Fisheries and Oceans Canada | Pêches et Océans Canada
Coast Guard | Garde côtière

70-000-000-EU-JA-001
(FORMERLY DGTE-69)

Specification for the Installation of Shipboard Electronic Equipment

Specifications

Canada

Published Under the Authority of:

Integrated Technical Support Directorate
Fisheries and Oceans Canada
Canadian Coast Guard
Ottawa, Ontario

K1A 0E6

70-000-000-EU-JA-001
(formerly DGTE-69)

Second Edition – March 2000
Revised July 2003

Available on CCG Intranet site at:
http://ccg-gcc.ncr.dfo-mpo.gc.ca

Disponible en français : **Spécification pour l'installation d'équipement électronique à bord des navires**

Printed on recycled paper

Record of Amendments

#	Date	Subject	Initials
1	June 1980	First Edition (known as DGTE 69)	
2	March 2000	Second Edition – Completed rewrite (not published)	
3	June 2002	Revision: New format (not published)	
4	July 2003	Revision: New document number	
5	August 02, 2004	Erratum: Appendix G.4, second paragraph. The temperature should read +5°C to +50°C not +50°C to +550°C.	

Foreword

This specification is issued by the Director General Integrated Technical Support, CCG's National Authority under delegation from Deputy Minister Fisheries and Oceans and the Commissioner of the Canadian Coast Guard.

1.1 SCOPE

This specification deals with workmanship standards and practices to be used in the installation of electronic equipment on Department of Fisheries and Oceans /Coast Guard vessels during new construction, minor repair or alteration and addition.

1.2 PURPOSE AND INTENDED USE

This specification defines the contractor's responsibilities for the planning, execution, testing and acceptance of shipboard electronics installations. The specification should be used in conjunction with the applicable documents specified.

1.3 ORGANIZATION

The specification consists of twelve sections as follows:

1) General Conditions
2) Government Personnel
3) Environmental/Service Conditions
4) Removal of Equipment
5) Installation
6) Electromagnetic Interference
7) Setting to Work
8) Test Requirements
9) Acceptance
10) Reports and Certificates
11) Documentation
12) Photographic Record of Work

Detailed and specialized subjects have been included as the following appendices:

Appendix A - Radio Frequency Interference

Appendix B - Grounding and Bonding

Appendix C - Installation of Cable and Waveguide

Appendix D - Choice of Electrical Materials

Appendix E - Location of Equipment

Appendix F - Choice of Materials

Appendix G - Environmental Conditions for Shipboard Computer Systems

Appendix H - Local Area Network Description and Installation

Appendix I - Check List

Appendix J - Definitions

1.4 Availability of Documents

Requests for copies of relevant documentation, including ship's drawings, shall be made to the contracting agent, usually PWGSC. Requests shall be made by the prime contractor only.

1.5 GLOSSARY OF DEFINITIONS

A glossary of the definitions of terms used in this specification is given in Appendix J.

1.6 CONTRACT OVERVIEW

The prime contractor shall have sole responsibility for the contract work, which shall include the tasks outlined below.

1.6.1 Material and Services

The contractor shall provide all equipment, material and services (other than existing or Government furnished equipment) required to complete the contract work.

1.6.2 Installation

The contractor shall be responsible for the work, specified by the Contract and Installation Specification, which generally includes the following tasks:

- Remove all equipment and material made superfluous by the contract work, including cable(s) and wire(s), without damaging the remaining cables;
- Install all equipment and material identified by the contract and installation specification;

Note: Particular care is to be exercised in the handling and transporting of all DFO/ CCG and contractor supplied equipment. All damage to the equipment is to be brought to the attention of the Project Manager or his representative before being removed from the

contractor's stores. If any scratches, dis-figuration or other damage occurs past this point, it shall be deemed to be the result of contractor handling and the equipment shall be repaired or replaced at the discretion of the Project Manager or his representative at no cost to the Government of Canada or any of its agents or departments.

- Furnish and install installation material and accessories, e.g., cable installation hardware, electrical switches, fuses, etc., which may not be detailed in the installation specification;
- Make good deficiencies identified by the Project Manager;
- Provide all special equipment and skills required to complete the contract work;
- Restore installed equipment to its original condition in both function and finish;
- Restore ship's furnishings to their original condition, including a matching paint finish to installed material and accessories;
- Remove superfluous material from the work site;
- Crate and ship redundant equipment, as directed by the Project Manager. The Department shall be responsible for shipping costs only; and
- Provide "as fitted" drawings, in electronic format, of the installation including unit schematics and unit and system interconnect drawings or equipment manufacturers' manuals (as detailed in section 11). Drawing shall be produced in AutoCAD, latest version.

1.6.3 Inspection

The work shall be subject to formal inspection, by the Project Manager, at the scheduled milestones. Before proceeding to the next installation phase, the contractor shall:

- obtain approval from the Project Manager;
- remedy the identified deficiencies; and
- ensure all work completed in sealed spaces is inspected and approved before sealing the space.

1.6.4 Acceptance

Upon completion of the tasks outlined above, and when the contractor is satisfied that the installation is functional, he shall inform the Project Manager of it’s availability for inspection and acceptance testing.

Inspection and acceptance testing is intended to ensure that the equipment is correctly installed and operates at its specified performance levels. Test requirements shall normally be specified by the Project Manager; failing this, the equipment manufacturer's test requirements shall be used.

The tests shall be conducted by a competent person supplied by the contractor, usually the manufacturer's representative, and shall be witnessed by the Project Manager. Any deficiencies identified shall be rectified, and the tests restarted at a point specified by the Project Manager.

The contractor shall ensure that all acceptance test certificates and other Proof of Performance documents are correctly completed, signed and witnessed.

1.6.5 Installation Documentation

The contractor shall ensure that, upon completion, the Project Manager receives a minimum of two copies of the installation and testing documentation.

The installation specification may call up any special documentation requirements considered necessary. The documentation should be of good commercial standard; where appropriate, legible, marked-up copies of supplied drawings are acceptable.

Drawings provided must be in electronic format.

1.6.6 Warranty Requirements

The terms warranty and guarantee are interchangeable. Warranty requirements are normally specified in the contract.

1.7 TENDER RESPONSES

Tender responses should be in accordance with the Invitation to Tender, but additional information is invited. It is noted that it is in both the Department and the contractor's interest that all points of confusion or conflict be clarified in the Tender. In particular, the contractor should note points where he is non-compliant to the requirement, where he detects ambiguity, or where he wishes to propose alternative methods to those specified

Table of Contents

CHAPTER 1 GENERAL CONDITIONS

This specification, together with other specifications, shall generally be a part of a set of contractual requirements. Where any conflict exists between this specification and the other contractual requirements, the following order of preference shall be observed:

1) Any requirements directly stated in the contract document.

2) The stated requirements of any ship construction or equipment installation specification to which this specification may be referred.

3) Any or all applicable regulations governing ship safety and/or construction. As a minimum such regulations shall include :

   a) Ship Safety Electrical Standard (TP 127).

   b) Regulations made pursuant to the Canada Shipping Act, the Radio-communication Act and the Arctic Waters Pollution Prevention Act.

   c) Regulations of the stipulated classification society.

   d) Regulations of the International Maritime Organization (IMO), and in particular IMO 110E (formally known as SOLAS – Safety of Life at Sea).

   e) Specifications for LAN/Fibre Optics.

   f) Standards for shipboard electrical installations (I.E.E.E.45).

   g) Electromagnetic interference standard BS1597 :1985

4) Detailed installation instructions from individual equipment manufacturers.

5) PWGSC 1029 Supplemental Conditions - Ship Repairs (956-4802-01).

Note: Any change to this order of precedence shall be approved by:

Fisheries and Oceans

Canadian Coast Guard

Integrated Technical Support Directorate

Centennial Towers 7th Floor

200 Kent Street

Ottawa, Ontario

K1A 0E7

Telephone (613) 998-1561

CHAPTER 2 GOVERNMENT PERSONNEL

In order to clarify the authority and/or responsibilities of Government personnel involved in the electronics part of this refit, the following descriptions are provided.

2.1 PROGRAM MANAGER

The Program Manager is the DFO/CCG contact man with the shipyard, through the contracting agent PWGSC, who has ultimate responsibility for the conduct of the Program. It is important to note that only the Program Manager, or his designated agent, has the authority to put additional work in hand, or otherwise modify the original specification requirements.

2.1.1 Project Liaison

Before starting work the contractor through the Program Manager shall:

a) Identify and resolve any perceived ambiguities in the contract documents.

b) Identify equipment/material shortages and schedule accordingly.

c) Schedule the work to minimize conflict with other contractors while exploiting any common areas of work, e.g., Use of special equipment or opening of sealed spaces.

d) Establish an inspection schedule.

e) Plan the conduct of the installation.

f) Resolve identified problems and establish an acceptable work schedule with the assistance of the Project Manager.

2.2 ELECTRONIC DESIGN AUTHORITY

The Electronic Design Authority is a member of DFO/CCG Headquarters or Regional Technical staff who has overall responsibility for all electronics tasks being addressed in the refit. His/her authority is restricted to technical matters and he/she may not modify work in hand without prior approval of the Program Manager, or his/her designated agent.

2.3 STANDBY ELECTRONICS OFFICER

The standby electronics officer is normally a member of the Regional Technical staff who is appointed as the head of the Electronic Department for the vessel on an as required basis until completion of the refit or construction. The standby officer is appointed to maintain close liaison with PWGSC Inspectors, and through PWGSC, the shipyard and their Sub-Contractors responsible for the construction of the ship and its systems; in Order to assure that the intent of the Specification is met. The standby electronics officer will also witness all tests and trials for

electronic equipment. He/she may not modify work in hand without the written approval of the Program Manager or his designated agent.

2.4 PWGSC ELECTRONICS INSPECTOR

The PWGSC Electronics Inspector carries out on site inspection to ensure that work carried out, and the equipment supplied, conforms to the requirements of the specification.

2.5 PWGSC CONTRACTS OFFICER

The PWGSC Contracts Officer is responsible for the negotiation of any changes to the original contract.

CHAPTER 3 ENVIRONMENTAL SERVICE CONDITIONS

Unless otherwise stated elsewhere in the specification, the following service conditions should be assumed.

3.1 ELECTRICAL SERVICE

Electrical service varies with the vessel but will generally fall into one, or more, of the following categories. The conditions given should be assumed at the load terminals.

Single phase, alternating current service

115 V ±10 %, 60 Hz ±5 %, 2 wire

Three phase, alternating current service

Three phase service may be provided in either 3 wire delta, or 4 wire star (wye):

a) 200 V ±10 %, 60 Hz ±5 % or

b) 115 V ±10 %, 60 Hz ±5 %.

Low-level direct current service

a) 24 V ±15 %, two wire ungrounded

b) 12 V ±15 %, two wire negative ground

3.2 ALTITUDE AND PRESSURE

All equipment shall be capable of its intended performance from sea level to 160 m (500 ft). Any part or component which is required to penetrate the hull, shall withstand a continuous hydrostatic pressure of 670 kPa (100 psi²) without damage to the component or leakage into the hull.

All hull penetrating components which will be required to operate in ice shall be certified by an approved classification society to at least the Ice classification level of the vessel.

3.3 TEMPERATURE AND HUMIDITY

3.3.1 Equipment Below Decks

Notwithstanding the normal between decks environment, all equipment shall be capable of its intended operation at temperatures from 0°C to 50°C, and relative humidity 5 % to 90 %.

3.3.2 Equipment Above Decks

Wherever practical, equipment shall be mounted below decks; where above deck installation is used, equipment may be protected by means of an enclosure, and shall be capable of its intended operation in the following conditions:

1) Ambient temperature (exterior)

   -50°C to +55°C

2) Adverse weather conditions

   a) Short term (up to 8 hours)

      Equipment and/or enclosure shall withstand a surface accumulation of 5 cm of ice and winds of 177 km/h.

   b) Continuous

      Equipment and/or enclosure shall withstand a surface accumulation of 1.25 cm of ice and winds of 150 km/h.

3) Solar radiation

   Equipment shall be capable of its intended performance, when the equipment and any associated enclosure is subjected to four hours continuous exposure to solar radiation levels of 1135 watts/sq. metre.

3.4 STORAGE CONDITIONS

All equipment intended for future installation or return to DFO/CCG shall be stored in a secure indoor environment, protected from damage, in temperatures ranging from -20°C to +50°C, and relative humidity from 5 % to 90 %.

3.5 SHOCK AND VIBRATION

All shipborne equipment, racks, cables and other accessories shall be mounted so as to be capable of their intended operation under the following conditions.

3.5.1 Shipboard Vibration

a) Short term (up to 8 hrs.)

   5 to 15 Hz at 0.75 mm amplitude

   15 to 25 Hz at 0.5 mm amplitude

   25 to 33 Hz at 0.25 mm amplitude

b) Continuous

   5 to 20 Hz at 0.5 mm amplitude.

3.5.2 Shock

Repeated shocks of 10 msec duration each.

a) Short term (up to 8 hrs.)

±2 G vertical and ±4 G horizontal.

b) Continuous

±1 G either axis.

3.5.3 Roll and Pitch

a) Short term (up to 8 hrs.)

±45° roll, ±20° pitch with cycle time of 5 to 20 seconds.

b) Continuous

±15 % roll, ±5 % pitch with cycle time of 5 to 20 seconds.

3.6 SALT SPRAY

The installation of equipment in weather deck locations shall be such that it is impervious to the effects of salt spray and the effect of direct spray from the ships hoses.

3.7 ELECTRONIC COMPARTMENTS

Compartments containing electronic equipment shall be provided with the ship services required to maintain the following conditions.

3.7.1 Manned Compartments

Manned compartments shall maintain:

a) Room temperature : 20°C to 25°C.

b) Relative humidity : 50% to 70%.

c) Lighting level: 100 lux average supplemented as required to provide150 lux upon work surfaces.

d) Noise level : 65 dBA.

3.7.2 Unmanned Compartments

Unmanned compartments shall maintain:

a) Room temperature : 20°C to 25°C.

b) Relative humidity: 40% to 70%.

c) Lighting level: 100 lux average.

d) Noise level: 80 dba.

CHAPTER 4 REMOVAL OF EQUIPMENT

All electronic equipment shall be removed from compartments in which work such as cutting, grinding and welding is to be carried out. DFO/CCG approval shall be obtained for any equipment to remain in place and such approval shall require the equipment to be protected from all possible hazards.

4.1 CABLES AND WAVEGUIDES

All cables removed from the vessel, or in any way disturbed, as a result of equipment removal or rearrangement shall be replaced by identical or upgraded cable type. Cables which remain undisturbed shall be examined for any sign of degradation, ie. insulation breakdown, brittleness etc., and subjected to insulation checks between conductors, as well as conductor to ground. Any evidence of failure shall result in the cable being replaced. All coaxial cable antenna feeders shall be replaced by identical or upgraded cable type. All existing waveguide runs shall be carefully examined for signs of physical damage, lack of mechanical support and simplicity of waveguide run. The waveguide shall be replaced if it is judged to be damaged or unnecessarily complex, or if either the transceiver or antenna have been replaced and/or relocated. Additional mechanical support shall be provided as required. All waveguide runs, both newly installed and original, shall be made capable of meeting a waveguide pressure test detailed in Appendix C Para 2.6.

4.2 SURVEY OF EQUIPMENT

Prior to its removal, all equipment, other than that deemed obsolescent, shall be jointly surveyed by shipyard and DFO/CCG representatives to establish the condition, both functional and cosmetic, of the equipment prior to removal. Survey results shall be recorded and used as a benchmark against which the shipyard shall restore the equipment upon re-installation.

N.B.: These checks will be limited to simple checks of equipment control and operational performance.

4.3 STORAGE OF EQUIPMENT

All electronic equipment whether removed from the vessel, purchased by the shipyard or supplied by the Crown, for installation in the vessel, shall be stored indoors as outlined in 3.4.

4.4 RETURN OF MATERIAL

All electronic equipment designated for return to DFO/CCG shall be packed in wooden crates, with each crate identified on the outside as to its content and return address. The return address will be provided by the DFO/CCG Technical Authority. The Shipyard should assume such equipment will be stored on board for return, although DFO/CCG may request an alternate method of transportation. Transportation costs shall be the sole responsibility of DFO/CCG.

4.5 RESTORATION OF DAMAGE

All electronic equipment previously removed from the vessel shall be returned to its surveyed condition and level of service, as outlined in 4.2 before final acceptance.

4.6 RETURN TO SERVICE

The Shipyard shall demonstrate that all of the equipment installed and/ or relocated has been correctly installed and checks repeated as in 4.2.

Note: The methods of demonstrating correct installation are outlined in section 8.0 of this specification.

CHAPTER 5 INSTALLATION

5.1 INSTALLATION OF CABLES

5.1.1 Acceptable Cables

Cables used in the interconnection of electronic equipment shall be per the specification or if not stated in the specification as recommended by the equipment manufacturer, subject to such cables satisfying the safety related requirements of TP127 and/or I.E.E.E 45. In cases where the manufacturer provides an optional cable kit, this shall be used.

Low loss coaxial cable of correct characteristic impedance shall be used for coaxial cable antenna feeders.

5.1.2 Routing of Cables

Cables shall be routed so as to avoid the possibility of damage, and away from locations where they may be subject to steam, heat or excessively moist or oily environment. Only cables which terminate in Radio and/or Electronic Equipment Rooms shall enter such compartments. All new cables which are installed shall be carried in concealed wireways, but may be surface mounted locally at the point of termination.

Surface mounted cable shall be dressed with a cable cover to match its surroundings. Cables which transit metal faced liner board or ceiling tile shall be protected against the possibility of abrasion. Where cables are terminated at any type of service outlet, the outlet box shall be securely mounted independently of the surrounding panel, in such a way that the panel can be removed without need to remove or disassemble the outlet.

5.1.3 Separation of Cables

The contractor is referred to Table 1, which indicates the physical separation to be maintained between various categories of cables. Because of space constraints, it is recognized that these requirements are unlikely to be completely satisfied, but cable in long runs shall be so separated or provided with additional screening. The separations do not apply to cables crossing at, or close to right angles. Cables of all types shall be kept well separated from antennas, antenna couplers and feed wires.

Cables may be bundled, according to their categories in TABLE 1, and as detailed in Appendix C.

5.1.4 Use of Wireways

Insofar as is practical, new cable runs shall employ the existing wireways. Where this is not possible, new wireways shall be provided of the KINDORF HANGAR type or approved equivalent. Cables shall be supported and secured at intervals no greater then 60 cm (24 inches),

in such a way that they shall remain supported in the event of fire. Metal hangers or straps are to be used.

Access shall be provided to wireways to facilitate maintenance. Any access panels marred or damaged by the Contractor in gaining access to existing wireways, shall be replaced with new matching panels.

5.1.5 Cable Penetrations

Cables penetrating watertight decks, bulkheads and/or fire boundaries, shall do so by means of an approved stuffing tube or transit. Cables penetrating any deck or platform shall be protected by means of a stuffing tube or kick pipe, 30 cm high, welded to the upper surface.

Cables making any such transit shall be protected from the possibility of abrasion.

5.1.6 Cable Splicing

Cables shall not be spliced, unless specifically identified herein, without the approval of the DFO/CCG Design Authority. Under no Circumstances shall any radio frequency coaxial cable be spliced. The use of inline connectors in such cables is forbidden, other than as required to terminate the cable.

5.1.7 Cable Identification

All installed cables shall be tagged with cable designations at all points of connection and at each side of any barrier. The same cable designation shall be used to identify cables in the "As Fitted" drawings.

The cable tags shall be of the embossed metallic type except in equipment racks where durable permanently printed plastic tags shall be used.

Individual conductors shall be either color-coded or identified using synthetic resin tubing and permanently printed legend.

5.1.7.1 Navigation and communication systems designation

(Ref : IEEE 45 37.32)

All navigation and communications systems shall be defined by designations. The list of systems and their designations, **Table 2,** shall be extended to suit particular applications.

Table 1

RECOMMENDED CABLE SEPARATION FOR ELECTRONIC NAVAID AND COMMUNICATION EQUIPMENTS

Cable Group	Classification	Recommended inter cable group separation in inches									
		A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**J**	**K**
A	Ships power and lighting	--	4	2	2	4	12	18	18	18	18
B	Receiving antenna cables	4	--	4	2	2	12	18	18	18	18
C	Electrical control cables	2	4	--	2	4	12	18	18	18	18
D	TV/VHF antenna distribution cables	2	2	2	--	2	12	18	18	18	18
E	Telephone/audio distribution cables	4	2	4	2	--	12	18	18	18	18
F	Echo sounder transducer	12	12	12	12	12	--	18	18	18	18
G	Transmitter/antenna coupler feed cables	18	18	18	18	18	18	--	18	18	18
H	Antenna coupler/antenna cables	18	18	18	18	18	18	18	--	18	18
J	VHF/UHF transceiver/antenna cables	18	18	18	18	18	18	18	18	--	18
K	Radar transceiver coaxial/waveguide	18	18	18	18	18	18	18	18	18	--

Table 2

CABLE DESIGNATION

SYSTEM	DESIGNATION
Call bells (radio 500 kHz)	AL
Electric clock	CE
Docking announcing (talk back)	DA
Direction finder MF-HF	DF-HF
Direction finder VHF	DF-VHF
Echo depth sounder	ES
Facsimile	FC
General alarm	G
Anemometer (wind speed and direction indicator)	HD
Automatic telephone	J
Telephone sound powered ship control	1JV
Telephone sound powered engineers	2JV
Telephone sound powered miscellaneous	3JV
Gyrocompas	LC
Gyropilot (auto pilot)	LP
Emergency announcing (public address)	MC
Rudder angle indicator	N
Radio : VHF - AM	R-A
Citizens band	R-C
VHF-FM Marine	R-F
Radio : HF	R-H
Loran	R-L
Radio : MF	R-M
PINS	R-P
Satellite communicator	R-SC
Satellite navigator	R-SN
Television distribution	R-TV
Cellular telephone	R-U
Radio broadcast antenna distribution	RB
Radio broadcast and receiver entertainment	RE
Radar navigation	R-ER
Underwater log	Y

5.1.8 Continuity/Insulation

All installed cables shall be checked for continuity of conductors, insulation between conductors, and insulation between conductors and ground before connection to equipment.

5.2 WAVEGUIDE INSTALLATION

Refer to Appendix C

5.2.1 Choice of Waveguide

The use of either rigid or flexible waveguide is permitted, the choice being dictated by the nature of the waveguide run. Long and/or straight forward runs dictate the use of rigid waveguide, while short and/or complex runs dictate flexible waveguide. In either case the lowest loss waveguide for the frequency of operation shall be used.

Waveguide flanges, pre-formed sections and other accessories shall be those recommended by the radar and/or waveguide manufacturer and their use shall take into account the following requirements:

- The use of pre-formed sections, i.e. bends, twists is mandatory to bend or re-orient the waveguide.
- Deck/bulkhead flanges are required for the waveguide to transit decks and/or exterior bulkheads.
- Waveguide may transit interior non- watertight bulkheads by means of cut out, but shall be protected from any form of mechanical damage.
- Where excessive vibration is anticipated between the scanner and its platform, a short (30 cm) length of flexible waveguide shall be used.
- Each waveguide run shall be fitted with the following:

    1) A bi-directional coupler (20 dB attenuation, 40 dB directivity) installed adjacent to the transceiver;

    2) A pair of pressure windows (70 Kpa) installed between the bi-directional coupler and pressure unit at the transceiver end, and between the waveguide and scanner at the scanner end; and

    3) A pressure unit, complete with gauge (0 to 5 psi), installed between the lower pressure window and the waveguide.

5.2.2 Routing Waveguide

The waveguide shall be routed along the most direct path between the transceiver and the antenna as detailed in Appendix C.

5.2.3 Bending/Jointing

Under no circumstances are sections of rigid waveguide to be forced or otherwise deformed during installation. Any bending shall be done using pre-formed sections.

Waveguide shall be installed so that in vertical sections, the choke flange faces down, with proper "0" rings fitted at each flange.

The waveguide run shall be carefully measured and cut. The end couplings shall not be stretched or forced into position, the transceiver shall be slightly relocated, if necessary and practical. Should it prove necessary to fabricate a waveguide section, the following shall be considered:

- The squareness of the waveguide cut and the fitting of the flange require the use of a proper jig.
- Jointing shall be by means of silver solder only.
- After jointing, the waveguide interior must be clean, dry and free of foreign matter.

5.2.4 Mechanical Support/Protection

All hardware used in joints and/or mechanical support shall be stainless steel. Waveguide shall be mechanically supported at intervals no greater than 60 cm for horizontal runs and 90 cm for vertical runs.

Waveguide shall be protected by means of kick pipes or cover plates wherever it is subject to mechanical abuse, eg. above deck penetrations, on horizontal surfaces at deck level.

5.2.5 Painting of Waveguide

Waveguide in above decks locations should be painted when installation and testing are complete. In painting near to the scanner, care must be taken not to paint the antenna aperture or any warning notices.

5.2.6 Waveguide Testing

Upon completion of installation, the waveguide shall be subject to a pressure leak test as detailed in Appendix C paragraph 2.6.

5.3 ANTENNA INSTALLATION

Refer to DGTE-75 for detailed information.

5.3.1 Location

The location of communication antennas aboard DFO/CCG ships is very difficult, due to the lack of available space, and the need to maintain physical separation, particularly between transmitting and receiving antennas. In siting antennas, the following ground rules should be applied:

- The maximum possible separation should be provided between the transmitting and receiving antennas. For this purpose, a radiotelephone should be classed as a transmit antenna.

- The siting of antennas should be such that the deck area surrounding the antenna is as clear of metallic obstruction as is practical.

- Wherever possible, metallic material located close by an antenna should be replaced by a non-metallic equivalent. Specifically, guard rails and/or stay wires close to antennas should be of a non-conducting material such as Phillystran non-metallic cable.

- Antennas shall be installed as high as is practical, but maximum height must be provided for :

  1) VHF direction finder;

  2) MF/HF direction finder; and

  3) VHF/FM radio telephones.

- Mast mounted antennas shall be on spars and separated by at least 2 m from the metal of the mast structure.

- Location of radar and satellite communication antennas shall take into account the shadowing effects of upper deck obstructions. The chosen locations shall minimize the effect of any shadow and/or blind arc created.

- Final antenna sittings must be approved by the Electronic Design Authority prior to commencement of installation.

5.3.2 Upper Deck Antenna Equipment Enclosures

An increasing number of equipments are being provided with automatic antenna tuners. For efficient operation, it is required that the tuner and the antenna be co-located. Wherever practical, this should be arranged with the tuner mounted below deck at the base of its associated deck piercing antenna. Where the tuner cannot be located below deck, it shall be mounted in an enclosure designed to assure its intended operation in the conditions given in section 3.0. The enclosure shall be designed to meet the following requirements.

5.3.2.1 Mechanical

The enclosure shall be completely watertight, with a locking watertight door, and a drainage arrangement to prevent the accidental accumulation of water. The enclosure shall be sufficiently strong to permit the top mounting of an associated antenna without the need for any additional strengthening. The enclosure and its door shall be sufficiently large to permit the easy installation and removal of the enclosed equipment without need for equipment re-orientation. The enclosure shall be large enough to permit "on-site" servicing of the equipment, taking into account the

removal of any access panels or opening of access doors. A means of ventilation shall be provided.

5.3.2.2 Environmental

While meeting the requirements of 3.0 the enclosure shall be provided with any facilities required to prevent the accumulation of condensation on its interior surfaces.

5.3.2.3 Electrical

The floor of the enclosure shall be covered with insulated matting, with 30 kV shock rating. It shall be equipped with the following electrical services:

- One, 115 V 100 W switched lighting circuit, complete with weatherproof lamp fixture and switch.
- One, 115 V 15 A electrical service circuit, complete with weatherproof dual, three pin, grounded U, service outlet and box. The lighting and service circuits may be combined.
- One thermostatically controlled heater and/or fan and circuit, rated to maintain the interior of the enclosure in a condition to ensure equipment operation under the conditions outlined in 3.3.

5.3.3 Bulkhead/Deckhead Penetration

Areas of the upper deck mounting whip antennas shall be strengthened to accept the mechanical stresses imposed by the antenna under the conditions outlined in 3.3.

Where an antenna feed is required to penetrate an external bulkhead or deck, the penetration shall be watertight. In the case of a continuous coaxial feeder cable this shall be accomplished by means of a stuffing tube or other approved cable transit. In the case of solid wire or copper tube antenna feeders a feed through insulator, preferably incorporated into the base of a deck piercing antenna, shall be used.

Where feed through insulators are used, the following precautions shall be taken:

- The area within approximately 15 cm radius of the feed through and wire shall be devoid of all unnecessary material including insulation, particularly of the metal faced type.
- Any metal edges shall be dressed so that no sharp or pointed surfaces come in contact with the feedwire.
- All surrounding metal shall be bonded to the ships structure.
- The area around the penetration shall be kept clear of moisture, particularly condensation.
- The feed through insulator shall not be painted or otherwise contaminated.

- Fastening hardware shall be stainless steel.

- Maintenance access shall be provided to both the antenna tuner and to the base of its associated antenna and feed through.

The feedwire length between the antenna tuner and antenna base shall be minimized, and should not exceed 60 cm.

- The feedwire shall be free of sharp bends or unnecessary kinks.

- The antenna tuner shall be bonded to the ships hull, using no more than 60 cm of 2.54 cm wide, 1 mm thick, solid copper strap.

- No joints or splices, including the use of in line connectors, is permissible in antenna feeders. In line connectors are permissible where required to terminate the feedwire. All such connections made above deck shall be fully protected from the marine environment.

5.3.4 D.F. Isolation

In so far as it is practical, a single means shall be provided to open circuit or ground all MF/HF antennas for the purpose of taking DF bearings. As a minimum, this shall apply to all hi-power transmitters (above 400 W), and shall be controlled by the Radio Officer.

5.3.5 Personnel Safety

All hi-power antennas (above 400 W), located in areas of the upper deck in normal use, shall be sited, or screened using non-metallic matter, so that personnel may not approach closer than 2 m. A cautionary notice warning of the danger of contact and/or prolonged exposure shall be posted.

Other antennas radiating above 150 W require only the posting of notices regarding dangers of direct contact.

Radar antennas shall be equipped with safety switches at entry to the antenna platform. The safety switch shall stop antenna rotation when operated. A cautionary notice warning of prolonged exposure shall be posted.

5.3.6 Painting of Antennas

The radiating surface of any antenna, or any associated insulators, shall not be painted.

5.3.7 Longwire Antennas

In the event that longwire antennas are to be installed, they shall be provided with proper safety loops, and with corrosion proof downhaul hardware to permit adjustment and lowering of the antenna for maintenance purposes.

5.4 EQUIPMENT INSTALLATION

5.4.1 General

5.4.1.1 Approval of Purchase Orders

All purchase orders raised by the shipyard against the Contractor furnished equipment, shall be forwarded to DFO/CCG for the approval of the Telecom Design Authority, prior to purchase of the equipment.

5.4.1.2 Equipment layouts

The contractor shall prepare layout drawings, showing the disposition of electronic equipment at both the rack/console and the compartment level. These shall be prepared for all compartments containing electronic equipment, e.g. Wheelhouse and Equipment rooms. An antenna layout diagram shall also be prepared. All layout drawings shall be forwarded to DFO/CCG for the approval of the Design Authority.

5.4.1.3 Installation Drawings

The contractor shall prepare drawings, based upon the Manufacturers installation data, showing the electrical details of each electronic system intended for installation. Cable details such as identifier numbers and types as well as connector detail and power supply detail should be included. Point to point connection detail may be supplied separately, but the drawing shall reference the source.

Installation drawings shall be submitted to DFO/CCG for the Design Authority approval.

The contractor should note that these drawings will form the bases of the "As Fitted" drawings referenced in 11.2. They should therefore be prepared with the requirements of the maintainer as well as the installer in mind.

5.4.1.4 Safety switches

Each piece of electronic equipment shall be capable of being switched off locally. This may be achieved by means of a normally provided front panel switch. For equipment not provided with such a feature, and which is remotely activated, a local on/off safety switch shall be provided.

5.4.1.5 Labelling

Each electronic unit, circuit breaker and safety switch shall be permanently labelled as to its identity and/or purpose.

Where any electronic unit or terminal box is obscured by ceiling tile or liner board, access to the obscured equipment shall be provided. The access panel shall be clearly and permanently marked with the identity of the obscured equipment.

5.4.2 Rack/Console Mounting

Rack and/or console mounting is the method for the mounting of electronic equipment, and should be used wherever space and equipment configuration allow. The Contractor shall be responsible for the supply of any racks and/or consoles required to mount the electronic equipment.

5.4.2.1 Mechanical requirements

Racks and/or Consoles shall be of an all welded, steel construction to provide both mechanical and electrical integrity, and shall be well secured in a vertical position. Welding is the preferred method of securing the rack or console although they may be bolted, provided the rack/console is properly bonded to ships metal. The rack/console shall be properly braced as required to meet the shock and vibration requirements of paragraph 3.5.

Racks and/or consoles shall be designed for the retractable, slide mounting of standard 483 mm (19 in.) electronic equipment to an equipment depth of 600 mm (24 in.). Console height should be the maximum consistent with its purpose and surroundings.

The mounting slides shall be of two piece construction, with one piece attached to the rack, the other piece to the equipment. In the extended position, the slides shall tilt and lock at 0° and ±45°, and shall be capable of easily supporting the mounted equipment. A means shall be provided to prevent cable snags during slide insertion and/or withdrawal. The racks shall be designed with removable side panels and doors, which shall be available as accessories. Racks shall be arranged so that adjacent racks may be bolted together without interior side panels. Preference shall be given to racks which are easily adapted for forced air ventilation.

The preferred method of equipment mounting shall be by means of the retractible slides. Any equipment not mounted in this way shall be supported from below. Equipment shall be retained in the rack by front panel retaining screws, which shall mate with captive threads mounted in the rack. The retaining screws shall in no way be required to provide mechanical support to the equipment. The retaining screws shall be standardized both for cosmetic and maintenance reasons, and the removal of equipment should require no other tools than those required to release the retaining screws and connectors.

Care shall be exercised regarding the location of equipment within the rack. Heavy equipment shall be located at the bottom of the racks, while lighter equipment without front panel controls, shall be at the top. Equipment requiring frequent maintenance or control actions shall be mounted in the centre portion, preferably between hip and shoulder levels. Racks and equipment shall be located with consideration for the requirements of both the operator and the maintainer. Racks shall be located so as not to obstruct passageways or doorways, even with the slide fully withdrawn. Wherever possible, clearance to the front of the rack shall be sufficient to allow the use of test equipment, say 1.5 m (5 ft) and allow the technician to easily adjust and observe front panel controls with the equipment slide extended. Clearance to the rear shall be sufficient to permit unimpeded access by a technician, say 0.6 m (24 in).

5.4.3 Bulkhead/Tabletop Mounting

Equipment mounted upon bulkheads shall be properly secured, either directly or indirectly, to the ships structure. Under no circumstances shall any equipment be supported on liner board or ceiling panels. Indirect mounting should be made by means of a solid wood or metal pad.

Tabletop mounting of equipment is acceptable, but the use of window sills shall be avoided unless approved by the Design authority. Maximum use shall be made of the Manufacturers standard mounting accessories. All mounted equipment shall be oriented to best serve the operator, i.e. panel legends shall be properly oriented.

The equipment shall be located and mounted while taking into consideration both the requirements of the operator and the maintainer.

All bulkhead and tabletop mounted equipment shall have equipment cases bonded to the ships metal structure.

A duplex, three pin grounded U service outlet shall be located nearby to support the requirement for power tools and test equipment.

5.4.4 Overhead Mounting

The overhead mounting of electronic equipment shall be avoided, and be used only when alternative methods of mounting are impractical. If the overhead mounting of equipment is unavoidable, the preferred method is to use an overhead console, securely fixed to the ships structure and designed to provide for ease of maintenance access. The siting of any such overhead console shall be such that there is no threat of personal injury, and the mounted equipment shall be easily accessible for operational purposes. All equipment so mounted shall be bonded to the ships' structure. A duplex, three pin, grounded U electrical service outlet shall be provided for power tools and/or test equipment.

5.4.5 Connection of Equipment

The connection of installed equipment shall be in accordance with the manufacturers' installation instructions, with maximum use made of any cable sets recommended by the manufacturer.

5.4.5.1 Mechanical Requirements

Although it is recognized that the connector arrangements are already dictated by the installed equipment, the Contractor should follow the following ground rules:

- Where similar connectors are co-located they shall be easily identified with their mating connectors. Ideally, this shall be by mechanical key but failing this, visual identification shall be provided.

- Some form of mechanical retention of the connection by its mate shall be provided. This may be by snap-lock fitting, screw thread or other mechanical device. If no such device is fitted, the connector should be tied in place.

- Some form of cable strain relief, shall be provided, either as an integral part of the connector, or by securing the cable to the same surface.

- Ensure that the cable is long enough and fitted in a way that permits equipment withdrawal, without snagging or any other form of mechanical strain.

5.4.5.2 Soldered Terminations

In making soldered terminations to a connector, the Contractor shall observe the following precautions. NOTE: Failure to do so, will result in rejection of the work.

- Always use a soldering iron, appropriate to the work. For electronic connectors, miniature pencil bits should be used in association with soldering irons of no more then 25 watts.

- The use of acid core solder or acid base cleaning flux is forbidden.

- Maximum practical use shall be made of heat sinking.

- Care shall be taken to isolate the work in hand; i.e. other cables and connectors, shall be separated from the work in order to minimize the probability of damage due to solder splash, or proximity to the hot soldering iron, etc.

- All wires when terminated shall be snugly sleeved with insulation to a point no more than 3 mm (0.125 in) from the soldered pin.

- When complete, each termination shall be clean and well soldered, free from solder splash and wire hairs, and cleaned of any residual flux.

5.4.5.3 Crimp Terminations

Where equipment is connected by crimped terminals, either screw type or connector type, the Contractor shall observe the following ground rules. NOTE: Failure to comply will result in rejection of the work.

- All crimp style terminations shall be made using the crimp terminals and crimping tool designated for the purpose. Under no circumstances is the use of standard electricians pliers acceptable for this purpose.

- Should the Contractor find it necessary to special purchase any specific terminals and/or crimping tools, they shall be provided with the vessel as special tools.

- As far as is practical, terminals shall be crimped in two places i.e. to the bared wire for electrical connection, and to the insulating sleeve for mechanical integrity.

- Screw type terminals shall be of the ring or hooked spade variety, using no more then three terminals per screw connection.

- Screw type terminals shall be the correct size to match the terminating screw.

- Each individual screw type termination shall be identified either by color code or coded sleeve.

- Screw type terminal blocks with connections carrying voltages in excess of 48 V shall be protected by means of clear plastic terminal guards, and shall be marked nearby with a warning notice, advising the presence of high voltage.

CHAPTER 6 ELECTROMAGNETIC INTERFERENCE

The Contractor shall be responsible for the identification of sources of electromagnetic interference, and for their subsequent suppression. Electromagnetic interference may be defined as the mechanism whereby electrical conditions in one or a number of ship systems interferes with the ability of another system to perform its' intended function. Electronic systems are particulary susceptible to this type of interference. Systems need not be physically interconnected, co-located, or have similar electrical characteristics in order to interfere with each other.

In tracing and suppressing sources of electromagnetic interference, the requirements of BS-1597: 1985 shall apply. The permissible levels of interference are paraphased herein and Appendix A details guidelines to be followed by the contractor to eliminate or lessen the effects of interference.

6.1 LIMITS OF INTERFERENCE

Separate limits are defined for radiated interference, that transmitted through the air, and for conducted interference, that transmitted by wire. Each type of interference has different levels allowed above and below 15 KHz.

6.1.1 Radiated Interference (30 Hz to 15 KHz)

As detailed in Appendix A paragraph A.3.1

6.1.2 Radiated Interference (above 15 KHz)

As detailed in Appendix A paragraph A.3.3

6.1.3 Conducted Interference (30 Hz to 15 KHz)

As detailed in Appendix A paragraph A.3.2

6.1.4 Conducted Interference (above 15 KHz)

Voltage interference levels measured at the terminals of any single piece of electrical or electronic equipment shall not exceed the levels given in Appendix A, Figure A1. If measured as a current, the levels shall not exceed those given in Appendix A, Figure A2.

Class 1 limits shall apply where equipment or cables are poorly screened, as follows:

- In wooden or fibreglass hulls and/or compartments.
- Above decks in general, unless proper screening has been used.

- Where close coupling exists between the affected equipment and their associated cables.

Class 2 limits shall apply in well screened situations, such as:

- Within the metallic structure of the vessel.
- Where screening has been specially provided.

6.1.5 Measurement Requirements

Measurements shall be made as detailed in Appendix A paragraph A.5. Measurements should be made under the worst case conditions.

6.2 INTERFERENCE SUPPRESSION

In general, interference shall be suppressed at its source in accordance with Appendix A paragraph A.2.

6.3 SCREENING OF CABLES

The screening of cables shall satisfy the following ground rules:

- Screens should have a shielding efficiency of at least 90%.
- Low frequency cables should use a ferrous screen material, grounded at a single point, below 15 KHz.
- High frequency cable should use bronze, copper, or aluminum material and should be grounded at intervals of less than 0.15 wavelengths at the highest frequency of interest, wherever practical.
- Metallic trunking may provide effective screening provided it is bonded as it passes through any bulkhead, and all seams and joints are continuously welded.

6.4 GROUNDING AND BONDING

(Pay specific attention to Appendix B)

Grounding and bonding is an important prerequisite in the proper performance and safety of electronic equipment. The Contractor shall comply with the following requirements.

6.4.1 Racks and Consoles

The following applies to the grounding of equipment racks and consoles:

- Racks and consoles should be of all welded construction, with direct electrical connection between the rack or console and ships metal. Where direct connection is not feasible groundstraps are required.

- The use of non welded racks and consoles, is subject to the requirements that each individual member is properly grounded. Members may be either individually grounded or they may be bonded to each other by means of straps. Electrical continuity between adjacent members shall not be assumed because of their proximity and mechanical connection.

- In the case of non-metallic hulls or compartments, a grounding rail shall be provided (see Appendix B).

6.4.2 Equipment Cases

Individual equipment cases shall be grounded in accordance with Appendix B paragraph B.2.

6.4.3 Methods and Materials

The following applies to materials and methods used in grounding and bonding:

- All contact surfaces shall be clean and free from paint, scale, rust or any material considered likely to impair the contact efficiency.

- The contact surface area shall be as large as is possible.

- Contact surfaces shall be bonded using a method which will not impair contact efficiency, e.g. welded stud.

- Straps shall be of 2.5 cm (1 in.) wide solid copper, 0.6 mm (0.025 in) thick and as short as possible while avoiding the creation of sharp bends and corners.

- Groundstraps and joints shall be accessible for maintenance.

- Other low resistance, chemically compatible, corrosion resistant materials may be approved for use by the Design Authority.

- All bonding hardware, i.e. nuts, washers, bolts, etc., shall be of low resistance, corrosion resistant material, preferably stainless steel. Upper deck hardware shall be of stainless steel.

CHAPTER 7 SETTING TO WORK

The term setting to work describes the activities required to demonstrate that the electronic systems have been correctly installed and are capable of performing their intended functions, prior to the trial and acceptance of the vessel. In carrying out a refit, there are three classes of equipment to be considered, each of which will involve different levels of testing, and different responsibilities for the shipyard.

7.1 SHIPS ORIGINAL EQUIPMENT

This describes equipment which was fitted in the vessel prior to the refit, and which will still be fitted in the vessel on completion of the refit.

Paragraph 4.2 describes a procedure whereby the operational/functional and cosmetic status of these equipment is determined prior to the refit. Setting to work of these equipment, shall consist of repeating the original equipment survey to establish that there has been no deterioration of its condition. The Contractor shall be responsible for all costs and actions required to restore the equipment to its original, surveyed condition.

The set to work survey of equipment shall be witnessed by DFO/CCG and/or PWGSC'S Electronic representative.

The Contractor shall provide a minimum of one calendar month notice of intent to conduct set to work.

Any additional testing and/or trial of equipment shall not be the responsibility of the Contractor.

7.2 CONTRACTOR FURNISHED EQUIPMENT

This describes all electronic equipment, purchased and installed by the Contractor or his agents. It shall also be taken to include all ships original equipment which has been modified and/or refurbished as part of the refit contract. As a minimum, the setting to work of these equipment shall include:

- A physical inspection of the installation to ensure that no damage will result from initial turn on of the equipment.
- Alignment and/or calibration of the equipment.
- A check to ensure that any requirements peculiar to the particular installation have been carried out, e.g. correct frequencies installed and / or programmed, and specified options provided.

- A series of installation checks to demonstrate that the equipment has been correctly installed and, where applicable, has been correctly interfaced to other equipment and/or components.

The alignment and installation checks are specific to the type of equipment being tested, and a broad outline is given in Section 8. From this outline, the contractor shall develop a Program and schedule of tests to be carried out. The test program shall be subject to the approval of the DFO/CCG Design Authority, and shall be submitted to them together with a proposed schedule at least two calendar months before the proposed starting date.

The Contractor shall be responsible for the costs associated with the afore-mentioned checks and tests. Should any problem arise as to the availability of test equipment or other test requirements, the Design Authority shall be notified at once.

The tests shall be witnessed by the DFO/CCG Design authority, Electronic Officer, and/or Public Works and Government Services Canada inspector or their designates. All test results shall be recorded, and three copies provided to the Design Authority.

In the event of damage to equipment as a result of the tests conducted by the contractor he shall be responsible for the restoration of the equipment to its required condition at no additional cost to the Crown.

Any additional tests which may be requested shall be outside of the Contractors responsibilities.

7.3 GOVERNMENT FURNISHED EQUIPMENT

This describes all electronic equipment, provided by the Crown and installed by the Contractor and in most cases is applicable to new construction.

Setting to work of these equipment, shall be as described in 7.2 with the following exceptions:

- They shall be limited to the physical inspection and installation checks.

- The contractor's repair responsibilities shall be limited to the rectification of installation defects, and to any equipment defects, which can be shown to result from improper installation.

CHAPTER 8 TEST REQUIREMENTS

The types of checkout required in setting equipment to work have been briefly discussed in section 7.

A minimum set of tests to be carried out on each class of equipment is given in the following paragraphs.

8.1 RADIO TRANSMITTERS

8.1.1 General

The following test requirements shall apply to all Radio transmitters operating in the LF, MF, HF, GRS, VHF and UHF bands, including those associated with Radiotelephones and/or Helicopter Beacons.

8.1.2 Physical Inspection

- Check the unit interconnection and power wiring prior to turning on.
- Ensure all units are properly grounded, paying particular attention to the antenna coupler.
- Check antenna feeder connections, and ensure all metal nearby is properly grounded.
- Identify and record power supply connections, for distribution panel and breakers.

8.1.3 Setting Up

The set up shall include all of the procedures recommended by the Manufacturer in the Installation or Instruction Manual. Apart from these recommendations, as a minimum, the following adjustments shall be confirmed:

- Output power levels are correct.
- Modulation/deviation levels are correct.
- Frequencies are accurate and properly assigned.
- All special requirements, e.g. programmed call sign or frequencies, and a distress generator have been provided.

8.1.4 Installation Checks

- Confirm that the setting up has been correctly carried out. This may be waived provided the setting up is witnessed by the DFO/CCG Design Authority or his designate, and the test results are properly recorded.

- Check and record both forward and reflected power to the antenna at a number of frequencies (up to 20) evenly distributed across the band, in all modes. Test should be made at the highest available power level (if possible).

- Calculate and record Voltage Standing Wave Ratio (V.S.W.R.) levels and correct any abnormalities.

- Conduct Radio checks to determine transmission quality in all modes, and check the operation of all controls.

8.1.5 Sea Trials

Check that the transmitter functions correctly in its intended environment. Determine V.S.W.R. levels if deferred from 8.1.4.

8.2 RADIO RECEIVERS

8.2.1 General

The following test requirements shall apply to all receivers operating in the LF, MF, HF, GRS, VHF and UHF bands including those associated with radiotelephones. They do not apply to alarm receivers, 2182 KHz watch receivers, direction finders, or entertainment receivers, which will be dealt with in separate sections.

8.2.2 Physical Inspection

- Check all unit interconnection and power wiring prior to turning on.

- Ensure the unit is correctly grounded.

- Identify and record power supply connections for distribution panel and breaker.

8.2.3 Setting Up

The set up shall include all of the set up procedures recommended by the Manufacturer in the Installation or Instruction Manual. As a minimum, the following parameters shall be confirmed:

- Squelch sensitivity (if applicable).

- 12 dB sinad sensitivity (without squelch).

- Dial or channel frequency accuracy.

8.2.4 Installation Check

- Confirm that set up has been correctly carried out. This may be waived provided the setting up is witnessed by the DFO/CCG Design Authority or his designate, and the test results are properly recorded.

- Carry out a receiver quality check of the following:

  1) aural quality;

  2) operation of controls;

  3) operation of remote speakers; and

  4) squelch operation (if applicable).

8.2.5 Sea Trial

Check that the receiver functions correctly in its intended environment.

8.3 SHIPS' TELEPHONE SYSTEMS

8.3.1 General

The following test requirements shall apply to both the Ships' Sound Powered Telephone Systems and the Ships' Automatic Telephone Exchange System. Unless otherwise indicated, the checks shall be made on both systems.

8.3.2 Physical inspection

- Check out the interconnection and power wiring, before turning on.

- Ensure that the appropriate fittings have been provided as follows:

  1) acoustic booths;

  2) visual ring indicators;

  3) external bells; and

  4) waterproof or explosion proof fixtures.

- Ensure units are properly grounded.

- Identify and record power supply connections.

8.3.3 Setting Up

- Check insulation to ground and between individual conductors on Sound Powered Telephone Systems.
- Check the ability of individual telephone stations to communicate.
- Check shore-line operation of the Automatic Telephone Exchange.

8.3.4 Installation Checks

- Confirm operation of the Sound Powered and Automatic Telephone Systems.
- As a minimum, sufficient test calls shall be made to eliminate the possibility of missed or crossed connections.
- Verify the voice quality, and signalling and supervisory tones of each station.
- Verify the shore-line operation of the Automatic Telephone Exchange.
- Verify that the required number of shore-lines can be handled.
- Ensure that incoming calls to the Quarter Masters' position may be held and transferred to or from the shore-line.
- Ensure that all special features have been provided, such as:
  1) privacy;
  2) priority override; and
  3) conference calls.
- Confirm that suitable up to date directories are located close by each phone station.

8.3.5 Sea Trials

Check the operation of each system in its intended environment. Noisy locations should be checked in particular.

8.4 INTERNAL COMMUNICATIONS SYSTEMS

8.4.1 General

These test requirements shall apply to Intercom systems, Public Address or Area paging systems, S.R.E. systems and Loudhailers.

8.4.2 Physical Inspection

- Check out the interconnection and power wiring prior to turning on.
- Check that the correct equipment has been provided and is correctly sited.
- Check that units and cable screens are properly grounded.
- Identify and record power supply connections.

8.4.3 Setting Up

- Carry out all required system setup and adjustment. As a minimum this must include :
  1) check the sound levels of all speakers, and adjust powertaps accordingly;
  2) make all necessary internal adjustments;
  3) test the operation of any supervisory systems provided; and
  4) check the system in all of its operating modes.

8.4.4 Installation Checks

- Demonstrate the adequacy of all speakers in the following modes:
  1) intercom;
  2) paging;
  3) public address;
  4) loudhailer ; and
  5) S.R.E.

  This shall include the quieting of non-vital speakers as required by specification.
- Demonstrate operation from all Control positions.
- Demonstrate any supervisory systems provided.

8.4.5 Sea Trials

- Check the operation of systems in their normal environment.

Particular attention shall be paid to operation of equipment in noisy locations, and to "hands off" and "privacy" features of the Intercoms.

8.5 NAVIGATION RADARS

8.5.1 General

These checks apply generally to all radars fitted aboard DFO/CCG vessels.

8.5.2 Physical Inspection

Carry out a complete inspection of the Radar installation, with special emphasis on the waveguide and antenna. In particular ensuring that waveguide is properly supported, accessible at all joints, and that waveguide flanges are properly fabricated.

- Check that all options, e.g. performance monitor, bi-directional coupler, pressure unit, etc. are installed.
- Ensure all units, including the antenna, are correctly grounded.
- Check out the interconnection and power wiring prior to turning on.
- Identify and record the power supply connections.

8.5.3 Setting Up

Carry out all calibration and adjustments specified in the Installation or Instruction Manual. As a minimum, the following must be checked:

- Operation of the performance monitor, with results to be recorded.
- Operation of the internal Test Panel, with results to be recorded.
- Check the accuracy and operation of:
  1) range rings;
  2) variable range marker; and
  3) heading marker
- Check the operation of the antenna safety switch.
- Check the quality of the Radar image and operation of controls.

8.5.4 Installation Checks

(Three Piece Radars only)

Measure and record:

- Average forward power into the antenna.
- Average reflected power.
- Pulse width.
- Pulse repetition rate.

From the above, calculate and record:

- Peak pulse power.
- V.S.W.R.

Demonstrate the setting up checks.

Carry out a waveguide pressure test.

8.5.5 Sea Trials

Check operation of the radar in its operational environment, paying particular attention to:

- Minimum range, and maximum range.
- Gyro stabilization of picture and operation of Azimuth Ring.
- Operation of polarization and clutter controls.

8.6 ECHO SOUNDER/SPEED LOG

8.6.1 General

These checks shall be applied to Echo Sounders and/or electronic Speed Logs fitted in DFO/CCG vessels.

8.6.2 Physical Inspection

While the vessel is drydocked, make a thorough inspection of the hull close to all transducers to ensure:

- That the transducer faces are flush with the hull, or that if proud of the hull, they are suitably faired.
- That the angle of the transducer face is in accordance with manufacturers' specifications.
- That the hull within 2m of the transducer is free from cavities and/or protuberances, which might cause turbulence.
- That the transducer faces are cleaned and free from paint.

Check that all units are grounded.

Check the separation and shielding of the transducer cables.

Check all unit interconnection and power wiring before turning on.

Identify and record the power supply connections.

8.6.3 Setting to Work

Perform all check out and alignment procedures outlined in the Installation and/or Instruction Manual, paying particular attention to:

- Draught adjustment (if required).
- Fresh/saltwater calibration (if required).
- Transducer/echo sounder tuning, where transmitter/receiver frequencies are the same, and transducer is tuned to the echo sounder frequency.

8.6.4 Installation Checks

- Demonstrate setting up has been carried out.
- Check the operation of any inter-switch capabilities.
- Check for simultaneous operation of systems.
- Check operation of depth alarm.

8.6.5 Sea Trials

Carry out calibration of all systems.

Check out interfaces with other units.

Confirm operation under conditions of intended operation, paying particular attention to the operation of the echo sounder when the ship is at high speeds or in going astern operations.

8.7 DIRECTION FINDING EQUIPMENT

8.7.1 General

These checks shall apply to all Direction Finding equipment operating in the LF/MF, GRS and VHF bands.

8.7.2 Physical Inspection

Location and alignment of antennas is critical for system operation:

- Check for mechanical alignment.
- Check antenna is as physically clear as practical from:
  1) other antennas; and
  2) metal stays, etc.
- Where specified, check that LF/MF antennas can be automatically isolated or grounded.
- Check that all units are properly grounded.
- Check all unit interconnections and power wiring before turning on.
- Identify and record power supply connections.

8.7.3 Setting Up

Carry out all check and alignment procedures outlined in the Installation and/or Instruction Manual.

Ensure antenna is aligned and loops are not crossed by doing a rough calibration.

Check operation in both manual and automatic modes as follows:

- Determine minimum signal level required for accurate D.F. operation in each mode.
- Check operation of D.F. signalling and antenna isolation/grounding (if specified).

- Check operation of the D.F. antenna protection unit.

8.7.4 Installation Checks

Demonstrate the D.F. operation as outlined in 8.7.3.

8.7.5 Sea Trials

- Check gyro stabilization, (if applicable).

- Carry out full D.F. calibration.

N.B. The calibration procedure should provide corrections at least every 15°, with correction curves plotted, recorded and a copy posted close by the Direction Finder. It should be arranged that each set is calibrated at two frequencies, (if practical).

- Check operation under conditions of actual operation.

8.8 AUTO ALARM PANEL

8.8.1 General

The auto alarm panel is comprised of the 500 KHz alarm Receiver and the Autokeying unit. It will be fitted only as a component of a radio console.

8.8.2 Physical Inspection

Check that the external alarms associated with the Alarm Receiver are correctly installed. Check that the unit interconnections and power wiring are correct before turn on. In particular, make sure any connections required to "self-test" the panel have been made.

Identify and record power supply connections.

8.8.3 Setting Up

Carry out all alignment and set up procedures specified in the Installation Manual.

Program the Autokeyer with the call sign and with emergency and distress sequences.

Check that the Autokeyer keys the required transmitters.

Check the operation of the Autokeyer and alarm receiver (including external bells), by cross connection if possible.

Check 12 dB Sinad for the alarm receiver.

Check and record the signal level required to activate the Alarm bells.

8.8.4 Installation Checks

Demonstrate the Alarm Panel's operation as outlined in 8.8.3.

8.8.5 Sea Trials

There are no special Sea Trial test requirements.

8.9 WEATHER FACSIMILE TERMINAL

8.9.1 General

The terminal may incorporate a recorder only, or both recorder and receiver. The recorder is often associated with a dedicated transmitter.

8.9.2 Physical Inspection

Check unit interconnections and power wiring before turn on. If both transmitter and recorder are provided, some form of cross connection should be used for self-testing if it is practical.

Identify and record power supply connections.

8.9.3 Setting Up

Carry out all alignment and adjustment procedures for both transmitter and recorder. Perform any self test procedures including check out by means of cross connection if practical.

Check out the Recorder using any standard facsimile broadcast.

8.9.4 Installation checks

Demonstrate terminal performance as in 8.9.3.

8.9.5 Sea Trials

Check the performance of the terminal under its actual operating conditions. In particular, observe whether local transmission affects facsimile reception.

8.10 COMMUNICATIONS ANTENNA SYSTEM

8.10.1 General

Communication antenna systems are provided to permit the shared use of receive antennas.

8.10.2 Physical Inspection

Check that the correct matching transformers and receiver protection units have been provided.

Ensure that the antenna feedline is a screened coaxial cable, and is properly grounded.

Check unit interconnection and power wiring before turning on.

Identify and record power supply connections.

8.10.3 Setting Up

Carry out all alignment and adjustment procedures.

Check insertion loss of at least one channel or multicoupler, and examine the remainder using a scope.

8.10.4 Installation Check

Demonstrate operation as outlined in 8.10.3.

8.10.5 Sea Trials

Operational test at sea, using local transmitters.

8.11 ENTERTAINMENT DISTRIBUTION SYSTEM

8.11.1 General

The entertainment distribution system distributes radio and TV signals throughout the ship. It includes all necessary antennas, amplifiers, cables and outlet boxes and any public TV/Radio equipment provided for public use.

8.11.2 Physical Inspection

Ensure that the antennas are mounted as clear as is practical from metallic obstructions.

Ensure that distribution cables are run as direct point to point as possible.

Check all unit interconnections and power wiring before turning on.

Ensure that each branch line, and unused splitter and/or amplifier outputs are correctly terminated, (usually with a 75 Ω resistor).

Identify and record power source.

Ensure connector cables are provided.

8.11.3 Setting Up

Carry out all alignment and adjustment procedures, including as a minimum

- Gain/attenuation setting of all head-end distribution amplifiers to achieve signal balance throughout the system. This shall be taken to mean that the signal strength, on each TV channel/radio band, at each outlet in the system shall lie within a worst case range of 0 dBμV ±2 dBμv, when the antenna input to the system is replaced by a TV/Radio signal no greater than 0 dBμV. If the system employs broadband amplification, the TV check should be made on channel 13. Record all signal levels.

- Monitor the signal quality, using a portable color TV, at the first and last outlet in each branchline, using VCR and finally antenna inputs.

- Ensure correct operation of the TV antenna rotor.

8.11.4 Installation Check

Demonstrate operation as in 8.11.3.

8.11.5 Sea Trials

Check system operation under conditions of normal use.

8.12 ELECTRONIC POSITIONING SYSTEMS

8.12.1 General

Electronic positioning systems shall be taken to include all electronic systems designed to provide position data in absolute terms. As a minimum, this includes:

- Loran C.

- Satellite navigation (DGPS).

- P.I.N.S. (Precision Instrument Navigation System).

- ECPINS.

8.12.2 Physical Inspection

Check the antenna siting, and pay particular attention to the grounding of any antenna couplers provided with the system. Check all unit interconnection and power wiring before turning on.

Identify and record power source.

8.12.3 Setting Up

Carry out all alignment and adjustment procedures. Using statistical methods, based upon at least twelve "stationary fixes", determine the "Repeatability error" of the system. If the ship is at a "Surveyed" position, determine the "position error".

Confirm the correct connection and operation of external interfaces, e.g. Gyro, speed log.

Confirm the operation of "secondary" modes of operation.

8.12.4 Installation Checks

Demonstrate correct operation as in 8.12.3.

8.12.5 Sea Trials

Check operation under conditions of actual use. Correlate with other position indicating systems.

8.13 GYROCOMPASS

8.13.1 General

These conditions apply generally to all gyrocompass systems fitted in DFO/CCG vessels.

8.13.2 Physical inspection

Check the location of all system components, paying particular attention to the grounding of the master compass and its' control unit. Ensure that the master compass is correctly oriented and aligned with the ships' fore and aft axis.

Check that approved bearing repeater slide rails have been fitted (if required) and that the arrangement will permit shimming for alignment. Check that all accessories have been provided, e.g. azimuth circles.

Check unit interconnection and power wiring before turning on.

Identify and record power source.

8.13.3 Setting Up

Carry out all alignment and adjustment procedures, including as a minimum:

- Complete start up and close down.
- Full gyro settling test with the settling curve plotted, the settling time and damping coefficient calculated (if applicable).

Check the operation of any power failure alarm changeover systems and backup power supply (if provided).

Check the operation of repeaters.

8.13.4 Installation Checks

Demonstrate operation as in 8.13.3.

8.13.5 Sea Trials

Carry out final alignment of both the master gyro and bearing repeaters, in co-operation with the ships navigating officer.

Operational test at sea under condition of actual use. Check ability of repeaters to follow during rapid manoeuvering.

8.14 AUTOPILOT/STEERING CONTROL

8.14.1 General

The autopilot/steering control system shall include those electrical control elements which serve to generate steering commands to the steering gear system. It shall not include the steering motors or the solenoid flow valves. It does not include any manoeuvring systems which simultaneously control thrust as well as rudder.

8.14.2 Physical Inspection

Ensure that the required controls and indicators are provided and convenient for use.

Ensure that the emergency steering (steering gear flat) is arranged so that control can be taken at this position, and that such control is independent of any other element of the autopilot/steering control system.

Check unit interconnection and power wiring before turn on. Note that the power should be linked to the power for the steering motors.

Identify and record power source.

Ensure gyropilot adaptor is convenient for use.

8.14.3 Setting Up

Carry out all alignment and adjustment procedures. As a minimum, this will include a check for the correct operation of:

- Each F.F.U. lever and wheel.
- Each N.F.U. switch control.
- Each rudder order indicator.
- Autopilot operation including "off course" and "power" alarms.
- A test to demonstrate the adequacy of the emergency steering arrangements.

8.14.4 Installation Check

Demonstrate operation as in 8.14.3.

8.14.5 Sea Trials

Set up autopilot coefficient for optimum sea keeping.

Operational test under conditions of intended use.

8.15 SATELLITE COMMUNICATIONS

8.15.1 General

These requirements apply to all SATCOM terminals fitted in DFO/CCG ships.

8.15.2 Physical Inspection

Pay particular attention to the antenna siting. Ideally there should be no shadowing certainly none above 5° elevation. If the radome is raised for this purpose, ensure that an adequate maintenance platform has been provided.

Check all unit interconnection and power wiring before turning on.

Identify and record power source.

8.15.3 Setting Up

Call in manufacturer to commission the ship station in accordance with IMCO requirements.

8.15.4 Installation Check

Demonstrate system operation.

8.15.5 Sea Trials

Operational test of ability to acquire and track satellite.

8.16 GLOBAL MARITIME DISTRESS AND SAFETY SYSTEM (GMDSS)

8.16.1 General

Consists of several systems but not limited to:

- COSPAS-SARSAT- Search and Rescue
- NAVTEX- Maritime safety information broadcasts
- INMARSAT C- General communications Enhanced Group Calling equipment
- High Frequency radiotelephone, radiotelex, digital selective dialing
- Search and Rescue Radar Transponders (SARTs)
- Digital Selective Calling-VHF, MF and HF

8.16.2 Physical Inspection

Ensure that required systems are fitted to satisfy operational role.

Check all unit interconnection and power wiring before turning on.

8.16.3 Setting Up

Carry out alignment and adjustment procedures on associated equipment.

8.16.4 Installation Check

Demonstrate operation.

8.16.5 Sea Trials

Perform operational test under conditions of extended use.

CHAPTER 9 ACCEPTANCE

Final acceptance of the electronic equipment is based upon satisfactory completion of the following three requirements:

1) The rectification of all deviations from the specification as well as any other defects identified by either the PWGSC Electronic Inspector or by DFO/CCG personnel.

2) The satisfactory completion of the setting up and installation checks outlined in section 8.0.

3) Satisfactory completion of the sea trials as outlined earlier in section 8.0. Conduct of all tests shall be witnessed by the PWGSC Electronic Inspector, and/or the DFO/CCG Electronic Design Authority or their designates. The shipyard shall advise the above witnesses of the intent to carry out these tests at least one working week in advance. Failure to do so, which results in a test not being witnessed, shall be sufficient reason to repeat the unwitnessed test. All test results shall be recorded, and an electronic copy shall be provided to the Design Authority.

9.1 PRE-ACCEPTANCE DEFECTS

The PWGSC Electronic Inspector shall be responsible for the initiation, recording and maintenance of a list of the outstanding deviations to electronic specifications and/or defects. This responsibility does not empower the Inspector to authorize additional work to be carried out at extra cost. This authority lies solely with the Program Manager and/or his designate. Predictably, disagreement will arise between the Inspector and the shipyard regarding the responsibility for the correction of some deviations and/or defects. Where these cannot be settled directly, they will be resolved by means of the formal Deviation Procedure, as follows:

- When a Formal Deviation Notice is raised, it is passed to the Program Manager and Design Authority for assessment. If the deviation is upheld, liability for any costs associated with correction will be negotiated by the Shipyard, PWGSC, Contract Officer, and the Program Manager.

At the time of acceptance of the vessel, it is probable that there will still be some outstanding defects. The Program Manager may accept the vessel conditionally, subject to rectification of the outstanding defects at no additional cost to the Crown. A tentative schedule for the repair actions is to be prepared at this time.

9.2 POST ACCEPTANCE DEFECTS

The warranty for defects identified in the vessels electronic systems shall extend for twelve calendar months beyond the final acceptance date of the vessel. The warranty repairs shall be made in accordance with PWGSC 1026.

In order to expedite the warranty repair procedure, the shipyard shall identify a warranty co-ordinator. All requests for warranty repair, and follow up actions regarding the status of warranty repairs shall be the responsibility of the warranty co-ordinator. A formal warranty repair procedure shall be established for handling electronic defects. It shall be based upon the following description:

- When a warranty defect is identified by local DFO/CCG personnel, (normally ships company), Regional Director of Operational Services, Regional Supervisor of Electronic and Information Systems, and the Program Manager will be informed of the problem, and the nature of the defect i.e; faulty assembly, faulty unit, etc. Some defects will be relatively minor and these will be handled locally by DFO/CCG without need of warranty action. Generally however, the local Program Manager or his designate shall contact the shipyard warranty co-ordinator to decide upon the appropriate repair action, and whether any items returned for repair will be returned via the shipyard or directly from DFO/CCG. Either way, this action will result in a work order number against parts, and labour charges are to be invoiced. Should DFO/CCG request that the repair be made at the ship site, they shall assume responsibility for all costs other than those which would have been incurred by the shipyard had the unit been returned for repair.

CHAPTER 10 REPORTS AND CERTIFICATES

The Contractor shall be responsible for obtaining all radio certificates and/or calibration data required for the vessel to operate. As a minimum, the following radio certificates are required.

10.1 RADIO LICENSE AND CALL SIGN

The vessel shall be provided with an Industry Canada approved call sign and with all radio licenses required to fulfill her operational requirements as well as to make any transit voyage which may be required.

If the vessel is built away from its eventual home port, application shall be made to Industry Canada for both a temporary license and call sign. DFO/CCG will arrange for a permanent license and call sign upon arrival at the home port.

If the vessel is built at its eventual home port, application shall be made for permanent license and call sign(s). In either event, these applications shall be co-ordinated through the ships standby electronic officer, who will assist the shipyard in making the application.

License application shall be made as early as is practical, but certainly no later than 15 working days prior to the start of sea trials. The approved license(s) and call sign shall be permanently and prominently displayed in the Radio Room and/or the Wheelhouse.

10.2 CALIBRATION CERTIFICATES

As outlined in section 8.0, the shipyard shall arrange for the calibration of all of the LF/MF, G.R.S., and VHF direction finders fitted on the vessel. Calibration shall be carried out in open water, under a set of standard conditions, which shall be recommended on the calibration curves. The calibration curves shall be prominently and permanently displayed in the wheelhouse, close by their respective Direction Finders.

CHAPTER 11 DOCUMENTATION

11.1 MANUALS

The contractor shall provide both Operational and Technical Manuals for all of those equipment which are furnished by the Contractor. The Manuals provided shall be commercially available from the Manufacturer and where a choice of Manuals is available they shall be those which most closely approximate the requirements of 11.1.1 and 11.1.2.

11.1.1 Operator's Manual

The Operator's manual shall be concerned with day to day operation, and shall contain sections concerning the following:

- Any procedures required to turn on, shut down, or change the mode of operation of the equipment.
- Any procedures by which the operator may judge whether the equipment is functioning correctly.
- External control adjustments, such as squelch, which are not self-evident.
- The adjustment procedure shall describe the system responses to be anticipated.

11.1.2 Maintenance Manual

The maintenance Manual shall include the technical information required by a competent electronic technician to service and maintain the equipment. It shall contain sections concerning the following:

- Maintenance Schedules.
- Alignment/Adjustment Procedures.
- Equipment Checkout/Fault Isolation Procedure.
- Signal Flow Diagram of the system at the level of the major assembly interfaces.
- Signal Flow Diagram of each major assembly, at the level of its major functional blocks.
- Theory of operation of the system and its assemblies, based upon the Signal Flow Diagrams.
- Schematic and Layout Diagrams.

- Parts Lists Material data, including:

    1) Component Identifiers, keyed to Schematic/Layout;

    2) Component descriptions;

    3) Commercial Part Numbers; and

    4) Supply source(s) of parts.

11.1.3 Language and Quantity

Six commercial quality manuals of each type shall be provided for each Contractor furnished equipment. These manuals shall be in the English language.

All manuals are to be stored aboard for eventual distribution as required by the DFO/CCG Regional Supervisor of Electronic and Information Systems.

FOR LAURENTIAN REGION VESSELS ONLY

Where French language manuals are commercially available from the Manufacturer, or his agent, six copies of each manual are to be provided in addition to the English Manuals.

The Contractor shall identify those equipment for which French language manuals are not available at the time of bid. The Contractor may be required to quote upon the translation and supply of six of each of those manuals identified by DFO/CCG. The quote shall also include the supply of one Electronic Master copy to be held by DFO/CCG for future reproduction.

Failure by the Contractor to identify those manuals, which are not available in the French language, will be taken to mean that they are commercially available and will be provided as part of the original bid.

11.2 DRAWINGS

11.2.1 Guidance Drawings

The Electronic Guidance Drawings provided with this specification are intended to provide background information to the Contractor. The Contractor is cautioned that the drawings are not necessarily up to date, and should not be regarded as completely accurate.

11.2.2 Working Drawings

Using the Guidance drawings together with the specification and installation details provided by the Manufacturer, the Contractor shall prepare a set of Working Drawings, defining the installation requirements i.e.; physical locations, power and unit interconnection.

Electronic copies of the Working drawings shall be submitted to both PWGSC inspection and the Technical Authority for examination and comment. The Contractor shall incorporate these comments into the Final Working drawings.

The examination cycle shall not exceed twenty working days after receipt of the drawing by DFO/CCG. The Contractor shall inform the Electronics Design Authority of any drawings that are overdue which could affect the work schedule should the drawing be delayed further. If no response to this notification is received within five working days, the Contractor may proceed as though the Drawing has been examined without comment.

11.2.3 As Fitted Drawings

As fitted drawings shall be provided, which accurately indicate the physical and electrical arrangement of electronic systems at the time of vessel acceptance.

The as fitted drawings shall be in the form of rack or compartment layouts which clearly identify the physical location of major system components. Interconnection diagrams, which show detailed electrical connection between the system units, must also be included.

11.2.3.1 Layout Diagrams

Layout diagrams shall be provided for all racks, consoles and compartments either added or rearranged by the Contractor.

As a minimum, layout diagrams shall be provided for, but not necessarily be restricted to:

- Racks and/or consoles.
- Antenna arrangements.
- Wheelhouse.
- Radio room.
- Electronic equipment room.
- Any compartment in which four or more electronic units are fitted.

11.2.3.2 Interconnection Diagrams

Interconnection diagrams shall contain the detail (connector identification and pinout detail) to permit future maintenance and identification of each unit location.

Where the unit interconnection is made by means of mating connectors, the pinout detail need not be included as long as the diagram identifies the source of such detail, e.g.; for connection detail, see figure XX in Radar Service Manual for type XYZ Radar.

Where unit interconnection is by means of accessible terminals, either screw type or soldered, full connection details shall be provided on the diagram. Such details need only be provided once if they are used elsewhere in the diagram and suitable reference is provided. Interconnection diagrams shall be provided for all electronic systems supplied and/or relocated by the Contractor. These shall include, but not necessarily be limited to the following drawings, (as they apply to this vessel):

- Radio console.
- VHF-FM radiotelephone(s).
- VHF-AM radiotelephone(s).
- HF-SSB radiotelephone(s).
- GMDSS.
- GRS radiotelephone.
- SATCOM terminal.
- Auto alarm and auto key system.
- Facsimile system(s).
- Radioteletype.
- TV/Radio Broadcast distribution.
- Receive antenna distribution.
- Internal communications including:
    1) all sound powered telephones;
    2) dial telephone including shore arrangement;
    3) talkback systems;
    4) paging systems;
    5) loudhailer;
    6) S.R.E.; and
    7) all central equipment.
- Gyrocompass(s).
- Radar(s).

- Echo sounder(s).
- Speed log.
- Loran C.
- Satnav.
- Direction finder(s).
- Steering control(s).
- Electric clock(s).
- Windspeed and direction indicator(s).
- Closed circuit TV system(s).
- Helicopter beacon.
- Rudder angle/order indicators.
- MF/HF transmitter(s).
- Communication/guard receivers.
- DGPS.
- ECPINS.
- Emergency power.
- Local Area Network.

11.2.4 Quantity

The requirements outlined in this paragraph apply to electronic as fitted drawings and replace any as fitted drawing requirements which may be outlined elsewhere in this specification.

The Contractor shall supply electronic copies of each as fitted drawing.

The drawings are to be distributed as follows:

- The electronic copies to be held by Integrated Technical Support (ITS) in DFO/CCG Headquarters.
- Electronic copies to be held by the ship.

- Electronic copies to be held by the appropriate Regional Superintendent of Electronic and Information Systems.

CHAPTER 12 PHOTOGRAPHIC RECORD OF WORK

DFO/CCG Personnel shall be permitted by the shipbuilder/Contractor, without hindrance or delay, to take photographic records of work in progress, and any other items or conditions as the DFO/CCG Personnel see fit, at any time that the vessel is in the hands or control of the shipbuilder/Contractor.

APPENDIX A RADIO FREQUENCY INTERFERENCE

A.1 GENERAL

The operation of electrical equipment on board ships may give rise to the generation of electromagnetic energy, which is capable of interfering with the proper operation of electronic equipment on board. The generation of electromagnetic interference (EMI) arises from rapid fluctuations in the electrical energy of the interfering equipment, and may be propagated to the susceptible equipment in a variety of ways. Among these are:

- Radiation from both the EMI source and from associated cabling.
- Conduction of energy via the input power lines to the EMI source.
- Conduction of energy via lines not directly associated with, but closely coupled to, the EMI source.
- Coupling introduced by common ground paths between the EMI source and the susceptible equipment.
- Re-radiation of EMI as a result of currents induced in non-grounded, or poorly grounded, metallic structures, e.g., ship's stays or ungrounded cable shields.

The information provided in the remainder of this section dealing with the methods of interference suppression, methods of measurement, and acceptable limits of radio frequency interference, has been derived largely from British Standards Publications for limits and methods of measurement of electromagnetic interference generated by marine equipment and installations. Should the user require a more detailed treatment than is provided in this section he should refer to BS1597-1985. In the event of conflict between this document and BS1597-1985, the latter should be given preference.

N.B: The International Electro-technical Commission Documents entitled:

"Electromagnetic Compatibility of Electrical and Electronic Installations in Ships", Publication IEC 60533, and "Marine Navigational Equipment, General Requirements, Methods of Testing and Required Test Results", Publication IEC 60945, are also good sources of reference for problems associated with EMI.

A.2 SUPPRESSION OF EMI

The suppression of EMI, or its reduction to acceptable limits, is the contractor's responsibility. This is usually accomplished at the interfering source and involves the use of capacitors, inductors or combinations of both used to construct suppression filters.

Where such components are fitted, the following guidelines should be used:

- Capacitors, when connected, should be connected on the equipment side of any equipment mounted isolating switch. Otherwise, the capacitor should be provided with a non-interruptible leakage path.

- Capacitors should not be used for arc suppression across relay or other electrical contact sets.

- Suppression filters, and other suppression components, should be located as close as practical to the source of interference.

- Suppression components provided in metallic containers should have their containers bonded directly, or connected by a short strap, to the grounded metal of the interfering EMI source.

- Isolation transformers, with suitable electrostatic shields, should be fitted in the AC power lines of all electronic equipment.

- Care should be exercised in the screening of cables, and in the grounding and bonding of equipment (see Appendix B).

The following general guidelines apply to the screening of cables:

- Cables to be screened from the effects of low frequency should employ a ferrous screen material.

- Cables to be screened from the effects of high frequency should employ a bronze, copper or aluminum screen material.

- Cables to be shielded from radiating, or susceptible to frequencies below 50 KHz, should be grounded at a single point.

- Cables to be shielded from radiating, or susceptible to higher frequencies, should be multi-point grounded at intervals approximately 0.15 wavelength or less of the highest frequency of concern.

- Metallic trunking will provide additional screening provided the trunking is effectively bonded where it passes through bulkheads and all seams and joints are continuous and of high quality.

A.3 LIMITS OF INTERFERENCE

The permissible limits of interference are defined in terms of two measurable quantities, one of which defines acceptable limits for radiated interference, the other for conducted interference.

A.3.1 Limits and Methods of Measurement of Radiated Interference (30 Hz to 10 KHz)

The maximum permissible noise level radiated into any pair of audio lines should not exceed 37 dBrnc (flat weighting from 300 Hz to 3400 Hz), measured across 600 Ω. This can be equated to -52 dBm or 1.95 millivolts across 600 Ω.

The measurement should be made at the audio amplifier end of the measured pair with the cable correctly terminated. The maximum common mode voltage should not exceed 0.5 volts.

A.3.2 Limits and Methods of Measurement of Conducted Interference (30 Hz to 10 KHz)

When measured at the electronic equipment power distribution panels, conducted interference should not exceed 3% measured as total distortion of the 60 Hz supply waveform.

Total distortion is defined as the ratio of the square root of the sum of the squares of the interfering voltages in the 30 Hz to 10 KHz band, to the square root of the sum of the squares of both the interfering voltages and the fundamental.

Measured at the power terminals of a single equipment, conducted interference should not exceed 1% distortion.

A.3.3 Limits and Methods of Measurement of Radiated Interference to Ship Receivers (10 KHz to 300 MHz)

Interference levels, measured at the receiver terminals of the antenna feeder cables, with the antenna disconnected and replaced by a suitable matching resistor, should not exceed 2 uv within the bandwidth of the measuring receiver, within the frequency range 10 KHz to 300 MHz.

This measurement should be made with all electrical and electronic equipment operating under both normal and emergency seagoing conditions. Figure A7 shows the equipment arrangement for antenna feeder tests.

A.3.4 Limits and Methods of Measurement of Conducted Interference (10 KHz to 50 MHz)

Interference levels, measured at the terminals of any single item of electrical or electronic equipment, should not exceed the limits defined in Figure A1. If the current transformer measurement method, outlined in A.4.2.4.1 is used, the limits imposed in Figure A2 should be used.

A.3.5 Limits and Methods of Measurement of Radiated Interference (30 MHz to 300 MHz)

The level of radiated emission from electrical and electronic equipment, when measured, should not exceed the limits shown in Figure A8.

These measurements should be made with the electrical and electronic equipment operating under both the normal and emergency seagoing conditions.

A.4 METHOD OF MEASUREMENT (30 HZ TO 10 KHZ) OF RADIO FREQUENCY VOLTAGES

An acceptable method of distortion measurement is by means of a distortion analyzer such as an HP 339A or equivalent, with an external R.M.S. reading meter, connected via a suitable line stabilization network or calibrated line probe. The line probe method is preferred if large currents are involved.

Measurement should be made at minimum, normal and maximum load conditions of the ship's power.

A.5 METHODS OF MEASUREMENT (10 KHZ TO 300 MHZ) OF RADIO FREQUENCY VOLTAGES

A.5.1 Antenna Feeder Measurement

The Electromagnetic Interference Measuring Instruments used for the measurement of radio frequency voltages should comply with the requirements of the following standards endorsed by the Canadian Standards Association (CSA):

- CISPR Type, C108.1.1-1977.
- ANSI Type, C108.1.2-M1981.

The equipment arrangement to be used is shown in Figure A7. During the measurement, the feeder shall be disconnected from the antenna, and terminated with a shielded resistor of a value to match the characteristic impedance of the feeder. The receiver end of the feeder shall be connected to the input of the measuring set, via an impedance matching device, if necessary. Should such a matching device be required, the indicated reading of the measuring set should be adjusted to compensate for the insertion loss of the matching device.

A.5.2 Measurement at Equipment Terminals

A.5.2.1 General

The preferred method for the assessment of radio interference from marine electrical equipment is by the measurement of the radio frequency voltages appearing across a defined impedance. The acceptable limits of radio frequency interference outlined herein, refer to voltage measurements made with impedance stabilizing networks connected in the lines of the equipment under test. However, circumstances may arise in which the use of an impedance stabilizing network is not possible. Only under these circumstances should the methods outlined in A.5.2.4 be used.

A.5.2.2 Extraneous Noise

Before and after the measurement of radio frequency interference, as described in A.5.2.3 or A.5.2.4, the background noise should be measured. This should be done using the same measurement set-up, but with the equipment under test switched off.

The level of the background noise should be at least 10 dB below the measured interference level, otherwise the measurement should be regarded as suspect, and should not be used to reject the equipment under test.

A.5.2.3 Measurement with Impedance Stabilization

The measuring receivers used in the measurement of radio frequency interference should comply with Canadian Standard C108.1.1-1977 or C108.1.2-M1981.

The measurement of radio frequency voltage at the power, or other terminals of an equipment, should be made using a line impedance stabilizing network. The impedance-frequency characteristics, and the circuit schematic of such a network, are given in Figures A3 and A4. The network shown is suitable for use between 150 KHz to 100 MHz. For frequencies 15 KHz to 150 KHz, an additional capacitor (8 uF) should be added between the supply/load terminal and ground, and the value of C1 + C2 increased to 0.25 uF.

Figure A3 shows the test equipment arrangement for measurement of radio frequency voltage at the power terminals of equipment under test. When making measurement of other equipment terminals, line stabilization networks should be used in the measured line, in addition to those used in the power lines to isolate the equipment from any radio frequency interference existing upon the mains power. Interconnecting leads should not exceed 6 cms (2.5 in.) in length.

Radio frequency interference measurements should be made with all test apparatus mounted on, and bonded to, a ground plane. Where such a ground plane cannot be provided, e.g.; large machines, equivalent arrangements should be made. The equipment under test should be operated under its specified conditions of mains supply and load.

A.5.2.3.1 Frequencies Below 150 KHz

The bandwidth of measuring instructions specified to measure radio frequency voltage below 150 KHz is 200 Hz. Thus, in measuring impulsive interference whose repetition frequency is

comparable to, or greater than, this bandwidth, normal broad band measurements do not apply. It is essential in these cases that the measuring receiver be carefully tuned for maximum response.

For example, in measuring the radio frequency interference associated with a 400 Hz inverter, above 150 KHz, the measuring receiver bandwidth is 9 KHz and normal broadband measurement is used. Below 150 KHz the measuring receiver bandwidth is 200 Hz and the receiver should be tuned for maximum response.

A.5.2.4 Measurement Without Impedance Stabilization

Two measurement methods are possible, but should be used only when the method outlined in A.5.2.3 is not practical. Measurement should be made with the equipment under test operating under as near normal operating conditions as possible.

A.5.2.4.1 Current Transformer

A current transformer should be installed around a complete cable form or group of cables. The limits of Figure A2 apply. If the group result exceeds the specified limit, individual cables should be tested.

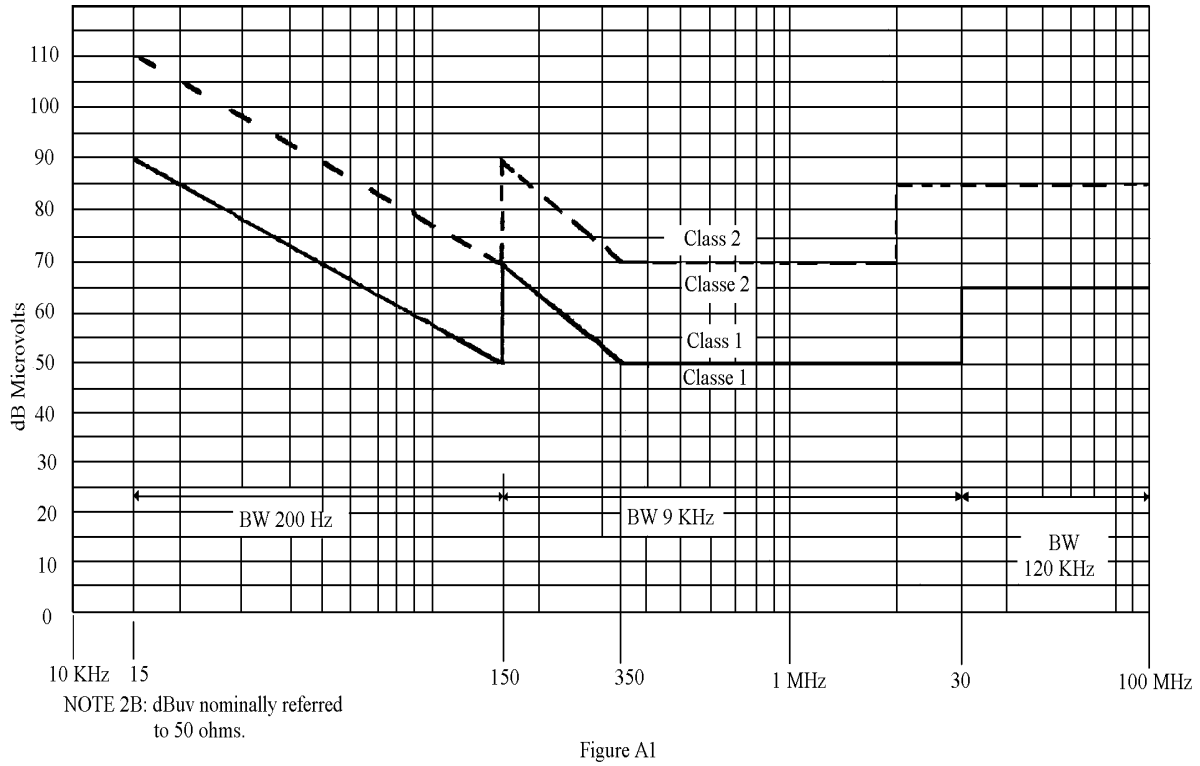
Current transformers should have the following characteristics:

- Frequency: 15 KHz to 160 MHz
- Transfer Impedance:
    1) 50 KHz > 0.5 Ω
    2) 100 KHz > 1.0 Ω
    3) 1 MHz to 100 MHz >3.0 Ω

The current transformer should have a current measuring capacity consistent with the measurement to be made, as high as 350A, without saturation. Its primary circuit insertion impedance should not exceed 1 Ω when its secondary is terminated in 50 Ω.

A.5.2.4.2 Capacitive Probe

The probe should be comprised of a blocking capacitor, in series with a resistor, so that the total resistance to ground, including the input resistance of the measuring set, is 1500 Ω (see Figure A6). A correction for the probe insertion loss should be made by adding 50 dB to the measured indication.



NOTE 2B: dBuv nominally referred to 50 ohms.

Figure A1
Limite D'Interference Tension
Voltage Interference Limits

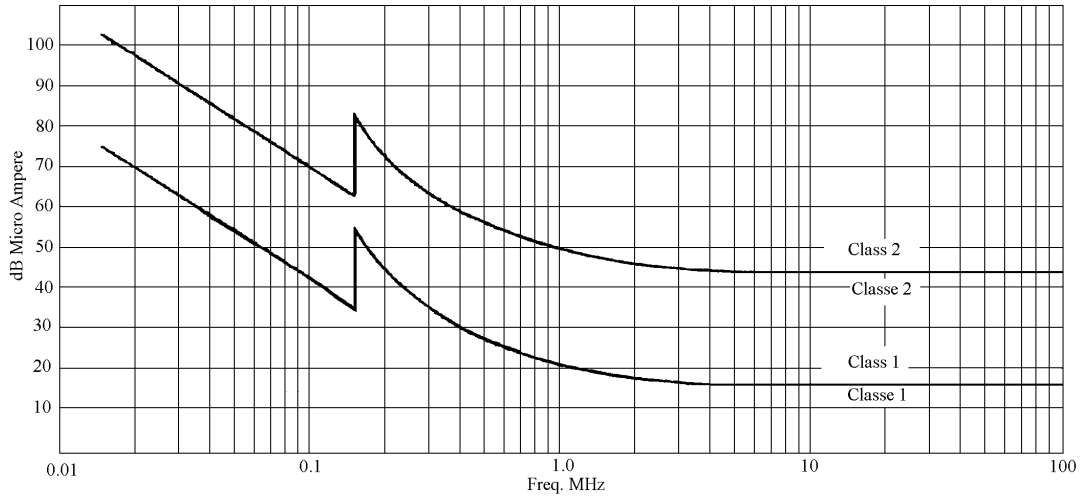


Figure A2
Limite D'Interference Courrant
Current Interference Limits

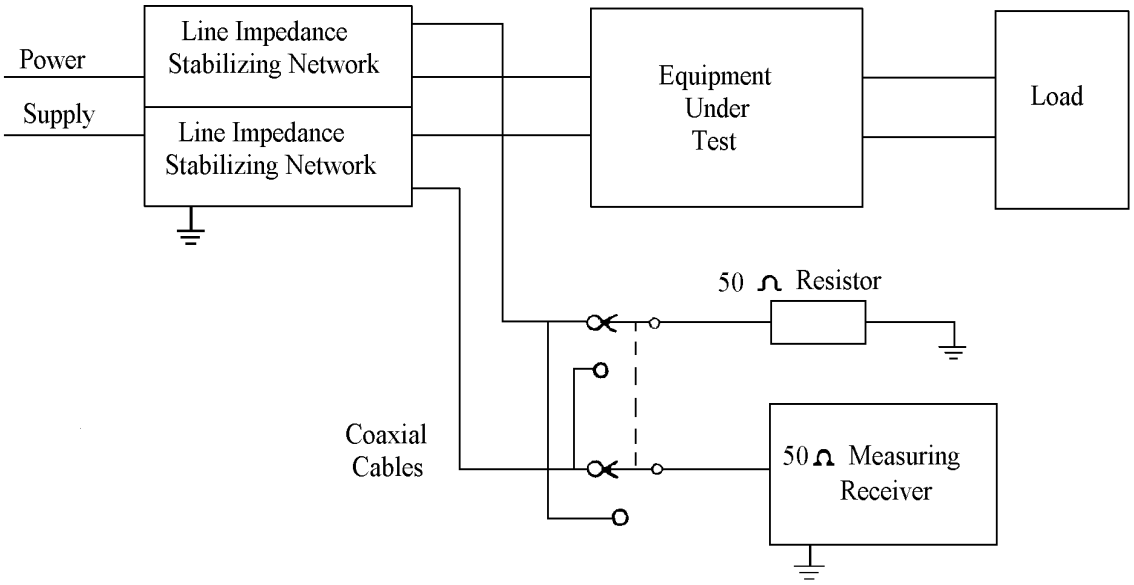


Figure A3 Test Circuit Block Diagram

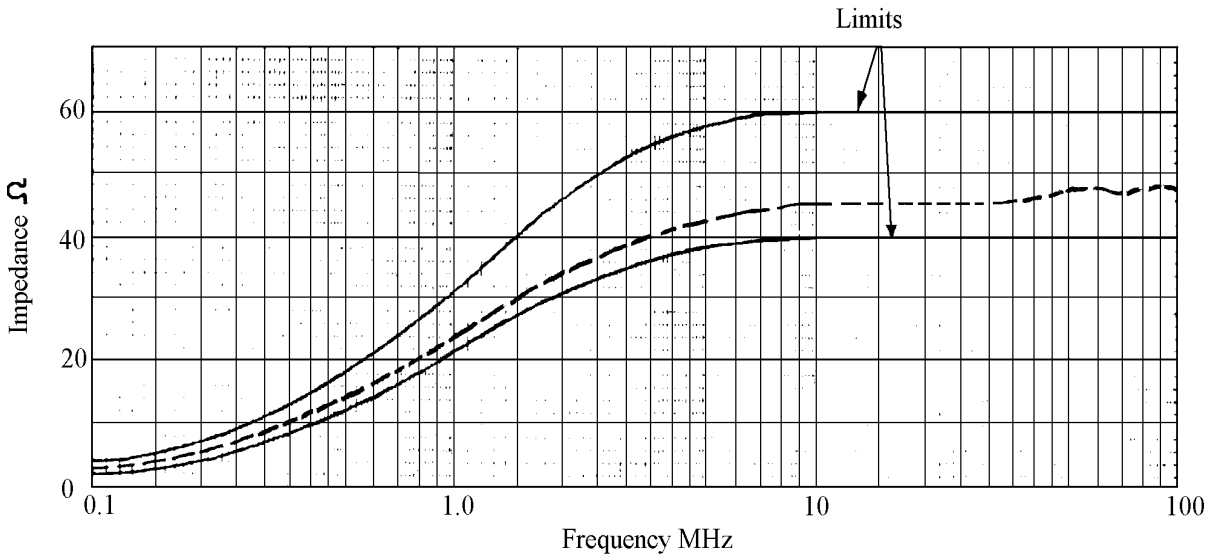


Figure A4
Impedance/Frequency
Characteristic Of A Line
Impedance Stabilizing Network

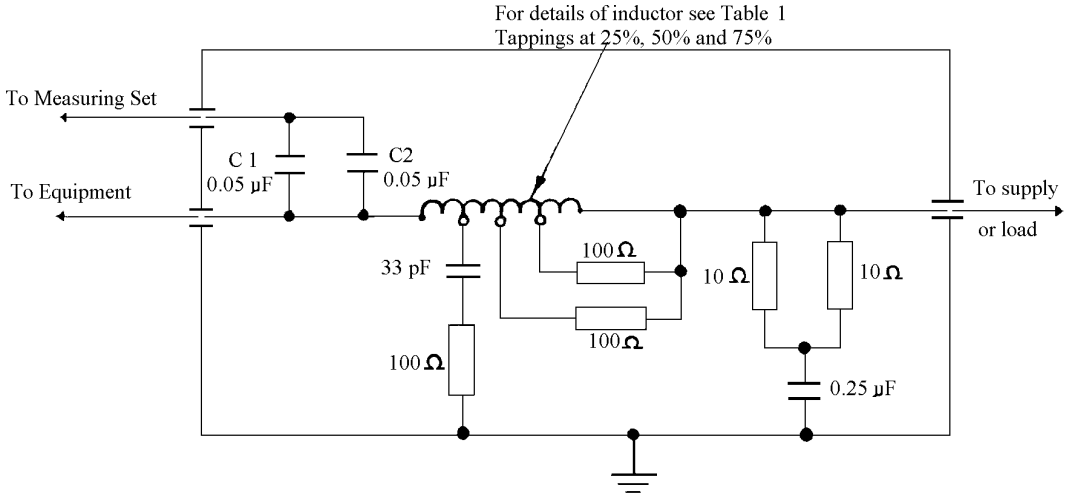


Figure A5
Circuit Diagram of Line
ImpedanceStabilizing Network

Table A1: Details of inductor in Figure A5

Current Rating	Inductance	Inside Diameter	Length	Number of Turns	Conductor Cross Section
A	uH	mm	mm		Mm
10	5	25.4	32	20	1.6 diameter
100	5	50	115	18	6 diameter
500	5	90	178	11	12.5 square

Note (to figure A5 and table A1): There is resistive loading at the midpoint of the coil when it is behaving as a full wave line and at the quarter and three-quarter points when the coil is behaving as a full wave line. The values of the damping resistors do not appear to be critical provided excessive loading of the coil does not occur at the low frequency end of the band. The resistance which is effectively in parallel with three-quarters of the coil provides most of the loading at low frequencies but the effect is reduced by the series capacitor.

The coupling between the appliance under test and the measuring set is provided by two 0.05 uF capacitors in parallel in order to keep the inductance as low as possible. The coupling capacitors are mounted at a distance of about 3mm from the wall of the box in order that the capacitance to ground is as low as possible.

Working drawings of a 100A unit and other information are given in Electrical Research Association Report 5076 " An isolating unit for use at frequencies up to 100 MHz and currents up to 100 A " by J.H. Bull, B.Sc. and R.W. Cotam.

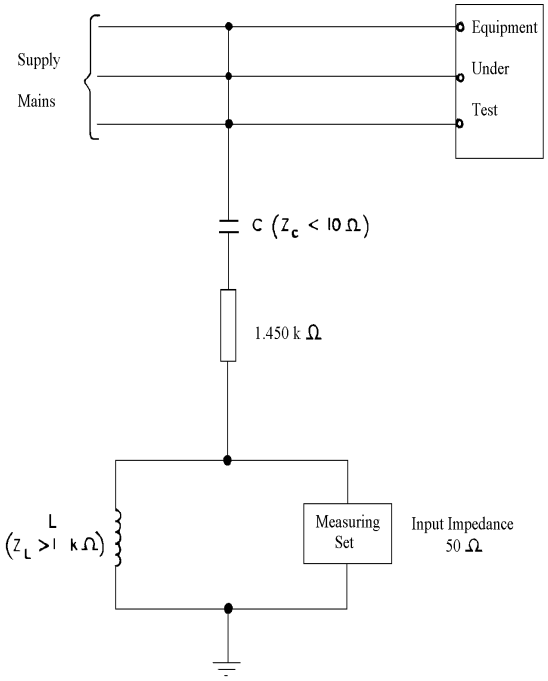


Figure A6
Circuit for use of Capacitive Probe for Radio Frequency Voltage Measurement

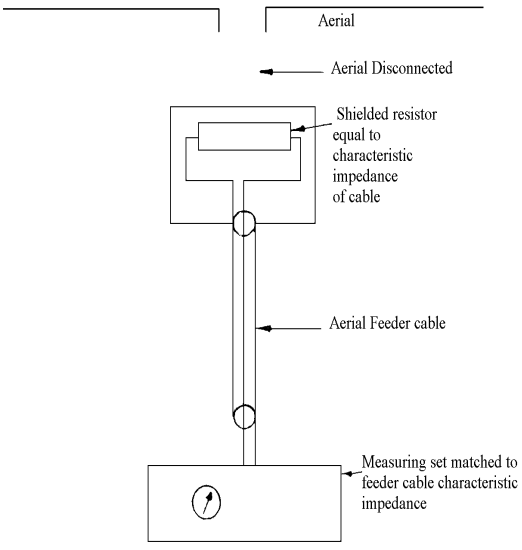


Figure A7
Arrangement for aerial feeder tests

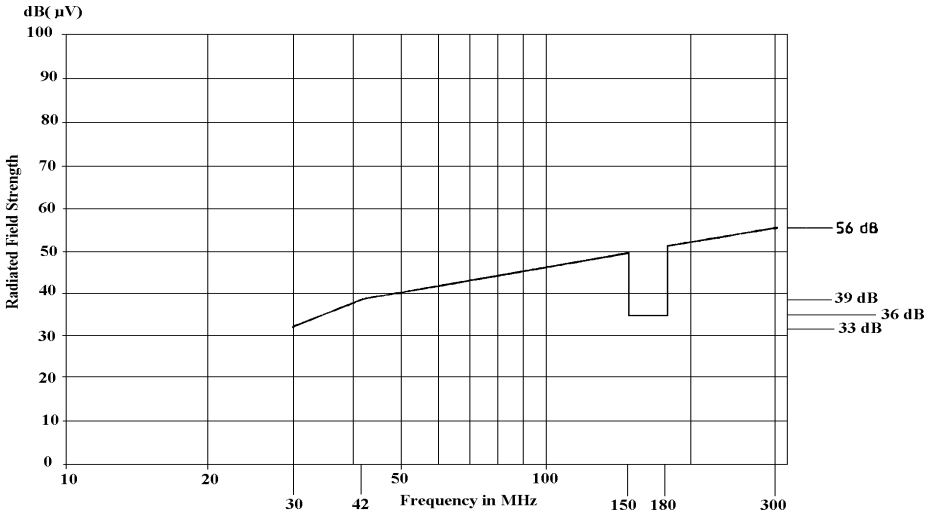


Figure A8
Level of Radiated Emission

APPENDIX B GROUNDING AND BONDING

B.1 GENERAL

Each metallic rack, console, frame or other structure used to house electronic equipment should be separately and individually grounded to the ship's metal structure. The following guidelines are provided for the grounding of equipment racks:

- Where equipment mounting racks, consoles or frames are of non-welded construction, grounding may be achieved by grounding members individually or interconnecting them by means of a strap. Interconnection of members should not be assumed because of mechanical construction.

- Direct electrical connection of the equipment rack, console, or frame to the ship's structure is preferred.

- Where direct connection is not practical, ground straps shall be used.

- Ground straps should be constructed of solid flexible copper, or of a similar low resistance corrosion resistant material, compatible with the surfaces to be connected.

- Ground straps should be at least 2.5 cm (1 in) wide and 0.06 cm (0.025 in) thick.

- Ground strap length shall be as short as possible, consistent with the need to avoid sharp bends and corners.

- When installed, ground straps should, if possible, be both visible and accessible, so that the mating surfaces may be inspected periodically and straps refurbished when necessary.

- All contacting surfaces, both direct and ground strap, shall be clean and free from rust, paint, scale or any substance likely to reduce the electrical efficiency of the contact.

- The contact surfaces shall be mechanically bonded by a method that does not impair contact efficiency, e.g.; welding, clamping or bolting.

- Care should be taken to maximize the area of contact, including the use of washers or other spreading devices.

- Bonding hardware shall be of low resistance, non-corrosive material, and full use should be made of lockwashers, locknuts, etc. in order to preserve the integrity of the bond.

B.2 SHIELDING OF EQUIPMENT

Insofar as it is possible, electronic equipment or groups of electronic units, e.g.; amplifiers, should be housed within metallic cases that are perforated as needed for ventilation. Each such equipment case should be separately and individually grounded using the following guidelines:

- Cases shall be grounded individually to the mounting structure in which they are located.
- Grounds must not rely upon electrical contact provided by the unit method of mechanical retention.
- Access doors or covers in the equipment case shall be connected separately to the case, and not rely upon hinges and/or retention screws for contact.
- On moveable parts or components, bonding straps may be fabricated from flexible braid.
- On slide mounted equipment, straps shall be long enough to withdraw the unit without removing the strap.
- On permanently installed or non-rack mounted equipment, straps shall be made as short as is practical.

B.3 SPECIAL PRECAUTIONS

Special care shall be taken in the grounding and bonding of metallic structures, and of electronic equipment, in areas of high radio frequency energy, such as radio and electronic equipment rooms. Assemblies, such as antenna tuners and radar transceivers, shall be considered to be particularly critical.

Within these areas, all conduits, cable shields, metal support frames for interior wall panels and ceiling tiles, air ducting, water pipes and other metallic structures shall be grounded and bonded to the ship's metal structure at intervals no greater than 1 m (3 ft).

All metallic structures located on upper decks, e.g.; exterior pipes, guard rails and stanchions, P.A. speaker cases, ventilation casings, etc., shall be bonded and grounded. Metallic stays in proximity to the direction finding antennae shall be separated by insulators into short lengths less than 6 m (19 ft).

All cables, which enter into areas of high energy radio frequency fields, shall be electrically shielded by armour or by internal shield. Such shields shall be continuous, and any junction boxes employed shall be properly grounded. Where shielded cable enters such a location, every effort must be made to ensure that the cable shield or armour is properly grounded.

Metallic foil backed insulation shall be avoided in the immediate vicinity of high energy radio frequency fields, such as antenna tuning units, antenna feed lines and antenna couplers to avoid arcing and/or corona discharge. Any equipment mounted upon isolators shall be grounded using ground straps across each isolator.

The mating of materials is of particular importance; every effort must be made to ensure that the materials to be mated are compatible from the standpoint of corrosion.

B.4 METAL HULLS

The theory behind good grounding and bonding is described in DGTE-75, Vol. I, paragraph 5.1.2. For coupler-tuned antennas in the LF/MF/HF ranges, a good ground connection is essential to maintain antenna efficiency and eliminate tuning problems. Antenna tuner enclosures are normally made of non-metallic material with a ground stud provided. This stud must be connected to the ship's metal structure using a short solid copper strap at least 25 mm (1 in) wide and 0.38-0.89 mm (0.015 - 0.035 in) thick.

Alternate methods for grounding and bonding may use 10 mm (3/8 in) diameter copper tubing flattened at each end with a hole drilled through the flattened portion; or heavy copper wire 4 mm/ 0.162 in/ # 6 AWG diameter or larger with brazed or swaged terminal lugs.

C Coaxial cables used to interconnect transmitters, transceivers and receivers with antennas /couplers shall be grounded at both ends. Proper grounding of the equipment enclosures on which the cable terminates will meet the grounding requirements. Shields of coaxial cables leading to antennas not equipped with a coaxial connector shall be grounded at the antenna end by using an "L" bracket-mounted bulkhead or panel receptacle, with the bracket properly mounted to the ship's metal structure. The most important rules for good grounding and bonding are as follows:

1) Clean all contact areas thoroughly;

2) Use conductive compound Eccoshield VX on all threaded connections;

3) Weld or braze ground studs to ship's structure, or use tapped holes and bolts;

4) Use star or lock washers with all threaded connections;

5) Maximize contact area by use of flat washers;

6) Do not use self-tapping screws, braid or steel wire;

7) Avoid dissimilar metals; and

8) When using copper straps for grounding on aluminum hulls place a stainless steel plate between copper and the aluminum structure. If other methods are known to contractor discussion shall be held with Technical Authority.

B.5 NON-METAL HULLS

The goal is to make the RF ground resistance as low as possible and for the apparent ground to be as close to the tuner as possible (see Figure B.1).

Contribution of each part of the ground system is as follows:

1) Water contact ground

Serves as a lightning protection ground and as an LF- RF ground.

Note: The use of a single outside connection with a long lead is not a sufficient ground at HF and additional elements are required;

2) Radials

Use #16 insulated wire for combined flexibility and long life in a salt water environment; and copper pipes, tubing and water lines found on most large power boats.

3) Ground Screens

In conjunction with the various large metal masses in the boat, such as the engine and the water tank, they act as a large capacitor to the sea (Figure B.2). This capacitance is effectively in parallel with all the other ground elements and its' effectiveness increases with frequency. These screens are easily constructed out of bronze window screen cut to fit the available space and soldered in a ring around the edges and across the centre, which is along the lines of maximum expected current. It is a good idea to spray the screen with Krylon or varnish and paint or seal it to the deck or other surface in an acceptable manner. The screen is a natural for placing under a carpet in the wheelhouse, just below the tuner, with the size being as large as possible using a shape that is a little longer than it is wide.

All grounds shall be connected separately to the tuner and not run from one to another in a chain-like configuration. The point of junction shall actually be made to the copper main ground strap a few inches below the point at which it connects to the tuner. If one particular channel cannot be properly tuned a resonant 1/4 wave radial for that frequency shall be added running through the boat behind molding or in the bilge depending upon the particular vessel. As most tuner problems are actually found to be ground problems the rule of thumb is when you feel a ground system is well done add some more. The built in screens in some hulls may be used to supplement the above methods. If a VHF antenna is located close to the HF antenna it may cause severe distortion on certain frequencies and a separate lead shall be run from the HF-SSB radio to the bronze block. (Figure B2 is provided for guidance).

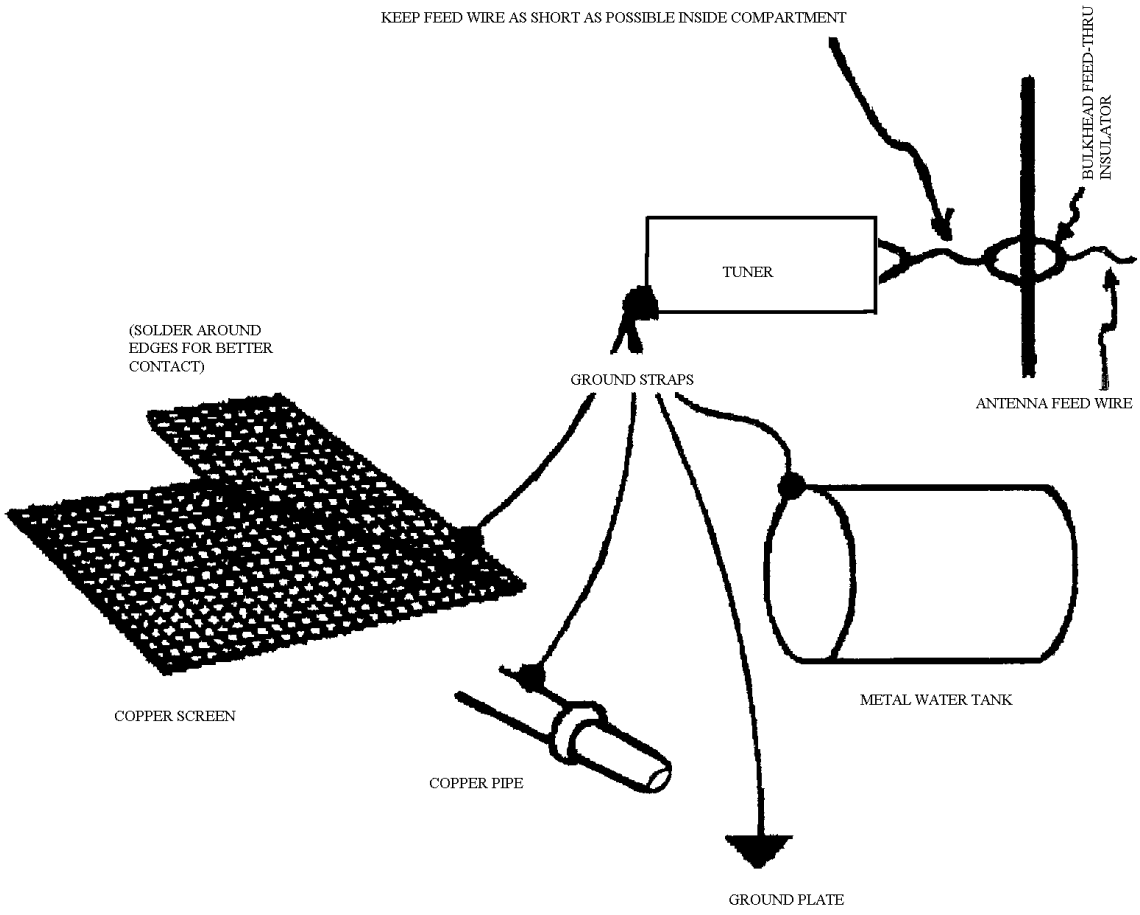


Figure B.1 Ground System On Fiberglass Boat

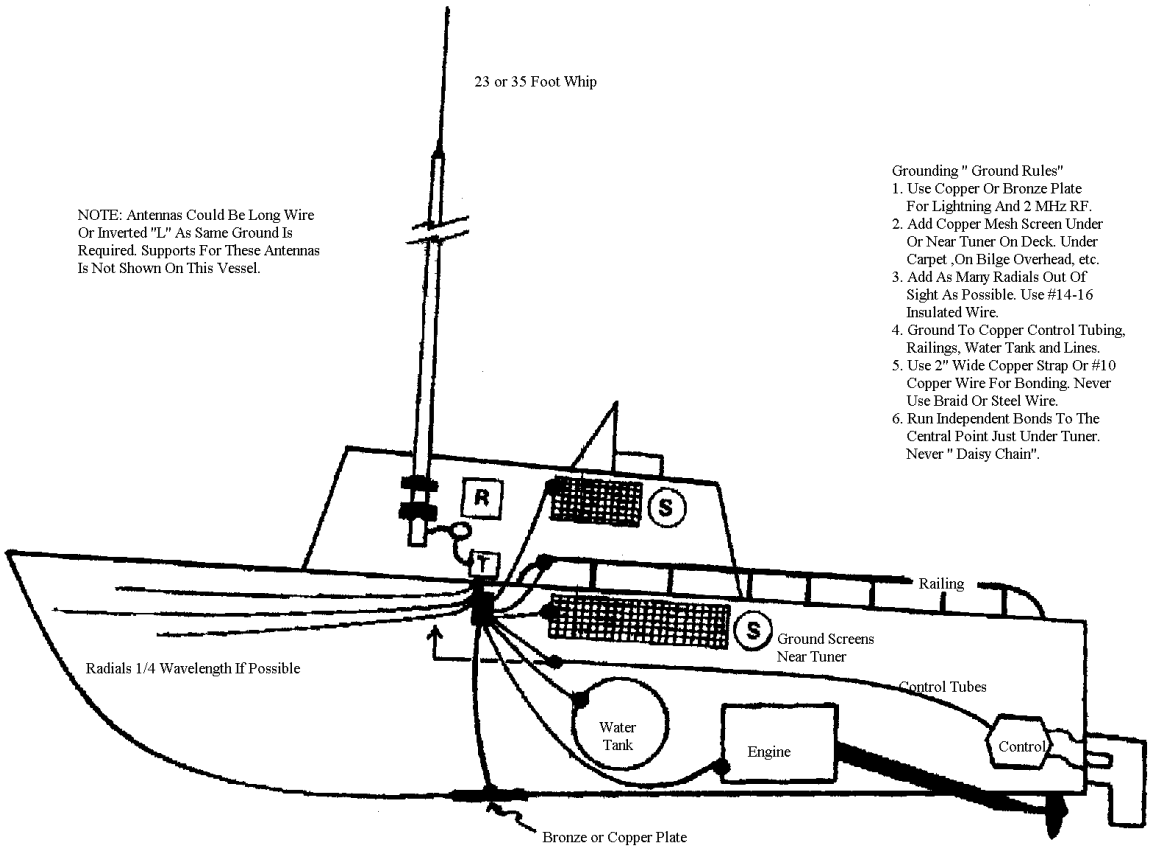


Figure B.2 Non-Metal Hull Grounding

APPENDIX C INSTALLATION OF CABLE AND WAVEGUIDE

C.1 INSTALLATION OF CABLE

The Contractor shall observe the following guidelines when installing electrical cables.

C.1.1 Mechanical Protection

Cable runs must be planned and installed to avoid locations which are:

- excessively hot or moist;
- vulnerable to damage; and
- within 4m of the magnetic compass.

When damage-prone locations are unavoidable, cable must be provided with external protection, such as:

- cable glands when metal structure is pierced;
- kickpipes when deckplate is pierced;
- rigid conduit where cable is subject to mechanical abuse.

Cables, which pierce watertight bulkheads, shall do so by means of an approved transit. Single cables of small diameter however, can use a stuffing tube sealed with an approved compound.

Kick pipes used in watertight locations shall extend at least 30 cm (12 in), and in other locations at least 15 cms (6 in), above the level of the pierced deckplate.

Cable transits, glands and stuffing tubes, shall have 20% extra capacity for future use.

C.1.2 Routing of Cables

Cables must follow the most direct route practical, consistent with the requirements of C.1.1.

- Cable runs shall be designed to minimize the need to pierce metal.
- Cable runs shall be straight, free from kinks and slack, and with a minimum of bends.
- Cables shall be run unobtrusively, preferably concealed from view, while remaining accessible for service.

- Cables shall be installed using a minimum number of junction boxes. Installed junction boxes must be accessible for service.
- Cables shall not be clipped directly onto watertight structures.
- Cables shall not be run through areas of high radio frequency field strength, such as:
    - equipment rooms;
    - radio rooms;
    - in the vicinity of antenna couplers.
- Cable routing shall take account of the minimum acceptable bending radii of cable as follows:
    - 8 diameters - non-armoured cable;
    - 10 diameters - armoured cable.
- Cable routes shall take into account the physical separation of cable groups recommended in Table 1(section 5), and paragraph C.1.4.
- Cables shall be easily accessible throughout the entire length of cable runs, ways and trays, by easily removable covers.

C.1.3 Mechanical Retention

- Cables shall be secured by clip to approved cable hangers, installed at approximately 50 cm (20in) separation.
- Straight cable runs, without slack shall only be clipped to every other hanger.
- Cable clips shall be 15 mm (5/8 in.) wide, corrosion resistant, and secured at each end of the clip (unless Kindorff hangers are used).
- Clips used to secure single, small diameter cable, must only be secured at one end, as long as the clip provides positive cable retention.
- Cables shall not exceed a double bank on a hanger and, where possible, be single banked.
- Care must be exercised not to pinch or deform any cable while clipping.

C.1.4 Separation of Cables

The Contractor is referred to Table 1 (section 5), which is intended as a guideline for the physical separation of various cable groups. Because of space constraints in various classes of ship, the separations are not mandatory, but represent levels towards which the Contractor shall work. If

the Contractor is unable to meet these separations, the use of additional screening material is recommended. This does not apply to cables crossing at, or close to, right angles.

The bundling of cables must follow these guidelines (Table 1, section 5):

- Bundling of cables of the same group is permitted for cables from GROUP A to GROUP E inclusive.
- Bundling of cables of the same group shall be avoided for GROUP F to GROUP K inclusive.
- Where bundling of GROUP F to GROUP K cables is necessary, the use of additional screening material, on each cable, is recommended.

C.1.5 Cable Termination

- Cables shall be terminated in approved connectors, preferably equipped with a suitable connector retention device.
- Cables shall be suitably strain relieved to ensure that the connector is not required to support the weight of any hanging cable.
- Terminating connectors and/or lugs shall be capable of withdrawal through the cable entry, without need for connector disassembly.
- Cable terminating at either a junction box or terminating equipment shall:
    - have cable, connector, and terminating equipment designations identified on suitable tags, secured to the cable;
    - have the integrity of the cable screen maintained, by connection to the chassis of the equipment or junction box, either of which must be grounded;
    - all unused conductors within a cable bundle shall be grounded.

C.2 INSTALLATION OF WAVEGUIDE

In planning waveguide installations, the Contractor must regard waveguide as a high-energy source of radio frequency, and must therefore, provide maximum separation from other electrical cables.

The use of rigid waveguide is strongly recommended and shall be consistent in any individual installation. The type of waveguide to be used shall be stated in the Installation Specification. The type will depend upon the length and complexity of the waveguide run and the radar to be installed.

Figure C.3 is included to assist the Regional personnel in making their selection.

C.2.1 Rigid Waveguide Installation

Rigid waveguide installation is as follows (see Figure C.1):

- Before installation inspect waveguide and special fittings for damage.
- Cut waveguide into sections to conform to vessels layout.
- Fit each section of waveguide with a choke flange at lower end and a plain flange at the other end. All flanges must be silver soldered to the waveguide.
- Fit all choke flanges with O-ring gaskets.
- Waveguide cleats must not be more than 3 ft apart.
- Install deck flange with care. Do not over tighten rubber seal as too much pressure will distort waveguide. Protect all cavities against moisture by filling and packing with sealing compound.
- On non-pressurized systems install moisture seal at cabinet outlet.
- Use 90-degree twist to bring sections into correct plane.
- Install H or E bends to change direction of waveguide.
- Use wall plates to provide a proper finish for waveguide entry at bulkhead.
- Install a 3 in. waveguide section atténuateur cabinet outlet to facilitate insertion of pressure gauge and test equipment or removal of equipment. If outlet is fitted with a choke flange use a 3 in section with two plain flanges.
- Periodically check waveguide sections for leaks using pressure windows or other means of sealing waveguide.

C.2.2 Elliptical Waveguide Installation

Elliptical waveguide installation is as follows (see Figure C.2):

- Before installation inspect the waveguide and special fittings for damage. If the waveguide jacket has been cut apply polyethylene tape to damaged areas.
- Pressure check factory prepared waveguide before installation. Pressure is set at 10 psig and loss should not be in excess of 1 psig in 24 hrs for waveguide over 20 ft. If excessive pressure loss is evident check all joints and tighten screws and clamping nuts. If leak cannot be corrected notify the Project Officer.

- Take great care to avoid twisting, bending or kinking waveguide. Do not fabricate bends of less than the recommended minimum radius.
- On non-pressurized systems fit connector type 36955 to elliptical waveguide.
- On pressurized systems fit connector types 185C or 185AC to elliptical waveguide.
- Fit moisture seal at Cabinet and at Antenna ends of waveguide.
- Install waveguide hangers one ft. apart for the first three ft. from antenna and three ft. apart thereafter.
- Fit all choke flanges with O-ring gaskets.
- Install deck flange with care. Do not over tighten rubber seal as too much pressure can distort waveguide. Protect all cavities against moisture by filling and packing with sealing compound.
- Use wall plates to provide a proper finish for waveguide entry at bulkhead.
- Install 3 in. waveguide section at cabinet outlet to facilitate insertion of pressure gauge or test equipment and removal of equipment.
- Periodically check waveguide sections for leaks using pressure windows or other means of sealing waveguides.

C.2.3 Protection of Waveguide

Waveguide runs must be planned to minimize the risk of mechanical damage. Where damage prone locations cannot be avoided, the waveguide shall be protected as follows:

- by kickplate or baffle plate;
- by choice of location offering the maximum inherent protection, e.g.; in the well of an I beam.

C.2.4 Routing of Waveguide

Waveguide runs shall take the most direct path between antenna and transceiver, consistent with the following objectives:

- Avoid damage prone locations.
- Maximum separation from other cables and cable groups.
- Least number of bends and joints in the waveguide. Bends shall be made using pre-formed waveguide sections.

- Avoid large temperature differentials along the waveguide run.
- Provide easy access to any waveguide joints installed, for inspection and maintenance.

C.2.5 Mechanical Retention

The following guidelines shall be followed in the mechanical retention of waveguides:

- Runs shall be secured to minimize vibration.
- Manufacturer designed, or recommended, fastening hardware shall be used to the greatest extent practical.
- Vertical waveguide runs must be secured every 120 cms (48 in).
- Horizontal waveguide runs must be secured every 90 cms (36 in).
- No deformation of the waveguide shall be introduced by the fastening hardware.
- Waveguide passing through bulkheads or deck-plating shall be protected from damage.

C.2.6 Waveguide Testing

Waveguide must be sealed at each end using pressure windows and a pressure pump fitting shall be included at the transceiver end. Before acceptance, the sealed waveguide shall be pressurized to 35 kPa (5 p.s.i.), and checked to ensure that pressure does not drop below 28 kPa (4 p.s.i.) within four hours. Any leaks so identified shall be repaired, and the test repeated until successful.

With the antenna disconnected, and replaced by a 50 ohm load, the waveguide installation shall exhibit a V.S.W.R. of 1.3 or less, at the operating frequency of the installed system.

Waveguide runs shall be checked for RF leakage at joints in accordance with Health and Welfare Safety Code 6 levels.

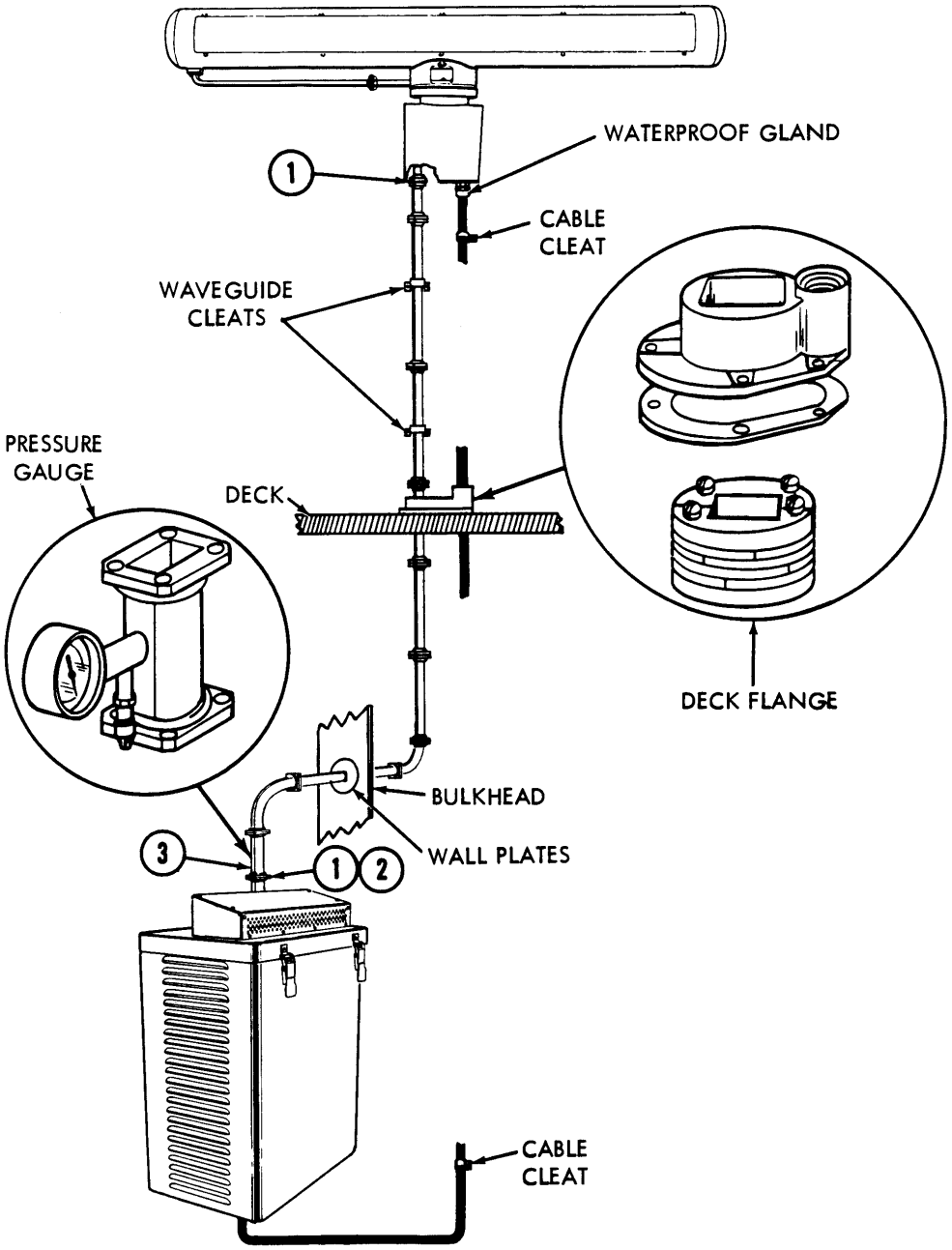


Figure C-1 Typical Rectangular Waveguide Installation

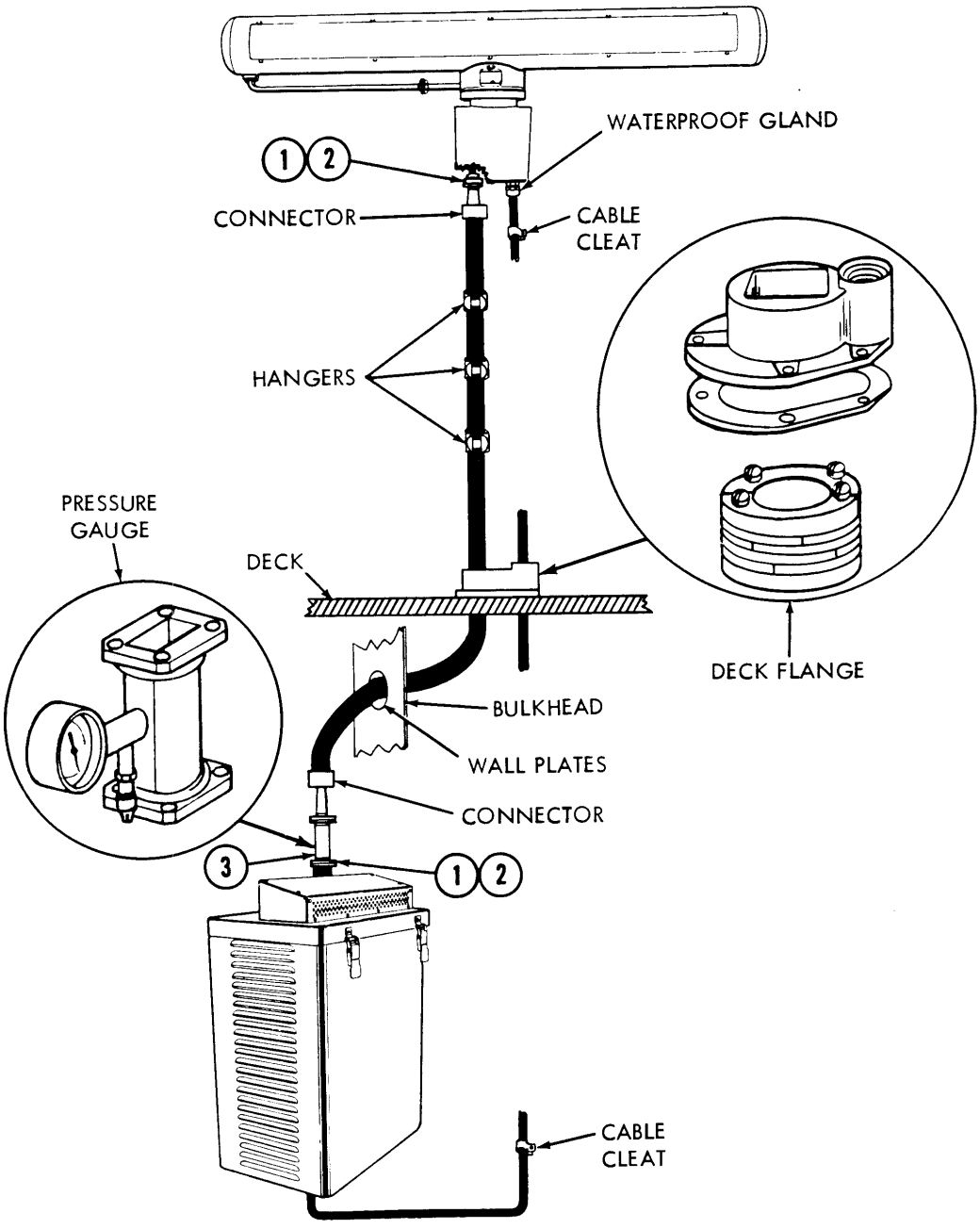
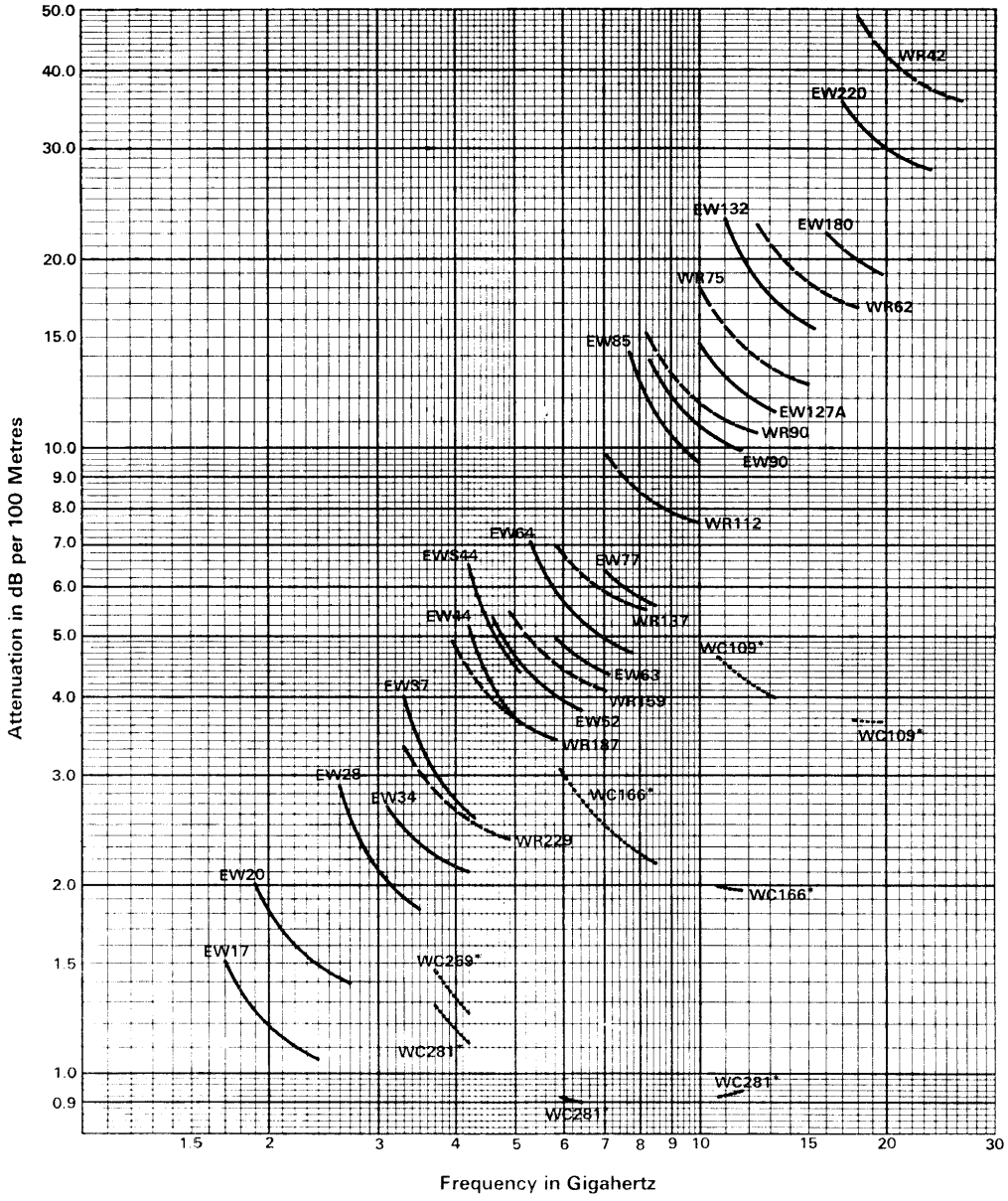


Figure C-2 Typical Elliptical Waveguide Installation

Technical Data – Waveguide Attenuation (Metric Units)



Attenuation curves based on:
VSWR 1.0
Ambient Temperature 24C(75F)
High Conductivity Copper

Figure C-3
Attenuation Curves

APPENDIX D CHOICE OF ELECTRICAL MATERIALS

Sometimes, installation materials will be Government furnished, as specified in the installation specification. These guidelines are provided for the Contractor in cases where this is not so.

D.1 ELECTRICAL CABLE AND WAVEGUIDE

The Contractor shall observe the following guidelines:

- Maximum use shall be made of the manufacturer's standard cable, unless other cables are specified in the construction specification.
- Contractor shall follow the installation detail provided by the manufacturer and/or available ship's drawings.
- Failing the above, the Contractor shall use the following data.

D.1.1 Electrical Service Cables

Cables shall be comprised of two, three or four insulated conductors (depending on the nature of electrical service). The conductors shall be clad in a flexible polyethylene sheath and the cable armoured preferably with a bronze basket weave.

- Cable must satisfy CGE-8240-D, or equivalent, rated for 600 volt working.
- Conductors must be multi-strand, soft annealed copper, either tinned or alloy coated.
- Conductors must be conservatively rated, 14 A.W.G. minimum, and insulated with cross-linked polyethylene, CSA approved RW 90.
- Outer jacket must be heavy duty, flexible, non-combustible material.
- Armour shall be low resistance, corrosion resistant material.
- Flame retardant as per I.E.E.E. 45 to FT-4 standard.

D.1.2 Control Cables

Control cables shall be multi-conductor, (dependent upon application), and of similar construction to the electrical service cable, but with the following differences:

- Cable must satisfy CGE 8237, or equivalent, for 300 volts working.

- Conductor gauge must be such that the receiving end voltage always exceeds 90% of the driving end voltage; the gauge shall not be less than 18 AWG unless recommended by the manufacturer.

- Must be flame retardant (I.E.E.E. 45) to FT-4 standard.

D.1.3 Audio Frequency Cables

Audio frequency cables must be of multiple twisted pair construction, electrically screened and sheathed in polyethylene. They must comply to the following points:

- Pairs will be individually shielded, unless specified otherwise in the Installation Specification.

- Twist length of twisted pairs shall not exceed 6 cms (2.5 in.).

- Conductors shall be multi-strand soft annealed copper, tinned or alloy coated, of 22 A.W.G. minimum.

- Multi-core cables, i.e., five or more pairs, shall carry a total of 10% of used pairs or one pair, whichever is greater, as spare conductors.

- Must be flame retardant (I.E.E.E. 45) to FT-4 standard.

D.1.4 Radio Frequency Cables

The following co-axial cable types are recommended for use. Electrically equivalent cable, of either RG or non-RG designation, is also acceptable.

- 50 ohm, flexible, non-bundled
  RG 58C/u; RG 213/U.

- 75 ohm, flexible, non-bundled
  RG 59B/U, RG 11A/U or
  CAC-6.

- 50 ohm, flexible, bundled
  RG 223/U; RG 214/U.

- 75 ohm, flexible, bundled
  RG 6A/U; RG 216/U.

N.B: The use of RG 59B/U shall be avoided for TV system cable

Contractor shall use CAC-6 or exact equivalent. The use of rigid or semi-rigid co-axial cable must be avoided.

D.1.5 Fibre Optic Cable

The SIECOR 62.5/125:m cable, or equivalent, shall be used for fiber distribution data interface (FDDI) networks.

The push-in and lock type SC connector shall be used in the ship environment and connector installation kits are readily available from the cable supplier.

D.1.6 Waveguide

Waveguide shall be used for radars operating at or beyond X band frequencies.

- Preferred types of rigid waveguide shall be: RG 51/U (WR 112); RG 52/U ; (WR 90).
- Preferred types of flexible elliptical waveguide shall be: Andrews Heliax type EW85 or equivalent.

D.2 INSTALLED EQUIPMENT

The equipment to be installed is normally specified, or GFE. Any substitution of equipment for that specified shall have the approval of the Design Authority. Contractor supplied equipment not so specified shall be approved by the Project Officer.

D.2.1 Accessories

D.2.1.1 Electrical Distribution Panels

All electrical distribution panels shall conform to CSA/UL standards or shipborne ruggedized applications. They shall also incorporate the following features:

- All materials shall be corrosion resistant, except those parts that carry current. Current carrying parts may be susceptible to corrosion, but shall have a corrosion resistant finish.
- Three-phase alternating current distribution panels shall be limited to eighteen branch circuits.
- Direct current, or single phase alternating current distribution panels, may provide up to twenty-six branch circuits.
- Each branch circuit shall be provided with a multipole circuit breaker (one pole/conductor).
- Each circuit breaker shall be identified as to its rating, and its associated branch circuit.
- Each panel shall have a self-latching inspection door.

- Cable entry shall be through an approved cable gland, preferably via the top or bottom surface of the panel.

- Explosion proof panels and breakers shall be used when required.

D.2.1.2 Receptacles and Switches

- Electrical boxes used to mount switches or receptacles, or used as a cable junction box, shall be of corrosion resistant metal, with a wall thickness of at least 2.5 mm (3/32 in.).

- The volume of boxes shall be sufficient to allow a clearance of 1.25 cms (1/2 in.) between live terminals and the surface of the box.

- All mounted switches, receptacles and cable terminations shall conform to the appropriate CSA/UL standard.

- Receptacles shall provide an additional terminal, internally connected to the enclosure for safety ground purposes.

- Receptacle body and current carrying contacts should be both flame and moisture proof, and mechanically rugged.

- Receptacle contact arrangements should be standardized for the service provided.

- Receptacles shall be such that plugs, when installed, are free from contact strain, and so positively engaged as not to suffer disconnection under vibration conditions.

- Switches shall be multipole (one pole per conductor), of conservative rating, and of reciprocating or toggle action, with quick make and break. Switches shall indicate their ON/OFF status in a failsafe manner.

D.2.1.3 Electrical Ancillaries

Electrical service to communications and electronic navigation aids equipment shall, to the greatest possible extent, be distributed by means of electrical service panels which are dedicated to these classes of equipment.

Ideally, electrical distribution shall be structured so that electrical service to critical electronic circuits maintains a high level of integrity. To this end, DFO/CCG vessels are often equipped with emergency and/or reserve sources of electrical power, to which critical services are transferred when primary power is interrupted. Since these reserve sources of power are of limited capacity, it is essential that they be used to support only those services specified by the Design Authority.

The Contractor therefore, shall observe the following ground rules:

- He shall attempt to provide separate electrical distribution panels for electronic and telecommunication circuits.

- He shall arrange that electrical distribution to critical circuits, as defined by the Project Officer, is made by means of a dedicated distribution panel.

- Insofar as it is possible, the service power requirements of all "critical" electronic and communication circuits shall be rationalized so that transfer to reserve sources of power may be done easily.

- Where the capacity of the reserve source is limited, a visual indicator shall be provided when the reserve source is in use. The indicator shall be failsafe.

- Care must be taken to ensure that only those circuits designated by the Project Officer are connected to this "critical" panel.

APPENDIX E LOCATION OF EQUIPMENT

The following guidelines shall be used to determine preferred locations for the following equipment. Reference shall be made to DGTE-75 with regards to Antennas and Antenna Systems.

E.1 GYROCOMPASS

The location of the master gyrocompass unit(s) shall represent the best compromise between operational convenience and the minimization of unwanted accelerations experienced by the gyrocompass. To this end, master gyrocompass unit(s) shall be located as follows:

- on, or as near to, the ship's centre of roll and pitch as possible, consistent with reasonable cable runs to the Navigating Bridge area;
- mounted with the lubber's line facing forward;
- with gyrocompass ancillaries (other than repeaters) located in the same compartment, if possible.

E.2 RADAR SYSTEMS

E.2.1 Radar Transceivers

Radar transceivers shall be located as follows:

- to provide the most direct antenna feed possible, with minimum twists or bends;
- well separated, at least 5 m (15 ft) separation, from the magnetic compass if possible. Otherwise, site according to instructions from the manufacturer.

E.2.2 Radar Antennae

Radar antenna(e) shall be located as follows:

- as high as possible, consistent with the requirements of other antennae;
- on an individual working platform(s), if possible;
- free from shadow effects, caused by external obstruction, in particular dead ahead or dead astern;
- equipped with antenna rotation safety switch to disable antenna rotation and signal transmission. This switch shall be installed at the entrance to the radar platform except in

the case of an inter-switch radar system where both safety switches shall be mounted side by side at the entrance to the first radar platform;

- with some form of internal communications between the platform and transceiver and display locations.

E.2.3 Radar Displays

Radar displays shall be located as follows:

- as close as possible to the Navigating Position;
- with a display orientation such that the operator retains the maximum degree of orientation when transferring his attention from the display to the real world and vice versa. This generally implies a fore and aft alignment, with the display top pointing forward;
- out of the direct path of strong lighting.

E.3 COMMUNICATIONS AND NAVIGATION AIDS SYSTEMS

E.3.1 Antennae

Antennae shall be located according to the following guidelines:

- as high as possible on the ship's superstructure;
- in a competition for height, preference should be given to antennae providing line-of-sight range, especially VHF-FM;
- receiving system, and MF/HF direction finding antennae shall be given the widest possible separation from all MF/HF transmitting antennae;
- individual antennas shall be separated, to the greatest extent practical, from one another and from external obstructions;
- ship's stays, near to DF antennae, shall be separated by insulators into short lengths, e.g.; less than 6 m (19 ft);
- rigid antennae shall be mounted to provide adequate structural strength under all service conditions;
- transmitting antennae located in work areas shall be fitted with safety screens and/or safety hazard notices.

E.3.2 Antenna Couplers

Antenna couplers shall be located as follows:

- to provide the most direct and shortest feed between antenna and antenna coupler.
- close to and connected to a good ground plane.
- with exposed antenna feed wires suitably guarded, and with hazard notices posted i.e.;

CAUTION - DO NOT TOUCH DANGER OF RF BURN

(Use CSA std. Picture)

E.3.3 Electronics Equipment

Equipment requiring no adjustment and only periodic or nil maintenance should be located as follows:

- in standard 483 mm (19-in) equipment racks;
- in an electronic equipment room.

Equipment subject to frequent operator action, shall be located as follow:

- to provide the most efficient operator/equipment interface.

Consistent with these requirements, all equipment shall be located to minimize interconnecting cable lengths, especially in those cables that carry RF.

E.4 SHIP EARTH STATIONS (SES)

E.4.1 Antenna (Radome)

Antenna shall be located according to the following guidelines:

- preferably high enough and in such a position that no obstacle appears in any azimuth direction down to -5° elevation;
- in practice, since the presence of some metallic objects in the propagation path between the antenna and the satellite is difficult to avoid for all azimuth directions, all obstructions within 3 m of the antenna shall be avoided;
- avoid locations:
  a) at the same level as the ship's radar antenna;
  b) where ship's personnel may be exposed to hazardous radiation;

c) where the structure could be affected by severe vibration and shock.

E.4.2 Access to Radome

The radome shall be provided with a platform or steps for easy access and a guard rail for the safety of the service personnel.

E.4.3 Below Deck Equipment (BDE)

The below deck equipment shall be located according to the following guidelines:

- It shall be possible to initiate and make distress calls by telephony or direct printing from the position at which the ship is normally navigated and also from any other position designated for distress alerting.

- In addition, where a room is provided for radio communications, means to initiate distress calls shall be fitted in that room.

E.5 406 MHZ EMERGENCY POSITION INDICATING RADIO BEACONS

(EPIRBs) CLASS I & II

E.5.1 Class I EPIRB

Shall be installed in an exposed and unobstructed location, preferably on the bridge top, in such a manner as to allow the EPIRB to activate automatically and float free, should the ship sink.

E.5.2 Class II EPIRB

Shall be installed on the bridge of a ship in a highly visible location in order to be carried by one person on board survival craft and activated manually in emergency situations.

APPENDIX F CHOICE OF MATERIALS

F.1 RACKS AND CONSOLES

Equipment racks and consoles shall be of standard 483 mm (19 in) construction, of 600 mm (24 in) and or 30 in. interior depth, and height suited to location. The cabinet shall incorporate the following:

1) all welded construction;

2) means of mounting equipment slides;

3) provision of captive thread mountings;

4) means of mounting doors and side panels as optional accessories; and

5) easy adaptation for forced-air cooling.

Note: Hammond 1469 series is acceptable. However, rack must have CSA approval.

F.2 SPECIAL EQUIPMENT ENCLOSURES

Enclosures provided to protect equipment from severe environments shall be selected in accordance with CSA Standards CAN/CSA-C 22.2 No. 94-M91(R1997) special purpose enclosures, and No. 30 dated 1986(R1992), as follows:

- Drip Proof Enclosure
  C 22.2 No. 94 - M91, Class 2

- Weather Proof Enclosure
  C 22.2 No. 94 - M91, Class 3

- Water Proof Enclosure
  C 22.2 No. 94 - M91, Class 4

- Dust Tight Enclosure
  C 22.2 No. 94 - M91, Class 5

- Explosion Proof Enclosure
  C 22.2 No. 30-M1986, Class 1, Hazardous Locations

- RFI Enclosure
  AMCO specification

F.3 MOUNTING HARDWARE

Interconnect and mounting hardware must be made of non-corrosive material, e.g., stainless steel, zinc-coated or brass in exposed areas. The contractor shall take all possible precautions to minimize the risk of corrosion in mounting equipment and/or racks. Separators are to be used between contact surfaces of dissimilar metals that are susceptible to cathodic corrosion. Such separation materials shall include Rubber/Mylar.

F.4 SHOCK AND VIBRATION MOUNTS

It is noted that the conflicting requirements for the isolation of equipment from shock and from vibration may lead to compromises that, in improving one condition, tend to make the other worse. Accordingly, equipment should normally be hard-mounted unless otherwise specified by the installation specification or by the manufacturer. When shock or vibration mounts are fitted, they shall be in accordance with the recommendations of the manufacturer to meet the specified service conditions.

APPENDIX G ENVIRONMENTAL CONDITIONS FOR SHIPBOARD COMPUTER SYSTEMS

G.1 GENERAL

Computers procured and installed for use aboard DFO/CCG vessels are required to function under the conditions described below.

G.2 ELECTROMAGNETIC (EMI) AND RADIO FREQUENCY (RFI) INTERFERENCE

The equipment must comply with Industry Canada, Radio Interference Regulations, Document RIR for Class B Digital Apparatus.

G.3 ELECTROMAGNETIC AND ELECTRICAL CONDITIONS

To comply, the subject equipment when exposed to the conditions stated below, shall be maintained in its normal operating condition without any spurious operation, unless otherwise stated, when power is applied. This will apply to the hardware and the logic circuits of the subject equipment.

There shall also be no un-anticipated visible deterioration (i.e.: melting or cracking) of the product. Un-anticipated deterioration does not include normal wear and tear.

G.3.1 Conducted Low Frequency Interference

Subjected to low order supply harmonics with an RMS voltage of 10% of the power supply voltage up to the 15th harmonic of the supply frequency, reducing to 1% at the 100th harmonic and onward.

The defined signal level is over the range from 50 Hz to 10 KHz superimposed over the supply lines to the equipment.

G.3.2 Conducted High Frequency Interference

Subjected through the power supply to a frequency swept from 10KHz to 50 MHz, at a signal amplitude of 1 volt and 30 % modulation at a frequency of 1 KHz, to the product at any continuous sweep rate.

G.3.3 Susceptibility to a Radiated Electric Field

Subjected to a radiated electric field at a frequency swept from 15 KHz to 200 MHz, at any continuous sweep rate, with 30 % modulation at a frequency of 1 KHz. The signal field strength

shall be 10 Volt/metre at a one metre distance from the product. The radiation shall be applied to all sides of the product.

G.3.4 Transients on Power Lines

Subjected, via the power supply lines, to transients applied at 15 millisecond bursts every 300 milliseconds for a duration of 10 minutes with positive polarity and 10 minutes with negative polarity. The transient pulse characteristics shall be:

- Rise time: 5 nanoseconds (10/90% value);
- Width: 50 nanoseconds (50 % value);
- Amplitude: 1 kilovolt; and
- Repetition Rate: 5000 pulses/second.

Subjected, via the power supply lines, to transients applied at 1 pulse per second for a duration of 10 minutes with positive polarity and 10 minutes with negative polarity. The transient pulse characteristics shall be:

- Rise time: 1.2 microseconds (10/90 % value);
- Width: 50 microseconds (50 % value);
- Amplitude: 1 kilovolt; and
- Repetition Rate: 1 pulse/second.

G.3.5 Power Supply Failure

Subjected to three power interruptions of 30 seconds minimum duration each over a five minute period. These interruptions are not to occur while data is in the process of being stored on magnetic media. This test is not to include an external un-interruptible power supply in the circuit. After each interruption, there shall be no damage to the equipment or permanent damage to the resident programs, and the system shall be completely restorable. Internal RAM memory erasure is permitted during an interruption but the magnetic storage media programs, and already stored data, must remain uncorrupted subject to the following conditions. Where an interruption occurs while data is being stored on magnetic media it is not required that the stored data be uncorrupted.

G.3.5.1 Electrical Service Conditions

Subjected to power with continuous and permanent characteristics of, single phase alternating current, 120 volts + 10% or -15 % and a frequency of 60 Hz ± 6 Hz.

Subjected to power with the transient characteristics of 120 volts ±20% for durations of up to 1 (seconds, and 60 Hz ± 6 Hz for durations of up to 5 seconds.

G.4 TEMPERATURE AND HUMIDITY

The following conditions shall apply:

- Section 3.3.1 Equipment below decks only.
- Equipment shall be capable of continuous operation over the temperature range from +5°C to +50°C.

G.5 DYNAMIC CONDITIONS

These conditions apply to all three mutually perpendicular axes unless otherwise stated.

G.5.1 Vibration

G.5.1.1 Short Term

- 5 to 15 Hz at 1.0 mm amplitude
- 15 to 33Hz at 0.7 G

G.5.1.2 Continuous

- 5 to 20 Hz at 0.5 mm amplitude

G.5.2 Shock

Repetitious accelerations for up to 10 msec as follows:

- Short term ± 4 G
- Indefinite ± 1 G

G.5.3 Roll and Pitch

Pitch and roll shall apply to either side from the vertical.

- Pitch for short periods: ± 20°
- Pitch indefinitely: ± 5°
- Roll for short periods: ± 45°
- Roll indefinitely: ± 15°

The cycle time shall be between 5 and 20 seconds for a duration of not less than 15 minutes.

APPENDIX H LAN DESCRIPTION AND INSTALLATION

H.1 GENERAL

The recommended 802.3 Ethernet network standard is perhaps the widest support network standard adopted by the industry. There is a large selection of compatible hardware and software available off-the-shelf. The fiber backbone ensures sufficient capacity to accommodate the present needs and future growth.

H.1.1 The Server / Client Environment

The LAN supports a "Server/Client" environment, where the workstations are generally regarded as "clients" connected to the "server" computer(s) which controls the distribution and flow of data.

The advantages include:

- Resource sharing makes programs, equipment and data available to authorized personnel anywhere on the network, sometimes at a great distance from each other.
- High reliability means having alternative sources of supply (such as file duplication or multiple processors).
- Saving money with centralized resources.
- Scalability means that it is relatively easy to expand the system by adding computers to the network.
- The communication medium embodied by the network enhances human-to-human communication even at great distances

H.1.2 Fiber Optics Ethernet

The reliability of fiber optics has increased substantially during the past number of years and has several advantages over copper, which are as follows:

- Support of high data transmission rates.
- No susceptibility to electrical interference.
- Support of longer cabling distances.
- Unaffected by power surges, power outages, or electromagnetic interference.
- Thin and lightweight.

- Photons in a fiber do not affect each other like electrons in a copper wire.

The selected fiber optics backbone will ensure sufficient bandwidth for future expansion, including voice and video signal transmission. The multi-mode fiber (MMF) is recommended for its lower cost given that a typical cable run on a vessel is within the 2,000 m transmission limit.

H.2 LAN COMPONENTS

The main components in a LAN are the file server, the workstations, the LAN communication chassis, the network interface card and the optical fiber cable. (Note: print server and printers are not discussed in this Appendix). Figure H-1 shows the major components covered.

H.2.1 Lists of Hardware

H.2.1.1 Fiber Optic Cable

The 62.5/125:m cable is the most commonly used fiber optic cable. It has greater bandwidth and lower attenuation than the 100/140:m cable. The 62.5/125:m cable is specified for the fiber distribution data interface (FDDI) networks, hence less susceptible to obsolescence.

H.2.1.2 Cable Connectors

The straight-tip (ST) is commonly used in 10Base fiber network cabling. The connector uses a precision plug and a flexible sleeve. The push-in and lock type SC connector is widely adopted in the 100 Base fiber network. Both types provide secure connections and are suitable in the ship environment. Connector installation kits are readily available from cable supplier and shall be used to simplify assembling the connectors.

H.2.1.3 Switch Chassis

The switch chassis provides a central switch at which to connect the user workstations and server(s), by means of a particular access method (such as Ethernet, Fast Ethernet or Gigabit Ethernet). The chassis should be complete with redundant power supply modules and a controller module. It shall also have the ability to accommodate future expansion and provide connections to either l0 Base or l00 Base workstations

H.2.1.4 Patch Panel

A fiber patch panel provides an interface between the fiber optic cables and the switch chassis. The advantages to using a patch panel are as follows:

- Allow quick diagnosis by swapping patch cords to identify connection or cable failure.
- Front accessible connectors allow quick re-assignment of ports.

- Reduce the handling of, and hence the risk of damaging, the main fiber cable and its connector if port re-assignment is needed.

Although there are some disadvantages, such as, the need for additional space to install the panel, normally adjacent to the switch chassis, and the lowering of the overall reliability a patch panel is commonly used due to benefits listed above.

All connections shall be clearly labeled on the panel. It is also a good practice to place a copy of the wiring diagram close to the patch panel for maintenance purposes.

H.2.1.5 Network Interface Card

The l0/l00 Base Ethernet Network Interface Card (NIC) is selected at time of LAN installation.

H.2.1.6 Fiber Optic Transceiver

A transceiver will be required for PCs and servers equipped with existing Ethernet Network Interface Cards, which only provide connectors for copper shielded twisted pair (STP) cable. The transceiver must meet the following minimum characteristics:

- Must be IEEE 802.3 compliant.
- Must inter-operate correctly at 10/100 Mbps with the switch.
- Must provide standard type connectors (ST for l0Mbps, SC for l00 Mbps) for physical connection to the network.
- Must be equipped to display indications as to whether it is:
  1) receiving power;
  2) transmitting data; or
  3) receiving data.

H.2.1.7 Workstations and Server

The workstations shall be certified to meet DFO/CCG marine specifications.

H.2.2 Operating System and Network Tools

H.2.2.1 Windows NT 4.0 Server

The Windows NT 4.0 Server (or better), with client licenses, is the operating system for the network server. One licensed copy is required for each server for each LAN. The number of client licenses required depends on the number of workstations running on the LAN. Additional client licenses can be purchased when needed.

H.2.2.2 Windows NT 4.0 Workstation

The Windows NT 4.0 Workstation (or better) is the operating system for all the network workstations. One (1) licensed copy is required for each workstation.

H.2.2.3 Network Management Software

The Network Management software is an application tool for configuring, controlling, monitoring and analyzing the network components. The software is fully SNMP compliant. It also provides Web-based secure remote access for network managers by removing location and capability limitations and extending management reach throughout the network. The Network Manager software program for the operating system is the 3Com Transcend Enterprise Manager for Windows NT.

H.3 INSTALLING THE HARDWARE COMPONENTS

H.3.1 Cabling and Connectivity Considerations

A wiring/cabling plan shall be in place before the installing of any cable, patch panel, switch chassis, etc. The plan shall include information on the following:

- Exact location of the switch chassis.
- Exact location and the number of patch panels required (more than one panel may be required for large ships).
- Number and location of the drops.
- Estimated distance of the cable runs.
- Accessibility to the existing cable trays.

A drawing tool, such as ATUOCAD lite, can be used to layout the block and wiring diagrams, which can be overlaid onto the ship drawings. These drawings can be used to keep track of the cable layout, wiring and colors and layers can also be used to identify different cable types. Figure H-1 shows a typical wiring diagram.

H.3.1.1 Other Considerations

H.3.1.1.1 Power connections

There are two primary options:

1) a centralized un-interruptible power supply (UPS); and

2) a stand alone UPS at each workstation location.

H.3.1.1.2 Selecting a centralized UPS

Points to be considered include:

- Cost for the UPS(s).
- Cost for power cable run from central location.
- Space required for a central UPS and that for the stand alone UPS at each workstation, etc.

Note: An AC outlet box shall be flush mounted at each workstation.

H.3.2 Running the Fiber Optics

The installation of wiring and cabling shall be carried out in accordance with the best standards practice. The manufacturer's installation guide and instructions shall also be followed to ensure a satisfactory installation.

As a general rule of thumb, fiber cable runs shall be neat, properly clamped, follow the existing runs and exposed to view within the cable racks. This exposed fiber cable alerts future installers that caution is required when running cable in this area. Care must be taken when routing fiber to not exceed minimum bend radius of cable. All cables shall be identified with metal tags, e.g. LAN-1, LAN-2, etc., and the list shall be kept with the wiring diagrams.

Note: In picture 2, flexible cableway is used (beside the doorway) to protect the cables. The cables shall be wrapped in 1/4" rubber prior to tie wrapping in cableways. Metal conduit is preferred but not required. It is also not practical, in most cases, due to the high material and labor cost and additional space required. PVC cable conduit should not be used for safety reasons (due to poisonous fumes produced in case of fire). Existing cable trays shall be used whenever possible for cable runs(Picture 1).

Extreme care shall be taken when running the fiber cables adjacent to other ship cables; particularly the bronze armored ship cable (BASC). Fiber cable can be damaged if a BASC is pulled over the fiber. If a centralized UPS is used, since the power cable would be BASC, then the power cables shall be run before running the fiber cables.

It is also important to choose a contractor that has current knowledge of ships cabling to run the cables because a ship environment is different than normal building structures.

All cables shall be tested with an attenuation meter for any damage. The signal attenuation shall not exceed 4db. A damaged cable can normally be detected by touching the cable surface.

H.3.3 Installing the Chassis, Cards and Patch Panel

As mentioned in section H.3.1, the locations of the chassis and the patch panel have certain implication on the cost of cabling. They shall be installed at the same location whenever possible.

The location shall easily be accessible since it would probably be the most visited area for maintenance purposes once the network is installed.

The other main consideration is the total space required. Ensure that the maintenance access space is included in the calculations In the case of a large ship, it may be more cost effective to install more than one patch panel. Another important consideration regarding the location of the workstation, chassis and patch panel is the radio frequency interference (RFI). If the equipment is to be co-located with an RF transmitter, shielding techniques should be employed. Pictures , 3 and 4, show the installation of a fiber patch panel and a fiber hub.

H.3.4 Connecting the Workstations and Peripherals

H.3.4.1 Workstation

The location of the workstation depends mainly on the space available. A workstation is normally located on a desktop. The network interface card (NIC) and its associated drivers shall be installed in the computer before being delivered on-site. Marina brackets are available from the workstation supplier (e.g. Hewlett Packard) to secure the computer system unit and the monitor on a desktop.

These brackets are generally expensive. An alternative is to fabricate custom brackets. This can normally be achieved at a lower cost, if the machinery and the facility are available. Ensure that the workstation is secured in a way that it will not be pushed against the bulkhead, which may result in damaging the fiber cable connector.

The keyboard can be secured by the use of Velcro strips (on the desktop and on the bottom of the keyboard). In the case, where a STP/UTP - Fiber transceiver is needed, additional space and mounting arrangement will be needed close to the workstation. A patch cord is usually supplied with the transceiver.

An adjustable nylon strap can also be used to strap down a monitor. This can accommodate different monitor types. Securing computer monitor on desktop with screws is not recommended. (See picture 6) If the system unit is placed on the floor, a barrier shall be used to prevent possible impact by any heavy free rolling objects, e.g. chair, on the floor.

H.3.4.2 Drop Box

The LAN drop box shall be located as close to the workstation as possible to avoid excessive run of exposed cables. Surface mounted raceway shall be used when there is not enough depth to run cables behind the bulkhead. The use of a fiber connector tool-kit simplifies the connector assembly.

Bi-directional optical attenuation measurements shall be performed between the patch panel and all drop boxes. Attenuation measurements shall not exceed 4db for each fiber.

H.3.4.3 UPS

If a stand alone UPS is used for each work station, the UPS shall be secured in a similar fashion as that for the computer work station.

H.4 MAKING THE LAN WORK

H.4.1 Installing the Operating System

The Microsoft Windows NT Work station and Windows NT Server (with Windows NT Client Access License) installation manuals provide an easy to follow step-by-step guide to configure the computer as a network server or a workstation. Once initiated the installation process runs through the system set-up program, though some user input is required. (Note. All hardware components shall be installed before installing the operating system).

Network groups and users privileges, security, etc. can be defined during the installation.

H.4.2 Configuring the Network Manager

The Network Management program can be installed once the LAN is operational. In order to make the full use of the SNMP service, ensure that the Windows NT SNMP service is installed on the computer after the TCP/IP has installed Windows NT. After the SNMP service is installed on a workstation, it automatically starts each time the computer is started.

The user manual and the on-line help program provide useful information in configuring the network component and the settings of different options.

H.4.3 Installing Other Network Applications

All applications shall be installed on and run from the server; this simplifies any future upgrades and configuration management of application software programs. Workstation installation can proceed once the network application is installed on the server.

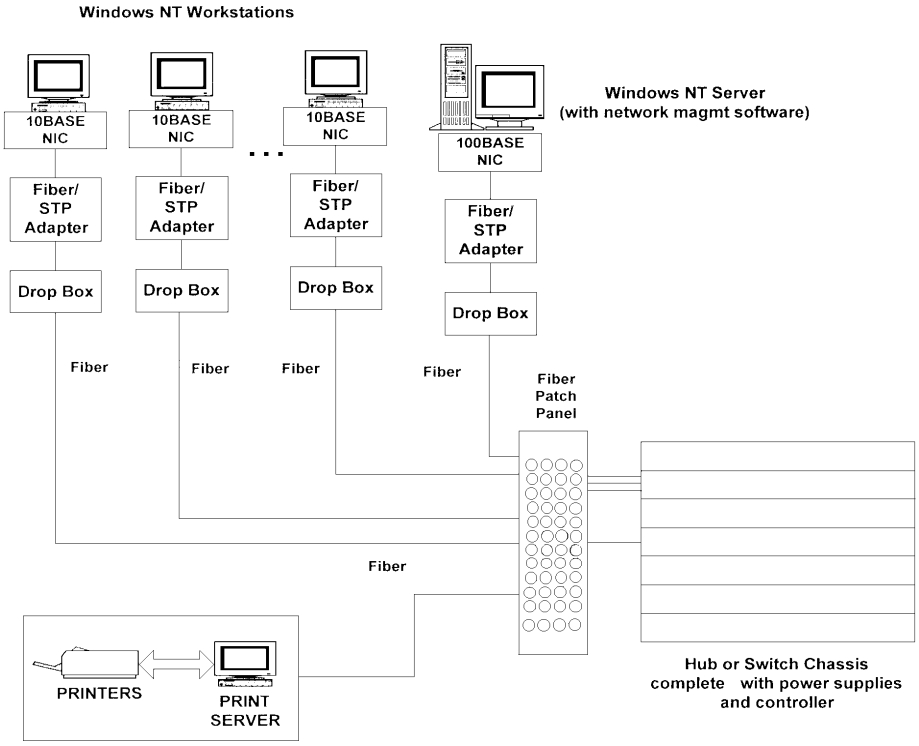


Figure H-1: STANDARD ARCHITECTURE BUS COMPONENTS

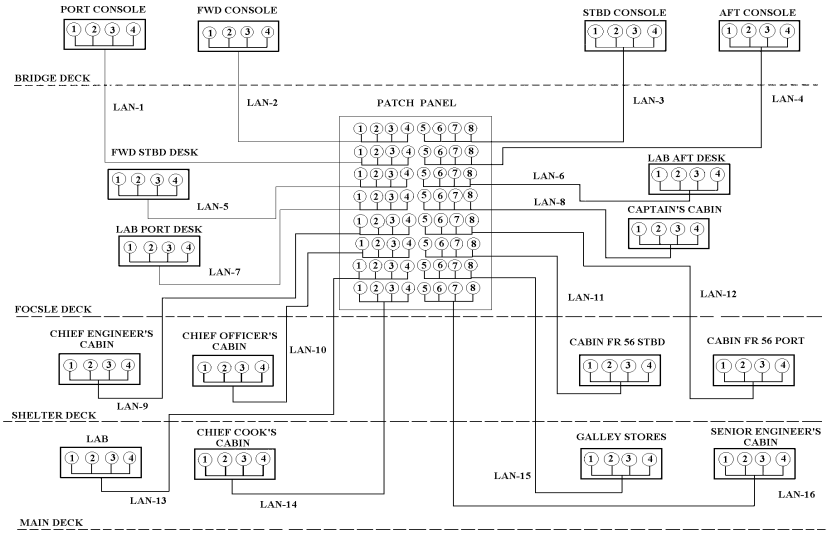


Figure H-2: TYPICALWIRINGDIAGRAM

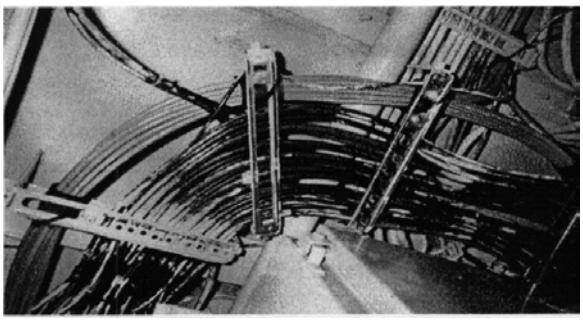


Photo 1

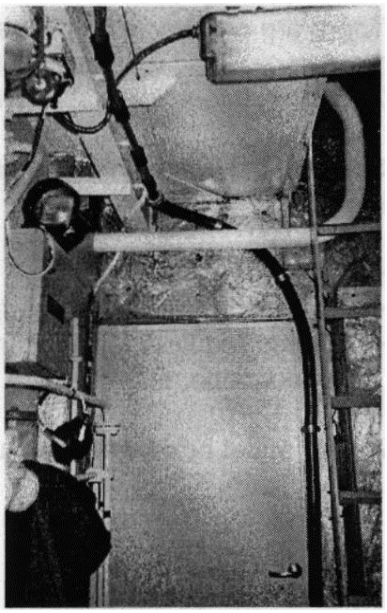


Photo 2

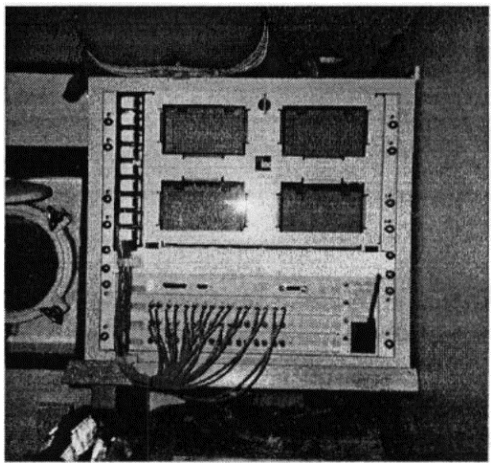


Photo3

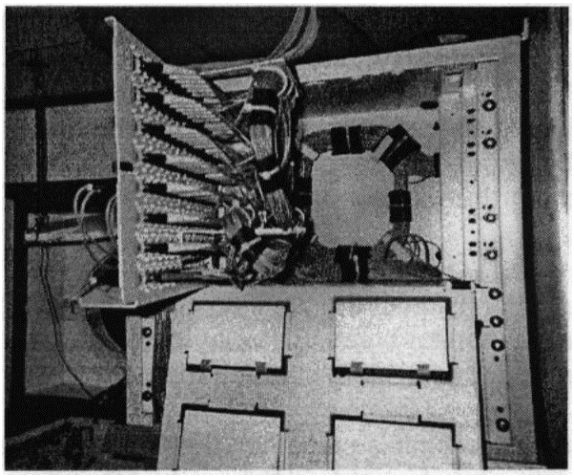


Photo 4

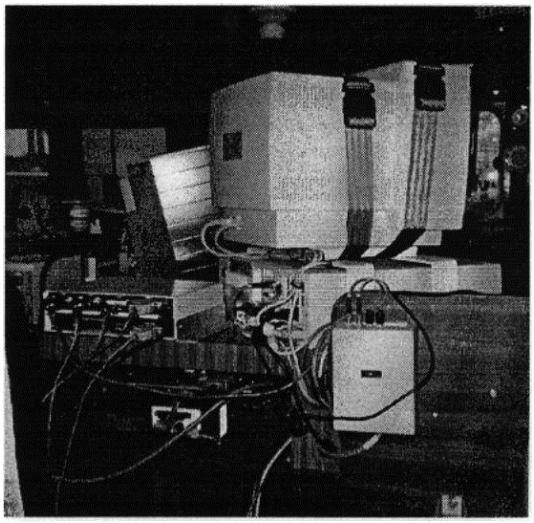


Photo 5

APPENDIX I CHECK LIST

I.1 VESSEL CONFIGURATION

Is the vessel to be equipped with Radio Room and/or Electronics Workshop? If so, consider:

- Rules for determining Size, Location and Configuration of Electronic Compartments.
- Requirement to provide:
  - Spare Parts
  - Test Bench
  - Test Equipment

I.2 EQUIPMENT REQUIREMENTS

If the new equipment is being fitted aboard the vessel, consider:

- Preferred Locations: Appendix E
- Method of Mounting: Appendix D & Chapter 5
- Choice of Material: Appendix F
- Electrical Materials: Appendix D

I.3 INSTALLATION REQUIREMENTS

Specific installation requirements are identified as follows:

- Electronic Cabling: Appendix D
- Electrical Ancillaries: Appendix D
- Grounding/ Bonding: Appendix B
- Workmanship: Chapter 5
- Radio Frequency Interference: Appendix A
- Fibre Optics: Appendix H

I.4 ACCEPTANCE

Acceptance of Installation is contingent upon the requirement for:

- Tests and Trials: Chapter 8
- As Fitted Drawings: Chapter 11
- Electronics Manuals: Chapter 11

I.5 SPECIFIC INSTRUCTIONS

Specific instructions regarding:

- equipment to be fitted
- number of manuals
- installation details
- schedules
- inspection
- warranty

will be detailed in the Vessel or Installation Specification. Installation details may alternatively be provided by the Equipment Manufacturer or his agent.

NOTE:

> The Contractor shall be responsible for the application for and receipt of the necessary radio licenses and/or call sign. An engraved plaque bearing the call sign and a framed copy of the Radio Certificate shall be suitably displayed on the vessel.

APPENDIX J DEFINITIONS

The following definitions apply to this specification.

CONTRACTOR	The contractor is the party whose tender for the contract work is accepted.
CONTRACTOR FURNISHED EQUIPMENT	Contractor furnished equipment (C.F.E.) means any piece of equipment or material supplied by the contractor.
CONTRACT WORK	The contract work is any and all of the tasks identified by the contract and any documents referenced therein.
DEPARTMENT	The Department is the Department of Fisheries and Oceans of the Government of Canada, or authorized representative thereof.
EQUIPMENT TO BE INSTALLED	Equipment to be installed is all equipment and material to be installed, refurbished, or relocated by the contract work.
EXISTING EQUIPMENT	Existing equipment means equipment or material affected by the required installation, which was fitted on board prior to start of the contract work.
GOVERNMENT FURNISHED EQUIPMENT	Government furnished equipment (G.F.E.) means any piece of equipment or material supplied by the Department.
MANUFACTURER	The manufacturer is the party who manufactured the equipment to be installed, or his technical representative.
PUBLIC WORKS AND GOVERNMENT SERVICES CANADA (PWGSC)	PWGSC is the Government Contracting authority.
PROJECT OFFICER	The Project Officer is that representative of the Department authorized to inspect the contract work.
REDUNDANT EQUIPMENT	Redundant equipment means all items of equipment or material which have value and which have been removed from the ship by the contract work.