



# Dryden Organizational Procedure

## Code O

# Space Shuttle Support Equipment Maintenance Requirements and Problem Reporting and Corrective Action System

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Electronically approved by  
Director, Flight Operations Directorate

## **1.0 PURPOSE OF DOCUMENT**

This document establishes the overall NASA Dryden plan for maintaining Space Shuttle support equipment for which DFRC has been delegated operational and maintenance responsibility. It provides guidance; defines the system for discrepancy reporting and establishing, utilizing, and controlling Test and Inspection Record (TAIR) books; and gives instruction on the proper use of the Space Shuttle Problem/Discrepancy Report Form, Kennedy Space Center dual purpose Form 2-151 (KSC 2-151) or equivalent.

## **2.0 SCOPE & APPLICABILITY**

The requirements defined within this document are applicable to all DFRC Government contractors tasked to provide operation and maintenance of government owned Space Shuttle ground support equipment located at NASA Dryden and within the Edwards Air Force Base complex.

## **3.0 PROCEDURE OBJECTIVES**

The objective of this document is to provide DFRC contractors tasked to maintain Space Shuttle support equipment with specific requirements to be utilized in the development of their operational and maintenance plans. In addition, it provides direction on the problem reporting and corrective action system to be utilized for supporting shuttle specific ground support equipment.

## **4.0 RELEVANT DOCUMENTS**

### **4.1 Authority Documents**

NSTS 07700 National Space Transportation System

### **4.2 Reference Documents**

Test and Inspection Record (TAIR) Book  
DCP-O-007 Metrology System

### **4.3 Informational Documents**

PRACA Problem Reporting and Corrective Action

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#### **4.4 Forms**

Kennedy Space Center Form 2-151 or equivalent

### **5.0 WAIVER AUTHORITY**

The NASA Dryden Space Shuttle Manager is delegated the authority to waive the use of, or alter, this procedure. Waivers to requirements defined in this DOP will be documented, approved by the Dryden Space Shuttle Manager, and submitted to the Contracting Officer for inclusion in the Contract file.

### **6.0 ABBREVIATIONS, ACRONYMS, & DEFINITIONS**

#### **6.1 Abbreviations – None**

#### **6.2 Acronyms**

SE	Shuttle support equipment
O&M	Operation and Maintenance
OMI	Operation and Maintenance Instruction
TD	Technical Directive
QCD	Quality Control Directive
MD	Maintenance Directive
SOP	Standard Operating Procedure
Systems Validation	Validated after integration with other SE systems elements
Unit Validation	SE and items that are validated independently from other SE elements

### **7.0 ROLES & RESPONSIBILITIES**

#### **7.1 Supervisor Responsibility**

- A. Maintain and control issuance and numbering sequence of contractor issued PR's/DR's.
- B. Schedule maintenance technicians to perform corrective action.
- C. Assure notification of the NASA Shuttle Area Manager and/or NASA Edwards Airfield Support Coordinator (EASC) verbally of any discrepancy/issue ASAP and as described in Section 13.0.

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- D. Assure delivery of an initial copy of the PR/DR describing the problem to the NASA Shuttle Area Manager and/or NASA Edwards Airfield Support Coordinator (EASC) within 4 hours and as described in Section 13.0.
- E. Review/concur with corrective actions.

## **7.2 Maintenance Technician Responsibility**

- A. Notify Supervisor/QA when a discrepancy has been discovered.
- B. Obtain PR/DR number; make appropriate entry in the TAIR book index.
- C. Document problem description on PR/DR before start of repairs.
- D. Perform corrective actions as required.
- E. Enter corrective action taken on PR/DR, initial the tech block, and ensure QA final inspection completed.
- F. Close out TAIR index after final inspection.
- G. Ensure notification process described in Section 13.0 is adhered to.

## **7.3 Quality Assurance (QA) Responsibility**

- A. Assure technicians have notified supervision of the discrepancy.
- B. Assure the technician has obtained a PR/DR number and have completed the problem description portion of the PR/DR form, prior to troubleshooting.
- C. Ensure the notification process as described in Section 13.0.
- D. Concur with corrective action, inspect and “buyoff” technicians work in process and/or at closeout of the PR/DR, as required.
- E. Assure PR/DR is accurate and completed.
- F. Review DR’s for possible upgrading to a PR.
- G. Verify TAIR book entries are accurate and complete.
- H. Ensure notification of the Shuttle Area Manager and/or EASC upon completion of corrective action.
- I. Ensure delivery of a copy of the completed PR/DR to NASA for review.
- J. Make distribution of the PR/DR to KSC per Section 13.0.

**Quality Assurance personnel may assist in the preparation of any or all of the above requirements.**

## **8.0 MINIMUM CONTRACTOR REQUIREMENTS**

This section establishes the minimum requirements to be implemented by contractors tasked to maintain shuttle support equipment for which DFRC has operation and maintenance responsibilities. The intent of this section is to define preventive maintenance requirements and the methods by which these requirements are to be implemented by the contractor to minimize equipment down time.

Preventive maintenance includes the following activities:

- A. Proof load testing
- B. Pressure testing of hoses/vessels
- C. Calibration
- D. Component time/cycle replacement
- E. Corrosion control
- F. Cleaning/decontamination
- G. Periodic maintenance
- H. Filter maintenance
- I. Periodic inspection

### **8.1 Criteria**

Preventive/periodic maintenance of support equipment (SE) will be lapsed-time oriented. Specific requirements for performance of preventive maintenance shall be contained in applicable maintenance procedures for the specific SE. The Contractors Quality Management System shall contain and define all periodic maintenance for all SE.

### **8.2 Work Authorizing Documents**

Applicable operations and maintenance instructions will be prepared, implemented, and maintained by the contractor tasked to operate and maintain the SE.

All work performed on specified shuttle equipment shall be documented in the SE TAIR BOOK as described in Section 9.0. The contractor shall submit a matrix listing of all SE they maintain to the DFRC Shuttle Support Manager, who shall identify and approve that SE that requires a TAIR book. (See Section 8.0, paragraph 8.2.1R.) SE not requiring a TAIR book shall be documented and adhere to the contractor's quality system.

Discrepant hardware removal, repair, replacement, revalidation, and/or unscheduled SE maintenance or operational deficiencies shall be

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documented by utilization of a Problem and/or Discrepancy Report form as described in this document.

8.2.1 Work requirements/implementation processes/systems.

A. Scheduling

The SE contractor will establish, schedule, and maintain records of SE periodic maintenance cycles. Impending periodic maintenance requirements should allow some extension flexibility (+/- 30 days) to allow use of equipment and not impact critical shuttle operations.

B. Accomplishment

Preventive maintenance will be accomplished by contractor-developed processes and procedures. The Shuttle Area Manager and/or NASA Edwards Airfield Support Coordinator (EASC) shall be made aware of, and approve in writing, all extensions beyond those identified above.

C. Proof Load Testing

Proof load testing provides periodic retesting of handling devices to assure the safety and reliability required for handling shuttle hardware and equipment. Proof load test procedures will be derived from specification and drawing requirements and be included in periodic maintenance instructions, as required.

D. Proof Pressure Testing of Hoses/Vessels

Proof pressure testing of flex hoses and pressure vessels is designed to provide maximum equipment operational safety and reliability.

Proof pressure test requirements will be derived from specification and drawing requirements and be included in periodic maintenance instructions, as required.

E. Calibration

Calibration involves the periodic comparison of quantitative measuring devices contained within SE end items against controlled standards to ensure obtaining required accuracy.

Calibration requirements will be derived from specification and drawing requirements and included in periodic maintenance instructions, as required.

Equipment requiring calibration shall be calibrated per DCP-O-007, Metrology System and be included in the automatic calibration recall system.

F. Component Time/Cycle Replacement

The component time/cycle replacement program provides for periodic replacement of SE components as a function of their design, intended use material limits, and measured reliability.

Time cycle component replacement will be derived from specification and drawing requirements and included in periodic maintenance instructions, as required.

G. Corrosion Control

Corrosion control consists of the detection, assessment, documentation, and treatment of corrosion. The scope of treatment is that which can be economically justified relative to maintaining the SE operational during the course of the program.

Corrosion treatment may be deferred where structural or functional integrity is not affected and such action is deemed advisable for economic or schedule reasons.

Corrosion control inspection should be included in periodic maintenance instructions, as required.

H. Cleaning/Decontamination

Cleaning/Decontamination consists of the inspection, assessment, and documentation of components and systems to determine if they are cleaned to the required system levels and are compatible with the particular commodities utilized in the system.

Cleaning/Decontamination requirements shall be insured through normal surveillance during system initial assembly and during change-out of components during scheduled maintenance.

I. Periodic Maintenance

Periodic Maintenance is the maintenance performed periodically to minimize deterioration and identify discrepancies requiring correction. Periodic maintenance is performed in accordance with procedures developed and/or controlled within the contractors quality management system. A periodic maintenance plan shall be written for each SE end item.

Preventive/periodic maintenance instructions of SE will be lapsed-time oriented and should be derived from the SE manufacturer maintenance manuals, technical orders, and/or drawing requirements. Specific preventive maintenance requirements shall be contained in applicable maintenance procedures for the specific SE.

- J. General Criteria for periodic Maintenance/Operational  
When establishing the periodic interval of periodic maintenance/operational instructions, the SE environment and the extent of utilization will be taken into consideration. Weekly, monthly, quarterly, semiannual, and annual requirements should be considered and implemented when practicable.

The periodic maintenance/ operational instruction will provide complete instruction necessary to accomplish the task. When sources such as drawings, manufacturer manuals, or T.O.s, etc. are referenced as having to be complied with, the source document, section, and page shall be clearly identified in the instructions. When a task involves a process such as general cleaning, corrosion treatment, or maintenance of cleanliness levels, the applicable specification shall be referenced.

When materials such as grease, oil, solvents, fluids etc., are required to accomplish a task, the specific type indicated by part number or specification shall be noted.

- K. Filter Maintenance  
Filter Maintenance consists of periodic replacement and/or cleaning of filter elements to provide maximum operational reliability of SE. Periodic replacement and/or cleaning of filters shall be clearly defined in the maintenance instruction.
- L. Fluids, Oil, Lubricant Replacement  
Periodic replacement, cleaning, and/or sampling of oils and lubricants to provide maximum operational reliability of SE shall be clearly defined in the maintenance instruction.
- M. Periodic Inspections  
Compliance with the preventive maintenance plan will be ensured through normal quality surveillance and periodic inspections during the period between scheduled periodic maintenance.
- N. Operational Readiness Requirements  
All contractors responsible for operation and/or maintenance of shuttle support equipment shall report the operational status of the SE to the Shuttle Area Manager and/or NASA Airfield Support Coordinator twenty-four hours prior to each shuttle launch. The contractor shall supply written verification that all SE under their control is operational and ready to support or define any discrepancies/limitations associated with the SE. The plan defines the minimum maintenance requirements for each SE end item. Validation will include leak check, functional test, shuttle SE-Facility interface compatibility, and system verification. Units will be in current calibration when validated.

O. Validation/Certification

All SE utilized to support shuttle operations shall be validated. Validation consists of the verification of satisfactory operation, as well as the culmination and completion of the contractor's on-going periodic maintenance requirements.

If an end item or system validation period has expired, the applicable operational checks and periodic maintenance must be performed prior to shuttle support.

Once validated, the validation for an end item or system will continue to remain in effect for a fixed period of time, normally not to exceed one year. Unscheduled maintenance does not necessitate revalidation, as performance of applicable troubleshooting techniques and proper functional/operational checks of the SE are required to be performed to re-verify and certify proper system operation of the SE.

Satisfactory performance and completion of all operational and periodic maintenance requirements of the SE during the validation time period will constitute a revalidation and a new validation cycle will be commenced

P. Validated GSE Identification

A certificate of validation or metal tag of validation will be attached to each SE end item. The certificate or tag shall clearly state the part number and serial number of the SE, if applicable, as well as the validation date and/or validation expiration date. Where this is not practical, the validation certificate will be displayed inside the front cover of the TAIR book. This certificate assures equipment readiness to support shuttle operations. The lack of a valid certificate of validation will be justification to withhold use of the equipment.

The Validation Certificate or Tag will indicate

- 1) SE model number
- 2) SE serial number
- 3) Validation/revalidation document number
- 4) Date of validation and/or revalidation
- 5) Q/A inspectors stamp

Q. Periodic Maintenance Records

Periodic maintenance records will be preformed, verified, closed, and retained, along with all deviations by the contractor for the life of the contract, at which time they will become the property of the government. Permanent deviations to instructions, required during performance, will be processed for update of the instruction being performed.

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#### R. Maintenance Requirements Table

Each Dryden contractor responsible for operation and maintenance of shuttle support equipment shall develop a matrix table that lists each end item for which they have operational and/or maintenance responsibility. This table shall be submitted to the Shuttle Support Manager who will identify and approve the specific SE that requires a TAIR book. The contractor shall incorporate this matrix table in their quality manual.

The Maintenance Requirements Table shall contain

- 1) The nomenclature of the SE, quantity on site, and TAIR book applicability
- 2) The part number / model number
- 3) All maintenance instructions utilized to validate the SE
- 4) The frequency the maintenance instruction is performed:
  - a) D / Daily
  - b) W / Weekly
  - c) M / Monthly
  - d) BI / Bi-Monthly
  - e) Q / Quarterly
  - f) SA / Semi-Annually
  - g) A / Annually
  - h) PL / Pre-launch
  - i) L / Pre- Landing
- 5) A remarks column for any necessary supplemental information.

## 9.0 TEST AND INSPECTION RECORD (TAIR)

This section defines required utilization and control of Test and Inspection Record (TAIR) books. TAIR books are developed and maintained by NASA DFRC contractors, for the Shuttle support equipment (SE) for which they have operations and maintenance responsibility. TAIR books contain both the active and completed maintenance history of the SE, as well as an accumulation of active documentation that define work tasks and control of the book.

A TAIR book is a binder or folder that provides for the accumulation, display, and status of specific SE work control system documentation.

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- A. TAIR books will contain a cover page and divided sections for the following work control documentation:
- TAIR Cover
  - TAIR Index
  - Document Charge-Out Record
  - Operations & Maintenance Instructions
  - Work Order, T.O., and Engineering Instruction Log
  - Problem Reports
  - Discrepancy Reports
  - Part Removal and Installation Record
  - Equipment Status Log
- B. Support Equipment (SE) TAIR books will be developed and maintained by the contractor for each major equipment end item. The TAIR books shall identify the SE model number, dash number, and serial number as applicable.
- A single TAIR book may be developed that contains "like items," i.e., Zeon lights, ball-bars, generators etc., although each end item shall be sectioned in the book in such a way so as to contain the work control documents identified in paragraph A above.
- The Area A operational intercom/communications systems will be contained within in a single TAIR Book. Due to the number of systems involved, the required operations and maintenance instructions shall be listed in index form to comply with paragraph A above. Separate supplemental books shall contain those maintenance instructions defined in the TAIR Book O&M index and be located in the same area as the TAIR book.
- C. A master record of all TAIR books issued and the assigned location for the book will be maintained by the Contractor Quality Assurance.
- D. TAIR books will be transferred with equipment being permanently relocated. SE information contained in a shared book, as defined above, shall be removed from the book, inspection sealed, and transferred with the specific item/equipment. SE information will be reviewed for completeness prior to such transfer and will be placed in an inspection-sealed plastic envelope. The envelope will be physically attached to the equipment, if practicable.
- E. TAIR books for SE on loan or being repaired off site will be retained by the contractor with O & M responsibility. Contractors borrowing SE will be responsible for notifying the contractor holding the TAIR book of any non-conformances, calibration expirations, or other problems affecting an item on loan to obtain concurrence or remedial action.
- F. When a TAIR book is lost, a letter from the head of the contractor's QA function is required to authorize its replacement.

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### **9.1 Documentation records will be maintained as follows**

- 1) A TAIR book cover will be completed for each SE end item.
- 2) The TAIR index form will be utilized to record the entry and closure of the following work control documents:
  - a. Operations & Maintenance Instruction
  - b. Work Order, T.O. & Engineering Instructions
  - c. Problem reports
  - d. Discrepancy reports
- 3) A Document Charge-Out Record entry will be made at any time a document is removed from a TAIR book.
- 4) Approved Operations & Maintenance Instructions will be utilized when accomplishing all scheduled maintenance. An entry will be made in the TAIR Index for each operation.
- 5) All Work Order, Technical Orders, and Engineering Instructions will be recorded in the TAIR index. A permanent file of all work-authorizing documents will be maintained in this section.
- 6) Problem / Discrepancy reports will be initiated on a KSC Form 2-151 (or equivalent).
- 7) Temporary and/or permanently removed parts from SE end items will be recorded on a Parts Removal & Installation Record.
- 8) A status record section will be utilized to record documentation of a miscellaneous nature.

### **9.2 Responsibilities and Handling**

- A. Contractor QA shall
  - 1) Issue and control TAIR books, including documentation and document removal
  - 2) Establish and maintain record file
  - 3) Monitor work control documentation to assure it reflects hardware status
  - 4) Process TAIR books and documentation for items being relocated
- B. Contractor operations shall routinely maintain work control documentation to reflect tasks accomplished.

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## **10.0 PROBLEM AND DISCREPANCY REPORTING**

The intent of this section is to provide instruction on the proper use of the Kennedy Space Center dual purpose and Problem/Discrepancy report form (KSC 2-151 or equivalent). This form can be replicated electronically to meet individual contractor requirements/needs.

This form shall be utilized to document all work performed on the SE.

### **10.1 Problem Report (PR)**

A Problem Report is utilized and will be initiated by supervisors, maintenance technicians, and/or quality assurance personnel to document the following:

- A. Problems requiring sustaining engineering analysis and/or direction
- B. Problems that may be systemic in nature and could affect similar shuttle support equipment
- C. Failures or discrepancies that places the equipment out of service for an extended period of time
- D. Test problems
- E. All other discrepancies beyond DR limitations

### **10.2 Discrepancy Report (DR)**

A Discrepancies Report is utilized and will be initiated by the supervisor, maintenance technicians, and/or quality assurance personnel to report the following:

- A. Discrepancies and/or operational failures that can be corrected utilizing previously approved methods, instructions, and practices. Included are operational anomalies and discrepancies due to wearout, mishandling, or damage in transit.
- B. Minor discrepancies that do not affect form, fit, or function
- C. Failures noted during preventative maintenance inspections
- D. Procedure deficiencies or noncompliance
- E. Unsatisfactory workmanship

**A Discrepancy Report may be upgraded to a Problem Report if circumstances warrant.**

## 11.0 PR/DR NUMBERING

PR's/DR's will be numbered as follows:

<b>XX</b>	<b>X</b>	<b>XXXXXX</b>
Identifies the form and DFRC	Identifies the initiating contractor or NASA	A numeric designation TBD by the contractor

- A. The first letter will be "P" for Problem Report and "D" for Discrepancy Report.
- B. The second letter "E" signifies DRFC as the maintainer of the end item.
- C. The third digit is a numeric designation assigned to NASA or the appropriate support contractor as follows:

NASA - 1  
 Lockheed Martin - 2  
 DTI - 3  
 Kay and Assoc. - 4

- D. The last six digits are assigned to the PR/DR by the contractor to track the report.

## 12.0 DOCUMENTATION REQUIREMENTS

- A. As a minimum, the following blocks on form KSC 2-151 (or equivalent) should be completed, as applicable: 1, 2, 3, 6, 7, 8, 9, 13, 14, 17, 29, 30, 31, 32, 33, 35 & 36.
- B. The problem description section (block 17) should contain a precise description of the problem. Follow-on information should be added as appropriate when troubleshooting uncovers pertinent information relating to the discrepancy.
- C. The disposition section (block 30) should contain a precise, sequential description of the corrective action taken to correct the problem and include relevant processes / procedures utilized to certify the system has been restored to its fully operational condition.
- D. Utilize KSC non-conformance continuation sheet (KSC Form 2-155) when additional space/information is required.

## 13.0 CONTRACTOR DISCREPANCY REPORTING REQUIREMENTS

The contractor shall insure that the Shuttle Area Manager and/or EASC are aware of all open discrepancies affecting equipment they are tasked to maintain. In addition, the contractor is tasked to ensure a completed copy of all PR/DR's are forwarded to the

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appropriate KSC sustaining engineer for entry into the KSC PRACA system when required.

### **Critical space-flight launch, on orbit, and landing operations**

The contractor shall immediately inform the Shuttle Area Manager and/or EASC of any shuttle support equipment discrepancies / failures starting 14 days prior to each scheduled launch and continuing through critical space flight and turnaround operations.

The Shuttle Area Manager and/or EASC will then be responsible to provide initial verbal discrepancy reporting to appropriate KSC management and sustaining engineering during this time frame.

In addition and upon discovery of a discrepancy during this time frame, the contractor shall initiate a preliminary Problem / Discrepancy Report (PR/DR) detailing the nature of the problem and the applicable steps being taken to resolve the problem. This initial PR/DR should be presented to the Shuttle Area Manager and/or EASC for review, and then be faxed or e-mailed, as soon as practical and no later than 4 hours after discovery, to the appropriate KSC sustaining engineer responsible for the equipment. When KSC engineering assessment/direction is desired/required, telephone communication should be established as soon as practical. The Shuttle Area Manager and KSC engineering shall be kept adequately informed during troubleshooting/repair and until final resolution has been accomplished. Upon completion, a copy of the PR/DR should be forwarded to the Shuttle Area Manager and KSC sustaining engineer ASAP.

The contractor shall

- A. Immediately inform the Shuttle Area Manager and/or EASC of all discrepancies and/or modifications to equipment requiring KSC engineering interface.
- B. Accomplish problem reporting during critical space flight operations as described above.
- C. Provide the Shuttle Area Manager and/or EASC with a copy of all PR/DR's upon initiation.
- D. Provide the Shuttle Area Manager and/or EASC with a copy of all PR/DR's upon completion.
- E. Provide KSC sustaining engineering a copy of all PR/DR's upon completion.

## **14.0 METRICS & TREND ANALYSIS**

Conformance metrics and trend analysis will be established and documented by the COTR per requirements established in the Contracting Officers letter of COTR delegation.

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## **15.0 MANAGEMENT RECORDS & RECORDS RETENTION**

Contractor performance evaluations are recorded in the Contracting Officers applicable contract file, which is retained for the life of the contract.

### Document History Log

This page is for informational purposes and does not have to be retained with the document.

Status Change	Document Revision	Effective Date	Page	Description of Change
Baseline		6-15-04		Consolidation of DFRC Process Instructions PI-02-A, PI-02-B, PI-02C and PI-02D.

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