ADMIRALTY
AIR MINISTRY

This is A.L. No. 15 to Air Publication 4282, Volume 2, Part 3 Section 7, Chapter 1. *Remove* and *dispose* of the existing Chapter 1 and *substitute* this Chapter 1. *Record* the incorporation of this A.L. in the Amendment Record Sheet.

Chapter 1

DUPLE BURNERS

(Derwent and Nene aero-engines)

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ENGINEER

PRELIMINARY INFORMATION

1. Duple burners as fitted to the Rolls-Royce Derwent and Nene aero-engines are of a similar design, and the information in this chapter will apply to both types of burner, except where otherwise stated. The importance of cleanliness during re-conditioning cannot be over emphasised, and care must also be taken to avoid damaging components during handling or storage.

SPECIAL TOOLS

2. The following is a list of special tools required for reconditioning the duple burners :—

HW. 11446	Vice block (Derwent)
HW. 11467	Vice block (Nene)
HW. 7469	Holding device (Derwent and Nene)
BL. 7532	Spanner (Derwent and Nene)

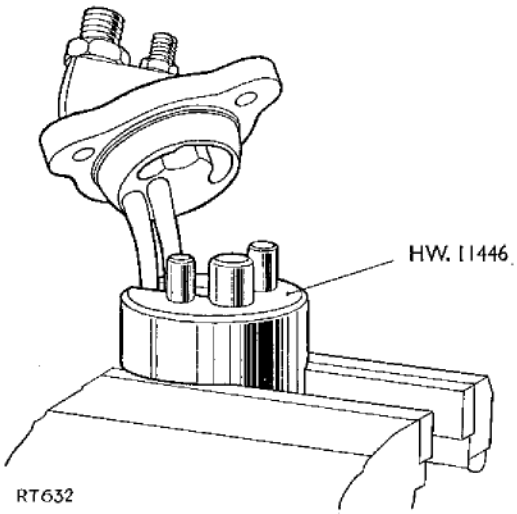


Fig. 1. Vice block for spherical connection (Derwent)

HW. 11386	Checking fixture (Derwent)
HW. 14099	Wooden block for use with HW. 11386
HW. 11468	Checking fixture (Nene)
HW. 11473	Gauge, for use with HW. 11386 and HW. 11468
HW. 14217	Fibre tipped drift for use with H.W. 11386 and HW. 11468

DISMANTLING

3. Remove the dust caps from the unions, and the transportation cover from the air shroud. Make a visual examination of the burner to ascertain that it is not damaged to a degree which would entail rejection.

4. After the burner has been visually examined it must be stripped, cleaned, and have any carbon removed. Care must be taken during these operations to avoid damaging the burner.

5. To dismantle the burner proceed as follows:—

(1) Separate the inner and outer sealing flanges and remove the inner flange by passing it over the burner head. Remove and discard the rubber sealing ring.

(2) Mount the burner, at the spherical end, on the vice block HW.11446 (Derwent) as shown in fig. 1 or HW.11467 (Nene).

(3) Unscrew the main and primary unions from the spherical connection. Remove and discard the aluminium joint washers. On Derwent burners the small union is the main feed, on Nene burners the large union is the main feed.

(4) Lift off the outer sealing flange. Derwent burners, pre-Mod. 472 have the rubber sealing ring fitted to this flange.

(5) Remove and discard the locking ring from the burner head.

(6) Secure the air shroud in the holding device HW.7469 (*fig.* 2).

(7) Unscrew the burner head from the air shroud, using the spanner BL.7532.

(8) Remove the air shroud from the holding device.

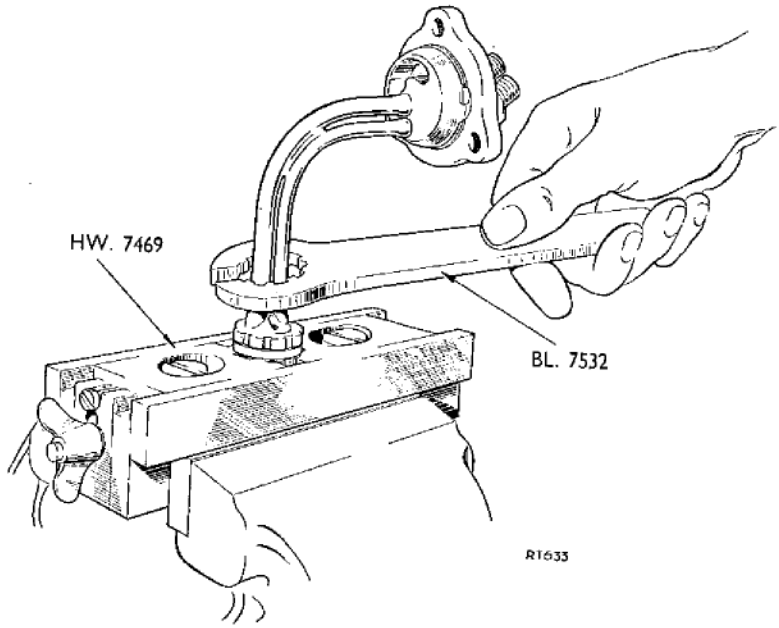


Fig. 2. Holding device for burner head (Derwent and Nene)

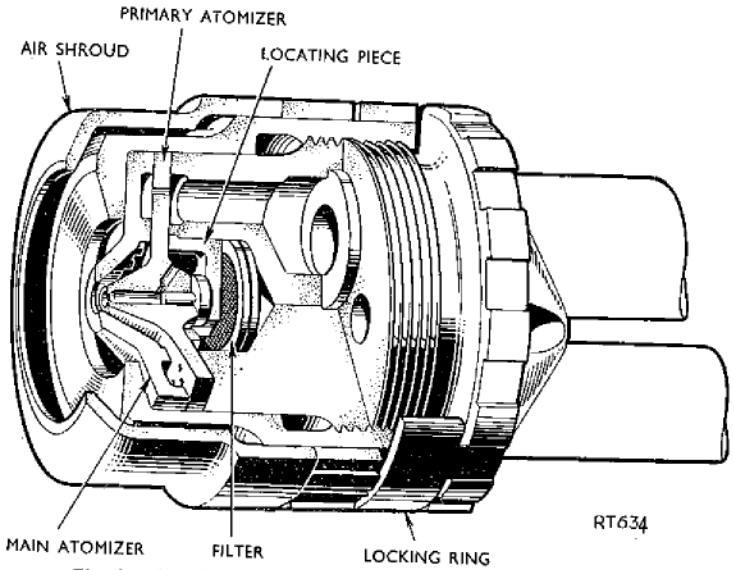


Fig. 3. Sectioned view of burner head (Derwent and Nene)

(9) Remove the filter locating piece and filter from the burner head.

Flushing the burner head in clean kerosine, and blowing down the main or primary feed pipe with compressed air will assist the removal of these parts.

(10) Using a piece of wooden dowelling or a soft aluminium drift, tap out the main and primary atomizer from the air shroud.

CLEANING

6. It is important that the work bench is scrupulously clean, and to facilitate this it should be covered with zinc sheeting or linoleum. A clean container in which to put the dismantled parts will also be required.

7. To facilitate the removal of carbon from those parts of the burner assembly so affected, immerse them in a Cresol-soap solution for a period not exceeding 30 minutes.

8. Upon removal from the solution, the parts must be washed in clean kerosine and blown off with dry compressed air. On no

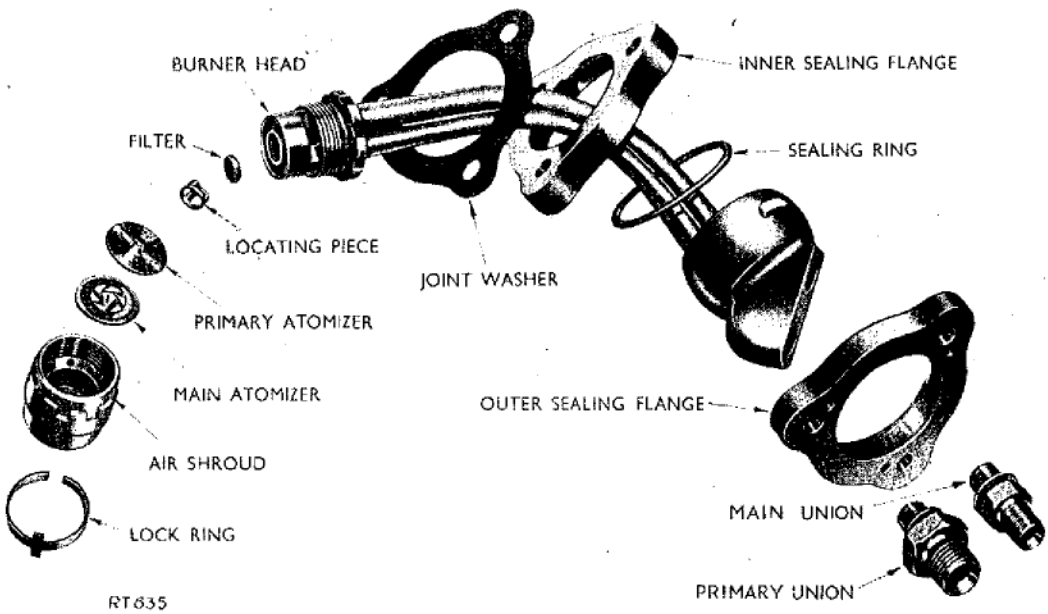


Fig. 4. Exploded view (Derwent)

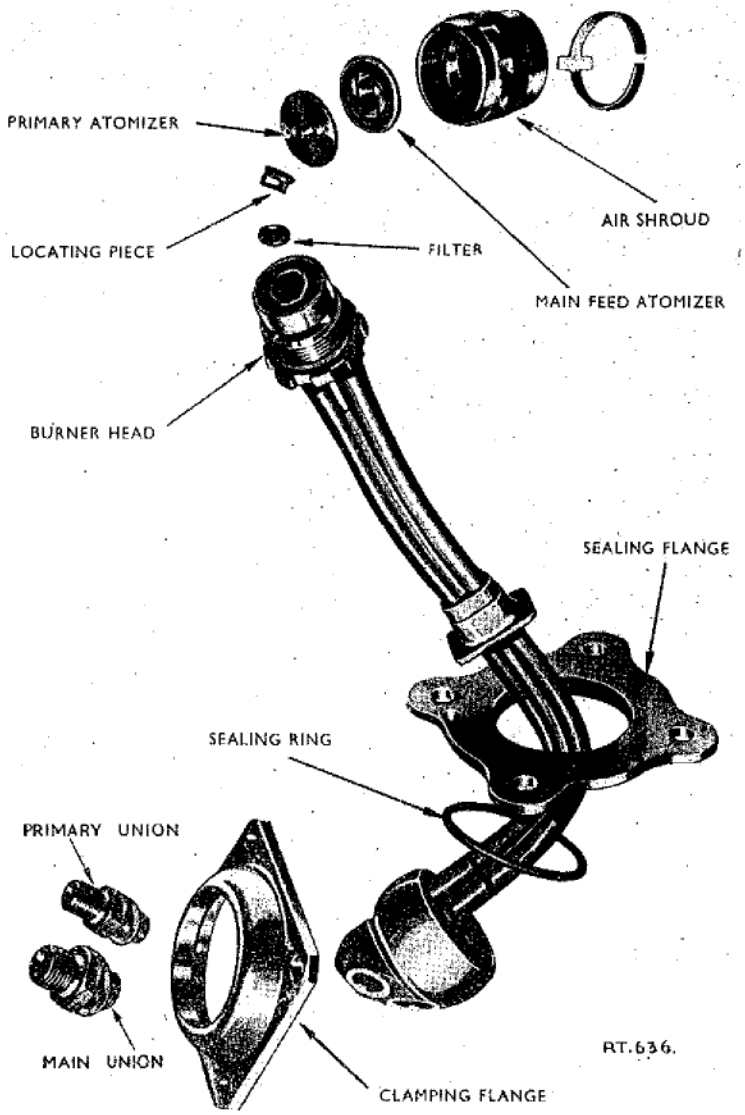


Fig. 5. Exploded view (Nene)

account must a bristle or wire brush be used during the cleaning, and if it is necessary to wipe the parts, only a clean lint-free cloth should be used.

INSPECTION

Redundant parts

9. All parts made redundant by the embodiment of modifications must be rejected during inspection.

Consumable parts

10. The following parts must be discarded during dismantling, irrespective of their condition.

Air shroud lock-ring
Flange sealing ring
Primary and main union joint washers.

Surface damage

11. The standard of acceptance for surface damage may vary, depending on the number of hours the burner is to be in use, and experience gained during the operation of these burners.

Plating

12. If there is any sign of flaking of the plating on any part, the defective part must be rejected and a replacement fitted. The rejected part or parts should be sent for replating.

Main assembly

13. Ensure that the threads on the burner head are in good condition, and that the air passages are unobstructed. Inspect the atomizer seating faces; these must be in perfect condition. Slight burrs or scratches may be removed by light stoning or lapping, but the seating faces must be kept square with the axis of the burner head. Damage to the seating faces which cannot be removed by stoning or lapping will entail the rejection of the main assembly.

14. Examine the spannering slots for damage. Blank off the main and primary fuel connections in the spherical end of the burner with slave adapters. Connect a kerosine supply line to the burner head and apply a pressure of 2,000 lb. per sq. in. With the assembly under pressure examine for cracks and porosity; if such defects are revealed, the assembly must be rejected.

15. Fretting on the spherical connection need only be cleaned up sufficiently to remove any high spots which may prevent satisfactory bedding.

16. The locating peg must be free to turn, but if tight, it may be freed by soaking in kerosine, and at the same time carefully exerting a twisting movement on the peg.

17. Examine the internal threads and seating faces of the union connections for damage.

Air shroud

18. Ensure that the internal threads are in good condition, and that all the air holes are unobstructed. The bore for the atomizers must be free from scores and damage marks. Examine the locking slots for cracks and damage, and the locating diameter for fretting.

Primary and main atomizers

19. Inspect the holes in the primary atomizers, and ensure that they are free from carbon or foreign matter. The tangential slots and mating face of the main atomizer must be carefully examined for any slight scores or damage marks.

Locating piece and filter

20. Examine the locating piece for damage, and the filter for damage and foreign matter.

Sealing flanges

21. Inspect the sealing flanges generally for damage, paying particular attention to the spigot for cracks and the sealing ring groove for burrs and damage.

22. Fretting on the spherical seatings need only be cleaned up sufficiently to remove any high spots which may prevent satisfactory bedding.

Primary and main union connections

23. Ensure that the conical seatings, threads and hexagon flats of the unions are in good condition. The conical seatings must be in a condition which will ensure a perfect seal with the pipe nipple.

REBUILDING

Sealing flange

24. Fit a rubber sealing ring to the inner flange of Nene, or Derwent post-Mod.472 burners; Derwent pre-Mod.472 burners have the sealing ring fitted to the outer flange.

Union connections

25. Fit the union connections as follows:—

(1) Mount the burner, at the spherical end, on the vice block HW.11446 (Derwent) or HW.11467 (Nene).

(2) Place the outer sealing flange on the spherical connection.

(3) Fit new aluminium joint washers to the connections.

(4) Screw in and tighten the connections.

(5) Remove the burner from the vice block.

26. On Derwent burners the small diameter (main) connection must be fitted in the position nearest to the sealing flange.

Filter and atomizers

27. Fit the filter and atomizers as follows:—

(1) Insert the filter into the burner head; and add the locating piece with its bridged end first.

(2) Place the main feed atomizer, orifice projection first, into the air shroud, followed by the primary atomizer, with its centre hole nearest to the main feed atomizer.

(3) Press the atomizers fully into position with the fingers.

Air shroud

28. Fit the air shroud as follows:—

(1) Screw the air shroud on to the burner head, ensuring that the assembled parts are not disarranged.

(2) Secure the air shroud in the fixture HW.7469, and tighten the burner head, using the spanner BL.7532.

The lock-ring is not fitted until after the rig test.

Inner sealing flange

29. Slip the inner sealing flange over the burner head, and temporarily secure it to the outer sealing flange, previously fitted. The burner is then ready for rig testing.

TEST PROCEDURE

30. The conditions at which the burners are to be tested are given in the Test Schedule at the end of this chapter. It may be expedient, however, when testing a large number of burners, to re-arrange the order of the tests. All the tests on the primary atomizer can then be completed before starting the combined atomizer tests.

31. As the performance limits are based on the "mean flow" of a complete set of burners, an accurate record of the performance of each burner must be kept throughout the tests.

32. Install each burner in turn on the rig J.46081; insert the nozzle in the swivel chamber and connect the primary and main fuel pipes to the burner.

Primary flow performance

33. With the main fuel cock closed, make a thorough visual inspection of the primary flow only, at the conditions given in the schedule. There must be no streakiness and the spray must be symmetrical about the nozzle axis.

34. Defects in the spray may be caused by small particles of foreign matter or a slight burr on the edge of the orifice. Particles of foreign matter can usually be removed by cleaning. Slight burrs on the edge of the orifice will necessitate the fitting of a new or replacement atomizer. Due to the fine limits on the orifice no attempt must be made to remove the burrs by lapping.

Combined flow performance

35. With the main fuel cock open, make a thorough visual examination of the spray produced by the combined flow, at the conditions given in the schedule. There must be no streakiness and the spray must be symmetrical about the nozzle axis. The flow must be carefully checked at the highest pressure and, if necessary, adjusted. The fuel flows at the lower pressures must be recorded and must be within the limits given for the mean flow of the nine burners.

36. The flow is adjusted by removing the main atomizer plate from the burner and lapping the joint face of the plate (the face which mates with the primary atomizer). Only a very fine lapping paste must be used and great care taken to lap accurately. The orifice end of the primary atomizer may also have to be lapped to compensate for this adjustment and keep the spray angle within the specified limits.

Note . . .

If any adjustment is made to the primary flow calibration after the combined flow check it will necessitate a re-check of the latter.

Primary spray angle

37. The chordal method of measuring the effective spray angle is used, the angle of the spray cone being defined as the included angle subtended by chords struck from the burner orifice and intersecting the spray boundary at a given distance from the apex (*fig.* 6).

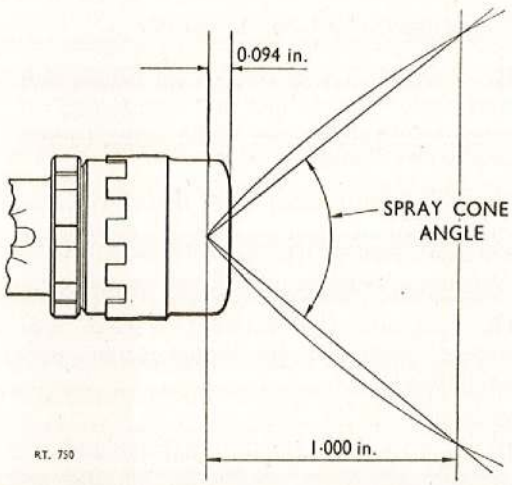


Fig. 6. Details of spray angle (Derwent and Nene)

38. The shape of the spray can be observed on the ground glass screen at the front of the spray chamber, and the angle of the cone can be measured with the transparent protractor supplied with the rig.

39. Close the main fuel cock and apply the inlet pressure given in the schedule to the primary atomizer. Set the centre point of the protractor at the point where the spray leaves the nozzle orifice and measure the angle and the symmetry of the spray. Turn the burner in the rig adapter until it is at an angle of 90 deg. from the previous position, then take a second reading. The angle and the symmetry of the spray must be within the specified limits.

Combined spray angle

40. Open the main fuel cock and apply the conditions given in the schedule to the burner, then check the combined spray angle in a similar manner to that used for checking the primary spray angle. The angle and the symmetry of the spray must be within the specified limits.

41. If the combined spray angle is not within the limits, it may be corrected by selective fitting of new atomizer plates, but if this method cannot be used, an increase in angle can be obtained by lapping the joint face of the main atomizer plate (the face which mates with the primary atomizer) to bring the two plates closer together. When correcting the angle by the latter

method, only a very fine paste must be used, and great care taken to lap accurately, as 0·0002 in. lapped from the joint face of the main atomizer will increase the angle by approximately 10 deg.

42. If new atomizer plates are fitted, or if the joint face of the main atomizer plate is lapped to correct the spray angle, it is essential to re-check the combined flow performance.

Leakage tests

43. With a continuous flow of fuel through the primary and main fuel pipes at the conditions given in the schedule, there must be no leakage from the burner other than the spray from the orifice.

44. Close the main fuel cock, open the main burner connection to atmosphere ; apply the schedule conditions and check the primary fuel pipe for leakage ; there must be no leakage other than through the burner orifice.

45. Any leakage from the open main connection will indicate a leak between the atomizer plates.

Air flow check

46. To make the check, fit a tightly fitting rubber hose connection over the burner air shroud and connect it to the Solex comparator J.42157. Turn on the air and check that the air flow through the shroud, in the reverse direction to normal, is within the limits ; during the check the open ends of the main and primary fuel connections should be blanked off with the fingers.

47. Should the air flow be above the maximum limit, the air shroud may be tightened *slightly* to alter the air gap, and so reduce the flow.

48. After the burners have been tested, fit the dust caps to the air shroud and union connections. The air shroud lock-ring is not fitted until after the alignment check has been made.

ALIGNMENT CHECK

49. The alignment of the burner head and its relative position to the spherical connection is checked with the fixture HW. 11386 (Derwent) and HW. 11468 (Nene).

50. Before positioning the burner on the fixture, remove the dust cap from the air shroud ; draw the fixture locating sleeve back to the stop, then mount the burner on the platform and secure it with the two clamps.

51. If the alignment is correct the locating sleeve should pass freely over the burner head until it abuts the end face of the air shroud (*fig.* 7).

52. With the locating sleeve abutting the end face of the air shroud, check the relative

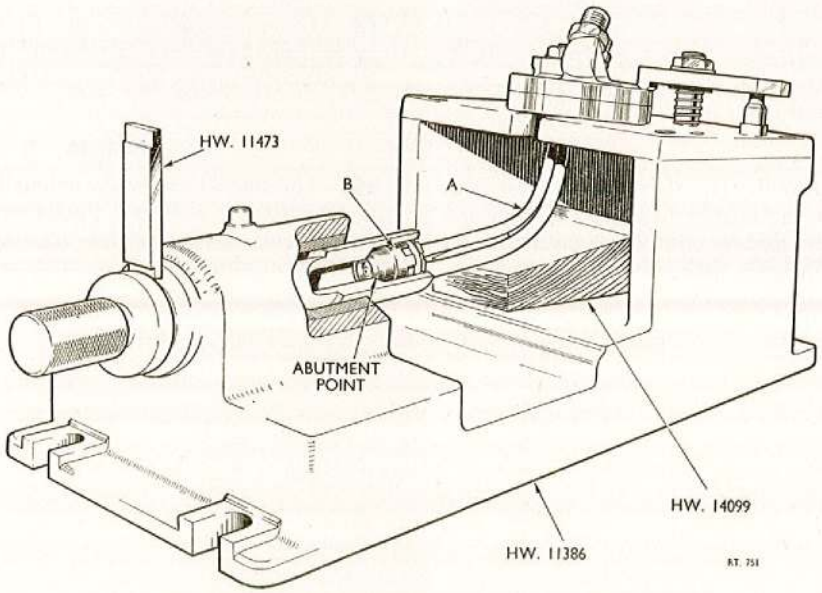


Fig. 7. Fixture for checking alignment of burner (Derwent)

position of the burner head to the spherical connection. To do this, check the distance between the flanges of the locating sleeve and its bush, with the gauge HW. 11473 ; this distance must lie between the HIGH and LOW limits of the gauge.

Correcting the alignment

Derwent

53. To correct the alignment of the burner head, tap it carefully with a hide mallet in the desired direction, until the locating sleeve passes freely over the head of the burner and abuts the end face of the air shroud.

54. The relative position of the burner head to the spherical connection can be corrected by increasing or decreasing the bend of the pipes. Increasing the bend will shorten the relative position of the burner head to the spherical connection, thereby reducing the distance between the flanges of the locating sleeve and bush. Decreasing the bend will have the reverse effect.

55. To shorten the pipes, pass the locating sleeve over the head of the burner ; move the wooden block to support the pipes and strike the pipes using the fibre tipped drift HW. 14217, at the point 'A' indicated in fig. 7.

56. To lenghen the pipes first ensure that the locating sleeve is clear of the burner head, then move the wooden block to the rearward position and strike the burner head with a hide mallet in a downward direction, indicated at point 'B' (*fig.* 7).

57. After either of these adjustments affecting the length of the pipes, repeat the check for alignment and correct if necessary.

Nene

58. To correct the alignment or relative position of the burner head to the spherical connection, slightly different methods are used as compared with the Derwent burners.

59. When correcting the alignment of the burner head the pipes may be bent by hand in the desired direction, due to their greater length.

60. If, when checking the relative position of the burner head to the spherical connection, it is found necessary to lengthen the pipes, this may be done by supporting the pipes from underneath with the fibre drift and bending them by hand. To shorten the pipes, pass the locating sleeve over the head of the burner and strike the pipes using the fibre tipped drift HW. 14217, at the point 'A' as indicated for Derwent burners (*fig.* 7).

61. After either of these adjustments affecting the length of the pipes, repeat the check for alignment and correct if necessary.

62. Upon the satisfactory completion of the alignment checks, fit the air shroud lock-ring, ensuring that the locking tabs fit snugly in the slots on the burner head and air shroud.

INHIBITING

63. Before fitting the dust caps the burners must be flushed with inhibiting oil OM-13 (Stores Ref. 34B/43). The flushing oil should be pumped through the primary and main fuel pipes at a pressure of 4 to 5 lb. per sq. in. ; this will ensure complete inhibition of the atomizers in the burner head.

64. Upon completion of the inhibiting operation fit the dust caps to the burner head, main and primary fuel connections.

PACKING

65. The burners must be packed in accordance with the Services Packaging Manuals, Vol. 2 and 3, and leaflet S.2, Packaging of R.A.F. equipment.

APPENDIX A

TEST SCHEDULE
DUPLE BURNERS (DERWENT)

Primary atomizer plate BL. 4521
Main atomizer plate B.L. 4520

Fuel

1. Aviation turbine fuel to Specification D. Eng. R.D. 2482 at a temperature of between 19 and 21 deg. C., and a maximum specific gravity of 0·810.

Primary flow performance

2. The visual inspection range is 20 to 700 lb. per sq. in. Rotate the burner about the nozzle axis during the test, to check the spray for streakiness over the whole surface of the spray cone.

Calibration limits

Inlet pressure lb. per sq. in.	100	300	700
Maximum flow gall. per hour	+ 5 per cent of mean flow	+ 5 per cent of mean flow	7·05
Minimum flow gall. per hour	— 5 per cent of mean flow	— 5 per cent of mean flow	6·4

The "mean flow" referred to is the average flow of the complete set of nine burners at the pressures quoted.

Combined flow performance

3. The visual inspection range is 20 to 700 lb. per sq. in. Rotate the burner about the nozzle axis during the test, to check the spray for streakiness over the whole of the spray cone.

Calibration limits

Inlet pressure lb. per sq. in.	100	300	700
Maximum flow gall. per hour	+ 1½ per cent of mean flow	+ 1½ per cent of mean flow	71
Minimum flow gall. per hour	— 1½ per cent of mean flow	— 1½ per cent of mean flow	69

The "mean flow" referred to is the average flow of the complete set of nine burners at the pressures quoted.

Spray cone angle

4. The chordal method of spray angle measurement is to be used with either an air flow of 2 to 5 ft. per sec. passing over the burner spray, or in still air.

Primary spray angle

Inlet pressure ... ... 300 lb. per sq. in.
Maximum cone angle ... 76 deg.
Minimum cone angle ... 69 deg.

The spray cone angle must be checked in planes, at right angles to one another, by rotating the burner about the nozzle axis. The maximum permissible difference between the spray angle in each plane is 2 deg. In both cases the spray cone must be checked for symmetry about the nozzle axis ; a maximum of 2 deg. asymmetry is permissible.

Combined spray angle

Inlet pressure ... ... 300 lb. per sq. in.
Maximum cone angle ... 95 deg.
Minimum cone angle ... 88 deg.

The spray cone angle must be checked in two planes, at right angles to one another, by rotating the burner about the nozzle axis. The maximum permissible difference between the spray angle in each plane is 2 deg. In both cases the spray cone must be checked for symmetry about the nozzle axis ; a maximum of 2 deg. asymmetry is permissible.

Leakage tests

5. (1) Test the burners assembly at a fuel pressure of 1,250 lb. per sq. in. minimum, for 2 min. Apply the pressure through the main and primary connections.

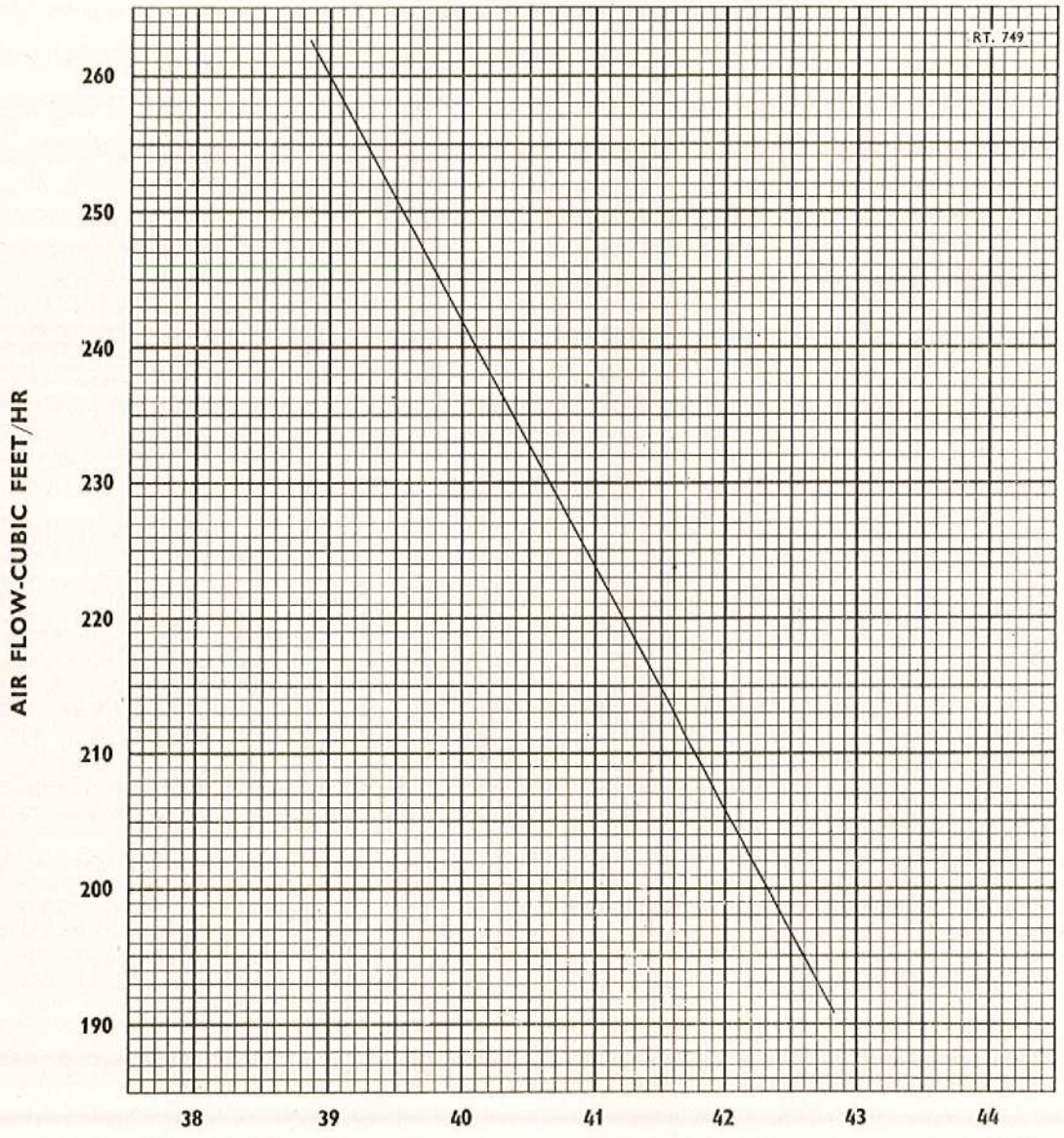
(2) Test the atomizer plate seal at a fuel pressure of 1,250 lb. per sq. in. minimum for 2 min. Apply the pressure through the primary connection.

Air flow check

6. Air flow limits 195 to 260 cu. ft. per hr. at 2 in. Hg. pressure drop.

Note . . .

This corresponds with readings on the Solex comparator rig of 42·6 to 39 (see graph overleaf for correlating actual air flow to Solex instrument readings).



GRAPH SHOWING RELATION BETWEEN SOLEX COMPARATOR READINGS AND ACTUAL AIR FLOW IN STANDARD CUBIC FEET PER HOUR, WITH A 2in. Hg. PRESSURE DIFFERENCE ACROSS THE BURNER AIR SHROUD

Fig. 1. Air flow graph (Derwent and Nene)

APPENDIX B

TEST SCHEDULE

DUPLE BURNERS (NENE)

Primary atomizer plate B.K. 7628
Main atomizer plate BK. 7503

Fuel

1. Aviation turbine fuel to Specification D. Eng. R.D. 2482 at a temperature of between 19 and 21 deg. C. and a maximum specific gravity of 0·810.

Primary flow performance

2. The visual inspection range is 20 to 700 lb. per sq. in. Rotate the burner about the nozzle axis during the test, in order to check the spray for streakiness over the whole surface of the spray cone.

Calibration limits

Inlet pressure lb. per sq. in.	100	300	700
Maximum flow gall. per hour	+ 5 per cent of mean flow	+ 5 per cent of mean flow	8·7
Minimum flow gall. per hour	— 5 per cent of mean flow	— 5 per cent of mean flow	7·9

The "mean flow" referred to is the average flow of the complete set of nine burners at the pressures quoted.

Combined flow performance

3. The visual inspection range is 20 to 700 lb. per sq. in. Rotate the burner about the nozzle axis during the test, to check the spray for streakiness over the whole of the spray cone.

Calibration limits

Inlet pressure lb. per sq. in.	100	300	700
Maximum flow gall. per hour	+ 1½ per cent of mean flow	+ 1½ per cent of mean flow	110·3
Minimum flow gall. per hour	— 1½ per cent of mean flow	— 1½ per cent of mean flow	107·0

The "mean flow" referred to is the average flow of the complete set of nine burners at the pressures quoted.

Spray cone angle

4. The chordal method of spray angle measurement is to be used with either an air flow of 2 to 5 ft. per sec. passing over the burner spray, or in still air.

Primary spray angle

Inlet pressure lb. per sq. in. 300
Maximum cone angle ... 76 deg.
Minimum cone angle ... 69 deg.

The spray cone angle must be checked in two planes, at right angles to one another, by rotating the burner about the nozzle axis. The maximum permissible difference between the spray angle in each plane is 2 deg. In both cases the spray cone must be checked for symmetry about the nozzle axis ; a maximum of 2 deg. asymmetry is permissible.

Combined spray angle

Inlet pressure lb. per sq. in. 300
Maximum cone angle ... 95 deg.
Minimum cone angle ... 88 deg.

The spray cone angle must be checked in two planes, at right angles to one another, by rotating the burner about the nozzle axis. The maximum permissible difference between the spray angle in each plane is 2 deg. In both cases the spray cone must be checked for symmetry about the nozzle axis ; a maximum of 2 deg. asymmetry is permissible.

Leakage tests

5. (1) Test the burners assembly at a fuel pressure of 1,250 lb. per sq. in. minimum, for 2 min. Apply the pressure through the main and primary connections.

(2) Test the atomizer plate seal at a fuel pressure of 1,250 lb. per sq. in. minimum for 2 min. Apply the pressure through the primary connection.

Air flow check

6. Air flow limits 195 to 260 cu. ft. per hr. at 2 in. Hg. pressure drop.

Note . . .

This corresponds with readings on the Solex comparator rig of 42·6 to 39 (see graph for correlating actual air flow to Solex instrument readings).

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