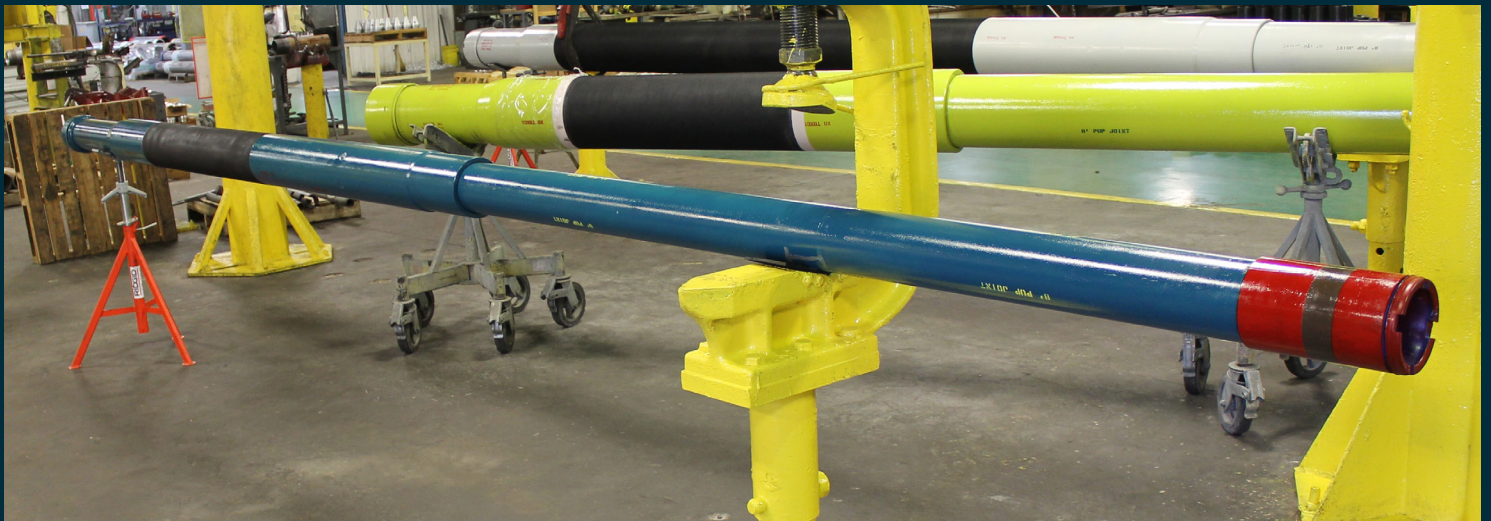


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## Packer Stage Collar Running Instructions

# Packer Stage Cementing Collar

**Recommended running procedures for the Forum Energy Technologies packer stage cementing collar (PSC), utilizing the first-stage sealing plug, free-fall inflate/opening device, and closing plug.**

1. Install the float shoe and one or two joints of casing.
2. Install the float collar.
3. Install the packer stage cementing collar at the desired point in the casing string.

Centralization recommendations near PSC:

- Centralizers should be placed above and below the tool, as close to the tool as possible.
- Box end - Ideally on the pup joint just above the tool, secured with one or more set-screw type stop collars, or immediately above the pup joint if prior assembly and centralizer type do not allow for installation above the tool.
- Pin end – On the casing coupling immediately below the pin end if using a hinged bow-spring centralizer, or secured immediately below the coupling secured with set-screw stop collars.
- Solid-body centralizers are preferred, if the OD is greater than the PSC maximum OD. Otherwise bow-spring centralizers should be used.

4. When casing is landed, circulate and condition for cementing.
5. Mix and pump first-stage cement.
6. After first-stage cement has been pumped, drop first-stage sealing plug and begin displacement. (This plug may or may not be pre-loaded in the plug container, depending on its compatibility with the dimensions of the plug container.) Note that better displacement of the 1st-stage plug can be realized by pumping the same density fluid immediately above the plug as below the plug. Preferably a small volume of cement washed out on top of the plug increases displacement efficiency.

**Displacement fluid should not contain LCM or other large particles that might prevent the FFOD from sealing properly. If the displacement fluid is heavier than 16 ppg, it is highly recommended that a lighter-weight fluid be placed at least 200 ft. above the tool to 100 ft. below to allow the FFOD to travel faster and seal properly.**

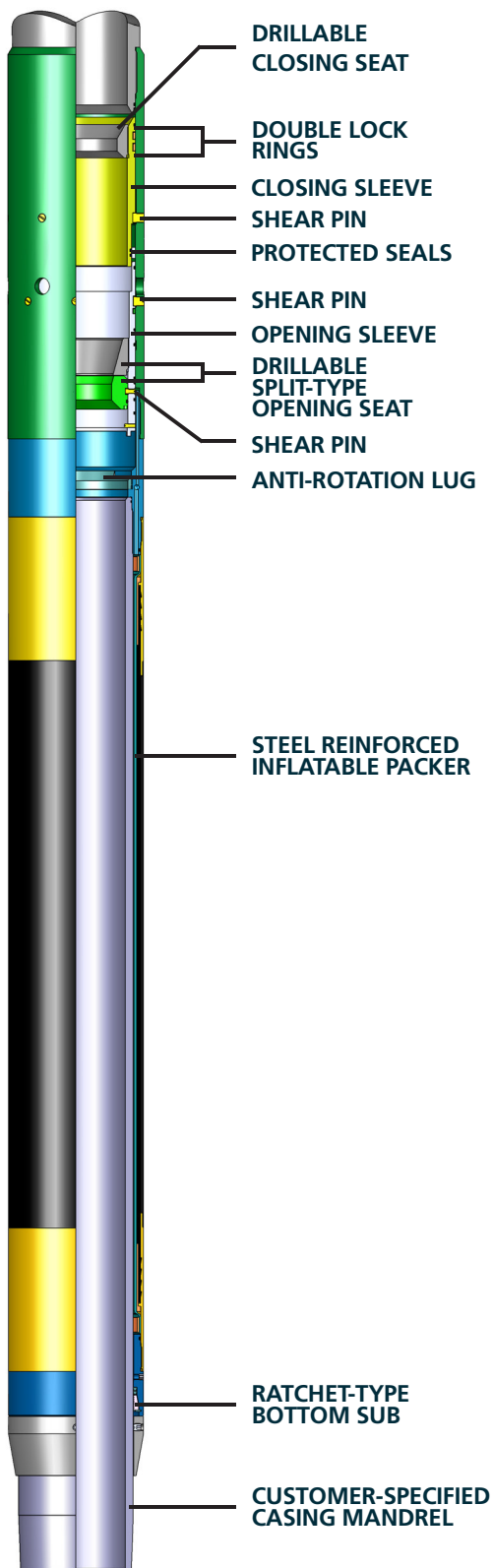
7. Pump calculated amount of displacement. Avoid stopping the pumps during displacement & maintain normal displacement rates for the applicable casing size as the plug passes through the tool as required to achieve and maintain optimum turbulent flow.
8. When plug lands apply pressure to 500 psi over circulating pressure.
9. After plug has landed, check floats for flowback.
10. With floats holding, break open cap on cement head and ensure that casing is full of fluid. If not, fill through cement head.
11. Drop free-fall inflate/opening device.
12. Allow time for the device to gravitate to the tool. Normal rate is approximately 200 ft. per minute.
13. When free-fall inflate/opening device has landed in the tool, slowly pressure to 250 psi to begin inflating the packer. Hold this pressure for two minutes. At 100 psi increments, increase the pressure and hold momentarily at each increment. Continue this process until a sudden pressure drop occurs, indicating the ports in the packer stage collar are open. (See chart on accompanying page for opening pressures for different sizes.)
14. Circulation can now be established through the packer stage collar. Mix and pump second stage cement.
15. After second stage cement has been pumped, drop the closing plug. (Plug may or may not be pre-loaded depending on its compatibility with the dimensions of the plug container. Caution: if the closing plug is pre-loaded, excessive suction forces may be applied to the plug due to cement falling inside casing, so the retaining pin must be very strong.) Begin displacement.
16. As the plug approaches the tool, slow displacement to 2 BPM.
17. When the plug lands in the packer stage collar, increase the pressure to 1200 to 1500 psi above final circulating pressure. (See chart on accompanying page for closing pressure for different sizes.) Hold this pressure for a few minutes. Increase the pressure to 500 psi over closing pressure and hold momentarily, then increase to 1000 psi over closing pressure and hold momentarily.
18. Slowly bleed off pressure and check for back flow.
19. With no flowback, the job is now complete.

## Packer Stage Cementing Collar Recommended Operating Pressures

Size	Opening Pressure	Closing Pressure
4 1/2 "	900 psi	1500 psi
5 "	900 psi	1500 psi
5 1/2 "	1500 psi	1500 psi
6 5/8 "	900 psi	1500 psi
7 "	1500 psi	1500 psi
7 5/8 "	900 psi	1500 psi
8 5/8 "	900 psi	1500 psi
9 5/8 "	900 psi	1500 psi
10 3/4 "	800 psi	1200 psi
13 3/8 "	600 psi	1200 psi

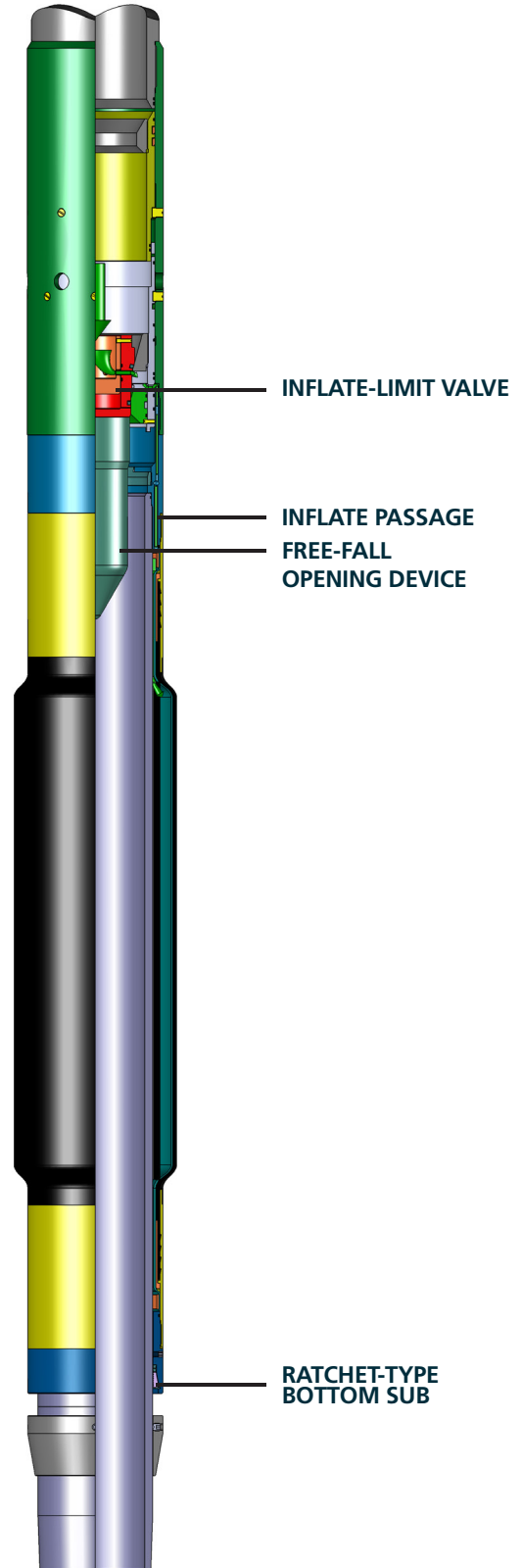
**Note:** Opening and closing pressure values are based on in-house testing, some variances may need to be implemented under certain well conditions. Closing pressures should be considered minimum values, and can be exceeded if casing design strength permits.

# Packer Stage Cementing Collar



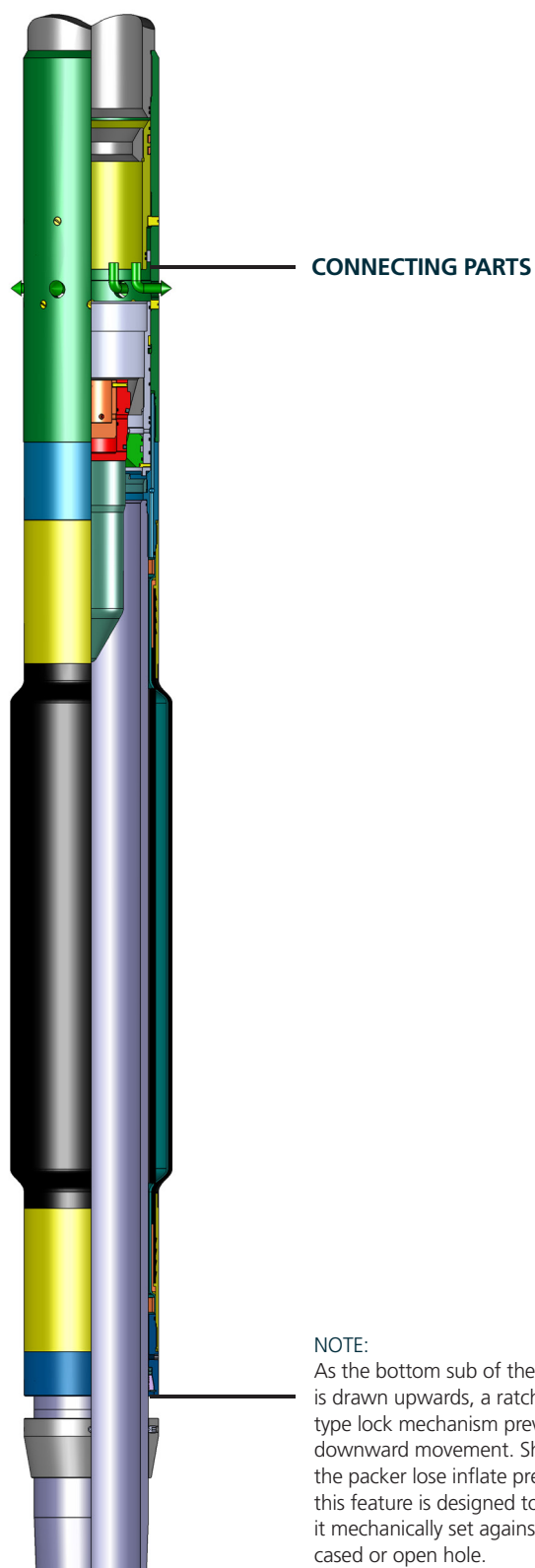
## Running in Hole

Shows packer stage cementing collar in running position with opening and closing sleeves pinned in place. Lower section of split-type opening seat isolates inflate passage preventing premature inflation of the packer.



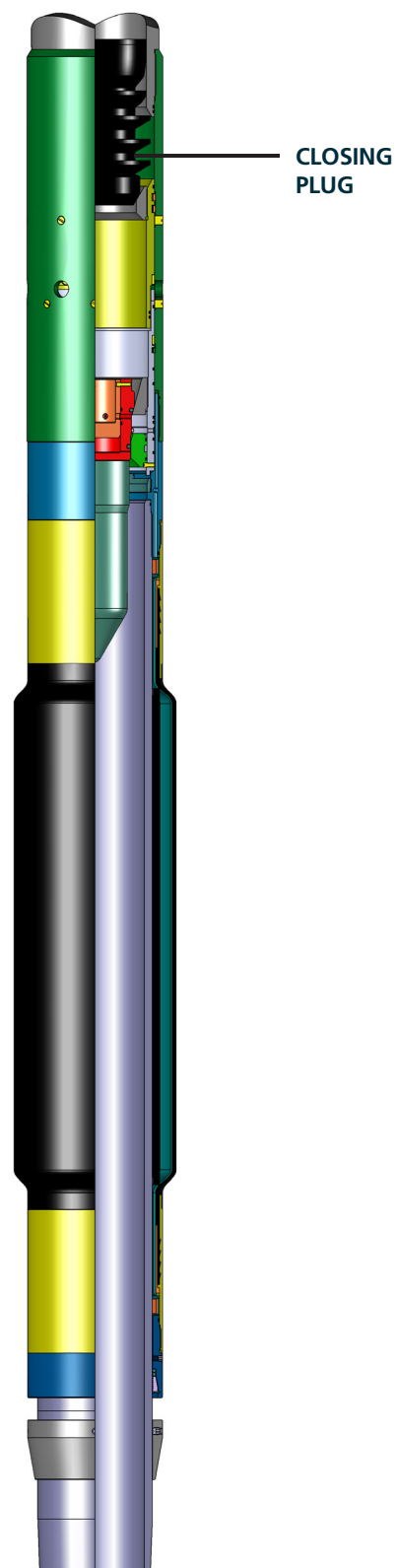
## Inflating Element

The free-fall opening device enters split-type opening seat shearing the pins in the lower section. This allows lower section to move down exposing the inflatable packer element to the fluid and pressure inside the casing. Fluid enters the packer element through the double-seal in the free-fall opening device and the split-type opening seat and inflation passage in the tool body.



#### Opening Cement Ports

With the free-fall opening device in place, pressure applied to the casing shears the pins in the opening sleeve and moves it downward to the open and locked position. This movement seals off the inflate passage and permanently traps the correct inflate pressure in the packer. The inflate-limit valve in the free-fall opening device insures that the correct inflate pressure is achieved but never exceeded when opening tool.



#### Closing Cement Ports

Once cement has been displaced and the closing plug seats in the closing sleeve, additional pressure is applied to the casing. This pressure shears the pins and allows the closing sleeve to travel downward to its final closed and locked position. The pressure required to do this varies with the tool size and the type of job performed.

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