

**ON A/C ALL

74-00-00-001 IGNITION SYSTEM, GENERAL

<u>Introduction</u>

The ignition system supplies the electrical energy to ignite the fuel/air mixture during engine start-up. It also provides in flight re-light capability in the event of a flame out.

General Description

The system function is performed by the ignition exciters, cables and plugs. The ignition system includes the systems that follow:

- Ignition Power Supply (74–10–00)
- Distribution (74–20–00)
- Ignition Selection (74–30–00)

Detailed Description

Refer to Figure 1.

The PW150A ignition system consists of the ignition exciter, the ignition cables and the ignition plugs. The ignition exciter is a dual channel unit contained in a single housing and is supplied with aircraft 28 VDC, through a single electrical connector for both channels. It outputs a high voltage signal to the igniter plugs when selected "ON". The ignition exciter is connected to the igniter plugs by a pair of braided cables. The cables are mounted with quick

release connectors to facilitate removal and installation. The igniter plugs are located in the gas generator case and are the drop in type.

Ignition Power Supply (Ignition Exciter)

The ignition exciter is flexibly mounted on the right side of the engine. The ignition exciter gets 28 Vdc from the aircraft bus and increases this voltage to a high enough level to cause the ignition plugs to spark.

Distribution

The distribution system consists of the ignition cables and the ignition plugs. The ignition cables transmit the high voltage electrical energy from the ignition exciter to the ignition plugs. The ignition cables connect the ignition exciter to the ignition plugs. They are installed on the right side of the engine and secured by quick release clamps, for easier maintenance. The ignition plugs use the high voltage power to create sparks that are used to ignite the fuel/air mixture. They are located on the gas generator case at the 4 and 7 o'clock positions. To facilitate removal and installation the plugs are the drop in type.

Ignition Selection

When the engine start is selected, the Full Authority Digital Electronic Control (FADEC) commands only one of the igniters to operate. On subsequent starts the other igniter is used, this is done to minimize wear of the igniters. During flame out caused by adverse weather conditions or when the engine is experiencing surging, the FADEC commands both ignitors to operate continuously to prevent, or recover from, an engine flameout.

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Training Information Points

The ignition plugs are the drop in type. Be careful when you disconnect the ignition cables and attaching hardware because the plugs can fall out.

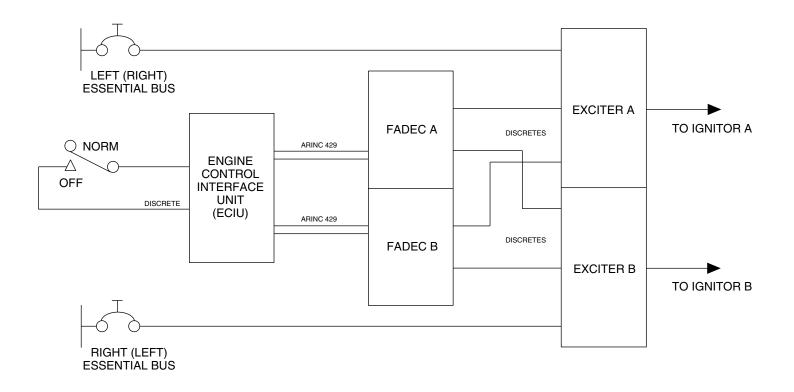
The ignition plugs are fragile. You must be careful when you remove them from the engine and during handling. If you drop a plug you must replace it with a new one because it may be damaged internally.

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Ignition System Block Diagram Figure 1

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**ON A/C ALL

74-10-00-001

IGNITION POWER SUPPLY

<u>Introduction</u>

The purpose of the ignition power supply is to provide the energy to the ignition plugs in order to create the spark that will ignite the fuel/air mixture.

General Description

The function of the ignition power supply is performed by the ignition exciter. The power supply has the component that follows:

Ignition Exciter (74–11–01)

Detailed Description

Refer to Figure 1.

The dual channel ignition system, is powered electrically by the aircraft essential buses and activated by the Full Authority Digital Electronic Control (FADEC). The aircraft essential power buses provide alternate electrical power to the FADEC for engine starting and in the event of a Permanent Magnet Alternator (PMA) malfunction. The PMA has independent coils that provide electrical power to the individual channels of the FADEC when High Pressure Turbine Speed (NH) is above 20% minimum.

The ignition system is configured such that both ignitors can be commanded by each FADEC channel, while maintaining electrical isolation between the FADEC channels and the aircraft essential buses. Only one of the two ignitors is turned on during a normal start (this is to identify any failures in the dual channel ignition system by cycling between ignitors used on subsequent ground starts).

When power is supplied to the ignition exciter the unit's circuitry will raise the energy of this power to a high enough level to cause the ignition plugs to spark. These sparks are used to ignite the fuel/air mixture.

The ignition exciter is a sealed unit and cannot be repaired in the field

Ignition Functional Test

Refer to Figure 2.

In order to verify the Ignition system, the FADEC performs an Ignition Test Function when in Maintenance Mode:

With the FADEC in Maintenance Mode, and the Ignition Selection on the Engine Start Panel in the "Normal" position, set the PLA to FI detent and the CLA in the Shutdown position, selection of the Max Power Button on the Engine Control Panel will cause the FADEC to command the Ignitors to Fire.

By disabling the power supply to ignition exciter box (through cockpit circuit breakers) each ignitor can be tested individually.

Ignition Exciter

Refer to Figure 3.

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The "Ignition Exciter Box" is a dual channel unit contained in a single enclosure. The Ignition Exciter Box is supplied with aircraft 28 Vdc through a single electrical connector, for both channels. It outputs a

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high-tension signal to the igniter plugs when selected "ON " by the FADEC. The Ignition Exciter Box is connected to the "Igniter Plugs" by a pair of braided cables. Each FADEC channel (A/B) can fire either ignitors A or B through discrete inputs to the Ignition Exciter box.

The ignition exciter is flexibly mounted on the right hand side of the engine. It is a sealed unit that contains electronic circuitry which provides a high voltage output (15 to 20 kVA) that is transmitted by the ignition cables to the igniter plugs.

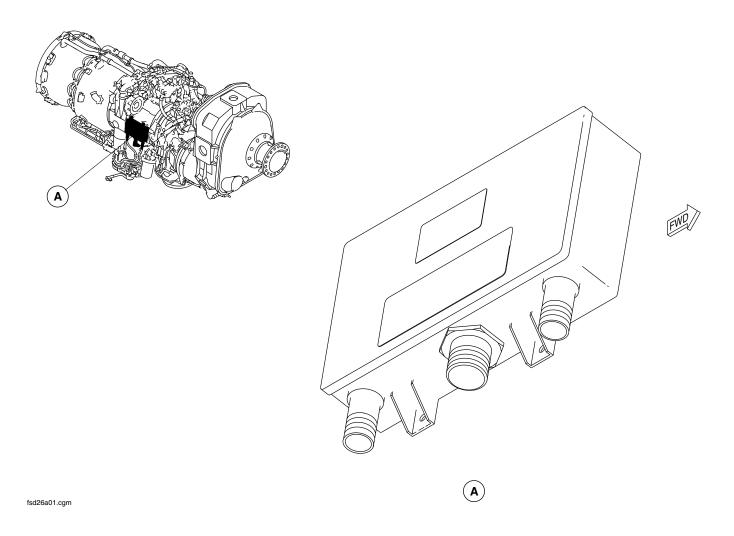
The two Igniter Plugs are located in the Gas Generator Case and are connected to the Ignition Exciter Box. They provide sparks for igniting the fuel/air mixture

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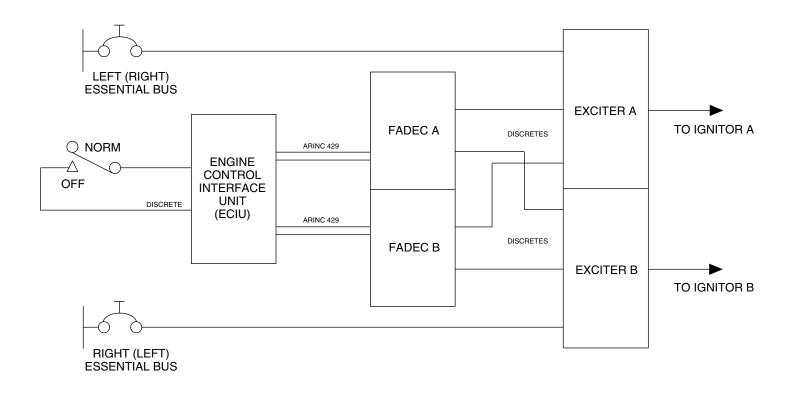
IGNITION POWER SUPPLY LOCATOR
Figure 1

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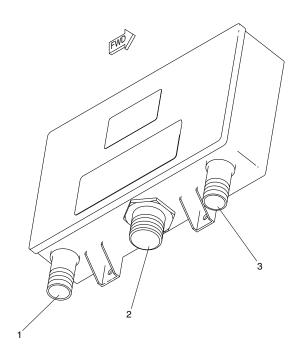
IGNITION POWER SUPPLY BLOCK DIAGRAM Figure 2

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LEGEND

- High Voltage Output (15 to 20KV).
 Input Voltage (28VDC).
 High Voltage Output (15 to 20KV).

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IGNITION POWER SUPPLY DETAIL Figure 3

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74-11-00-001 POWER SUPPLY

Introduction

The ignition exciter transforms a DC voltage input into a pulsed high voltage output to provide the energy to the igniter plugs in order to create the spark that will ignite the fuel/air mixture.

General Description

The function of the ignition power supply is performed by the ignition exciter. The ignition exciter has the components that follow:

- Ignition Exciter housing (74–11–01)
- Ignition Exciter circuitry (74–11–01)

Detailed Description

Refer to Figure 1.

The dual channel ignition system, is powered electrically by the aircraft essential buses and activated by the Full Authority Digital Electronic Control (FADEC). The aircraft essential power buses provide alternate electrical power to the FADEC for engine starting and in the event of a Permanent Magnet Alternator (PMA) malfunction. The PMA has independent coils that provide electrical power to the individual channels of the FADEC when High Pressure Turbine Speed (NH) is above 20% minimum.

The ignition system is configured such that both ignitors can be commanded by each FADEC channel, while maintaining electrical isolation between the FADEC channels and the aircraft essential buses. Only one of the two ignitors is turned on during a normal start (this is to identify any failures in the dual channel ignition system by cycling between ignitors used on subsequent ground starts).

When power is supplied to the ignition exciter the unit's circuitry will raise the energy of this power to a high enough level to cause the ignition plugs to spark. These sparks are used to ignite the fuel/air mixture.

The ignition exciter is a sealed unit and cannot be repaired in the field.

Ignition Functional Test

In order to verify the Ignition system, the FADEC performs an Ignition Test Function when in Maintenance Mode:

With the FADEC in Maintenance Mode, and the Ignition Selection on the Engine Start Panel in the "Normal" position, set the PLA to Flight Idle (FI) detent and the Condition Lever Angle (CLA) in the Shutdown position, selection of the Max Power Button on the Engine Control Panel will cause the FADEC to command the Ignitors to operate.

By disabling the power supply to ignition exciter box (through cockpit circuit breakers) each ignitor can be tested individually.

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Ignition Audible Check for FADEC S/W D809.3 (POST SB84-73-02 OR POST MODSUM 4-113553)

Refer to Figure 2.

Refer to Figure 3.

Refer to Figure 4.

In order to verify that the engine Ignition system associated wiring is correctly installed, select the ignition "ON" and listen for the "Sparking" noise.

With the Engines "OFF" and FADEC in Maintenance Mode, set the PLA for both engines to "Flight Idle" (FI) position. With the Condition Lever Angle (CLA) in the Shutdown position, set the Ignition to the "Normal" position on the Engine Start Panel for the engine under test. Select "MAINT DISC" button to "ON" position from the Engine Maintenance Panel. The ITT indication should read 492.8 °F (256 °C) confirming that the FADEC is in Maintenance mode. Select "MCR" on the Engine Control Panel.

The Igniters will be commanded to fire sequentially for 10 second intervals. The ITT gauge will indicate 32 °F (0 °C) when Ignitor A is commanded to fire and 3257.6 °F (1792 °C) when Ignitor B is commanded to fire. Check igniters are firing (for the engine under test) by audible check in the vicinity of combustor area. Ignition audible check can be done for the other engine by repeating the procedure.

Ignition Exciter

Refer to Figure 5.

The Ignition Exciter Box is a dual channel unit contained in a single enclosure. The Ignition Exciter Box is supplied with aircraft 28 Vdc

through a single electrical connector, for both channels. It outputs a high–tension signal to the igniter plugs when selected " ON " by the FADEC. The Ignition Exciter Box is connected to the Igniter Plugs by a pair of braided cables. Each FADEC channel (A/B) can fire either ignitors A or B through discrete inputs to the Ignition Exciter Box.

The ignition exciter is flexibly installed on the right hand side of the engine. It is a sealed unit that contains electronic circuitry which provides a high voltage output (15 to 20 kVA) that is transmitted by the ignition cables to the igniter plugs. This high voltage output causes the ignition plugs to spark at a rate of 1 to 1.4 sparks per second.

The two Igniter Plugs are located in the Gas Generator Case and are connected to the Ignition Exciter Box. They provide sparks for igniting the fuel/air mixture.

Ignition Exciter Circuitry and Operation

Refer to Figure 6.

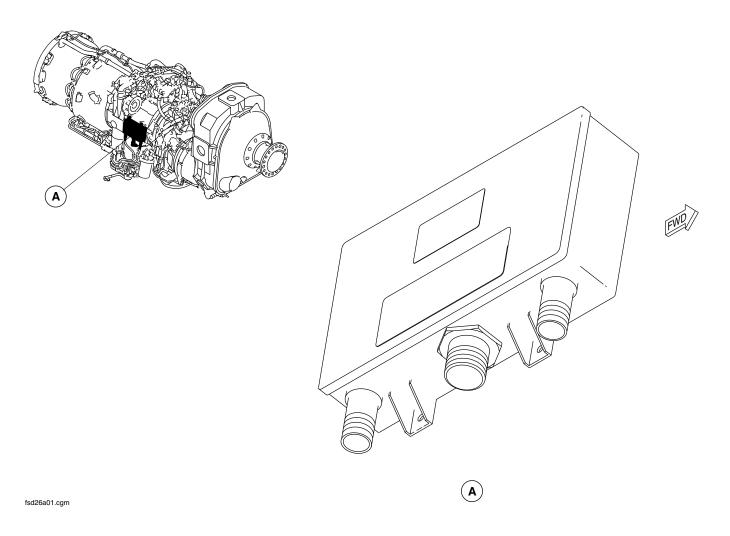
When the unit is energized, a capacitor on the high voltage side of the output transformer is progressively charged. When sufficient energy to ionize a spark gap in the unit is accumulated, the capacitor discharges through a dividing and step—up transformer network across the two ignition plugs. the unit will continue functioning if one of the plugs is open or shorted, in order to operate the remaining plug. If both ignition plugs fail, or if the input voltage is switched off, the capacitor automatically discharges.

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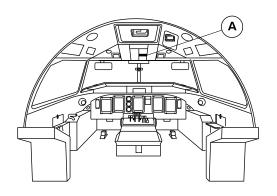
IGNITION POWER SUPPLY LOCATOR
Figure 1

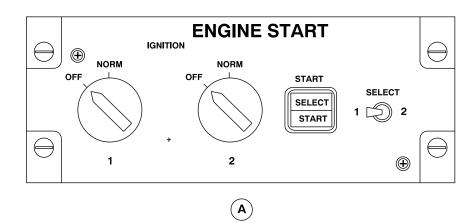
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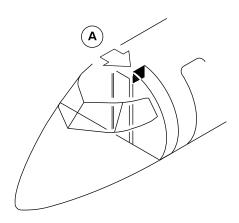
Engine Start Panel Figure 2

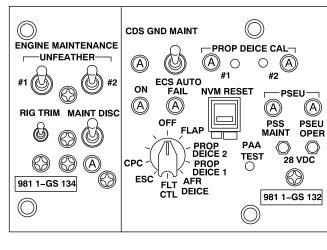
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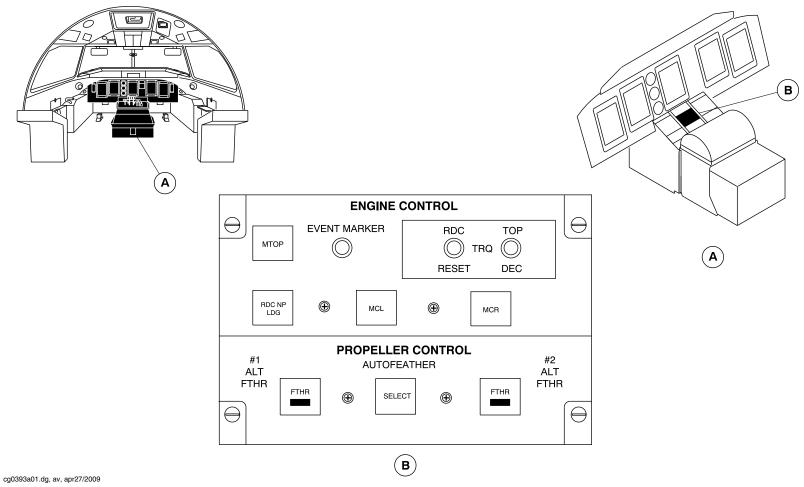
Engine Maintenance Panel Figure 3

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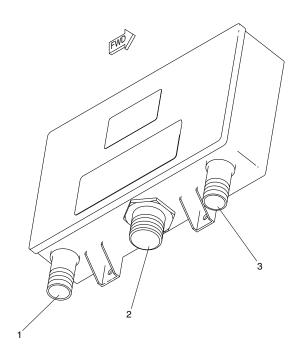
Engine Control Panel Figure 4

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LEGEND

- High Voltage Output (15 to 20KV).
 Input Voltage (28VDC).
 High Voltage Output (15 to 20KV).

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IGNITION POWER SUPPLY DETAIL
Figure 5

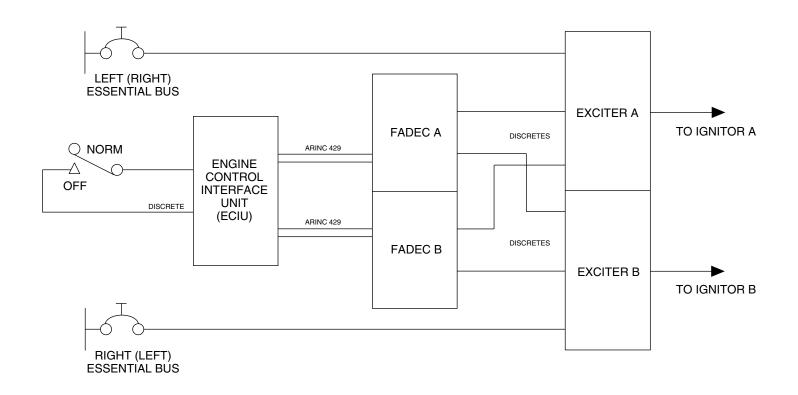
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Ignition Power Supply Schematic Figure 6

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DISTRIBUTION

Introduction

The ignition distribution system transmits the dc pulsed high voltage output from the ignition exciter to the ignitors. The voltage is then converted to sparks that are used to ignite the fuel/air mixture.

General Description

The function of the ignition distribution system is performed by the ignition cables and the ignitors. The distribution system has the components that follow:

- Ignition Cables (74–21–06)
- Ignition Plugs (74–21–01)

Detailed Description

Refer to Figure 1.

When 28 Vdc is supplied to the ignition exciter the unit outputs a pulsed high voltage signal which is carried by the ignition cables to the ignitors. This voltage is then transformed into sparks which ignite the fuel/air mixture.

Ignition Cables

The cables are mounted on the right side of the engine. They are secured with guick release clamps. This makes removal and installation easier.

Ignition Plugs

There are two ignition plugs. They are installed in the gas generator case at the 4 and 7 o'clock positions.

Training Information Points

The ignition plugs are fragile. If they are dropped during handling they must be replaced with new ones. This is because damage to the interior of the plug cannot be seen from the outside.

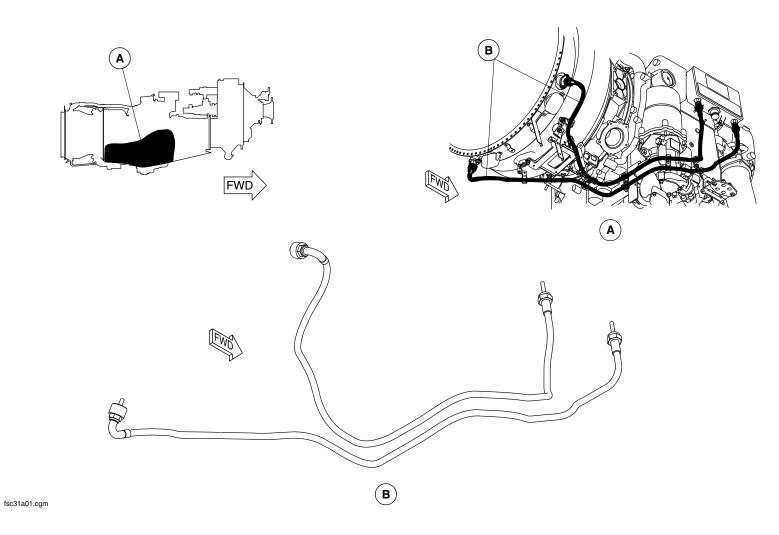
The ignition cable fittings are coated at installation to ensure good electrical conductivity.

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Ignition Distribution System Figure 1

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**ON A/C ALL

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IGNITION DISTRIBUTION

<u>Introduction</u>

The ignition distribution system transmits the dc pulsed high voltage output from the ignition exciter to the ignition plugs and converts this voltage to sparks that are used to ignite the fuel/air mixture.

General Description

The function of the ignition cables is to transmit the high voltage signal from the ignition exciter to the ignition plugs. The function of the ignition plugs is to convert the high voltage signal to high temperature sparks to ignite the fuel/air mixture.

Detailed Description

When 28 Vdc is supplied to the ignition exciter the unit outputs a pulsed high voltage signal which is carried by the ignition cables to the ignition plugs. This voltage is then transformed into sparks which ignite the fuel/air mixture.

Ignition Cables

Refer to Figure 1.

The cables are mounted on the right side of the engine. The cables are flexible and provide for a shielded electrical connection between the ignition exciter and the ignition plug. Each cable is constructed

from a 5 mm silicon jacketed conductor wire enclosed by an inner braid of nickel–clad copper wire. This is further enclosed by an inner core braided with nickel wire. The end fittings are stainless steel and the inner core of the cable is hermetically sealed. This is to provide protection against electromagnetic interference.

Ignition Plugs

Refer to Figure 2.

There are two ignition plugs per engine. They are installed in the gas generator case at the 4 and 7 o'clock positions. The plugs are of the drop—in type and are secured to the engine by installing them between the gas generator case and the ignition cable fittings. This reduces the time required to replace the plugs. Each plug has a central electrode within a shell which acts as the ground.

As the energy potential increases, a small current passes across the semi-conducting material until the air between the electrode and the shell ionizes. At this point, high energy voltage discharges across the gap creating a spark. The spark always occurs between the electrode and the shell.

The plug shells are made from Hastelloy X for creep and fret resistance. The electrodes are made from Iridium for maximum life. Holes in the igniter body let cooling air pass to the igniter tip. This cooling air helps to keep the igniter tip cool.

Training Information Points

REMOVE THE POWER TO THE IGNITION EXCITER AND WAIT SIX (6) MINUTES BEFORE YOU TOUCH THE IGNITION CABLES. THE VOLTAGE IN THE CABLES CAN INJURE OR KILL YOU IF TOUCH THEM WITH THE IGNITION EXCITER POWERED ON.

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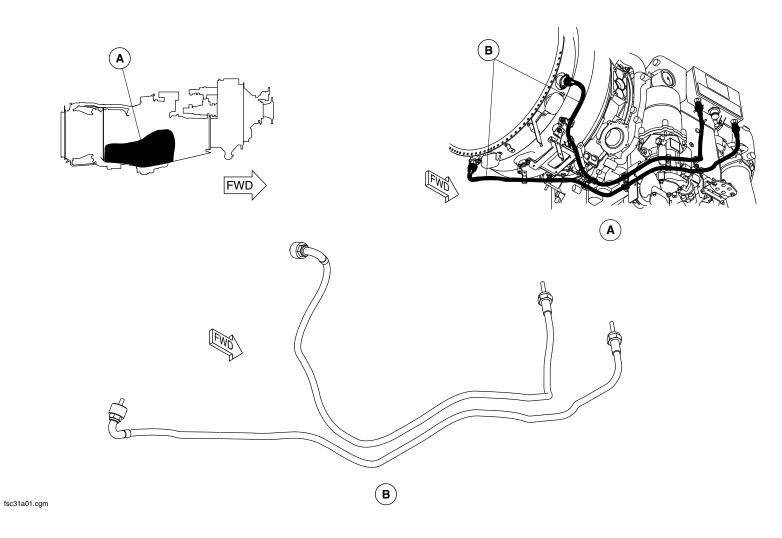
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Ignition Distribution Cables Figure 1

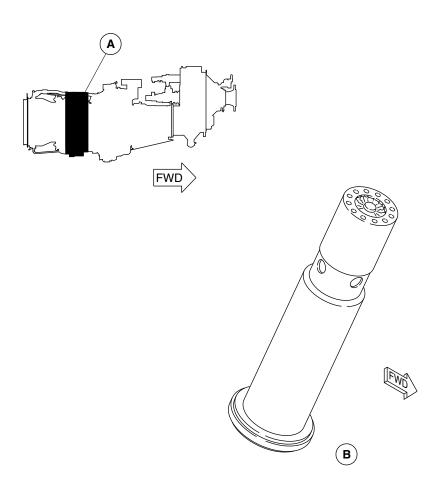
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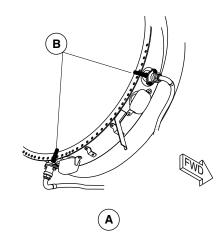
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Ignitors Locator Figure 2

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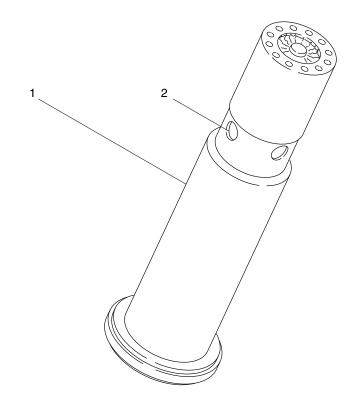
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LEGEND

- Ignitor Shell.
 Cooling Air Holes.



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Ignitors Detail Figure 3

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IGNITION SELECTION

Introduction

The ignition selection system selects the engine to be started and transmits this instruction to the Full Authority Digital Electronic Control (FADEC). The system is also used to set the ignition system mode to either "NORMAL" or "OFF"

General Description

The function of the ignition selection system is performed by the ignition selection switches. A panel mounted in the flight compartment has the switches that are used for engine ignition selection. This panel is labeled ENGINE START and has the switches that follow:

- Ignition Selection Switches
- Engine starter select switch
- Engine start pushswitch

Detailed Description

Refer to Figure 1.

Switches on the flight compartment instrument panel are used to select which engine is started and in what mode the ignition system is set to operate. The ignition selection system operates in two modes. They are the "OFF" mode and the "NORMAL" mode

Ignition Selection Switches

Refer to Figure 2.

The ignition selection switches allow the flightcrew to select the ignition mode. There are two ignition modes; "NORMAL" and "OFF". When the switches are in the "NORMAL" position, the FADEC activates ignition during engine starts (on the ground or in–flight). When the switches are in the "OFF" position, the FADEC disables ignition regardless of the ground or flight status. The FADEC can command both igniters to operate during flameout or for surge accommodation.

Engine Starter Select Switch

The engine starter select switch is used to select the left or right engine starter. The switch is a three position toggle switch with a left, center and right positions. The center position is neutral.

Engine Start Pushswitch

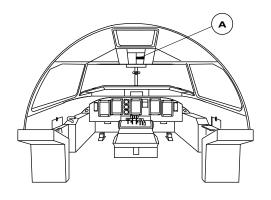
This switch signals the related FADEC to activate the selected engine's starter.

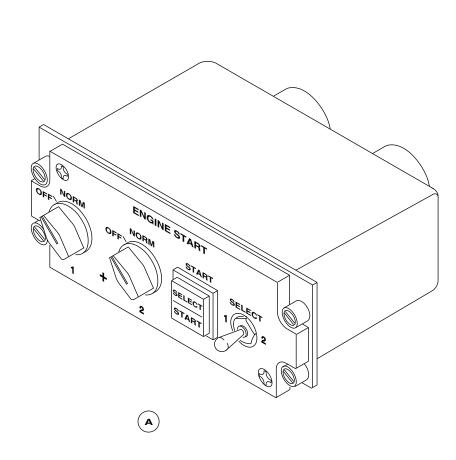
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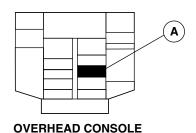
Engine Start Panel Locator Figure 1

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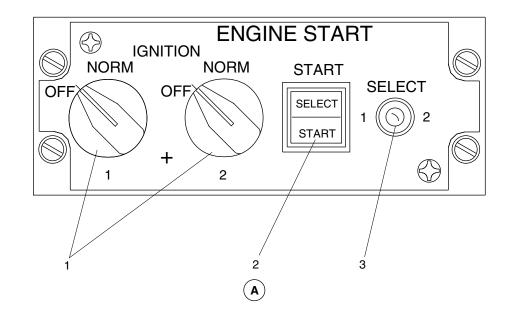
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LEGEND

- 1. Engine Ignition Switches.
- 2. Select and Start Switchlight.
- 3. Engine Start Select Switch.



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Engine Start Panel Detail Figure 2

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