XL Systems developed the integral-threaded XLF connector over 30 years ago as a cost-effective alternative to large-bore weld-on connectors. The industry has evolved to more demanding casing and connector performance requirements and the XL Systems product line has evolved to meet these changing conditions. However, the original XLF connector still uniquely satisfies a market segment for large-bore, flush-profile connectors with full pipe body pressure ratings.

The XLF connector design, like all subsequent XL Systems wedge thread connector designs, is a dovetail wedge thread design. The tapered wedge thread design provides for deep stabbing, low-torque spin-up, and fast make-up times. The dovetail thread shape keeps threads engaged even under extreme overload conditions. XLF connectors feature a robust metal-to-metal primary pressure seal plus a secondary thread-fit seal.

XLF connectors are generally supplied in an integral-threaded configuration with pin and box threads machined directly onto the pipe ends. This produces the ideal connector geometry of a true flush OD and flush ID profile. Higher-strength, weld-on XLF-RB and XLF-HS connectors are also available based on the original XLF design.

XLF connectors have more than 30 years of successful field service history in onshore, offshore shallow water, and offshore deepwater conductor, surface casing, and liner string applications.

XLF, XLF-RB, and XLF-HS connectors are available in 20- to 48-inch sizes suitable for onshore and offshore surface casing and liner string applications.

Typical Applications

- Surface casing strings
- Downhole liner strings
- Slim-hole wells with tight annular clearances
- Drilling with casing
XLF Connectors

Unique Features and Benefits

Wedge Thread Technology
Wedge thread connectors have unique make-up and performance characteristics which enable robust and reliable field performance: deep-stabbing, low-torque spin-up, slim connector profiles, high strength efficiency, and high torque resistance.

Dovetail Thread Shape
Negative load flank and stab flank angles produce a dovetail thread shape which prevents thread jumpout under extreme loading conditions.

Dual Seal Design
The XLF connector primary pressure seal is a metal-to-metal seal on the ID side of the threads near the pin nose. A secondary thread-fit seal provides backup pressure resistance.

Full Pipe Body Pressure Ratings
XLF connector internal and external pressure ratings match full pipe body capacity in most configurations. Note that XLF connectors are intended for liquid pressure service, not gas.

Proven Performance
XLF connectors have an extensive and successful field service history spanning over 30 years and including a wide range of onshore and offshore conductor and casing string applications.

Three Connector Configurations

**XLF Connectors**: Integral-threaded pin and box connectors produce the ideal connector geometry of a true flush ID and true flush OD profile. Connector tension, compression, and bending strength efficiency ranges from 50% to 70% of full pipe body ratings depending on size. Integral-threading is the most cost-efficient large-bore connector design.

**XLF-RB Connectors (Reduced Bore)**: Standard XLF connector threads are machined on thicker-wall ring sections welded to pipe ends. XLF-RB connectors have strength ratings that meet or exceed full pipe body strength. The connector profile is flush OD with a slightly reduced bore dimension.

**XLF-HS Connectors (High Strength)**: Standard XLF connector threads are machined on higher-grade ring sections welded to pipe ends. Weld-on rings match pipe body dimensions producing a flush OD and flush ID connector profile. The higher material strength increases connector strength ratings to meet or exceed pipe body strength in many configurations.
XLF Connectors

20- to 48-inch Sizes

Figures on this page show the integral-threaded XLF connector configuration with pin and box threads machined directly onto the pipe joint ends. This produces the ideal connector geometry of a true flush OD and flush ID profile. Integral-threaded XLF connectors have internal and external pressure ratings that match full pipe body ratings. Connector tension, compression, and bending capacities typically range from 50% to 70% of pipe body capacity.

The XLF connector is a dual-seal design with an internal metal-to-metal primary pressure seal. The tight-fitting tapered wedge thread provides a secondary thread-fit seal. XLF connectors are intended for use on casing strings where liquid pressure containment is a primary design driver.

Handling large-bore, flush OD connectors can be a challenge. XLF connectors can be supplied with multi-function lifting devices called ‘PDLs’ which act as a thread protector, drive adapter, and include a lift shoulder for handling joints with standard casing running tools like elevators.

XLF connectors share favorable field make-up characteristics with all XL Systems wedge connectors: fast make-up, deep stabbing, low-torque spin-up, high torque capacity, and built-in resistance to unintended back-off.

XLF connectors make-up in approximately 3 turns from stab to full make-up and do not require a mechanical anti-rotation device to prevent unintended connector back-off.

**Integral-Threaded Pin**
Threads are machined directly onto pipe joint ends

**True Flush OD Connector Profile**

**True Flush ID Connector Profile**

**Integral-Threaded Box**

**Visual Make-up Indicator**
Shoulder gap verifies correct make-up position

**Wedge Thread Design**
Narrow thread near end face and wider thread near connector back shoulder

**Dovetail Thread Shape**
Negative load flank and stab flank angles create a dovetail fit

**Secondary Thread Fit Seal**
Close-tolerance thread design creates a secondary pressure seal

**Metal Seal**
Internal metal-to-metal primary pressure seal
XLF-RB Connectors

20- to 48-inch Sizes

Illustrations on this page show the weld-on XLF-RB (reduced bore) connector configuration. Standard XLF connector pin and box profiles are machined into thicker-wall ring sections welded to pipe joint ends. The increased wall thickness at the pin and box connectors increases connector strength to meet or exceed full pipe body strength in most configurations.

XLF-RB connectors are intended for use in heavily-loaded surface casing string applications where a flush OD connector profile, full pipe body pressure ratings, and full pipe body structural strength are desired or required. The grade and wall thickness of the weld-on connector rings can be optimized to meet wide-ranging connector strength design criteria.

Since XLF-RB connectors use the same wedge thread design as standard XLF connectors, handling and make-up characteristics are identical to XLF connectors: fast make-up, deep stabbing, low-torque spin-up, high torque capacity, and built-in break-out resistance.

XLF-RB connectors make-up in approximately 3 turns from stab to full make-up and do not require a mechanical anti-rotation device to prevent unintended connector back-off.
XLF-HS Connectors

20- to 48-inch Sizes

Illustrations on this page show the weld-on XLF-HS (high-strength) connector configuration. Standard XLF connector pin and box profiles are machined into higher-grade ring forgings welded to pipe joint ends. The increased material strength at the pin and box connectors increases connector strength to meet or exceed full pipe body strength in many configurations.

XLF-HS connectors are intended for use in deviated strings or other heavily loaded surface casing string applications where flush OD and flush ID connector profiles are desired and where integral-threaded XLF connector strength ratings do not meet design criteria. Several standard forging grade options are available to match XLF-HS connector strength ratings to project design criteria.

Since XLF-HS connectors use the same wedge thread design as standard XLF connectors, handling and make-up characteristics are identical to XLF connectors: fast make-up, deep stabbing, low-torque spin-up, high torque capacity, and built-in break-out resistance.

XLF-HS connectors make-up in approximately 3 turns from stab to full make-up and do not require a mechanical anti-rotation device to prevent unintended connector back-off.
**PDL Subs**

A common method of running and handling pipe with flush-profile XLF, XLF-RB, and XLF HS connectors is to use a PDL (Protecting, Driving, Lifting) sub. This device is simply a short length of pipe threaded with a complete connector thread. The PDL device is a multi-function tool, serving as a thread protector, a drive sub for pipe installed by pile driving, and as a lifting tool or ‘lift nubbin’.

The PDL sub provides robust protection against impact damage to the connector threads, metal seals, and thin end faces during transportation and handling. Lifting holes on the PDL provide convenient options for lifting and handling single joints during transportation and bringing joints to the rig floor. A lifting ring on the PDL provides an interface for elevators lifting single joints into the derrick and for lifting and lowering the full string weight on the rig.

In pile driving applications, pile driving forces are transmitted through the XLF connector threads. A properly installed PDL sub is required at the top end of each joint during driving to serve as the interface between the conductor string being driven and the pile driving hammer or drive chaser. It is noted that XLF connectors are rarely used in driven conductor applications since the introduction of XL Systems second-generation XLC-S connector, a structural connector specifically designed for drive pipe applications.

In some pipe sizes, usually larger-diameter or heavier-wall sizes, joints are shipped with PDLs pre-installed in each joint. In other cases, usually smaller-diameter sizes, joints are shipped with conventional composite (plastic) protectors installed plus a small number of swappable PDLs for running and handling pipe on the rig.

PDLs are often supplied as rental tools which are returned to XL Systems at the end of the job.
XLF Connectors

Connector Performance Data Sheets

XL Systems maintains a library of connector performance data sheets or ‘spec sheets’ for all of our connector products on the nov.com website. Select the Specs Direct link from the XL Systems homepage at nov.com/xlsystems. Pipe and connector performance data change from time to time and users are encouraged to obtain up-to-date product data for each project.

Connector Material Grades

XLF connectors are integral-threaded directly on the pipe body, so connector material grade is the same as the pipe grade. Weld-on rings for XLF-RB connectors are manufactured to either API 5L pipe grade requirements or XL Systems ring forging specifications. Weld-on ring forgings for XLF-HS connectors are manufactured to XL Systems forging material specifications. The following table provides common pipe and connector grade combinations. Other forging grades with higher strength or special alloying are also available.

<table>
<thead>
<tr>
<th>API 5L Pipe Grade</th>
<th>XLF Connector Grade</th>
<th>XLF-RB Connector Grade Options</th>
<th>XLF-HS Connector Grade Options</th>
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<tbody>
<tr>
<td>X52</td>
<td>X52</td>
<td>Pipe grades X52 or higher</td>
<td>Forging grades M70, M80, M95</td>
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<td>Forging grades M70, M80, M95</td>
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<td>Forging grade M95</td>
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Connector Material Properties

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<tr>
<th>Connector Grade</th>
<th>Minimum Yield Strength</th>
<th>Material Specification</th>
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<td>X52</td>
<td>52.2 ksi = 360 MPa</td>
<td>API 5L</td>
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<td>X56</td>
<td>56.6 ksi = 390 MPa</td>
<td>API 5L</td>
</tr>
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<td>65.3 ksi = 450 MPa</td>
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<tr>
<td>X70</td>
<td>70.3 ksi = 485 MPa</td>
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<tr>
<td>X80</td>
<td>80.5 ksi = 555 MPa</td>
<td>API 5L</td>
</tr>
<tr>
<td>M70</td>
<td>70.0 ksi = 483 MPa</td>
<td>NOV XL Systems</td>
</tr>
<tr>
<td>M80</td>
<td>80.5 ksi = 555 MPa</td>
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<tr>
<td>M95</td>
<td>95.0 ksi = 655 MPa</td>
<td>NOV XL Systems</td>
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</table>

Field Service Procedures

See the following XL Systems field service procedures for additional information on running and handling pipe with XLF, XLF-RB, and XLF-HS connectors:

FSPXL0007  Wedge thread connector storage, inspection, and repair
FSPXL0010  XLF connector field service procedure
FSPXL0019  Approved thread compounds