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Long Term Storage for Missile Hydraulic Control Systems - Design and Operational Practices Guide

RATIONALE

This document has been determined to contain basic and stable technology which is not dynamic in nature.

STABILIZED NOTICE

This document has been declared "Stabilized" by the SAE A-6A2 Military Aircraft Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
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DESIGN ELEMENTS	DESIGN CONSIDERATIONS RELATIVE TO LONG TERM STORAGE EFFECTS	REFERENCE OR REMARKS
1. Materials	Corrosion: Due to dry storage ambient conditions.	
A. Metals	Due to chemical change of fluids in contact with metals during long term storage. Consideration must be given to each particular requirement based on type and length of storage requirement. Protective coatings of metals must be considered on their ability to remain stable when exposed to atmospheric and/or fluid changes.	
B. Fluids	Compatibility of fluids with metals over long periods of time. Stability of fluids over long idle storage periods. Fluids having good long term storage capabilities, but short operational characteristics may be considered. Further consideration may be given to periodic fluid changes, if other servicing is to be done.	Ref. No. 12 - See Appendix
C. Gases	Diffusion, stability, absorption, compatibility with contact materials, should all be considered when preparing for long term storage.	
D. Elastomerics, Natural, Synthetics	Effects of: temperature, humidity, gases, fluids, dryness, ionized air, fungus, load life, rotational or sliding life after long storage periods, cleaning agents, vulcanization, stiction. The above areas should be studied for possible effects on the ability of the elastomer to perform satisfactorily for its designed mission life.	

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2. Lubrication	All moving parts shall be self or long term lubricated. Lubricant materials should be given the same consideration as Item 1-B, Fluids, above. Periodic actuation to insure proper lubrication may be considered. Such items as soft metals, porous sintered metals, dry type lubricants, dissimilar metals may also be considered.	
3. Springs (Stored-Kinetic Energy)	Change in modules, creep or set, stress corrosion cracking, should all be considered when designing for long term storage.	This would apply to all spring actuating devices, servo valve centering and feedback springs, compensating spring.
4. Sealing	Material aging, breakout force, or friction, compatibility with fluids, gases, propellants. The following types of seals are included: face seals, shaft seals, rod seals, static seals. Type seals should be given the same consideration as Item 1-D above. Metal seals should receive the same consideration as Item 1-A above.	Ref. No. 12 - See Appendix
5. Components A. Electrical	Breakdown of insulating materials due to aging, and effects of ambient environments. Corrosion of wiring, brushes, armatures, etc. Performance degradation due to changes in system grounding and insulation resistance.	
B. Pumping	Since all hydraulic pumps contain all or most of the above items, consideration must be given to the following areas: 1. Metals: Corrosion of close fitting surfaces due to long periods of static storage; corrosion caused contamination. 2. Fluids: Compatibility of fluids/metals, effects of fluid breakdown (See Item 1-B). 3. Seals: The items in 1-D apply here, as well as items in 4 above. 4. Springs: Variable displacement pumps contain pressure compensating springs. All items in No. 3 above should be considered. Consideration to periodic operational checks.	Ref: Nos. 9 and 10 - See Appendix

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C. Valves Servo, Flow, Pressure Relief, Check Valves, etc., may be electrical, pressure or spring actuated or controlled	When designing valves for long term storage requirements, the following areas should be considered: Fluid, gas and propellant compatibility with metals, and seals. Lubricity problems, sealing, corrosion of close fitting parts, due to ambient atmospheric conditions, fluid breakdown, or non-compatibility. Material property changes, orifice protection, filter loading (built in type in servos). In general, all of the above design elements, Items 1 thru 5, may be applied to valves. Retained austenite has some effect on valve growth.	
D. Actuators	Stress corrosion, effects from stress risers, moisture protection, as well as compatibility of metal and seals to liquids, gas or propellants. Lubrication, consideration to periodic actuation may be desired.	Ref: Nos. 9, 10 and 12 See Appendix
E. Accumulator	High pressure gas or fluid retention over long periods of storage. Effects of fluids or gas on blatter material in diaphragm type or seals in piston type.	Ref: No. 10 - See Appendix
F. Reservoir	Seals (see 1-D) compatibility of metal with fluids, fill and bleed characteristics, filtration.	Ref: No. 13 - See Appendix
G. Fluid Transmission	Use of manifolding, corrosion produced contamination, use of stainless steel lines, flex lines, permanent fittings and/or connections.	Ref: No. 14 - See Appendix
H. Sensing Devices	Sealing, performance degradation, minimum number of solder joints and connections.	Ref: No. 11 - See Appendix
I. Primary Battery	Aging and breakdown of electrolite, cell and or case explosion, loss of energy, effects of temperature, moisture, humidity, solid propellant gas effects.	

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6. General Contamination	Generally, a missile system will be cleaned to a pre-determined level to preclude any foreign contaminate. All system components will also be cleaned to a specified level. It may be assumed that a complete missile system will be clean to the specified level prior to becoming operational. By the term Operational the missile could be placed in a ready storage condition which might last from 1 to 3 or more years. The type of contamination which could be detrimental to the mission would then be slowly generated by the following: 1. Normal generation due to repeated system activation during ground check-outs. 2. Fluid breakdown such as agglomeration, separation of additives, etc. 3. Corrosion due to effects of fluids and gases which may not be compatible with contact materials. 4. Water content due to humidity conditions and/or temperature changes. 5. Deterioration of elastomerics. 6. Contamination due to system servicing due to malfunctions found during routine check-outs. This could be either in the form of contained components or the omission of a flushing operation after reassembly of a system break.	