ARMSTRONG FLIGHT PROCEDURAL REQUIREMENTS (AFPR)	**Directive:**	**AFPR-7123.1-001, Revision G**
	Effective Date:	**July 22, 2025**
	Expiration Date:	**July 22, 2030**

Compliance is mandatory.

SUBJECT: Systems Engineering Requirements Document

RESPONSIBLE OFFICE: Director of Research & Engineering

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PREFACE

P.1 Purpose

a. The purpose of this document is to establish the Armstrong Flight Research Center (AFRC, hereinafter referred to as Center) in Edwards, California requirements for the implementation of systems engineering (SE) practices in accordance with National Aeronautics and Space Administration procedural requirement (NPR) 7123.1, NASA Systems Engineering Processes and Requirements. SE is a logical systems approach performed by multidisciplinary teams to engineer and integrate the Center's systems to ensure products meet customers' needs. This systems approach is applied to all elements of a system and all hierarchical levels of a system over the complete project life cycle.

P.2 Applicability

a. This document and the requirements that are developed or revised after the effective date of this AFPR apply to projects that have been assigned a project chief engineer (CE). Projects and tasks that include engineering design work, but do not have a project CE assigned, will comply with other applicable processes such as Armstrong Flight Research Center operational procedure (AFOP)-7900.3-023, Airworthiness & Flight Safety Review Process; AFOP-7900.3-021 ,Aircraft Structural Modification Analysis, Review, and Documentation Requirements; and AFOP-7123.1-006, Structural Ground Test Development and Execution. This document does not apply to projects and tasks that are undertaken strictly for research and that have no material products other than knowledge and experience.

b. Through partnerships with industry, academia, other NASA Centers, and other government agencies, the Center enters into projects at various stages of their life cycles, often just prior to the operations phase. When a project CE is assigned, the applicability of this document and other Center requirements will be assessed.

c. 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.

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

P.3 Authority

a. NID 7120.148, NASA Space Flight Program and Project Management Requirements

b. NPR 7123.1, NASA Systems Engineering Processes and Requirements

P.4 Applicable Documents and Forms

IEEE 1012-2016, Standard for System, Software, and Hardware Verification and Validation

NPR 1280.1, NASA Integrated Management System Policy

NPD 2570.5, NASA Electromagnetic Spectrum Management

NPR 2810.1, Security of Information and Information Systems

NPR 7120.5, NASA Space Flight Program and Project Management Requirements

NPR 7123.1, NASA Systems Engineering Processes and Requirements

NPR 7150.2, NASA Software Engineering Requirements

NPR 8000.4, Agency Risk Management Procedural Requirements

NASA/SP-2010-576, NASA Risk-Informed Decision Making Handbook

NASA/SP-2011-3422, NASA Risk Management Handbook

NASA/SP-20210010952, Human Systems Integration Handbook

NASA/SP-6105, NASA Systems Engineering Handbook

NASA-SPEC-2600, Enumeration of ASCS Cybersecurity Requirements

AFPD-8040.1-001, Configuration Management

AFG-7120.5-001, Project Chief Engineer’s Handbook

AFG-7900.4-002, Operations Engineer’s Handbook

AFOP-7120.5-003, Project Management Manual

AFOP-7150.2-004, Software Assurance

AFOP-7900.3-024, Flight Operational Readiness Review (ORR)

AFOP-8715.3-003, Flight Load Laboratory Ground Test Hazard Analysis

P.5 Measurement/Verification

None.

P.6 Cancellation

AFPR-7123.1-001 F-8, Systems Engineering Requirements Document, effective July 31, 2024.

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s/Center Director Date

DISTRIBUTION: Approved for release via the Document Library.

CHAPTER 1: INTRODUCTION

1.1 Project Lifecycle

1.1.1 The Center SE requirements are defined to establish a standard, disciplined engineering approach to systems development throughout the life cycle of a project. In alignment with NPR 7120.5 and NPR 7123.1, the project life cycle shown in Figure 1 has been defined for projects performed by the Center. For a more detailed discussion of the Center project lifecycle, refer to AFOP-7120.5-003, Project Management Manual.

1.1.2 The life cycle is intended to be a standard for the Center's projects, but it is common for the Center to enter partnerships with external entities on existing projects at various stages of their life cycles. The requirements of this document are intended to ensure consistency between all projects being conducted at the Center.

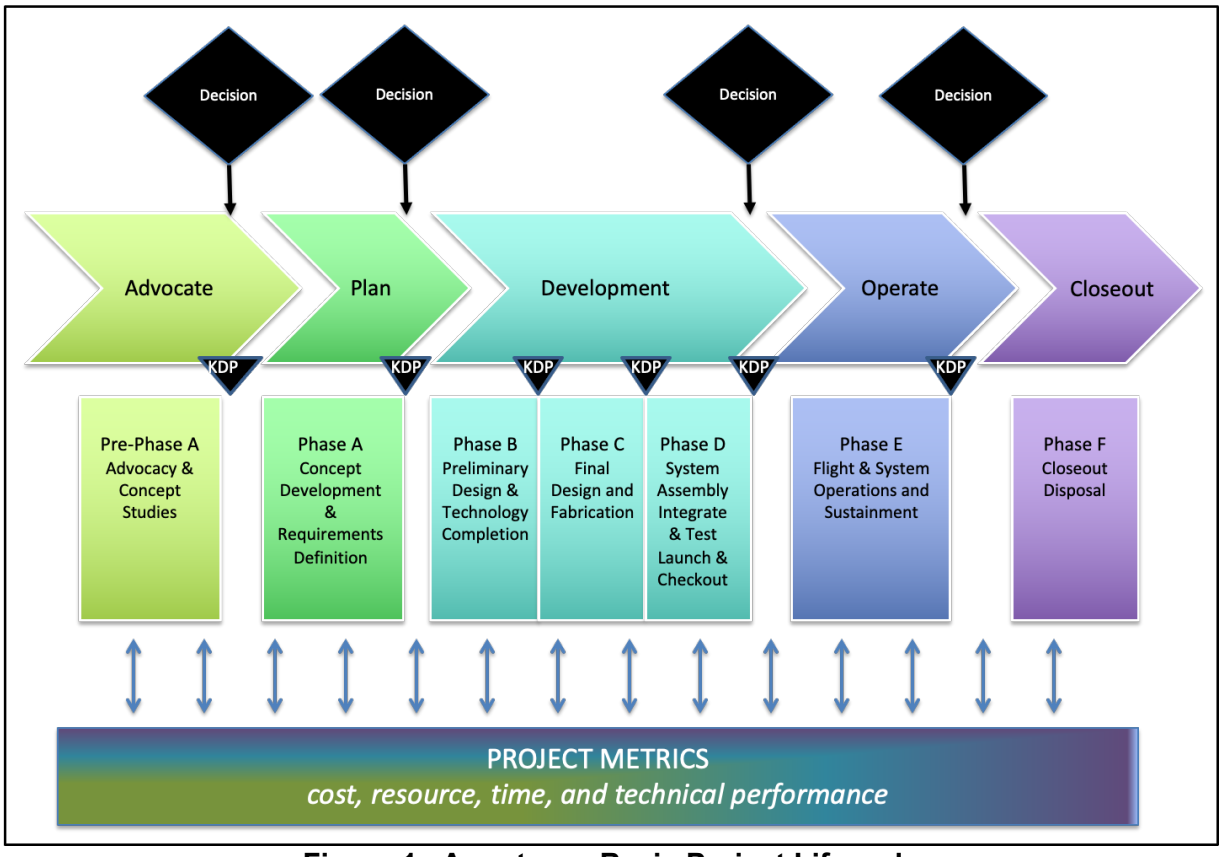

Figure 1. Armstrong Basic Project Lifecycle

KDP – Key Decision Point

1.2 Armstrong Flight Research Center Procedural Requirement (AFPR) Scope

This document describes the Center's implementation of the requirements in NPR 7123.1.

1.3 Complying with Agency Requirements

Center projects will meet the intent of the requirements allocated to projects by NPR 7123.1. Guidance for meeting the intent of the project-allocated requirements is contained in AFG-7120.5-001, Project Chief Engineer's Handbook. The method of compliance for each requirement is documented in the project Systems Engineering Management Plan (SEMP) or equivalent.

1.4 NPR 7123.1 Requirements Allocated to the Center

The compliance matrix mandated by NPR 7123.1 requirement SE-04 is found in Appendix C. The matrix references other Center documents in which the relevant policies, procedures, and processes may be found for each NPR 7123.1 requirement allocated to the Center.

1.5 Process Improvement and Training

1.5.1 The Chief of the Systems Engineering and Integration Branch will identify improvement areas each year and document the status of improvement efforts on the branch's Sharepoint site.

1.5.2 The Chief of the Systems Engineering and Integration Branch will develop a training package to Programs & Projects Directorate Branch Chiefs, Research & Engineering Directorate Branch Chiefs, the CA Human Capital Learning & Development, and Center Chief Technologist to help funders and participants in engineering efforts understand their responsibilities with regard to the SE requirements.

1.6 Standards

Project CEs are responsible for working with the project manager and the lead operations engineer to implement design standards appropriate for each project. Among the standards that should be considered are those listed in Section P.3, as well as those design standards listed in the Standards Documents section of the On-Line Document Information Exchange (ODIE).

1.7 NPR 7123.1 Requirements Allocated to Projects

1.7.1 The project CE is responsible for completing the SEMP worksheet (found as an appendix in AFG-7120.5-001) or equivalent and obtaining the required signatures before System Requirement Review (SRR) or, in the case of a project that has arrived at the Center in a later phase, at a milestone negotiated by the Director of Research &

Engineering and the project CE. The SEMP worksheet or equivalent, when completed, stands as the compliance and implementation agreement and the engineering review plan agreement between the project and the Director of Research & Engineering.

1.7.2 The Chief of the Systems Engineering and Integration Branch will collect SEMP worksheets and equivalents in a library available on the Branch's Sharepoint site.

CHAPTER 2: RESPONSIBILITIES

Per NPR 7123.1, the Designated Governing Authority for the technical effort described in this document begins with the Center Director. From there, authority is delegated to the Director of Flight Operations or Director of Research & Engineering Directorates. Authority for issues that relate to the application of aircraft airworthiness standards for modification, operation, or maintenance of aircraft are further delegated through the Director of Flight Operations to a project's lead operations engineer. Authority for issues related to the application of technical requirements and standards, including the approval of waivers, are delegated to the project's CE through the Director for Research & Engineering Directorate. See Figure 2 for a graphical representation of this process.

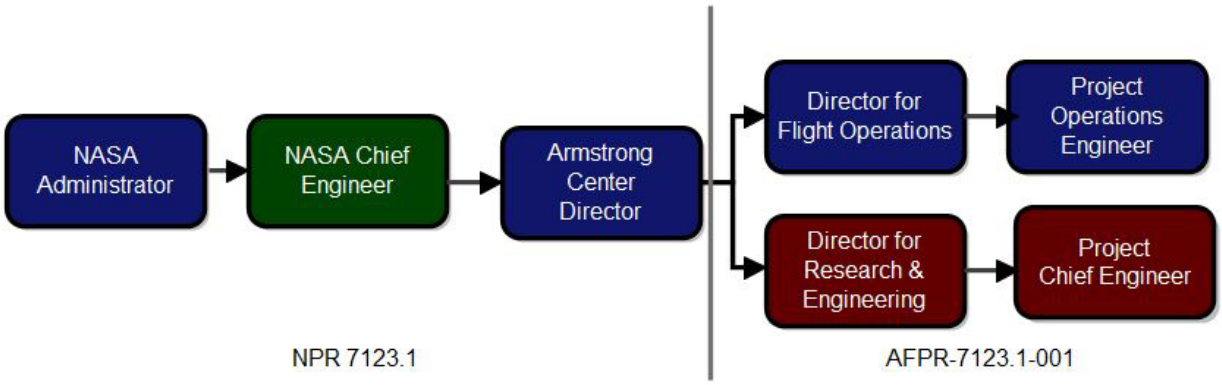

Figure 2. Flow of Technical Designated Governing Authority at Armstrong

Appendix A: Definitions

Verification. Proof by examination of objective evidence that the product complies with specifications. Verification is performed to ensure the product complies with requirements and may be determined by test, analysis, demonstration, inspection, or a combination of these.

Validation. Proof by examination of objective evidence that the product accomplishes the intended purpose. Validation is performed to ensure that the product is ready for a particular use, function, or mission, and may be determined by test, analysis, demonstration, or a combination of these.

Appendix B: Acronyms

AFG	Armstrong Flight Research Center Guide
AFOP	Armstrong Flight Operational Procedure
AFPR	Armstrong Flight Procedural Requirement
CDR	Critical Design Review
CE	Chief Engineer
HIS	Human Systems Integration
KDP	Key Decision Point
NASA	National Aeronautics and Space Administration
ORR	Operational Readiness Review
PDR	Preliminary Design Review
SE	Systems Engineering
SEMP	Systems Engineering Management Plan
SIR	Systems Integration Review
SRR	Systems Requirement Review

Appendix C: Mapping of NPR 7123.1 Common Technical Processes

C.1 The goal of this Appendix is to establish traceability of NPR 7123.1 Common Technical Process requirements with elements in this document and additional guidance information. All document references listed under Justification column of mapping are subject to change after publication of this document. Please use the respective document repository to research Justification column information.

NPR Reqt		Comply?	Justification
SE-07	Program/Project Managers shall identify and implement an ETA-approved Stakeholder Expectations Definition process to include activities, requirements, guidelines, and documentation as tailored and customized for the definition of stakeholder expectations for the applicable product layer.	Yes	Guidelines for stakeholder expectation definition in AFG-7120.5-001
SE-08	Program/Project Managers shall establish and maintain a Technical Requirements Definition process to include activities, requirements, guidelines, and documentation, as tailored and customized for the definition of technical requirements from the set of agreed upon stakeholder expectations for the applicable product layer.	Yes	Guidelines for Technical Requirements Definition in AFG-7120.5-001
SE-09	Program/Project Managers shall identify and implement an ETA-approved Logical Decomposition process to include activities, requirements, guidelines, and documentation, as tailored and customized for logical decomposition of the validated technical requirements of the applicable product layer.	Yes	Guidelines for Logical Decomposition in AFG-7120.5-001
SE-10	Program/Project Managers shall identify and implement an ETA-approved Design Solution Definition process to include activities, requirements, guidelines, and documentation, as tailored and customized for designing product solution definitions within the applicable product layer that satisfy the derived technical requirements.	Yes	Guidelines for Design Solution Definition in AFG-7120.5-001
SE-11	Program/Project Managers shall identify and implement an ETA-approved Product Implementation process to include activities, requirements, guidelines, and documentation, as tailored and customized for implementation of a design solution definition by making, buying, or reusing an end product of the applicable product layer.	Yes	Guidelines for Product Implementation in AFG-7120.5-001
SE-12	Program/Project Managers shall identify and implement an ETA-approved Product Integration process to include activities, requirements, guidelines, and documentation, as tailored and customized for the integration of lower level products into an end product of the applicable product layer in accordance with its design solution definition.	Yes	Guidelines for Product Implementation in AFG-7120.5-001

NPR Reqt		Comply?	Justification
SE-13	Program/Project Managers shall identify and implement an ETA-approved Product Verification process to include activities, requirements/specifications, guidelines, and documentation, as tailored and customized for verification of end products generated by the product implementation process or product integration process against their design solution definitions.	Yes	Guidelines for Product Implementation in AFG-7120.5-001
SE-14	Program/Project Managers shall identify and implement an ETA-approved Product Validation process to include activities, requirements, guidelines, and documentation, as tailored and customized for validation of end products generated by the product implementation process or product integration process against their stakeholder expectations.	Yes	Guidelines for Product Implementation in AFG-7120.5-001
SE-15	Program/Project Managers shall identify and implement an ETA-approved Product Transition process to include activities, requirements, guidelines, and documentation, as tailored and customized for transitioning end products to the next higher level product layer customer or user.	Yes	Guidelines for Product Implementation in AFG-7120.5-001
SE-16	Program/Project Managers shall identify and implement an ETA-approved Technical Planning process to include activities, requirements, guidelines, and documentation, as tailored and customized for planning the technical effort.	Yes	Guidelines for technical planning in AFG-7120.5-001
SE-17	Program/Project Managers shall identify and implement an ETA-approved Requirements Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for management of requirements throughout the system life cycle.	Yes	Guidelines for Requirements Management in AFG-7120.5-001
SE-18	Program/Project Managers shall identify and implement an ETA-approved Interface Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for management of the interfaces defined and generated during the application of the system design processes.	Yes	Guidelines for Interface Management in AFG-7120.5-001
SE-19	Program/Project Managers shall identify and implement an ETA-approved Technical Risk Management process to include activities, requirements, guidelines, and documentation for management of the risk identified during the technical effort.	Yes	Risk Management Requirements and Guidelines in AFOP-7120.5-003,
SE-20	Program/Project Managers shall identify and implement an ETA-approved Configuration Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for configuration management.	Yes	Configuration Management Requirements and Guidelines in AFPD-8040.1-001

NPR Reqt		Comply?	Justification
SE-21	Program/Project Managers shall identify and implement an ETA-approved Technical Data Management process to include activities, requirements, guidelines, and documentation, as tailored and customized for management of the technical data generated and used in the technical effort.	Yes	Technical Data Management Guidelines in AFG-7120.5-001
SE-22	Program/Project Managers shall identify and implement an ETA-approved Technical Assessment process to include activities, requirements, guidelines, and documentation, as tailored and customized for making assessments of the progress of planned technical effort and progress toward requirements satisfaction.	Yes	Technical Assessment Guidelines in AFG-7120.5-001
SE-23	Program/Project Managers shall establish and maintain a Decision Analysis process to include activities, requirements, guidelines, and documentation, as tailored and customized for making technical decisions.	Yes	Decision Analysis Guidelines in AFG-7120.5-001
SE-47	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: SIR: Updated integration plan.	Yes	AFG-7120.5 Appendix C
SE-65	The technical team shall develop and document an approach to Human Systems Integration (HSI).	Partial	Comply for projects of record, HSI approach should be adopted for local projects when Goals and Objectives dictate.
SE-66	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: SRR: Baselined Human Systems Integration approach.	Partial	Comply for projects of record, HSI approach should be adopted for local projects when Goals and Objectives dictate.
SE-67	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: PDR: Baselined integration plans.	Partial	Comply for projects of record. Local projects will baseline by CDR
SE-68	The technical team shall provide the following minimum products at the associated life-cycle review at the indicated maturity level: PDR: Baselined Verification and Validation Plan.	Partial	Comply for projects of record. Local projects will baseline by CDR

Change Log

Baseline, 11-09-07

Baseline-1, 05-04-09
- Redline version created to satisfy NCR deadline. To be updated by Aug 3, 2009.

Baseline-2, 07-23-09
Note: This document was originally approved as DPR-1420.1. The signature page in this minor revision still shows the original number. The content of the document has not changed. The minor revision applies only to the addition of the document serial number.
- Changed document number from DPR-7123.1 to DPR-7123.1-001
- Pgs. 3 & 12, removed references to cancelled document DOP-M-106, Western Aeronautical Test Range (WATR) Mission Control Center (MCC) Systems Software Acceptance Testing

Revision A
- Relined to answer NCR

Revision B, 08-06-10
- Extended expiration date by 6 months

Revision C, 03-09-11
- Formatted to comply with Agency requirements
- Removed references to cancelled documents DCP-P-005, DCP-P-006, DHB-P-002, DOP-P-003
- Changed DHB-O-001 to G-7900.4-002
- Changed DHB-X-001 to G-7900.3-001
- Incorporated Section 5.0, description of the SE engineer processes and mapping to the DPR processes
- Addresses the audit finding, NPR 7123.1A requirements not flowed to center documentation
- Updated the Dryden lifecycle to include the SMB and PMB project development review process
- Added Appendix B Acronyms
- Added Appendix C Mapping of NPR 7123.1 Common Technical Processes
- Updated Figure 2, Designated Governing Authority at Dryden, which eliminates the associate director of operations.

Admin Change, C-1, 03-09-11
- Changed reference to DCP-$-604 to DOP-R-604

Revision D,
- Deleted part of 1.2 DPR Scope
- Deleted 1.4.1
- Deleted 1.5 Risk Management
- Deleted Chapter 2 Engineering Life Cycle Requirements
- Deleted Chapter 3 LifeCycle Review Criteria
- Deleted Chapter 4 Common Technical Process
- Updated Appendix C Mapping of NPR 7123.1 Common Technical Processes
- Added Appendix D Reference Documents
- Updated references to G-7120.5-001, Project Chief Engineer's Handbook

Admin Change, D-1, 08-30-16
- Deleted reference to cancelled DCP-P-025 in Appendix D

Revision E, 08-14-17
- DPR-7123.1-001 renumbered to AFPR-7123.1-001 in accordance with Center instruction.
- Formatted document to current PR template
- Addresses findings:
  - Section 1.4.1: Corrected reference to Appendix containing the compliance matrix. Was: Appendix X; Is: Appendix C. [NCR 17I01-RE-1032]
  - Section 1.5.1 and Section 1.5.2: Corrected the name of the branch. Was: Systems Engineering; Is: Systems Engineering and Integration. [NCR 17I01-RE-1032]
  - Section 1.5.1: Changed how progress on branch improvement areas are statused. Was: Brief the Director for research and Engineering at least quartlerly; Is: document the status of improvement efforts at least four times each calendar year on the branch's Sharepoint site. [NCR 17I01-RE-1033, NCR 17I01-RE-1036]
  - Section 1.5.2: Clarified how often design review metrics will be updated and who will use them. Was: identify and collect design review metrics in a library on the branch's Sharepoint site and use them quarterly to to identify areas to consider for process improvement. Is: The Branch Chief will update metrics at least four times each calendar year and will identify areas to consider for process improvement at least annually. [CAP 719-11]

Revision E-001, Redline, 06-11-2018
- Updated sections P.2 Applicability, P.4 Applicable Documents, P.5 Measureent/Verification, and P.6 Cancellation
- Updated Figure 1 to latest version of AFRC Project LifeCycle
- Chapter 3: AS9100 (AEROSPACE QUALITY MANAGEMENT SYSTEM STANDARD) REQUIREMENTS removed in its entirety
- Removed definitions A.1 First Article, A.2 Formulation Phase, and A.3 Key Characteristics from Appendix A
- Definitons A.4 Verification and A.5 Validation renumbered to A.1 and A.2 respectively
- Document reference hyperlinks updated in Appendix D: Reference Documents
- TOC updated to reflect changes made within body of this directive
- Addresses NCR 823-01 and metric action

Revision E-002, Redline, 06-14-2018
- Updated sections P.2 Applicability
- Added directives to Appendix D: Reference Documents

Revision F, 08-20-2018
- Accepted changes from Redline Revision E-001 and E-002
- Renumbered paragraphs
- Updated Distribution statement
- Updated document referenced in Appendix C

Revision F-1, Admin Change, 12-05-2019
- Removed cancelled document references AFOP-7900.3-022, Tech Brief (T/B) & Mini Tech Brief (Mini T/B), and AFG-7900.3-001, Airworthiness & Flight Safety review, Independent Review, Technical Brief, and Mini Tech Brief
- Fixed typo in Appendix C requirement number SE-16
- Appendix D renumbered

Revision F-2, Admin Change, 10-04-2020
- Fixed typo in page headers 2-13

Revision F-3, Admin Change, 05-17-21
- Added page break between Chapter 1 and Chapter 2.

Revision F-4, Admin Change, 07-31-23
- Extended expiration from 8/1/23 to 2/1/24.

Revision F-5, Admin Change, 01-31-24
- Extended expiration from 2/1/24 to 8/1/24.

Revision F-6, Admin Change, 07-31-24
- Extended expiration from 8/1/24 to 2/1/25.

Revision F-7, Admin Change, 01-15-25
- Updated reference AFOP-8715.3-003 to AFOP-8715.1-005.

Revision F-8, Admin Change, 01-30-25
- Extended expiration date from 2/1/25 to 8/1/25.

Revision G, 07-24-25
- Rewrite throughout.