

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.

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<u>DESIGN ELEMENTS</u>	<u>DESIGN CONSIDERATIONS RELATIVE TO LONG TERM STORAGE EFFECTS</u>	<u>REFERENCE OR REMARKS</u>
1. <u>Materials</u>	Corrosion: Due to dry storage ambient conditions.	
A. <u>Metals</u>	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. <u>Fluids</u>	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. <u>Gases</u>	Diffusion, stability, absorption, compatibility with contact materials, should all be considered when preparing for long term storage.	
D. <u>Elasto- meric, Natural, Synthetics</u>	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. <u>Lubrication</u>	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. <u>Springs</u> (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. <u>Sealing</u>	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. <u>Components</u> A. <u>Electrical</u>	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. <u>Pumping</u>	Since all hydraulic pumps contain all or most of the above items, consideration must be given to the following areas: 1. <u>Metals</u> : Corrosion of close fitting surfaces due to long periods of static storage; corrosion caused contamination. 2. <u>Fluids</u> : Compatibility of fluids/metals, effects of fluid breakdown (See Item 1-B). 3. <u>Seals</u> : The items in 1-D apply here, as well as items in 4 above. 4. <u>Springs</u> : 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. <u>Valves</u> 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. <u>Actuators</u>	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. <u>Accumulator</u>	High pressure gas or fluid retention over long periods of storage. Effects of fluids or gas on bladder material in diaphragm type or seals in piston type.	Ref: No. 10 - See Appendix
F. <u>Reservoir</u>	Seals (see 1-D) compatibility of metal with fluids, fill and bleed characteristics, filtration.	Ref: No. 13 - See Appendix
G. <u>Fluid Transmission</u>	Use of manifolding, corrosion produced contamination, use of stainless steel lines, flex lines, permanent fittings and/or connections.	Ref: No. 14 - See Appendix
H. <u>Sensing Devices</u>	Sealing, performance degradation, minimum number of solder joints and connections.	Ref: No. 11 - See Appendix
I. <u>Primary Battery</u>	Aging and breakdown of electrolyte, cell and or case explosion, loss of energy, effects of temperature, moisture, humidity, solid propellant gas effects.	

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6. <u>General</u> <u>Contamination</u>	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 <u>Operational</u> 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.	