

## NASA Glenn Safety Manual

### CHAPTER 23 - HIGH PRESSURE HOSE

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#### 23.1 SCOPE

This Chapter sets forth the regulations for the use of high pressure flexible hose assemblies in stationary and mobile process systems, hydraulic systems, and research rigs. High pressure service for flexible hose is defined as a normal operating pressure of 200 psig or greater. See [Chapter 5](#) of this Manual for special requirements for oxygen service and [Chapter 6](#) for special requirements for hydrogen service.

#### 23.2 APPLICABILITY

This Chapter applies to high pressure flexible hose assemblies on stationary and mobile process systems, research rigs, and stationary hydraulic systems at the Cleveland Center and, Plum Brook Station. It does not apply to hydraulic hoses on such equipment as construction equipment, tractor trailers, fire extinguishing equipment, SCBAs and other breathing apparatus, HVAC systems and refrigerant systems

#### 23.3 AUTHORITY

The authority for these regulations comes from the Executive Safety Board of the Glenn Safety Organization.

## 23.4 POLICY

### 23.4.1 Obtaining High Pressure Assemblies

High pressure flexible hose assemblies may be obtained through the Facilities Division (7300) by calling the Work Control Office at 3-3101. Prepare and submit to the Facilities Division a work request with the following information in the work description:

- a. System description and location
- b. Number of hoses
- c. Hose size
- d. Overall length of hose including fittings
- e. Size, type, and material of fittings
- f. Medium to be used in hose
- g. Maximum operating pressure (maximum system pressure or line relief valve setting)
- h. Maximum flow rate of system
- i. Type of restraint used (if hose is 6 feet or longer), and whether restraint is to be included in purchase
- j. Cleanliness requirements
- k. Tag information requirements

### 23.4.2 Use of High Pressure Hose

Flexible hoses shall be used only when required for hookup of portable equipment, for vibration isolation, or to provide for movement between interconnecting fluid lines when no other feasible means is available. The maximum operating pressure for a flexible hose shall not exceed 25 percent of the manufacturer's specified minimum burst pressure.

Hose assemblies purchased for flammable and other hazardous commodities shall have a hazards analysis performed for the specific application or operating hazards of assemblies may be addressed in a process hazards analysis. Flex hose applications and hazards analysis shall be reviewed through the GRC Recertification Program.

### 23.4.3 Purchasing Specifications

All high pressure flexible hose assemblies purchased must meet the following criteria:

- a. Hose assemblies for stationary and mobile process systems shall consist of a seamless polytetrafluoroethylene (PTFE, e.g., Teflon) or compounded PTFE inner tube reinforced with a 300-series stainless steel wire construction of braid, spiral, or combination wrap. End fittings shall be carbon steel or 300-series stainless steel to mate with the appropriate fitting for the service, as described in Appendix A.
- b. Although hose assemblies for research rigs will be specified by the research engineer, seamless PTFE inner tube reinforced with a 300-series stainless braid is

the recommended construction. End fittings should be 300-series stainless steel. Other assemblies may be used based on manufacturer recommendations, engineering specifications, hazards analysis documentation and appropriate review and approval through the GRC Recertification Program.

- c. Hydraulic system hose assemblies should be conventional hydraulic hose and fittings. Replacement hose for existing systems should match the existing hose, and hose for new hydraulic systems should be industry or manufacturers standards.
- d. Hose shall be purchased for the specific fluid that flows through it. Since manufacturers rate hoses for suitability with specific fluids, these compatibility ratings and the manufacturer's minimum specified burst pressure ratings shall be used for determining acceptability (see Sec.23.4.2).
- e. Hoses shall be purchased to meet or exceed the maximum working pressure of the system. Maximum working pressure is defined to be the maximum system pressure or the pressure at which line relief valves release; whichever is higher (because relief pressure may be higher than working line pressure in some instances).
- f. At the time of fabrication, the hose assembly shall be pressure tested by the manufacturer to a minimum of 1.5 times the working pressure. Documentation of such testing must be included with each hose assembly.
- g. Flexible hose for oxygen service must conform to special requirements for cleanliness, as described in **Chapter 5** of the GSM.
- h. High pressure hose for use in aircraft must be approved military type hose.

#### **23.4.4 Restraints for Hose**

All high pressure hose assemblies 6 feet long or longer shall be restrained with Kellems restraints.. For hydrogen service, it is recommended that the hose restraints be at least 50% stronger than the calculated impact force on an open line moving through the flexure distance of the restraint.

Eyebolts or other anchor points capable of withstanding any loads that could occur should the hose break in service shall be provided for attachment of required hose restraints. The manifold or other pressure piping shall not be used as an anchor. Tube trailers are provided with anchoring points for harnesses. It will be local responsibility to provide a sturdy anchor point for the other end. An appropriate analysis shall be conducted for anchor points to ensure they are capable of withstanding potential loads.

#### **23.4.5 Tagging and Testing by the Manufacturer**

High pressure hoses shall be assembled, pressure tested, and tagged with a permanent stamped metal tag by the manufacturer. The tag shall show, at least, the date of pressure test, the maximum rated operating pressure, the manufacturer and part number, and the fluid it will accommodate.

Owners of research rigs and hydraulic systems may implement a tag numbering system where by a unique number is identified for each hose tag and that number is traceable to supporting documentation for the hose assembly. If such a tag numbering system is implemented, a permanent file that contains a complete hose inventory, all assigned tag numbers and required supporting documentation is to be maintained by the Operations, Area Supervisor or Research Engineer.

All high pressure hose assemblies must be pressure tested by the manufacturer at the time of fabrication. The manufacturer shall furnish test records with the hose assembly, and the records shall be retained by the custodian of the hose assembly.

#### **23.4.6 Inspection**

**Systems other than research rigs and hydraulic systems** - For stationary and mobile process systems (excluding research rigs and hydraulic systems), manufacturers' pressure test records shall be furnished with the hose and will be maintained by the Recertification Program Office. The Recertification Contractor, as part of the Inservice Inspection (ISI) Program, shall visually inspect the entire length of all flexible hoses in positive pressure applications at least annually for evidence of damaged fittings, kinks, broken wire braid, or other signs of degradation.

**Research rigs** - Research engineers or technicians shall conduct inspections of research rig flexible hoses, including annual external examinations, as in the preceding paragraph. Inspection dates for research rig flexible hoses shall be maintained by the research engineer. Hose assemblies shall be removed from service upon evidence of damage or misuse. Appendix B of this Chapter includes a recommended Annual High Pressure Inspection Form.

**Hydraulic systems** - The Area or Operations Supervisor shall ensure that inspections are performed annually on the exterior of all hydraulic system hoses. Hydraulic system hoses may be replaced at the discretion of the Area or Operations Supervisor or by the assigned Inspector. Hose assemblies shall be removed from service upon evidence of damage or misuse. Appendix B of this Chapter includes a recommended Annual High Pressure Inspection Form.

Verification of the flexible hose annual inspection is a requirement for renewal of Safety Permits.

#### **23.4.7 Recertification**

The recertification interval will be determined by the Recertification Program manager; it is typically 2 or 5 years, depending on fluid and pressure. Recertification intervals for high pressure hoses can be found in Appendix A of GRC-M-7500.001, Glenn Research Center at Lewis Field, Pressure Vessel/System Recertification Handbook, Rev. October 2001. At the recertification date of the hose, a bore scope shall be used to inspect the hose interior at both end connections. Hose shall be replaced if any degradation is found.

The dates of inspection shall be documented and maintained by the Recertification Program Office.

Research rigs (by commodity) and hydraulic system high pressure hose recertification intervals can be found in Appendix A of GRC-M-7500.001. Owners of research and hydraulic equipment are to ensure that high pressure hose recertification is completed per these intervals. Recertification shall include the following:

- Documentation review that includes, identification tag number or serial number, manufacturer, nominal size, material of construction, rated working pressure, hydro or pneumatic test date, and material compatibility with working fluid.
- External visual examination and interior bore scope inspection
- A pressure test to the MAWP.

Other recertification methods may be acceptable based on manufacturer's recommendations, service history of equipment, and available documentation. Hoses may be replaced in lieu of recertifying providing replacement hoses meet all required commodity and pressure specifications along with appropriate tagging and documentation per 23.4.5.

#### **23.4.8 General Rules**

- a. Keep high pressure areas clean. If a hose should rupture, loose objects become dangerous projectiles.
- b. Do not allow a hose bend radius to become less than the manufacturer's specified minimum. Safe operating pressure decreases when bend radius is reduced below the specified minimum.
- c. Use only the hose designated for the specified fluid. Hoses are not interchangeable for use with different fluids. Check the tags for fluid use before installing the hose.
- d. Maximum operating pressure of a system can be determined by relief valve settings. If settings have been changed to allow a higher operating pressure, verify the flexible hose working pressure, and replace the hose if necessary.
- e. Install only tagged hose assemblies. Send all untagged assemblies to equipment maintenance for identification, retesting, or disposal.

#### **23.4.9 Documentation**

**General** - The Recertification Program Office is responsible for maintaining the documentation for all flexible hoses in stationary and mobile process systems. The documentation shall consist of (a) the manufacturer's specification sheet with size, material commodity, and pressure rating; (b) a copy of the pressure test report from the manufacturer; and (c) the annual inspection results.



## 23.6 APPENDIX B - HIGH PRESSURE HOSE ANNUAL INSPECTION FORM

### HIGH PRESSURE HOSE INSPECTION

DATE: \_\_\_\_\_  
LOCATION - BUILDING: \_\_\_\_\_ ROOM/AREA: \_\_\_\_\_

EQUIPMENT DESCRIPTION: \_\_\_\_\_

HOSE MANUFACTURER: \_\_\_\_\_

MODEL #: \_\_\_\_\_

TAG #: \_\_\_\_\_

HOSE DIAMETER: \_\_\_\_\_

FLUID:  Hydraulic  Air  Hydrogen  Oxygen  Nitrogen  Helium  
 Argon  Other – Specify \_\_\_\_\_

SYSTEM MAXIMUM ALLOWABLE WORKING PRESSURE: \_\_\_\_\_

RATED PRESSURE OF HOSE: \_\_\_\_\_

TYPE OF HOSE:  Stainless steel  Rubber  Other – Specify \_\_\_\_\_

DATE OF LAST PRESSURE TEST: \_\_\_\_\_

DATE OF LAST RECERTIFICATION: \_\_\_\_\_

#### VISUAL EXTERNAL INSPECTION:

Evidence of Cracks	y	n	
Evidence of Leaking	y	n	
Evidence of Kinks or Crimping	y	n	
Evidence of Twisting	y	n	
Evidence of Cuts	y	n	
Evidence of Abrasion	y	n	
Evidence of Hose/Connector Separation	y	n	
Hose subjected to physical damage	y	n	
Hose subjected to chemical damage	y	n	
Deliberate painting of hose	y	n	
Support used on 6' lengths and longer	y	n	na

INSPECTED BY: \_\_\_\_\_ DATE \_\_\_\_\_

## 23.7 REFERENCES

- NPD 8710.5, NASA Safety Policy for Pressure Vessels and Pressurized Systems, Effective Date March 17, 1998.
- NPG 1700.6A, Guide for In-service Inspection of Ground-Based Pressure Vessels and Systems – with changes 1-8, dated July 13, 2000, Effective Date December 24, 1997.
- GRC-M-7500.001, Glenn Research Center at Lewis Field, Pressure Vessel/System Recertification Handbook, Rev. October 2001, Can be found within GRC’s Business Management System (BMS) Library.
- American Society of Mechanical Engineers, ASME-B31.3, Process Piping, 2002.
- American Society for Testing and Materials, ASTM, D380-394, Standard Test Methods for Rubber Hose, Reapproved 2000.
- Society of Automotive Engineers, SAE, ARP 1658, Rev. B, Hose Assemblies, Installed, Visual Inspection Guide for, Issued 1982-03, Revised 1997-08, Reaffirmed 2001-12.

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