

INCH-POUND

MIL-STD-1622A(SH)

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SUPERSEDING

MIL-STD-1622(SHIPS)

20 September 1973

# MILITARY STANDARD

## CLEANING OF SHIPBOARD COMPRESSED AIR SYSTEMS



FSC 4310

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### FOREWORD

1. This military standard is approved for use by the Naval Sea Systems Command, Department of the Navy and is available for use by all departments and agencies of the Department of Defense.

2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should addressed to: Commander, Naval Sea Systems Command, Sea 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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**1. SCOPE**

**1.1 Scope.** This standard provides the requirements for cleaning shipboard compressed air systems and non-oxygen interfacing gas systems. This standard does not apply to reactor plant air systems.

**1.2 Exhaust gas and carbon dioxide systems.** Additionally, this standard provides the requirements for cleaning shipboard exhaust gas and carbon dioxide systems.

**2. APPLICABLE DOCUMENTS****2.1 Government documents.**

**2.1.1 Specifications and standards.** The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issue of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

**SPECIFICATIONS****FEDERAL**

BB-N-411	Nitrogen, Technical
O-S-642	Sodium Phosphate, Tribasic, Anhydrous; Dodecahydrate; and Monohydrate; Technical

**MILITARY**

MIL-D-16791	Detergents, General Purpose (Liquid, Nonionic)
MIL-C-81302	Cleaning Compound, Solvent, Trichlorotrifluoroethane

**STANDARDS****MILITARY**

MIL-STD-1330	Cleaning and Testing of Shipboard Oxygen, Nitrogen, and Hydrogen Gas Piping Systems
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(Unless otherwise indicated, copies of federal and military specifications and standards are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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**2.1.2 Other Government documents and publications.** The following other Government documents and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

## PUBLICATIONS

## NAVAL SEA SYSTEMS COMMAND (NAVSEA)

Instruction 4855-9	Operation and Certification Requirements for Fleet Mechanical Instrument Calibration Activities
OD45845	Metrology Requirement List
S9086-SY-STM-010/CH551	Compressed Air Plants

(Applications for copies should be addressed to: Commanding Officer, Naval Publications and Forms Center, Attn: 1053 Tabor Avenue, Philadelphia, PA 19120-5099.)

**2.2 Non-Government publications.** The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

## AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

D471	Standard Test Method for Rubber Property – Effect of Liquids
D1414	Standard Test Methods for Rubber O-Rings; (DOD adopted)

(Applications for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

## 3. DEFINITIONS

**3.1 Clean.** A clean surface shall be free of all loose scale, rust, grit, filings, oil, grease, other organic materials, and foreign substances, as specified within this standard.

**3.2 Standard conditions.** For the purpose of this standard, standard conditions refer to an atmospheric pressure of 14.7 pounds per square inch (lb/in<sup>2</sup>) at a temperature of 68 degrees Fahrenheit (°F) and a relative humidity of 36 percent.

**3.3 Dead-end piping.** Dead-end piping is a pipe through which the flow of a gas or liquid cannot be accomplished without cutting or removing a pipe or component.

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**3.4 Sample.** A sample is a representative amount of cleaning or purging medium collected in clean containers at selected end of system sample points specified by the cleaning activity.

**3.5 Low-pressure air system.** A low-pressure air system is an air system which operates at pressures between 0 and 150 lb/in<sup>2</sup>.

**3.5.1 Vital air main.** A vital air main is that portion of the ship service low-pressure air system which serves users whose continuous operation is essential for safety and mission capability of the ship.

**3.5.2 Non-vital air main.** A non-vital air main is that portion of the ship service low-pressure air system which serves other than vital users.

**3.5.3 Electronics dry air main.** An electronics dry air main is that portion of the vital air main which is used for pressurization of various types of radar waveguides and antennas, electronic equipment, and transmission systems.

**3.6 Medium-pressure air system.** A medium-pressure air system is an air system which operates at pressures between 151 and 1,000 lb/in<sup>2</sup>.

**3.7 High-pressure air system.** A high-pressure air system is an air system which operates at pressures above 1,000 lb/in<sup>2</sup>.

**3.8 Bleed air system.** A bleed air system is a system in which air is supplied from compression stage of a gas turbine generator or a propulsion gas turbine.

**3.9 Deballast air system.** A deballast air system is a low-pressure air system which is used for deballasting amphibious assault ships.

**3.10 Nitrogen system.** Nitrogen systems are used for pressure operated mechanisms such as recoil systems, optical instrument applications, and where inert gas-blankets are required. Nitrogen systems that are used for purging the oxygen system and the oxygen generator shall be cleaned in accordance with MIL-STD-1330.

**3.11 Carbon dioxide system.** Carbon dioxide systems are used for fixed fire fighting systems, inerting cofferdams and purging and charging gasoline system piping.

**3.12 Diver's air system.** Diver's air systems provide driver-quality compressed air at high pressure. The conditions which this specification may be used to clean any driver's air system that supports oxygen, helium, or helium-oxygen driving facilities shall be as specified (see 6.3).



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**3.13 Emergency breathing air system.** Emergency breathing air systems provide emergency breathing air via stations throughout submarines and specified pump rooms and machinery spaces.

**3.14 Exhaust gas system.** Exhaust gas systems supply exhaust for purging and charging gasoline tank compartments, inerting of cofferdams surrounding gasoline tanks, and for flooding the exhaust gas producer room.

**3.15 Compressed air components.** For the purpose of this standard, compressed air components include the following: compressors, dehydrators, filters, valves, pressure vessels, pressure gauges, control panels, and orifices.

**3.15.1 Pressure gauges.** Pressure gauges shall be cleaned in accordance with NAVSEA Instruction 4855.9, and meet the cleanliness levels specified in tables II and III (as applicable) before installation into the system.

**3.16 Cleaning agents.**

**3.16.1 Cleaning solution.** Cleaning solution is a cleaning medium containing water and dissolved tribasic sodium phosphate (TSP) as specified in 4.6 or a similar cleaning medium in accordance with S9086-SY-STM-010/CH-551 or as otherwise specified (see 6.3).

**3.16.2 Cleaning solvent.** Cleaning solvent is trichlorotrifluoroethane (R-113) as specified in 4.5. Unless otherwise specified (see 6.3) trichlorotrifluoroethane (R-113) shall not be used for cleaning.

**3.17 Water.** Three grades of water, A, B, and C in descending order of purity which are to be used for cleaning, flushing, and engineering tests are defined in table I. Water purity requirements specified throughout this standard are minimum requirements and do not preclude the use of water of greater purity for any operation. When the conductivity of grade A water is 0.25 micromhos/centimeter or less, hydrogen-ion concentration (pH) measurements are not required.

**TABLE I. Water grades.**

Grade	A	B	C
Chloride ion, maximum, ppm	0.1	1.0	35
Conductivity, maximum micromhos/cm	2.5	20	550
ph range	6.0 – 8.0	–	–
Visual clarity	No turbidity, oil, or sediment		

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Power plant condensate and distilled water normally meet the requirements for grade B water. Ordinary tap water normally meets the requirements for grade C water. The lower pH specification of 6.0 for grade A water is for water supplied directly from a demineralizer. Where water has been subject to possible carbon dioxide absorption, such as when retained in storage tanks, the pH specification may be lowered to 5.7 to compensate for the carbon dioxide pickup. The above pH, conductivity, and turbidity requirements do not apply when water is treated with a corrosion inhibitor as approved by NAVSEA or its authorized representative.

### 4. GENERAL REQUIREMENTS

#### 4.1 Flushing and sampling equipment.

**4.1.1 Flushing equipment.** A typical flushing rig should have the following components:

- a. Holding tank (with a heat source when cleaning with a solution or conducting a hot water flush)
- b. Recirculation pump
- c. Isolation valves
- d. Flow and pressure measuring devices
- e. Flexible hoses and fittings (required to connect into an affected system)
- f. Filters
- g. Strainers.

A typical flushing rig may be configured as shown on figure 1. Flushing rig shall meet the temperature, pressure, and flow rates required by the cleaning procedures being used. Flushing rig components shall be compatible with the cleaning medium being used, as specified in 5.1.2. Polyvinylchloride tubing should not be used when flushing with R-113. Prior to use, flushing rig components shall be cleaned to the applicable level required for the system being flushed (see table II or III). The differential pressure across the flush rig filter shall be monitored during flushing operations and the element cleaned or replaced based upon manufacturers recommendations.

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TABLE II. Submarine compressed air system cleanliness level.

System	Maximum allowable particulate	Maximum allowable hydrocarbons	Maximum allowable dew point <sup>2</sup>	Maximum allowable water content
Low-pressure air	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup>	0.000079 lb H <sub>2</sub> O/lb dry air <sup>4</sup>
Medium-pressure air	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup>	0.000079 lb H <sub>2</sub> O/lb dry air <sup>4</sup>
High-pressure air	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup> -5	0.000079 lb H <sub>2</sub> O/lb dry air <sup>4</sup>
Diver's air	5 mg/m <sup>3</sup> non-dec <sup>1</sup>	15 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup>	0.000079 lb H <sub>2</sub> O/lb dry air <sup>4</sup>
Nitrogen	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup>	0.000079 lb H <sub>2</sub> O/lb dry air <sup>4</sup>
Carbon dioxide	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup>	0.000079 lb H <sub>2</sub> O/lb dry air <sup>4</sup>
Emergency breathing air	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup>	0.000079 lb H <sub>2</sub> O/lb dry air <sup>4</sup>

<sup>1</sup>The maximum allowable particulate sizes shown here refer to the micrometer ( $\mu\text{m}$ ) rating of the particulate filter shown in the flushing and blowdown rigs, figures 1 and 2.

<sup>2</sup>The maximum allowable dew points shown here are for the degree of dryness required after cleaning with this standard and other hydrostatic and tightness testing that may be required. Operational dewpoint requirements shall be attained by normal operations after the system has been restored.

<sup>3</sup>Milligrams per cubic meter (mg/m<sup>3</sup>).

<sup>4</sup>Pound of water per pound (lb H<sub>2</sub>O/lb).

<sup>5</sup>Maximum allowable dewpoint for the EMBT blow system will be -60 °F at 14.7 lb/in<sup>2</sup>.

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TABLE III. *Surface ship compressed air system cleanliness level.*

System	Maximum allowable particulate	Maximum allowable hydrocarbons	Maximum allowable dew point	Maximum allowable water content
Low-pressure non-vital air	No visible traces	No visible traces	N/A	No visible traces
Low-pressure vital air	5 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	+50 °F at 90 lb/in <sup>2</sup>	0.0015 lb H <sub>2</sub> O/lb dry air
Electronics dry air	5 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup> <sub>-2</sub>	0.000079 lb H <sub>2</sub> O/lb dry air
Medium-air pressure	No visible traces	No visible traces	N/A	No visible traces
High-pressure air	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup> <sub>-2</sub>	0.000079 lb H <sub>2</sub> O/lb dry air
Bleed air <sup>3</sup>	No visible traces	No visible traces	N/A	No visible traces
Deballast air	No visible traces	No visible traces	N/A	No visible traces
Emergency breathing air	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	N/A	No visible traces
Diver's air	5 mg/m <sup>3</sup> non-decl <sup>1</sup>	15 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup> <sub>-2</sub>	0.000079 lb H <sub>2</sub> O/lb dry air
Nitrogen	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup> <sub>-2</sub>	0.000079 lb H <sub>2</sub> O/lb dry air
Exhaust gas	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup> <sub>-2</sub>	0.000079 lb H <sub>2</sub> O/lb dry air
Carbon dioxide	15 $\mu\text{m}$ particle size <sup>1</sup>	50 p/m by weight	-40 °F at 14.7 lb/in <sup>2</sup> <sub>-2</sub>	0.000079 lb H <sub>2</sub> O/lb dry air

<sup>1</sup>The maximum allowable particulate sizes shown here refer to the micrometer rating of the particulate filter shown in the flushing and blowdown rigs, figures 1 and 2.

<sup>2</sup>The maximum allowable dew points shown here are for the degree of dryness required after cleaning with this standard and other hydrostatic and tightness testing that may be required. Operational dewpoint requirements shall be attained by normal operations after the system has been restored.

<sup>3</sup>Maximum allowable chloride content is 1.0 p/m.

**4.1.2 Sampling equipment.** Sampling containers, specified by the laboratory or cleaning activity, shall be cleaned to the applicable level required for the system being flushed.

**4.2 Water.** Unless otherwise specified (see 6.3), water shall be in accordance with paragraph 3.17, grade B or better.

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**4.3 Nitrogen.** Nitrogen shall be in accordance with BB-N-411, type I, class 1, grade A or B.

**4.4 Air.** As a minimum, air shall meet the quality requirements of the system in which it is used.

**4.5 Trichlorotrifluoroethane.** Unless otherwise specified (see 6.3), trichlorotrifluoroethane (R-113) shall not be used for cleaning. Trichlorotrifluoroethane (R-113) shall be in accordance with MIL-C-81302, type I. Used or contaminated R-113 may be reclaimed for use if it is purified by distillation and meets the requirements of MIL-C-81302, type I, with the following exceptions:

Property	Requirement
Moisture content, parts per million (p/m) maximum by weight	35
Hydrocarbon content, p/m maximum by weight	3
Residue content, p/m maximum by weight	3

**4.6 Tribasic sodium phosphate.** TSP shall be in accordance with O-S-642, type I or II. For the purpose of this standard, a TSP solution shall be prepared by dissolving 2 pounds of type I or 4.5 pounds of type II, per 5 gallons of water. The water shall be heated and agitated to dissolve the TSP, and the solution shall be maintained at a minimum inlet temperature of 150 °F and a minimum exit temperature of 110 °F when used for cleaning. To prevent solid TSP from separating, the solution shall not be allowed to cool below 110 °F or remain uncirculated in a system. For this reason, TSP shall not be used for flushing dead-end piping. In cases where dead-end piping cannot be eliminated, guidance for cleaning method will be provided (see 6.3).

**4.7 Disposal of waste solvents and water.** R-113 is an environmental pollutant and shall be returned to its original container after use. The container shall be marked "DIRTY R-113 SOLVENT" and retained for proper disposal. Used or contaminated R-113 may be reclaimed for use as specified in 4.5. TSP shall be neutralized and discharged in accordance with local and federal regulations. Flushing water containing flux residue shall be disposed of in accordance with local and federal regulations.

**4.8 Shipboard conditions.** If shipboard conditions are such that a particular system cannot be flushed as a single unit, that system may be divided into sections and flushed separately. Caution shall be exercised so that portions of a system which have been certified clean by the laboratory are not flushed with contaminated cleaning solvent or solution.

**4.9 Visual inspection.** Samples of cleaning solvent, cleaning solution, and rinse water shall be visually inspected for particulate and hydrocarbon contamination. Samples of cleaning solvent and cleaning solution for inspection shall be obtained and analyzed in a clean white dish or clean glass sample bottle. Inspection shall be performed by a person with normal visual acuity, natural or corrected. Particulate inspection shall be conducted under bright white light of at least 100 foot-candles. A general purpose two D-cell flashlight, in good condition, positioned no greater than

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18 inches directly above a surface will illuminate the surface with an intensity of not less than 100 foot-candles. Hydrocarbon inspection shall be conducted under an ultraviolet (black) light lamp of 3600 to 3900 angstrom units. Any visible contaminants shall be cause for rejection. Rinse water samples shall be visually inspected for hydrocarbon residue or film which can be readily seen floating on the surface of the sample. TSP cleaning solution shall be agitated to form bubbles. Under black light, these bubbles may or may not exhibit fluorescence, depending on the type of hydrocarbon present. R-113 samples shall be evaporated using a low heat. The surface of the sample container shall be wiped with filter paper and the filter paper shall be inspected for fluorescence.

### **4.10 Safety precautions.**

**4.10.1 Space ventilation.** Prior to cleaning with R-113, compartments and ballast tanks with air piping shall be well ventilated so that when halide leak detectors are used they will not register any foreign gasses such as paint fumes or fluorocarbon refrigerants from other equipment. Tests shall be made to ensure that compartments and ballast tanks are free of all detectable gases.

**4.10.2 Atmosphere monitoring.** When a cleaning evolution using R-113 is in progress, affected compartments shall be monitored by an industrial hygienist or gas free engineer to ensure safe limits of the agent are not exceeded. The American Conference of Governmental Industrial Hygienists (ACGIH) states that the threshold limit value (TLV) (8 hours per day, 5 days per week without adverse effect) is 1000 p/m for R-113. For submarines, R-113 be used only when the submarine is surfaced and open to the atmosphere.

**4.10.3 Hearing protection.** Ear protective devices shall be worn during bleed off or pressure relief of high-pressure air systems. Sound pressure levels can reach intensities high enough to cause hearing damage.

**4.10.4 High-pressure air.** High-pressure air systems constitute a hazard in themselves in addition to the hazards involved when hydrocarbons and other contaminants are present. Energy added as air is compressed can result in temperatures high enough to ignite any hydrocarbons in a system. Pressure may subsequently increase enough to cause component failure. To prevent the possibility of a fire, explosion, and component failure, the presence of hydrocarbons or other contaminants in high-pressure air systems shall be eliminated.

**4.10.5 R-113.** Pure R-113 is a colorless liquid at room temperature. It is odorless and nonflammable at room temperature. It is classified as a toxicity 4 on a scale of 1 to 6 by the National Fire Underwriters where 1 is the most toxic and 6 is the least toxic. It has a boiling point of 118 °F at 1 atmosphere. R-113 solvent is chemically and thermally stable below 400 °F. It is nonflammable and nonexplosive in liquid or vapor form. R-113 vapors are several times heavier than air and tend to collect in low areas including spaces near and below the space where R-113 is being used. The solvent is noncorrosive to most metal when free of water, especially for short exposure times required for cleaning. R-113 has minimal effect on most elastomers and plastics; however, it does extract the plasticizer from polyvinylchloride tubing. Therefore this tubing shall not be used in handling the solvent in order to avoid contaminating the solvent with plasticizer.

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**4.10.5.1** R-113 can decompose into phosgene gas and other toxic byproducts when exposed to open flame or hot surfaces having temperatures of 400 °F or greater. The products of decomposition have a pungent odor, are very irritating, and are noticeable even in minute quantities.

**4.10.5.2** Although R-113 is considerably less toxic than many other widely used solvents, exposure to large amounts can cause death. The vapors are toxic in high concentration and may also cause suffocation due to the displacement of air. In high concentrations, fluorocarbons like R-113 have an anaesthetic effect (causing incoordination such as stumbling), can affect the heart beat (causing irregular beats and even stoppage), and can cause tremors, convulsions, and death.

**4.10.5.3** The following safety precautions shall be followed when using R-113.

- a. At least two people shall be present at all times while solvent is being used. Do not leave the area unattended while cleaning is in progress.
- b. When R-113 is being transferred by hose or pipe from a remote location, telephone communication shall be established between the pumping station and the space involved.
- c. To permit escape in the event of an accidental spill, a self-contained breathing device shall be immediately available to each person in any space where operations involving R-113 are taking place or occupied spaces where R-113 leaks may occur while systems containing fluorocarbons are being cleaned. Each person shall have received instruction and practice in the use of the particular self-contained breathing device to be used. When a spill occurs, a high concentration of solvent vapor may rapidly fill the space and dilute the air in the space. Breathing this diluted, contaminated air can result in rapid (10 to 15 seconds) loss of consciousness caused by oxygen being washed from the lungs. It is therefore necessary to stop breathing until the self-contained breathing device has been put on and is supplying air. The Navy Emergency Escape Breathing Device (EEBO) may be used for emergency escape.
- d. All hot work in the space shall be suspended before introducing the solvent into the system. An exception is that during an overhaul in a shipyard, hot work may be performed on board a ship while systems are being flushed with fluorocarbon compounds. Each operation of this type shall be authorized by a gas free engineer. Personnel shall be instructed to leave the area immediately if anyone experiences any irritation of the eyes, nose, or throat. During specially authorized hot work, self-contained breathing devices for emergency escape are not required in spaces where all lines being flushed contain only welded joints (no flanges, valves, or other fittings having mechanical joints). The following caution sign shall also be displayed at the entrance to all work spaces:



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### CAUTION

FLUOROCARBON (FREON) OPERATION; DO NOT ENTER UNOCCUPIED SPACE WITHOUT FIRST TESTING FOR FLUOROCARBONS; NO HOT WORK OR OPEN FLAMES ALLOWED IN THIS SPACE UNLESS AUTHORIZED BY A GAS FREE ENGINEER; LEAVE SPACE IMMEDIATELY IF ANYONE NOTICES ANY EYE, NOSE, OR THROAT IRRITATION.

- e. Carefully check the system for leaks before pumping solvent through the system (see.5.1.3).
- f. Chemical safety goggles or a face shield shall be used while handling the solvent. An eyewash must be located in the area. If splashed into the eyes, flush the eyes with fresh water for at least 15 minutes and obtain prompt medical attention.
- g. Repeated contact with the skin may cause cracking and irritation. Wear solvent-resistant rubber gloves if contact with the hands cannot otherwise be prevented. Clothing that becomes saturated with solvent should be removed at once.
- h. The atmosphere in the space where this solvent is used shall be continuously monitored with an electronic halide leak detector with alarm or equivalent instrument. The concentration of R-113 shall not be allowed to exceed a TLV of 1,000 parts of solvent per million parts of air during a normal working day. If the alarm sounds, immediately put the on the EEBD and promptly leave the space. Anyone reentering the space should wear self-contained breathing apparatus operated in pressure-demand mode.
- i. Be sure ventilation in the space is adequate to keep the concentration of R-113 below 1,000 parts of solvent per million parts of air during anticipated operations, excluding accidents or spills. If necessary, use portable blowers. Exhaust ventilation is preferable to blowing air into the space. Route exhaust ventilation away from populated areas.
- j. Should someone be overcome in a space which lacks oxygen or because of the presence of a high solvent vapor concentration, the person should be removed immediately and given artificial respiration if necessary.

### CAUTION

SINCE FLUOROCARBONS CAUSE CARDIAC SENSITIZATION, THE ATTENDING PHYSICIAN MUST NOT ADMINISTER AN INJECTION OF EPINEPHRINE OR SIMILAR HEART STIMULANT AS CARDIAC ARRHYTHMIA, INCLUDING VENTRICULAR FIBRILLATION, MAY RESULT. THE PATIENT SHOULD BE GIVEN FRESH AIR IMMEDIATELY AND SHOULD NOT BE ALLOWED TO EXERT HIMSELF OR HERSELF.



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- k. When drying out the system with nitrogen, ensure that the solvent vapors and nitrogen are vented outside the skin of the ship away from populated areas. If they cannot be vented outside, a gas free engineer should be consulted. It may be necessary to use an oxygen monitor to ensure that there is not an excessive dilution of oxygen in the air.
- l. Emergency rescue procedures shall be established and proficiency documented to ensure that personnel can be safely removed in the event of hazardous exposures.

**4.10.6 TSP.** TSP is a solid, crystalline material which has a caustic action upon the skin, eyes, and mucous membranes. Repeated or prolonged contact with the solid material or its solutions shall be avoided. Chemical safety goggles or face shield, rubber gloves, and rubber aprons or coveralls shall be worn to prevent skin contact. If skin contact occurs, exposed areas shall be washed with large amounts of fresh water. If irritating dust or solution mist is present, approved respirators shall be worn to avoid inhalation.

**4.10.7 Nitrogen.** For the purpose of this standard, nitrogen shall be considered a nontoxic inert gas. Care shall be exercised in small, closed, or confined spaces to ensure that an excess of nitrogen does not cause suffocation. If any doubt exists, an oxygen monitor with alarm shall be used to monitor the area. Adequate ventilation shall be maintained during use of nitrogen in confined spaces.

**4.10.8 Hot water and cleaning solution.** When flushing with hot water or a heated cleaning solution, a potential burn hazard exists. Precautions shall be taken to prevent personnel from coming in direct contact with hot water, cleaning solution, or with piping being flushed.

## 5. DETAILED REQUIREMENTS

**5.1 Preparation.** Preparation measures shall be followed as specified in 5.1.1 through 5.1.6.

**5.1.1** Isolate and depressurize that portion of the system which is to be cleaned. Ensure that any electrically operated components (such as compressors, dehydrators, solenoid valves, and so forth) are secured and safety tagged. Remove or install jumpers, as applicable, around all system components (defined in 3.15) which could restrict the flow of or be damaged by the cleaning medium. Remove components should be cleaned separately in accordance with 5.5.2 or 5.6.2, as required. Pressure gauges shall be cleaned and calibrated as specified in the applicable procedures in accordance with NAVSEA OD45845.

**5.1.2** Cleaning solvent or cleaning solution shall not be used on rubber, plastic, painted, or coated components with which they are not compatible. When specific information with respect to compatibility is lacking, tests shall be conducted. A repair facility, if properly equipped, may conduct these tests. Compatibility tests shall consist of immersion of test specimens in the cleaning solvent or cleaning solution. Conditions of immersion and testing shall be in accordance with ASTM D 471 and ASTM D 1414. Test specimens shall be completely surrounded by the solvent or solution during immersion. The solvent or solution volume shall be not less than 12 times the total volume of the specimen. Tensile strength, elongation, and hardness after evaporation of the solvent or solution shall be determined in accordance with ASTM D 471. Test requirements to establish compatibility are:

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Volume change:	Minus 0 percent, plus 10 percent
Retention of tensile strength:	Minimum 85 percent
Retention of ultimate elongation:	Minimum 85 percent
Change in durometer hardness:	Maximum durometer unit: plus or minus 5 points
Hydrocarbon check of solvent:	O p/m acceptable

Several cleaning agents and the software with which they are compatible are shown in table IV.

TABLE IV. *Cleaning agents compatible with software.*

Software	Freon PCA MIL-C-81302	TSP O-S-642	Nonionic detergent MIL-D-16791
Adiprene C	X		X
Adiprene L	X		X
Buna N		X	X
Buna S	X	X	X
Butyl			X
Delrin	X	X	X
Epoxy resin	X		X
Kel-f	X	X	X
Hypalon 40	X		X
Kralartic ABS	X		X
Lexan	X		X
Lucite	X		X
Neoprene W	X		X
Nylon		X	X
Polyethylene 7050	X	X	X
Polypropylene 9140	X	X	X
Polyvinyl chloride		X	X
Surlyn A	X		X
Teflon TFE	X	X	X
Teflon FEP	X	X	X
Thiokol FA	X		X
Viton A	X	X	X
Viton B	X	X	X
Zytel 101	X		X
Ethylene propylene		X	X

X – Solvent is compatible with software.

Blank – Solvent is not compatible with software.

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**5.1.3** Prior to cleaning, the system shall be pressurized with air as specified below and all mechanical joints shall be tested with a soapsuds solution to ensure tightness. All leaks shall be repaired prior to cleaning evolutions. Ensure that all temporary flush components are compatible with the test pressures specified below.

- a. Systems operating at pressures less than 75 lb/in<sup>2</sup> test to normal system operating pressure.
- b. Systems operating at pressures greater than 75 lb/in<sup>2</sup> test to 75 lb/in<sup>2</sup> minimum.

**5.1.4** The system may be subdivided as necessary to facilitate optimum cleaning. Proper system subdivision should minimize the need to clean dead-end piping.

**5.1.5** Prior to the use of a cleaning solvent or solution, all new silver brazed piping shall undergo either a hot water flush as specified in 5.3 or a cold water soak as specified in 5.4.

**5.1.6** Applicable compressed air system cleaning procedures are specified in tables V and VI.

**TABLE V. Submarine compressed air system cleaning procedure applicability.**

System	Blowdown	Hot-water flush	Cold-water soak	TSP flush	R-113 flush
Low-pressure air	P	P/S	P/S	P/H	P/H
Medium-pressure air	P	P/S	P/S	P/H	P/H
High-pressure air	P	P/S	P/S	P/H	P/H
Driver's air	P <sup>1</sup>	P/S	P/S	P/H	P/H
Nitrogen	P	P/S	P/S	P/H	P/H
Carbon dioxide	P	P/S	P/S	P/H	P/H
Emergency breathing air	P	P/S	P/S	P/H	P/H

<sup>1</sup>See 6.3.

Types of contamination:

P = Particulate

S = Silver brazing flux

H = Hydrocarbon

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TABLE VI. *Surface ship compressed air system cleaning procedure applicability.*

System	Blowdown	Hot-water flush	Cold-water soak	TSP flush	R-113 flush
Low-pressure non-vital air	P	P/H/S	P/S	P/H	P/H
Low-pressure vital air	P	P/S	P/S	P/H	P/H
Electronics dry air	P	P/S	P/S	P/H	P/H
Medium-pressure air	P	P/H/S	P/S	P/H	P/H
High-pressure air	P	P/S	P/S	P/H	P/H
Emergency breathing air	P	P/S	P/S	P/H	P/H
Diver's air	P <sup>1</sup>	P/S	P/S	P/H	P/H
Bleed air	P	P/H/S/C	P/S/C	P/H	P/H
Deballast air	P	P/H/S	P/S	P/H	P/H
Nitrogen	P	P/S	P/S	P/H	P/H
Carbon dioxide	P	P/S	P/S	P/H	P/H
Exhaust gas	P	P/S	P/S	P/H	P/H

<sup>1</sup>See 6.3.

Types of contamination:

P = Particulate

S = Silver brazing flux

H = Hydrocarbon

C = Chlorides

**5.2 Blowdown procedure.** The blowdown procedure shall be followed as specified in 5.2.1 through 5.2.8.

**5.2.1** This procedure provides a method of verifying system cleanliness without necessitating the introduction of a liquid cleaning agent into an air system. Where hydrocarbons or silver brazing flux must be removed, the procedure of 5.3, 5.4, 5.5, or 5.6 shall be used. NAVSEA approval shall be obtained prior to using this procedure.

**5.2.2** The contaminated section of piping shall be prepared as specified in 5.1.1 and 5.1.3.

**5.2.3** Safety precautions as specified in 4.10.3 and 4.10.4 shall be followed.

**5.2.4** To effect maximum particulate removal, blowdown air flow rates shall be calculated so that turbulent flow will be achieved in all piping runs.

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**5.2.5** Blowdown air may be taken from the affected system or other shipboard or dockside sources. The blowdown source shall provide air of equal or better quality than that of the affected system. The source shall also sustain the flow rate specified in 5.2.4.

**5.2.6** A typical blowdown rig (see figure 2) may consist of and be configured in the following order: a mechanical fitting suitable for connecting to the affected system, pressure gauge, particulate filter, flowmeter, and globe valve. All blowdown rig components shall be sized for the affected system pressure as well as the flow rate criteria specified in 5.2.4. The particulate filter for submarine systems shall be rated at not greater than 15 micrometers. The particulate filter for surface ship systems shall be rated at not greater than 15 micrometers, with the exception of low-pressure vital air and electronics dry air which shall be rated at not greater than 5 micrometers. The particulate filter for submarine and surface ship diver air systems shall be as specified (see 6.3).

**5.2.7** Secure and tag-out all end users for the duration of the blowdown. Isolate and depressurize the contaminated section of pipe. Connect the blowdown rig to the nearest mechanical joint downstream of the contaminated section. Shut the globe valve on the blowdown rig and slowly pressurize the contaminated section to normal system operating pressure or 1500 lb/in<sup>2</sup>, whichever is less. Open the globe valve on the blowdown rig slowly until the required flow is obtained. Blowdown at this rate for 15 seconds and secure. Blowdown with three additional 15-second bursts at the required flow rate. Follow with one continuous 60-second blowdown at the required flow rate. Depressurize the contaminated section and remove and inspect the filter element for visible traces of particulate contamination.

**5.2.8** Repeat the procedure in 5.2.7 as necessary, up to a maximum of three times, until all visible traces of particulate contamination have been removed. If the blowdown procedure is unsuccessful, the procedures in 5.3 or 5.4 may be used.

**5.3 Hot-water flush.** The procedure shall be followed as specified in 5.3.1 through 5.3.7.

**5.3.1** The contaminated section of piping shall be prepared as specified in 5.1.

**5.3.2** Safety precautions as specified in 4.10 shall be followed.

**5.3.3** Used flushing water shall be disposed of as specified in 4.7.

**5.3.4** The water, as specified in 4.2, shall be maintained at a system exit temperature of not less than 110 °F for the duration of the flush. The flushing rate in gallons per minute (gal/min) shall be not less than 1.5 times the inner diameter (in inches) of the line being flushed.

**5.3.5** Completely fill the system or lines with the clean hot water. Circulate the water for a minimum of 1 hour. If the flushing circuit is through parallel piping, flow shall be isolated as necessary to ensure that each path is flushed with full flow or for at least 10 minutes. In those cases where flushing is being accomplished to remove hydrocarbons, all manually operated valves shall

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be cycled several times from full open to partially closed and back to full open to remove any hydrocarbons from the valve balls and stems. Follow with a 1-hour flush of the entire system with all parallel paths open (full flow not required in each leg). Repeat the cycling of manually operated valves during this flush.

**5.3.6** Draw a sample of the flushing water and inspect for visible traces of contamination as specified in 4.9. When flushing installed systems with parallel branches, samples shall be drawn from each branch being flushed. When flushing individual pipe assemblies with parallel branches in a shop, a single sample can be utilized. If contamination is found, continue flushing. Flush until all visible contaminants have been eliminated.

**5.3.7** Following a successful visual inspection, drain the system completely and purge with a medium specified in table VII. Purge until the applicable dew point and water content in table II or III is attained.

TABLE VII. *Compressed air system purging medium applicability.*

Surface ships	Purging medium	
	Air	Nitrogen
Low-pressure non-vital	X	
Low-pressure vital	X	X
Electronics dry air	X	X
Medium-pressure air	X	
High-pressure air	X	X
Deballast air	X	
Emergency breathing air	X	X
Diver's air	X	X
Nitrogen	X	X
Submarines		
Low-pressure air	X	X
Medium-pressure air	X	X
High-pressure air	X	X
Diver's air	X	X
Nitrogen	X	X

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**5.4 Cold-water soak.** The procedure shall be followed as specified in 5.4.1 through 5.4.7.

**5.4.1** The contaminated section of piping shall be prepared as specified in 5.1.

**5.4.2** Safety precautions as specified in 4.10 shall be followed.

**5.4.3** Used flushing water shall be disposed of as specified in 4.7.

**5.4.4** Fill the affected portion of the system completely with clean fresh water as specified in 4.2 at a temperature of not less than 60 °F and allow the water to stand for 12 hours. At the end of 12 hours, completely drain the system.

**5.4.5** Refill the system completely with clean fresh water. Circulate the water for 4 hours, maintaining a temperature of not less than 60 °F. The flushing rate in gal/min shall be not less than 1.5 times the inner diameter in inches of the line being flushed.

**5.4.6** At the end of 4 hours, sample the flush water and examine for visible traces of contamination as specified in 4.9. When flushing installed systems with parallel branches, samples shall be drawn from each branch being flushed. When flushing individual pipe assemblies with parallel branches in a shop, a single sample can be utilized. If visible traces of contamination are found, continue flushing. Flush until all visible traces of contamination have been eliminated.

**5.4.7** Following a successful visual inspection, drain the system completely. Purge the system with the medium specified in table VII until the dew point and water content are within the applicable requirements to table II or III.

**5.5 R-113.** Unless otherwise specified (see 6.3) trichlorotrifluoroethane (R-113) shall not be used for cleaning.

**5.5.1 R-113 system cleaning procedure.** The cleaning procedure shall be followed as specified in 5.5.1.1 through 5.5.1.9.

**5.5.1.1** The contaminated section of piping shall be prepared as specified in 5.1.

**5.5.1.2** Safety precautions as specified in 4.10 shall be followed.

**5.5.1.3** Used R-113 solvent shall be disposed of as specified in 4.7.

**5.5.1.4** Completely fill the affected portion of the system with R-113 solvent. Circulate the solvent for a minimum of 30 minutes. The flushing rate in gal/min shall be calculated so that a Reynolds number of 4000 is maintained in the line being flushed. If the flushing circuit is through parallel piping, the flow shall be isolated as necessary to ensure that each path is flushed with full flow for at least 5 minutes. During the flush, all manually operated valves shall be cycled several times from full open to partially closed and back to full open to remove any hydrocarbons from the valve balls and stems. Follow with a 30-minute flush of the entire system, with all parallel paths open (full flow not required in each leg). Repeat the cycling of manually operated valves during this flush.

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**5.5.1.5** Draw a sample of the cleaning solvent and visually inspect for contamination as specified in 4.9.

**5.5.1.6** If visible traces of particulate are found, continue flushing until acceptable samples are obtained. When flushing installed systems with parallel branches, samples shall be drawn from each branch being flushed. When flushing individual pipe assemblies with parallel branches in a shop, a single sample can be utilized. If visible traces of hydrocarbon contamination are found, drain the system and repeat the flush using clean solvent as specified in 4.5. Reflush as necessary until all visible traces of hydrocarbon contamination have been eliminated.

**5.5.1.7** For those systems whose maximum allowable hydrocarbon content is expressed in p/m as specified in table I or II, as applicable, hydrocarbon content shall be determined after a successful visual particulate inspection by using the following method:

Infrared spectroscopy is an accurate method of hydrocarbon detection and very rapid once a calibration curve is established. Reagent grade n-hexane or mineral oil is used as the hydrocarbon standard material. To prepare calibration standards, densities are used to convert milligrams n-hexane or mineral oil to microliters and grams to milliliters. Calculated volumes of reagent grade n-hexane or mineral oil are measured with a microliter syringe and diluted in volumetric glassware with R-113 which has been certified to meet the residue requirement of MIL-C-81302, type I. Prepare a series of weight/weight standards to establish a calibration curve of p/m hydrocarbons versus absorbance. On a single-beam spectrophotometer, the meter is zeroed with a specimen of certified R-113 in a 5-centimeter-pathlength near-infrared silica cell. On a double-beam instrument, certified R-113 is used in 5-centimeter cells in the reference and sample beams to zero the chart pen. Replace the R-113 in the sample cell with a calibration standard or sample and determine the absorbance in the 3.4-micrometer wavelength region. For calibration standards, plot p/m hydrocarbons versus absorbance. For samples, refer to the calibration curve to determine p/m hydrocarbon content corresponding to the absorbance obtained.

**5.5.1.8** If hydrocarbon contamination exceeds the limits specified in table II or III, as applicable, the system shall be completely drained and the flush repeated. Re-flush as necessary to meet the applicable hydrocarbon contamination limits.

**5.5.1.9** When the hydrocarbon contamination limits are within the applicable requirements of table I or II, drain the system completely. Purge with the medium specified in table VII. A vacuum pump may be used in the final stages of solvent removal. Heat (200 °F maximum) may be applied to the external surfaces of the pipe to facilitate removal of the cleaning solvent. Monitor the exhaust with a halide leak detector for traces of cleaning solvent. Continue the purge until there are no detectable traces of solvent in the system. Upon the removal of all detectable traces of solvent, submarine and diver's air systems shall be pressurized with nitrogen at 100 lb/in<sup>2</sup>. After 1 hour, samples of nitrogen shall be taken under pressure and analyzed for solvent content by gas chromatographic or equivalent procedures. The maximum allowable solvent content shall be 10 p/m by volume. Repeat the purge as necessary until an acceptable sample is obtained.



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**5.5.2 R-113 component cleaning procedure.** The cleaning procedure shall be followed as specified in 5.5.2.1 through 5.5.2.9.

**5.5.2.1** Prepare the section of piping in which the component is located as specified in 5.1.

**5.5.2.2** Safety precautions as specified in 4.10 shall be followed.

**5.5.2.3** Used R-113 solvent shall be disposed of as specified in 4.7.

**5.5.2.4** Remove the component from the system. If it is impractical to remove a component from a system, it may be cleaned and inspected in place using the procedure specified in 5.5.2.6 and 5.5.2.7. Disassemble the component as required to permit thorough cleaning. Parts or component internals which may be damaged by the solvent (see 5.1.2) shall also be removed and cleaned separately.

**5.5.2.4.1** Completely immerse the component in a container filled with solvent. Soak and agitate the component for a minimum of 10 minutes. If available, an ultrasonic cleaner may be used. R-113 shall be used only in ultrasonic cabinets designed for R-113 use. Such cabinets are equipped with local exhaust ventilation, and temperature gradients compatible with R-113 solvent. A non-metallic scrub brush compatible with the solvent may be used to facilitate cleaning. At the end of 10 minutes, a sample of used solvent shall be taken and inspected visually for contamination as specified in 4.9.

**5.5.2.4.2** If visible contamination is found, drain and rinse the container and refill it with clean solvent as specified in 4.5. Repeat the procedure specified in 5.5.2.4.1, as required, until an acceptable visual sample is obtained.

**5.5.2.5** For components whose maximum allowable hydrocarbon content is expressed in p/m as specified in table I or II, as applicable, hydrocarbon content shall be determined as specified in 5.5.1.7 after a successful visual particulate inspection. Clean as necessary until the hydrocarbon content is within the applicable limits of table II or III.

**5.5.2.6** If a component cannot be isolated from the system for flushing and must be cleaned in place, the following procedure may be used: Disassemble the component to the extent required for thorough cleaning. Using a clean lint-free white cloth compatible with the cleaning agent, saturated with cleaning agent, thoroughly wipe the internal portion of the component. Wipe as required until there are no visible traces of particulate contamination when the rag is examined as specified in 4.9.

**5.5.2.7** Visually inspect the internal portion of the component for hydrocarbon materials using a black light of 3600 to 3900 angstrom units, bright white light, and clean filter paper surface swipes.

**5.5.2.8** If visible traces of hydrocarbon are present, the component shall be cleaned as specified in 5.5.2.4 and 5.5.2.5.

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**5.5.2.9** When the component has been cleaned to the applicable requirements of table II or III, it shall be blown completely dry using the medium specified in table VII or by vacuum oven means. Reinstall the component in the system.

**5.5.3 R-113 dead-end piping cleaning procedure.** The cleaning procedure for the dead-end piping in the R-113 system shall be as specified in 5.5.3.1 through 5.5.3.9.

**5.5.3.1** The contaminated section of piping shall be prepared as specified in 5.1.

**5.5.3.2** Safety precautions as specified in 4.10 shall be followed.

**5.5.3.3** Disposal of used solvent shall be as specified in 4.7.

**5.5.3.4** The dead-end piping shall be evacuated to a minimum of 25 inches of mercury (Hg) vacuum and the vacuum broken with solvent. A moderate nitrogen pressure of 5 to 7 lb/in<sup>2</sup> may be applied, if necessary, to ensure complete filling of piping. Soak the piping for a minimum of 1 hour.

**5.5.3.5** At the end of 1 hour, drain and sample the solvent and visually inspect for contamination as specified in 4.9.

**5.5.3.6** If visible traces of contamination are found, completely drain the system and repeat the soak as specified in 5.5.3.4. Repeat the soak with clean solvent as necessary until there are no visible traces of contamination.

**5.5.3.7** For those systems whose maximum allowable hydrocarbon content is expressed in p/m as specified in table I or II, as applicable. Hydrocarbon content shall be verified as specified in 5.5.1.7.

**5.5.3.8** If the hydrocarbon content exceeds the applicable limit as specified in table II or III, the system shall be drained and the procedure repeated. Repeat the procedure as necessary to ensure that hydrocarbon contamination is within the applicable limit of table II or III.

**5.5.3.9** Following a successful hydrocarbon inspection, drain the system completely and purge as specified in 5.5.1.9.

**5.6 TSP.**

**5.6.1 TSP system cleaning procedure.** The cleaning procedure shall be followed as specified in 5.6.1.1 through 5.6.1.10.

**5.6.1.1** The contaminated section of piping shall be prepared as specified in 5.1.

**5.6.1.2** Safety precautions as specified in 4.10 shall be followed.

**5.6.1.3** Used TSP solution shall be disposed of as specified in 4.7.

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**5.6.1.4** A TSP solution shall be prepared as specified in 4.6. The solution shall be maintained at a inlet temperature of not less than 150 °F and an exit temperature of not less than 110 °F through the duration of the flush. The flushing rate in gal/min shall be not less than 1.5 times the inner diameter in inches of the line being flushed.

**5.6.1.5** Completely fill the affected portion for the system with the TSP solution. Circulate the solution for a minimum of 30 minutes. If the flushing circuit is through parallel piping, the flow shall be isolated as necessary to ensure that each path is flushed with full flow for at least 5 minutes. During the flush, all manually operated valves shall be cycled several times from full open to partially closed and back to full open to remove any hydrocarbons from the valve balls and stems. Follow with a 30-minute flush of the entire system, with all parallel paths open (full flow not required in each leg). Repeat the cycling of manually operated valves during this flush.

**5.6.1.6** Draw a sample of clear solution and inspect visually for contamination as specified in 4.9. If visible traces of particulate contamination are found, continue flushing. Flush until all visible particulate contamination is eliminated. If visible traces of hydrocarbon contamination are found, drain the system and repeat the flush. Flush until there is no visible hydrocarbon contamination.

**5.6.1.7** For systems whose maximum allowable hydrocarbon content is expressed in p/m as specified in table II or III, as applicable, hydrocarbon content shall be determined after a successful visual inspection, as follows:

A sample of the TSP solution shall be cooled. The sample shall then be mixed with a solution of hydrochloric or sulfuric acid as required to achieve a pH below 7. Perform an extraction on the solution using an equal volume of R-113. The extraction shall be accomplished in two steps so that the final volume of R-113 is equal to the volume of the TSP sample. The extract shall then be analyzed for hydrocarbon content as specified in 5.5.1.7. The system shall then be flushed until the hydrocarbon contamination is within the applicable limits of table II or III.

**5.6.1.8** If an infrared spectrophotometer is not available, a residue test may be used. A suitable portion of TSP solution shall be acidified and an extraction with R-113 shall be accomplished as specified in 5.6.1.7. The extract shall be filtered through medium-grade filter paper to remove suspended TSP, evaporated to dryness and the residue weighed. An equivalent volume of unused cleaning solution shall be processed in the same manner as the sample. The weight of residue is used to calculate p/m weight contamination in the sample and unused solution. The contamination content of the sample shall not exceed that of the unused solution by more than the limits specified in table I or II, as applicable. Re-flush as necessary to meet this requirement.

**5.6.1.9** When the used TSP sample is within the applicable hydrocarbon contamination limits of table I or II, the system shall be completely drained. Immediately following the removal of the cleaning solution, fill the system with clean fresh water as specified in 4.2. Circulate the water at the flow rate specified in 5.6.1.4, maintaining an inlet temperature of not less than 150 °F and an exit temperature of not less than 110 °F. Continue the rinse until the pH of the outlet rinse water is within 0.5 of the pH value of the inlet rinse water and there are no visible traces of contamination when examined as specified in 4.9.

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**5.6.1.10** Drain all free standing water from the system. Purge the system with the medium specified in table VII until the water content and dew point meet the applicable requirements as specified in table II or III. Heat (not greater than 200 °F) may be applied to external surfaces of the piping to facilitate water removal.

**5.6.2 TSP component cleaning procedure.** The cleaning procedure shall be followed as specified in 5.6.2.1 through 5.6.2.7.

**5.6.2.1** Prepare the section of piping in which the contaminated component is located as specified in 5.1.

**5.6.2.2** Safety precautions as specified in 4.10 shall be followed.

**5.6.2.3** Used TSP solution shall be disposed of as specified in 4.7.

**5.6.2.4** Remove the component from the system. If it is impractical to remove a component from a system, it may be cleaned and inspected in place using the procedures as specified in 5.5.2.6 and 5.5.2.7. If visible traces of hydrocarbons are present, the component shall be cleaned as specified in 5.5.2.4 and 5.5.2.5. Disassemble the component as required to permit thorough cleaning. Parts or component internals which may be damaged by cleaning solution (see. 5.1.2) shall also be removed.

**5.6.2.4.1** Completely immerse the component in a container filled with TSP solution prepared as specified in 4.6. If available, an ultrasonic cleaner may be used. The solution shall be heated and maintained at a temperature between 160 to 190 °F for the duration of the cleaning evolution. Soak and agitate the component for a minimum of 10 minutes. A non-metallic scrub brush compatible with the solution may be used to facilitate cleaning. At the end of 10 minutes, a sample of clear used solution shall be taken and inspected visually for contamination as specified in 4.9.

**5.6.2.4.2** If visible contamination is found, drain and rinse the container and refill it with clean TSP solution prepared as specified in 4.6. Repeat the procedure as specified in 5.6.2.4.1, as required, until an acceptable visual sample is obtained.

**5.6.2.5** For components whose maximum allowable hydrocarbon content is expressed in p/m as specified in table II or III, as applicable, hydrocarbon content shall be determined as specified in 5.6.1.7 or 5.6.1.8 after a successful visual particulate inspection. Clean as necessary until the hydrocarbon content is within the applicable limits of table II or III.

**5.6.2.6** When the contamination of the used cleaning solution is within the applicable limits of table I or II, drain the container and refill it with clean fresh water as specified in 4.2, heated to a temperature between 160 and 190 °F. Completely immerse the component in the water. Soak and agitate the component. Continue soaking and agitating, changing the water as necessary, until the pH of the final rinse water is within 0.5 of the pH value of the clean rinse water.

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**5.6.2.7** When the pH of the rinse water is acceptable, remove the component from the container and blow it completely dry with the applicable purging medium specified in table VII or by vacuum oven. Reinstall the component in the system.

### **5.6.3 Cleaning pressure gauges.**

**5.6.3.1** Pressure gauges shall be cleaned in accordance with NAVSEA Instruction 4855.9 and shall meet the cleanliness levels specified in tables I and II, as applicable.

## **6. NOTES**

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

**6.1 Intended use.** The standard is intended to be used in the cleaning of Naval shipboard compressed air systems and non-oxygen interfacing gas systems, excluding reactor plant air systems. Also included are shipboard exhaust gas and carbon dioxide systems.

**6.2 Issue of DODISS.** When this standard is used in acquisition, the applicable issue of the DODISS must be cited in the solicitation (see 2.1.1 and 2.2).

**6.3 NAVSEA approval and direction.** Deviations from specified materials, procedures, and requirements and selection of specific alternative materials and procedures require NAVSEA approval or direction.

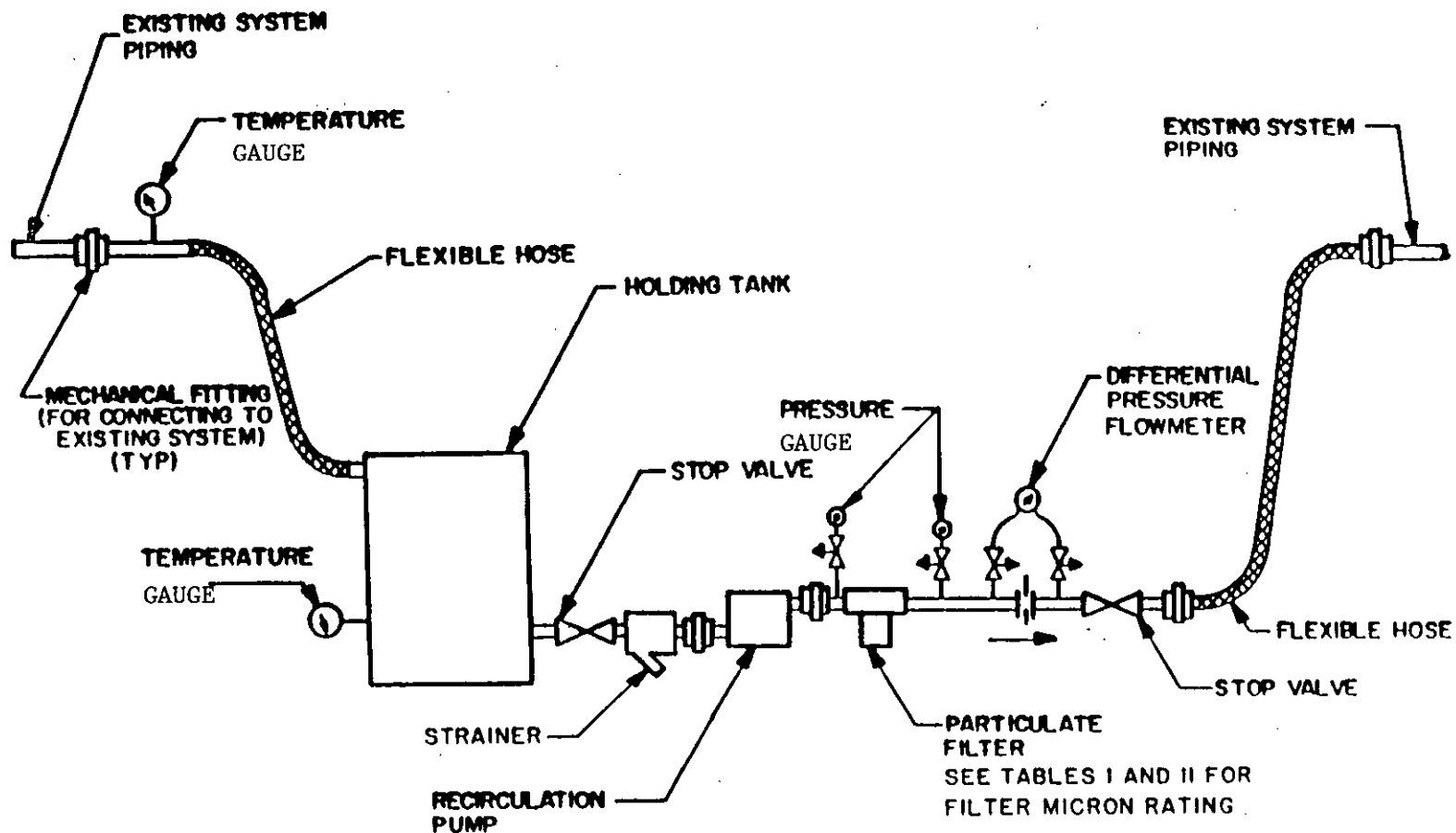
### **6.4 Subject term (key word) listing.**

Driver's air system  
Gases, non-oxygen  
Hydrocarbons  
Solvents  
Tribasic sodium phosphate  
Trichlorotrifluoroethane (R-113)

**6.5 Changes from previous issue.** Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Preparing Activity:  
NAVY -SH  
(Project 4310-N103)

25

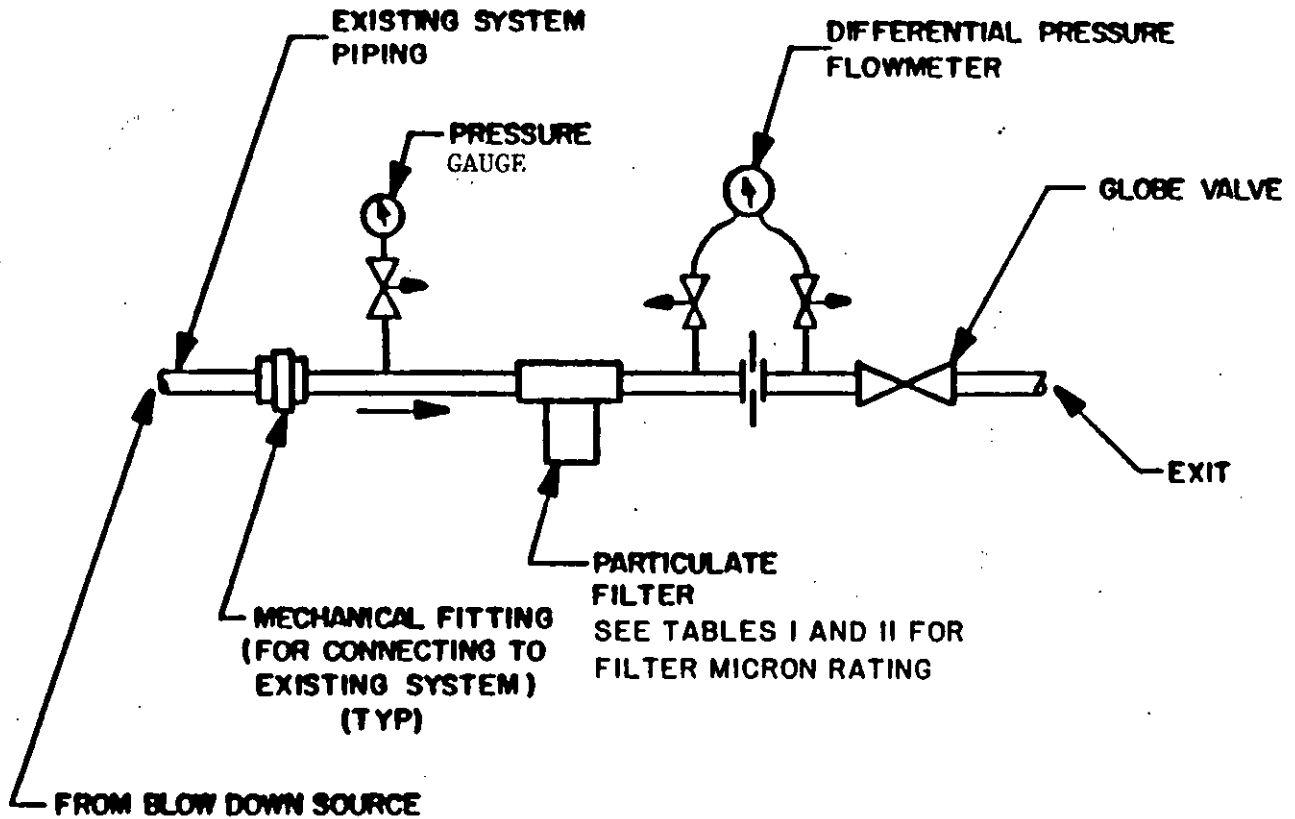


MIL-STD-1622A(SH)

SH1319922

FIGURE 1. Typical flushing rig.

MIL-STD-1622A(SH)



SH 1319921

FIGURE 2. Typical blowdown rig.

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

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### I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

MIL-STD 1622A(SH)

2. DOCUMENT DATE (YYMMDD)

920108

### 3. DOCUMENT TITLE

CLEANING OF SHIPBOARD COMPRESSED AIR SYSTEMS

### 4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

### 5. REASON FOR RECOMMENDATION

### 6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

(1) Commercial

(2) AUTOVON

(If applicable)

7. DATE SUBMITTED  
(YYMMDD)

### 8. PREPARING ACTIVITY

a. NAME

Technical point of contact:  
Mr. B. Linstrom, SEA 56Y62

b. TELEPHONE (Include Area Code)

(1) Commercial

703-602-6964

(2) AUTOVON

332-6964

c. ADDRESS (Include Zip Code)

Commander, Naval Sea Systems Command  
SEA 5523  
Washington, DC 20362-5101

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Defense Quality and Standardization Office  
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Telephone (703) 756-2340 AUTOVON 289-2340