

Safe Ignition System for Exposed Operations Technical Manual

ADP-PX16-232

MAN-PX1-010 (R01)

OWEN OIL TOOLS

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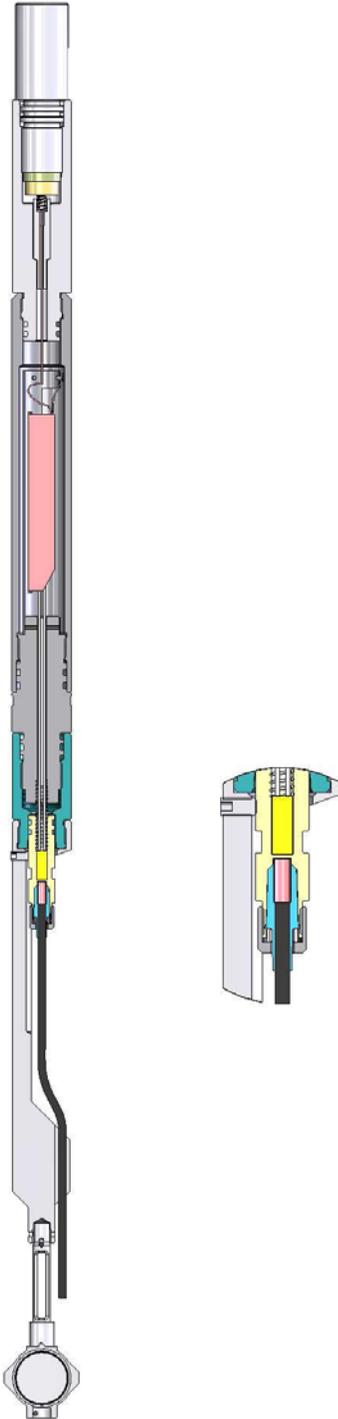
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INTRODUCTION

The ADP-PX16-232, Safe Fire PX-1 Initiation System utilize Exploding Bridgewire technology to increase safety during firing operations.

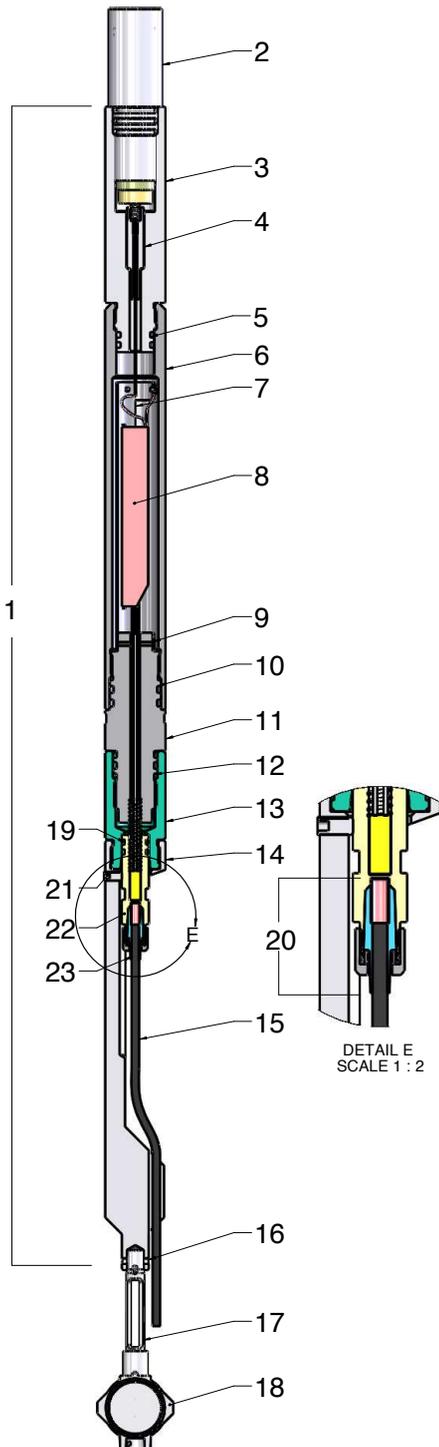
Incorporation of the EBW into the Firing Systems adds increased safety against rig-site hazards such as R-F transmitters, cathodic protection, and stray voltages. The PX-1 EBW fireset allows normal oilfield operation to continue while perforating and other completion services are being performed.

All safety rules and regulations should be strictly followed when storing, handling, assembling, and using these tools and/or detonators. Safety precautions should be taken in accordance with your company's safety policies, governmental regulations, and the American Petroleum Institute Recommended Practice 67 (API RP-67).



SPECIFICATIONS

| | | |
|------------------------|----------------|-------------|
| PRESSURE RATING | 15000 psi | 103.4 Mpa |
| THREAD CONNECTION, TOP | 1-3/16 - 12 UN | |
| TOOL DIAMETER | 1.69 in | 42.9 mm |
| TEMPERATURE RATING | 330 F DEG | 165.5 C DEG |
| LENGTH | 32.4 in | 82.3 cm |



| ITEM | PART NO. | DESCRIPTION |
|------|----------------|---|
| 1 | ADP-PX16-232 | Assembly. Exposed Initiation PX-1 Firing System for Link Operations |
| 2 | AES-AS80005 | 1-1/2in. HP Firing Head (sold separately) |
| 3 | ADP-PX16-214 | Contact Body |
| 4 | HSC-0100-011 | Spring Contact Assembly |
| 5 | OOO-V569-211 | O-Ring, Viton #211 - 2 Required |
| 6 | ADP-PX16-102 | Top Housing |
| 7 | SEV-1375-250 | Carriage, PX-1 |
| 8 | PUR-0610-008 | PX-1 Fireset with Wire Outputs |
| 9 | PUR-0509-040 | 6-32 x 1/4 Pan Head Screw - 2 Required |
| 10 | OOO-V569-217 | O-Ring, Viton #217 - 2 Required |
| 11 | ADP-PX16-231 | Detonating Housing |
| 12 | OOO-V569-214 | O-Ring, Viton #214 - 2 Required |
| 13 | ADP-PX16-224A | Firing Adapter |
| 14 | ADP-PX16-224L | Firing Head Extension for Link |
| 15 | Ref Cord Chart | Detonating Cord (sold separately) |
| 16 | PUR-0506-052 | Cotter Pin, 1/8" x 1-1/4" |
| 17 | Ref Link Pages | Link Spacer, 3" long |
| 18 | | Link Charges |
| 19 | OOO-V569-113 | O-Ring, Viton #113 - 2 Required |
| 20 | ADP-PX16-235 | Ecosse Sealing Kit |
| 21 | PUR-0504-026 | 0.25 - 20 x 0.50 Set Screw |
| 22 | ADP-PX16-225 | Booster Holder |
| 23 | PUR-6000-005 | Seizing Cord (sold separately) |
| - | ADP-PX16-233 | Redress Kit, includes items: 4, 5, 7, 8, 9, 10, 12, 19, 20, 21, 22 |
| D | EBW-RISI-800 | EBW - RDX Detonator (sold separately) |
| | 2-300180-3 | EBW - CP Detonator (sold separately) |



Note: To fire DC (+); connect the white/black wire to ground and connect the red wire to hot. REFERENCE MANUAL: MAN-PX1-010

1.0 Pre-Assembly



Warning: *Explosives are destructive by nature! Do not attempt to disassemble or alter explosive products in any manner! Do not crush, hammer, pinch, impact, pull wires or abuse any explosive product!*



Warning: *Be sure to follow safe operating practices as found in API RP-67 in accordance with governmental regulations, company policies and manufacturer's recommendations!*



Note: *Before assembly, visually inspect all components for any defects.*

2.0 Assembly

2.1 Feed wires of Spring Contact Assembly (item #4) thru Contact Body (item #3).

2.2 Unwrap the PX-1 Fireset (item #5) from its protective wrapping.

Note: The PX-1 Fireset is polarity sensitive; to fire with positive voltage (VDC+), the hot lead is the red wire; to fire with negative voltage (VDC-), the hot lead is the black/white wire.

2.3 Press the PX-1 into the Carriage slots, making sure that the PX-1 is secured in place by the slots (as shown below).

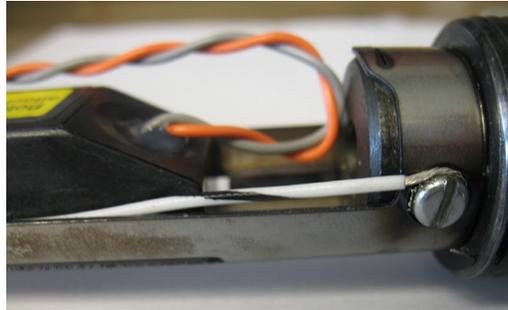


2.4 Install the 2 O-rings (item #10) to the Detonator Housing (item #11), and then attach the housing to the PX-1 Carriage (item #7) using the 2 Pan Head Screws (item #9).

- 2.5 Loosen one of the Pan Head Screws that is attached to the Detonator Housing enough to attach the ground lead from the PX-1. Strip the PX-1 ground lead from the PX-1 to the appropriate length and ground to the Pan Head Screw (as shown below.)



Note: *The PX-1 Fireset is polarity sensitive; to fire with positive voltage (VDC+), the ground lead is the white/black wire; to fire with negative voltage (VDC-), the ground lead is the red wire.*



- 2.6 Install the Detonating Housing O-rings (item #12) onto the Detonating Housing (item #11).
- 2.7 Install the Support Spring (item #20) onto Detonating Housing (item #11).
- 2.8 Install O-rings (item #19) onto Booster Holder (item #22).
- 2.9 Feed the Detonator (item #D) lead wires through the Support Spring and Detonating Housing.
- 2.10 Thread the Blast Shield (item #24) onto the assembled Detonating Housing.
- 2.11 Cut the Detonator leads to an appropriate length, then strip 1/2" of insulation from each lead.
- 2.12 Using an approved digital blaster's multimeter, check the resistance of the detonator. The resistance should read less than one ohm.
- 2.13 Check the output lead wires (orange and grey wires) of the PX-1 using an approved digital blaster's multimeter to make sure that no voltage is present before connecting the Detonator.
- 2.14 Connect the EBW detonator lead wires to the PX-1 output lead wires by attaching one detonator wire to the PX-1's orange wire and the other detonator wire to the PX-1's grey wire. Insulate each individual wire connection with electrical tape or other electrically insulating methods.



Note: *Each detonator lead wire must be connected to a PX-1 output wire; it is not permitted to connect either wire directly to ground. The user may wish to cut and strip the PX-1 wires to length prior to connection so as to avoid extra wire length when proceeding to the next step.*

- 2.15 Insert the PX-1 and Carriage assembly into the Top Housing (item #6) and tighten. Splice the lead from the Spring Contact Assembly to the wire of the PX1.
- 2.16 Install o-rings (item #5) onto Contact Body (item #3).
- 2.17 Lubricate the O-rings on the Contact Body (item #3).
- 2.18 Thread the Contact Body into the Top Housing and tighten.
- 2.19 Connect to the wireline toolstring.
- 2.20 Remove the Blast Shield.
- 2.21 Thread the Firing Adapter (item #13) onto the Firing Head Extension (item # 14). Thread the Firing Adapter and Extension together onto the Detonating Housing (item #11)
- 2.22 Mechanically connect the Exposed Link Gun System (not shown) to the Firing Adapter.
- 2.23 Feed the Det Cord through the Firing Adapter from the tool below.
- 2.24 Slide the Retaining Nut (item #20) and Thrust Bushing (item #20) onto the Det Cord (item #15).
- 2.25 Lubricate 2in. - 3in. (5.08 cm - 7.62 cm) of the Det Cord with silicone grease.



Caution: *Do not use a non-silicone grease, as it could affect the properties of the explosive in the Det Cord!*

- 2.26 Slide the small end of the Seal Boot (item #20) over the end of the Det Cord.
- 2.27 Remove any slack in the Det Cord.

2.28 Cut the end of the Det Cord to leave a clean, flat surface. Cut the end of the Det Cord so that the correct length of cord is needed to make a connection.

2.29 Slide the Aluminum End Seal (item #20) onto the cord but do not crimp.



Caution: *Crimping the End Seal onto the cord could cause the system to leak!*

2.30 Push the Det Cord back into the Seal Boot until the 1/8" of the End Seal protrudes from the bottom of the Seal Boot.

2.31 Insert the Det Cord assembly into the Booster Holder (item #22). Push assembly in below top edge to bottom out end seal and Rubber Boot. This will allow the Thrust Bushing to align straight when tightening Retainer Nut.

2.32 Holding the Det Cord in place, tighten the Retaining Nut onto the Booster Holder.

2.33 Tie the protruding end of the Seal Boot with Seizing Cord (item #23).

2.34 Insert Booster Holder (item #22) with o-ring into Firing Adapter (item #13) and secure with Set Screw (item #21).

2.35 Follow the standard running procedure for the gun system you are using.

3.0 PX-1 Firing Instructions



Warning: *Explosives are destructive by nature! Do not attempt to disassemble or alter explosive products in any manner! Do not crush, hammer, pinch, impact pull wires or abuse any explosive product!*



Warning: *Be sure to follow safe operating practices as found in API RP-67 in accordance with governmental regulations, company policies and manufacturer's recommendations!*



Note: *Before assembly, visually inspect all components for any defects.*



Note: *PX-1 firesets are now packed in a clear plastic tube with a tamper-evident seal on the cap. The words “Ecosse Inc” are printed in blue on the seal. If these words are missing or the seal has been cut, it should be assumed that the PX-1 has already been fired, and that the fireset should not be used for critical applications.*

3.1 *When ready to fire the detonator, slowly increase the applied voltage (positive DC to the red wire, negative DC to the black/white wire). At 200-230VDC cablehead voltage the PX-1 will switch on and draw current (160-260mA). Continue increasing the voltage quickly until the PX-1 fires, which should be almost immediately, then power down. Note that at downhole temperatures the PX-1 requires up to 30V more to switch on and fire than it does on the surface.*



Note: *If the power supply being used does not provide a true DC output, see Q1/A1 and Q7/A7 on the other side of this page for power-up characteristics.*

4.0 Frequently Asked Questions

Q1 - Is any special equipment required to use the PX-1?

A1 No equipment is required other than a DC power supply to activate the PX-1. However, the power supply needs to supply true DC to power the PX-1 efficiently. Many of the DC supplies used in perforating operations actually deliver unsmoothed full-wave-rectified AC, which is a series of 100-120 voltage “bumps” per second rather than flat DC. Although the PX-1 will work with this input it does so less efficiently, and it will not work above temperatures of about 290-300F with this kind of supply. Also, because of the way most volt meters work it will look as if the PX-1 is switching on at a lower voltage than it actually is (the voltmeter will indicate the average or RMS voltage, while the PX-1 will switch on with the peak voltage). You should be aware that if you are using the above type of unsmoothed power supply with a very short wireline (7000ft or less), it might be necessary to continue increasing the voltage quickly for a few seconds after the PX-1 switches on before it will fire. It is preferable to avoid this situation by using a true DC power supply to fire the PX-1. Filtering can be added to an unsmoothed shooting supply to provide a true DC output. In its simplest form this can be little more than a capacitor (1000-2000uF) and bleed resistors; if required Ecosse can supply a low-cost plug-in box to meet this need. Finally, the CCL and other downhole hardware must be capable of handling the cablehead voltage required by the PX-1 (see A4 below), and all electrical connections and insulation must be clean.

Q2 - Can the PX-1 be test-fired prior to use?

A2 No. All PX-1s are test-fired by Ecosse prior to shipping, and further testing is unnecessary. Also, experience has shown that test-firing prior to use is more likely to cause an otherwise-good tool to fail than it is to detect a problem.

Q3 - Can the PX-1 be test-fired for demonstration or troubleshooting purposes?

A3 Yes, although any tools used for this purpose should be expected to fail quite quickly and must not be used afterward on a job. If test-firing is required it should be done into a low- inductance load resistor (solid ceramic type preferred) with a resistance of 100200S, minimum voltage rating of 6kV, and a minimum power rating of 10W; Ecosse can supply a suitable resistor. The general firing method is the same as described overleaf for downhole operation. At about 200-210VDC input voltage the PX-1 will draw current (160-260mA) and start firing rapidly; power down as soon as this happens to avoid overheating and damaging the tool. The power should be ramped down quickly, not toggled off, otherwise damage to the PX-1 might occur. The firing will be indicated by a series of pulsing sounds from the PX-1. Wait 2 minutes after powering down and disconnecting the PX-1 from the power supply, then remove the load resistor.

Q4 - Is 260mA @ 210VDC all the surface-supplied power necessary to charge and activate the PX-1?

A4 At a minimum, yes. However, to allow for variations in firesets and a drop in efficiency at higher temperatures you really want a power supply that can provide at least 1A @ 250VDC downhole to give you some margin. At downhole temperatures, the PX-1 requires up to 30V more to switch on and fire than it does on the surface. Also, the coil in most shooting Casing Collar Locators (CCL) drops current to ground when you apply power to the line. With conventional detonators this usually isn't noticeable, as you will normally be applying only about 30V at the cablehead to fire a 55ohm detonator; if the CCL has a coil resistance of 1000ohm, the coil will draw 30mA versus about 500mA going to the detonator. With the PX-1 and a cablehead voltage of 220V, the PX-1 will be drawing maybe 200mA and the CCL coil will be drawing 220mA. So, your power supply has to be able to supply current to the CCL coil as well, and the engineer has to be aware that even although the PX-1 won't power up until the cablehead voltage is about 220V, the CCL will be drawing current immediately. Adding it all up, a power supply that can generate 750-1000mA @ 250VDC at the cablehead would be suitable for use with the PX-1. Depending on the type of wireline used and the CCL coil resistance, the voltage required at the surface from the power supply might be as high as 350-400VDC.



Q5 - How is the PX-1 connected in the gun?

A5 There are two input wires to the PX-1 - a red wire (positive) and a black/white striped wire (negative). One of these wires is connected to ground and the other wire is connected to the gun through-wire; either wire can be the ground as long as the correct polarity is applied to the other wire when firing the PX-1. The detonator lead wires are connected to the orange and grey output lead wires from the PX-1. Since EBW and EFI detonators are not polarity sensitive, it does not matter the configuration in which the detonator lead wires are connected to the PX-1.

Q6 - What is the firing procedure?

A6 It's the same as firing a conventional detonator, except that you're going for 200-230V at the cablehead rather than 20-30V; basically you hold down the fire button and increase the voltage until the detonator fires. A single sheet with operating instructions for the PX-1 is packed with each device. After firing the voltage should be ramped down quickly rather than switched off instantly, otherwise the rapidly collapsing electromagnetic field around the CCL coil might generate extremely high voltage spikes which can cause insulation problems elsewhere.

Q7 - After the PX-1 switches on, how long does it take before the attached EBW/EFI is fired?

A7 With a true DC power supply the PX-1 will switch on and fire the attached detonator almost instantly (less than one second) after the voltage at the input leads reaches 200-230VDC. With an unsmoothed shooting power supply (see Q1/A1) or a long wireline, before the PX-1 will fire the detonator, it might be necessary to continue increasing the voltage quickly for a few seconds after it switches on.

Q8 - Can the PX-1 be fired by toggling the necessary input voltage onto it rather than by ramping it up?

A8 Yes, the PX-1 has been tested successfully with this firing method, with up to 280VDC being switched to the input leads. However, whenever possible the PX-1 should be fired by ramping up the voltage as described earlier.

Q9 - Can the PX-1 be fired with a capacitive-dump power supply?

A9 Probably not. The PX-1 has not been tested with this firing method, and it is not a recommended procedure.

Q10 - How does the PX-1 work?

A10 The PX-1 uses a capacitor discharge to fire the detonator, triggered by an over-voltage switch. Basically, the fireset has a safety circuit, a high voltage supply, an output capacitor, and a trigger mechanism.

Q11 - Can the fireset be used in an exposed gun application?

A11 The PX-1 is not designed to withstand pressure directly, so it must be contained in a protective housing for exposed gun applications. Also, the EBW and EFI detonators currently available are not pressure-rated, so they must be protected as well. If you have a need in this area Ecosse can supply adapter hardware with a 5-6 week lead time (we would need to know your CCL connection looking down and your gun connection looking up). All of the hardware except the detonator housing would be reusable. Ecosse can also supply adapters to use the PX-1 with chemical cutters, setting tools, and cutting/severing tools, down to 1-3/8in. OD.