Chapter 5

PUMP, FUEL, TYPE SPE.3506

LIST OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

LIST OF APPENDICES

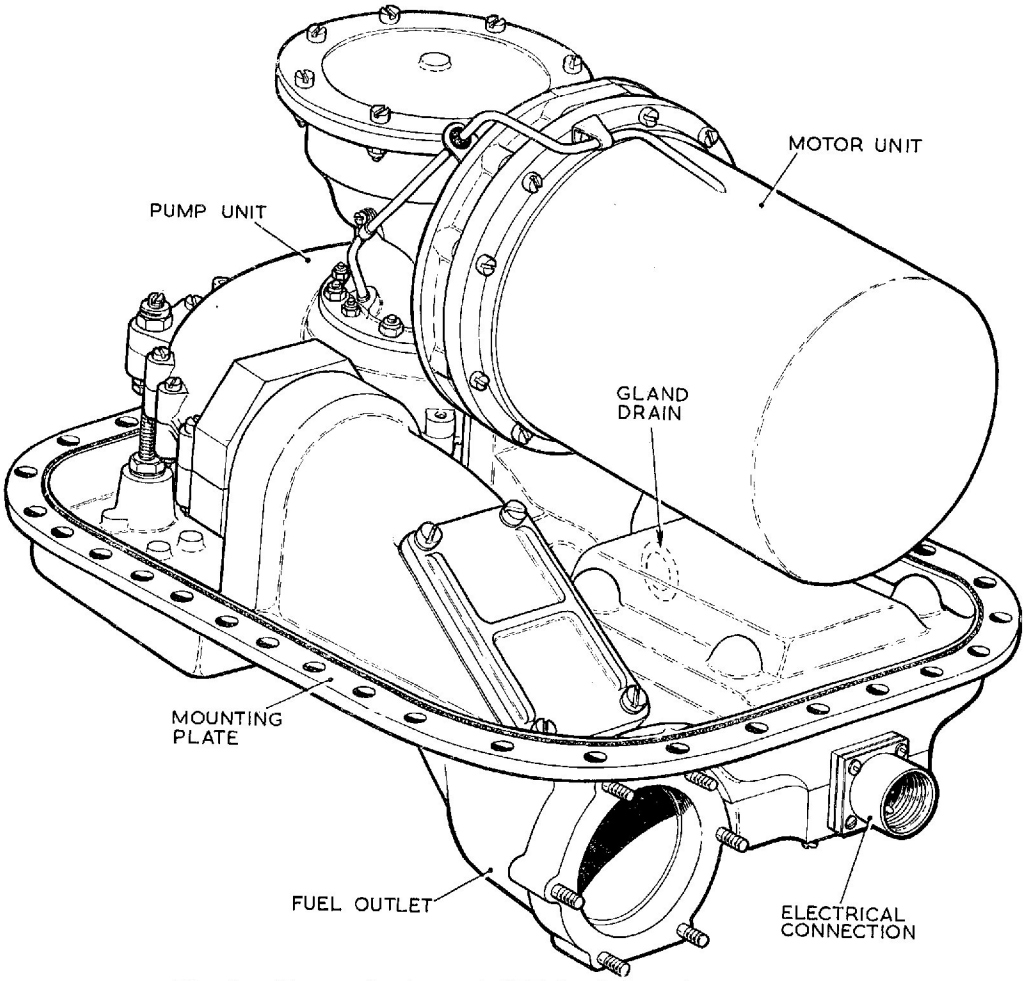

Fig. 1. External view of SPE.3506 fuel booster pump

Introduction

1. Type SPE.3506 pumps are designed to maintain the required fuel flow to the aircraft engine driven pump under the varying fuel temperature and altitude conditions experienced in flight. The units are of the inclined-base sump mounting type and comprise a two-stage centrifugal pump driven through right-angle bevel gearing by a d.c. motor. Details of the differences between the mark numbers of SPE.3506 pumps, together with the Leading Particulars, are given in the appendices to this chapter.

DESCRIPTION

General

2. A typical SPE.3506 pump is shown in Fig. 2. The basic pump design is a self-contained unit comprising three main sub-assemblies:

(1) The pump unit.
(2) The driving motor unit.
(3) The mounting plate.

Pump unit

3. The two stage centrifugal pump unit, driven through right-angle bevel gearing, comprises first stage helical and second stage centrifugal impellers mounted to a common vertical shaft. This shaft is supported at its upper end by a shielded ball bearing and at its lower end in a plain carbon bearing lubricated by fuel. Fuel from the impeller system is fed into a spiral volute and then passes into the main delivery line through an outlet duct cast into the pump mounting plate.

4. The main pump casting houses the impeller system and also contains the metallic bellows type gland which prevents fuel ingress into the gear chamber and motor unit.

Any slight fuel leakage past this gland will be contained by shaft seals and a labyrinth type thrower arrangement; fuel discharged by the thrower is drained through channels in the pump castings and external piping to atmosphere.

5. A wire mesh filter, surrounding the fuel inlet to the pump, prevents the entry of foreign matter into the impeller system. Separation of fuel and air vapour, which may be dissipated from the tips of the helix blades, is assisted by a guide cone which is fitted around this inlet.

6. The delivery outlet of the volute assembly is connected, by means of an internal sleeve and seal rings, to an outlet duct which is cast integrally with the inclined sump mounting plate. A simple flap valve in the outlet duct, normally held open by the fuel delivery pressure, serves to minimise the reverse flow through the pump during refuelling operations.

bearings, both of which are pre-packed during manufacture, with an anti-freeze high melting point grease, and cannot be relubricated. The outer bearing assembly includes a pre-load washer to introduce an end load on the armature shaft, thus maintaining constant bearing contact between the inner and outer races through the balls.

8. The extended armature shaft carries the bevel pinion component of the right-angle reduction gearing used to transmit the motor drive to the pump unit. Lubrication of the gears is provided for during assembly and no further lubrication during the normal life of the pump is necessary.

Mounting plate

9. The sump mounting plate is inclined to suit the configuration of the aircraft fuel tank, and is attached to the tank stud ring. Sealing is effected by a synthetic rubber seal ring which is cemented into position on the upper surface of the mounting plate, and provision

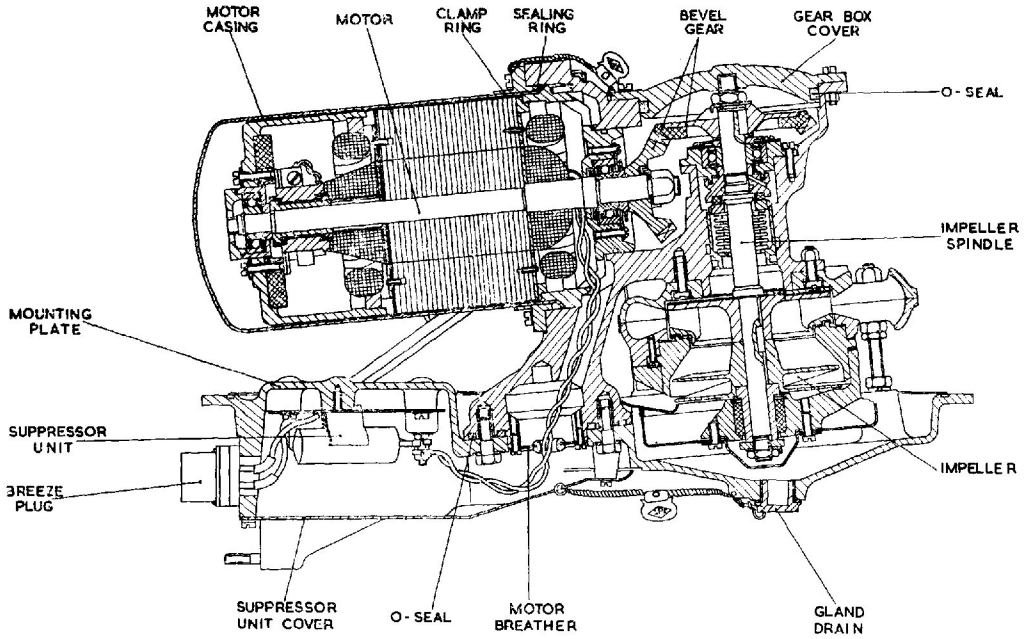

Fig. 2. Sectional view of SPE.3506 fuel booster pump

Motor unit

7. The motor unit is a totally enclosed, compound wound, two-pole machine operating on a d.c. supply. Brush gear is of unit construction to facilitate assembly and the armature shaft is supported by two shielded ball

is made for drawing off any water which may settle at the bottom of the fuel tank. The mounting plate carries the electrical connection and gland drain tappings, together with a housing for the two radio interference noise suppressors. An access cover to the

suppressor unit housing is provided in the base of the mounting plate.

OPERATION

10. Fuel from the tank enters the pump through a wire mesh filter and is picked up by a helical impeller which serves the dual purpose of de-aerating and pressurising the fuel at the eye of the centrifugal impeller. This latter forces the fuel through the spiral volute into the outlet duct and delivery line.

11. Under conditions in which the flow from the pump is low due to reduced engine requirements, the impellers continue to rotate at approximately normal speed without causing any excessive increase in fuel pressure.

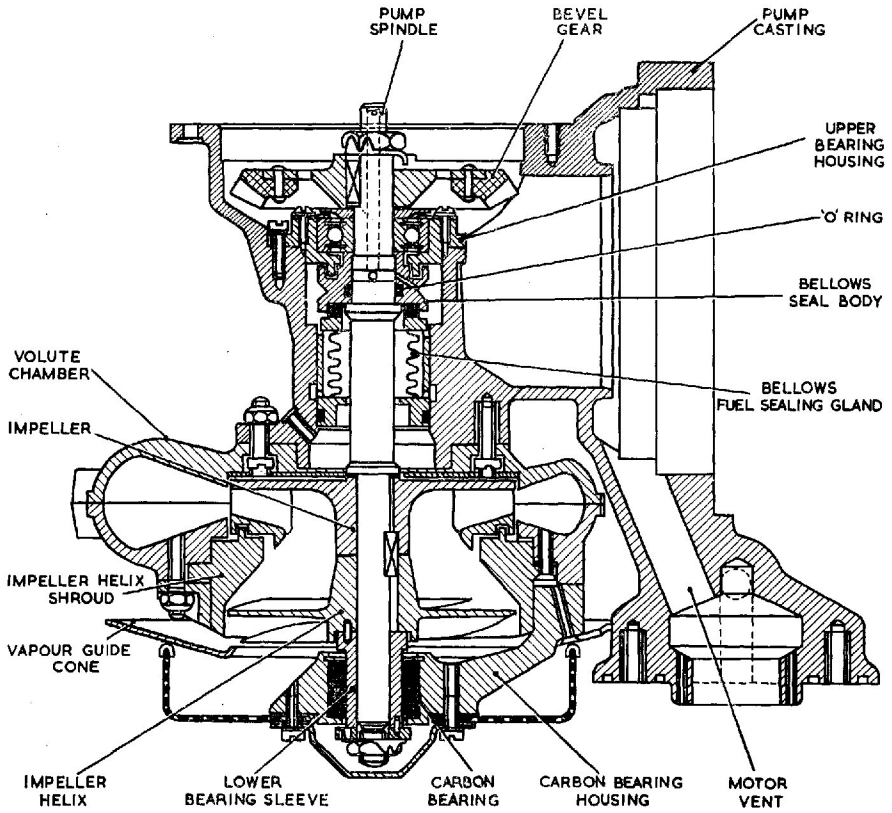

Fig. 3. Sectional view of pump unit

12. The original design of this pump included a by-pass valve. This was superseded by the fitting of a valve external to the pump in the fuel delivery line with a connection to the tank. When fuel pump delivery pressure in this valve is relieved due to the pump failing, the valve opens to allow the engine driven pump to draw fuel directly from the tank without it passing through the pump impeller system.

REMOVAL AND INSTALLATION

Removal

13. Before attempting to remove a pump, ensure that the tank has been drained of fuel and that the electrical supply to the pump has been switched off. The former can be checked by easing the drain plug in the base of the sump mounting plate.

14. The precise method of removing an SPE.3506 fuel pump is detailed in the appropriate Aircraft Handbook. In general terms it will consist of disconnecting the fuel delivery line at the stud ring on the mounting plate, the gland drain pipe and the electrical connection socket. The pump can then be removed by releasing the thirty eight nuts and lockwashers securing it to the tank mounting ring. Take care to support the weight of the pump during this operation.

Pre-installation checks

15. The installation of a new pump should be preceded by the following checks:—

(1) Ensure that the pump has not been stored for longer than the specified maximum periods (i.e. 12 months in the original packing and carton as supplied by the pump manufacturer, or 3 years where special packing has been provided). Pumps stored for periods in excess of these maxima must not be used without being dismantled, examined and tested as detailed in Vol. 6.

(2) Inspect the exterior of the pump for evidence of damage, security of locking wires, general cleanliness and corrosion. Blend out slight areas of corrosion and apply an approved protective finish (chromic acid solution) to the unprotected area.

(3) Check that transit plugs and caps have been removed from the fuel delivery stud ring, electrical and gland drain connections and remove any tape or any other protective material from the inlet filter and motor breather gauzes.

(4) It is advisable to make a starting check on the pump before installation. Apply a 110V d.c. electrical supply through the electrical connection on the mounting plate. The pump must start immediately. Repeat the test several times. If the pump fails to start immediately it should be returned to an overhaul base for further testing using approved equipment.

Installation

16. The above pre-installation checks apply to all aircraft installations of these pumps. For detailed procedure covering installation in a particular aircraft, reference should be made to the relevant Aircraft Handbook.

17. As a general example, installation in the aircraft will comprise the following operations:—

(1) Ensuring that the seal ring in the periphery groove of the mounting plate is secure at all points. The seal ring is fixed in position with rubber cement and must be renewed at each overhaul of the pump assembly or whenever there is any evidence of deterioration.

(2) Securing the pump mounting plate to the fuel tank stud ring.

Note . . .

Tighten diagonally opposite nuts in turn by degrees to ensure an even compression of the seal ring.

(3) Connecting the fuel delivery pipe to the mounting plate stud ring using gaskets and jointing compound as detailed in the appropriate Aircraft Handbook.

(4) Re-connecting the gland drain pipe. Ensure when relevant that the level of this pipe is at no point higher than the connection to the mounting plate when the aircraft is on the ground or in level flight attitude.

Note . . .

The outlet end of the pipe must be external to the aircraft and must terminate in a low pressure area. The end of the pipe should be cut at 45 degrees with chamfer facing aft. Failure to fit this pipe correctly could result in fuel, which may have seeped past the main gland, washing away grease from the gear chamber or the pump and motor unit bearings, thus causing motor or pump failure.

(5) Reconnecting the electrical supply lead plug to the socket on the mounting plate.

(6) Wire-locking all external pipe connections, union nuts, etc.

SERVICING

Routine inspection

18. At routine inspections the following procedure applies:—

(1) Inspect all the pipe connections and external wire-locking to the pump. Check the joint between the fuel mounting plate and the tank for leakage. Correct as necessary.

(2) Test the pump as detailed in para. 20-26. If the pump performance is found to be unsatisfactory in any way, the pump must be removed from the aircraft and new or reconditioned unit fitted. No in-situ maintenance is possible.

19. At the periods laid down in the appropriate Servicing Schedules, all pumps are to be replaced by new or reconditioned units drawn from Stores. Faulty and time expired pumps must be returned to a Maintenance Unit or to the manufacturer for repair.

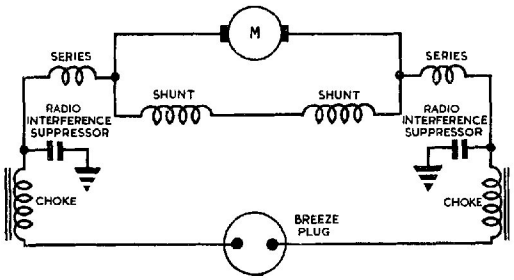

Fig. 4. Circuit diagram

Electrical Test

20. A routine electrical test in accordance with the appropriate Servicing Schedule should be made to ascertain that the motor unit is functioning satisfactorily. These tests must be made with the motor unit on load i.e. -immersed in and pumping fuel. The pump must be replaced by a new or reconditioned unit if there is any evidence of erratic performance such as excessive current consumption.

'No fuel flow' test

Note . . .

The following 'no fuel flow' electrical test is only applicable to aircraft with the necessary test instrumentation. Where no test panel is provided, particular attention must be paid to the electrical test (para. 20) and to the operational test (para. 24).

21. Ascertain the positions of the aircraft pump test socket and switches by reference to the relevant Aircraft Handbook. Proceed as follows :—

(1) Close all fuel cocks between the pumps and the engines to ensure that no fuel can flow.

(2) Connect a suitable portable ammeter to the socket on the test panel.

Note . . .

When using a clip-on type ammeter the tongs should be opened and closed smartly prior to use to reduce the hysteresis error.

(3) Switch on the pump by depressing the switch on the test panel, not the normal fuel pump switch, for a period of not less than 30 seconds.

22. Interpret the readings obtained as follows :—

(1) A steady reading not exceeding that indicated by the graph (Fig. 5) for the measured applied voltage, indicates that the motor unit is functioning satisfactorily.

Note . . .

The graph (Fig. 5) is provided as a guide to pump performance under 'no flow' conditions : the figures derived from it are not to be interpreted as forming a part of the approved Acceptance Test Specification for the pump.

(2) Current consumption in excess of the graph reading indicates either a faulty motor unit, a rise in torque loading due to the obstruction of moving parts or a restriction of the fuel flow.

(3) A fluctuating reading indicates faulty contacts, defective brushes, faulty commutation or that bearings or other rotating parts are binding.

(4) A zero reading indicates an open circuit and is consistent with a blown fuse, defective switch, faulty wiring or a complete motor failure.

23. When the above tests have been completed, release the test switch and disconnect the ammeter from the test socket.

Operational test

24. Subject to the electrical tests having been completed satisfactorily, the pump should be tested where possible for proof of performance and checked against the performance figures quoted in the appropriate Appendix to this Chapter. Refer to the relevant Aircraft Handbook for procedure details. Possible causes of failure to obtain the required performance are given in Table 1.

Gland leakage check

25. During the above tests an examination should be made of the gland drain exit for fuel leakage. The leakage must not exceed two drops per minute while the pump is running, or one drop per minute while stationary. This check should be made at a point as close to the gland drain exit from the pump mounting plate as possible. Any leakage in excess of these figures will necessitate removal of the pump from the aircraft.

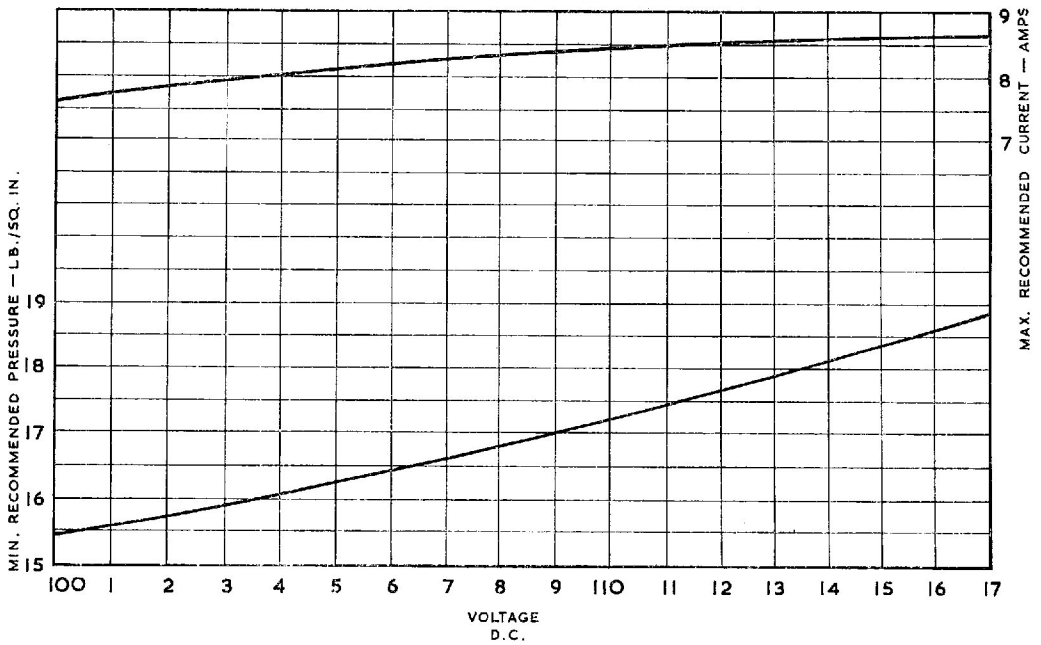

Fig. 5. "No fuel flow" electrical test graph

Insulation resistance test

26. Using a 250V constant pressure insulation resistance tester, measure the insulation resistance between the electrical socket pins and earth. When a new pump is drawn from Stores the insulation resistance must be not less than 2 megohms. After installation, due to the humidity conditions prevalent in aircraft at dispersal points, the minimum permissible insulation resistance is 50,000 ohms.

TABLE 1

Faults, possible causes and rectification

Fault	Possible cause	Rectification
Gland leakage	(1) Bad finish between gland seal seal faces. (2) Insufficient pressure between gland seal faces.	All these conditions require that the pump is removed from the aircraft and returned to a Maintenance Unit or to the Manufacturer for reconditioning.
Excessive current consumption	(1) Excessive loading on main gland. (2) Faulty motor unit. (3) Fouling of the impeller by foreign matter.	
Low delivery pressure	(1) Faulty motor unit.	
Pressure surge	(1) Tight or pre-loaded bearings. (2) Excessive loading on the main gland.	
Low insulation resistance	(1) Dampness in the motor windings.	