

Chapter Fifteen

# IGNITION SYSTEM, SERVICING AND MAINTENANCE

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THIS CHAPTER, which is applicable to the Ghost 48 Mk. 1 and the Ghost 48 Mk. 2, contains instructions for removing and refitting the ignition system components. Reference should also be made to the chapters which deal with these components individually for further information regarding their testing and repair, and, as necessary, to the general information contained in chapter 5. Where the information concerns one mark of engine only, this is indicated in the text. For information regarding aircraft components, such as switches, wiring, etc., reference must be made to the relevant aircraft handbook or accessory manufacturer's publications.

### WARNING

The energy stored in the capacitor can, under certain circumstances, be of a lethal nature. Consequently, no servicing should be attempted until at least one minute has elapsed after disconnecting the L.T. supply cable from the input plug on the high energy unit. Where instructions call for the connection of the L.T. cable and checking of the discharge (sparking) at the igniter plug, for any reason, the following precautions are recommended.

- (1) Allow at least one minute to elapse after disconnecting the L.T. supply cable, before commencing to work on the high energy unit or its associated equipment.
- (2) If the L.T. supply cable is re-connected, to enable the circuit and igniter plug operation to be checked, ensure that all personnel are clear of the equipment before energising the unit.
- (3) After any such test, observe the warning given above.

*Ghost 48 Mk. 2, torch igniters.* When testing torch igniters, consideration must be given to the

fire hazard and precautions must be taken to ensure that the atomized spray of fuel is not ignited accidentally, either by the engine's electrical ignition equipment or by any other source of ignition.

### CHECKING

The method of checking the electrical ignition equipment is described in chapter 8. This in situ check does not, however, check the fuel supply to the torch igniters on the Ghost 48 Mk. 2.

### DEFECT ISOLATION

*On both marks,* each high energy ignition unit, ignition cable assembly, and igniter plug (which forms part of the torch igniter on the Ghost 48 Mk. 2) is independent of the other. Assuming the low tension supply to the ignition units to be satisfactory, a defect in the system can be isolated by changing the components in turn, for serviceable items. Occasionally, the coil and trembler mechanism of the high energy ignition unit can be heard operating although there is no discharge at the igniter plug; i.e. without the 'bang' which normally accompanies discharge at the plug. This can be caused by an incorrect connection at some point in the airframe circuit between the aircraft battery and the ignition unit; for instance, a positive lead may have been connected to a negative terminal, or vice versa. Therefore, it is recommended that the serviceability of the ignition unit be checked, before it is rejected, by changing over the port and starboard ignition units.

*On the Ghost 48 Mk. 2,* the fuel jet assemblies in the two high energy torch igniters are both fed from a common source of supply—the valve group and circulating pump unit, via the torch igniter valve therein. Therefore, if fuel reaches either torch igniter, any defect must lie down stream of the "T" piece in the torch igniter fuel feed. Conversely, if neither torch igniter receives fuel, any

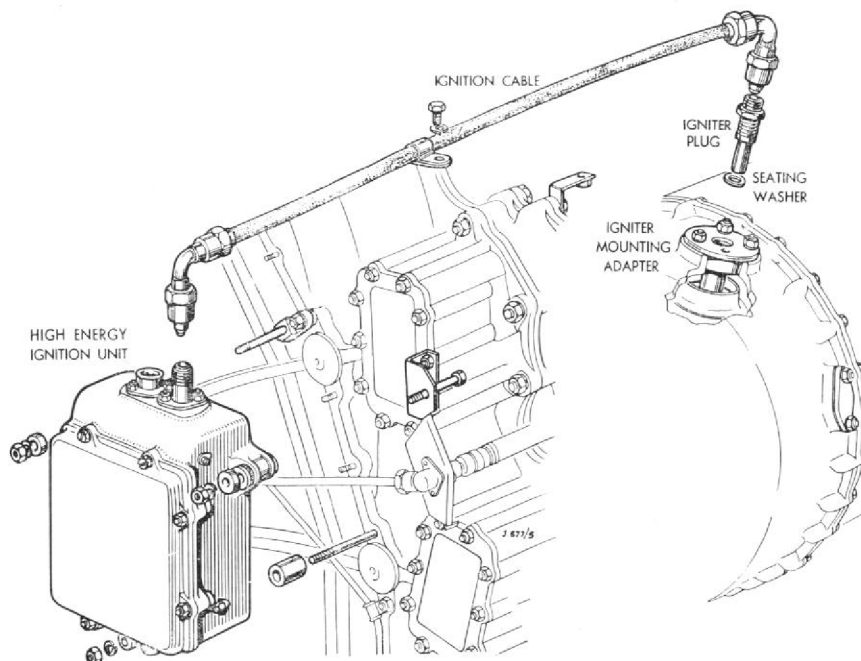


Fig. 1. High energy ignition equipment on Ghost 48 Mk. 1.

defect must lie up stream of the "T" piece and is probably due to a defect in the main fuel system.

Further information on the tracing of running defects is contained in the Defect Diagnosis Tables in chapter 11 and at the end of chapter 47.

#### HIGH ENERGY IGNITION UNITS

*Ghost 48 Mk. 1.* The high energy ignition units are mounted on the front of the diffuser casing. To remove either of these units proceed thus.

- (1) If the engine is installed in an aircraft, disconnect the low tension wiring from the socket at the top of the ignition unit.
- (2) Unscrew the union nut which secures the elbow on the ignition cable to the unit.
- (3) Remove the  $\frac{1}{4}$  in. B.S.F. plain nut and spring washer from the stud through the lug at the bottom of the unit, and the two  $\frac{1}{4}$  in. B.S.F. plain nuts, spring washers, and bolts which secure the lugs at each side of the unit to the brackets on the diffuser casing.
- (4) Lift the ignition unit clear of the engine.

Carefully note the position of any spacers or washers; it is advisable to reassemble the mounting details and temporarily secure them with the bolts and nuts so that none of the parts are mislaid. Two rubber-lined mounting ferrules are fitted in each ignition-unit mounting lug and care should be taken that these are not displaced and lost.

Mod. 1051 introduced Rotax high energy ignition units as an alternative to the B.T.H. units. To obviate a foul between the Rotax units and No. 3 and 9 burner feed pipes, six spacers (Part No. N.639) are introduced between the Rotax condenser units and the mounting on the engine. To accommodate these spacers, longer bolts and studs are introduced also. These longer bolts and studs, and their associated distance pieces are used with both types of condenser units to facilitate interchangeability. On *Ghost 48 Mk. 1*, when these spacers are used in conjunction with the B.T.H. units, a foul may occur between the units and adjacent airframe components. To obviate this, on *Ghost 48 Mk. 1* only, the spacers should be fitted outboard of the B.T.H. ignition units—Fig. 2.

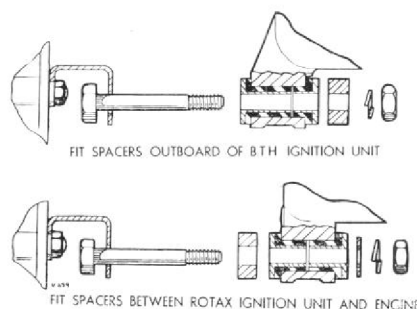


Fig. 2. Location of spacers relative to ignition units, *Ghost 48 Mk. 1*.

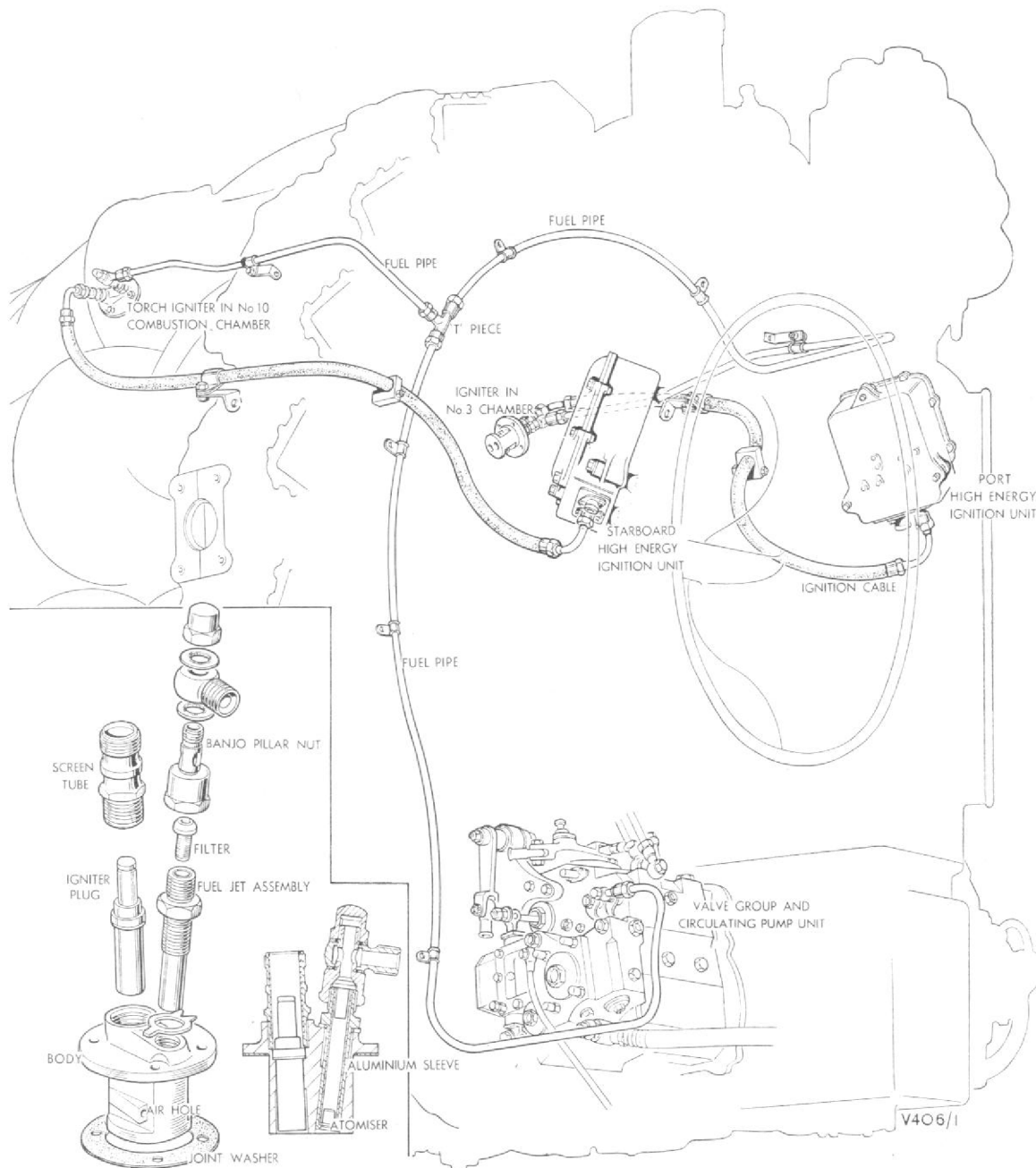


Fig. 3. Torch igniter ignition equipment on Ghost 48 Mk. 2.

*Ghost 48 Mk. 2.* The high energy ignition units are mounted on either side of the air-intake. To remove either of these units proceed thus.

- (1) Disconnect the low tension wiring, and the ignition cable, as described for the Ghost 48 Mk. 1.
- (2) Slacken each of the three  $\frac{1}{4}$  in. B.S.F. set-bolts, which pass through the lugs at the top and on each side of the unit into threaded bosses cast on the air-intake.
- (3) Supporting the unit with one hand, remove the three set-bolts together with the three spring

and plain washers, and lift it clear of the engine.

The remarks in the two preceding paragraphs are equally applicable to the Ghost 48 Mk. 2, except that the spacers introduced by mod. 1051 are fitted between the engine and both the B.T.H. and the Rotax units.

*On both marks,* refitment is a direct reversal of these instructions. If any of the mounting ferrules have been removed, the longer of the two should be inserted in the lug from its underside. The union nut on the ignition cable must be tightened to the torque specified in the table at the

end of this chapter using a suitable torque wrench in conjunction with adapter wrench (special crowsfoot spanner) T.76567.

## IGNITION CABLES

*Ghost 48 Mk. 1.* To remove either of the ignition cables, unscrew the union nut at each end connecting the elbows to the ignition unit and igniter plug screen tube respectively. Remove the 2 B.A. nut and bolt which secures the cable clip to the bracket on the diffuser casing rear cover and lift the cable clear of the engine. Pre-mod. 488, if a new ignition cable is being fitted, transfer the rubber sleeve and pipe clip to the new cable.

*Ghost 48 Mk. 1.* To eliminate a possible fire risk, pre-mod. 488 ignition cables should be covered with Lessovick tape, the tape should be  $\frac{3}{4}$  in. wide and wrapped round the cable puttee-wise with a  $\frac{1}{8}$  in. overlap. Where mod. 488 has been embodied the ignition cables are completely covered with a rubber sleeve and no separate sleeve is fitted in the pipe clip. Different ignition cables, which are listed in the following table, are required according to the modification standard of the high energy units and the high energy igniter plugs.

| Ignition unit     | Igniter plug                          | Ignition cable Part No.                        |
|-------------------|---------------------------------------|------------------------------------------------|
| C10TS/1           | Lodge type LH101/1                    | 97406 (12 mm. at each end)                     |
| C10TS/2 or NB25/2 | Lodge type LH101/1                    | 98784 (12/15 mm. with 15 mm. end to H.E. unit) |
| C10TS/1           | K.L.G. type KH102 or Lodge type LH102 | 98784 (12/15 mm. with 12 mm. end to H.E. unit) |
| C10TS/2 or NB25/2 | K.L.G. type KH102 or Lodge type LH102 | 602977 (15 mm. at both ends)                   |

\* The "12 or 15 mm." refers to the length of the flash-over path at the cable end fittings.

*Ghost 48 Mk. 2.* To remove either of the ignition cables, unscrew the union nuts which connect the ignition cable elbows to the ignition unit and igniter plug screen respectively. Remove the 2 B.A. set-bolt and spring washer from the clip which secures the cable to the bracket fastened to one of the  $\frac{5}{16}$  in. B.S.F. diffuser casing/rear cover studs. Slacken the  $\frac{1}{4}$  in. B.S.F. plain nut which clamps the two halves of the second ignition cable clip, until the top half of the clip can be swivelled clear without damaging the cable. Lift the cable clear of the engine. When refitting the ignition cable, if the second cable clip has been removed completely, place the larger portion (the bottom half) of the clip on the stud in the diffuser casing, position the cable in the bottom half, and refit the top half, the plain and spring washers and the  $\frac{1}{4}$  in. B.S.F. plain nut. The union nuts at each end of the ignition cable must be tightened to the torque specified in the table at the end of this chapter; using a suitable torque wrench in conjunction with adapter wrench (special crowsfoot spanner) T.76567.

## HIGH ENERGY IGNITER PLUGS, *Ghost 48 Mk. 1*

To remove either of the igniter plugs, unscrew the union nut which fastens the elbow at the end of the ignition cable to the igniter plug screen tube and withdraw the cable end fitting from the screen tube. Unscrew the screen tube and withdraw the igniter plug from the igniter mounting adapter in the combustion chamber; pre-mod. 966 the assembly is similar to the centre electrode assembly of a normal detachable type sparking plug; when mod. 966 is embodied the screen tube is integral with the igniter plug. There is a seating washer within the mounting adapter which tends to remain in the latter and this should not be disturbed unless it is unserviceable or loose.

When refitting the igniter plug, ensure that the seating washer is in position in the mounting adapter and lightly smear the threads on the screen tube with the recommended anti-seize compound. Care must be taken to ensure that it is the end of the screen tube having the greater length of thread that is screwed into the mounting adapter; the ignition cable union nut should be attached to the shorter length of thread. Incorrect assembly may result in the ingress of kerosene into the screen tube and the consequent loosening of the mica lining. Under no circumstances may the screen tube be washed in kerosene as this also will result in loosening of the mica lining.

When assembling the ignition equipment, a suitable torque wrench must be used in conjunction with a socket for tightening the pre-mod. 966 screen tube, or the mod. 966 igniter plug, to the igniter mounting adapter, and in conjunction with adapter wrench (special crowsfoot spanner) T.76567 for tightening the ignition cable union nuts to both the igniter plug screen and to the high energy unit.

Different igniter mounting adapters are required for the pre-mod. 966 Lodge type LH101/1 igniter plugs and the mod. 966 K.L.G. type KH102 and mod. 957 Lodge type LH102 igniter plugs. The igniter mounting adapters also differ in the type 4 and type 5 combustion chambers. Pre-mod. 966 igniter mounting adapters can be modified in accordance with part 3 of mod. 966. Adapters which have been salvaged in this way can be identified by "15 mm." etched on the upper face of the flange. The following table identifies the Part No. of the adapter relative to the igniter plug and combustion chamber type.

| Igniter plug                             | Part No.                         |                                  |
|------------------------------------------|----------------------------------|----------------------------------|
|                                          | Type 4<br>Combustion<br>Chambers | Type 5<br>Combustion<br>Chambers |
| Lodge type LH101/1                       | 91727                            | 96382                            |
| K.L.G. type KH102<br>or Lodge type LH102 | 600966                           | 600965                           |

## HIGH ENERGY TORCH IGNITERS, *Ghost 48 Mk. 2*

Each high energy torch igniter may either be removed from the combustion chamber as a complete unit, or the igniter plug, and the fuel jet

assembly may be removed independently, leaving the body of the torch igniter in position. The course to be adopted will depend upon the servicing operation which it is required to carry out. In any case, it will usually be easier to slacken, and finally tighten, the igniter plug screen tube, the fuel jet assembly, and its banjo pillar nut and cap nut, whilst the body is secured to the combustion chamber; unless some form of simple vice fixture is available to hold the body without damage whilst these operations are performed.

TO REMOVE THE COMPLETE TORCH IGNITER from the engine or from the combustion chamber after the latter has been removed from the engine; in the second instance, the first two operations will have been done already before removing the combustion chamber from the engine.

- (1) Unscrew the elbow union nut which secures the ignition cable to the igniter plug screen tube and withdraw the cable end fitting from the screen tube.
- (2) Cut the locking wire and unscrew the union nut which couples the fuel pipe to the banjo on the fuel jet assembly.
- (3) Remove the four 2 B.A. plain nuts, spring and plain washers which secure the body of the torch igniter to the combustion chamber expansion chamber.
- (4) Withdraw the complete torch igniter from the combustion chamber, and remove the Klingerit joint washer which is under the flange of the torch igniter body.

Refitment of the complete torch igniter is a direct reversal of the removal instructions given above but the following points should be borne in mind. If the Klingerit joint washer is in any way unserviceable, a new joint washer, Part No. 26010, should be fitted. The two air holes in the torch igniter body must face upstream relative to the gas flow through the combustion chamber. The ignition cable union nut must be tightened to the torque specified in the table at the end of this chapter; using a suitable torque wrench in conjunction with adapter wrench (special crowsfoot spanner) T.76567.

TO REMOVE THE IGNITER PLUG FROM THE TORCH IGNITER BODY, whether the latter is in situ or has been removed from the engine.

- (1) *If the torch igniter body is in situ.* Unscrew the elbow union nut which secures the ignition cable to the igniter plug screen tube and withdraw the cable end fitting from the screen tube.
- (2) Unscrew the screen tube from the torch igniter body.
- (3) Withdraw the igniter plug, which resembles the centre electrode assembly of a normal detachable type sparking plug.

There is a seating washer within the torch igniter body. This washer tends to remain in the body and should not be disturbed unless it is

unserviceable or loose. On later type igniters, the screen tube may be integral with the igniter plug.

EXAMINATION OF IGNITER PLUG. The surface gap of the igniter plug should be examined for evidence of flaking and erosion and the plug should be tested for sparking. The screen tube should be cleaned with a soft rag only. Do not wash mica-lined screen tubes in kerosene as this will cause loosening of the mica lining; ceramic-lined screen tubes are not affected in this way.

TO REFIT THE IGNITER PLUG. Immediately before refitting the igniter plug, ensure that the seating washer is in position in the torch igniter body and lightly smear the threads on the screen tube with the recommended anti-seize compound. Care must be taken to ensure that the end of the screen tube having the greater length of thread is screwed into the body; the ignition cable union nut should be screwed on to the shorter length of thread. Incorrect assembly may result in the ingress of kerosene into the screen tube with consequent loosening of the mica lining. Failure to clamp the igniter plug firmly into position may allow movement of the plug within the body. This may cause the flange to break up which will leave the igniter plug free to enter the combustion chamber whence it will be blown through the engine and cause extensive damage to the nozzle and turbine blades. Both the screen tube and the ignition cable union nut must be tightened to the torque specified in the table at the end of this chapter; using a suitable torque wrench in conjunction with a socket for tightening the screen tube, and in conjunction with adapter wrench (special crowsfoot spanner) T.76567 for the ignition cable union nut.

TO REMOVE THE FUEL FILTER FROM THE FUEL JET.

- (1) *If the torch igniter body is in situ.* Cut the locking wire and unscrew the union nut which couples the fuel pipe to the banjo on the fuel jet assembly.
- (2) Unscrew the banjo pillar nut, complete with the banjo union, joint washers, and cap nut.
- (3) Withdraw the wire-wound filter from the fuel jet tube.

Thoroughly wash the wire-wound filter in clean kerosene. If possible connect it to a source of clean filtered kerosene under pressure, and reverse flow the filter to wash away any dirt. Examine the filter for signs of damage or obstruction.

Refitment of the filter is a direct reversal of the removal instructions given above. The banjo pillar nut should be tightened to the torque specified in the table at the end of this chapter. If either of the banjo union joint washers are faulty, new washers Part No. A.G.S.1186 should be fitted.

TO REMOVE THE FUEL JET ASSEMBLY.

- (1) *If the torch igniter body is in situ.* Cut the

locking wire and unscrew the union nut which couples the fuel pipe to the banjo on the fuel jet assembly.

- (2) Release the locking tab, and, using a spanner on the hexagon which is adjacent to the torch igniter body, unscrew the complete fuel jet assembly from the body.

**EXAMINATION OF THE FUEL JET ASSEMBLY.** The fuel jet assembly can be examined either whilst assembled to the torch igniter body after the body has been removed from the combustion chamber, or after the jet assembly has been removed from the body. Apart from a visual examination to ensure that no external damage has been done, the only efficient way of checking the fuel jet assembly is to test it with kerosene under pressure. Whilst this test is being carried out, precautions must be taken to ensure that the atomised spray of fuel is not accidentally ignited, either by the engine's electrical ignition equipment or by any other source of ignition. Connect the torch igniter banjo union to a suitable source of clean filtered kerosene under pressure; the pressure required is about 100 lb. per sq. in. at a flow of 3 gallons per hour, and the kerosene must pass through a fine mesh or fabric filter before entering the torch igniter. Apply the specified pressure and observe the atomised spray. Streaks in the spray, or spray from a limited portion of the atomiser circumfer-

ence only, suggest dirt or obstruction in the atomiser. A very low flow, very weak spray, or no spray at all, suggests a blockage in the fuel jet filter. If cleaning the filter and thorough washing of the fuel jet assembly in clean kerosene, fails to effect a cure, the fuel jet assembly should be replaced by a serviceable one.

Refitment of the fuel jet assembly is a direct reversal of the removal instructions; the threads should be smeared with the anti-seize compound recommended in chapter 5, and the assembly tightened to the torque specified in the table. A new tab washer, Part No. DA2280, must be used to lock the jet tube to the torch igniter body.

#### TORQUE LOADING TABLE

| <i>Application.</i>                                                                           | <i>Torque loading.</i> |
|-----------------------------------------------------------------------------------------------|------------------------|
| Tightening screen tube, or igniter plug, to igniter mounting adapter or to torch igniter body | 240 to 300 lb./in.     |
| Tightening ignition cable union nuts                                                          | 150 to 160 lb./in.     |
| Tightening fuel jet assembly to torch igniter body                                            | 336 to 396 lb./in.     |
| Tightening banjo pillar nut to fuel jet assembly                                              | 216 to 240 lb./in.     |

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