Chapter 12

PUMP, FUEL, SPE.1003 and SPE.1007 SERIES

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Introduction

1. Type SPE.1003 and Type SPE.1007 series fuel booster pumps are electrically driven, self contained units designed to supply fuel under pressure to the aircraft engine driven fuel pump or, alternatively, to transfer fuel from auxiliary to main tanks. Rated operating voltage is 24V d.c.

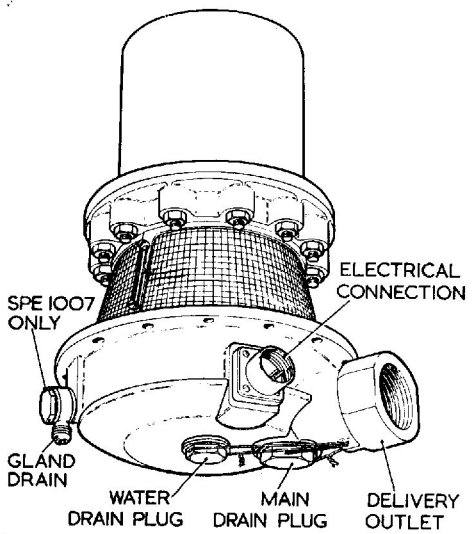

Fig. 1. External view of typical SPE. 1003/ SPE. 1007 fuel pump

2. All SPE.1003 and SPE.1007 series pumps are of the direct drive type, designed for installation in a vertical attitude in the base of the fuel tank or sump. The SPE.1007 differs from the SPE.1003 only in the by-pass flap valve assembly; the SPE.1007 valve assembly incorporates a metering device for controlling delivery pressures within close limits. In other details, apart from the gland drain connection to the pump, the SPE.1003 and SPE.1007 are similar. The pumps can be installed in inverted flight valves if required to maintain fuel delivery pressure for a predeterminable time under negative "g" and inverted flight conditions. Details of the differences between the mark numbers of each type, together with leading particulars, are given in appendices to this chapter.

DESCRIPTION

General

3. A typical SPE.1003 pump is illustrated in Fig. 2. This basic arrangement is common to all pumps covered by this chapter. The special by-pass valve incorporating a metering device of the SPE. 1007 pump is illustrated in Fig. 3. The basic pump design is a self-contained unit comprising three main sub-assemblies :—

(1) The diving motor unit with casing.
(2) The upper base assembly.
(3) The lower base assembly.

Motor unit

4. The motor unit is a flameproof, d.c. compound wound machine suitable for use on a supply voltage of 22·0/28·8V d.c. Brush gear is of unit construction, to facilitate assembly, comprising four brushes, two on each side in pairs, producing two brush tracks. The armature shaft is supported by two shielded-type ball bearings, both of which are pre-packed during manufacture with an anti-freeze/ high melting point grease and cannot be re-lubricated. The commutator-end bearing is retained in a stainless steel sleeve, and the inner race of the lower bearing is locked to the armature shaft by a screwed ring which incorporates a thrower ring to fling off any fuel seepage past the main gland. The design of thrower nut fitted varies according to the mark number of the pump (refer to appendices).

5. The complete motor unit spigots into a recess in the pump upper base casting and is enclosed in a light alloy casing which, when bolted into position, compresses a synthetic rubber joint ring to form a fuel tight assembly.

Upper base assembly

6. The upper base casting comprises mainly two circular ends separated by two cored pillars. The upper end of the casting is recessed to locate the motor unit, and the pillars provide (1) a combined motor vent and a conduit for the electrical supply leads to the motor unit brush gear, and (2) a drain duct through which fuel seepage past the main gland is drained to external piping and atmosphere. The main metallic bellows type gland preventing fuel ingress into the motor unit is also fitted in this casting.

7. The armature shaft of the motor unit extends through the main gland and car-

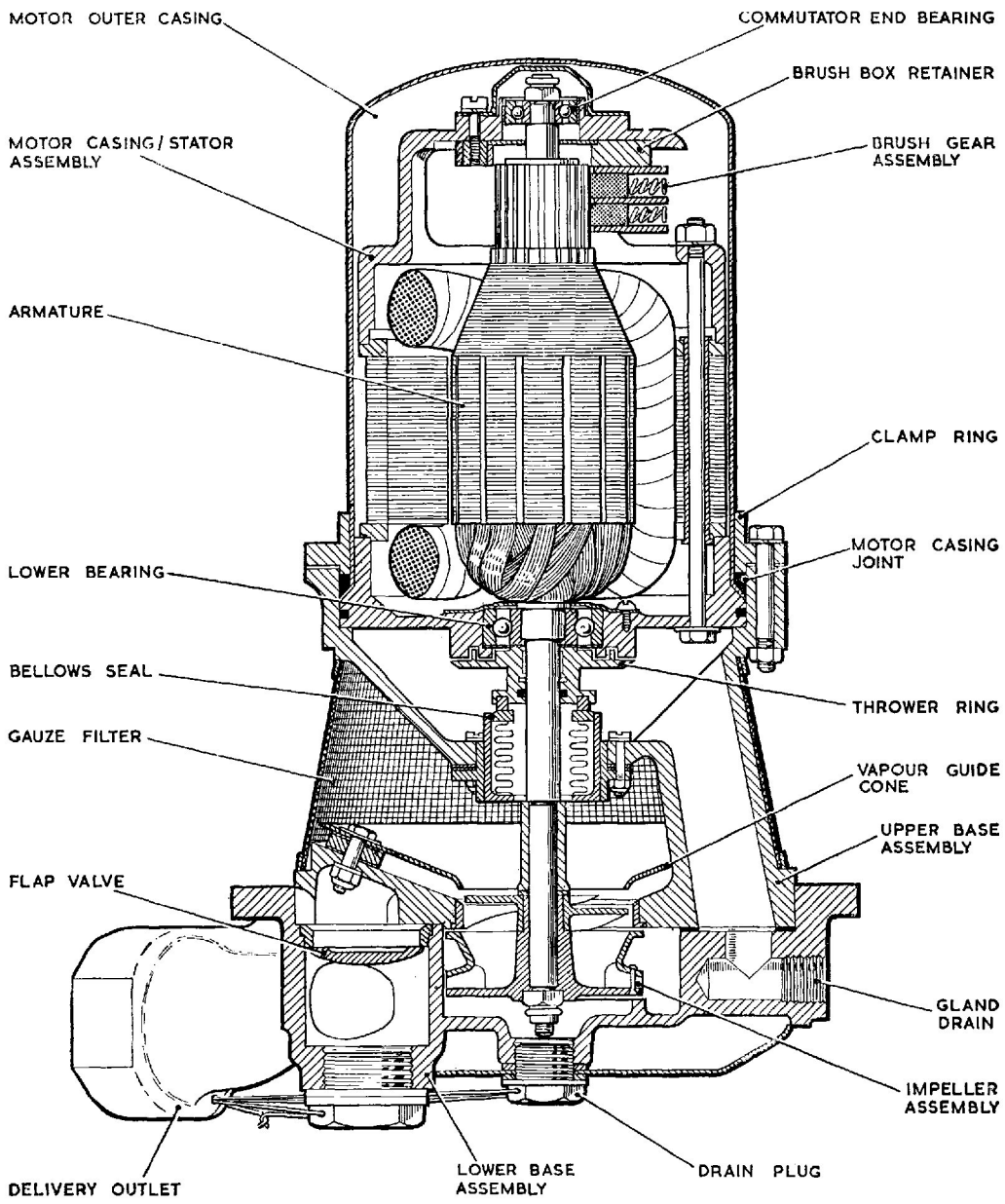

Fig. 2. Sectional view of SPE. 1003, Mk. 3 fuel pump

ries the rotating member of the seal and a combined helico-centrifugal type impeller. A vapour guide fitted around the fuel inlet to the impeller system diverts any fuel and air vapour, which may be evolved under operating conditions, out of the main fuel stream through the pump.

Lower base assembly

8. The lower base casting has a circular flange with twelve 2-B.A. clearance holes for attachment of the pump assembly to the tank stud ring. It also carries the $1\frac{1}{4}$ in. B.S.P. fuel delivery outlet, a $\frac{1}{4}$ in. B.S.P. gland drain connection and a mount-

ing for the electrical connection socket, all of which are outside the tank when the pump is installed. A cast spiral volute from the impeller chamber connects with the delivery outlet and provision is made for fitting a by-pass valve at the delivery outlet end of the volute passage. This valve allows the engine driven pump to draw fuel direct from the tank, without passing through the impeller system, when the booster pump is idle. Under normal operating conditions this valve is held closed by pump delivery pressure. A metering device fitted to the by-pass valve of SPE.1007 pumps only enables the delivery pressure of the pump to be controlled within closely defined limits. Adjustment of this device is made during the manufacture of the pump to meet specific installation requirements.

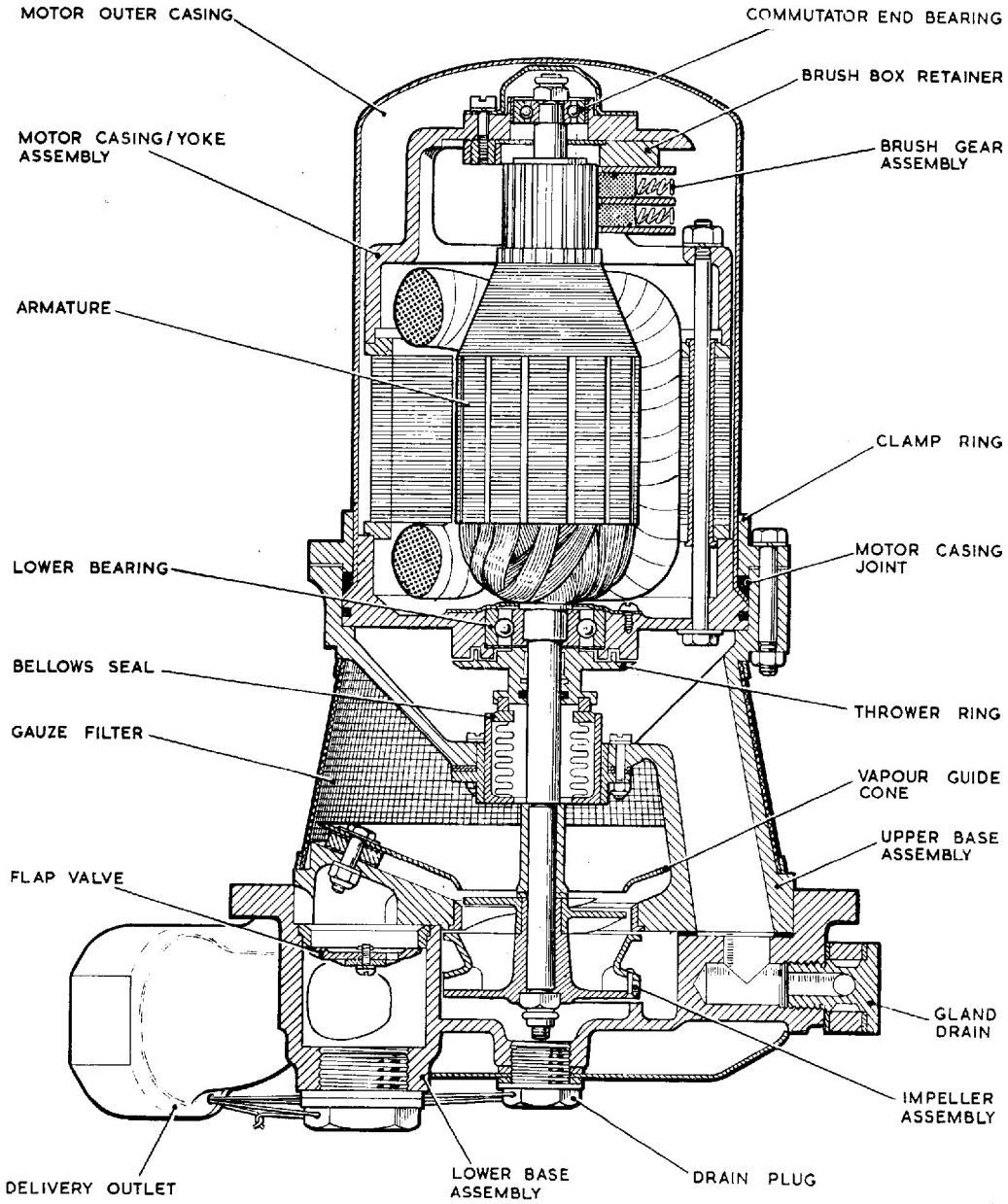

Fig. 3. Sectional view of SPE. 1007, Mk. 3 fuel pump

Filter

9. A wire mesh filter completely surrounds the fuel entry to the pump and prevents ingress of fuel and tank sediment into the impeller system and fuel delivery line.

OPERATION

10. When the pump motor is energised, fuel from the tank is drawn into the eye of the helico-centrifugal impeller and then forced through the spiral volute in the pump base casting to the fuel outlet connection and to the delivery line.

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

12. When the pump is idle, the fuel delivery pressure on the underside of the by-pass valve is relieved, allowing the valve to open. The engine driven pump is then able to draw fuel direct from the tank without passing through the impeller system of the pump.

REMOVAL AND INSTALLATION

Removal

13. Before attempting to remove a pump, ensure that the tank has been emptied 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 delivery outlet of the lower base casting, when, if there is any fuel remaining in the tank it will have a free flow through the by-pass and volute passages of the pump to the drain plug.

14. The exact method of removing an SPE.1003 or SPE.1007 fuel pump is detailed in the appropriate Aircraft Handbook. In general terms it will consist of disconnecting the fuel delivery and gland drain pipes and the electrical connection socket. The pump can then be removed by releasing the fourteen nuts securing it to the tank or inverted flight valve mounting ring. Take care to support the weight of the pump during this operation. Two $\frac{1}{4}$ in. B.S.F. screws can be used, if necessary, in the lower base casting tapped flange holes to assist in breaking the joint with the tank mounting ring.

Pre-installation checks

15. 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 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 transit plugs have been removed from the delivery outlet, gland drain, and electrical connection and remove any tape or any other protective material from the inlet filter.

(4) It is advisable to make a starting check on the pump before installation. Apply a 24V d.c. electrical supply through the 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

16. The above pre-installation checks apply to all aircraft installations of these pumps. For detailed procedure relating to 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) Fitting a new joint washer between the pump mounting flange and the tank or inverted flight valve stud ring, using an approved jointing compound on both sides of the washer.
(2) Securing the pump with fourteen 2-B.A. nuts and lockwashers.
(3) Reconnecting the fuel delivery and gland drain pipes, ensuring when relevant that the open end of the latter faces towards the rear of the aircraft to prevent possible pressurisation in flight.
(4) Reconnecting the electrical supply to the pump socket.
(5) Wire-locking all pipe connectors, union nuts, etc.

SERVICING

Routine inspection

18. 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 or inverted flight valve 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 a new and reconditioned unit fitted. No in-situ maintenance is possible.

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

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

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 indication 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 instrumentation. Where no test panel is provided, particular attention should be paid to the electrical test (para. 20) and Operational test (para. 24).

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

(1) Close all fuel cocks between pump and engines so that no fuel can flow.
(2) Connect a suitable portable ammeter to the test 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. Observe the ammeter reading 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 appropriate graph (fig. 4 or 5) for the measured applied voltage, indicates that the motor is functioning satisfactorily.

Note . . .

The graphs (fig. 4 and 5) are provided as guides to pump performance under no-flow conditions: the figures derived from them must not 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 some restriction of the fuel flow.

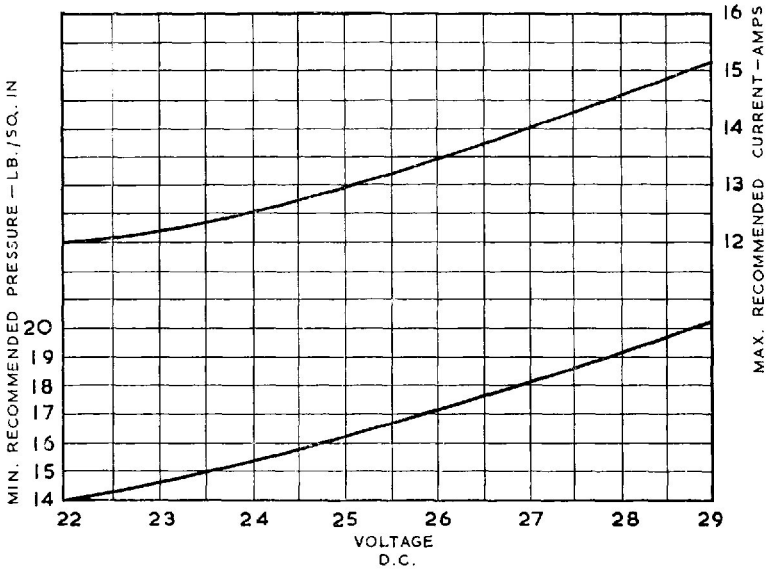

Fig. 4. "No fuel flow" electrical test graph (SPE. 1003)

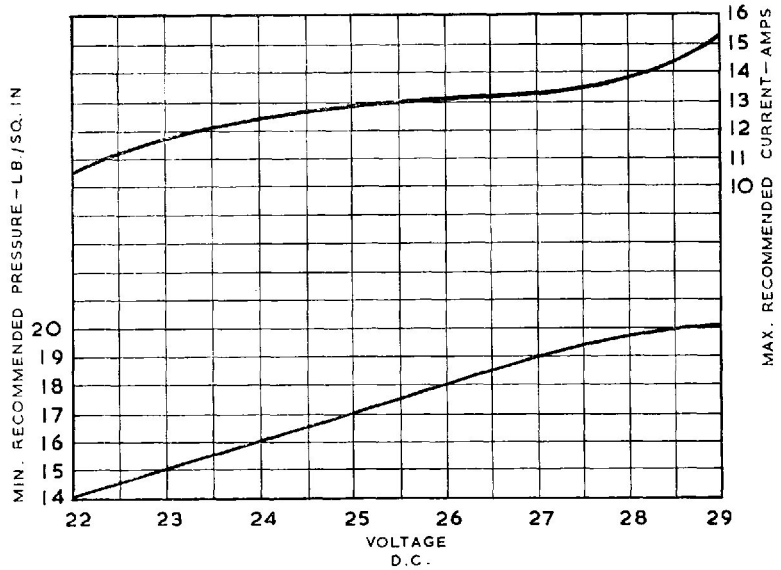

Fig. 5. "No fuel flow" electrical test graph (SPE. 1007)

(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, faulty wiring, defective switch or in extreme cases a complete motor failure.

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

Operational test

24. Subject to the electrical test being completed satisfactorily, the pump should be tested in situ 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

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

Insulation resistance test

26. Using a 500 Volt 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 not be less than 2 megohms. After installation, due to humidity conditions prevalent at aircraft 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 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 pump manufacturer for reconditioning.
Excessive current	(1) Excessive loading on metallic bellows gland. (2) Faulty motor unit. (3) Fouling of impeller by foreign matter.	
Low delivery pressure	(1) Faulty motor unit.	
Pressure surge	(1) Tight or pre-loaded bearings. (2) Excessive loading on metallic bellows gland.	
Low insulation resistance	Dampness in motor windings.	

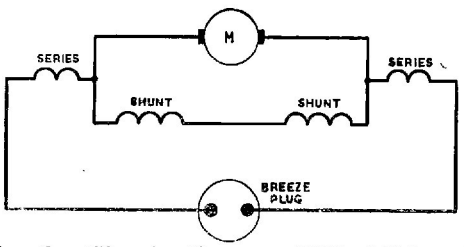

Fig. 6. Circuit diagram, SPE. 1003 and SPE. 1007 fuel pumps

Appendix 1

PUMPS, FUEL, TYPE SPE.1003 MK. 1, MK. 2 AND MK 3

Pump, fuel, Type SPE.1003 Mk. 1	**Ref. 5UE/5907**
Pump, fuel, Type SPE.1003 Mk. 2	**Ref. 5UE/6281**
Pump, fuel, Type S.P.E.1003 Mk. 3	**Ref. 5UE/6535**
Voltage limits	22·0/28·8*V d.c.*
Rated voltage	24·0*V d.c.*
Rated output at 24·0V d.c.	1000 *gal./hr.*
Delivery pressure at rated output/voltage	11·0 *lb./in².* *min.*
Maximum current consumption at rated output voltage	14·0*A.*
Max. no flow delivery pressure at 28·8V d.c.	24·0 *lb./in².*
Minimum no-flow delivery pressure	*See Fig. 4, basic chapter*
Electrical connection (Plessey 2CZ.111402)	*Ref. No. 5X/7143*
Delivery outlet tapping	1¼ *in. B.S.P.*
Gland drain tapping	¼ *in. B.S.P.*
Weight of unit	12·0 *lb.*

Introduction

1. The type SPE.1003 series fuel booster pump conforms to the description given in the basic chapter. No metering device is fitted to the by-pass valve. The pump can be mounted directly to the tank stud ring or into an inverted flight valve.

Type differentiation

2. Basic differences between the various marks of SPE.1003 pumps covered by this appendix are as follows :—

SPE.1003 Mk. 1. Design as introduced into service.

SPE.1003 Mk. 2. Generally similar to Mk. 1 pump, but method of fitting the vapour guide cone redesigned to absorb vibration.

SPE.1003 Mk. 3. Generally similar to the Mk. 2 pumps but incorporating the following improvements.

(1) Incorporation of a rubber seal between the upper pump body casting and the motor base at the cable inlet.

(2) Improved thrower assembly.

(3) Inclusion of a seal washer under the head of the motor unit tie-bolt.

Improved lower motor bearing fitted.

Appendix 2

PUMPS, FUEL, TYPE SPE.1007 MK. 1, MK. 2 AND MK. 3

Pump, fuel, Type SPE.1007 Mk. 1	**Ref. 5UE/6167**
Pump, fuel, Type SPE.1007 Mk. 2	**Ref. 5UE/6532**
Pump, fuel, Type SPE.1007 Mk. 3	**Ref. 5UE/7515**
Voltage limits	22·0/28·8*V d.c.*
Rated voltage	24·0*V d.c.*
Rated output at 24·0*V d.c.*	1000 *gal./hr.*
Delivery pressure at rated output/voltage	11·0 *lb./in².* *min.*
Maximum current consumption at rated output voltage	14·0*A.*
Special rating (obtained by adjusting metered by-pass valve)	400 *gal./hr. at* 17·75/18·0 *lb./in². with* 27·0*V d.c. input. Max. current consumption* —15·0*A.*
Maximum no-flow delivery pressure at 28·8*V d.c.*	24·0 *lb./in².*
Minimum no-flow delivery pressure	*See Fig.* 4, *basic chapter*
Electrical connection (Plessey 2*CZ.*111402)	*Ref. No.* 5*X*/7143
Delivery outlet tapping	1¼ *in. B.S.P.*
Gland drain tapping	¼ *in. B.S.P. (Banjo)*
Weight of unit	12·1 *lb.*

Introduction

1. The type SPE.1007 series fuel booster pump conforms to the description given in the basic chapter. A metering device is fitted to the by-pass valve which can be set by the pump manufacturer to control delivery pressure within specified close limits for a given flow. The pump can be mounted directly to the tank stud ring or into an inverted flight valve.

Type differentiation

2. Basic differences between the various marks of SPE.1007 pumps covered by this appendix are as follows :

SPE.1007 Mk. 1. Design as introduced into service.

SPE.1007 Mk. 2. Generally similar to the Mk. 1 pump but incorporating the following modifications :

(1) A rubber seal fitted between the pump body casting and the motor base at the cable inlet.

(2) Improved thrower assembly.

(3) Inclusion of a seal washer under the head of the motor unit tie-bolt.

(4) Improved lower motor bearing.

SPE.1007 Mk. 3. Basically similar to the Mk. 2 pump but includes a rubber bonded sealing washer under the base plug, and deletion of the base cover.