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**SOLICITATION AMENDMENT**  
**MODIFICATION DE L'INVITATION**

The referenced document is hereby revised; unless otherwise indicated, all other terms and conditions of the Solicitation remain the same.

Ce document est par la présente révisé; sauf indication contraire, les modalités de l'invitation demeurent les mêmes.

**Comments - Commentaires**

Guideline revised RFP, all amendments remaining in effect.

Solicitation révisé comme guide, tous les avenants demeurant en effet.

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<b>Title - Sujet</b> REPAIR AND OVERHAUL SUPPORT SERVICE	
<b>Solicitation No. - N° de l'invitation</b> W8482-116492/A	<b>Amendment No. - N° modif.</b> 011
<b>Client Reference No. - N° de référence du client</b> W8482-116492	<b>Date</b> 2012-09-13
<b>GETS Reference No. - N° de référence de SEAG</b> PW-\$\$ML-002-22827	
<b>File No. - N° de dossier</b> 002ml.W8482-116492	<b>CCC No./N° CCC - FMS No./N° VME</b>
<b>Solicitation Closes - L'invitation prend fin</b> <b>at - à 02:00 PM</b> <b>on - le 2012-09-24</b>	
<b>F.O.B. - F.A.B.</b> <b>Plant-Usine:</b> <input checked="" type="checkbox"/> <b>Destination:</b> <input type="checkbox"/> <b>Other-Autre:</b> <input type="checkbox"/>	
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Solicitation No. - N° de l'invitation

W8482-116492/A

Client Ref. No. - N° de réf. du client

W8482-116492

Amd. No. - N° de la modif.

011

File No. - N° du dossier

002mlW8482-116492

Buyer ID - Id de l'acheteur

002ml

CCC No./N° CCC - FMS No/ N° VME

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LA VERSION FRANÇAISE SERA PUBLIÉE SUR DEMANDE.

# TECHNICAL STATEMENT OF WORK FOR THE REPAIR AND OVERHAUL OF MISCELLANEOUS MARINE PUMPS

## 1 SCOPE

### 1.1 Definition

This Technical Statement of Work (TSOW) defines the requirements and scope of work necessary to accomplish the repair and/or overhaul (R&O) and support of a variety of pump assemblies or subassemblies used in various fluid systems aboard Department of National Defence (DND) ships.

### 1.2 Background

The Department of National Defence has a requirement to repair/overhaul and test various pumps, their prime movers and their components, on an as requested basis. Also included in this requirement, on an as requested basis, are performing modification, conducting Special Investigations and Technical Studies (SITS), supplying Field Service Representatives / Mobile Repair Parties (FSR/MRP) and providing Technical Investigation and Engineering Support (TIES) for the stated equipment and their applicable systems. The equipment, listed in four groups in Appendices 4 to 7 in this TSOW, are predominantly pumps used in fresh & salt water and fuel & lube oil systems, but also includes some pumps from pollution abatement and other systems.

### 1.3 Terminology

#### 1.3.1 Acronyms applicable to Annex A:

SOW - Statement of Work

R&O - Repair and Overhaul

DND - Department of National Defence

SITS - Special Investigations and Technical Studies

FSR - Field Service Representatives

MRP - Mobile Repair Parties

TIES - Technical Investigation and Engineering Support

OEM - Original Equipment Manufacturer

VA - Vibration Analysis

#### 1.3.2 Definitions applicable to Annex A

Major Overhaul: the Work to overhaul the equipment to 'as good as new' condition and performance. The Work includes: all labour and material required to perform pump repairs and overhauls including receipt, disassembly, visual, dimensional and non destructive inspections, mandatory part replacements, missing components replacement, cleaning,

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repair, rebuilding and reconditioning work resulting from inspections, reassembly, fitting, calibrating, testing, painting, preservation, preparation for delivery, packaging and shipping. This applies to all components of the equipment (major and minor). It also includes, when items are delivered to the contractor in reusable containers, the inspection of the container and all minor container repairs (such as: partial repainting, stenciling, patching of holes, recaulking of the seals and weather-stripping).

## **2 APPLICABLE DOCUMENTS**

D-03-002-006/SG-000 - Repair/Overhaul and Post Repair/Overhaul Inspection and Test Procedures for Shipboard Electric Motors dated 2001-07-01 shall apply to the Work.

## **3 REQUIREMENTS**

### **3.1 General**

Contractors shall either possess or be capable of obtaining the R&O Specifications, the Technical Data, and the capabilities necessary to undertake and successfully complete all aspects of the R&O services described in this requirement. The use of subcontractors to perform part or all aspects of the R&O services described in this requirement is acceptable, however, relationship and division of the work must be clearly established.

### **3.2 Scope of Work**

The different types of work to be performed under the resulting contracts are as follows:

- 3.2.1 In plant R&O of pumps units, pump ends, prime movers and their associated components;
- 3.2.2 Conduct and documentation of approved modifications as requested by the Technical Authority;
- 3.2.3 Performance and vibration testing of equipment after overhaul;
- 3.2.4 In plant reduction of equipment to spares;
- 3.2.5 Special investigations and technical services on failed components;
- 3.2.6 Technical investigations and engineering support as required by specific taskings;
- 3.2.7 Mobile repair parties and field service representatives; and
- 3.2.8 Drawings and documentation updates.

### **3.3 R&O Requirements**

Unless specifically advised, the Contractor shall repair, overhaul and test all equipment delivered to his facility to obtain 'as good as new' condition and performance. Repairs and overhauls shall

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be made only to recognized OEM, military and marine standards, specifications, procedures and practices. Only procedures and methods resulting in permanent repairs are acceptable.

3.3.1 General

Complete assemblies or their major subassemblies will generally be supplied to the contractor (e.g. pump/motor assemblies or pump end or motor) for overhaul and performance testing. They will also be generally supplied without any shock mounts. Components or subassemblies of the pumps or their drives may also be supplied to the Contractor for repair on an as requested basis. The Contractor may receive equipment packed into shipping crate without any flexible mounts.

3.3.1.1 For the following Ingersoll Dresser Pumps, complete assemblies will generally be supplied to the contractor (e.g. pump-motor assemblies). These assemblies are defined by the "Standard Disconnect Point Specifications" that follows:

NSN	DESCRIPTION	SPECIFICATION
4320-21-904-1983	Main fire pump	C-27-876-000/TD/001
4320-21-907-5967	Diesel driven fire pump. (Pump end only)	C-27-877-000/TD-001
4320-21-904-1985	Auxiliary sea water circulating pump	C-27-880-000/TD-001
4320-21-904-1989	Jockey fire pump	C-27-931-000/TD-001
4320-21-904-1976	Fresh hot water circulating pump	C-27-878-000/TD-001
4320-21-904-1965	Fresh water service pump (complete with priming pump)	C-27-879-000/TD-001

The Technical Authority shall be informed before work is started on assemblies which do not conform to these Standard Disconnect Point Specifications should any be received. After overhaul, assemblies shall be returned to DND in conformance with the applicable Standard Disconnect Point Specification.

3.3.2 For each individual piece of equipment delivered to their facility for overhaul, the Contractors shall be responsible for all aspects of a major overhaul from receipt, to overhauling and testing, to return of the equipment.

3.3.3 The Contractor must supply and utilize only genuine OEM parts in all repairs.

3.3.4 Clearances/tolerances shall be returned to original "as new" condition

3.3.5 The Contractor shall overhaul all equipment to achieve the performance and vibration requirements outlined on the Equipment Performance Sheets in Appendices 4 through 7 in Annex A.

3.3.6 As part of the major overhaul for individual equipment, the Contractor shall install/replace any missing or damaged Vibration Analysis (VA) blocks prior to performance

testing. The required number and location of VA blocks are shown on the Equipment Performance Sheets in Appendices 4 through 7 in Annex A. The Contractor shall follow the installation procedure provided at Appendix 2 of Annex A.

3.3.7 Assemblies or subassemblies, which are missing components and do not conform to the "Equipment Configuration Checklist" outlined on each Equipment Performance Sheet of Appendices 4 through 7 in Annex A, are to be identified prior to commencement of work. The identified "missing components" are to be exclusive of the VA blocks and of any parts requested to be replaced in the major overhaul. The Contractor shall supply all missing components if replacement parts are not available from DND. All equipments returned to DND after overhaul shall be in conformance with the applicable "Equipment Configuration Checklist" outlined on each Equipment Performance Sheet in Appendices 4 through 7 in Annex A.

### 3.3.8 Pump Overhaul:

Pumps shall be inspected, repaired and overhauled, and tested. Impeller type pumps shall be balanced. Items 5, 6, 8 and 9 of the following components are to be replaced during basic overhaul under normal conditions. Item 9 may be re-used only if in exceptional condition and requires the advanced approval of DND (even then the wear rings must be replaced). The remainder shall be assessed and replaced as required. Required replacement of either 3.3.8.1, 3.3.8.2, 3.3.8.3 and/or 3.3.8.7, shall constitute add-ons to the basic overhaul requiring the advanced approval of DND. Serial numbers for all replacement parts installed shall be tracked and provided to DND upon request.

- 3.3.8.1 Main pump shaft;
- 3.3.8.2 Main pump casing;
- 3.3.8.3 Pump/motor mounting bracket;
- 3.3.8.4 Pump rotors/housing (where fitted);
- 3.3.8.5 Mechanical seal cartridge;
- 3.3.8.6 Steady bearing (where fitted);
- 3.3.8.7 Shaft sleeve (where fitted);
- 3.3.8.8 Casing wear rings (where fitted);
- 3.3.8.9 Impeller(s) and impeller wear ring(s) (where fitted);

3.3.8.9.1 Although the Major Overhaul includes the replacement of the impeller, the Contractor is authorized to re-install a good used impeller at their discretion, as long as the Contractor is in compliance with section 3.3.3. If so, the Contractor shall still continue to assume all risk for both achieving post-overhaul test requirements and for meeting contractual warranty requirements. Also, the Contractor shall provide a credit against the Firm Fixed Price for the

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Major Overhaul of the pump of 50% of the current market value of a new impeller.

3.3.8.10 All sealing soft goods, i.e. gaskets, seals, 'o' rings, packing etc.;

3.3.8.11 All securing fasteners e.g. nuts, cap screws, flat and lock washers, etc. (studs shall be removed from castings unless damaged); and

3.3.8.12 The contractor shall replace the packing seals with mechanical seals on all Coffin Feed Pumps (4320-21-867-1152).

3.3.8.13 The preferred method of metal replacement/build-up is by either an approved High Velocity Oxy Fuel (HVOF) arc spray coating or preferably a High Pressure/High Velocity Oxy Fuel (HP/HVOF) arc spray coating. Though other methods of repair are acceptable, they must be a recognized procedure as previously stated; otherwise, approval must be obtained from the Technical Authority. Critical repaired areas shall be restored to "as good as new" condition and shall not suffer any performance or capability degradation/restrictions.

3.3.8.14 The contractor shall be paid a firm price per pump to apply a ceramic coating for the first time to a pump or to replace excessively corroded coatings thereafter. Any repair of coating (touch up) shall be reimbursed to the contractor on a time and material basis in accordance with the Off Ramp rates applicable up to a maximum of the cost of a new coating.

The contractor shall use a 3 phase ceramic coating:

Belzona product:

- 1) 9111 Supermetal
- 2) 1341 Supermetal Glide Blue
- 3) 1341 Supermetal Glide Grey

Use of any other equivalent substitute ceramic product must be beforehand approved by the Technical Authority in writing.

The contractor shall apply a ceramic coating to the following pumps:

Motor Driven Fire Pumps (4320-21-904-1983)

Motor Driven Jockey Fire Pumps (4320-21-904-1989)

Auxiliary Sea Water Circulating Pumps (4320-21-904-1985)

Diesel Driven Fire Pumps (4320-21-907-5967)

### 3.3.9 Electric Motor Overhaul

Motors shall be dimensionally inspected, overhauled and tested as specified in D-03-002-006/SG-000. Motor bearings shall always be replaced. Components to be inspected, tested, and overhauled as necessary include:

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3.3.9.1 Motor shaft and armature;

3.3.9.2 Stator windings; and

3.3.9.3 Motor Housing.

### 3.3.10 Steam Turbine Overhaul

Steam turbines shall be inspected, overhauled, balanced and tested. Normally, the following components shall be inspected and replaced as necessary replaced as part of the major overhaul price:

3.3.10.1 main turbine casing;

3.3.10.2 turbine rotating assembly;

3.3.10.3 turbine/gearbox/pump mounting brackets;

3.3.10.4 gearbox assembly;

3.3.10.5 steam and oil labyrinths;

3.3.10.6 journal and thrust bearings (where fitted);

3.3.10.7 shaft sleeves (where fitted);

3.3.10.8 all sealing soft goods i.e.gaskets, seals and packing, etc; and

3.3.10.9 all securing fasteners e.g.. nuts, studs, cap screws, flat and lock washers, etc.

### 3.3.11 Component Repair

All components shall be repaired to OEM “as new” tolerances and condition. Repairs shall be made only to recognized OEM, military and marine standards, specifications, procedures and practices. Only procedures and methods resulting in permanent repairs are acceptable.

### 3.3.12 Testing of Equipment

The Contractor shall test and record the performance and vibration levels of each pump unit, pump, electric motor or steam turbine on a suitable test loop. Performance points, performance test parameters and maximum acceptable vibration levels are provided in the Equipment Performance Sheets of Appendices 4 through 7 in Annex A. The pumps are to be tested at their rated speeds.

### 3.3.13

Performance point readings shall be taken as close as possible to the operating point specified. Special test parameters specified for individual equipment as specified in the Equipment Performance Sheets of Appendices 4 through 7 in Annex A shall be achieved.

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All specifications listed in the Appendices are the latest versions (amended by waiver or specification change).

#### 3.3.14

Vibration readings shall be taken at various octave bands as required by Appendix 1 of Annex A. Except for stand alone electric motors, these tests and readings are in addition to those required by D-03-002-006/SG-000.

#### 3.3.15

In addition to the vibration readings required in para. 3.3.14, noise and vibration readings shall be taken on designated HALIFAX Class equipment in accordance to the test procedures and specifications provided in Appendix 3 of Annex A. Equipment requiring these additional test are identified in their respective Equipment Performance Sheets provided in Appendices 4 through 7 in Annex A. The maximum noise and vibration limits that must be achieved on complete pump units are provided in attachments to Appendix 3 of Annex A.

#### 3.3.16

The Contractor shall allow the Technical Authority or its representatives access to witness equipment testing.

#### 3.3.17 Acceptance Criteria of Overhauled Equipment

Performance points, performance test parameters and maximum acceptable vibration levels are provided in Equipment Performance Sheets of Appendices 4 through 7 in Annex A.

#### 3.3.18

The performance of the overhauled equipment shall be within +5% to -3% of the performance point specified for the particular equipment.

#### 3.3.19

All vibration readings in all required directions shall not exceed the levels provided for the particular equipment. Acceptance levels for motors alone shall be as specified in D-03-002-006/SG-000. Maximum levels for stand alone pumps or turbines shall not exceed those provided for the relevant complete pump assembly.

#### 3.3.20

HALIFAX Class equipment identified as requiring airborne noise and vibration testing in their respective Equipment Performance Sheets in Appendices 4 through 7 in Annex A shall not exceed the levels stated in Appendix 3 of Annex A. Data sheets as requested in Appendix 3 of Annex A shall be forwarded to the airborne noise and vibration Technical Authority to determine compliance or noncompliance prior to final acceptance.

#### 3.3.21

Equipment which fails to meet these requirements shall be reworked and retested at the Contractor's expense.

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### 3.3.22 Documentation

For each piece of equipment repaired and overhauled, the Contractor shall produce and retain documentation as required below.

3.3.22.1 The contractor shall produce a "Final Test Report" consisting of the following:

- 3.3.22.1.1 Equipment name, serial number, and NSN;
- 3.3.22.1.2 Initial strip down condition including defects and observations;
- 3.3.22.1.3 Table of performance data versus achieved performance;
- 3.3.22.1.4 Test documentation requested in section 5.0 of Appendix 1 of Annex A, with VA readings presented in tabular form for each block in two directions as specified at Appendix 1 of Annex B;
- 3.3.22.1.5 Balancing certificate (if applicable);
- 3.3.22.1.6 Closing dimensional inspection;
- 3.3.22.1.7 Description of work done; and
- 3.3.22.1.8 List of all serial numbers of OEM parts used.

One copy is to be enclosed with the equipment, one is to be retained by the Contractor and one is to be forwarded to the Technical Authority.

3.3.22.2 The contractor shall retain the following information:

- 3.3.22.2.1 Receiving information and the initial strip report;
- 3.3.22.2.2 Motor inspection report;
- 3.3.22.2.3 Final test report (para 3.3.22.1 above);
- 3.3.22.2.4 Motor test results in accordance with D-03-002-006/SG-000;
- 3.3.22.2.5 Contractors and subcontractors/suppliers QC documentation; and
- 3.3.22.2.6 Shipping information.

The Technical Authority or his designated representative shall have access to this information on an as required basis.

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### **3.4 MRP/FSR/TIES**

#### **3.4.1 MRP**

The Contractor shall provide Mobile Repair Parties to travel to a designated ship or base, either nationally or internationally, and conduct repair, overhaul or modification to equipment listed in Annex B. The use of qualified local international mobile repair capability is preferred over extensive travel of the Canadian representative.

#### **3.4.2**

The Contractor shall supply and convey all necessary OEM parts to complete the repairs unless otherwise specifically advised in writing by the Technical Authority.

#### **3.4.3**

The Contractor must be prepared to respond to urgent requirements. A response time of 48 hours is expected for emergency repairs to the equipment specified herein fitted in vessels located anywhere in the world.

#### **3.4.4 FST/TIES**

Specific tasking under the FSR/TIES element of this contract may include, but will not be limited to the following areas:

3.4.4.1 Technical investigation of equipment faults;

3.4.4.2 On-site inspection and related follow-up support (defect correction, modification or supervision of repairs);

3.4.4.3 Provide engineering recommendations and reports on equipment/system improvements and upgrades;

3.4.4.4 Assist in the review of technical documentation and provide recommendations for changes or improvements, including training and maintenance procedures;

3.4.4.5 Make amendments to technical documentation;

3.4.4.6 Provide training for DND personnel on the job or in the Canadian Forces Fleet Schools. Supply of course materials will be charged extra, at cost;

3.4.4.7 Assist in identification of spare parts and the maintenance of configuration control;

3.4.4.8 Inspect components held as spares in the Canadian Forces Supply System; and,

3.4.4.9 Other tasks as submitted by the Technical Authority directly relating to the fitted equipment.

#### 3.4.5 Reports

Pre-Overhaul Inspection reports shall be submitted to the Technical Authority 2 weeks prior to commencing repairs (see template in Appendix 8 of Annex A). Upon completion of repair, reports shall be submitted to the Technical Authority within 2 weeks of completion of each tasking. Report shall consist of the work undertaken, recommendations and conclusions, drawings and any conversations or correspondence related to the task. For simple tasking, report may consist solely of a technical letter.

#### 3.4.6 Security Clearance

Contractor personnel working onboard vessels will be assigned an escort.

#### 3.4.7 Inspection

All services rendered shall be subject to inspection by the Technical Authority or his designated representative. The work and the premises where any work is being performed shall be accessible to the TA during normal working hours.

### **4 DELIVERABLES**

- 4.1 Prior to beginning any repairs, the contractor shall assess the condition of the equipment and provide requested data to the technical Authority. This data must be provided at least 2 weeks before the repair is scheduled to take place. A template of the data requested per pump repair is provided in Appendix 8 of Annex A.
- 4.2 The Contractor shall submit data sheets as requested in Appendix 3 of Annex A for equipment identified as requiring airborne noise and vibration testing after overhaul. These data sheets shall be forwarded to the airborne noise and vibration Technical Authority.
- 4.3 The Contractor shall deliver one hard copy and one soft copy in Microsoft Word of the “final test report”, as defined in subsection 3.3.22.1, to the Technical Authority within 3 weeks of completing each equipment overhaul. The Contractor shall deliver one hard copy and one soft copy in Microsoft Word of the report for MRP or FSR or TIES tasking to the Technical Authority within 2 weeks of completion.
- 4.4 The contractor shall deliver quarterly report for all repairs. This report shall include as a minimum the following for each pump: NSN, pump name, job repair number, cost to repair, date received, date shipped back, revised turn around time with justification.

### **5 TASKING AUTHORITY**

All tasks shall be authorized by the Technical Authority, through the Requisitioning Authority. Requests by other DND organizations shall only be accepted with the approval of the Requisitioning Authority.

APPENDIX 3

To: ANNEX A to W8482-11-6492

Dated: 01 March 2011

**HALIFAX CLASS EQUIPMENT  
REPAIR AND OVERHAUL NOISE AND VIBRATION TEST PROCEDURES  
AND SPECIFICATIONS**

OPI: DMSS 2-5-3

DATED: 19 FEB 2001

## APPENDIX 3

To: ANNEX A to W8482-11-6492

Dated: 01 March 2011

### **HALIFAX CLASS EQUIPMENT R & O NOISE AND VIBRATION TEST PROCEDURES AND SPECIFICATIONS**

- 1.1 The Repair and Overhaul Contractor shall conduct airborne noise and vibration tests to demonstrate conformance with requirements defined in Table 1 and Table 2 of this Appendix 3.
- 1.2 The performance sheets for individual items provided in Appendices 4 through 7 of Annex A specify which HALIFAX Class equipment require the additional noise and vibration testing. Airborne noise and vibration measurements shall be carried out on each and every repaired and overhauled piece of equipment identified in Appendix 4 through 7 of Annex A and are to be reported in accordance with Figures 1 to 5.
- 1.3 Test reports shall contain all of the data specified in Figures 1 to 5.
- 1.4 Non compliance with DND requirements renders the machinery not acceptable. Rework must be carried out by the Contractor until DND approves the airborne noise and vibration levels to be acceptable.

#### **2.0 TEST REQUIREMENTS AT THE R&O FACILITY**

##### **2.1 General Arrangement**

- 2.1.1 The machinery shall be tested in conditions as free from interference of external sources of noise and vibration as possible.
- 2.1.2 All machinery shall be tested while supported on resilient mounts, even if they are to be bolted directly to other machines or structures onboard ship. The vertical natural frequency of the complete mounted assembly is to be less than either one half of the lowest frequency associated with significant disturbing forces, or 7 Hz, whichever is the lower frequency. For machinery which are to be individually resiliently mounted in the ship, mounts of the type specified in para 3.1 of Appendix 1 in Annex A for the ship installation shall be used.
- 2.1.3 All gas, fluid, electrical and mechanical connections to the mounted assembly shall be at least as flexible as those provided in the ship. These should not have a significant influence on the movement of the machine when it is being tested.
- 2.1.4 Air and gas ducts connected to the machine shall be fitted with silencers (mufflers) similar to those used onboard the ship. The ducts themselves shall be lagged to the same extent as on the ship.

##### **2.2 Test Foundation**

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- 2.2.1 The mass of the test foundation and associated brackets shall be at least three times that of the complete supported assembly.
- 2.2.2 Any pedestals are to be as short and stiff as possible.
- 2.2.3 Mounts shall be rigidly attached to the test foundation.
- 2.2.4 The foundation and associated pedestals should, wherever possible, be of reinforced concrete. They shall be free from any resonance that will influence either the machines airborne noise or vibration levels.
- 2.2.5 Vertical and transverse vibration levels on the foundation shall be a minimum of 10 dB less than the levels obtained on the machine in all octave bands from 31.5 Hz to 8 kHz.

### 2.3 Machine Operation

- 2.3.1 Machines shall be tested at all normal operating speeds and loads.
- 2.3.2 Airborne noise and vibration measurements are to be reported under fully established (steady state) operating conditions. Continuous readings of speed, voltage, current, pressure and temperature are to be taken, as appropriated, to demonstrate that steady state stability is being maintained.

### 3.0 **REQUIREMENTS FOR DESCRIPTION OF THE TEST ARRANGEMENT**

- 3.1 The R&O Contractor shall submit at least the following information to the Technical Authority (TA), DMSS 2-5-3, as part of his Test Agenda.
  - 3.1.1 A general layout plan of the test environment; a sketch of the test rig; positions and arrangement of the flexible mounts, and a sketch of all connections to the machine under test.
  - 3.1.2 A list of all instrumentation to be used for measuring noise and vibration, for calibration and for establishing the running conditions. Instrumentation calibration certificates are required to prove calibration is not more than 12 months old.
  - 3.1.3. A sketch showing the positions of all microphones, noting the method of support.
  - 3.1.4 A sketch showing the positions of all accelerometers, noting the method of attachment.
  - 3.1.5 Identification of the procedures that are intended to be used for calibration of measuring equipment and for processing the data.

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3.1.6 Specimens of data sheets that are intended to be use for reporting test data. Suggested formats for reporting of airborne noise and vibration data are given in Figures 1 to 5.

3.2 The R & O Contractor is only required to provide the above testing plan for approval to the TA, DMSS 2-5-3, for the initial pump testing except in the case where he wants to depart from this initial plan whereby he shall resubmit his plan for approval.

### 4.0 **AIRBORNE NOISE MEASUREMENTS AND PERFORMANCE REQUIREMENTS**

#### 4.1 Requirements

4.1.1 The Contractor is required to demonstrate that the airborne sound pressure levels emitted from the piece of machinery after R&O meet DND requirements.

#### 4.2 Measurement of Sound Pressure Levels

4.2.1 A sound level meter having “A” weighted response to sound pressure, equal to scale “A” of ANSI Standard S1.4 and octave band analysis capability, shall be used to measure the dBA sound pressure levels and octave band levels. The meter shall be of a type approved by DND for this purpose, such as a Bruel & Kjaer 2230 SLM with 1624 Filter Set or a General Radio 1983 Precision Sound Level Meter and Analyzer. Approval to use other suitable meters may be obtained by application to DND. The meter shall be read as the observed arithmetic mean of the digital or analogue readout with the meter in the damped or “slow” condition, RMS mode. If there is a 4 dB or more fluctuation in the readout, this shall be noted and appropriate comments or reasons given.

4.2.2 Four “A” weighted sound pressure level measurements shall be made with the microphone at three positions roughly on a level with the centre of the machine or equipment and maximally spaced (roughly 120° apart) plus one above the approximate centre of the equipment.

4.2.3 An octave band analysis over the frequency range 31.5 Hz to 8 kHz inclusive shall be taken at each of the four positions, identified at 4.2.2, for comparison with the equipment requirements stated in Table 1 of Appendix 3 to Annex A. The sound level meter shall be set to the flat or unweighted mode when recording the octave band measurements. A spectrum based on the maximum octave band level for each band at all measurement locations shall be developed and compared to the acceptance levels specified in Table 1 of Appendix 3 to Annex A. Excess in any octave band is grounds for rejection by the DND. For example, in the 63 Hz octave band, levels of 83, 81, 80 and 80 dB are measured at the four locations. A level of 83 dB in the 63 Hz octave band would be compared to the acceptance level stated in Table 1 of Appendix 3 to Annex A.

4.2.4 Nothing apart from air shall be interposed between the equipment as designed complete

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for shipboard installation (e.g. hoods in place if so fitted) and the microphone. It is the responsibility of the Contractor to provide this environment in the factory test measurements. No subtractions are allowed from the measured levels due to reflection or ambient noise.

4.2.5 Prior to taking the equipment airborne noise measurements, a set of background (ambient) dBA and octave band airborne noise levels shall be taken to establish a baseline without the equipment running. Where in any octave band the background level is within 10 dB of the acceptance level, the Contractor shall identify the source of that "high" background level, and take all reasonable steps to reduce it. Although narrow band analysis of the airborne noise levels is not a contractual requirement, such analysis may be helpful in identifying sources of background interference.

4.2.6 The reference sound pressure for all measurements shall be 20  $\mu$ Pa @ 1 metre.

### 4.3 Operating Conditions

Airborne noise measurements shall be taken with the machine operating in accordance with the conditions stated in Para 2.3.

## 5.0 **VIBRATION MEASUREMENTS AND PERFORMANCE REQUIREMENTS**

### 5.1 Requirements

5.1.1 The Contractor is required to carry out measurements that demonstrate that the vibration levels emitted from the R&O piece of machinery meet DND requirements. These requirements are a particular subset of current industry norms and contain no unusual criteria.

5.1.2 Vibration measurements shall be made using piezoelectric accelerometers, whose frequency response is flat to within  $\pm 2$  dB from 10 Hz to 10 kHz.

5.1.3 Accelerometers shall be attached to metal blocks that shall be permanently welded or brazed to the machine's structure at the specified locations. These locations are different than the VA block locations used for health monitoring (Appendices 1 and 2 in Annex A). If blocks are not attached when received bidder use procedure as described in Appendix 2: "VA Block Installation Procedure".

5.1.4 The method of accelerometer attachment to the blocks can have a major influence on the frequency response of the accelerometer. For this reason the Contractor is to take all reasonable precautions to minimize the influence of accelerometer attachment resonance. Use of a torque spanner to control accelerometer tightness in accordance with manufacturer's instructions is recommended. Magnetic attachment, plasticine or similar materials shall not be used for other than exploratory purposes, as they cannot ensure accurate measurements at higher frequencies.

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### 5.2 Location of Accelerometers

5.2.1 Accelerometer blocks shall be attached to the machine feet at the four corners above the mount locations to provide measurements in three mutually perpendicular directions.

### 5.3 Conversion of Acceleration to Velocity Levels

5.3.1 DND requirements are specified in VdB reference  $10^{-8}$  m/s. Precise conversion from measured acceleration levels to velocity levels can only be carried out if the exact distribution of vibrational energy with respect to frequency is known. The conventional conversion procedure employed in this specification involves the assumption that all vibrational energy is concentrated at the centre frequency of an octave, in conversion from acceleration to velocity. Inaccuracies of up to 3 dB may be introduced by this process as the actual energy may be concentrated at one end of the octave band. The inaccuracy falls to 1 dB when the conversion is carried out on 1/3 octave band data and to negligible proportions when performed on highly resolved data, as obtained using high resolution FFT analyzers.

### 5.4 Averaging of Vibration Data

5.4.1 Spatial power averages of vibration levels shall be computed using the following formulae:

$$\bar{x} = 10 \log\left(\frac{1}{3}\right) \sum_{i=1}^3 10^{0.1x_{ij}}$$

$$x_j = 10 \log\left(\frac{1}{n}\right) \sum_{i=1}^n 10^{0.1x_{ij}}$$

in which:

$x_j$  = spatial power average in any one direction

$\bar{x}$  = spatial power average for all three directions

$n$  = number of measuring locations

$x_{ij}$  = acceleration (AdB) or velocity (VdB) at  $j^{\text{th}}$  location

### 5.5 General Requirement for Reporting of Vibration Data

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5.5.1 The Contractor shall report a complete set of vibration data that includes 1/3 and octave band data.

### 5.6 Reference Acceleration and Velocity Levels

5.6.1 One-third and octave band data shall be reported in tabular form. Acceleration and velocity levels shall be quoted in AdB ref  $10^{-5}$  m/s<sup>2</sup> and VdB ref  $10^{-8}$  m/s, respectively.

### 5.7 Reporting of 1/3 Octave and Octave Band Data

5.7.1 The following data are to be reported:

5.7.1.a Measured above mount acceleration levels for each ISO 1/3 octave band in the frequency range 10 Hz to 10 kHz,

5.7.1.b calculated 1/3 octave spatial power averages of the measured accelerations for each of three directions of measurement and over all three directions,

5.7.1.c calculated 1/3 octave spatial power average velocity levels for each of the three directions of measurements, and over all three directions,

5.7.1.d calculated octave band spatial power average velocity levels for each of the three directions of measurements, and over all three directions.

5.7.2 Octave band velocity levels may be obtained by power summation of the corresponding 1/3 octave data.

5.7.3 1/3 and octave levels are to be reported on the standard data sheets attached as Figure 4 of this specification.

### 5.8 Background Vibration Levels

5.8.1 Background acceleration levels in ISO octave bands from 31.5 Hz to 8 kHz inclusive shall be measured before and after each test run, and reported to demonstrate the extent to which apparent machine vibration may have been influenced by extraneous sources. When a machine under test has to be supplied with fluids under pressure using auxiliary units, the Contractor shall establish the influence of these auxiliary units on the measured vibration of the test machine.

### 5.9 Calibration

5.9.1 Calibration shall be carried out before and after vibration measurement, by removing each accelerometer in turn from its mounting block and applying a known acceleration to it via a calibrator. The calibrator output shall be clearly identified and stated. The output signal from the signal conditioning and analysis instrumentation shall be checked against

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the accelerometer sensitivity stated by the manufacturer. The Contractor shall provide full details of date and place of calibration with his test report (see Figure 1).

### 6.0 **COMPARISON WITH DND REQUIREMENTS**

#### 6.1 Acceptance

6.1.1 A machine will be accepted in respect to its noise and vibration performance when compliance with DND's Airborne noise and Vibration requirements (see Table 1 & 2 of Appendix 3) have been demonstrated. All airborne noise and vibration data is to be provided to DMSS 2-5-3 for analysis to determine equipment compliance/non-compliance.

#### 6.2 Rejection

6.2.1 Any excess of the acceptance levels in any octave band shall be an adequate reason for rejection by DND.

### 7.0 **DATA SHEETS FOR AIRBORNE NOISE AND VIBRATION TESTS**

7.1 Standard data sheets are included in this specification as:

Figure 1 Airborne Noise and Vibration Instrumentation Data

Figure 2 Airborne Noise Sound Pressure Level Test Data

Figure 3 Octave Band Vibration Test Data

Note: For Halifax-class pumps only

Figure 4 One Third Octave Band Vibration Data

Figure 5 Sketch of Machinery Test Installation

Table 1 Machinery R&O Noise Requirements

Table 2 Machinery R&O Power Average Vibration Requirements

Note: This table is not exhaustive of the Halifax-class pumps covered by this RFP. The performance criteria for any pumps missing from this table can be found in Appendix 4, 5, 6 or 7 to Annex A depending on the group.

### 8.0 **ENQUIRIES**

8.1 All enquiries concerning this specification should be submitted to DND attention DGMEPM/DMSS 2-5-3.

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**AIRBORNE NOISE AND VIBRATION INSTRUMENTATION DATA SHEET**

<b>INSTRUMENTATION USED IN TESTS</b>					
<b>ITEM</b>	<b>MANUFACTURER</b>	<b>TYPE</b>	<b>CALIBRATION</b>		<b>NOTES</b>
			<b>DATE</b>	<b>PLACE</b>	
<b>AIRBORNE NOISE</b>					
MICROPHONE					
PRE-AMP					
CALIBRATION DEVICE					
SOUND LEVEL METER					
<b>VIBRATION</b>					
ACCELEROMETER					
ATTACHMENT					
PRE-AMP					
AMP					
CALIBRATOR					
<b>SIGNAL PROCESSING EQUIPMENT</b>					
1/3 OCTAVE ANALYSER					
OCTAVE ANALYSER					

**FIGURE 1**

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**AIRBORNE NOISE SOUND PRESSURE LEVEL TEST DATA**

STATE	MICROPHONE POSITION	AIRBORNE SOUND PRESSURE LEVELS dB REF 20µPa @ 1 metre									
		OCTAVE BAND CENTRE FREQUENCY IN HZ									dB(A) TOTAL
		31.5	63	125	250	500	1k	2k	4k	8k	
BACKGROUND BEFORE TEST											
	MAX										
MACHINE RUNNING											
	MAX										
BACKGROUND AFTER TEST											
	MAX										

Show positions of all microphones on Sketch - Figure 5

N.B.

- (i) Test results will not be acceptable if the Background Levels are within 10 dB in any octave band when the machine is running.
- (ii) Complete a new sheet for each running state if this machine has more than one normal operating state.

**FIGURE 2**

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**MEASURED OCTAVE BAND VIBRATION TEST DATA**

DIRECTION OF MEASUREMENT	LOCATION OF ACCELEROMETERS	MEASURED ACCELERATION LEVELS AdB REF 10 <sup>-5</sup> m/s <sup>2</sup>								
		OCTAVE BAND CENTRE FREQUENCY IN HZ								
		31.5	63	125	250	500	1k	2k	4k	8k
VERTICAL										
	POWER AVERAGE									
F/A AXIAL ON HORIZONTAL MACHINE										
	POWER AVERAGE									
TRANSVERSE										
	POWER AVERAGE									
TRI-AXIAL	O/A POWER AVERAGE									
		EQUIVALENT AVERAGE VELOCITY LEVELS VdB REF 10 <sup>-8</sup> m/s								
	CONVERSION AdB to VdB	+14	+8	+2	-4	-10	-16	-22	-28	-34
VERTICAL	POWER AVERAGES									
F/A										
TRANSVERSE										
TRI-AXIAL										

N.B. (i) All vibration measurements must be 10 dB above Background Levels in all octave bands.

(ii) Complete a new sheet for each running state if this machine has more than one operating state, and for each set of background measurements.

**FIGURE 3**



**SKETCH OF MACHINERY TEST INSTALLATION**

Sketch to show the following information:

- (i) Location of the mounts, connections
- (ii) Location of microphones and accelerometers
- (iii) Numbering scheme for accelerometers and microphones

Test Room Dimensions: Length - \_\_\_\_\_ Width - \_\_\_\_\_ Height-

Machine Identification Number:

Date:

Report Compiled By:

Job Title:

**FIGURE 5**

**HALIFAX CLASS MACHINERY R & 0 AIRBORNE NOISE REQUIREMENTS**

MACHINE	EAC	OCTAVE BAND CENTRE FREQUENCY IN Hz dB REF 20µPa @ 1 metre								
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1kHz	2 kHz	4 kHz	8 kHz
FUEL OIL BOOST & TRANSFER PUMP (FAST SPEED)	25-548	67	60	59	60	57	65	64	62	55
JP5 FUEL OIL SUPPLY PUMP	39-168	72	60	64	70	75	74	70	65	60
MD LUBE OIL PUMP	25-549	75	70	73	75	70	70	70	64	60
HP AIR COMPRESSOR	27-899	55	55	66	72	72	74	70	69	67
LP AIR COMPRESSOR	27-886	55	55	60	70	80	80	82	80	75
FUEL OIL CENTRIFUGE	25-551	63	58	59	65	70	75	75	70	65
LUBE OIL CENTRIFUGE	25-547	63	55	54	60	60	68	66	63	57
AUX SEAWATER CIRC PUMP	27-880	61	61	56	55	53	58	52	48	41
JOCKEY FIRE PUMP	27-931	62	66	66	73	81	75	75	78	73
MOTOR DRIVEN FIRE PUMP	27-876	67	70	70	75	81	79	77	71	65
SEWAGE COLLECTION EDUCTOR PUMP	27-953	60	68	74	76	77	78	75	71	65
COLD FRESH WATER PUMP	27-879	60	60	62	60	61	68	72	78	62

**TABLE 1**

**HALIFAX CLASS MACHINERY R & 0 POWER AVERAGE VIBRATION REQUIREMENTS**

MACHINE	EAC	OCTAVE BAND CENTRE FREQUENCY IN Hz VdB REF 10 <sup>-8</sup> m/s								
		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1kHz	2 kHz	4 kHz	8 kHz
FUEL OIL BOOST PUMP (FAST SPEED)	25-548	82	84	81	78	80	80	74	66	63
FUEL OIL TRANSFER PUMP (FAST SPEED)	25-548	82	84	81	78	80	80	74	66	63
JP5 FUEL OIL SUPPLY PUMP (ABOVE UPPER STAGE MOUNTS)	39-168	85	87	94	92	90	85	75	70	65
MD LUBE OIL PUMP (PUMP TO BE RESILIENTLY MOUNTED FOR TESTING AT R&O FACILITY)	25-549	79	84	95	93	85	81	80	80	78
HP AIR COMPRESSOR(ABOVE UPPER STAGE MOUNTS)	27-899	104	102	105	103	95	86	80	75	75
LP AIR COMPRESSOR	27-886	97	86	95	100	90	89	82	82	75
FUEL OIL CENTRIFUGE(ABOVE UPPER STAGE MOUNTS)	25-551	98	85	85	94	88	87	82	77	75
LUBE OIL CENTRIFUGE	25-547	91	85	102	92	79	74	68	76	75
AUX SEAWATER CIRC PUMP	27-880	84	75	85	80	78	69	69	50	45
JOCKEY FIRE PUMP	27-931	86	86	87	96	90	82	82	77	76
MOTOR DRIVEN FIRE PUMP	27-876	90	94	84	98	95	87	84	82	80
SEWAGE COLLECTION EDUCTOR PUMP	27-953	90	95	92	85	90	80	80	72	65
COLD FRESH WATER PUMP	27-879	87	85	86	95	90	88	79	74	73

**TABLE 2**

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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

<b>DESCRIPTION</b>	<b>NSN</b>	<b>PART NO.</b>	<b>MANUFACTURER</b>	<b>EAC</b>
PUMP, ROTARY	4320 12 338 6322	LN164/210 FL-GL	Leistritz AG	25319
PUMP UNIT,CENTRIFUGAL	4320 21 867 1152	S53906	Carter/FMC	25328
ROTATING ASSEMBLY	4320 21 871 5370	SPT-1268	Carter/FMC	25328
PUMP UNIT, ROTARY	4320 21 850 3236	B10527	Plenty Mirrlees Pumps	25339
PUMP UNIT,CENTRIFUGAL	4320 21 850 3327	B0215	Grampotex	27379
PUMP UNIT,CENTRIFUGAL	4320 01 331 2439	34464/SK-341	Separation and Recovery Systems	27911
PUMP UNIT,ROTARY	4320 21 911 2453	38960	Sansom Equipment Ltd.	27A90
PUMP, CENTRIFUGAL	4320 21 856 0323	81 1-4A6B	Gorman Rupp	39108

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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 25319**

**IRO CLASS - GEAR DRIVEN MAIN LUBE OIL PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-12-338-6322	LN164/210-FL-GL	Pump, Rotary	D9550

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump, Rotary consists of pump, and pump end coupling.

**PERFORMANCE TEST CRITERIA**

Flow	3785 l/min. (833 IGPM)
Total Head	4.8 Bar (142.2 In. Hg)
Pump Speed	1330 RPM
Power Requirements	43 kW (57.7 HP)
Viscosity Range	80-90 mm <sup>2</sup> /s (centistokes)
NPSH	4.8 mWC (15.78 Ft. HD. H <sub>2</sub> O)

**PERFORMANCE TEST NOTES**

The main gearing drives this pump. A different mode of driving the pump will be required to conduct the performance test.

Operate pump at rated conditions for eight hours to prove flow rate.

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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 25319**

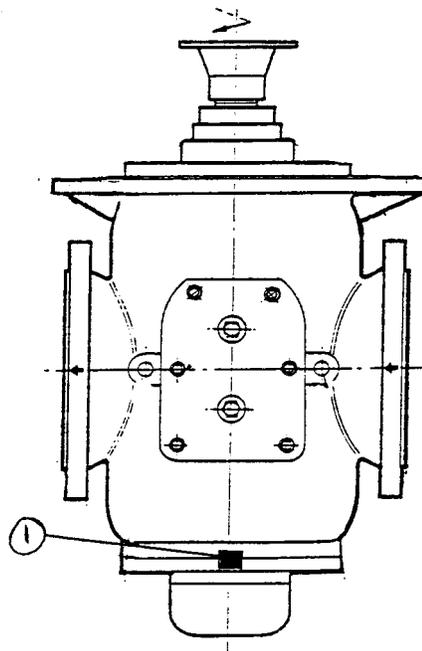
**VIBRATION LEVELS**

Octave Band Frequency (Hz)	Maximum Level (VdB)
16	100
31.5	105
63	111
125	102
250	93
500	92
1K	94
2K	91
4K	85

**VIBRATION TEST NOTES**

The VA readings (fleet norms) were compiled from ships at sea, while operating at 200 shaft RPM with 32 degrees of pitch. These reading may be unsuitable for use as a repair standard.

Vibration block locations for the Gear Driven Main Lube Oil Pump are as indicated on attached drawing. The VA block location on the upper (driven end) of the pump, is fitted to the flange adapter. As this flange adapter is not returned with the pump, the VA block location is not shown. VA readings are to be taken at this end also.



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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 25328**

**COFFIN FEED PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-867-1152	S53906	Pump Unit, Centrifugal	OAPJ5
4320-21-871-5370	SPT-1268	Rotating Assembly	OAPJ5

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit, Centrifugal consists of the pump, steam turbine, governor, dash pot assembly, oil cooler, steam strainer, turbine exhaust relief, and gland relief valve.

Rotating Assembly consists of the bucket wheel assembly, main shaft, impeller assembly, governor trip assembly, bearings, deflectors and fasteners.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Pump Discharge Pressure	758 PSIG
Pump Suction Pressure	47 PSIG (min)
Pump Suction Temperature	280 F
Pump Flow	325 IGPM

**TURBINE**

Steam Inlet Pressure	580 PSIG
Steam Temperature	515 F
Exhaust Pressure	40 PSIG
Turbine Speed	7130 RPM
L.O. Cooling Water Flow	2-4 IGPM
L.O. Cooling Water Temperature	85 °F (max)
Overspeed Trip Setting	8300 RPM
Casing Relief Valve Setting	50 PSIG

**PERFORMANCE TEST NOTES**

Record following data hourly for 4 hours: flow rate; discharge pressure; inlet pressure, inlet temperature and speed. Pump to have an endurance run time of 8 hours (which includes the 4 previous hours).

The rotating assembly is to be dynamically balanced to manufacture’s specification.

**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 25328**

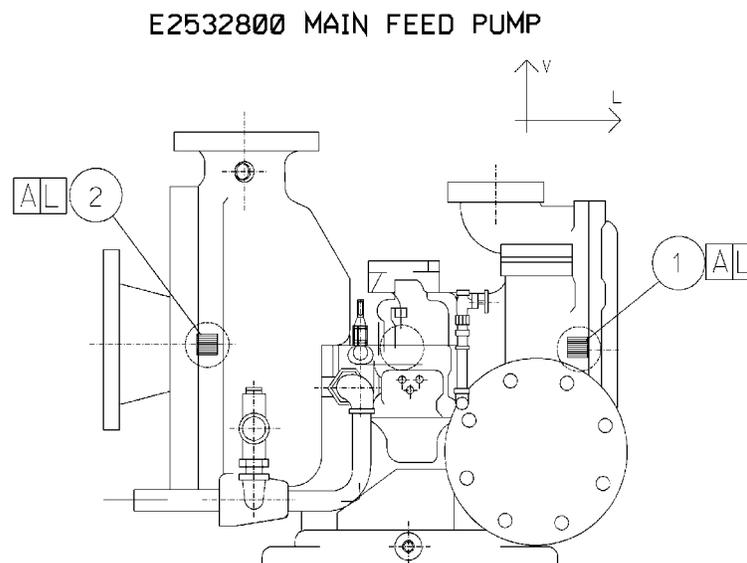
**VIBRATION LEVELS**

Octave Band Frequency (Hz)	Maximum Level (VdB)
16	95
31.5	94
63	90
125	105
250	90
500	88
1K	90
2K	92
4K	95

**VIBRATION TESTING NOTES**

Vibration readings are to be taken while operating unit at design flow only on blocks 1 and 2 as shown below.

**Vibration Block Locations for Coffin Feed Pump**



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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 25339**

**PTR CLASS - FUEL OIL TRANSFER PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-850-3236	B10527	Pump Unit, Rotary	K2596

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Rotary consists of the pump, bracket and motor.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Discharge Pressure	93 PSIG
Suction Pressure	0 PSIG
Flow	140 IGPM

**MOTOR**

Voltage	440 Volts
Current	30 Amps
Speed	1150 RPM

**PERFORMANCE TEST NOTES**

Unit to be operated at rated conditions for eight hours after readings have stabilised.

**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 25339**

**VIBRATION LEVELS**

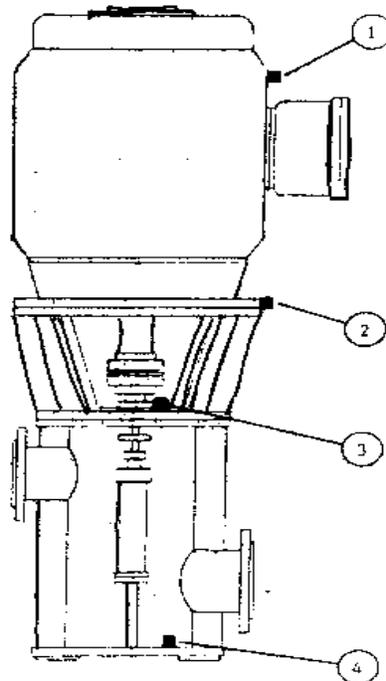
Octave Band Frequency (Hz)	Maximum Level (VdB)
16	94
31.5	87
63	91
125	89
250	83
500	84
1K	85
2K	85
4K	80

**VIBRATION TEST NOTES**

VA reading to be taken while unit is operating at rated conditions.

Motor Vibration Category: A

Vibration block locations for the Fuel Oil Transfer Pump are as indicated on the attached drawing.



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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 27379**

**PUMP UNIT CENTRIFUGAL**

<u>NSN:</u>	<u>P/N</u>	<u>ITEM NAME</u>	<u>NSCM</u>
4320-21-850-3327	B0215	Pump Unit, Centrifugal	35074

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Centrifugal, consists of the pump directly coupled to the electric motor.

**PERFORMANCE TEST CRITERIA**

Flow	252 IGPM
Discharge Pressures	110 Feet

**MOTOR**

Rating	15 BHP
Speed (Synchronous)	1760 RPM
Frame Size	GE 284UC
Volts	440
Amps	19
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

Record following data hourly for 4 hours: flow rate; discharge pressure; inlet pressure, inlet temperature, speed; volts; amps; K watts; power factor; and time.

**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 27379**

**VIBRATION LEVELS**

Octave Band Frequency (Hz)	Maximum Level (VdB)
16	101
31.5	100
63	95
125	99
250	96
500	90
1K	95
2K	92
4K	90

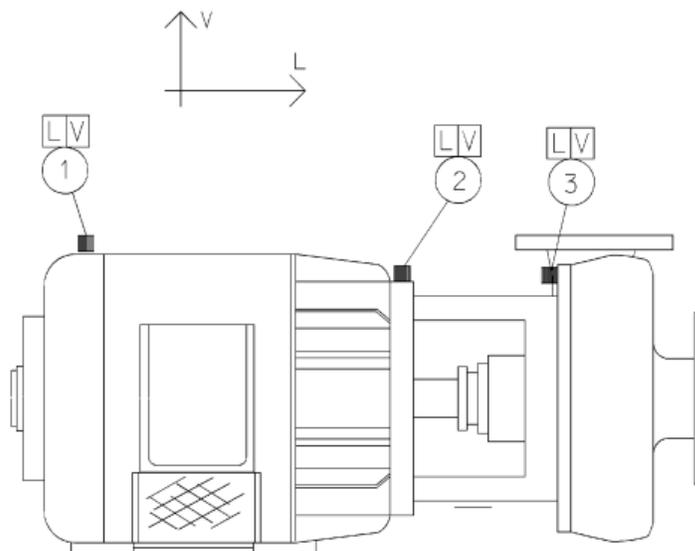
**VIBRATION TESTING NOTES**

Vibration readings are to be taken while operating unit at design flow only on blocks 1, 2 and 3 as shown below.

Motor Vibration Category: B

**Vibration Block Locations for 252 GPM Designed for Brine**

**E2737900 EVAPORATOR BRINE PUMP**



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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 27911**

**CPF CLASS OILY WATER SEPARATOR PUMP**

<u>NSN:</u>	<u>P/N</u>	<u>ITEM NAME</u>	<u>NSCM</u>
4320 01 331 2439	34464/SK-341	Pump Unit Rotary	53918

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Rotary, consists of the pump, electric motor, and coupling.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Discharge Pressure	45 PSIG
Suction Pressure	25 ft
Flow	10 IGPM

**ELECTRIC MOTOR**

Rating	0.5 HP
Speed	1425 / 1725 RPM
Volts	230/ 460 VAC, 60 Hz
Amps	2.4/1.2

**PERFORMANCE TEST NOTES**

Operate unit for two hours after readings have stabilised at rated conditions.

**VIBRATION LEVELS**

Vibration levels for pump assemblies are to be within manufacturer’s repair specifications. No VA blocks fitted.

Motor Vibration Category: C

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**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 27A90**

**CPF CLASS BILGE STRIPPING PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320 21 911 2453	F000708/2	Pump Unit, Rotary	38960
4320 99 513 7755	CAB12H1R3/A1115	Pump, Rotary	K2605
3010 01 394 1145	RX61DT80N4	Gear case/motor	62672

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Rotary, consists of the pump, gear case/electric motor, and base plate.

Pump Rotary, consists of the pump end only.

Gear case/motor, consists of reduction gearing and a/c motor.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Max Differential Pressure	87 psig
Flow	57cubic meters/hr @1450 motor RPM
Max Pump RPM	575 RPM

**ELECTRIC MOTOR**

Rating	1 HP
Speed	1500 RPM
Volts	440/60/3
Amps	4.2

**PERFORMANCE TEST NOTES**

Operate unit for four hours after readings have stabilized at rated conditions.

**VIBRATION LEVELS**

Vibration levels for pump assemblies are to be within manufacturer’s repair specifications. No VA blocks fitted.

Motor Vibration Category: C

APPENDIX 6

To: ANNEX A To W8482-116492

Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 27B00**

**FIRST STAGE PUMP UNIT**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-01-381-0285	L1122D-RODCN	Pump, Reciprocating	50492

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Reciprocating, consists of the pump end only.

**PERFORMANCE TEST CRITERIA**

Not applicable.

**PERFORMANCE TEST NOTES**

Not applicable.

**VIBRATION LEVELS**

Not applicable.

APPENDIX 6

To: ANNEX A To W8482-116492

Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 27B01**

**SECOND STAGE PUMP UNIT**

NSN	P/N	DESCRIPTION	NSCM
4320-01-381-0377	M0406AB-RO	Pump, Reciprocating	36219

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Reciprocating, consists of the pump end only.

**PERFORMANCE TEST CRITERIA**

Not applicable.

**PERFORMANCE TEST NOTES**

Not applicable.

**VIBRATION LEVELS**

Not applicable.

APPENDIX 6

To: ANNEX A To W8482-116492

Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 39108**

**IRO CLASS - JP5 SUMP PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-856-0323	81 1-4A6B	Pump, Centrifugal	21056

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Centrifugal consist of pump only.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Discharge Pressure	12 PSIG
Suction Pressure	10 in. HG (Max)
Flow	20 GPM
Speed	3480 RPM

**MOTOR**

Speed	3480 RPM
Voltage	440 VOLTS
Current	0.55 AMPS
Power	1/3 HP

**VIBRATION LEVELS**

Vibration levels for pump assemblies are to be within manufacturer's repair specifications. No VA blocks fitted.

Motor Vibration Category: C

APPENDIX 6

To: ANNEX A To W8482-116492

Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #3 (MISCELLANEOUS)**

**EAC 39169**

**HFX CLASS - JP5 SYSTEM PRIMING PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-01-332-5307	M8SOVTTFVT	Pump, Reciprocating	52837

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Reciprocating consists of the air pump only.

**PERFORMANCE TEST**

Suction Lift	3 Meters Water Column
Flow Rate	22.8 M <sup>3</sup> /HR
Discharge Pressure	0 PSI - Open Discharge
Air Supply Pressure	120 PSI

**PERFORMANCE TEST NOTES**

The pump shall be run for a period of 2 hours at the required suction lift, during which time the flow rate will be checked.

**HYDROSTATIC TEST**

The test pressure shall be held for 15 minutes, during this time there shall be no pressure drop, no permanent distortion, and no leaks.

Holding Time	15 Minutes
Test Pressure	190 PSI

**VIBRATION LEVELS**

Not applicable.

## APPENDIX 7

To: ANNEX A To W8482-116492

Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

DESCRIPTION	NSN	PART NO.	MANUFACTURER	EAC
PUMP,CENTRIFUGAL	4320-21-904-1991	FF704103	Ingersoll-Dresser	25534
PUMP,CENTRIFUGAL	4320-21-904-1992	FF704204	Ingersoll-Dresser	25534
PUMP UNIT,CENTRIFUGAL	4320 21 856 0286	3NVMK50	Ingersoll-Dresser	27334
PUMP UNIT,CENTRIFUGAL	4320 21 856 0290	1-1-2NVMK20	Ingersoll-Dresser	27335
PUMP UNIT,CENTRIFUGAL	4320-21-904-1983	15487N18 <u>or</u> 13869N18	Ingersoll-Dresser	27876
PUMP,CENTRIFUGAL	4320-21-907-5967	FF704191	Ingersoll-Dresser	27877
PUMP UNIT,CENTRIFUGAL	4320-21-904-1976	Ff704100-0	Ingersoll-Dresser	27878
PUMP UNIT,CENTRIFUGAL	4320-21-904-1965	FF704106-0	Ingersoll-Dresser	27879
PUMP UNIT,CENTRIFUGAL	4320-21-904-1985	FF704112-0	Ingersoll-Dresser	27880
PUMP UNIT,CENTRIFUGAL	4320-21-904-1989	FF704118-0	Ingersoll-Dresser	27931
PUMP UNIT,CENTRIFUGAL	4320-21-904-1973	FF704109-0	Ingersoll-Dresser	39164

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 25534**

**HFX CLASS - GEAR DRIVEN MAIN SEA WATER PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-904-1991	FF704103	Pump, Centrifugal (Stbd)	05563
4320-21-904-1992	FF704204	Pump, Centrifugal (Port)	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump, Centrifugal consists of pump only.

**PERFORMANCE TEST CRITERIA**

Flow	175 M <sup>3</sup> /HR
Total Head	0.81 Bar
Shaft Speed	1200 RPM
Motor Rating	7 BHP

**PERFORMANCE TEST NOTES**

Driver not supplied. Test facility to be set up to demonstrate performance.

**VIBRATION LEVELS**

<u>Octave Band Frequency (Hz)</u>	<u>Maximum Level (VdB)</u>
31.5	97
63	100
125	97
250	93
500	90
1K	87
2K	83
4K	80

**VIBRATION TESTING NOTES**

VA testing to be done on test base plate (to be fitted with VA blocks) mounted via resilient mounts sized according to weight.

APPENDIX 7

To: ANNEX A To W8482-116492

Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27334**

**IRO CLASS - MAIN FIRE PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-856-0286	3NMK50	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit, Centrifugal, consists of the pump, electric motor, and coupling.

**PERFORMANCE TEST CRITERIA**

Flow	325 IGPM
Discharge Pressures	125 PSIG
Suction Lift	Flooded

**MOTOR**

Rating	50 BHP
Speed (Synchronous)	3535 RPM
Volts	440
Amps	61
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

Record following data hourly for 4 hours: flow rate; discharge pressure; inlet pressure, inlet temperature, speed; volts; amps; K watts; power factor; and time.

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27334**

**VIBRATION LEVELS**

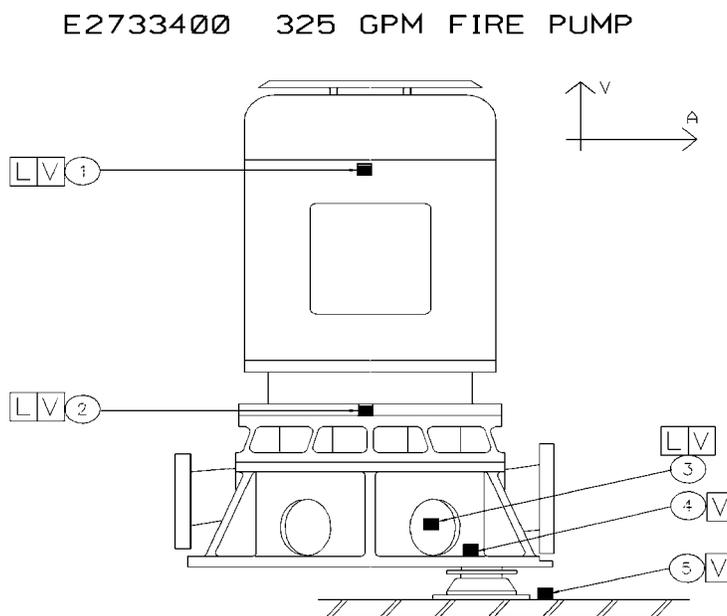
Octave Band Frequency (Hz)	Maximum Level (VdB)
31.5	100
63	103
125	100
250	105
500	104
1K	96
2K	102
4K	100

**VIBRATION TESTING NOTES**

Vibration readings are to be taken while operating at design flow only on blocks 1, 2, 3 and 4 as shown below.

Motor Vibration Category: A

**Vibration Block Locations for 280 CL Main Fire Pump**



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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27335**

**IRO CLASS - JOCKEY FIRE PUMP**

<u>NSN:</u>	<u>P/N</u>	<u>ITEM NAME</u>	<u>NSCM</u>
4320-21-856-0290	1-1-2NVMK20	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit, Centrifugal, consists of the pump, electric motor, and coupling.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Flow	100 IGPM
Discharge Pressures (Total Head)	125PSIG
Suction Lift	Flooded

**MOTOR**

Rating	20 BHP
Speed (Synchronous)	3535 RPM
Frame Size	286PX
Volts	440
Amps	24.5
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

Record following data hourly for 4 hours: flow rate; discharge pressure; inlet pressure, inlet temperature, speed; volts; amps; K watts; power factor; and time.

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27335**

**VIBRATION LEVELS**

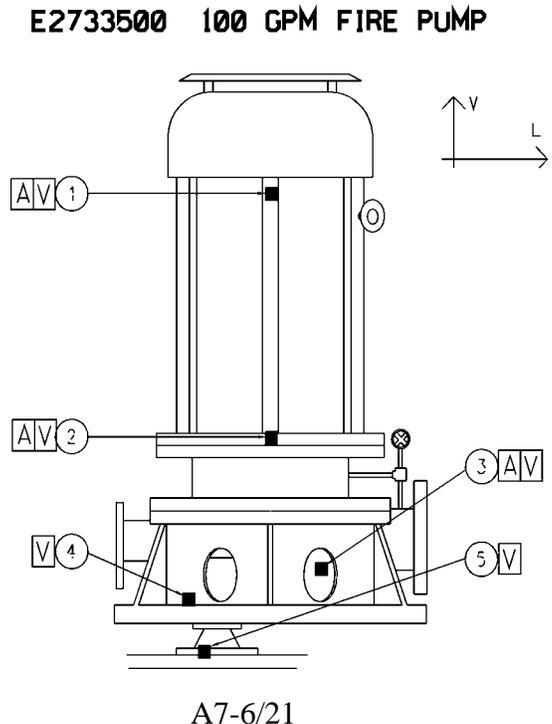
Octave Band Frequency (Hz)	Maximum Level (VdB)
31.5	97
63	100
125	97
250	102
500	101
1K	93
2K	99
4K	97

**VIBRATION TESTING NOTES**

Vibration readings are to be taken while operating at design flow only on blocks 1, 2, 3 and 4 as shown below.

Motor Vibration Category: A

**Vibration Block Locations for 280 CL Jockey Fire Pump**



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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27876**

**HFX CLASS - MOTOR DRIVEN FIRE PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-904-1983	15487N18 <u>or</u> 13869N18	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Centrifugal consists of pump and motor. Note: All pump ends are the same and Chesterton type 180 mechanical seal is used on all main fire pumps ( see drawings #901169 Adapter for 180-16 Seal Hull & Fire Pump and #37240 rev A Seal Installation).

**PERFORMANCE TEST CRITERIA**

**PUMP**

Flow	146 M <sup>3</sup> /HR
Total Head	10 Bar

**MOTOR**

Rating	75 HP
Speed (Synchronous)	3550 RPM
Volts	440
Amps	85
Hertz	60
Phase	3

APPENDIX 7

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**  
**PERFORMANCE TEST NOTES**

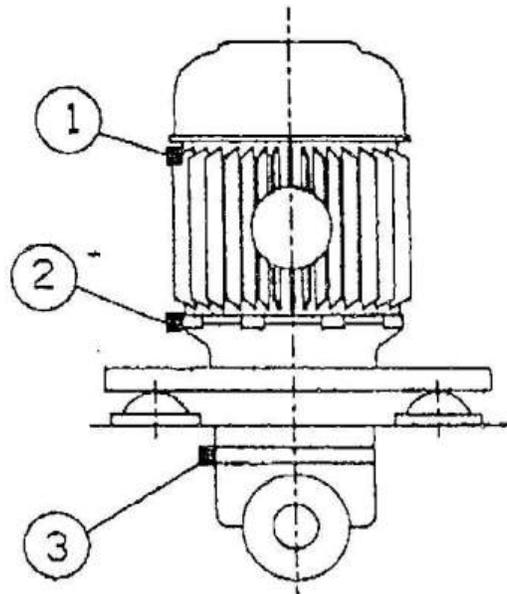
1. The contractor shall test the hydraulic performance and vibration levels of each pump and motor on a suitable test loop.
2. Pump characteristic curves will be produced. Specific readings will be taken as close as possible to the specified points for each pump.
3. In addition to the maximum vibration levels required below, noise and vibration readings shall be taken in accordance to the test procedures and specifications provided in Appendix A3 of Annex A. The maximum acceptable noise and vibration limits that must be achieved on the complete pump unit are provided in Tables 1 and 2 of the fore mentioned Appendix.

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27876**

**VIBRATION TEST NOTES**

Motor Vibration Category: A



Vibration block locations are as indicated on the attached drawing.

Block 1: On motor body/frame, left side (when facing terminal box cover), 1 inch below fan hood.

Block 2: On motor drive end head flange, left side.

Block 3: On pump support head flange, left side.

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27877**

**HFX CLASS - DIESEL DRIVEN FIRE PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-907-5967	FF704191	Pump, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump, Centrifugal consists of pump only.

**PERFORMANCE TEST CRITERIA**

Flow	146 M <sup>3</sup> /HR
Total Head	10 Bar
Shaft Speed	2700 RPM
Motor Rating	75 HP

**PERFORMANCE TEST NOTES**

Diesel driver not supplied. Test facility to be set up to demonstrate performance.

**VIBRATION LEVELS**

<u>Octave Band Frequency (Hz)</u>	<u>Maximum Level (VdB)</u>
31.5	109
63	105
125	95
250	100
500	92
1K	92
2K	88
4K	88

**VIBRATION TESTING NOTES**

VA testing to be done on test base plate (to be fitted with VA blocks) mounted via resilient mounts sized according to weight.

APPENDIX 7

To: ANNEX A To W8482-116492

Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27878**

**HFX CLASS - MAIN FRESH WATER PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-904-1976	FF704100-0	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Centrifugal consists of pump and motor.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Flow	0.55 M <sup>3</sup> /HR
Total Head	0.55 Bar

**MOTOR**

Rating	0.5 HP
Speed (Synchronous)	1800 RPM
Volts	440
Amps	0.8
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

The contractor shall test the hydraulic performance and vibration levels of each pump and motor on a suitable test loop.

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27878**

**VIBRATION LEVELS**

Octave Band Frequency (Hz)	Maximum Level (VdB)
31.5	90
63	92
125	89
250	85
500	83
1K	80
2K	77
4K	74

**VIBRATION TEST NOTES**

Motor Vibration Category: C

Vibration blocks to be mounted on pump base plate.

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27879**

**HFX CLASS - MAIN FRESH WATER PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-904-1965	FF704106-0	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Centrifugal consists of pump end, vacuum pump, motor, piping, and check, flex and relief valves.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Flow	14 M <sup>3</sup> /HR
Total Head	4 Bar

**MOTOR**

Rating	7.5 HP
Speed (Synchronous)	3550 RPM
Volts	440
Amps	9.1
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

1. Performance of priming pump to be demonstrated with 7 M suction. Fresh water pump to maintain prime after initial priming.
2. The contractor shall test the hydraulic performance and vibration levels of each pump and motor on a suitable test loop.
3. Pump characteristic curves will be produced. Specific readings will be taken as close as possible to the specified points for each pump.
4. In addition to the maximum vibration levels required below, noise and vibration readings shall be taken in accordance to the test procedures and specifications provided in Appendix A3 of Annex A. The maximum acceptable noise and vibration limits that must be achieved on the complete pump unit are provided in Tables 1 and 2 of the fore mentioned Appendix.

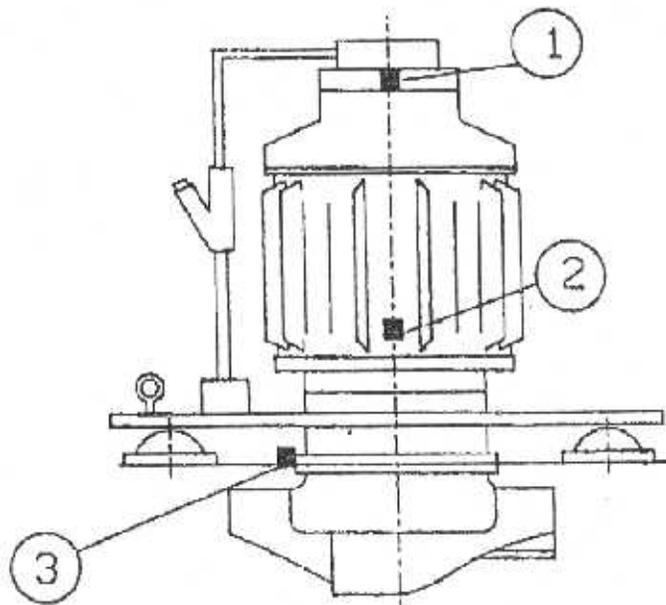
**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27879**

**VIBRATION TEST NOTES**

Motor Vibration Category: B

Vibration block locations are as indicated on the attached drawing.



- Block 1: On motor non-drive end, top flange, back side (when facing the terminal box cover)
- Block 2: On motor body / frame, 1 inch above drive end head flange, back side.
- Block 3: On pump support head flange, right side.

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27880**

**HFX CLASS - AULILIARY SEA WATER CIRCULATING PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-904-1985	FF704112-0	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Centrifugal consists of pump and motor.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Flow	154 M <sup>3</sup> /HR
Total Head	1.2 Bar

**MOTOR**

Rating	10 HP
Speed (Synchronous)	1150 RPM
Volts	440
Amps	14
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

1. The contractor shall test the hydraulic performance and vibration levels of each pump and motor on a suitable test loop.
2. Pump characteristic curves will be produced. Specific readings will be taken as close as possible to the specified points for each pump.
3. The contractor shall demonstrate the watertight integrity of the auxiliary seawater circulating pump motor. He will carry out a vacuum/pressure test, which will demonstrate that the Auxiliary Seawater Circulating Pump is water proof to a depth of 15 ft. while running.
4. In addition to the maximum vibration levels required below, noise and vibration readings shall be taken in accordance to the test procedures and specifications provided in Appendix A3 of Annex A. The maximum acceptable noise and vibration limits that must be achieved on the complete pump unit are provided in Tables 1 and 2 of the fore mentioned Appendix.

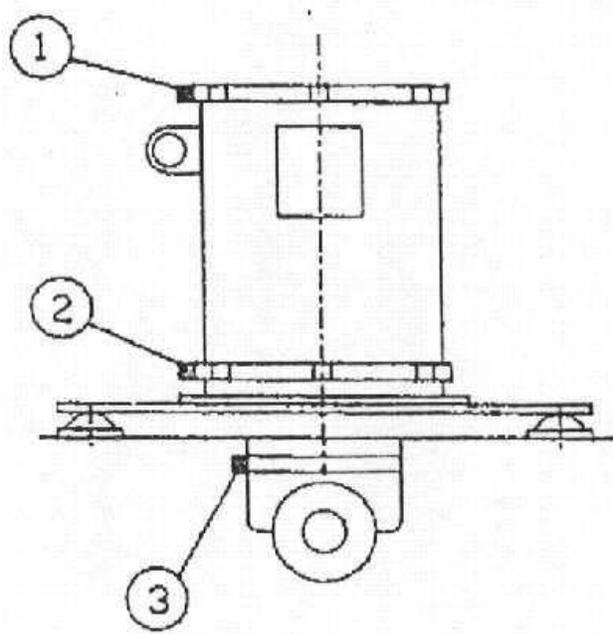
**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27880**

**VIBRATION TEST NOTES**

Motor Vibration Category: B

Vibration block locations are as indicated on the attached drawing.



Block 1: On motor non-drive end, head flange, left side (when facing the terminal box cover)

Block 2: On motor drive end head flange, left side.

Block 3: On pump support head flange, left side.

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27931**

**HFX CLASS - JOCKEY FIRE PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-904-1989	FF7044118-0	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Centrifugal consist of pump and motor

**PERFORMANCE TEST CRITERIA**

**PUMP**

Flow	80 M <sup>3</sup> /HR
Total Head	10 Bar

**MOTOR**

Rating	50 HP
Speed (Synchronous)	3550 RPM
Volts	440
Amps	58
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

1. The contractor shall test the hydraulic performance and vibration levels of each pump and motor on a suitable test loop.
2. Pump characteristic curves will be produced. Specific readings will be taken as close as possible to the specified points for each pump.
3. In addition to the maximum vibration levels required below, noise and vibration readings shall be taken in accordance to the test procedures and specifications provided in Appendix A3 of Annex A. The maximum acceptable noise and vibration limits that must be achieved on the complete pump unit are provided in Tables 1 and 2 of the fore mentioned Appendix.

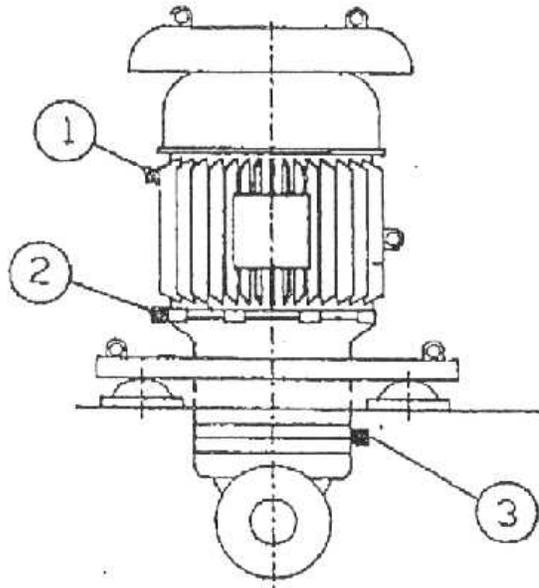
**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 27931**

**VIBRATION TEST NOTES**

Motor Vibration Category: A

Vibration block locations are as indicated on the attached drawing.



Block 1: On motor body/frame, left side (when facing terminal box cover), 1 in below fan hood.

Block 2: On motor drive end head flange, left side.

Block 3: On pump support head flange, right side.

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Dated: 5 Nov 2010

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 39164**

**HFX CLASS - HELO WASHDOWN PUMP**

<u>NSN</u>	<u>P/N</u>	<u>DESCRIPTION</u>	<u>NSCM</u>
4320-21-904-1973	FF704109-0	Pump Unit, Centrifugal	05563

**EQUIPMENT CONFIGURATION CHECKLIST**

Pump Unit Centrifugal consists of pump and motor.

**PERFORMANCE TEST CRITERIA**

**PUMP**

Flow	2.4 M <sup>3</sup> /HR
Total Head	5 Bar

**MOTOR**

Rating	5 HP
Speed (Synchronous)	3550 RPM
Volts	440
Amps	6.3
Hertz	60
Phase	3

**PERFORMANCE TEST NOTES**

The contractor shall test the hydraulic performance and vibration levels of each pump and motor on a suitable test loop.

Pump characteristic curves will be produced. Specific readings will be taken as close as possible to the specified points for each pump.

**PERFORMANCE SHEETS – GROUP #4 (INGERSOLL-DRESSER)**

**EAC 39164**

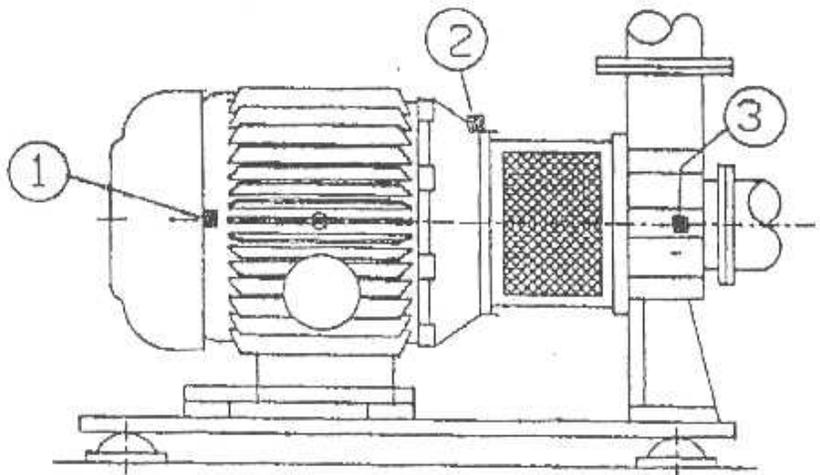
**VIBRATION LEVELS**

Octave Band Frequency (Hz)	Maximum Level (VdB)
31.5	87
63	90
125	86
250	90
500	82
1K	77
2K	74
4K	70

**VIBRATION TEST NOTES**

Motor Vibration Category: B

Vibration block locations are as indicated on the attached drawing.



Block 1: On motor non-drive end housing, front side (when facing the terminal box cover), on boss 2 inches above cooling ribs.

Block 2: On motor drive end coupling flange, top side.

Block 3: On pump impeller casing, front side.