



OPERATING INSTRUCTIONS FOR 6-3/4" PBL SUB

(Applicable to sizes 6-1/4", 6-1/2" & 7")
(5 Cycles)

TOOL SERIAL NUMBER(S)	

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1.0 Purpose

This Procedure has been created to ensure that the DSI PBL Tool is properly managed and used. The correct use of the DSI PBL Tool will ensure its efficiency and guarantee expected results.

2.0 Responsibility

The Operations Department of DSI FZE is responsible for this Procedure. The QHSE Department of DSI FZE is responsible of its review and worldwide distribution.

It is the Final user's responsibility to fill in the Pre-Job Questionnaire prior to calling out the PBL.

Final users are responsible for the correct application of this Procedure. DSI FZE and its branches do not have any responsibility for the improper or wrong application of this Procedure.

3.0 Operating Procedure

3.1 Receiving PBL at Rig Site

3.1.1 On receipt of PBL Bypass Tools at Rig site, it must be checked for the following:

- PBL Serial Numbers located on ID band below Ports on the Main Body.
- Confirm rig end connections are as required.
- Confirm Drop Ball Kit matches tool size and number.
- Shearing pressures for Ball Seat (Deactivation Pressure) and Ports (Unlocking Pressure) are marked on tool and on Tech Sheet included in the kit box.
- Confirm PBL Activation Ball will drift through entire drill string above PBL Tool.
- Confirm PBL No-Go will allow passage of any required third-party Activation Balls.
- Drift the third-party ball thru PBL prior to connecting BHA.
- Remove tape covering PBL Ports prior to RIH.

3.1.2 The Drop Ball Kit that comes with each tool should contain the below.

- | | |
|---|----------------------------|
| • 5 x 2" Activation Balls | • 2 x 1-1/8" Locking Balls |
| • 10 x 1-3/8" Steel De-Activation Balls | • 1 x 2" Fast Dart |

3.2 Activation Mediums

- Ertalyte Ball (white colour) – Standard balls used when the BHT is below 265° F (130° C)
- Torlon Ball (black colour) – Used when the BHT is above 265° F (130° C), up to 450° F (230° C)
- [Fast Dart](#) - A heavy dart which can be used in the highest mud weights or where mud cannot be circulated (pack off situation).
- [Fast Ball \(copper/ golden colour\)](#) – Used in heavier density fluids (14 ppg+) as an alternative to Fast Dart or when Fast Dart cannot be pumped down. Has a temperature rating of 500° F (260° C)

NOTE:

The PBL tool will be fully tested & ready to RIH when it arrives at the rig site. However, a surface test (shallow hole) is mandatory prior to re-run of tool; refer to [section 4.0](#) for surface test instructions.

3.3 Activation Procedure

- 3.3.1** Prior to activating the tool, Record flow rate ____ & SPP _____. This will be used as a reference to confirm de-activation of the tool.
- 3.3.2** Calculate the fluid displacement volume and time in the drill string to estimate when the Activation Ball will reach the PBL Bypass Tool.
- Break drill string at rig floor and drop 1 x 2" Activation Ball. Ensure the tool is within fluids and fill the drill string with fluid prior to dropping the Activation Ball.
- 3.3.3** Displace approximately 50% of the drill string volume at normal drilling flow rates then reduce the flow rate so that the spp is 1,000 psi below the ball shearing pressure until the ball lands on the Seat.
- In addition, please consider: Flow rate shall be maximum 300 gpm when ball lands on Seat (150 gpm for Fast Ball and Fast Dart).
 - Care must be taken when pumping the Activation Ball down as pumping the Activation Ball on Seat at high flow rates and/or pressures would cause the Activation Ball to blow through the Seat.
 - The Activation Ball will often seat sooner than calculated.
 - The Activation Ball has an equivalent density of 11.2 PPG (20.9 PPG for Fast Ball & 64 PPG for the Fast Dart) drilling fluid.
 - In the event the ball does get blown through the Seat, as indicated by no change in flow rate vs. spp as recorded in [Step 3.3.1](#), drop 2 x 1-3/8" De-activation Balls (refer to [section 3.5](#)) to ensure the Activation Ball has gone through the Seat. This step must be done prior to dropping another vinyl ball.
 - Repeat the normal tool activation process to re-open the tool.
- 3.3.4** When the Activation Ball lands on Seat, the Sliding Sleeve will shift to its open position against the Spring.
- It takes less than 250 psi to activate / open the tool.
 - Surface indication of the tool being in the open position is a pressure drop. Compare flow rates vs. SPP to flow rates and SPP recorded in [step 3.3.1](#). Once the tool is open, flow rates can be increased to the desired rate above the ball deactivation shearing pressure. High flow rates/ SPP will not push the ball through the seat and deactivate the tool. The deactivation pressure, marked on the tool and on Tech Sheet, only applies after the steel balls have been dropped to deactivate the tool.
 - Fluid will now be diverted through the side Ports. As long as pumping is continuous, fluid will be diverted through the Ports. If pumping is halted, the Sliding Sleeve will shift to the closed position; when pumping resumes, the Sleeve will shift open.
 - A constant, high flow rate shall be maintained while the tool is in the open position. If low flow rates, low differential pressures between drill pipe and annulus, bull heading, squeezing or similar low flow operations are required, it is recommended to de-activate the PBL Tool prior to commencing such operations.
 - Rotating and reciprocating the drill string is a good practice while activating and deactivating the PBL Tool.

3.4 Activation during 'TOTAL LOSS'

3.4.1 Vertical Well

In case of a vertical well, drop the Activation Ball and wait until the ball reaches the Seat by way of gravity (chasing the Activation Ball by pumping would cause the Activation Ball to blow through the Seat due to a combination of the suction caused by the loss zone and pumping).

3.4.2 Horizontal Well

In case of a horizontal well or highly deviated well, chase the Activation Ball with as low pumping as possible until it lands on the ball Seat.

3.5 De-Activation Procedure

3.5.1 Prior to deactivation, ensure that there is no residual LCM or cement in the drill string. Pump a minimum of 1.5 – 2 x string volume of clean drilling fluid (after displacing LCM/ cement to the annulus) prior to dropping the steel balls.

3.5.2 Break the drill string at rig floor and drop 2 x 1-3/8" steel De-activation Balls (It is a good practice to drop the second steel ball 5-10 seconds after dropping the first one).

3.5.3 After dropping the steel De-activation Balls, immediately start pumping at 50% of the normal drilling flow rates (or at least a minimum of 200 GPM). The flow rate should not drop below 200 GPM. Higher flow rates can be chosen depending on the standpipe limitation. Ensure that the chosen flow rate is maintained constantly throughout the deactivation and watch for a standpipe pressure increase. When the steel balls reach the PBL Bypass Tool, they will cut off flow through the Ports creating an immediate pressure increase.

- It is important to Increase or maintain the same flow rate once a pressure increase is observed. Do not slow the pumps down once a pressure increase is observed. If pumping is not resumed after dropping the two steel balls, there is a risk that the tool will not be able to deactivate. The balls can stay misaligned from the side ports; so starting flow asap is very important at this step.
- Continue to build the pressure rapidly while continuing pumping at high constant flow rates until a pressure decrease is seen. Pressure will drop as soon as the activation ball shears through the seat (A pressure increase beyond the ball seat shear pressure rating is often required).
- The Activation Ball will blow through the Seat at +/- 10% of stated shear pressure depending upon downhole conditions. A pressure decrease is an indication the Activation Ball has blown through the Seat into the Ball Catcher. The steel balls will follow into the Ball Catcher.
- After the Activation Ball shears through the Seat, the Sleeve will move to the closed position. Circulation will now be through the BHA.
- If the pressure increase reaches 500 psi below the pump pop off setting and no deactivation is seen, shut down pumps. An informed decision will be made at this point on how to proceed.

3.5.4 When pumping is resumed, check that the flow rates and SPP are the same as they were prior to activating the PBL Tool (See data recorded in [Step 3.3.1](#)).

NOTE:

After tripping out of the hole, the balls must be removed from the Ball Catcher Sub before RIH again. The used Activation Balls must be immediately discarded and never re-run. Do not Run In Hole with balls in the catcher sub.

If required, ensure float valve is in BHA below PBL or finger trap (only for completion operations) has been installed in cage to prevent movement of balls. Consult DSI if situation arises.

If the PBL Sub is to be rerun after being activated, de-activate the tool prior to tripping out of the hole to minimize the wear within the tool.

3.6 Fast Darts

A 2" Fast Dart is supplied as part of the Kit Box. This Dart is to be utilized only in cases where it is not possible to pump down the Activation Ball. The weight of the Fast Dart is 6-7 times greater than the standard ball to facilitate quicker activation of the PBL Sub when limited or no circulation is possible.

The Fast Dart must be dropped in the direction indicated below down the drill string when activating the tool. Fast Darts can be utilized in well bores with angles up to 55° without having pump availability.

Fast Dart



NOTE:

Activation & deactivation procedure is same as the standard ball.

With little or no circulation due to partial or full blockage of the bit or BHA, the Fast Dart will descend by gravity in a well bore with a maximum inclination of up to 55 deg. However, if the Fast Dart can be pumped down, it can be possible to get the dart to the seat in boreholes of up to 90 degrees. In horizontal wells we recommend using the standard activation ball or the Fast Ball to activate the tool.

If Fast Dart is utilized in conditions when circulation is possible, the maximum flow rate is 150 GPM when it is pumped down.

Each Fast Dart cycle equals two standard ball cycles. For example: If 1 x Fast Dart cycle has been utilized, the remaining available cycles in the tool would be three.

3.7 Fast Ball

Fast Balls are used in heavier density fluids (14 ppg+) as an alternative to Fast Dart or when Fast Dart cannot be pumped down.

When choosing to utilize the Fast Ball over the Ertalyte or Torlon Ball, an increase in deactivation pressure of the tool by approximately 800 – 1000 psi than the stated deactivation pressure is to be expected.



4.0 Make up and Testing

4.1 Make up and Testing the PBL at the Surface (Mandatory during Re-Run of Tool and Rig Crew Familiarization)

4.1.1 Pick up the tool and make up the Main Body to the Ball Catcher Sub.

- Ensure that the Sleeve is in the closed position by looking through the Port on the side of the tool.
- Ensure that the Ball Catcher cage in Ball Catcher Sub has the bevelled end facing up and no-go cage facing down.
- Make-up torque is the same as the rotary shoulder thread connection (Do not Over Torque).

4.1.2 Lower the BHA into the hole ensuring that the Ports are below the rotary table.

4.1.3 Drop one (1) x 2" Activation Ball to activate the tool.

- Ensure the tool is within fluids and fill the drill string with fluid prior to dropping the Activation Ball; make-up Kelly to PBL Tool.

4.1.4 Engage the pump slowly and watch for the Sleeve opening and the fluid diverting through the Ports.

- The Sleeve should function within 250 psi. The Sleeve will return to its original position when pumping is stopped.

4.1.5 Break the Kelly from the PBL Tool and drop 2 x 1-3/8" steel De-Activation Balls into the top of the Tool; make-up Kelly to PBL Tool.

4.1.6 Engage the pump and record the pressure at which the Activation Ball shears through the Ball Seat. Build pressure rapidly.

- The activation ball blows through the seat at plus or minus 10% of the recorded pressure that was sent with the Tool.
- Refer to the deactivation pressure of the tool in the tech sheets supplied with the tool (this can be set between 1,600-4,500 psi). Ensure the shear pressure is suitable for the application the tool is planned to be used.
- If unable to build pressure for deactivation, rotate & shake string for the steel balls to engage.
- The deactivation pressure seen during the surface test at the Rig site may differ from the shop test; this could be due to various factors. The Deactivation pressure seen during the surface test on the rig will be the benchmark pressure for deactivation downhole.

4.1.7 With the Activation Ball sheared and the Port closed, keep pumping, and lift the tool above the rotary table to visually check the Port is closed.

4.1.8 If there is fluid dripping from the ports after the sleeve is closed, bleed off pressure completely and wait for 10 minutes until there is no more residual fluid exiting the ports.

4.1.9 Stop the pumps, pick up string and place in the slips.

- Break the PBL Tool between the Main Body and the Ball Catcher Sub.
- Back out Kelly/Main Body from the string and retrieve the balls from the Ball Catcher by removing Ball Catcher Cage.
- Reinsert Ball Catcher Cage and make-up Kelly/Main Body and Ball Catcher Sub before RIH.

NOTE: Do not under any circumstances re-use the Activation Balls once they have been used in the tool.

5.0 PBL SUB - DO's & DON'Ts

- All IDs of the drill string components shall be larger than the diameter of the activation ball otherwise the ball could get stuck during the pumping process.
- If other ball-activated tools are used in the drill string (e.g. ball-activated reamer) consider the "drift" of the PBL tool.
- Remove any "mud cleaning filters" before dropping the activation or de-activation balls.
- Be careful that no other objects (cement chunk, glove, part of a drill pipe screen, thread protector, etc.) get inside the drill pipe and land on the seat. These objects could act like an activation ball and improperly or partially activate the tool. Place a filter in the standpipe and drill string to prevent unintended activation of the tool due to junk/debris.
- If the optional surface test is done, always ensure the PBL tool is fully within drilling fluids to avoid ball shattering during de-activation.
- Large diameter LCM materials can be pumped through the PBL ports. LCM size shall not normally exceed 1/3 of port diameter (if in any doubt please call a DSI representative).
- Pump the activation ball with a fluid spacer (normal drilling mud, no LCM included) otherwise LCM may pass the ball during the pumping process before the activation ball lands on the seat and LCM gets access to the sensitive BHA.
- When LCM has been displaced, pump a minimum of 1.5 to 2 x string volume of clean drilling fluid (normal drilling mud, no LCM included), before dropping the de-activation balls.
- Never re-use a previously dropped activation ball (vinyl).
- Do not drop a Fast Dart in a Total Loss situation, refer to [Sec 3.4](#).
- If the BHA is "packed-off" and therefore unable to circulate, the PBL tool kit contains a Fast Dart. This can be dropped to reach the seat without pumping (up to 55 degrees) and it may be possible to regain circulation through the PBL by starting the pumps and opening the PBL ports.
- Once the PBL has been activated, high flow rates can be used with pressures that are much higher than the PBL de-activation pressure. DSI recommends the use of high flow rates to fully make use of the extra cleaning power of the PBL sub or high flow to pump LCM (the de-activation pressure ONLY applies when the steel balls have been dropped to de-activate the tool & cannot be exceeded by high flow rates when the tool is open).
- In operations that are normally performed with closed BOP such as bull heading, squeezing or similar operations with low differential pressure between drill pipe and annulus, deactivate the PBL tool before commencing such operations as the PBL will be partially open.
- If the PBL sub is laid down and is planned to be re-run in hole, please jet-wash fully with clean water when first POOH.
- If required, ensure float valve is in BHA below PBL or finger trap has been installed in cage (for completion operations) to prevent movement of balls.
- After dropping steel deactivation balls, start pumps immediately & pump down balls at a constant flow rate as outlined in [Sec 3.5](#). Do not slow down or stop the pumps during the process.
- The deactivation pressure seen during the surface test at the Rig site may differ from the shop test; this could be due to various factors. The Deactivation pressure seen during the surface test on the rig will be the benchmark pressure for deactivation downhole.

NOTE:

Please fully use the operating instructions which are sent with each PBL tool (if in doubt please call a DSI representative).


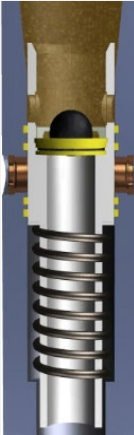
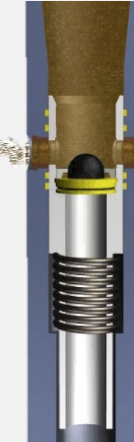
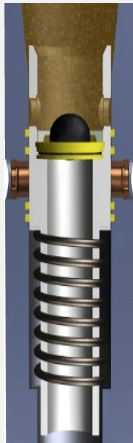
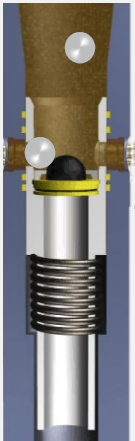

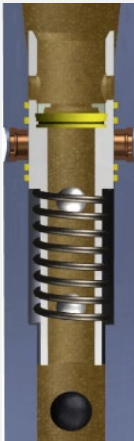

6.0 Trouble Shooting

SL	Scenario	Possible Cause	Solution
1	Activation ball broken into pieces during surface test	Due to impact of activation ball striking the catcher cage because tool not within fluids.	Ensure tool is within fluids and fill drill string prior to dropping activation ball. The fluid will provide a cushioning effect for deactivated balls.
2	Fluid dripping through closed ports after deactivation on surface test	Possibly the sleeve has not completely closed yet or residual fluid around ports.	Bleed off pressure completely and wait for 10 minutes until there is no fluid dripping from ports.
3	Unable to build pressure to deactivate tool during surface test	Deactivation balls not sealed off ports	Rotate & shake string for the steel balls to engage
4	Dropped Activation ball, pumped more than one string volume, no indication of pressure change	Ball pumped down too fast (at high flow rate/psi), could have blown through the seat.	Complete cycle by dropping 2 x steels balls to confirm activation ball has sheared through seat. Maintain SPP 1000 psi below tool deactivation pressure while dropping activation ball to ensure successful activation.
5	Sudden drop in pressure while drilling ahead	Presence of junk / debris in drilling fluid has restricted flow through the PBL creating unintended activation.	Ensure clear drilling fluid is pumped into the well. Place drill pipe filter in the string.
6	Activation ball dropped, increase in pressure, no sign of PBL activation	Activation ball could have got stuck in the string.	Check ID of string above PBL, should allow unrestricted passage of PBL activation ball.
7	Dropped steel balls for deactivation, no indication pressure build-up	Dropped steel balls together, could be stuck at a change in cross section in the string ID	Rotating and sudden jerking of the string will release the balls. To avoid this from happening, drop steel balls 5-10 seconds apart.
8	No pressure build-up during deactivation	LCM not completely flushed out from tool preventing the deactivation balls from sealing the ports	When LCM has been pumped, clean the drill string (with normal drilling mud, no LCM included) before dropping the de-activation balls.
9	Found LCM particles below PBL	Drilling fluid not clear	Pump the activation ball with a fluid spacer (normal drilling mud, no LCM included) otherwise LCM may pass the ball during the pumping process before the activation ball lands on the seat and LCM gets access to the sensitive BHA.
10	Sudden increase in pressure after spotting LCM & trip out	LCM not completely flushed out from string. Residual LCM settled on top of the activation ball during tripping out or when pumps off and could have plugged the tool	POOH & L/D PBL. Whenever LCM displacement is complete, circulate a minimum 1.5 – 2 x string volume of clear drilling fluid to ensure LCM is completely flushed out.
11	Pressure drop even after PBL deactivated downhole	Possible sleeve not fully returned to closed position	Drop another activation ball and switch pump on and off to oscillate the sleeve until change in pressure is noticed. Then, drop steel balls and deactivate tool.
12	Unable to deactivate tool even after exceeding the deactivation pressure of the tool.	Reached the Rig pumps pop off limits	Deactivate the tool by connecting a cementing unit.

7.0 Service cycle guidelines

TOTAL USAGE	<p>300 hours. Time starts from when the PBL goes below Rotary for the 1st run in the hole. The 300 hours includes tripping times and laid down times between runs, hours are calculated from the first time the PBL is run below the rotary.</p> <p>Re-run is NOT permitted in the case of pumping cement, acid, and fluids with gelling properties through the PBL tool, and the tool must be replaced upon POOH.</p>
RERUN AFTER WAIT	<p>Re-run is allowed only once, and this re-run must occur within 72 Hours from POOH provided the tool is flushed out with fresh water at surface when POOH and a successful function test has been conducted prior to the next RIH.</p>
DOWNHOLE VIBRATION	<p>If the BHA is subject to abnormal / excessive downhole vibration, stick-slip vibration, according to the Industry / Operator's best drilling practices, the PBL must be replaced upon next POOH.</p>
IN CASE OF NON-CONFORMANCE	<p>Any PBL Tool to be shipped back for investigation <u>MUST</u> be sent back in its existing state / condition with no alterations by means of readjusting the internal components (all balls <u>MUST</u> be left in the tool as it is, and the PBL Tool <u>MUST NOT</u> be cleaned prior to return to base)</p> <p>Removing the balls & cleaning the internal diameter of the tool will affect the investigation process tremendously.</p>

8.0 PBL Operation Summary

<p>1</p>  <p>Activation Ball pump down at SPP 1000 psi less than tool Deactivation pressure</p>	<p>2</p>  <p>Flow to BHA cuts off as Ball Seats</p> <p>NO MWD SIGNAL</p>	<p>3</p>  <p>Sleeve moves down at less than ~250 psi</p> <p>Flow bypassed</p>
<p>4</p>  <p>Pumps off = No Bypass</p> <p>Tool Closed</p>	<p>5</p>  <p>Drop 2 x Steel Deactivation Balls</p> <p>2nd steel ball 10 Secs. after 1st steel ball</p> <p>Start Pumps ASAP</p>	<p>6</p>  <p>Build-up SPP as quick as possible</p> <p>!! DO NOT SLOW DOWN OR TURN OFF PUMP!!</p>
<p>7</p>  <p>Activation Ball is sheared thru seat and falls into the cage</p> <p>Often higher pressure required to shear ball</p>	<p>8</p>  <p>Tool returns to Closed position</p> <p>Back to Drilling mode</p> <p>Return of MWD Signal</p>	

8.1 Activation



DO NOT PUMP DOWN BALL TOO FAST
MAX SPP 1000 PSI BELOW TOOL
DEACTIVATION PRESSURE



INDICATORS OF PBL ACTIVATION

- PRESSURE DROP
- LOSS OF MWD SIGNAL



IN CASE OF NO INDICATION OF
ACTIVATION – DROP TWO STEEL BALLS
AND COMPLETE CYCLE.

8.2 Deactivation



Prior to dropping the steel balls, circulate a minimum of 1.5 – 2 x string volume of clear drilling fluid and ensure there is no residual LCM in the string.



DROP 2ND STEEL BALL 10 SECONDS
AFTER 1ST



BUILD PRESSURE AS QUICKLY AS POSSIBLE
DO NOT STOP OR SLOW DOWN PUMPS
UPON DROPPING THE STEEL BALLS IMMEDIATELY START PUMPING



A PRESSURE INCREASE BEYOND THE BALL SEAT SHEAR PRESSURE RATING IS OFTEN REQUIRED, THIS IS NORMAL



PUMP DOWN THE STEEL BALLS AT A CONSTANT FLOW RATE AS MENTIONED IN THE OPERATING INSTRUCTIONS.



INDICATORS OF PBL DEACTIVATION

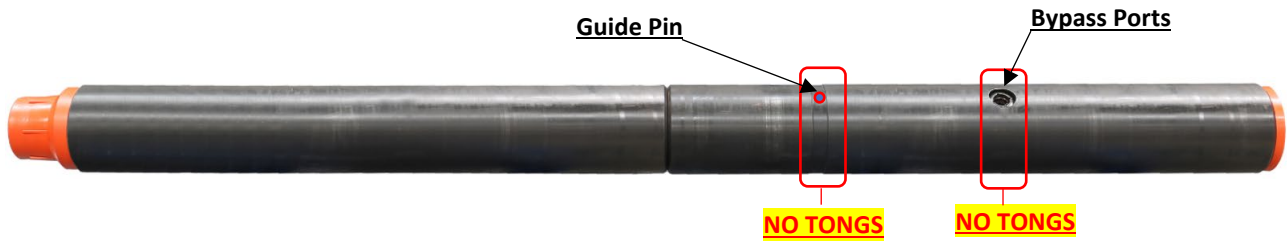
- SUDDEN DECREASE IN PRESSURE – FLOW RATE & SPP SAME AS PRIOR TO ACTIVATION
- RETURN OF MWD SIGNAL

8.3 Tool specific deactivation information

Tool Serial Number	ERTALYTE / TORLON BALL or DART		FAST BALL	
	Tool Deactivation Pressure	Max SPP when pumping ball down	Tool Deactivation Pressure	Max SPP when pumping ball down

9.0 Placement of slips and rig tongs

When engaging slips and/or rig tongs, care must be taken to ensure they are not placed on the ports of the PBL sub. **DO NOT** engage slips / tongs in the areas marked in the image below.



10.0 Additional information

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