Serial numbers will be issued by DTR-N.

Whilst anyone can identify the need, only Authorised Engineering Organisations may sponsor TM 181s.

Expiry date is to be no more than 12 months from the Date of Issue.

All TM 181s are to contain a point of contact within the originating AEO.

All TM 181s are to be endorsed by an Engineering Authority of the appropriate level determined by the category of technical risk associated with the TM 181 and only after having assessed that risk. See ABR 6492 Volume 2 Section 5 Chapter 2 Annexes A&B for risk and engineering authority levels. Endorsement indicates that technical risk has been assessed, and that the endorser is satisfied that any risk is being appropriately managed.

TM 181s may only be released by an Executive Authority within the originating AEO. Releasing officers are to note that they are accepting, on behalf of the Commonwealth, the technical risk associated with the TM 181.

<table>
<thead>
<tr>
<th>Originating AEO:</th>
<th>Date of Issue:</th>
<th>EIC / CMC:</th>
<th>Expiry Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NAVSYS</td>
<td>8 DEC 05</td>
<td>N/A</td>
<td>7 DEC 06</td>
</tr>
</tbody>
</table>

Subject:

GENERAL REQUIREMENTS FOR THE TESTING AND REPLACEMENT OF FLEXIBLE PIPING DEVICES

Applicability:

SURFACE SHIPS SUBMARINES AND HYPERBARIC FACILITIES IN RAN ESTABLISHMENTS

References:

A. TM 181 060/04
B. A203650 Requirements for Type Testing of High Pressure Breathing Air and Oxygen Hoses for Diving use
C. A203959 Specification for the Cleanliness of Hyperbaric Oxygen and Breathing Gas Components
1. Reference A is cancelled and replaced by this Technical Directive. This Directive is based on the following philosophy:

- For items supplied through the ADF supply chain it is the responsibility of the ADFLM to ensure that the item meets the requirements. ADFLMs have a responsibility to ensure that an appropriate certification plan is put in place to ensure items meet procurement specification. Therefore items supplied via the ADF supply chain can be assumed to comply with material requirements and the only certification required is evidence that the correct item has been demanded and supplied.

- There is no need to separately tag and track:
  - Non critical items as by definition the items are not critical and require no special testing or survey
  - Critical Hoses apart from hyperbaric hoses, supplied via the ADF supply chain provided each of the following requirements is met:
    • the hose is marked with the cure date (if applicable)
    • the manufacturer’s part number or DSN is marked on the hose assembly, and
    • the manufacturer’s part number or DSN is traceable to the installed position via approved documentation for the equipment. Eg illustrations parts breakdowns APL etc

- Approved planned maintenance takes precedence over the generic instructions provided in this TM181. When approving Planned maintenance and amendments to PM DARs should take the instructions in this TM181 into account.

INTRODUCTION

2. The management of flexible hoses in the RAN has necessarily come under increased attention in recent times. The purpose of this instruction is to provide clear guidance to ship engineering staff on the general requirements for the testing and replacement of flexible piping devices.

3. The basic principle for the management of flexible piping devices is centred on safety and fitness for purpose. Each flexible piping device is to have a traceable path to a quality endorsed manufacturer certifying both its quality and fitness for purpose in the application for which it is intended. This may take the form of a test certificate for an individual device or a quality certificate delivered with a group of devices of which an individual item is a part. Excluding hyperbaric hoses, there is no specific requirement for each device to have a separate test conducted prior to installation so long as its quality can be assured.

4. Where flexible piping devices, apart from hyperbaric hoses, are delivered as an integral part of an assembly and cannot be separately traced to a test or quality certificate, the quality certificate supplied with the higher assembly together with the manufacturer's recommended maintenance routines are sufficient for certification purposes.

5. For hyperbaric applications, only approved hoses shall be used. Any non-approved hose in a hyperbaric application must be replaced.

SCOPE

6. This directive is applicable to hose assemblies – that is hoses fitted with end fittings. It does not cover ship’s refuelling hoses, aircraft refuelling hoses, helicopter in-flight refuelling hoses, fire hoses, general purpose hoses such as workshop air hoses or hoses secured with clamping bands eg Jubilee Clips.

PROCEDURE OVERVIEW

7. This directive covers aspects of maintenance, testing and replacement of flexible hose assemblies and is to be used by ship’s staff, SPO maintenance management staff and other authorities engaged in external maintenance. The following flowchart gives an overview of the maintenance, testing and replacement procedures and the relationships between this directive and other instructions and specifications covering maintenance and OEM requirements.
Hose Assembly Maintenance—Replacement—Testing Procedures Overview

START
Hose maintenance required

Yes

Maintainer checks are instructions in PM card and/or in Maint Mgt System (eg AMPS)?

Yes

Maintainer conducts maintenance/inspections as per PM card

No

Conduct maintenance inspections as per this TM 181

Inform SPO of deficiency

No

Is Replacement hose assembly available from navy stores?

Yes

Replace and Record

No

Obtain local replacement using OEM’s specifications or instructions from this TM

Inspect, test and tag hose iaw this TM 181

Record and inform SPO

Maintainer checks are instructions in PM card and/or in Maint Mgt System (eg AMPS)?

Yes

Maintainer conducts maintenance/inspections as per PM card

No

SPO loads requirements into Maint Mgt System and amends PM card

Record as completed maintenance

No

Conduct maintenance inspections as per this TM 181

Inform SPO of deficiency

Record as completed maintenance
## DEFINITIONS

8. The definition of the words and phrases used in discussing hoses, end fittings and hose assemblies is as follows:

a. **Abrasion.** The wearing away by friction.

b. **Adaptor.** A device for connecting two different mechanical connections or seal system for the passage of liquid or gaseous materials. A hose assembly adaptor is located between the hose assembly and ship’s piping.

d. **Adhesion.** The strength of bond between cured rubber surfaces or a cured rubber surface and a non-rubber surface.

d. **Ageing.** Changes in physical properties of rubber over a period of time due to long term exposure to heat, sunlight, ozone, moisture, etc.

e. **Approved hyperbaric hose.** A hose that has been approved by an authorised designer and certified by an Design Acceptance Representative to meet an approved RAN configuration drawing and/or specification iaw the requirements of the Navy Technical Regulatory System.

f. **Bend radius.** The radius of a bent section of hose measured to the innermost surface of the curved portion.

g. **Blister.** A raised spot on the surface, cover or tube, indicating a separation between the layers usually forming a void or air pocket in the vulcanised article.

h. **Braid.** A continuous sleeve of interwoven single or multiple strands of yarn, cord or wire. The strands of reinforcement spiral around the inner hose structure (tube) in both directions in addition to being interlaced.

i. **Burst pressure.** The pressure at which rupture of the hose occurs.

j. **Carcass.** The strength member of the hose containing fabric, cord or wire reinforcement.

k. **Cover.** The outer rubber layer of a hose assembly. Protects the reinforcement (carcass) from abrasion and exposure to harmful chemicals and other conditions which can harm the carcass.

l. **Criticality.** The criticality is used only to determine the expected service life cycle of rubber flexible hose assemblies iaw Table 1.

m. **Cure.** The process of vulcanising.

n. **Cure date designation.** Any combination of letters, numbers or symbols used by the manufacturer to identify the period of manufacture of a rubber product. Military specifications for hose require the cure date to be expressed as the quarter and year of manufacture. Example; 2Q04, which would represent the second quarter of 2004, or 01 April to 30 June 2004.

o. **Dash size.** In general, the dash size is the inside diameter of a hose expressed in 16th of an inch. However, for some hoses it represents the nominal ID and not the true ID.

p. **Design pressure - system.** The pressure used in the calculation of piping and piping components minimum section thickness.

q. **Dogleg elbow.** A fitting connecting two sections of hose to form a 90° hose assembly.

r. **End fitting.** A device attached to the ends of a hose to facilitate the connection of a hose
assembly to a piping system.

s. **Free hose length.** The visible portion of hose between two end fittings or between one end fitting and a dogleg elbow which is free to absorb motion under operating and shock conditions.

t. **Hose.** A flexible conduit of circular cross section, and usually consisting of an inner element (tube), reinforcement element (carcass) and an outer element (cover).

u. **Hose assembly.** A length of hose with an end fitting attached to each end. A dogleg (or 180° return) assembly would consist of 2 lengths of hose, 2 end fittings and either a 90° dogleg elbow or 180° U-bend fitting.

v. **Hose type.** Hose designation shall be either national, military, commercial or manufacturer’s designation.

w. **Hose working pressure – rated.** The maximum working pressure for which a hose is designed.

x. **Hyperbaric hose.** Any hose that is used in a life support application involving air, oxygen or mixed breathing gases.

y. **Impulse Pressure.** The maximum sustained pressure acquired during an impulse cycle.

z. **Layline.** A legible marking, parallel to the longitudinal axis of the hose, which identifies the hose as required by the applicable specification.

aa. **Life cycle.** The life cycle of a rubber hose contains two separate elements. These elements are shelf life and service life. They do not overlap.

1. **Shelf life.** That period of time starting from time of manufacture (cure date) and generally ending upon installation.

2. **Service life.** That period of time in which a rubber hose is installed and in use. Service life is considered continuous once started and includes intermittent down time.

ab. **Objective Quality Evidence (OQE).** A collection of evidence showing that a product or service complies with a specification or requirement. The evidence may consist of any or all of the following:

1. Record results demonstrating that the work complies with the Maintenance Action examination requirements and Set to Work requirements (as applicable).

2. The specified work having been undertaken satisfactorily as indicated by written reports.

3. Monitoring of Physical Inspection Readings (where applicable).

4. Observation that equipment meets performance criteria upon setting to work.

5. A certificate from an accredited quality organisation, certifying the suitability of the hose for its intended use.

ac. **Peak pressure.** The maximum pressure achieved at the beginning of an impulse pressure cycle.

ad. **Pin prick.** Needle holes placed in the cover of a rubber or plastic hose intended for gas service to prevent the formation of blisters.

ae. **Pressure categories.** The classification for air pressure categories are as defined at Chapter
23 of ABR 5505 (or reference B, for hyperbaric hoses):

<table>
<thead>
<tr>
<th>RAN origin</th>
<th>Low pressure (LP)</th>
<th>350 psig (2410 kPa) and below</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High pressure (HP)</td>
<td>Above 350 psig.</td>
</tr>
<tr>
<td></td>
<td>Hyperbaric LP</td>
<td>20 bar (300psi) and below</td>
</tr>
<tr>
<td></td>
<td>Hyperbaric Medium Pressure</td>
<td>21 bar (310 psi) to 67 bar (990psi)</td>
</tr>
<tr>
<td></td>
<td>Hyperbaric HP</td>
<td>Above 68 bar (1000psi)</td>
</tr>
<tr>
<td>USN origin</td>
<td>Low pressure.</td>
<td>150 psig (1030 kPa) and below.</td>
</tr>
<tr>
<td></td>
<td>Medium pressure.</td>
<td>Above 150 psig and below 1000 psig (6890 kPa).</td>
</tr>
<tr>
<td></td>
<td>High pressure.</td>
<td>1000 psig (6890 kPa) and above.</td>
</tr>
</tbody>
</table>

af. **Proof pressure.** A non-destructive pressure applied to a hose or hose assembly to determine reliability under normal working pressure. Normally equal to twice (2x) the rated working pressure of the hose. For hyperbaric hoses this is normally 1.5 times the rated working pressure of the hose and should be iawapproved design or configuration documentation.

ag. **Prototype Hose.** A preliminary version of a hose assembly developed for a new application or a change from one type of fitted hose to another type, eg PTFE to rubber, or from fixed piping to hose.

ah. **Tube.** The innermost layer of a hose.

ai. **Type-Tested Hose.** A hyperbaric hose meeting the requirements of A203650 (ref B).

aj. **Working pressure - system.** The pressure which exists in a system or sub-system when performing its normal function in which a hose or hose assembly may be installed.

**NOTE:** A hose shall not have a rated working pressure that is less than the design pressure of the portion of the system in which it is to be installed.

9. For the purpose of this directive the term ‘planned maintenance requirement’ means any or all of the following:


b. SLIMS(E).

c. USN 3-M System.

d. Class Maintenance Plan,

e. AMPS, and

f. Other authorised specific system instructions.
GENERAL REQUIREMENTS

Hose Life Requirements

10. Polytetrafluoroethylene (PTFE), Thermoplastic and Metal Hose. These hose materials do not normally degrade from exposure to atmospheric conditions and they are not subject to any shelf or service life limitations, except where recommended by the manufacturer or as determined by periodic inspections and any subsequent hydrostatic tests or as required in accordance with the appropriate planned maintenance requirements.

11. Synthetic Rubber Hose. Synthetic rubber deteriorates, both in storage and in use, and ultimately becomes unserviceable. Therefore the following shelf and service life is specified so that the optimum life may be obtained from these hoses:

a. Shelf Life. The shelf life for rubber hose, either in bulk form or as a hose assembly, is four years (16 quarters) from the date of manufacture, not counting the quarter of manufacture. For example, a hose manufactured in the second quarter of 2004, denoted as 2Q04 at repetitive intervals on the layline, has a shelf life that ends on the 30th September 2008.

b. Service Life. The service life is determined by the criticality of the system in which it is installed. For critical systems the service life is a maximum of 12 years. For non-critical systems it is as determined by condition based monitoring (CBM). System criticality shall be as determined at Table 1. Service life begins from the date of installation for hoses installed between major refits and from a date agreed upon between the relevant authority and the contractor for installation during major refits and construction. This date may mark an event such as system hydrostatic test, date system filled with fluid, system start up, etc. From the above maximum life of rubber hoses in critical systems is 16 years. Hoses may be issued, installed and remain in service in critical systems provided this period is not exceeded e.g., hoses issued 6 years after cure have remaining service life of 10 years. When accepting hoses with shelf life over 4 years ships should consider the cost of condemning the hose for disposal against the reduction in service life.
## METHOD FOR DETERMINING SYSTEM CRITICALITY FOR RUBBER HOSE ASSEMBLIES

<table>
<thead>
<tr>
<th>Hose Assembly Application</th>
<th>Critical</th>
<th>Non-critical</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hyperbarics</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathing Air/Oxygen/Gas Mixtures</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><strong>Compressed Gas</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above 150 psig (1030 kPa)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>150 psig and less</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Refrigerants</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Other compressed gases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above 150 psig (1030 kPa)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>150 psig and less</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><strong>Drains</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auxiliary drain</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Plumbing/gravity drain system</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Systems open to ship’s atmosphere</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><strong>Oil Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel oil</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Hydraulic oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above 600 psig (4140 kPa)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>600 psig and less</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Lubricating oil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fill, transfer and purification</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Machinery lubricating oil systems</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td><strong>Water Systems</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chilled fresh water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Portion where single hose failure results in loss of electronic cooling.</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Portion where single hose failure results in loss of one half of ship’s air conditioning or loss of air conditioning to entire space</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Distilling plant systems (including distillate or demineralised water distribution)</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Potable water</td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Sea Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Where it is Probable that failure would result in direct major internal flooding or inundation of electrical equipment is Probable <strong>1</strong></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>All other seawater systems</td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

---

**Table 1.**

---

**1** “Probable” is defined in ABR 6303 Chapter 5 Annex A.
Hose-Assembly Manufacturing

12. There are occasions when a hose assembly may need to be manufactured in lieu of acquisition through DMO. On these occasions, the fabrication of the hose shall be in accordance with a suitably approved standard or procedure. If in doubt, approval must be sought from the Centre for Maritime Engineering (CME) or other DAR. The hose should also be supplied with a quality or test certificate. All hyperbaric hoses, regardless of working pressure, shall be approved and have objective quality evidence including traceability, cleaning iaw reference C and identification tags iaw paragraph 15.

Hose-Assembly Inspection Requirements

13. Upon fabrication of a hose assembly, the entire assembly configuration shall be visually examined as follows:
   a. Ensure that the tube and cover are intact and contain no cuts, cracks or abrasions. Any cut, nick or abrasion that removes one half of the cover thickness shall be cause for rejection.
   b. Where segmented socket fittings are used, ensure that the hose butts against the nipple shoulder and that the bolts and nuts, where used, are tight and the segments are evenly spaced.
   c. Ensure that the hose has not been twisted and that it has not bunched or blistered on the inside of the tube at the nipple edge.
   d. Ensure that the pressure ratings of the hose end fittings and the hoses are comparable.
   e. Ensure that the hose end fitting threads have not been damaged.
   f. Ensure that the hose and end fittings are suitable for the application.

Hose Proof-Testing

14. On completion of a satisfactory visual examination, subject the hose assembly (for hyperbaric hoses refer to para d. below) to a hydrostatic proof test as follows:
   a. Using fresh water or other appropriate liquid (hose assemblies for water and gaseous systems shall be tested using fresh water only), apply the required hydrostatic pressure for a period of between one and five minutes. The hose shall not burst, leak or show signs of fitting separation or unusual signs of distortion during this time. The required pressure will be determined by one of the following, in order of precedence:
      (1) the test pressure stated by an applicable manufacturer’s drawing, ship’s drawing, technical manual or other accredited document,
      (2) a test pressure equivalent to twice (2x) the rated hose working pressure (1.5x for hyperbaric hoses), or
      (3) subject to CME/DAR approval, a test pressure equivalent to twice (2x) the maximum system working pressure (1.5x for hyperbaric hoses) provided that the pressure is accurately known and that the effects of any surges or pulsations are taken into account.
   b. On completion of testing, hyperbaric hoses shall be cleaned iaw ref. C. All other hose assemblies shall be flushed with clean fresh water at a temperature of between 130°F (54.4°C) and 180°F (82.2°C) for a period of between 5 and 10 minutes. Flush shall be straight through and not recirculated. The assembly is to be dried and the end fittings capped, plugged or taped to prevent the ingress of contaminates.
c. Alternative cleaning and drying methods, eg hose cleaning foam pellets, may be used providing it can be demonstrated that the process will provide an equivalent level of cleanliness.

d. For hyperbaric hoses, testing should be conducted iaw the individual approved configuration drawing. In the absence of this data the hose should be tested iaw the instructions provided above.

15. On completion of a satisfactory test an identification/test status tag shall be inscribed with the relevant data attached to the hose as detailed below:

a. Tags for hoses other than hyperbaric shall be 0.75mm thick (minimum) corrosion resistant steel or other approved durable, corrosion resistant material and engraved or permanently marked with the information shown at Figure 1.

NOTE 1: Under no circumstances is a hose to be used on a system where the systems pressure is greater than one half the proof pressure recorded on the tag affixed to the hose.

<table>
<thead>
<tr>
<th>SHIPS HOSE ID</th>
<th>PROOF TEST PRESSURE (or OQE)</th>
</tr>
</thead>
</table>
| DATE INSTALLED | DATE TESTED | HOSE TYPE/SIZE | CURE DATE (If Applicable)

Figure 1. Identification/Test Status Tag

NOTE 2: If Objective Quality Evidence (OQE) is used in lieu of a proof pressure test, then the words ‘proof pressure’ are to be scribed out and the letter ‘OQE’ inscribed.

NOTE 3: For hyperbaric hose identification requirements, first consult the approved hose configuration drawing. If no specific detail is provided, the hose identification should be conducted iaw paras b and c below.

b. Hyperbaric hoses shall be labelled with the identification listed below. The identification is to be clearly printed on plastic transfer firmly secured around hose and encased in clear heat shrink, providing a water tight seal.

Manufacturer’s identification mark
‘For Breathing Gas - (Air/Oxygen/Mixed Gas) Only’
‘Maximum Working Pressure – (value) (units)’
‘Hydrostatic Test Pressure - (value = 1.5 x WP) (units)’
‘Pneumatic Test Pressure - (value = WP) (units)’
‘Initial Test Date – (date)’

c. Unless otherwise specified on the approved hose configuration drawing, all hyperbaric hoses shall have the initial test date and subsequent test dates shall be engraved /etched onto one or other of the end fittings. One flat of each end fitting shall be engraved/etched with ‘MAX WP (value) (units)’

d. Non critical hoses (other than hyperbaric hose) do not need to be tagged and critical hoses identified in paragraph 4 do not require special tagging. There may be instances, however, where ship’s staff prefer to use tags or some other unique identifier on these hoses in order to assist in hose identification and management. This is acceptable but it is not a mandatory requirement and should not be demanded on Navy stores supplies.

e. In instances where it is considered inappropriate or unsafe to attach a metal tag to a hose assembly, (eg very small hoses or hoses used on electrical equipment) this requirement may be omitted provided some other form of hose identification, such as an inscribed ID, is used (see para 16 below)
**Hose Installation**

16. On installation of a critical hose assemblies subject to lifting iaw paragraph 11 the identification/test status tag is to be inscribed with a ship's identifier and installation date and the relevant information recorded in the ship's hose register. In applications where it is impractical to have the identification/test status tag attached (e.g., very small hoses or hoses used on electrical equipment), ships may opt to remove the tag providing the hose assembly is otherwise identified in an approved manner and the register so noted. Tags shall not be removed from hyperbaric hoses under any circumstances. For ease of management ship staff may uniquely identify all hose assemblies iaw Note 3d and record relevant data in the ship's hose register.

**GENERAL INSPECTION REQUIREMENTS**

17. All flexible piping devices shall be subjected to regular inspections as specified in the relevant planned maintenance routines or as specified in this directive. Additional criteria for rejection of hoses over and above any that may be described in planned maintenance documentation is also detailed below.

**Hose In-service Inspections**

18. Periodic visual inspections shall be made of all installed flexible hose assemblies for signs of physical damage. This periodicity shall be in accordance with the appropriate planned maintenance requirement but should be at least annually. Inspection of assemblies whilst subject to system pressure is desirable, but must be limited to those locations where personnel safety is not placed at unacceptable risk. Hose assemblies found defective or due for life expiry shall be replaced at the first opportunity. Type-tested hyperbaric hoses shall be returned to an approved hyperbaric repairer every 24 months for inspection and testing. All other hyperbaric hoses shall be tested and cleaned iaw their approved configuration drawing requirements and Planned Maintenance Schedules.

19. All hose assemblies shall be visually inspected for the following:

a. Evidence of leakage at and/or slippage of the hose out of the fittings.

b. Evidence of twisting, kinking or other distortion or unusual appearance of the hose.

c. Evidence of fluid hammer or whipping as a result of peak pressure pulsations.

d. Evidence of large vibrations due to improper, or lack of, supports. Ensure that pipe and hose assembly supports are intact and that there is no distortion or other damage and that all fasteners are tight.

e. Presence and legibility of the identification tag/ship's identifier

f. Large areas covered in paint. The objection to painting hoses is that it not only hides the condition of the outer cover during examination but a build up of paint layers will slowly destroy the noise attenuating properties of the hose. It is not necessary to replace a hose if a few drops of paint fall on it, nor should any attempt be made to clean off dried paint as this may cause damage to the hose.

g. If it is necessary to remove the hose from the system, the opportunity shall be taken to conduct the following examinations and/or test:

(1) If possible, examine the interior of the hose for cracks or other signs of deterioration of the tube.

(2) Examine the end fittings for scratches, cuts, erosion or corrosion of the surface that forms a leakage path across 50 percent of the sealing surface. Do not try to dislodge marine growth in seawater hoses as this may damage the hose.
If the hose has been disconnected as part of a component replacement and remains under the control of ships staff eg on board repair, then the hose does not require retesting.

If a hyperbaric hose is removed from a system for any reason, both the system and the hose shall be appropriately capped. No hyperbaric hose shall be re-installed if it has not been appropriately capped, bagged and certified.

Some hydraulic and fuel hoses have been fitted with additional slip-on covering or sleeve that is not part of the fabricated hose assembly but designed to protect the hose or contain a leak. It may be necessary to uncouple the hose and remove the sleeve to facilitate inspection of the hose.

**Rubber Hose Rejection**

20. Irrespective of the results obtained from any other inspection, any of the following conditions shall be cause for rejection of rubber hoses:

   a. cover rubbed thin by abrasion or chafing,
   b. cracking or blistering of the cover due to ageing,
   c. soft spots or bulges of the cover which would indicate weakening of the adhesive bond between the cover and carcass or deterioration of the reinforcing wire, or
   d. the life period expires before the next scheduled inspection.

**PTFE Hose Rejection**

21. Irrespective of the results obtained from any other inspection, any of the following conditions shall be cause for rejection of PTFE hoses:

   a. twenty or more wires of the external wire braid broken or corroded through at random,
   b. any gouge or cut involving four or more adjacent wires, or
   c. tube showing signs of cracking, blistering, splitting or other signs of failure.

**Thermoplastic Hose Rejection**

22. Irrespective of the results obtained from any other inspection, the following conditions shall be cause for rejection of thermoplastic hoses:

   a. cover rubbed thin by abrasion or chafing, or
   b. tube showing signs of cracking, blistering, splitting or other signs of failure.

**Metal Hose Rejection**

23. Irrespective of the results obtained from any other inspection, the following conditions shall be cause for rejection of metal hoses:

   a. twenty or more wires of the external braid broken or corroded through at random, or
   b. any gouge or cut involving four or more adjacent wires.
Fire Sleeve Rejection

24. Certain fuel and oil hoses are fitted with protective fire sleeves constructed from fibreglass and coated with iron oxide impregnated silicon rubber. Cuts and abrasions, which expose glass fibre, shall be cause for rejection. Minor cuts and abrasions to fire sleeves may be temporarily repaired using an approved fire sleeve tape under the following conditions:

a. Prior to the fire sleeve repair, a limited maintenance inspection should be performed on the surface of the hose beneath the damaged area using the rejection criteria in the General Inspection Requirements listed above.

b. Once put into service, the repaired hose assembly shall then be routinely inspected iaw the current maintenance practice and the tape renewed if it displays fraying or unbonding. The repaired hose may remain in service (subject to routine inspections) until the hose is removed for testing iaw the current maintenance scheduling.

c. When the hose is removed for scheduled maintenance testing the fire sleeve is to be removed and replaced with a new sleeve without dismantling the end fittings. If difficulty is experienced with removal or replacements of the sleeve, then the complete assembly shall be replaced.

d. The approved fire sleeve tape has been codified under NSN 5640-66-148-5239. Alternatively, the tape can be procured by local purchase as follows:

Identification: RYCO Part Number FSTAPE-16
Description Fire Sleeve Tape, 25mm x 0.5mm x 11M
Supplier: Hi-Impulse Equipment Pty Ltd
21 Ilma Street
Condell Park NSW 2200
Tel: (02) 9772 2555   Fax: (02) 9774 5935

SPECIFIC REQUIREMENTS

In-service Testing

25. **PTFE, Thermoplastic and Metal Hose Assemblies.** These hoses shall only be hydrostatically tested as required by the appropriate planned maintenance requirement or when a requirement exists to use a hose that does not meet all of the criteria at Paragraph 17, to 150 percent of the system working pressure but not less than 100 psig, (690 kPa) except for LM2500 gas turbine flexible hoses. Hoses operating in vacuum service shall be tested to 100 psig (690 kPa). The hose must not burst, leak nor show signs of fitting separation.

26. **Gas Turbine (GTRB) Flexible Hoses.** Gas Turbine Engine flexible hoses are wire braided teflon hoses fitted with a fire sleeve. These hoses are to be periodically inspected according to the appropriate planned maintenance requirement but do not normally require any pressure testing between overhauls of the gas turbine. Should any in service hydrostatic pressure testing be required for FFG equipment the test pressures and procedures are covered in TMS 2341-RAN-001. ANZAC Class GTRB hoses are not subject to periodic testing and any queries on this matter should be directed to the ANZAC System Program Office.

27. All flexible hoses integral to the GTRB are to be subjected to a proof test when the engine undergoes an overhaul (ie depot level repair). The proof pressure, as determined by General Electric USA, is covered in NAVSEA S9234-AB-MMD-020/LM2500 for FFG hoses and in General Electric factory manuals for ANZAC hoses.
28. Metal hoses that have been welded or brazed into their system shall not be removed for the purpose of post examination hydrostatic testing. Pressure testing of these hoses, whether hydrostatic or other means, should be concurrent with any system pressure tightness test/s conducted.

29. If required, in-service hydrostatic pressure testing procedures, except for the applied pressure, shall be as defined at Paragraph 13.

30. On completion of a satisfactory test, a new completed identification/test status tag, iaw Paragraph 14, shall be attached and the ship’s register of flexible piping devices annotated accordingly.

### Spare Hose Assemblies

31. Hose assemblies not addressed at paragraphs 1 and 4 that are received without an identifying/test status tag attached shall be inspected and hydrostatically proof tested in accordance with Paragraph 13 before use. Where it is not feasible to conduct a proof test and exigencies of service dictate that the hose be used, it shall be proof tested at the earliest opportunity.

32. It is emphasised that the shelf and service life requirements imposed by this directive apply only to synthetic rubber hoses used in critical applications. Spare rubber hose assemblies, whose shelf life has expired, may be used when exigencies of service dictate. In these instances, any planned maintenance inspection and testing that is normally applicable to that item should be conducted prior to the item being put into service and the baseline for the planned maintenance periodicity should be set at that date. Any shelf life expired hose assemblies that have to be used in critical systems, as defined at Table 1, shall be managed so that the excess shelf life is deducted from the 12 years maximum service life and should be replaced no later than 16 years from their cure date. For example, if the shelf life of a hose is extended from 4 to 6 years, then the maximum service life should be reduced from 12 to 10 years. Users should be aware of this condition by comparing the Cure Date and Installation Date recorded on the hose tag. Any shelf life expired hose assemblies that are used in non-critical systems, as defined at Table 1, shall be replaced as determined by condition based monitoring.

33. If a critical synthetic rubber hose is provided via the DMO supply chain without an identifiable cure date it may still be used provided it meets the General (visual inspection) Requirements. In such cases the hose assembly can be assumed to have a remaining service life of eight years. This can be managed by inserting an estimated cure date of eight years prior to installation on the tag and register. Further advice should be sought from CME or other DAR before using spare rubber hose assemblies whose origin and cure dates are unknown.

### Original Equipment Manufacturer’s (OEM) Hoses

34. OEM hoses may be replaced with hoses of the same material type, to an equal or higher standard, if the installed hoses have not been a problem, subject to CME or other DAR concurrence.

### Prototype Hoses

35. For a prototype hose to be qualified, it must be certified by a Design Acceptance Representative (DAR). One sample of each new type of hose assembly is to be subjected to a qualifying hydrostatic pressure test of the complete assembly, including end fittings, of five times the maximum system working pressure or the hose assembly proof pressure, whichever is higher (apart from hyperbaric hoses). In no case is the bursting pressure to be less than five times (5x) the maximum system working pressure. The prototype hose assembly that is subjected to a qualifying pressure that is higher than the proof pressure is not to be used as a working hose assembly. Hyperbaric hoses shall require the hose to be approved by an approved designer and certified by a DAR.

36. Irrespective of the requirement at paragraph 35, all prototype hose assemblies are to be subjected to a proof (or initial) pressure as required at paragraph 14.
Rubber Expansion Joints – Inspections

37. All rubber expansion joints should be inspected externally in accordance with the appropriate planned maintenance requirement. The periodicity of inspection should be at least quarterly, with special attention being given to the large diameter joints installed in the sea connections to and from main condensers. Visually examine the outer cover of joints for evidence of cracks. Shallow cracks in the cover that do not expose the reinforcing fabric are not considered serious enough to warrant replacement of the joint, however, if the reinforcing fabric is exposed, but not damaged, the joint should be replaced at the next availability of the ship. If any exposed reinforcing fabric is torn, cut or otherwise degraded, the joint should be replaced at the earliest opportunity.

38. Rubber expansion joints in normally unmanned spaces should be replaced at least every 6 years. In manned spaces they should be replaced no later than 12 years after installation and internally inspected in accordance with the appropriate planned maintenance requirement during each 6 year period. For small diameter joints this inspection will require the removal of the joint from the system. However for large joints, where access is provided, it may be possible to conduct the internal inspection without removal of the joint.

RECORDING OF INFORMATION

39. Ships are to maintain a register of all critical fitted hose assemblies subject to lifting in paragraph 11 and rubber expansion joints, in which the following minimum information shall be held for each individual hose assembly and expansion joint:
   a. unique identifier,
   b. where fitted,
   c. test pressure,
   d. date last tested, (if applicable)
   e. hoses type and size, and
   f. cure date (if applicable).

OTHER CONSIDERATIONS

40. If a conflict exists or is deemed to exist between this directive and a planned maintenance requirement, it should be directed to CME for arbitration and amendment.

41. These instructions will be included in the relevant documentation including chapters of ABR 5225 for general requirements, and DEF(AUST) 5000 Volume 4 for specific hyperbaric requirements in due course.

42. This TM 181 has also been endorsed by CSO(E).
<table>
<thead>
<tr>
<th>Drafted by:</th>
<th>Endorsed by:</th>
<th>Released by:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signature:</td>
<td>Signature:</td>
<td>Signature:</td>
</tr>
<tr>
<td>Original signed by</td>
<td>Original signed by</td>
<td>Original signed by</td>
</tr>
<tr>
<td>Name: CMDR Bob Horsnell</td>
<td>Name: CDRE R.J. Longbottom</td>
<td>Name: CDRE R.J. Longbottom</td>
</tr>
</tbody>
</table>

**TM 181**

March 2004

Department of Defence

**TECHNICAL DIRECTIVE**

Serial Number: 070/05