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Ares I Preferred Common Parts Selection Document

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EXPLORATION LAUNCH PROJECTS PLAN

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TABLE OF CONTENTS

1.0 INTRODUCTION.....	5
2.0 PURPOSE.....	6
3.0 SCOPE.....	6
4.0 Document Application	7
4.1 CHANGE AUTHORITY/RESPONSIBILITY	8
4.2 COMMONALITY REQUIREMENTS	8
4.3 OTHER REQUIREMENTS	8
5.0 APPLICABLE DOCUMENTS	9
5.1 Applicable Documents List.	9
5.2 Acronyms.....	10
6.0 DEFINITIONS.....	11
7.0 ARES I Preferred Common Parts List	12
7.1 Structures	13
7.2 Fluids	23
7.3 Electrical	26
Appendix A: Subject Matter Experts.....	30
Appendix B: Common Systems/subassemblies	31

LIST OF FIGURES

TBD

1.0 INTRODUCTION

Commonality can be broadly defined as the use of identical, or interchangeable, interoperable, functionally compatible hardware, software, Support Equipment (SE), operations, maintenance and training procedures, and technical design approaches across a program for satisfying different sets of functionally similar requirements. For a large, complex, and long term program such as the Constellation Program (CxP), use of commonality will usually reduce both the initial and the recurring Life Cycle Cost (LCC) components. The types of commonality are as follows:

- Identical: Identical interfaces, parts, layout, form, fit, and function
- Interchangeable: Different parts and layout, but with identical external layout and interfaces; form fit and function interchangeable.
- Modular: Common at a lower level; this is a subset of interchangeable. Internal devices/components are common to other higher assemblies.
- Interoperable: Items that can be used in different systems without modification; identical and interchangeable items are interoperable.
- Interchangeable with software change: The same as interchangeable, except requires appropriate software install to function in the installation.

The Constellation Program has developed the Constellation Program Commonality Plan CxP 70132 which strives to achieve the maximum practical level of commonality for the Constellation Program. There will be six components of this commonality program:

- Commonality within systems and elements
- Commonality between systems and elements
- Commonality within subsystems, assemblies and subassemblies
- Commonality between subsystems, assemblies and subassemblies
- Use of standard parts
- Commonality relative to the Software Support Environment (SSE)

The Ares I Preferred Common Parts Selection Document, CxP 72142 Is designated to be used primarily by ARES I Level 4 and associated subelement designers to be focused on promoting commonality within systems and elements and within subsystems, assemblies and subassemblies, and commonality within the ARES I Project for all new development hardware. During development, ARES I designers shall add, delete, revise and reference identified common parts within the Ares I Preferred Common Parts Selection Document, CxP 72142.

The intent is to eliminate redundant parts used in the design of the ARES I and provide the design engineer a list of identified common parts for reference in development activities. Fewer unique parts potentially allow for reliability improvements that will ultimately improve crew survival and likelihood of mission success. Another benefit will be larger purchases of common items that will result in lower unit and thus system life-cycle cost. Also, fewer vendors would need to be sustained for the life of the program. It will trickle down to reduce costs associated with qualification testing, minimize the number of spares, reduce the number of processes (manufacturing, test, inspection, maintenance, etc.), reduce training/cross training of technicians, etc.

2.0 PURPOSE

The purpose of the document is to identify and establish ARES I preferred qualified parts and/or common sub systems/sub assemblies to provide selection information for designers. This document does not preclude the use of other qualified parts not listed herein which meet design requirements.

3.0 SCOPE

The Ares I Preferred Common Parts Selection Document is the guiding source for ARES I designers to choose part standards for *select items* in order to preserve commonality within the ARES I.

The ARES I Preferred Common Parts List is comprised of the Upper Stage (US), Upper Stage Engine/J-2X (USE), and the First Stage (FS) elements (see figure 3-1) which make up the ARES I launch vehicle. The Ares I Preferred Common Parts Selection Document was developed by a working group made up of representatives from each of the Ares I elements, as well as, some subject matter experts not strictly representing ARES I and led by ARES I Integrated Operations. These working group members defined the common items to be used within their element and determined applicability across elements. This data is contained in section 7.0 of this document.

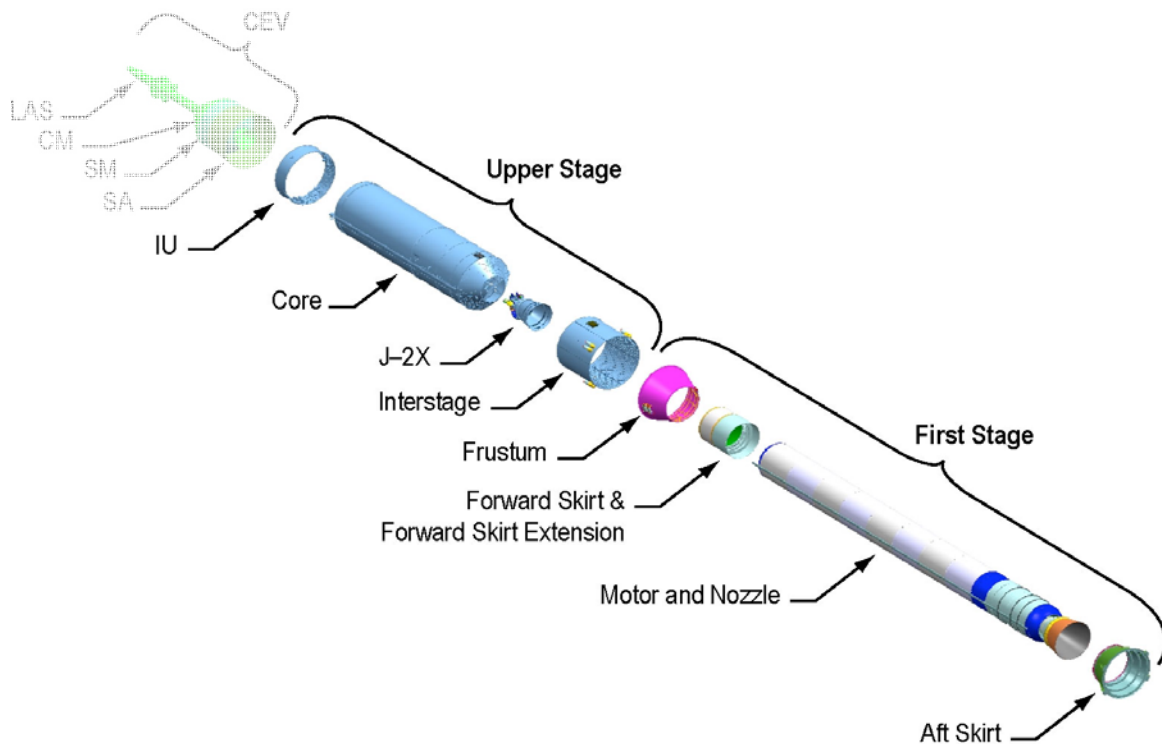


Figure 3-1 ARES 1 Launch Vehicle

4.0 Document Application

This document is intended to aid designers in the selection of parts that will be common for the entire vehicle to the greatest extent possible. While not every item a designer needs will be found in the document, this should be the first place a designer looks when selecting parts.

Section 7.0 of the ARES I Common Parts list is comprised of parts that have been commonly used in the past, are known to be flight qualified for certain space flight applications, and are recommended for use in the future. It is the designer's responsibility to verify the parts are appropriate for his specific application.

When using the document, the designer first selects the particular part from the ARES I Preferred Common Parts List (Section 7.0) as depicted in figure 4-1. If more than one entry is given within that category, the designer would narrow the choice based on specific design criteria for that part, such as strength, material, etc. The designer would then go to the specification for any suitable candidates and determine which exact part will meet his needs based on the details given in the specification. This document points the designers in the right direction, but the exact information needed to make a final selection must come from reading the specification. Additions/deletions and/or revisions to the ARES I Preferred Common Parts List can be made by the designers following the process outlined in section 4.1 Change Authority/Responsibility. Parts that are designated for commonality within the elements are identified by providing a Y in the Elements column. Other elements can agree to their commonality in their designs and provide a Y also or an N for a non common item. The green shading identifies where there is commonality between two or more elements.

6.1.1 Fasteners						
Elements						
US	FS	USE	6.1.1.1 Bolts (all fine thread unless noted)			
			eye bolt	part no.		notes
Y				AN42-AN49		document no. is NASM42-NASM49
Y				MS51937		
			flush head bolt	csk degree	strength (KSI)	material/finish
Y				100	95	A286/passivated or bare Ti 6AL-4V
Y				100	95	A286/passivated or bare Ti 6AL-4V
			double hex head bolt	tensile/shear	strength (KSI)	material/finish
Y				shear	145	MP35N/bare
Y				tensile	160	A286/passivated
Y				tensile	185	Inconel 718/bare
Y				tensile	200	A286/passivated
Y				tensile	260	MP35N/bare
			hex head bolt	tensile/shear	strength (KSI)	material/finish
Y	Y			shear	108	various
Y	Y			tensile	140	A286/passivated

Figure 4-1 ARES I Preferred Common Parts List (example)

Parts are also identified for potential future Launch vehicles as depicted in Appendix B. The Cargo Launch Vehicle (CaLV) may make use of common parts, sub-assemblies, and assemblies/systems associated with the ARES I. This document will provide reference in annotating possible common areas as delineated in appendix B for the avionics systems. Additional Appendices can be added for additional common items/subsystem categories that correspond to ARES I Parts.

4.1 CHANGE AUTHORITY/RESPONSIBILITY

Proposed changes to this document shall be submitted by a Change Request (CR) to the appropriate ???? Control Board for consideration and disposition.

The CR must include a complete description of the change and the rationale to justify its consideration. All such requests will be processed in accordance with CxP ?????, Constellation Program Management Systems Requirements, Volume 1: Configuration Management Requirements.

The NASA Office of Primary Responsibility (OPR) for this document is the Constellation Systems Engineering & Integration (SE&I) Program Office.

4.2 COMMONALITY REQUIREMENTS

The commonality design requirements for the CxP are contained in CxP-70000, Constellation Architecture Requirements Document and in Cxp 72034, Ares I System Requirements Document (SRD).

4.3 OTHER REQUIREMENTS

Configuration Management requirements and guidelines shall be in accordance with CxP-70073, Volume 1, Configuration Management Requirements.

5.0 APPLICABLE DOCUMENTS

5.1 Applicable Documents List.

External applicable documents are available to all ARES projects, Engineering teams and other MSFC employees through Windchill via the Integrated Collaborative Environment (ICE) Portal. Employees should verify that they are working with the correct version before use.

Add Table and reference applicable documents.

5.2 Acronyms

CaLV	Cargo Launch Vehicle
CR	Change Request
CU	Controller Unit
CWG	Common Working Group
CxP	Constellation Program
DAU	Data Acquisition Unit
DB	Data Bus
FS	First Stage
LCC	Life Cycle Cost
MDU	Master Data Unit
MSFC	Marshall Space Flight Center
PDU	Power Distribution Unit
OPR	Office of Primary Responsibility
US	Upper Stage
USE	Upper Stage Engine
SME	Subject Matter Expert
SE	Support Equipment
SE&I	Systems Engineering & Integration
SRD	Systems Requirement Document
SSE	Software Support Environment

6.0 DEFINITIONS

Common Parts – Generally ordinary items that are likely to be widely used within a design. Also, items which are prescribed to be common within or across designs.

Commonality - Commonality can be broadly defined as the use of identical, or interchangeable, interoperable, functionally compatible hardware, software, Support Equipment (SE), operations, maintenance and training procedures, and technical design approaches across a program for satisfying different sets of functionally similar requirements. Commonality types are defined below:

- Identical: Identical interfaces, parts, layout, form, fit, and function
- Interchangeable: Different parts and layout, but with identical external layout and interfaces; form fit and function interchangeable.
- Modular: Common at a lower level; this is a subset of interchangeable. Internal devices/components are common to other higher assemblies.
- Interoperable: Items that can be used in different systems without modification; identical and interchangeable items are interoperable.
- Interchangeable with software change: The same as interchangeable, except requires appropriate software install to function in the installation.

7.0 ARES I Preferred Common Parts List

During development, ARES I designers shall add, delete, revise and reference identified common parts within this section of the Ares I Preferred Common Parts Selection Document, CxP 72142.

7.1 Structures

7.1.1 Fasteners						
Elements						
US	FS	USE	7.1.1.1 Bolts (all fine thread unless noted)			
			eye bolt	<u>part no.</u>		<u>notes</u>
Y	N			AN42-AN49		document no. is NASM42-NASM49
Y	N			MS51937		
			flush head bolt	<u>csk degree</u>	<u>strength (KSI)</u>	<u>material/finish</u>
Y	Y			100	95	A286/passivated or bare Ti 6AL-4V
Y	Y			100	95	A286/passivated or bare Ti 6AL-4V
			double hex head bolt	<u>tensile/shear</u>	<u>strength (KSI)</u>	<u>material/finish</u>
Y	Y			shear	145	MP35N/bare
Y	Y			tensile	160	A286/passivated
Y	Y			tensile	185	Inconel 718/bare
Y	N			tensile	200	A286/passivated
Y	N			tensile	260	MP35N/bare
			hex head bolt	<u>tensile/shear</u>	<u>strength (KSI)</u>	<u>material/finish</u>
Y	Y			shear	108	various
Y	Y			tensile	140	A286/passivated
Y	Y			tensile/shear	160/95	A286/passivated
Y	Y			tensile	160	A286/passivated
			shoulder bolt	<u>part no.</u>		
Y	Y			NAS1160		
			pan head	<u>tensile/shear</u>	<u>strength(KSI)</u>	<u>material/finish</u>
N	Y			tensile	160-180	alloy steel -4140, cres-A286
			flat 100 deg	<u>tensile/shear</u>	<u>strength(KIPS)</u>	<u>material/finish</u>
N	Y			tensile	160-180	alloy steel -4140, cres-A286

US	FS	USE	7.1.1.2 Screws (all fine thread unless noted)					
			<u>captive screw</u>	<u>type</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	Y			self-retracting, hex head, hex recess	160	A286/passivated	CA22035-4	use CA2210-4R retaining ring
			<u>socket head cap screw</u>	<u>tensile/shear</u>	<u>strength</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	Y			tensile	various	various	NAS1351	SELF LKG PATCH, ALY STL, ATK PN 1U75756-10, US does not want to use fasteners with a patch-type self-locking feature
Y	Y			tensile	various	various	NAS1352	coarse thread
Y	Y			tensile	80	various	MS16995	coarse thread, doc. no. is NASM16995
Y	Y			tensile	80	various	MS16696	document no. is NASM16996
	Y			tensile	80	Cres, passivated	MS21295	Self Lkg
			<u>countersunk screw</u>	<u>csk degree</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	Y			100	80	300 series CRES/bare	MS24693	document no. is NASM24693
Y	Y			82	80	300 series CRES/passivated	MS51959	document no. is NASM51959
Y	Y			100	160	A286/passivated	NAS1102E	
			<u>flat 100 Deg</u>	<u>tensile/shear</u>	<u>strength(KIPS)</u>	<u>material/finish</u>		
	Y			tensile	160-180	alloy steel & Cres A286	NAS1189	self lkg
			<u>flat, fillister</u>	<u>tensile/shear</u>	<u>strength(KIPS)</u>	<u>material/finish</u>		
	Y			tensile	160-180	alloy steel -4140, cres-A286	NAS1101	Full Thread, offset cruciform
			<u>pan head, slotted</u>	<u>tensile/shear</u>	<u>strength(KSI)</u>	<u>material/finish</u>		
	Y			tensile	160-180	alloy steel -4140, cres-A286	NAS 1216	Full Thread, Dovetail slotted recess
			<u>set screw, headless</u>	<u>tensile/shear</u>	<u>strength</u>	<u>material/finish</u>		
	Y					alloy steel, cres -A286	NASM565	cres-passivate, IAW QQ-P-35
	Y					cres 300 series	MS51021	cres-passivate, IAW QQ-P-35, plain & self lkg

US FS USE			7.1.1.3 Washers				
			<u>flat washers</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	Y			75	CRES/passivated	NAS1587	also available in thin version
Y	Y			80	300 CRES/passivated	NAS620	reduced OD; also available in thin version
Y	Y			80	300 CRES/passivated	MS15795	document no. is NASM15795; larger OD than NAS1587
	Y			160	alloy steel -4130, CRES A286	NAS1149	PASSIVATE PER AMS 2700
Y	Y			160	A286/passivated	NAS1149E	multiple thicknesses; other materials and strengths also available
Y	Y			160	A286/passivated	VN900-x	Voishan part no., CAGE code 92215
Y	Y			220	Inconel 718/passivated	MS14183L	document no. is NASM14183
Y	Y			260	17-44PH/passivated	MS21299	document no. is NASM21299
			<u>countersunk washers</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	Y			75	CRES/passivated	NAS1587-xC	
Y	Y			160	A286/passivated	VN900-xC	Voishan part no., CAGE code 92215
Y	Y			220	Inconel 718/passivated	MS14183L-C	document no. is NASM14183
Y	Y			260	17-44PH/passivated	MS21299C	document no. is NASM21299
			<u>CSK and flat</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
	Y			125-145	alloy steel 4130 Heat Treated	ms20002	MS Part # MS20002C8
			<u>lock washers</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
	Y				CRES, Austenitic series, RC35-45	NAS 1640	Passivate per QQ-P-35
Y	Y			75	CRES/passivated	MS35338	document no. is NASM35338
			<u>sealing washer</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
	Y				synthetic rubber molded to CRES, RC35-45	NAS 1598	Passivate per QQ-P-35

US	FS	USE	7.1.1.4 Nuts all fine thread unless noted)					
			self-locking nuts	type	strength (KSI)	material/finish	part no.	notes
Y	Y			hex	125	A286/dry film lube	NAS1291	low height, light weight
	Y			hex, reg height	125	CRES, alloy steel	NASM21045	Passivate per QQ-P-35
	Y			reduced hex		steel, AISI C1035, C1042, 1050, 4027, 4037, 8630, 8740, dry flm lube	NASM21042	Non-corrosion resist steel
	Y			hex, reg height	125	CRES type 303, XM-7, 305, A286; Silver plate all threads	NASM21046	
Y				double hex	160	A286/dry film lube	92347M	SPS part no., CAGE code 56878
Y	Y			hex	180	A286/silver plated	MS21043	low height
Y	Y			double hex	180	A286/passivated or dry film lube	NAS1805	
Y	Y			double hex	220	A286/dry film lube	72275M	SPS part no., CAGE code 56878
Y	Y			double hex	260	MP35N/silver plated + dry film lube	EWNM26	SPS part no., CAGE code 56878
			nutplates	type	strength (KSI)	material/finish	part no.	notes
Y	Y			self-locking, floating, low ht., reduced rivet spacing, tw o lugs	125	A286/dry film lube	MS21076L	doc. no. NASM21076
Y	Y			self-locking, floating, low ht., tw o lugs	125	A286/dry film lube	MS21060L	doc. no. NASM21060
Y	Y			self-locking, floating, low ht., one lug	125	A286/dry film lube	MS21062L	doc. no. NASM21062
Y	Y			self-locking, floating, low ht., tw o lugs	160	A286/dry film lube	NAS1773CxM	
Y	Y			self-locking, floating, low ht., one lug	160	A286/dry film lube	NAS1789CxM	
	Y			floating/slf lok	125	alloy stl, Ht Treat, CRES A286	NAS 1791	
	Y			floating/slf lok		CRES Nut	NAS 1474	Passivate per MIL-S-5002, sealed back nut plate
			Plain	type	strength	material/finish	part no.	notes
	Y			hexagon	125	steel, AMS 6322, 26-32 HRC,CAD plate per AMS 2400	AS9881	
	Y			hexagon		steel, aluminum alloy, CRES	NASM 315	
			jam nuts	type	strength (KSI)	material/finish	part no.	notes
Y	Y			hex		CRES/passivated	MS3186CxP	
Y	Y			hex		CRES/passivated	MS35691	fine and coarse threads
	Y			drilled	150 KSI TS	steel 4130, CRES A286	NAS 509	
			free-running nuts	type	strength (KSI)	material/finish	part no.	notes
Y	N			hex	80	CRES/dry file lube	MS35650-xB	

US FS USE			7.1.1.5 Inserts (all fine thread unless noted)					
			<u>helical coil</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>		
Y	Y	N		CRES/dry film lube	MS21209	fine and coarse threads, locking, doc. no. NASM21209		
			<u>locked in screw thread</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>		
Y	Y	N		A286/dry film lube	M45932/1-xDL	doc. no. MIL-I-45932/1, locking, thin-walled		
Y	Y	N		303 CRES/passivated	KNHLxxxxL	Fairchild/Tridair part no., CAGE code 0X872		
Y	Y	N		A286/dry film lube	MS51831CAxxxL	fine and coarse threads, locking, heavy duty		
Y	Y	N		A286/dry film lube	NAS1395CAxL	fine and coarse threads, locking, heavy duty		
	Y			CRES, AMS 7245	NASM124700	Fine Thread		
US FS USE			7.1.1.6 Studs					
			<u>PIN</u>	<u>type</u>	<u>part no.</u>	<u>material/finish</u>	<u>notes</u>	
	Y			spring, tublr	NASM 16562	Steel. Grades 1070 thru 1095; CRES typ 410 & 420		
	Y			swage locking	NAS 7014-7022	CRES A-286	head type protruding	
US FS USE			7.1.1.7 Pins					
			<u>dowel pins</u>	<u>material</u>	<u>part no.</u>	<u>notes</u>		
Y				CRES	MS9390	doc. no. is SAE-AS-9390		
US FS USE			7.1.1.8 Hi-Lok Pin and Collar					
			<u>protruding head</u>	<u>tensile/shear</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	N			shear	95	Ti 6AL-4V / film/alcohol lube	HL10	Hi-Shear part no., CAGE code 73197, 750°F
Y	N			tensile	95	Ti 6AL-4V / film/alcohol lube	HL12	Hi-Shear part no., CAGE code 73197, 750°F
Y	Y			shear	95	A286 / passivated - film/alcohol lube	HL40	Hi-Shear part no., CAGE code 73197, 1200°F
Y	Y			tensile	95	A286 / passivated - film/alcohol lube	HL48	Hi-Shear part no., CAGE code 73197, 1200°F
Y	N			shear	125	PH13-8Mo / passivated - film/alcohol lube	HL644	Hi-Shear part no., CAGE code 73197, 600°F
Y	N			tensile	125	PH13-8Mo / passivated - film/alcohol lube	HL646	Hi-Shear part no., CAGE code 73197, 600°F
			<u>flush head</u>	<u>tensile/shear</u>	<u>strength (KSI)</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	N			shear	95	Ti 6AL-4V / film/alcohol lube	HL11	Hi-Shear part no., CAGE code 73197, 750°F
Y	N			tensile	95	Ti 6AL-4V / film/alcohol lube	HL13	Hi-Shear part no., CAGE code 73197, 750°F
Y	Y			shear	95	A286 / passivated - film/alcohol lube	HL41	Hi-Shear part no., CAGE code 73197, 1200°F
Y	Y			tensile	95	A286 / passivated - film/alcohol lube	HL49	Hi-Shear part no., CAGE code 73197, 1200°F

Y	N		shear	125	PH13-8Mo / passivated - film/alcohol lube	HL645	Hi-Shear part no., CAGE code 73197, 600°F	
Y	N		tensile	125	PH13-8Mo / passivated - film/alcohol lube	HL647	Hi-Shear part no., CAGE code 73197, 600°F	
			<u>standard collar</u>	<u>tensile/shear</u>	-	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	N		shear		2024 AL / anodized - film/alcohol lube	HL70	Hi-Shear part no., CAGE code 73197	
Y	Y		tension		A286 / dry film or alcohol lube	HL78	Hi-Shear part no., CAGE code 73197	
			<u>self-aligning collar</u>	<u>tensile/shear</u>	-	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>
Y	N		shear		2024 AL / anodized - film/alcohol lube	HL82	Hi-Shear part no., CAGE code 73197	
Y	Y		tension		A286 / dry film or alcohol lube	HL275	Hi-Shear part no., CAGE code 73197	

7.1.2 Clamps							
Elements							
US	FS	USE	7.1.2.1 P-clamps				
			<u>cushioned loop/P clamp</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	Y	N		CRES/passivated	NAS1715CxT	cushion material is PTFE, used with 1/4" or #10 fasteners	
Y	Y	N		CRES/passivated	TA022	cushion material is silicone, used with 1/4" or #10 fasteners; Kirkhill part no., CAGE code 75345; web address: http://www.kirkhill-ta.com/pdf/200-Clamp.pdf	
US	FS	USE	7.1.2.2 Saddle clamps				
			<u>cushioned saddle clamp</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	Y	N		CRES/passivated	NAS1716CxT	cushion material is PTFE, used with #10 fasteners	
Y	Y			CRES/passivated	TA091	cushion material is neoprene, used	
US	FS	USE	7.1.2.3 Hose Band clamps				
			<u>hose band clamp</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	N	N		CRES/passivated	NAS1922	no locking feature, so usually needs to be lockwired	
US	FS	USE	7.1.2.4 Clips				
			<u>clips/attach brackets</u>	<u>material/finish</u>	<u>part no.</u>	<u>description</u>	<u>notes</u>
Y	Y			CRES/passivated	TA408x	L-bracket	Kirkhill part no., CAGE code 75345; web address: http://www.kirkhill-ta.com/pdf/4000C-2_Bracket_90_3_4.pdf ; other styles available at http://www.kirkhill-ta.com/aerospace/bracketry.stm
Y	N			CRES/passivated	CB5000CRA	stud, small base, adhesive bonded	Click Bond part no., CAGE code 66530; use CB359-50 epoxy
Y	N			CRES/passivated	CB3001CRA	standoff, locking thread, adhesive bonded	Click Bond part no., CAGE code 66530; use CB359-50 epoxy
Y	N			CRES/passivated	CB3000CRA	stud, adhesive bonded	Click Bond part no., CAGE code 66530; use CB359-50 epoxy
Y	Y			CRES/passivated	CB3019CRM	mount, cable tie	Click Bond part no., CAGE code 66530; use CB359-50 epoxy

7.1.3 Fluid Connectors						
Elements						
US FS USE						
		<u>unions</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	N	N	various	AA67000-	37 degree flared; Alan Aircraft part no., CAGE code 06581; ph # 818-765-4992	
7.1.4 Sealing Device						
Elements						
US FS USE 7.1.4.1 Seals						
		<u>seals</u>				
US FS USE 7.1.4.2 Gaskets						
		<u>gaskets</u>				
US FS USE 7.1.4.3 O-Rings						
		<u>o-rings</u>	<u>material</u>	<u>part no.</u>	<u>notes</u>	
Y	N	N	EPR	M83248/1-	doc. no. AMS-R-83248/1	
Y	N	N	Viton	V0747-75	Parker part no., CAGE code 02697	
US FS USE 7.1.4.4 Packings						
		<u>packings</u>	<u>material</u>	<u>part no.</u>	<u>notes</u>	
	Y		CRES, PASSIVATE PER QQ-P-35	NAS1523	PACKING WITH RETAINER	
7.1.5 Thermal Protection System						
Elements						
US FS USE 7.1.5.1 Insulation						
		<u>Type</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
	Y		EPDM	EPDM, Silica filled, uncured	STW4-3775	
	Y		EPDM	EPDM Rubber, Silica filled, uncured, calendared STK	STW4-2536	
	Y		EPDM	EPDM Rubber, Carbon Fiber Filled filled, uncured	STW4-2868	
	Y			Ablation Compound, cork filled	5752, STW5-3183	
	Y		NBR	NBR, Asbestos & Silicon Dioxide Filled	STW4-2621	

7.1.6 Valves						
Elements						
US FS USE 7.1.6.1						
	<u>Type</u>		<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
7.1.7 Filters						
Elements						
US FS USE 7.1.7.1						
	<u>Type</u>		<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
7.1.8 Locking/Securing Devices						
Elements						
US FS USE 7.1.8.1 Lockwire/Safety Wire						
	<u>lockwire</u>		<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	Y	N	various (recommend CRES or Inconel)	MS20995	doc. no. NASM20995, .032 dia. is easy for shop to work with, LOCK WIRE NEW SPEC # NASM20995	
	Y		Inconel, 700 DEG and above			
	Y		Monel, below 700 deg			
	Y		Copper, use for shear or sealing wire			
US FS USE 7.1.8.2 Safety Cables						
US FS USE 7.1.8.3 Retaining Rings						
US FS USE 7.1.8.4 Rivets						
	<u>countersunk head rivet</u>		<u>csk degree</u>	<u>solid/hollow</u>	<u>material/finish</u>	<u>part no.</u>
Y	Y		100 degree	solid	various aluminum/anodized or titanium columbium/bare	MS20426
Y	Y		100 degree	solid	A286/passivated	NAS1199
						90 KSI shear strength
	<u>universal head rivet</u>		<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	Y		A286/passivated	NAS1198	90 KSI shear strength	
Y	Y		various aluminum/anodized or titanium columbium/bare	MS20470	doc. no. is NASM20470	
	<u>blind rivet</u>		<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	Y		A286/passivated	NAS1921C	100 degree head, mechanically locked spindle	
US FS USE 7.1.8.5 Other (wires, ropes, cables)						
	<u>jumper cables</u>		<u>wire/terminal material</u>	<u>part no.</u>	<u>notes</u>	
Y	N		copper	M83413/8-A	doc. no. is MIL-DTL 83413/8; used for bonding; not fuel compatible	
Y	N		aluminum	M83413/8-C	doc. no. is MIL-DTL 83413/8; used for bonding; for use only within fuel tanks and cells	

7.1.9 Springs				-				
Elements				-				
US	FS	USE	7.1.9.1					
				-				
7.1.10 Protective Closures				-				
Elements				-				
US	FS	USE	7.1.10.1 Environmental Closures					
US	FS	USE	7.1.10.2 Blanking Plates					
US	FS	USE	7.1.10.3 Keys					
				-				
7.1.11 Other				-				
Elements				-				
US	FS	USE	7.1.11.1 Plugs					
US	FS	USE	7.1.11.2 Spacers					
				<u>spacers</u>	<u>material/finish</u>	<u>part no.</u>	<u>notes</u>	
Y	N			-	A286/passivated	NAS1057W	also available in Inconel	
US	FS	USE	7.1.11.3 Restrictors					
				-				

7.2 Fluids

7.2.1 Water						
Elements			-	-	-	-
US	FS	USE	7.2.1.1	-	-	-
			<u>Type</u>	<u>part no.</u>	<u>Material Finish</u>	<u>notes</u>
			-			
			-			
7.2.2 Lubricants						
Elements			-	-	-	-
US	FS	USE	7.2.2	-	-	-
			<u>Type</u>	<u>part no.</u>	<u>Material Finish</u>	<u>notes</u>
	Y		Lubricant	STW4-2955	SPRAY, DRY FILM, AIR DRYING	DOW CORNING 321
	Y		Grease	STW5-2942	CARTRIDGE ASSY, HD CALCIUM GREASE II	MFG CONOCO INC.
Y	Y		Grease	KRYTOX 240 AC	Cage Code-23077	END USER, USA, used on fitting threads, o-rings

7.2.3 Adhesives						
Elements			-	-	-	-
US	FS	USE	7.2.3	-	-	-
			Type	part no.	Material Finish	notes
	Y		-	6509, STW5-2970	ADHESIVE, METHYL-2-CYANOACRYLATE, QUICK SETTING	M-BOND 200 ADHESIVE AND CATYLIST
	Y		-	3165, STW5-3837	ADHESIVE, FILLED	
	Y		-	7566, STW4-2874	ADHESIVE, ELECTRICALLY CONDUCTIVE	ECCOBOND SOLDER 56C AND CATALIST 9
	Y		-	STW5-9349-001	ADHESIVE, DILUTED	
	Y		-	3034, STW4-3347	CEMENT, HEAT TRANSFER	T-85 HEAT TRANSFER CEMENT
	Y		-	6668, MIL-S-8802	SEALING COMPOUND	
	Y		-	STW3-9336	TAPE, PRESSURE SENSITIVE	
	Y		-	STW3-9338	COMPOUND, THREAD LOCKING	
	Y		-	3102, STW4-3611	TAPE, ADHESIVE TRANSFER	SCOTCH Y9460 AND Y9469
	Y		-	3031, STW5-3215	ADHESIVE, PRIMER, COLORLESS	
	Y		-	6783, STW5-2878	ADHESIVE, EPOXY RESIN WITH AMINE CURING AGENT	
	Y		-	5716, STW4-3218	EPOXY RESIN ADHESIVE, STRUCTURAL BONDING	
	Y		-	AMS-S-8802	SEALING COMPOUND, TEMP RESISTANT, HIGH ABRASION	
	Y		-	MIL-A-46106	ADHESIVE, SEALANT, SILICONE, RTV ONE COMPONENT	RTV 732
	Y		-	10753-0036-801	ADHESIVE, EPOXY, THIXOTROPIC	
	Y		-	7460, STW5-2664	ADHESIVE, PRIMER, RUBBER TO METAL	
	Y		-	7604, STW5-2712	BONDING AGENT, RUBBER TO METAL	
	Y		-	6192, STW5-2798	ADHESIVE, RUBBER TO METAL, ELEVATED TEMP CURING	
	Y		-	STW5-3248	ADHESIVE, RUBBER, PATTERNING CLOTH, TACKIFIER	
	Y		-	7784, STW5-2813	SEALANT, SILICONE	
	Y		-	STW5-9072	SEALANT, POLYSULFIDE	
Y			-	MIL-I-19166	Fiberglass Tape	.007" thick x .75" wide used for taping items to prevent abrasion
Y			-	Type 1, Class C per MIL-PRF-23377	Epoxy primer,	Used to coat exterior threads of inserts to prevent galvanic corrosion
Y			-	Stycast 2651-1	Epoxy adhesive, CAGE CODE 0B562	Used to pot sharp ends of lockwire
Y			-	EA934A	Epoxy, CAGE CODE 33564	
Y			-	RTV142	Sealant adhesive, CAGE CODE 00139	
Y			-	LOctite 242	Thread locker	CAGE code 05972

7.2.4 Paints/Inks						
Elements			-	-	-	-
US	FS	USE	7.2.4	-	-	-
			Type	part no.	Material Finish	notes
	Y		-	5691, STW5-3225	COATING, EPOXY-POLYAMIDE (WHITE)	RUST-OLEUM,CO 93-9518, WHITE
	Y		-	5690, STW5-3226	PRIMER, ZINC RICH, EPOXY POLYAMIDE	RUST-OLEUM,CO 93-3315, ZINC-SELE
	Y		-	3283, STW4-9084	PAINT, MOISTURE AND FUNGUS PROTECTION, (WHITE)	ACRYMAX SP130XT
	Y		-	6656, STW5-2914	PRIMER COATING, CORROSION RESISTANT, EPOXY RESIN	
	Y		-	6611, STW5-2922	ENAMEL PROTECTIVE COATING, EPOXY RESIN	443-3-1 WHITE, 443-3-17 BLACK, X-304 CATALYST
	Y		-	6968, MIL-C-5541	COATING, CHEMICAL, ALODINE 1201	
	Y		-	6274, STW5-2788	ENAMEL, MARKING, SILK SCREEN	
	Y		-	6457, STW5-2994	PAINT, POLYETHYLENE, CHLOROSULFONATED	
	Y		-	MIL-T-4053	PRIMER, EPOXY	
	Y		-	3213, STW4-3875	PRIMER	
	Y		-	3550, STW4-9237	PRIMER FOR METAL SURFACES	AEROGLAZE 9924
	Y		-	3137, STW4-3785	PRIMER, POLYURETHANE FOR NEOPRENE SURFACES	PR-1523-M
	Y		-	MIL-M-24041	MOLDING AND POTTING COMPOUND, CHEM CURE, POLYURETHANE, TYPE 1	
	Y		-	3553, STW4-9245	MOULDING COMPOUND, POLYURETHANE, ELEVATED TEMP CURING	PR-1592 PRC, DESOTO
	Y		-	3358, STW4-9231	PRIMER, POLYURETHANE FOR METAL SURFACES, FLIGHT CONNECTORS	
Y			Ink	M-O-N/CAT 20A	Black Ink CAGE CODE - 12405	Used for rubber stamping per MIL-STD-130
Y			Ink	A-A-56032, Type 1	White Ink	Used for filling in engraved characters
7.2.5 Solvents						
Elements			-	-	-	-
US	FS	USE	7.2.5	-	-	-
			Type	part no.	Material Finish	notes

7.3 Electrical

7.3.1 Avionics Common Components						
Elements						
US	FS	USE	7.3.1.1 Data Acquisition Unit (DAU)	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
7.2.2 Lubricants	FS	USE	7.3.1.2 Data Bus	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.3 Command Decoder/Receiver	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.4 Antenna	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.5 Battery Unit	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.6 Lightning Stub	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.7 Transponder	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.8 RF Power Divider	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.9 RF Controller	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			
US	FS	USE	7.3.1.10 Master Data Unit	-	-	-
			<u>Type</u>	<u>part no.</u>		<u>notes</u>
			-			

7.3.2 Piece Parts

Elements

US FS USE 7.3.2.1 Connectors

			Type	part no.		material/finish	notes
	Y		SHIM STOCK	MIL-S-22499	Laminated	COMPOSITION 1; ALUMINUM, 1100-H19 COMPOSITION2; CRES, TYPE 302/304 COMPOSITION3; POLYIMIDE FILM IN H CONDITION PER MIL-P-46112	
	Y		TAPE, ELECT	STW3-9336		INSULATED, HIGH TEMP	REF MIL-I-23594
	Y		HEAT SHRINK	MIL-DTL-23053/1	Sleeve	CROSSLINKED CHLORINATED POLYOLEFIN	REF STW3-9332
	Y		CONNECTOR	MSFC 40M39569	Receptacle	HERMETIC, SOLDER MOUNT, BAYONET COUPLING	REF P/N NB7EXX-XXX
	Y		BACKSHELL, RFI	MSFC 40M39569			REF P/N NB-RFI-XX-X, REF
	Y		SEALING PLUG	MSFC 40M39569			REF P/N NB-GSP-XX
	Y		CONNECTOR	MS3474		RCPT, ELECT, SERIES 2, CRIMP TYPE, REAR JAMB NUT, BAY CPLG	
	Y		CONNECTOR	MS3471		RCPT, ELECT, SERIES 2, CRIMP TYPE, REAR JAMB NUT, BAY CPLG	
	Y		Cover Protective	MS3181		ELECT CONN RCPT, BAY CPLG FOR MIL-C-26482 CONN	
	Y		Cable Elect	MIL-C-27500			
	Y		Insulation Electrical	MIL-I-631			
	Y		CORD	MIL-Y-1140		YARD, SLEEVING, CLOTH AND TAPE-GLASS, CLC, UNTREATED	
	Y		Rubber, Synthetic, tubing	MIL-R-6855			
	Y		WIRE, COPPER, TINNED, 36 AWG	ASTM B33			
	Y		TAPE, LACING AND TYING	MIL-T-43435		WAX IMPREGNATED, NATURAL COLOR,	USED FOR TYING WIRE INTO BUNDLES
	Y		PLASTIC SHEET	MIL-P-46112		POLYIMIDE, HEAT SEALABLE, TWO SIDES COATED	
	Y		SOLDER	QQ-S-571			
	Y		MARKER, CABLE	EUT/361-CM		WRAP AROUND	
	Y		BRAIDED STRAP	QQ-B-575		COPPER BRAID TIN COATED WITH PVF2 POLYVINYLIDENE FLOURIDE	

US	FS	USE	7.3.2.2 Cabling	-	-	-	
			Type	part no.		material/finish	notes
	Y		clamp	NAS 1715			
	Y		torque seal	6472, STW5-2984			
	Y		TORQUE SEAL	6472, STW5-2984		LAQUER	
	Y		TAPE, PRESSURE SENSITIVE	6756			
	Y		SEALING, LOCKING COMPOUND	ASTM D5363			LOCTITE 242, 262, AND 277
	Y		THREAD COMPOUND, ANTISEIZE	MIL-T-83483		MOLYBDENUM DISULFIDE-PETROLATUM	
	Y		SLEEVE, HEAT SHRINK	AMS-DTL-23053/5		INSULATION SLEEVING, ELECTRICAL, HEAT SHRINKABLE, POLYOLEFIN, FLEXIBLE, CROSSLINKED	
	Y			SAE			
	Y		SOLDER, WIRE	J-STD-006		FLUX CORED	
	Y		TAPE	P-100		HIGH TEMP, ALUMINIZED, GLASS CLOTH	USA SPEC 99605-0018
	Y		CLAMP, LOOP	NAS 1715		CUSHIONED, 2024 ALU ALLOY, CRES 302, 304, 321AS	
	Y		FILM, FEP	ASTM D3368		FEP-FLUOROCARBON RESIN, WITHOUT FILLER OR PLASTICIZER	
	Y		STRAP, TIE DOWN	SAE-AS33671		NYLON PER ASTM D 4066	USED FOR ELECTRICAL COMPONENTS
	Y		TAPE	MIL-I-23594		INSULATION, ELECT, PTFE, HIGH TEMP, SMOOTH BACKING	
	Y		THERMOCOUPLE ASSY	1U51945		TC BUILD REQUIRES TT-J-24 CABLE AND QQ-S-571 SOLDER	
	Y		WIRE, BRAID, TUBULAR	A-A-59569		36 AWG, TIN COATED	
	Y		SENSOR, TEMP	MSFC 16A03054		KAPTON OR TEFLON INSULATED, NICKEL COATED COPPER	SILVER PLATED WIRE SHALL NOT BE USED
	Y		NICKEL BAR	MIL-N-46025		FLAT WIRE AND STRIP, RIBBON,	
	Y		WIRE FABRIC	RR-W-360		SQUARE MESH, PLAIN WEAVE TYPE 1	
	Y		NICKEL-CHROMIUM-IRON ALLOY	ASTM B168		.002 THICK, MATERIAL USED FOR TEMP SENSOR FABRICATION	

US FS USE	7.3.2.3 Batteries				
	<u>Type</u>	<u>part no.</u>			<u>notes</u>
US FS USE	7.3.2.4 Electrical Wiring Components				
	<u>Type</u>	<u>part no.</u>			<u>notes</u>
US FS USE	7.3.2.5 Cameras				
	<u>Type</u>	<u>part no.</u>			<u>notes</u>
7.3.3 Instrumentation					
Elements					
US FS USE	7.3.3.1 Sensors				
	<u>Type</u>	<u>part no.</u>			<u>notes</u>

Appendix A: Subject Matter Experts

Function	Name	Number	Email Address	Organization
Propulsion				
Avionics	Eric Corder	256-544-3473	ERIC.CORDER@NASA.GOV	EI21
Materials				
Structures	Jon Colbert	256-544-3362	JON.COLBERT@ATK.COM	ATK THIOKOL
US Structures				

Appendix B: Common Systems/subassemblies

Avionics Common Components		ELEMENTS		PROJECTS		Comments	
		FS	US	USE	CaLV	EDS	
Command & Data Handling System		7.3.1.1 Data Acquisition Unit (DAU)					
CDIU -TVC	FS		X	X	X		
			X	X	X		
7.2.2 Lubricants		7.3.1.2 Data Bus					
	Recovery Control Unit, TVC Actuator Controller)						
	Control Electronics		X	X	X		
		RS42		X	X		
		GS -1394	X				
	Microprocessors	Power	X	X	X		
	Hybrid Coupler		X				
	Directional Coupler		X				notes
	Battery Unit		X				X
	Coaxial Cable		X				X
C Band Tracking			X				notes
	Transponder		X				notes
	Interconnecting Cables		X	X			?
	Coaxial Cable		X	X			?
Guidance Navigation & Control							notes
	Rate Gyro Assembly		?	X			X
	Attitude Sensor Assembly		X				X
Electrical Power System							
	Battery Unit		X	X			X
	Power Distribution Unit		X	X			X
	Primary Power Cabling			X	X		?
	Primary Cable Harness			X	?		?
Development or Operational Flight Instrumentation							
		7.3.1.9 RF Controller					
	Data Acquisition Unit		X	?	?		X
	Data Recording Unit		X	?			X
	Temperature Sensor		?	X	X		X
	Fluid/Liquid Level Sensor		?	X			X
	Position/Displacement Sensor		?	X	X		X
7.3.2 Piece Parts			?	X			X
	Standard Camera			X			X
	Cables			X			X
	Camera Controller		?	X			X
	Camera Lense		?	X			X
Pyro Control Systems		SHIM STOCK					
	Pyrotechnic Initiation Circuit		X	X			X