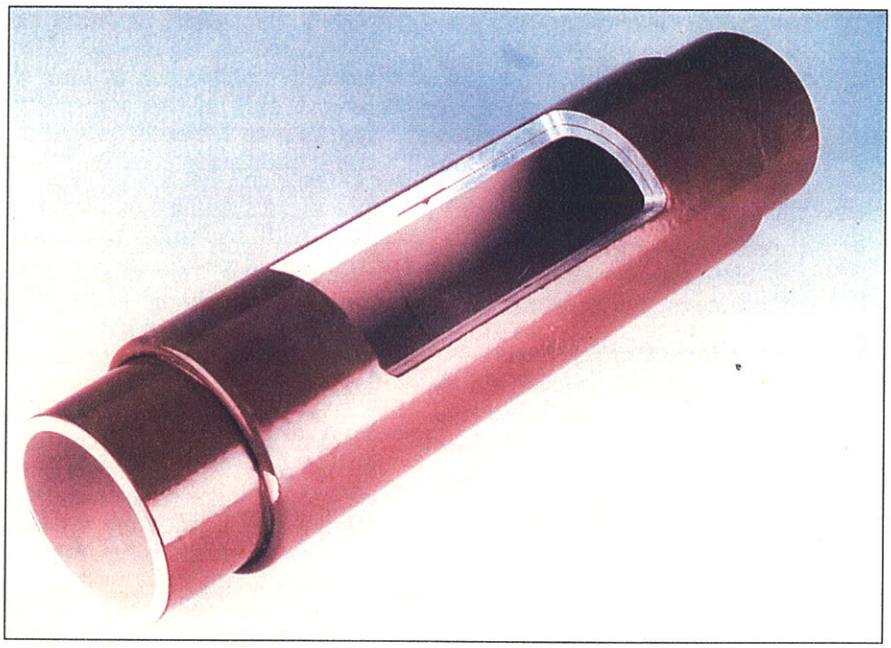
Coupling System Joins Internally Coated Pipe Without Welding



A press-on mechanical metal-to-metal interference fit is made between the pipe and a coupling with finely machined internal serrations. This produces a connection that exceeds specifications of the pipe itself.

by M. Joseph Holland
Jetair International, Inc.,
Houston

Internal corrosion control is a major concern for the pipeline industry. Driving this concern are factors such as shortened life expectancies of capital goods, corrosion byproduct damage, environmental damage from corrosion-induced failures, lost productivity and the potential danger to health and safety of operating personnel and the public.

Using internal coatings to mitigate corrosion is a vital element in the battle to maintain integrity of pipelines. Development of these coatings has kept pace with industry's needs, but attention should be focused on the method of joining components of the pipeline system. Usually a joint or connection is the most likely location of failure. Conventional joining methods rely heavily on welding, which can damage internal coatings and result in ineffective corrosion protection in that area.

Development Of A Joining Method

In 1978, Shell Oil Co. wanted to use internally coated pipe on a project but was not satisfied with existing methods of joining it. Certain technical criteria were established for the connection process, including:

- No significant yielding or cold working of pipe ends was allowed.
- Reduction in pipe length was unacceptable.
- Significant reduction of the internal pipe diameter was not permitted.
- Flow direction or pigging operations could not be restricted.
- Internal coating could not be damaged.
- Installation time could not be detrimentally impacted.
- The method must be cost effective.

These requirements led to the development of a positive seal coupling system (PSC) and its use on 400,000 feet of internally coated line pipe for Shell's project which spanned two years. The system currently is operating and no operational failures of the PSC have been reported. Over the next several years, many PSCs were placed in service. By 1984, over 30,000 were in service in the U.S. Today, there are over 80,000 PSCs in service with 3,000 installed in water depths up to 50 feet.

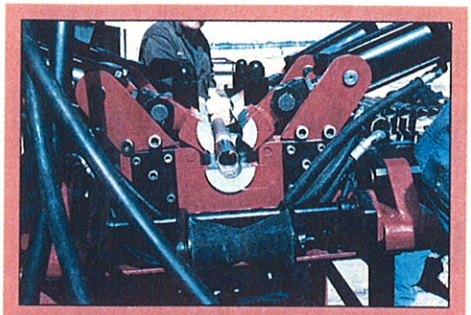
Process Description

This system offers a high-strength, cost effective alternative to welding and joining NPS 2-inch through 12-inch line pipe. Although originally developed for use with internally coated pipe and elimination of internal girth weld coating repair, the coupling system is equally suited for bare pipe applications.

Pipe wall thickness schedules up to 160 and API 5L Grades through X65 are joined quickly, require a minimum of end preparation and require no radiographic inspection. This reduces construction time and there is no internal diameter size reduction to restrict product flow or pigging. Also, there is no loss of pipe length during make up, and stress fatigue or cracking of pipe ends is non-existent. The result is a pipe connection that is as strong as the specified yield strength of the pipe itself. It has 100 percent pressure, stress, and load capability under Piping Codes ANSI/ASME B31.1, B31.4, B31.8, CAN/CSA-Z183 and Z184, and complies with requirements of the U.S. Department of Transportation 49CFR Parts 192 and 195.

Couplings are manufactured from either mechanical tubing that is cold drawn over mandrel or of high-strength casing coupling grade tube stock. Material specifications for the tube stock have been developed and third party testing of metallurgical properties is required for each order.

Heart of the PSC is the use of a press-on mechanical metal-to-metal interference fit and a coupling with finely machined internal serrations.



Alignment during insertion is maintained by specially designed pipe slips and coupling backups.

The field joining unit can be suspended by a sideboom tractor and easily moved down the pipeline.

This controlled interference fit, combined with serrations on the internal coupling surface, produces a connection that exceeds specifications of the pipe itself.

Before insertion into the coupling, the outside diameter (OD) of the pipe ends and the inside diameter (ID) of the coupling are coated with a specially formulated epoxy sealant. Then the pipe is hydraulically pressed to a pre-marked insertion depth inside the coupling. This insertion depth is usually one-half of the coupling length and produces a complete metal-to-metal seal. Epoxy serves as a lubricant, prevents galling during installation, and cures to form a secondary seal around the pipe ends and ID area of the coupling. A shaped seal ring gasket also can be used between pipe ends to form a redundant seal in the connection.

Coated Pipe Connections

For coated pipe, the process begins during application at the coating facility. A coupling and gasket are installed on one end of the pipe. The pipe is capped on both ends and shipped to the field for pipeline construction. Since no overlapping of pipe ends occurs, each joint retains its original length unlike bell and spigot joining methods which reduce pipe length, ID, and flow characteristics. These methods also cold work pipe ends which can produce longitudinal stress risers in the bell as a result of the sledging process. In turn, stress risers cause loss of pipe due to split ends and tend to increase the likelihood of sulfide stress cracking and corrosion.

Since the need for welding is completely eliminated, pipelines can be constructed without damage to internal coatings. Construction is done with a positive seal field joining unit which has its own hydraulic power source and is completely portable. It holds in place the pipe end that is to be inserted and then presses the pipe end into the coupling with hydraulic rams and clamping slips. True alignment during insertion and strong, lasting connections are assured by the design of both pipe slips and coupling backups used in the process.

The field joining unit can be suspended by a sideboom tractor and easily moved down the pipeline from one coupling insertion to the next. For marine pipeline installations, the unit can be transported on a barge. **P&GJ**