METRIC/INCH-POUND

KSC-STD-P-0006
Revision A

QUICK RELEASE PINS AND PIN TETHERS,

STANDARD FOR

NOT EXPORT CONTROLLED

This document has been reviewed by the KSC Export Control Office and it has been determined that it does not meet the criteria for control under the International Traffic in Arms Regulations (ITAR) or Export Administration Regulations (EAR).

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Engineering Directorate

National Aeronautics and
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John F. Kennedy Space Center

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REV LTR	CHG NO.	DESCRIPTION	DATE
		Basic issue.	March 20, 1995
A		General revision. Updated and removed obsolete standards. Added general clarifications in line with other existing KSC standards.	March 22, 2022

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ABBREVIATIONS, ACRONYMS, AND SYMBOLS

AISI	American Iron and Steel Institute
ASTM	American Society for Testing and Materials
COTS	commercial off-the-shelf
DE	Engineering Development Directorate
EMF	electromotive force
FOD	Foreign Object Debris
ft	foot (feet)
GS	ground systems
GSE	ground support equipment
GSS	ground support systems
in	inch
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
ksi	kips (1000 lbs) per square inch
lbs	pounds
M&P	Materials and Processing Engineering
MIL	military
mm	millimeter
MPa	megapascal
MSC	Manned Spacecraft Center
MSFC	George C. Marshall Space Flight Center
NAS	National Aerospace Standard
NASA	National Aeronautics and Space Administration
SCC	stress corrosion cracking
SPEC	specification
STD	standard
TM	technical manual
UTS	ultimate tensile strength
Ø	diameter
˚C	degree Celsius
˚F	degree Fahrenheit

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1. SCOPE

This standard covers the usage and installation of quick release pins and pin tethers on ground support equipment (GSE) and facilities at the John F. Kennedy Space Center (KSC) or areas under KSC responsibility. This standard identifies types of pins, materials approved for use, and installation methods to provide designers, engineers, and technicians with standard practices to ensure the proper use of pins.

This standard applies to facilities and GSE where hazards to flight hardware or personnel exist. Hazardous areas include the vicinity of flight hardware, launch environments, and at heights where a falling object might cause injury to personnel or damage to flight hardware. Work authorization documents prepared for technicians to install or replace quick release pins shall cite this standard and provide applicable sections.

2. APPLICABLE DOCUMENTS

The following documents form a part of this document to the extent specified herein.

80K56817	Tab, Quick Release Pin, Specification for
ASTM A380	Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
ASTM D5363	Standard Specification for Anaerobic Single-Component Adhesives (AN)
MIL-DTL-83420/2	Wire Rope, Flexible, Type I, Composition B
MIL-DTL-83420/4	Wire Rope, Flexible, Type II (Jacketed), Composition B
MS51844	Sleeve, Swaging-Wire Rope
MSFC-STD-486	Standard, Threaded Fasteners, Torque Limits for
MSFC-STD-3029	Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments
SAE HS-1086	Metals & Alloys in the Unified Numbering System

3. DEFINITIONS

For the purpose of this document, the following definitions shall apply.

commercial off-the-shelf (COTS): equipment, including hardware and associated software, that is commercially available from a vendor and built to industry specifications. This includes items purchased as a standard off-the-shelf part with options available to any purchaser. Items purchased against a Government design specification or drawing, or custom-made by a vendor for NASA, are not COTS. The selection of COTS for use in GS is required to meet the design requirements of this standards manual and the performance and safety requirements of the system.

controlled environment: a continuous indoor air-conditioned environment, such as an office or clean room, where both temperature and humidity are controlled more than 90 percent of the time.

corrosive environment: a marine (sea coast) or launch-induced environment that causes accelerated degradation of materials as a result of oxidation or chemical reaction.

detent pins: quick release pins with spring loaded locking ball(s). No mechanism is used to disengage ball lock mechanism. Pins are pushed to insert and pulled to remove. The pins contain 1 ball or 2 balls (standard). The standard handle styles are "L" handles, "T" handles, and ring handles.

dissimilar metals: Two metals or alloys that have different electromotive force (EMF) characteristics and which when in contact with or in the presence of an electrolyte will result in the accelerated corrosion of the more active dissimilar metal or alloy.

engagement hole: hole upon whose edge the locking ball mechanism of a quick release pin engages when the pin is fully installed.

M&P, M&P Technical Authority: NASA or NASA-approved cognizant engineer/scientist with authority to approve deviations from materials and processes requirements in this standards manual. In general, the phrase, M&P Approval, refers to the cognizant materials and processes engineer who approves design drawings and documents. The M&P Technical Authority is the single materials and processes engineer with delegated technical authority from the KSC Chief Engineer.

positive locking, double acting pins: quick release pins requiring actuation of a spring loaded button to disengage ball lock mechanism. Button can be actuated with a push or pull. The locking mechanism consists of 2 balls (standard) or 4 balls. The standard handle styles are "L" handles, "T" handles, button handles, and ring handles. Ball lock mechanism must be disengaged to install or remove pin. Release of button causes ball lock to engage.

positive locking, single acting pins: quick release pins requiring actuation of a button to disengage ball lock mechanism. Button can only be actuated with a push. The locking mechanism consists of 2 balls (standard) or 4 balls. The standard handle styles are "L" handles, "T" handles, button handles, and ring handles Ball lock mechanism must be disengaged to install or remove pin. Release of button causes ball lock to engage.

quick release pin: removable pin with locking ball mechanism that can be removed and unlocked with one hand. At full installation through a hole, the pin is constrained axially on one

end by a head that is larger than the hole and by radially protruding balls on the opposite end of the hole. Also referred to simply as “pin” in this standard.

roll pin: hollow pins formed from a thin rolled sheet of metal. Roll pins are typically pressed into holes with a smaller diameter than that of the pin. The rolled construction of the pin allows it to easily radially contract and conform to a relatively large range of hole sizes for a press fit, requiring less precision than a press fit using a solid pin.

stress corrosion cracking (SCC): spontaneous cracking produced by the combined action of corrosion and static residual or applied stress. For this phenomenon to occur, stress and corrosion acting together must lead to greater damage than if they acted separately.

uncontrolled environment: an environment that is not a “corrosive environment” as defined herein but has no substantial temperature or humidity control and may be subject to outdoor exposure.

tethers: tethers are also referred to as lanyards or cable assemblies. Tethers are used to attach pins to adjacent structures to prevent loss and to prevent pins from becoming falling objects.

4. GENERAL REQUIREMENTS

The requirements and criteria specified herein shall be the minimum necessary to specify and install quick release pins and pin tethers. In the event more stringent requirements are necessary, they shall be determined by the responsible design organization in consultation with its customers. This standard applies to all designs with the following exceptions:

a. Existing tethers shall be upgraded to meet this standard only if the applicable design authority deems it necessary.
b. When an existing pin and/or tether is replaced for any reason, the replacement pin shall meet the requirements of this standard.

4.1 Facility Applicability

This standard applies to all KSC facilities containing flight hardware or subjected to a launch environment and to areas where falling objects might cause injury to personnel.

4.2 GSE Applicability

This standard applies to all GSE.

4.3 GSS Applicability

This standard applies to all GSS.

5. DETAILED REQUIREMENTS

5.1 Materials

5.1.1 Pin Materials

Shanks of corrosion resistant steel and alloy steel pins, COTS or custom, shall be fabricated from an alloy that is highly resistant to stress corrosion cracking from Table I of MSFC-STD-3029. Alternatively, the material can be moderately resistant to stress corrosion cracking from Table II of MSFC-STD-3029 with M&P approval.

Many component parts of both commercial quality and military standard pins do not meet the requirement to be highly resistant to stress corrosion cracking in accordance with MSFC-STD-3029. The pin shank can be replaced with materials which are highly resistant to stress corrosion cracking on an economically feasible basis. The pin shank is usually the only critical component and this standard provides a means for bringing the shank into compliance when replacement of the pin is necessary. Existing pins not meeting this requirement may remain in service until replacement is required.

5.1.2 Tether Materials

5.1.2.1 Controlled Environments

In controlled environments, tether cable shall be per MIL-DTL-83420/4 (corrosion resistant steel, type II (nylon jacketed), composition B) or MIL-DTL-83420/2 (corrosion resistant steel, type I (non-jacketed), composition B).

5.1.2.2 Corrosive and Uncontrolled Environments

In corrosive environments, tether cable shall be per MIL-DTL-83420/2 (corrosion resistant steel, type I (non-jacketed), composition B) so that the cable may be more easily inspected. Covering can promote wicking of corrosive substances inside and around the cable.

5.1.2.3 Cable Size

The minimum cable size shall be 1.588 mm (1/16 in) wire diameter and 2.381 mm (3/32 in) outside diameter (includes vinyl coating in the case of covered cable). Cable size shall be specified within grip length limits as shown in .

Table 1.

Table 1. Maximum Allowable Grip Lengths [inch (mm)] per Cable Size

Pin Diameter [inch (mm)]	Cable Dash No. per MIL-DTL-83420/2 or MIL-DTL-83420/4*			
	-002	-003	-004	-005
3/16 - 9/16 (4.8 - 14.3)	12 (305)			-

5/8 (15.9)	9.8 (249)	12 (305)	-
3/4 (19.0)	7 (178)	9.4 (239)	12 (305)
7/8 (22.2)	4.7 (119)	6.4 (163)	12 (305)
1 (25.4)	3.1 (79)	4.5 (114)	12 (305)

* Dash no. denotes same cable diameter and breaking strength for MIL-DTL-83420/2 and MIL-DTL-83420/4

5.1.2.4 Alternate Tether Materials

In either environment, alternate materials may be used for tether material only if all following requirements are met:

a. Alternate cable shall meet minimum breaking strength of the corresponding diameter of wire rope stated in Table 1.
b. Alternate cable material shall be one of the three following alloys as designated by SAE HS-1086:
   (1) S30200
   (2) S30400
   (3) S31600
c. Where cable per MIL-DTL-83420/4 is specified in this standard, jacketing shall be any flexible polymer deemed acceptable for use in the specified application per M&P review.

5.1.3 Swage Fittings

Stainless steel swage fittings shall be either MS51844 or a similar commercially available fitting.

5.2 Protective Finishes

5.2.1 Alloy Steel

Alloy steel shall be zinc plated per ASTM B633 or zinc-nickel plated per ASTM B841.

5.2.2 Corrosion Resistant Steel

Corrosion resistant steel shall be passivated per ASTM A967.

5.2.3 Cadmium Plating

Cadmium plating of any type shall only be used with approval from M&P.

5.3 Pin Usage

5.3.1 Controlled Environments

Passivated stainless steel and zinc plated alloy steel pins are allowed for use in controlled environments.

5.3.2 Corrosive Environments and Uncontrolled Environments

Passivated stainless steel pins are allowed for use in corrosive environments. Zinc plated pins should be avoided. Dissimilar metals should be taken into consideration.

5.4 Pin Characteristics

5.4.1 Pin Handles Permitted

The following pin handle styles shall be permitted for use for GSE:

a. Single Action Pins
   (1) “L” or “T” Handle with tethering hole, see Figure 1
   (2) Button Handle with tethering hole, see Figure 2
b. Double Acting Pins
   (1) “L” or “T” Handle with solid handle (not hollow) and tethering hole, see Figure 3
   (2) Ring Handle with tethering hole, see Figure 4
      (a) This handle type should be avoided where inadvertent actuation by snagging the ring could cause accidental release of pin.
c. Detent Pins
   (1) "L" or "T" Handle with solid handle (not hollow) and tethering hole, see Figure 5
   (2) Ring Handle with tethering hole, see Figure 6
      (a) This handle type should be avoided where inadvertent actuation by snagging the ring could cause accidental release of pin.

5.4.2 Pin Handles Not Permitted

Pin handle styles in the following list shall not be used for GSE:

a. Single Acting Pins: Ring Handle, see Figure 2
   This ring handle style, also called a "C" or "D" type handle, can spread open, separating the tether from the pin, and allowing the pin to fall.
b. Double Acting Pins: Roll Pin “L” or “T” Handle, see Figure 3
   Internal corrosion can weaken the roll pin causing it to break upon actuation.

c. Detent Pins: Roll Pin “L” or “T” Handle, see Figure 5
Internal corrosion can weaken the roll pin causing it to break upon actuation.

5.4.3 Pin Lengths

Many design drawings specify nonstandard lengths which require long lead times. When the next longer standard length can be used in an application, and will not affect the function of the installation, the pin may be replaced with approval from design engineering. Design engineering will determine if a drawing change is required per the applicable configuration management system.

5.4.4 Pin Diameters

Any proposed change in pin diameters will require approval from design engineering.

5.4.5 Substitution of Pins

5.4.5.1 Requiring Prior Engineering Approval

The following types of pin substitutions shall require engineering approval:

a. Replacing positive locking pins with detent pins.
b. Replacing corrosion resistant steel pins with steel pins in an uncontrolled atmosphere or launch environment.
c. Changing to a cadmium plated pin.
d. When design drawings state "no substitutions permitted."
e. Any other pin specified on a GSE drawing

5.4.5.2 Not Requiring Engineering Approval

The following types of pin substitutions do not require engineering approval for facilities applications:

a. Replacing detent pins with positive locking pins conforming to this standard.
b. Changing cadmium plating to zinc plating.
c. Changing handle styles as long as pins conform to this standard.

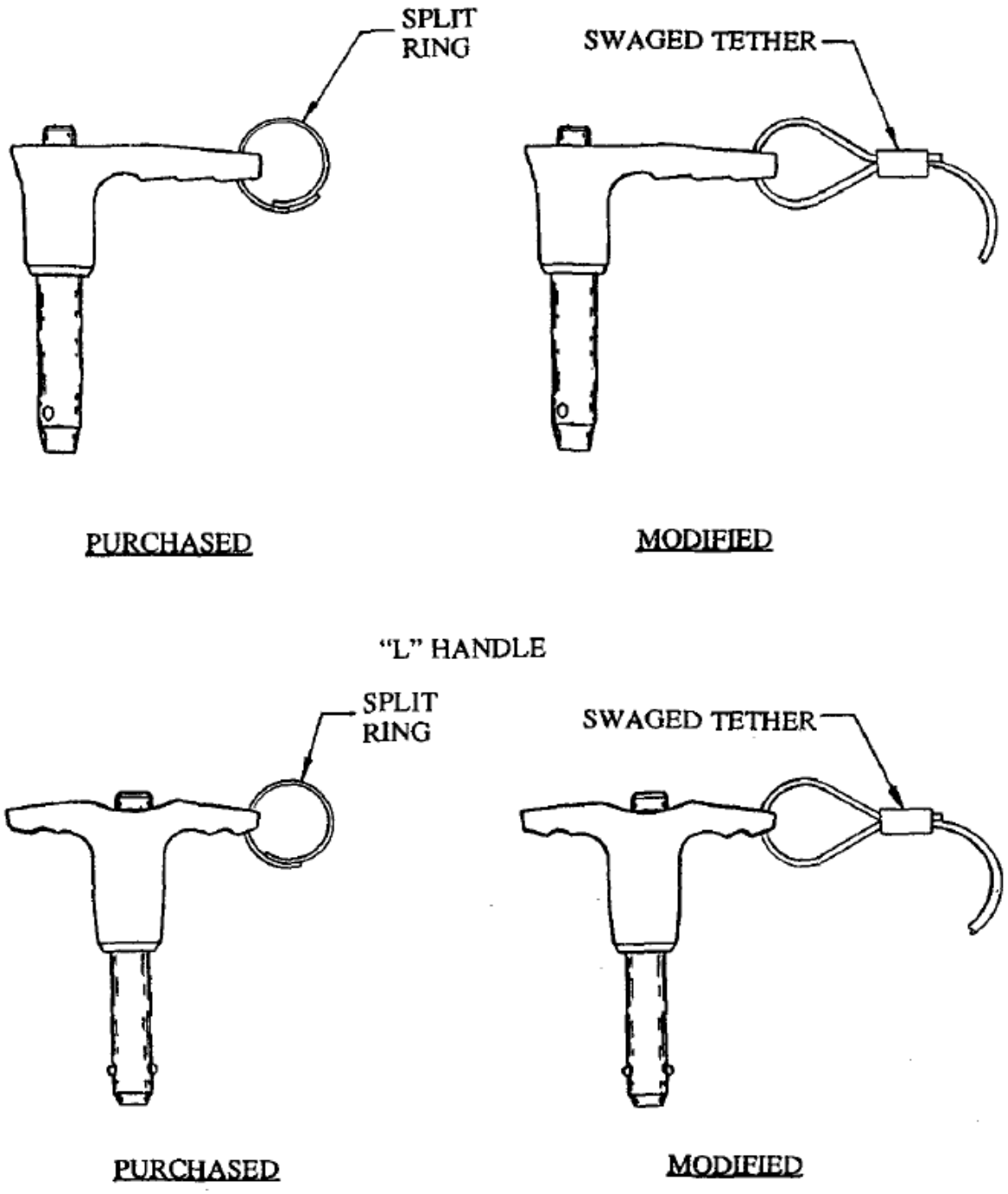


Figure 1. Single Acting Quick Release Pins, "L" and "T" Handles

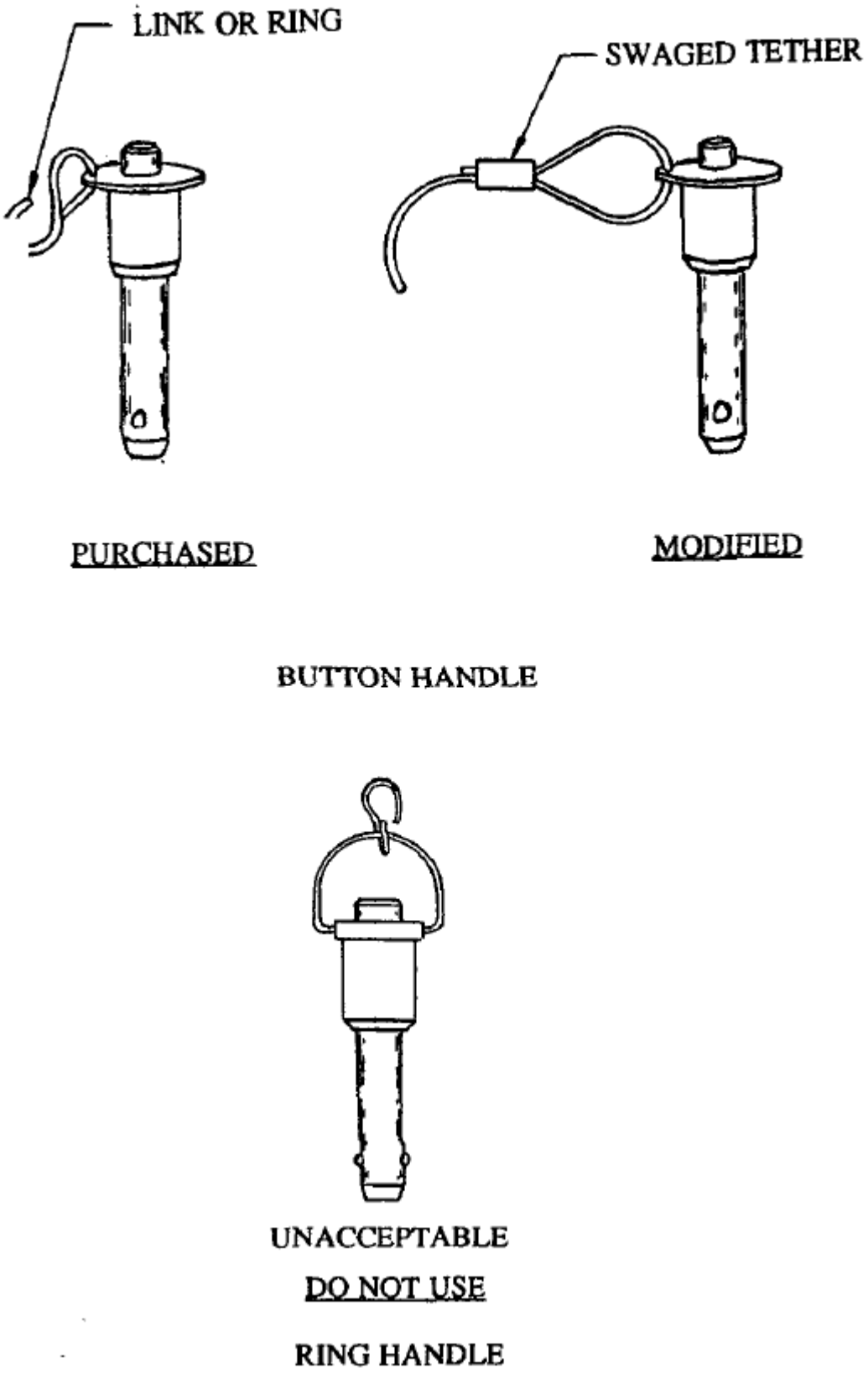


Figure 2. Single Acting Quick Release Pins, Button and Ring Handles

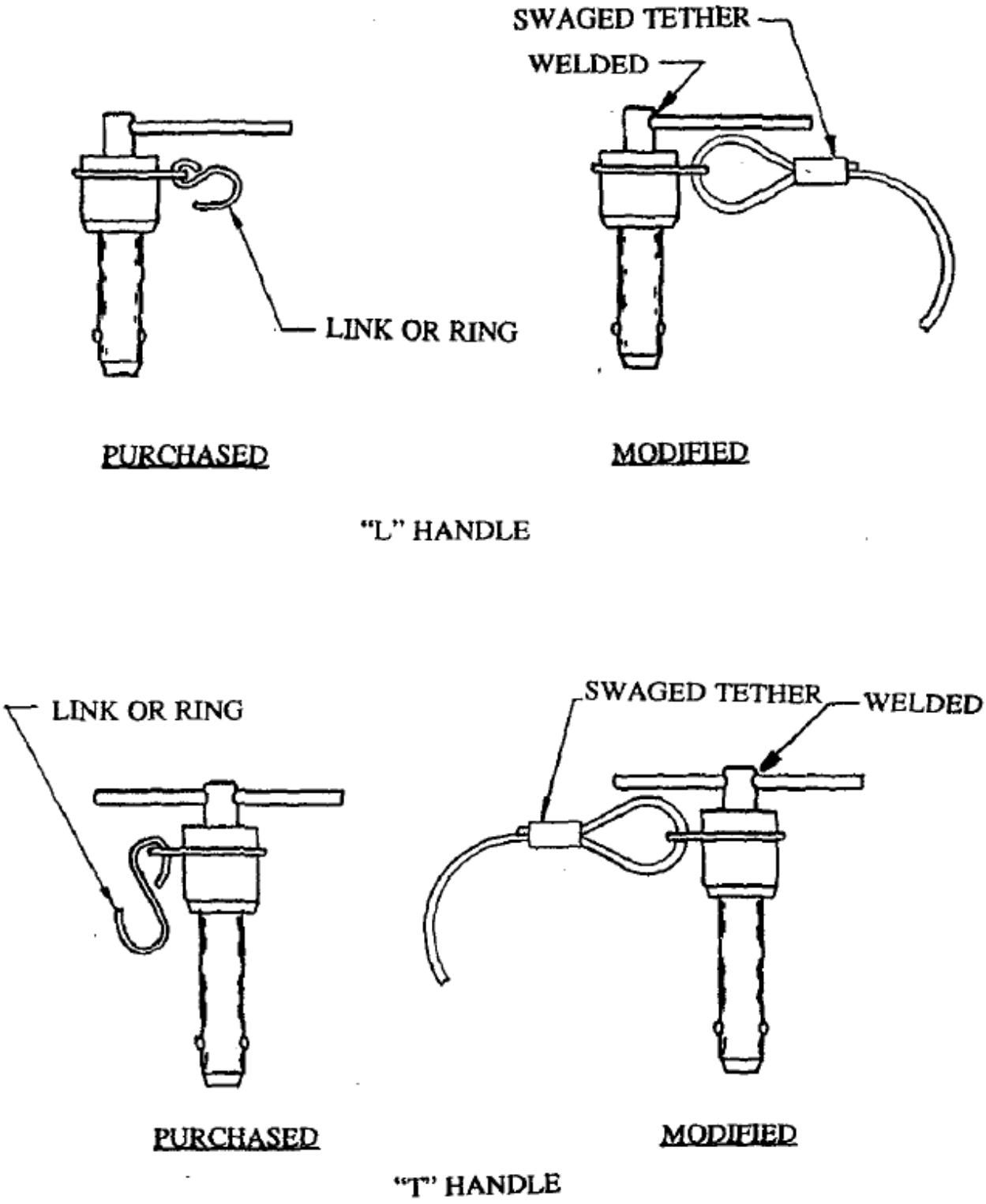


Figure 3. Double Acting Quick Release Pins, "L" and "T" Handles

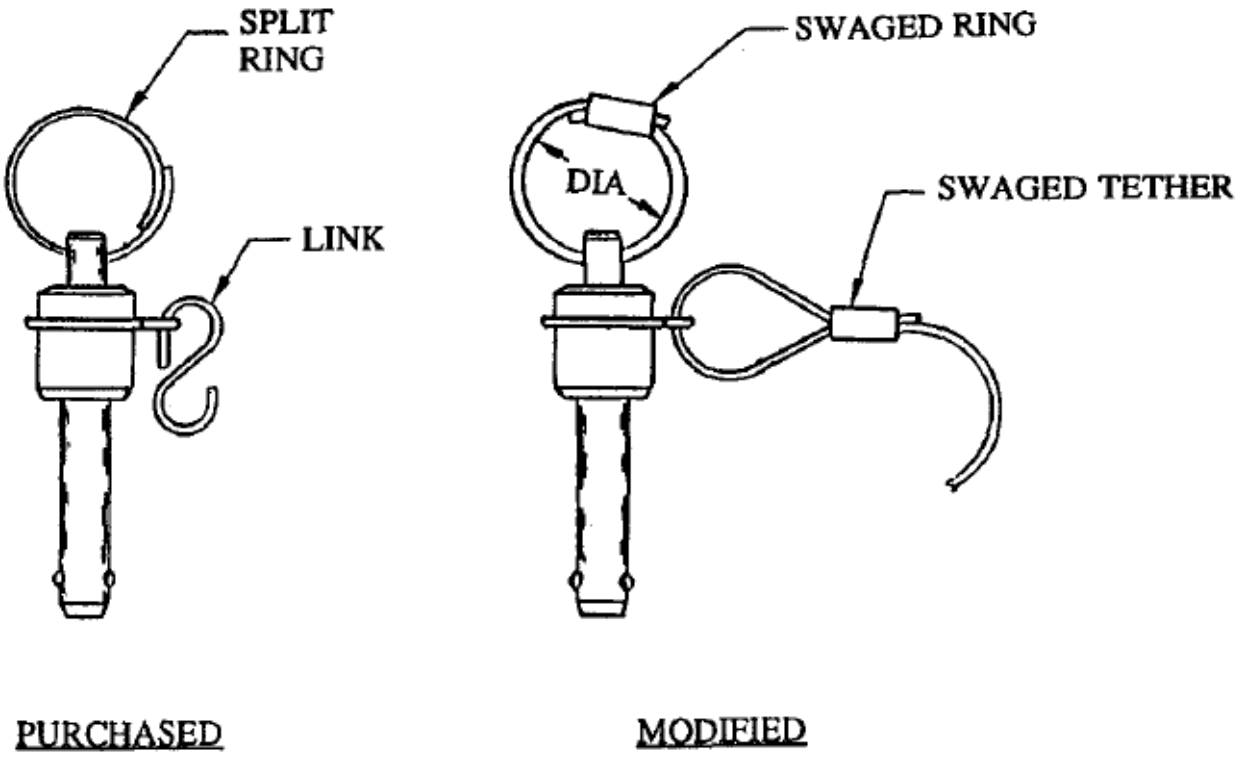
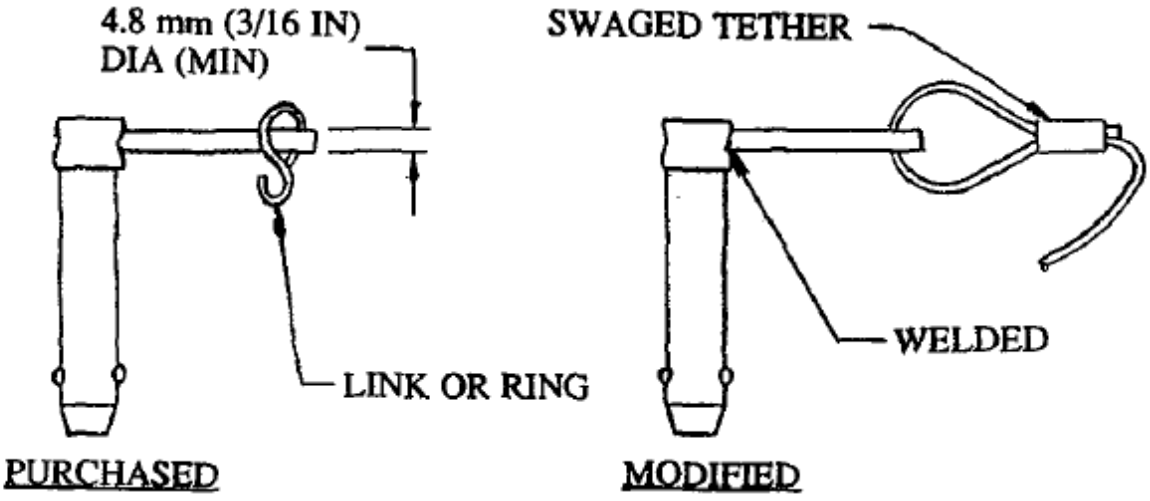


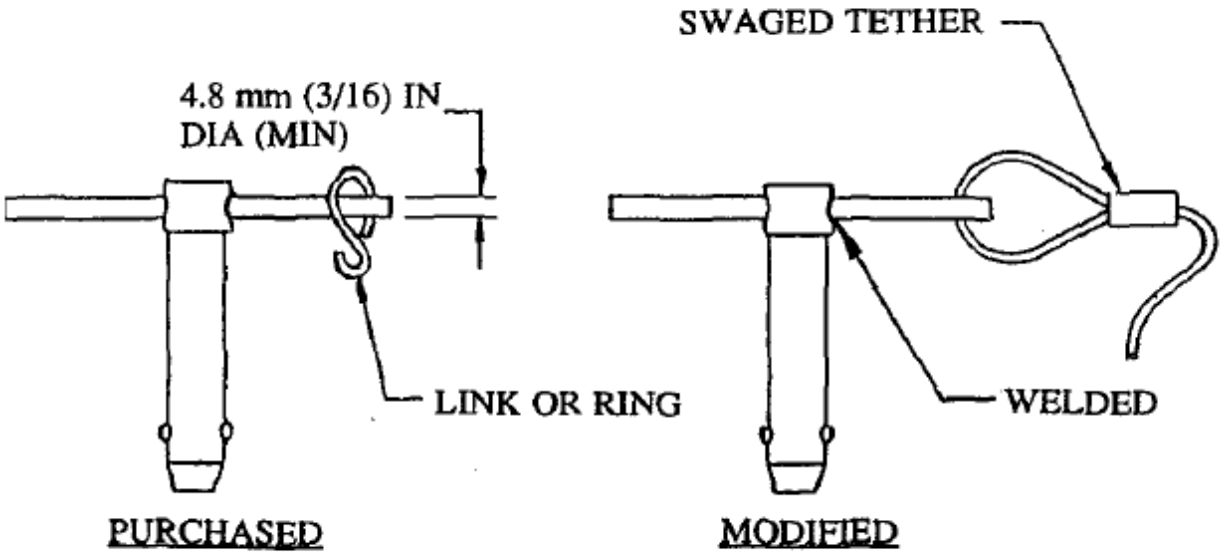
Figure 4. Double Acting Quick Release Pin, Ring Handle

Table 2. Swaged Ring Handle Minimum Inner Diameters for Quick Release and Detent Pins

Pin Diameter [inch (mm)]	Minimum Inner Diameter [inch]	Minimum Inner Diameter [mm]
3/16 - 1/2 (4.8 - 12.7)	1.00	25.4
9/16 - 5/8 (14.3 - 15.9)	1.50	38.1
3/4 - 1 (19.1 - 25.4)	2.00	50.8



"L" HANDLE



"T" HANDLE

Figure 5. Detent Pin, Quick Release, "L" and "T" Handles

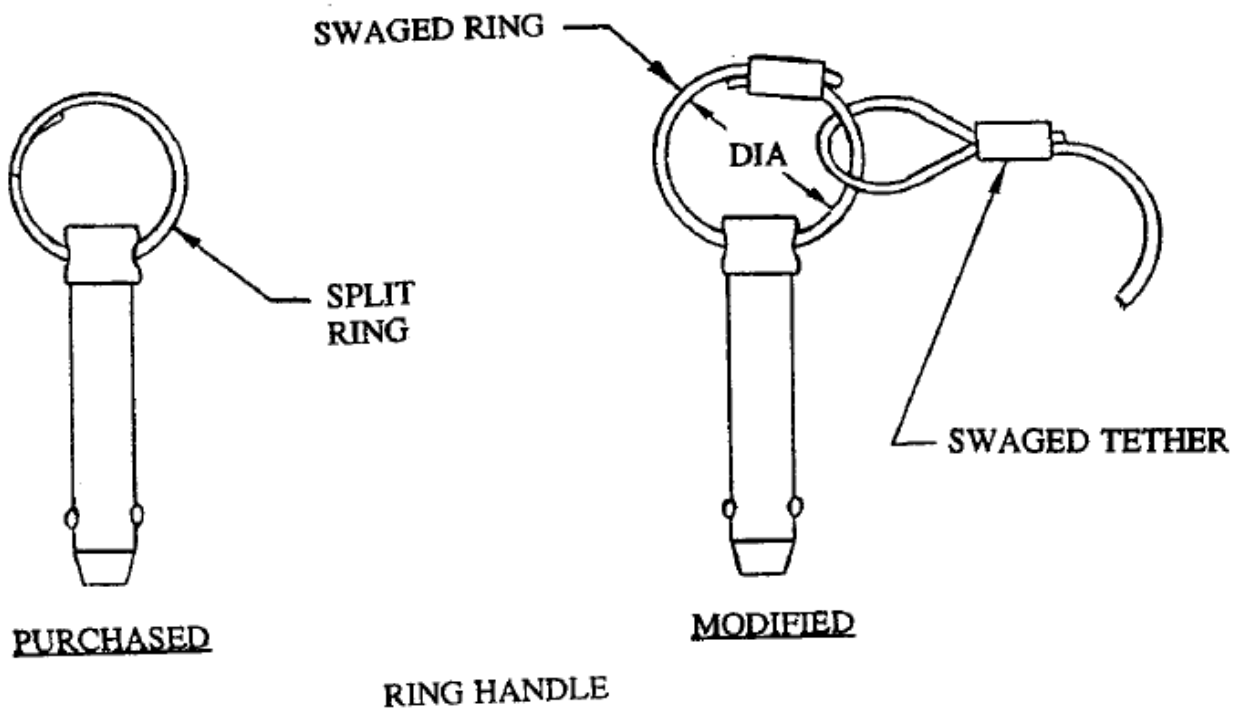


Figure 6. Detent Pin, Quick Release, Ring Handle

5.4.6 COTS Pin Modification

The following modifications to COTS pins shall be made before use. Invoking this standard in design drawings is sufficient to specify these modifications.

a. Split rings, links, or any other removable hardware occupying tethering hole in the procured state of the pin shall be discarded.

b. Solid handles in double acting pins and detent pins shall be tack welded to the body of the pin. For applications where FOD is a concern, welding to attach the handle to the body of the pin must be reviewed and approved by M&P.

Split ring handles on ring handle double acting pins and ring handle detent pins shall be replaced with swaged wire rope rings as shown in Figure 4 and Figure 6, respectively. Swaged wire rope rings shall have internal diameter per .

c. Table 1. Wire rope and swage fittings shall be per Section 5.1.2. Swage fittings shall be installed per Section 5.5.2.

5.5 Tether Installation

5.5.1 Pin Preparation

Modifications defined in Section 5.4.6 shall be made prior to tether installation.

5.5.2 Swage Fitting Installation

Swage fittings shall be per Section 5.1.2.4. Swage fitting installation shall be performed in accordance with swage fitting manufacturers' instructions. Cable jacketing shall be removed from cable at location of the swage fitting.

5.5.3 Tether Attachment to Pin

Tether attachments to pins shall be swaged connections as shown in Figure 1 through Figure 6. Tether diameters shall be sized according to pin grip length, as shown in .

Table 1. The standard tether length should be between 10 to 12 in (250 to 300 mm), but shorter or longer lengths may be necessary depending on the application. Tether length shall be minimized to only perform the intended function.

5.5.4 Tether Attachment to Structure

When used, tethers shall connect to the structure in which pin is used. Direct termination or tab termination shall be used for attachment of tether to structure.

5.5.4.1 Direct Termination

For direct terminations, the tether cable is swaged through existing or dedicated openings or holes in the structure. Figure 7 shows minimum spacing and hole size requirements for direct termination.

5.5.4.2 Tab Termination

Tab termination involves an intermediate tab between the structure and the tether. The tether is swaged through a hole on one end of the tab and a hole in the opposite end of the tab is used to screw or bolt the tab to the structure. Tabs shall be per 80K56817. Installation of tab and swaged tether shown in Figure 8. Tabs may be substituted with a similar design with engineering approval.

5.5.4.3 Tab Attachment Hardware

Tab attachment hardware comprises any screws, bolts, washers, and nuts for the installation of tabs onto the structure.

(1) Screw size shall be No. 8 or larger.

(2) Material shall have a high resistance to SCC per MSFC-STD-3029.

(3) Threaded hardware shall be self-locking or have a liquid-locking compound designated in accordance with ASTM D5363.

(4) Hardware shall be torqued per MSFC-STD-486. Prevailing torque of locking fasteners shall be added to installation torque when applicable. Installation torque

shall be multiplied by reduction factor (typically available from manufacturer) to account for extra lubricity from liquid-locking compound when applicable.

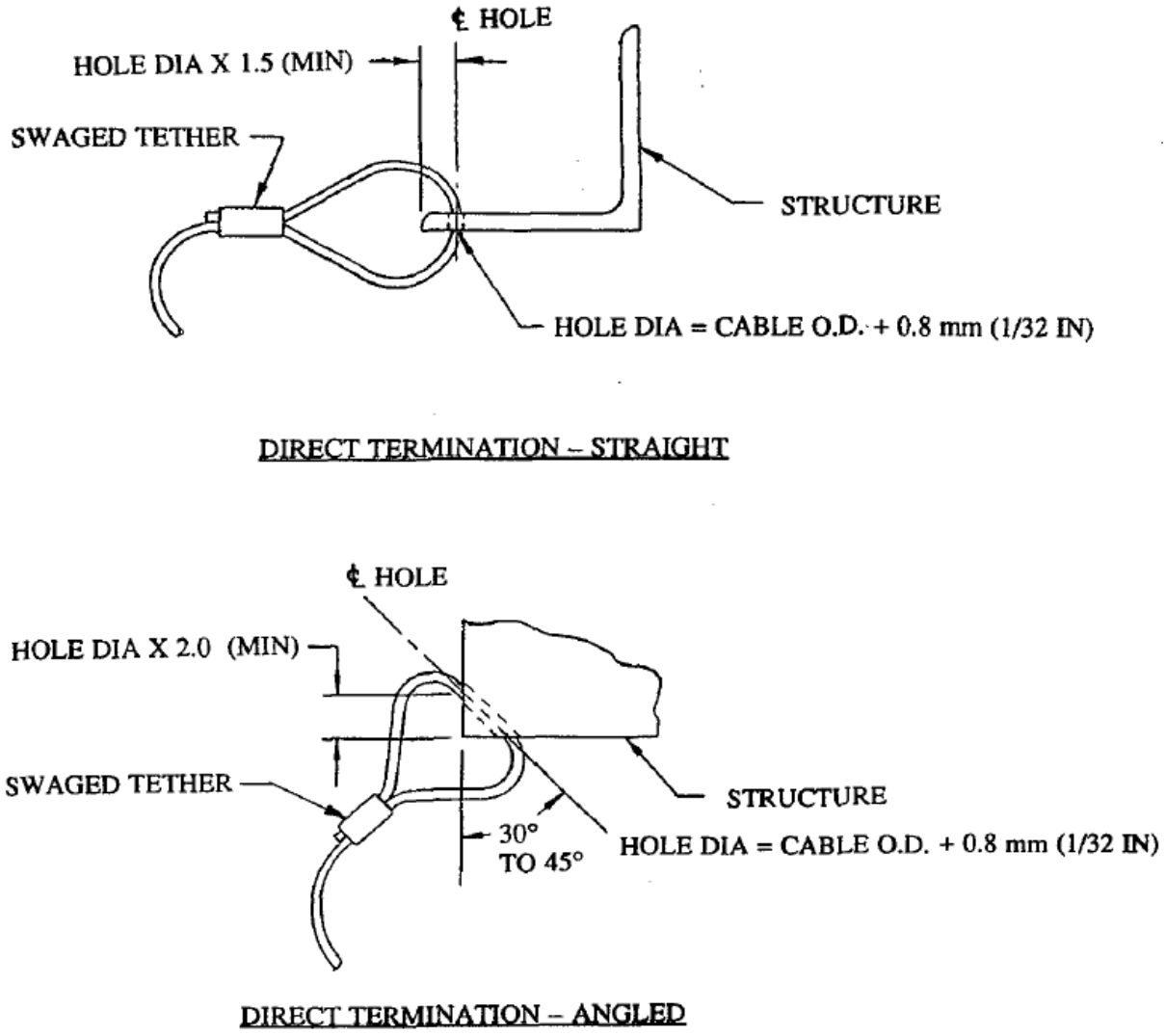


Figure 7. Tether Attachment to Structure, Direct Termination

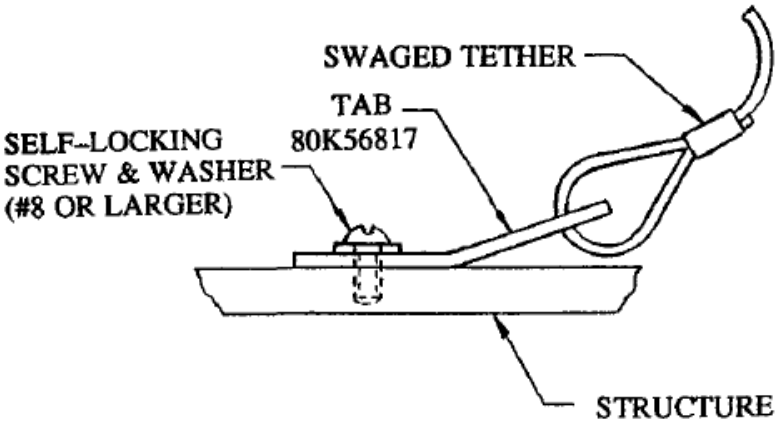


Figure 8. Tether Attachment to Structure, Tab Termination

5.6 Design

5.6.1 Design Drawings

This standard shall be referenced on new drawings when quick release pins are specified. The pins shall be specified on the drawing describing the type of pin, part number, and manufacturer or specification. Details of lanyard installations are not required unless special considerations not covered by this standard are necessary. When substitutions are not permitted, the design drawing shall state "no substitutions permitted." The standard shall be referenced on existing drawings when they are updated for other reasons.

5.6.2 Design Considerations

Design engineering shall consider all criteria covered by this standard. Design shall also consider the following:

a. Storage of pins when not in use.

b. Pinch points, where tether could be damaged, shall be avoided.

c. Single shear shall be avoided in load carrying applications.

d. Axial tension shall be avoided unless the quick release pin is specifically designed for the application.

e. Standard lengths should be used when possible. Tolerance stack-up shall be addressed to ensure adequate grip lengths of pins.

f. In low stress applications, the entrance hole may be slightly larger than the ball engagement hole to aid in assembly and disassembly.

g. If a tether can’t be attached to a critical part due to degradation by drilling a hole for tab termination, design shall provide for tether attachment.

h. Avoid tripping or snag hazards from lanyards.

i. Quick release pins should be limited to routinely removed items.

j. Engagement hole shall be sized per pin manufacturer's instructions.

k. Engagement hole parent material shall be resistant to deformations from locking ball mechanism in quick release pins that would compromise functionality of locking mechanism. Engagement hole may require reinforcement or use of a separate receptacle upon which the pin's ball lock mechanism can engage.

6. NOTES

6.1 Intended Use

This document is intended to be used to standardize the usage and installation of quick release pins and pin tethers in the vicinity of flight hardware, launch environments, and at heights.

Custodian:	Preparing Activity:
NASA – John F. Kennedy Space Center Kennedy Space Center, Florida 32899	John F. Kennedy Space Center Name of Preparing Directorate