Chapter 20 A

INSPECTION FOR DAMAGE AFTER SHOCK LOADING

Contents

Illustrations

THIS CHAPTER, which is applicable to both the Ghost 48 Mk. 1 and the 48 Mk. 2, describes the examination of an engine which has been shock loaded as the result of a crash landing; where information is applicable to one mark of engine only, the text is suitably endorsed. To provide a correct assessment of the damage sustained and at the same time avoid unnecessary work the checks should be made in the order given.

FRONT AND REAR MAIN BEARINGS

The front and rear main bearings of engines which have been shock loaded and accepted for further service as a result of the following inspection, should be changed for new components at the next overhaul, regardless of the apparent condition of the bearings.

INSPECTION OF ENGINE

Remove the engine from the airframe, as described in chapter 7, and transfer it to the dismantling and assembly stand T.75592—see chapter 23, page 3. Remove the exhaust cone assembly as described in chapter 18 and make a thorough visual examination of the whole engine for external damage. Particular attention should be given to the mounting flanges of the oil sump and, *Ghost 48 Mk. 1*, the bottom wheelcase, for indications of fracture when there is evidence of impact between these components and the aircraft cowling. The engine must be rejected if distortion or cracks are confirmed.

Check the freedom of the main shaft assembly by spinning the main shaft as fast as possible by hand, and by listening for any unusual noises during the time taken for the main shaft assembly to cease rotating; observe that there is a slight tendency for the assembly to swing back as rotation ceases. Noises from some of the accessories, in particular the fuel pump/s and air compressor, will be audible during the run down; if in doubt these accessories should be removed.

If the oil sump and, *Ghost 48 Mk. 1*, the bottom wheelcase, flanges are undamaged, carefully examine the sump floor for signs of collapse and cracking—*Ghost 48 Mk. 1*, in the region of the oil pump and metering pumps. The examination will be facilitated if the engine is rotated in the stand until the underside of the sump is vertical or facing slightly upwards. Remove all dirt, oil and loose paint, and paint the floor of the sump with a solution of 25 to 30 per cent lard oil in kerosene heated to 80 deg. C. Wipe off the excess oil, coat the oil sump with chalk, and examine for cracks. If necessary, remove the damaged oil sump, and fit a serviceable assembly.

Examine the engine mounting eyes and the immediate surrounding area of the diffuser casing, and the whole of the lower part of the diffuser casing, for cracks or distortion. Remove the paint from the areas around the mounting eyes and apply the recommended solution of oil in heated kerosene. Wipe away excess oil and coat with chalk. Examine for cracks; if satisfactory, remove the oil and chalk, and repaint.

Remove combustion chambers No. 5, 6, and 7, and thoroughly examine each combustion chamber for signs of cracking and distortion. Pay particular attention to the cast light-alloy expansion chambers. Apply the recommended solution of oil in heated kerosene. Wipe away excess oil, coat these components with chalk and examine for cracks. If the combustion chamber components are in a satisfactory condition reassemble them to the engine.

Where the materials are available, Met-L-chek dye and developer may be used instead of oil and chalk. If this alternative is employed, particular care must be taken that the supplier's instructions are strictly adhered to and the dye thoroughly removed by washing after use.

Rotate the engine in the stand to the vertical position with the turbine uppermost; this will ensure that the thrust bearing end float is fully taken up in the forward position. Check the clearance between the impeller vanes and the diffuser casing using lead-tipped plugs and rotating the impeller by hand. The equipment necessary for the check is illustrated in Fig. 2, and consists of four lead-tipped plugs T.74099, four cap-nuts T.73412, to secure the lead-tipped plugs in the unions which form a permanent part of the diffuser

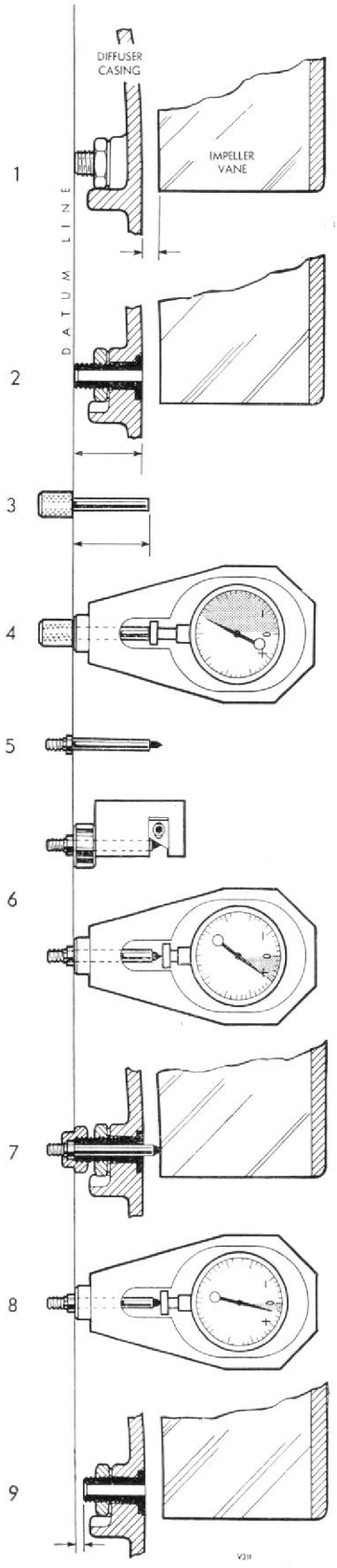

Fig. 1. Method of checking impeller/diffuser casing clearance.

casing ; a cutting jig T.73413, with which must be used spacing collar T.74100, to trim the lead-tipped plugs to length, and a measuring jig T.74101. The procedure is detailed in the next paragraph.

The following instructions should be read in conjunction with Fig. 1 to which the sub-para. numbers refer.

(1) The clearance between the impeller vanes and the diffuser casing must not be less than the minimum permissible worn clearance specified in chapter 38 (page 27 and 74), when measured with the main axis of the engine vertical, air-intakes downwards, so that the thrust bearing end float is fully taken up in the forward position.

(2) During initial manufacture, the unions, at the four lead-tipped plug positions in the diffuser casing, are machined when in position to an effective length of 1·223-1·227 inch, and the actual dimension is stamped on the diffuser casing adjacent to each union. In these instructions, it has been assumed that the unions have been machined, in position, to the maximum effective length —1·227 inch. The method of correcting the observed readings for shorter unions is given in sub-para. 9.

(3) The nominal length of the setting pin (item 3 of T.74101) is 1·265 inch. There is a tolerance of ± ·001 inch on this length and the actual length, to four places of decimals, is marked on the pin. It is, however, considered unnecessary to take this manufacturing tolerance into account.

(4) Insert the setting pin into measuring jig T.74101. By altering the position of the dial test indicator in the jig—slacken the clamping screw to permit the indicator to be slid to and fro as required—set the indicator to read **MINUS** 0·0215 inch—re-tighten the clamping screw ; final adjustment of the setting will, of course, be made, in the usual way, by turning the bezel of the indicator. When this has been done, a zero reading will correspond to the minimum permissible clearance.

(5) Prepare four lead-tipped plugs T.74099 as described in sub-para. 6. The lead tip, which can be manufactured locally, consists of a 1 inch length of $\frac{3}{32}$ inch diameter lead and is secured in the body of the plug by a $\frac{1}{32}$ inch diameter silver steel pin ; the ends of this pin must be below the surface of the plug. To renew the lead tip, knock out the silver steel pin, insert a new length of lead, drill through the existing holes using a $\frac{1}{32}$ inch drill, and refit the silver steel pin.

(6) Using cutting jig T.73413 in conjunction with spacing collar T.74100, trim the four lead-tipped plugs until, when each is inserted in the measuring jig, a reading of 0·005 inch is observed on the dial test indicator. That is, trim the lead-tipped plugs to the maximum effective union length **PLUS** the minimum permissible clearance **PLUS** 0·005 inch.

(7) Insert the four trimmed lead-tipped plugs into the unions in the diffuser casing, and secure them with special cap nuts T.73412. Rotate the impeller by hand. Remove the lead-tipped plugs.

(8) Recheck the lead-tipped plugs in the measuring jig. If a reading **below ZERO** is observed on the dial test indicator, the clearance is **below the permissible minimum**—*but, if necessary, correct the observed reading for any variation in the effective length of the union as described below.*

(9) If the effective length of the union is less than 1·227 inch, i.e., if 1223, 1224, 1225, or 1226, is stamped on the diffuser casing adjacent to the union, the difference between that number and 1227 (thousandths of an inch) must be **ADDED** to any reading observed on the dial test indicator.

Return the engine to the horizontal position in the stand. Check the turbine blade/turbine shroud clearance as described in chapter 17. Check the clearance between the exhaust cone and the turbine disc as described in chapter 18, and if satisfactory, refit the exhaust cone assembly as described in that chapter.

Install the engine in the airframe, as described in chapter 6. Start the engine and carry out all the normal ground running checks, particular attention being given to possible fuel, oil, or gas leakage. Using a slave recording instrument and compensating leads where necessary, check the rear bearing temperature. Run the engine up to the maximum permissible r.p.m. and maintain this speed for approximately 5 minutes ; the rear bearing temperature should not exceed 150 deg. C., in normal temperate climates ; i.e., ambient temperature up to + 20 deg. C. In tropical climates with an ambient temperature of + 40 deg. C. and above the acceptable value will rise to a maximum of 195 deg. C. Check the time taken for the engine to run-down during stopping as described in chapter 9.

The slave recording equipment required for checking the rear bearing temperature should be assembled as follows. Connect a Mk. 1 engine cylinder temperature indicator (Air Ministry Stores Ref. 6A/1305) to the terminal block mounted on starboard wing rib No. 1, in the engine bay, using a compensating lead type A (Air Ministry Stores Ref. 6A/841) modified as follows. The type A compensating lead must be modified by shortening it so that its overall continuity resistance is reduced from the standard value of 1·75 ohms to 1·55 ohms. It is essential that correct polarity is maintained throughout ; the copper lead is identified by a RED or GREEN coloured sleeve, and the constanan by a BLUE sleeve. The **copper** lead must be connected to the **positive** terminal of the indicator. The shunt which will be found to be fitted to the indicator as supplied, must be removed for the purpose of this test ; and should be refitted after the test has been completed.

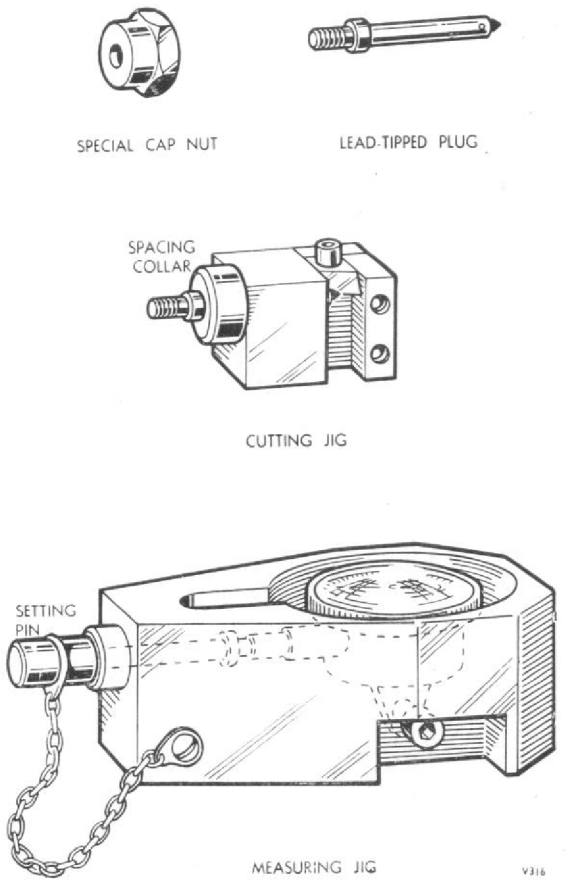

Fig. 2. Equipment for checking impeller/diffuser casing clearance.

Provided that the results of all the foregoing examinations and checks are satisfactory, the engine may be considered to be serviceable.