LS-15™ Liner Hanger System
Dril-Quip introduces a new generation of Liner Hanger and Liner Hanger Packer, utilizing Dril-Quip’s field-proven subsea technology.

The Dril-Quip LS-15 Liner Hanger products are built to perform under a wide range of conditions, and are ideally suited for long reach, high angle, horizontal and ultra-heavy liner completions. This premium liner hookup incorporates many innovative tool designs, ensuring reliable operation and service in many of today’s most demanding wells.

Rugged, Durable, Built to Drill Down . . .

The LS-15 Liner Hanger System has been purpose-built for true drill-down applications. Operators in many areas of the world experience considerable difficulty with wellbore stability that may cause hole problems. The LS-15 Liner Hanger System is capable of accommodating, depending on the size requested, from 20,000 to 160,000 ft-lb of rotational torque through the tool, enabling the operator to rigorously “drill” the liner into the hole.

. . . With Subsea Annulus Sealing Technology

The LS-15 Liner Hanger System is available with an integral single-trip packer. This proprietary packer system uses the innovative LS-15 Liner-to-Casing Seal and incorporates a variation of the true metal-to-metal sealing technology used in Dril-Quip’s highly successful, patented SS-15® Subsea Wellhead System.

The LS-15 Packer Seal is designed and constructed to maximize flow-by area and resist damage due to swabbing while tripping into the wellbore and circulating. The packer is recessed in the running position and the elastomer backup seal is molded to the metal carrier. This design greatly reduces rig expense and operational risk when compared to more conventional liner hanger packers. The LS-15 Packer Seal also ensures high pressure and high temperature (HPHT) metal-to-metal sealing in the most demanding wellbore environments for the life of the well.
The liner hanger is run to total depth with the slip in the retracted, running position. The hanger body is then slacked off onto the slip. The sharp teeth on the slip will secure the liner hanger to the supporting casing. At light loading, the dull inner slip teeth will not yet grab the cone as it slides behind the slip.

When released from its locked-down running-in position, the slip will spring open and come into contact with the ID of the supporting casing.

As the loading increases and travel progresses, the inner teeth begin to form small shoulders on the liner hanger slip cone. As the shoulders increase in size, the downward travel of the liner hanger is stopped before loading gets high enough to collapse the liner hanger body or burst the supporting casing.

The LS-15 System Incorporates a Unique Hanger Slip Design

**Dril-Quip’s** proprietary one-piece C-Ring Hang-Off Slip has been developed to greatly reduce the amount of hoop stress placed on the supporting casing by the liner load. **Dril-Quip’s** circumferential slip design distributes the liner load much more evenly around the casing than conventional multi-slip segment hanger systems. The C-Ring Slip also incorporates a method of controlling the friction between the slip and the hanger body. This “controlled friction” design redirects hoop load into axial load, drastically reducing the collapsing load on the hanger body and burst pressure on the casing. This combination of stress loading permits the LS-15 Liner Hanger System to hang longer and much heavier liners than possible with conventional technology.
**Features and Benefits**

**LS-15 System Features**

The LS-15 Liner Hanger System features field-proven technology that incorporates the following:

- High strength, high pressure, high load-carrying capacity
- Metal-to-metal Annulus Packer Seal for high pressure service
- No hydraulic or mechanical devices on the hanger body, minimizing leak paths
- Large slip area and controlled friction minimizes stress in the supporting casing
- All hangers are automatically centralized when C-Ring Slip is set
- Bypass flow area is the same after setting the liner hanger slip as in the running-in position
- Maximizes circulating flow-by areas for efficient cementing operations
- The LS-15 Liner Hanger System can be sized and configured to customer specifications

**LS-15 Packer Seal Features**

- Integral, one-trip metal-to-metal sealing design
- Anti-swab design for faster running speeds and higher circulating rates, and resists mechanical damage while running
- Standard service for many sizes is 10,000 psi at 400°F; higher pressures are achievable and are only limited by the capacity of the packer mandrel and casing

**Rotational Option**

With the addition of a rotating bearing assembly, the LS-15 Liner Hanger can be rotated with the slips in the set position during the cementing operation. This feature can assist in completing a successful cement job.
Dril-Quip thoroughly researched the difficulties encountered by operators during the typical liner hanger installation and engineered a Liner Hanger System that solves many of these problems:

<table>
<thead>
<tr>
<th>Typical Liner Hanger Installation Problems</th>
<th>Dril-Quip’s Engineered Solutions</th>
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<tbody>
<tr>
<td>The liner hanger slip system can prematurely activate. The running tool can prematurely release.</td>
<td>The LS-15’s hydraulic slip-setting system is isolated from drill pipe pressure while running into the hole, allowing pressure without premature activation.</td>
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<tr>
<td>Conventional liner hangers’ hydraulic circuits have access ports that are exposed to the wellbore environment.</td>
<td>All hydraulic functions are contained in the LS-15 Running Tool, eliminating access ports on the hanger body, so that no seals or ports are exposed to the wellbore environment.</td>
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<tr>
<td>Packer setting assembly and cementing system cannot be picked up out of PBR for running tool release verification.</td>
<td>The LS-15 Running Tool provides a one-time unlimited distance pickup for release verification.</td>
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<tr>
<td>High loads are required to set packer seal.</td>
<td>The LS-15’s packer seal is initially set with minimum weight, then energized to create metal-to-metal seal with test pressure.</td>
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<tr>
<td>Typical liner hangers have poor liner-to-casing sealing in HP/HT environments.</td>
<td>Dril-Quip’s HP/HT metal-to-metal Liner Packer Seal was designed utilizing our extensive experience in subsea wellhead sealing technology. The seal is rated to burst pressure of the next outer casing and can be tested to ISO Production Packer Performance Standards for the most demanding well environments.</td>
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<tr>
<td>Slower running and cementing operations are required to avoid packer seal “swab-off.”</td>
<td>Packer seal is molded onto a steel seal carrier and cannot “swab off.”</td>
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<tr>
<td>Most running tools cannot rotate the liner hanger adequately to facilitate installation.</td>
<td>Dril-Quip’s LS-15 Liner Hanger System incorporates reaming and drilling features as standard. The running tool provides high torque capacity equal to or greater than most drill pipe and liner connections.</td>
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<td>Hydraulic release running tools have left-hand mechanical “backup” releasing system.</td>
<td>Dril-Quip’s Hydraulic Release Running Tool has a right-hand hydromechanical “backup” releasing system. Therefore, left-hand backlash will not release the running tool.</td>
</tr>
<tr>
<td>Conventional slip segments require multiple rows of multiple slip segments to get the required slip-load capacity.</td>
<td>The LS-15 slip system utilizes Dril-Quip’s field-proven one-piece C-Ring Slip design, which distributes the liner load more efficiently than conventional slip design.</td>
</tr>
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<td>It is difficult to observe at the surface the release of the liner wiper plug from the running tool.</td>
<td>Dril-Quip utilizes an innovative time-delayed plug-releasing assembly for positive indication of liner wiper plug separation from the running tool.</td>
</tr>
<tr>
<td>It is difficult to release conventional hydraulic running tools with drill pipe in tension.</td>
<td>Dril-Quip’s Running Tool releases hydraulically in tension, neutral or compression.</td>
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LS-15 Running Tool

• The system incorporates high torque capacity for drill-down, wash-down applications and rotation during cementing operations
• The running tool incorporates a port isolation system that eliminates the possibility of prematurely setting the slip or releasing from the hanger while running into the hole
• The hydraulics to set the liner hanger slip are built into the running tool, not as part of the hanger system, eliminating the need for a hydraulic port through the body of the liner hanger
• The running tool is hydraulically released from the liner hanger and also incorporates a unique right-hand hydro-mechanical secondary release

Running Procedures

In order to solve many of the problems encountered during liner installation, Dril-Quip has simplified the running procedures of the liner hanger for exceptional ease of use.

1. Trip into hole to liner setting depth.
2. Launch setting ball from cementing manifold, pump ball to seat in running tool.
3. Pressure to 1,000 psi, shift the port isolation sleeve and release liner hanger slip, slack off liner weight onto slip.
4. Pressure to 2,000 psi to release running tool from liner hanger.
5. Reduce drill pipe pressure to 500 psi to accomplish soft release of setting ball. Pick up drill pipe string approximately 4” to check for release of running tool, which is confirmed when drill pipe pressure bleeds off.
7. Launch pump-down plug from cementing manifold and displace to liner wiper plug.
8. Pressure to 1,000 psi, release the liner wiper plug from the running tool.
9. Continue fluid displacement and pump the plug set to landing collar.
10. Pick up running tool to release packer setting assembly and slack off weight to set packer seal.
11. Pressure down the annulus to pressure assist setting and testing the packer seal.
12. Pull out of hole with running tool.
Dril-Quip’s Cementing Manifold is designed with a unique head that contains four pockets at circumferentially placed locations. This arrangement eliminates stacked-plug launching heads and their corresponding height requirements, allowing for a more compact design. The operator can load releasing balls and pump-down plugs in three of the four pockets easily on the rig floor. The manifold eliminates the need to break any connections when loading and launching releasing balls or pump-down plugs. The manifold allows circulating the hole through the fourth bypass pocket located in the head.

Dril-Quip’s Cementing Manifold can be made up in the string prior to running the liner hanger for ease of operations, and can accommodate rotational torque so that drilling the liner hanger into position, if required, is not a problem.

Dril-Quip’s Cementing Manifold is compact and easy to operate to facilitate liner hanger installation.

**System Features**

- Standard manifold rated to 1 million lbs tensile load capacity with 10,000 psi working pressure and maximum torque capacity of 68,000 ft-lb
- High-capacity manifold rated to 2 million lbs tensile load capacity with 10,000 psi working pressure and maximum torque capacity of 100,000 ft-lb
- Pneumatically operated remote-control manifold available upon request
- Compact and easy to operate
- Accommodates one releasing ball and two pump-down plugs (fourth pocket is for bypass circulation)
- Allows circulation through the top drive and/or cement line, even when fully loaded, and while rotating the landing string
- Simplifies operation when circulating the hole
- Plugs and balls can be loaded on the rig