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METRIC

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DEPARTMENT OF DEFENSE  
STANDARD PRACTICE

CHEMICAL CLEANING OF SALT WATER PIPING SYSTEMS (METRIC)



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20 August 1987

DEPARTMENT OF THE NAVY  
NAVAL SEA SYSTEMS COMMAND

Washington, DC 20362-5101

Chemical Cleaning of Salt Water Piping Systems (Metric)

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2. Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, 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.

## FOREWORD

This Military Standard provides instruction for the removal of deposits, scale and marine growth from salt water piping systems such as the firemain and flushing piping systems.

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1. SCOPE

1.1 General. This military standard covers the general requirements governing the chemical agents, mobile treating equipment and procedure for the removal of deposits, scale and marine growth from salt water piping systems such as the firemain and flushing piping systems. This standard is intended for use by Navy-approved private contractors or naval shipyards.

2. REFERENCED DOCUMENTS

2.1 Government documents.

2.1.1 Specifications. Unless otherwise specified, the following specifications of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this standard to the extent specified herein.

SPECIFICATIONS

FEDERAL

- O-H-765 - Hydrochloric Acid, Technical.
- O-S-571 - Sodium Carbonate, Anhydrous, Technical.

MILITARY

- MIL-D-16791 - Detergents, General Purpose (Liquid, Nonionic).
- MIL-I-17433 - Inhibitor, Hydrochloric Acid Descaling and Pickling Solutions.

(Copies of specifications required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Order of precedence. In the event of a conflict between the text of this standard and the references cited herein, the text of this standard shall take precedence.

3. DEFINITIONS

Not applicable.

4. GENERAL REQUIREMENTS

Not applicable.

5. DETAILED REQUIREMENTS

5.1 Chemical agents. Chemical agents shall be as specified in 5.1.1 and 5.1.2.

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5.1.1 Acid solution. The acid chemical cleaning solution shall have the compositions as specified below. Only fresh water shall be used to prepare the chemical cleaning solution that may be blended in an acid mixing tank or by means of a proportioning header. The solution shall not be blended before arrival on the job site.

- (a) Hydrochloric acid (HCl), 20 degrees Baume' in accordance with O-H-765 - 10.0 + 1.0 percent of HCl by weight
- (b) Corrosion inhibitor in accordance with MIL-I-17433 - concentration as specified by manufacturer
- (c) Detergent in accordance with type I of MIL-D-16791 - 0.1 percent by weight

5.1.2 Neutralizing solution. The neutralizing solution shall contain 4 ounces of sodium carbonate, anhydrous, technical (soda ash) conforming to O-S-571 per gallon of fresh water required to fill the system.

5.2 Utilities. Utilities shall consist of the following:

- (a) A supply of fresh water for making dilutions and for flushing.
- (b) Saturated steam at 690 kilopascals (kPa) (100 pounds per square inch (lb/in<sup>2</sup>)).
- (c) A source of compressed air at 621 to 690 kPa (90 to 100 lb/in<sup>2</sup>).
- (d) A source of electrical power.

5.3 Equipment. The equipment shall be as specified in 5.3.1 through 5.3.5.

5.3.1 Equipment assembly. The acid solvent shall be in a mobile tank. The assembly of the mobile equipment shall be such as to provide utmost safety to operating personnel. The following equipment shall be a part of the assembly:

- (a) One acid tank.
- (b) One acid pump.
- (c) One proportioning header or its equivalent for dilution of concentrated solutions.
- (d) One steam heater assembly for heating solutions.
- (e) Acid resistant hose for admitting solutions to piping system.
- (f) Assorted hoses for venting air and water supply.
- (g) Steam hose.
- (h) One chemical testing kit for checking acid concentration of solutions.
- (i) Pressure, temperature and flow regulators.
- (j) One explosimeter.
- (k) One portable pyrometer.
- (l) One in-line thermometer to measure the temperature of solutions during filling and recirculation.

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- (m) Assorted nonsparking tools including hammers, wrenches and screwdrivers.
- (n) Safety clothing to be worn by operating crew and other safety provisions, as required (see 5.6).
- (o) Equipment needed for disposal of spent solutions.
- (p) Strainers for submarine flushing as specified in flushing diagram.

5.3.2 Composition of equipment. The proportioning header, steam heater assembly and fittings, and valves that contact the acid solution shall consist of mild steel.

5.3.3 Equipment grounding. Provisions shall be available for elimination of stray electrical charges and accumulated electrostatic charges on equipment.

5.3.4 Integrity of assembly. When the unit is completely assembled to deliver solutions to a piping system, no leaks shall be evident at connecting points. Pump seal and valve stems shall be tightened or replaced as necessary to avoid creating hazardous conditions in the working area.

5.3.5 Explosion-proof motor. The acid pump shall be driven by an explosion-proof motor.

5.4 Operators. A minimum of two qualified operators shall oversee and perform duties related to the cleaning operation. Two operators shall be present during the entire cleaning operation beginning with pumping of the acid solvent into the piping system and ending with completion of the final freshwater flush.

5.5 Procedures and operations. The procedures and operations shall be as specified in 5.5.1 through 5.5.15.

5.5.1 General. Chemical cleaning of saltwater piping systems shall be accomplished in the six following major steps. (Supplementary steps may be added at the discretion of the activity concerned.)

- (a) Segregation, clean, freshwater flushing and leakage testing of the piping system.
- (b) Filling the piping system with heated acid solvent followed by soaking and circulation of the acid while maintaining the temperature.
- (c) Draining of the acid solvent.
- (d) Flushing of the piping system with clean, fresh water to remove remaining acid as well as loosened deposits that were not completely dissolved.
- (e) Neutralizing with alkaline solution.
- (f) Final freshwater flush to remove remaining alkali.

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5.5.2 Piping system preparation. The piping system preparation shall be as specified below:

- (a) For ships. The piping system shall be given a thorough examination and clean, freshwater flushing before chemical cleaning. Apply a hydrostatic test at 135 percent of the working pressure to the piping system in the cleaning configuration and inspect carefully for the presence of leaks. Valves and fittings shall be checked for tightness and any leakage found shall be repaired. The piping system shall be isolated from all connected machinery items and other systems including heat exchangers to which it may be connected. Control devices and instruments shall be blanked off or removed. The piping system (particularly the firemain system) should be divided into separate sections by the removal of valves, waster spools, gaskets, O-rings, and other fittings. The sections shall be fitted with blanks having hose connectors. The system shall be carefully inspected before cleaning to be certain that no section of piping is left connected into the system which cannot be completely neutralized and flushed with fresh water after application of the acid.
- (b) For submarines. The piping systems shall be flushed as specifically defined by approved flushing diagrams and procedures established for each submarine. The flushing diagram shall show details for bypassing components, details for blanking of piping such as gauges and instrument lines, and shall indicate required flow rates.

5.5.3 Preparation of equipment. Fill and return lines shall be connected to the treating equipment and the piping system. The highest point in the piping system shall be selected for making the return connection as the return line also serves as the vent.

5.5.4 Hot operational check of piping system. The piping system shall be heated to  $82 \pm 5$  degrees Celsius ( $^{\circ}\text{C}$ ) ( $180 \pm 10$  degrees Fahrenheit ( $^{\circ}\text{F}$ )) by heating and circulating hot fresh water. During preheating, the circulating water temperature shall not be permitted to rise at a rate greater than  $5^{\circ}\text{C}$  ( $10^{\circ}\text{F}$ ) per minute. Circulate heated water through all anticipated flow paths of the piping system and verify that no obstructions to flow exist. During circulation of the heated water, carefully check the piping and treating system, including valves and fittings for the presence of leaks. Any leakage found shall be repaired. The piping and treating system shall be drained immediately before beginning the acid fill.

5.5.5 Acid fill. The piping system shall be filled with the chemical cleaning solution specified in 5.1.1 at a temperature of  $60 \pm 5^{\circ}\text{C}$  ( $140 \pm 10^{\circ}\text{F}$ ) as determined by an in-line thermometer. After the piping system is filled, the acid shall be circulated for 15 minutes.

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5.5.6 Soaking period. Following the initial circulation, the acid solvent shall be allowed to soak for a total of 6 hours. The acid shall be recirculated for 15 minutes during each hour of acid exposure. During the recirculation, the acid shall be heated to  $60 \pm 5^{\circ}\text{C}$  ( $140 \pm 10^{\circ}\text{F}$ ) using the steam heater assembly as needed, determining the temperature by the in-line thermometer.

5.5.7 Temperature readings. Using the portable pyrometer, hourly temperature readings shall be taken at various points on the pipe in the system and logged.

5.5.8 Depletion of solvent strength. Samples of the acid solvent shall be obtained hourly during the recirculation periods and tested for acid concentration. The results shall be logged. Additional samples shall be obtained at the same times and labeled with the time of sampling. These samples shall be reserved for use by the activity concerned.

5.5.9 Draining the spent acid. Spent acid shall be removed from the piping system through drains provided for this purpose at the lowest points in the system. The solution shall be displaced by pumping or by air or nitrogen pressure not exceeding 207 kPa (30 lb/in<sup>2</sup>). Air or nitrogen pressure shall not be used if any uncontrollable leaks developed during the soaking period. If leaks develop when the system is under air or nitrogen pressure, immediately secure the pressure source and vent the system to reduce pressure to atmospheric pressure.

5.5.10 Disposal of spent solutions. The spent acid as well as the other spent solutions resulting from the cleaning operation shall be disposed of in accordance with local regulations. Disposal of spent solutions shall be the contractor's responsibility.

5.5.11 Flushing the piping system. The piping system shall be given a minimum of two flushes with clean, fresh water at temperatures of  $60 \pm 5^{\circ}\text{C}$  ( $140 \pm 10^{\circ}\text{F}$ ). The effluent pH shall be greater than 4 upon completion of flushing.

5.5.12 Neutralizing the piping system. The neutralizing solution specified in 5.1.2 shall be prepared in the contractor's equipment. The piping system shall be filled with the neutralizing solution at a temperature of  $54 \pm 5^{\circ}\text{C}$  ( $130 \pm 10^{\circ}\text{F}$ ). After the piping system is filled, the neutralizing solution shall be recirculated for 15 minutes. The neutralizing solution shall then be allowed to soak for 30 minutes, after which it shall be drained in the same manner as the spent acid (see 5.5.9). The  $54 \pm 5^{\circ}\text{C}$  ( $130 \pm 10^{\circ}\text{F}$ ) temperature shall be maintained throughout the entire process.

5.5.13 Final flush. The piping system shall be flushed with clean, fresh water. The flushes shall be repeated until the pH of the water in the piping system is in the range of 5 to 9 as indicated by pH paper. The piping system shall then be drained (see 5.5.9).

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5.5.14 Hydrostatic tests for ships and submarines. After completion of the cleaning, the piping system shall be given a final hydrostatic test with clean, fresh water as specified below:

- (a) For ships: ships shall be tested at 135 percent of the system operating pressure and shall be carefully inspected for the pressure of leaks.
- (b) For submarines: submarines shall be tested as established on the applicable diagram.

5.5.15 Inspection of submarine piping. After cleaning, the piping wall thickness shall be measured at representative locations. The wall thickness shall be not less than the minimum values currently established by NAVSEA for renewal of submarine seawater piping.

5.6 Safety precautions. Safety precautions are as specified in 5.6.1 through 5.6.5.

5.6.1 Coordination with safety superintendent. The contractor shall ensure that the cleaning work is coordinated through the safety superintendent at the activity in order to provide adequate protection from acid and chemical hazards.

5.6.2 Posting of warning signs. Some hydrogen is always developed in the course of acid cleaning the piping system. Since hydrogen mixed with air in the right proportions is highly explosive, every precaution shall be taken to prevent accumulation of hydrogen in the working vicinity and to keep sparks and open flames away from the piping system and vent discharge. From the time acid is started into the piping system until all traces of it have been removed by flushing with water there should be no welding on the piping system being cleaned, no grounding of electric welding equipment on the piping system, and no smoking, open flame or sparks within 25 feet of the vent discharge. For this reason, "no smoking", "no burning", and "no welding" signs shall be posted in the spaces in which the piping system being cleaned is located and at the mixing tank.

5.6.3 Use of non-sparking tools. Non-sparking tools and safety spark-proof lights shall be used if it becomes necessary to work on the piping system before the neutralization step.

5.6.4 Neutralizing spills. Any spillage of acid that may occur shall be neutralized with sodium carbonate, and the area shall be washed down with water.

5.6.5 Flushing hoses. Hoses used in the acid flushing shall be inspected for damage, hydrostatically tested, and verified to be within service life before use.

6. NOTES

6.1 Intended use. This standard is used for chemical cleaning of salt-water piping systems. This standard is intended for use under the supervision of the shipyard chemist and is not intended for use by ships' force due to the hazardous nature of the chemicals employed. Naval Sea Systems Command (NAVSEA) approval shall be obtained prior to acid cleaning.

6.2 Subject term (key word) listing.

Corrosion inhibitor  
Hydrochloric acid  
Mild steel  
Neutralizing solution

Preparing activity:  
Navy - SH  
(Project 4710-N773)

## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER DOD-STD-2187(SH)		2. DOCUMENT TITLE CHEMICAL CLEANING OF SALT WATER PIPING SYSTEMS (METRIC)	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR	
		<input type="checkbox"/> USER	
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5. PROBLEM AREAS			
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b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	

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