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Comparison of Hydraulic System Cleanliness Procedures and Requirements for Ten Aerospace Companies

In May 1979 Martin Marietta Aerospace, Denver Division, completed a survey of missile hydraulic system cleanliness and contamination control procedures and practices at several aerospace companies. The intent of this survey was to gather and assemble the data from companies that manufacture missiles with hydraulic systems, similar to the Titan III System, from a contamination control standpoint. The survey concentrated on 15 subject areas of interest.

Participating companies have agreed that this information may be distributed through SAE Committee A-6, Aerospace Fluid Power and Control Technologies, as an Aerospace Information Report, AIR 1918.

The accumulated data is presented on the attached summary table. No comparisons or conclusions are made--this is left to the reader. A current contact in hydraulic systems contamination control is listed for each company and any questions or further discussion should be directed to the person listed.

PREPARED BY THE A-6A3 MISSILE AND SPACE SYSTEMS PANEL
OF SAE COMMITTEE A-6, AEROSPACE FLUID POWER AND CONTROL TECHNOLOGIES

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COMPARISON OF HYDRAULIC SYSTEM CLEANLINESS PROCEDURES AND REQUIREMENTS FOR TEN AEROSPACE COMPANIES, CONDUCTED BY MARTIN MARIETTA DENVER AERO

Company/ Program	Contamination Problems	System Cleanliness Rqmts—per 100 ml Particle Size Range / Max Allowed	Cleaning-In-House	Cleaning-Suppliers	Supplier Conformance	Facilities & Clean Rooms	Contamination Limits per 100 ml—In House Particle Size Range / Max Allowed
Martin Marietta Denver/Titan III—Fluid-Mil-H-6083, Contact—D. Macumber 303/ 977-5692 or M. Nakai 303/ 977-1337	Flight—None Confirmed—Contamination Suspected in 7% of Ground Failures	<30 Unlimited 31-90 100 91-150 4 151-1000 3 >1000 0 Includes Fibers	Tube Assemblies—Solvent Degrease, Alkaline Flush, Deionized Water Rinse, Dry, Bag, Tag	Per Suppliers Process Which Meets Martin Marietta Requirements	Detail Mfg & Assy—Supplier QA&DCAS; Accept. Test—Martin Marietta/QA Paper Check at Martin Marietta	Cleaning in Class—100,000 Cleam Room	<30 Unlimited 31-90 100 91-150 4 151-1000 3 >1000 0 Includes Fibers
Martin Marietta Orlando/Patriot Pershing, Fluid-Mil-H-5606, Contact Dick Caswell 305/ 352-2342	None	5-10 9700* >10-25 2680 >25-50 380 >50-100 56 >100 5 >300 0	Vapor Degrease, Solvent Flush Ultrasonics, Solvent Flush, Blown Dry-Packaged, Tagged	No Specific Rqmts Except Fluid, Which Is Same As System Cleanliness	Periodic Surveillance—100% on Acceptance and Process Paper Work	Class 100,000 for Pre-Cleaning, Class 100,000 for Final Cleaning & Bagging; Laminar Flow Benches for Assy	5-10 9700* >10-25 2680 >25-50 380 >50-100 56 >100 5 >300 0
McDonnell Douglas Astronautics/Thor-Delta, Fluid-Mil-H-5606, Contact J. Shearer 714/896-2222, R. C. Libby 714/896-4829	Flight—None; Some Built in by Suppliers; Few Contamination Suspect—None Confirmed	10-25 5570 26-50 570 51-100 110 >100-Fibers 24 >500-Fibers 0	Vapor Degrease, Ultrasonics, Double-Bagged, Tagged	Must Meet McDAC Spec-Pre-Award Surveys, Audits to Verify	Supplier QA, Some McDAC Source QA, Some Rec-Insp (Naked Eye)	Cleaning Is in Class 100,000 Controlled Access Clean Room, Std Clean Room Attire	10-25 5570 26-50 570 51-100 110 >100+Fibers 24 >500-Fibers 0
Rockwell International Space Division/Space Shuttle; Fluid-Mil-H-83282 Contact H. B. Edgar 213/ 922-3304	None—Few Suspected on Previous Program, (Saturn)—None Confirmed	5-15 36,200 >15-25 4,443 >25-50 1,612 >50-100 232 >100 24	Chemically Cleaned-Vapor Degreased, Particle Counts, Precision Clean Packaged (Tube Assemblies)	Suppliers Submit Plans, RISD Approves	Supplier QA and Periodic Audits by RISD	Class 100,000 Clean Room, Laminar Flow Benches	5-15 19,331 >15-25 2,373 >25-50 860 >50-100 124 >100 13
General Dynamics Convair—San Diego/ Atlas, Fluid-Mil-H-6083, Contact M. Ogman/J. Soltman 619/277-8900, Ext 2686, 2038	Flight—None; Few Built In. During Early Dev One Blocked Nozzle; Some Halogen Solvent Corrosion	26-50 530(A) 51-100 60(A) 101-1000 10(B) 1001-2000 1(B) >2000 0(B) (A) Particles Only (B) Particles & Fibers	Vapor Degrease, Ultrasonics, Double-Bagged, Tagged	Must Meet GD In-House Spec; Some Parts Cleaned by Cleaning Houses Approved by GD	Supplier QA, Periodic Audits by GD; GD Source QA if Problems Arise	Cleaning Is in Class 100,000 Controlled Access Clean Room (Tube Assembly Details)	26-50 1000 51-100 70 101-200 12 201-500 3 >500 0 Fibers 100-1000-13
Lockheed Missile and Space Co/Polaris Family, Agene. Fluid-Mil-H-5606 and Brayco 745, Contact Ted Schalit 408/756-0657	Flight—None; Very Rare during Ground Test	5-14 3500 15-24 1250 25-49 250 50-99 25 >99 3	Tube Assemblies Degreased; Solvent Flush, Blown Dry, and Packaged	Lockheed Approves Supplier Procedures, Clean Room Assy Reqd	Source Insp Up to 100%; Supplier QC	Not Reqd for Vehicle Assy, Class 100,000 for Suppliers Assy	5-14 3500 15-24 1250 25-49 250 50-99 25 >99 3
Vought Corp/ Scout—Fluid-Mil-H-6083 and Mil-H-5606; Contact Larry Johnson 214/ 266-3341; B. N. Eulder 214/266-7424	Flight—None; One Pump Failure Partly due to Contamination	Comparison of Contamination Patch to LTV Standard Patch	Solvent Flush Followed by Vapor Degrease, Detergent Wash, Tap Water Rinse; Dry with Filtered Air or Dry Nitrogen	No Specific Limits; General Cleanliness Statement	Interim Source Insp and DCAS	Dust Free for Fluid Sample Preparation	Comparison of Contamination Patch with LTV Standard Patch
Rockwell International, Autonetics Division/Minuteman; Fluid-Mil-H-5606, Contact J. R. Anderson 714/ 632-1621	None	5-15 6250 >15-25 1000 >25-50 200 >50-100 35 >100 1	None Reqd—No Hardware Built In-House, Have Specifications for Outside Cleaning Suppliers	Class 70,000 for Final Assembly	Full-Time Source Insp by Autonetics QA; Annual Supplier Certification by QA	Class 70,000 or Better for Final Assembly	5-15 6250 >15-25 1000 >25-50 200 >50-100 35 >100 1
Boeing-SRAM-Fluid-Mil-L-46004, Contact J. C. Johnson 206/ 773-5611	Flight—None; Others Rare, Some Anodize Flake Off during Development	>5 6900 >100 4	Vapor Degrease, Ultrasonics; Filtered Solvent Rinse, Packaged, Tagged	Cleaning Solvent for Cleaning Detail Parts >5 1500 >100 1	Supplier QA and Certs, Periodic Boeing Audits	Parts Assembled in Class 100,000 Laminar Flow Benches	>5 1500 >100 1
Hughes Aircraft—Tucson-Phoenix, Fluid HMS20-1124 (Brayco 762) Contact A. Laos/ R. Denker 602/ 295-8864, -8874	Flight—None Confirmed—Few Suppliers Built-In	5-10 4600† >10-25 1340 >25-50 210 >50-100 28 100+Fibers 3	Vapor Degrease¶; Ultrasonics; Filtered Solvent Rinse, Blown Dry-Air or N_2, Packaged	Suppliers Submit Plans to Meet Hughes Rqmts, Hughes Approves	Supplier QA and Periodic Source QA	Parts Cleaned and Assembled in a Dust-Free, Positive Pressure Area	5-10 4600† >10-25 1340 >25-50 210 >50-100 28 >100+Fibers 3

*Limits Same As SAE 749D, Class 2
†Limits Same As SAE 749D, Class 1
‡High and Low Pressure Relief Valves and Reservoir Are Removed from Vehicle, Bench Tested, and Reinstalled after Storage and before Flight
¶Before O-Ring Installation Only