



**LARRY PAYNE,  
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DISCUSSES CLEANING,  
HYDROTESTING, GAUGING  
AND DEWATERING A BRAND  
NEW PIPELINE.**

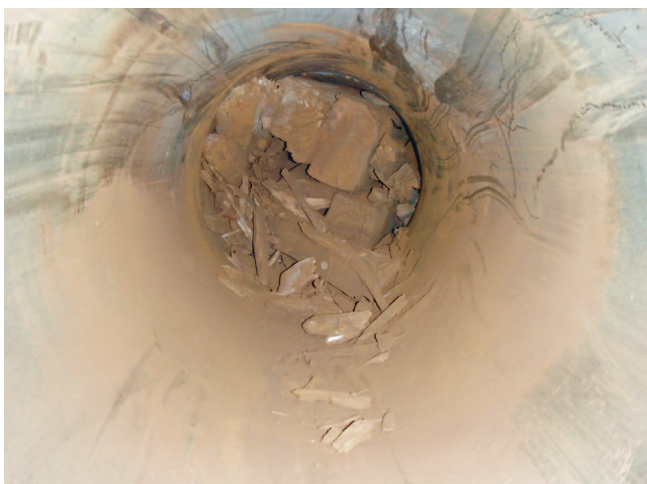
# PREPARING FOR SERVICE

**O**n any given day, somewhere around the world, at least one new pipeline is being prepared for service. Industry reports show that, worldwide, pipeline projects totalling more than 35 000 miles are currently in various stages of planning or construction. In light of the number of new lines expected to go into service within the next few years, the importance of an effective pipeline precommissioning programme becomes very apparent.

Commissioning is typically considered the first-time act of filling a line with the product it will transport, be it crude, refined products, natural gas or something else. Precommissioning is everything that happens before that, including pre-cleaning, filling the line with water, hydrotesting, dewatering, geometry inspection and drying. Each of these steps brings special considerations and potential challenges. But when performed correctly and thoroughly, each step also contributes to the eventual success of the line, a success measured by safe operation, long service life, optimal throughput and operator revenue. What follows is a closer look at each step in the precommissioning process.

## **Pre-cleaning**

At a very basic level, putting a new pipeline in place is a messy endeavour. Once a section of line is in place, the first thing that needs to be done to prepare it for service is to pre-clean it. It is



**Figure 1.** Pre-cleaning a line in advance of hydrotesting offers the chance to remove debris left behind during construction.



**Figure 2.** Heavy foam pigs are ideal for pre-cleaning a line because they are forgiving of obstacles and less likely to become stuck.



**Figure 3.** Pumps, such as the one shown here, are used to fill a line section with water in advance of hydrotesting.

amazing what may have made its way into a line during construction, including - but by no means limited to - mud, sand, rocks, leaves, tools, lost gloves, skids and even small animals. Needless to say, any unwanted items left in a line after construction can easily become problems once operation begins, fouling or blocking it up completely.

Removing line debris is a straightforward process accomplished through use of cleaning pigs in conjunction with launchers and receivers. Not all cleaning pigs are created equal, and because it is uncertain what the pig may encounter in the line, it is best not to use the most aggressive pig to initially clean the line. Cleaning of pipeline debris should be accomplished using cleaning pigs that progressively become more aggressive with each run; this is known as progressive pigging. The first type of pig to use to prove and pre-clean is a heavy foam pig because they are more forgiving of obstacles and less likely to plug the line. In the case of a typical line section, which might stretch for 15 miles, anywhere from five to ten pigs of various types may be used. In some cases, water may be used in conjunction with the pigs; dirt and other residue are sometimes moved more easily in suspension with what is referred to as 'wash water'.

### Filling with water

Once the line is clean, the next step is to fill it with water. This is a critical step in the precommissioning process. The goal is to get as much water into the line with as little air as possible. A high volume, low-pressure pump is typically used in an effort to achieve a solid water state, i.e., volume with no air pockets. The success of a hydrotest (see next step) depends on the line containing a minimal amount of air. To that end, it is advisable to use a high quality sealing pig at the head of the water supply so as to minimize air ingress. An 'air lock' occurs when pockets of air are trapped at the high places, making each elevation change additive, thereby rendering it impossible to reach a uniform test pressure.

Filling a line can be complicated by a couple of factors. The first is the water supply itself. Where does the water come from for filling? This will depend largely on location. If the line is in a remote area, the only option may be to haul water in, though this can be very expensive. In some cases, it may be possible to use water from available sources, such as a nearby creek, lake or river, bearing in mind that proper permissions will need to be obtained in advance and that 'found' water may need to be filtered or treated before use so as not to introduce new contaminants into the line. City water, though expensive, may also be used if available and approved.

The second major challenge often associated with line filling involves elevation changes. If the line features prominent rises and falls (hills and valleys), filling it properly may require additional pump power to help push the water uphill. If the line includes significant declines, the sealing pig at the head of the water may tend to 'run away' as a result of gravity, pulling air in behind it, air that forms unwanted pockets in the water column.



Figure 4. A variety of instrumentation, including dead weights, may be used to gauge pressure levels in the line during hydrotesting.



Figure 5. Geometry tools, such as the TDW KALIPER® 360 tool shown here, can identify possible dents and buckles in a line.



Figure 6. Many operators run baseline magnetic flux leakage (MFL) inspections on new pipe to identify possible mill defects.

## Hydrotesting

With the line filled, the next step is to 'lock in' by closing all of the valves in the line. This is followed by what is known as 'stabilisation', in which the line is pre-pressurised for a period of time. Stabilisation allows the water to settle in preparation for the actual hydrotesting of specific line sections. Test section lengths are variable and are determined by elevation changes within a given length, so pre-planning is critical. Based on anticipated service conditions, the line operator will generally specify the test pressure with an allowance variable, such as 1800 - 1850 psi. A line is typically tested to a pressure that is 25 - 50% more than its maximum operating pressure. Test duration is normally for an eight hour period, as required by pipeline codes. A high pressure, low volume pump is used to bring the line up to test pressure.

Pressure testing may use a variety of instrumentation, chart records, temperature recorders, dead weights or digital recorders. It is important to note that environmental conditions can have a big impact on hydrotesting. Keep in mind that as ambient temperature changes, so does pressure, with increasing temperature raising line pressure and decreasing temperature lowering it. Pressure changes seen during a hydrotest must be justified. If line pressure drops below what might be caused by temperature changes, the first thing to do is check all obvious leak paths, such as flanges and threaded connections. Small leaks are more difficult to find than large leaks. If a leak is suspected, the first step is to close valves to isolate the leak to progressively shorter sections of pipe, potentially making the precise location easier to pinpoint. In some cases, it may help to use either odouriser or dye to locate a leak. A leaking line is no small matter; when you factor in the costs of cut out and replacement, refilling and retesting, a leak at this point can easily cost US\$ 1 million to fix. Still, that is far less expensive than a leak detected only after operation commences.

In any precommissioning job, hydrotesting one line section should occur while preparing the next section. Once testing of a section is complete, advance planning and good coordination of resources may allow the same water to be reused and transferred into the next section. Bearing in mind that water is a critical (and costly) resource, reuse when possible makes good sense, both economically and environmentally. A good sealing pig can be used to push the water out and into the next section. If the next section to be tested is of a different length than its predecessor, water may be added or subtracted as needed to meet the fill requirements. Keep in mind that the used water will likely require checking and filtering before it can be returned to its source or released to the surface.

## Dewatering

As soon as testing of all sections is complete, the next step is to remove the water from the line. This is typically accomplished using what is known as a dewatering pig. Water tends to collect in pockets or pools along the bottom of a line, so the goal of dewatering is to remove as much of

this free or standing water as possible, leaving only a wet wall, in one run. Multiple runs require more time and money, and a line in which free water has not been fully removed takes much longer to dry. Just as pig selection is critical when filling the line with water, using the right pig is also a vital part of dewatering success. Pigs with multiple sealing cups are typical; in some cases the same pig that was used during filling can also be used for dewatering.

### Geometry inspection

Before fully drying the line, a geometry inspection tool is run to identify possible dents and buckles in the line. Even if the greatest of care has been taken during all phases of construction, the line should be checked to make sure it is free of dents and buckles. And while dents and buckles can be problematic, experience has also revealed that mill defects

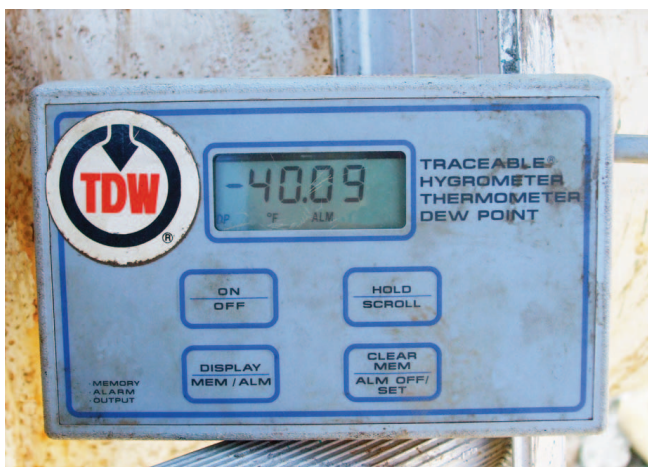


Figure 7. Line dryness is measured using a dew point meter such as the one shown here. Operators will specify different levels of dryness depending on the product to be transported by the line.

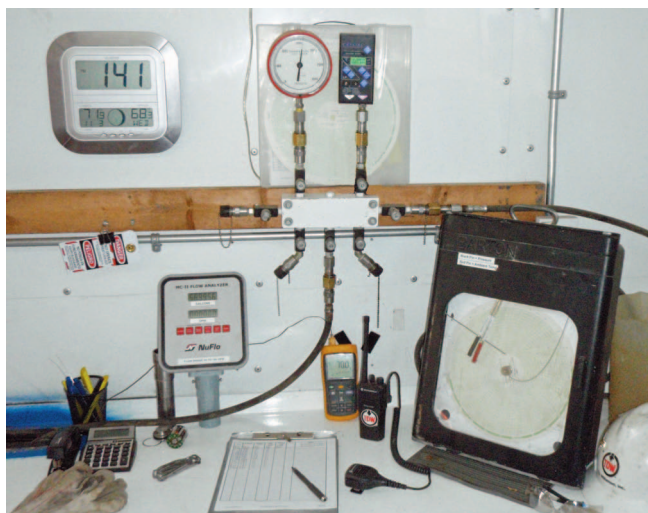


Figure 8. Pressure testing may use a variety of instrumentation, including chart records, temperature recorders, dead weights or digital recorders.

can also be detrimental and are often more difficult to identify. For this reason, many operators are opting to run baseline magnetic flux leakage (MFL) inspections on new pipe to identify possible mill defects. Note that geometry inspection tools are being run after dewatering but prior to drying. This is because some moisture in the line (such as a wet wall) can act as lubrication for pig cups. Should a dent or buckle need to be removed, drying (see next step) would not have to be repeated.

### Drying

Following geometry inspection, the final major step prior to commissioning is complete drying of the line. The level of line dryness is typically specified by the operator as a dew point requirement; a common specification is -20 to -40 °F. Dew point reading devices are used at the launch and receive sites. The lower the dew point, the dryer the air. The eventual content of the line will determine the level of dryness required. For example, most natural gas lines require that the line be dried to a low dew point.

Three main methods are used for drying. The first is vacuum drying, which literally pulls humidity out of the line. The second method is nitrogen insertion. An inert gas, nitrogen is very dry, and its presence in a line has a natural drying effect. The third - and most common - method is by injecting volumes of hot, dry air into the line. This method requires use of high volume air compressors with dryers on the downstream side. Open cell foam pigs pushed by the hot, dry air are generally used at the same time to spread out and absorb remaining moisture.

### Commissioning

Once all sections are dry, launchers and receivers (and test headers) are removed and tie-ins made using pre-tested pipe sections. Once complete, all welds are then 100% X-rayed to ensure complete integrity of the connections. The line is then ready for filling with product. All precommissioning activities (from pre-cleaning to hydrotesting) are fully documented, with certified test reports furnished to the operator.

Finally, it is important to understand that a handful of things will likely have a great impact on the precommissioning process. First, configuration of the pipeline, including bends, radii, sags, overbends, switchbacks, back-to-back fittings and custom fit-ups, as well as section lengths (accuracy and elevation). Second, the depth of the line, which can be as much as 50 - 60 ft in some instances. Third, site access and preparation. The more you understand and plan, the smoother the process will be. And fourth, do not forget about external events, which are typically uncontrollable (though not unpredictable). These can include everything from inclement weather to the start of hunting season in a particular area. Above all, remember that a job can be planned based on a perfect scenario, but there will never actually be perfection in the field. For that reason, consult a service company with experience and expertise to assist with preparation and planning. **WP**