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TECHNICAL MANUAL
CLEANLINESS STANDARDS

CLEANING AND INSPECTION PROCEDURES
FOR
BALLISTIC MISSILE SYSTEMS

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SECTION IV

ATLAS, THOR, AND TITAN I WEAPON SYSTEMS

4-1. GENERAL.

4-2. SCOPE. This section includes specific policies and procedures for cleaning all components and systems used in the Atlas, Thor, and Titan I weapon systems. General cleaning procedures are specified in Section III, General Cleaning Procedures.

4-3. RESPONSIBILITY. Prior to the start of and during the cleaning operation, the supervisor in charge will ensure that proper procedures and materials are being used as specified herein. The supervisor will obtain necessary coordination with appropriate base organizations to ensure use of safe practices (reference Sections II and III).

4-4. CLEANING FACILITIES. Typical Titan I and Atlas cleaning facility equipment layouts are shown in Figures 4-1 and 4-2, respectively. The cleaning area is divided into the pre-clean (or rough clean) area and the final cleaning area. The cleaning supervisor will ensure that cleanliness requirements are met. All tools used in the final cleaning area will be cleaned and maintained at the same standards as specified for the parts, components, or assemblies to be cleaned. When equipment is not available at the Base for the accomplishment of required pre-cleaning or final cleaning tasks, the contaminated item shall be returned to the depot for processing.

4-5. GENERAL CLEANING REQUIREMENTS.

4-6. PROCESSING COMPONENT PARTS. Instructions outlining the general processes for cleaning components are shown in Figures 3-2 through 3-9. Figure 3-1 has been included as a guide for selecting applicable cleaning procedures.



Use extreme caution when handling machined parts (seats, poppets, etc) and filter elements. Arrange items in such a manner as to prevent their striking one another, since any damage may be sufficient to render the part unserviceable.

4-7. Component Parts -

4-8. Parts or tools shall never be laid on floors or on uncleaned surfaces. Lay parts on clean table top or on clean polyethylene sheet.

4-9. Never touch interior of components with bare hands. If it is necessary to wipe off flanges or interior of parts, wear alcohol or solvent-resistant polyvinyl gloves and use a clean line-free cloth (Federal Specification CCC-C-46 Type I) moistened with methylene chloride (Dichloromethane, Military Specification MIL-D-6998, Grade A).

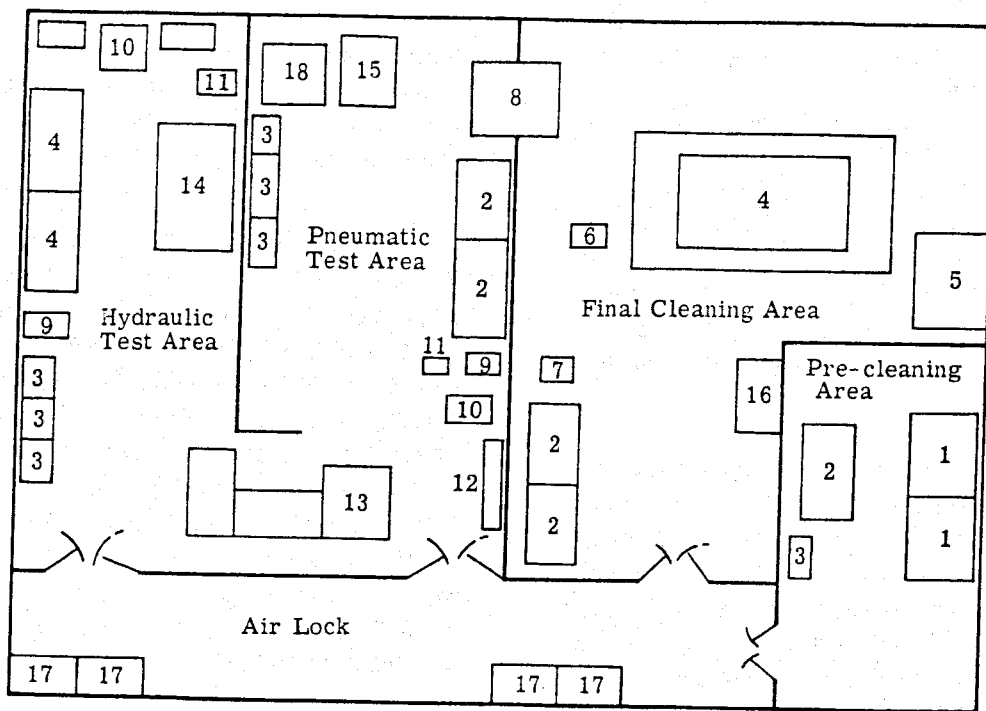
4-10. Components shall be cleaned, dried, reassembled, inspected, and packaged in the final cleaning area only.

4-11. Corrosion Removal - Metal parts which are found to be corroded must be treated to remove the existing corrosion and to retard further corrosion prior to being taken into the clean room. Parts that have been plated or anodized, and which have been damaged to such an extent that the base metal has corroded, shall not be cleaned (with the exception of painted parts). Also, if the strength or function of a part will be impaired by the corrosion removal process, the part shall not be cleaned. For such unclean parts, the supervisor shall request disposition instructions from the responsible depot.

4-12. Painted Parts -

WARNING

Paint remover produces dangerous and noxious fumes. Avoid breathing the fumes over a protracted period of time or in confined spaces. Always provide for adequate ventilation. Wear alcohol or other solvent-resistant polyvinyl gloves during the cleaning process. As an added precaution, wear an approved face mask. Failure to take proper precautions can result in serious injury or death.



LEGEND

- | | |
|------------------------------------|--------------------------------------|
| 1 Detergent/Rinse Tanks | 11 Electric Oven |
| 2 Work Benches | 12 CTU Hose Rack |
| 3 Cabinets | 13 CTU |
| 4 Vapor Degreaser | 14 CTU Adapter Set |
| 5 Deionized H ₂ O Rinse | 15 Cryogenic Test Stand ("D" Series) |
| 6 Solvent Reclaimer | 16 Handling Cart |
| 7 Sonic Cleaner | 17 Smock Racks |
| 8 Pass-thru Oven | 18 Liquid Nitrogen Cart ("D" Series) |
| 9 Sink | |
| 10 Plastic Dip | |

Figure 4-2. Typical Atlas Cleaning Facility Layout (MAMS)

Painted parts, which require cleaning, shall have the paint completely removed by applying paint remover (Military Specification MIL-R-25134) with a long-handled, non-metallic brush to the painted surface until all paint has softened and lifted. Rinse thoroughly with filtered (10 micron, nominal) Solution I (Paragraph 3-30) and allow part to dry thoroughly. Continue the cleaning process per Section III.

4-13. PROPELLANT LOADING SYSTEMS (PLS).

4-14. PLS CLEANLINESS STANDARDS AND INSPECTION. These cleanliness standards and inspection techniques are applicable to the systems and components of the missile and ground support system containing, or used in connection with RP-1 fuel, liquid oxygen, liquid nitrogen, and pneumatic gases.

4-15. Component Standards and Inspections - The contamination limits for the propellant and pneumatic subsystem components are shown in Figures 4-3 and 4-4. Cleanliness of components shall be determined by the procedures of Inspections No. 1, 2, 3, 4, 5, and 6, as applicable and as described in Paragraphs 9-12 through 9-35. Inspections No. 1 and 2 shall be utilized for checking test fluids and final-cleaning solvents. They shall also be used as a quality control technique for the verification of component cleaning process and where system maintenance manuals require a particle count for cleanliness certification of specific components. Inspections No. 3, 4, and 5 shall be utilized as the general methods for verification of component cleanliness. Inspection No. 6 shall be conducted as a referee inspection by the Depot or other qualified test agency where the level of hydrocarbon contamination is questioned after completion of Inspections No. 4 or 5. The results from Inspection No. 6 shall be final and binding when a significant difference exists in the interpretation of the results of other inspections. Only components of the liquid oxygen, nitrogen, and helium subsystems need to be certified as LOX clean (no hydrocarbons) by Inspections No. 4 and 5. Ultraviolet inspection of hydraulic and fuel system components is commonly used as a means of hydrocarbon detection; however, since these systems employ hydrocarbon-base fluids, the presence of hydrocarbons shall not be cause for rejection.

4-16. System Standards and Inspection - Propellant and gas systems shall be judged clean if the contamination limits specified in this section have not been exceeded. The liquids or gases used during cleanliness testing shall comply with the latest issue of applicable military or other cited specifications. All propellant liquids and gases used during cleanliness testing, except RP-1 fuel, shall be filtered through 10 micron nominal, or less, filter units. RP-1 fuel shall be passed through a 40 micron absolute, or less, filter/dewatering unit.

4-17. Liquid Oxygen, Liquid Nitrogen, Gaseous Nitrogen, and Helium Systems - Cleanliness is determined by gas blowdown test, Inspection No. 10. The contamination permitted entrapped on the filter pad of a blowhorn (or equal), during testing of a dry system, or in the test fluid effluent of a pressure bomb sample is shown in Figure 4-5. The filter pad will be inspected with black light. Fluorescence resulting from fibers and solid particles which do not exceed the maximum size criteria will not be cause for system recleaning. Fluorescence of filter pad stains or entrapped globules will be cause for recleaning the system.

4-18. HYDRAULIC SYSTEMS.

4-19. HYDRAULIC SYSTEMS CLEANLINESS STANDARDS AND INSPECTIONS. Cleaning of hydraulic systems includes cleaning of components and piping for missile, ground facilities systems, and maintenance ground equipment. Hydraulic components and piping systems will be cleaned using the detailed processes and the applicable standards indicated in this manual, and in accordance with the detailed disassembly and reassembly procedures contained in the applicable weapons system technical manuals.

4-20. Titan I systems and Maintenance Ground Equipment (MGE) requiring component and piping cleaning are:

- a. Missile hydraulic systems - Stage I and II.
- b. Hydraulic pumping unit - Missile MGE.

9-42. INSPECTION NO. 9-WATER CONTENT DETERMINATION, MINUTEMAN THRUST VECTOR CONTROL SYSTEM.

9-43. The maximum water content shall be 20 ppm (0.002% by wt.) when tested in accordance with the ASTM D1364 and ASTM D1533 methods (Reference Document Item 51, Section XI) as applicable (Karl Fischer reagent titration method).

9-44. INSPECTION NO. 10-SERVICE FLUID SCREENING.**9-45. SERVICE FLUID SAMPLING FROM SYSTEMS.**

Samples of the service fluids used to certify system (subsystem, piping and skid units) cleanliness shall be obtained and tested. The service fluid used for the final rinse or purge shall be flowed through the system for a minimum of two minutes at maximum operational flow rates whenever possible. For gas blowdowns, nitrogen gas conforming to MIL-P-27401 or clean dry air with moisture and hydrocarbon content equivalent to limits established for nitrogen in MIL-P-27401 shall be introduced into the system. A two minute blowdown with a minimum of 100 ft/sec gas velocity in the largest diameter pipe section being sampled will be acceptable, except that the maximum velocity attainable through the permanently installed system and approved sampling device may be used where 100 ft/sec cannot be obtained. The sampled effluent shall be passed through a 50 mesh sieve (ASTM Designation E11-61, Fine Series #50); except for Titan I and Atlas, the effluent is passed through the filter pad of a blowhorn (or equal). After the test, the screen (filter pad) is carefully removed from the sampling unit and sealed in a clean polyethylene bag until it is examined.

9-46. SERVICE FLUID SAMPLING FROM TANKS.

For storage, transport, and holding tanks, a fill and drain cleanliness inspection method can be used, although Inspection No. 10 is preferred when size permits. The sampler is installed in the drain line

and all of the effluent is passed through a 50 mesh stainless steel screen. The screen is carefully removed from the sampling unit and sealed in a clean polyethylene bag until it is examined.

9-47. SERVICE FLUID SCREENING INSPECTION. The 50 mesh sieve samples shall be inspected with a 10 power magnifying glass (FSN 6650-526-4239). If no particulate matter remains on the screen, the equipment shall be certified for use. If any particulate matter remains on the screen other than that specified in Section VI or VII as applicable, collect the contamination in an appropriate sampling fluid (Paragraph 9-15 - Reagent Fluid) using the Significant Surface Sampling technique specified in Paragraph 9-14 and perform a Total Filterable Solids Determination (Paragraph 9-22).

9-48. INSPECTION NO. 11-TANK VACUUM CLEANING.

9-49. Missile propellant tanks shall be visually inspected after final assembly is completed and prior to system checkout. Other tanks may be inspected by this method after the final cleaning and drying operations. Inspection shall consist of vacuum cleaning all places where contamination entrapment could occur. The vacuum cleaning operation shall in no way affect the structural or functional integrity of the tanks or any related component or subsystem. The debris vacuumed away shall be collected on a 100 mesh screen, and examined by the Service Fluid Screening Inspection (Paragraph 9-47). If the particulate matter does not exceed the applicable limits of Sections IV, V, VI and VIII the tanks shall be certified for use. If these limits are exceeded, repeat the cleaning and drying operations and the vacuum cleaning inspection. If re-entry into the tank is made subsequent to this inspection, the vacuum inspection shall be repeated.