ZERO180 Gun System

MAN-Z180-000 (R00)

OWEN OIL TOOLS

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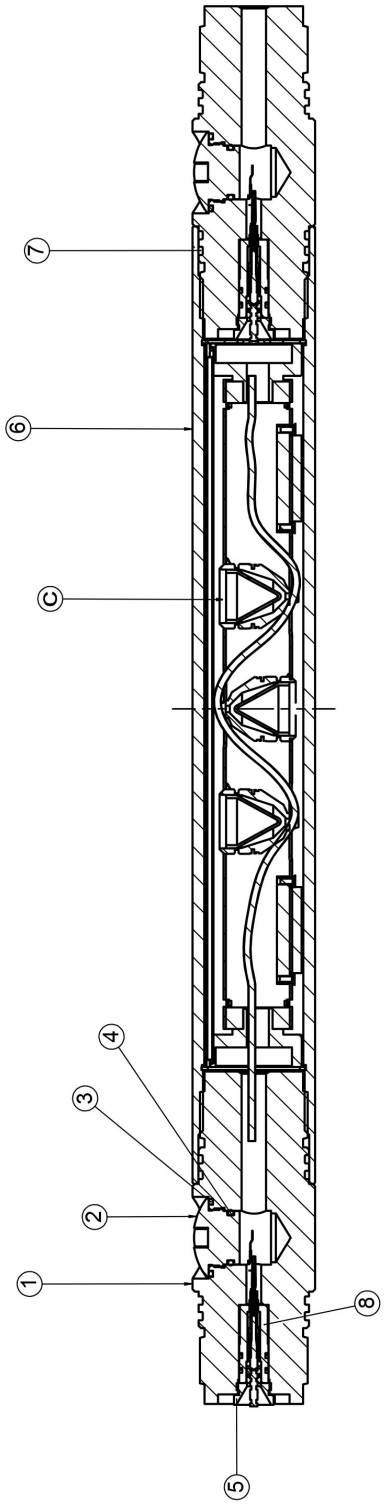
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BOM and Schematic



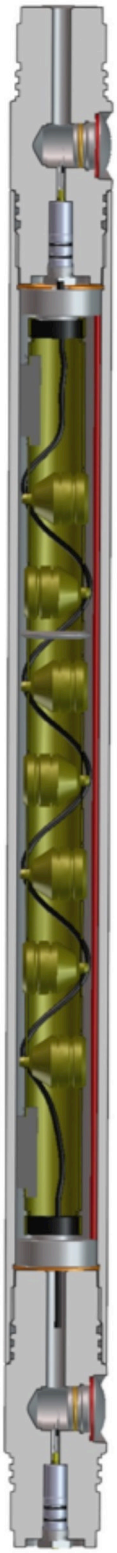
ITEM	PART NO.	DESCRIPTION
1	30-079-0002-10	Gris Switch Sub
3	OOO-N569-224	O-Ring, #224, 90 Duro Nitrile - see ref. section
	OOO-V569-224	O-Ring, #224, 90 Duro Viton - see ref. section
4	OOO-N569-216	O-Ring, #216, 90 Duro Nitrile - see ref. section
	OOO-V569-216	O-Ring, #216, 90 Duro Viton - see ref. section
5	PUR-EBRN-000	Switch Retaining Nut
6	S31-0445-R02WHA	SHIP ASSY, 3-1/8 X 2FT, 4SPF, WIRELINE-HOSS, 0°-180°
	S31-0545-R02WHA	SHIP ASSY, 3-1/8 X 2FT, 5SPF, WIRELINE HOSS, 0°-180°
	S31-0645-R02WHA	SHIP ASSY, 3-1/8 X 2FT, 6SPF, WIRELINE HOSS, 0°-180°
	S31-0445-R03WHA	SHIP ASSY, 3-1/8 X 3FT, 4SPF, WIRELINE HOSS, 0°-180°
	S31-0545-R03WHA	SHIP ASSY, 3-1/8 X 3FT, 5SPF, WIRELINE HOSS, 0°-180°
	S31-0645-R03WHA	SHIP ASSY, 3-1/8 X 3FT, 6SPF, WIRELINE HOSS, 0°-180°
	S31-0445-R04WHA	SHIP ASSY, 3-1/8 X 4FT, 4SPF, WIRELINE HOSS, 0°-180°
	S31-0545-R04WHA	SHIP ASSY, 3-1/8 X 4FT, 5SPF, WIRELINE HOSS, 0°-180°
	S31-0645-R04WHA	SHIP ASSY, 3-1/8 X 4FT, 6SPF, WIRELINE HOSS, 0°-180°
	S31-0445-O02WHA	SHIP ASSY, 3-1/8 X 2FT, 4SPF, WIRELINE HOSS, 0°
	S31-0545-O02WHA	SHIP ASSY, 3-1/8 X 2FT, 5SPF, WIRELINE HOSS, 0°
	S31-0645-O02WHA	SHIP ASSY, 3-1/8 X 2FT, 6SPF, WIRELINE HOSS, 0°
	S31-0445-O03WHA	SHIP ASSY, 3-1/8 X 3FT, 4SPF, WIRELINE HOSS, 0°
	S31-0545-O03WHA	SHIP ASSY, 3-1/8 X 3FT, 5SPF, WIRELINE HOSS, 0°
	S31-0645-O03WHA	SHIP ASSY, 3-1/8 X 3FT, 6SPF, WIRELINE HOSS, 0°
	S31-0445-O04WHA	SHIP ASSY, 3-1/8 X 4FT, 4SPF, WIRELINE HOSS, 0°
	S31-0545-O04WHA	SHIP ASSY, 3-1/8 X 4FT, 5SPF, WIRELINE HOSS, 0°
	S31-0645-O04WHA	SHIP ASSY, 3-1/8 X 4FT, 6SPF, WIRELINE HOSS, 0°
7	OOO-N569-230	O-Ring, #230, 90 Duro Nitrile - see ref. section
	OOO-V569-230	O-Ring, #230, 90 Duro Viton - see ref. section
8	SFS-N	Select Fire Switch Negative
	SFS-P	Select Fire Switch Positive
9	DET-3050-429	Bi-Directional Booster
C	SDP-2715-310	Charge, RDX, SDP-HERO®-HARD ROCK
	SDP-2715-410	Charge, HMX, SDP-HERO®-HARD ROCK
	SDP-2750-311NT4	Charge, RDX, SDP-NT4 - HERO®
	SDP-2750-411NT4	Charge, HMX, SDP-NT4 - HERO®
	TAG-2750-401BH	Charge, HMX, BH
	TAG-2750-311	Charge, RDX, GH/DP
	TAG-2750-411	Charge, HMX, GH/DP

SPECIFICATIONS		
PRESSURE RATING	144.8 Mpa	21,000 psi
TEMPERATURE	UP to 260°C	UP to 500°F
TENSILE STENGTH	89,000 daN	200,000 lbf
CARRIER THREAD	2-3/4" - 6 STUB ACME	
TORSIONAL YIELD	4,475 N*m	3,300 lb-ft

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BOM and Schematic – WL Version:



PART NUMBER	OD	SHOT DENSITY	PHASING	LENGTH	# SHOTS
S31-0445-O02WHA	3 1/8	4	0	2	3
S31-0445-O03WHA	3 1/8	4	0	3	7
S31-0445-O04WHA	3 1/8	4	0	4	11
S31-0445-R02WHA	3 1/8	4	180	2	3
S31-0445-R03WHA	3 1/8	4	180	3	7
S31-0445-R04WHA	3 1/8	4	180	4	11
S31-0545-O02WHA	3 1/8	5	0	2	3
S31-0545-O03WHA	3 1/8	5	0	3	8
S31-0545-O04WHA	3 1/8	5	0	4	13
S31-0545-R02WHA	3 1/8	5	180	2	3
S31-0545-R03WHA	3 1/8	5	180	3	8
S31-0545-R04WHA	3 1/8	5	180	4	13
S31-0645-O02WHA	3 1/8	6	0	2	4
S31-0645-O03WHA	3 1/8	6	0	3	10
S31-0645-O04WHA	3 1/8	6	0	4	16
S31-0645-R02WHA	3 1/8	6	180	2	4
S31-0645-R03WHA	3 1/8	6	180	3	10
S31-0645-R04WHA	3 1/8	6	180	4	16

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BOM and Schematic – TCP Version:



PART NUMBER	OD	SHOT DENSITY	PHASING	LENGTH	# SHOTS
S31-0445-O02THA	3 1/8	4	0	2	3
S31-0445-O03THA	3 1/8	4	0	3	7
S31-0445-O04THA	3 1/8	4	0	4	11
S31-0445-R02THA	3 1/8	4	180	2	3
S31-0445-R03THA	3 1/8	4	180	3	7
S31-0445-R04THA	3 1/8	4	180	4	11
S31-0545-O02THA	3 1/8	5	0	2	3
S31-0545-O03THA	3 1/8	5	0	3	8
S31-0545-O04THA	3 1/8	5	0	4	13
S31-0545-R02THA	3 1/8	5	180	2	3
S31-0545-R03THA	3 1/8	5	180	3	8
S31-0545-R04THA	3 1/8	5	180	4	13
S31-0645-O02THA	3 1/8	6	0	2	4
S31-0645-O03THA	3 1/8	6	0	3	10
S31-0645-O04THA	3 1/8	6	0	4	16
S31-0645-R02THA	3 1/8	6	180	2	4
S31-0645-R03THA	3 1/8	6	180	3	10
S31-0645-R04THA	3 1/8	6	180	4	16

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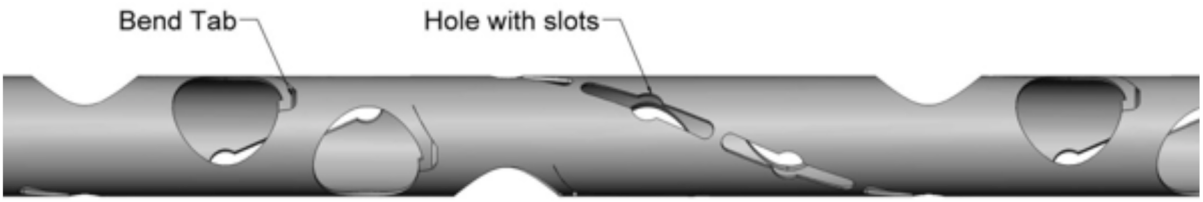
Warning: ***Shot gun systems may trap pressure which can be hazardous to personnel. If the gun components trap pressure, maintain a safe distance from the carrier and slowly remove the gun sub until the o-rings are exposed and the pressure safely vents.***

1.0 ZERO180 Gun System Overview

Owen Oil Tools offers a wide variety of Threaded Gun systems; varying in OD size, length of carrier, the number of shots per foot (SPF), phasing of charges, charge type, and explosive materials. The ZERO180® Gun system is unique and patent protected.

The procedures in this manual are strictly a suggested method for loading and arming the ZERO180® Gun system with explosive components. It is understood that each customer or company may have their own rules, procedures, or recommended method of loading perforating guns. Owen Oil Tools does not want to contradict these procedures in any way or form. We strongly suggest that our customers observe and abide by all the rules and regulations pertaining to the handling, storage and transportation of explosive components.

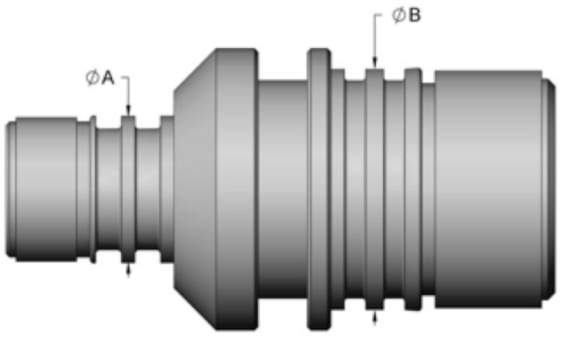
With this system the shaped charge seats all the way through the tube strip after the detonating cord has already been installed. Each charge is held in place by a bend tab (no Det Cord Clip required). This system features a round hole with slots in the tube strip.



Using Threaded Gun Subs

There are many types of subs that can be used with Owen Threaded Gun Systems. Often these subs can be used several times without problems. However, over time, these subs can and will swell. Because of this, Owen recommends using the graphic and chart below to reference maximum sub.

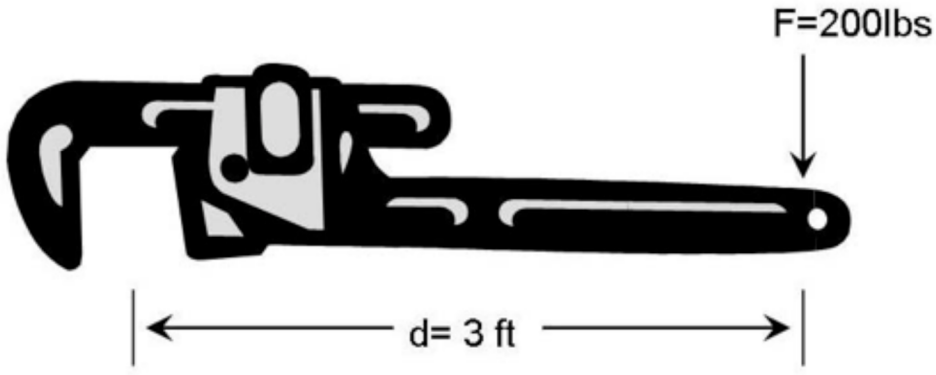
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GUN OD	MAX. DIAMETER (IN.)		MAX. DIAMETER (MM.)	
(IN.)	(A)	(B)	(A)	(B)
3.125	2.812	2.816	71.42	71.53

The gun subs used with the Owen Threaded Gun Systems are designed for a range of applications including high pressure and temperature as well as high bending and tensile loads. For high pressure and temperature applications o-ring backups may be required (refer to Technical Information, O-Ring Specifications for details). It is recommended that each gun sub be tightened to the carrier and torqued with the appropriate equipment. Refer to recommended torque values below.

RECOMMENDED MAKE UP TORQUE						
GUN SYSTEM	MINIMUM		MAXIMUM		YIELD TORQUE	
	FT-LBF	N-M	FT-LBF	N-M	FT-LBF	N-M
3.125	600	814	1650	2239	3300	4478



Example:
T = FXd = 200 lbs.X 3 ft. = 600 lb. ft.
F = Applied Force (lb.)
d = length of the pipe wrench (ft.)

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2.0 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: ***Always 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 loading, visually inspect the carrier and components for any defects and make sure that all threads and seal bores are clean.*

Once you have obtained all the necessary hardware and explosives for your particular job application, there are a few steps that will assist you in a successful operation.

2.1 Place the gun on a loading table or workbench and remove the shipping caps from each end. The gun is identical on each end. Designate one end as top of gun and the other as bottom.

2.2 Remove the snap ring from the designated bottom of gun. With a wooden broom handle, push the tube assembly with endplates out the bottom end of the gun and place it on the loading table or workbench. On the tube strip, designate one end as the top of the tube and the other as bottom. *It is important to push the tube because the endplates are not secured to the tube strip and may separate if pulled.*

2.3 Look down the inside of the empty gun body from the bottom end of the gun. Rotate the empty gun body so that the gap between the ears of the snap ring (on the top end of gun) is in the 9 o'clock position. On the bottom end of gun, mark the outside of the gun body with a line at the 12 o'clock position.

2.4 Remove the thru wire holder from the endplates and set aside *(WL Version only)*.

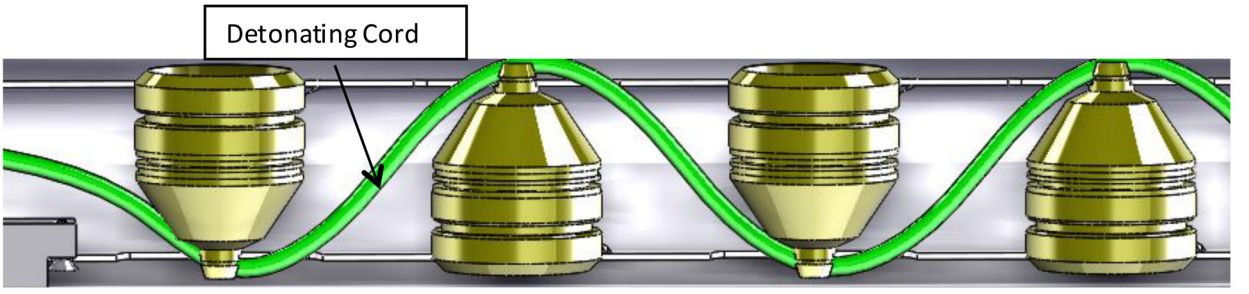
2.5 It may also be important to mark the outside of the carriers to correspond with the zones to be perforated. Start with the bottom shot and measure upward. Don't forget to take into account the lengths of any subs which will be used to connect the carriers together. Mark these zones clearly and label accordingly on the gun body and the tube strip.

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3.0 Loading WL Version

The detonating cord on this style, is placed on the inside of the tube strip and spirals around, connecting the charges forming the explosive sequence. Do not to remove the endplates at this time.

Note: *With the internal wrap style tube strip, the det cord is held in place by the charge and tube strip (no Det Cord Clips are required).*



3.1 Using Owen Super Cutters, cut a sufficient length of det cord that will completely load your tube strip and that will allow for det cord initiation. One method of doing this, is to lay the det cord on the tube strip following the charge holes. Take that length and add 3 - 4 ft (0.9 -1.2m). It is always better to have too much, than not enough.

Note: *To determine the next length of det cord to be cut, measure the first cut length before loading, then measure the scrap length when finished. Subtract the scrap length from the original cut length to determine the length of the next piece of det cord.*

Warning: ***Never load a tube strip when the det cord is still attached to the roll! Cut the necessary length of cord, the remove the roll from the loading area!***

3.2 Insert the det cord through end plate and tube strip on the designated bottom of the tube strip.

3.3 Allow the det cord to exit the tube strip at the first charge. Make a 6” long loop at the det cord and secure this configuration with electrical tape. Insert the det cord back into the tube strip and push it along the center of the tube until it contacts the endplate at the top of the tube strip. *The excess det cord in the loop insures the switch receives a sufficient pressure pulse to set properly and aids in the installation of det cord in the tube.*

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3.4 To load the charges, start at the top of the tube strip and insert a charge through the large hole until the det cord grooves of the charge sticks out through the small hole (you may need to rotate the charge so that the det cord groove aligns with the path of the det cord). Secure in place by using the bend tab on the tube strip. The charge should not be able to move side to side. Continue to load the required charges to complete the tube strip.

3.5 Make a clean, squared-off cut of the det cord 4.0 in. (10 cm) from the recessed face of the end plate to install an end seal. *Cut 3.25 in. (8.25 cm) if using a bi-directional booster as originally designed.*

3.6 Visually inspect the cut, then install the proper end seal or booster over the end of the det cord and crimp in place by using Owen Super Crimpers.

3.7 Using a pair of wire cutters, cut a sufficient length of 22 gauge, 19 strand, Teflon insulated wire that will completely pass through the thru wire holder and allow for electrical connection through the gun. One method of doing this, is to add 3 - 4 ft. (0.9 -1.2 m) to the length of the thru wire holder. It is always better to have too much, than not enough.

3.8 Pass the insulated wire through the thru wire holder and strip the insulation back from each end approximately 2”.

3.9 Install the thru wire holder back on the endplates in the appropriate slot. Loop approximately 12” of the insulated wire back into the hole in the top end plate.



Note: *The carrier to be loaded must be on sturdy supports and be at an elevation of such to make inserting the loaded tube strip easy and safe.*

3.10 The empty gun body should be positioned with the visible mark on the gun body at 12 o’clock (The gap between the ears of the endplate will be at 9 0’clock when looking from the bottom of gun).

3.11 Lift the loaded tube strip from the loading bench and carry it to the accompanying carrier. Use as many people as necessary to safely handle the tube strip. Position then tube strip with the thru wire holder on top or at 12 o’clock.



Note: *It is important for the ZERO180® system to have the ability to move freely within the carrier. Do not tie down charge tube or other components restricting motion of the system. The system must be able to move freely within the carrier.*

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Warning: ***A loaded tube strip can be very heavy, especially the larger diameter tube strips, and must be handled accordingly to prevent personal injury, dropping or bending the tube strip!***

3.12 With the thru wire holder positioned at 12 o'clock, slowly slide the loaded tube strip into the carrier. Be careful not to cause any damage to the components of the loaded tube strip.



Note: *When inserting the tube strip; the roll pin on the top end plate should fit in the gap between the ears of the snap ring. Verify the roll pin position between the gap before proceeding.*



Warning: ***If any difficulty is encountered while inserting the tube strip, STOP and check for the cause of the difficulty! If necessary, pull the tube strip back out of the carrier and determine the problem! Never beat or force a loaded tube strip into a carrier!***

3.13 With the End Plate against the Snap Ring at the top of gun, install the bottom Snap Ring with the roll pin positioned in the gap between the ears. Be careful not to pinch the det cord or the thru wire with the snap ring. The loaded tube strip is now secured in the gun body.



Note: *You may wish to check the continuity of the thru wire for an open or a short to the gun body at this time.*

3.14 Install the proper top sub (if top gun) or select-fire tandem sub at top of gun.

For top gun: Place the size 230 O-rings on the sub. Pass the thru wire through the top sub. Apply grease to threads and O-rings of the sub, and thread it into carrier and tighten. Attach thru wire to appropriate electrical contact (spring boot assembly or contact block), insulate the connection, and secure to top sub while pulling out the slack in thru wire from bottom of gun.

Other than top gun: The select-fire tandem complete with pressure switch or dual diode should already be installed in the bottom of the previously assembled gun. Slide a short piece of silicon tubing (insulation for pin on switch) and retainer nut onto the thru wire. Make a mechanical and electrical connection from the thru wire to the pin of switch, insulate it with tubing, and install retainer nut to secure switch in tandem. Apply grease to threads and O-rings of the sub and thread it into the assembled gun onto the tandem while pulling out the slack in thru wire from bottom of gun.

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3.15 The next step is to install select-fire tandem sub at bottom of gun. *This system requires a select fire tandem at the bottom of each gun.* Place the size 230 o-rings on the sub. Pass the thru wire through the tandem. Insert the tip of the end seal or booster into the 9/16" ID hole in the tandem sub.



Warning: ***If any difficulty is encountered while inserting the tandem sub, STOP and check for the cause of the difficulty! If necessary, remove the tandem sub from the gun body and determine the problem! Never beat or force the tandem sub into the loaded tube strip into a carrier!***

Apply grease to threads and o-rings of the sub and thread it into carrier. Before the second o-ring engages during assembly, verify the end seal or booster has moved along the 9/16" ID by feeling for it with a finger through the port. Once verified, finish threading the tandem and tighten the sub while pulling out the slack in thru wire from bottom of sub.

3.16 Rotate the gun string assembly on the workbench where the port in the tandem sub is visible. From inside the port, grab the thru wire and pull it back thru the port.

3.17 Attach a ground wire to the tandem sub in the bottom of the port. Cut a minimum of 12" piece of 22 gauge buss wire (bare, non-insulated wire).

O-ring method: Coil 6" of the bare wire around the cross section of a size 216 o-ring leaving approximately 6" of bare wire for making a ground connection to detonator while arming.

Snap ring method: Coil 6" of the bare wire around the cross section of a size 0125 internal snap ring leaving approximately 6" of bare wire for making a ground connection to detonator while arming.

3.18 Insert the o-ring or snap ring into the bottom of the port and allow the free end of the wire to exit the port.

3.19 Choose the appropriate polarity pressure switch or dual diode and pass the wires into the sub and out the port. Apply minimal grease to the o-rings of switch/diode and seat it in in place with care not to push on switch pin or not to pinch wires.

3.20 Electrically connect and insulate the thru wire of the gun to the input wire of the switch/diode (yellow for switch and white for diode). *Keep the wires as short as possible to allow room for*

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all connections in port and prevent knicked or cut wires. Carefully tuck the new connection into the bottom of the port. Also, carefully tuck the other wire from the switch/diode and the bare wire into the port to prevent damage to either wire.

Note: *You may wish to check the continuity of the thru wire and electrical connections for an open or a short to the gun body at this time from the top sub to the pin of the switch/diode.*

Repeat steps 3.1 – 3.13 for loading each gun and steps 3.14 – 3.20 for assembling the gun string. On the bottom gun place either a plug and shoot sub or blank gun and bull plug as appropriate.

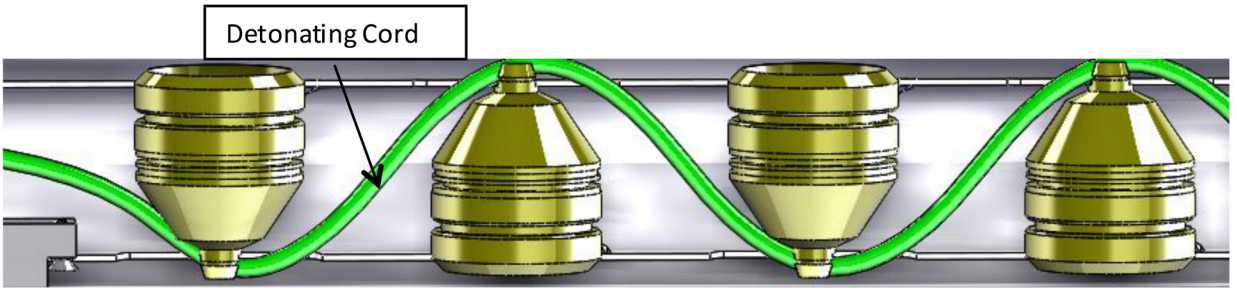
3.21 Install the appropriate port plugs into each select-fire tandem taking care not to knick or cut the wire during insertion.

3.22 Perform any additional necessary actions to prepare gun(s) for storage or transportation.

4.0 Loading TCP Version

The detonating cord on this style, is placed on the inside of the tube strip and spirals around, connecting the charges forming the explosive sequence. Do not to remove the endplates at this time.

Note: *With the internal wrap style tube strip, the det cord is held in place by the charge and tube strip (no Det Cord Clips are required).*



4.1 Using Owen Super Cutters, cut a sufficient length of det cord that will completely load your tube strip and that will allow for det cord initiation. One method of doing this, is to lay the det cord on the tube strip following the charge holes. Take that length and add 3 - 4 ft (0.9 -1.2m). It is always better to have too much, than not enough.

Note: *To determine the next length of det cord to be cut, measure the first cut length before loading, then measure the scrap length when finished. Subtract the scrap length from the original cut length to determine the length of the next piece of det cord.*

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Warning: ***Never load a tube strip when the det cord is still attached to the roll! Cut the necessary length of cord, the remove the roll from the loading area!***

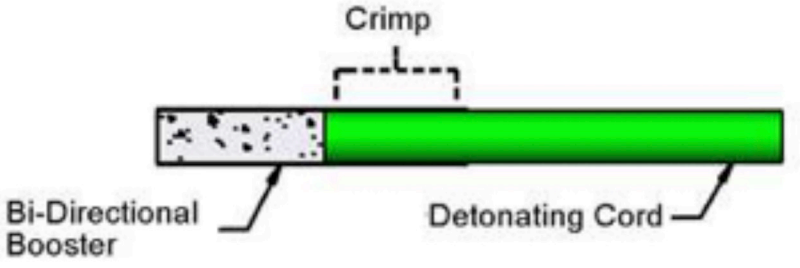
4.2 Place the det cord through the tube strip and both end plates.

Note: *To help run the cord through the tube strip, use a non-sparking Fish Tape or Fish Tape Leader (used by electricians and plumbers). Insert the fish tape through tube strip and attach det cord to its end using electrical tape. Withdraw the fish tape, pulling det cord through tube strip. Be careful not to scrape the outer covering of the cord as the fish tape is retracted.*

4.3 Install the crimp tube support (provided in the booster transfer kit) over the end of the det cord on designated bottom end of gun with the flared end of the crimp tube support near the end of cord.

4.4 Make a clean, squared-off cut on the bottom end of the det cord by using Owen Super Cutters.

4.5 Visually inspect the cut, then install the proper Bi-directional Booster over the end of the det cord and crimp in place by using Owen Super Crimpers. *The crimp support tube will not be crimped to the cord at this time.*



4.6 Slide the short booster retainer tube over the booster and det cord and thread the short booster retainer tube into the end plate making sure that the booster stays against the internal stop of the short booster retainer tube. Also make sure crimp support tube is pushed into the endplate and protrudes out the opposite side of endplate. Tighten firmly by hand. *No rubber grommets will be used in this system.*

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4.7 Remove the endplate with booster and booster tube from the tube strip. Crimp the crimp support tube to the det cord while pulling slight tension on the crimp support tube using Owen Super Crimpers.

4.8 Re-install the endplate into the tube strip without pressing on the booster or booster tube.

4.9 To load the charges, start at the bottom of the tube strip and insert a charge through the large hole until the det cord grooves of the charge sticks out through the small hole (you may need to rotate the charge so that the det cord groove aligns with the path of the det cord). Secure in place by using the bend tab on the tube strip. The charge should not be able to move side to side. Continue to load the required charges to complete the tube strip. *Insert only the number of charges that you need loaded. The tube strip can be fully or partially loaded.*

4.10 Install the scale or ruler onto the Owen Super Cutters. Holding slight tension on the cord, make a clean, squared-off cut of the det cord 7.5 in. (19.05 cm) from the face of the top end plate.

4.11 Visually inspect the cut, then install the proper Bi-directional Booster over the end of the det cord and crimp in place by using Owen Super Crimpers.

4.12 Slide the long booster support tube over the booster and det cord and thread into end plate. As you thread in the tube, the booster should be positioned flush with the end of the booster tube. Tighten firmly by hand. *No rubber grommets will be used in this system.*



Note: *The carrier to be loaded must be on sturdy supports and be at an elevation of such to make inserting the loaded tube strip easy and safe.*

4.13 Lift the loaded tube strip from the loading bench and carry it to the accompanying carrier. Use as many people as necessary to safely handle the tube strip.



Note: *It is important for the ZERO180® system to have the ability to move freely within the carrier. Do not tie down charge tube or other components restricting motion of the system. The system must be able to move freely within the carrier.*

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Warning: ***A loaded tube strip can be very heavy, especially the larger diameter tube strips, and must be handled accordingly to prevent personal injury, dropping or bending the tube strip!***

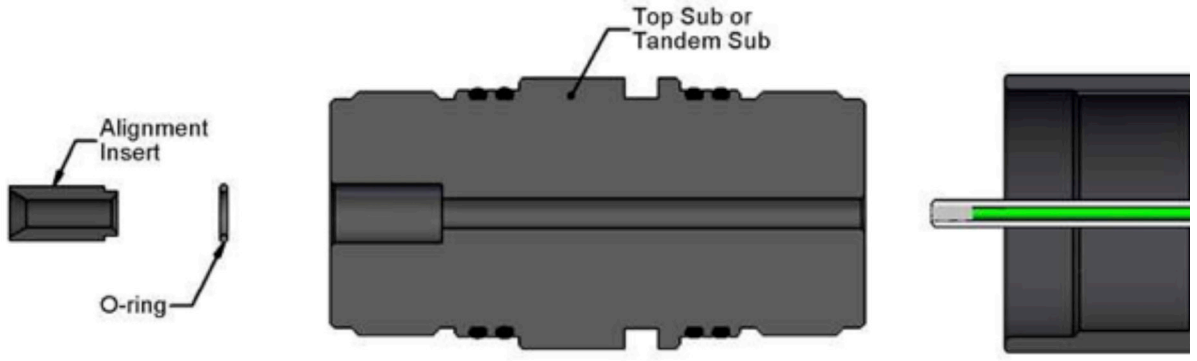
Caution: ***Do not damage or break the Booster Transfer Tube (if applicable), during insertion! Do not pinch the det cord or Booster during insertion!***

4.14 Slowly slide the loaded tube strip into the carrier. Be careful not to cause any damage to the components of the loaded tube strip.

Warning: ***If any difficulty is encountered while inserting the tube strip, STOP and check for the cause of the difficulty! If necessary, pull the tube strip back out of the carrier and determine the problem! Never beat or force a loaded tube strip into a carrier!***

4.15 With the End Plate against the Snap Ring at the top of gun, install the bottom Snap Ring. The loaded tube strip is now secured in the gun body.

4.16 Install the proper top sub or tandem sub at top of gun. Place the size 230 O-rings on the sub. Apply grease to threads and O-rings of the sub, and thread it into carrier and tighten.



4.17 Install an alignment insert and o-ring (provided in the booster transfer kit) into the sub.

Repeat steps 4.1 – 4.17 for loading and assembling each gun.

4.18 Perform any additional necessary actions to prepare gun(s) for storage or transportation.

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5.0 Arming WL Version

The ZERO180® gun system should be armed according to each company's standard operating procedures. While the guns themselves are unique, the assembly method and connections external to the guns or gun string are not. The ballistic connection of the detonator to det cord is unique and will be covered in this section.



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



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!***

The following steps as a minimum should be completed prior to commencing the arming procedures:

- **Hazard Identification and Resolution**
- **Safety Meeting**
- **Stray Voltage Check**
- **Installation of grounding cables**
- **Check Fire through logging equipment (not perforating equipment)**
- **Power down all power sources and rf devices**
- **Remove safety key from inside of WL operating unit**
- **Attach perforating equipment to the WL cable**
- **Verify no voltage exists at the electrical connections of the gun**



Warning: ***Detonators should be removed from their packaging and storage in the loading/arming area at the time of arming! Always insert the detonator inside a safety tube after removal from packaging and storage!***

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Caution: ***It is recommended to handle one detonator at a time to minimize the hazards; furthermore, arm each gun individually from the top of the gun string working towards the bottom to reduce exposure and risk.***

5.1 Remove an Austin Powder A-140F detonator from its storage container and packaging. Discard the plastic detonator block; it is not required for this system.

5.2 Place a pencil at the wire end of the detonator. Bend the detonator lead wires around the pencil back to the body of the detonator taking care not to pull on the wires. Secure the wires to the body of the detonator with 2 – 3 wraps of electrical tape around the wires and detonator. *Do not cover the fluid holes of the detonator. Bend the wires back in their original direction. This step will prevent you from pulling the lead wires directly on the end of the detonator.*

5.3 Insert the detonator into a detonator safety tube and secure the lid closed.

5.4 Remove the electrical shunt from the wires and verify the resistance of the meter with a blaster's multimeter or blaster's galvanometer. The resistance of the detonator should read between 50 and 60 Ohms.

5.5 Through the port, electrically connect the ground wire of the gun to the purple wire of the detonator. Since this is the ground no insulation of the connection is necessary. *Keep the wires as short as possible to allow room for all connections in port and prevent knicked or cut wires.*

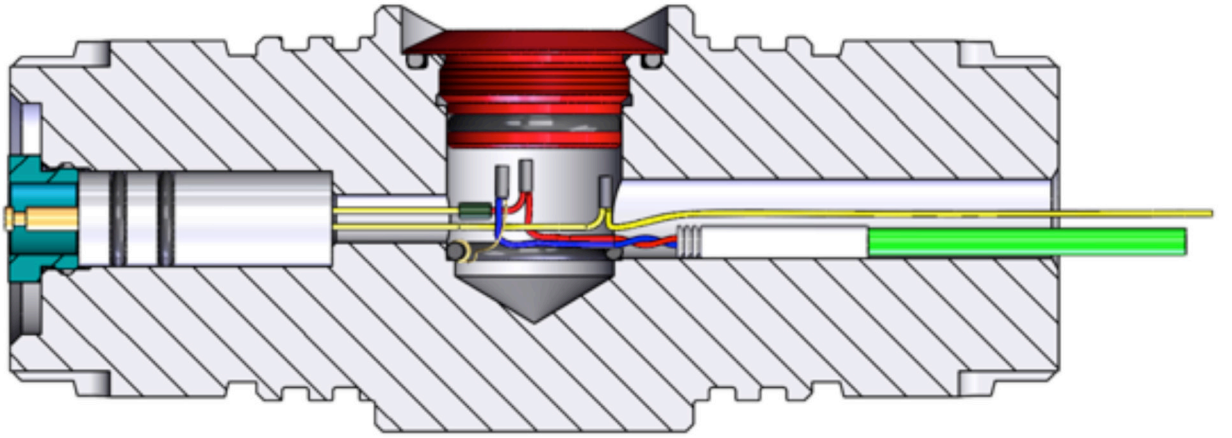
5.6 Also through the port, electrically connect and insulate the wire from the switch/diode to the red wire of the detonator. *Keep the wires as short as possible to allow room for all connections in port and prevent knicked or cut wires.*

5.7 The detonator is fully connected electrically. Remove the detonator from the detonator safety tube. Insert the detonator, output end first, through the port and into the 9/16" hole in the sub. (It is important to use sub 30-079-0002-95 as it has the correct confinement for lap splice initiation.) The detonator is positioned next to the det cord and is now ballistically armed.

5.8 Carefully tuck the new connections into the bottom of the port.

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5.9 Install a size -224 o-ring on the port hole and a size -216 o-ring on the port plug if not completed prior. Apply a minimal amount of grease to threads and o-rings. Thread the port plug into the tandem taking care not to knick or cut the wires and tighten.



Repeat steps 5.1 – 5.9 to arm each gun.

5.10 Perform any additional necessary actions to prepare gun string for conveyance in well.

6.0 Arming TCP Version

The ZERO180® gun system should be armed according to each company's standard operating procedures, gun assembly and firing head. While the guns themselves are unique, the assembly method and connections external to the guns or gun string including the firing heads are not.

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