FAA DER APPROVED MODIFICATIONS [Repairs & Alterations] Workshop

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FAA DERT / RS-DER /DARF

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What is a DER?

- A DER [Designated Engineering Representative] are individuals who meet the requirements of 14 CFR Part 183, and order 8100.8.
- The DER designation covers discipline specialties as defined in Order's 8100.8, and 8110.37.
- These delegations are defined by charts

10 Areas

Chart A, DER Structural
Chart B, DER Powerplant Installations
Chart C1, DER Systems and Equipment
Chart C2, DER Systems and Equipment (Electrical Equipment)
Chart D, DER Radio
Chart E, DER Engines
Chart F, DER Propellers
Chart G, DER Flight Analyst
Chart H, DER Flight Test Pilot
Chart I, DER Acoustical

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Delegated Disciplines

(1) Structural engineering,
(2) Powerplant engineering,
(3) Systems and equipment engineering,
(4) Radio engineering,
(5) Engine engineering,
(6) Propeller engineering,
(7) Flight analyst,
(8) Flight test pilot, and
(9) Acoustical engineering.

C1 & C2

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DER CHART A

2-5. DER Designations.

a. Structural DERs may approve, within the limits of their appointment, the following items that comply with pertinent regulation(s):

(1) Engineering reports,

(2) Drawings,

(3) Material and process specifications used in structural applications, and

(4) Other data relating to structural considerations.

Let's look at the chart A layout

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Appendix B. Delegated Functions and Authorized Areas

Figure 1. Chart A, DER Structural

Functions and areas that *can* be authorized are defined by *white squares*. Each DER's authority may be different, and is identified in their letter of appointment.

	DELEGATED FUNCTIONS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
	AUTHORIZED AREAS	Structural-General (1)	Structural-Wing Group	Structural-Fuselage Group	Structural-Empennage Group	Structural-Landing Gear	Structural-Flight Controls	Structural-Rotor	Loading Control Documents	Metallic Materials (2)	Nonmetallic Materials (3)	Interior Arrangements	Interior Materials	Fire Protection	Evacuation Systems	Door Systems	Special (Specify)
1	STATIC ANALYSIS		■	■	■		■		■	■	■	■	■	■	■	■	
2	DYNAMIC ANALYSIS		■	■	■		■		■	■	■	■	■	■	■	■	
3	FATIGUE ANALYSIS		■	■	■		■		■	■	■	■	■	■	■	■	
4	DESIGN AND CONSTRUCTION		■	■	■	■	■	■	■	■	■						
5	FLUTTER/GROUND VIBRATION		■	■	■	■	■	■	■	■	■	■	■	■	■	■	
6	SAFETY ANALYSIS		■	■	■	■	■	■	■	■	■	■	■	■	■	■	
7	FLOTATION & DITCHING ANALYSIS		■	■	■	■	■	■		■	■	■	■	■	■	■	
8	STRUCTURAL LOADING LIMITATIONS	■	■	■	■	■	■	■		■	■	■	■	■	■	■	
9	SERVICE DOCUMENTS								■								
10	MATERIAL & PROCESS SPEC.	■	■	■	■	■	■	■	■		■	■	■	■	■	■	
11	FLAMMABILITY	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
12	DAMAGE TOLERANCE EVALUATIONS		■	■	■	■	■		■	■	■	■	■	■	■	■	

Note (1): Includes all airframe components: wing, fuselage, empennage, landing gear, flight controls, engine mounts, and special components. Does not apply to rotors.
Notes (2) and (3): Select Specialty by Note number and sub-letter from lists below. General applies to all processes listed.

(2) Metallic Materials/Processes
- A - Materials & Processes - General
- B - Non-Destructive Inspection/Testing
- C - Metallurgy
- D - Metal Joining Processes
- E - Structural Adhesives
- F - Mechanical Fasteners
- G - Surface Treatment/Coatings
- H - Bearings

(3) Nonmetallic Materials/Processes
- A - Material & Processes - General
- B - Transparent (Glazed) Material
- C - Polymeric Materials
- D - Structural Adhesives
- E - Mechanical Fasteners
- F - Composites
- G - Non-Destructive Inspection/Testing
- H - Surface Treatment & Coatings
- I - Structural Joining Methods

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Figure 2. Chart B, DER Powerplant Installations

Functions and areas that *can* be authorized are defined by *white squares*. Each DER's authority may be different, and is identified in their letter of appointment.

	DELEGATED FUNCTIONS	AUTHORIZED AREAS A Airplane Turbine Engine	B Airplane Piston Engine	C Rotorcraft Turbine Engine	D Rotorcraft Piston Engine	E Auxiliary Power Unit (APU)	F Special (Specify)
1	ENGINE INSTALLATION						
2	FUEL & OIL						
3	INDUCTION/EXHAUST SYSTEMS						
4	THRUST REVERSERS						
5	FIRE PROTECTION						
6	ICE PROTECTION						
7	COOLING						
8	ENGINE PERFORMANCE/OPERATIONS						
9	INDICATING SYSTEMS						
10	LIGHTNING/HIRF PROTECTION						
11	SOFTWARE						
12	CONTROL SYSTEM - ELECTRONIC						
13	CONTROL SYSTEM - MECHANICAL						
14	EMISSIONS						
15	VIBRATION - ENGINE, PROPELLER, OR DRIVE SYSTEM						
16	PROPELLER						
17	DRIVE SYSTEM						
18	TRANSMISSIONS						
19	SAFETY ANALYSIS						
20	SERVICE DOCUMENTS						

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Figure 3. Chart C1, DER Systems and Equipment (Mechanical Equipment)

Functions and areas that *can* be authorized are defined by *white squares*. Each DER's authority may be different, and is identified in their letter of appointment.

	DELEGATED FUNCTIONS	AUTHORIZED AREAS A Air Conditioning	B Hydraulic	C Ice Protection	D Rain Protection	E Oxygen	F Pneumatics	G Wheels, Tires, and Brakes	H Interior Arrangements	I Interior Materials	J Pressurization	K Fire Protection	L Water System, Potable and Waste	M Evacuation Systems	N Special (Specify)
1	DETAIL DESIGN AND INSTALLATION														
2	EQUIPMENT QUALIFICATION TESTS														
3	SOFTWARE														
4	SAFETY ANALYSIS														
5	FLAMMABILITY														
6	LIGHTNING/HIRF PROTECTION														
7	SERVICE DOCUMENTS														

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Figure 4. Chart C2, DER Systems and Equipment (Electrical Equipment)

Functions and areas that *can* be authorized are defined by *white squares*. Each DER's authority may be different, and is identified in their letter of appointment.

	DELEGATED FUNCTIONS	A	B	C	D	E	F	G	H	I	J	K	L
	AUTHORIZED AREAS	Electrical Equipment/Systems	Electronic Equipment/Systems	Communications Systems/Antennas	Automatic Flight Controls/Augmentation	Instruments	Navigation Systems/Antennas	Air Data/Pitot Static	Warning Systems	Interior/Exterior Lighting	Flight Data/Voice Recording	Passenger Address/Entertainment	Special (Specify)
1	DETAIL DESIGN AND INSTALLATION												
2	EQUIPMENT QUALIFICATION TESTS												
3	SOFTWARE												
4	SERVICE DOCUMENTS												
5	ELECTRICAL LOAD ANALYSIS												
6	SAFETY ANALYSIS												
7	LIGHTNING/HIRF PROTECTION												

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Figure 6. Chart E, DER Engines

Functions and areas that *can* be authorized are defined by *white squares*. Each DER's authority may be different, and is identified in their letter of appointment.

	DELEGATED FUNCTIONS	A	B	C
	AUTHORIZED AREAS	Turbine Engines	Piston Engines	Special (Specify)
1	DETAIL DESIGN			
2	BLOCK TESTS			
3	PERFORMANCE CHARACTERISTICS			
4	VIBRATION ANALYSIS			
5	OPERATION MANUALS			
6	OVERHAUL MANUALS			
7	SERVICE DOCUMENTS			
8	EXHAUST EMISSIONS EVALUATION			
9	SOFTWARE			
10	SAFETY ANALYSIS			
11	LIGHTNING/HIRF PROTECTION			

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What is a DER? [Cont]

- DER's can also be granted additional special delegations that are identified in Order 8110.37 [DER Handbook].These special delegations are not part of the DER basic authority areas. These are:

Approval of Service Documents. ----------
DER International Operating Procedures. ----------
PMA Identicality Procedures. ----------
Repairs and Alterations.----------
Repair Specifications (RS).----------
Flammability Testing of Interior Materials. ----------

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Which FAA branch appoints DER's

- Aircraft Certification Office which is has primary responsibility for engineering and design aspects of any airworthiness data.
- Additional shared responsibilities with Organizational Designees [A/R's] are shared with FAA MIDO for new ODA-TC/PMA designs. And with FAA FSDO for ODA-M/R.

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What types of data can the DER approve

- Repairs, Alterations and other data approved by a Designated Engineering Representative (DER or RS-DER) of the FAA ACO.
- Alternate means of compliance (AMOC) {Ref 14 CFR Part 39}
- Evaluation of repair design data against the same FAA regulations used to issue the aircraft TC (i.e., Part, 23, 25)
- DER issues FAA Form 8110-3 which defines applicability, limitations and ICA for the repair
- Repair is executed to FAA Approved Data [ACO/DER] under the oversight of the cognizant FSDO of the applicant.

→ The Modifications must be as good as or better than the TC design! [14 CFR 1.1]

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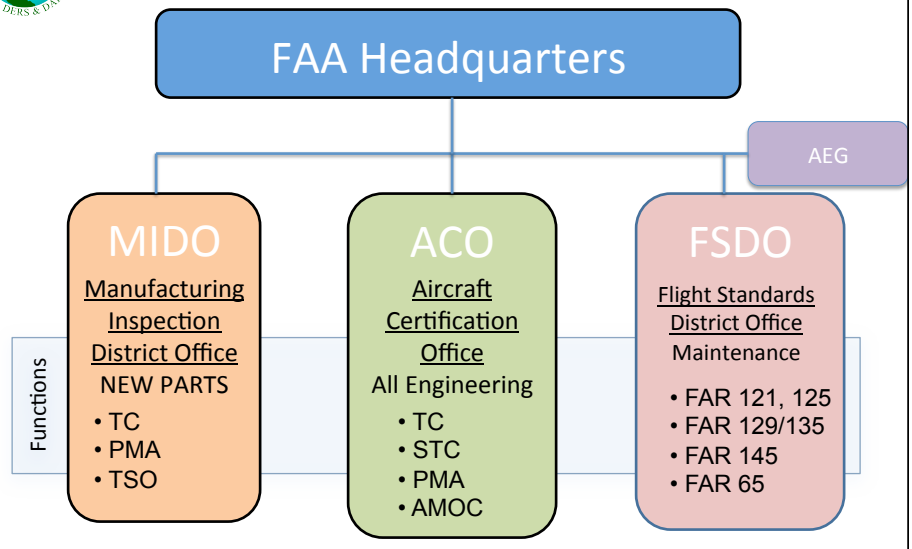
FAA Organizational Structure



Simplified for clarity

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FAA ACO

- ALL Engineering Aspects
  - Design Approvals for all 14 CFR Part 21 Products/Articles
    - TC /Amended TC
    - STC
    - PMA
    - TSO
    - Repairs /Alterations
- Designee & Organizational Oversight
  - DERT, DERY, RS-DER
  - ODA /TC/STC/TSO/PMA & MR

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FAA FSDO

- Maintenance Aspects
  - Repairs
  - Alterations
  - Rebuilds
  - Overhauls
- Airworthiness Rules
  - FAR 65 – Repairmen/Mechanics/Inspection Authorization
  - FAR 43 – Performance Rules
  - FAR 145 – Repair Stations / ODA MR
  - FAR 121, 125, 129, 135 operators
  - ODA MR Oversight & DART Designees

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FAA MIDO

- New Manufacturing & Conformity Inspections Aspects
  - ➢ Oversight of Production Approval Holders [PAH]
    - ✧ TC Holders
    - ✧ PC Holders
    - ✧ PMA PAH
    - ✧ TSO PAH
- Oversight & Designees
  - ➢ ODA TC/PC/PMA/TSO, & DARF/DMIR

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Basic Regulatory Framework

New Aircraft TC	• ACO approves design data showing compliance to FAA requirements (i.e., Part 21, and 23, or 25, 27, 29 etc)
Aircraft Production System	• MIDO approves the Fabrication Inspection System to ensure manufacturing compliance to approved design data
Continued Airworthiness	• FSDO ensures Instructions for Continued Airworthiness (ICA) are properly implemented and executed (e.g., SRM's; , SB, AMM, ESM, CMM's)

Alternate Means of Compliance 14 CFR Part 39 (AMOC) can be used, BUT, must meet the FAA mandated AD requirements or show ELOS.

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FAA Delegation & Oversight Summary

Areas	MIDO	ACO	FSDO	AEG
DER Approval	X	X	X	*
TC/OEM Repairs		X	X	X
PMA/TSO/TC Parts	X	X		X*
PAH Alterations		X	X	*
New AWL		X	X	X

Repairs, whether OEM or DER Approved, are dictated by the same regulations & branches of the FAA [ACO/FSDO/AEG]

New Spares, whether OEM or PMA, are dictated by the same regulations & branches of the FAA [ACO/MIDO/AEG]

* May be req'd

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Why are DER Repairs of Interest?

- Improved part availability
- Lower Part Replacement cost
- Using service experience, design improvements can be implemented to improve part performance (e.g., reliability, weight reduction)
- On Wing Service is extended

Avoid scrapping hard to replace and/or expensive parts

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DER Repair – V2500 Ducting

Engine Anti-Ice & Starter Ducts
Courtesy Exotic Metals

- Typical defects:
  - Chafing, Dents, Cracking
- Problem:
  - CMM has limited repairs
  - Ducts are $25K-$90K to replace and have long lead times
- Solution:
  - FAA DER Approved Repair

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Duct DER Approval Process

Create Repair Plan
- Section replacement
- Dent removal
- Weld repair

Identify Applicable Part Design Chapters
- 25.301 [Loads]; 25.303 [Factor of Safety]; 25.305 [Strength]; 25.307 [Structure] and others…

Substantiate Proposed Repair
- Stress Analysis
- Weld samples & Elongation Testing
- Comparative Analyses
- Inspection criteria (weld x-ray)

Need for Supplemental ICA/AWL?
- Use existing CMM

Submitted to FAA (DER & RS-DER)

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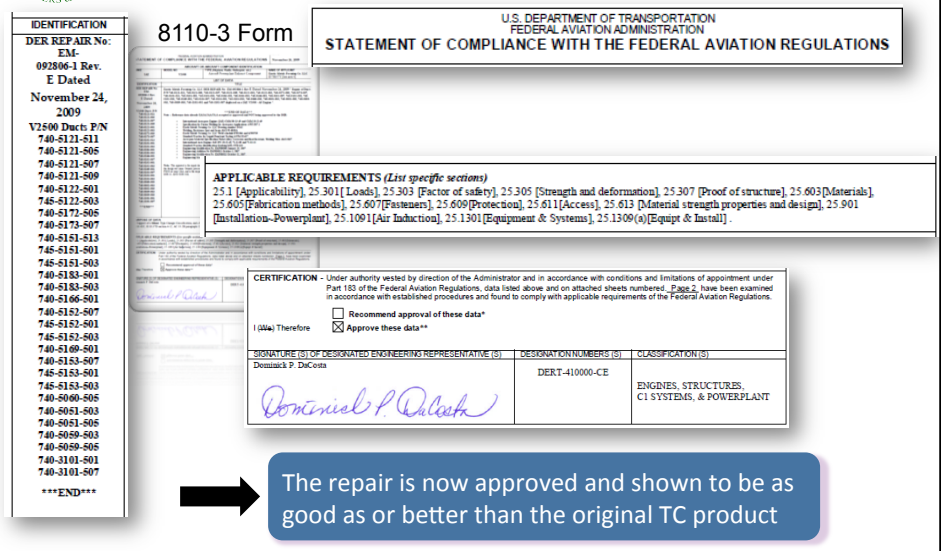
FAA Approved Data



The repair is now approved and shown to be as good as or better than the original TC product

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DER Repair - Exhaust Cone

V2500/A5 Engine Exhaust Cone
Courtesy Exotic Metals

- Typical defects:
  - Cracking in perforated outer skin
- Problem:
  - CMM has limited repairs
  - Cracking re-occurs after short time in service
  - Cones are >$100K to replace
- Solution:
  - FAA DER Approved Repair

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DER Approval Process

- Essentially the same as for the duct example

- In this case design improvements were made to address service difficulties (frequent removals due to cracking)

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V2500 Exhaust Cone Repair

- Primary cracking source eliminated–improved durability
- Weight savings of 1.5lbs per engine
- 40 to 80% reduction in repair or replacement cost
- Lead time cut by > 50%

Courtesy Exotic Metals

Great example of how a DER repair can not only reduce repair cost and TAT, but also improve the product performance!

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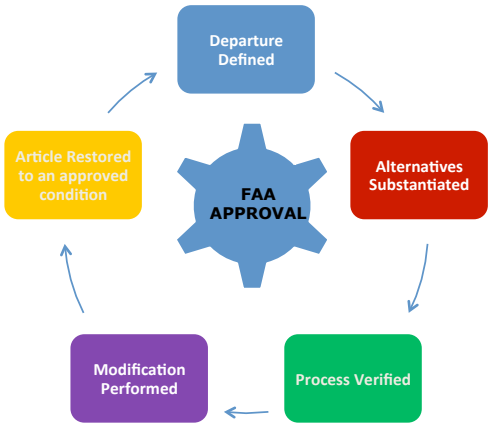
DEVELOPING A NON-BOOK REPAIR

Path to FAA APPROVAL

RepairAlterationModel.pdf

Modification Process Flow



NON-BOOK REPAIRS – An Example

Our Situation is:

1. We have a combustor which we have used existing ESM repair procedure ATA 72-31-12 011 [Repair 011 “Weld cracked cooling holes, blend, re-drill, FPI, re-flow, Pass/Fail. [limits are no adjacent holes can have more than ten (10) connections without one hole interruption that ends the linkage of the crack. You may have up to 210 degrees around one (1) fuel nozzle of total repaired crack length. You may have up to thirteen (13) of twenty six (26) repaired nozzles. [Air flow must be met after all holes are repaired and re-drilled per airflow standard AFS13542-01.

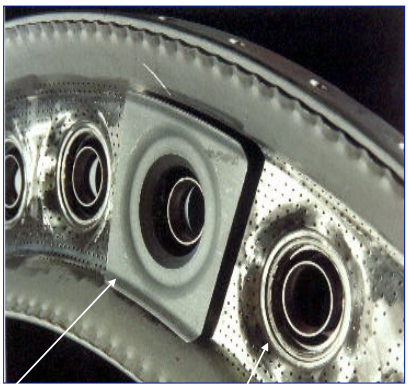
2.Repeated attempts of this repair have proven unsuccessful, and warranty claims by end user and TAT are negative.

3.What shall we do?
   A. OEM has been notified and they have no adequate response.
   B. Develop a DER repair alternative.

Example of a DER Alternative Repair with a Locally Mfg Part – Non-Book Repair

1. A Nozzle SPAD is locally produced, by the repair facility.
2. The damaged area is cut out
3. The new SPAD is welded in place
4. The SPAD & weld is blended
5. The weld repair is NDT Inspected
6. The new SPAD is laser drilled for air cooling holes.
7. The Combustor dome is air flowed and re-inspected to OEM Stds.
8. Repair data is FAA DER approved, in accordance to AC 43-18 Chg 1

A Non-book repair of a Combustor



NON-Book DER Repairs - Continued

- Flange Replacement & Guide Fin Replacement APU exist vent duct

Fab by Maintenance

Missing Spar detail

What Rules Apply to MRP's?

Much depends on WHO is accomplishing the Modification Replacement Part tasks!

- **Repair Stations: 14 CFR Part(s) 43.13, CFR Part(s) 21.303, 21.8, and the specific product design rules [i.e. Part 25, Part 33 etc.], Order(s) 8110.4C, 8110.42C, 8110.37E, 8900.1, 8100.13, 8110.54, AC 33.2b,AC 43 –18 Chg 1, AC 33 -9 Repair, AC 23.1309-1C, AC 25.1309-1A, AC 25.571, AC 33.75-1, AC 20-62D, & AC 120-77]**

What is the Status of DER acceptance in EASA member states

FAA and EASA Reciprocal Acceptance of Repair Data within the United States and European Union

Presented to: Workshop on the Implementation of Annex 2 (Maintenance) to the Agreement between USA and EU

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FAA & EASA RECIPROCAL AGRREMENT

- The FAA and EASA have agreed to reciprocal acceptance of repair data.
  - Implemented through the new US/EU Aviation Safety Agreement, effective May 1, 2011
    - Annex 1, paragraph 3.2.7
    - Technical Implementation Procedures, paragraph 3.3
  - Implemented prior to May 2011 through Bilateral Aviation Safety Agreements Implementation Procedures for Airworthiness with 6 EU member states.

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REPAIR ACCEPTANCE BY EASA & FAA

- **FAA and EASA will accept each others approved repair design data regardless of State of Design of the component/product.**

Two processes established:

- Streamlined Reciprocal Acceptance of repair data for non-critical components and critical components developed by the TC/STC holder
- Formal approval of critical component repair data developed by a third party

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Process 1: Streamlined acceptance of repair data

US to EUROPE:

- **EASA has certificated/validated the product or appliance, i.e. the product has an EASA TC/STC or ETSO approval.**
- **FAA is the authority of the State of Design for the repair design data.**
- **Data approved using the FAA system, major repair data approval via an FAA letter, FAA Form 8110-3, 8100-9 or 337**

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Process 1: Streamlined acceptance of repair data (continued)

EUROPE to US:

- **FAA has certificated/validated the product, part, appliance or component (i.e. the product has an FAA TC/STC or TSO approval).**
- **EASA is acting on behalf of the State of Design for the repair design data.**

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Process 1: Streamlined acceptance of repair data (continued)

EUROPE to US continued:

- **EASA repair design data approval is substantiated via an EASA repair design approval letter or a repair design approval issued under a Design Organisation Approval (DOA), and**
- **The repair is not in an area that is subject to an FAA AD, unless the AD allows for acceptance of an EASA repair design approval**

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Acceptance of repair data

FAA and EASA have agreed to accept each other's systems for the classification and approval of repair data.

- **Data must have a local approval.**
  - **FAA approval for repairs designed in the US system;**
  - **EASA approval for repairs designed in the EU system**

Remember, FAA or EASA must approve/accept the repair design data under its own system before the other bilateral partner can accept it.

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Process 2: CRITICAL COMPONENTS

Formal Approval of Critical Component Repair Data (by other than the TC/STC holder)

- **Make application through FAA/EASA:**
  - **Fast track process when the FAA or EASA can confirm that the applicant has entered into an arrangement with the TC/STC holder for this data.**
  - **Validation process is required when there is no arrangement with the TC/STC holder.**
  - **FAA or EASA will issue its own approval of the critical component repair.**

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EASA & FAA AGREEMENT SUMMARY

- FAA and EASA will accept each others approved repair design data regardless of State of Design of the component/product.
- Critical components will require additional review.

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Summary

- Benefits of DER Approved Repairs
  - Often deliver benefit of reduced maintenance costs
  - Many times improve availability of parts, getting your aircraft back into revenue sooner
  - Offer the potential for design improvements that enhance aircraft utilization and lower operating cost

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