SEVERING TOOLS (ST)
FIELD ASSEMBLY and ARMING

June 2, 2009

1.0 DESCRIPTION

1.1 Titan Severing Tools (ST) are colliding tools, making use of EBW (Exploding Bridge Wire) Detonators, initiated by the ECOSSE fire set (**Fig. 2**). For reference, a wiring diagram is included (**Fig. 1**).

1.2 The ST is a "user friendly" design, **pre-wired** at the factory with detonators **pre-installed** and with the electrical circuit **pre-checked**. It is shipped ready for installation of the HMX Explosive Pellets at the well site in accordance with the procedures in **Section 3.0**. The carrier, void of Explosive Pellets, serves as a "safety tube" for the detonators, with a shipping classification of UN 1.4S.

1.3 Titan 1-3/4" and 2" Severing Tools are rated for 20,000 PSI (137.90 mPa) service at 325º F (163º C) when shipped with RDX EBW detonators, or at 400º F (204º C) when shipped with HNS EBW detonators for one hour of exposure. The 2-1/8" and 2-5/8" tools are rated at 400º (204º C) and 25,000 PSI (172.37 mPa) for one hour of exposure (see table below).

2.0 SPECIFICATIONS

[1] Part Numbers for Hardware / Pellet Kit (Exclude Shipping Class)	Tool O.D in. / mm	Explosive Column in. / cm	Tool Ass'y Exp. / kg	EBW Det. Type	Minimum Restriction in. / mm	Drill Collar O.D. in / mm	Rating Temperature Pressure	[2] Number of Pellets
SEV-1750ST100 (1.4S) SEV-1750SPB (1.4S)	1.775 45.09	28.0 71.1	HMX 1.25	RDX	1.875 47.6	6-1/2" / 165	325° F. 20,000 PSI	55 X 22.7 g (58 in Kit)
SEV-1750STHT (1.4S) SEV-1750SPB (1.4S)	1.775 45.09	28.0 71.1	HMX 1.25	HNS	1.875 47.6	6-1/2" / 165	400° F. 20,000 PSI	55 X 22.7 g (58 in Kit)
SEV-2000ST100 (1.4S) SEV-2000SPB (1.4S)	2.030 51.56	28.0 71.1	HMX 1.59	RDX	2.125 54.0	8" / 203	325° F. 20,000 PSI	70 X 22.7 g (74 in Kit)
SEV-2000STHT (1.4S) SEV-2000SPB (1.4S)	2.030 51.56	28.0 71.1	HMX 1.59	HNS	2.125 54.0	8" / 203	400° F. 20,000 PSI	70 X 22.7 g (74 in Kit)
SEV-2125ST100HP (1.4S) SEV-2125SPB (1.4D)	2.125 53.97	48.0 121.9	HMX 2.87/2.93	HNS	2.250 57.2	8" / 203	400° F. 25,000 PSI	95/97 X 30.2 g (99 in Kit)
SEV-2625ST100HP (1.4S) SEV-2625SPB (1.4D)	2.625 66.67	48.0 121.9	HMX 4.47/4.52	HNS	2.750 69.9	11" / 279	400° F. 25,000 PSI	117/119 X 38.0 g (120 in Kit)

[1] A complete ST assembly requires one each of the Hardware Kit (includes pre-installed detonators) and (HMX) Pellet Kit. The shipping classification is shown to the right of the part number(s).

[2] See **Page 5** for additional details regarding the Number of Pellets required.

3.0 FIELD ASSEMBLY / ARMING PROCEDURE

3.1 This tool, as well as others containing explosive components, must be used in accordance with the Recommended Practices for Oilfield Safety (API RP 67) and your company's safety policies and procedures. The steps in 3.2 are excerpts from the RP 67 and serve as reminders of basic operational and safety procedures commonly used in the field.

3.2 Pre-check electric cable circuit, cable head, CCL and any adapters for continuity and insulation prior to assembly and installation of the ST to the wireline connection. Turn off all the main circuit breaker(s) in the unit except for those required for essential safety systems (RP 67, 8.3.3) . Be sure the cable Safety Switch is in SAFE mode. Measure for stray voltages between the Wireline unit to ground (earth), rig to ground and well head to ground, ensuring no hazardous stray voltages greater than 5 volts (AC and DC) are present (RP 67, 8.1.3.7). Electrically bond Wireline unit, rig and well head together with grounding straps and clamps.

3.3 The ST electrical circuit was pre-checked at the factory. No further testing is required. If necessary, for troubleshooting purposes, electrical tests on the Ecosse FireSet may be conducted using a Digital Safety Multimeter following the procedures outlined below. **MAKE SURE THAT THE TOOL HOUSING IS VOID OF EXPLOSIVE PELLETS BEFORE ANY ELECTRICAL TEST IS PERFORMED.**

- The Tool Housing serves as the Detonator Safety tube used while arming all perforating devices. Stand clear of the open end of the Tool Housing when making electrical checks or be sure the Bottom Nose and its Retainer Screws are in place.
- Using a Digital Safety Multimeter set on the 20 megohm scale, take measurements at the Input and Output leads of the Ecosse FireSet.
    - **INPUT LEADS** (or at the Top Sub of the ST) – 0.95/1.05 megohms
    - **OUTPUT LEADS** (or at the wire connections exiting the bottom of the tool, with the lower EBW Detonator disconnected) – 4.4/4.6 megohms.

3.4 **IN COMPLIANCE WITH API RP 67, BE SURE THE FIRING PANEL SAFETY KEY IS VISIBLE AT THE SEVERING TOOL TO BE CONNECTED.** Install any adapters or firing head required to accept the Shock Sub Assembly to the wireline tool connection. Install the 3' steel Shock Sub Assembly provided with the ST to the Top Sub and attach the ST to the wireline. Detailed assembly drawings for the Shock Sub Assembly and two common versions of wireline tool connection adapters are located at the end of this document.

3.5 Remove the ST Bottom Nose from the Tool Housing and position it to the side as shown in **Fig. 3**. **WARNING: AVOID EXCESSIVE FORCE ON WIRES.** Use of Channel-Lok pliers may be helpful to remove the Bottom Nose from the Tool Housing.

3.6 Remove the Load Rod from the Tool Housing. Remove and save the 007 Viton retainer O-Ring from the Load Rod.

3.7 Install Pellets onto Load Rod (**Fig. 4**) until the last one comes to rest within the ½" wide **"GREEN"** band painted on the rod. If after installing the minimum number of Pellets onto the Load Rod, the **"GREEN"** band is completely visible and there is a gap between the last Pellet and the end of the **"GREEN"** band, add one more Pellet. Slip on the 007 Viton retainer O-ring retainer until it butts up against the last Pellet.

3.8 Gently insert the Load Rod/Pellet subassembly into the Housing (**Fig. 5**) until it stops. **WARNING: DO NOT USE EXCESSIVE FORCE.** The end of the Load Rod will be protruding about 3/8" beyond the end of the Tool Housing.

3.9 While feeding excess wire into the off-center bore in the Bottom Nose, guide the Load Rod into the center bore and seat the Bottom Nose into the Tool Housing.

3.10 Align the holes in the Bottom Nose and the Tool Housing and install the Cap Screws. The ST is now ready to be run into the well.

3.11 To fire the tool, increase the voltage from 0 VDC to 200-225 VDC+. For additional details and full specifications, please contact the PX-1 FireSet manufacturer listed below:

Ecosse, Inc.
Jim Ellis
15831 Laurel Heights Drive
Houston, Texas 77084
Office Number: (281) 550-7675
E-mail: ellis@ecosseinc.com

4.0 DISARMING / DOWNLOADING AN UNFIRED/MISFIRED ST

4.1 Reverse the assembly procedure outlined in steps **3.1** through **3.10** above. **WARNING: IF, AFTER A TRIP INTO THE WELL, THE TOOL CONNECTIONS PROVE HARD TO BREAK, FIRST ATTEMPT TO BLEED OFF INTERNAL PRESSURE BY CAREFULLY BACKING OFF THE PRESSURE BLEED-OFF PLUG (FIG. 5) AT THE BOTTOM OF THE TOOL.** High pressure liquid (in case of a leak) or high pressure gas (in event of a low order detonation) could be present, therefore wear appropriate PPE (personal protection equipment) and exercise all other safety precautions as specified by your Service Company.

4.2 Remove Bottom Nose and position it to the side as shown in **Fig. 3**.

4.3 Pull-out Load Rod/Pellet Assembly.

4.4 Remove the 007 Viton retainer O Ring. Slide pellets off the Load Rod and place them in their original shipping box for transportation back to an approved storage magazine/facility.

Note:

a) **WARNING: DISCONNECTING THE TOP SUB IN THE FIELD SHOULD NEVER BE DONE. IT WILL DAMAGE OR DISCONNECT THE ELECTRICAL CIRCUIT.**

b) In event of an electrical malfunction within the tool, contact the Titan Distribution Center where it was originally acquired for an RMA (Returned Material Authorization). The Explosive Pellets must be removed and placed back into their original shipping container(s) while the ST is temporarily stored or prior to transportation from the wellsite.

c) Unless the operator is experienced in handling malfunctioned explosive tools, it is recommended that, in case of hard to break connections, you contact your field technical representative **IMMEDIATELY** for assistance.

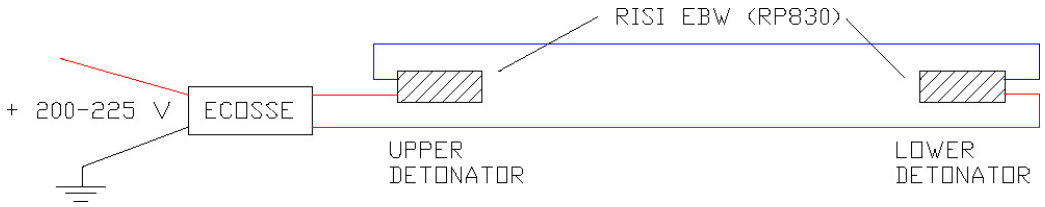


Fig. 1 Wiring Diagram (for reference only).

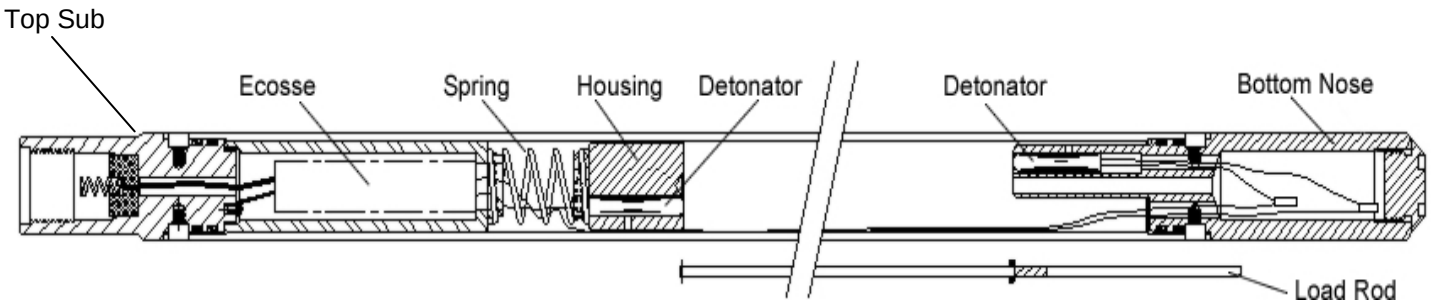


Fig. 2 Severing Tool as received in shipping package (Load Rod shown removed for clarity).

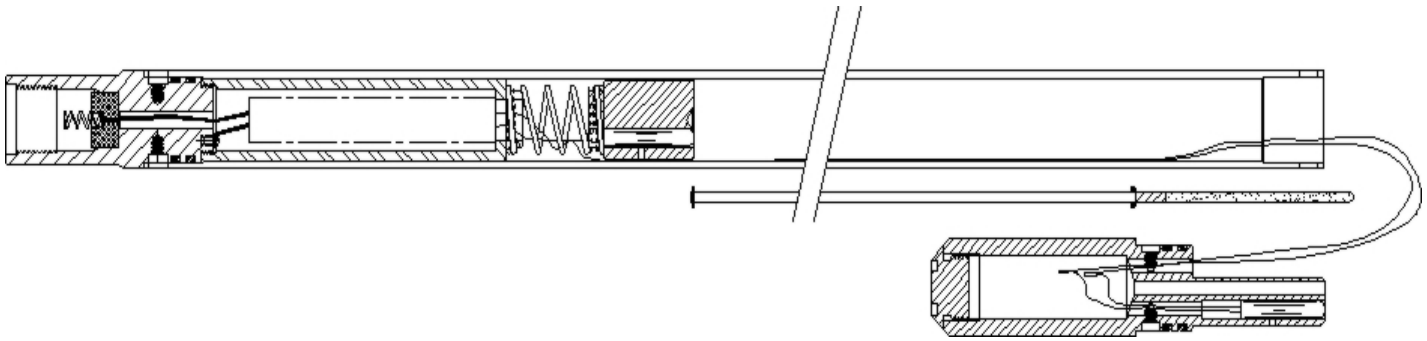


Fig. 3 Remove the Bottom Nose and the Load Rod and position them alongside Housing as shown.

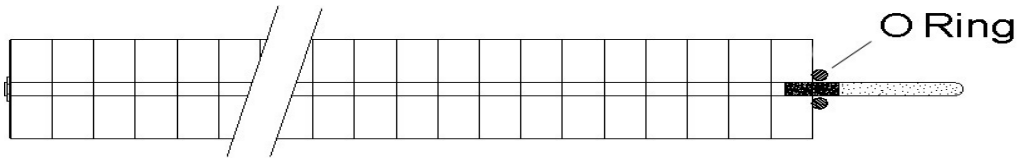


Fig. 4 Remove 007 Viton retainer O-Ring from Load Rod. Install pellets ******* until last one resides in "green" zone. Install the 007 Viton O-Ring retainer against last pellet to retain the stack in place on the Load Rod.

***** Note:** The 1-3/4" tool requires 55 Pellets (58 Pellets are shipped with each tool), the 2" tool requires 70 pellets (74 pellets are shipped with each tool), the 2.125" requires 95 to 97 pellets (99 shipped with each tool) and the 2.625" tool requires 117 to 119 pellets (120 shipped with tool). **Note:** Additional pellets are provided with each tool to achieve the correct column length and to provide extra pellets in the event that one or more are damaged during tool assembly.

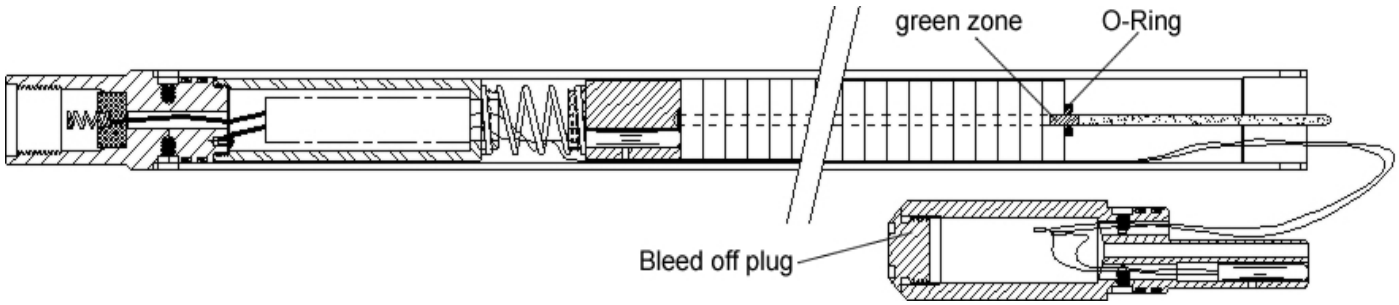


Fig. 5 Slide Load Rod / Pellet Assembly into Housing.

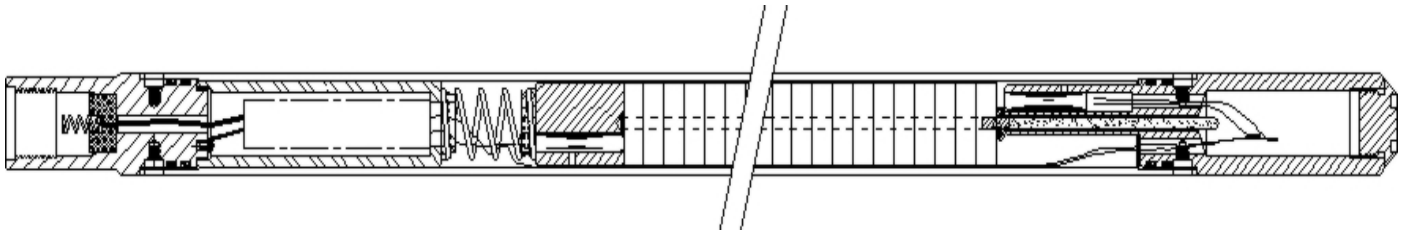
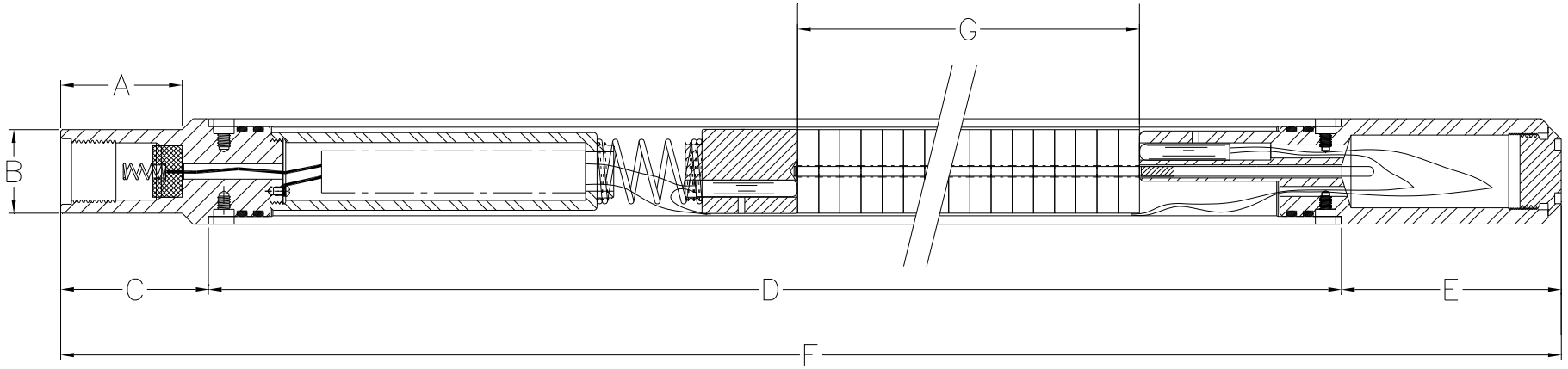


Fig. 6 While aligning the Load Rod into the center bore of the Bottom Nose, guide excess wire into the offset bore and re-insert the Bottom Nose into the Housing. Align holes in the Bottom Nose and the Tool Housing and install Cap Screws.



Running Dimensions For 1-3/4", 2", 2-1/8" and 2-5/8 ST Assemblies							
O.D. In. / mm	**Dim A In. / mm**	**Dim B In. / mm**	**Dim C In. / mm**	**Dim D In. / cm**	**Dim E In. / mm**	**Dim F In. / cm**	**Dim G In. / cm**
1.775 / 45.08	2.31 / 58.68	1.592 / 40.44	2.81 / 71.38	43.19 / 109.70	4.19 / 106.43	50.19 / 127.48	28.00 / 71.12
2.030 / 51.56	2.31 / 58.68	1.592 / 40.44	2.81 / 71.38	42.85 / 108.84	4.19 / 106.43	42.85 / 108.84	28.00 / 71.12
2.125 / 53.98	2.31 / 58.68	1.592 / 40.44	2.81 / 71.38	63.00 / 160.02	4.19 / 106.43	70.00 / 177.80	48.00 / 121.92
2.625 / 66.68	2.31 / 58.68	1.592 / 40.44	2.81 / 71.38	63.00 / 150.02	4.19 / 106.43	70.00 / 177.80	48.00 / 121.92