# CHAPTER

# 80

# STARTING

# CHAPTER 80 - STARTING SYSTEM

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# STARTING SYSTEM - DESCRIPTION AND OPERATION

1. General.

The engine starting (ignition) system consists of an ignition exciter, 2 igniter leads and 2 igniter plugs. These components are engine furnished, externally mounted on the engine and are accessible for removal and replacement.

NOTE: The engine starter motor is airframe furnished.

2. Description.

A. Ignition Exciter. The ignition exciter is powered by the aircraft system and is a high-energy, parallel-circuit generator of the low-voltage capacitor discharge type. It generates the periodic surges of DC voltage required by the igniters.

B. Igniter Plugs. The igniter plugs are the self-ionizing, shunted-gap type which, when energized, release a high-energy arc for igniting the atomized fuel-air mixture during an engine start. The igniters are always energized simultaneously.

C. Igniter Leads. There are 2 igniter leads and each lead connects an igniter plug to the ignition exciter unit. Each end of the lead has a mechanical connector for attaching to the plugs and ignition exciter.

3. Operation.

A. General. Ignition of the atomized fuel-air mixture is accomplished by an intense electrical spark produced at the 2 igniter plugs which are immersed in the combustor. A dual output capacitor discharge type of ignition exciter produces the electrical energy necessary to create the high intensity spark at the igniter plugs. At the completion of the starting cycle sparking automatically ceases and combustion is self sustaining.

B. Ignition Exciter. The ignition exciter works from a 28 volt DC input, which is supplied to the exciter from an airframe mounted battery or generator. From the input power it generates the periodic surges (approximately 800 volts) of DC voltage required for ignition. Table I lists the leading particulars of the ignition exciter.

TABLE I - IGNITION EXCITER DATA

| | |
|---|---|
| Input Voltage | 14-30 Volts D.C. |
| Input Current | 4.4 Amps. Max |
| No. of Plugs Fired | 2 |
| Operating Altitude | 60,000 Feet |
| Ambient Operating Temperature Range | -65° to +250°F |
| Spark Rate | 2.0/Sec. Min. at 14 Volts D.C. |
| Stored Energy | 2.05 Joules Nominal |

C. Ignition Plugs. When the ignition unit output reaches approximately 800 volts, enough current flows through the semi-conductor to ionize the igniter plug air gap. Once ionization has been initiated, a conducting path is provided for the output current, which arcs across the air gap.

## STARTING SYSTEM - TROUBLE SHOOTING

1. General.

The starting (ignition) system troubles are generally easy to detect. However, isolating the trouble to the individual components is sometimes more difficult. If replacement components are available, it is normally quicker and more economical to isolate the defective component by replacing parts with known good parts. The component most likely to malfunction first, is the igniter plugs, then the ignition exciter.

Trouble-Shooting information is furnished in Chapter 72-00.

## STARTING SYSTEM - MAINTENANCE PRACTICES

1. General.

Maintenance of the starting system deals primarily with the routing and clamping of the system.

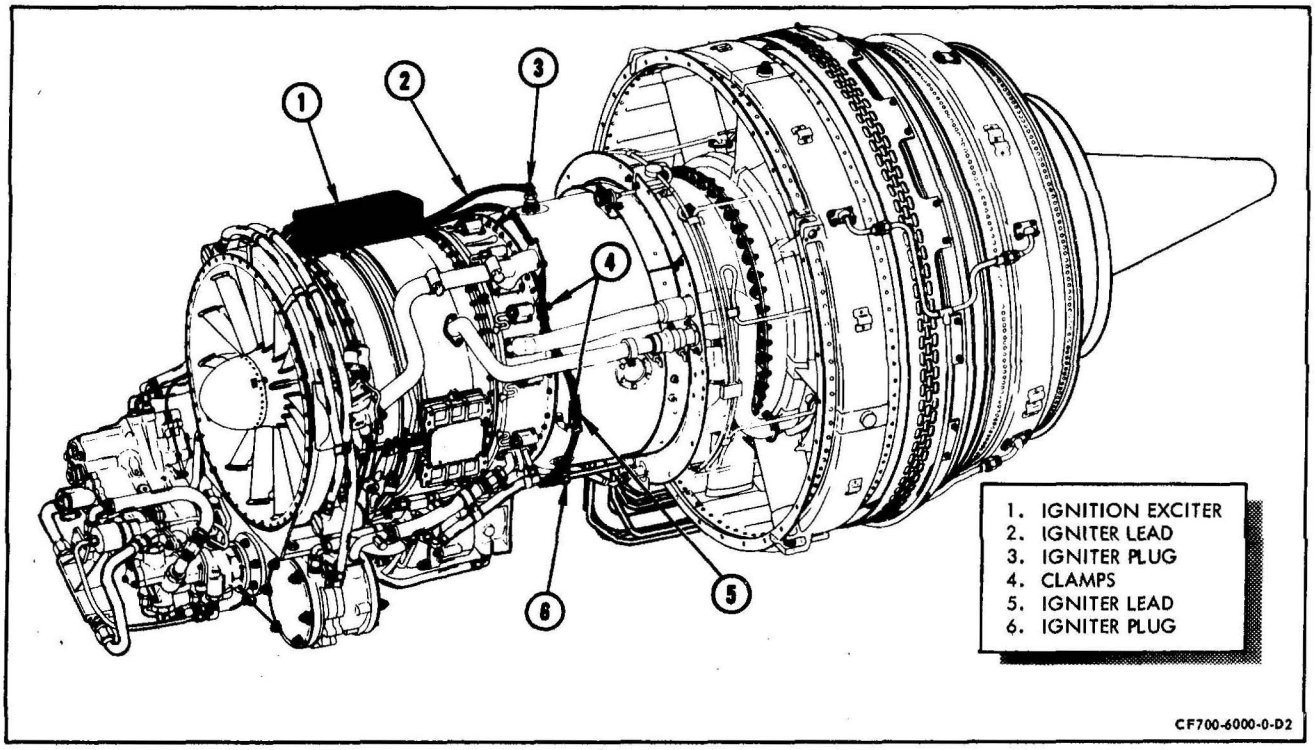
WARNING: EXERCISE CARE WHEN HANDLING ANY IGNITER COMPONENT IN ORDER TO AVOID CONTACT WITH THE ELECTRICAL OUTPUT. MAKE SURE THAT THE IGNITION UNIT AND IGNITER PLUGS ARE GROUNDED PROPERLY BEFORE ENERGIZING UNIT.

2. Inspection/Check.

A. Check for security of all components, brackets and bolts.

B. Check for high voltage arc-through or shorts, indicated by burnt or severely discolored cable.

C. Check for loose connections.




Engine Starting System
Figure 201

D. Run engine up to maximum, available starter speed without attempting ignition. Check that RPM available is normal.

3. Approved Repairs.

A. Tighten any loose component.

B. Replace any component indicating shorts.

C. Tighten loose connections.

## STARTER - MAINTENANCE PRACTICES

1. General.

Refer to the Aircraft Maintenance manual for starter operating and replacement procedures.

NOTE: When installing the starter, lubricate the engine attaching spline with grease, Plastilube Moly No. 3 or Plastilube No. 3, G.E. Spec A50T18 (Warren Refining Company, Cleveland, Ohio) or approved equivalent. Be sure there is a gasket between the gearbox and starter mounting pad. Mounting bolts are to be tightened to 220-325 lb-in.

## IGNITION EXCITER - MAINTENANCE PRACTICES

1. Removal/Installation of Ignition Exciter. (See figure 201, Section 80-00.)

A. Removal.

(1) Disconnect electrical power supply to the ignition exciter (1).

WARNING: DISCONNECTING IGNITION LEADS

HIGH VOLTAGE MAY BE PRESENT. CONTACT WITH CENTER CONDUCTOR OF ELECTRICAL CABLE OR CENTER ELECTRODE OF IGNITER PLUG WILL CAUSE ELECTRIC SHOCK IF THE BLEED RESISTORS INSIDE IGNITION UNIT HAVE FAILED.

BEFORE REMOVING IGNITER PLUG, BE SURE THAT DISCHARGE CONNECTOR IS GROUNDED.

(2) Disconnect the main ignition leads.

(3) Disconnect the igniter plug leads (2 and 5) at the ignition exciter (1).

(4) While supporting the ignition exciter to prevent it from falling remove the ignition exciter, isolators, and ferrules from the mounting brackets.

B. Installation.

(1) Install an isolator and ferrule above and below the ignition exciter mounting brackets at the 4 mounting hole locations. Secure the ignition exciter (1) (isolators and ferrules in place) to the brackets with four bolts and nuts. Torque the nuts to 8-10 lb-in.

(2) Connect the main ignition leads and the igniter plug leads (2 and 5) to the ignition exciter connectors. Torque the nuts to 125-150 lb-in.

(3) Connect the electrical power supply to the ignition exciter.

2. Inspection.

| Inspect | Maximum Serviceable Limits | Corrective Action |
|---|---|---|
| A. The cover for: | | |
| (1) Dents. | Any number, 1/8 inch deep. | Replace exciter. |
| (2) Scratches. | Any number. | Not applicable. |
| (3) Cracks. | Not serviceable. | Replace exciter. |
| B. The case and support for: | | |
| (1) Dents. | Any number, 1/16 inch deep. | Replace exciter. |
| (2) Scratches. | Any number. | Not applicable. |

3. Operation Duty Cycle.

Do not use the ignition exciter in excess of the following limits:

2 Min. On, 3 Min. Off

2 Min. On, 23 Min. Off
or
5 Min. On, 25 Min. Off

## IGNITER LEADS - MAINTENANCE PRACTICES

1. Removal/Installation of Igniter Leads. (See figure 201, Section 80-00.)

A. Removal.

(1) Disconnect electrical power supply to the ignition exciter (1).

WARNING: DISCONNECTING IGNITION LEADS

HIGH VOLTAGE MAY BE PRESENT. CONTACT WITH CENTER CONDUCTOR OF ELECTRICAL CABLE OR CENTER ELECTRODE OF IGNITER PLUG WILL CAUSE ELECTRIC SHOCK IF THE BLEED RESISTORS INSIDE IGNITION UNIT HAVE FAILED.

BEFORE REMOVING IGNITER PLUG, BE SURE THAT DISCHARGE CONNECTOR IS GROUNDED.

(2) Disconnect the igniter leads (2 and 5) at the ignition exciter (1) and igniter plugs (3 and 6).

(3) Remove the clamps from the igniter leads and remove the leads from the engine.

B. Installation.

(1) Coat the threads of the igniter plug with unflavored milk of magnesia. Place the igniter leads (2 and 5) on engine as shown in figure 201, Section 80-00, and connect to the ignition exciter (1) and plugs (3 and 6). Torque connections to 125-150 lb-in.

(2) Install clamps (4) as shown and torque nuts to 8-10 lb-in.

(3) Connect the electrical power supply to the ignition exciter.

2. Inspection.

| Inspect | Maximum Serviceable Limits | Corrective Action |
|---|---|---|
| A. The braided shielding for broken wires. | 25 broken wires or a break that is less than 1/4 of the circumference. | Replace lead. |
| B. Connectors for: | | |
| (1) Loose or missing pin or socket contacts. | Not serviceable. | Replace item with the damaged connector. |
| (2) Cracked shells. | Not serviceable. | Replace item with the damaged connector. |
| (3) Swelling of insert. | Swelled not more than 0.060 inch beyond end of connector with no breaks between insert holes. | Replace harness. |
| C. Lockwire hole worn through the wall. | Not serviceable. | Replace lead. |

## IGNITER PLUGS - MAINTENANCE PRACTICES

1. Removal/Installation of Igniter Plugs. (See figure 201, Section 80-00.)

   A. Removal.

      (1) Disconnect the wire lead (2 or 5) from the igniter plug (3 or 6).

      (2) Remove the igniter plug and washers (shims) from the combustion casing.

         NOTE: Keep the washers (shims) together for use at replacement.

   B. Installation. Use one of the following methods for installing igniter plug.

      (1) Install igniter plug using tool 2C5318 as follows: (See figure 201A, Type I.)

         (a) Insert the gage (1, figure 201A) 2C5318, into the igniter plug boss (4) on the outer combustion casing (7).

         (b) Push down and twist the spring-loaded hook (2, figure 201A) 180 degrees (arrow on the gage denotes hook direction) so as to engage the inner face of the igniter eyelet (5). Lock the hook in place by tightening screw (3).

         (c) Insert the igniter plug (8) into the recessed groove of the gage body so that the electrode tip touches the top surface of the spring-loaded hook (2, figure 201A).

         (d) Add shims (9) until the clearance between the top shim and the igniter shoulder is 0.010 to 0.015 inch. Check the clearance with a thickness gage (10, figure 201A).

         (e) Remove the igniter and gage.

            NOTE: The igniter is now shimmed to give an immersion depth of 0.000 to 0.015 inch. Be sure that this immersion depth is maintained. The 0.010 to 0.015 inch clearance between the shim and the igniter shoulder compensates for the radial clearance that is built into the igniter eyelet.

         (f) Lubricate the threads of the igniter with unflavored milk of magnesia. Install the igniter and torque to 225-275 lb-in.

            NOTE: Avoid contacting the igniter tip or ceramic with the unflavored milk of magnesia.

CAUTION: POSITION THE WASHER/S TO PERMIT PROPER INSPECTION OF IGNITER PLUG. PLUG SHOULD THREAD EASILY INTO BOSS BY HAND. ANY ADDITIONAL FORCE MAY INDICATE AN INTERFERENCE PROBLEM WITH SHIM NOT SEATED IN BOSS OR IGNITER PLUG NOT ENGAGED IN COMBUSTION LINER FERRULE. EITHER CONDITION WILL CAUSE RAPID BURN OUT OF COMBUSTION LINER. NOTE FIGURE 202 FOR LOCATIONS.

(g) Connect the igniter leads to the igniter plugs. Torque not to 125-150 lb-in.

(2) Install igniter plug using tool 2C5388 as follows: (See figure 201A, Type II.)

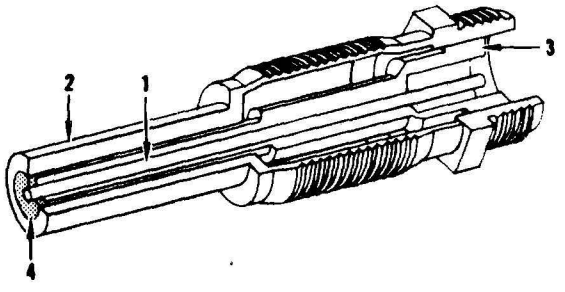
(a) Retract the contact foot at the lower end of pin (8) by turning the upper thumb knob (1) fully clockwise. Note the position of the index mark on the upper thumb knob.

(b) Insert the gage 2C5388 into the igniter plug boss (4) on the outer combustion casing (7) making sure the shoulder of body (9) is seated on the seating surface inside the igniter plug boss.

(c) Rotate the upper thumb knob (1), 180 degrees counterclockwise, arrow on the knob denotes contact foot direction.

(d) Engage the contact foot of the pin (8) under the inside surface of the igniter plug eyelet (5) by pulling the pin outward.

1. CENTER ELECTRODE
2. OUTER ELECTRODE
3. CERAMIC INSULATOR
4. SEMI-CONDUCTOR

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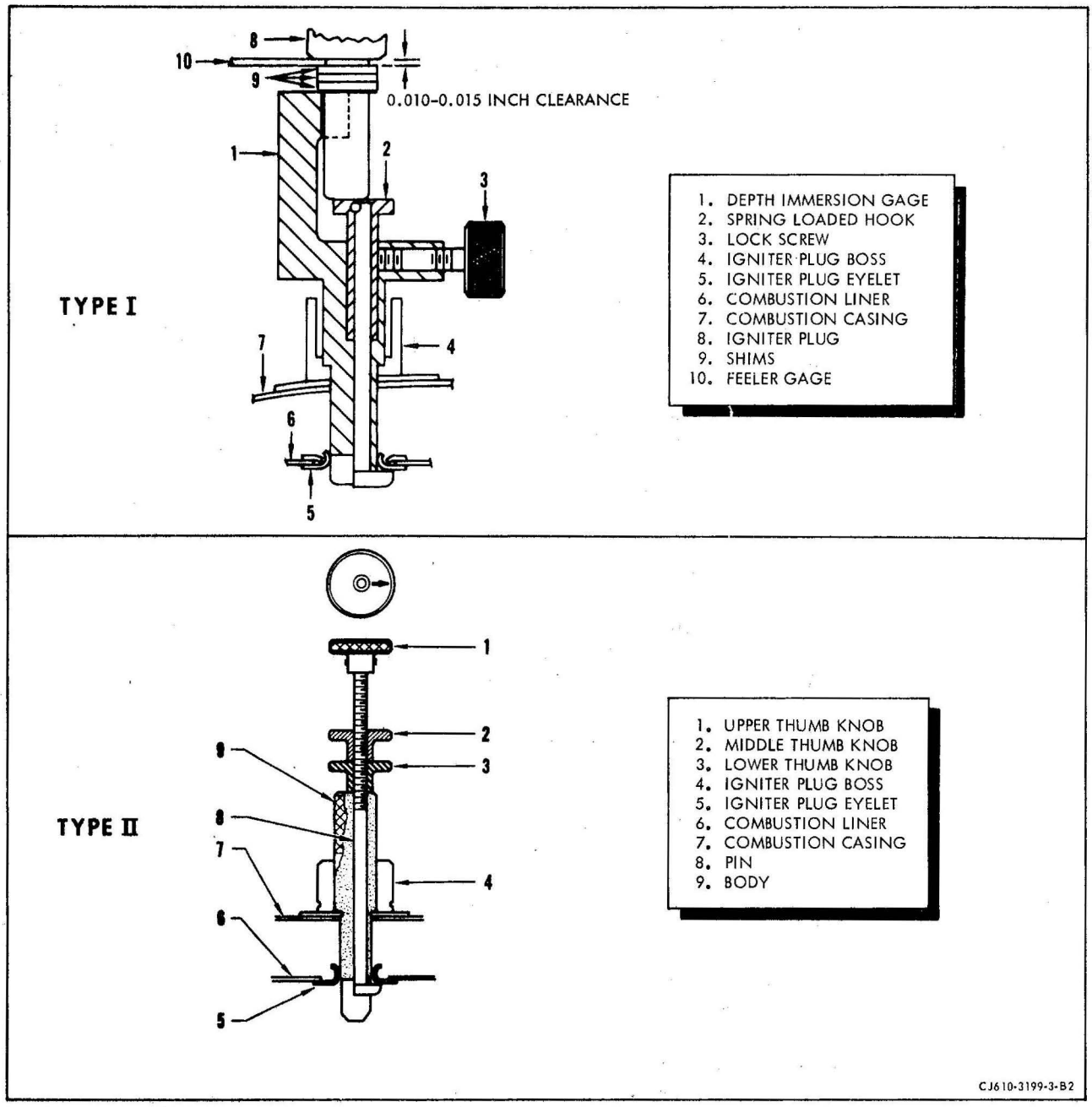
Igniter Plug
Figure 201




Igniter Immersion Depth Check
Figure 201A

(e) Lock the pin in place by turning the lower thumb knob (3) down until it just contacts the body (do not tighten) then turn the middle thumb knob (2) down jamming the lower thumb knob in place. This sets the gage to the depth between the seal inside the igniter plug boss and the inner surface of the igniter plug eyelet.

(f) Disengage the contact foot of pin by rotating the upper thumb knob clockwise 180 degrees and remove the gage.

(g) Measure the distance between the inside surface of the contact foot and the seating shoulder on the body and record the dimension.

(h) Measure the length from the plug tip to the seating shoulder on the plug and record the dimension.

NOTE: This measurement to be to inner end of igniter OD. Not center electrode.

(i) Subtract the dimension obtained in step (g) from the measured length of the igniter plug body obtained in step (h). Select washers to reduce this difference to 0.010-0.015 inch. (Dimension from plug tip to the washer face to be 0.010-0.015 inch greater than dimension obtained in step g.)

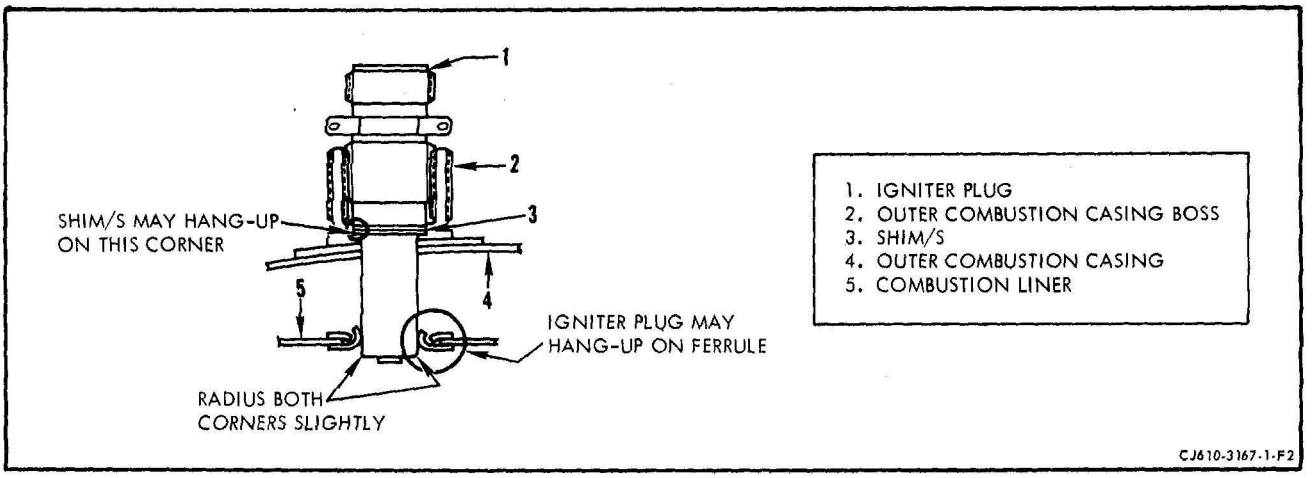
NOTE: The igniter is now shimmed to give an immersion depth of 0.000 to 0.015 inch. Be sure that this immersion depth is maintained. The 0.010 to 0.015 inch greater plug length compensates for the radial clearance that is built into the igniter eyelet.

(j) Lubricate the threads of the igniter plug with unflavored milk of magnesia. Install the igniter and torque to 225-275 lb-in.

NOTE: Avoid contacting the igniter tip or ceramic with the unflavored milk of magnesia.

CAUTION: POSITION THE WASHER/S TO PERMIT PROPER INSPECTION OF IGNITER PLUG. PLUG SHOULD THREAD EASILY INTO BOSS BY HAND. ANY ADDITIONAL FORCE MAY INDICATE AN INTERFERENCE PROBLEM WITH SHIM NOT SEATED IN BOSS OR IGNITER PLUG NOT ENGAGED IN COMBUSTION LINER FERRULE. EITHER CONDITION WILL CAUSE RAPID BURN OUT OF COMBUSTION LINER. NOTE FIGURE 202 FOR LOCATIONS.

(k) Connect the igniter leads to the igniter plugs. Torque nut to 125-150 lb-in.




Igniter Plug Installation
Figure 202

2. Inspection. See figure 201.

| Inspect | Maximum Serviceable Limits | Corrective Action |
|---|---|---|
| A. The igniter for chafing | 0.030 inch deep on diameter | Replace igniter. |
| B. The outer electrode for cracks, breakage or looseness | Not serviceable | Replace igniter. |
| C. The weld for cracks | Not serviceable | Replace igniter. |
| D. The center electrode for: | | |
| (1) Loose center | Not serviceable | Replace igniter. |
| (2) Erosion | 0.040 below outer electrode | Replace igniter. |
| E. The ceramic insulator for: | | |
| (1) Missing material | 25 percent of original area | Replace igniter. |
| (2) Cracks or looseness | Not serviceable | Replace igniter. |