



George C. Marshall Space Flight Center  
Marshall Space Flight Center, Alabama 35812

QS-R-009  
REVISION D

EFFECTIVE DATE: October 21, 2003

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# ORGANIZATIONAL INSTRUCTION

## RELIABILITY PREDICTION

OPR(s)

QS40

OPR DESIGNEE

Prince Kalia

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| <b>Organizational Instruction</b> |                       |                     |
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**DOCUMENT HISTORY LOG**

| <b>Status<br/>(Baseline/<br/>Revision/<br/>Canceled)</b> | <b>Document<br/>Revision</b> | <b>Effective<br/>Date</b> | <b>Description</b>   |
|--|------------------------------|---------------------------|--|
| Baseline   |                              | 11/20/97                  |  |
| Revision   | A                            | 7/1/99                    | Changes made to reflect new organization code changes and/or Changes made to reflect new directives renumbering scheme and to incorporate the corrective action for closure of NCR 266 |
|  | B                            | 7/1/01                    | Changed OPR and OPR Designee. Added Quality Records table.   |
| Revision   | C                            | 9/09/02                   | Format and numbering change to implement requirements of QS-A-001 rev F.   |
| Revision   | D                            | 10/21/03                  | Added applicable and referenced documents, revised Instructions.   |

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## Reliability Prediction

### 1. PURPOSE, SCOPE, APPLICABILITY

#### 1.1 Purpose.

The purpose of this Organizational Instruction (OI) is to describe the process for quantitatively estimating the reliability of systems/subsystems and components during concept definition and design phases for flight hardware and flight support equipment.

#### 1.2 Scope.

This OI provides procedures for performing, evaluating, and approving reliability predictions.

#### 1.3 Applicability.

This OI is applicable to all S&MA personnel supporting MSFC programs and projects that require or specify reliability requirements.

### 2. DOCUMENTS (Applicable and/or Reference)

#### 2.1 Applicable Documents

|                 |  |
|-----------------|--|
| NPD 8720.1      | NASA Reliability and Maintainability (R&M) Program Policy                                    |
| NASA-STD-8729.1 | Planning, Developing and Managing an Effective Reliability and Maintainability (R&M) Program |

#### 2.2 Reference Documents

MIL-STD-756B, Reliability Modeling and Prediction

*Reliability Toolkit: A Practical Guide for Commercial Products and Military Systems Under Acquisition Reform*,  
Reliability Analysis Center

### 3. DEFINITIONS

All definitions applicable to this OI are addressed in NASA-STD-8729.1

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#### 4. INSTRUCTIONS

A considerable amount of information from a wide variety of sources is required to perform most reliability predictions. Assumptions must be clearly stated and identified. Inputs required to perform reliability prediction include,

- Hardware functional description including specifications, schematics, functional flow diagrams
- Parts list
- Mission profile and environments
- Failure rate data sources
- Reliability math model and block diagram or logic diagram

The reliability prediction should be updated as appropriate (i.e., with design changes or design evolution). The steps below define the procedure for developing a reliability prediction and are referenced in the Flow Diagram in Section 11.

| <u>Steps</u> | <u>Action</u>   |
|--------------|---|
| 4.1          | Define the system for which the prediction is applicable and the underlying design assumptions and groundrules for which the reliability prediction analysis will be anchored         |
| 4.2          | Define the purpose and intended use (life cycle) for which system reliability will be modeled and predicted. Describe prediction analysis approach and expected tools to be utilized. |
| 4.3          | Develop system reliability block diagrams or other models (i.e., fault tree).   |
| 4.4          | Identify applicable data sources; identify interpolated or extrapolated data sources.   |
| 4.5          | Define the failure distribution for model elements and rationale for selection.   |
| 4.6          | Compute the system reliability.   |

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- 4.7 Report results and recommendations for the configuration evaluated. Identify potential design improvements or updates and update reliability prediction through quantitative methods or probabilistic risk assessment

5. NOTES

5.1 Directive Replacement

This Directive replaces S&MA-CR10-R-Y-009, Reliability Prediction.

6. SAFETY PRECAUTIONS AND WARNING NOTES

None.

7. APPENDICES, DATA, REPORTS, AND FORMS

None.

8. QUALITY RECORDS

| <u>Quality Record</u>         | <u>Repository</u>   | <u>Period of Time</u>                     |
|-------------------------------|---|---|
| Reliability Prediction Report | Hardcopy maintained in R&M files in Building 4471 Room A105 | Retain until end of program plus 3 years. |

9. TOOLS, EQUIPMENT, AND MATERIALS

The user should define any tools, special equipment, or materials used during the reliability predication analysis process.

10. PERSONNEL TRAINING AND CERTIFICATION

Reliability training will include reliability prediction analysis.

11. FLOW DIAGRAM(S)

The following flow diagram represents the Reliability Prediction instructions outlined in Section 4.

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