LESSONS LEARNED AND TECHNICAL STANDARDS: A LOGICAL MARRIAGE FOR FUTURE SPACE SYSTEMS DESIGN

Paul S. Gill and Danny Garcia NASA Technical Standards Program Office National Aeronautics and Space Administration Huntsville, Alabama paul.gill@msfc.nasa.gov, danny.garcia@msfc.nasa.gov

> William W. Vaughan University of Alabama in Huntsville Huntsville, Alabama <u>Vaughan@nsstc.uah.edu</u>

<u>ABSTRACT</u>

A comprehensive database of engineering lessons learned that corresponds with relevant technical standards will be a valuable asset to those engaged in studies on future space vehicle developments, especially for structures, materials, propulsion, control, operations and associated elements. In addition, this will enable the capturing of technology developments applicable to the design, development, and operation of future space vehicles as planned in the Space Launch Initiative. Using the timehonored tradition of passing on lessons learned while utilizing the newest information technology, NASA has launched an intensive effort to link lessons learned acquired through various Internet databases with applicable technical standards. This paper will discuss the importance of lessons

Copyright © 2002 by the International Astronautical Federation or the International Academy of Astronautics. No copyright is asserted in the Unites States under Title 17, U.S. Code. The U.S. Government has a royality-free license to exercise all rights under the copyright claimed herein for Governmental purposes. All other rights are reserved by the copyright owner. learned, the difficulty in finding relevant lessons learned while engaged in a space vehicle development, and the new NASA effort to relate them to technical standards that can help alleviate this difficulty.

INTRODUCTION

NASA, DOD, and organizations in the domestic and international aerospace industry are either planning or are currently engaged in actions relative to the development of new or improved manned and un-manned space vehicles (launch vehicles, space craft, and satellites). For example, NASA is currently involved in a Second Generation Recoverable Launch Vehicle Development Program. All of these developments will benefit from the lessons learned on previous space vehicle designs, developments, and operations. The key to the success of the new or improved space vehicles will depend on the applicable lessons learned that are identified and applied. All of the new or improved space vehicle developments have one thing in common---the application of technical standards developed by NASA, DOD,

ESA, NASDA, or space agencies of other governments in addition to the technical standards produced by other Standards Developing Organizations such as ASTM, SAE, ASME, IEEE, JSA, IEC, ISO, etc., plus those prepared internally by companies within the aerospace industry. The active identification and application of lessons learned is a principal component of an organizational culture committed to continuous improvement.

The NASA Technical Standards Program (<u>http://standards.nasa.gov</u>) was formally established in 1997 as an Agency wide effort by direction of the Administrator. It has the following principal elements:

- ** Increase NASA Use of Voluntary Consensus (non-Government) Technical Standards.
- ** Selective Development of NASA-Unique Technical Standards.
- ** Develop and Promote the Use of an Integrated Technical Standards System (Full-text Standards Access, Standards Update Notification, and Lessons Learned—Standards Integration)
- ** Exploit the Potential of Web-based Standardization Information

The Program's Website is a key mechanism for the accomplishment of these efforts. Figure 1 is the Homepage for the Program's Website. Its content provides users, both within the nasa.gov Domain and otherwise, with information on technical standards and related material

LESSON LEARNED PROBLEM

Lessons learned are a powerful method of sharing ideas for improving work processes, facility or component design and operation, quality, safety, and cost effectiveness. Properly implemented lessons learned should improve management decision-making during every phase of project activity.

Information on lessons learned may be found in a number of different locations, including organizational technical reports, professional engineering journals, and databases specifically focused on lessons learned. Locating a lessons learned applicable to one's specific interest has not been a very "user friendly" experience. Thus, the motivation for developing a "marriage" with technical standards.

With the "explosion" in technical accomplishments during the past century, especially during the last few decades, the ability to rapidly communicate lessons learned, and the knowledge gained there from, has become critical. This is very true for activities associated with producing more advanced products within the "faster, better, cheaper" philosophy. The dependence upon "word-of-mouth" and textbooks to communicate lessons learned, while still important, is no longer adequate or realistic. Expecting engineers and scientists to search through the ever-increasing number and contents of lessons learned databases has proven to be less than productive. It is difficult and time consuming for most engineers to search for and use such lessons learned databases. However, there is a potential solution to this problem.

POTENTIAL SOLUTION

All Programs/Projects are based on the application of technical standards, whether produced by government organizations, or by non-government standards developing organizations. The development of these technical standards have gone through an extensive review process. Given this database of technical standards, along with the existence of a screened lessons learned database, a productive "marriage" is now readily possible.

Over 130 national and international aerospace related lessons learned databases, can readily be located by addressing the NASA Technical Standards Program Web-site at <u>http://standards.nasa.gov</u> and then click the NASA ACCESS or PUBLIC ACCESS sites on the menu page. Once registered, then click on the Lessons Learned/Best Practices—Technical Standards site for direct access to the listing of lessons learned databases related to aerospace engineering.

Some examples of lessons learned databases on the NASA Technical Standards Program Web-site are:

- NASA/Headquarters—Lessons Learned Information System
- NASA/Glenn Research Center Frequently Asked Questions On Failures
- NASA/Kennedy Space Center -Cryogenic Transfer System Mechanical Design
- NASA/Goddard Space Flight Center – Systems Engineering Office Lessons Learned
- AIAA/Satellite Mission Operations Best Practices

NASA/Langley Research Center
 Lessons for Software Systems

On the surface this "marriage" appears to be an easily achieved action. However, such is not the case. It requires the talents of dedicated and experienced engineers who must also possess the gifts of persistence and meticulous attention to detail. The material involved must be read and interpreted and then correlated. The lessons learned database must then be integrated with the technical standards database. Both databases continue to grow at a prolific rate.

A NASA "pilot" effort to test this approach has been successful. Consideration is being given to expand the effort beyond the NASA Preferred Technical Standards database. To the degree practical, this should be done in collaboration with the Standards Developing Organizations.

The result will be an invaluable database whereby technical standards required for a Program/Project design, development, or operations process will also have identified with them any applicable lesson(s) learned. This "marriage" will without doubt significantly enhance the accomplishment of "better, faster, cheaper" products. Also, technical standards identified with associated lessons learned may be candidates for revision or updating or the development of a new technical standard.

EXAMPLES OF INITIAL RESULTS

To illustrate the results of the pilot effort regarding the integration of information on lessons learned with technical standards, two examples are presented as the products appears within the NASA Technical Standards Program Web-site. These two examples are taken from the Agencywide Full-Text Technical Standards System within the NASA ACCESS site on the menu page. Due to licensing agreements on the access to Non-government Technical Standards Products, the NASA ACCESS site is only available to those within the <nasa.gov> Domain.

Figure 2 provides an illustration of the Standards Document Summary Page for MIL-STD-1686 C, a NASA Preferred Technical Standard. The information provided for a user on this NASA Preferred Technical Standard includes two lessons learned links, plus a brief description of each, that are available on the NASA Lessons Learned Information System (LLIS) Database. The nasa.gov Domain user of this standard can then easily locate the two listed lessons learned through hyperlinks and decide whether the contents might be applicable to their use of this MIL-STD. The fulltext content of this MIL-STD is readily available from both the NASA ACCESS and PUBLIC ACCESS sites.

Figure 3 provides a similar illustration of the Standards Document Summary Page for ASTM-B117. This ASTM Technical Standard is one that has been adopted (endorsed) by the Agency as a NASA Preferred Technical Standard. It is so identified on both the NASA ACCESS and PUBLIC ACCESS sites. However, its full-text content is readily available only from the NASA ACCESS site due to licensing restrictions noted above. Figure 3 has the same format as Figure 2. There is one lessons learned entry noted from the NASA LLIS Database.

VALUE OF MARRIAGE

Both Government and Industry conscientiously investigate, document, and track all of their successes and failures. Yet, much of that effort is meaningless if an Industry or Government Agency fails to incorporate these experiences into ongoing and future Programs/Projects and their operations. They need a viable mechanism to identify and incorporate lessons learned into their design, development, and operations efforts, thus reducing mission risk. The cost of achieving the "marriage" of lessons learned and technical standards will be modest compared to the significant results that will be achieved

Links should be established as soon as practical between lessons learned and, where possible, the technical standard to which they relate. This can be accomplished by a government organization such as NASA and DOD, Industry Groups, and Standards Developing Organizations. The results can then be made available and shared with all interested parties. Given the scope of many non-government technical standards, they would be an excellent database to use and benefit from this "marriage". Users of the technical standards would then have immediate links/access to lessons learned and other relevant information as they select and apply technical standards in the normal design, development, and operations process.

The longer-term goal should be to update technical standards, where appropriate, to reflect lessons learned. Normal practice in the standards community is for technical standards to be reviewed and, where necessary, updated at least once in five years. Links to related lessons learned would provide a basis for additions and updates of technical standards, thus facilitating the "marriage" process. For government and non-government developed technical standards, the addition of lessons learned can be made directly whenever prudent. To accomplish this goal, and thus reduce mission risk, it is recommended that initiatives by those developing and using technical standards products be established to integrate lessons learned with technical standards

SUMMARY

There are no guarantees that future mishaps like the recent two NASA/JPL Mar's Missions will not occur. However, the existence of an Integrated Lessons Learned and Technical Standards System will certainly contribute toward minimizing such risks. Only one Project saved, or whose performance is enhanced, will repay the cost of developing an Integrated Lessons Learned and Technical Standards System many fold. Without this "marriage" the lessons learned databases, and other similar databases, will continue to find limited and very focused utility relative to the development and operation of future industry and government aerospace Programs/Projects.

<u>Credits</u>: This paper is based on the contents of a paper entitled "Lessons Learned and Technical Standards: A Logical Marriage" produced by the authors and published in the November 2001 issue of ASTM Standardization News.

<u>Presentation:</u> Prepared July 17, 2002 for presentation at 53rd International Astronautical Congress, Session U.3. Systems Engineering, Tools and Processes. Houston, Texas, October 17, 2002.



Figure 1. NASA Technical Standards Program Homepage

	Summa	ii y page			
MIL STD 1686	Revision: C		Status: Active	NASA Status: Preferred	
DISS INfo E: ELECTROSTAT	No. of NASA Accesses since Ub/2001 4 TO DISCHARGE CONTROL PROGRAM FOR PROTECTION C	FELECTRICAL	AND ELECTRONIC	PARTS. ASSEMBLIES AND E	OUIPMENT
LUDING ELECTRI	CALLY INITIATED EXPLOSIVE DEVICES) (SUPERSEDING N	<u>AIL STD 1686B</u>)	19 03065	View Der View 100	
ase	Date: 10/25/1995		15 pages	Trice pac Telline Loc	
se - 10/25/1995	Docume	nt Scope	919 - 940 - 14 - 14 - 16 - 16 - 16 - 16 - 16 - 16		
purpose of this star	ndard is to establish comprehensive requirements for an ESD c	ontrol program t	o minimize the effect	s of ESD on parts, assemblies, a	and equipment
tenance actions ar	nd lifetime costs. This standard shall be tailored for various type	es of acquisition	s.		
in section of the sec	Applicat	ian Notes			362/w. 100
vision Project I	D Center Date		Net State	Less ESD sectors (in a	vamela coo
•	JPL 4/26/2001 Requires that each facility have MSFC-RQMT-2918).	e a document th	at describes now the	ly implement ESD controls (for e	xample, see
	l essons L carned	and Best Pract	lices		
LL/BP No.	This	Date	a de la compañía	Relevance to the Standard	
<u>;5</u>	Electrostatic Discharge (ESD) Control in GSE	2/1/1999	The Lesson pr control of ESD	ovides technical recommen in aerospace equipment.	dations for I
22	Electrostatic Discharge (ESD) Control in Flight Hardware	2/1/1999	The Lesson ac	dresses the generation of t	riboelectric
22			and electrostatic charges as a common cause of damage and/ordegradation to unprotected Electrostat		
			Discharge Ser	isitive (ESDS) devices A c	arefully
			provide protec	tion from this damage and/	ogramean or
		<u></u>	degradation	<u></u>	
	Docume	nt History			A State
L-STD-1686A A	PARTS, ASSEMBLIES AND FOUIPMENT (EXCL MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 06/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO	GRAM FOR PR			Superse
L-STD-1686A A Figure 2. N R • Ea Yow Bo	PARTS, ASSEMBLIES AND EQUIPMENT (EXC) MILSTD-1686C) (SUPERSEDING MILSTD-1686 00/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MILSTD-1686C) MIL-STD-1686C Standards Doct	LUDING ELECTI (A) GRAM FOR PR LUDING ELECTI UMENT S	OTECTION OF ELE-	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC AGC	c) Supersi
L-STD-1686A A Figure 2. N R E Ed Yew So	Parts, assemblies and Edulment (RCI MiLSTD-1686C) (SUPERSEDING MILSTD-1686 08/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (RCC (S/S BY MILSTD-1686C) MIL-STD-1686C Standards Doct Commicate Heb Ageneys ide Full Jest Technical Standards System Support	UDING ELECTI (A) GRAM FOR PR UDING ELECT UMENT S	OTECTION OF ELE-	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC AGC	C) Superse
L-STD-1686A A Figure 2. N E E Yow Go	PARTS, ASSEMBLIES AND EQUIPMENT (FXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 08/08/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (FXC) (S/S BY MIL-STD-1686C) MIL-STD-1686C Standards Doct Comminicator Heb Agency wide Full-Jest Technical Standards System Revision 1997	UDING ELECTI (A) GRAM FOR PR LUDING ELECTI UMENT S INTERNATIONAL INTERNATIO	OTECTION OF ELE RICALLY INITIATED UMMARY P:	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC Age	C) Superse
L-STD-1686A A Figure 2. N For Eat Yew Go ASSMENT Declissants Declissants	PARTS, ASSEMBLIES AND FOUPMENT (FXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 D8/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND FOUPMENT (FXC) (S/S BY MIL-STD-1686C) MILL-STD-1686C Standards Doct Commission Heb Ageneywide Full-fest Technical Standards System Summer Revision: 1997 No. of NASA Accesses pince 09/2001 0 TSPRAY (FOG) APPARATUS (SUPERSEDING ASTMENT7:1925)	UDING ELECTI (A) GRAM FOR PR UDING ELECTI UMENT S 131Y page	OTECTION OF ELE RICALLY INITIATED UMMARY PA Status Addive Sed Astm	Inasa Statu: Preferred	C) Superse
LISTO 1686A A Figure 2. N R De Ed Yow Go ASTMENT Declissions The operating Sal Base	PARTS, ASSEMBLIES AND EQUIPMENT (EXC) MIL-STD-1686() (SUPERSEDING MIL-STD-1686 D8/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC (S/S BY MIL-STD-1686C) MILL-STD-1686C Standards Doct Communicator Heb Agency wide Full Jest Technical Standards System Revelor: 1997 Ne. of NASA Accesses since 09/2001: 0 T SPRAY (FOG) APPARATUS (SUPERSEDING ASTMEDIT: 1995) Date: 04/10/1997	UDING ELECTI (A) GRAM FOR PR UDING ELECTI UMENT S (A) (A) (A) (A) (A) (A) (A) (A)	OTECTION OF ELE RICALLY INITIATED UMMARY P Status Adive SDO ASTM	INASA Status: Prefamed Vear Readfurmed View Doc	Supersi
L-STD-1686A A Figure 2. N Figure 2. N Figu	PARTS, ASSEMBLIES AND EQUIPMENT (EXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1666 06/06/1968 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MIL-STD-1686C Standards Doct Commicator Heb Revision: 1907 Ne. of NASA Accesses since 00/2001: 0 TSPRAY (FOG) APPARATUS (SUPERSEDING ASTMEDITY: 1935) Date 04/10/1007	UDING ELECTI (A) GRAM FOR PR UDING ELECTI UMENT S 13117 page	OTECTION OF ELE RICALLY INITIATED UMMARY P: Status Adive SDD ASTM 0 pages	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC AGC NASA Status: Professed Vear Readinged	Superse
L-STD-1686A A Figure 2. N R Fe Ed Yew Go Edifs Har Ecclissing The Operating Sal Base - 04/10/19 1 Scone	PARTS, ASSEMBLIES AND EQUIPMENT (EXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 08/08/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MIL-STD-1686C Standards Doct Commicator Heb Ageneys idle Full-Jost Technical Standards System Revision: 1907 Ne of NASA Accesses since 00/2001: 0 TSPRAY (FOG) APPARATUS (SUPERSEDING ASTMEDIT7-1995) Date 04/10/1907	UDING ELECTI (A) GRAM FOR PR UDING ELECTI UMENT S HATY PADE	OTECTION OF ELE RICALLY INITIATED UMMARY P: Status Adive SDD ASTM	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC Age NASA Status: Prefamed Vear Readinged (View Doc	Superse NASA
L-STD-1686A A Figure 2. N R Fe Ed Yew Go Edissints The: OPERATING SAL Base (Base - 04/10/15 1. Scope	PARTS, ASSEMBLIES AND EQUIPMENT (EXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 D8/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686C Standards Doct Commicator Heb Ageneywide Full-fest Technical Standards System Revision: 1997 Revision: 1997 Revision: 1997 Date: 04/10/1997 Commicator Superseding AsTMEN17:19951 Date: 04/10/1997	UDING ELECTI (A) GRAM FOR PR UDING ELECTI UMMENT S HATY PARC () () () () () () () () () ()	OTECTION OF ELE RICALLY INITIATED UMMARY P: Status Active SDD ASTM 9 pages	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC AGC NASA Status: Prefamed Vear Reathinged View Doc	Superse
L-STD-1686A A Figure 2. N R Fe Edi Vew Go ASIMENT Declissanta Declissanta Declissanta Base Base - 04/10/15 1. Scope 1.1 This practice describ	12/3/1/992 ELECTROSTATIC DISCIPLES AND EQUIPMENT (EXC) MIL-STD-1686() (SUPERSEDING MIL-STD-1686 D8/08/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Docu Communicator Heb Apromotive Problement (Supersention of the second state of the second st	LUDING ELECTI IA) GRAM FOR PR LUDING ELECTI LUMENT S HATY PADE 4 Jail Spray (Dog) Last for product, nor the L	OTECTIÓN OF ELE: RICALLY INITIATED UMMARY PA Status Active Soo. ASTM 8 pages environment. Suitable ap nterpietation to be given 1	EXPLUSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC Age NASA Status: Pretanted Vear Realflimed Vear Realflimed paralus which may be used is described in o the results	Superse NASA
L-STD-1686A A Figure 2. N For Eath Yew Ge Control Yew Ge C	12/3/1/92 ELECTROSTATIC DISCIPLES AND EQUIPMENT (EXC) MIL-STD-1886() (SUPERSEDING MIL-STD-1686 08/08/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Commerceder Heb Agency wide Full Jost Revelor: 1997 Ne. of NASA Accesses since 09/2001: 0 T SPRAY (FOG) APPARATUS (SUPERSEDING ASTMEDIT7: 1995) Dete: 04/10/1097 10 297] 297] 2985 the apparatus, procedure, and conditions required to reate and maintain th vot prescribe the type of tast specimen or exposure periods to be used for a speci	LUDING ELECTI A) GRAM FOR PR LUDING ELECTI LUMENT S A) A) A) A) A) A) A) A) A) A)	NICALLY INITIATED OTECTION OF ELE RICALLY INITIATED UMMARY P: Status Adive SDD ASTM 9 pages environment Suitable ap nterpretation to be given t	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC AGC NASA Status: Preferred Year Realthmed Vear Realthmed View Doc	Superse Appendix X1.
L-STD-1686A A Figure 2. N Figure 2. N Fig	12/3/1/992 ELECTROSTATIC DISCIPLES AND EQUIPMENT (EXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 00/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Communicator Heb Ageopcy side Full (Dost Technical Standards System) Revision: 1997 Ne. of NASA Accesses since 00/2001: 0 T SPRAY (FOG) APPAATUS (SUPERSEDING ASTMEDITY: 1995) Dete 04/10/1097 997] Net the apparatus procedure, and conditions required to create and maintain th not prescribe the type of test speciment or exporting partiads to be used for a specim 15 Units are to be regarded as standard. The inch-pound units in id for information and my be approximate	UDING ELECTI (A) GRAM FOR PR UDING ELECTI UMENT S (A) (A) (A) (A) (A) (A) (A) (A)	Interpretation to be given to organize of this standard	EXPLUSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC RESULTS (METRIC RESULTS) (MASA Status: Proteined (View Doc paralus which may be used is described in to the results To establish	Superse NASA
L-STD-1686A A Sigure 2. N R Fe Edt Yew Go ASTA BUT PACING AND PACING AND ASTA BUT PACING AND ASTA BUT PACING AND ASTA BUT Base I.S COPE 1.1 This practice describ 1.2 This practice describ 1.3 This values rated in appropriate safety and h	12/3/1/992 PEECINOS IND BOURMENT (RCC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 DB00/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (RCC) (S/S BY MIL-STD-1686C) MIL-STD-1686CC Standards Doc1 Communicator Heb PARTS, ASSEMBLIES AND EQUIPMENT (RCC) (S/S BY MIL-STD-1686C) MIL-STD-1686CC Standards Doc1 Communicator Heb PARTS, ASSEMBLIES AND EQUIPMENT (RCC) (S/S BY MIL-STD-1686C) MIL-STD-1686CC Standards Doc1 Communicator Heb PARTS, ASSEMBLIES AND EQUIPMENT (RCC) (S/S BY MIL-STD-1686C) MIL-STD-1686CC Standards Doc1 Communicator Heb PARTS, ASSEMBLIES AND EQUIPMENT (RCC) SUBMILSTD-1686C) MIL-STD-1686CC Standards Doc1 Communicator Heb Summ Revision: 1907 No of NASA Accesses since 00/2001: 0 TSPRAY[FOG]APPARATUS (SUPERSEDING ASTMEDITY: 1995] Date: 04/10/1907 Set the apparatus, procedure, and conditions required to create and maintain th Not prescribe the type of test epociment or exporuse periods to be used for a speci s1 ond; are to be regarded as standard. The inch-pound units in if for information and may be approximate not purpod to address all of the safety concerns, if any, associated with its use. It health practices and determine the applicability of regulatory limitations prior to	LUDING ELECTI (A) GRAM FOR PR LUDING ELECTI LUDING ELECTI LUD	NICALLY INITIATED OTECTION OF ELE RICALLY INITIATED ummary P: Status Active SDD ASTM 8 pages environment. Suitable ap neuroretation to be given to of the user of this standard	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC Age NASA Status: Prefarind Vear Reathinned Vear Reathinned	Superse
L-STD-1686A A Figure 2. N For Edi Vew Go ASTA FEIT ECCISSING CASTA FEIT ECCISSING ECCISSING CASTA FEIT ECCISSING ECCISSING CASTA FEIT ECCISSING ECCISSING CASTA FEIT ECCISSING ECCISSI	12/3/1/1992 ELECTROSTATIC DISCIPANENT (EXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1666 D8/D8/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Communicator Heb Agreency wide Full Jest Technical Standards System Revision: 1997 Ne. of NASA Accesses since 09/2001: 0 T SPRAY (FOG) APPARATUS (SUPERSEDING ASTMEDIT7: 1995) Date: 04/10/1997 Set the apparatus, procedule, and conditions required to create and maintain th not prescribe the type of test specimen or exposure periods to be used for a speci 1 S1 onds are to be regarded as standard. The inch-pound units in difformation and may be approximate not purport to address all of the safety concerns, if any, associated with its use. It regulations and determine the applicability of regulatory limitations prior to	LUDING ELECTI (A) GRAM FOR PR LUDING ELECTI UMENT S HATY PADE • Fail Spray (Pag) Left for product, nor the (is the responsibility use.	Status Active Status Active SD ASTM B paget environment. Suitable ap naterpretation to be given to of the user of this standard	EXPLUSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC AGC NASA Status: Prefared Vear Readiumed View Doc paralus which may be used is described in to endolish	Superse NASA
L-STD-1686A A Figure 2. N R Fe Edt Yew Go Control Yew Go	12/3/1/392 PLECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (FXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1666 DB/DB/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (FXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Communicator Heb Agromy vide Pull-Jest Technical Standards System Revision: 1997 No. of NASA Accesses since 09/2001: 0 T BPRAY (FOG) APPARATUS (SUPERSEDING ASTMEDIT: 1995) Det: 04/10/1097 Det: 04/1	LUDING ELECTI A) GRAM FOR PR LUDING ELECTI LUDING ELECTI LUDI	NICALLY INITIATED OTECTION OF ELE RICALLY INITIATED UMMARY PA Status Active SDD ASTM 8 pages environment. Suitable ap Interpretation to be given to of the user of this standard	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC A ge NASA Status: Pretained Vear Realflimed Vear Realflimed Vear Realflimed paralus which may be used is described in to the results to establish	Superse NASA
L-STD-1686A A Figure 2. N R Fe Edt Yew Go Control of the second second Control of the second second Control of the second second 12 This practice describ 1.3 The values stated in parentheses are provide 1.4 This standard does a appropriate safety and b	12/3/1/92 ELECTROSTATIC DISCRARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC MIL-STD-1686C) (SUPERSEDING MIL-STD-1666 08/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Commercedor Heb Agency wide Pull Jost Technical Standards System Revision: 1997 Ne. of NASA Accesses since 09/2001: 0 T SPRAY (FOG) APPARATUS (SUPERSEDING ASTM B117: 1995) Det. DA4004097 997] bes the apparatus, procedure, and conditions required to create and maintain th vot prescribe the type of tast speciminate not purport to address all of the safety concerns, if any, associated with its use. It vealth practices and determine the applicability of regulatory limitations prior to	LUDING ELECTI A) GRAM FOR PR LUDING ELECTI UMENT S A) A) A) A) A) A) A) A) A) A)	NICALLY INITIATED OTECTION OF ELE RICALLY INITIATED UMMARY PA Status Active SDD ASTM 0 pages environment. Suitable ap Interpretation to be given t of the user of this standard	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC Age NASA Status: Preferred Vear Reathined Vear Reathined Vear Reathined (View Doc paratus which may be used is described in o the results to establish	C) Superse
L-STD-1686A A Figure 2. N R Fe Edt Yew Ge Control of the second Control of the second	12/3/1/92/2 ELECTROSTATIC DISCHARGE CONTINUENT (EXC) MIL-STD-1686() (SUPERSEDING MIL-STD-1686 08/08/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doci Communicator Help Agency wide Full Jost Technical Standards System Revision: 1997 Ne. of NASA Accesses since 08/2001: 0 T SPRAY (FOG) APARATUS (SUPERSEDING ASTMEDITY: 1993) Date: 04/10/1097 Port Index Standards The Inch-pound units in of prescribe the type of test speciment or exposure periods to be used for a specim state practices all of the safety concerns, if any, associated with its use. It is practices and determine the applicability of regulatory limitations prior to	a contract the responsibility	OTECTION OF ELE RICALLY INITIATED UMMARY P: Status Adive SDD ASTM 8 pages environment. Suitable ap nterpietation to be given t of the user of this standard	EXPLOSIVE DEVICES) (SIS BY CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC REPLOSIVE DEVICES) (METRIC RESPLOSIVE DEVICES) (METRIC REPLOSIVE DEVICES) (METRIC REPLOSIVE DEVICES) (METRIC REPLOSIVE DEVICES) (METRIC REPLOSIVE DEVICES) (SIS BY REPLOSIVE DEVICES) (SIS	Superse
L-STD-1686A A Sigure 2. N R For Edit Yow Go ASTATEST Pactific Edit Yow Go ASTATEST Pact	12/3/1/92/2 ELECTROSTATIC DISCHARGE CONTINUENT (EXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 00/06/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Communicator Help Ageophysical Standards System Fechnical Standards System Revision: 1907 Ne. of NASA Accesses since 00/2001: 0 T SPRAY (FOG) APPARATUS (SUPERSEDING ASTALENT7. 1925) Date 04/10/1007 997] bes the apparatus, procedule, and conditions required to create and maintain th not prescribe the type of test specimen or exposure periods to be used for a speci s 10 only be applicability of regulatory limitations provide statin practices and determine the applicability of regulatory limitations provide Contact Contact State Contact C	LUDING ELECTI (A) GRAM FOR PR LUDING ELECTI UMENT S A A A A A A A A A A A A A	NICALLY INITIATED OTECTION OF ELE RICALLY INITIATED UMMARY P: Status Active SDD ASTM 8 pages environment. Suitable ap ntarpretation to be given t of the user of this standard	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC Age NASA Status: Preferred Vear Reathinned Vear Reathinned View Doc	Superse Appendix X1.
L-STD-1686A A Figure 2. N Fe Ed Yew Go ASTREET DCUSSIMO COERTING SAL Date Date Date Date 1.1 This plactice descill 1.2 This plactice descill 1.3 This plactice descill 1.3 This plactice descill 1.3 This plactice descill 1.4 This standard does a specificate after and b Sector State Astreet after and b Sector State Coefficient Standard does a specificate after and b Sector State Coefficient State Sector State S	12/3/1/92/2 ECHOOSTATIC DISCHARGE CONTINUENT (EXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 D008/1988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Communicator Heb Agropcy to idle Full-Jos (Technical Standards System Revision: 1907 No of NASA Accesses since 00/2001: 0 TSPRAY (FOG) APPARATUS (SUPERSEDING ASTMEDING 117-1995) Date 04/10/1907 Date 04/10/1907 Service of the specimen or exporte periods to be used for a specime sol on the top the applicability of regulatory limitations prior to sol on the address all of the periodment in the applicability of regulatory limitations prior to Sol on the address all of the periodment Controlling Stress Corosion Clading in Accesses Applications	LUDING ELECTI A) GRAM FOR PR LUDING ELECTI LUDING ELECTI LUDI	NICALLY INITIATED OTECTION OF ELE RICALLY INITIATED ummary Pa Status Active SDD ASTM 9 pages environment Sulfable ap naterpretation to be given to of the user of this standard	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC Age NASA Status: Prefamed Veal: Reathined View Doc paralug which may be used is described in to the results to establish to establish	Superse
L-STD-1686A A Figure 2. N R Fo Edi Yew Go ASTMENT Declission	12/3/1/992 PLECTROSTATIC DISCHARGE CONTINUENT (FXC) MIL-STD-1686C) (SUPERSEDING MIL-STD-1666 09/08/1968 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (FXC) (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Commincator Help Parts, Assembling Standards System Revision: 1907 Ne. of NASA Accesses pince 08/2001: 0 T SPRAY (FOG) APPARATUS (SUPERSEDING ASTM 8117: 1935) Date: 04/10/1907 Commission: 1907 Ne. of NASA Accesses pince 08/2001: 0 T SPRAY (FOG) APPARATUS (SUPERSEDING ASTM 8117: 1935) Date: 04/10/1907 Commission: 1907 Parts of the standard System Parts of the standard System Parts of the standard System Date: 04/10/1907 Commission: 1907 Parts of the standard System Parts of th	LUDING ELECTI A) GRAM FOR PR LUDING ELECTI UMENT S AUTONG ELECTI UMENT S AUTONG ELECTI AUTONG ELECTI A	Status Active Status Active Solution of ELE: ummary Pa Status Active Solutionment Suitable ap Interpretation to be given to of the user of this standard	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC A ge NASA Status: Prefamed Vear Reaffirmed Vear Reaffirmed View Doc paralus which may be used is described in to the results to establish to establish	Superse NASA Appendix X1.
L-STD-1686A A Figure 2. N R Fo Edi Yew Go Control Yew Go	12/3/1/392 PLECTROSTATIC DISCHARGE CONTINUE TO TROL PARTS, ASSEMBLIES AND EQUIPMENT (EXC MIL-STD-1686C) (SUPERSEDING MIL-STD-1686 DB00//3988 ELECTROSTATIC DISCHARGE CONTROL PRO PARTS, ASSEMBLIES AND EQUIPMENT (EXC (S/S BY MIL-STD-1686C) MILL-STD-1686CC Standards Doc1 Communicator Heb Aconycy vide Pull Jost Technical Standards System Standards Doc1 Technical Standards System Standards Doc1 Technical Standards System Standards Doc1 Technical Standards System Date 04/10/1007 Date 04/10/1007 Date 04/10/1007 Standards The inch-pound units in If for information and may be approximate not purpor to address all of the safety concerns, if any, associated with its use it health practices and determine the applicability of regulatory limitations prior to Controlling Stress Contrained Example Controlling Stress Contrained Example Controlling Stress Contrained Example Technical Standard Stress Controlling Stress Contrained Example Contrain	LUDING ELECTI A) GRAM FOR PR LUDING ELECTI UMENT S AUTONG ELECTI AUTONG ELECTI AUTONG AUTONG ELECTI AUTONG	Statur Active RICALLY INITIATED UMMARY Pa Statur Active SDD ASTM 0 pages environment. Suitable ap nterpretation to be given t of the user of this standard of the user of this standard considerations that sho end crack propagation increase applications	EXPLOSIVE DEVICES) (SIS BT CTRICAL AND ELECTRONIC EXPLOSIVE DEVICES) (METRIC A ge NASA Status: Pretrained Vear Realtimed Vear Realtimed (View Doc paralus which may be used is described in to the results to edablish NASA Status: Pretrained View Doc	Superse NASA NAPPendix X1.

٠

-. •

Figure 3. ASTM B-117 Standards Document Summary Page