Subject: Langley Research Center (LaRC) Standards for the Acquisition and Use of Threaded Fasteners

Responsible Office: Safety and Mission Assurance Office

P.1 POLICY

It is LaRC policy to ensure the safe use of threaded fasteners. Three categories of fasteners, “safety-critical,” “spaceflight,” and “specialized” (defined in Appendix A), have been established to define which fastener applications require the controls and requirements specified herein. This directive sets forth requirements, responsibilities, and definitions for safety-critical, spaceflight, and specialized fastener usage at LaRC. Exceptions for fasteners to this policy based on other usages or applications are included in Appendix C for additional clarification.

a. Receipt Inspection, Screening and Certification Validation Testing inspections

(1) Safety-critical and spaceflight fastener products, regardless of procurement method or source of supply, shall be sent to the Mission Assurance Branch (MAB), Materials Analysis and Quality Assurance Laboratory (MAQAL), upon delivery for receipt inspection, screening, and Certification Validation Testing (CVT) inspections.
   (a) Receipt inspection, screening, and CVT inspections requirements for safety-critical and spaceflight fasteners are specified in LAPD 4520.1 and LMS-CP-4520.6.

b. Procurement

(1) Safety-critical and spaceflight fasteners are subject to the procurement requirements specified below. Personnel procuring safety-critical or spaceflight fasteners shall include the following requirements in the appropriate purchase documentation:
   (a) All fasteners shall be procured in lots.
   (b) A single lot of fasteners shall not include fasteners that have traceability to different material batches/lots.
   (c) Manufacturer’s registered trademark and any style names or other identification shall be identified on the container/packaging.
   (d) Manufacturer’s Certification Traceability Documentation shall be included within the container/packaging to ensure traceability of item identification and lot integrity.
   (e) Items shall be packaged in containers that are coded for identification of the lot to enable traceability of certification and test reports back to the heat treatment of the material.
   (f) Items shall be packaged in sealed containers in a manner to ensure no commingling of lots.
   (g) A Manufacturer’s Test Report (MTR) shall be obtained from the manufacturer or distributor selling the fasteners for all fastener lots.

(h) A Certificate of Conformance (CoC) shall be obtained from the manufacturer or distributor selling the fasteners for all fastener lots.
(i) For spaceflight fracture-critical fasteners, low-risk fracture-critical and nuts and inserts used with such fasteners; manufacturers or distributors shall be evaluated/approved in accordance with LMS-CP-8705.3 prior to procurement.
(j) For spaceflight fracture-critical fasteners and nuts and inserts used with such fasteners, complete traceability documentation as specified in P1.d shall be required.

c. Spaceflight Fastener Specific Requirements

(1) Spaceflight fastener applications are subject to the following additional requirements.

(2) The appropriate LaRC engineering organization shall:
(a) Select all fasteners used in spaceflight hardware by specifying government or industry specifications that include design, performance, and quality assurance requirements (controlled specification fasteners) unless a special specification fastener (P1.c.(5)) is required.
(b) Classify the use of each fastener and fastener-related product based upon engineering analysis techniques.
(1) These classifications include, but are not limited to, Fracture Critical, Low-Risk Fracture Critical, Fail Safe, Low Released Mass, and Contained fasteners.
(2) Provide the fastener classifications of P1.c.(2)(b) to the individual procuring the fastener product to ensure the applicable requirements for having an approved manufacturer, traceability, and CVT can be met.
(3) Select metallic fastener materials from tables IA-E of MSFC STD-3029, which lists alloys that exhibit a high resistance to stress corrosion cracking.

(3) Use of other (non-table I) metallic materials shall require documentation of acceptance rationale in a Material Usage Agreement (MUA) that is approved by the responsible LaRC engineering and Safety and Mission Assurance organization.

(4) Approved Manufacturers and Distributors
(a) Fracture-critical fasteners, low-risk fracture critical fasteners, and nuts and inserts used with such fasteners shall be obtained from manufacturers and distributors who have been approved in accordance with LMS-CP-8705.3.
(b) Fastener types that are not listed in paragraph P.1.c.(4)(a) may be procured from non-audited distributors or manufacturers, provided the screening requirement and the CVT requirements specified in LMS-CP-4520.6 are performed.
(c) Approval is limited to the audited location and its product and not to affiliated companies or dissimilar products.
(d) The approval of the supplier shall not exceed a period of 3 years after which the supplier shall be re-audited/assessed as specified in P1.c.4.(a).

(e) LaRC may utilize the audits and approved vendor lists from any other NASA Center or any NASA prime contractor for approving a manufacturer or distributor following the approval process specified in LMS-CP-8705.3. The manufacturer or distributor shall be placed on the LaRC MAB approved vendor list as specified in LMS-CP-8705.3.

(5) Specialized Fasteners

(a) Specialized fasteners are generally for unique applications and require non-standard or "special" specifications.
(b) Specialized fasteners shall meet the requirements of P1.g.
(c) These specifications shall be approved by the governing Technical Authority and placed in the program/project requirements document(s).

(6) Fasteners Critical for Mission Success

If the LaRC Technical Authority (as described in LPR 7120.4, "Langley Research Center Technical Authority Implementation Plan") determines that a fastener is critical for mission success, they may impose the same traceability and receiving inspection requirements as a fracture-critical fastener, even when the actual fracture classification is of a less critical nature.

(7) Fasteners in Commercial-Off-The-Shelf (COTS) Hardware

Fracture-critical, low-risk fracture-critical, and fail safe fasteners used in COTS hardware shall meet the traceability requirements of this directive.

d. Traceability

(1) Traceability of fasteners is required for all safety-critical and spaceflight fasteners.

(2) Fastener traceability documentation shall be maintained for all spaceflight, and other flight projects defined in Appendix A.13(a) by the project.

(3) Complete traceability shall be required for all fracture-critical fasteners and all inserts and nuts that are used with fracture-critical fasteners.

(4) Complete traceability documentation includes the entire chain of custody and all of the following stipulations:

(a) The original manufacturer shall have lot traceability back through the manufacturing process to the raw material test certifications.
(b) Any subsequent manufacturer that modifies a given fastener shall have lot traceability to the manufacturing process performed and back through to the original manufacturer.
(c) Any subsequent supplier(s) or vendor(s) shall have lot traceability back through to the original manufacturer.

(5) Partial traceability shall be required for all other safety-critical and spaceflight non-fracture critical fasteners, including low-risk and fail safe fasteners, provided that lot CVT is performed for verification according to LMS-CP-4520.6.

(a) Meeting the procurement requirements in P1.b results in obtaining partial traceability.

e. Audits

(1) Audits of fastener manufacturers or distributors for determining “approved status” shall be limited to fracture critical and low risk fracture critical fastener products.
(2) The need for an on-site physical audit of a manufacturer/distributor shall be determined as specified in LMS-CP-8705.3.

f. Storage

(1) Fasteners shall be maintained in storage according to program/project or facility requirements until issued for use.

(2) Utilization of a storage system where fasteners or inserts from two or more different lots are commingled (co-located or stored in the same bin or other holding container) shall be expressly prohibited.

g. Specialized Fasteners

(1) Specialized fasteners (defined in A.12) shall be:
(a) Described in the specification document (drawings, procurement specifications, Statement of Work, or other area of the solicitation).
(b) Complete in detailing the appropriate material, design, processing, and quality assurance screening requirements.
(c) Approved, in the specification document, in writing, by a governing Technical Authority, such as a standard practice engineer, model system engineer, facility safety head, project chief engineer, or a line manager who is cognizant of the application.

(2) Specialized fasteners manufactured shall be clearly marked as to their strength, grade, and manufacturer identification, if practical. If marking is not practical, then other controls (i.e. bagging and tagging and/or bonded stores) should be implemented to ensure the fastener(s) are not used in the wrong application.

(3) Non-metallic fasteners shall be considered specialized fasteners.

(4) Specialized fasteners used in safety-critical or spaceflight applications shall adhere to the applicable requirements as specified in P1.a. through P1.f.

h. Prohibitions

Screws or bolts as described in Appendix C.1.(a), or fasteners not considered controlled specification fasteners or specialized fasteners (as defined in Appendix A.7 and A.12, respectively), shall not be used in safety-critical or spaceflight applications.

P.2 APPLICABILITY

a. This LAPD is applicable to all LaRC civil service employees and to contractors engaged in the acquisition and use of threaded fasteners at LaRC to the extent specified in their contracts.

b. In this directive, all mandatory actions (i.e., requirements) are denoted by statements containing the term “shall.” The terms “may” or “can” denote discretionary privilege or permission, “should” denotes a good practice and is recommended, but not required, “will” denotes expected outcome, and “are/is” denotes descriptive material.

c. In this directive, all document citations are assumed to be the latest version unless otherwise noted.

P.3 AUTHORITY

None

P.4 APPLICABLE DOCUMENTS AND FORMS

a. NASA-STD-5019, Fracture Control Requirements for Spaceflight Hardware

b. NASA-STD-6008, NASA Fastener Procurement, Receiving Inspection, and Storage Practices for Spaceflight Hardware

c. NPD 8730.5, NASA Quality Assurance Program Policy

d. LAPD 4520.1, Langley Research Center (LaRC) Requirements for Safety-Critical Product Testing

e. LPR 5300.1, Product Assurance Program

f. LMS-CP-4520.6, Receipt Inspection for Fastener, Insert and Nut Products

g. LF 290, Fastener Work Request-MAQAL

h. MSFC-STD-3029, Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments Materials, Processes, and Manufacturing Department Metallic Materials and Processes Group

P.5 RESPONSIBILITY

a. Acquiring Organization

(1) The organization acquiring the fasteners shall ensure that fasteners obtained (via procurement, credit card, stock, excess, contractor, or other) comply with this Policy.

(2) This includes organizations initially buying and using the fasteners, or any organization that gains possession of the fasteners at a later date.

a. Engineering Organization

(1) The cognizant engineering organization shall comply with the design/selection criteria as specified in P.1.c.(1)-(7).

(2) The cognizant engineering organization shall comply with this Policy during planning and execution of center projects and hardware fabrication tasks.

b. Quality Organization

The Safety and Mission Assurance Office shall be responsible for the receipt inspection and testing of the fasteners as specified in P.1.(a).

P.6 DELEGATION OF AUTHORITY

None

P.7 MEASUREMENT/VERIFICATION

Evidence consists of affirmative test documentation.

P.8 CANCELLATION

LAPD 5330.3 F, dated December 5, 2011

/s/ Cathy H. Mangum **7/26/2016**
Center Associate Director *Date*

Distribution:
Approved for public release via the Langley Management System; distribution is unlimited.

ATTACHMENT A: DEFINITIONS

A.1 **Certificate of Conformance (COC)** – a document that is signed by the fastener supplier to affirm that the product has met the requirements of the relevant specifications(s), contract(s), and any other applicable regulations. It attests that the fasteners are of the quality specified in the acceptance document and conform in all respects with contractual requirements, including specifications, drawings, preservation, packaging, packing, marking requirements, applicable heat/lot number, and physical item identification part number.

A.2 **Complete Traceability** – documentation that demonstrates a solid chain of custody from the original fastener manufacturer through all intermediate distributors down to the buyer. Normally, it consists of a string of purchase orders from the original manufacturer down through each distributor or vendor, linking the sale of a particular lot of fasteners with a unique fastener manufacturer's lot number.

A.3 **Fail Safe** – a fracture control classification based on redundancy where, after failure of a single fastener, the remaining structure can withstand the redistributed loads and the failure will not release a potentially catastrophic free body. A fail safe fastener meets the criteria specified in NASA-STD-5019, section 4.1.1.3.

A.4 **Fastener** – an item such as a bolt (could be a tensile or shear bolt, shoulder bolt, screw, HiLok®, HiTigue®, or lockbolt), nut, nut plate or anchor nut, rivet, shear pin, helical or cylindrical insert, setscrew, washer, safety wire, cotter pin, etc., which joins or retains components or structural elements.

A.5 **Fracture-Critical Fastener** – a classification that assumes that fracture or failure of the fastener resulting from the occurrence of a crack will result in a catastrophic hazard, as specified in NASA-STD-5019.

A.6 **Grade identification marking** – any symbol appearing on a fastener purporting to indicate the fastener's base material, strength or properties.

A.7 **Controlled Specification Fastener** – a screw, threaded bolt, nut, insert, washer, rivet, shear-pin, set-screw, retention device, or stud having internal or external threads, or a load-indicating washer, which bears a grade identification marking required by a standard or specification, or performance capabilities that conform to a specific standard of a consensus standards organization or government agency (i.e., American Society of Testing Materials (ASTM), American National Standards Institute (ANSI), American Society of Mechanical Engineers (ASME), Military Standards (MS), National Aerospace Standards (NAS)).

A.8 **Low Released Mass** – a fastener that meets the criteria specified in NASA-STD-5019, paragraph 4.1.1.1.

A.9 **Low-Risk Fracture Fastener** (or Low-Risk Fastener) – a fastener that meets the criteria specified in NASA-STD-5019, paragraph 4.1.1.12.

A.10 **Manufacturer's Test Report (MTR)** – a document that is produced by the fastener manufacturer to certify information required by the applicable fastener specification. The information typically includes fastener lot number,

manufacturing date, lot quantity, raw material heat number, chemical composition, and mechanical and metallurgical test results.

A.11 **Partial Traceability** – documentation from a supplier or vendor that does not necessarily include the full chain of custody back to the original fastener manufacturer.

A.12 **Specialized Fasteners** – fasteners that fall under categories such as custom-designed and manufactured fasteners; pyrotechnic fasteners; non-metallic fasteners or commercial fasteners such as eyebolts, clevises, hooks, wire rope, turnbuckles, and continuous threaded rods; as well as those not otherwise specified.

A.13 **Safety Critical Fastener**

a. Any fastener/nut/insert/retention device used in spaceflight project or non-spaceflight flight project hardware and associated ground support equipment as defined within the scope of LPR 5300.1. These projects include all spaceflight projects, sub-orbital flight tests supporting space flight programs, low-risk flight projects, risk reduction flights or flight experiments; flights of opportunity that are sub-orbital; involve sounding rockets; un-crewed aerospace vehicles; and major drop models or Unmanned Aerial Vehicles (UAV), as decided by LaRC Center Management. Excluded from this definition are flight projects involving experiments on aircraft.

***NOTE**: Spaceflight fasteners are actually included in the definition of safety-critical fasteners, but are broken out as a separate category in this directive as there are some specific requirements for spaceflight fasteners that do not apply to other safety-critical fasteners. Specialized fasteners, as a category, are similar in that these fasteners when used in either a A.13.(a) or (b) application have some specific requirements detailed in this directive that are different from a "non-specialized" safety critical fastener.*

b. Any fastener or other component used in a Langley facility that is critically loaded/stressed (factor of safety is less than 4 on ultimate strength and 3 on yield strength) and whose failure can result in a catastrophic or critical (Category I or Category II) injury/facility damage, as defined in LPR 1740.4. The factor of safety calculation shall be made by the appropriate engineering organization. The Facility Safety Head or Project Engineer shall contact cognizant center personnel (e.g., Model Systems SPE) for guidance to determine the appropriate engineering organization. A fastener is any single part that joins other structural elements and transfers loads from one element to another across a joint.

A.14 **Traceability** – the concept that a buyer can trace the history of a given lot of fasteners back through any number of distributors or vendors to the original manufacturer(s).

ATTACHMENT B: ACRONYMS

ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASTM	American Society of Testing Materials
COC	Certificate of Conformance
CoF	Construction of Facilities
COTS	Commercial-Off-the-Shelf
CP	Center Procedure
CVT	Certification Validation Testing
LaRC	Langley Research Center
LPR	Langley Procedural Requirements
MAB	Mission Assurance Branch
MAQAL	Materials Analysis and Quality Assurance Laboratory
MS	Military Standards
MTR	Manufacturer's Test Report
NAS	National Aerospace Standards
SPE	Standard Practice Engineer
UAV	Unmanned Aerial Vehicles

ATTACHMENT C: EXCEPTIONS TO POLICY

C.1 Non-Safety-Critical Application Fasteners:

(a) Wood screws, sheet metal screws, lag bolts, carriage bolts, stove bolts, or screws made of brass or aluminum used as intended are not considered safety-critical fasteners.

(b) Screws or bolts as specified in C.1.(a), or fasteners not considered controlled specification fasteners or specialized fasteners (as defined in Appendix A.7 and A.12, respectively) shall not to be used in safety-critical or spaceflight applications.

C.2 Aircraft Fasteners

Fasteners used on aircraft, for both the aircraft itself and for installed experimental hardware, are procured, inspected and controlled according to Research Services Directorate processes.

C.3 General Building Construction Fasteners used in Construction of Facility Projects

Fasteners brought into the Center for general building construction use on Construction of Facility projects that are designed, built and tested in accordance with National Consensus Codes (e.g., International Building Code) will be procured and inspected as specified in the contract.

C.4 Facility Pressure System Fasteners

Fasteners (e.g., for high-pressure piping systems) that are assembled into a system that is (1) designed, built, and tested in accordance with National Consensus Codes; (2) placed or to be placed into the Center's Configuration Management program; **and** (3) maintained in accordance with National Consensus Codes, and Agency and Center policies, are exempt from this policy.

NOTE: Replacement fasteners not tested with the initial assembled system are subject to this policy.