Civil Aviation Authority

MANDATORY PERMIT DIRECTIVE

Number: 2016-001 R1

Issue date: 20 February 2017

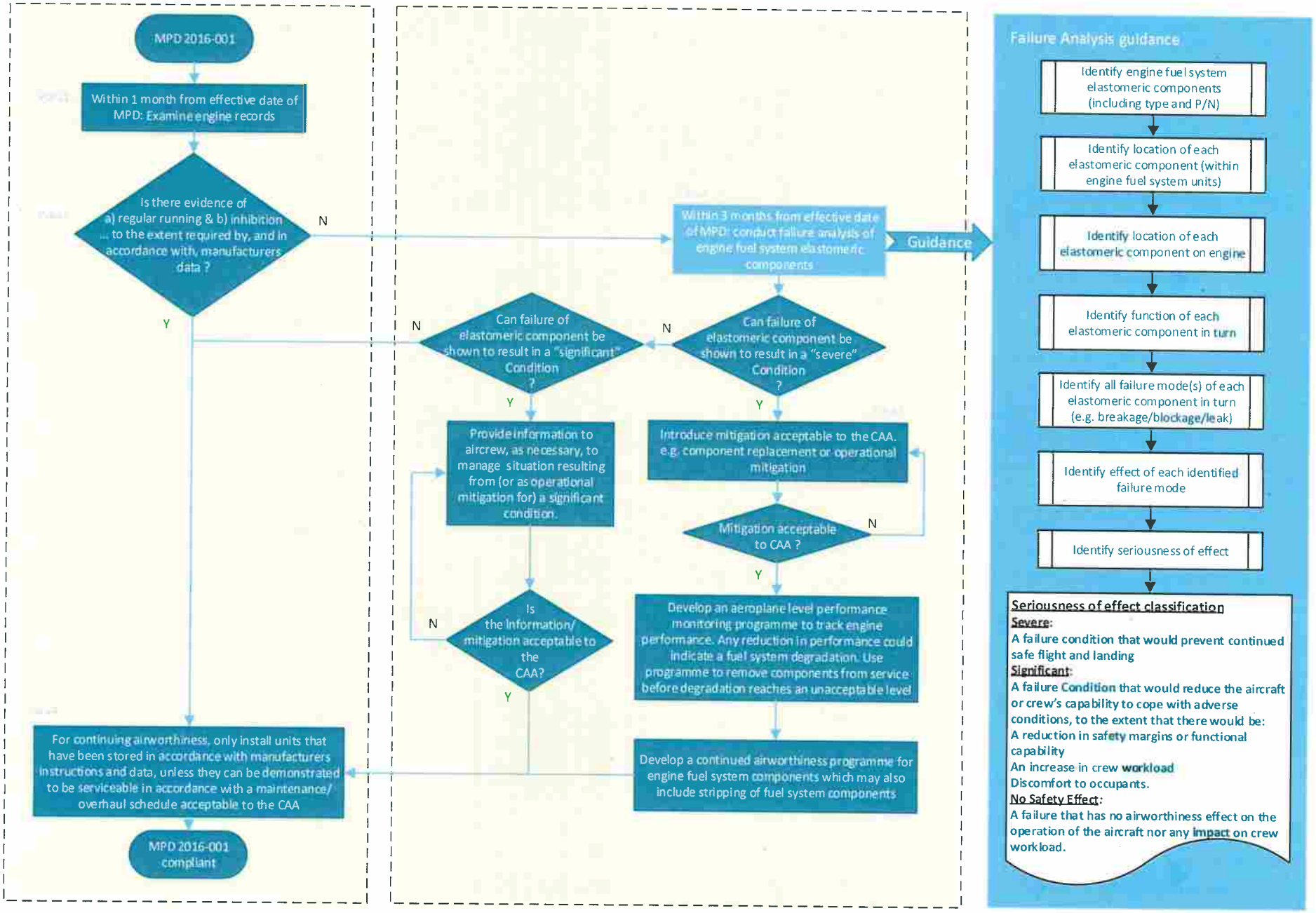
In accordance with Article 41(1) of The Air Navigation Order 2016, as amended, the following action required by this Mandatory Permit Directive (MPD) is mandatory for applicable aircraft registered in the United Kingdom operating on a UK CAA Permit to Fly.	
Type Approval Holder's Name: Rolls-Royce, de Havilland, Motorlet, Ivchenko	**Type/Model Designation(s):** Rolls-Royce Avon series, Rolls-Royce Viper series, Rolls-Royce Orpheus series, Rolls-Royce Nene series, Rolls-Royce Derwent series, de Havilland Goblin series, de Havilland Ghost series, Motorlet M701 series, Ivchenko AI-25 series
Title:	Engine Fuel System – Ageing Effects
Manufacturer:	Rolls-Royce, de Havilland, Motorlet, Ivchenko
Applicability:	Turbine engines of the following types fitted to ex-military jet aircraft: Rolls-Royce Avon series, Rolls-Royce Viper series, Rolls-Royce Orpheus series, Rolls-Royce Nene series, Rolls-Royce Derwent series, de Havilland Goblin series, de Havilland Ghost series, Motorlet M701 series, Ivchenko AI-25 series
Reason:	During an investigation following an accident involving a turbojet powered aircraft, CAA has been notified of significant deterioration in a rubber coated diaphragm used in the fuel pump of an engine fuel system. While not being considered a factor in the accident, the deterioration observed has been attributed by the engine manufacturer to ageing, chemical attack and air exposure. Such components were not lifed by the original manufacturer, since the extended calendar times in service now experienced in civil operation were not envisaged for the original military operation. Once fitted to an engine, the life of rubber or rubber coated seals and diaphragms can be affected by various factors including fuel type, operating environment, compression load and time. Stale fuel in contact with diaphragms and seals over long periods with the aircraft parked or stored causes attack of rubber parts due to reaction with the material.

Reason Cont:	Draining of fuel away from diaphragm and seal faces during periods of inactivity also leads to air exposure, loss of plasticity and subsequent cracking. During periods of inactivity, it is therefore important that regular running and/or inhibiting of fuel systems is carried out in accordance with the manufacturer's instructions. Note that many manufacturers specify the need for action to protect the fuel system after as little as 1 month of inactivity. Failure of an elastomeric component within a fuel system unit could lead to interruption of the fuel supply to the engine and therefore to partial or total engine failure. This unsafe condition, if not corrected, could lead to an emergency landing or the need to abandon the aircraft. Note: An unsafe condition is accepted by the CAA as: An unsafe condition exists if there is factual evidence (from service experience, analysis or tests) that: a) An event may occur that would result in fatalities, usually with the loss of the aircraft, or reduce the capability of the aircraft or the ability of the crew to cope with adverse operating conditions to the extent that there would be: i) A large reduction in safety margins or functional capabilities, or ii) Physical distress or excessive workload such that the flight crew cannot be relied upon to perform their tasks accurately or completely, or iii) Serious or fatal injury to one or more occupants unless it is shown that the probability of such an event is within the limit defined by the applicable certification specifications, or b) There is an unacceptable risk of serious or fatal injury to persons other than occupants, or c) Design features intended to minimise the effects of survivable accidents are not performing their intended function. For the purposes of this MPD, an unsafe condition is a "severe" failure of an elastomeric component such that continued safe flight and landing would be prevented. This MPD is raised to require a review of records of ageing fuel systems used on ex-military gas turbine jet engines to check that fuel system protection has been carried out in accordance with the manufacturer's instructions. At Revision 1 of this MPD, paragraph (2) has been amended to require the identification of any actions necessary as a result of "significant" failures and the provision of any necessary crew information. This action has been added to the MPD as it was considered that while "significant" failures are not unsafe conditions, in order to maintain an appropriate level of safety, they may still require crew actions to mitigate the failures. Paragraph (4) has been added as a result.

Reason Cont:	In addition, paragraph (6) has been introduced to require the repetitive application of this MPD every 12 months. CAA views this as an interim step while the investigation continues, with the potential for further action.
Effective Date:	The original MPD became effective on 10 October 2016. Revision 1 becomes effective on 24 February 2017.
Compliance/Action:	1) For any applicable turbine engine with calendar time greater than 20 years since last overhaul: Within 1 month or 10 flying hours from the effective date of this MPD, whichever limit is reached first: Examine the engine records subsequent to the release from military service and record evidence found of: a) Regular running of the engine, shown to be at intervals and to methods in accordance with manufacturer's instructions and b) Inhibition of the engine fuel system in accordance with manufacturer's instructions after any period of inactivity specified in the relevant operating manuals. If, following examination of the records, it can be shown that the engine has been run at the specified intervals and inhibited in accordance with the manufacturer's instructions, the requirements of this paragraph can be considered to have been met and paragraphs (2), (3) and (4) are not applicable. 2) Following examination of the records, for any engine which cannot be shown to have been run at specified intervals and inhibited in accordance with the manufacturer's instructions, within three months from the effective date of this MPD, conduct a failure analysis of the elastomeric components in the engine fuel system units and determine the seriousness of each mode of failure. Guidance material is provided with this MPD which includes the classification of the different levels of seriousness. If there are "severe" failures, i.e. failure of any elastomeric component within any particular fuel system unit that would prevent the aeroplane's continued safe flight and landing, paragraph (3) of this MPD is applicable. If there are "significant" failures, i.e. failure of any elastomeric component within any particular fuel system unit that could potentially reduce the aircraft or crew's capability to cope with adverse conditions to the extent that there would be a reduction in safety margins or functional capability, an increase in crew workload or discomfort to occupants, paragraph (4) of this MPD is applicable. Note: Such a failure analysis is considered an Alternative Method of Compliance (AMOC) and requires separate CAA acceptance. The authors of the analysis and the analysis method to be used are to be acceptable to the CAA.

Compliance/Action Contd:	3) If the failure analysis identifies "severe" failures, the AMOC must be enhanced and include: a) Mitigation, acceptable to the CAA, of the "severe" failures b) Based on the outcome of the failure analysis, development of an ongoing aeroplane level performance monitoring programme may be required to assess deterioration within the fuel system and remove parts from service before this reaches an unacceptable level. c) Based on the outcome of the failure analysis, a continuing airworthiness programme for the engine fuel system items, potentially including a programme of stripping of fuel system units, may also be required. 4) For any failures that are categorised as "significant", any actions required by the crew following the identification of such a failure must be defined. If such actions are not already covered by the aircraft flight manual/pilot's operating handbook/pilot's notes, supplementary information must be provided to and accepted by the CAA. 5) Due to the potential for age related deterioration, from the effective date of this MPD, do not install engine fuel system units which have not been stored in accordance with manufacturer's instructions and any time limits specified unless they can be demonstrated to be serviceable in accordance with a maintenance/overhaul schedule acceptable to the CAA. 6) Repeat the actions in paragraph (1) every 12 months and if necessary carry out the requirements in paragraphs (2), (3) and (4).
ENSURE COMPLIANCE WITH THIS MPD IS RECORDED IN THE AIRCRAFT LOGBOOK	
Reference Publications:	Nil
Remarks:	1. The original issue of this MPD was posted on 18 February 2016 as PMPD 16-01 for consultation until 29 February 2016. 2. If requested and appropriately substantiated, the CAA may accept Alternative Methods of Compliance to this MPD. Application for an Alternative Method of Compliance (AMOC) must be made to the CAA and, if agreed, the CAA will issue a written acceptance that confirms the AMOC meets the necessary compliance requirements. 3. Enquiries regarding this Mandatory Permit Directive should be referred to: GA Unit, Civil Aviation Authority, Safety and Airspace Regulation Group, Aviation House, Gatwick Airport South, West Sussex, RH6 0YR. Telephone: +44 (0)1293 573988 E-mail: ga@caa.co.uk

MPD 2016-001 Engine Fuel Systems – Ageing Effects Guidance Material (GM)



GM to Engine Fuel System – Ageing Effects. Elastomeric Component Failure Analysis

Company Name: Aircraft type/serial: Engine type/model:

Elastomeric component definition *What is it? Where is it? What does it do?*						Elastomeric component failure analysis *What could possibly go wrong? How serious is it?*			Significant & Severe effect Mitigation
No.	Type (Seal, diaphragm, etc.)	Part number	Location in system (pump, connection, etc.)	Location on engine (high vibration/hot /swamp – Visible/not visible when installed)	Function	Functional failure mode (Leak, blockage, etc.)	Functional effect of failure (Degraded performance, lost function, etc.)	Severity of effect[1]	Component replacement or operational/ maintenance mitigation[2]
1	Diaphragm	AB-12-XY-2	Fuel Pump	Visible when installed on combustor case when accessed t.a.w. manual	Primary function e.g. fuel feed regulation	Leak/blockage	Loss of fuel feed (engine thrust reduction/shutdown)	Significant/Severe	
							Excess fuel feed (Excess engine speed/possible trigger of overspeed protection)	Significant/Severe	
					Secondary function e.g. overspeed protection	Leak/blockage	Loss of overspeed protection by diaphragm (Overspeed protection provided by two systems rather than three)	Significant	
2	Etc.						Unintended overspeed activation (engine shutdown)	Severe	

The severity of each functional failure effect is to be classified in accordance with the following criteria:

- **Severe:**
  A failure that would prevent continued safe flight and landing.
- **Significant:**
  A failure condition that would reduce the aircraft or crew's capability to cope with adverse conditions, to the extent that there would be:
  - A reduction in safety margins or functional capability
  - An increase in crew workload
  - Discomfort to occupants
- **No Safety Effect:**
  A failure that has no airworthiness effect on the operation of the aircraft, nor any impact on crew workload.

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[1] Failures classified as Severe require mitigation. The example shown that three of the identified four failures could be classified as severe. However, any one failure mode of each unit classified as severe drives the need for mitigating action. Such mitigation needs to be acceptable to the CAA.

[2] Failures classified as significant or severe require mitigation. Component replacement or development of new procedure to be defined if necessary. If no additional mitigation is required beyond that of existing AFM/MOM/AMM procedures, enter the reference to the relevant procedure.