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3 1/8” PBL Operating Procedure

Receiving the Ball Locking PBL at the Rig Site

On receipt of the Ball Locking PBL, the tool should be checked for the following:

A shearing pressure for the **ball seat*** and ports should be marked on the tool.
(**PBL De-activation/shearing pressure***)
The tool box that comes with each Tool should contain:-
4 x 1” vinyl opening/activation balls
8 x 7/8” steel closing/de-activation balls
4 x 0.7” vinyl ‘locking’ balls
2 x 1” Ball/Dart. Weighted Ball Combo

Make Up and Testing the PBL Sub at Surface (Optional)To familiarize rig crew only- tool will be ready to RIH , NB : Mid connection is normally NOT made up)

1. Pick up the tool and make up the Circulating sub on top of the ball catcher sub. Ensure that the inner mandrel, of the circulating sub, is in the closed position by looking through the port on the side of the tool. Check that the ball catcher cage is inside the sub. Make-up torque is the same as the drill collar thread connection. (Do not Over Torque).
1. When tool is placed in the BHA, drop vinyl ball in the top of the tool and allow to sit in the ball seat
2. Pick up the Kelly and make up in the top of the tool.
3. Pick up string out of the slips and lower into the hole ensuring that the opening ports are below the rotary table.
4. Engage the pump very slowly and watch for the sleeve opening and the fluid diverting through the port. It will not take a lot of pressure to overcome the spring tension when opening the sleeve (+/- 200 psi).
5. When fully satisfied that the tool is functioning properly, stop pumping, and pick up string and place in the slips. The PBL Sub piston/sleeve will close when the pumping is stopped.
6. Break the Kelly and drop 2 x 7/8” STEEL de-activation Balls into the tool on top of the vinyl ball.
7. Re-engage the Kelly and pick up out of the slips and lower the string so that the opening port is below the Rotary Table & within drilling fluids.
9. Engage the pump and record the pressure at which the vinyl ball shears through the ball seat. This should be plus or minus 10% of the recorded pressure that was sent with the tool.CHECK * (NB: De-activation Pressures are 'tool specific' and can vary from 1600 to 4500 psi) **NB: BUILD PRESSURE RAPIDLY**

10. With Opening Ball sheared and the port closed, keep pumping and lift the tool above the table to visually check the port is closed.
11. Stop the pumps, pick up string and place in the slips, and break the tool between the circulating sub and the ball catcher sub. Remove Kelly and back out the circulating sub from the string and retrieve the balls from the ball catcher. Do not under any circumstances re-use the vinyl opening balls once they have been used in the tool.
12. ***NB : During normal operations, when PBL is activated/open the PUMPS can be used at normal/high rates (eg Above 3,000 psi SPP) High pump rates/psi will NOT push the ball through the seat & de-activate the tool. The de-activation psi , marked on the tool, ONLY applies after the Steel balls have been dropped to de-activate the tool**

Activation of the PBL Sub when in the hole.

1. Record pump pressure and strokes prior to dropping the opening ball. This will be referred to upon de-activation of the tool to confirm that the tool has closed.
2. Stop the pumps and place string in the slips.
3. Break the string at floor level and drop the vinyl ball into the string. Ensure that the Screen has been removed.
4. Make up the string and pump the ball down the string ensuring that at 90% displacement the pumps are slowed to about 50% of pump rate in vertical wells & 80% rate in high angle holes. This will ensure that the ball is landed gently and not allowed to blow straight through the tool*. (If this should occur, drop the de-activation steel balls and recycle the tool*)
5. When the ball engages the seat, a very brief rise in pressure MIGHT be seen at the surface, a PRESSURE LOSS will occur as the inner mandrel moves down to its OPEN position and the FLOW is diverted through the side ports. Increase the pump strokes and circulate the desired fluid keeping a constant pump rate for the PBL Sub. Drop the locking ball if required to keep ports/tool in open position when pumps are switched off.

6. It is advised to **'FULLY'** use/pump the tool once activated. Ie **KEEP** the pumps running at normal or high rates, **AVOID** long periods of **SLOW** pump rates.

Activate the PBL with Vinyl/White ball for all normal Operations.
HPHT Balls are Black (Torlon)

NB : If the string is **plugged** (ie No Circulation possible) then the Ball/Dart Combination should be dropped in the string to activate PBL, and the weight of this ball will allow it to migrate down the string to the ball seat and activate the tool. (This has been successful in high angle hole but is not guaranteed)

AUTOLOCK FEATURE

Use of the Locking Ball for Tripping etc.

NB : Use of Locking Ball - PBL should be 'Locked Open' only to :-

a) Drain Pipe/Dry Trip
b) Fill Pipe/Trip In
c) Reverse Circulate to adjust fluid density.

NB: The PBL should NOT be used for normal Circulation/pumping with the Locking ball in place.

1. With Activation ball on the seat.
2. Break String at surface and drop the locking ball
3. When the Ball/Dart is on the seat and the pressure has dropped, stop pumps and break string at surface and drop the Locking Ball (Vinyl 0.70"
4. The string should be fully circulated whilst the locking ball is dropping down the string. Use normal GPM/high flow rate to ensure locking ball 'seats'properly

5. When the **pressure rises** this will indicate that the locking ball is in the PORT and (& flow is through one port only) the pumps may now be switched off. The tool,is locked open…ONE port stays open
6. When pumping slugs etc. be aware of the shear pressure of the locking ball.

De-Activation of the PBL Sub when in the Hole

1. Stop pumps and place string in the slips.
2. Break the string at the floor level, and drop 2 x 7/8" steel de-activation balls in the string.
3. Make up the string and engage pumps and pump at 80%+ flow rates
   When the steel balls engage the two open orifices, **the pressure will rise quickly. Take the pressure VERY RAPIDLY to the known shearing pressure to achieve De-activation**
4. The shear pressure down hole may be 10% lower or higher than on surface as down-hole conditions (eg Temperature) may affect psi. (NB: De-activation Pressures are 'tool specific' and can vary from 1600 to 4500 psi)
5. When the 1 " Activation ball is sheared through the ball seat of the PBL Sub, the piston will move up, closing the circulating port, and allowing the two Steel Closing Balls to fall into the Ball Catcher. Circulation will now be through the bottom-hole assembly. **Pressure increase as tool closes**
6. Check the pre-recorded pump pressure and strokes to see if they are the same as before the PBL Sub was activated, (if the fluid weight in the hole is the same).

De-Activation of the PBL Sub when in the Hole with Locking Ball in place

1 Stop pumps and place string in the slips.
2 Break the string at the floor level, and drop 2 x 7/8" steel de-activation balls in the string.
3 Make up the string and engage pumps and pump at normal flow rate.
4 When the steel balls engage the one open orifice and the Locking Ball, the pressure will rise quickly to the Locking Ball Shear Pressure (1000psi below Activation Ball Shear Pressure). When the Locking Ball has been sheared through the Orifice, the second Steel De-Activation Ball will take its place in the orifice. Continue pumping and raise the pressure to the Shear Pressure required.(As pre-set/labelled on tool-normally 3000psi*CHECK - can vary from 1600 to 4500 psi) It is recommended to take the pressure quickly to the shearing pressure.
5. The shear pressure down hole may be 10% lower/higher than on surface as down-hole conditions can have an effect on the tool.
6 When the 1 " Activation ball is sheared through the ball seat of the PBL Sub, the piston will move up, closing the circulating port, and allowing the two Steel Closing Balls to fall into the Ball Catcher. Circulation will now be through the bottom-hole assembly.
7 Check the pre-recorded pump pressure and strokes to see if they are the same as before the Ball Locking PBL Sub was activated, (if the fluid weight in the hole is the same).
8 NB : With the tool activated HIGH pump rates will not de-activate the tool, with the large TFA's that the tools have NOT enough pressure could be applied to the opening ball to push it through, this can only be achieved by dropping the steel de-activation balls

Trouble Shooting , PBL Contacts and Operating Diagrams

1. If the tool has not opened after dropping the opening ball, continue to 100% excess of string volume before dropping the closing balls to ensure tool is cycled correctly.
2. When pumping LCM, it might be possible to block the circulating ports(very unlikely), check the particle size of the LCM compared to the size of the circulating orifice. Blockage could possibly cause the pressure to rise and blow the ball through the ball seat, therefore closing the tool.
3. If this should happen, Drop the Steel De-Activation Balls before dropping another Opening Activation Ball.

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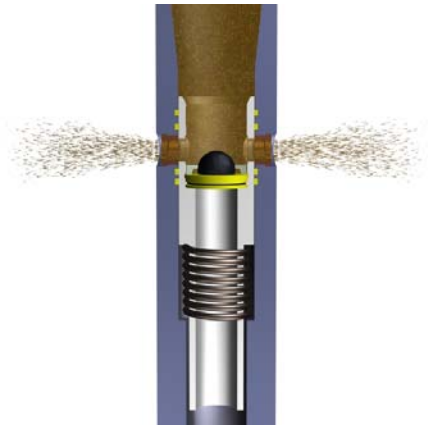
Operational Diagrams : -

1) Tool Closed : Recorded Pressure Before Ball Drop ……..?
2) Activation ball Dropped & lands on seat.



3)PUMPS STARTED, SLEEVE MOVES DOWN & TOOL IS OPEN. FLOW THRU' PORTS
Recorded pressure with Ports/PBL Open ……?

4) TWO x DEACTIVATION STEEL BALLS DROPPED, THESE WILL MIGRATE TO PORTS AND CUT OFF FLOW, WHEN PUMPS STARTED ALL PRESSURE IS ON THE ACTIVATION BALL

5) STEEL BALLS EXERT PRESSURE AND DE-ACTIVATE THE TOOL
ALL BALLS FALL INTO BALL CATHER AND SLEEVE MOVES UP TO CLOSE OFF THE PORTS AND CIRCULATION IS NOW BACK TO THE BIT.
Recorded pressure After De-activation ……..?

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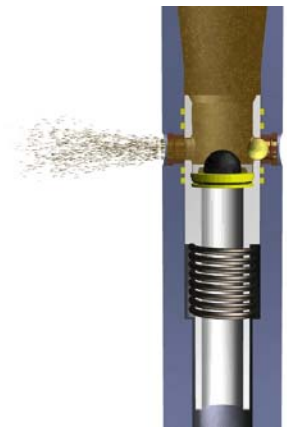
AUTOLOCK FEATURE



Locking Ball has been dropped and landed in Port correctly-Flow Thru' ONE port only. NB: FOR Tripping ONLY not for normal pumping.

6)AT ANY TIME 2 X STEEL BALLS CAN BE DROPPED TO DE-ACTIVATE THE TOOL IN NORMAL WAY (THE LOCKING BALL IS FIRST FORCED THRU' PORT INTO THE ANNULUS & Then tool de-activates in normal way)