



MICROCOPY RESOLUTION TEST CHART

NATIONAL BUREAU OF STANDARDS-1963-A

AD A094250

ERRATA SHEET - NAVSEA 80300-AC-MMA-010-R&M

P. 11 add

(q) Are warning lables provided on equipment stating that assemblies, subassemblies etc. contain electrostatic sensitive devices?

Yes No

— —

(r) Are handling warnings placed in maintenance aides (T.M., MRC's, etc.) where assemblies, subassemblies, etc. involved in maintenance action contain electrostatic sensitive devices?

— —

P. 14 add

to (aa)

Has each suppliers parts been tested in the intended use circuit(s)?

— —

P. 20 add

(o) Is the handling of the following failed items controlled by procedures such that further damage to the item beyond the original failure is not incurred:

- (1) Assembly
- (2) Subassembly?
- (3) Printed Circuit Board?
- (4) Part?

— —

— —

— —

— —

(p) Is the failed non-repairable (throwaway) item stored in a retrievable, protected, and controlled storage facility with its failure data attached?

— —

JAN 29 1961

FOREWORD

This document has been developed by the Naval Ship Engineering Center of the Naval Sea Systems Command to aid in the assurance of adequate levels of Reliability (R) and Maintainability (M) of Naval shipboard equipment. It consists of two separate but complementary checklists for reviewing and evaluating a contractor's R program and M program with emphasis on the detailed R&M design efforts. In addition to the detailed R&M design efforts (Sections 2 through 11 and 22 through 28) these checklists also cover the areas of: R&M Management (Sections 1 and 21); and R&M Demonstration Test Planning (Sections 12 and 28). During a program applicable sections of these checklists should be completed and updated as the program progresses.

These checklists can be provided to the contractor to be used as guides for establishing and implementing his R&M programs, or can be contractually required to be completed by the contractor and submitted as a data item to the Navy prior to formal design reviews. They can be used by the Navy for randomly auditing the contractor's R&M program, design effort and demonstration test planning effort; as guides for evaluating R&M during design reviews; or used for follow-up of corrective action in areas found to be deficient.

Although these checklists were developed for electronic equipment acquisition, the majority of the questions contained therein are equally applicable to electrical, mechanical and electro-mechanical systems and equipment.

The Naval Ship Engineering Center welcomes comments and suggestions on the use and improvement of this document. Please direct all comments in writing to: Naval Ship Engineering Center, Code 6181B, Washington, D. C. 20362.

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SECTION 1

MAINTAINABILITY (M) DESIGN CHECKLIST

MAINTAINABILITY (M) DESIGN CHECKLIST
(160 Basic Questions)

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Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	<input type="checkbox"/>
By	
Distribution/	
Availability Codes	
Dist	Avail and/or
A	Special

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
1	<u>Management</u>			
(a)	Does contractor have a permanent in-house <u>M</u> staff?	—	—	
(b)	Is staff composed of experienced <u>M</u> engineers?	—	—	
(c)	Does program <u>M</u> engineer report directly to program manager?	—	—	
(d)	Does <u>M</u> group have the facility/authority to interface directly with other engineering groups: (1) Design? (2) Systems Engineering? (3) Quality Control? (4) Integrated Logistics Support? (5) Procurement? (6) Test and Evaluation?	—	—	
(e)	Is <u>M</u> group representative(s) member(s) of design review team?	—	—	
(f)	Does <u>M</u> group review all drawings and specifications for adequacy of <u>M</u> requirements?	—	—	
(g)	Does <u>M</u> program engineer have sign-off authority on all drawings and specifications?	—	—	
(h)	Does <u>M</u> engineer/group review Purchase Orders and Purchase Specifications to assure all parts and sub-assemblies are procured with adequate <u>M</u> requirements?	—	—	
(i)	Does <u>M</u> group have membership and a voice in decisions for Engineering Change Review Board?	—	—	
(j)	Is <u>M</u> group represented on surveys and quality audits of potential subcontractors?	—	—	
(k)	Is <u>M</u> group represented at subcontractor design reviews and meetings where <u>M</u> is a topic of discussion?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(1)	Does an <u>M</u> group member(s) monitor/witness sub-contractor <u>M</u> tests?	---	---	
(m)	Does <u>M</u> group contain experts in the fields of BIT, ATE, PMFL and other fault detection/localization and isolation methodology?	---	---	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
2	<u>Maintenance Concept</u>			
(a)	Is maintenance concept in accordance with specification requirements with respect to:			
	(1) Types of repairs allowable at various levels of maintenance?			
	(2) Allowable skill and manpower levels for performing maintenance (CM & PM)?			
	(3) Restrictions on special tools and support equipment?			
	(4) Ability of Built-in-Test (BIT) to detect and isolate faults to specified levels of assembly?			
	(5) Sparing requirements/Navy sparing philosophy?			
	(6) Use of throwaways/Navy throwaway philosophy?			
	(7) MTR/MCTMAX?			
	(8) Test Point Requirements?			
(b)	Is proposed maintenance concept cost effective with respect to:			
	(1) Repairs to be performed at different levels of maintenance?			
	(2) Transportation cost and time to send repairables to depot?			
	(3) Designation of modules as non-repairable?			
	(4) Test equipment proposed for organizational/intermediate levels of maintenance?			
	(5) Proposed sparing requirements?			
(c)	Is maintenance concept compatible with Navy repair facilities for:			
	(1) Organizational level:			
	(a) Test/support equipment and tools?			
	(b) Manpower/skill levels requirements?			
	(2) Intermediate level:			
	(a) Test/Support equipment and tools?			
	(b) Manpower/skill levels requirements?			

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(c) (Cont'd)	(3) Depot Level: (a) Test/support equipment and tools? (b) Manpower/skill levels requirements?	—	—	
(d)	Does technical manual include information for repairs at: (1) Organizational level? (2) Intermediate level? (3) Depot level?	—	—	
(e)	Is training program consistent with: (1) Available skill levels at organizational level? (2) Repairs to be performed at organizational level of maintenance? (3) Special tools/support equipment to be used? (4) Special handling for Electro Static Discharge (ESD)? (5) Other special conditions?	—	—	
(f)	Has consideration been given to ensure the capability to transport, preserve, package and handle the equipment being procured?	—	—	
(g)	Is technical data package complete and adequate for equipment: (1) Installation and checkout? (2) Operation? (3) Maintenance (Preventive and Corrective)?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
3	<u>Design for Accessibility</u>			
(a)	Is equipment as exposed and easily accessible as conditions permit?			
(b)	Structural members do not prevent access to components for removal/replacement, true?			
(c)	Are both visual and manual accesses including working envelopes provided where necessary for maintenance operations?			
(d)	Are subassemblies, especially those requiring frequent maintenance, independently removable (i.e., do not require removal of other subassemblies)?			
(e)	Do accesses satisfy safety requirements (e.g., protection of personnel from high voltage, high temperature points? Are safety warnings provided where needed)?			
(f)	Are large, heavy parts situated so they can be safely removed without damaging other components? Are weight warnings provided where needed?			
(g)	Are check points, test points, cables and connectors accessible and visible and clearly identifiable for maintenance?			
(h)	Does the design provide greatest accessibility to performance critical and high failure rate items?			
(i)	Are components mounted on an orderly two-dimensional surface rather than stacked one on another?			

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(j)	If rear, side or top access to components is provided in the design will installation aboard ship allow the proper use of this access?	—	—	
(k)	Have clothing constraints of maintenance personnel, if any, been considered in the accessibility of the design?	—	—	
(l)	Has design been modularized using plug-in units for ease and rapidity of removal/replacement?	—	—	
(m)	Has equipment been designed to "not require" soldering, brazing and/or welding for removal/replacement at the organizational level?	—	—	
(n)	Are hinged doors and covers used and do they have adequate swing clearances?	—	—	
(o)	Are drawers and racks used effectively to facilitate maintenance operations and do they have adequate opening clearances?	—	—	
(p)	Do hinged covers and drawers have detents/stops to lock cover or drawer in open position?	—	—	
(q)	Do large covers have locating or holding pins to facilitate replacement by one man?	—	—	
(r)	Is layout of modules logical and consistent?	—	—	
(s)	Are delicate/vital/sensitive components located or guarded so they are not susceptible to damage during maintenance?	—	—	
(t)	Are items requiring preventive/scheduled maintenance directly accessible?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(u)	Units requiring high skill level for removal/replacement are not in the way of removal/replacement of units requiring low skill level for removal/replacement thus tying up the service of high skilled technicians for jobs which can be performed by lower skill levels?	—	—	
(v)	Are covers designed to provide maximum access (e.g., 5-sided cover vs 1-sided cover)?	—	—	
(w)	Are enclosures designed to be lifted from units rather than units lifted from enclosures?	—	—	
(x)	Are modules removable along a straight line rather than through an angle?	—	—	
(y)	Are hinged units and drawers equipped with braces to provide support in the extended position?	—	—	
(z)	Are the number of covers and panels to be removed in a maintenance action kept to a minimum?	—	—	
(aa)	Are lamps and fuses directly accessible without disassembly of unrelated items?	—	—	
(bb)	Where cables/connectors enter from the rear is access provided for test purposes?	—	—	
(cc)	Are access covers provided for items requiring frequent maintenance?	—	—	
(dd)	Where visual access is required are: (1) Openings without covers provided where such will not degrade system performance?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(dd)(Cont'd)	(2) Transparent windows provided where dirt or moisture might create a problem?	—	—	
	(3) Break resistant glass windows provided where wear, heat or contact with solvent would cause optical deterioration?	—	—	
	(4) Quick opening metal covers provided where glass will not meet stress or other requirements?	—	—	
(ee)	Are safety interlocks provided to protect maintenance personnel from hazardous voltages, etc.?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
4	<u>Mounting Provisions:</u>			
(a)	Are standard types of fasteners used throughout ?	—	—	
(b)	Are captive fasteners used whenever practicable ?	—	—	
(c)	Are quick release fasteners used where structural integrity would not be compromised ?	—	—	
(d)	Are the number and diversity of structural fasteners kept to a minimum commensurate with structural/bonding requirements ?	—	—	
(e)	Are the fasteners selected to keep the number of required tools to a minimum ?	—	—	
(f)	Are modules/components mounted/oriented to facilitate identification for maintenance ?	—	—	
(g)	Are alignment pins and guides provided where necessary or practical ?	—	—	
(h)	Have mounts been chosen that are appropriate to the expected environment (e.g., shock, vibration, corrosion due to dissimilar metals, etc.) ?	—	—	
(i)	Have measures been taken to prevent improper orientation, mounting or installation of units by coding or keying ?	—	—	
(j)	Are similar components with different functional properties readily identifiable and distinguishable and not physically interchangeable in their mounting positions ?	—	—	
(k)	Are the types of fastener heads consistent with torque requirements to prevent stripping or rounding ?	—	—	
(l)	Are the number of fasteners on covers/doors kept to a minimum, hand operated and of the quick release type ?	—	—	
(m)	Are module racks marked with module part numbers ?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
5	<u>Handling Provisions:</u>			
(a)	Are all sharp/pointed edges either rounded, finished or protected to prevent injury to maintenance personnel?	—	—	
(b)	Do large, heavy or bulky replacement items have handles or lifting/grasp areas for ease of handling?	—	—	
(c)	Are handles/grasp areas where used located over center of gravities to preclude swinging or tilting when lifted?	—	—	
(d)	Do hinged or foldout handles have stop positions for locking handles perpendicular to mounting surface?	—	—	
(e)	Are handle openings large enough to obtain required grasp for the item weight?	—	—	
(f)	Is maximum weight of a replaceable item limited to the following (Ref.: MIL-STD-1472A, Table X):			
	<u>Height of Lift</u>			<u>Maximum Weight</u>
	<u>Above Ground</u>			<u>of Item</u>
	5 ft (152 cm)	—	—	35 lb (16 kg)
	4 ft (122 cm)	—	—	50 lb (23 kg)
	3 ft (91 cm)	—	—	65 lb (29 kg)
	2 ft (61 cm)	—	—	80 lb (36 kg)
	1 ft (30 cm)	—	—	85 lb (39 kg)
(g)	Have all replaceable items been sized and weighted to be easily handled by one man?	—	—	
(h)	Are items weighing above one-man lift capability prominently so labeled (e.g., mechanical lift required, 2-man lift required)?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(i)	Are lift points for items requiring mechanical/power lift appropriately labeled?	—	—	
(j)	Where the use of extra heavy replaceable items cannot be avoided are means provided for using mechanical lifting devices and proper lifting clearances (e.g., eye bolts)?	—	—	
(k)	Are such design features as tongue and slot catches used to minimize the number of fasteners required?	—	—	
(l)	Are heads of mounting bolts and fasteners located on surfaces readily accessible to the technician?	—	—	
(m)	Are combination bolt head and slotted hex head fasteners used where feasible to allow removal by different tools?	—	—	
(n)	Are irregular, fragile and awkward extensions such as cooling ducts, wave guide, etc., designed for easy removal from a unit before handling?	—	—	
(o)	Are rests and stands provided for irregularly shaped modules that could be easily damaged if not properly supported?	—	—	
(p)	Is storage space provided within the equipment for special tools, card pullers, ESD shorting bars; ESD protective bags, etc. (where required)?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
6	<u>Built-in Test (BIT) Provision:</u>			
(a)	Are circuits packaged on a functional basis to assist in detection and isolation of a faulty module?	—	—	
(b)	Has the BIT been automated to the fullest extent practicable?	—	—	
(c)	Has a balanced combination of automatic/semi-automatic/manual BIT, and classic trouble-shooting techniques been considered to avoid an overly complex automatic BIT with a high failure rate (in excess of 10% of system failure rate), and provide an efficient/effective method for trouble-shooting all faults?	—	—	
(d)	Is the BIT cost effective with regards to first cost and decreased maintenance burden?	—	—	
(e)	Does BIT meet specified probability levels (where levels are not specified, reasonably achievable levels), of fault detection, isolation and specified times to fault locate when specified?	—	—	
(f)	Has BIT been designed with fail safe features to preclude failures of the BIT affecting operation of the equipment?	—	—	
(g)	Does the BIT provide fault isolation to specified number of lowest replaceable units (where not specified are numbers reasonable)?	—	—	
(h)	Does BIT provide continuous monitoring of critical circuits (e.g., coolant water temperature; power supply output voltage)?	—	—	
(i)	Have diagnostic programs been developed for processors/computers used within the system (where applicable) which provide a high degree of confidence in the functioning of the computer?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(j)	Does BIT provide a "go-no-go" indication of an equipment function?	—	—	
(k)	Is BIT capable of detecting degradation of equipment performance outside of specified limits rather than just catastrophic failure?	—	—	
(l)	Has BIT eliminated the need for special auxiliary test equipment?	—	—	
(m)	Has provisions been incorporated in the BIT design to differentiate BIT failure from system failure?	—	—	
(n)	Does the BIT provide an easily discernable alarm upon detection of a fault (e.g., audible alarm)?	—	—	
(o)	Does BIT perform a confidence check to eliminate/reduce the possibility of false alarms?	—	—	
(p)	Does BIT and other fault isolation techniques sequence testing in order of most frequently occurring faults?	—	—	
(q)	Is fault isolation sequence performed in a manner to minimize backtracking?	—	—	
(r)	Is BIT designed to keep the equipment on the line for confidence checks or to keep off-line time to a minimum?	—	—	
(s)	Does BIT and fault isolation procedures flow in a logical sequence?	—	—	
(t)	Is there a design feature to test lamps to preclude shut-down of the system due to an erroneous indication of equipment failure?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
7	<u>Test Point Provisions:</u>			
(a)	Are circuits packaged on a functional basis to reduce the number of required test points ?	—	—	
(b)	Are test points centrally located and grouped into connectors to facilitate testing ?	—	—	
(c)	Are test points grouped in a logical manner for systematic trouble-shooting ?	—	—	
(d)	Are test points directly accessible without removal of covers, components or subassemblies ?	—	—	
(e)	Are test points buffered to prevent damage to circuitry due to inadvertent shorting ?	—	—	
(f)	Are test points labeled and readily identifiable via: (1) Symbol or name ? (2) Tolerances of signals ? (3) Test parameters ? (4) Color coded ?	—	—	
(g)	Are test points protected from high voltage hazards to prevent high voltage from being induced in the circuit ?	—	—	
(h)	Are jacks rather than terminals used to avoid test probes from slipping off test points ?	—	—	
(i)	When terminals are used for test points, do they contain ears/flags for attaching alligator clips, barriers, or holes for inserting test probes to keep probe from slipping off the terminal ?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(j)	Are voltages at test points limited to a maximum of 300 volts RMS where possible (eliminates need for warning plates, barriers, guards and enclosures)?	---	---	
(k)	Where voltages exceed 300 volts RMS but are less than 500 volts RMS, do they have guards or barriers to prevent accidental contact with such voltages?	---	---	
(l)	Where voltages exceed 500 volts RMS, is the part with the voltage enclosed and a warning plate provided in close proximity?	---	---	
(m)	Where connectors and parts used for test points are located on the external surface of the equipment, are covers provided to keep out dirt and moisture?	---	---	
(n)	Are test points selected to minimize circuit loading or detuning caused by the connection of test equipment?	---	---	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
8	<u>Adjustment/Alignment/Calibration Provisions:</u>			
(a)	Are adjustments kept to a bare minimum ?	—	—	
(b)	Are adjustment points readily accessible, both physically and visually ?	—	—	
(c)	Can adjustments be performed without the need for special tools ?	—	—	
(d)	Can adjustments be performed without the need for special test equipment ?	—	—	
(e)	Are adjustments designed so that modules can be adjusted prior to being installed in the equipment ?	—	—	
(f)	Are adjustments designed to be independent so that the adjustment of one module does not require subsequent adjustment or alignment of other modules in the equipment ?	—	—	
(g)	Are knobs used for frequent, common adjustments ?	—	—	
(h)	Are factory set adjustments, sensitive adjustments, or calibrations that are critical and not performed frequently or need test equipment to perform the alignment protected from being inadvertently disturbed ?	—	—	
(i)	Are reference scales provided for adjustment controls to aid in performing the adjustments ?	—	—	
(j)	Do adjustment controls contain resistance to movement as to not be disturbed by vibrations and shocks typical of its use environment ?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(k)	Are adjustment controls located away from hazards such as high voltage/high temperature areas and rotating/moving parts?	---	---	
(l)	Are mechanical stops provided for those adjustments whose over-adjustment could cause damage to the equipment?	---	---	
(m)	Are holes for mounting screws large enough to permit alignment considering positioning tolerance of fasteners/mounting holes?	---	---	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
9	<u>Tools and Test Equipment:</u>			
(a)	Is the need for special tools and auxiliary or special test equipment justifiable?	—	—	
(b)	Are standard tools and test equipment used to the fullest extent practicable?	—	—	
(c)	Are all tools and test equipment needed defined?	—	—	
(d)	Are special tools required for adjustment or maintenance securely mounted within the equipment in a readily accessible location?	—	—	
(e)	Are storage spaces provided within the test equipment for the necessary leads, probes, spares, manuals and special tools to be used with the test equipment?	—	—	
(f)	Are instructions for operating the test equipment provided on the face of the equipment in a lid or special compartment?	—	—	
(g)	Are the performance requirements for the test equipment clearly specified with respect to: (1) Types of measurements? (2) Accuracy? (3) Range of measurements? (4) Calibration requirements? (5) Special requirements if applicable?	—	—	
(h)	Are adapters, interface boxes, extender cards or cables defined for use with the test equipment?	—	—	
(i)	Is test equipment ruggedized to meet environmental requirements?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
10	<u>Connectors:</u>			
(a)	Are standard connectors used in the design ?	—	—	
(b)	Are quick disconnect connector plugs provided wherever feasible (requiring no more than one turn) ?	—	—	
(c)	Are connector plugs keyed to prevent inserting a wrong plug into a receptacle ?	—	—	
(d)	Are mating connecting plugs and receptacles clearly identified by color coding or labeling ?	—	—	
(e)	Are connector plugs or receptacles provided with alignment pins or devices to aid in correct mating without bending pins ?	—	—	
(f)	Do aligning pins extend beyond the plug electrical pins to insure that alignment is obtained prior to electrical pin engagement ?	—	—	
(g)	Are plugs and receptacles arranged so that aligning pins/devices are oriented in the same relative position ?	—	—	
(h)	Do plugs and receptacles show positions of a aligning pins/devices for proper insertion ?	—	—	
(i)	Are connectors adequately spaced so that they can be firmly grasped for connecting and disconnecting (1-inch minimum) ?	—	—	
(j)	Is the rear of the plug receptacle accessible for testing and servicing ?	—	—	
(k)	Are large plug-in/slide-in modules and drawers on rails fitted with rack and panel type connectors with guide pins ?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>										
(l)	Do connectors have removable pins/contacts ?	—	—											
(m)	Can connectors be disassembled and pins replaced without the need for special tools ?	—	—											
(n)	When adapters are required are they capable of being hand-tightened ?	—	—											
(o)	Are connectors fitted with cable clamps to prohibit cables from being pulled out of contact terminals ?	—	—											
(p)	Are insertion and withdrawal forces for connectors within the capability of one hand ?	—	—											
(q)	Where large connectors requiring high insertion and withdrawal forces are used, are mechanical advantage devices provided to allow insertion and withdrawal with ease ?	—	—											
(r)	Do spare connector contacts on all connectors meet the following requirements:	—	—											
	<table border="0" style="width: 100%;"> <tr> <td style="text-align: center;"><u>Total No. of Contacts</u></td> <td style="text-align: center;"><u>Minimum Spare</u></td> </tr> <tr> <td style="text-align: center;"><u>in Connector</u></td> <td style="text-align: center;"><u>Contacts ?</u></td> </tr> <tr> <td style="text-align: center;">Up to 25</td> <td style="text-align: center;">2</td> </tr> <tr> <td style="text-align: center;">26-100</td> <td style="text-align: center;">4</td> </tr> <tr> <td style="text-align: center;">101 and over</td> <td style="text-align: center;">6</td> </tr> </table>	<u>Total No. of Contacts</u>	<u>Minimum Spare</u>	<u>in Connector</u>	<u>Contacts ?</u>	Up to 25	2	26-100	4	101 and over	6	—	—	
<u>Total No. of Contacts</u>	<u>Minimum Spare</u>													
<u>in Connector</u>	<u>Contacts ?</u>													
Up to 25	2													
26-100	4													
101 and over	6													
(s)	Are connector shells used that can be mounted from the outside rather than inside of the equipment (e.g., square flanged) ?	—	—											
(t)	Are connector shells finished with a non-conductive finish ?	—	—											

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(u)	Are female contacts always used on the hot side of the circuit?	---	---	
(v)	Are protective connector covers provided for use when connectors are not in use?	---	---	
(w)	Are female contacts recessed to avoid shock when being handled?	---	---	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
11	<u>Cables:</u>			
(a)	Are standard type cables/wiring used?	—	—	
(b)	Are all cables/wires color coded or appropriately labeled for identification?	—	—	
(c)	Do cables/wires have sufficient slack/service loops for drawer retraction, door opening, connector insertion/removal, removal of units where connectors are not readily accessible inside the equipment?	—	—	
(d)	Are wires/cables laced, taped, spiral wrapped or otherwise formed into harnesses for ease of handling and installation?	—	—	
(e)	Are wires in modules or on printed circuit boards laced and tied down?	—	—	
(f)	Are multi-conductor cables fitted with spare leads?	—	—	
(g)	Are wires logically grouped and routed in the equipment chassis?	—	—	
(h)	Are planned performed wiring harnesses used?	—	—	
(i)	Are cables secured by clamps at proper intervals so they do not move or flex during shock or vibration?	—	—	
(j)	Are clamps properly sized and fitted with resilient material to avoid damage to cables?	—	—	
(k)	Are cable clamps of the quick disconnect/release type?	—	—	
(l)	Are solder or crimp type connectors used consistently throughout the design for same application?	—	—	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(m)	Where test cables terminate on control or display panels are they so located as not to interfere with controls or displays?	---	---	
(n)	Are cables routed so as to be readily accessible for inspection and repair?	---	---	
(o)	Are cables routed or protected from being damaged by doors, lids or personnel?	---	---	
(p)	Where cables are routed through holes in metal partitions are they protected from damage or wear by grommets or equivalent means?	---	---	

MAINTAINABILITY (M) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
12	<u>Maintainability Demonstration Test Planning</u>			
(a)	Has an <u>M</u> test team been organized?			
(b)	Does this test team have government representatives?			
(c)	Are the following to be demonstrated: (1) <u>MTTR/MCTMAX</u> or <u>ERT</u> for: • Corrective Maintenance? • Preventive Maintenance? (2) Test point adequacy? (3) Built-in Test: • Size of fault groups? • Probabilities of fault detection/isolation?			
(d)	Have tasks been selected in accordance with the procedures of MIL-STD-471 Appendix A?			
(e)	Have a sufficient number of tasks (twice the number to be demonstrated) been selected to allow for substitute tasks when required?			
(f)	Will technical manual be available for use during the demonstration?			
(g)	Will test be performed per agreed upon schedule?			
(h)	Will Navy be notified at least 30 days prior to start of test?			
(i)	Is test DD 1423 documentation on schedule?			
(j)	Will test area simulate shipboard installation with respect to access restrictions, working envelopes, etc.?			
(k)	Will test technician be provided by: (1) Navy? (2) Contractor? Resume submitted? Name _____			

SECTION II

RELIABILITY (\bar{R}) DESIGN CHECKLIST

RELIABILITY (R) DESIGN CHECKLIST

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RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
21	<u>Management</u>			
(a)	Does contractor have a permanent in-house R staff?			
(b)	Is staff composed of experienced R engineers?			
(c)	Does program R engineer report directly to program manager?			
(d)	Does R group have the facility/authority to interface directly with other engineering groups: (1) Design? (2) Systems engineering? (3) Quality Control? (4) Integrated Logistics support? (5) Procurement? (6) Test and Evaluation?			
(e)	Is R group representative(s) member(s) of design review team?			
(f)	Does R group review all drawings and specifications for adequacy of R requirements?			
(g)	Does R program engineer have sign-off authority on all drawings and specifications?			
(h)	Does R engineer/group review Purchase Orders and Purchase specifications to assure all parts and subassemblies are procured with adequate R requirements?			
(i)	Does R group have membership and a voice in decisions for the following: (1) Material Review Board? (2) Failure Review Board? (3) Engineering Change Review Board?			

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(j)	Is <u>R</u> group represented on surveys and quality audits of potential subcontractors?	—	—	
(k)	Is <u>R</u> group represented at subcontractor design reviews and meetings where <u>R</u> is a topic of discussion?	—	—	
(l)	Does an <u>R</u> group member(s) monitor/witness subcontractor <u>R</u> tests?	—	—	
(m)	Does <u>R</u> group contain experts in the fields of components/failure analyses?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
22	<u>Design for R</u>			
	THERMAL REQUIREMENTS:			
(a)	Have detailed thermal analysis been performed to determine component/module ambient operating temperature?			
(b)	Has a unit similar to final configuration (e.g., brassboard, preproduction unit, etc.), been instrumented to develop a thermal mapping of the design?			
(c)	Have anemometer probes been used to measure coolant air flow patterns?			
(d)	Are equipment internal cooling considerations sufficient to limit internal temperature rises to 20°C maximum?			
(e)	Are high power dissipation components (e.g., large power resistors, diodes, transformers, etc.) heat sunk?			
(f)	Where chilled water or chilled air is used for cooling have hermetically sealed components been selected due to possible moisture condensation?			
(g)	Where chilled water or chilled air is used for cooling are components shielded or otherwise protected from moisture condensation?			
(h)	Where chilled water or chilled air is used for cooling has consideration been given to removal of condensation to avoid accumulation of moisture and possible fungus growth or corrosion within the equipment?			
(i)	Are all printed circuit boards conformally coated?			

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(j)	Have circuit performance tests been conducted at high and low temperature extremes to assure circuit stability over the required operating temperature range?	—	—	
(k)	Do heat conducting surfaces make good contact (no air gaps) and have low thermal resistances?	—	—	
(l)	Do surface coatings and paints provide good conduction, convection and radiation coefficients for heat transfer?	—	—	
(m)	Do adhesives where used for fastening components to PCB's or chassis have good thermal conductive properties?	—	—	
(n)	Do potting, encapsulation and conformal coating materials where used have good thermal conducting properties?	—	—	
(o)	Have differences in thermal expansion of interfacing materials been taken into account?	—	—	
(p)	Are high power dissipation components mounted directly to the chassis for better heat sinking rather than encapsulated or thermally insulated?	—	—	
(q)	Is thermal contact area between components and heat sinks kept to a maximum?	—	—	
(r)	Are components sensitive to heat located away from heat flow paths, power supplies and other high power dissipation components?	—	—	
(s)	Are air gaps or thermal insulation provided where necessary to avoid heat flow to temperature sensitive components?	—	—	
(t)	Are temperature overload devices, alarms used to prevent damage due to loss of cooling apparatus?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(u)	Do inlet temperature ducts have filters to prevent accumulation of dirt on assemblies which would result in reduction of heat transfer?	—	—	
(v)	Do components mounted on PCB's have adequate lead lengths and are the leads formed to relieve lead stresses during thermal expansion and contraction?	—	—	
VIBRATION/SHOCK/STRUCTURAL REQUIREMENTS:				
(w)	Has analysis been performed to determine resonant frequencies to be experienced in the equipment environment?	—	—	
(x)	Have detailed vibration/shock/structural analyses been performed to validate structural integrity of the design?	—	—	
(y)	Have critical/unique assemblies been instrumented with accelerometers and tested to verify design adequacy with respect to vibration and shock transmissibility factors?	—	—	
(z)	Have structural mountings been designed to resonate away from resonant frequencies and their harmonics?	—	—	
(aa)	Have damping considerations been applied to sub-assemblies and components mounting where natural frequencies are close to expected environmental frequencies?	—	—	
(bb)	Are large components (over 1/2 oz.) being clamped or tied down to the chassis or printed circuit boards to prevent high stresses or fatigue failure of electrical leads?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

No.	Item Description	Yes	No	Remarks
(cc)	Heavy components are mounted near corners of the chassis near mounting points for direct structural support rather than between supports?	—	—	
(dd)	Centers of gravity of heavy components are kept low close to the plane of the mounts?	—	—	
(ee)	Are cables/harnesses clamped close to terminal connections to avoid resonances and prevent stress and failure at the point of connection?	—	—	
(ff)	Do cables/wires have sufficient slack to prevent stresses during thermal changes and mechanical vibration/shock?	—	—	
(gg)	Stranded wire is used when cabling might be susceptible to fatigue failure?	—	—	
(hh)	Components and subassemblies have adequate sway space to avoid collision during vibration and shock?	—	—	
(ii)	Welding (not spot welding) and/or riveting is used for permanently attached structural members rather than nuts and bolts?	—	—	
(jj)	All component leads have minimum bend radii to avoid overstressing?	—	—	
MISCELLANEOUS REQUIREMENTS:				
(kk)	Has consideration been given to avoid the use of dissimilar metals?	—	—	
(ll)	Have the PCB's been designed for the following considerations: (1) PCB material is compatible with storage and operating temperature (plus operating temperature rises) with respect to: (1) PCB material? (2) Metal cladding/bonding strengths? (3) Board warping?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(11) (Cont'd)	(2) PCB resistivity is sufficiently high to meet circuit leakage current requirements even under high humidity?	—	—	
	(3) PCB arc resistance is sufficiently high where high voltages are present?	—	—	
	(4) PCB dielectric constraint is sufficiently low to prevent building up of unwanted capacitances?	—	—	
	(5) PCB flexural strengths (function of board material and dimensions) is sufficient to meet structural and vibration requirements?	—	—	
	(6) PCB conductors width is sufficient to handle maximum current flow without harmful heat generation or resistance drop?	—	—	
	(7) PCB's have plated through holes to aid in soldering of lead electrical connections?	—	—	
	(8) PCB conductor spacings have a minimum spacing based upon voltage between conductor (e.g., .025" per 150 volts peak)?	—	—	
	(9) PCB conductor paths are spaced and designed to keep capacitance between conductors to a minimum?	—	—	
	(10) Are PCB's conformally coated?	—	—	
(mm)	Where encapsulation, embedding and potting used, does the material have:	—	—	
	(1) Good thermal conductivity for heat transfer?	—	—	
	(2) Good electrical isolation/dielectric ?	—	—	
	(3) Provide dampening for shock and vibration?	—	—	
	(4) Thermal expansion coefficients which match those of items encapsulated?	—	—	
	(5) Will not crack or shatter under vibration and mechanical and thermal shock?	—	—	
	(6) Has good chemical stability under anticipated use environments?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(nn)	<p>Have worst case analyses or statistical variation of parameters been conducted to determine required component electrical tolerances considering:</p> <p>(1) Manufacturing tolerances? _____</p> <p>(2) Tolerances due to temperature changes? _____</p> <p>(3) Tolerances due to aging? _____</p> <p>(4) Tolerances due to humidity? _____</p> <p>(5) Tolerances due to high frequency or other operating constraints? _____</p>	_____	_____	
(oo)	<p>Has redundancy been considered for critical functions where practical? _____</p>	_____	_____	
(pp)	<p>Where redundancy is used, has considerations been given to avoid common mode failure situations which could disable all redundant circuits? _____</p>	_____	_____	
(qq)	<p>Has design practices been applied to obtain RFI suppression such as:</p>	_____	_____	
	<p>(1) Use alternating current non-commutating machinery rather than direct current machinery when feasible? _____</p>	_____	_____	
	<p>(2) Provide optimum interference suppression with two twisted wires in a common shield whenever wire pairs can be used? _____</p>	_____	_____	
	<p>(3) Use short wires in preference to long wires? _____</p>	_____	_____	
	<p>(4) Filter power lines to remove harmonics and other types of inherent interference? _____</p>	_____	_____	
	<p>(5) Mount filters as close to interference sources as possible without altering the effectiveness of the filter? _____</p>	_____	_____	
	<p>(6) Use bonding techniques to insure that good electrical contact is made between chassis, conduit, shielding, connectors, structural and housing metal parts? _____</p>	_____	_____	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(qq)(Cont'd)	(7) Remove non-conducting coatings from bolts, nuts, and tapped holes?	—	—	
	(8) Internally shield individual sections of equipment which are either highly susceptible to interference or which generate interference. For example, the r-f input stages and local oscillators should be shielded individually?	—	—	
	(9) Use a bandwidth consistent with the minimum possible value for the received signal. This often improves the signal-to-noise ratio?	—	—	
	(10) Use direct current filament sources where practicable?	—	—	
	(11) Ground center tap of filament transformer secondary winding to reduce hum?	—	—	
	(12) Avoid the use of gaseous lighting devices in the vicinity of sensitive wiring or electronic equipment?	—	—	
	(13) Do not cable noisy and clean leads together?	—	—	
	(14) Never route cables near known interference sources?	—	—	
	(15) Do not use shields or metal structures for return current paths?	—	—	
	(16) Avoid the use of corrosion preventive compounds with high insulating qualities at bond joints?	—	—	
(rr)	Have considerations been given to preclude damage due to:	—	—	
	(1) Installation?	—	—	
	(2) Handling?	—	—	
	(3) Transportation?	—	—	
	(4) Storage?	—	—	
	(5) Shelf Life?	—	—	
	(6) Packaging?	—	—	
	(7) Maintenance environment?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(8)	Other environments: (a) Humidity? (b) Fungus? (c) Sand and dust? (d) Salt atmosphere?	—	—	
(ss)	Has reliability been considered as a factor in all tradeoff studies affecting equipment reliability?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
23	<u>Parts Program</u>			
(a)	Does contractor have a Parts Control Board (PCB) to promote proper selection and application of parts used in the design?			
(b)	Has contractor established and maintained an up-to-date Preferred Parts List (PPL) to be used by designers?			
(c)	Has contractor established derating guidelines for derating of electrical/electronic parts electrical stresses?			
(d)	Do derating guidelines correspond to specification requirements and/or Navy proposed derating levels?			
(e)	Has contractor developed part application guidelines for proper selection of part types for circuit use?			
(f)	Are military grade parts used in the design?			
(g)	Are non-standard parts used only when a military equivalent part cannot be obtained?			
(h)	Where non-standard parts are used do they have adequate qualification/test data and a history of high reliability?			
(i)	Where non-standard parts are used are they procured via specification control drawing which specifies: (1) Reliability requirements? (2) Environmental requirements? (3) Test requirements?			
(j)	Has contractor submitted non-standard part data for approval per applicable specification (e.g., MIL-STD-749/965)?			

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(k)	Do parts used in the design meet the environmental requirements to which they will be subjected during use with respect to: (1) Operating temperature (plus worst case internal case temperature rises)? (2) Non-operating/storage temperature? (3) Humidity? (4) Vibration? (5) Shock?	—	—	
(l)	Have parts been reviewed for proper application, have part stresses been calculated () or measured () and do they meet: (1) Derating guidelines? (2) Application guidelines?	—	—	
(m)	Are established reliability (ER) components and JAN semiconductors and microcircuit devices used in the design?	—	—	
(n)	Where ER components are used, is the most representative level of all ER components used: (1) L ? (2) M ? (3) P ? (4) R ? (5) S ? (6) T ?	—	—	
(o)	Where JAN semiconductors (MIL-S-19500) are used, the most representative level of all such devices used are: (1) JAN ? (2) JANTX ? (3) JANTXV ?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(p)	Where JAN microcircuits (MIL-M-38510) or high quality microcircuits are used the most representative level of all such devices used are: (1) MIL-M-38510 Class A ? (2) MIL-M-38510 Class B ? (3) MIL-M-38510 Class C ? (4) MIL-STD-883 Class A ? (5) MIL-STD-883 Class B ? (6) MIL-STD-883 Class C ? (7) Vendor equivalent to _____ ?	—	—	
(q)	Do parts meet the interchangeability requirements of MIL-STD-454 Requirement 7?	—	—	
(r)	Do all parts selected meet the life requirements of the equipment?	—	—	
(s)	Are handling requirements specified for critical and delicate parts susceptible to damage, degradation, contamination from shock, vibration, static electric discharge, uncleanliness, etc.?	—	—	
(t)	Are assembly and cleaning procedures specified to prevent damage to components during assembly on PCB's, chassis, etc.?	—	—	
(u)	Have dominant failure modes of a particular part type been considered in the selection of that part?	—	—	
(v)	Are fixed rather than variable components (such as resistors, capacitors, inductors, etc.) used in the design wherever possible?	—	—	
(w)	Are all relays, motors, dynamotors, rotary power converters, etc. suppressed so as not to produce excessive spikes or transients during operation?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(x)	Are all semiconductor devices silicon rather than Germanium?	—	—	
(y)	Plastic coated and/or encapsulated semiconductor devices are not used?	—	—	
(z)	Do all microcircuits have hermetically sealed ceramic cases rather than plastic cases?	—	—	
(aa)	Do all microcircuits used have at least two potential suppliers?	—	—	
(bb)	Do all unused gates of a digital microcircuit have inputs grounded?	—	—	
(cc)	Are the number of expandable gates limited to no more than 75% of allowable number of expandables?	—	—	
(dd)	Where humidity is not controlled are hermetically sealed resistors, capacitors, relays, etc., used?	—	—	
(ee)	Are all power supplies designed and manufactured in-house?	—	—	
(ff)	Are parts, even MIL-M-38510, JAN TX, Established Reliability (ER) parts screened at incoming inspection: (1) 100%? (2) Sampling plan per _____? (3) Environmentally _____?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
24	<u>Developmental Test Program</u>			
(a)	Is contractor conducting a developmental test program?			
(b)	Does developmental test program include: (1) All critical assemblies? (2) Each assembly with a unique form factor? (3) Critical non-standard parts?			
(c)	Does developmental testing include environmental testing at or above the levels specified for qualification: (1) High and low temperature? (2) Vibration? (3) Shock? (4) Humidity?			
(d)	Are performance requirements checked over required operating temperature levels?			
(e)	Are life tests or reliability tests of critical components/subassemblies being or have they been conducted?			
(f)	Is "Step Stress" testing being performed on sub-assemblies, etc., to determine design margins?			
(g)	Is developmental test program monitored by the reliability group or does the reliability group provide inputs to developmental testing?			
(h)	Are failure data and maintenance data collected during developmental testing for determining need for reliability improvement?			

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
25	<u>Reliability Analyses</u>			
(a)	Have the following reliability analyses been performed: (1) Reliability Mathematical Models? (2) Reliability Apportionments? (3) Reliability Predictions? (4) Failure Modes and Effects Analyses? (5) Criticality Analyses? (6) Circuit Analysis (nominal and worst cases)? (7) Thermal Analysis? (8) Sneak Circuit Analysis?			
(b)	Do predictions meet apportioned values?			
(c)	Do predictions meet numerical reliability specification requirements?			
(d)	Have the results of the predictions been used to increase equipment reliability by: (1) Reduction of circuit complexity? (2) Reduction of ambient temperature conditions? (3) Reduction of internal temperature rises? (4) Reduction of part stresses by further derating? (5) Increase of part quality levels? (6) Addition of redundancy?			
(e)	Has a numerical approach for Criticality Analysis been used?			
(f)	Does the numerical criticality analysis consider: (1) Frequency of failure? (2) Degree of effect on system performance? (3) Difficulty to diagnose and/or repair? (4) Personnel or equipment safety?			
(g)	Have all critical modes of system failure been identified?			
(h)	Have critical items been ranked as to criticality?			

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(k)	Has the use of limited life items been kept to a minimum?	—	—	
(l)	Have the analyses considered the effects of storage, transportation and handling on failure modes, effects and failure rates?	—	—	
(m)	Has the use of circuit analysis provided a stable, design over the worst case conditions?	—	—	
(n)	Has protective circuitry been utilized in the equipment design?	—	—	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
26	<u>Burn-in Program</u>			
(a)	Does the contractor impose burn-in at: (1) Component level? (2) Subassembly/module level? (3) Equipment/system level?	_____ _____ _____	_____ _____ _____	
(b)	Is burn-in performed under: (1) Temperature (elevated)? (2) Temperature cycling? (3) Vibration?	_____ _____ _____	_____ _____ _____	
(c)	Are lengths of burn-in adequate for each level?	_____	_____	
(d)	Do spares receive same burn-in as modules/subassembly level?	_____	_____	
(e)	Do all equipments/systems receive the same amount of burn-in?	_____	_____	
(f)	Does contractor have a failure free burn-in requirement prior to acceptance of the equipment?	_____	_____	
(g)	Is random vibration performed? (1) Equipment level? _____ (2) "g" level? _____ (3) Frequency range? _____ (4) Time duration? _____	_____ _____ _____ _____	_____ _____ _____ _____	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
27	<u>Failure Reporting Analysis and Corrective Action (FRACA) Program</u>			
(a)	Has contractor implemented a FRACA program?			
(b)	Does FRACA program cover failures during: (1) Source inspection at subcontractor's plant? (2) Incoming inspection? (3) In-process inspection? (4) Development tests? (5) Subassembly/module test? (6) Equipment integration and checkout? (7) Equipment burn-in? (8) Equipment formal tests: (a) Acceptance tests? (b) Environmental/qualification tests? (c) Reliability/Maintainability tests?			
(c)	Does contractor have in-house facilities for performing detailed failure analysis?			
(d)	Is failure analysis conducted for all failures?			
(e)	Are failures summarized by part number and failure type to determine trends and patterns?			
(f)	Has contractor established thresholds (percent defective or failure rate) for determining need for corrective action?			
(g)	Does failure report form contain the necessary information with regards to: (1) Identification of failed part subassembly, assembly, etc.? (2) Elapsed time meters (for failure at equipment level)? (3) Failure symptoms?			

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(g)(Cont'd)	(4) Effect of failure on system/equipment?	---	---	
	(5) Test and environmental conditions at time of failure?	---	---	
	(6) Suspected cause of failure?	---	---	
(h)	Is the same type of FRACA program imposed upon subcontractors of critical subassemblies?	---	---	
(i)	Are subcontractor failure reports included in contractor failure summaries?	---	---	
(j)	Are all failure reports, analyses and corrective actions reviewed by the reliability group?	---	---	
(k)	Are failure trends monitored by the reliability group?	---	---	
(l)	Are corrective actions involving design changes tested in the equipment for an adequate period of time prior to their formalization?	---	---	
(m)	Are corrective action investigations reopened upon a recurrence of the same type of failure?	---	---	
(n)	Are proposed corrective actions referred to the Navy for concurrence?	---	---	

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
28	<u>Reliability Demonstration Test Planning</u>			
(a)	Will test simulate operating profile that will be seen aboard ship?			
(b)	Will all modes of equipment operation be tested?			
(c)	Is definition of failure in accordance with contract specification requirements?			
(d)	Are relevant and non-relevant failure definitions adequately defined?			
(e)	Will test be performed under environmental levels specified by the contract specifications?			
(f)	Will burn-in to be performed on reliability test units be no more or no less than that specified for production units?			
(g)	Non-operating and equipment standby time will be discounted from applicable test time for validating reliability, true?			
(h)	No Preventive Maintenance other than that contained in technical manuals and approved by the Navy will be performed during the test, true?			
(i)	Performance checks capable of checking the complete equipment failure rate, performed no less frequently than daily have been defined for the test, true?			
(j)	Test will be performed per agreed schedule, true?			
(k)	Navy will be notified of the exact test date at least 30 days prior to the test, true?			
(l)	All interfaces are simulated or stimulated?			
(m)	All interfaces are real?			

RELIABILITY (R) DESIGN CHECKLIST

<u>No.</u>	<u>Item Description</u>	<u>Yes</u>	<u>No</u>	<u>Remarks</u>
(n)	If interfaces are real, is GFE required?	---	---	
(o)	If GFE is required, has a request been made to obtain GFE?	---	---	
(p)	Is test DD 1423 documentation on schedule?	---	---	

**DAT
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