



Ball Activated Differential Safety Firing Assembly - LP/HP

TC-022-2375-000
TC-022-2375-200

MAN-TC-022 (R04)

Owen Oil Tools LP

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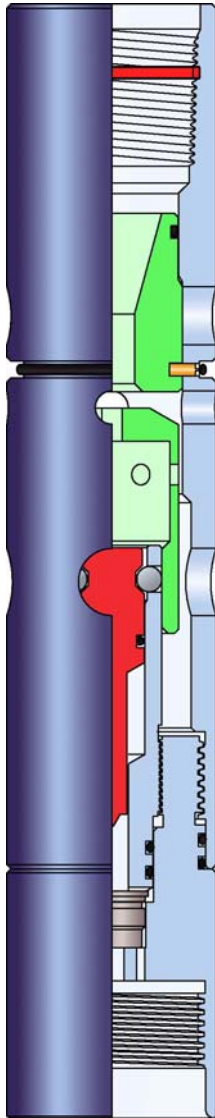
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Differential Safety Firing Assembly



Description

This Differential Safety Firing Head was designed to be used in overbalanced tubing conveyed perforating in highly deviated wells, wells with open perforations, when achieving an absolute pressure is not possible, in a situation where it is desirable to allow the tubular to fill itself, or while tripping in the well. This Firing Head has a set of ports to allow circulation of well fluids prior to activation. A drop ball is introduced into the work string, which conveyed the firing head down hole. The ball can be allowed to free fall or be pumped down to the differential piston. The piston is pinned to a predetermined differential pressure and, once the ball is seated, that pressure is applied against the piston and seated ball. When the piston is sheared free, it will strike the Hydro-Safety Impact assembly releasing the firing pin. This action will allow the well's hydrostatic pressure to drive the released firing pin into the detonator. Once the firing head assembly is activated a set of ports are exposed, allowing circulation of well fluids after detonation. The pressure piston can be differentially pinned up to 4,600 psi @72

Features and Benefits

- Overbalanced Tubing Conveyed Perforating in highly deviated wells with open perforations.
- When achieving an absolute pressure is not possible.
- In a situation where it is desirable to allow the tubing to fill itself while tripping in the well.

Specifications

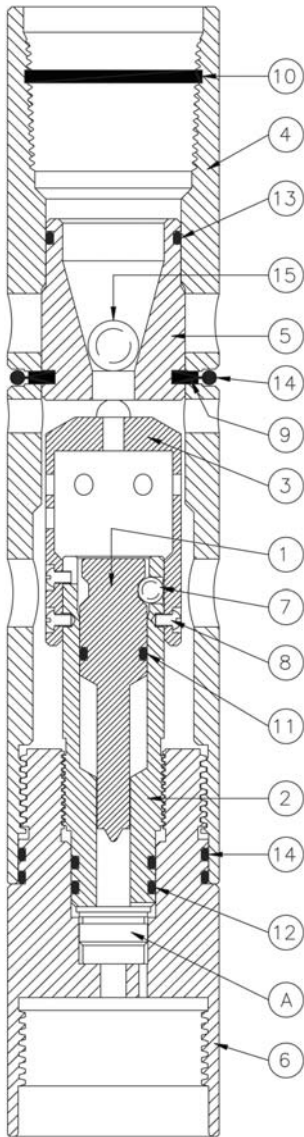
	TC-022-2375-000	TC-022-2375-200
Top Thread	2-3/8 EUE Box	
O.D.	3-1/8" (79.4 mm)	
Overall Length	16-3/4" (42.55 cm)	
Max. Temperature ¹	250°F (121°C)	
Min. Operating Hydrostatic	300 psi (2.0 MPa)	2,000 psi (13.8 MPa)
Max. Operating Hydrostatic	8,000 psi (55.4 MPa)	20,000 psi (137.9 MPa)

¹The maximum temperature can be increased to 450°F (230°C) by substituting the 90 durometer Nitrile O-rings with 90 durometer Viton O-rings. Refer to the Time vs Temperature chart for Explosives to confirm any explosives requirements.

Ball Activated Differential Safety Firing Assembly - LP/HP



TC-022-2375-000 (LP) BOM and Schematic

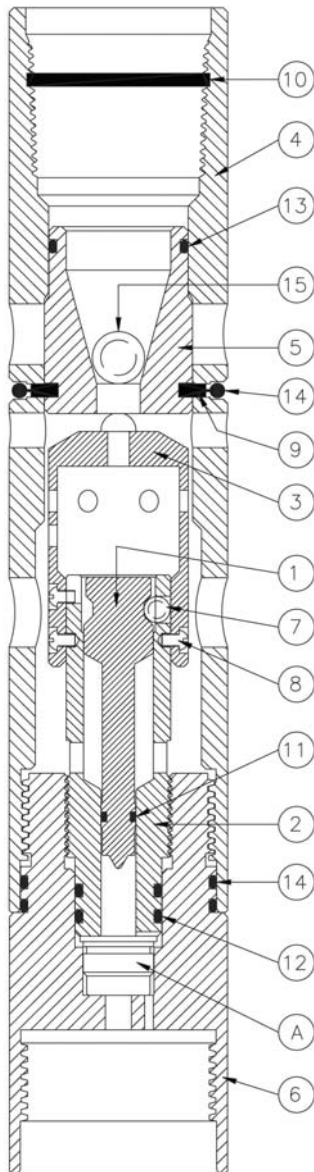


Item	Part Number	Qty.	Description
-	TC-022-2375-000	-	Differential Safety Firing Head, Ball Activated (LP)
1	TC-022-0000-000	1	Firing Pin, HSI (Low Pressure)
2	TC-022-0001-000	1	Body, Firing Pin (LP)
3	TC-022-0002-000	1	Retainer Cap HSI
4	TC-022-0003-000	1	Body, BADSFA
5	TC-022-0005-000	1	Piston, BADSFA
6	TC-005-0002-000	1	Detonator Body
7	ST-040-0375-000	3	Retaining Ball
8	PF-030-019F-025B	3	Shear Screws, Brass
9	SF-010-0189-045	12	Shear Pins, (Owen)
10	MI-305-2375-000	1	API Seal Ring
11	OOO-N569-210	1	O-Ring, N-90 (Low Pressure)
12	OOO-N569-214	2	O-Ring, N-90
13	OOO-N569-224	1	O-Ring, N-90
14	OOO-N569-230	3	O-Ring, N-90
15	ST-040-0750-000	1	Steel Ball, 3/4" dia.
A	Reference	1	Percussion Detonator
--	TC-022-2375-099	--	Redress Kit (Low Pressure)
	MAN-TC-022		Assembly Manual for low and high pressure
Item	Part Number	Qty.	Description
--	TC-022-2375-099	--	Redress Kit (Low Pressure)
7	ST-040-0375-000	3	Retaining Ball
8	PF-030-019F-025B	3	Shear Screws, Brass
9	SF-010-0189-045	12	Shear Pins, (Owen)
10	MI-305-2375-000	1	API Seal Ring
11	OOO-N569-210	1	O-Ring, N-90 (Low Pressure)
12	OOO-N569-214	2	O-Ring, N-90
13	OOO-N569-224	1	O-Ring, N-90
14	OOO-N569-230	3	O-Ring, N-90
15	ST-040-0750-000	1	Steel Ball, 3/4" dia.
--	ST-045-0875-000	1	Fract Ball
--	ST-040-1000-000	1	Steel Ball

Ball Activated Differential Safety Firing Assembly - LP/HP

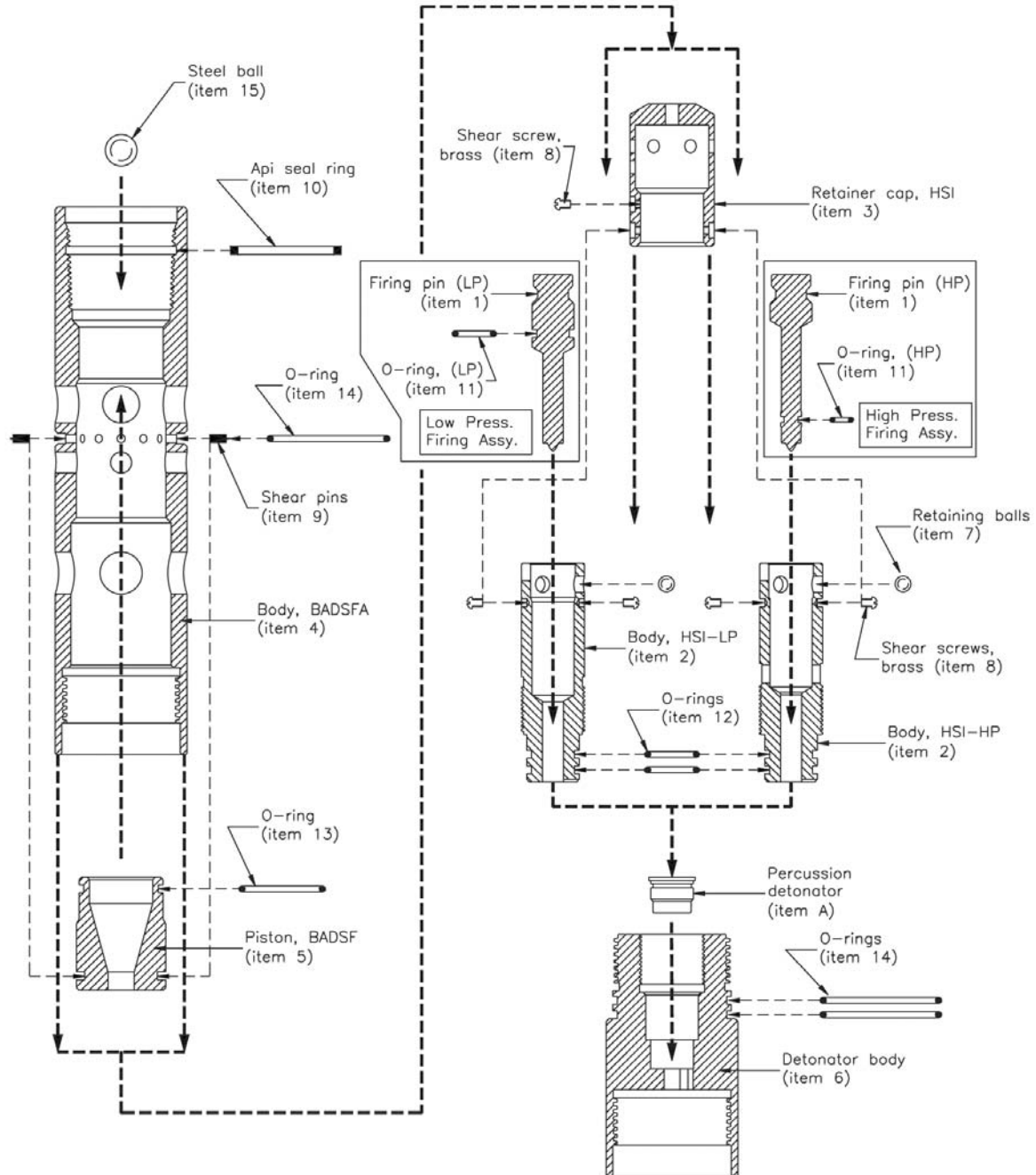


TC-022-2375-200 (HP) BOM and Schematic



Item	Part Number	Qty.	Description
-	TC-022-2375-200	-	Differential Safety Firing Head, Ball Activated (HP)
1	TC-022-0000-200	1	Firing Pin, HSI (High Pressure)
2	TC-022-0002-200	1	Body, Firing Pin (HP)
3	TC-022-0002-000	1	Retainer Cap HSI
4	TC-022-0003-000	1	Body, BADSFA
5	TC-022-0005-000	1	Piston, BADSFA
6	TC-005-0002-000	1	Detonator Body
7	ST-040-0375-000	3	Retaining Ball
8	PF-030-019F-025B	3	Shear Screws, Brass
9	SF-010-0189-045	12	Shear Pins, (Owen)
10	MI-305-2375-000	1	API Seal Ring
11	OOO-N569-109	1	O-Ring, N-90 (High Pressure)
12	OOO-N569-214	2	O-Ring, N-90
13	OOO-N569-224	1	O-Ring, N-90
14	OOO-N569-230	3	O-Ring, N-90
15	ST-040-0750-000	1	Steel Ball, 3/4" dia.
A	Reference	1	Percussion Detonator
--	TC-022-2375-299	--	Redress Kit (High Pressure)
	MAN-TC-022		Assembly Manual for Low and High Pressure
Item	Part Number	Qty.	Description
--	TC-022-2375-299	--	Redress Kit (High Pressure)
7	ST-040-0375-000	3	Retaining Ball
8	PF-030-019F-025B	3	Shear Screws, Brass
9	SF-010-0189-045	12	Shear Pins, (Owen)
10	MI-305-2375-000	1	API Seal Ring
11	OOO-N569-109	1	O-Ring, N-90 (High Pressure)
12	OOO-N569-214	2	O-Ring, N-90
13	OOO-N569-224	1	O-Ring, N-90
14	OOO-N569-230	3	O-Ring, N-90
15	ST-040-0750-000	1	Steel Ball, 3/4" dia.
--	ST-045-0875-000	1	Fract Ball
--	ST-040-1000-000	1	Steel Ball

Exploded View (LP /HP)



Ball Activated Differential Safety Firing Assembly - LP/HP





Warning: *The assembly of this tool requires the handling of an Explosive Device and all safety precautions must be adhered to and observed!*



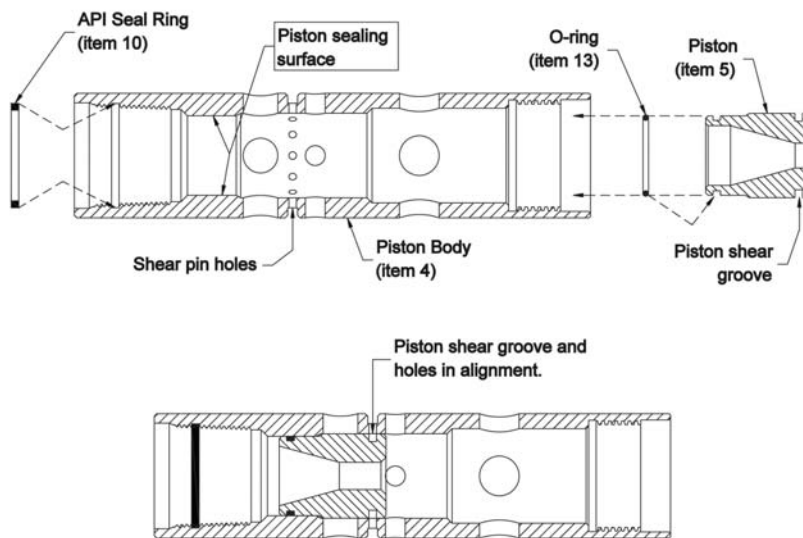
Note: *Check all items against the parts list to be sure of having the correct parts and quantities.*



Note: *Check for any damage to the parts which would prevent the part from being assembled correctly, easily and safely.*

1.0 Assembly


1.1 Install the O-ring (item #13) onto the Piston (item #5) and also install the API Seal Ring (item #10) into the Piston Body (item #4) thread groove. Apply grease to the O-ring and Piston and also on the internal sealing surface of the Piston Body. Insert the Piston into the body until the shear groove of the Piston is in alignment with the shear pin holes in the body.



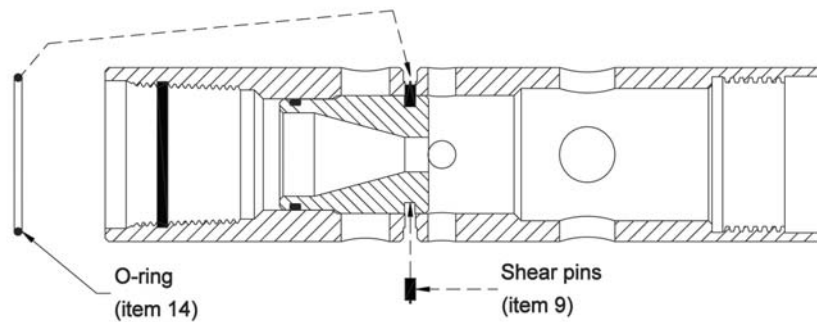
1.2 Calculate the number of Shear Pins (item #9) to be used, by referring to the Pinning Calculation Sheets for shear pin values vs. temperature. Insert the selected number of pins into the shear pin holes on the body and into the piston groove.

Ball Activated Differential Safety Firing Assembly - LP/HP

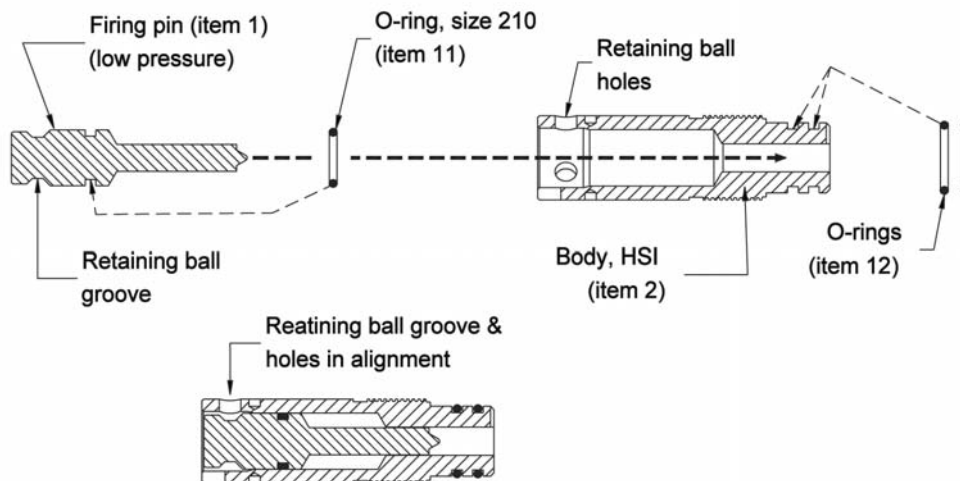


 *Note: Space the pins symmetrically as possible around the tool to provide a balanced shearing force.*

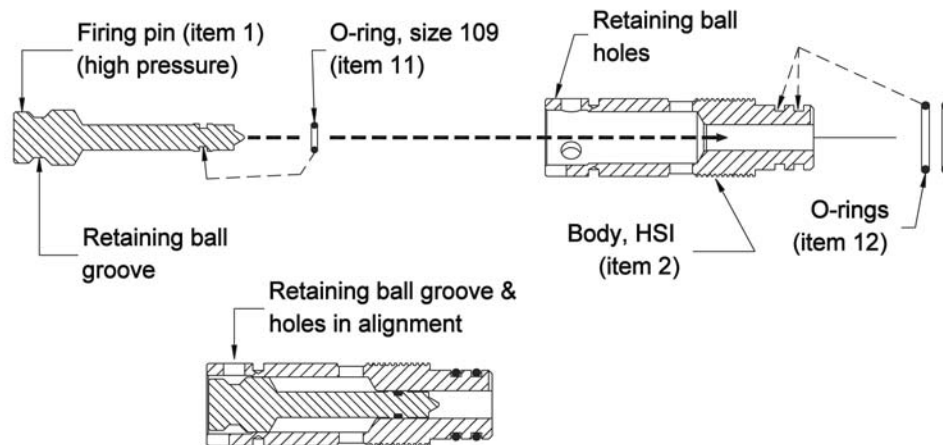
Install the O-ring (item 14) into the shear pin groove on the body to retain the pins.



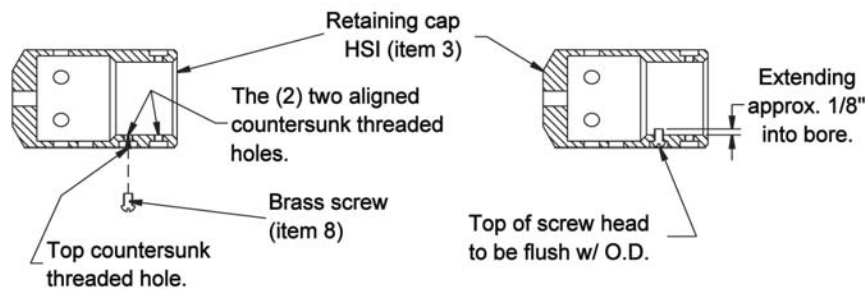
1.3 Low Pressure Impact Firing Assembly - Install the O-rings (item #12) on the Firing Pin Body HSI (item #2) and the O-ring (size 210, item 1#1) on the Firing Pin (Low Pressure, item #1). Apply grease to the O-ring on the Firing Pin and insert into the Firing Pin Body until the retaining ball groove in the pin is aligned with the retaining ball holes on the body. After completion, proceed to step 1.5



1.4 High Pressure Impact Firing Assembly - Install the O-rings (item #12) on the Firing Pin Body HSI (item #2) and the O-ring (size 109, item #11) on the Firing Pin (High Pressure, item #1). Apply grease to the o-ring on the Firing Pin and insert into the Firing Pin Body until the retaining ball groove in the pin is aligned with the retaining ball holes on the body.



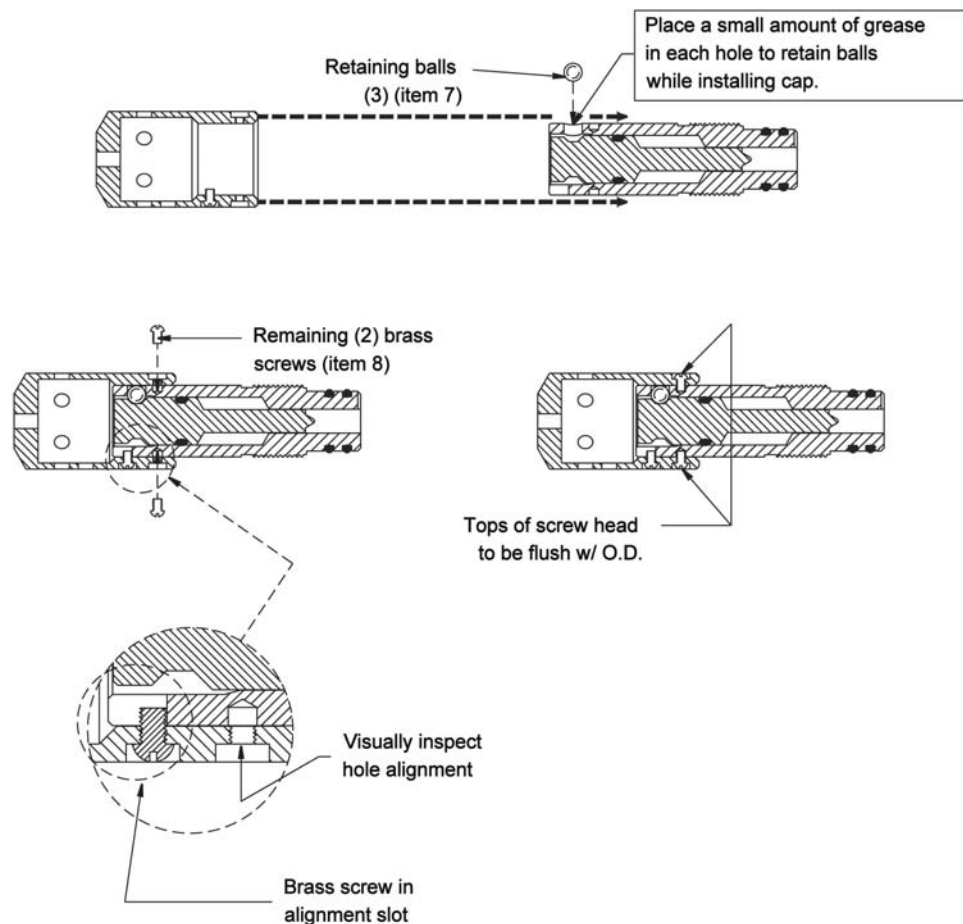
1.5 Thread one (1) of the Brass Shear Screws (item #8) into the top countersunk threaded hole of the two (2) aligned countersunk threaded holes of the Retaining Cap HSI (item #3). Thread all the way in until the head bottoms out in the countersink. The top of the screw head should be flush with the OD of the cap and approximately 1/8" (3.18 mm) of threads should be extending into the ID bore of the cap. This is an important step because this screw will align the retaining cap with the drilled securing holes in the Firing Pin Body.



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1.6 Apply a small amount of grease in each retaining ball hole and insert the three (3) Retaining Balls (item #7). Slide the Retaining Cap over the Firing Pin Body; aligning the extended brass screw with and into the slot cut into the Firing Pin Body. Visually inspect to see if the two (2) remaining countersunk threaded holes (@ 180° to each other) are lined up with the two (2) drilled holes in the Firing Pin Body. If so, thread the two (2) remaining brass screws into the cap, securing it to the Firing Pin Body. Again, to be installed correctly, the top of the screws should be flush with the OD of the Retaining Cap.

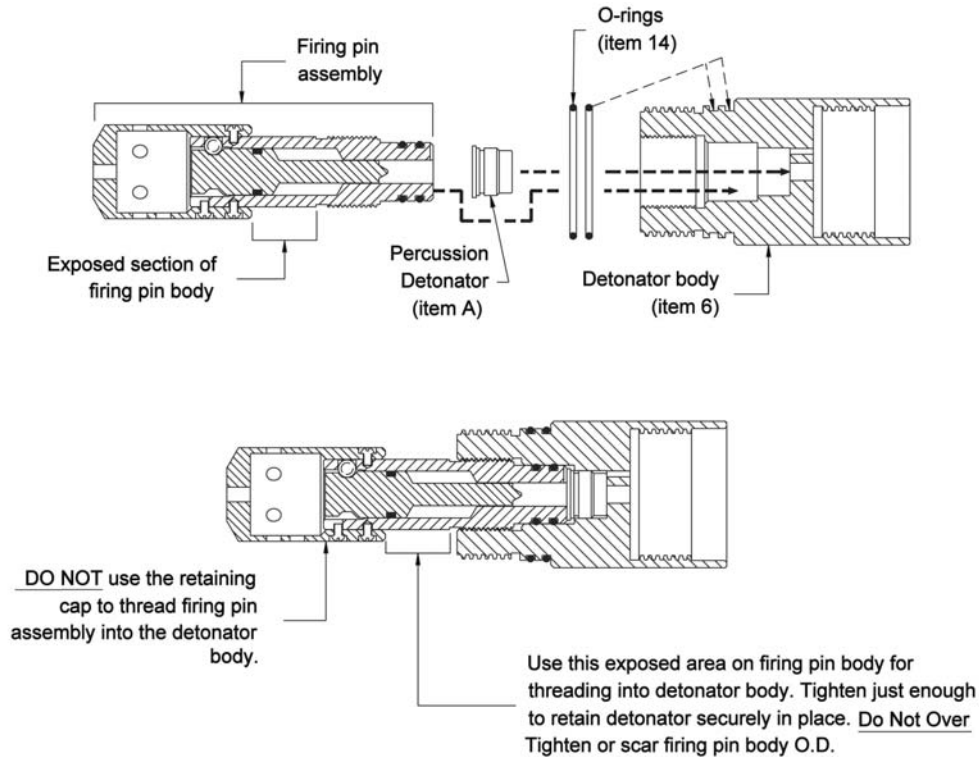


1.7 Install the O-rings (item #14) onto the Detonator Body (item #6). Carefully insert the Percussion Detonator (item A) into the recess of the Detonator Body.

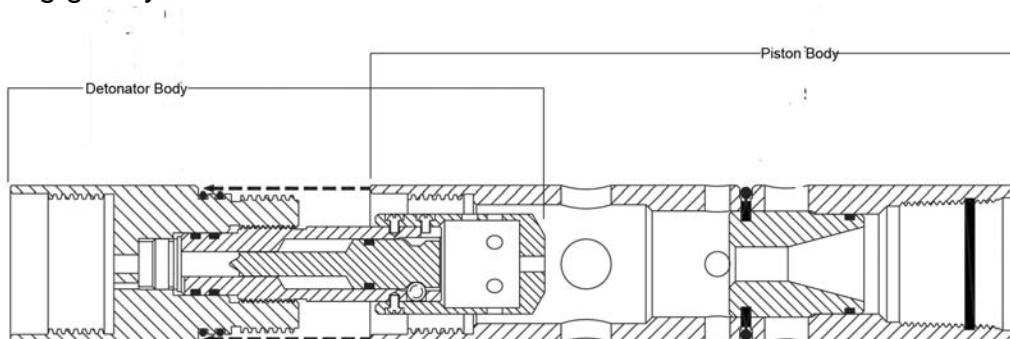


Warning: Remember, you are handling an explosive device and all safety precautions must be observed and adhered to!

Apply grease to the O-rings and threads of the firing pin assembly and thread into the Detonator Body until it contacts with the detonator. Tighten just enough to secure detonator. **Use** the exposed section of the Firing Pin Body to tighten and **not** the Retaining Cap. Also, avoid scarring the OD surface of the body while tightening.



1.8 Apply grease to the O-rings and threads of the Detonator Body and thread the assembled Piston Body onto the assembled Detonator Body; tighten. The Ball Activated Differential Safety Firing Assembly is now complete and ready to be attached to a perforating gun system.



2.0 Imperial Pinning Calculations

2.1 Correct for the bottom hole temperature (BHT). Refer to the Imperial Temperature Correction Chart.

_____ °F Correction Factor _____

2.2 Choose the desired downhole shear value from the Pin Value List below and calculate the actual shear value at bottom hole temperature.

_____ Shear press. desired X _____ (corr. fact.) = _____ shear psi @ BHT

2.3 If this value is acceptable, use the corresponding number of pins in the firing head. If not acceptable, re-calculate using a different shear value.

2.4 There is a $\pm 5\%$ operating tolerance on the shear pins, so now calculate an average, a high, and a low operating pressure.

Average shear press. _____ (step 2 @ BHT)

High side: 1.05 X _____ (average psi) = _____ psi

Low side: 0.95 X _____ (average psi) = _____ psi

Refer to the Shear Pin shipping package for this tool. The psi shear value @ 72° F will be listed on a sticker label attached to the package. Use that listed value for your calculations.

Operating Suggestions - Owen suggests using a minimum of four (4) pins or more with this firing assembly. This allows time for the pressure to stabilize during activation of the firing sequence.



3.0 Metric Pinning Calculations

3.1 Correct for the bottom hole temperature (BHT). Refer to the Metric Temperature Correction Chart.

_____ °C Correction Factor _____

3.2 Choose the desired downhole shear value from the Pin Value List below and calculate the actual shear value at bottom hole temperature.

_____ Shear press. desired X _____ (corr. fact.) = _____ shear kPa @ BHT

3.3 If this value is acceptable, use the corresponding number of pins in the firing head. If not acceptable, recalculate using a different shear value.

3.4 There is a $\pm 5\%$ operating tolerance on the shear pins, so now calculate an average, a high, and a low operating pressure.

Average shear press. _____ (step 2 @ BHT)

High side: $1.05 \times$ _____ (average kPa) = _____ kPa

Low side: $0.95 \times$ _____ (average kPa) = _____ kPa

Reference Shear Pin shipping package for this tool. The kPa shear value @ 22° C will be listed on a sticker label attached to the package. Use that listed value for your calculations.

Operating Suggestions - Owen suggests using a minimum of four (4) pins or more with this firing assembly. This allows time for the pressure to stabilize during activation of the firing sequence.

4.0 Imperial Temperature Correction Chart

	Correction		Correction		Correction		Correction	
Deg. F	Factor	Deg. F	Factor	Deg. F	Factor	Deg. F	Factor	
70	1.00000	180	0.9440	290	0.9025	400	0.8820	
80	0.9950	190	0.9395	300	0.8980	410	0.8840	
90	0.9880	200	0.9350	310	0.8970	420	0.8850	
100	0.9825	210	0.9315	320	0.8945	430	0.8860	
110	0.9775	220	0.9275	330	0.8925	440	0.8880	
120	0.9725	230	0.9235	340	0.8900	450	0.8900	
130	0.9675	240	0.9195	350	0.8880	460	0.8940	
140	0.9620	250	0.9165	360	0.8870	470	0.9000	
150	0.9570	260	0.9125	370	0.8860			
160	0.9530	270	0.9090	380	0.8845			
170	0.9485	280	0.9060	390	0.8835			

5.0 Metric Temperature Correction Chart

	Correction		Correction		Correction		Correction	
Deg. C	Factor	Deg. C	Factor	Deg. C	Factor	Deg. C	Factor	
21	1.00000	82	0.9440	143	0.9025	204	0.8820	
27	0.9950	88	0.9395	149	0.8980	210	0.8840	
32	0.9880	93	0.9350	154	0.8970	216	0.8850	
38	0.9825	99	0.9315	160	0.8945	221	0.8860	
43	0.9775	104	0.9275	166	0.8925	227	0.8880	
49	0.9725	110	0.9235	171	0.8900	232	0.8900	
54	0.9675	116	0.9195	177	0.8880	237	0.8940	
60	0.9620	121	0.9165	182	0.8870	243	0.9000	
66	0.9570	127	0.9125	188	0.8860			
71	0.9530	132	0.9090	193	0.8845			
77	0.9485	138	0.9060	199	0.8835			