

Engineering Design

Evolving Options for Offshore Fluid Services

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The selection of fitting technology depends on pressures, temperatures and media. However, when applications demand very high reliability, or involve pressures beyond the scope of other industry-standard fittings, choice becomes limited and the cost of the fitting itself can be a tiny fraction compared to the cost of installation. This is especially the case with many marine applications in hydraulic lines, services and instrumentation.

This is the application focus of a new type of tube connector system for permanent connections, Phastite. Designed primarily as an alternative to welded and cone-and-thread fittings, the technology introduces a unique, patented method of sealing with four raised compression 'rings' that grip the tubing and ensure 100 percent leak-tight performance every time - providing the means to reduce assembly times by up to 100 fold (Figure 1).

Offshore applications are an important focus, and during development the fitting has been subjected to a number of tests to demonstrate its effectiveness. These include simulating pressures at depths of over 20,000 feet.

Unique Assembly Method

The fitting is available for tube outside diameter sizes up to 1 inch/25 mm, and is designed to withstand working pressures up to 1,379 bar (20,000 PSI). In the oil and gas sector, a wide



Figure 1. Phastite fittings bring simplified assembly to permanent-connection and high-pressure applications currently served by welded and cone and thread technologies.

variety of applications fall within this category, ranging from pump-driven high-pressure hydraulics, through deep-water oil and gas drilling operations, to vessels and even sub sea equipment.

Before looking at the fitting in a little detail, it's worth reviewing currently available alternatives and the problems they face. Here, we are talking of rigid steel tubing which involves stainless steel fittings in the so-called 'medium pressure' region, working generally up to around 1,000 bar / 15,000 PSI.

In general, twin-ferrule fittings with the simple and familiar compression-assembly principle ('one and quarter turns' to assemble) can be specified for pressures up to 15,000 PSI depending on the tubing size selected. Notwithstanding this, many users will restrict such fittings to a 6,000 PSI maximum. Beyond this point, less-convenient fitting technologies are typically used, usually welded or cone and thread - depending on the need or difficulty of maintenance and the pressures involved.

Cone and Thread

With a cone and thread interface, tubing does not simply abut into a fitting, but enters a countersunk arrangement which demands that the tube end is 'coned'. For a good joint, these angled ends must be precision-made (usually on site), with a fine surface finish. The end of the tubing must then be threaded (again, often in the field) to allow the tubing to be assembled hard against the joint. The 'price' that users of these fittings pay, lies largely in assembly. It can take half an hour or more to perform the coning and threading operations, and requires a set of tools (vice, coning tool, dies etc).

Threaded fittings in general, can be prone to problems when subjected to changing pressure and temperature. Leakage can occur because they are torque-sensitive and could 'gall' in certain circumstances. Threads are also liable to loosen when exposed to vibration, and this in particular, can be an issue for cone and thread fittings.

Welded Connections

When welded connections are used, it's for long-term permanency. Effectively, when the fittings are in the same material as the tubing, they become an integral part of the system. Although the aim is laudable, as with cone and thread systems, there is a considerable price to be paid in terms of the worker skill and equipment required, and the time to fabricate each joint. Installers of welded fittings also face extra difficulties. When working on oil and gas platforms,

'hot work' permits are often needed, involving administration and safety procedure work, all of which adds to the cost of the field work. If testing is required using dye penetrant or X-ray techniques, as it can be for high reliability applications, then the costs can escalate substantially.

Rapid Assembly

What the Phastite fitting sets out to achieve is to reduce assembly time considerably. A compact hydraulically operated tool, which accompanies the fittings, enables this (Figure 2). In the offshore field in particular, this approach allows fittings to be positioned closely against panels, thus avoiding having to bend the tubing to engage the tool.

After sliding each tube end into the fitting, the loose assembly is then placed in the tooling. The tooling applies hydraulic pressure to the collar(s) of the fitting. As the collars are moved inwards they force the profiles of the internal sleeve to grip the tubing, thus providing a high-pressure, leak-tight seal. Installation is complete when a metal-to-metal dead stop of the collars is reached.

The designed-for-purpose nature of the tool assures users of correct, right-first-time assembly (with other tube fitting systems, a degree of rework is almost always required). The assembly time itself is measured in seconds, and requires no consumables. The relative scales of operations and costs compared with welded and cone and thread fittings are illustrated in Figure 3.

Phastite's sealing mechanism is based on a series of raised compression rings that create a compression seal (visible in Figure 1) without weakening the tubing surface. The

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Figure 2. Phastite tooling allows assembly direct against panels and bulkheads.

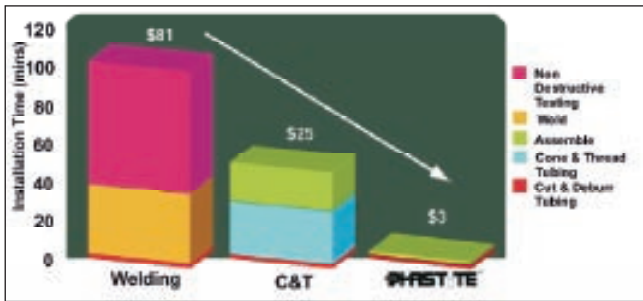


Figure 3. An illustration of the relative scale of fittings assembly costs based on representative labour charges and the author's timings.

compression rings effectively grip in a way that retains all of the tubing's strength. In contrast, cone and thread systems must cut a thread into the tubing - reducing a fitting's ability to deal with vibration and stress. Flexure/fatigue load tests have demonstrated that cone and thread systems perform markedly less well than conventional compression fitting systems for example. Phastite's novel compression sealing mechanism is believed to enhance this advantage even further.

These profiles also make the fitting particularly suitable for vibration prone environments. In testing to verify conformance with BS 4368 for example (which calls for 20 million vibration cycles at between 23 and 47 Hz - some 238 hours of testing in total), Phastite fittings were left on the rig until destruction. The fittings still retained their seal even in excess of 400 hours, and at this point, the test frequency was

increased way beyond the range of the standard, and the fittings continued to operate for another 40 hours.

An additional point to consider in terms of cost is the ability to use thinner wall tubing on gas services, due to Phastite's multiple profiles providing excellent sealing without any detrimental effect on the tubing. Compared with cone and thread fittings, which require thicker wall tubing sizes because of the thread cutting, the savings in both weight and cost, could be very significant. On an offshore platform or FPSO (where each ton of topside equipment might cost say USD 80k in superstructure), the savings can be enormous. A typical platform might have 250,000 feet of tubing. A large percentage of that might be used for gas service, depending on the type of platform. ■



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RIL Mulls 40, 000 Crore Chip in

Mumbai: Reliance Industries Ltd (RIL), India's largest private sector enterprise, plans to invest 40,000 crore to expand the world's biggest refining complex in Jamnagar, Gujarat.

Mukesh Ambani, owner of the company, has allowed 16,000 crore to build a cracker unit as part of a proposed petrochemicals project in Jamnagar. The cracker will produce ethylene, propylene, low-density polyethylene and monoethylene glycol that have a wide range of applications in industry. Besides, the company will invest 15,000 crore in a coke gasification plant that will fuel power plants in the complex. It plans to spend 6,850 crore on a plant to produce paraxylene, used in the production of fibre and film, and a unit



to manufacture butyl rubber that has applications in industries, including adhesives, agricultural chemicals and personal care products. Many other projects cost 4,000 crore such as a fifth crude distillation unit (CDU) that would utilize crude from Cairn India Ltd's Mangala oil field in Rajasthan.

First time the company has specified the investment on the petrochemical projects in Jamnagar

as part of an expansion drive called J3, which denotes the third phase of expansion of the complex. The planned investment is a step in the direction of realizing Mukesh's ambition of doubling the enterprise value of the firm to 7.4 trillion in less than 10 years--a target he outlined in June. He said in the June meeting, "I had announced the setting up of an off-gas cracker at Jamnagar in 2007. We are accelerating the implementation of this cracker. This off-gas cracker with over 1.5 mtpa of olefins capacity with matching downstream capacities will be one of the largest facilities in the world." The company is likely to announce the plans publicly in January 2011.