Document # ZHM-001
Rev. A 08.16.2017

4J Power Spark

12J Rapid Fire

4J and 12J High Energy Ignition (HEI) Systems User's Technical Guide

ZEECO®

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INTRODUCTION

The Power Spark and Rapid Fire High Energy Ignition (HEI) systems are non-fouling, inextinguishable, high energy electric ignitors for all common oil and gaseous fuels. Essentially, each HEI system consists of a controlled capacitor discharge that produces a high temperature spark. This spark is generated at the rate of 3 to 6 sparks per second (SPS) for the Power Spark system and 9 to 12 SPS for the Rapid Fire system. In schematic form, each ignitor uses a high voltage direct current (DC) source to supply a DC current to a capacitor. When the capacitor is charged to a preset level, it discharges through a gas-filled 'Spark Gap' to the semiconductor spark tip, where the electric energy is dispersed in the form of a high temperature spark, which ignites the fuel. After discharging, the ignitor automatically recharges the capacitor. This charging/discharging occurs in less than a second, so in a typical 10 second pilot ignition period, the Power Spark ignitor will deliver 30 to 60 high temperature/high energy sparks and the Rapid Fire will deliver 90 to 120 high temperature/high energy sparks.

The ignitor's energy output is rated in joules. A joule is the unit of energy that refers to the energy stored and discharged in each capacitive discharge sequence. Therefore, the Power Spark will deliver a total of 12 to 24 joules of heat to the fuel in one second, ensuring a sustainable, reliable ignition of the gaseous or liquid fuel. For mechanically atomized heavy fuel oil, the Rapid Fire will deliver 108 to 144 Joules of heat in one second, also ensuring a sustainable, reliable ignition of even the hardest to light fuels exiting the nozzle at such a high velocity.

Ignitors are made up of three basic components: a Spark Rod assembly which includes the spark tip that touches the fuel and provides the high temperature spark, the HEI Power Pack which is the power supply that provides the pulsating energy to the spark tip, and the interconnecting Cable between the spark rod and the power pack. These components are designed to work together in order to have a fully functioning ignition system. In particular, the pulsating aspect of the Power Pack only becomes apparent when properly connected to the spark rod.

This manual focuses on applications and general troubleshooting criteria.

For specific understanding of the equipment, the equipment itself or its drawings should be reviewed.

Models

This technical manual is suitable for use with the following Power Spark HEI ignition models:

- P/N: 041-007-0001 - 4J COMPACT HEI MODULE W/ VIEWABLE SPARK GAP
- P/N: 041-007-0002 12J RAPID FIRE HEI MODULE W/REPLACEABLE SPARK GAP

Approvals

Part Number 041-007-0001FM has FM Approval number PR450144
Part Number 041-007-0001cUL has CSA Approval # XPZZ8 and UL approval # XPZZ2

** WARNING **

Please read this manual before installation, operation, or troubleshooting. Follow all instructions for proper use.

Use the Power Spark and Rapid Fire HEI components in complete compliance with the instructions contained in this manual.

Use this device strictly for the purpose described in this manual.

This device is only to be used, operated, and serviced by trained personnel. The Power Spark and Rapid Fire HEI systems should only be operated and serviced by personnel with appropriate knowledge, qualifications, and training. The user should also adhere to the burner manufacturer's instructions, safety advice, and warnings when installing and commissioning this device.

The Power Spark and Rapid Fire HEI systems are to be used in a grounded line voltage network only. Third-party electrical devices not mentioned in this manual should only be connected after consulting with the manufacturer or a manufacturer-authorized expert.

Liability for the function of the device shall be transferred to the owner or user upon sale. Liability for the function of the device shall be borne by the owner or user insofar as the device has been used by personnel without the necessary knowledge; has been improperly used, serviced, or repaired; or has been

handled in a manner that does not conform to proper use. Modifications to the device with type approval render the type approval null and void. Inputs and outputs of the device, and associated modules, may only be connected as indicated in this manual.

Zeeco, Inc., or its affiliates and subsidiaries (collectively, Zeeco), are not liable for damages occurring as a result of non-compliance with the above instructions.

Unless otherwise indicated, insofar as reference is made to laws, regulations, and standards, the basis for these shall be the governing laws of the United States of America.

Safety Symbol Glossary

Review this section to safely install, commission, and operate the device. The following symbols are used throughout this manual to draw the user's attention to important safety information. It is essential that all safety information is adhered to.

DANGER! This symbol draws the user's attention to the likelihood of an imminent hazardous situation. Failure to comply with this type of notice may result in loss of life or serious injury. Damage to plant and physical property may also occur.

WARNING! This symbol draws the user's attention to the possibility of a potentially hazardous situation. Failure to comply with this type of notice may result in loss of life or serious injury. Damage to plant and physical property may also occur.

CAUTION! This symbol draws the user's attention to the possibility of a harmful situation. Failure to comply with this type of notice may result in minor injury. Damage to plant and physical property may also occur.

NOTICE! This symbol draws the user's attention to important additional information about the system or system components, and offers further recommendations.

The user or operator is required to:

1. Comply with all instructions contained herein and take all necessary steps to prevent injury to persons or damage to property.

2. Comply with all health and safety regulations to prevent injury to persons and damage to property.

USING THIS PRODUCT IN SUCH A WAY THAT THE USER KNOWS OR SHOULD REASONABLY KNOW TO BE UNSAFE OR IN A MANNER OTHER THAN IS PRESCRIBED IN THIS USER'S TECHNICAL MANUAL IS, AND SHALL BE CONSIDERED TO BE, A VIOLATION OF THE WARRANTY.

CAUTION!

The Power Spark HEI system deals with:
- Stored Energy in a Large Capacitor
- Sizable Electric Currents
- High Voltage
- Bright, High Temperature Welding Type Spark.

CAUTION must be used when handling these ignitors

PRINCIPLES OF OPERATION

GENERAL:

The spark of the ignitor is not like a normal 6,000 or 10,000-volt AC spark that one might have experience with. Rather, it is a high current DC spark at a relatively lower voltage, and is initiated many times per second.

The energy output of the Power Spark and Rapid Fire HEI systems are rated in joules, referring to the energy of each spark. Larger energies are needed for heavier fuels to burn through viscosity and contaminates. The energy rating of 4 Joules, coupled with the spark frequency, provides the necessary sustained heat energy needed to reliably ignite gaseous and liquid fuels. The energy rating of 12 Joules, coupled with the rapid spark frequency, provides the necessary sustained heat energy required to reliably ignite mechanically atomized heavy oils.

A Joule is equal to one watt-second, or disbursing one watt of energy in one second. When a unit is rated at 4 joules it means that each spark of the ignitor is delivering 4 joules. This high current spark is accomplished by taking the energy stored in a capacitor and discharging it over a short period of time. The discharged energy enables the spark to ignite the fuel and clear any contamination on the spark rod. It is the frequency of the spark that allows the Joules delivered to be able to reduce the quench time as the fuel moves over the sparking area. Together, the power of the spark and the spark frequency delivers reliable ignition energy to the fuel, while keeping the spark tip free from contaminants.

IMPORTANT ASPECT:

The actual spark of the spark rod occurs directly on the end surface of the spark tip. The spark that one might see is the incidental aura of this surface spark - not the spark itself. As a result, the spark rod that is delivering the pulsed energy must be in the fuel stream such that the fuel spray is touching the surface of the tip of the spark rod.

The spark of the spark rod, in almost all cases, reliably lights the small bit of fuel it touches. This can usually be observed by yellow-white flames coming from the blue-white spark. However, this small amount of burning fuel is only a portion of the total fuel spray. Complete ignition of the fuel happens by propagation of this small amount of heat to the balance of the fuel pattern.

TECHNICAL DATA

Input Power

Power: 120Vac to 240Vac (+/- 16.7%)
Fuse rating: 5A Recommended
Frequency: 50/60Hz
Consumption: 90VA


NOTICE!

Line voltage input affects the Output Energy Frequency (spark rate).

Output Energy

Power: 2000Vdc
Energy: 4 Joule spark or 12 Joule specific to model
Frequency: 3 to 6 sparks per second for 4J; 10 sparks per second for 12J


WARNING!

When mounting the power pack in a cabinet, a minimum of 1" clearance should be observed for the HEI output stud. This is to prevent a short circuit of the door against the HEI output stud of the power pack.

Duty Cycle:

(4J) On: 20 minutes max.
(4J) Off: 10 minutes min.

(12J) On: 30 minutes max.
(12J) Off: 15 minutes min.

Recommended Cable:

Supply Voltage: 18 AWG (1.0mm2), 3 conductor cable
HEI Output Cable: 12 AWG (2.0mm^2), 2 conductor cable (HV connection)
Max Distance (HEI): 20 Feet (6m) – see INSTALLATION section for ideas on longer lengths

NOTICE!

When calculating cable lengths, voltage drop must be taken into account so the supply voltages do not fall below the device's lower operating limits.

Operating environment

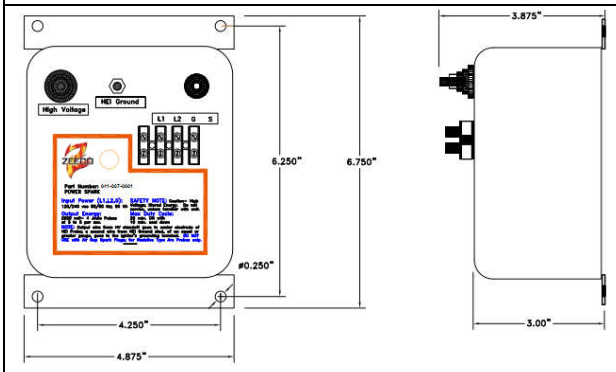
Temperature min.:	- 20°C (-4°F)
Temperature max.:	+90°C (+194°F)
Relative Humidity:	0% to 100%, non-condensing

Weight (shipping):

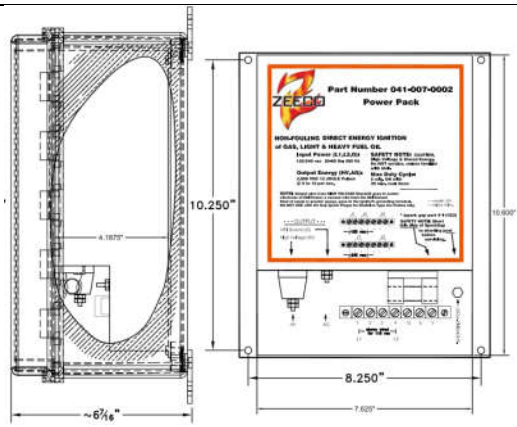
4J HEI Power Pack:	10 lb. (4.54 kg)
12J HEI Power Pack:	20 lb. (9.07 kg)

Dimensions:

P/N: 041-007-0001 4J HEI Power Pack



P/N: 041-007-0002 12J HEI Power Pack



Model Selection Criteria

Model	Gaseous Fuels	Air /oil	Steam /oil	Mechanically atomized/Oil	Application - Fuel type
4 Joule	X	X	X	-	Oil, gas (special gases such as refinery and blast furnace)
12 Joule Rapid Fire	X	X	X	X	Heavy Oil, mechanically atomized

INSTALLATION

General & Oil Fired:

When used to ignite oil, the ignitor should be installed according to the burner manufacturer's recommendation. The inserted Spark Tip should just reach the oil spray approximately 3" - 6" from the burner tip, perpendicular to, and within ½ inch of the solid part of the fuel spray. In most applications after ignition, the ignitor rod must be withdrawn to prevent the igniter tip overheating.

As soon as the fire is stable, the aim for retraction is to withdraw the ignitor tip to an area behind the diffuser, where it is much cooler. Under no circumstances should the ignitor tip be left in the fire when not sparking, nor longer than its duty cycle. The point at which retraction should be initiated is accomplished by the logic of the burner management control system (BMS) and determined by the requirements of the application engineer when the system is initially designed or an existing burner is modified.

NOTICE!

The questions pertaining to the retraction distance and timing must be directed to those responsible for applying the ignitor, and not to this manual.

The driving energy for the spark rod comes from the Power Pack. Since the Power Pack is delivering high pulsating currents (see the "Theory of Operation" section for review), the distance between the Power Pack and the Ignitor Tip can be critical. Line losses can reduce the amount of energy delivered. Generally, the cable between the Power Pack and Ignitor should be as short as possible, usually no more than 20 feet.

However, if an application allows for less than full energy, a longer cable run can be used. For instance, a 12 Joule Power Pack might be used with a 140 ft. long cable run if only a 4 joule Power Pack would have been sufficient energy to light the fuel. In other words, the cable loss can be made up with a larger Power Pack.

Physical clearances must also be considered. Since the ignitor will be moving in and out during normal operation, care must be taken to ensure the ignitor does not hit a physical obstruction, such as the burner's diffuser on insert or a burner front obstruction on retraction. Also, outside clearance for removing the ignitor rod as well as the thermal expansion of the boiler with respect to the foundation should be anticipated.

For Natural & LP Gas Firing:

Generally, the same criteria that apply to oil fired applications also apply to gas fired situations, with two additional considerations:

When one immerses a spark rod into an oil spray, the spark of the ignitor lights the oil because there is adjacent oxygen for oil to combust. However, gaseous fuels tend to displace surrounding air. Therefore, it is possible that the spark of the ignitor might be positioned in a fuel cloud with no oxygen, resulting in the spark not lighting the gas.

In applying the Power Spark or Rapid Fire systems, care should be taken to position the spark rod in an area of the burner that has a mixture of both air and gas. Often this can be found in the outside zone of the gaseous spray pattern. If this is not immediately possible, then some other region of turbulence must be established where the ignitor tip must see both gas and air to ensure reliable ignition.

Unlike an oil-fired system, the ignitor tip may sometimes be left in a flame pattern without the need for retraction. Careful attention is required to the exact placement of the ignitor tip and the firing conditions in order to determine the need for retraction on gaseous fuels. Ultimately, the decision involves ensuring the ignitor tip is not seeing too much heat.


NOTICE!

In both the above cases, choosing the described position involves subtle design criteria. The need for retraction and proper spark tip placement is the responsibility of application engineering, and is therefore beyond the scope of this manual.

EQUIPMENT STORAGE

For long term storage, it is advisable to store the Ignitor in a heated facility to minimize condensation build up. Normal temperature extremes (-20 degrees F to +180 degrees F) will not affect the unit. However, if it is suspected that the unit has been exposed to excess water or temperatures, it is advisable to troubleshoot the system as outlined under the "No Spark" subsection, or at least thoroughly pre-test the ignitor as outlined below in the "Initial Check Out" section.

INITIAL CHECK OUT

It is best to operate the ignitor and its control system before a light off is attempted. This can often be accomplished by manually shutting off the fuel valve and then initiating a light off attempt. However, this should only be done with the knowledge and consent of the burner operator(s).

1. For initial start-up, check all physical, electrical and pneumatic connections.
2. Disconnect the line voltage input wire to the Power Pack, ensuring the ignitor itself is not turned on.
3. Stroke the ignitor in and out to ensure the spark rod is moving into the anticipated position.
4. When the igniter is back in the retracted position and the sequence of operation is stopped, reconnect the voltage input wire.
5. After initiating a light off attempt, check to ensure the ignitor is sparking.

CAUTION!

Since the Ignitor is delivering the spark into a combustion area, the furnace must be free from combustion vapors prior to an attempted light off.

Any difficulty at this point should be evaluated as described later in this manual. If the ignitor is inserting and sparking, a light-off attempt can be initiated by opening back up the fuel valve.

Read the "Principles of Operation" section of this manual and "Combustion Setting" subsection of the Troubleshooting section, to understand how the ignitor lights a burner in order to anticipate light-off problems.

TROUBLESHOOTING

If a fuel ignition problem is experienced, first determine if the ignitor is sparking at the spark tip. If the igniter is sparking at the tip, then an ignition problem is either caused by an improper combustion setting or the igniter is not positioned correctly to the fuel/air mixture.

Combustion Setting:

If the ignitor is sparking and touching the oil spray, the igniter will light the area of the fuel the spark tip encounters. However, the propagation of this small flame to the balance of the oil spray can be retarded if the air or fuel velocity is too high. The exit velocity of the fuel and air can quench the initial ignition effort.

To overcome ignition quenching, a stagnation area would need to be created to allow more time for the initial oil flame to propagate to the rest of the fuel spray. For example, the sequence of operation might require the air dampers to be deliberately closed at light off. Another example may require the fuel or air pressure settings to be reduced for the light off situation.

The following potential situations could negatively affect ignition: Low oil temperature, short duration of oil spray, a different spray angle, wet atomizing steam, cold air temperature, clogged oil nozzle, fuel or air pressures that are different than the designed start-up settings.

Some burners are more susceptible to the above situations than others. Therefore, becoming familiar with the normal light-off conditions is helpful in troubleshooting a failed light off.

Retract Models: Not in Position

If the Ignitor is sparking but not in position:

1. If the Ignitor is not inserting, check the power and air supply to the solenoid valve. Check the solenoid valve to make sure air supply is changing from retract to insert ports. Check the cylinder for leaking gaskets and/or piston rings. There are kits available to re-build both the retract cylinder and solenoid.

2. If the Ignitor is inserting but not in the edge of the fuel spray, check the guide pipe and retract assemblies, make sure they are correctly installed and tight. To reposition the ignitor, loosen its jam nut and move it.

No Spark

If no spark is observed during the ignition sequence, check the following:

This is a high voltage unit. Troubleshooting this equipment should be done by trained personnel only.

CAUTION!

1. Check the supply power to the Power Pack, and make sure there is proper voltage to the correct terminals. Check that the proper jumpers are installed as per the power pack drawing.

2. Turn off power. Make a visual check of ignitor cables, electrical connectors and spark tip. Ensure the ignitor cable is not damaged, that connectors are seated properly and the spark tip is not eroded (Carbon buildup will not affect spark). Check all wires are properly connected to their termination points.

3. With the cable disconnected, check continuity.

4. If the power pack has an external resistor, check its continuity.

5. Check the resistance of the Spark Tip by putting a meter across the two terminals in the probe housing. The Tip is a semi-conductor device and can have a resistance between a few ohms and 10 mega ohms. The resistance should not be much above 10 mega ohms and should not read infinity. Carbon build-up will not affect the spark, but it will affect the resistance readings. To replace the tip, hold the tip nut and loosen the socket nut. To remove, pull the tip straight out.

6. Check for shorting in the single conductor wire. Since the spark rod is neither an open circuit nor a pure conductor, one must remove the spark rod and then measure the cable's continuity. With the spark rod removed, there should be NO RESISTANCE between the central conducting wire and ground. If there is, this is an indication of a short circuit of the pulsating voltage, and might be the cause of "No Spark" being delivered to spark tip when the tip is installed.

7. The spark gap is designed to be easily replaced in the Rapid Fire power pack. A defective spark gap could be preventing a spark from reaching the spark tip. Replace the spark gap with a new spark gap.

8. Try the ignitor with a new power pack, or one known to be good. If the ignitor sparks, replace the power pack. A defective Power Spark power pack cannot be field repaired; return it to a factory repair facility. Before removing make sure power is off and short each terminal to ground, to make sure all voltage bleeds off.

Sparking along cable or in ground areas

If the ignitor is sparking in places other than the electrode end.

Because the ignitor's pulses are very large current spikes, earth grounds (similar to what is used in a high tension ignition system) are not used in these circuits. A separate ground wire of equal or larger gauge is provided. Make sure the provided ground connections are as solidly connected as the High voltage side, or electric sparks and shocks could follow on the grounded side of these systems.

1. Turn off power. Make a visual check of ignitor cables and electrical connectors. Assure that cables are not damaged, connectors are seated properly and all wires are connected properly to their termination points.

2. Check to make sure cable connectors are tight, and make sure both ends of a braided cable is well grounded, when using an armored cable.

PLEASE CONTACT YOUR LOCAL ZEECO OFFICE FOR MORE ADVANCED TROUBLESHOOTING AND ALL WARRANTY RELATED ISSUES.

Include model number, part number, serial number and a description of the problem and the application when requesting submitting a warranty claim. Zeeco can also be contacted at:

Telephone: +1 (918) 258-8551
E-mail: ProFlame@zeeco.com
Website: www.zeeco.com

Maintenance

Provisions shall be made to ensure the spark tips are inspected and cleaned at regular intervals. The interval period depends on the operating conditions of the furnace. The power packs do not need maintenance, but should be visually inspected to confirm the spark is crossing the spark gap when the power pack is energized.

Repair

DANGER!

This ignitor is an ignition device. Any repair work or other changes to the device shall only be performed by the manufacturer's specialist or by someone appointed by the manufacturer. Tampering with the ignition system's internal components voids the manufacturer's warranty.

Warranty

All Power Spark and Rapid Fire HEI systems are warranted against defects in material and workmanship for the Warranty Term. The Warranty Term for all Power Spark and Rapid Fire HEI systems shall be eighteen (18) months from the date of shipment, or twelve (12) months from date of first operation, whichever occurs first. NOTE: The spark tube in the power packs and the HEI tips are consumable items, and will not be replaced under warranty.

FAILURE TO STRICTLY COMPLY WITH ALL PROVISIONS OF THIS USER'S TECHNICAL MANUAL MAY RESULT IN THE WARRANTY BEING INVALIDATED.

THE POWER SPARK AND RAPID FIRE HEI SYSTEMS ARE DESIGNED TO BE USED IN EXTREME AND IN DANGEROUS LOCATIONS. ALL PRUDENT INDUSTRY SAFETY PROTOCOLS MUST BE FOLLOWED AT ALL TIMES.

Nothing in this User's Technical Manual shall be construed to limit any rights or remedies in law or contract that Zeeco may have.

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