Chapter 41

PUMP, FUEL, PDC.2400 DE

LIST OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF APPENDICES

Introduction

1. Type PDC.2400 fuel booster pumps are electrically driven self-contained units designed to supply fuel under pressure to the aircraft engine driven pumps. Rated operating voltage is 26V d.c.

2. The pump has two first stage, single entry impellers which pressurise the pump canister from either end, together with a second stage, double entry impeller to generate the pressure required for the fuel system of the aircraft. This system enables the pump to maintain a pressurised fuel supply irrespective of the aircraft attitude, subject only to predetermined limitations of time and fuel supply, and eliminates the necessity for either inverted flight valves or fuel recuperators in the aircraft fuel system.

3. Details of the differences between the mark numbers of each type together with the Leading Particulars are given in appendices to this chapter.

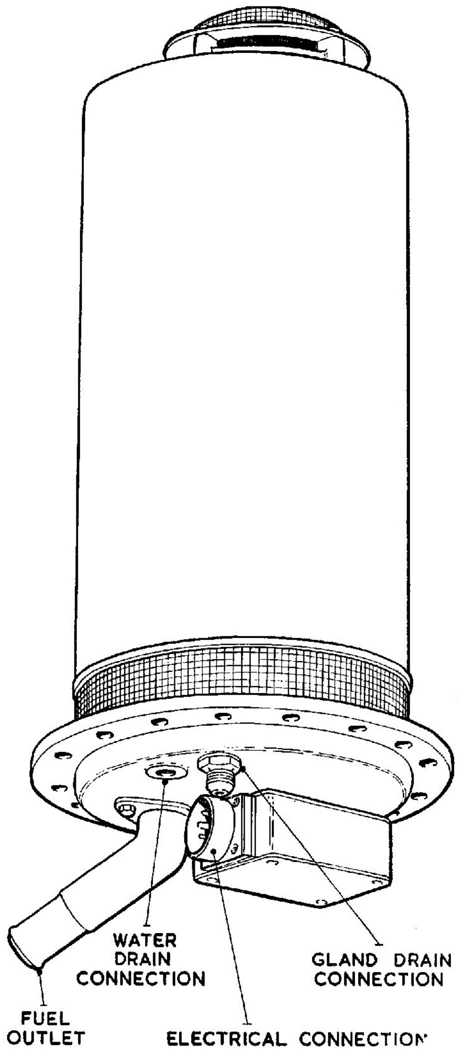


Fig. 1. External view of typical PDC.2400 DE fuel pump

DESCRIPTION

Motor Unit

4. A typical PDC.2400 pump is shown in Figs. 1 and 2. The pump driving motor is a four pole, compound wound, totally enclosed and flameproof 26V d.c. continuously rated machine. The armature is supported at each end by shielded ball bearings, pre-packed during manufacture with an approved anti-freeze/high melting point grease. These bearings cannot be re-lubricated. The motor unit is fully screened and suppressed to minimize any interference with radio aparatus. Brush boxes are aluminium bronze castings designed to retain their shape and size under all working conditions and brushes are retained in contact with the commutator by flat coil springs secured to the brush boxes.

Pump unit

5. To enable the pump to operate in the normal installed position or under inverted flight conditions, both ends of the motor unit armature shaft are extended and fitted with first-stage impellers which pressurise the canister enclosing the complete pump assembly. Both first stage impellers rotate in end casings, which also house the fuel sealing glands preventing fuel seepage into the motor unit. A second stage, double entry impeller is fitted on the armature shaft, between the normal flight first stage impeller and the gland, and this delivers fuel under pressure through the volute passages of the lower pump body casting to the delivery outlet of the pump.

6. The pump is provided with a circular mounting plate for attachment of the complete unit to the tank stud ring. This mounting plate also carries the delivery elbow, suppressor housing, electrical connection and the common gland drain exit for any fuel seepage past either of the two main glands.

7. A by-pass flap valve is fitted to the side of the pump base casting with access to the delivery duct from the impeller system. This valve is normally held closed by fuel pump delivery pressure but enables fuel to be drawn from the tank by the engine driven pump when the booster pump is idle. Fuel inlets to both single stage impellers are protected by wire mesh filters.

OPERATION

8. Fuel from the tank enters the pump canister through the first stage impellers and is pressurised by the second stage double entry impeller before being forced through

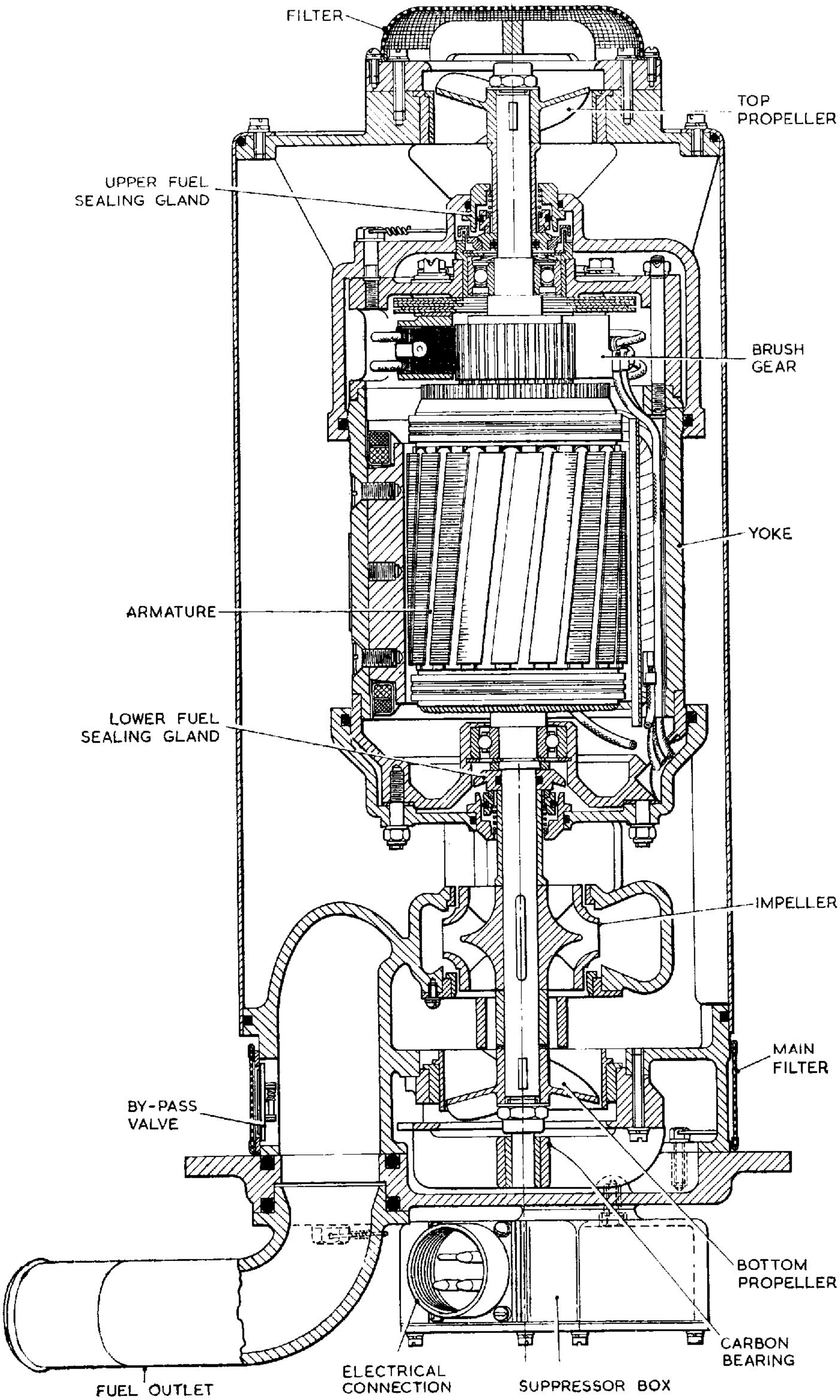


Fig. 2. Sectional view of PDC.2400 DE fuel pump

the volute channels of the pump base casting into the fuel delivery line to the engine driven fuel pumps. Under inverted flight conditions fuel will still be drawn from the tank by the now immersed 'upper' single stage impeller and the pump will continue to deliver fuel without any pressure drop.

9. 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 delivery pressure.

10. When the pump is idle, the fuel delivery pressure on the back of the by-pass valve is relieved, allowing the valve to open and enabling the engine driven pump to draw fuel direct from the tank without passing through the impeller system of the pump.

REMOVAL AND INSTALLATION

Removal

11. 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 connection to the pump delivery elbow, when any fuel in the tank will have a free flow through the by-pass valve and volute passages of the pump base casting.

12. The precise method of removing a PDC.2400 fuel pump is detailed in the appropriate Aircraft Handbook. In general terms it will consist of disconnecting the fuel delivery pipe at the elbow on the pump base, the gland drain pipe and the electrical connection socket. The pump can then be removed by releasing the twenty nuts and washers securing it to the stud-ring of the aircraft fuel tank. Take care to support the weight of the pump during this operation. Two ¼in. B.S.F. screws can be used, if necessary, in the tapped flange holes to assist in breaking the joint with the tank mounting ring.

Pre-installation checks

13. The installation of all new pumps should be preceded by the following checks :—

(1) Ensure that the pump has not been stored for longer than the specified maximum period (i.e. 12 months in the original packing and carton as supplied by the 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 a protective finish (e.g. chromic acid solution) to the unprotected area.

(3) Check that the transit plugs and caps have been removed from the delivery outlet, gland drain union and electrical connection socket, and remove any tape or any other protective material from the inlet filters and by-pass valve.

(4) It is advisable to make a starting check on the pump before installation. Apply a 26V d.c. electrical supply through the pump electrical connection. 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 serviceability testing, using approved equipment.

Installation

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

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

(1) Fitting a new joint washer between the pump mounting flange and the tank stud ring, using an approved jointing compound on both faces of the washer.

(2) Securing the pump with twenty ¼ in. B.S.F. nuts and lockwashers.

(3) Reconnecting the fuel delivery and gland drain pipes, ensuring when relevant that the open end of the latter is brought out in a low pressure area to avoid the possibility of pressurisation in flight.

(4) Reconnecting the electrical supply to the pump socket.

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

SERVICING

Routine inspection

16. At routine inspections the following procedure applies :—

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

(2) Test the pump as detailed in para. 18-24. If the pump performance is found to be unsatisfactory in any way. the pump must be removed from the aircraft and a new or reconditioned unit fitted. No in-situ maintenance is possible.

(3) Ensure that the by-pass valve is functioning satisfactorily by completing the relevant tests detailed in the appropriate Aircraft Handbook.

17. 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.

Electrical test

18. 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 (e.g. excessive current consumption, fluctuating current consumption etc.)

'No fuel flow' test

Note . . .

The following 'no fuel flow' electrical test is only applicable to aircraft with the necessary instrumentation. Where no test panel is provided, particular attention should be paid to the Electrical test (para. 17) and the Operational test (para. 21).

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

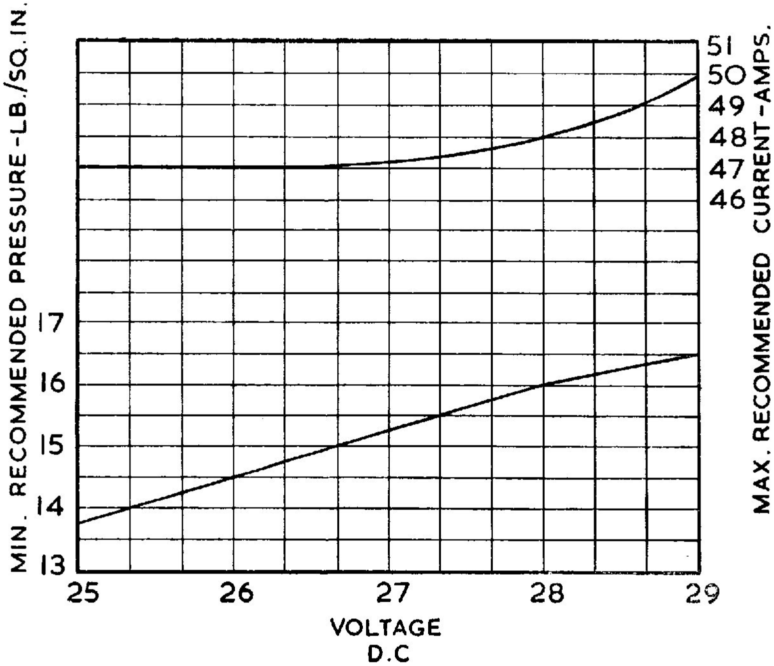


Fig. 3. "No fuel flow" electrical test graph

(1) Close all fuel cocks between the pump and the aircraft engine to ensure that no fuel can flow.

(2) Connect a suitable portable ammeter to the socket on the aircraft 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 aircraft test panel. Observe the ammeter reading for a period of not less than 30 seconds.

20. Interpret the readings obtained as follows :—

(1) A steady reading not exceeding that indicated by the graph (fig. 3) for the measured applied voltage, indicates that the motor unit is functioning satisfactorily.

Note . . .

The graph (*fig.* 3) *is provided as a guide to pump performance under 'no flow' conditions. The figures derived from it are not to be interpreted as forming 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 complete motor failure.

21. When the above test have been completed, release the test switch and disconnect the ammeter.

Operational test

22. Subject to the electrical test having been completed satisfactorily, the pump should be tested where possible for proof of performance and checked against the figures quoted in the relevant appendix to this chapter. Refer to the appropriate Aircraft Handbook for procedure details. Failure to obtain the required performance will necessitate removal of the pump for servicing by a Maintenance Unit or by the pump manufacturer. Possible causes of failure are detailed in Table 1.

Gland leakage

23. 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 when the pump is running or one drop per minute while stationary. Any leakage in excess of these figures which will represent the leakage past either or both of the glands fitted to the pump, will necessitate removal of the pump from the aircraft.

Insulation resistance test

24. Using a 250 Volt constant pressure insulation resistance tester, measure the insulation resistance between the 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 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 (Top or bottom glands)	(1) Bad finish between gland seal faces. (2) Insufficient pressure between gland seal faces. (3) Faulty seal rings in gland assembly.	All these conditions require that the pump is removed from the aircraft and returned to a Maintenance Unit or to the pump manufacturer for reconditioning.
Excessive current consumption	(1) Excessive gland loading. (2) Fouling of impellers by foreign matter. (3) Faulty motor unit.	
Low delivery pressure	Faulty motor unit.	
Pressure surge	(1) Tight or pre-loaded bearings. (2) Excessive gland loading.	
Low insulation resistance	Dampness in motor windings.	

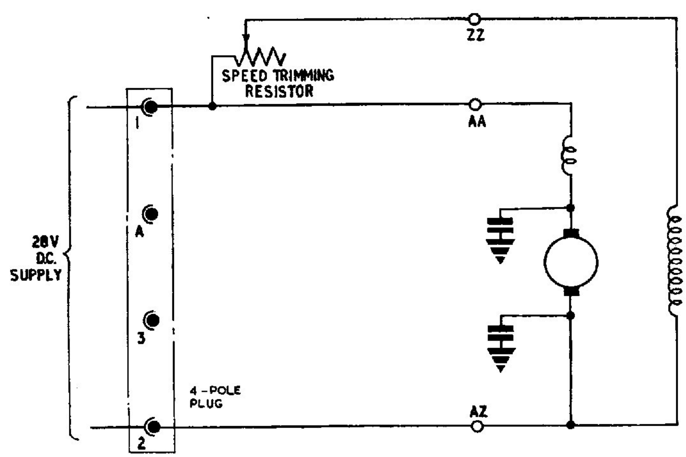


Fig. 4. Circuit diagram

Appendix 1

PUMPS, FUEL, PDC.2400 DE MK. 1, 2, 3 and 4

Pump, fuel, Type PDC.2400 DE Mk.1	**Ref. 5UE/6315**
Pump, fuel, Type PDC.2400 DE Mk.2	**Ref. 5UE/6315**
Pump, fuel, Type PDC.2400 DE Mk.3	**Ref. 5UE/6852**
Pump, fuel, Type PDC.2400 DE Mk.4	**Ref. 5UE/6881**
Voltage limits	*24·0/29·0V d.c.*
Rated Voltage	*26·0V d.c.*
Rated output at 26V d.c.	*2,400 gal./hr.*
Min. delivery pressure at rated output/voltage	*11·0 lb./in².*
Maximum current consumption at rated utput/voltage	*48A.*
Maximum 'no flow' delivery pressure at 28·8V d.c.	*27·0 lb./in².*
Minimum 'no flow' delivery pressure	*See Fig. 3 basic chapter.*
Electrical connection (Plessey 2CZ.111406)	*Ref. No. 5X/7150*
Delivery outlet	*1·50 in. dia.*
Gland drain tapping	*¼ in. B.S.P.*
Weight of unit	*28lb.*

Type differentiation

1. Basic differences between the various marks of PDC.2400 DE series pumps covered by this appendix are as follows :—

PDC.2400 DE Mk.1

Basic design.

PDC.2400 DE Mk.2

Generally similar to Mk.1 unit but the motor unit is fitted with CM. 9022 brushes. Ball bearing lubricant changed.

PDC.2400 DE Mk.3

Generally similar to Mk. 2 unit but fitted with a modified motor unit in which the circlip holding the lower bearing in position on the spindle is replaced with a spacer to enable all the rotating parts on this end of the pump to be clamped in position.

PDC.2400 DE Mk.4

Generally similar to Mk.3 unit but fitted with a modified motor unit incorporating an armature with improved inter-turn insulation. The gland drain diameter is also increased from $\frac{3}{16}$in. to ¼in. to ensure that fuel seepage is not trapped and caused to contaminate the motor unit lower bearing and the suppression assembly.

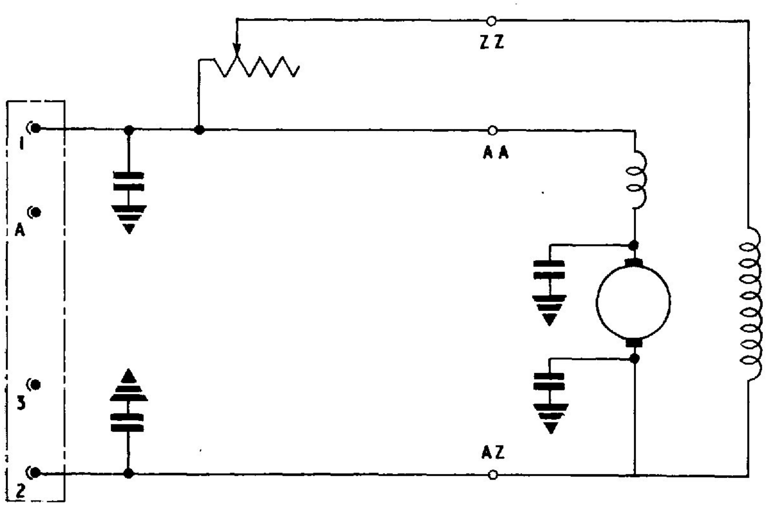
Appendix 2

PUMP, FUEL, PDC.2400 DE MK. 5

PUMP, FUEL, TYPE PDC.2400 DE Mk.5	**Ref. 5UE/7609**
Voltage limits	*26·0/29·0V d.c.*
Rated voltage	*28·0V d.c.*
Rated output at 28V d.c.	*2,400 gal./hr.*
Min. delivery pressure at rated output/voltage	*11·0 lb./in².*
Maximum current consumption at rated output/voltage	*48A.*
Maximum 'no flow' delivery pressure at 29·0V d.c.	*27 lb./in².*
Minimum 'no flow' delivery pressure	*See Fig. 3, basic chapter.*
Electrical connection (Plessey 2CZ.111406)	*Ref. No. 5X/7150*
Delivery outlet	*1·50 in. dia.*
Gland drain tapping	*¼ in. B.S.P.*
Weight of unit	*28 lb.*

General

1. The PDC.2400 DE Mk.5 fuel pump design is basically as described in the basic chapter. It differs from the Mk.4 pump (App.1.) in that it incorporates a method of adjustment to the resistor, which, together with a re-rating to 28V d.c., reduces the current consumption and consequently the heat generated in the motor unit.



App. 2, Fig. 1 Circuit diagram, 2400DE Mk.5