AURA
NETWORK SYSTEMS

AAM Supply Chain & Production Certification

Presented to the NASA AAM Supply Chain Working Group

July 26, 2021

Outline

1. Supply Chain and Safety
2. FAA Regulatory Structure
3. Aircraft
4. Equipment
5. Operators

Why is the Supply Chain Important to Safety?

ASA Flight 2311 Accident April 5, 1991

- Caused by Supply Chain Error
- PCU Quill (below) failed due to plating incompatibly
- Caused hull loss and 23 fatalities

Embraer EMB-120 - Photo By JetPix

From NTSB Report AAR-92/03

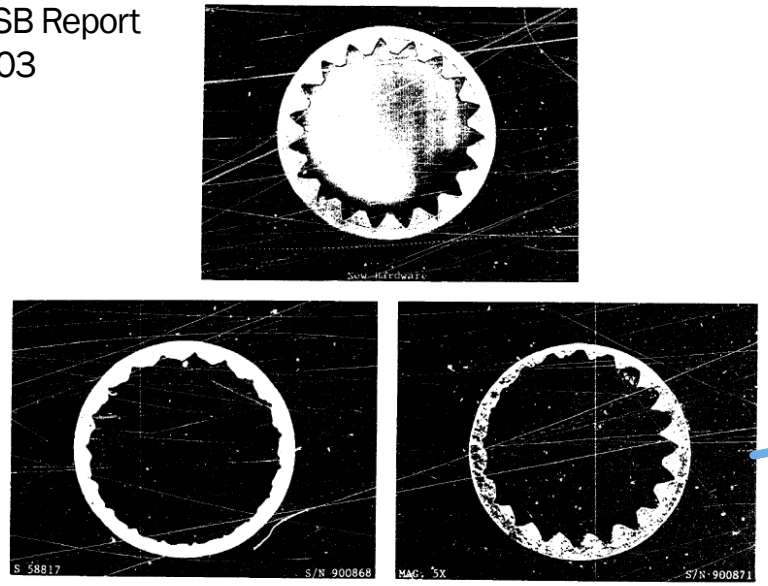


Figure 3.--PCU quill.

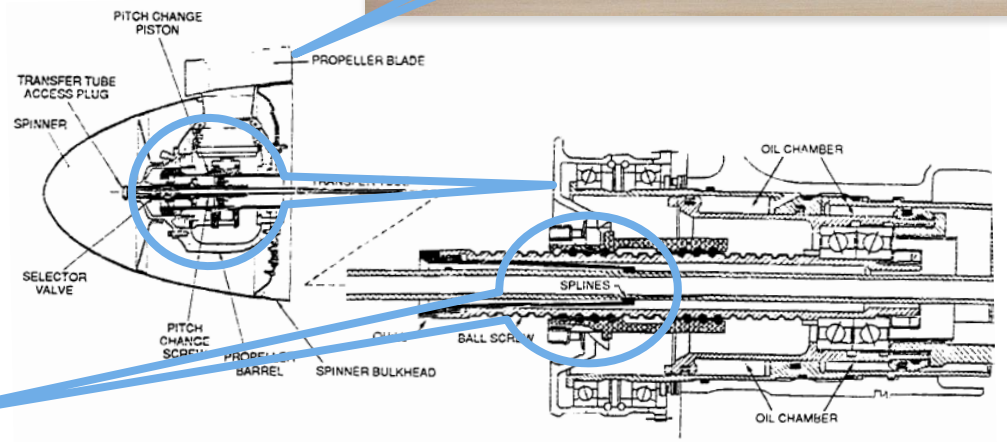
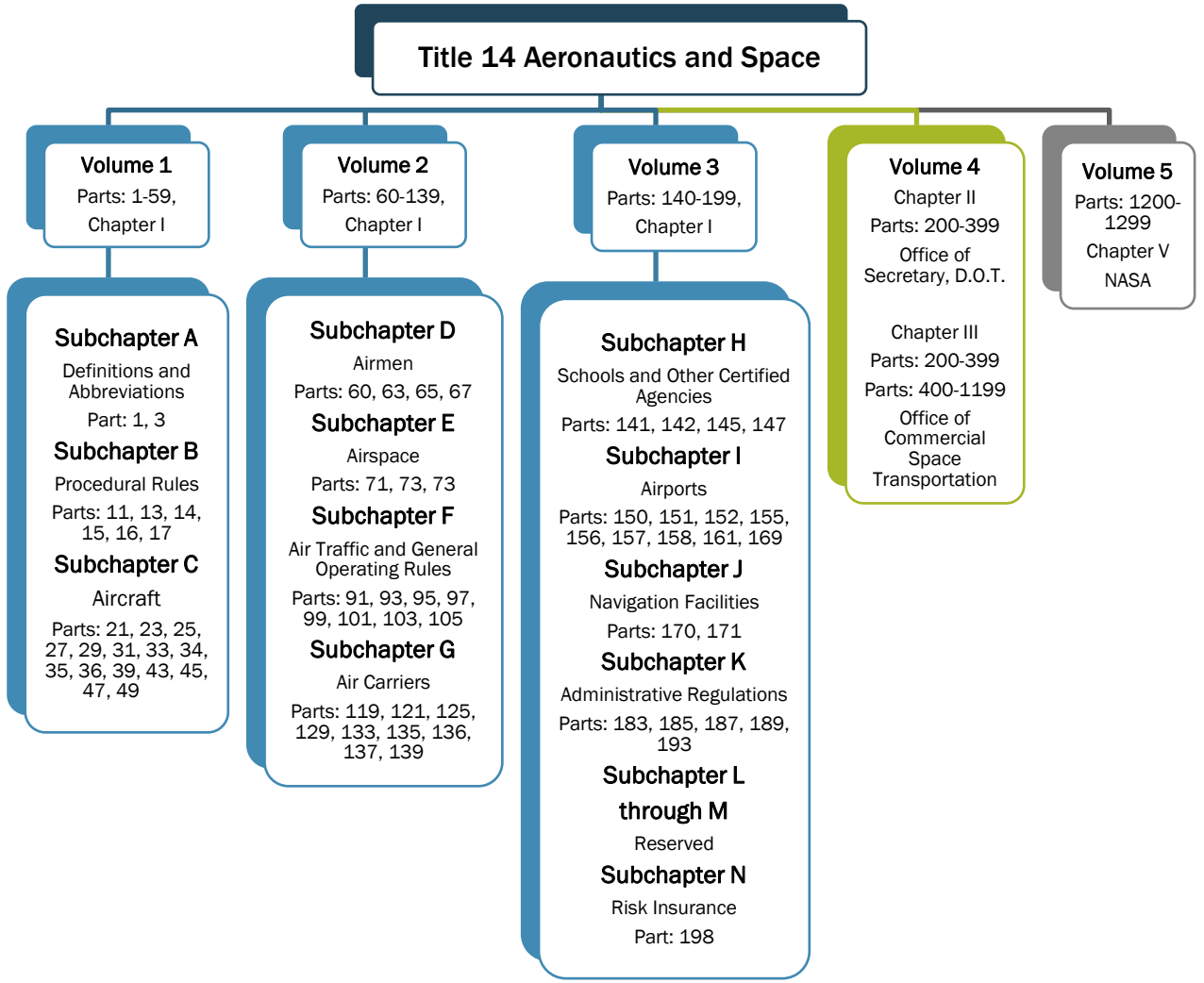


Figure 2.--Hamilton Standard propeller system Model 14RF.

Title 14 Aeronautics and Space Code of Federal Regulations

US Regulations are broken into major groupings called Titles. Each Title Covers a Specific Area of Laws. Regulations are divided into Volumes, Chapters, and Parts

- **FAA**
  Volumes 1-3 and Chapter I
- **DOT**
  Volume 4 Chapter II
- **Commercial Space Transportation**
  Volume 4 Chapter III
- **NASA**
  Volume 5 Chapter V



Regulatory basics

- **All aircraft require FAA Approval to fly**
- **Three basic requirements:**
  1. Aircraft must have airworthiness certificate (14 CFR Part 21)
  2. Flight Crew must be Certificated (14 CFR Part 61)
  3. Commercial Operations must be certificated (14 CFR Part 135, 121, etc.)

jobyaviation.com

kittyhawk.aero/heaviside

wisk.aero

Certificates based on 14 CFR Part 21

- **Three certificates:**
  1. Type
  2. Production
  3. Airworthiness
- **Address different aspects of aircraft development**
- **Design, production and condition of individual product**

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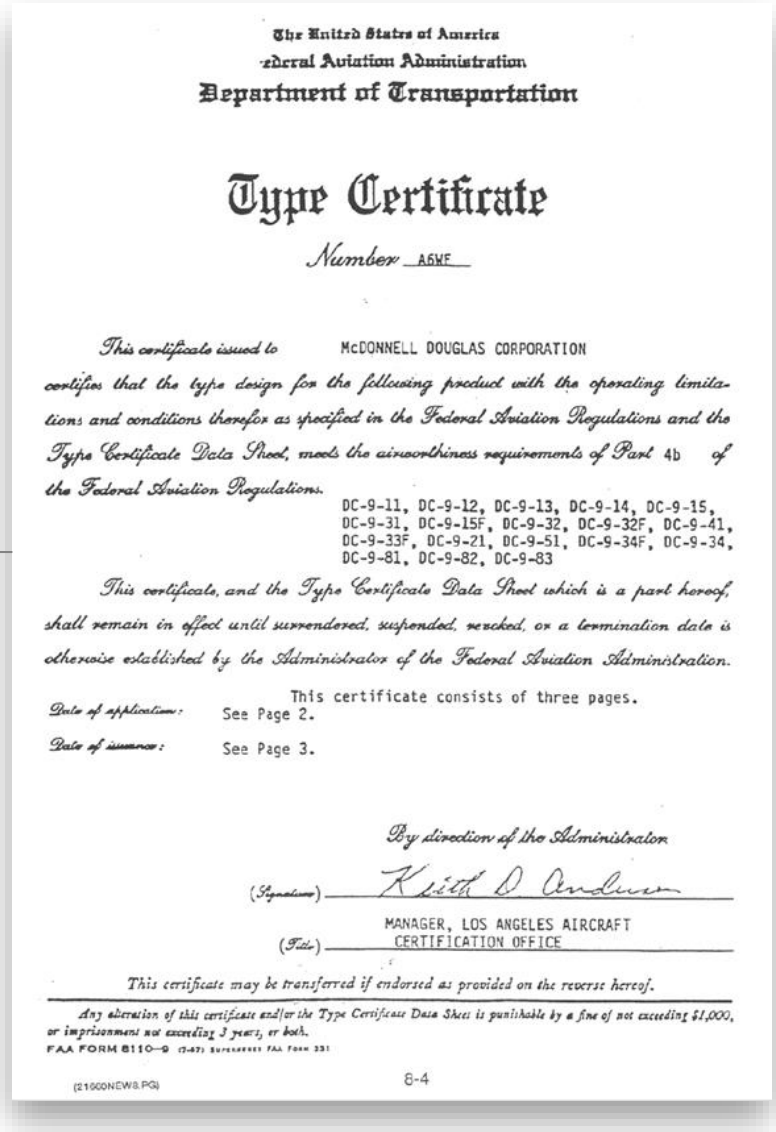
Type Certificate (TC)

- Approves design
- Spells out limitations
- Involves approval of designs on paper



The United States of America
Federal Aviation Administration
Department of Transportation

Type Certificate

Number A6WE

This certificate issued to McDONNELL DOUGLAS CORPORATION

certifies that the type design for the following product with the operating limitations and conditions therefor as specified in the Federal Aviation Regulations and the Type Certificate Data Sheet, meets the airworthiness requirements of Part 4b of the Federal Aviation Regulations.

DC-9-11, DC-9-12, DC-9-13, DC-9-14, DC-9-15, DC-9-31, DC-9-15F, DC-9-32, DC-9-32F, DC-9-41, DC-9-33F, DC-9-21, DC-9-51, DC-9-34F, DC-9-34, DC-9-81, DC-9-82, DC-9-83

This certificate, and the Type Certificate Data Sheet which is a part hereof, shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

This certificate consists of three pages.

Date of application: See Page 2.

Date of issuance: See Page 3.

By direction of the Administrator

(Signature) Keith D. Anderson

(Title) MANAGER, LOS ANGELES AIRCRAFT CERTIFICATION OFFICE

This certificate may be transferred if endorsed as provided on the reverse hereof.

Any alteration of this certificate and/or the Type Certificate Data Sheet is punishable by a fine of not exceeding $1,000, or imprisonment not exceeding 3 years, or both.

FAA FORM 8110-2 (7-67) SUPERSEDES FAA FORM 331

(2190ONEW8.PG)

8-4

Production Certificate (PC)

Allows holder to make duplicates of approved design

Certifies holder's competence

The United States of America
Department of Transportation
Federal Aviation Administration

Production Certificate

Number 722NM

This certificate, issued to

CUB CRAFTERS, INC.

whose business address is

1918 SOUTH 16TH AVENUE
YAKIMA, WASHINGTON 98903

and whose manufacturing facilities are located at

1918 SOUTH 16TH AVENUE
YAKIMA, WASHINGTON 98903

authorizes the production, at the facilities listed above, of reasonable duplicates of

AIRCRAFT

which are manufactured in conformity with authenticated data, including, drawings, for which Type Certificate specified in the pertinent and currently effective Production Limitation Record were issued. The facilities, methods, and procedures of this manufacturer were demonstrated as being adequate for the production of such duplicates on date of February 12, 2007.

Duration: This certificate shall continue in effect indefinitely, provided, the manufacturer continuously complies with the requirements for original issuance of certificate, or until the certificate is canceled, suspended, or revoked.

By direction of the Administrator

Date issued
February 12, 2007

Wolf R. Caliebe
Manager, Seattle Manufacturing
Inspection District Office

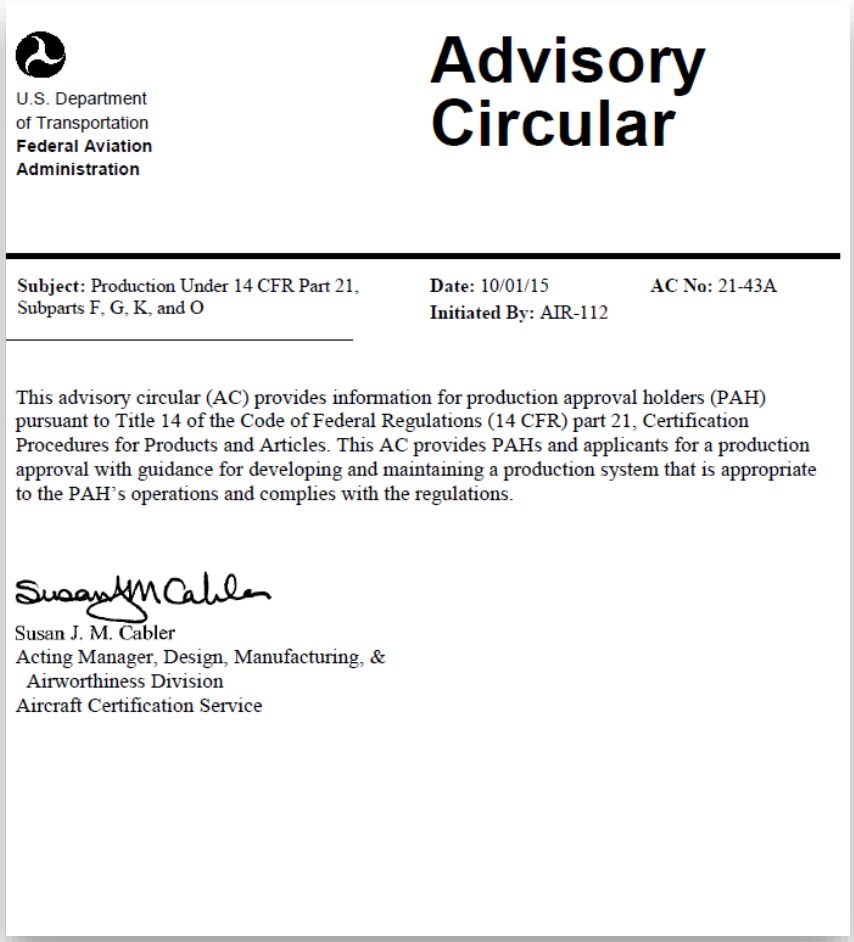
This Certificate is not Transferable, AND ANY MAJOR CHANGE IN THE BASIC FACILITIES OR IN THE LOCATION THEREOF, SHALL BE IMMEDIATELY REPORTED TO THE APPROPRIATE REGIONAL OFFICE OF THE FEDERAL AVIATION ADMINISTRATION.

Any alteration of this certificate is punishable by a fine of not exceeding $1,000, or imprisonment not exceeding 3 years or both

FAA FORM 8120-4 (12-00) SUPERSEDES FAA FORM 333

Supplier Control (see FAA AC 21-43A, Chapter 3)

- Part 21 requires aircraft manufacturers to establish and maintain a quality system
- Part 21 also requires that this quality system ensure supplier-produced components (for example, software, articles, and subassemblies), conform to the manufacturer's requirements
- A manufacturer is responsible for ensuring that each product or article conforms to the FAA-approved design data and is in a condition for safe operation
- The manufacturer should ensure access to, and cooperation of, all involved facilities in the supply chain for the themselves and the FAA
- The manufacturer is responsible for supplier adherence to the requirements flowed-down through the supply chain
- A manufacturer does not delegate responsibility under its production approval to a supplier
- Level of control can vary based on a safety risk assessment of the potential safety impact of the supplied product on the overall aircraft safety



U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: Production Under 14 CFR Part 21, Subparts F, G, K, and O

Date: 10/01/15 **AC No:** 21-43A
Initiated By: AIR-112

This advisory circular (AC) provides information for production approval holders (PAH) pursuant to Title 14 of the Code of Federal Regulations (14 CFR) part 21, Certification Procedures for Products and Articles. This AC provides PAHs and applicants for a production approval with guidance for developing and maintaining a production system that is appropriate to the PAH's operations and complies with the regulations.

Susan J. M. Cabler
Acting Manager, Design, Manufacturing, &
Airworthiness Division
Aircraft Certification Service

Airworthiness Certificate

There are two different classifications of FAA Airworthiness certificates - Standard & Special

- **Signifies individual aircraft's (1) Design conformity, and (2) Condition for safe operation**
  - Certificate is valid if both are true
- **Contingent on proper, continued maintenance**
- **Need Type Certificate to get Airworthiness Certificate**
- **Need Airworthiness Certificate to operate legally (airworthy)**
- **Changes to the aircraft (except routine maintenance) invalidate airworthiness certificate**
  - Paperwork required to "return to service"

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION—FEDERAL AVIATION ADMINISTRATION
STANDARD AIRWORTHINESS CERTIFICATE

1 NATIONALITY AND REGISTRATION MARKS	2 MANUFACTURER AND MODEL	3 AIRCRAFT SERIAL NUMBER	4 CATEGORY
N2631A	PIPER PA-22-135	22-903	NORMAL

5 AUTHORITY AND BASIS FOR ISSUANCE
This airworthiness certificate is issued pursuant to the Federal Aviation Act of 1958 and certifies that, as of the date of issuance, the aircraft to which issued has been inspected and found to conform to the type certificate therefor, to be in condition for safe operation, and has been shown to meet the requirements of the applicable comprehensive and detailed airworthiness code as provided by Annex 8 to the Convention on International Civil Aviation, except as noted herein.
Exceptions

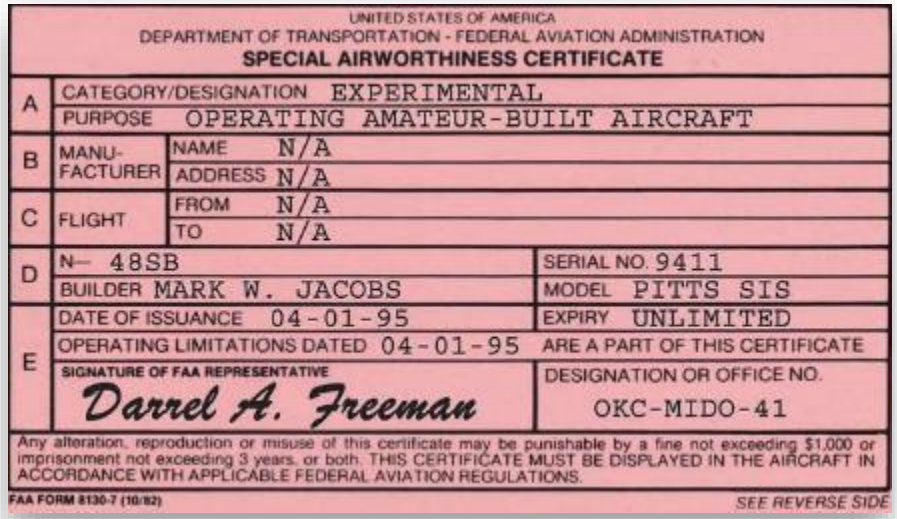
NONE

6 TERMS AND CONDITIONS
Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, this airworthiness certificate is effective as long as the maintenance, preventative maintenance, and alterations are performed in accordance with Parts 21, 43, and 91 of the Federal Aviation Regulations, as appropriate, and the aircraft is registered in the United States.

DATE OF ISSUANCE	FAA REPRESENTATIVE	DESIGNATION NUMBER
08-10-95	MARION W. WILLIAMS	SW-FSDO-OKC

Any alteration, reproduction, or misuse of this certificate may be punishable by a fine not exceeding $1,000, or imprisonment not exceeding 3 years, or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE FEDERAL AVIATION REGULATIONS.

FAA Form 8100-2 (8-82) GPO 892-804



UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION - FEDERAL AVIATION ADMINISTRATION
SPECIAL AIRWORTHINESS CERTIFICATE

A	CATEGORY/DESIGNATION	EXPERIMENTAL	
	PURPOSE	OPERATING AMATEUR-BUILT AIRCRAFT	
B	MANU-FACTURER	NAME N/A	
		ADDRESS N/A	
C	FLIGHT	FROM N/A	
		TO N/A	
D	N- 48SB		SERIAL NO. 9411
	BUILDER MARK W. JACOBS		MODEL PITTS SIS
E	DATE OF ISSUANCE 04-01-95		EXPIRY UNLIMITED
	OPERATING LIMITATIONS DATED 04-01-95		ARE A PART OF THIS CERTIFICATE
	SIGNATURE OF FAA REPRESENTATIVE *Darrel A. Freeman*		DESIGNATION OR OFFICE NO. OKC-MIDO-41

Any alteration, reproduction or misuse of this certificate may be punishable by a fine not exceeding $1,000 or imprisonment not exceeding 3 years, or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE FEDERAL AVIATION REGULATIONS.

FAA FORM 8130-7 (10/82) SEE REVERSE SIDE

Changes to Aircraft

- Repairs must be signed off by FAA approved mechanic with appropriate credentials (power plant, airframe, etc.)
- Minor changes can be approved by FAA inspectors or designees (install radio, repair to upholstery)
- Major changes require FAA engineer or designee approval (changing type of engine, increasing aircraft maximum weight)
- Supplemental Type Certificates required for major design changes
- Production Approval required for parts manufactured for sale with STC

Supplemental Type Certificate

- Issued by the FAA approving a product (aircraft, engine, or propeller) modification
- Defines the product design change, states how the modification affects the existing type design, and lists serial number effectivity
- Identifies the certification basis listing specific regulatory compliance for the design change
- Possession of the STC document does not constitute rights to the design data or installation of the modification

Department of Transportation Federal Aviation Administration

Supplemental Type Certificate

Number ST02127SE

This certificate, issued to: Dugan Kinetics, LLC
8900 State Hwy 3 SW., Suite 201
Bremerton, WA 98367

certifies that the change in the type design for the following product with the limitations and conditions therefore as specified hereon meets the airworthiness requirements of Part 25 *of the* Federal Aviation *Regulations.*

Original Product—Type Certificate Number: A6WE
Make: Boeing
Model: DC-9-81/-82/-83/-87, MD-88

Description of the Type Design Change: Fabrication of Dugan Kinetics Ejector Thrust Reverser in accordance with Dugan Kinetics Master Drawing List (MDL) No. 115-100, Revision A, dated September 14, 2010, and installation in accordance with Appendix B of Dugan Kinetics Maintenance Program Supplement (MPS) Manual No. MPS115-307, Revision B, dated February 25, 2011, or a later FAA-approved revision to either of these documents.

Limitations and Conditions: The installation should not be incorporated in any aircraft unless it is determined that the interrelationship between this installation and any previously approved configuration will not introduce any adverse effect upon the airworthiness of the aircraft.

This ejector thrust reverser installation must be maintained in accordance with Dugan Kinetics Instructions for Continued Airworthiness (ICA) Manual No. ICA115-305, Revision A, dated February 25, 2011, or later FAA-accepted revision. This modification is applicable to the above model aircraft equipped with Pratt and Whitney Turbofan JT8D-217, 217A, -217C or -219 engines only.

A copy of this certificate must be maintained as part of the permanent records for the modified aircraft.

If the holder agrees to permit another person to use this certificate to alter the product, the holder shall give the other person written evidence of that permission.

This certificate and the supporting data which is the basis for approval shall remain in effect until surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator of the Federal Aviation Administration.

Date of application: January 13, 2008
Date of issuance: April 08, 2011
Date reissued:
Date amended:

By direction of the Administrator

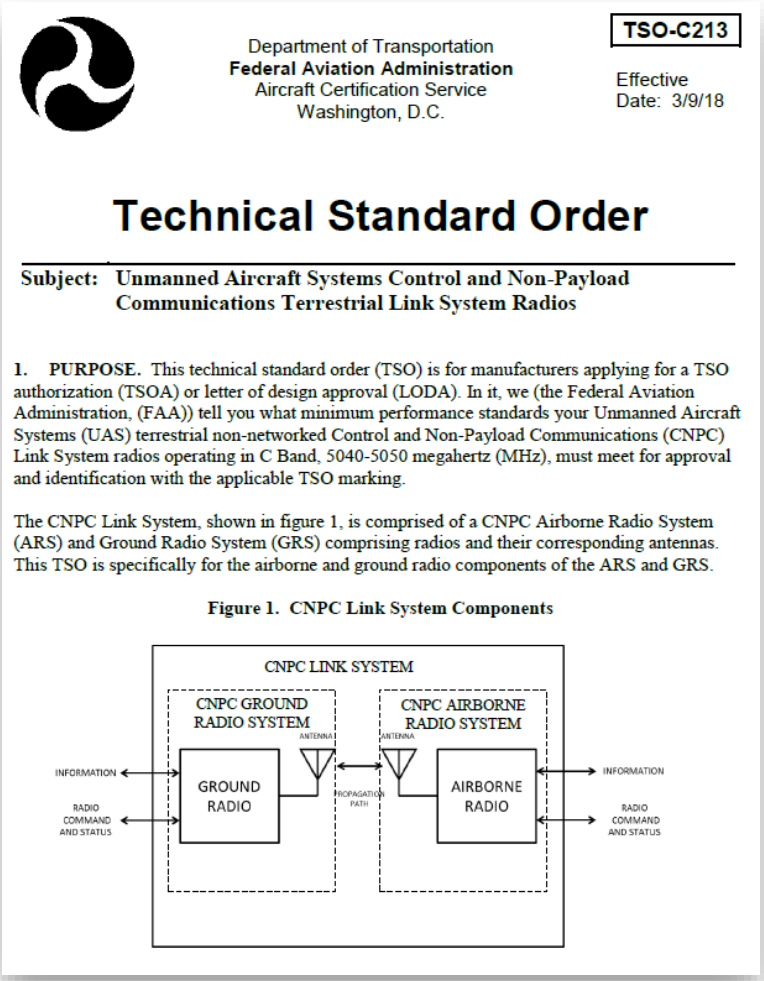
Acting Manager, Seattle Aircraft Certification Office

Any alteration of this certificate is punishable by a fine of not exceeding $1,000, or imprisonment not exceeding 3 years, or both.

This certificate may be transferred in accordance with FAR 21.47.

What is a TSO?

- **TSO stands for Technical Standard Order, which is defined in 14 CFR Part 21, section 21.601(b)(1) as:**
  - "….a minimum performance standard for specified articles (for the purpose of this subpart, articles means materials, parts, processes, or appliances) used on civil aircraft."
- **A TSO authorization is an FAA design and production approval issued to the manufacturer of an article which has been found to meet a specific TSO**
- **Supply chain control is required for TSO's as well as part of the production approval process**



Department of Transportation
Federal Aviation Administration
Aircraft Certification Service
Washington, D.C.

TSO-C213

Effective
Date: 3/9/18

Technical Standard Order

Subject: Unmanned Aircraft Systems Control and Non-Payload Communications Terrestrial Link System Radios

1. PURPOSE. This technical standard order (TSO) is for manufacturers applying for a TSO authorization (TSOA) or letter of design approval (LODA). In it, we (the Federal Aviation Administration, (FAA)) tell you what minimum performance standards your Unmanned Aircraft Systems (UAS) terrestrial non-networked Control and Non-Payload Communications (CNPC) Link System radios operating in C Band, 5040-5050 megahertz (MHz), must meet for approval and identification with the applicable TSO marking.

The CNPC Link System, shown in figure 1, is comprised of a CNPC Airborne Radio System (ARS) and Ground Radio System (GRS) comprising radios and their corresponding antennas. This TSO is specifically for the airborne and ground radio components of the ARS and GRS.

Figure 1. CNPC Link System Components

Certification of Air Carriers: Part 121, 125, 135, 129

Part 121

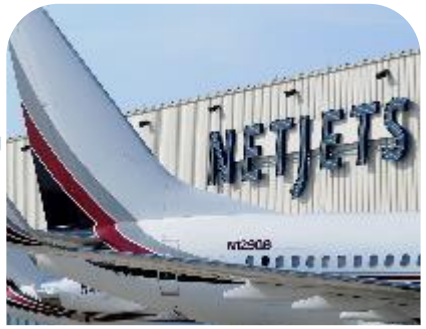
Any domestic, flag or supplemental operation (Scheduled Airlines)

- Domestic Operation - 10 or more pax seats, or a payload capacity greater than 7,500 pounds.
- Flag Operation - 10 or more pax seats, or a payload capacity greater than 7,500 pounds.
- "Supplemental Operation - more than 30 pax seats with a payload capacity of more than 7,500 pounds.

Part 125

Airplanes Having a Seating Capacity of 20 or More Passengers or a Maximum Payload Capacity of 6,000 Pounds or More

- Boeing BBJs



Part 135

Commuter, on demand and air-taxi operations

- Applicable to short distance commercial aircraft operations or "commuters" and nonscheduled carriers that operate "on demand."
- Includes Non-Scheduled Cargo

Part 129

Foreign Air Carriers Operating in the US

- British Airways
- Emirates Air
- EL AL Airlines
- Lufthansa

General Rules For Maintaining Aircraft

- **Part 43 covers the basic rules for maintenance of United States registered aircraft, and component parts**
- **The owner or operator of an aircraft is primarily responsible for maintaining that aircraft in an airworthy condition; maintenance records must be maintained for one (1) year**
- **No person may operate any aircraft that has undergone maintenance, preventive maintenance, rebuilding, or alteration unless;**
  1) approved for return to service by authorized mechanic, and
  2) the maintenance record entry
- **Part 91 covers the basic rules for flight operations, which also establishes the requirements for maintenance programs and records keeping**

AURA