# Chapter 9D—RIG TESTING

# HIGH PRESSURE FUEL PUMPS
## Types M.G.B.B.124 and M.G.B.B.125

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**Introduction**

**1.** This chapter details the calibration and rig testing of the high pressure fuel pumps, Types M.G.B.B. 124 and M.G.B.B. 125.

**Note . . .**

*The pump speed calibration figures which are enclosed in parentheses apply only to pumps Type M.G.B.B.* 124.

**General**

**2.** Record the test results for approval against the specified test limits and subsequent entry in the pump log book.

**3.** Sub-assembly tests as called in Sect. 2. Chap. 9B and 9C are included in the chapter.

**4.** If any calibration requirements cannot be met by normal adjustment methods, refer to the 'Fault Diagnosis', Appendix 1 for information.

**5.** The pressures quoted in this chapter are gauge pressures.

**Special tools**

**6.** The following special tools are required during rig testing:—

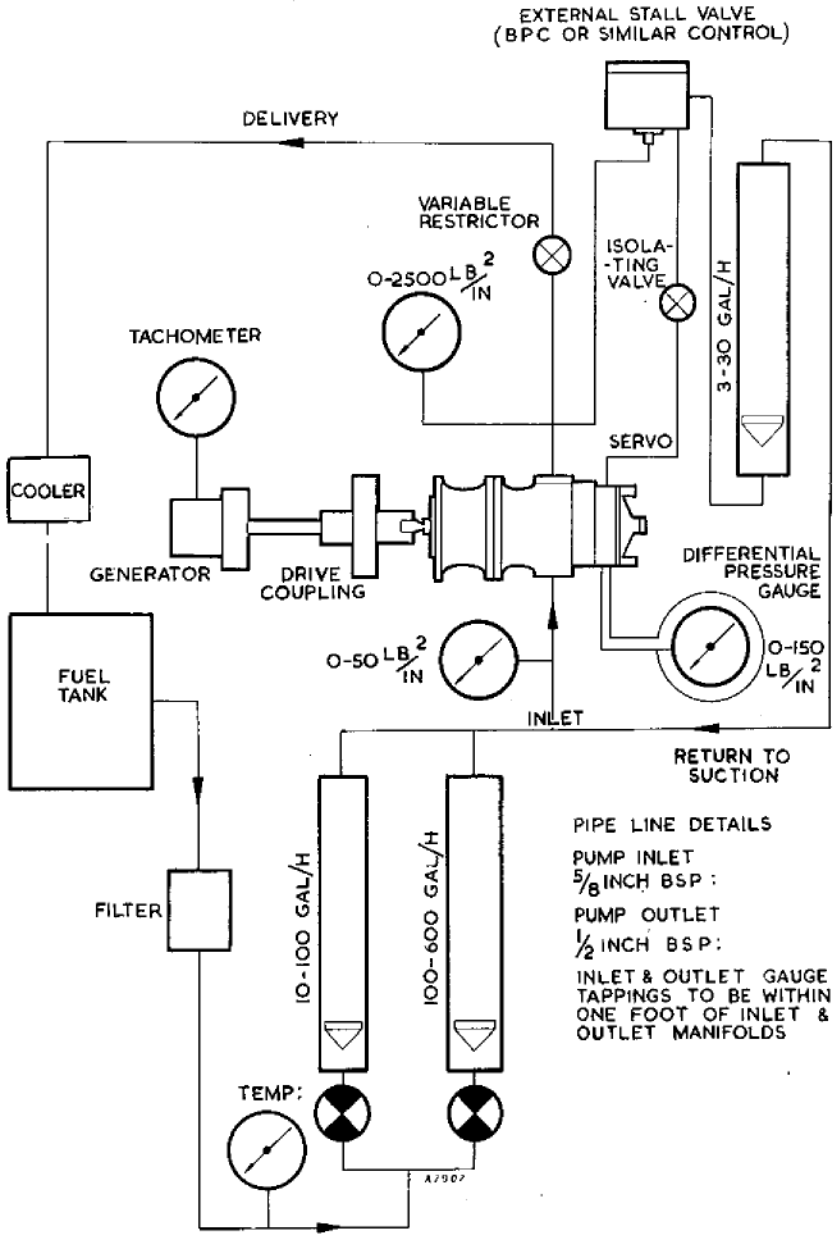



**Fig. 1. Diagrammatic layout of pump test rig**

| *Tool No.* | *Description* |
|---|---|
| T.175579 | Bleed tool, bleed valve assembly |
| T.160988 | Box key, overspeed governor adjusting |
| T.193939 | Box key, flow adjusting screw, and stall pressure adjustment |
| T.282139 | Extractor and assembly tool, h.m.g. feed orifice |
| RSK 485/17 | Flow test fixture, h.m.g. feed orifice |

**Sub-assembly tests**

*Hydro-mechanical governor (h.m.g.) feed orifice*

**7.** The h.m.g. feed orifice is to be calibrated prior to assembly to the pump, using the test fixture RSK 485/17, fig. 2. At an applied fuel pressure of 1000 lb/in², and a fuel temperature of 20 to 25°C, the fuel flow through the orifice must be 22·0 to 23·0 gal/h, using fuel to specification AVTUR 50.

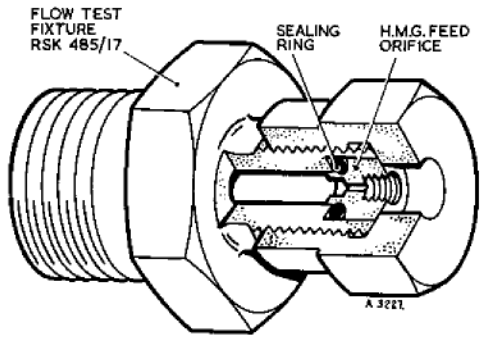



**Fig. 2. H.m.g. feed orifice flow test fixture**

**8.** If the fuel flow is below the stated limits, remove the orifice from the test fixture, using the tool T.282139, and examine the orifice bore. If clean and free from obstruction, lap the orifice bore, using fine grade lapping paste and suitable lapping wire of approximately the same diameter as the orifice bore. Lap in stages and rig check the fuel flow at each stage until the required flow is obtained.

**9.** If the fuel flow is above the stated limits and the feed orifice sealing ring is sound, fit a new replacement orifice and lap out the bore until the correct flow is obtained.

**Bleed valve assembly**

**10.** (1) *Leakage test.* Apply a fuel pressure of 5 lb/in² and 20 lb/in² to the inlet end of the valve. The maximum leakage through the valve must not exceed 5 cm³/min at each pressure.

(2) *Pressure test.* Fit the dome cap nut and sealing ring and apply a fuel pressure of 80 lb/in². No external leakage is permissible.

**11.** The ball valve and spring inside the bleed valve body is retained by a rolled lip and should not be disturbed. If a valve is faulty, fit a new assembly.

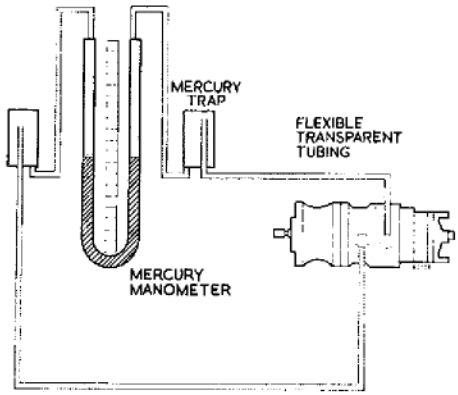



**Fig. 3. C.F. test, rig piping diagram**

**General test conditions**

**12.** The calibrating fuel for initial running-in and for endurance testing is 73 NL AVGAS (petrol to Spec. D.ENG.RD.2485 Grade 80). The calibrating fuel for final calibration is 73 NL AVGAS, or AVTUR 50 (kerosine to Spec. D.ENG.RD.2492).

**13.** The calibration limits specified in this chapter apply for test rig fuel temperature of 20 to 40°C. During rig testing, the fuel temperature is to be within ±5°C of the temperature at which the flowmeters were calibrated. Where high ambient temperature conditions exist, the temperature correction factors as detailed in the calibration tests should be applied.

**14.** The inlet boost pressure is to be 10 to 15 lb/in² unless otherwise stated.

**15.** The pump is to include the previously calibrated h.m.g. feed orifice.

**16.** Where necessary, the h.m.g. lever weight is to be trimmed before endurance in order that the governor pressure characteristics requirements are met. In this case refer to Sect. 2, Chap. 9C, for the trimming method and details.

**17.** Before completion of the pump build, the individual slipper lifts and overall lengths of the piston and slipper assemblies must be recorded for reference against the 'after endurance' figures.

**18.** Where calibration conditions call for adjustment to the pump stroke, no increase in camplate angle from the original build setting of 15½° is permissible. The flow delivery adjusting screw may be turned in to decrease flow only.

**Running-in**

**19.** Connect the fully assembled pump to the test rig. Remove the overspeed control assembly. Apply sufficient load to the rocker lever and orifice assembly adjusting screw to enable the half-ball valve to hold the delivery pressures specified in the running-in and endurance tests. To increase the load turn the adjusting screw clockwise, using the box key T.193939. Refit the overspeed control assembly.

**20.** Set the fuel inlet boost pressure and bleed the pump of air from the bleed valve assembly, using the bleed tool T.175579, and from the delivery connection.

**21.** Run the pump at the following conditions obtained by adjusting the external stall valve:—

| *Speed* (*rev/min*) | *Delivery pressure* (*lb/in²*) | *Time* (*minutes*) |
|---|---|---|
| 500 | 100 | 2·5 |
| 1000 | 200 | 2·5 |
| 1500 | 300 | 2·5 |
| 2000 | 400 | 2·5 |
| 2500 | 500 | 2·5 |
| 3000 | 600 | 2·5 |
| 3000 | 700 | 2·5 |
| 3500 | 800 | 5·0 |
| 3500 | 900 | 5·0 |
| 4000 | 1000 | 10·0 |

Set the maximum flow to 560 gal/h at 100 lb/in² delivery pressure and 4500 rev/min, (no increase in stroke from the 15½° build setting is permissible), then run at 4500 rev/min and 1100 lb/in² delivery pressure for 15 minutes.

**Preliminary calibration**

**22.** Before commencing endurance testing, the following preliminary calibration is to be carried out by submitting the pump to the tests as detailed in para. 23, 26, 29, 30, 31 and 32.

*Servo flow check*

**23.** Check the servo flow to suction, with the pump conditions controlled by means of the external stall valve, as follows:—

(1) Set the overspeed governor in the maximum position.

(2) Run the pump at 4000 rev/min and 1000 lb/in² delivery pressure and a fuel flow of 150 gal/h with the servo line isolating valve open.

(3) Check that the servo flow to suction flowmeter reading is 14 to 15 gal/h, using AVTUR 50, or 14·5 to 15·5 gal/h, using 73 NL.AVGAS.

**24.** Where the servo flow is below requirements, the servo orifice may be lapped out, using fine grade lapping paste and suitable wire of approximately the same diameter as the orifice bore, until the correct flow is obtained. The orifice and plug must be thoroughly cleaned in a kerosine pressure wash after each lapping stage.

**25.** Where the servo flow is above the requirements and the sealing ring is sound, a new replacement orifice and plug must be fitted. Torque tighten to 125 lb. in. maximum when refitting the orifice and plug.

*Stall pressure test*

**26.** The stall pressure is the delivery pressure obtained sufficient to overcome the spring loading on the rocker lever and orifice assembly half ball valve and open the valve, so allowing fuel to bleed initially from one side of the servo control piston. (The control piston will then move the camplate towards the minimum pump stroke position.)

**27.** The stall pressure required is obtained by adjusting the rocker lever and orifice assembly adjusting screw, as detailed in para. 19. To increase pressure turn the screw clockwise; one quarter turn will vary the stall pressure by approximately 150 lb/in².

**28.** Check the stall pressure as follows:—

(1) Set the overspeed governor in the maximum position, that is with the governor adjusting screw turned fully in.

(2) Run the pump at 4260 (4150) rev/min at a fuel inlet boost pressure of 1 to 5 lb/in$^2$.

(3) Increase the delivery pressure, by adjusting the downstream variable restrictor, until the pump stalls-denoted by a rapid decrease in fuel flow.

(4) Stall the pump to zero fuel flow at which point the delivery pressure must be 1600 to 1800 lb/in$^2$.

(5) Repeat the test 10 times. The required delivery pressure must be obtained in each test.

*Volumetric efficiency test*

**29.** The volumetric efficiency of the pump is to be checked by running the pump at high and low delivery pressures and noting the flow difference, which should be within the limits specified, as follows:—

(1) Set the overspeed governor in the maximum position.

(2) Run the pump at a constant speed of 4460 (4150) rev/min.

(3) Increase the delivery pressure to 1000 lb/in$^2$ and note the flow reading.

(4) Decrease the delivery pressure to 100 lb/in$^2$ and note the flow reading.

(5) The flow difference between the two readings must not exceed 42 gal/h, using AVTUR 50, or 70 gal/h, using 73NL AVGAS. An additional flow difference of 0·5 gal/h is permissible for every increment of 1°C inlet fuel temperature above 20°C.

*H.M. governor pressure characteristics*

**30.** The differential pressure across the h.m.g. diaphragm is to conform to the specified limits at the following conditions:—

(1) Connect the differential pressure gauge to the pump at the points shown in fig. 10.

(2) Run the pump at a constant speed at 4500 rev/min.

(3) Adjust the downstream variable restrictor to obtain a delivery pressure of 150 lb/in$^2$. Note the differential pressure gauge reading.

(4) Increase the delivery pressure to 1250 lb/in$^2$ and note the differential pressure gauge reading. This is the Datum pressure and must be 85 to 100 lb/in$^2$.

(5) Check that the differential pressure noted in (3) is not greater than, or a maximum of 4 lb/in$^2$ less than, the Datum pressure.

*Overspeed governor setting*

**31.** The governor is to be set at point 'A' and the governor operation checked at the following points and conditions:—

| | *Delivery pressure lb/in$^2$* | *Speed rev/min* |
|---|---|---|
| Point 'A' | 1100 | 4460 (4150) |
| Point 'B1' | 400 | 4530 (4220) to 4600 (4290) |
| Point 'B2' | 200 | 4585 (4275) to 4650 (4340) |
| Point 'C2' | 200 | Less than that recorded at point 'B2' by 30 rev/min max. |
| Point 'C1' | 400 | Less than that recorded at point 'B1' by 30 rev/min max. |
| Point 'D' | 1100 | 4430 (4120) to 4460 (4150) |

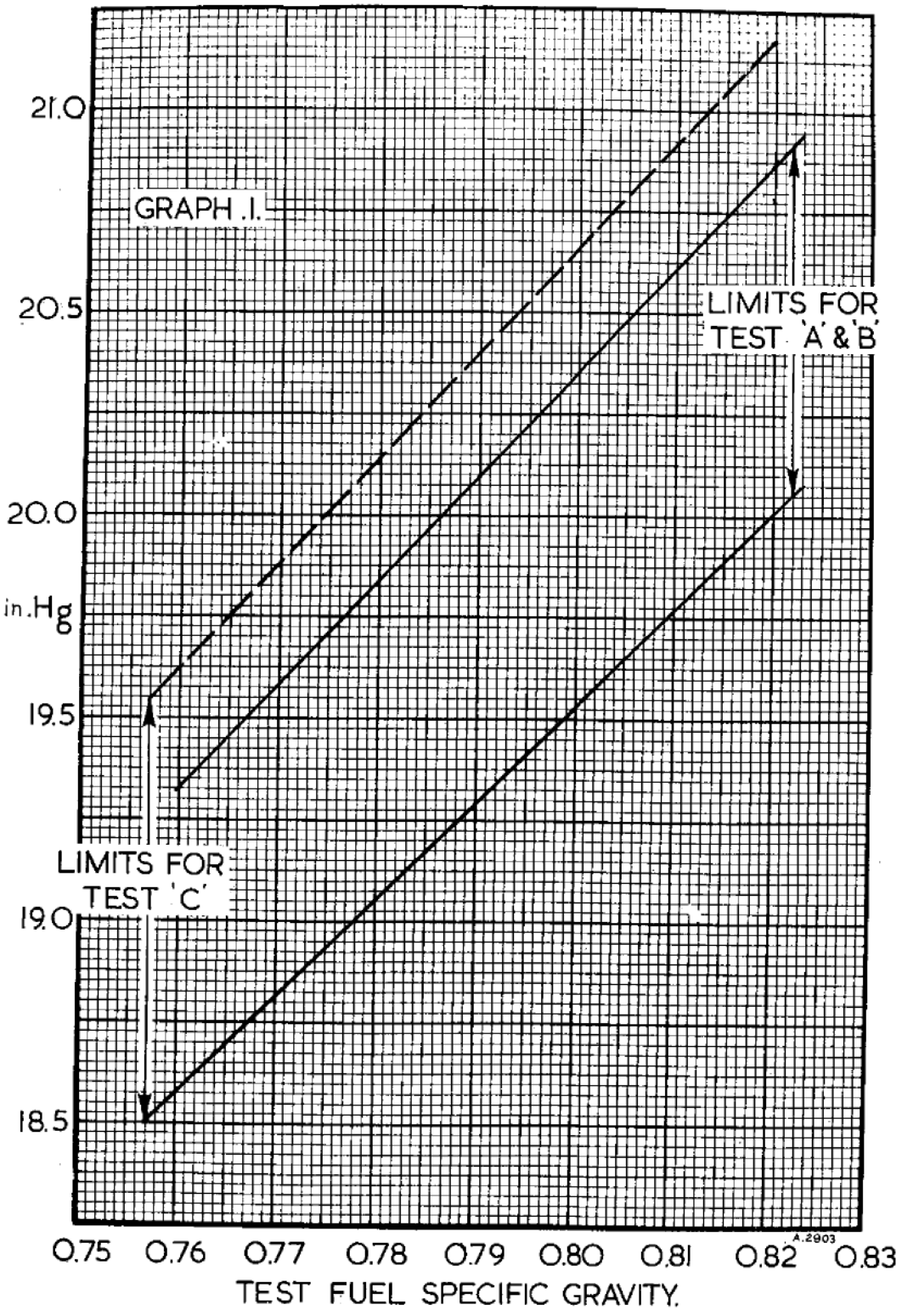



Fig. 4. C.F. pressure signal limits, tests A. B and C

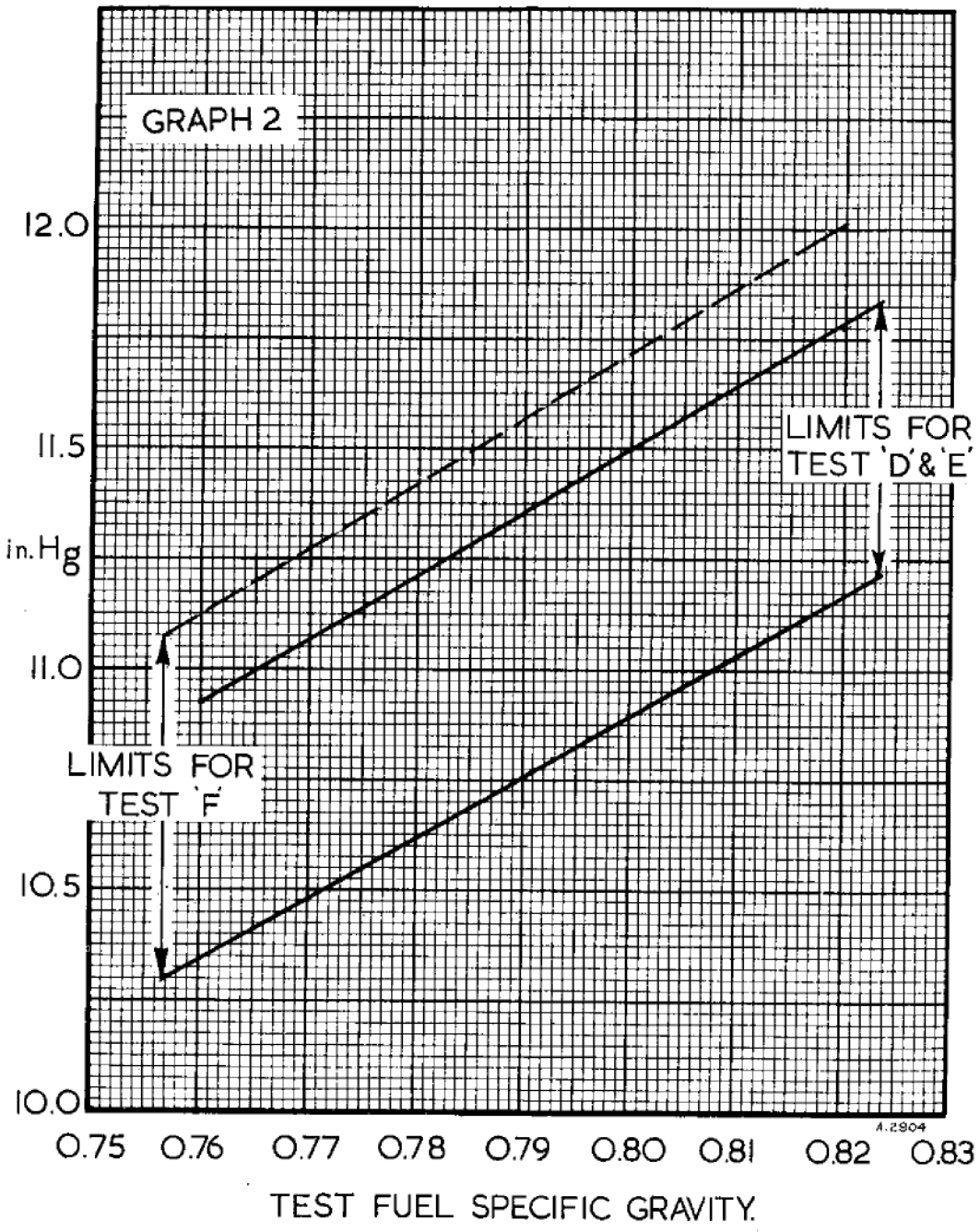



**Fig. 5. C.F. pressure signal limits, tests D, E and F**

Point 'A' is obtained by setting the delivery pressure to 1100 lb/in² and adjusting the overspeed governor adjusting screw such that when the pump speed is increased above 4460 (4150) rev/min the delivery pressure starts to fall.

Point 'B1' is obtained by further increasing pump speed until the delivery pressure falls to 400 lb/in².

Point 'B2' is obtained by further increasing the speed until the delivery pressure falls to 200 lb/in².

Point 'C2' is obtained by increasing the speed until the delivery pressure falls below 200 lb/in² and then reducing the speed until 200 lb/in² is re-established.

Point 'C1' is obtained by further decreasing the speed until the delivery pressure reaches 400 lb/in².

Point 'D' is obtained by further decreasing the speed until 1100 lb/in² delivery pressure is re-established.

*Time recovery test*

**32.** Run the pump at point 'C2' conditions, para 31, then rapidly decrease the speed to that at point 'D'. The time taken for the delivery pressure to recover from point 'C2' to point 'D' must be between 0·8 to 2 seconds.

**Endurance testing**

**33.** Run the pump for a period of 1¼ hours at 1350 lb/in² delivery pressure, 4500 (4400) rev/min and 440 gal/h fuel flow, obtained by adjusting the external stall valve. During this period the fuel inlet temperature must be allowed to rise to 36 to 38°C for a period of 15 minutes, then reduced again. The pump must then be run for 15 minutes at 1500 lb/in² delivery pressure and 4800 (4600) rev/min and full stroke.

*Pump cyclic endurance*

**34.** Run the pump at the following conditions:—

(1) 4500 (4400) rev/min and 390 to 420 gal/h at 1600 to 1800 lb/in² delivery pressure for a period of 5 minutes.

(2) 1200 rev/min and 40 to 45 gal/h at 1350 lb/in² delivery pressure, obtained by adjusting the external stall valve, for a period of 10 minutes.

(3) Repeat sub-para. (1) and (2) 12 times.

*Governor cyclic endurance*

**35.** Endurance test the overspeed governor at the following conditions:—

(1) Set the governor at point 'A' as detailed in para. 31.

(2) Increase the pump speed until the delivery pressure falls to below 200 lb/in².

(3) Decrease the pump speed until the delivery pressure recovers to 1100 lb/in².

(4) Repeat sub-para. (1), (2) and (3) 240 times.

*Starting tests*

**36.** Run the pump at a speed of 1200 rev/min and 1350 lb/in² delivery pressure and a fuel flow of 40 to 45 gal/h, these conditions obtained by adjusting the external stall valve, then stop the test rig. This starting cycle is to be repeated 25 times during which no adjustments are to be made to the test rig controls.

**37.** Repeat the tests detailed in para. 23, 26, 29, 30, 31 and 32.

**Strip examination and final assembl**

**38.** Dismantle the pump (Sect. 2, Chap. 9A) and examine and crack test the component parts (Sect. 2, Chap. 9B).

**39.** Measure the piston and slipper assemblies overall lengths and slipper lifts and compare the figures with those obtained on initial pump build before endurance testing. The reduction in overall length must not exceed 0·002 in. on new assemblies or 0·001 in. on used assemblies. The increase in slipper lift must not exceed 0·004 in. on new assemblies or 0·001 in. on used assemblies. The maximum individual total slipper lift on used assemblies must not exceed 0·010 in.

**40.** Clean the component parts as detailed in Sect. 2, Chap. 9B, and rebuild the pump as detailed in Sect. 2, Chap. 9C. In addition, all internal locking must be completed at this stage except for those components which may require adjustment during final calibration. Fit the installation connections to the pump.

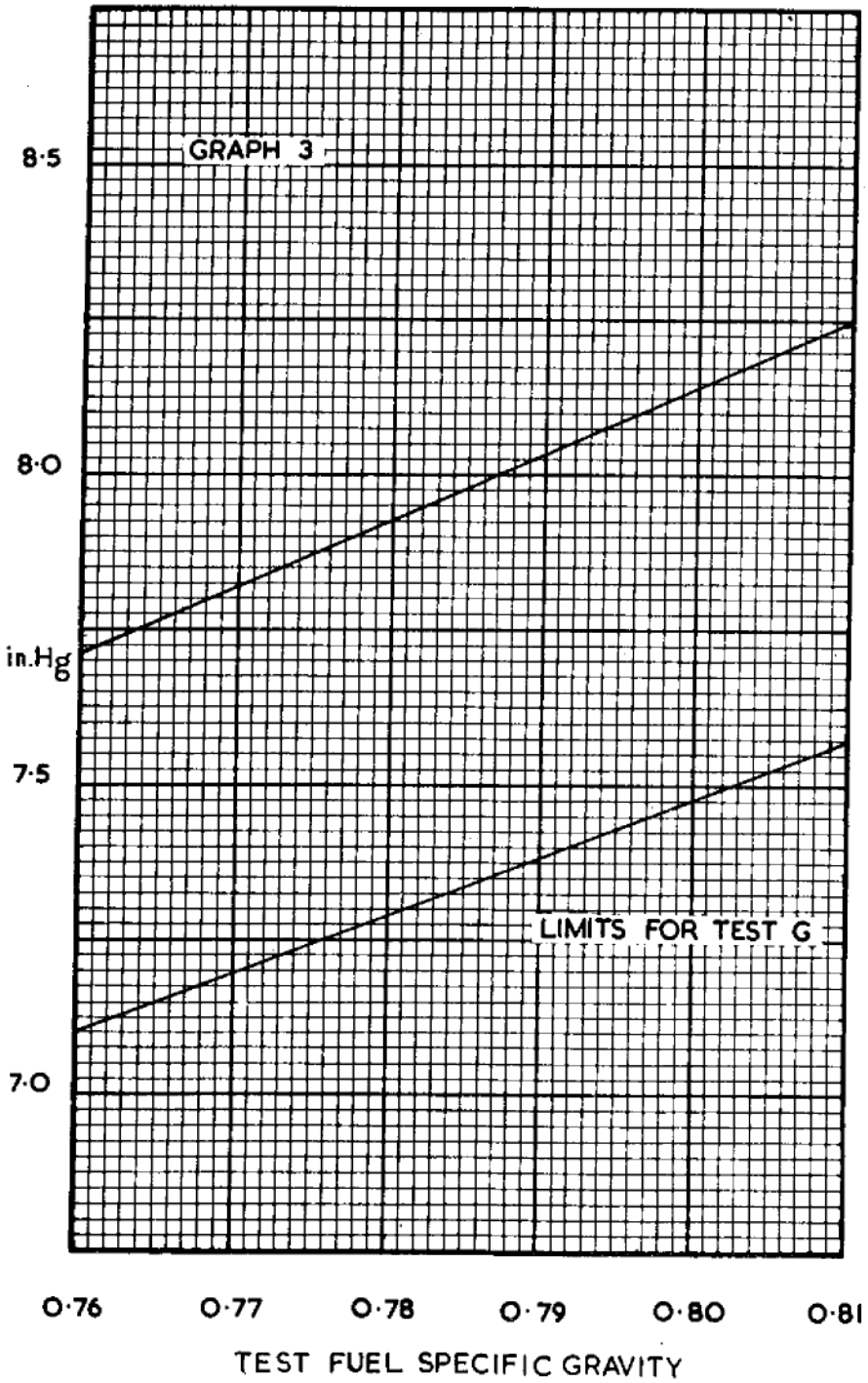



**Fig. 6. C.F. pressure signal limits, test G**

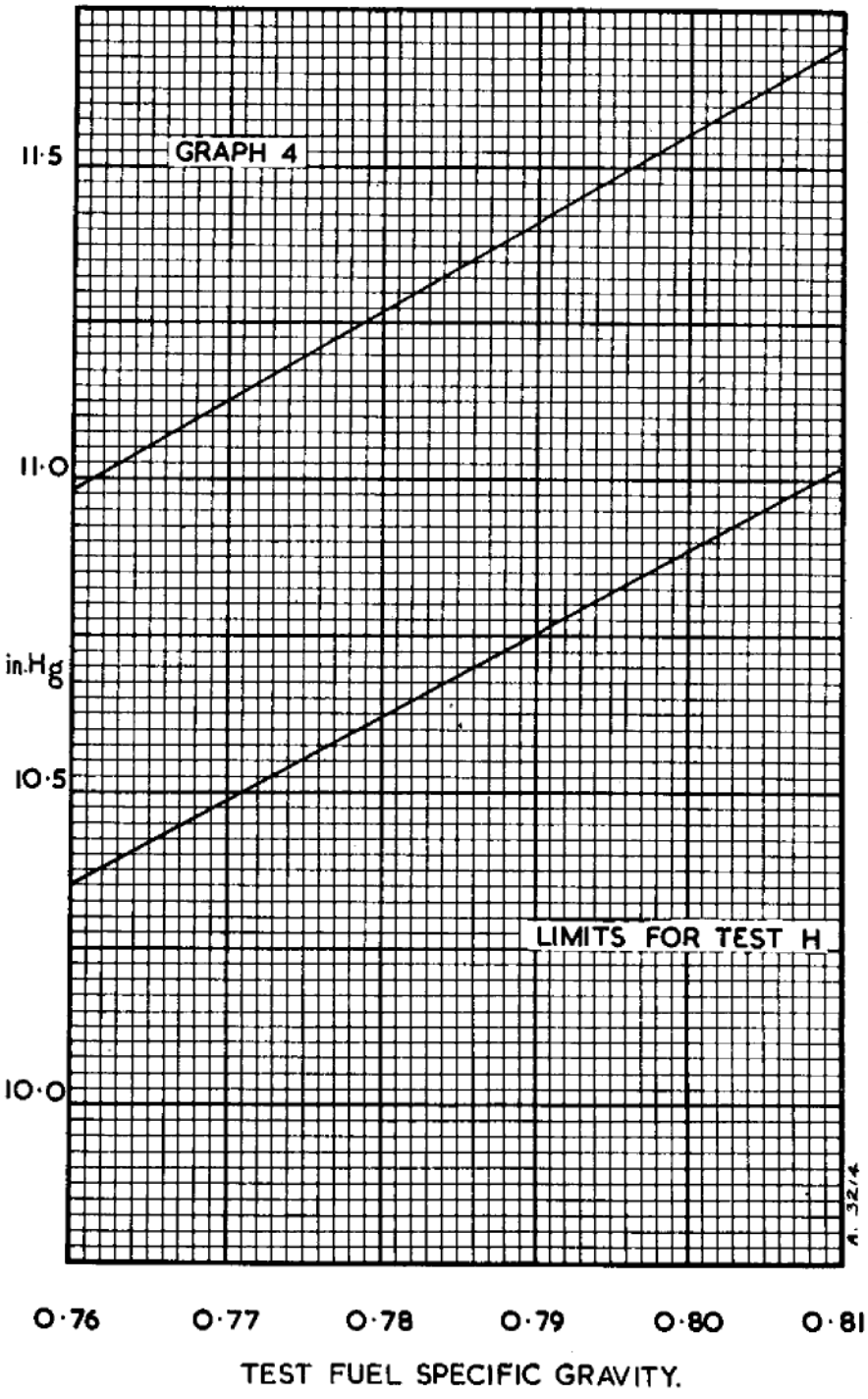



Fig. 7. C.F. pressure signal limits, test H

**Second endurance test**

**41.** Repeat the governor cyclic endurance test detailed in para. 35 using AVTUR 50 fuel at an inlet pressure of 5 to 10 lb/in$^2$.

**Final calibration**

**42.** Repeat the h.m.g. feed orifice flow check as detailed in para. 7.

*Maximum stroke setting*

**43.** Check the maximum flow at each of the following conditions with the overspeed governor set in the maximum position and the fuel inlet boost pressure set at 5 to 10 lb/in$^2$:—

| *Speed (rev/min)* | *Delivery pressure (lb/in$^2$)* | *Flow (gal/h)* |
|---|---|---|
| (a) 4200 | 1000 | 485 minimum |
| (b) 1100 | 300 | 100 minimum |

No increase from the original 15½° camplate angle build setting is permissible.

*Servo flow check*

**44.** Repeat the test detailed in para. 23.

*Stall pressure test*

**45.** Repeat the test detailed in para. 26.

*Volumetric efficiency test*

**46.** Repeat the test detailed in para. 29.

*Overspeed governor range test*

**47.** Run the pump at the conditions stated and at the lower and higher speeds in order to check the overspeed governor range of adjustment. Set the fuel inlet pressure to 1 to 5 lb/in$^2$, the pump delivery pressure to 1100 lb/in$^2$, and run the pump at 4150 (4100) rev/min. Rotate the governor adjusting screw anti-clockwise, using the box key T.160988, until the pump governs, denoted by a rapid decrease in delivery pressure and fuel flow. Reduce and increase pump speed several times about the 4150 (4100) rev/min setting point and check for satisfactory governor operation at this setting. Increase the pump speed to 4670 (4550) rev/min and rotate the governor adjusting screw clockwise until the delivery pressure and flow recover, then re-adjust the screw anti-clockwise until the pump governs. Check for satisfactory governor operation at this speed setting. The governor adjusting screw locknut should be tight each time the governor operation is checked.

*H.M. governor pressure characteristics*

**48.** Repeat the test detailed in para. 30.

*Overspeed governor setting*

**49.** Repeat the test detailed in para. 31.

*Flow recovery test*

**50.** Govern the pump from point 'A' conditions, para. 31, down to 200 lb/in$^2$ delivery pressure. Close the downstream variable restrictor to reduce the fuel flow to zero. Open the restrictor; the flow must recover immediately.

*Time recovery test*

**51.** Repeat the test detailed in para. 32.

*Centrifugal (C.F.) pressure signal tests*

**52.** The fuel to be used for this test is AVTUR 50. Measure the temperature and specific gravity of the fuel and refer to the graphs to determine the limits of C.F. pressure, in inches of mercury, required at the specific gravity of the fuel. During the tests maintain the fuel temperature within ±2°C of the temperature measured and within 20 to 25°C.

**53.** Connect the mercury manometer to the pump at the points shown in fig. 10; flexible transparent tubing must be used to allow a visual check for any air in the fuel. The mercury in the manometer limbs must be level before and after the tests with the pump stationary. The mercury must be in direct contact with the fuel and the system bled of all air.

**54.** Run the pump for the following tests at the following conditions; the C.F. signal pressure to be within the limits shown in the graphs.

**55.** Disconnect the manometer connections from the pump, blank the two pump tappings and connect the manometer to the camplate housing and inlet pressure tappings at the points shown in fig. 10. Bleed the system of air. Run the pump for the tests at the following conditions, record the resultant C.F. pressure signal and check against the graphs.

| *Test No.* | *Pump speed (rev/min)* | *Delivery pressure (lb/in²)* | *Flow (gal/h)* | *C.F. pressure signal (in. Hg.)* |
|---|---|---|---|---|
| A | 4000 | 300 | 250 | |
| B | 4000 | 300 | 50 | Limits as fig. 4 |
| C | 4000 | 800 | 250 | |
| D | 3000 | 300 | 250 | |
| E | 3000 | 300 | 50 | Limits as fig. 5 |
| F | 3000 | 800 | 250 | |

These conditions obtained by use of the external stall valve.

| *Test No.* | *Pump speed (rev/min)* | *Delivery pressure (lb/in²)* | *Flow (gal/h)* | *C.F. pressure signal (in. Hg.)* |
|---|---|---|---|---|
| G | 2500 | 300 | 250 | Limits as fig. 6 |
| H | 3000 | 300 | 250 | Limits as fig. 7 |
| J | 3500 | 300 | 250 | Limits as fig. 8 |
| K | 4000 | 300 | 250 | Limits as fig. 9 |
| L | 4000 | 800 | 250 | As recorded at test K. +0·4 in. max. |

These conditions obtained by use of the external stall valve.

**Note . . .**

*Pumps which meet the C.F. limits given in test G to L must be marked for identification purposes with a white painted cross adjacent to the nameplate. Pumps which do not meet these limits, however are not to be marked and are to be progressed in the normal manner.*

*Governor operation at inlet depression conditions*

**56.** Run the pump at 1100 lb/in² delivery pressure and adjust the fuel inlet pressure until a depression of 12 in. Hg is obtained. Check that at these conditions the pump governing speed is 4460 (4150) to 4480 (4170) rev/min. Do not run the pump at inlet depression conditions for any period longer than is necessary to ensure correct functioning of the governor.

**Fuel leakage tests**

**57.** Run the pump at a fuel inlet pressure of 20 lb/in² and 40 lb/in² at the following conditions for a period of 5 minutes for each test. Set the pump speed to 4000 rev/min. Adjust the downstream variable restrictor until the pump stalls and the fuel flow decreases to 350 gal/h. Check that any fuel leakage from the seal drain does not exceed 5 cm³/h at 20 lb/in² inlet pressure and 20 cm³/h at 40 lb/in². Dry the pump externally during these tests and examine for any external fuel leaks. No leakage other than from the seal drain is allowed.

**Self priming test**

**58.** Run the pump at 500 rev/min and close the fuel inlet line. A minimum inlet depression of 20 in. Hg must be obtained. Do not run the pump at inlet depression conditions for any period longer than is necessary to ensure correct functioning of the pump.

**Air leakage tests**

**59.** *Pump body.* Disconnect the pump from the rig; allow the fuel to drain, and blank all connections including the oil seal drain. Connect the pump inlet to a moisture free compressed air supply and apply air at 40 lb/in². Immerse the pump in fuel for a period of 5 minutes. No air leakage is permissible.

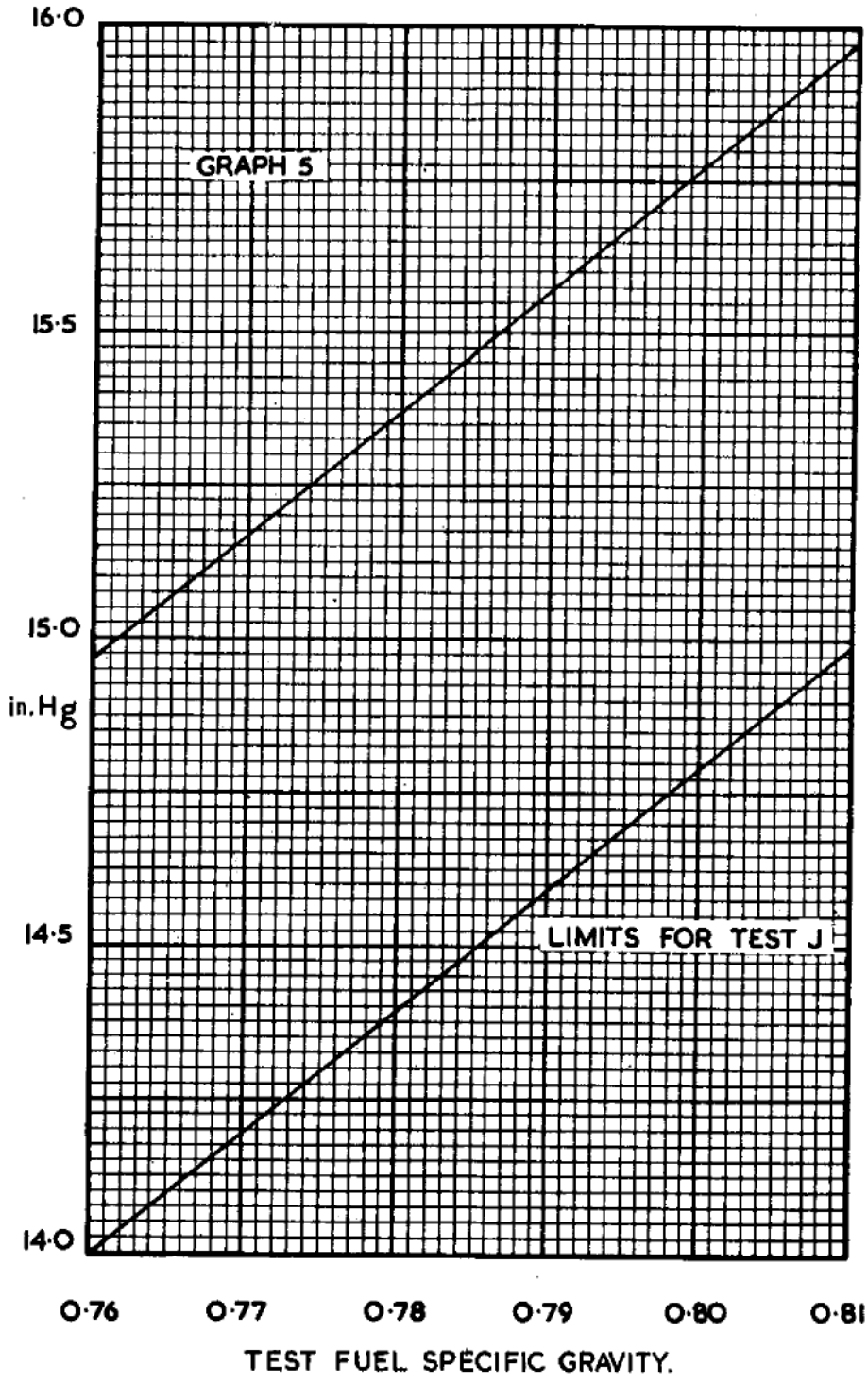



**Fig. 8. C.F. pressure signal limits, test J**

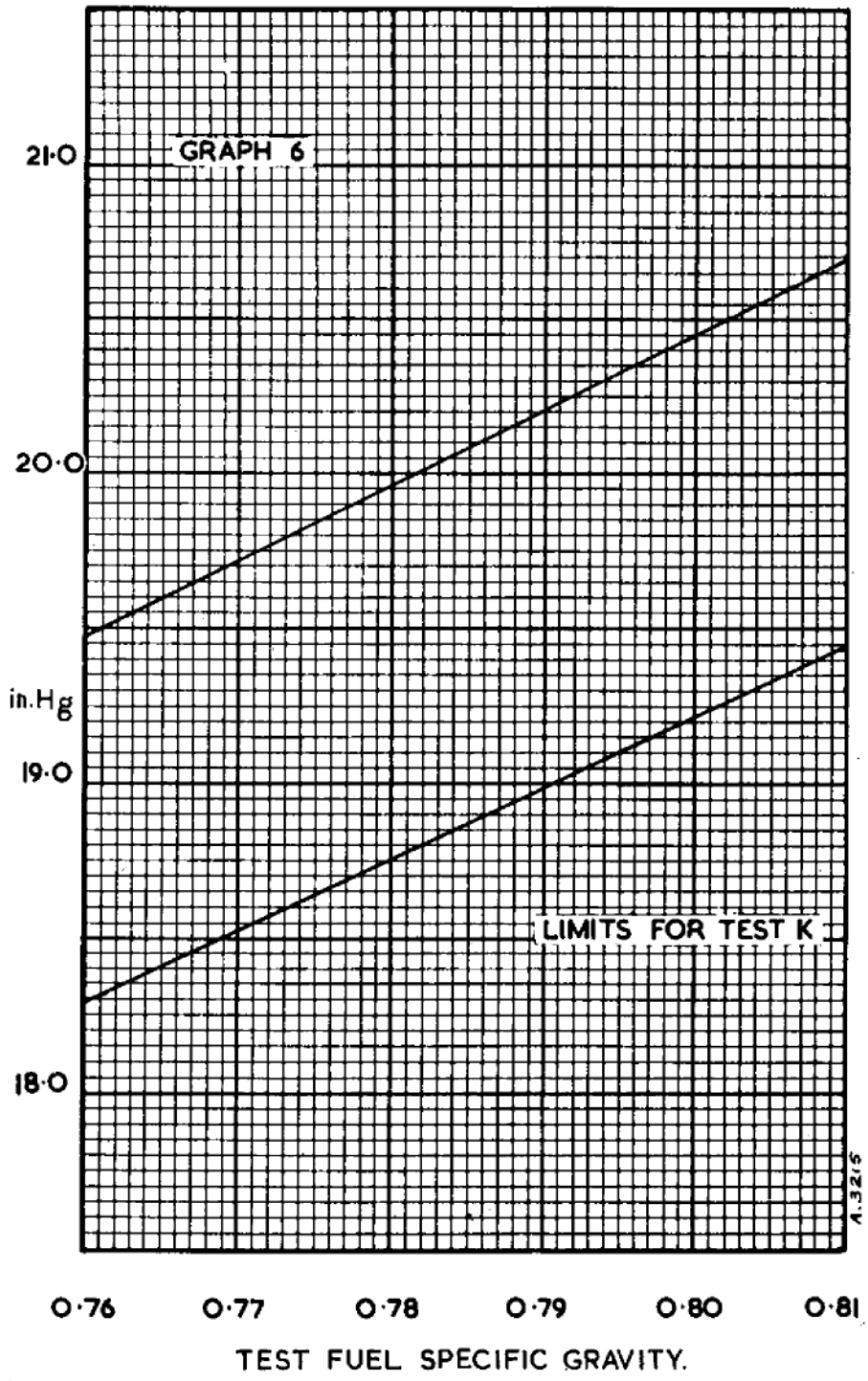
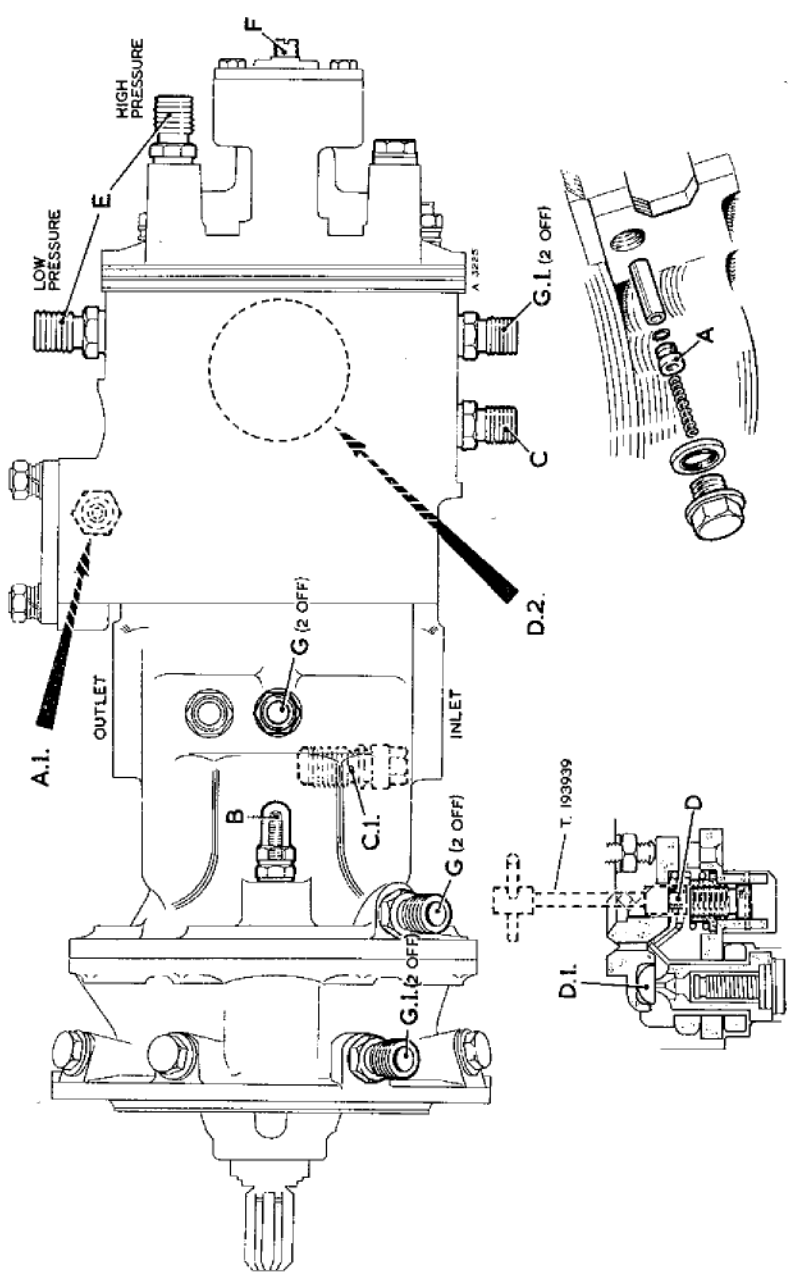



Fig. 9. C.F. pressure signal limits, test K




A. HYDRO-MECHANICAL GOVERNOR (H.M.G.) FEED ORIFICE
A1. H.M.G. FEED ORIFICE LOCATION
B. MAXIMUM FLOW SETTING ADJUSTING SCREW
C. SERVO FLOW CHECK ALTERNATIVE CONNECTION
C1. SERVO ORIFICE
D. STALL ADJUSTING SCREW
D1. STALL VALVE HALF-BALL AND ORIFICE ASSEMBLY
D2. STALL VALVE LOCATION
E. H.M.G. PRESSURE CHARACTERISTICS TAPPINGS
F. OVERSPEED GOVERNOR ADJUSTING SCREW
G. CENTRIFUGAL (C.F.) PRESSURE SIGNAL CONNECTIONS FOR TESTS 'A' TO 'F' (2 OFF)
G1. CENTRIFUGAL (C.F.) PRESSURE SIGNAL CONNECTIONS FOR TESTS 'G' TO 'L' (2 OFF)

**Fig. 10. Test tappings, connections and adjusting points**

**60.** *Rotor quill shaft oil seal.* Remove all blanking plugs from the oil seal drain connections and fit the pressure test fixture T.282146 and a gasket to the camplate housing and secure with nuts and bolts. Apply air at a pressure of 5 lb/in$^2$ to the fixture inlet union, then immerse the pump and fixture in fuel for a period of 5 minutes. No air leakage is permissible.

**61.** Remove the fixture T.282146; fit the blanking plugs and union to the oil seal drain connections, then wirelock all points except those required for the tests detailed in para. 62.

**Final fuel leakage tests**

**62.** Repeat the test given in para. 57.

**63.** Inhibit the pump in accordance with A.P.4471A.

**64.** Remove the rig adapters from the pump. Fit dust caps to unions, blanking plates and gaskets to open ports and a quill-shaft protection cover to the pump engine mounting face.

**65.** Complete all external wirelocking. Check to ensure the identity and modification standard of the pump, and that all inspection records are complete.

## APPENDIX 1

**Fault diagnosis**

(1) Any dismantling, examination and rebuilding necessary during fault finding must be carried out as detailed in the relevant chapters of this volume with particular reference to cleanliness and the use of special tools.

**Note . . .**

*Upon completion of the rebuild any pump calibration previously achieved must be checked and reset if necessary.*

(2) Carry out the fault finding checks in the sequence given to avoid unnecessary dismantling.

| *Symptom* | *Possible cause* | *Check for* | *Remedy* |
|---|---|---|---|
| (3) No flow, no pressure | (i) Servo orifice blocked | (a) Foreign matter in orifice | Remove orifice and clear |
| | (ii) Governor in operation | (a) Insufficient clearance between governor tappet and rocker lever tail | Check clearance and reset if necessary |
| | (iii) Rotor quillshaft broken | (a) Remove pump from rig and rotate quillshaft by hand. There should be a high resistance | Renew affected parts |
| (4) Excessive noise during running | (i) Pump overstroking | (a) Incorrect setting of flow delivery adjusting screw | Strip pump and check camplate angle is 15½° maximum |
| | (ii) Piston and slipper assemblies | (a) Slipper plating edging; excessive slipper lift; pistons tight in rotor bores | Strip pump and examine affected components |
| (5) Low maximum flow | (i) Governor in operation | (a) Check as in para. (3) (ii) | |
| | (ii) Leakage from servo system | (a) External leakage from pipe lines; through the servo isolating valve or the external stall valve | Ensure pipe connections are tight and dry; check sealing condition of isolating valve and stall valve |
| | | (b) Damaged sealing rings on servo control piston or between control cylinder liner and pump body | Strip pump and renew seals |
| | (iii) Incorrect camplate angle | (a) Check as in para. (4) (i) | |
| (6) High volumetric efficiency, i.e. low flow loss | (i) Sealing of rotor face to port insert too effective | (a) Worn rotor port face plating; worn port insert | Examine rotor port face. Check parallelism of port insert |

| *Symptom* | *Possible cause* | *Check for* | *Remedy* |
|---|---|---|---|
| **Note . . .** *This is not considered a fault but it is advisable to check the pump if the loss is exceptionally low since excessive rise in fuel temperature and therefore bearing overheating may occur.* | | | |
| (7) Low volumetric efficiency, i.e. high flow loss | (i) H.m.g. feed orifice | (a) Orifice sealing ring damaged | Fit new sealing ring |
| | | (b) Flow through orifice above limits | Check flow as detailed in sub-assembly tests |
| | (ii) Pump governor in operation | (a) Check as in para. (3) (ii) | |
| | (iii) Pump stalling | (a) Check as in para. (11) (ii) | |
| | (iv) Servo orifice blocked | (a) Foreign matter in orifice | Clean and refit |
| | (v) Eccentric drive from rig to pump | (a) Adapter between pump quill drive and rig drive shaft not seated square | Reseat adapter |
| | (vi) Port insert | (a) Not seated square in pump body | Reseat port insert |
| | (vii) Rotor small carbon bearing | (a) Excessive clearance between rotor and bearing | Dimensionally check affected parts. Fit replacement carbon at the minimum clearance limit |
| (8) Inability to obtain h.m.g. pressure characteristics | (i) H.m governor carbon face seals | (a) Deterioration of the sealing faces. Check for an unbroken running witness mark; sealing ring(s) damaged. | If sufficient land exists, carefully lap the carbon sealing face to restore the surface finish, using fine grade silicon carbide paper on a surface table. Polish the face to aid visual examination, using a flat glass. Fit new sealing ring(s) |
| Pressure high | (ii) H.m. governor | (a) Insufficient clearance between governor lever weight and the end cover plate | Check for minimum clearance of 0·025 in. Examine for any distortion of the end plate. Renew affected parts |
| Pressure low | (iii) H.m.g. mounting plate assembly | (a) Shroud plate damping orifice blocked | Clear orifice |
| | (iv) H.m. governor hinge | (a) Examine hinge for distortion | Fit new hinge |
| (9) Excessive leakage from oil seal drain | (i) Carbon face seal | (a) Check as in para. (8) (i) (a) | |
| | (ii) Rotor | (a) Imperfect mating face | The rotor face may be renewed in accordance with an approved repair scheme |

| *Symptom* | *Possible cause* | *Check for* | *Remedy* |
|---|---|---|---|
| (10) Inability to obtain correct servo flow | (i) Servo orifice | (a) Orifice sealing rings damaged | Fit new sealing rings |
| | (ii) Servo control piston seal | (a) Seal damaged | Fit new seal |
| | (iii) Servo control piston cylinder liner | (a) Liner badly scored; sealing ring between liner and pump body damaged | Reclaim cylinder liner in accordance with an appropriate repair scheme; fit new sealing rings |
| (11) Inability to set correct stall pressure. Pressure too low | (i) Governor in operation | (a) Check as in para. (3) (ii) | |
| | (ii) Rocker lever and orifice assembly | (a) Buckled or distorted torsion hinges allowing leakage | Fit new hinges |
| | | (b) Leakage across orifice face under half-ball valve | Examine orifice face for scratches or damage. Re-lap in accordance with appropriate repair scheme if necessary or fit new component |
| | | (c) Orifice sealing ring damaged | Fit a new sealing ring |
| Pressure too high | | (a) Rocker lever preload excessive | Check pre-load and reset towards minimum setting permissible |
| (12) Incorrect governing performance. Unable to obtain point 'A' | (i) H.m.g. feed orifice | (a) Foreign matter obstructing orifice | Clean orifice and refit |
| | (ii) Overspeed governor assembly | (a) Fractured diaphragm | Fit new diaphragm assembly |
| | | (b) Incorrect tappet clearance | Reset clearance |
| | (iii) Rocker lever and orifice assembly | (a) Distorted torsion hinges | Fit new hinges |
| Unable to obtain points B1, B2 or C2 within the given speed limits. | (i) Rocker lever and orifice assembly | (a) Excessive rocker lever pre-load | Check and reset pre-load towards minimum permissible limits |
| | (ii) Excessive leakage through h.m.g. control orifice | (a) H.m.g. lever pad not square to orifice | Check h.m.g. lever hinge for distortion. Fit new hinge as necessary |
| | (iii) H.m.g. mounting plate and diaphragm assembly | (a) Diaphragm centre piece pre-loading the lever and pad away from the orifice | Fit new diaphragm assembly |

| *Symptom* | *Possible cause* | *Check for* | *Remedy* |
|---|---|---|---|
| (13) Centrifugal (C.F.) pressure signal. | | | |
| *Above limits* | Rotor and port insert mating faces | (a) Leakage across faces from high pressure (outlet) side of pump into C.F. side | Examine the mating faces for undue wear. Check that the rotor face is not concave. Dimensionally check the port insert for flatness |
| *Below limits* | | (a) Leakage from C.F. side into low pressure (inlet) side of pump | |
| (14) Pump overheating | (i) End loading of rotor | (a) Interference between rotor quill drive and rig drive | Dimensionally check; if satisfactory, strip pump and examine rotational parts |
| | (ii) Insufficient auxiliary camplate lift | | Check lift setting and re-shim if necessary |
| | (iii) Insufficient leakage across port insert | Check as in para. (6) | |

**RESTRICTED**

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