

# Safe Ignition System for Exposed Fluid Operations Technical Manual

**ADP-PX16-242**

**MAN-PX1-011 (R06)**

## **OWEN OIL TOOLS**

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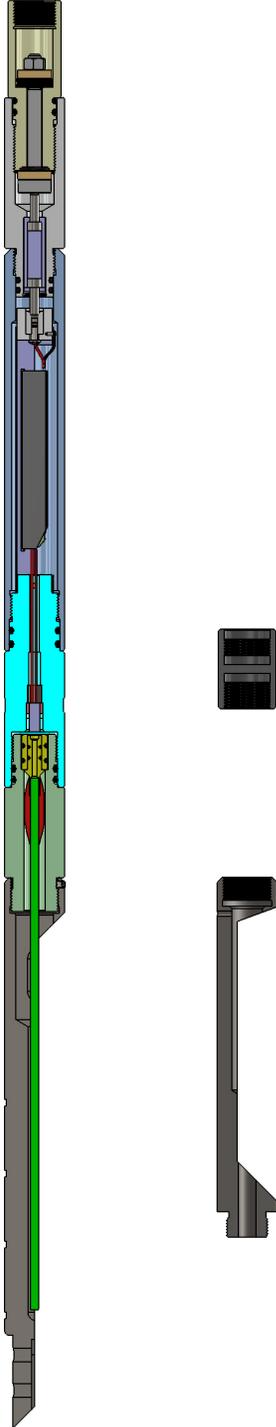
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## INTRODUCTION

The ADP-PX16-242, Safe Fire PX-1 Initiation System utilizes Exploding Bridgewire technology to increase safety during firing operations.

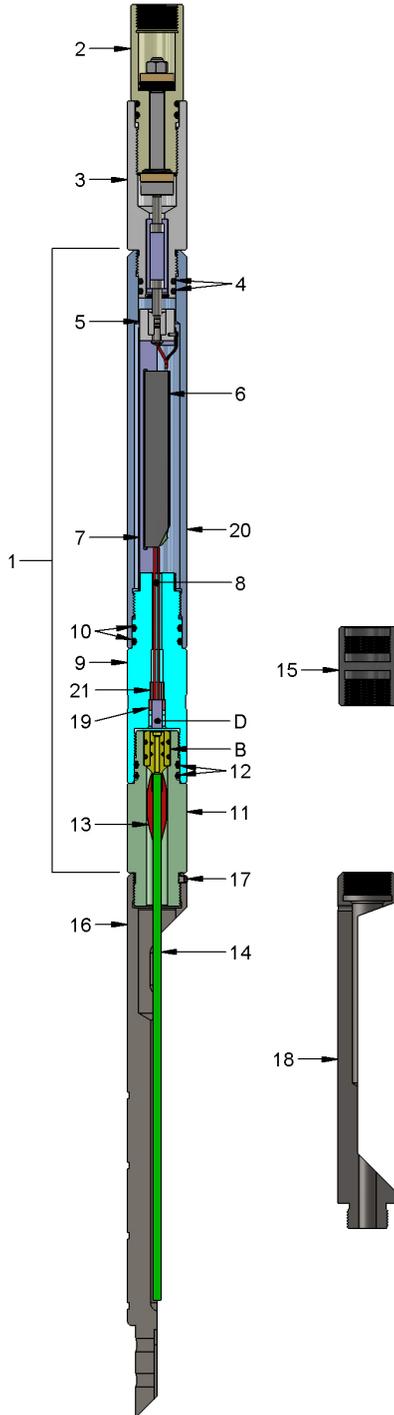
Incorporation of the EBW into the Firing Systems adds increased safety against rig-site hazards such as R-F transmitters, cathodic protection, and stray voltages. The PX-1 EBW fireset allows normal oilfield operation to continue while perforating and other completion services are being performed.

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	12,500 psi	86.2Mpa
THREAD CONNECTION, TOP	1-3/16 - 12 UN	
TOOL DIAMETER	1.69 in	42.9 mm
TEMPERATURE RATING	365 DEG F	185 DEG C
LENGTH	23 in	58.4 cm

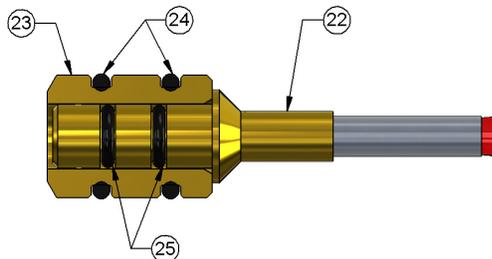


ITEM	PART NO.	DESCRIPTION
1	ADP-PX16-242	Assembly, Exposed Initiation PX-1 Firing System (Includes items: 5-12, 19, 20)
2	AES-AS80005	1-1/2" HP Firing Head (sold separately)
3	ADP-PX16-245	Sub Assembly, Double Contact, 1-11/16" OD
4	OOO-V569-211	O-Ring, Viton #211 - 2 required
5	ADP-PX16-107	Contact Assembly
6	PUR-0610-008	PX-1 Fireset with Wire Outputs
7	SEV-1375-250	Carriage, PX-1 Fireset
8	PUR-0509-040	6-32 x 0.25 Pan Head Screw - 2 required
9	ADP-PX16-119	Detonator Housing
10	OOO-V569-217	O-Ring, Viton #217 - 2 required
11	ADP-PX16-700	Detonator Firing Sub
12	OOO-V569-215	O-Ring, Viton #215- 2 required
13	PUR-6100-006	Temp Tape (sold separately)
	PUR-6100-011	Mocap-Tape (sold separately)
14	Ref Cord Chart	Detonating Cord (sold separately)
15	ADP-PX16-705	Loading Cap, EFI Booster Tool (sold separately)
16	ADP-PX16-284	Firing Head Extension for 1-11/16" Shogun Systems (Sold Separately)
17	PUR-0504-017	Locking Set Screw, #10-32x1/8" Lg. (Sold Separately)
18	ADP-PX16-224C	Firing Head Extension for Stim Gun, Shogun & String Shot (Sold Separately)
19	TC-001-0003-000	Rubber Grommet
20	ADP-PX16-102	TOP Housing
21	ADP-PX16-123	Spacer, 3/8" OD x 0.218" ID x 1/2"
B	EFI-1000-005	EFI Booster Assembly (sold separately)
D	2-300180-3	EBW - CP Detonator (sold separately)
*	ADP-PX16-243	Redress Kit (Includes items: (4-12, 17, 19)
*	TAG-1687-078	BULL Plug/Blast Plug

REF: MANUAL: MAN-PX1-011

### EFI-1000-005 - EFI BOOSTER ASSEMBLY

ITEM	PART NO.	DESCRIPTION
22	EFI-1000-001	EFI Transfer Body Assembly
23	EFI-0100-149	EFI Booster Insert
24	OOO-V569-113	O-Ring, Viton #113
25	OOO-V569-010	O-Ring, Viton #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 Install the Contact Assembly (item #5) to the PX-1 Carriage (item # 7) using the 3 screws of the Carriage.
- 2.2 Unwrap the PX-1 Fireset (item #6) from its protective wrapping.
- 2.3 Loosen one of the center screw on the Contact Assembly enough to attach the PX-1 lead wire, then tighten the screw.



**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.*

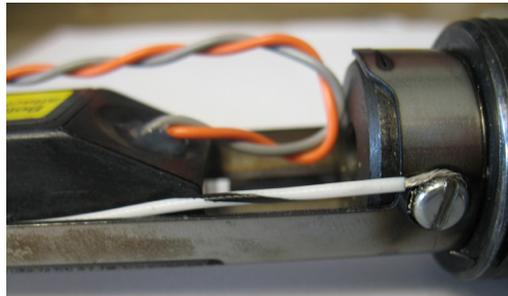
- 2.4 Press the PX-1 into the Carriage slots, (item #7) making sure that the PX-1 is secured in place by the slots (as shown below).



- 2.5 Install the 2 O-rings (item #10) to the Detonator Housing (item #9), and then attach the housing to the PX-1 Carriage (item #7) using the 2 Pan Head Screws (item #8).
- 2.6 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.*



- 2.7 Feed the Detonator (item D) lead wires through the spacer (item #21) and Detonator Housing (item #9) and seat the Detonator inside the borehole on the spacer and secure with the Rubber Grommet (item #19). Using a TAG-1687-078 Bull Plug as a Blast Plug, screw into the end of the Detonator Housing.
- 2.8 Cut the Detonator leads to an appropriate length, then strip ½" of insulation from each lead.
- 2.9 Using an approved digital Blaster's Multimeter, check the resistance of the Detonator. The resistance should read less than one ohm.
- 2.10 Check the output lead wires (orange and grey wires) of the PX-1 using using an approved digital Blaster's Multimeter to make sure that no voltage is present before connecting the Detonator.
- 2.11 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.

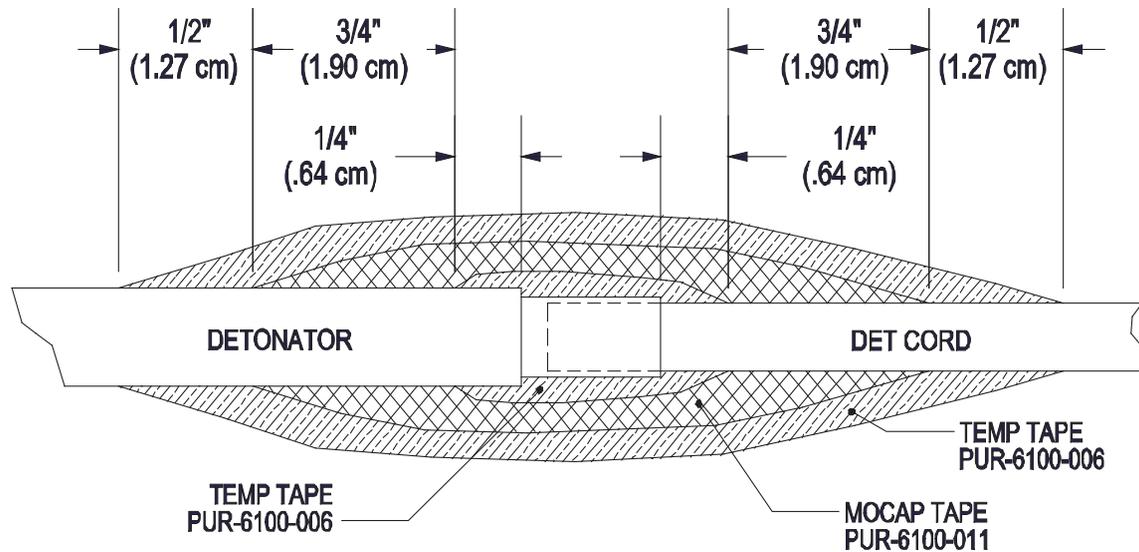


**Note:** *Each detonator lead wire must be connected to a PX-1 output wire; it is not permitted to connect either wire directly to ground. The user may wish to cut and strip the PX-1 wires to length prior to connection so as to avoid extra wire length when proceeding to the next step.*

- 2.12 Insert the PX-1 and Carriage assembly into the Top Housing (#20) and tighten.
- 2.13 Install O-Rings (item #12) onto Detonator Firing Sub, and feed Detonating Cord thru sub before attaching to Exposed Gun System with Firing Head Extension, either (items #16 or #18).
- 2.14 Leave enough Detonating Cord past the end of the Detonator Firing Sub (item #11) to attach and seal the EFI Booster (item #B).
- 2.15 Ensure there is a clean square cut on the Detonating Cord and insert the end into the EFI Booster until stop. Make a double crimp near the outside of the aluminum tube on the Booster Assembly.
- 2.16 Follow the Exposed Detonator Sealing Procedure (attached) to seal the EFI Booster to the Detonating Cord crimp joint. Ensure that the overall diameter of the taped section is less than the ID of the Detonator Firing Sub (item #11).
- 2.17 After the sealing process is completed, grease the o-rings of the EFI Booster and slide into the Detonator Firing Sub until the first o-ring makes contact with the face of the sub.
- 2.18 Use the EFI Loading Cap (item #15) to fully install the Booster into the Firing Sub. Use end #1 to start the installation and screw on the sub until it stops. Unscrew and use the #2 end to seat the Booster in place. Unscrew the Loading Cap and check to see if the Booster is flush with the end of the Sub.
- 2.19 Pull slack out of Detonating cord and secure to exposed gun where necessary to prevent any rubbing, kinking or nicking of the cord.
- 2.20 Seal exposed end of Detonating Cord as described previously with Exposed Detonator Sealing Procedure.
- 2.21 Remove the Blast Plug from the Detonator Housing (item #9) and attach to the Firing Head Extension that was used for your Exposed Gun System.

2.22 The Safe Fire PX-1 (EFI) Initiation Assembly to the Exposed Gun System is now complete.

## Exposed Detonator Sealing Installation instructions



### Instructions:

1. Flush cut end of det cord with Owen Super Cutters.
2. Insert the cut end of the det cord into the opened end of the detonator until the cord stops. While holding detonator firmly, crimp the end with Owen Super Crimpers.
3. Using Temp Tape (PUR-6100-006) wrap over the two joints and past the joint 1/4", with 4 layers of tape.
4. Using 10" of Mocap Tape (PUR-6100-011), wrap over the first layer of tape and 3/4" past with four layers of tape at the joints.
5. Using Temp Tape (PUR-6100-006) cover the Mocap Tape with two smooth layers.
6. This procedure must be followed for all Owen Detonators used in exposed applications. Owen exposed detonators were designed and qualified using the sealing method. All QC tests are performed with the same procedure.

## 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.

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### 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.

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### 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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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**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.

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