



Davis Stage Cementing Collars and Equipment

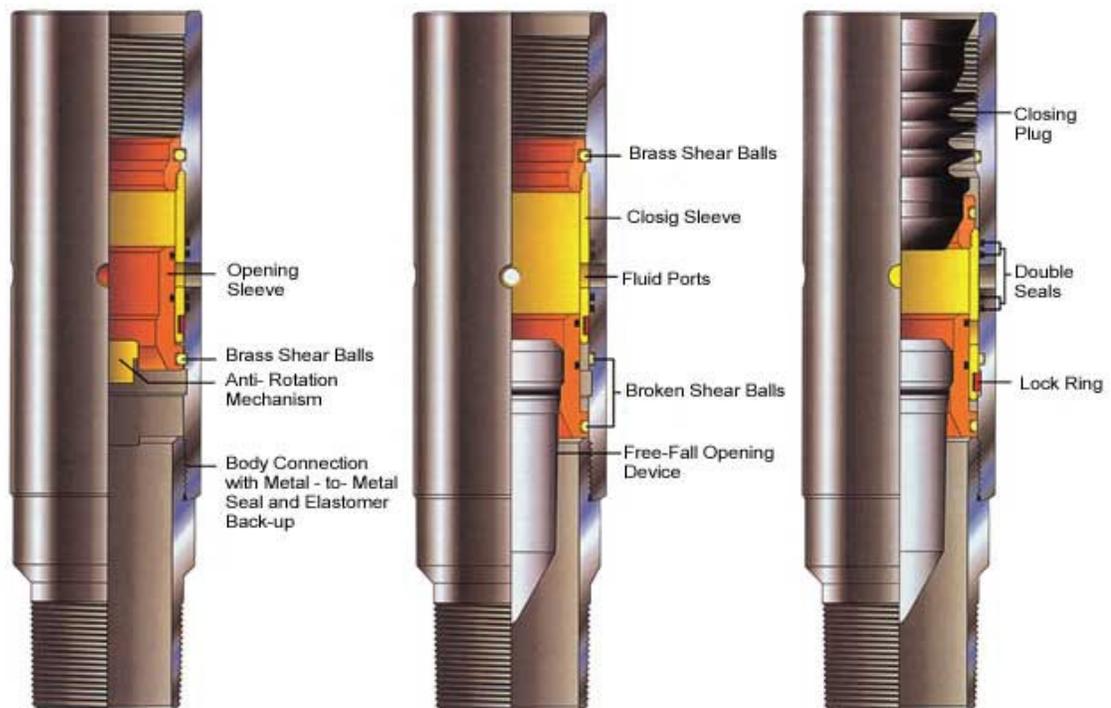
For over 20 years, Davis stage cementing collars have been used by operators for their special applications. Now Davis offers three stage collar designs: a mechanically opened tool, a hydraulically opened tool, and a mechanically opened tool with a built-in inflatable packer.

Type 778 MC Mechanical Stage Cementing Collar

While now established as a field-proven tool, this tool continues to be the subject of research and development to find new materials for faster drillout time, greater PDC bit drill-ability and better metal-to-metal sealing.

Features of the 778 MC Stage Cementing Collar include:

- Tools can be made from material grades up to 135,000 psi minimum yield, including material suitable for sour gas service.
- All parts are custom fitted and subjected to extensive quality control standards for maximum performance downhole.



Running Position

Pin and Box threads are identical to the casing threads. Stage collar integral connection is designed for gas tightness. Seals on opening sleeve provide internal and external pressure integrity across the fluid ports.

Opened Position

Opening device has landed and, after pressure is applied, the lower set of shear balls is broken and the sleeve shifts downward to uncover the fluid ports. Pumping operations can now be conducted through the stage collar.

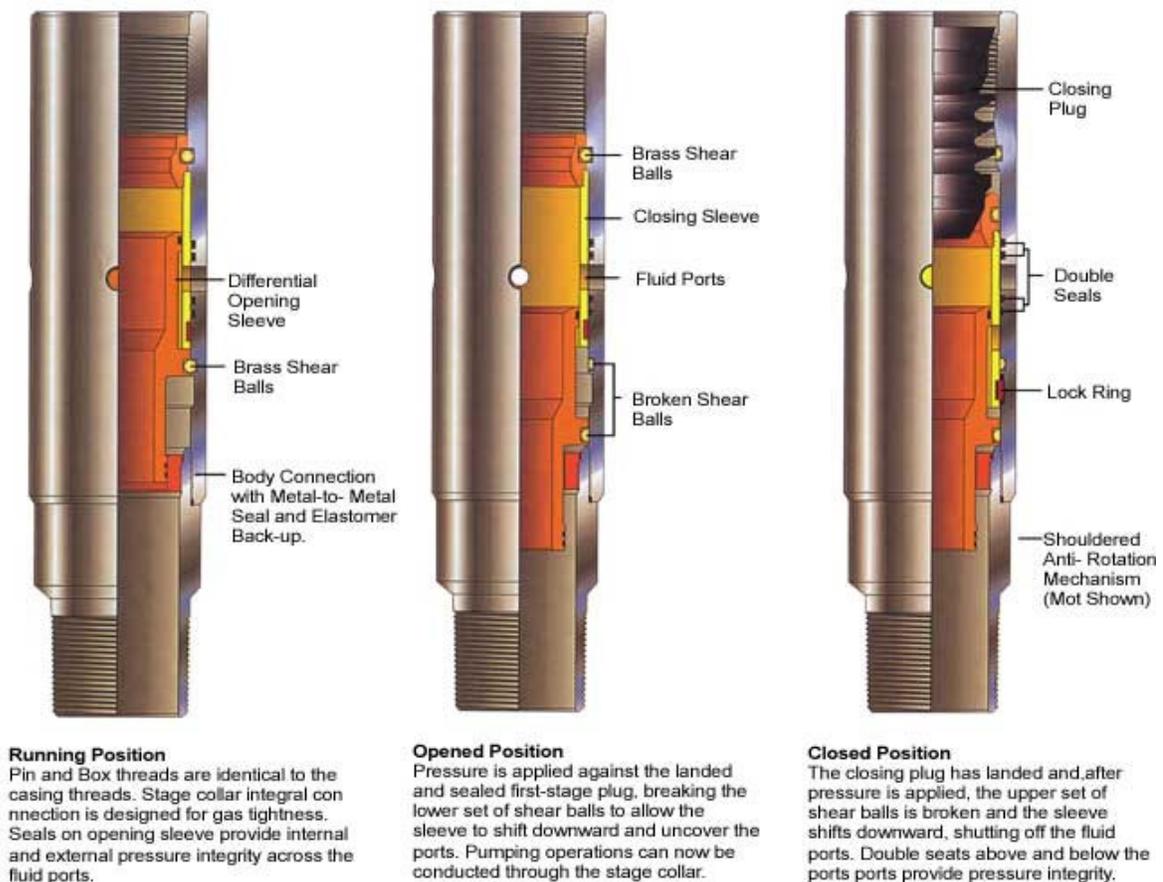
Closed Position

The closing plug has landed and, after pressure is applied, the upper set of shear balls is broken and the sleeve shifts downward, shutting off the fluid ports. Double seals above and below the ports provide pressure integrity.

- The connection that adjoins the stage collar body and the bottom sub effects a metal-to-metal seal and engages a back-up elastomer seal, the two of which are designed to provide gas-tight pressure integrity.
- No welds are used on any portion of the tool.
- The reduced length of the tool minimizes the effect of bending stresses.
- The seals providing internal and external pressure integrity are housed in the stage collar body and remain stationary throughout operation, minimizing chances of their being damaged.
- The pressure-relief design prevents fluid trapping and compression between the opening device and the closing plug during the closing phase of the tool's operation.
- The closing sleeve is held in the closed position by an internal lock ring.
- Both the opening and closing sleeves lock against rotation for easy drill-out.
- A minimum amount of aluminum and rubber are the only materials encountered during drill-out. Plug sets for four different cementing applications are available.

Type 777 HY Hydraulic-Opening Stage Cementing Collar

This stage collar features an opening sleeve with area differences on opposite ends that allows it to be manipulated hydraulically. The closing sleeve is identical to the one contained in the Davis Type 778 MC Mechanical Stage Cementing Collar. The development and introduction of this model was spurred on by the tremendous upswing in horizontal drilling activity that has occurred in recent years. The hydraulic-opening feature makes this tool's use very practical in horizontal wells.



The elimination of the need to use a mechanical opening device has several other merits. Casing runs in highly deviated wells can now be two-stage cemented without having to use continuous displacement type plugs. In certain applications, liners run with drill pipe can be run in conjunction with one or several inflatable packers and used to isolate and selectively cement certain casing intervals. Slotted or pre-drilled liner can be run below a Davis inflatable packer/hydraulic stage collar assembly, allowing cement to be pumped above the packer and isolated from highly sensitive producing zones.

Along with all the features inherent in the 778 MC Stage Cementing Collar, the Type 777 HY offers:

- Effective differential area on the opening sleeve that generates a high opening force while requiring only optimal pressure to do so.
- The ability to open immediately upon the completion of first-stage cement displacement.
- Opening pressure values that can be adjusted at the time of assembly to assure that all inflatable packers or other hydraulic tools present in the casing string will be triggered at the correct juncture.

Stage Cementing Plug Systems

Two-Stage Cementing with the Type 778 MC using a First-Stage Sealing Plug, Free-Fall Opening Device, and Closing Plug	Two-Stage Cementing with the Type 778 MC using a By-Pass Plug, Shut-Off Plug and Baffle, Free-Fall Opening Device, and Closing Plug*
 <p>CLOSING PLUG</p>  <p>FREE-FALL OPENING DEVICE</p>  <p>FIRST STAGE SEALING PLUG</p> <ol style="list-style-type: none"> 1. A Davis float shoe and float collar along with the Type 778 MC Stage Collar, are installed in the casing string and the casing is run to bottom. 2. Circulation is established and first-stage cement is mixed and pumped. 3. The first-stage sealing plug is launched and cement is displaced. At the conclusion of displacement, the first-stage sealing plug lands and effects a seal against the Davis float collar. No baffle is required. 4. The free-fall opening device is dropped and allowed to gravitate to position. Pressure is applied to the casing and the stage collar is opened. 5. Circulation is established and second-stage cement is mixed and pumped. 6. The closing plug is launched and cement is displaced. At the conclusion of displacement, the closing plug lands and effects a seal in the stage collar. Pressure is applied to the casing and the stage collar is closed. 	 <p>CLOSING PLUG</p>  <p>FREE-FALL OPENING DEVICE</p>  <p>FIRST STAGE SHUT-OFF PLUG</p>  <p>SHUT-OFF BAFFLE</p>  <p>BY-PASS PLUG</p> <ol style="list-style-type: none"> 1. A Davis float shoe and float collar along with the Type 778 MC Stage Collar, are installed in the casing string and the casing is run to bottom. The yellow shut-off baffle is installed in the casing string at least (1) one joint above the Davis float collar. If API threads are run (8RD or Buttress) the baffle can be installed in the "J" section of a coupling. If premium threads are run, a separate baffle collar must be run. 2. After the hole is conditioned, the by-pass plug with the yellow nose piece is launched ahead of first-stage cement. This plug will pass through the shut-off baffle and land on any Davis manual or self-fill float collar. Once landed, approximately 50 psi will invert the wipers on the by-pass plug and allow cement to pass. 3. After cement is mixed and pumped, the shut-off plug is launched and cement is displaced. At the conclusion of displacement, the shut-off plug lands and effects a seal in the shut-off baffle. 4. The opening of the stage collar and the ensuing second stage cementing and closing of the stage collar are carried out identically to that described for two stage cementing with first stage sealing plug. <p>*NOTE: When using the Type 777 HY Hydraulic-Opening Stage Collar, the standard plug system is a first-stage shut-off baffle, a first-stage shut-off plug, a contingent opening device, and a closing plug. A first-stage latch-in plug with a special Davis float collar is available on request.</p>

Continuous Two-Stage Cementing with the Type 778 MC using a By-Pass Plug, Pump-Down Opening Plug, and Closing Plug.



CLOSING PLUG



PUMP-DOWN
OPENING PLUG



BYPASS PLUG

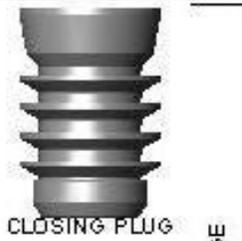
In this application, the by-pass plug follows first-stage cement and it is advisable to run a minimum of two joints between the float shoe and float collar.

1. After first-stage cement is mixed and pumped, release the by-pass plug and begin displacing. Once the calculated volume of displacement fluid between the stage collar and the float collar has been pumped, less a pre-determined amount acting as a safety buffer, release the pump-down opening plug.

2. As the pump-down opening plug approaches the stage-collar, slow the pump rate to 1-2 bbls./min. Once the plug has landed in the opening seat (indicated by a pressure increase), apply pressure to the casing to open the stage collar.

3. Once the stage collar is open, second-stage circulating, cementing, and closing operations may be carried out as previously described.

Three-Stage Cementing with the Type 778 MC and the Type 778 MC-3S Stage Cementing Collars



CLOSING PLUG



FREE-FALL
OPENING DEVICE



CLOSING PLUG



FREE-FALL
OPENING DEVICE



FIRST STAGE
SEALING PLUG

The Type 778 MC-3S stage collar is identified by its red markings and is always run as the lower of the two tools. Its free-fall opening device and closing plug are also identified by their red markings. The upper stage collar is always the Type 778 MC and the free-fall opening device and closing plug for it are standard. The first-stage sealing plug is standard and will pass through both stage collars and land and seal on any manual- or self-fill Davis float collar. First, second, and third-stage cementing and displacing operations, including opening and closing both tools, are carried out as previously described.