific aircraft areas, especially engines and wing tips, to prevent ground accident damage.

Illustrations of recommended safety cone placements for different aircraft types are provided in the appendix (pages A-4 through A-9).

PROCEDURES FOR LINE MAINTENANCE (RAMP SAFETY PROCEDURE)

6.16.2.5 REFUELLING

General guidelines during refueling of aircraft include:

- Use caution when maneuvering vehicles and rolling stock near aircraft being refueled. Look for fuel hoses and fuel hydrants.

- Keep at least 1 meter (3 feet) away from the refueling vehicle, hoses and static lines while servicing the aircraft.

PROCEDURES FOR LINE MAINTENANCE (RAMP SAFETY PROCEDURE)

6.16.2.6 PREVENTING FOREIGN OBJECT DAMAGE

Foreign object debris (FOD) can damage aircraft and cause injury. Ramp personnel must be familiar with the local program to prevent foreign object damage. Keep the ramp clear of FOD such as nuts and bolts, rags, paper, plastic, drink containers, baggage parts and tags, pavement fragments, aircraft galley waste, food and garbage. Do not wait; clean as you go.

Guidelines for preventing foreign object damage include:

- Pick up FOD as soon as you see it.
- If the FOD cannot be easily removed by hand, ask the supervisor to request that the airport or terminal operator use a manual or airfield sweeper to remove it.
- Frequently clean or vacuum work areas.
- Ensure receptacles for FOD are in work areas.
- Account for all tools in and around aircraft.
- Do not leave lock wire (safety wire) and other loose items such as nuts and bolts in work areas.
- Continuously inspect ramp areas for F.O.D.

PROCEDURES FOR LINE MAINTENANCE (RAMP SAFETY PROCEDURES)

6.16.2.7 FIRE PREVENTION

Ramp personnel must know local fire prevention procedures, emergency evacuation plans and procedures for inspecting and maintaining fire equipment.

Operators and supervisors should ensure that:

- Appropriate types and numbers of fire extinguishers are serviceable and positioned in well-marked areas, and that access to them is kept clear.
- Fire alarm stations are well marked and accessible.
- Fire hydrants and hoses are well marked and accessible.
- Emergency shutoff points for in-ground fueling systems are clearly marked and accessible.
- All personnel know the locations of fire extinguishers, hydrants, alarms and emergency fuel shutoff systems, and are familiar with their operation.
- Emergency exits and escape routes are clearly marked and unobstructed, and illuminated exit signs are functional.
- Flammable materials are properly stored and disposed of.
- No-smoking areas are defined, and signs alert personnel to smoking restrictions.
- Aircraft and fuel servicing equipment are securely bonded before refueling or defueling commences.
- Unserviceable fire equipment is reported immediately to a supervisor

PROCEDURES FOR LINE MAINTENANCE (RAMP SAFETY PROCEDURES)

6.16.2.8 MARSHALLING HAND SIGNAL

Marshalling Hand Signals

Marshall all vehicles that must be driven very close to the aircraft. The marshaller must maintain a clear line of sight with the vehicle driver and give all hand signals with direct, precise actions.

Illustrations of standard hand signals are provided in the appendix (page A-10).

Additional guidelines for giving and receiving hand signals include:

- The marshaller should position his/her hands well over his head or to the side of the body so the vehicle driver can easily understand the signal.
- The marshaller should always face the vehicle when it is being driven forward and reposition himself if he loses sight of the vehicle driver.
- The vehicle driver must stop if he loses sight of the marshaller or believes the vehicle is too close to the aircraft.
- When guiding from behind, the marshaller must be visible to the driver but not directly in the path of the vehicle.
- The marshaller should check the ramp area through which he walks to ensure that there are no obstructions.
- The marshaller must monitor the vehicle's path.
- The marshaller must use bright or lighted wands when visibility is reduced

PROCEDURES FOR LINE MAINTENANCE

6.16.3 ENGINE TEST RUN PROCEDURE

1. Check the Following before engine installation at test cell
   a. Engine Mount installation and security
   b. Fuel Injector installation and filling for pre-soak
   c. Starter installation
   d. Spark Plug and Thermocouple installation
   e. Fuel Pump installation
   f. Exhaust stack installation and security
   g. Propeller governor pad installation
   h. Oil Relief Valve position for possible adjustment
   i. Fuel Pump for possible adjustment
   j. Removal of plug from fuel pump vent
   k. Engine dressing

2. Check Test Block before starting
   a. Engine mount to test stand for security
   b. Master switch at "OFF" position
   c. Magneto ground connection
   d. Oil connection
   e. Oil Pressure gauge line connection
   f. Oil temperature gauge line connection
   g. Manifold pressure gauge line connection
   h. Fuel inlet connection
   i. Fuel pressure gauge line connection
   j. Tachometer connection
   k. Primer distribution line connection
   l. Fuel injector control connection
   m. Injector mixture control connection
   n. Starter connection
   o. Propeller test club installation , Set blade angle to 35 torque 650 in lbs
   p. Air intake installation and security
   q. Cooling shroud installation and security
   r. Removal of loose objects from test cell
   s. Rotation of test club by hand five (5) revolutions minimum in normal direction. Check safety wire

PROCEDURES FOR LINE MAINTENANCE

6.16.3 ENGINE TEST RUN PROCEDURE

3. Check Control Cubicle before starting
   a. Oil supply in scale for proper quantity and grade 12 quarts
   b. Correct oil temperature for starting
   c. Zero reading in instruments. Check calibration records.
   d. Correct grade of fuel and quantity
   e. Proper operation of engine
   f. Notation in test log sheet
   g. Check injector connection for leak under fuel pressure

4. RUN UP
   Start engine in accordance with the following procedures

   b. For float type Simmonds injectors, place mixture control in FULL RICH position
   c. For Bendix fuell injector, place mixture control in IDLE CUT OFF position
   d. Turn fuel valve to ON position
   e. Set throttle to 1/10 open position
   f. Turn magneto switch to LEFT and engage starter
   g. Turn magneto, starter combination switch to "START"
   h. When engine fires, move mixture control smoothly to FULL RICH on pressure Bendix fuel injector
   i. Move magneto switch to BOTH position

CAUTION: If oil pressure is not indicated within 10 seconds, stop engine and determine cause

PROCEDURES FOR LINE MAINTENANCE

6.16.3 ENGINE TEST RUN PROCEDURE

j. Operate the engine at approximately 1000 RPM until a minimum Oil temperature of 140 deg F is obtained. Check magneto drop off and general operation of the engine. Check the engine for oil leak. Any malfunction or oil leak must be corrected before continuing the run.

k. An oil Complete the test run in accordance with the schedule listed RPM

1200 - 10 minutes
1500 - 10 minutes
1800 - 10 minutes
2000 - 10 minutes
2200 - 10 minutes
2400 - 10 minutes

Note: Check magneto drop off.
Do not exceed 125 RPM drop or 35 RPM spread between Magnetos

Normal rated 15 minutes
Normal rated 60 minutes – oil consumption run

l. Consumption run should be made at end of the run. Oil consumption can be determine by the use of a scale tank through which the oil line passes and the scale reading taken at the beginning and end of the oil consumption run. Or it can be determined by draining and weighing the oil supply before and after the oil consumption run. Oil temperature should be held as closely as possible to the limits (IN at 164-230 deg F) (OUT at 190-210 deg F) Oil consumption should not exceed 1.8 lbs/hr or 1 qrt /hr

Note: Re-check primary and secondary oil filters

PROCEDURES FOR LINE MAINTENANCE

6.16.3 ENGINE TEST RUN PROCEDURE

5. Preservation of engine

   a. Engine to store mixture of 35% MIL-C-6529 Type 1 and LIM-L-6082 oil.
   b. Fuel system Grade 1010 oil MIL-L-6081

6. Upon completion of run-in

   a. Drain the oil
   b. Refill the engine with 1:1 mixture MIL –L-6259 Type 1 and Bayol "D" or equivalent
   c. Remove top sp. Plug with crankcase full of oil. Slowly turn the propeller 2 revolutions.
   d. Spray the exhaust port and valve of each cylinder using MIL-C-6529 oil
   e. Spray each cylinder using an air less spray gun through the sp. Plug hole with approximately 2 ounces of MIL-C-6529 oil.
   f. Apply a generous amount of oil on the breather openings and seal with moisture resistant cap or dehydration plug.
   g. Exhaust ports and other openings must be closed with appropriate covers.

6.16.4 WEIGHT AND BALANCE OF AIRCRAFT

6.16.4.0 OBJECTIVE

This chapter provides technical guidance for use in conducting, evaluating and approval of Aircraft Weight and balance. As per Part 5 of Civil Aviation Regulations which requires that all RP registered aircraft with respect to its certificate of airworthiness issued or rendered valid, shall be weighed and its center of gravity determined. This chapter lays the procedures of aircraft weighing.

6.16.4.1 REWEIGING OF AIRCRAFT

Aircraft shall be physically weighed by PADC authorized Inspector and AMT's who is authorized to weigh the aircraft. The weighing shall be carried out in the presence of authorized inspector from CAAP/FSIS and the AMO Authorized Aeronautical Engineer shall compute the empty weight and its center of gravity and complete the AMO Aircraft Weighing Report and sample loading.

WEIGHT AND BALANCE OF AIRCRAFT

6.16.4.2 WEIGHING PROCEDURES

The following procedures are to be followed in conducting aircraft weighing

a) Weighing should be performed in an enclosed area or inside closed hangar where wind cannot blow over the surface and cause fluctuating or false scale readings.

b) Weighing equipment used must be currently calibrated and applicable for the aircraft being weighed.

c) The aircraft should be clean inside and out, with special attention paid to the bilge area to be sure no water or debris is trapped there, and outside of the aircraft should be as free as possible of all mud and dirt.

d) All of the required equipment included in the aircraft Basic Empty Weight should be checked and verified using the Aircraft Weight and Balance Checklist and there should be no equipment installed that is not included in the equipment list. If such equipment is installed, the weight and balance report must be corrected to indicate it.

e) All aircraft fluids which includes but not limited to fuel, water methanol/fluid, engine oil and hydraulic fluids must be set in accordance to the specified aircraft manufacturer or as prescribed in the TCDS for aircraft weighing.

f) Consult the aircraft service or aircraft weight and balance manual regarding position of the landing gear shock struts and control surfaces for weighing (Example, when weighing a helicopter, the main rotor must be in its correct position)

WEIGHT AND BALANCE OF AIRCRAFT

6.16.4.2 WEIGHING PROCEDURES

g) The aircraft weighing scale reading should be set at zero before the start of weighing and any scale correction must be included in the final computation to indicate it.

h) Aircraft towing or jacking and leveling for the purpose of aircraft reweighing should be done in accordance with Aircraft Weight and Balance /Maintenance or Owner's Manual of each aircraft type

i) Record of each reading on each reaction points must be recorded and averaged depending on the number of trials made.

j) Measurements or distances of the reaction points should be taken while the aircraft is on its leveled position based from the Reference Datum (as per specified on the Aircraft weight and Balance/Maintenance or Owner's Manual of Aircraft Type Certificate Data Sheets.) Moments and arms are also specified in the Aircraft Weight and Balance /Maintenance Manual.

k) All corrections made with regards to the aircraft weighing must be reflected in the final aircraft weight and balance report.

WEIGHT AND BALANCE OF AIRCRAFT

6.16.4.3 SAFETY CONSIDERATIONS

Special precautions must be taken when raising an aircraft on jacks:

a) Stress plates must be installed under the jack's pads if the manufacturer specifies them.

b) Is anyone is required to be in the aircraft while it is being jacked, there must be no movement.

c) The jacks must be straight under the jack pads before beginning to raise the aircraft.

d) All jacks must be raised simultaneously and the safety devices are against the jack cylinder to prevent the aircraft tipping if any jack should lose pressure. Not all jacks have screw down collar, some use drop pins or friction locks.

WEIGHT AND BALANCE OF AIRCRAFT

6.16.4.4 AIRCRAFT WEIGHT AND BALANCE REPORT

After an aircraft has been weighed, the C.G position shall be determined, by PADC authorized aeronautical engineer and shall prepare an Aircraft Weight and Balance Report (QA Form WB-1) which shall contain at least the following information:

a) Aircraft registration Number
b) Aircraft make , model and serial number
c) Aircraft owner
d) Date and place of weighing
e) W & B Engineer's name
f) AMO Inspector's name
g) Owner's authorized representative
h) Scale Reactions
i) Empty weight as weighed
j) Items weighed but was not part of the aircraft basic empty weight
k) Items which are part of aircraft basic weight not on the aircraft when weighed
l) New Basic Empty Weight and Centre of Gravity
m) Sample loading
n) Equipment listing
o) Signature of authorized AMO licensed aeronautical engineer (W& B Engineer)
p) Signature and stamp of Authorized Quality Inspector
q) Signature of owner's representative

There must be an attached form in case there are basic items that are not installed in the aircraft when weighed and items weighed but not part of the basic weight as specified on the Aircraft Weight and Balance/ Maintenance or Owner's Manual or Aircraft Type Certificate Data Sheets.

Copy of the aircraft Weight & Balance report shall be submitted by the AMO to the CAAP/FSIS for evaluation and recording to its aircraft records.

WEIGHT AND BALANCE OF AIRCRAFT

6.16.4.5 AIRCRAFT WEIGHT AND BALANCE REPORT RECORDING

PADC shall accomplish three copies of the Aircraft Weight and Balance Report which will be submitted to the:

a) Operator/owner

b) CAAP- FSIS/EARD, for evaluation and recording

c) Additional copy of the Aircraft Weight and Balance Report shall be recorded by the AMO for reference until superseded by conditions, or till it is replaced or superseded by a new Aircraft Weighing Report.

6.17 LINE MAINTENANCE LOCATIONS

PADC provide services at the following locations as per customer's request

The following are the list of customer's/operators locations that PADC provide maintenance services:

1. Luzon Areas
2. Visayas Areas
3. Mindanao Areas

Updated Master list of customers/operators (Flying Schools, Private /Civilian and Government) and its locations, will be provided as other documents to be presented by PADC during the CAAP Facility Audit Inspection. Refer on the PADC MPM Appendices

6.18 REFERENCE TO SPECIFIC MAINTENANCE PROCEDURES

6.18.1 ENGINE RUN UP

GENERAL

Only authorized maintenance personnel are permitted to run aircraft engine and perform aircraft engine run-up checks. In the absence of qualified maintenance personnel, a qualified pilot may do the engine run-up

REQUIREMENTS:

1. Valid CAAP Airframe and Poweplant with a written concurrence by the Officer-In-Charge, Quality Assurance Department or his designate.

2. At least an Airframe and Powerplant Mechanic who has successfully completed required Engine Run-up Training Course.

3. A Mechanic must demonstrate familiarity with customer's or manufacturer's procedures governing run-up

4. Must have been authorized by the Customer and Officer-In-Charge, Quality Assurance Division

6.18.2 CORROSION AND TREATMENT PROCESS CONTROL

PURPOSE:

To establish effective control and treatment process control of aircraft.

PROCEDURE

1. Maintenance supervisory personnel shall be responsible for the following:
   a. Ensuring that only approved equipment and materials are used in the processes.
   b. Paint stripping, cleaning treatment processes applied on metal surfaces are in accordance with the recommended technical applications
   c. Metal surfaces are thoroughly cleaned prior to repainting.

2. Inspector concerned shall ascertain that the process applied during corrosion control and treatment operation is in accordance with applicable application.
3. Aircraft metal surfaces other that Titanium and corrosion resistant steels require protection and coating for corrosion prevention.
4. In conducting inspection for corrosion, particular attention shall be given to the underside of the fuselage, wing flaps, aileron and actuating mechanism. Areas subject to battery acid, smoke and exhaust fumes shall be require closer attention.
5. Preventive maintenance shall be properly observed for the control of corrosion like:
   a. Periodic internal and external cleaning
   b. Proper maintenance of protective finish
   c. Inspection of the aircraft for corrosion
   d. Treatment of typical areas for corrosion
   e. Polishing aircraft aluminum surfaces
6. Aluminum alloys and Brass have a definite affinity for Mercury and because of this property, contact with Mercury and Mercury salts results in rapid and severe corrosion of all surfaces and parts affected - Corrosion will occur with a few minutes after contact.

6.18.3 NON-DESTRUCTIVE TESTING

POLICY

Philippine Aerospace Development Corporation's on performing Non-Destructive Testing such as Surface Method, Eddy Current Inspection ,Fluorescent Penetrant Inspection , Magnetic Particle Inspection and Ultrasonic testing will be based on applicable manuals from the manufacturers, NDT Manuals and documents or current publications that may be supplied by the customer.

It is important that the assigned personnel be fully knowledgeable of the capabilities of each method, but it is equally important that he recognize the limitations of the methods.

Use of the techniques contained in the applicable manuals shall be in conformity with the manufacturers and customers requirements.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESSES

1 INTRODUCTION

The following information gives guidance on the penetrant dye processes used for the detection of defects which break the surface of the part, such as cracks, cold shuts, folds, laps and porosity.

1.1 Penetrant dye processes are used mainly for the detection of flaws in non-ferrous and non-magnetic ferrous alloys but may also be used for ferrous parts where magnetic flaw detection techniques are not specified or are not possible. However, in some instances both penetrant dye and magnetic flaw detection techniques may be specified for a particular part (see paragraph 1.5.4). Penetrant dyes may also be used on some non-metallic materials but their use with perspex-type materials is not recommended, since crazing may result.

1.2 Although the processes are usually marketed under brand names, those used on aircraft parts for which a penetrant process of flaw detection is a mandatory requirement must comply with the requirements of Process Specification DTD 929. It must be ensured that any storage limiting period prescribed by the manufacturer of the process is not exceeded.

1.3 The processes available can be divided into two main groups. One group involves the use of penetrants containing an emulsifying agent (termed water-emulsifiable or water-washable processes) whilst in the other group a dye solvent has to be applied separately after the penetration time (paragraph 4) has elapsed if the surplus dye is to be removed by a water-wash operation. The processes may be further sub-divided insomuch that with some processes the use of a dry developer is recommended whilst with others a wet developer is used. The manufacturers' recommendations and instructions for each individual process must be followed carefully to ensure satisfactory results.

NOTE: An emulsifier is a blending of wetting agents and detergents which enables excess dye to be removed with water and, in the case of wide flaws, assists in preventing the dye seeping out too quickly.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

1.4 Basically all the processes consist of applying a red penetrant dye to the surface of the part to be tested, removing after a predetermined time the dye which remains on the surface and then applying a developer, the purpose of which is to draw to the surface any dye that has entered into defects, the resultant stains indicating the positions of the defects.

1.5 The selection of the most suitable type of penetrant process (e.g. penetrant dye or fluorescent penetrant (Leaflet BLj8-7); with or without post-emulsification) for any given application must largely be governed by experience, since when used correctly a high degree of efficiency can be obtained with any of the processes. Guidance on some of the factors which should be given consideration is provided in the following paragraphs.

1.5.1 Within a given type of process, the post-emulsification method is generally considered to be the most sensitive and is. usually selected for finished machined parts and for the detection of "tight" defects. However, its use on rougher surfaces (e.g. castings) may be less effective than would be the use of a penetrant containing an emulsifier, since it may pick up the surface texture of the material, thus rendering the detection of actual defects more difficult.

1.5.2 Where large heavy parts are concerned, and particularly where mechanical handling is involved, the use of penetrant dyes may be more practicable than that of fluorescent penetrants, since the necessity of darkening a relatively large area before the examination can be made does not arise.

1.5.3 When making "in situ" checks on aircraft, the use of penetrant dyes may be more suitable where there is sufficient light but in darker areas a fluorescent process may provide better definition of defects.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

1.5.4 With steel castings, for example, porosity may be detected more easily by a penetrant process than by a magnetic flaw detection technique (Leaflet BL/8-5) and for this reason the application of both processes is sometimes specified. If the magnetic flaw detection test precedes the penetrant test, great care will be necessary with the intervening degreasing process to ensure that all traces of the magnetic testing medium are removed; otherwise the subsequent penetrant test may be unsuccessful.

1.6 Some of the materials associated with penetrant testing have low flash points and the appropriate fire precautions should be taken.

1.7 Guidance on fluorescent penetrant processes, which previously formed part of this leaflet, will be given in Leaflet BL/8-7, at present in preparation.

2 SURFACE PREPARATION

The major reason for the failure of penetrant processes to provide indications of defects is incorrect or inadequate surface cleaning. For example, embedded extraneous matter can seal off cracks, etc., whilst contaminants remaining on the surface can trap the dye and give rise to false indications or, more detrimentally, obscure genuine defects. Thus the surface to be tested must be free from oil, grease, paint, rust, scale, welding flux, carbon deposits, etc., and the method of cleaning should be selected with the intention of removing extraneous matter from within the defects as well as from the surface to permit maximum dye penetration.

2.1 On unmachined steel stampings and forgings it may be necessary to remove rust or scale by sandblasting and to prepare aluminium alloy forgings by light sandblasting. However, the use of such processes must be given careful consideration, since they may result in the filling or "peening-over" of defects. Generally, unless specified otherwise, aluminium alloy forgings should be prepared by a suitable pickling process (e.g. by one of the methods prescribed in Process Specification DTD 901).

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

2.2 Magnesium alloy castings should be tested after chromating in order to reduce the risk of corrosion, but the requirements of Process Specification DTD 911, with regard to surface protection, must be taken into account and a suitable sequence devised.

2.3 Where contamination is mainly of an organic nature, de greasing by the trichloroethylene process (unless there are instructions to the contrary) is usually suitable. However, not all types of trichloroethylene are suitable for use with titanium alloys and further guidance on this and other aspects of trichloroethylene cleaning is given in Leaflet BL/6-8. The cleaning of titanium alloys by methanol should be avoided.

2.4 Where parts have to be tested "in situ", the use of volatile solvents (e.g. carbon tetrachloride) as cleaning agents should be given consideration. Where paint is present, this should be removed from the surface to be tested prior to cleaning. Subsequent to the test, the surface should be reprotected in the prescribed manner.

NOTE: Suitable fire precautions must be taken when flammable materials are used.

2.5 Sufficient time should be allowed after cleaning for drying out; otherwise the efficiency of the penetrant dye may be affected. The time interval allowed for the evaporation of solvents can only be determined by the prevailing conditions of temperature and humidity and the type of solvent used.

3 APPLICATION OF THE DYE

The penetrant dye can be applied to the surface by dipping, spraying or brushing; the method used depending largely on the size, shape and quantity of the parts to be examined. The surface must be dry before the dye is applied. Even the condensation which forms on a cold surface in humid conditions may interfere with dye penetration; in such conditions the part should be warmed to a temperature of about 90°F to l00°F but temperatures in excess of 140°F must be avoided, since these may result in the volatilization of some of the lighter constituents of the dye.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

3.1 **Dipping Method.** Dipping should generally be used where large numbers of small parts are to be examined. The parts must be completely dried before immersion, since apart from affecting penetration, water or solvents will contaminate the dye.

3.1.1 During dipping care must be taken to ensure that the parts are so racked that air pockets are avoided and all surfaces to be examined are completely wetted by the dye.

3.1.2 It is not necessary for the parts to remain submerged in the tank during the penetration time (see paragraph 4) but only for a period sufficient to permit thorough wetting. "Drag-out" losses can be reduced if the dye is allowed to drain back into the tank during the penetration time.

3.2 **Flooding Method.** The flooding method should generally be used where large areas are to be examined. The dye should be applied with low-pressure spray equipment which will not permit atomization of the fluid, any surplus dye being allowed to drain back into the tank.

3.3 **Aerosol Can Method.** Penetrant contained in Aerosol type cans is often used for "in situ" inspections. The best results are obtained when the can is held about twelve inches from the surface under test.

3.4 **Brushing Method.** The brushing method is generally used for individual items and items of complicated shape. A clean soft bristle brush should be used and retained only for this purpose.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

4 PENETRATION TIME

The penetration time is the time which has to be allowed for the dye to penetrate effectively into the defects. It is dependent upon a number of factors, such as the characteristics of the process being used, the material from which the part is made, the size and nature of the defects being sought, the processes to which the part has been subjected and the temperatures of the atmosphere, the part and the dye. Clearly the time can be decided only by experience of the particular local conditions but is usually in the range of 5 minutes to 1 hour, the smaller the defect the longer the time necessary.

4.1 Temperatures below 60°F. will retard the penetrant action of the dye, thus the penetration time should be extended proportionately. Testing in temperatures at or near freezing point should, if possible, be avoided, since in such conditions the performance of the penetrant is considerably reduced.

4.2 Where the effectiveness of the pre-cleaning process cannot be guaranteed or where parts have been sandblasted, the penetration time should be extended but it should be borne in mind that this is no guarantee that defects will, in fact, be revealed in such conditions.

5 REMOVAL OF EXCESS DYE

Any dye remaining on the surfaces of the parts after expiry of the penetration time should be removed as thoroughly as possible but without disturbing the dye which would have found its way into any defects present. Excessive cleaning, however, may result in the dilution of the dye or its complete removal from defects. The method of removal depends on whether a water-washable or post-emulsifiable dye was used and the size and condition of the surface under test.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

5.1 **Water-washable Dye.** Water-washable dye should be removed as indicated in the following paragraphs.

5.1.1 The dye should be removed from "in situ" parts with clean rags saturated in water, followed by wiping with clean rags until the surfaces are both dry and free from dye.

5.1.2 The dye should be removed from small parts with clean rags saturated in water, followed by drying as recommended in paragraph 5.3.

5.1.3 The dye should be removed from large areas or irregularly shaped parts by flushing with an aerated spray of water, followed by drying as recommended in paragraph 5.3.

5.2 **Post-emulsifiable Dye.** Post-emulsifiable dye should be removed from small areas and "in situ" parts first by wiping with a clean rag damped with dye solvent, followed by wiping or blotting with a clean dry rag. The bulk of the dye may be removed from large areas, irregularly-shaped parts and rough-textured surfaces by a quick water wash (allowing this to drain) followed by the application of the dye solvent and a final water wash. The dye solvent should be applied by spraying, swabbing, dipping or brushing, except that brushing should not be used where relatively large defects are suspected. Washing should be followed by thorough drying, as outlined in paragraph 5.3.

5.3 **Surface Drying.** Prior to applying the developer (paragraph 6) it should be ensured that the surfaces of the part under test are completely dry. The following methods of surface drying are recommended which, although slower than the use of, for example, compressed air, are less likely to disturb entrapped dye.

5.3.1 Small areas may be wiped dry but since this may disturb the dye in the wider defects, the use of warm air is preferred.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

5.3.2 Hot-air ovens and similar equipment may be used for drying, a temperature of about 130°F being suitable; temperatures in excess of 175°F must be avoided. The use of lamps for drying is not recommended unless uniform heat application can be guaranteed.

6 APPLICATION OF THE DEVELOPER

The developer usually consists of a very fine absorbent white powder which may be applied in (a) the form of a spray, the powder being suspended in a volatile carrier liquid which rapidly evaporates, leaving a white coating on the surface, (b) as a dip with the powder suspended in water or (c) as a dry powder which may be blown on to the component or into which the component may be dipped. The action of the absorbent powder is to draw out the dye from the surface defects, thus indicating their position by the resulting stain.

6.1 Where it is suspected that microscopic defects may be present, great care is necessary to ensure that the developer is applied evenly and very thinly, since a thick layer might conceal completely a defect holding only a minute quantity of dye.

6.2 Where a wet developer is concerned, the best results are obtained when the developer is applied by means of a paint-type spray gun operating at an air pressure not in excess of 15 lb. sq. in. The pressure pot of the spray gun should be equipped with a stirrer to keep the developer agitated and the absorbent particles in suspension. Before pouring the developer into the spray gun it should be well shaken to ensure a thorough distribution of the absorbent particles.

6.3 When requirements are not too exacting, small parts can be dipped into a bath of developer but the action must be performed rapidly to minimize the possibility of the dye being washed out of shallow defects. The bath should be agitated from time to time to ensure that the absorbent particles are kept in uniform suspension. The formation of pools of developer on the parts during draining must be avoided; otherwise the resultant thick coatings may mask defects.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

6.4 Due to the usually uneven results obtained, the use of a brush for applying the developer is not recommended.

6.5 If the developer dries with a slightly pinkish hue, this is probably due to faulty cleaning or "carried over" penetrant in the penetrant remover (see paragraph 7.2) but provided sufficient contrast remains to enable minute defects to be detected, the condition is acceptable.

6.6 Water must not be permitted to enter the developer containers, since its presence will retard considerably the drying rate of the developer.

7 INTERPRETATION OF DEFECTS

If defects are present and all stages of the process have been applied correctly, the position of the defects will be indicated by red marks appearing on the whitened surface. The majority of defects are revealed almost immediately the developer dries but additional time (approximately equal to the penetration time (paragraph 4)) should be allowed for "tight" flaw indications to appear and for flaw patterns to reach their final shape and size. (Figure 1)

7.1 By noting and comparing the indications that appear during the first 30 seconds of development with those which exist after about 10 minutes, a more accurate assessment of the characteristics of the defects is possible. For example, the dye exuding from a shallow crack is little more after 10 minutes than after 30 seconds but in the case of a deep narrow crack, considerably more dye is present, causing a much wider indication to develop over a similar period of time. Thus the rate of staining is an indication of the width and depth of the defect, whilst the extent of staining is an indication of its volume.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

Figure 1 **INDICATIONS GIVEN BY DEFECTS**

7.2 Scattered dots of dye indicate fine porosity or pitting (Figure led»~ whilst gross porosity may result in an entire area becoming stained. Where doubt exists as to whether the overall pinkish effect is due to inadequate washing, the process should be repeated, more care being taken particularly during the stage of cleaning off the excess dye.

7.3 Closely spaced dots in a line or curved pattern (Figure l(c» usually indicate tight cracks or laps but such patterns are also characteristic of very wide defects from out of which most of the dye has been washed. Wide cracks, lack of fusion in welded parts and other similar defects are indicated by continuous lines as shown in Figures l (a) and l (b).

7.4 Examination by means of a powerful magnifying glass is often useful when minute defects are being sought.

7.5 All defects should be suitably marked prior to removing the developer, but crayons should not be used on highly-stressed components subject to heat treatment, since this is known to induce fractures.

NON-DESTRUCTIVE TESTING

6.18.3.1 DYE PENETRANT PROCESS

8 REMOVAL OF DEVELOPER

Developer can be removed by brushing or by air or water under pressure, but since the surface is then in a condition susceptible to corrosion (where this is applicable) the prescribed protective treatment should be applied with the minimum of delay. It should be noted that the adhesion of paints and resins may be seriously impaired by certain oil-base dyes if thorough cleaning is not ensured.

9 LEAK TESTING WITH PENETRANT DYES

On components or assemblies where the main purpose of the test is to locate defects which would result in a fluid leakage (e.g. cracks in pressure vessels) the methods of testing described in the previous paragraphs may not be conclusive. In such cases the inner and outer surfaces should be thoroughly cleaned and degreased, the dye being applied to one surface (usually the inside of pressure vessels) and the developer to the other. After the pentration time (paragraph 4) has elapsed, the surface should be inspected for evidence of staining.

9.1 Where no definite penetration time has been determined then, with a wall thickness of from 1/16 in. to 1/8 in., the penetration time should be at least three times that which would be allowed for a standard "one-side-only" test.

9.2 More than one application of the dye is often required and as a general rule an additional application for each 1/16 in. to 1/8 in. wall thickness is recommended.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

1 INTRODUCTION

This section gives guidance on the use of eddy current equipment for detecting cracks, corrosion or heat damage in aircraft structures, and also shows how the method can be used for the measurement of coating thickness or for sorting materials. Elementary theory of eddy currents is included to show the variables which are being measured and to indicate the interpretation of results which may be necessary for a particular application. Nothing in this Leaflet should be taken as overriding the information supplied by aircraft or engine manufacturers.

1.1 Eddy current methods can detect a large number of physical or chemical changes in a material, and the selection of the required parameter presents the equipment manufacturer with many problems; interpretation of the test indications would be very difficult if undesired parameters were not reduced or nullified. Conversely, equipment set up for a particular purpose is comparatively easy to use when indications are compared with a 'standard' or known defect. Eddy current equipment is normally built to perform only certain types of tests, these falling broadly into the categories of flaw detection, conductivity measurement and thickness measurement.

1.2 The main advantages of the use of eddy current methods are that they do not normally require extensive preparation of the surface or removal of the part to be tested, do not interfere with other work being carried out on the aircraft and, with surface defects, offer improved sensitivity over other non-destructive techniques. Small portable sets are battery powered and can easily be used in comparatively inaccessible places in aircraft structures.

1.3 Eddy current testing may be subject to certain difficulties, including depth of penetration and the effects of surface coatings and unseen changes in the geometry of the material under· test. In addition the results of a test can only be related to the size of signal received, and are not necessarily an indication of the size of defect. Techniques are established after trials have shown a method which gives consistent results.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

1.4 In aircraft work, eddy current testing is usually of the comparative type, a reference piece or standard in similar material containing an artificial defect, being used to compare indications from the part under test.

2 PRINCIPLES OF OPERATION

Eddy currents are induced in an electrically conducting material when the material is subjected to a changing magnetic field, and normally flow parallel to the surface of the material (Figure 1). In eddy current testing a coil is supplied with alternating current and held in contact with (or in close proximity to) the test specimen. The alternating magnetic field produced around the coil induces an alternating eddy current in the specimen, and the eddy current itself produces an alternating magnetic field which opposes and modifies the original coil field. The resultant magnetic field is the source of information which can be analyzed to reveal the presence of flaws in the test specimen.

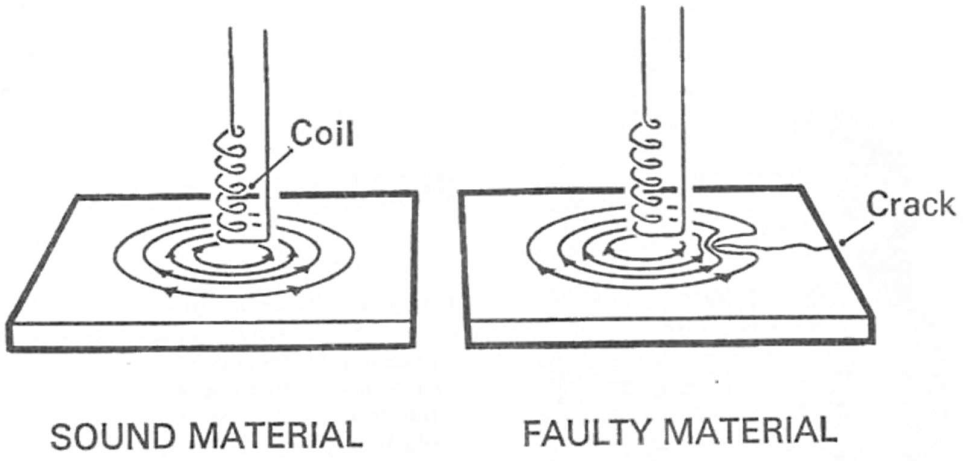

Figure 1 **EDDY CURRENT FLOW**

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

2.1 **Permeability.** This quality is a measure of the ease with which a material will conduct magnetic lines of force and decides the density of flux which can be induced in that material. Permeability is a function of magnetizing force and flux density; air and non-magnetic materials have, for testing purposes, permeability (μ) of 1, while ferromagnetic materials have permeability greater than 1. Permeability is not constant in magnetic materials, and varies with the magnetizing force (coil current). Eddy currents are induced by flux changes in a material and are directly related to flux density; as permeability increases so the strength of eddy currents increases. Non-magnetic materials do not generate additional flux densities, but magnetic materials produce high flux densities which can mask all other measurements. During tests on ferromagnetic materials, that is materials with a permeability greater than 1, these effects can be suppressed or made constant by saturation with high D.C. or A.C. fields which, in effect, restore the permeability to 1.

2.2 **Conductivity.** Conductivity (δ) is a measure of the ability of electrons to flow through a material and is one of the main variables in eddy current testing. Each material has a unique value of conductivity and this fact enables changes in chemistry, heat treatment, hardness or homogeneity to be detected simply by comparing the conductivity with a specimen of known properties; increased conductivity gives increased eddy currents (although depth of penetration decreases). Conductivity is measured in either of two ways;· it can be compared to a specific grade of high purity copper known as the International Annealed Copper Standard (IACS), which is considered as 100%, or it can be measured in meters per ohm millimetre^2. (58 m/Omm^2=100% IACS).

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

2.3 **Effects of Specimen on Test Coil.** A probe coil placed on the surface of a specimen will possess a particular value of impedance which can be found by measuring the voltage across the coil. The voltages due to resistance and reactance can also be separated and, if required, displayed on a cathode ray tube. Any change in conductivity, permeability or dimensions (d) of the specimen will, through the eddy current field, alter the coil's impedance, either in magnitude or phase, and, depending on the parameter sought, can be indicated on a meter or cathode ray tube display. Changes affecting apparent conductivity, e.g. a crack, will be 90° out of phase with changes affecting permeability or dimensions under certain test conditions.

2.4 **Geometry.** The size and shape of the test specimen may distort the primary magnetic field and mask defects in the affected area (Figure 2). The effects of geometry can be overcome by probe design, equipment calibration, frequency selection, or the use of jigs to maintain the probe in a particular relationship to the material surface, but must often be taken into account when conducting tests.

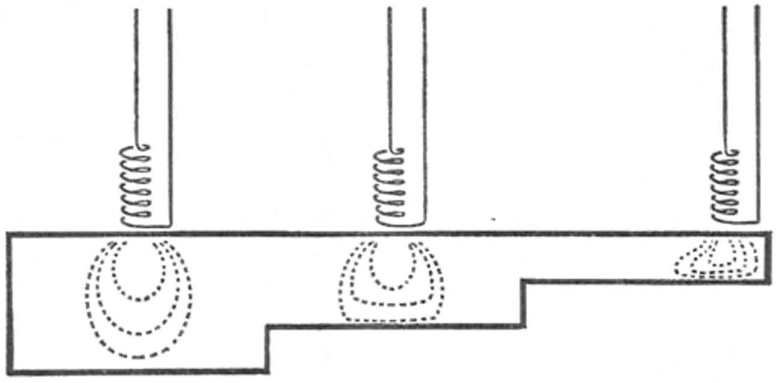

Figure 2 **GEOMETRIC EFFECTS ON PRIMARY MAGNETIC FIELD**

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

2.5 **Penetration.** Eddy currents are strongest at the surface of a material and weaken with depth. This effect becomes more pronounced with increased frequency (f) of the alternating magnetic field and is known as 'skin effect'. Increases in permeability (μ) and conductivity (δ) in a material also decrease penetration depth. In practice the depth of penetration (P) of eddy currents is related to a depth where the current is reduced to 1/e (approximately 37 %) of the surface current and may be calculated from the

formula, $\frac{P}{\sqrt{f\delta\mu}} = 500$ where P is in mm, and δ is in m/Ωmm^2.

2.6 **Effects of Frequency.** Any particular material possesses what is known as a characteristic frequency (f_g), which depends on its conductivity, permeability and dimensions. A practical use of the characteristic frequency is that samples of different materials tested at the same f/f_g ratio will give similar indications for similar defects. Actual test frequency is selected to obtain the best results from a particular test and depends on the type of defect sought, the depth of penetration required and the geometry of the specimen. When it is necessary to determine the phase of a signal, the frequency should be within the range where phase angle is greatest. When testing for conductivity only, to check hardness, heat treatment, etc., some penetration is required so a low frequency would be used, but when testing for surface cracks greater sensitivity would be obtained at a higher frequency.

2.6.1 In aircraft work testing is often concerned with thin sheet structure in aluminum alloy, and test frequencies between 5 kHz and 4 MHz are used, depending on the defect sought. However, frequencies as low as 50 Hz are used for checking material properties in ferromagnetic materials.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

2.7 **Lift-off.** This may be defined as the change in impedance of a coil when the coil is moved away from the surface of the specimen. This produces a large indication on the test equipment. In some equipment the lift-off effect is nullified by applying a compensating current to the probe circuit, thus enabling rapid testing without the need for special jigs, but in other equipment the lift-off effect is analyzed to measure, for example, the thickness of a non-conducting coating. This effect, when applied to encircling coils and bar specimens, is known as 'fill factor'.

3 COIL ARRANGEMENTS A number of different coil arrangements may be used in eddy current testing, and some of the more common are discussed below. The types shown in Figures 3, 4 and 5 are not generally used during aircraft maintenance operations, but are widely used by material and component manufacturers.

3.1 **Single Primary Coil.** Figure 3 shows the simplest arrangement. If a sound specimen is placed in the coil the impedance of the coil is modified and if a faulty specimen is placed in the coil the impedance is modified to a different degree.

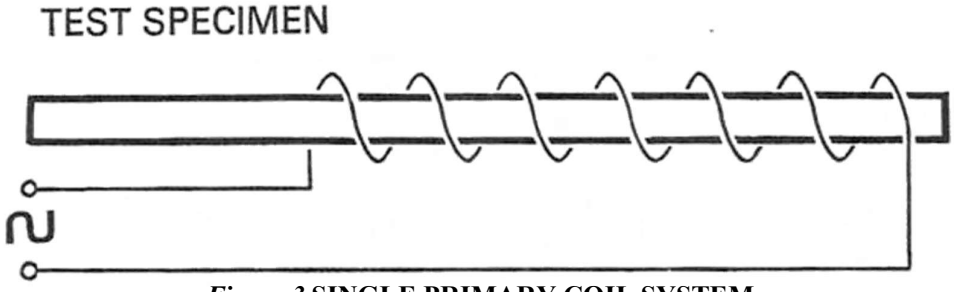

Figure 3 **SINGLE PRIMARY COIL SYSTEM**

3.2 **Comparative Coil System.** Figure 4 shows a coil arrangement which has two arms, one containing a flawless reference piece and the other the test specimen. Since the two sets of coils are identical any fault in the test piece will result in a voltage across AB.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

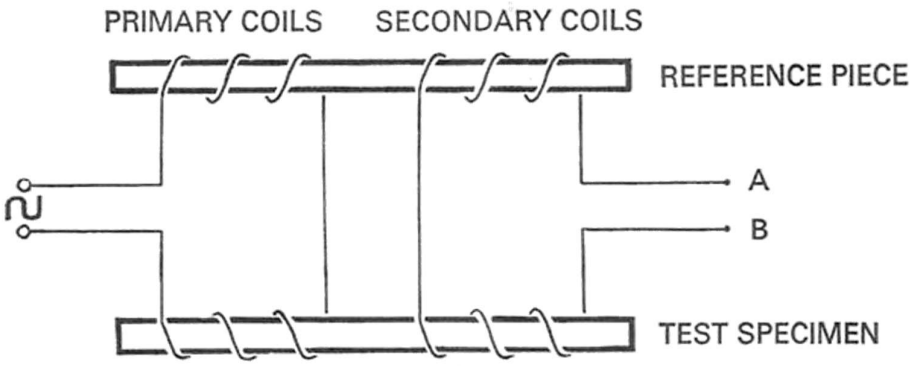

Figure 4 **COMPARATIVE COIL SYSTEMS**

3.3 **Differential Coil System.** Figure 5 shows a coil arrangement which is also a comparison method, but in this case adjacent portions of the test specimen are compared with each other. The coil windings are, in effect, identical to the comparative coil system shown in Figure 4.

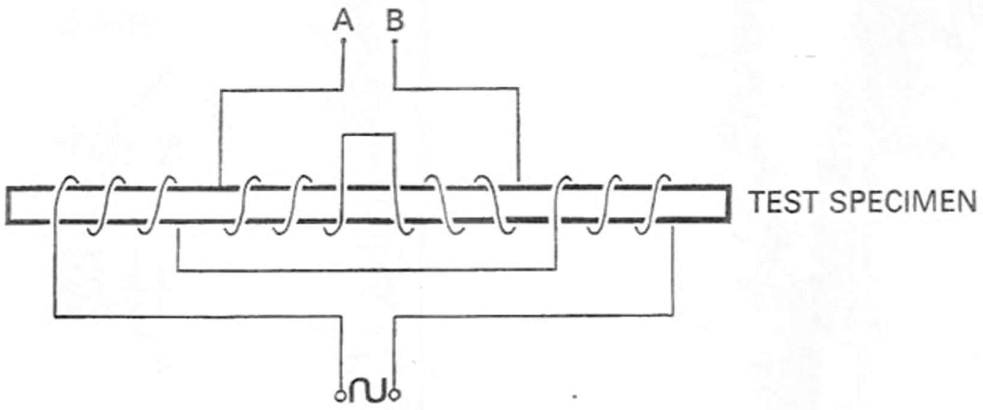

Figure **5 DIFFERENTIAL COIL SYSTEMS**

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

3.4 **Surface Coils.** In aircraft work a single coil is generally used, with the axis of the coil normal to the surface being tested (Figure 6). A ferrite core is used to increase sensitivity to small defects, and the arrangement is used for detecting cracks in flat surfaces, curved surfaces or holes, by mounting the coil within a specially shaped probe. Impedance changes obtained during a test are compared with those obtained from a defective part or a reference piece.

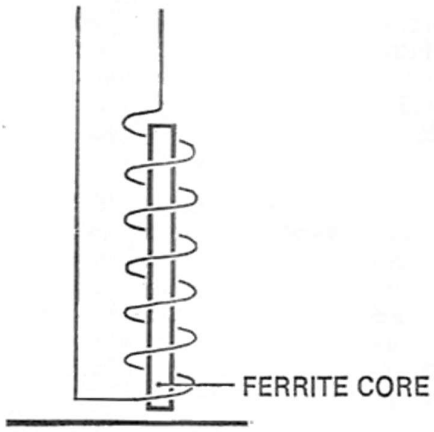

Figure 6 **SURFACE COIL**

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

4 TYPES OF CIRCUITS

4.1 **Bridge Circuits.** Figure 7 shows a bridge circuit, one arm of which consists of two adjustable controls and a coil, and the other arm comprises the reference and test coils. The bridge is balanced initially (meter zeroed by adjustment of the variable resistor and inductor) with the probe located on a flawless specimen. In use, any alteration in the impedance of the probe coil (due to faults in the test piece, or to lift-off) will unbalance the bridge and result in a deflection of the meter needle.

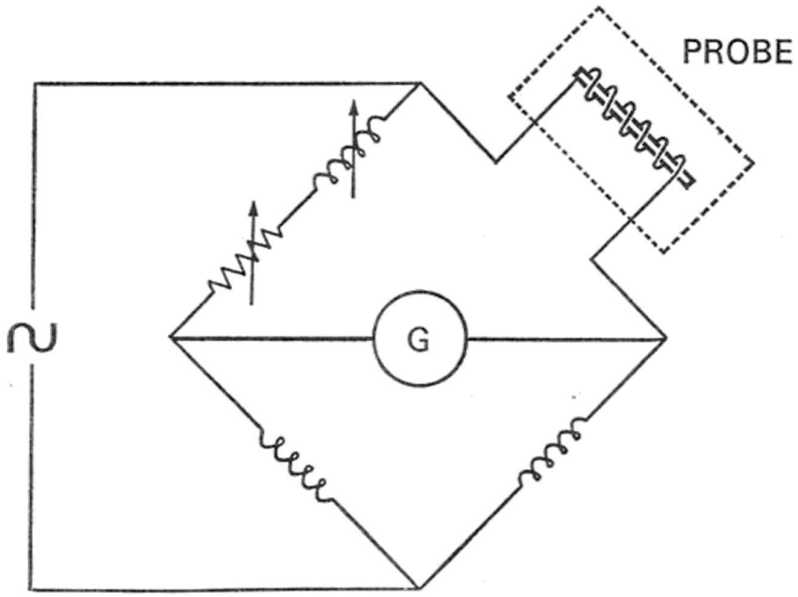

Figure 7 **BRIDGE CIRCUIT**

4.2 **Resonant Circuits.** The capacitance of a coil is usually small in relation to its inductance. However, if a capacitor is connected in the same circuit as a coil, since inductive reactance increases with frequency and capacitive reactance decreases with frequency, a condition will occur, at some frequency, when the effects are equal and opposite. This condition is known as resonance and the circuit then behaves as if it contained only resistance, resulting in a large change in current flow.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

4.2.1 Figure 8 shows a typical eddy current circuit which operates on the resonance principle. The probe is a parallel tuned circuit connected to the grid of an oscillator and determines the frequency at which the circuit oscillates. If the flux density (and hence the impedance) of the probe coil is altered (e.g. by placing the probe on a metallic object) the oscillator frequency changes. Consequently, the frequency developed in the anode tuned circuit is no longer the frequency at which that circuit is tuned. This results in a change of impedance, which is recorded on the meter through the secondary windings of the anode coil.

4.2.2 Operation of the circuit shown in Figure 8 is dependent upon adjustment of the controls to suppress lift-off. With the probe located on the test specimen the anode circuit is tuned to a frequency in sympathy with the probe circuit by adjustment of the variable capacitor (i.e. the lift-off control) until the meter reads zero. If the probe is now removed from the specimen a change in impedance will again occur and result in deflection of the meter needle; this deflection can be counteracted by adjustment of the set-zero and lift-off controls. Further adjustment of these two controls will enable a zero meter reading to be obtained with the probe on or off the specimen. Any change in the specimen (e.g. a defect) will result in a change in the impedance of the probe coil and a deflection of the meter needle, regardless of the presence of, for example, a paint film of uneven thickness.

A different type of resonant circuit is shown in Figure 9, the probe coil and capacitor in this case being connected in series. Lift-off is suppressed by the addition of a compensating voltage to the measurement voltage.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

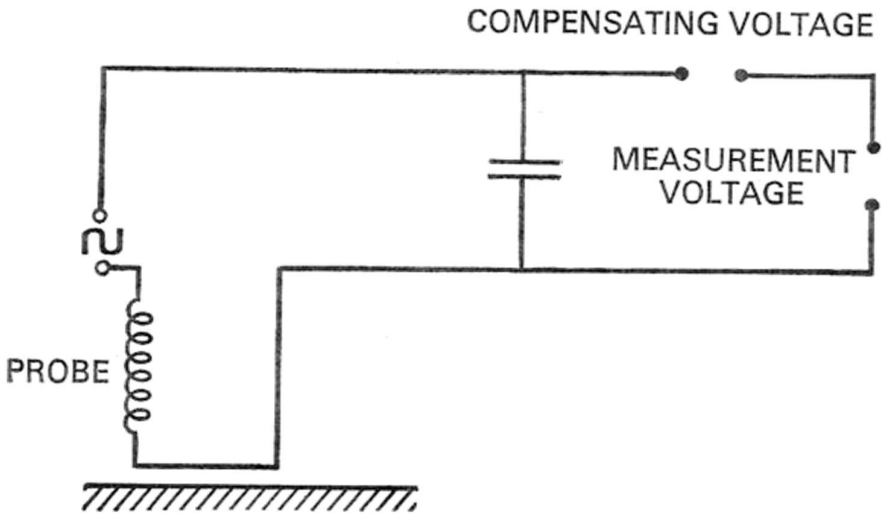

Figure 9 SERIES RESONANT CIRCUIT

5.1 **PHASE ANALYSIS** Where one of the parameters affecting impedance is required and all others can be assumed to be constant, the measurement of total impedance changes will satisfactorily reveal the presence of a defect or change in the unknown parameter, provided that a suitable reference piece is used for comparison. However, in many cases it is necessary to separate the reactive and resistive components of impedance in order to detect a particular type of defect and more sophisticated equipment becomes necessary.

Figure 10 shows the oscilloscope trace of a signal containing two voltages, V1 and V2, which are representative of the signal which could be obtained from eddy current equipment under certain test conditions. While the voltages are of the same frequency they can be seen to start at different points of the time scale, the difference resulting from the effects of reactance and being known as a phase change. Eddy current testing based on the use of phase change is known as phase analysis.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

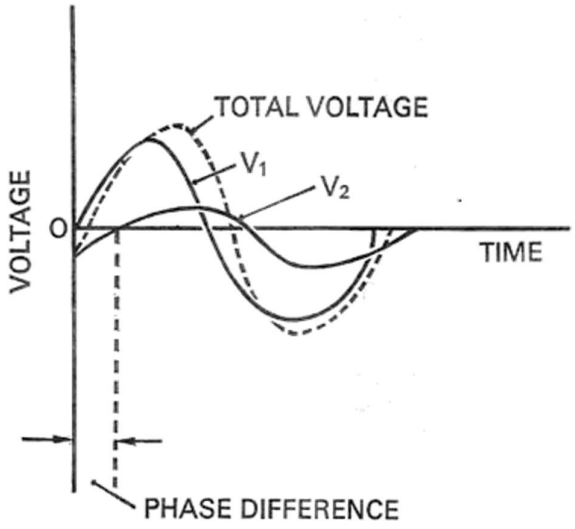

Figure **10 PHASE DIFFERENCE**

5.2 One method of suppressing the unwanted components of the measurement voltage (i.e. probe coil voltage) and presenting only the parameter required, is to include a phase sensing device in the circuit. This operates on the principle that only those components which are in phase with a reference voltage are passed to the meter. Figure 11 shows a typical phase sensing circuit in which the measurement voltage is applied to one diagonal of a bridge and a reference voltage to the other. The rectifiers act as switches which pass current during one half of each cycle of the reference voltage only, but no reference current flows through the meter due to the symmetry of the bridge circuit. The measurement voltage is applied to the meter during those periods when the rectifiers are conducting, and, by varying the phase of the reference voltage, unwanted components of the measurement voltage can be eliminated.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

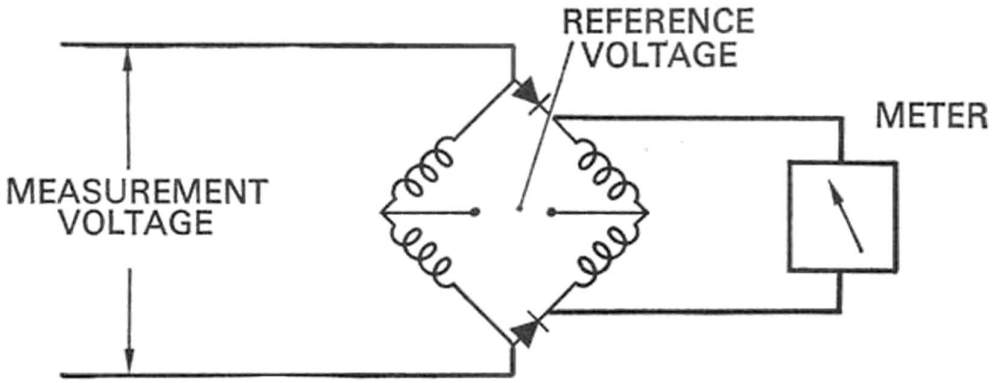

Figure 11 **SENSING CIRCUIT**

5.3 The resistive and reactive components of the measurement voltage (Vi and V. respectively) can also be separated, fed to separate plates of a cathode ray tube (CRT) and presented as a two-dimensional display on the screen. By suitable phase controls the vertical and horizontal components can be made to represent, for example, conductivity variations and dimensional variations respectively. The most common types of display are the vector point, ellipse and linear time base.

5.3.1 **Vector Point.** A spot is projected on to the screen of the CRT, representing the end of the impedance vector (Z) (Figure 12) and is adjusted to the centre of the screen when the test piece has the same properties as the reference specimen. Any anomaly in the test piece t: will result in movement of the spot, the direction of movement being an indication of the cause of the anomaly. If more than one variable is present, since the position of the spot indicates direction and magnitude, the cause can often be determined by vector analysis.

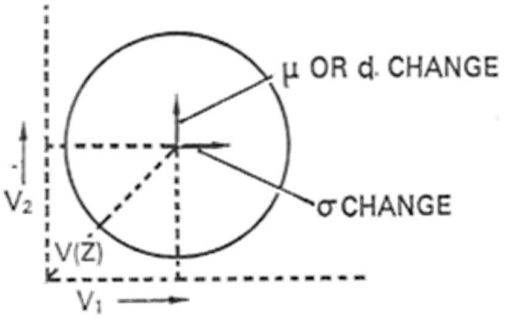

Figure **12 VECTOR POINT**

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

5.3.2 **Ellipse Method**. A comparative coil arrangement is also used in this method. In the balanced condition a horizontal line is shown on the screen of the CRT whilst an unbalanced condition can be shown in either of two ways. One variable can be displayed by a change in the angle of the line and a second variable by the formation of an ellipse (Figure 13). By analyzing the position and shape of the ellipse both variables can be evaluated.

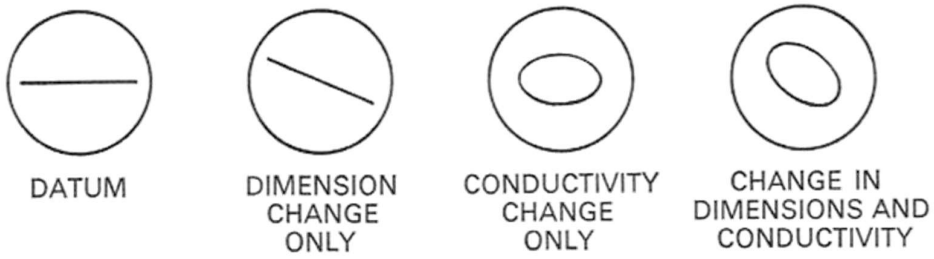

Figure **13 ELLIPSE METHOD**

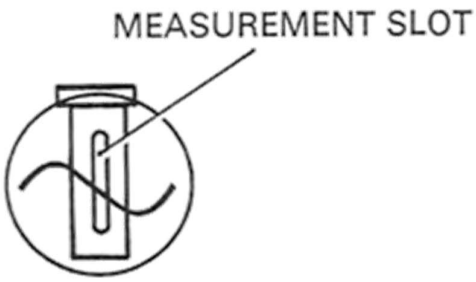

Figure **14 LINEAR TIME**

5.3.3 **Linear Time Base.** A spot moving across the screen at a constant rate can be adjusted to show the wave-form of the voltage from a comparative coil system. A change in impedance will alter the wave-form and either of the components of impedance can be measured by adjustment of the phase shift controls. To assist in measuring any changes, the screen is often fitted with a slotted cursor (Figure 14).

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

6 **PROBES** Unlike ultrasonic probes, the probes used in eddy current testing, because they are connected to the material by a magnetic field, do not require a coupling fluid, and no surface preparation is necessary other than the removal of any surface condition which would hinder free movement of the probe. Coils are also normally wound on a ferrite core, and this has the effect of concentrating the magnetic field and increasing sensitivity to small defects. Coils are often protected by enclosures in a plastics case, but the ferrite core is often left unprotected when required by particular test conditions. To maintain the coils in close proximity to the work it is often necessary to design a probe for one particular use only; some of the probes commonly used in aircraft work are discussed in 6.1,6.2, and 6.3.

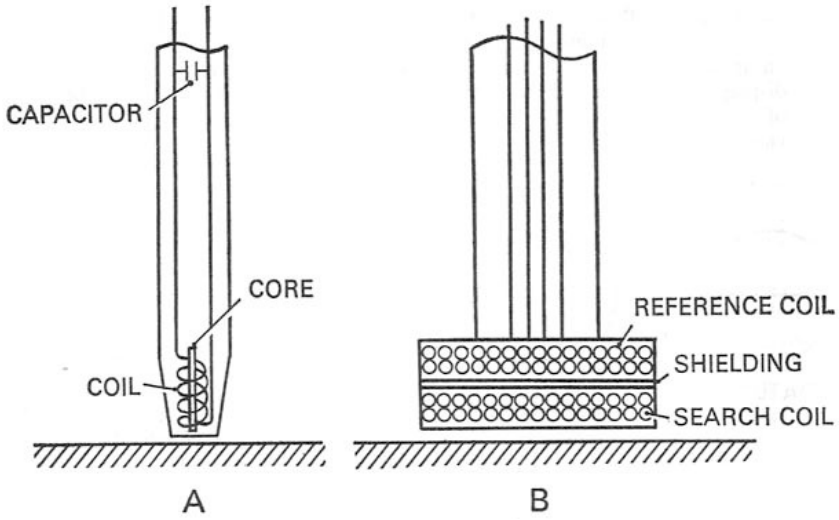

Figure 15
SURFACE PROBES

6.1 **Surface Probes.** Figure 15 shows two typical surface probes. (A) could be used for detecting surface cracks, and would be connected to a resonant circuit type of test set, whereas (B) could be used for coating thickness measurement or conductivity tests and would be connected in a bridge circuit type of test set. In the case of (A) a simple jig may be necessary to prevent spurious indications due to inadvertent probe angulations.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

6.2 **Hole Probes.** Hole probes used during material manufacture would normally consist of a coil, the axis of which would be coincident with the axis of the tube under test, but in aircraft work a hole probe is normally located with the coil diametrically across the hole to achieve greater sensitivity. This type of probe is therefore a surface probe used for testing the surface of a hole. Figure 16 shows a typical hole probe of the latter type, the main use for which would be the detection of radial cracks round fastener holes.

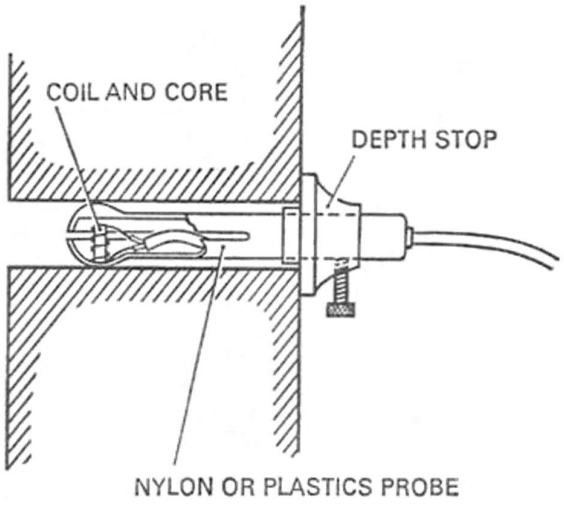

Figure 16 **HOLE PROBE**

6.2.1 The actual position of a crack can be determined by using an offset coil as illustrated, or by shielding one end of the coil.

6.3 **Special Probes.** Probes may be designed to suit any application, the object being to present a coil at a particular position on a component, so that information can be obtained from changes in the coil's impedance. Examples of the use of special probes would be for the detection of cracks in wheel bead seats, turbine engine compressor or turbine blades, and each of these probes could be connected to a single test set of suitable frequency and complexity. Probes are also designed with a view to eliminating the need for disassembly when carrying out routine maintenance operations.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

7 REFERENCE PIECES +-

In order to calibrate the equipment, standard reference pieces, manufactured from a material similar to that being tested, are necessary. These pieces should contain defects of known size and shape, so that the change in coil impedance against a known defect could be used as an acceptance limit.

7.1 A typical reference piece for surface crack tests would contain, for example, three cuts of different depths, the depth being marked adjacent to each cut, and the block being marked with the material specification. The test acceptance level could then be related to a signal of the same amplitude as that obtained on a specified cut in the block.

7.2 Reference pieces are usually small in size and can be taken to the test location so that quick cross-reference can be made between the reference piece and the test specimen.

NOTE: Since the manufacture of a reference piece involves the removal of metal (by saw cut or spark erosion), the phase and magnitude of the impedance changes will not be identical with those obtained from a natural crack of similar depth. For this reason, actual defective aircraft components are sometimes used to give comparative readings.

8 **TYPICAL APPLICATIONS OF EDDY CURRENTS.** The eddy current equipment used in many material manufacturing processes is very sophisticated and completely automatic. Bar, tube and wire materials are normally passed through encircling coils of suitable size, and defects are both displayed on a cathode ray tube and recorded by tape or memory store. Audible warning, marking, and defective component rejection systems, actuated by the defect signal, are also often included. A recent innovation is the use of rotating probes through which bar material can be passed, the advantage of this method being an increase in the sensitivity to surface cracks. In aircraft maintenance work, however, eddy current equipment is usually restricted to conductivity tests and crack detection, mainly by the use of surface probes. Sophisticated equipment such as that described above is not normally required and equipment is usually portable and battery operated. The following paragraphs describe typical eddy current applications.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

8.1 **Checking Fastener Holes for Cracks.** Suitable equipment for testing holes would be a simple impedance test set (i.e. not including phase analyzing circuits) with lift-off control, and the probe would be similar to that shown in Figure 16, adjusted to be a snug fit in the hole. The reference piece should be of similar material to that being tested, and should contain holes of the same size as the probe with natural cracks or artificial notches at various depths in the hole to simulate cracks of maximum acceptable size.

8.1.1 The following procedure should be used when carrying out a test:

(i) Clean loose paint, dirt, burrs, etc. from inside and around the holes being checked.

(ii) Calibrate instrument and adjust for lift-off in accordance with the manufacturer's instructions.

(iii) Insert probe in hole in reference piece and adjust depth stop to obtain maximum needle deflection from a selected notch or crack. Adjust sensitivity to give the specified scale deflection from the crack.

(iv) Insert probe in hole in test specimen and slowly rotate, noting and marking any holes producing needle deflections greater than that from the reference piece. Re-check probe in reference piece frequently.

NOTE: Any ovality in hole diameter will give a meter deflection which can be confused with the signal from a crack. Generally the indication from ovality shows a much slower change than that from a crack as the probe is rotated.

(v) Repeat (iii) and (iv) at incremental depths to cover the hole surface completely.

(vi) Ream out marked holes as recommended by aircraft manufacturer and repeat test with an appropriate sized probe and reference piece hole.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

8.2 **Checking Heat Damaged Skin.** The conductivity of aluminum alloy sheet will increase with exposure to elevated temperatures up to approximately 500°C, and above this temperature obvious signs of damage such as melted or charred metal become apparent. Tests conducted on the surrounding material will show the extent of the area in which the metal is below strength requirements and must be replaced.

8.2.1 The acceptable range of conductivity readings depends on the type of material and its heat treatment condition, and these readings may be stipulated in the appropriate Maintenance Manual. As a rough guide, the conductivity of unclad 7075- T6 material is 31 to 35% IACS, but the important reading in relation to heat damage is the change in conductivity between sound and defective material.

8.2.2 A conductivity meter should be used for this test, and this will normally be an impedance change instrument, with a meter and separate scale graduated in percentage IACS. This equipment is supplied with a surface probe and two test samples, one of high purity copper (with high conductivity) and the other a material of low conductivity, for calibration purposes.

8.2.3 The following procedure should be followed when carrying out the test:

(i) Thoroughly clean area to be inspected.

(ii) Calibrate instrument in accordance with the manufacturer's instructions.

(iii) Place probe on sound skin of similar material and thickness and remote from the heat affected zone, and adjust scale until meter is zeroed. Compare this reading with the expected conductivity.

(iv) Check conductivity all round the affected area, noting any meter deflection, and marking the skin accordingly. By this means a demarcation line can be drawn round the damaged area, and material removed up to this line.

NON-DESTRUCTIVE TESTING

6.18.3.2 EDDY CURRENT METHODS

8.3 **Detection of Corrosion.** Corrosion on hidden surfaces can be detected by eddy current methods using phase sensitive equipment. If a reading at the normal thickness of a sheet material can be taken, since corrosion reduces the thickness of a sheet, when the probe is over a corroded area a different reading will be obtained. The equipment can be set up by noting the readings obtained from a sound material of, say, 90% of the thickness of the test specimen, and a rough estimation of the volume of corrosion beneath the probe can be obtained during a test.

8.3.1 Equipment is available which is specially designed for thickness measurement having a meter graduated in appropriate units, but any equipment operating at a frequency which would give a penetration depth at least equal to the sheet thickness could be used to give an indication of the presence of corrosion. Equipment designed for detecting surface cracks and operating at very high frequency would be unsuitable.

8.3.2 Care is necessary when checking for corrosion to ensure that underlying structure (stringers, frames, etc.), chemically contoured areas, and loose debris, do not cause misinterpretation of results.

8.4 **Material Sorting.** Provided that a known sample is available, eddy current equipment can be used to ensure that a batch of materials is correctly identified, or that a component is made from the correct material. Simple impedance equipment could be used for coarse sorting, but in order to differentiate between materials closely related in composition, equipment with phase sensing circuits is necessary. By placing the known sample in an encircling coil the characteristic trace of that material can be displayed on an oscilloscope and unknown samples accepted or rejected by comparison.

8.5 **Coating Thickness Measurement.** The thickness of conducting or non-conducting coatings on ferrous or non-ferrous bases can be measured using basic eddy current methods; although measurement becomes difficult where the conductivity of the coating and base metal are similar. It is possible to utilize crack detection equipment for measuring thick coatings, by comparing the readings obtained from the test specimen with the lift-off effect obtained when the probe is placed on slips of non-conducting material (e.g. mica) of known thickness.

NON-DESTRUCTIVE TESTING

6.18.3.3 FLUORESCENT PENETRANT PROCESSES

When measuring very thin coatings however (i.e. less than 0·12 mm (0·005 inch», it is recommended that equipment designed specially for coating thickness

1. **INTRODUCTION.** This leaflet gives guidance on the fluorescent penetrant processes used for the detection of defects in a component, such as cracks, cold shuts, folds, laps and porosity when these break the surface of the component.

1.1 Fluorescent penetrant processes are used mainly for the detection of flaws in non-ferrous and non-magnetic ferrous alloys but may also be used for ferrous parts where magnetic flaw detection techniques are not specified or are not possible. In some instances both fluorescent penetrant and magnetic flaw detection techniques may be specified for a particular part (see paragraph 1.5.4). Fluorescent penetrants may also be used on some non-metallic materials, such as plastics and ceramics, but in each case a suitable process for the particular material must be selected. The processes are not suitable for use on absorbent materials.

1.2 Although the processes are usually marketed under brand names, those used on aircraft parts for which a penetrant process of flaw detection is a mandatory requirement must comply with the requirements of Process Specification DTD 929. It must be ensured that any storage limiting period prescribed by the manufacturer of the process is not exceeded.

1.3 There are two types of fluorescent penetrants, a minor water-based group and a major oil-based group; the manufacturers of the processes usually specify the materials for which each process is suitable. There are variations in the processes which must be taken into account. For example, some types of penetrants contain an emulsifier, whilst in other processes the penetrant and the emulsifier are applied as separate stages. Again in some processes the use of a dry developer is recommended whilst in others a wet developer is used. The manufacturer's recommendations and instructions for each individual process must be followed carefully to ensure satisfactory results.

NOTE: An emulsifier is a blending of wetting agents and detergents which enables excess penetrant to be removed with water.

NON-DESTRUCTIVE TESTING

6.18.3.3 FLUORESCENT PENETRANT PROCESSES

1.4 Fluorescent penetrant testing is based on the principle that when ultra-violet radiation falls on certain chemical compounds (in this case the penetrant) it is absorbed and its energy is re-emitted as visible light (i.e. the wavelength of the light is changed). Thus, if a suitable chemical is allowed to penetrate into surface cavities, the places where it is trapped and has been drawn to the surface by the developer will be revealed by brilliant greenish-yellow lines or patches (according to the nature of the defect) under the rays of an ultra-violet lamp.

1.5 The selection of the most suitable type of penetrant process (e.g. penetrant dye (Leaflet BLJ8-2) or fluorescent penetrant; with or without post-emulsification) for any given application must largely be governed by experience, since when correctly used a high degree of efficiency can be obtained with any of the processes. Guidance on some of the factors which should be given consideration is provided in the following paragraphs.

1.5.1 Within a given type of process, the post-emulsification method is generally considered to be the most sensitive and is usually selected for finished machined parts and for the detection of "tight" defects. However, its use on rougher surfaces (e.g. castings) may be less effective than would be the use of a penetrant containing an emulsifier, since it may pick up the surface texture of the material, thus rendering the detection of actual defects more difficult.

1.5.2 Where large, heavy parts are concerned, and particularly where mechanical handling is involved, the use of penetrant dyes may be more practicable than that of fluorescent penetrants, since the necessity of darkening a relatively large area before the examination can be made does not arise.

1.5.3 When making "in situ" checks on aircraft, the use of penetrant dyes may be more suitable where there is sufficient light but in the darker areas a fluorescent process may provide better definition of defects.

1.5.4 With steel castings, for example, porosity may be detected more readily by a penetrant process than by the magnetic flaw detection techniques (Leaflet BLj8-S) and for this reason the use of both processes is sometimes specified. If the magnetic flaw detection test precedes the penetrant test, great care will be necessary with the intervening degreasing process to ensure that all traces of the magnetic testing medium are removed; otherwise the subsequent penetrant test may be unsuccessful.

NON-DESTRUCTIVE TESTING

6.18.3.3 FLUORESCENT PENETRANT PROCESSES

1.6 Some of the materials associated with penetrant testing have low flash points and the appropriate fire precautions should be taken.

1.7 Guidance on dye penetrant processes is given in Leaflet **BL/8-2.** Information on the performance testing of penetrant testing materials is given in Leaflet **BL/I0-9.**

2 **SURFACE PREPARATION.** The major reason for the failure of penetrant processes to provide indications of defects is incorrect or inadequate surface cleaning. For example, embedded extraneous matter can seal off cracks, etc., whilst contaminants remaining on the surface can trap the penetrant and give rise to false indications or, more detrimentally, obscure genuine defects. Thus the surface to be tested must be free from oil, grease, paint, rust, scale, welding flux, carbon deposits, etc., and the method of cleaning selected must be capable of removing extraneous matter from within the defects as well as from the surface to permit the maximum penetration.

2.1 With unmachined steel stampings and forgings it may be necessary to remove rust or scale by sandblasting. Aluminum alloy forgings may also need light sandblasting. However, the use of such processes must be given careful consideration, since they may result in the filling or "peening-over" of defects. Generally, unless specified otherwise, aluminum alloy forgings should be prepared by a suitable pickling process (e.g. by one of the methods prescribed in Process Specification DTD 901).

2.2 Magnesium alloy castings should be tested after chromating in order to reduce the risk of corrosion, but the requirements of Process Specification DTD 911, with regard to surface protection, must be taken into account and a suitable sequence devised.

2.3 Where contamination is mainly of an organic nature, degreasing by the trichloro-ethylene process (unless there are instructions to the contrary) is usually suitable. However, not all types of trichloroethylene are suitable for use with titanium alloys and further guidance on this and other aspects of trichloroethylene cleaning is given in Leaflet BLf6-8. The cleaning of titanium alloys by methanol should be avoided.

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2.4 Where parts have to be tested "in situ", the use of volatile solvents (e.g. carbon tetrachloride) as cleaning agents should be given consideration. Where paint is present this should be removed from the surface to be tested prior to cleaning. Subsequent to the test, the surface should be reprotected in the prescribed manner.

NOTE: Suitable fire precautions must be taken where flammable materials are used.

2.5 Sufficient time should be allowed after cleaning for drying-out, otherwise the efficiency of the penetrant may be affected. The time interval allowed for the evaporation of solvents can only be determined by the prevailing conditions of temperature and humidity and the type of solvent used.

3 APPLICATION OF THE PENETRANT PROCESS (WITHOUT POST EMULSIFICATION)

3.1 **Application of Penetrant.** The penetrant can be applied to the surface by dipping, spraying or brushing; the method used depending largely on the size, shape, and quantity of the parts to be examined. The surface must be dry before the penetrant is applied. Even the condensation which forms on a cold surface in humid conditions may interfere with penetration; in such conditions the part should be warmed, preferably within the temperature range of 70°F. to 90°F.

3.1.1 Dipping Method. Dipping should generally be used where large numbers of small parts are to be examined. The parts must be completely dried before immersion, since apart from affecting penetration, water or solvents will contaminate the penetrant.

(i) During dipping care must be taken to ensure that the parts are so racked that air pockets are avoided and all surfaces to be examined are completely wetted by the penetrant.

(ii) The parts should be dipped for a few seconds and allowed to drain, care being taken to ensure that the solution is able to drain away from any pockets or cavities in the parts. If there is a tendency for the penetrant to dry on the surfaces the parts should be redipped.

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6.18.3.3 FLUORESCENT PENETRANT PROCESSES

3.1.2 **Flooding Method.** The flooding method should generally be used where large areas are to be examined. The penetrant should be applied with low-pressure spray equipment which will not permit atomization of the fluid, care being taken to ensure that the penetrant completely covers the surface and remains wet. On no account should the penetrant be allowed to dry during the penetration period (paragraph 3.2).

3.1.3 **Aerosol Method.** Penetrant contained in aerosol-type cans is often used for "in situ" inspections. The best results are obtained when the can is held about 12 in. from the surface under test.

3.1.4 **Brushing Method.** The brushing method is generally used for individual items and items of complicated shape. A soft clean bristle brush should be used and retained only for this purpose. On no account should the penetrant be allowed to dry during the penetration period.

3.2 **Penetration Time.** The penetration time is the time which has to be allowed for the penetrant to enter effectively into defects and usually a period of up to ten minutes is sufficient for the larger type defects, but longer times may be necessary where minute defects are being sought. (See Table 1)

3.2.1 Typical penetration times are given in Table 1 but these may vary according to the temperature and process used. The manufacturer's recommendations must always be followed where these differ from the figures given.

3.2.2 Where the effectiveness of the pre-cleaning process cannot be guaranteed or where parts have been sandblasted, the penetration time should be extended but it should be borne in mind that this is no guarantee that defects will, in fact, be revealed in such conditions.

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6.18.3.3 FLUORESCENT PENETRANT PROCESSES

TABLE 1

Material	Nature of Defect	Penetration Time (Minutes)
Sheets and Extrusions	Heat treatment cracks, grinding cracks and fatigue cracks.	15
Forgings	Laps, Cracks.	30
Castings	(i) Shrinkage, cracks and porosity. (ii) Cold Shuts.	3-10 20
Welds	(i) Cracks, porosity. (ii) Included flux.	20 1
Plastics	Cracks, crazing.	1-5

3.3 Removal of Excess Penetrant. Excess penetrant should be removed by spraying with running water at a mains pressure of about 30 lb. sq. in. or by the use of an air/ water gun. In the case of self-emulsifying penetrants, it may be necessary with some surfaces to use a detergent solution, supplied by the manufacturer, prior to spraying the developer. It is most important to ensure that the rinsing operation is completely effective, otherwise traces of the residual penetrant may remain on the surface and interfere with the subsequent diagnosis of defects.

3.3.1 After rinsing, the surfaces of the component should be quickly inspected by means of ultra-violet light to ascertain the efficiency of the rinse. If any general fluorescence is still evident the rinsing operation should be repeated.

3.3.2 If a wet developer is to be used, the surfaces need not be dried but drying is essential if a dry developer is to be used. On large parts the excess water can be blown off with clean, dry, oil-free air but when parts are of convenient size, drying in a recirculation hot-air drier is recommended. Excessive time in the drier should be avoided, as the penetrant will slowly evaporate.

3.4 Application of the Developer. The developer usually consists of a very fine white powder which may be applied in (a) the form of a spray, the powder being suspended in a volatile liquid carrier, (b) as a dip with the powder suspended in water or (c) as a dry powder which may be blown on to the component or into which the component may be dipped. The action of the absorbent powder is to

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draw out the dye from the surface defects, thus indicating their position by the resultant yellowish-green stain when viewed under ultra-violet light.

3.4.1 Where it is suspected that microscopic defects may be present, great care is necessary to ensure that the developer is applied evenly and very thinly, since a thick layer might completely conceal a defect holding only a minute quantity of dye.

3.4.2 Where a wet developer is concerned, the best results are obtained when the developer is applied by means of a paint-type spray gun operating at an air pressure not in excess of 15 lb. sq. in. The pressure pot of the gun should be equipped with a stirrer to keep the developer agitated and the absorbent particles in suspension. Before pouring the developer into the spray-gun it should be well shaken to ensure thorough distribution of the absorbent particles.

3.4.3 When requirements are not too exacting, small parts can be dipped into a bath of developer but the action must be performed rapidly to minimize the possibility of the penetrant being washed out of shallow defects. The bath should be agitated from time to time to ensure that the absorbent particles are kept in uniform suspension in the solvent. The formation of pools of developer on the parts during draining must be avoided; otherwise the resultant thick coatings may mask defects.

3.4.4 Due to the usually uneven results obtained, the use of a brush for applying the developer is not recommended.

3.4.5 After the developer has been applied, the parts should be allowed to stand for at least 15 minutes and should then be examined in a darkened room, using ultraviolet light. Where doubt exists as to the validity of an indication, the part should be left for at least two hours and then re-examined. If viewing periods are to exceed 30 minutes, the use of special viewing goggles is recommended to reduce the risk of eyestrain and headaches.

NOTE: Portable lamps specially manufactured for fluorescent viewing are available.

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6.18.3.3 FLUORESCENT PENETRANT PROCESSES

4. APPLICATION OF THE PENETRANT PROCESS (WITH POST EMULSIFICATION) In principle the process is similar to that described in the previous paragraph, except for the addition of the emulsification step. However, the separate application of penetrant and emulsifier does introduce additional factors which must be taken into account and these are described below.

4.1 After the parts have been dipped in the penetrant, the drain-off period should not be less than 15 minutes and not more than 2 hours. If the period is less than 15 minutes, dilution of the emulsifier by the penetrant may occur and penetration of contaminated defects may not be complete. If the period exceeds 2 hours, partial drying of the penetrant may occur, resulting in exceptionally long emulsification times. Once an optimum draining period has been determined for a particular part, it should be adhered to within ±20 per cent, since this period directly influences the process and effects of emulsification.

4.2 The parts should be dipped into the emulsifier (the length of time the emulsifier is allowed on the parts being somewhat critical), and should be held to the minimum time necessary to give a good water wash, since this will result in the highest sensitivity. It should be determined by experience for each type of part and finish and then strictly adhered to.

4.3 An average emulsification time is about 2 minutes, but may vary between 30 seconds to 5 minutes, according to the surface condition of the part.

4.4 After removal of the emulsifier, the part should be dried, treated in the dry developer and then inspected for defects.

5. INTERPRETATION OF INDICATIONS. If defects are present and all stages of the process have been applied correctly, they will be indicated by brilliant greenish-yellow marks on the surface of the part; some may appear immediately as the developer dries but others may take longer to develop. The characteristics of the markings, such as the rapidity with which they develop and their final shape and size, provide an indication as to the nature of the defect revealed (see Figure 1).

5.1 The rate of staining is an indication of the width and depth of the defect, whilst the extent of staining is an indication of its volume. A wide shallow defect is revealed almost instantly but narrow deep defects may take some time to display the final pattern.

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6.18.3.3 FLUORESCENT PENETRANT PROCESSES

Figure 1 **INDICATION GIVEN BY DEFECTS**

5.2 Scattered dots indicate fine porosity or pitting (Figure 1 (d)), whilst gross porosity may result in an entire area becoming stained.

5.3 Closely spaced dots, in a line or curved pattern (Figure 1 (c», usually indicate tight cracks or laps but such patterns are also characteristic of very wide defects from out of which most of the penetrant has been washed. Wide cracks, lack of fusion in welded parts and other similar defects are indicated by continuous lines as shown in Figures 1 (a) and 1 (b).

5.4 All defects should be suitably marked prior to removal of the developer, but crayons should not be used on highly-stressed components subject to heat treatment, since this is known to induce fractures.

6. REMOVAL OF DEVELOPER. Developer should be removed by washing with water spray or by dipping the component in an aqueous solution of 2 per cent chromic acid. Since the surface is then in a condition susceptible to corrosion (where this is applicable) the prescribed protective treatment should be applied without delay.

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6.18.3.4 MAGNETIC PARTICLE INSPECTION

1. **INTRODUCTION.** This Leaflet gives guidance on the detection of surface and sub-surface defects in ferro-magnetic materials by magnetic processes. The procedures recommended in this Leaflet are complementary to British Standard (BS) M35, and should not be taken as overriding the techniques of examination prescribed by the manufacturer of a particular component, either in drawings or in approved manuals.

   1.1 Magnetic flaw detection tests are applied to many steel parts at the manufacturing, fabrication and final inspection stages. The process is normally applied to all Class 1 aircraft parts manufactured from Ferro-magnetic materials, and to any other parts where the designer or inspection authority considers it to be necessary.

   NOTE: A Class 1 part is defined as a part, the failure of which, in flight or ground maneuvers, would be likely to cause catastrophic structural collapse, loss of control, power unit failure, injury to occupants, unintentional operation of, or inability to operate, essential services or equipment.

   1.2 The methods of magnetizing in general use are the magnetic flow and the current flow processes, which are described in paragraph 3. By choosing the most suitable process, or combination of processes, for a particular component, both surface and subcutaneous defects may be revealed.

   1.3 Great care must be taken when establishing a technique of examination suitable for a particular component, in order to ensure that consistent results are obtained. Operators of magnetic flaw detection equipment should be thoroughly trained in its use, and experienced in interpreting technique requirements and the indications obtained from a test.

2. **THE PRINCIPLE OF MAGNETIC FLAW DETECTION.** If a component is subjected to a magnetic flux, any discontinuity in the material will distort the magnetic field and cause local leakage fields at the surface. Particles of magnetic material applied to the surface of the magnetized component will be attracted to the flux leakage areas and reveal the presence of the discontinuity.

   2.1 The sensitivity of magnetic flaw detection depends largely on the orientation of the defect in relation to the magnetic flux, and is highest when the defect is at 90° to the flux path. Sensitivity is considerably reduced when the .angle between the

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defect and the flux path is less than 45°, so that two tests are normally required with each component, the flux path in the first test being at 90° to the flux path in the second test. Components of complex shape may require tests in several different directions.

2.2 A component may be magnetized either by passing a current through it, or by placing it in the magnetic circuit of a permanent magnet or electromagnet. The required strength of the applied magnetic field varies considerably, and depends largely on the size and shape of the component and on the magnetic characteristics of the material from which it is made.

2.3 The magnetic particles used to reveal defects are either in the form of a dry powder, or suspended in a suitable liquid. They may be applied by spray, pouring, or immersion, depending on the type of component. Magnetic flaw detection 'inks' complying with BS 4069 are used in aircraft work, and consist of finely divided black or red magnetic oxides of low coercivity (i.e. they will not retain the magnetism induced during testing), suspended in a liquid (normally kerosene). Pigments may be added to provide a contrast with the surface of the specimen. Black inks are suitable for use on bright, machined components, but red inks may be more suitable for unmachined parts or, alternatively, a thin coat of white paint or strippable lacquer may be added to the component before carrying out the test.

2.3.1 If magnetic inks are left standing for long periods the solid particles settle at the bottom of the container and form sediment which may be difficult to redisperse. If the machine does not have pump agitation, frequent manual agitation must be provided during tests to ensure satisfactory inking of the specimens. The solids concentration in inks manufactured to BS 4069 should be 0,8 to 3·2 % by volume, but with fluorescent inks the solids content is approximately one tenth of these values. Methods of determining the solids content of magnetic inks are detailed in BS 4069. Magnetic ink should be discarded if it becomes diluted by solvents or contaminated with oil or any foreign substance likely to reduce its effectiveness as a detecting medium.

2.3.2 Fluorescent inks are also widely used and are often specified where high sensitivity is required. Inspection of a component to which fluorescent ink has been applied, should be carried out under black light.

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3. METHODS OF MAGNETISATION

3.1 **Current Flow Method.** If an electric current is passed through a conductor, a magnetic flux is induced, both within the conductor and in the surrounding atmosphere, in a series of concentric circles at 90° to the direction of current flow. With steady current the strength of the internal magnetic flux is greatest at the surface of the conductor and decreases uniformly to zero at the centre, but with alternating current both the current and magnetic flux are confined to a thin layer at the surface, because of the effects of induction. Magnetization at the surface can be greater with alternating current than with direct current, but direct current has the advantage of greater depth of penetration. In practice, machines are often designed so that alternating or rectified current can be applied to a specimen, to make use of the advantages of each method.

3.1.1 Current flow machines normally provide a sustained current through the specimen, ink being applied while current flows. The specimen is usually clamped between contact pads on a static machine, but portable units are available in which the contacts take the form of hand-held prods, and these are often used for checking components which are difficult to mount in a static machine. Good electrical contact is essential, and the contacts are usually provided with copper gauze pads, sufficient pressure being used to prevent arcing between the pads and the specimens. Because of the dangers of burning and possible subsequent fatigue cracking, the use of prods is often prohibited on finished parts, especially those of high tensile steel.

3.1.2 A variation of current flow magnetization is the "impulse" method, which employs either direct or alternating current in the form of a short impulse (generally less than one second). Difficulty may be experienced in satisfactorily inking the specimen while current is flowing, and the specimen may be immersed in a bath of magnetic ink. Alternatively, with some materials, remanent magnetism may be sufficiently strong to provide defect indications when ink is applied after current has ceased to flow. The alternating current impulse method is not often used, due to the difficulty of interrupting the current at a point in the hysteresis loop which will leave the specimen adequately magnetized.

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3.1.3 For testing purposes it is usual to apply a sufficiently heavy current to give a satisfactory magnetic flux in the specimen, and to use a low voltage to safeguard the operator. As a rough guide to the basic current setting to use, most steels can be satisfactorily tested using an alternating current of 500 A rms per inch diameter or, for specimens of irregular shape, 150 A rms per inch of periphery. Some steels, e.g. nickel-chrome steels, may require a higher magnetizing force due to their low permeability. Current values for irregular shaped components should be decided by fixing an artificial defect to the area required, applying ink, and varying current value until a satisfactory indication is obtained.

NOTE: The effective current value with regard to magnetization is the peak value. Ammeters do not usually record the peak value however, and testing techniques must state whether the current values specified are rms (root mean square) or peak. It is normally assumed that an ammeter reading rms is fitted to an a.c. machine, and an ammeter reading mean current is fitted to a rectified a.c. or constant potential d.c. machine. Current values producing a magnetic flux equivalent to that produced by 500 Arms, a.c., with these types of ammeter fitted, are: ---

d.c.	– 710 A
half-wave rectified a.c.	– 225 A
full-wave rectified a.c.	– 450 A

If a peak-reading ammeter is fitted to an a.c. machine, the current value should be the same as for d.c. (i.e. 710 A). In cases where the wave form is unknown, the relationship between peak and average· values must be determined empirically, and the current adjusted accordingly.

3.1.4 The passage of a heavy current will have a heating effect on the specimen, particularly when direct current is used. This could cause burning in specimens such as thin tubes, and possibly have an adverse effect on any heat treatment previously applied. The duration of each test should, therefore, be limited to as short a time as possible, consistent with satisfactory inking of the specimen.

3.2 **Induction Methods.** In all induction methods, the magnetic field external to the current-carrying element is used to induce a magnetic flux in the specimen.

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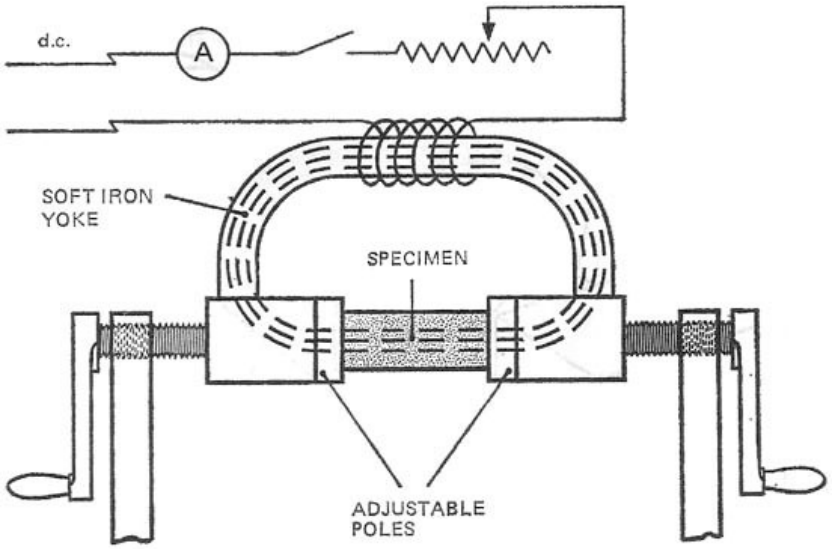

Figure 1 **MAGNETIC FLOW MACHINE**

3.2.1 **Magnetic Flow Method.** Figure 1 shows the arrangement of a typical magnetic flow machine, the specimen being clamped between adjustable poles in the magnetic circuit of a powerful electromagnet. Good contact between the poles and specimen is essential; otherwise a marked lowering of the field strength will result. Laminated pole pieces are often used to ensure that good contact is maintained with specimens of curved or irregular shape, and in some portable equipment which employ a permanent magnet; contact is obtained through a number of spring-loaded pins.

(i) The magnetizing force required to carry out a test using a magnetic flux machine, will depend on the length, cross-section and permeability of the yoke, the number of turns of the windings, and the magnetic characteristics of the test piece. No set current value would be suitable with all machines, and tests should be conducted to ascertain the current value which will ensure magnetization just below the saturation level. Saturation is indicated by a heavy build-up of magnetic ink at the ends of the specimen, or an overall coating on its surface. In all tests the cross-sectional area of the pole pieces should be greater than that of the specimen, but the maximum cross- sectional area which can be tested will

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normally be stated in the operating instructions for a particular machine.

(ii) To ensure that the strength of the magnetic flux in a specimen is sufficient to reveal defects during a test, it is common practice to employ portable flux indicators. These may take the form of thin steel discs containing natural cracks, which, when attached to the surface of a specimen during a test, will give an indication of flux strength and also, with some indicators, the flux direction.

(iii) With many machines it is easy to over-magnetize, particularly when carrying out tests on small specimens. If the machine does not have controls for adjusting the energizing current, a reduction in magnetic flux can be achieved by inserting nonmagnetic material between the pole pieces and the specimen.

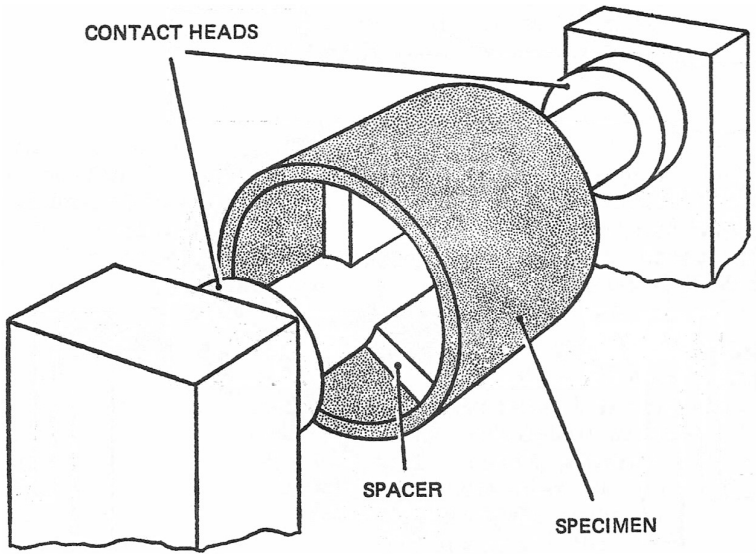

Figure 2 **THREADING BAR METHOD**

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(iv) Magnetic flow machines are generally designed to operate with direct current, the magnetizing coil containing a large number of turns of wire and carrying a current of a few amps only. This type of coil would be unsuitable for use with alternating current, since the coil would have too much inductance. If it is required to use alternating current for magnetic flow tests, the coil must be replaced by one having a few turns and carrying a heavy current.

3.2.2 **Threading Bar Method.** This method is used for testing rings and tubes, and is illustrated in Figure 2. A current flow machine is used, and a conductor connected between the contact heads of the machine. Current flowing through the: conductor induces a magnetic flux in the specimen at 90° to the direction of current flow; this flux may be used to reveal defects in line with the axis on the specimen. Best results are obtained when the air gap is smallest, i.e. the conductor is only slightly smaller than the internal diameter of the specimen, but a larger air gap is often necessary in order to permit examination of the interior surface.

(i) A symmetrical flux may be obtained in the specimen by inserting non-conducting spacers between the conductor and the specimen, but this is not essential except to prevent burning should the conductor overheat. If the shape of the item undergoing test precludes the use of a straight conductor, a heavy flexible cable may be used.

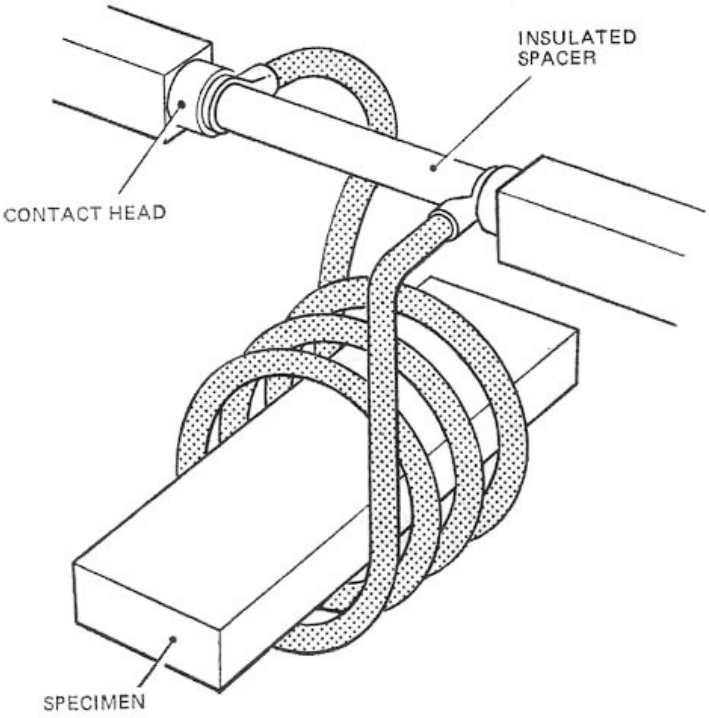

Figure 3 **MAGNETISING COIL METHOD**

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(ii) The basic current setting should be determined from the length of the flux path, i.e. the outside periphery of the specimen, 100 to 200 amps per inch being a satisfactory basic setting for most steel specimens. The current required is unaffected by the length of the specimen, except that if the specimen is very long the resistance of the conductor may limit the available current.

3.2.3 **Magnetizing Coil Method.** A current flow machine is also used for the magnetizing coil method. An insulated heavy gauge copper wire or strip is connected between the contact heads of the machine ,as shown in Figure 3, and formed into a coil; a.c. coils have 2-!- to 4 turns and d.c. coils 6 to 10 turns, the space between turns being less than the cross-sectional diameter of the wire in order to minimize flux leakage. The magnetic lines of force resulting from passing current through the coil will induce a magnetic flux in the specimen, in the direction of the coil axis.

(i) Components of simple shape may be placed within the coil during a test, but satisfactory magnetization will only be obtained within the length of the coil. Difficulty may be experienced with short components, due to the de-magnetizing effect resulting from the close proximity of the free poles (i.e. the ends of the specimen), and it is often advisable to complete the magnetic circuit using a yoke manufactured from mild steel, or extend the effective length of the component with end blocks.

(ii) When components of complicated shape are being tested, it is difficult to estimate the strength and direction of the magnetic flux in all parts of the specimen during a single test. It is often preferable to make several tests with the coil located at several positions within or around the specimen, inspecting only those parts adjacent to the coil at each position.

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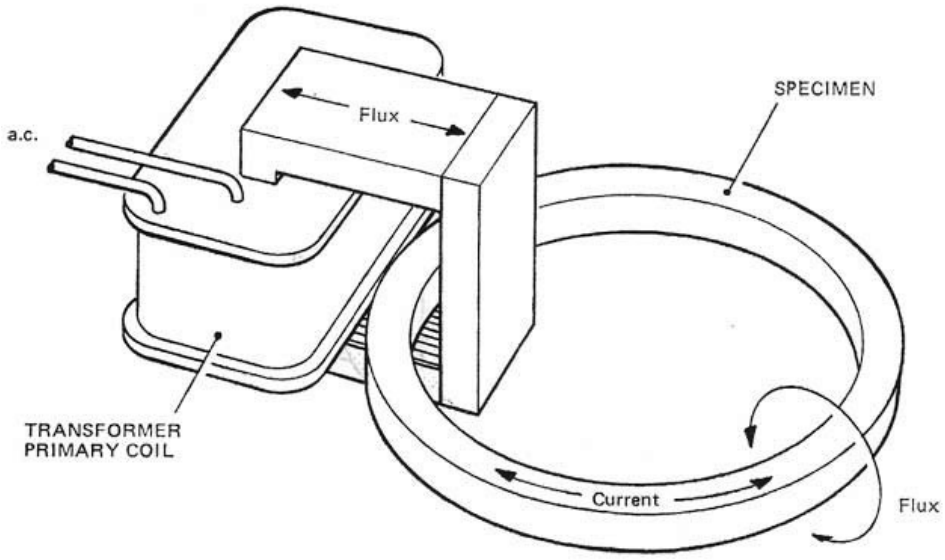

Figure 4 **INDUCED CURRENT FLOW METHOD**

(iii)

As with the magnetic flow method, the current required depends on a number of factors, including the relative diameters of the specimen and coil, and the length/ diameter ratio of the specimen. BS M35 gives a formula for calculating the current required under specified conditions, but the most suitable values are generally obtained by experiment, and by selecting a current which gives a field strength just less than that required to saturate the material.

3.2.4 **Induced Current Flow Method.** Figure 4 shows the coil arrangements for this method, in which current is induced to flow through the specimen by the action of the primary coil of a transformer. The induced current itself provides a magnetic field within the specimen, which may be used for detecting defects lying mainly in a longitudinal direction. This method is often used on ring specimens of large diameter.

4. TESTING PROCEDURES. Techniques of testing by magnetic methods are established after preliminary tests have shown that defects can be consistently revealed in similar parts to those under test. When carrying out routine tests in accordance with a specified technique, each instruction must be carefully followed in order to obtain satisfactory results. The full test procedure consists of degreasing,

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magnetizing, application of magnetic ink or powder and interpretation of indications, this process being repeated for each test specified on the technique sheet and concluding with final demagnetizing and cleaning. The use of a hand lens of low magnification is normally specified for the examination of defects.

4.1 **General Considerations.** Before carrying out a test the equipment should be checked to ensure that it is functioning properly. The technique sheet (see paragraph 5) will usually specify the capacity of the machine required for a test, and stipulate the type of magnetic ink or powder to use. An initial test, using it specimen containing known defects, may be carried out to verify that these defects can be revealed. Alternatively, in the absence of a cracked specimen a test may be carried out using a "portable crack" taped to the surface of the specimen. This often consists of a thin strip of material in which a crack has been artificially induced, and may be used as a guide for acceptance or rejection of the specimen under test. Equipment is usually checked with standard test pieces.

4.1.1 Good lighting is essential for examining the specimen. Good daylight provides the best illumination for normal inks, but fluorescent lighting, free from highlights and of correct intensity, is a suitable substitute. When using fluorescent inks, black light is essential and daylight should, as far as possible, be excluded from the viewing area; efficiency of the black light source should be checked periodically (BS 4489).

4.1.2 Adequate bench space should be provided adjacent to the testing machine and, where the nature of the work permits, should be away from noisy or otherwise distracting locations.

4.1.3 When specimens are tested in batches and set aside in a magnetized condition for subsequent examination, they should not be permitted to come into contact with one another, or with any other magnetic material, such as steel-topped benches or steel brackets, until the examination has been completed. If specimens do come into contact with other magnetized objects a local dis-arrangement of the magnetic field may occur, giving an effect similar to that obtained with a real defect.

4.2 **Selection of Method.** In cases where a technique of examination has not been specified, tests must be made to ensure that defects in the specimen can be satisfactorily revealed.

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4.2.1 Factors to be considered are the size and shape of the specimen, and the capacity of the machines available. Changes of cross-section in a component will result in variations in the intensity of magnetization through the component, requiring several tests using different current settings at each change of cross-section. The shape of a component may also modify the distribution of magnetic flux and result in misleading indications in the ink pattern. Examples of difficult specimens are toothed gears, turbine blades with fir tree roots and threaded components, where over-magnetization may result in build-up of iron oxide at the extremities, and cause defects to be hidden. This type of component may often be examined using a remanent magnetism technique, a d.c. supply being used with fluorescent ink; the part should be gently swilled in paraffin after application of the ink to clear the background, but retain any defect indications.

4.2.2 Since the majority of specimens must be tested for longitudinal and transverse defects, both current flow and magnetic flow tests are normally required; both tests may be carried out on a single universal machine.

4.2.3 Table 1 gives guidance on the most suitable methods of testing materials of various simple shapes; components of complicated shape may require special techniques. Tests using flux detectors and portable cracks will usually permit a satisfactory technique to be established, however, and great difficulty is not often experienced.

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TABLE 1

Specimen	Suitable Test Methods
Bar	Current flow for longitudinal defects. Magnetic flow for transverse defects. Magnetizing coil for transverse defects.
Tube	Threading bar for longitudinal defects. Magnetic flow for transverse defects. Current flow for longitudinal defects. Magnetizing coil for transverse defects.
Ring	Threading bar for defects in line with ring axis, and radial defects. Current flow or induced current flow for circumferential defects.
Plate	Current flow or current flow using prods for both longitudinal and transverse defects.
Disc	Current flow or current flow using prods, with the disc rotated 90° between successive tests.
Sphere	Current flow or current flow using prods, sphere being rotated to reveal any defects. Magnetic flow or magnetizing coil may also be used if flux path is extended using steel extension pieces.

4.3 **Preparation.** Specimens should be free from dirt, grease or scale, since these may hide defects and contaminate the magnetic ink. Scale may usually be removed by abrasive blasting or approved chemical methods, and trichloroethylene or other suitable solvents are normally used for degreasing when the parts are being tested away from their assembled positions. Trichloroethylene should not be used for cleaning parts in situ, due to the health hazard. It is not usually necessary to remove paint or plating except to provide good electrical contact for the current flow process.

NOTE: The fluorescent properties of certain magnetic inks may be diminished by chemical reaction with acids. When acid pickling is used as a cleaning process, care is necessary to ensure that all traces of acid are washed off.

4.3.1 Preparation of the specimen should also include demagnetization. Magnetization may have been induced by working, by machining in a magnetic chuck, or by lying adjacent to magnetized components or material. In the case

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of raw material, magnetization may be removed by heating to a temperature above the Curie point for the material, but generally, for finished parts, it must be removed as detailed in paragraph 4.8.

4.3.2 Apertures such as oil ways and deep tapered holes, which do not form part of the area to be examined, should be plugged to prevent the intrusion of ink, which may be difficult to remove.

4.4 **Magnetization.** Components of simple shape will normally require magnetizing in two directions, by a selection of the methods described in paragraph 3, so that defects of any orientation will be revealed. Components of complicated shape may require further magnetization in selected areas to ensure complete coverage. A component"--should normally be demagnetized between each test, to remove the effects of residual magnetism, which could cause spurious indications.

4.5 **Inking.** Except where remanent magnetism is used to reveal defects (paragraph 3.1.2), magnetic ink should be applied gently, immediately before and during the period of magnetization. With a.c. machines the magnetic flux should be applied for at least three seconds to allow time for the ink to build up at defects, but d.c. machines are often fitted with a time switch which limits the application of flux to between t and I second. When the immersion method is used, extreme care is necessary during removal of the specimen from the bath, in order to avoid disturbing the magnetic ink and any indications of defects which it may show.

4.6 **Interpretation of Indications.** Particles of magnetic ink are attracted to flux leakage fields, and these may occur at defects, brazed joints, the heat affected zone in welds, or sudden changes of section. The presence of a sudden build-up of ink on a specimen is not, therefore, necessarily an indication of a crack, inclusion or similar discontinuity, and experience is essential in interpreting the indications produced by a test.

4.6.1 Cracks are revealed as sharply defined lines on the surface of the specimen, the magnetic particles often building up into a ridge which stands proud of the surface.

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4.6.2 Subcutaneous defects such as may occur during manufacture of the material, will be more blurred than surface cracks. Non-metallic inclusions are often revealed by a diffuse clustering of magnetic particles, but may sometimes give an indication which is as sharply defined as a crack.

4.6.3 Grinding cracks are usually readily identified, and consist of a pattern of irregular lines over the affected area, or, on small radius bends or teeth, they may appear as short parallel lines.

4.6.4 Tool marks may give an indication similar to cracks, but the bottom of a tool mark can usually be seen with the aid of a hand lens with approximately 5x magnification, whereas cracks are usually deep and narrow.

4.6.5 Localized magnetic flux resulting from ineffective demagnetization, or careless handling after a specimen has been magnetized, may give indications known as magnetic writing. Careful demagnetizing and retesting will show whether the magnetic writing is spurious, or an indication of a real defect.

4.6.6 Excessive magnetization causes furring, and magnetic particles tend to follow the grain flow, giving the appearance of clusters of inclusions. The remedy is to reduce magnetization when testing areas of reduced cross-section.

4.6.7 Changes in permeability within a specimen, such as may occur at welds, may give misleading indications. Magnetic detection methods may not be suitable in these instances, and radiography may have to be used.

4.7 **Recording of Defects.** Defects are normally marked with grease pencil or paint for future reference, but it may be necessary, for record purposes, to preserve the indications obtained in a test, either on the specimen or as a separate permanent record.

4.7.1 If the magnetic ink has an oil based carrier, the specimen should be drained and dried or, alternatively, another test may be carried out using an ink containing a volatile carrier fluid. If dry powder is used no preparation is necessary.

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4.7.2 In cases where the specimen is to be retained, it should be gently sprayed with quick-drying lacquer or covered with a transparent adhesive film, care being taken not to disturb the surface indications.

4.7.3 If a separate permanent record is to be retained the specimen may be photo-graphed, or one of the following actions taken

(i) The indications may be covered with a transparent adhesive tape, which may then be peeled off and applied to a paper or card of suitably contrasting color, to show the defects.

(ii) A strippable adhesive coating may be gently sprayed on to the surface of the specimen. When carefully removed, this coating will retain the indications of defects, and these may be viewed on the surface which was in contact with the specimen.

(iii) The specimen may be heated and dipped in a thermosetting plastic powder material. When cured and stripped off, this material may be viewed as in (ii) above.

4.8 **Demagnetization.** There are a number of reasons why specimens should be de-magnetized before, during or after magnetic particle testing. These include the effects of magnetic writing (see paragraph 4.6.5), the difficulty which would be experienced in any subsequent machining operation due to the adherence of swarf, bearing wear due to the adherence of fine metallic particles, and interference with the aircraft magnetic . compasses. A specimen should, therefore, be demagnetized before starting tests, between tests which involve a change in flux direction, and after tests have been completed.

4.8.1 The most commonly used demagnetizer is an aperture type of coil carrying an alternating current. The specimen should be placed inside the energized coil and withdrawn a distance of at least 11 meters (5 feet) along the coil's axis with the current switched on, or may be placed inside the coil and the current gradually reduced to zero. Ideally, the coil should be just large enough to accept the specimen.

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4.8.2 If a demagnetizing coil is not available the crack detecting machine may be used. Alternating current from the machine may be passed through two or three turns of heavy cable, which may be used in the same way as a demagnetizing coil. Alternatively, a suitably equipped direct current electromagnet machine may be used, the specimen being placed between the poles and the current being gradually reversed and reduced simultaneously to zero.

4.8.3 For demagnetizing parts in situ an alternating current yoke is normally used. This consists of a coil wound on a laminated yoke, which is used in a stroking action on the specimen. The strokes should always be in the same direction along the specimen and the yoke should be moved away in a circle on the return stroke.

4.8.4 After demagnetizing, the specimen should be removed from the vicinity of the demagnetizing coil, the testing machine, or any other magnetized material.

4.9 **Tests for Demagnetization of Parts.** Any components which are manufactured from steel and liable to affect the aircraft compass, should be demagnetized and a test for remanent magnetism carried out before assembly in the aircraft. The standard test for remanent magnetism in aircraft parts is the deflection of a magnetic compass needle under controlled conditions, but an alternative method, such as the use of a flux meter, may be permitted, and suitable limits prescribed.

4.9.1 The test consists of placing a suitable magnetic compass in a position away from all stray magnetic influences, and slowly rotating the component at a position along the east/west axis of the compass. The distance of the component from the compass should be specified for the test, and should be the same as the distance from the aircraft compass to the installed component. Deflection of the compass needle by more than 10 will require the component to be demagnetized again and the test to be repeated.

4.10 **Final Cleaning.** When a component has been accepted following a magnetic detection test, all traces of detecting ink, contrast paint or temporary marking should be removed. Wiping or washing in solvent or immersion in an approved degreasing agent are the methods normally use. During cleaning, any plugs or blanks fitted during the preparation for the test should be removed. A temporary rust protective should be applied after cleaning, and the part should be identified in accordance with the appropriate drawing, to indicate that magnetic flaw detection has been satisfactorily carried out.

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5. **TECHNIQUE SHEETS**. A technique sheet is a document detailing all the magnetizing operations to be performed when inspecting a particular component by the magnetic particle method. It may be accompanied by an illustration of the component and by instructions applicable to all magnetic particle tests, such as the methods of cleaning and demagnetizing to be used.

   5.1 A technique sheet should show all the relevant details for each magnetizing operation, including type of equipment, strength and form of current, acceptance standard, contact areas, positions of flux detectors, type of coil, size of threading bar, and test pattern, as appropriate to the particular test. It is recommended that the symbols used in BS M35 should be used on all technique sheets and, where appropriate, on related drawings or sketches.

6.18.4 COMPOSITE REPAIR

Philippine Aerospace Development Corporation's method on performing composite repairs will be based on applicable Structural Repair Manual from the manufacturers and current publication that may be supplied by the customer.

It is important that the assigned personnel has undergone the Composite Repair Training and knowledgeable in the repair process.

It is also important that the personnel is capable of correctly interpreting the repair procedures required by Structural Repair Manual.