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APPLICATION		PART NO.	MF	REVISIONS			
NEXT ASSY	USED ON			SYM	DESCRIPTION	DATE	APPROVAL
				A-D	ON FILE IN TDC	a) 4/17/90 b) 12/11/90 c) 8/7/91 d) 10/13/92	C. GLASSBURN (all revisions)
				E	DELETED TABLE 5 DATA, MOVED TABLE 1 DATA TO TABLE 5 AND MADE TABLE 1 "NOT USED." DELETED DIS TAG REQUIREMENTS. ADDED FLEXHOSE INSPECTION TAG/LABEL. ADDED FLEXHOSE LENGTH VARIATIONS CAPABILITY. UPDATED AND CORRECTED TABLES 9, 10, AND 11. CORRECTED FIGURE 19. CLARIFIED USE OF KSC FORM 28-593 AS THE CLEANLINESS VERIFICATION FORM. CHANGED LSOC TO LMSO SEVERAL PLACES.	6/30/95	C. GLASSBURN
				F	REVISED SHT 1 - 57. ADDED SH 58 - 60. INC EO's 3 - 7. CHANGED "LMSO" TO "USA" AND "SPC" TO "SFOC". MOVED FIG 3 & 3A TO SHT 14 FROM 15. PLACED NEW FIG 3B ON SHT 15 AND NEW TABLES 1 & 1A ON SHT 16. REPLACED "KELLEMS" WITH "AMTEC / KELLEMS". REVISED P. 8.3A, L/I'S 1) - 7) TO REFLECT NEW SHT NUMBERS AND TABLE NUMBERS. REVISED TABLE 3 PER LATEST REV OF 79K80260. REVISED TABLES 4 & 5. ADDED "RECOMMENDED" AMTEC P/N'S TO TABLES 9, 11 & 13. MOVED ORIGINAL "KELLEMS" P/N'S TO 3 NEW SHEETS FOR "ALTERNATE" P/N'S IN TABLES: 10, 12, & 14. REVISED "QA 001" TO "OP USA004642" AND REVISED "79K19000" TO "80K57897". REVISED "REFERENCE DOCUMENTS" TO REFLECT CHANGES IN BODY OF DOCUMENT. REVISED PARAGRAPH 7.5 TO REFLECT CURRENT PRACTICE. REVISED SHEET NOS. 16-57 TO 17 - 60 ACCORDINGLY.	08/11/04	T. ADAMS J. PHILLIPS

THIS COMPUTER DRAWING WAS  
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FILED UNDER THE DRAWING NUMBER

UNLESS OTHERWISE SPECIFIED	ORIGINAL DATE OF DRAWING <b>5 OCT 88</b>		<b>FLEXHOSE HANDLING AND INSTALLATION REQUIREMENTS SPECIFICATION FOR</b>	JOHN F. KENNEDY SPACE CENTER, NASA  KENNEDY SPACE CENTER FLORIDA	
DIMENSIONS ARE IN INCHES TOLERANCES ON FRACTIONS DECIMALS ANGLES	DRAFTSMAN	MATERIALS			
	CHECKER	STRESS			
MATERIAL	ENGINEER <b>S.A.FIELD</b>	ENGINEER			
HEAT TREATMENT	SUBMITTED <b>LSOC 17-92D C.GLASSBURN 11/3/88</b>				
FINAL PROTECTIVE FINISH	APPROVED <b>HORACE L. LAMBERTH</b>		SCALE	DWG SIZE <b>A</b>	<b>80K51846</b>
		UNIT WT		SHEET	<b>1 OF 60</b>

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## GLOSSARY OF TERMS

C/L	Center Line
CDR	Cleaning Decontamination Request
DR	Discrepancy Report
EO	Engineering Order
ESR	Engineering Support Request (KSC Form 21-319)
FDS	Fluid Distribution System
ID	Inside Diameter
MAWP	Maximum Allowable Working Pressure
MMP	Mechanized Maintenance Plan
OD	Outside Diameter
OMI	Operation and Maintenance Instruction
OMRSD	Operational & Maintenance Requirements & Specifications Document
PMN	Program Model Number
PR	Problem Report (KSC Form 2-152V2)
PSIG	Pounds Per Square Inch Gage
QPRD	Quality Planning and Requirements Document
RMRS	Repeatable Maintenance Recall System
SFOC	Space Flight Operations Contract
SR	Support Request (KSC Form 19-15)
TPS	Test Preparation Sheet
USA	United Space Alliance
WA	Work Authorization
WAD	Work Authorization Document

1.0 SCOPE

This specification establishes requirements for Flexhose Assemblies used by the supporting elements of Facility and Ground Support Equipment (GSE) at Kennedy Space Center.

2.0 PURPOSE

This specification defines the methods and procedures by which SPC and other personnel will install, maintain, inspect, and test all types of flexible hoses.

### 3.0 DEFINITIONS

#### 3.1 FLEXHOSE

A flexhose is a flexible conduit which carries/transfers a service media from one point to another

##### 3.1.1 TYPE I FLEXHOSE ASSEMBLY

Permanently-dedicated hose whose installation and placement are indicated by design-controlled engineering drawings. Once installed, the flexhose is considered to be an integral part of that installation. Type I hoses have an assigned drawing reference designator such as an "A" number or "FH" number.

##### 3.1.2 TYPE II FLEXHOSE ASSEMBLY

Temporarily-installed and assigned, non-dedicated flexhose whose installation is authorized and controlled by a WAD. Hose identification will be established by the controlling WAD or other appropriate control document.

Note: Type / Category are the same. For the purposes of this document, Type shall be used

##### 3.1.3 TYPE III FLEXHOSE ASSEMBLY

For all systems except refrigeration systems, a utility hose which is a temporarily installed, mobile, or special purpose hose for use with equipment where normal working pressure is 150 psig or below. This flexhose assembly may be used for flowing all media excluding those which carry hazardous/toxic fluids.

For refrigeration systems: A refrigeration service hose which is a commercially fabricated braid reinforced flexible hose with low loss fittings which meet SAE requirement J1296 (or equivalent) recognized component for R-12, R-22, R-500, R-502 and R134a refrigeration systems with operating pressures to 300 psig.

#### 3.2 PRESSURE TESTING

- a. Hydrostatic Test: A water pressure test of the hose when manufactured and as required thereafter by the design-controlled drawing or OMRSD to verify structural integrity of the hose assembly. The hose shall not be damaged or deformed nor leak when subjected to its required pressure. The hydrostatic pressure shall be a minimum of 150% of the hose's rated pressure unless otherwise specified by the OMRSD, design-controlled drawing or manufacturer's specification.
- b. Pneumatic Test: A gas pressure test of the hose to verify structural integrity of the hose assembly. Such a test is to be performed only as required by special engineering instructions. The hose shall not be damaged or deformed nor leak when subjected to the required pressure. The required pressure is 110% of the rated pressure of the hose.
- c. System Test: A leak test of the hose while installed in the system. The hose shall not leak when Subjected to the maximum system working pressure.



3.3 PRESSURE SYSTEM

A system containing a gas or liquid media with greater than ambient pressure.

3.4 REFERENCE DESIGNATOR (FIND NUMBER)

An alphanumeric combination that provides a unique system identification of each flexhose as designated by applicable design drawing.

3.5 SERIAL NUMBER

A unique five character number assigned to a specific flexhose to provide manufacturer traceability.

3.6 TAG PART NUMBER

See Figure 2 on page 14 for part numbers of typical tags that can be used for hose identification / information. See Figure 3b, page 15, for part numbers of typical SST I.D. Band mounted with two SST tie wraps.

3.7 RMRS TRACKING NUMBER

A unique four character number assigned to GSE upon installation to provide maintenance traceability.

3.8 VISUAL INSPECTION TAG

A metal dog tag or band bearing the date on which the hose received a visual inspection. The due date for the next inspection shall also appear on the visual inspection tag. (Ref. Figure 3, page 14 for dog tags and Figure 3b, page 15 for bands. See Paragraph 3.9 for an approved option.

3.9 FLEXHOSE INSPECTION TAG/LABEL

An optional use tag/label that denotes WAD number, clean level of the hose, media, date issued and next inspection due date. It has a space for a required user ink stamp (use indelible ink to mark). The tag/label is self-adhering and may be placed on a dog tag or other appropriate tag or location. The tag/label is KSC Form 29-911(7/95). (Ref Figure 3a on page 14.)

#### 4.0 ACCEPTANCE CRITERIA

All newly fabricated flexhose assemblies shall meet the following criteria:

#### 4.1 PRESSURE TESTING

Type I and Type II flexhose assemblies shall be pressure tested to the manufacturer's standards or per the design drawings or specifications. Flexhoses tested at facilities other than KSC shall have evidence accompanying the hose indicating that the hose pressure test meets KSC requirements. The flexhose shall then be processed for use.

Note: Evidence consists of a copy of the Quality Control (QC) accepted pressure test document or an attached QC accepted pressure test tag. Test documentation shall be reviewed and verified as meeting KSC criteria.

- 4.1.1 If a pressure test tag with the required information is not attached to the flexhose assembly when received by USA, a metal dog tag or band must be prepared and affixed to the hose. If documentation has not been provided, the hose shall be pressure tested locally to manufacturer's standards or design drawing /specification

Note: Type III flexhose assemblies shall be exempt from this requirement.

#### 4.2 MANUFACTURER'S IDENTIFICATION

A metal tag or band as specified in Section 5.0 of this specification shall be supplied by the manufacturer (whether SPC or outside contractor and irrespective of Design Control Center) bearing the following information:

- a. Manufacturer's Name
- b. Manufacturer's Part Number
- c. Fabrication Date (Month and Year)
- d. Hydrostatic / Pneumatic Test Date (Month and Year)
- e. Rated Working Pressure
- f. Serial Number, if applicable

Note: If the manufacturer's identification tag is not supplied, USA Pneumatics Shop shall prepare an impression stamped metal dog tag per Figure 2, page 14, or band, Figure 3b, page 15, bearing the above information.

- 4.3 Flexhose assemblies manufactured under the NASA / JSC / Boeing and NASA / MSFC / USA Design Centers(s) Control shall be identified per their controlled drawings.

## 5.0 IDENTIFICATION

KSC Shuttle and Ground Support Engineering, KSC Shops/Process Subcontractors, or KSC Support Operations as applicable shall be responsible for providing proper identification / marking of flexhose assemblies. General categories of identification information required on all flexhose assemblies (except Type III) are as follows:

- a. Identification Group Marking Tapes (per Section 5.1 of this Specification).
- b. Manufacturer's Identification (per Section 4.2 of this Specification).
- c. Find Number Tag (per Section 5.2 of this Specification).
- d. Hydrostatic / Pneumatic Information (per Section 4.2 and 10.0 of this Specification.)
- e. NOT USED
- f. Serial Number / RMRS Tracking Number (on tags as applicable).
- g. Inspection Information (per Section 6.0 of this Specification).

### 5.1 IDENTIFICATION GROUP MARKING TAPES

Flexhose assemblies shall be identified as specified in KSC-STD-SF-0004 (latest rev.).

**Note:** this applies to Type I and installed Type II hoses only. Also note that KSC-STD-SF-0004 covers media, system working pressure, and flow direction.

- 5.1.1 Tapes shall be used to band all flexhose assemblies less than four inches in diameter (nominal) except hot lines (200 deg F or higher), cold lines (-60 deg F or lower) and other lines where tape adhesion would be severely impaired. In the aforementioned conditions, an imprinted metal band (etched or stamped) may be used.
- 5.1.2 Tapes shall be placed at both ends of the flexhose assembly except in such cases where the hose is under six feet in length. Flexhose assemblies under six feet in length require only one set of tapes (single identification shall be located in the center of the hose). Spacing between tapes within a group shall be a minimum of one inch, except where precluded by length of line. In such cases, spacing less than one inch shall be allowed. Additional placement shall be accomplished as necessary to ensure that one complete group is readily visible.

### 5.2 FIND NUMBER TAG

An impression stamped metal dog tag or band bearing the following information shall be attached to each flexhose assembly. (Ref Figure 2 on page 14 for dog tags and Figure 3b, page 15 for bands.) Tags for Type I and II hoses, six feet or less in length, shall be placed in the center and at an orientation that information on the tags are readable. Tags for Type I and II hoses greater than 6 feet in length shall be located at each end.

- 5.2.1 For Type I hoses, use the find number (AXXXXXX) for NASA DE designed systems or reference designator (FHXX) for SFOC designated systems.

5.2.2 For Type II hoses, use the drawing identification number, (i.e., 79K80260 followed by the appropriate dash numbers)

### 5.3 ID TAG INSTALLATION VERIFICATION

The user shall be responsible to verify that current identification tags / labels are affixed to each flexhose assembly.

### 5.4 METAL TAGS

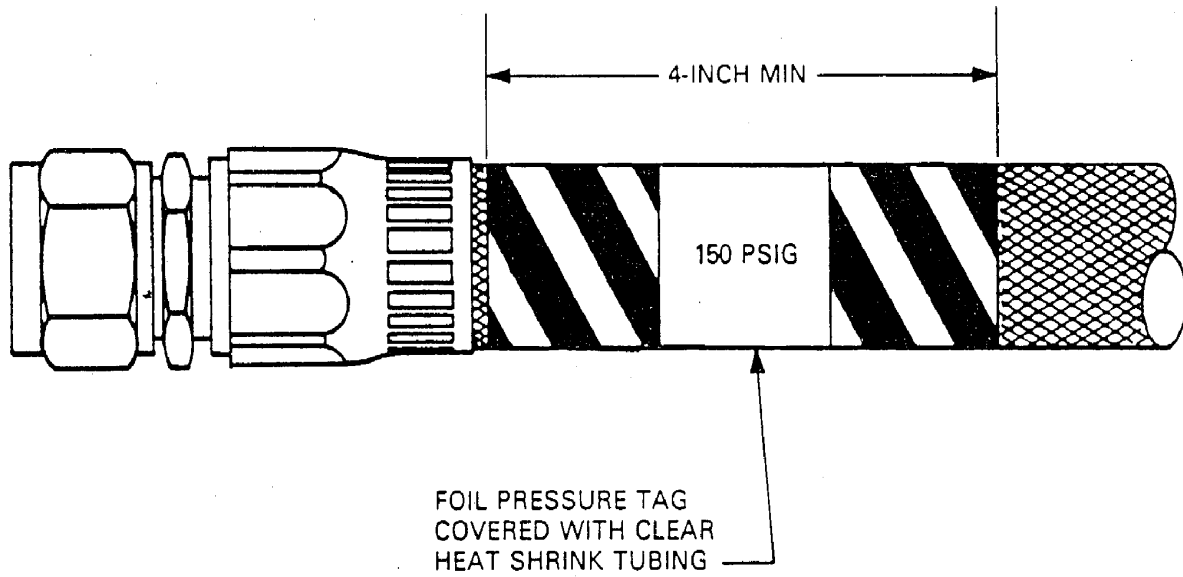
Metal tags (dog tags, Ref Fig. 2 and 3) as required by this specification shall be fabricated from stainless steel or aluminum and marked in accordance with the preceding paragraphs. The tags shall have no burrs or sharp edges which could tear or cut safety clothing such as SCAPE suits. Tags shall be attached to the flexhose assembly with two (2) nylon coated stainless steel cable (0.04 min. dia., FSN 4010-00-K03-8998 per MIL-W-83420) or two (2) number 16 AWG SST wire and secured using a stainless steel ferrule. Stainless steel wire ends shall be stowed to prevent injury to personnel or damage to clothing. When tags or the attaching wires become damaged/frayed/illegible (as applicable), the tags/wires are to be replaced.

### 5.5 STAINLESS STEEL (SST) IDENTIFICATION BANDS

SST ID bands can be used as an alternate to metal tags. Figure 3b, page 15, identifies the part number of the band and tie wraps. The bands shall be 304/316 SST and have no burrs or sharp edges. The bands shall be attached to the flexhose with two SST tie-wraps as shown in Figure 3b, page 15. The bands shall be impression stamped with the following data.

- a. Find Number
- b. Part Number
- c. Manufacturer's Name
- d. Rated Working Pressure
- e. Hydrostatic / Pneumostat Test Date
- f. Fabrication Date
- g. Serial Number

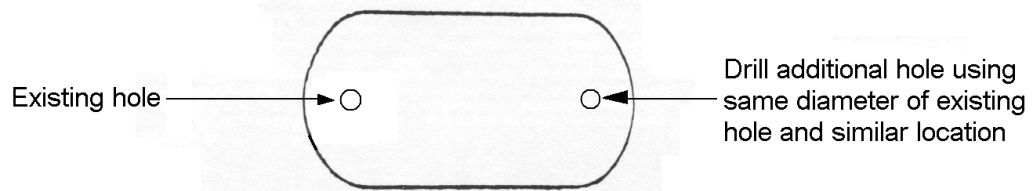
**NOTE:** If there is not adequate space on the band for all the above data, then continue text on a second band.



NOTES:

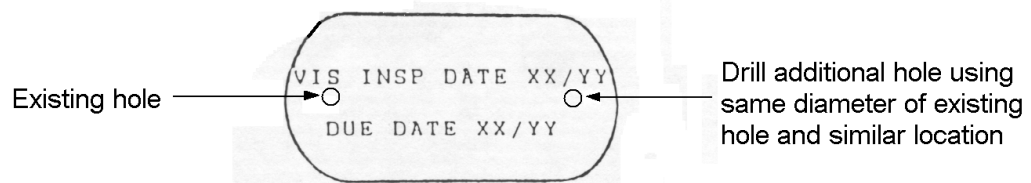
1. IF HOSE IS UNDER 6 FEET LONG, TAG TO BE LOCATED IN CENTER.
2. IF HOSE IS OVER 6 FEET LONG, TAG TO BE LOCATED AT EACH END.

Figure 1. Type III Hose Identification



DOG TAG P/N 8465002424804

Figure 2. Tag Part Number



DOG TAG P/N 8465002424804

Figure 3. Visual Inspection Tag

FLEXHOSE INSPECTION
DATE PERFORMED:
_____
NEXT INSPECTION DUE:
_____
INSPECT BY:
_____
WAD NUMBER:
_____
MEDIA / COMMODITY:
_____
CLEAN LEVEL:
_____
KSC Form 29-911(7/95)

Figure 3a. Flex Hose Inspection Tag / Label

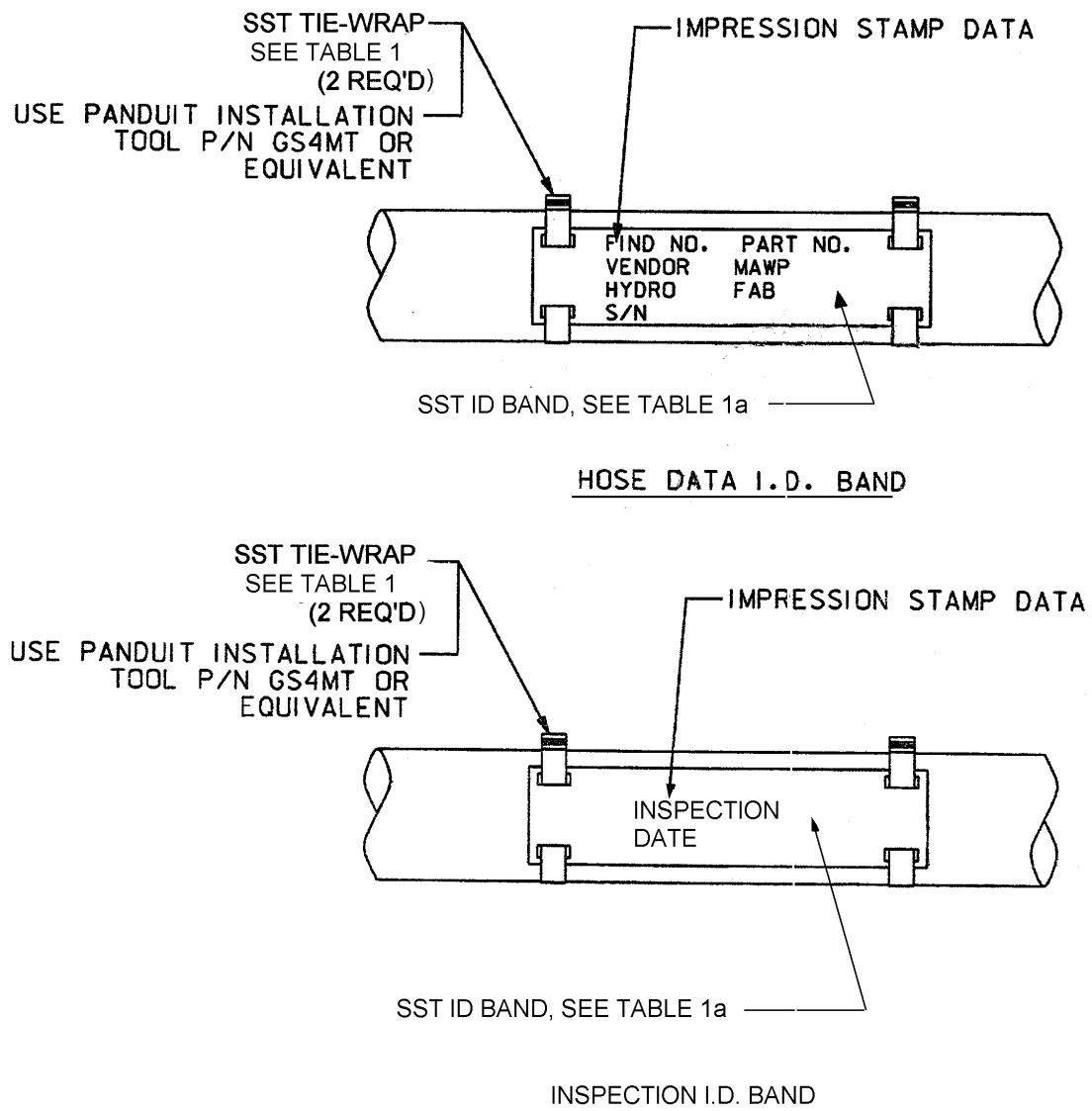


Figure 3b. Installation of Hose ID Data and Inspection ID Bands

Table 1: SST TIE-WRAP VENDOR PART NUMBERS

SST TIE-WRAP. VENDOR PART NO	MAX BUNDLE SIZE INCHES	LENGTH INCHES	WIDTH INCHES	MIN LOOP TENSILE STRENGTH LBS
MLT1S-CP	1.00	5.0	.18	100
MLT2S-CP	2.00	7.9	.18	100
MLT2.7S-CP	2.70	10.2	.18	100
MLT4S-CP	4.00	14.2	.18	100
MLT6S-CP	6.00	20.4	.18	100
MLT8S-CP	8.00	26.8	.18	100
MLT10S-CP	10.00	33.0	.18	100
MLT12S-Q	12.00	42.0	.18	100
MLT14S-Q	14.00	47.0	.18	100
MLT2H-LP	2.00	7.9	.31	250
MLT2.7H-LP	2.70	10.2	.31	250
MLT4H-LP	4.00	14.2	.31	250
MLT6H-LP	6.00	20.4	.31	250
MLT8H-LP	8.00	26.8	.31	250
MLT10H-LP	10.00	33.0	.31	250
MLT12H-Q	12.00	42.0	.31	250
MLT14H-Q	14.00	47.0	.31	250
CUSTOM LENGTH BANDING SYSTEM				
MBS-TLR	ANY	N/A	.18	N/A
MBS-MR	ANY	N/A	.18	N/A
MBH-TLR	ANY	N/A	.31	N/A
MBH-MR	ANY	N/A	.31	N/A
BANDING HEADS				
MTHS-C	N/A	N/A	N/A	N/A
MTHH-C	N/A	N/A	N/A	N/A

Table 1a. SST ID BAND VENDOR PART NUMBER

SST I.D. BAND VENDOR PART NO.	USED WITH TIE-WRAP WIDTH INCHES	WIDTH INCHES	LENGTH INCHES
MMP350-C	.18	.75	3.50
MMP350W38-C	.18	.38	3.50
MMP350H-C	.18/.31	.75	3.50

VENDOR: PANDUIT CORPORATE HEADQUARTERS  
 (Tbl. 1 & 1a) 17301 Ridgeland Avenue  
 Tinley Park, IL 60477  
 Tel: 708-532-1800/888-506-5400  
 Fax: 708-532-1811



## 6.0 INSPECTION CRITERIA

The user shall perform the visual inspection given in 6.1 through 6.10 at times and situations given in 6.11 and 6.12 for Type I and installed Type II flexhoses. If discrepancies are found, they will be documented and dispositioned in accordance with OP USA004642 or current logistical procedures. If evaluation for Type I hose indicates that the hose condition / situation is not detrimental to continued use and, specifically, would not adversely affect safety or operation of the system, an appropriate MR may be written and processed.

- 6.1 All permanently installed flexhoses which operate at 1034 kPa (gage) [150 psig] or higher pressure shall be externally visually inspected over their entire length at least annually for damaged threads, broken braid, kinks, flattened areas, or other evidence of degradation. When any such discrepancies are found, a Discrepancy Report (DR) or Problem Report (PR) must be processed. If evaluation by cognizant engineering personnel indicates the discrepancy is not detrimental to continued safe use, a Material Review (MR) may be processed.
- 6.2 All permanently installed flexhoses used with toxic/lethal fluids (MMH, N<sub>2</sub>H<sub>4</sub>, N<sub>2</sub>O<sub>4</sub>, NH<sub>3</sub>, etc.), regardless of operating pressure, shall be externally visually inspected over their entire length at least annually for damaged fittings, broken braid, kinks, flattened areas, or other evidence of degradation. REF: KSC-STD-Z-0006 for additional servicing/inspection criteria.
- 6.3 All temporary-use flexhoses used with nontoxic / non-lethal fluids which operate at 1034 kPa (gage) [150 psig] or higher pressure shall be externally visually inspected over their entire length on a periodic basis for damaged fittings, broken braid, kinks, flattened areas or other evidence of degradation. When any such discrepancies are found, a DR or PR must be processed. If evaluation by cognizant engineering personnel indicates the discrepancy is not detrimental to continued safe use, an MR may be processed.
- 6.4 All temporary-use flexhoses used with toxic / lethal fluids (MMH, N<sub>2</sub>H<sub>4</sub>, N<sub>2</sub>O<sub>4</sub>, NH<sub>3</sub>, etc.) regardless of operating pressure, shall be externally visually inspected over their entire length on a periodic basis for damaged fittings, broken braid, kinks, flatten areas or other evidence of degradation. REF KSC-STD-Z-0006 for additional servicing/inspection criteria.

**NOTE:** Non-metallic hoses installed in hypergol systems are subject to the life cycle limitations of paragraph 3.5.1.5 of KSC-STD-Z-0006.

- 6.5 Verify that the flexhose has all required identification in accordance with Section 5.0 of this document.
- 6.6 Not used.
- 6.7 Verify that rigid protective covers have been installed over sections of flexhose in traffic areas / walkways, or routed through proper dressing.

- 6.8 Verify hose configurations / installations are in accordance with Tables 4 and 5 and Figures 4 through 13 of this specification. (See pages 23 through 36)
- 6.9 Ensure that no hot spots exist. It is normal for the stainless steel braid to turn a uniform golden-brown color after exposure to high temperatures. Isolated patches of color are not normal. If spots of color are found, check surfaces that the installed flexhose assembly may be touching for temperatures higher than the maximum rating for that particular hose. If the heat was high enough to discolor the braid in isolated patches, replace the assembly and reroute to avoid the heat.
- 6.10 The date of inspection and due date for the next inspection shall be documented on the hose by means of an attached metal band which has been die-stamped or electro-chemically etched per KSC-STD-E0015. Alternately, the dates may be stamped or embossed on a dog tag (FSN 8465-00-242-4804) that is attached to the hose by a number 16 AWG SST wire or a nylon coated steel cable, 0.040 inch minimum dia. FSN 4010-00-K03-8998, per MIL-W-83420. An optional tag / label as denoted in 3.9 is also acceptable. (See Figures 3 and 3a on page 14) The inspection interval shall be defined in the system OMRSD and other operating and maintenance documents. Severity of operating environment, type of service media and operating pressure are to be considered in establishing the inspection interval.
- 6.11 VISUAL INSPECTION OF TYPE I FLEXHOSES:
- a. Visual inspections shall be performed to the requirements defined in 6.1 - 6.10.
  - b. Visual inspections shall be performed at least annually on installed hoses. The due date for the next inspection shall be added to the inspection tag, as denoted in section 6.10.
  - c. For Type I hoses in storage, the inspection may be made just prior to or at issuance. At that point, the due date for the next inspection shall be added to the inspection tag denoted in section 6.10 with the inspection interval being at least annually.
- 6.12 VISUAL INSPECTION OF TYPE II FLEXHOSES:
- a. Visual inspections shall be performed to the requirements defined in 6.1 - 6.10.
  - b. The interval of inspection for flexhoses in storage / not in-use will be selected from the following two options. The selection will be made based on operational criteria and GSE resource management of the individual work site.
    - 1) Inspection prior to issuance for use, and certification thereof
    - 2) Inspection based on an annual frequency, and certification thereof

**NOTE:** At either inspection, the inspection tag denoted in 6.10 shall be completed and affixed to the hose

- b. The interval of visual inspection for an installed / in-use flexhose is 1 year.

## 7.0 INSTALLATION

This section covers hose installation, problem reporting, and flexhose connection.

### 7.1 The user shall perform the following tasks during installation:

- a. Check for broken braid. Broken wires are not permitted.
- b. When required by WAD, verify that hose ends on hoses which are to be installed have been properly controlled for cleanliness and that no visible evidence of contamination exists. Verify that the cleanliness level specified on drawings, OMD, or installation WAD has been accomplished and that the hose bears certification thereto.
- c. Verify that the flexhose has all required identification (Ref. Section 5.0 of this document).
- d. Verify that the pressure rating specified on the flexhose identification band / tag is equal to or greater than the intended use.
- e. Verify that the flexhose is identified for the commodity type to be transferred.

#### **Notes:**

- 1) Flexhose used for hypergols shall be permanently dedicated to that commodity and are prohibited from use in any other system.
  - 2) Flexhoses used for hydrogen service shall not contain any 17-4PH stainless steel parts that could come in contact with the media, nor shall 17-4PH stainless steel be specified in any applicable WAD.
  - 3) An uninstalled flexhose (Type II) may be used as a temporary replacement for a permanently installed flexhose (Type 1) without changing tracking numbers as long as the WAD remains open until replacement and recycle of the temporary flexhose has been accomplished
  - 4) Flexhoses used for oxygen service shall be only those specified as being oxygen compatible and shall be dedicated to that commodity. They are prohibited from use in any other system
- f. Maintain cleanliness control while removing protective caps, plugs, or covers from flexhose and fittings and connecting fittings. Do not reuse caps, plugs, or covers unless they have been verified to be clean.
  - g. Ensure that flexhose and fittings and the fitting to which the flexhose is to be connected are free of chips, burrs, dents, nicks, pits, gouges, or foreign material that could endanger proper operation. Visually inspect welded and brazed fittings for cracks, corrosion, or discontinuities. Inspect end fittings for cracks, stripping, or galled threads.

- h. Verify that seals and / or sealing surfaces are in good condition. If any defect / deterioration is detected, seals must be changed-out prior to installation.
- i. Teflon tape shall be applied to male pipe thread fittings counter to the direction of tightening, leaving forward two threads bare per A-A-58092, FSN-8030-889-XXXX, as required.
- j. Lubrication of fitting threads shall be accomplished per KSC-SPEC-Z-0009.

**Note:** Krytox lubricant is normally used for 79K or 80K hoses. Brayco lubricant is specified on Rockwell supplied hoses.

- k. Install flexhose in a neat and orderly manner and route in a manner that will not place an additional (that is, caused by poor / improper routing, etc.) load on the hose or connecting hardware. (Ref. Figures 5 through 12, pages 29-36.)
- l. Avoid sharp bends in flexhose and ensure that bend radius is greater than occasional flexure as defined in the Flexhose Drawing. When not specified, the minimum bend radius shall be five (5) times the outside diameter of the hose. (Ref Figures 5 through 10, pages 29-34 and Tables 4 and 5, pages 25 & 26)
- m. For large diameter flexhose, use transfer line saddles as specified in design drawings to support the hose as applicable.
- n. While ensuring that the flexhose does not turn or twist and, where applicable, using appropriate type and size wrench, tighten coupling to desired degree of tightness, Table 6, 7, & 8, pages 27 & 28. Use back-up wrench on B-nut type fittings The user shall verify gap dimension on Resistoflexhoses. (Ref.. Figure 4 on page 23 and Tables 2 and 3, page 24.)
- o. NOT USED
- p. A rigid protective cover or multipurpose routing equipment shall be installed over sections of flexhose in traffic areas / walkways.
- q. All flexhoses with two-piece end fittings (i.e., B-Nut, hex flat nipple portion which screws into a socket with hex flats) where it is possible to back out the nipple, the hex or B-Nut fitting must have a safety sleeve installed over the socket sleeve and nipple hex flat to prevent backing out. Forward all hoses without safety shields or protective sleeves to the USA Pneumatics Shop for shield / sleeve installation as applicable. Ensure that gap measurements on fittings for Resistoflexhoses are per applicable specifications and drawings. (Ref. Figure 4 on page 23 and Tables 2 and 3, page 24)
- r. Unless otherwise specified by design drawing, fuel and oxidizer hoses shall be routed so as to provide a minimum distance of 24 inches between the two hoses.
- s. For Rockwell / Boeing designed equipment, torque values for fittings shall be as specified in Tables 6 and 7 on page 27. Torque class shall be per drawing callout. (Ref. MAO102-306, Fabricated and Installed Rigid Tube and Flexible Hose Assemblies.) For KSC/USA designed equipment, torque per Table 8 on page 28.

## 7.2 NOT USED

## 7.3 FLIGHT VEHICLE INTERFACE

When flexhoses are routed through vehicle access doors, and no equipment exists to provide support and/or protection to the flexhoses, the following guidelines should be used:

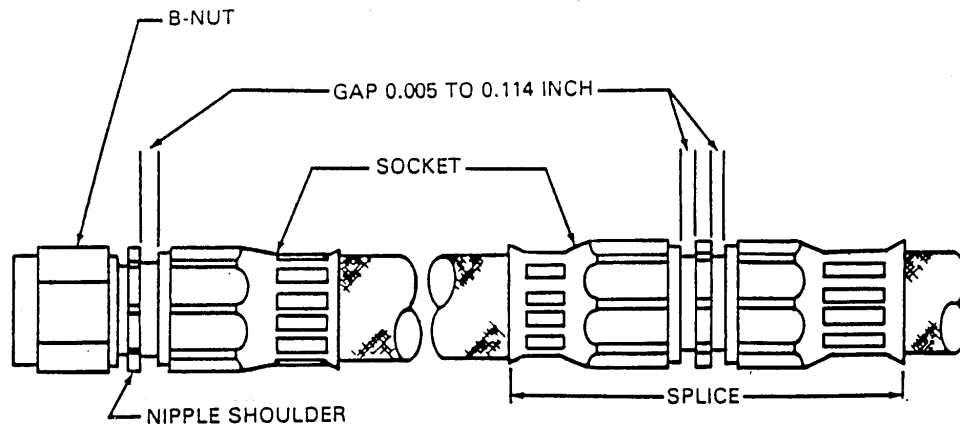
- a. The flexhoses should be secured to the multipurpose support stand (Figure 11 on page 35) using tie-wraps at approximately 12 inches or as close to the entry point as possible from the point of ingress to the flight vehicle. Permanent attachment devices shall be provided to prevent tipping of the stand.
  - 1) Where possible, flexhoses should be routed to the side or top of the access door / hatch of the flight vehicle
- b. The flexhoses should be "dressed" back to the source and routed through the multipurpose (PVC) "dressing" and routing equipment (Figure 12 on page 36).
- c. "Tie-Offs" to movable platforms should have a "fluorescent orange" tag (Figure 13 on page 36) attached to each tie point to ensure removal prior to platform movement.
- d. Edge Protection to the flight vehicle and flexhoses routed through the door / hatch shall be provided by using "elephant hide" taped around the hoses at the point of entry.
- e. Vehicle drag-on hoses should include tie-offs as close to the vehicle entry point as is practical and shall be tied to structural members. Tie-offs are not allowed on tubing, electrical harness, or any sensitive equipment.
- f. Flexhose routing in or near the flight vehicle should be adequately restrained to protect the vehicle, hoses, and GSE from damage and to preclude potential personnel injury.
- g. Routing of flexhoses on the floor is undesirable. Where routing of flexhoses on the floor / platform surface becomes the only viable alternative, covers or the multipurpose support stand should be used and / or the area shall be roped off for controlled access.

#### 7.4 SPECIAL INSTRUCTIONS

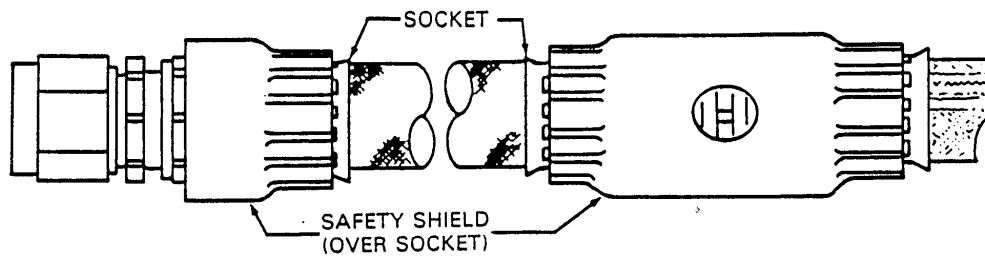
When installing or disconnecting a flexhose from a hard-line system resulting in a loose hose end, ensure that the hose end is capped/plugged, properly integrity sealed and secured.

#### 7.5 FLEXHOSE LENGTH VARIATIONS

When a design-stipulated (Type I) flexhose needs to be replaced and no hose of the exact design-assigned length is available, a hose of reasonably different length (up to + or - 12 inches or up to + or - 10 %, whichever is greater) may be used by the System Engineer as long as it does not create safety or operational problems. PRACA documentation and MRB disposition is required as follows: "Use as repaired pending installation of correct hose length - MRB marking required."



BEFORE SHIELD INSTALLATION



AFTER SHIELD INSTALLATION

Figure 4. Resistoflex Gap Measurement/Shield Installation

RESISTOFLEX No.	GAP	KSC NO.
R62800CCKSC-4-XXXX	0.005 TO 0.114IN.	79K80260-3-XXXX
R65800CCKSC-4-XXXX	0.005 TO 0.114IN.	79K80260-19-XXXX
R62800CCKSC-6-XXXX	0.005 TO 0.114IN.	79K80260-6-XXXX
R65800CCKSC-6-XXXX	0.005 TO 0.114IN.	79K80260-22-XXXX
R62800CCKSC-8-XXXX	0.005 TO 0.114IN.	79K80260-9-XXXX
R65800CCKSC-8-XXXX	0.005 TO 0.114IN.	79K80260-25-XXXX
R25330CC-4-XXXX	0.005 TO 0.114IN.	N/A
R25331CC-4-XXXX	0.005 TO 0.114IN.	N/A
R25332CC-4-XXXX	0.005 TO 0.114IN.	N/A

KSC NO. (for 6000 psi hoses)	RESISTOFLEX NO.
79K80260-3-XXXX	R62800CCKSC-4-XXXX
79K80260-6-XXXX	R62800CCKSC-6-XXXX
79K80260-9-XXXX	R62800CCKSC-8-XXXX
79K80260-19-XXXX	R65800CCKSC-4-XXXX
79K80260-22-XXXX	R65800CCKSC-6-XXXX
79K80260-25-XXXX	R65800CCKSC-8-XXXX
N/A	R25330CCKSC-4-XXXX
N/A	R25331CCKSC-4-XXXX
N/A	R25332CCKSC-4-XXXX



Table 4: TYPE 1 AND II FLEXHOSE MINIMUM BEND RADIUS	
HOSE SIZE (INCH)	3000 – 6000 psi RATED HOSE (INCH)
¼	3
3/8	5
½	5-3/4
¾	7-3/4
1	9-5/8
1-1/4	11
1-1/2	14
2	22

TABLE 5: STAINLESS STEEL CONVOLUTED FLEXHOSE MINIMUM BEND RADIUS

PART NUMBER (PARTIAL)	NOMINAL ID (INCHES) (REF.)	MAX. ALLOWABLE WORKING PRESSURE <sup>1</sup> (PSIG)	MINIMUM BEND RADIUS (INCHES)
80K57897-02	1/4"	2000	4-3/4"
80K57897H-02	1/4"	3675	5-1/4"
80K57897E-02	1/4"	5000	5-1/4"
80K57897-03	3/8"	1475	6"
80K57897H-03	3/8"	2645	6-1/2"
80K57897-04	1/2"	1195	7"
80K57897H-04	1/2"	2095	7-1/4"
80K57897-06	3/4"	885	8-1/4"
80K57897H-06	3/4"	1505	8-1/2"
80K57897-08	1"	715	9-1/4"
80K57897H-08	1"	1195	9-1/4"
80K57897-10	1-1/4"	605	10-1/4"
80K57897H-10	1-1/4"	995	10-1/2"
80K57897-12	1-1/2"	530	11"
80K57897H-12	1-1/2"	860	11-3/4"
80K57897-16	2"	425	13-1/4"
80K57897H-16	2"	680	14-1/4"
80K57897-20	2-1/2"	360	15-1/2"
80K57897H-20	2-1/2"	565	17"
80K57897-24	3"	315	18"
80K57897H-24	3"	490	20"
80K57897-28	3-1/2"	280	21"
80K57897H-28	3-1/2"	430	23-1/4"
80K57897-32	4"	255	23-3/4"
80K57897H-32	4"	385	26-3/4"
80K57897-40	5"	215	30-1/4"
80K57897H-40	5"	325	34"
80K57897-48	6"	190	36-1/4"
80K57897H-48	6"	280	41"
80K57897-64	8"	155	48"
80K57897H-64	8"	220	52-3/4"

Table 6. FLUID FITTINGS TORQUE VALUES (IN-LBS.) FOR SIZES 7/8 INCH & SMALLER FOR ROCKWELL/BOEING DESIGNED EQUIPMENT

TUBE O.D (INCHES)	SIZE	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E	CLASS F	CLASS G	CLASS H	CLASS I
1/8	-2	----	----	----	----	60-70	70-90	30-40	25-35	10-16
3/16	-3	60-105	60-105	----	----	90-115	130-150	60-80	50-75	30-40
1/4	-4	120-165	145-190	70-100	90-110	135-160	170-200	110-130	60-90	40-65
5/16	-5	120-190	180-250	100-120	100-135	180-205	200-240	120-155	80-110	60-80
3/8	-6	180-300	240-360	120-140	170-200	270-305	320-360	165-200	125-175	80-120
1/2	-8	360-480	300-480	200-250	330-375	450-505	480-540	380-420	180-250	150-200
5/8	-10	500-650	540-720	230-290	400-480	650-700	700-780	530-575	250-375	200-360
3/4	-12	600-840	630-860	300-480	510-800	900-1000	1020-1140	780-840	450-600	300-500
7/8	-14	720-1020	----	----	----	----	----	----	----	----

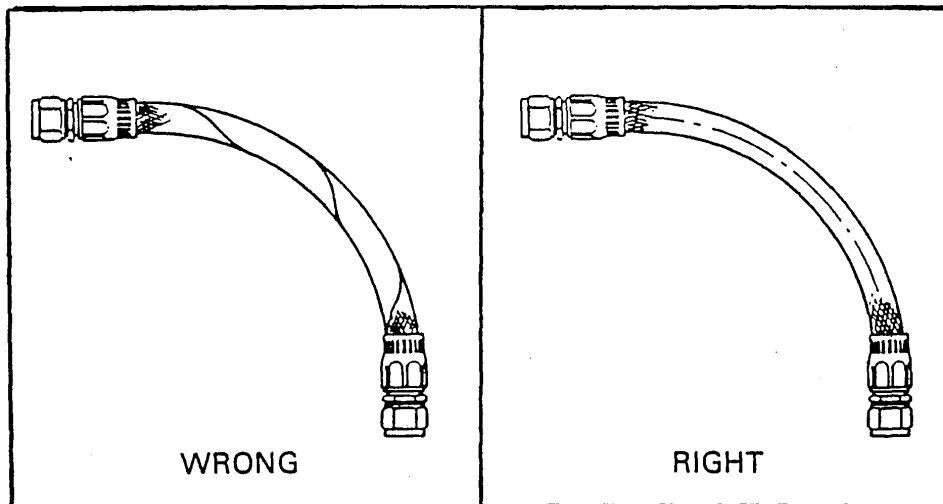
Table 7. FLUID FITTINGS TORQUE VALUES (FT-LBS.) FOR SIZES LARGER THAN 7/8 INCH FOR ROCKWELL/BOEING DESIGNED EQUIPMENT

TUBE O.D (INCHES)	SIZE	CLASS A	CLASS B	CLASS C	CLASS D	CLASS E	CLASS F	CLASS G	CLASS H	CLASS I
1	-16	70-95	78-102	30-75	50-125	100-108	110-120	90-95	50-75	37-50
1-1/4	-20	(a)	120-150	45-100	75-155	125-138	135-155	115-125	70-85	50-60
1-1/2	-24	(b)	160-200	60-125	100-200	165-180	180-200	150-160	80-90	50-67
1-3/4	-28	----	----	100-200	165-300	215-230	230-250	190-200	----	----
2	-32	----	----	120-230	200-400	265-280	280-300	235-250	----	----

**Notes:**

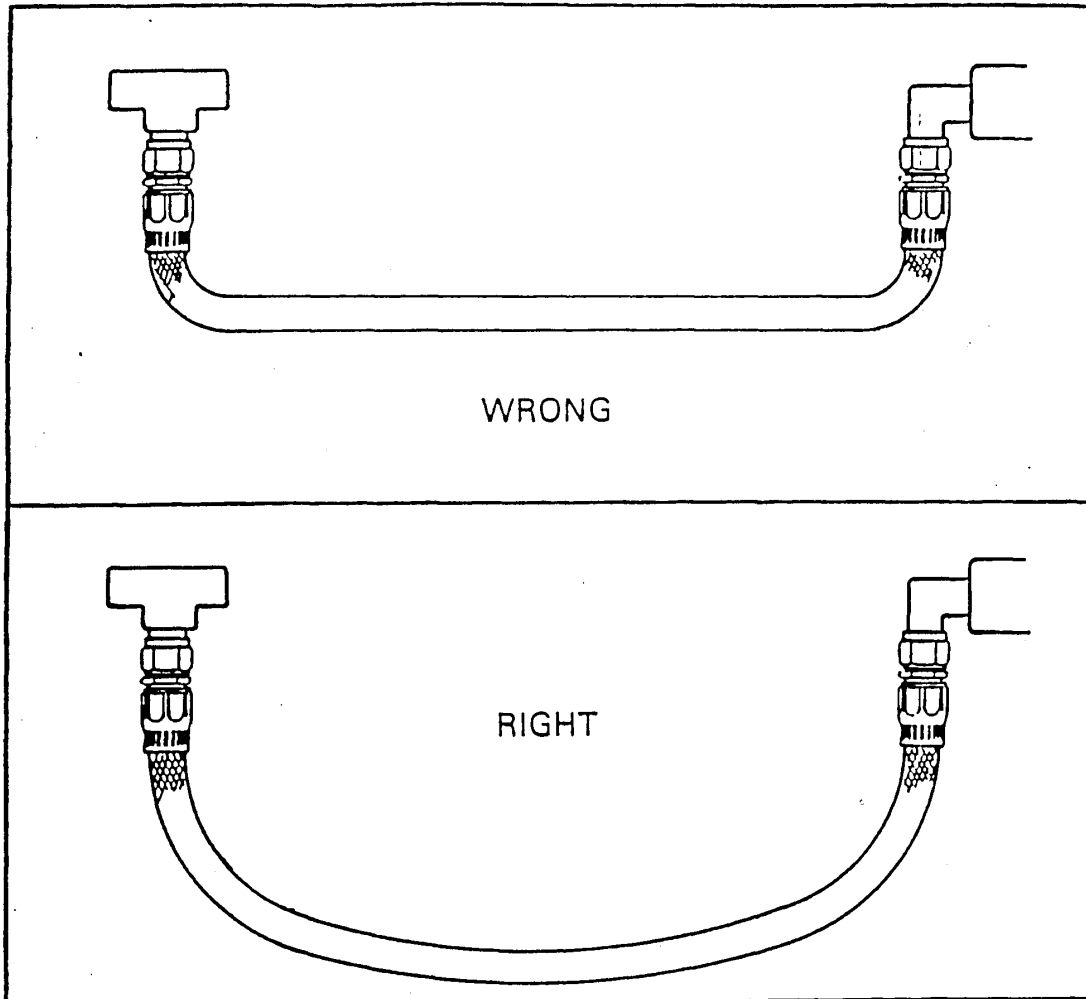
- a. Class A size-20 torque = 90-120 ft-lbs, size-21 torque = 96-128 ft-lbs
- b. Class A size-24 torque = 110-150 ft-lbs, size-25 torque = 125-165 ft-lbs
- c. Reference MA0102-306 for definition of classes

Table 8. FLUID FITTINGS TORQUE VALUES FOR KSC DESIGNED EQUIPMENT								
	FITTINGS		FITTINGS		TUBE ASSYS		BLKHD FITTINGS	
	KC105 fitting end, KC136 fitting end, or KC138 fitting end with AN924 nut and KC140 washer installed with O-Ring seal in MC240 boss		KC139 nut over KC137 or KC141 fitting end installed on fitting end per KC104 or KC105		Tube assembly coupling nuts per KC142 installed on fitting end per KC104 or KC105		AN924 locknuts installed on bulkhead fitting end KC104	
APPLICABLE FITTINGS	KC108, 110, 111, 112, 113, 114, 115, 119, 120, 124, 125, 126, 127, 128, 129, 130, 133, 134, 135, 144, 164		KC106, 107, 109, 131, 132, 150		KC142		KC113, 114, 119, 120, 124, 127, 128, 134, 144	
TUBE O.D.	TORQUE (Inch-pounds)		TORQUE (Inch-pounds)		TORQUE (Inch-pounds)		TORQUE (Inch-pounds)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
1/4	55	80	135	185	135	185	75	100
3/8	100	150	270	345	270	345	150	200
1/2	180	230	450	525	450	525	200	250
3/4	420	600	900	1,100	900	1,100	450	650
1	600	840	1,200	1,400	1,200	1,400	650	900
1-1/4	720	960	1,500	1,800	1,500	1,800	800	1,000
1-1/2	840	1,080	2,000	2,300	2,000	2,300	900	1,100
2	1,000	1,300	3,200	3,600	3,200	3,600	900	1,100



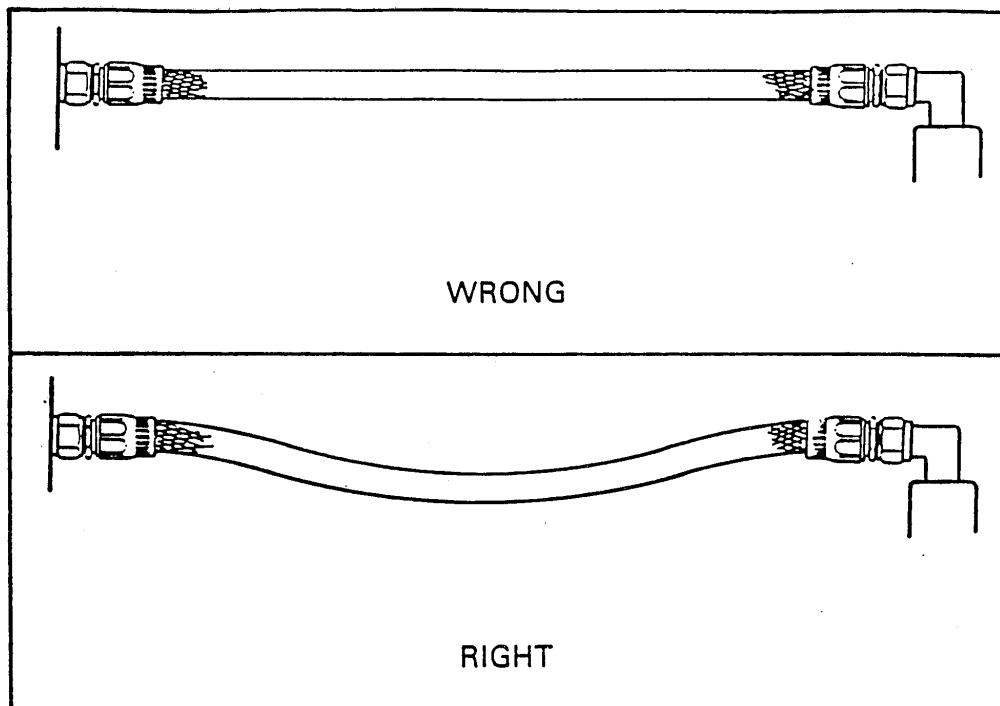
NOTE:  
IF HIGH OPERATING PRESSURES ARE APPLIED TO A  
TWISTED HOSE, THE HOSE MAY FAIL OR THE  
ATTACHING NUT MAY BECOME LOOSE.

Figure 5. Twisted/Untwisted Hose Installation



NOTE:  
KEEP THE BEND RADII OF THE HOSE AS LARGE AS NECESSARY TO AVOID KINKING OF LINE AND RESTRICTION OF FLOW.

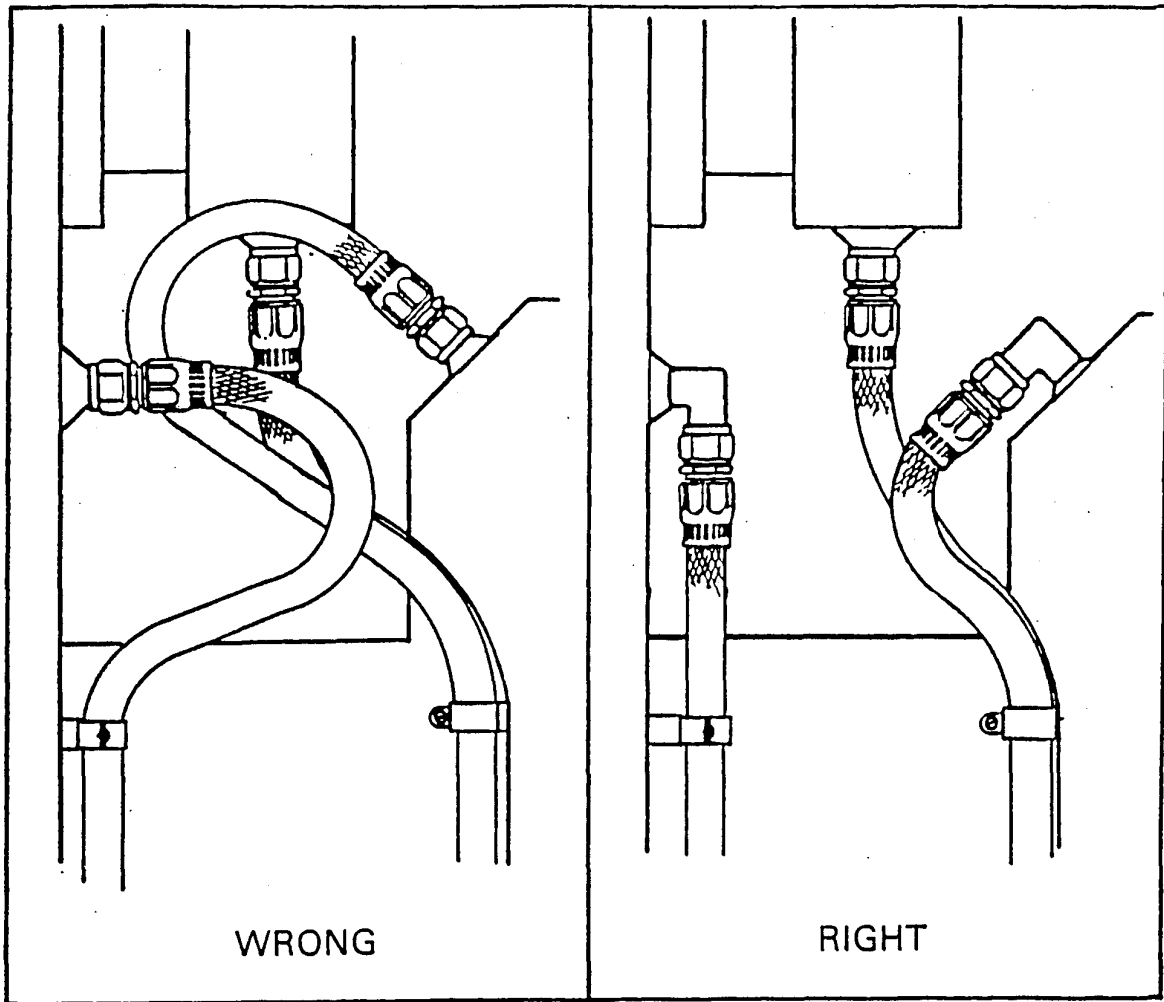
Figure 6. Short/Large Bend Radii Hose Installation



**NOTE:**

REMEMBER THAT THE HOSE WILL CHANGE IN LENGTH FROM +2% TO -4% WHEN PRESSURIZED. PROVIDE SLACK OR BEND IN THE HOSE TO COMPENSATE FOR ANY CHANGES IN LENGTH THAT MIGHT OCCUR.

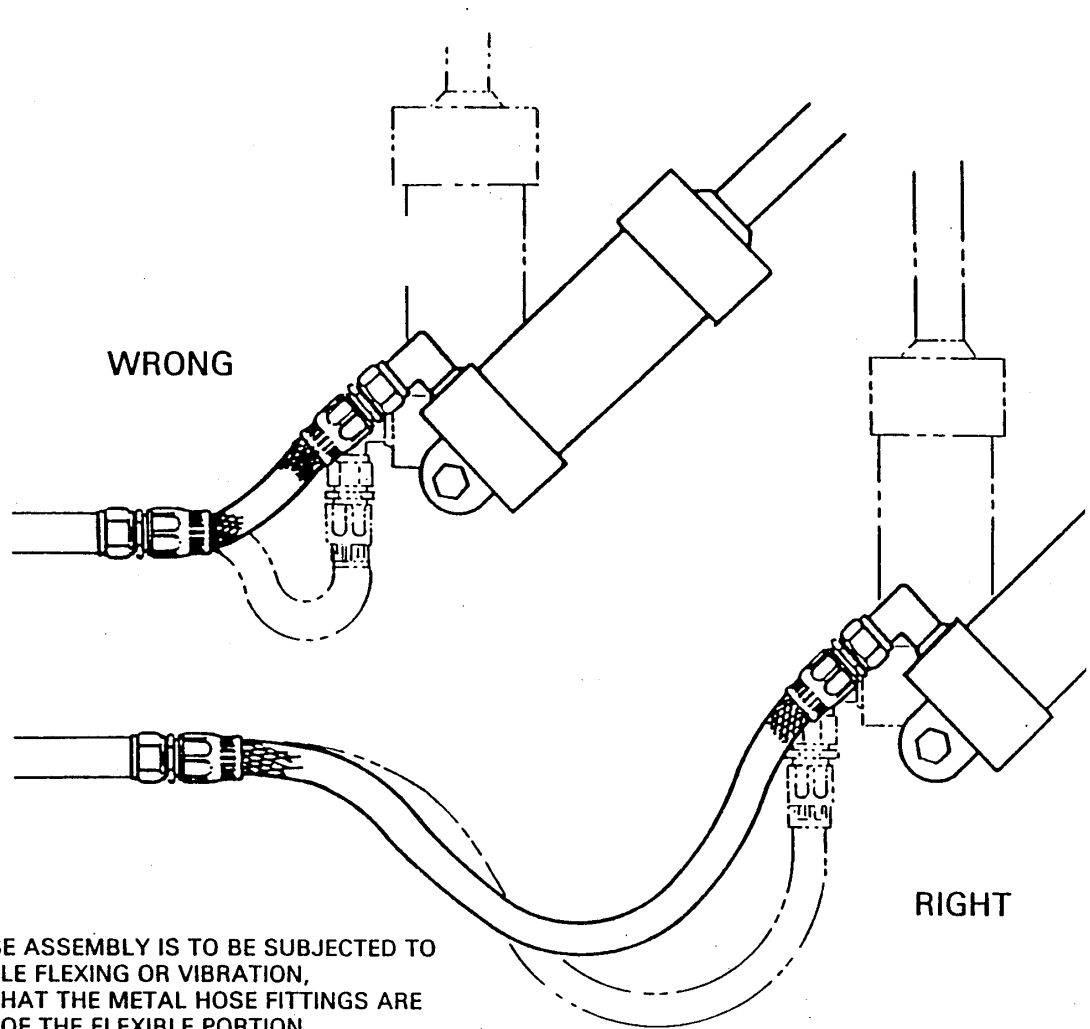
Figure 7. Tight/Slack Hose Installation



**NOTE:**  
USE ELBOWS AND ADAPTERS TO ENSURE  
CLEANER INSTALLATIONS FOR EASY INSPECTION  
AND MAINTENANCE.

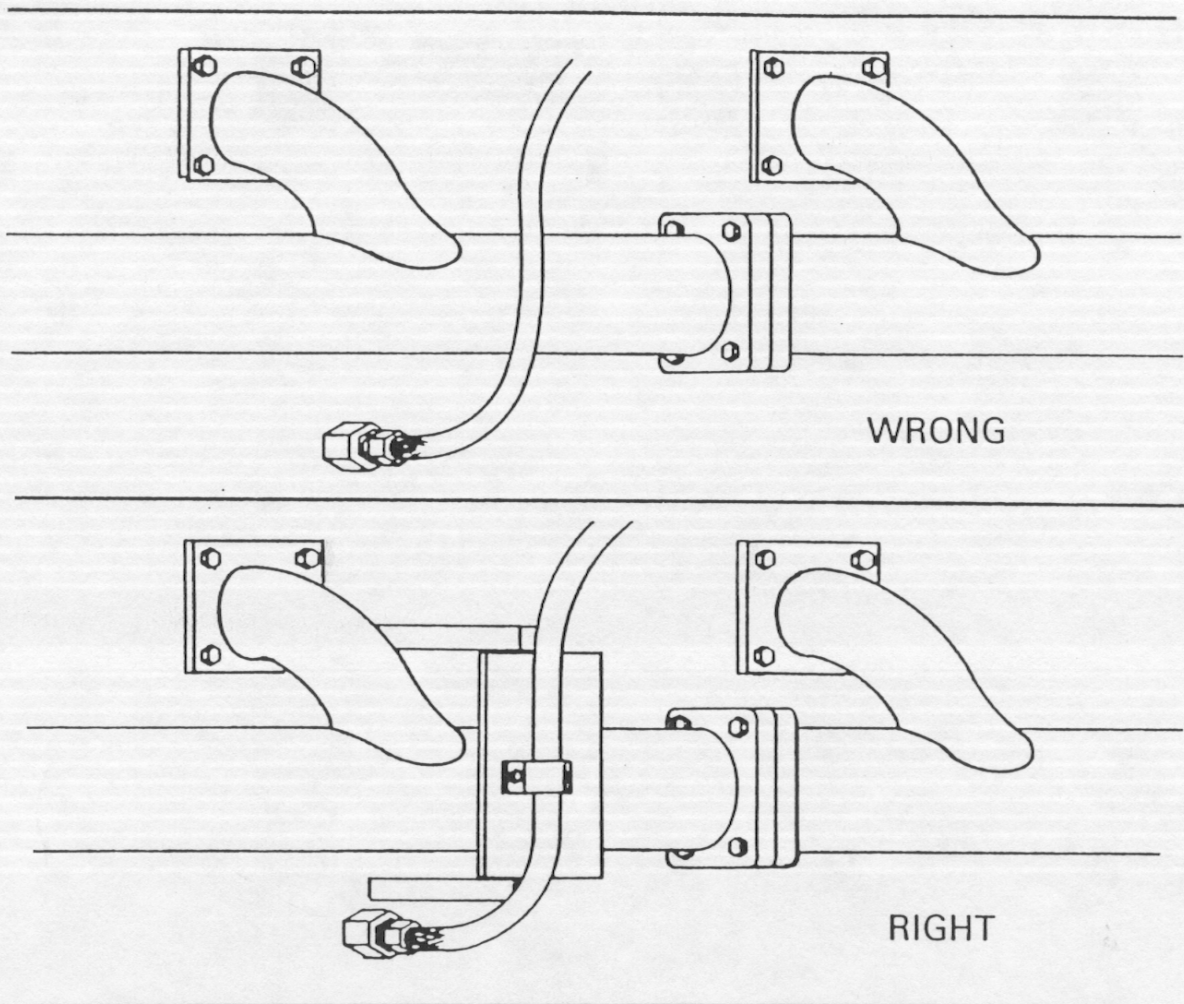
Figure 8. Elbow/Adapter Hose Installation Usage





**NOTE:**  
WHEN A HOSE ASSEMBLY IS TO BE SUBJECTED TO CONSIDERABLE FLEXING OR VIBRATION, REMEMBER THAT THE METAL HOSE FITTINGS ARE NOT A PART OF THE FLEXIBLE PORTION.

Figure 9. Flexing/Vibrating Hose Installation



NOTE:  
WHEN HOSE LINES PASS CLOSE TO A HOT EXHAUST  
MANIFOLD, PROTECT THE HOSE WITH A FIREPROOF  
BOOT OR METAL BAFFLE.

Figure 10. Fireproof/Metal Baffle Hose Installation Usage

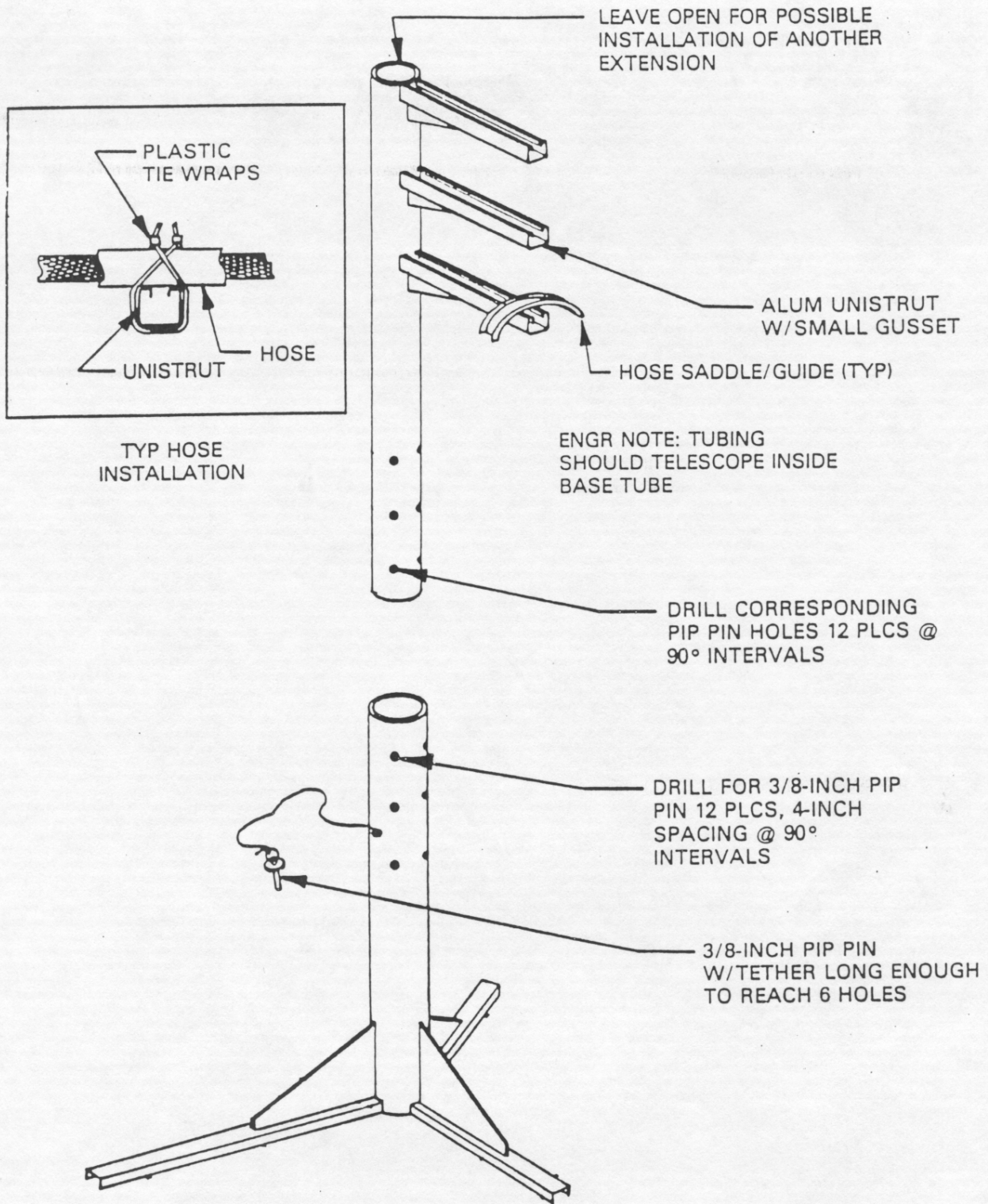


Figure 11. Multipurpose Support Stand

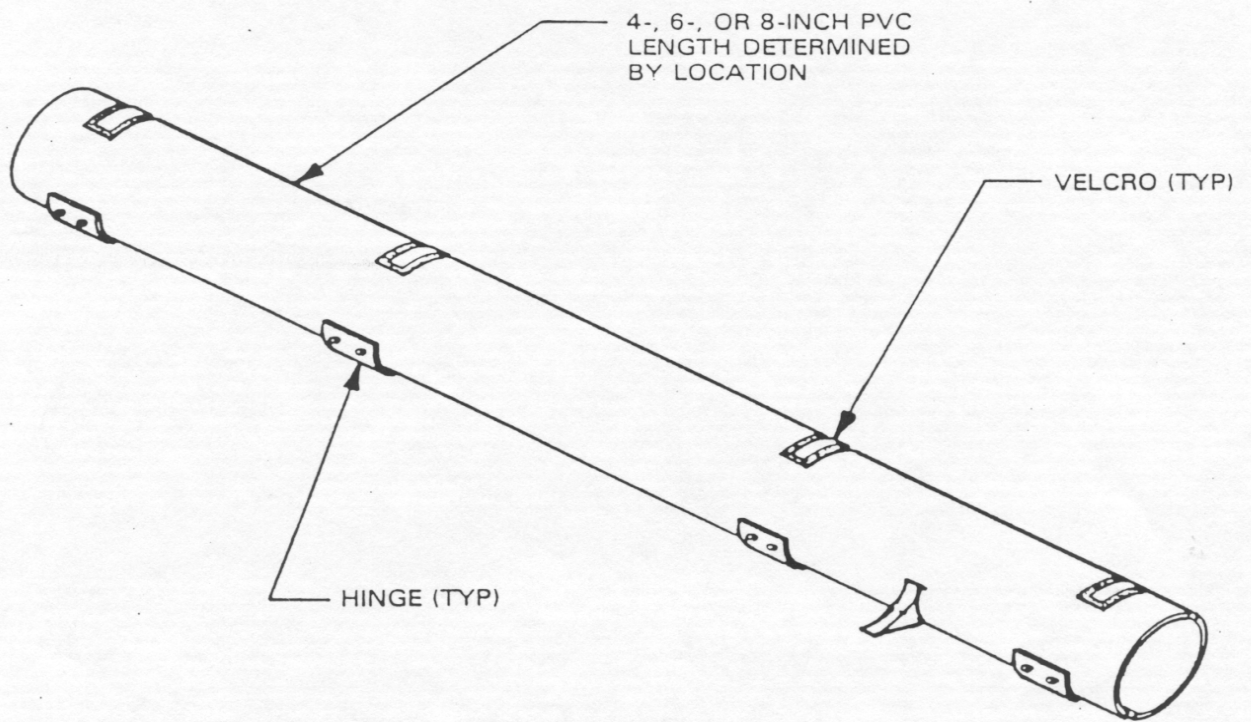


Figure 12. Multipurpose Dressing and Routing Equipment



Figure13. Tie Point Tag

## 8.0 CONTAINMENT / RESTRAINT AND SAFETY REQUIREMENTS

The primary purpose of containment / restraints is to prevent whipping / lashing of the flexhose in the event of rupture or fitting failure, ensuring personnel safety and minimizing equipment damage.

- 8.1 The majority of installations have containment / restraint device requirements defined on the installation drawings. Those requirements are to be adhered to
- 8.2 Where special situations such as test set-ups are not covered by installation or other drawings, the following sections shall be adhered to.
- 8.2.1 Install safety approved flexhose restraints to sustain shock, to contain force on longitudinal axis, and to prevent whipping or backlash if a flexhose or fitting fails.
- 8.2.2 Ensure that all flexhoses pressurized to greater than 150 psig are equipped as follows:
- a. A containment or restraining device securely attached across **each** hose end and **each** union.
  - b. For non-bale type flexhoses, a minimum containment grip length of 12 inches at each hose end
  - c. Are restrained at 6-foot intervals by using a minimum of 50-lb of dead weight via suitable proof load weights or Amtec / Kellums Universal Bale if substantial attachment points are available. Proof load weights may be used (sand bags in approved areas) if no structural support is available.
  - c. If a flexhose is placed on a surface that could cause braid damage, place a sandbag / shotbag (or other approved padding / protective device) under weighted portions of the hose.
  - d. Weights, restraints, containment shall not be applied in any manner as to cause side loading (at any angle) to the connecting fittings.

**Notes:**

1) Hoses which are contained by surrounding structure that provides adequate protection to personnel and hardware are exempted from the preceding requirements.

2) Hoses in the hypergolic servicing umbilical assembly racks (cat racks) on the launch complex shall be orderly routed and mechanically secured per design drawings.

- 8.2.3 Ensure that flexhose containments or restraints are securely attached to substantial objects such as permanently installed eyebolts, U-bolts, brackets, etc.
- 8.2.4 Copper or copper containing material(s) in flexhoses or containment / restraints shall not be used for ammonia or hypergolic fluids.

### 8.3 FLEXHOSE CONTAINMENT / RESTRAINT SELECTION AND INSTALLATION

The preferred method for flexhose restraint is the flexible wire grip that contains the hose within its length. The universal bale restraint may be used if the limitations as specified herein are met.

The following supplemental information provides proper selection and application of flexhose containment / restraints (ref. Tables 9 through 14, pages 47 - 52):

a. Available Flexhose Containment Grips and Restraints.

- 1) Universal Eye (Type U): Tables 9 - 12 (page 47 - 50) and Figure 17 (page 44).
- 2) Single Eye (Type A): Tables 9 - 12 (page 47 - 50) and Figure 17 (page 44)
- 3) Double Eye (Type E): Tables 9 - 12 (page 47 - 50) and Figure 17 (page 44).
- 4) Threaded Bolt (Type Y): Tables 9 -12 (page 47 -50) and Figure 17 (page 44).
- 5) Tube (Type T): Tables 9 & 10 (pages 47 & 48) and Figure 19 (page 46)
- 6) Split Fitting (Type F): Tables 13 & 14 (page 51 and 52) and Figure 18 (page 45).
- 7) Amtec / Kellems Universal Bale: Figures 15 and 16 (page 42 and 43).

b. Construction. All containments / restraints shall be constructed of corrosion resistant steel. Bonding clamps shall be included with each assembly. Universal bale keeper bars may be fabricated from copper or copper containing material. However, those containing copper or copper containing material shall not be used for ammonia or hypergol service.

c. Containment Selection Criteria. Tables 9 through 14 and Figures 17, 18 and 19 (pages 44 through 52).

- 1) Pressure Rating: Determine the flexhose or system rated working pressure.
- 2) Flexhose O.D. and largest diameter: Determine the flexhose outside diameter and the largest diameter of the hose end fitting over which the grip must pass. (Ref. KSC DWG. 79K80260 or 79K80264 or 79K80463).
- 3) Containment Type: Select flexhose containment style (Type U, A, E, Y, T, F or Universal), and applicable end attachment.
- 4) Mesh Length: Select a mesh length available that will provide a maximum of hose containment or restraint (grips are available in 12", 18", 24", 48", 60", and 72" lengths: ref. Table 9 & 10 on pages 47 & 48).

d. Flexhose Containment Installation Instructions.

The following steps describe the methods of installing or securing the different types of containments described in this section.

1) Universal (Type U).

This containment is used primarily for securing the ends of a flexhose. However, it can be adapted to anchor center sections if there is an existing anchor point for the containment leads. After containment is installed, secure the leads by wrapping around and through a suitable anchor point, then work grip along the hose to take slack out of the leads. Secure end of grip to the hose by tightening the clamp that is provided finger tight, but not greater than 25 inch-pounds.

2) Tube Type T.

The tube constraint is adapted to fluid systems for three purposes:

- a) To tie across a pair of hoses that are joined together by a coupling (the diameter should not vary more than 1/4 inch).
- b) To tie across a hose splice.
- c) To enclose a hose length in its entirety.

**Note:** To install, uncouple the joint and slip the entire containment over one of the hoses, couple the hoses together, and work the grip over the coupling to equalize the amount of containment of each hose. Tighten the clamps provided on each end of the containment finger-tight, but not greater than 25 inch-pounds.

3) Split Fitting (Type F).

This containment is provided for connection to the end of the hose only. The Shell on the end of this assembly is designed to fit over the standard AN type B-nuts. To install, disconnect the flexhose and slip the entire containment over the hose. Reconnect the hose and work the containment toward the end of the hose and enclose the B-nut in the split shell (the ridge inside the split shell must fit on the outermost edge of the hex area of the B-nut. After the shell is positioned properly, tighten the clamp around the shell and tighten the clamp at the end of the containment finger-tight, but no greater than 25 inch-pounds.

4) Threaded (Type Y).

This containment is the same as the universal Type with the exception of the leads. Install this grip in the same manner as the Universal Type and secure leads through holes that are provided on the unit for this purpose, or drill two 5/16-inch-diameter holes through existing structure which is suitable for holding the containment. Materials for securing the leads should be at least 1/8 inch thick, or use a large diameter backup washer.

5) Double Eye Grip (Type E).

This containment is similar to the Universal Type with the exception that the end connection consists of two steel cable loops. This unit is installed in the same manner as the Universal Type except that the cable loops are fastened with eye bolts or similar anchor termination to the anchor points.

6) Single Eye Grip (Type A).

This containment is similar to the double eye grip, but is used where fastening must be made from one anchor point.

e. Restraints.

## 1) Universal Bale (sliding bar style).

This type of restraint may be used to confine hose ends and unions where substantial structural attachment points are available and the following limitations are met:

- a) The bale must be tightly secured to the flexhose by a properly applied tie-wrap, 5/16 inch wide by a minimum of 6 inches long with one end having a locking device (FSN 5975-C-838-7450 or FSN 5975-00-838-7450). The tie-wrap must pass between the base nipples as they protrude through the keeper bar and around the hose (Ref Figure 14, Page 42, tie-wrap installation). The tie-wrap shall be drawn as tight as possible to secure the base cables against the hose. Excess tie-wrap may be cut off and corners chamfered to remove sharp edges. The structural attachment does not need a tie-wrap unless sliding of the base would cause slack in the restraint.
- b) The bale hose attachment bolt shall be between 10 and 14 inches from the hose fitting.
- c) There shall be a minimum amount of slack in the restraint, but it shall not be so tight as to introduce a load onto the flexhose. Maximum slack shall be 1 inch for every 6 inches of bale.
- d) Reference Figure 16 (page 43) for approved restraint configuration.
- e) Restraints with bronze keeper bars shall not be used within 25 feet of lines or systems containing ammonia or hypergolic propellants.
- f) These restraints may be used on 1/2 inch O.D. and larger hoses which are pressurized up to 3000 psig.



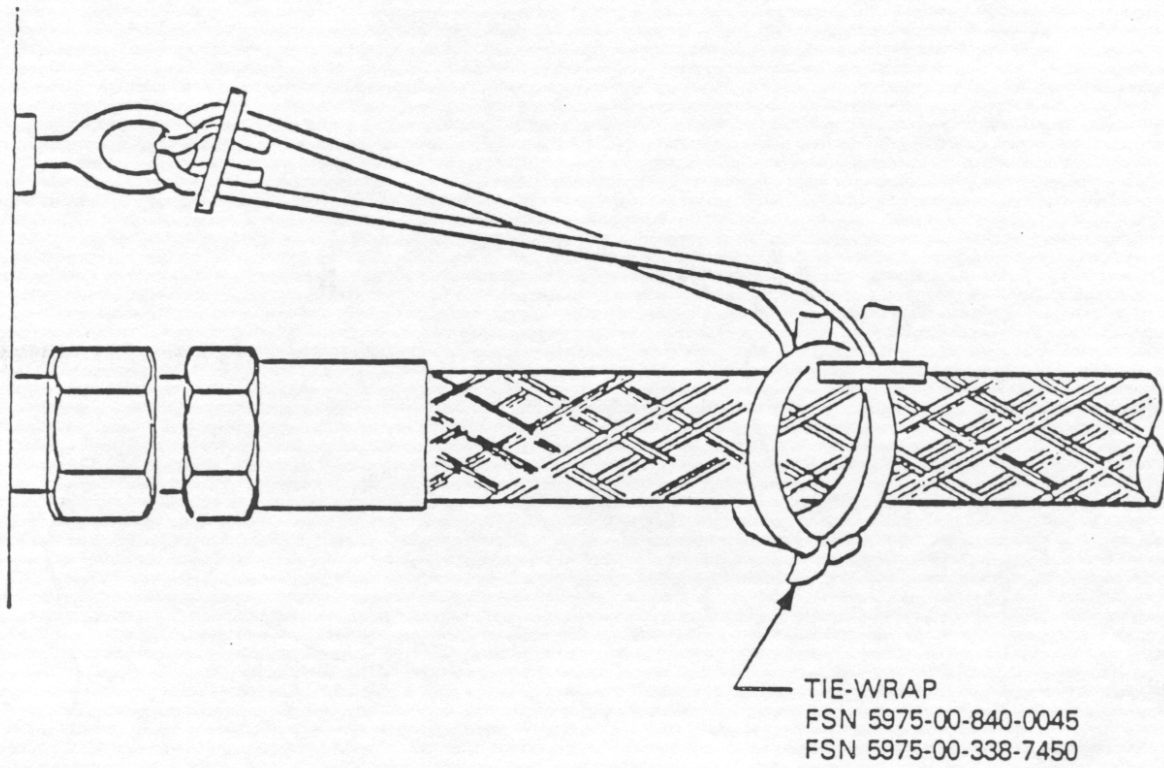
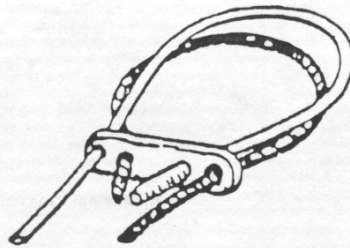
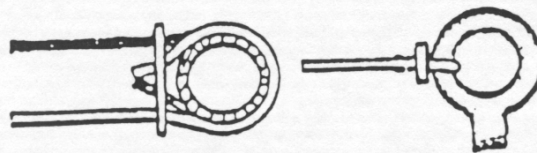


Figure 14. Tie-Wrap Installation

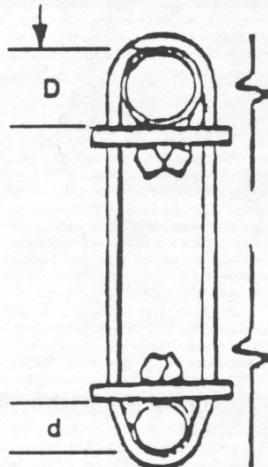


Ends of bale are wrapped around or fed through the object and secured through keyed openings in the sliding bar. Swaged lugs on bale ends lock bales in place.



Amtec/Kellems Support Sling shown attached to pipe, left. And to closed eye, right.

DIM. TO WELDING BARS  
FULLY EXTENDED



Working Loads:

Design strengths of new unused Slings are shown below. These strengths are shown for selected diameters ("D" and "d") for objects being held under static load conditions.

Age and condition of the Sling, plus abnormal conditions such as shock loading, determine the safety factor which should be considered.

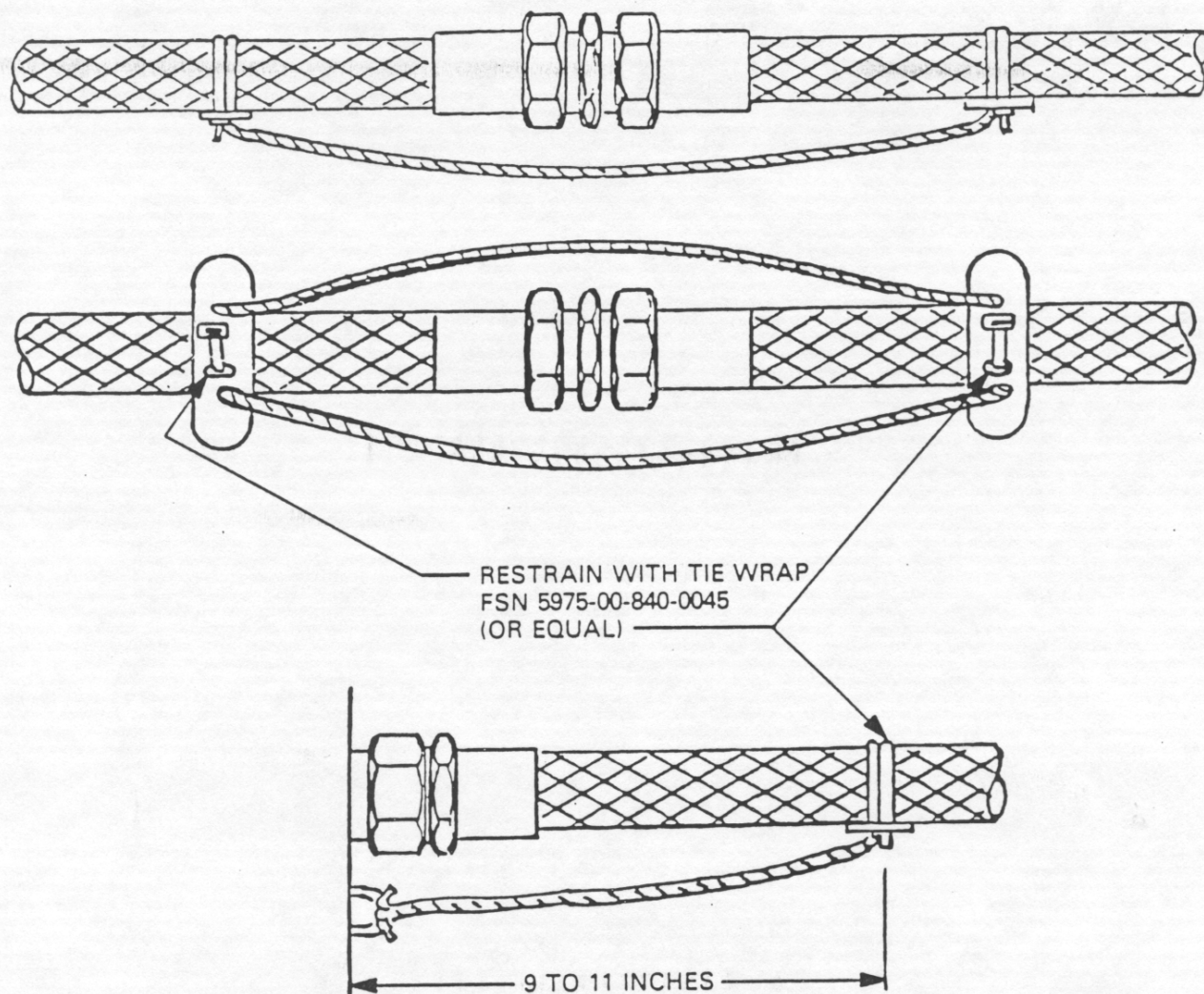
DIAMETER "D" (INCHES)	DIAMETER "d" INCHES)		
	1/2	1-1/2	4
1/2	2200	2200	2200
1-1/2	2200	3200	3000
4	2200	3000	3000

DESIGN STRENGTH (POUNDS)

STAINLESS STEEL	GALVANIZED STEEL	LENGTH (L. NOMINAL)
204-12-001	203-12-001	12"
204-12-005	203-12-005	18"
204-12-002	203-12-002	24"
204-12-003	203-12-003	36"
204-12-004	203-12-004	48"

CATALOG NUMBER

Figure 15. Amtec / Kellems Support Sling



**NOTES:**

1. SAFETY APPROVED FOR USE WITH HOSE: DIA 1/2-INCH AND ABOVE, PRESS. - UP TO 3,000 PSIG.
2. RESTRAINTS WITH BRONZE COMPONENTS SHALL NOT BE USED WITHIN 25 FEET OF HYPERGOLICS AND AMMONIA FLUIDS.

Figure 16. Amtec / Kellems Flex Hose Restraint Configuration



TYPE E: DOUBLE EYE GRIP - USED WHERE FASTENING IS MADE WITH EYE BOLTS OR SIMILAR ANCHOR TERMINATIONS.



TYPE A: SINGLE EYE GRIP - USED WHERE FASTENING MUST BE MADE FROM ONE ANCHOR POINT.



TYPE U: UNIVERSAL BALE GRIP - USED TO FASTEN AROUND A STRUCTURE OR CLOSED EYE.



TYPE Y: THREADED BOLT 5/16-18 x 1-1/2 INCH LONG - USED TO FASTEN THROUGH DRILLED HOLES IN PLATE.

NOTES:

1. PLACE THE ENDLESS WEAVE END OF THE GRIP OVER THE HOSE AND SLIDE THE GRIP PAST THE HOSE FITTING.
2. CONNECT THE HOSE FITTING.
3. POSITION THE GRIP FOR ATTACHMENT TO THE SUPPORTING STRUCTURE AND SECURE GRIP EYE TO STRUCTURE.
4. REMOVE ANY SLACK IN GRIP EYE AND MESH BY SMOOTHING DOWN THE MESH, STARTING FROM THE EYE ATTACHMENT POINT AND WORKING TOWARD THE ENDLESS WEAVE END OF THE GRIP.
5. PLACE THE CLAMP OVER THE ENDLESS WEAVE END WITH APPROXIMATELY 1-1/2 INCH OF MESH BEYOND THE CLAMP. TIGHTEN CLAMP FINGER TIGHT BUT NOT MORE THAN 25 INCH-POUNDS.
6. SAFETY APPROVED FOR ALL HOSE SIZES AND PRESSURE RATINGS.

Figure 17. Type E, A, U, and Y Restraint Configuration



**TYPE F:** SPLIT FITTING TO FIT AN818 NUTS. FITTING IS POSITIONED OVER NUT AND LOCATED WITH INTERNAL FLANGE. A HOSE CLAMP IS FURNISHED AND REQUIRED TO CORRECTLY POSITION FITTING.

**NOTES:**

1. PLACE GRIP WITH SPLIT FITTING OVER END OF HOSE (TAB ENDS FIRST) AND SLIDE THE GRIP OVER THE HOSE, PAST THE HOSE FITTING.
2. CONNECT HOSE FITTING
3. POSITION GRIP'S SPLIT FITTING OVER HOSE FITTING TO ENGAGE THE INTERNAL SHOULDER OF GRIP FITTING AND TIGHTEN CLAMP TO 25 INCH-POUNDS.
4. REMOVE SLACK IN GRIP BY SMOOTHING DOWN THE MESH, STARTING FROM THE MESH ATTACHMENT POINT AND WORKING TOWARD END TABS OF THE GRIP.
5. PLACE THE TYPE "F" HOSE CLAMP OVER THE END WITH APPROXIMATELY 1 ½-INCH OF MESH BEYOND THE CLAMP. TIGHTEN CLAMP FINGER TIGHT BUT NOT MORE THAN 25 INCH-POUNDS.
6. SAFETY APPROVED FOR ALL HOSE SIZES AND PRESSURE RATINGS.

Figure 18. Type F Restraint



TYPE T: TUBE GRIPS OBTAIN COMPLETE GRIP COVERAGE WHEN HOSE IS PARTIALLY COVERED AT EITHER END WITH ATTACHMENT GRIPS. THE T-GRIPS FILL IN THE HOSE AREA BETWEEN. A TELESCOPED ASSEMBLY PERMITS OVERLAP TO ANY DEGREE DESIRED BEYOND THE 3-INCH MINIMUM.

NOTES:

1. SLIDE THE GRIP OVER THE HOSE, PAST THE HOSE FITTING.
  2. CONNECT HOSE FITTING WHERE GRIP IS BEING APPLIED.
  3. SLIDE GRIP AND CENTER OVER THE COUPLING FITTING.
  4. SMOOTH DOWN THE MESH, STARTING AT THE CENTER AT THE COUPLING POINT, AND WORKING TOWARD BOTH ENDS.
  5. ASSEMBLE THE CLAMPS OVER THE GRIP ENDS WITH APPROXIMATELY 1 1/2-INCH OF MESH BEYOND THE CLAMP. TIGHTEN CLAMPS FINGER TIGHT BUT NOT MORE THAN 25 INCH-POUNDS.
  6. TYPES U AND F MAY BE SUBSTITUTED FOR TYPE T.
- NOTE: SAFETY APPROVED FOR ALL HOSE SIZES AND PRESSURE RATINGS.

Figure 19. Type T Restraint

Table 9. RECOMMENDED AMTEC PART NUMBERS: FULL LENGTH CONTAINMENT. USE TYPE "T" GRIPS FROM THIS TABLE ALONG WITH GRIPS FROM TABLE 11 AND/OR TABLE 13 FOR TYPES E, A, U, Y & F								
GRIP DIA. OF HOSE		MAX MESH OPENING	GRIP PART NUMBERS AND APPROXIMATE BREAKING STRENGTH					
MIN.	MAX.		1 FT	2 FT	3 FT	4 FT	5 FT	6 FT
.25	.38	.56	1402-1542 2300 lbs.	1402-1501 2300 lbs.	1402-2000 2300 lbs.	1402-2002 2300 lbs.	1402-2005 2300 lbs.	----
.31	.56	.69	1402-1543 2300 lbs.	1402-1160 2300 lbs.	1402-2001 2300lbs.	1402-2003 2300 lbs.	1402-2006 2300 lbs.	1402-2011 2300 lbs.
.37	.69	.87	1402-1319 2900 lbs.	1402-1180 2900 lbs.	1402-1363 2900 lbs.	1402-2004 2900 lbs.	1402-2007 2900 lbs.	1402-2012 2900 lbs.
.50	.94	1.15	1402-1318 3400 lbs.	1402-1152 3400 lbs.	1402-1320 3400 lbs.	1402-1153 3400 lbs.	1402-2008 3400 lbs.	1402-2013 3400 lbs.
.75	1.25	1.50	1402-1544 6000 lbs.	1402-1085 6000 lbs.	1402-1242 6000 lbs.	1402-1067 6000 lbs.	1402-2009 6000 lbs.	1402-2014 6000 lbs.
1.00	1.56	1.87	1402-1545 9400 lbs.	1402-1154 9400 lbs.	1402-1374 9400 lbs.	1402-1155 9400 lbs.	1402-2010 9400 lbs.	1402-2015 9400 lbs.
1.25	1.94	2.30	1402-1546 9400 lbs.	1402-1087 9400 lbs.	1402-1222 9400 lbs.	1402-1072 9400 lbs.	1402-1550 9400 lbs.	1402-2016 9400 lbs.
1.44	2.19	2.60	----	1402-1090 12500 lbs.	1402-1547 12500 lbs.	1402-1075 12500 lbs.	1402-1551 12500 lbs.	1402-2017 12500 lbs.
1.69	2.38	2.75	----	1402-1092 12500 lbs.	1402-1548 12500 lbs.	1402-1078 12500 lbs.	1402-1347 12500 lbs.	1402-2018 12500 lbs.
2.25	2.94	3.25	----	1402-1094 12500 lbs.	1402-1549 12500 lbs.	1402-1081 12500 lbs.	1402-1376 12500 lbs.	1402-1375 12500 lbs.
2.75	3.44	3.75	----	1402-1097 12500 lbs.	1402-1370 12500 lbs.	1402-1083 12500 lbs.	1402-1371 12500 lbs.	1402-1552 12500 lbs.

Table 10. ALTERNATE KELLEMS PART NUMBERS: FULL LENGTH CONTAINMENT. USE TYPE "T" GRIPS FORM THIS TABLE ALONG WITH GRIPS FROM TABLE 12 AND/OR TABLE 14 FOR TYPES E, A, U, Y & F								
GRIP DIA. RANGE		MAX MESH OPENING	GRIP PART NUMBERS AND APPROXIMATE BREAKING STRENGTH					
MIN.	MAX.		1 FT	2 FT	3 FT	4 FT	5 FT	6 FT
.25	.38	.56	014-02-1542 2300 lbs.	014-02-1501 2300 lbs.	----	----	----	----
.31	.56	.69	014-02-1543 2300 lbs.	014-02-1160 2300 lbs.	----	----	----	----
.37	.69	.87	014-02-1319 2900 lbs.	014-02-1180 2900 lbs.	014-02-1363 2900 lbs.	----	----	----
.50	.94	1.15	014-02-1318 3400 lbs.	014-02-1152 3400 lbs.	014-02-1320 3400 lbs.	014-02-1153 3400 lbs.	----	----
.75	1.25	1.50	014-02-1544 6000 lbs.	014-02-1085 6000 lbs.	014-02-1242 6000 lbs.	014-02-1067 6000 lbs.	----	----
1.00	1.58	1.87	014-02-1545 9400 lbs.	014-02-1154 9400 lbs.	014-02-1374 9400 lbs.	014-02-1155 9400 lbs.	----	----
1.25	1.94	2.30	014-02-1546 9400 lbs.	014-02-1087 9400 lbs.	014-02-1222 9400 lbs.	014-02-1072 9400 lbs.	014-02-1550 9400 lbs.	----
1.44	2.19	2.60	----	014-02-1090 12500 lbs.		014-02-1075 12500 lbs.	014-02-1551 12500 lbs.	----
1.69	2.38	2.75	----	014-02-1092 12500 lbs.	014-02-1548 12500 lbs.	014-02-1078 12500 lbs.	014-02-1347 12500 lbs.	----
2.25	2.94	3.25	----	014-02-1094 12500 lbs.	014-02-1549 12500 lbs.	014-02-1081 12500 lbs.	014-02-1376 12500 lbs.	014-02-1375 12500 lbs.
2.75	3.44	3.75	----	014-02-1097 12500 lbs.	014-02-1370 12500 lbs.	014-02-1083 12500 lbs.	014-02-1371 12500 lbs.	014-02-1552 12500 lbs.



Table 11. RECOMMENED AMTEC PART NUMBERS FOR PARTIAL HOSE CONTAINMENT-TYPE E, A, U & Y								
GRIP DIA. RANGE			MIN. MESH LENGTH AT MAX. HOSE O.D.	GRIP PART NUMBERS AND APPROXIMATE BREAKING STRENGTH - FOR CONTAINMENT OF HOSE ENS ONLY				
OUTSIDE DIA. OF HOSE		MAX. MESH OPENING		TYPE E DOUBLE EYE 8" EYE LENGTH	TYPE A SINGLE EYE 10" EYE LENGTH	TYPE U UNI-VERSAL BALE 12" EYE LENGTH	TYPE U UNI-VERSAL BALE 24" EYE LENGTH	TYPE Y THREADED BOLT 10" EYE LENGTH
MIN.	MAX.							
.25	.38	.56	2 ft.	1402-1500 2300 lbs.	1402-1520 2300 lbs.	1402-1525 2100 lbs.	1402-1526 2100 lbs.	1402-1530 2300 lbs.
.31	.56	.69	2 ft.	1402-1329 2300 lbs.	1402-1442 2300 lbs.	1402-1304 2100 lbs.	1402-1286 2100 lbs.	1402-1302 2300 lbs.
.37	.69	.87	2 ft.	1402-1451 2900 lbs.	1402-1285 2900 lbs.	1402-1308 2600 lbs.	1402-1307 2600 lbs.	1402-1303 2900 lbs.
.50	.94	1.15	2 ft.	1402-1224 3400 lbs.	1402-1230 3400 lbs.	1402-1138 3100 lbs.	1402-1139 3100 lbs.	1402-1149 3400 lbs.
.75	1.25	1.50	2 ft.	1402-1223 6000 lbs.	1402-1284 6000 lbs.	1402-1140 4500 lbs.	1402-1141 4500 lbs.	1402-1086 6000 lbs.
1.00	1.56	1.87	2 ft.	1402-1279 9400 lbs.	1402-1305 9400 lbs.	1402-1142 6000 lbs.	1402-1143 6000 lbs.	1402-1150 6000 lbs.
1.25	1.94	2.30	3 ft.	1402-1221 9400 lbs.	1402-1521 9400 lbs.	1402-1527 6000 lbs.	1402-1166 6000 lbs.	1402-1272 8000 lbs.
1.44	2.19	2.60	3 ft.	1402-1430 12500 lbs.	1402-1522 12500 lbs.	1402-1173 6000 lbs.	1402-1528 6000 lbs.	1402-1235 8000 lbs.
1.69	2.38	2.75	3 ft.	1402-1477 12500 lbs.	1402-1512 12500 lbs.	1402-1513 6000 lbs.	1402-1529 6000 lbs.	1402-1514 8000 lbs.
2.25	2.94	3.25	4 ft.	1402-1519 12500lbs.	1402-1523 12500 lbs.	1402-1107 6000 lbs.	1402-1080 6000 lbs.	1402-1082 8000 lbs.
2.75	3.44	3.75	4 ft.	1402-1445 12500 lbs.	1402-1524 12500 lbs.	1402-1108 6000 lbs.	1402-1148 6000 lbs.	1402-1084 8000 lbs.

Table 12. ALTERNATE KELLEMS P/N's FOR PARTIAL HOSE CONTAINMENT - TYPES E, A, U & Y								
GRIP DIA. RANGE			MIN. MESH LENGTH AT MAX. HOSE O.D.	GRIP PART NUMBERS AND APPROXIMATE BREAKING STRENGTH - FOR CONTAINMENT OF HOSE ENDS ONLY				
OUTSIDE DIA. OF HOSE		MAX MESH OPENING		TYPE E DOUBLE EYE 8" EYE LENGTH	TYPE A SINGLE EYE 10" EYE LENGTH	TYPE U UNIVERSAL BALE 12" EYE LENGTH	TYPE U UNIVERSAL BALE 24" EYE LENGTH	TYPE Y THREADED BOLT 10" EYE LENGTH
MIN.	MAX.							
.25	.38	.56	2 ft.	014-02-1500 2300 lbs.	014-02-1520 2300 lbs.	014-02-1525 2100 lbs.	014-02-1526 2100 lbs.	014-02-1530 2300 lbs.
.31	.56	.69	2 ft.	014-02-1329 2300 lbs.	014-02-1442 2300 lbs.	014-02-1304 2100 lbs.	014-02-1286 2100 lbs.	014-02-1302 2300 lbs.
.37	.69	.87	2 ft.	014-02-1451 2900 lbs.	014-02-1285 2900 lbs.	014-02-1308 2600 lbs.	014-02-1307 2600 lbs.	014-02-1303 2900 lbs.
.50	.94	1.15	2 ft.	014-02-1224 3400 lbs.	014-02-1230 3400 lbs.	014-02-1138 3100 lbs.	014-02-1139 3100 lbs.	014-02-1149 3400 lbs.
.75	1.25	1.50	2 ft.	014-02-1223 6000 lbs.	014-02-1284 6000 lbs.	014-02-1140 4500 lbs.	014-02-1141 4500 lbs.	014-02-1086 6000 lbs.
1.00	1.56	1.87	2 ft.	014-02-1279 9400 lbs.	014-02-1305 9400 lbs.	014-02-1142 6000 lbs.	014-02-1143 6000 lbs.	014-02-1150 8000 lbs.
1.25	1.94	2.30	3 ft.	014-02-1221 9400 lbs.	014-02-1521 9400 lbs.	014-02-1527 6000 lbs.	014-02-1166 6000 lbs.	014-02-1272 8000 lbs.
1.44	2.19	2.60	3 ft.	014-02-1430 12,500 lbs.	014-02-1522 12,500 lbs.	014-02-1173 6000 lbs.	014-02-1528 6000 lbs.	014-02-1235 8000 lbs.
1.69	2.38	2.75	3 ft.	014-02-1477 12,500 lbs.	014-02-1512 12,500 lbs.	014-02-1513 6000 lbs.	014-02-1529 6000 lbs.	014-02-1514 8000 lbs.
2.25	2.94	3.25	4 ft.	014-02-1519 12,500 lbs.	014-02-1523 12,500 lbs.	014-02-1107 6000 lbs.	014-02-1080 6000 lbs.	014-02-1082 8000 lbs.
2.75	3.44	3.75	4 ft.	014-02-1445 12,500 lbs.	014-02-1524 12,500 lbs.	014-02-1108 6000 lbs.	014-02-1148 6000 lbs.	014-02-1084 8000 lbs.

Table 13. RECOMMENED AMTEC PART NUMBERS FOR PARTIAL HOSE CONTAINMENT - TYPE "F" FOR AN818 NUT									
GRIP DIA. RANGE		MIN. MESH LENGTH AT MAX. HOSE O.D.	APPROX. BREAKING STRENGTH	GRIP PART NUMBERS - FOR CONTAINMENT OF HOSE ENDS ONLY TYPE "F", FOR AN818 NUT					
OUTSIDE DIA. OF HOSE	MAX. MESH OPENING			-4 .56 HEX FLT	-6 .68 HEX FLT	-8 .87 HEX FLT	-10 1.00 HEX FLT	-12 1.25 HEX FLT	
MIN.	MAX.								
.31	.56	.69	2 ft.	2300 lbs.	1402-1182				
.37	.69	.87	2 ft.	2900 lbs.	1402-1208	1402-1181			
.50	.94	1.15	2 ft.	3400 lbs.	1402-1112	1402-1156	1402-1216	1402-1170	
.75	1.25	1.50	2 ft.	6000 lbs.			1402-1113	1402-1114	1402-1301
					-12 1.25 HEX FLT	-16 1.50 HEX FLT	-20 2.00 HEX FLT	-24 2.25 HEX FLT	
1.00	1.56	1.87	2 ft.	8000 lbs.	1402-1157	1402-1366			
1.25	1.94	2.30	3 ft.	8000 lbs.		1402-1314	1402-1531		
1.44	2.19	2.60	3 ft.	8000 lbs.		1402-1491	1402-1492	1402-1172	
1.69	2.38	2.75	3 ft.	8000 lbs.				1402-1515	

Table 14. ALTERNATE KELLEMS PART NUMBERS FOR PARTIAL HOSE CONTAINMENT - TYPE "F" FOR AN818 NUT									
GRIP DIA. RANGE		MAX. MESH OPENING	MIN. MESH LENGTH AT MAX. HOSE O.D.	APPROX. BREAKING STRENGTH	GRIP PART NUMBERS - FOR CONTAINMENT OF HOSE ENDS ONLY TYPE "F", FOR AN818 NUT				
MIN.	MAX.				-4 .56 HEX FLT	-6 .68 HEX FLT	-8 .87 HEX FLT	-10 1.00 HEX FLT	-12 1.25 HEX FLT
.31	.56	.69	2 ft.	2300 lbs.	014-02-1182				
.37	.69	.87	2 ft.	2900 lbs.	014-02-1208	014-02-1181			
.50	.94	1.15	2 ft.	3400 lbs.	014-02-1112	014-02-1156	014-02-1216	014-02-1170	
.75	1.25	1.50	2 ft.	6000 lbs.			014-02-1113	014-02-1114	014-02-1301
					-12 1.25 HEX FLT	-16 1.50 HEX FLT	-20 2.00 HEX FLT	-24 2.25 HEX FLT	
1.00	1.56	1.87	2 ft.	8000 lbs.	014-02-1157	014-02-1366			
1.25	1.94	2.30	3 ft.	8000 lbs.		014-02-1314	014-02-1531		
1.44	2.19	2.60	3 ft.	8000 lbs.		014-02-1491	014-02-1492	014-02-1172	
1.69	2.38	2.75	3 ft.	8000 lbs.				014-02-1515	

## 9.0 CONTAMINATION CONTROL

The following techniques shall be used when removing or installing flexhoses to maintain system cleanliness levels. The responsibility to verify cleanliness and / or commodity shall be determined by the QPRD.

### 9.1 System cleanliness:

- a. Visible contamination is not permitted on the connection / area / tools prior to breaking the connection. If contamination is present, clean with freon TF, isopropyl alcohol, or de-ionized water. Freon (TF) FSN 6850-00-983-0292 is per MIL-C-81302 and isopropyl alcohol FSN 6505-00-205-6513 is per TT-I-735.
- b. Connection points / interface area will be maintained (at a minimum) to the same cleanliness level as the system.
- c. System cleanliness level is to be defined as the worst (numerically higher - less clean) clean level of all individual pieces of GSE used in a specific configuration. One exception is when cleaner components are upstream of lesser clean (dirtier) components and no backflow could occur. Additionally, since most filters do not remove NVR, if a non "A" level component is connected upstream of an "A" level component / system, the "A" level is violated (unless, of course, an NVR-removing filter is used). Reference the following hypothetical examples (assuming no back flow):
  - i.e. 1. Three pieces of GSE with cleanliness levels of 100, 300 and 500 are connected together (in the direction of fluid flow). The individual component cleanliness levels remain the same.
  - i.e. 2. Three pieces of GSE with cleanliness levels of 500, 300 and 100 are connected together (in the direction of fluid flow). The individual component / system cleanliness level becomes 500.
  - i.e. 3. One piece of GSE with cleanliness level of 500 is connected to a facility GN2 supply (300A). The system / component level remains 500; the GN2 supply remains 300A.
  - i.e. 4. A GO2 panel with cleanliness level of 100A is pressurized through a flexhose and a 10 micron filter where the latter two are level 100. The GO2 panel cleanliness level has been violated and is now level 100.
- d. At the time of GSE setup, (\*) record cleanliness level and commodity of the connection of the panel / flexhose / GSE / etc., using information taken from the existing cleanliness verification form(s).

(\*) The information can either be attached to the flexhose at or near the connection point using colored plastic tape and a cleanliness verification form or recorded in the WAD provided the same WAD performs the disassembly.

Upon completion of teardown / removal of panel / flexhose / GSE / etc., affix a cleanliness verification form (KSC Form 28-593) over ports annotating the system cleanliness level and commodity using information previously recorded or worst clean level encountered.

i.e. A flexhose with cleanliness level of 100A is connected downstream of a piece of GSE (300) for nitrogen use. The connection becomes 300 upon disassembly, both the GSE and the flexhose will be annotated with the commodity (GN2) and cleanliness level (300).

i.e. A GSE set-up is used to service a water system. A GN2 purge is used to remove residual water from the flexhoses, followed by evacuation by a vacuum pump. The commodity recorded on the cleanliness verification form may be either water or water / GN2, not GN2 alone. All commodities used in the set-up must be listed on the cleanliness verification form.

9.2 Special cautions are as follows:

CAUTION: Any fitting, panel port, or hose end that could see pressure from a system will be sealed with a cap / plug.

CAUTION: All components and flexhoses contaminated with hypergolic propellants shall be tagged with a Propellant Warning Tag (KSC Form 4-296). Flexhose fittings shall be marked on both ends, with an "O" for Oxidizer, "N2H4" for Hydrazine, and "MMH" for Mono-Methyl Hydrazine. Disconnection (removal and identification of contaminated hoses) shall conform to USA004760 Hypergol System Component processing.

9.3 Cleanliness Protection Coverings:

- a. General Type I and II flexhose ends and ends of associated components are controlled for cleanliness in a variety of ways.

General / common aspects of the methods are:

- 1) When wrapping or bagging, Aclar is the material that is to be used.
- 2) There may be some difficulty in using Aclar sheets (sticking together) unless they are provided to the user with an edge doubled over and crinkled or embossed (or similar approach to allow easy separation of sheets). It is thus acceptable to use a bag to wrap as if it were a sheet.

- 3) When capping or plugging is done in lieu of wrapping or bagging, the interface is to be wrapped with colored plastic tape (not electrical tape) and provided with a courtesy tab before the cleanliness verification form is applied to the interface. In other words, put the decal over the tape instead of directly on the component surface.
- 4) Capping or plugging includes "dust covers" used with QDs, bayonet covers, and the common caps and plugs.
- 5) The cleanliness verification form to be used to ensure cleanliness integrity is KSC Form 28-593. It is a tamper-proof decal and it is to be filled out completely with cleanliness level and commodity.
- 6) Torque all associated fittings per Tables 6, 7, or 8 on pages 27 & 28, as applicable.

b. There are three basic cases of cleanliness protection for which protection methods are provided.

They are:

**CASE I: PREFERRED CLEANLINESS PROTECTION METHOD FOR ALL SYSTEMS EXCEPT HY-PERGOLS.**

- Plug or cap appropriate end(s)
- Wrap with Aclar sheet such that the sheet extends well past the interface Do not use it to enclose any ends (do not bag)
- Tape around the sheet with at least a double wrap (part No. MB0295008 tape). Be sure to tape sufficiently beyond any high point that the covering cannot slip off the covered area in either direction.
- Place the completed cleanliness verification form over the tape at / close to the covered interface.

**CASE II: REQUIRED CLEANLINESS PROTECTION METHOD FOR ALL SYSTEMS, EXCEPT HY-PERGOLS, IN LAUNCH AREA WHERE SHEET OR BAG PROTECTION METHODS ARE NOT EFFECTIVE, BECOME DEBRIS, OR ARE NOT FEASIBLE.**

- Plug or cap appropriate end(s).
- Wrap the interface with plastic tape (not electrical tape). Provide a courtesy tab.
- Put the (completed) cleanliness verification form (decal) on the tape.

CASE III: REQUIRED CLEANLINESS PROTECTION METHOD FOR HYPERGOL SYSTEMS IN ALL AREAS AND OPTIONAL METHOD FOR ALL OTHER SYSTEMS IF THE LATTER ARE IN ENVIRONMENTALLY CONTROLLED AREAS.

Double bag end(s) with Aclar bags. The bags must be large enough to extend over ends and past any fittings. Tape the inner bag with no fewer than two wraps of MB0295008 tape. Tape the outer bag in the same manner, but tape beyond the inner bag's tape to ensure that the outer bag does not slip off. When working in hazardous controlled areas where taping is not permitted / feasible, remove the flexhose to a safe area before taping.

9.4 Preparing flexhoses for transport / return to storage:

- a. Ensure ends of hose are covered or plugged and tamper-proof decal sealed as required.
- b. Coil hoses, as applicable, not to exceed minimum bend radius and secure using approved tape or tie-wraps.

9.5 External Cleanliness: If a hose is visually dirty or otherwise suspect regarding contamination, wipe down with alcohol, freon TF, or de-ionized water.



10.0 PRESSURE TESTING

10.1 Hydrostatic / Pneumostatic testing of Type I flexhoses shall be an annual requirement for the following conditions:

- a. Wherein the drawings or OMRSD dictate periodic hydrostatic or pneumostatic testing.
  - 1) Those hoses under the design cognizance of USA design / process / systems engineering shall have the inspection and/or hydrostatic / pneumostatic requirements (as applicable) annotated on the hose tags and FDS (79K or 80K) drawings.
  - 2) Those hoses which are controlled by NASA / JSC / Boeing and NASA / MSFC / USA shall require an OMRS File VI entry reflecting the calendar interval for inspection and / or hydrostatic / pneumostatic test requirements as applicable.
- b. Wherein corrosive environment dictates periodic inspection as determined by engineering.
- c. Wherein suspect installation or problems dictate periodic testing / inspection.

Other than these situations, Hydrostat / Pneumostatic testing of Type I flexhose assemblies, after initial acceptance testing (as specified in 4.0 of this document), shall not be required on an annual/ periodic frequency

**Notes:**

- 1) Type I hoses in a periodic recall program for pressure testing shall have the latest test date and the next due date annotated on an attached data tag per section 4.1 of this specification. Otherwise, only the manufacturer's tag denoted in 4.2 (which gives the pressure test date) is required.
- 2) Commercial off-the-shelf equipment which contain flexhoses which are stamped, tagged, or otherwise approved by NIOSH or other safety certifying organizations are exempt from the proof pressure tag requirement.
- 3) For hoses pressure tested and then stored, the next due date for retesting, if applicable, shall be based on a service period that starts at the date of installation. A new pressure test tag shall be annotated with this new due date and attached at the time of installation.

10.2 Hydrostat / Pneumostatic Testing of Type II Hoses:

- a. Shall be subject to testing at intervals based on the following operational criteria, when a problem is identified / suspected:
  - 1) Severity of usage
  - 2) Subjected environment

## 3) Flexhose anomalies

- b. Shall be required a minimum of once every 20 years as defined by the manufacturer's pressure testing date.

11.0 TRANSPORTATION AND STORAGE

## 11.1 STORAGE

- a. Flexhoses shall be stored in a protected area, in cabinets with hose coils supported by wall pegs or hangers, or laying flat on storage shelves or in drawers. Store hypergol-contaminated flexhoses in the same manner but in designated areas approved by Safety (ref. USA004760).
- b. Large diameter (greater than 1-1/4 I.D.) flexhoses shall be stored on racks that support the flexhose at various places along its length.
- c. Cryogenic flexhoses shall be placed in a suitable storage rack that allows maintaining cleanliness and dryness as required for the particular system involved.

## 11.2 TRANSPORTATION

When transporting flexhoses, the following criteria shall apply:

- a. Coil flexhose and tape coils together. Coil radius shall be greater than the rated minimum bend radius (ref. Tables 4 and 5, page 25 & 26). Place large diameter hose, such as cryogenic transfer hose, on a flat horizontal surface straight or in the form of a "U".
- b. Avoid placing any items such as tools, tool boxes, materials, etc., on top of flexhose.
- c. Avoid dragging flexhose on the ground or hard surfaces.

12.0 REFERENCE DOCUMENTS

KSC-STD-Z-0005, Design of Pneumatic Ground Support Equipment  
KSC-STD-Z-0006, Design of Hypergolic Propellants Ground Support Equipment  
KSC-STD-Z-0007, Design of Hydrocarbon Fuel Ground Support Equipment  
KSC-STD-Z-0008, Design of Ground Life Support Systems and Equipment  
KSC-STD-Z-0009, Design of Cryogenic Ground Support Equipment  
KSC-STD-Z-0010, Design of Environmental Control Systems, Coolant Servicing Systems, and  
Ground Support Equipment  
KSC-SPEC-Z-0008, Fabrication and Installation of Flared Tube Assemblies & Installation of Fittings  
and Fitting Assemblies  
KSC-SPEC-Z-0009, Lubrication, Thread, Corrosion Resistant Steel Tube Fittings  
KSC-STD-E-0015, Marking of Ground Support Equipment  
KSC-C-123, Surface Cleanliness of Fluid Systems  
MPP-LO-0006, RI Material Processing Procedure, Flexhose Criteria  
USA004760 Hypergol System Component Processing  
AA58092 Tape, Antisieze, Polytetrafluorethylene  
79K80260, Hose Assembly Component Specification, Resistoflex / Defense  
79K90260, Hose Assembly Maintenance Requirements Resistoflex / Defense  
79K80264, Hose Assembly Component Specification, Aeroquip Corp.  
79K90264, Hose Assembly Maintenance Requirements, Aeroquip Corp.  
79K80463, Hose Assembly Component Specification, Titeflex Corp.  
79K90463, Hose Assembly Maintenance Requirements, Titeflex Corp.  
80K57897, Hose Assembly, Convoluted Metal, Specification for  
79K02544, Identification Tape, Fluid Systems  
MIL-H-6083, Hydraulic Fluid  
MIL-H-5606, Hydraulic Fluid  
MIL-H-83282, Hydraulic Fluid  
L070-00010, Flexhose Tabulation  
MPP-LO-0007, Hydrostatic Proof Pressure Testing  
MPP-LO-0012, Marking GSE Fluid Lines with Safety Warning Tapes

MPP-LO-0004, Precision Cleaning Parts and Assemblies to Participate Levels and Non-Volatile Residue

QQ-A-250/1, Tags, Aluminum, Identification

MIL-P-27401, Nitrogen

KSC-STD-SF-0004, Safety Standard for Ground Piping Systems, Color Coding, and Identification

T.O.-00-25-223, Tech. Manual - Integrated Pressure Systems and Components (Portable and Installed)

KNPR-8715.3, KSC Safety Practices Procedural Requirements

MPP-LO-0011, Handling and Processing of Parts Contaminated by Hypergolic Propellants

KSC-P-0011, Particulate Screening Re-verification Sample Requirements on Space Shuttle Ground Systems

MAO-104-301, Applied Markings

STD-C11-12, RI, Space Div. Safety Operating Procedure

LO70-000080, Flexhose Assembly Tabulation

LO11-10-27, Serialization, Proof Pressure Testing and Control of Hoses

MIL-C-81307, Cleaning Agent, 1.1.2, trichlorotrifluoroethane

MB0205-006, Film, Transparent, Precision Cleaning Packaging

MA0102-306, Fabricated and Installed Rigid Tube and Flexible Hose Assemblies

K-H29A-SMRP-001, Fabrication/Repair of Flexible Hose Assemblies and Fabrication / Installation of Flared Tubing Assemblies

KSC Form 28-593, NASA Commodity and/or Cleanliness Verification

OP USA004642 - Problem Reporting (PRACA) and Corrective Action