SEMAE3146

Removing and replacing components of aircraft hydraulic systems

Overview

This standard identifies the competences you need to carry out the removal and replacement of components of aircraft hydraulic systems, in accordance with approved procedures. It covers both fixed wing and rotary winged aircraft, and includes a range of hydraulic equipment such as landing gear, flying controls, main and tail rotor control, blade fold, rotor brakes, nose wheel steering, cargo and weapon bay doors, emergency and utility systems and other aircraft specific equipment.

The removal and replacement activities will include making all necessary checks to support and chock pistons/moving parts, isolating and de-pressurising the system, breaking into the system circuit, removing and replacing faulty equipment at component or unit level, replenishing fluids, pressurising the system, setting and adjusting the completed system, and leaving components in a safe condition and ready for testing.

Your responsibilities will require you to comply with organisational policy and procedures for the removal and replacement activities undertaken, and to report any problems with these activities that you cannot personally resolve, or that are outside your permitted authority, to the relevant people. You must ensure that all tools, equipment, and materials used are correctly accounted for on completion of the activities, and that all necessary job/task documentation is completed, accurately and legibly. You will be expected to work with a minimum of supervision, taking personal responsibility for your own actions and for the quality and accuracy of the work that you carry out.

Your underpinning knowledge will provide a good understanding of your work and will provide an informed approach to applying the appropriate removal and replacement techniques and procedures on aircraft hydraulic equipment and systems. You will understand the removal and replacement methods and procedures, and their application, along with the systems maintenance requirements. You will know how the equipment functions, the common problems that can occur, the purpose of the individual components and associated defects, in adequate depth to provide a sound basis for carrying out the removal and replacement activities, and for ensuring that the equipment is replaced to the required standard. In addition, you will have sufficient knowledge of these components to ensure that they are fit for purpose and meet the specifications, thus providing a sound basis for carrying out the replacement.

You will understand the safety precautions required when working on aircraft hydraulic systems, especially those for isolating the equipment. You will be required to demonstrate safe working practices throughout and will understand

your responsibility for taking the necessary safeguards to protect yourself and others in the workplace.

Notes:

1. To display competence in this standard, it is necessary to both remove and replace components from aircraft hydraulic systems. You must remove components; however, you may fit a replacement component where the original was previously removed by another person.
2. The removal of major airframe assemblies, such as undercarriage and flying control surfaces, is covered by other standards.

Performance criteria

You must be able to:

1. work safely at all times, complying with health and safety and other relevant regulations, directives and guidelines
2. follow the relevant aircraft manuals and publications to carry out the required work
3. establish and, where appropriate, mark component orientation for re-assembly
4. ensure that any stored energy or substances are released safely and correctly
5. carry out the removal and replacement activities, within the limits of your personal authority
6. remove and replace the required components, using approved tools and techniques
7. take suitable precautions to prevent damage to components and the surrounding structure
8. complete the relevant documentation, in accordance with organisational requirements
9. label and store (in an appropriate location) components that require repair or overhaul
10. dispose of waste materials and scrap components, in accordance with safe working practices and approved procedures
11. leave the aircraft and the hydraulic system in a safe and appropriate condition, free from foreign object debris and in a condition ready for testing

Knowledge and understanding

You need to know and understand:

1. the specific safety practices and procedures that you need to observe when working on aircraft hydraulic systems and when using synthetic oils (including any specific legislation, regulations/codes of practice for the activities, equipment or materials)
2. the importance of maintenance on, and impact upon (extended twin operations procedures) ETOpS systems, legislation and local procedures
3. the hazards associated with removing and replacing aircraft hydraulic system components, and with the tools and equipment used (such as the need to support the aircraft and/or its components, the use of cylinder chocks and wedges, safe release of pressurised systems, handling hydraulic fluids, misuse of tools) and how to minimise them and reduce any risks
4. the requirements and importance of understanding and applying human factors as defined by the regulatory requirements and the potential impact if these are not adhered to
5. the protective equipment that you need to use for both personal protection (PPE) and protection of the aircraft
6. what constitutes a hazardous voltage and how to recognise victims of electric shock
7. how to reduce the risks of a phase to earth shock (such as insulated tools, rubber matting and isolating transformers)
8. how to extract and use information from aircraft manuals, history/maintenance reports, flight logs, charts, circuit and physical layouts, specifications, symbols used in aircraft hydraulic systems and other documents needed in the removal and replacement process
9. how to carry out currency/issue checks on the specifications you are working with
10. terminology used in aircraft hydraulic systems and the use of fluid power diagrams and associated symbols
11. the various types of pipe and component that make up the aircraft hydraulic

system (such as rigid pipes; flexible hoses; pipe connectors; pipe sealing and supporting devices; valves used for pressure, flow and directional control; double and single action cylinders/actuators; pump; pressure intensifier, mechanical and electrical control device)

12. the principles of operation of the hydraulic system being worked on and the performance characteristics and function of the valves, cylinders/actuators within the circuit

13.
the techniques used to remove components from aircraft hydraulic systems, without damage to the components or surrounding structure (such as release of pressures/force, draining of fluids, proof marking, extraction of components) and the need to protect the circuit integrity by fitting blanking plugs and labelling exposed circuits

14.
the various mechanical fasteners that will need to be removed and replaced and their method of removal and replacement (such as threaded fasteners, special securing devices)

15. the various types of electrical connector that are used, methods of unlocking, orientation indicators and locating and locking in of the connections

16. the importance of applying electrostatic discharge (ESD) procedures when working on sensitive equipment or devices

17. methods of lifting, handling and supporting the components/equipment during the removal/replacement activities

18. the importance of ensuring that the work area is free from dirt, swarf and foreign object damage, and of ensuring that any exposed components or pipe ends are correctly covered/protected

19. recognition of contaminants and the problems they can create; the effects and likely symptoms of contamination in the hydraulic system

20. the need to correctly label and store components that require repair or overhaul and to check that replacement components have the correct part/identification markings

21. how to re-connect components into the circuit (such as the use of gaskets/seals and jointing/sealing compounds; ensuring correct tightness of pipe fittings and valve connections; eliminating stress on pipework/connections; ensuring that pipework is supported at suitable intervals; carrying out visual checks of all components; checking the security of joints and that the system is safe to re-pressurise)

22. how to make adjustments to components/assemblies to ensure that they function correctly (such as pressure settings and their effect on the system, travel and working clearance)
23. why electrical bonding is critical and why it must be both mechanically and electrically secure
24. why securing devices need to be tightened to the correct torque, locked and labelled, and the different methods that are used
25. the tools and equipment used in the removal and replacement activities and their calibration/care and control procedures
26. why tool/equipment control is critical and what to do if a tool or piece of equipment is unaccounted for on completion of the activities
27. the problems that can occur with the removal/replacing operations and how these can be overcome
28. the recording documentation to be completed for the activities undertaken and where appropriate, the importance of marking and identifying specific pieces of work in relation to the documentation
29. the procedure for the safe disposal of waste materials, scrap components and hydraulic fluids
30. the extent of your own authority and to whom you should report if you have a problem that you cannot resolve

Scope/range related to performance criteria

1.

Carry out all of the following during the removal and replacement activity:

1.1 obtain clearance to work on the aircraft, and observe all relevant safety procedures
1.2 obtain and use the appropriate documentation (such as job instructions, aircraft manuals, technical instructions, and other relevant maintenance documentation)
1.3 adhere to procedures or systems in place for risk assessment, COSHH, personal protective equipment and other relevant safety regulations and procedures to realise a safe system of work
1.4 obtain the correct tools and equipment for the activity and check that they are in a safe. tested and usable condition and within current certification/calibration date
1.5 ensure the safe isolation and depressurisation of the hydraulic equipment before breaking into the system
1.6 ensure that all relevant safety devices and mechanical/physical locks are in place (where appropriate)
1.7 where appropriate, apply electrostatic discharge (ESD) protection procedures
1.8 use approved removal and replacement techniques and procedures at all times
1.9 ensure that components and surrounding structures are maintained free from spillages, damage and foreign objects
1.10 return all tools and equipment to the correct location on completion of the activities

2.

Remove components from three of the following aircraft hydraulic systems, and replace components from three of the following aircraft hydraulic systems:

2.1 main undercarriage
2.2 flying controls
2.3 doors (such as cabin, cargo, hold)
2.4 nose undercarriage
2.5 rotor brakes
2.6 weapon bay doors
2.7 tail undercarriage
2.8 blade fold
2.9 emergency systems
2.10 nose wheel steering
2.11 main rotor control
2.12 utility systems
2.13 main gear steering
2.14 tail rotor control

2.15 ram air turbine (RAT)
2.16 wheel braking system
2.17 spoilers
2.18 damping mechanisms
2.19 outriggers
2.20 other specific hydraulic systems (such as hoists)

3.

During the activities identified in scope 2 above, you must cover the removal and replacement of the following:

Major hydraulic components: Remove and replace two of the following:

1. pumps
2. pressure intensifiers
3. reservoirs/tanks
4. hydraulic motors
5. brake units
6. actuators/rams
7. oil coolers
8. accumulators
9. control valves

Other system components: Remove and replace two of the following:

10. filters
11. pipes and hoses
12. gauges
13. non-return valves
14. pressure reducing valves
15. hydraulic fuses
16. regulators
17. sensors
18. computers/control cards

1.

Carry out all of the following removal and replacement activities:

1.1 chocking and supporting components
1.2 replacing all 'lifed' items (seals, filters, gaskets)
1.3 releasing stored pressure
1.4 positioning and aligning replaced components
1.5 draining and removing fluids
1.6 making mechanical connections
1.7 disconnecting electrical connections
1.8 making electrical connections
1.9 disconnecting/removing hoses and pipes

1.10 tightening fastenings to the required torque
1.11 applying and removing covering/protection to exposed components, wires, pipework or vents
1.12 replacing damaged/defective components
1.13 applying bolt locking methods (such as split pins, wire locking, lock nuts)
1.14 replacing fluids and bleeding the system
1.15 making 'off-load' checks before re-pressurising
1.16 checking components for serviceability
1.17 re-pressurising the system
1.18 labelling (and storing in the correct location) components that require repair or overhaul
1.19 setting, and adjusting replaced components (such as travel, working clearance)

2.

Remove and replace aircraft hydraulic components in compliance with one of the following:

2.1 Civil Aviation Authority (CAA)/European Aviation Safety Agency (EASA)
2.2 extended twin operations procedures (ETOpS) (where appropriate)
2.3 Ministry of Defence (MoD)
2.4 Military Aviation Authority (MAA)
2.5 Aerospace Quality Management Standards (AS)
2.6 Federal Aviation Authority (FAA)
2.7 BS, ISO or BSEN standards and procedures
2.8 customer standards and requirements
2.9 company standards and procedures
2.10 aircraft manufacturer's requirements

3.

Complete the relevant paperwork, to include one from the following and pass it to the appropriate people:

3.1 job cards
3.2 computer records
3.3 aircraft service/flight log
3.4 aircraft log book
3.5 permit to work/formal risk assessment

Behaviours

You will be able to apply the appropriate behaviours required in the workplace to meet the job profile and overall company objectives, such as:

- strong work ethic
- positive attitude
- team player
- dependability
- responsibility
- honesty
- integrity
- motivation
- commitment

SEMAE3146

Removing and replacing components of aircraft hydraulic systems

Developed by	Enginuity
Version Number	3
Date Approved	30 Mar 2021
Indicative Review Date	01 Mar 2024
Validity	Current
Status	Original
Originating Organisation	Enginuity
Original URN	SEMAE3146
Relevant Occupations	Engineer, Engineering, Engineering and Manufacturing Technologies, Engineering Technicians
Suite	Aeronautical Engineering Suite 3
Keywords	Aeronautical; engineering; aircraft hydraulic systems; fixed wing; rotary wing; landing gear; flying controls