

# BARREL TRAPS VS PIGGING VALVES

Nicolaas Ainsworth, Argus Machine Co. Ltd (Argus), discusses barrel traps and pigging valves, explaining where each works best, and why.

Operators use pipeline pigs to clean, batch, dewater, and inspect lines, with pig launchers and receivers as the core equipment for launching and retrieving those pigs.<sup>1</sup> Two common launcher/receiver systems



Figure 1. Pigging Valve (top, Argus), barrel trap launcher (bottom, adapted from reference).<sup>13</sup>



are barrel traps and pigging valves. Both accomplish the same objective, but with fundamentally different constructs that lead to distinct practices and best use cases. This article will explore those practices, and differences, to derive where each thrives and where each is weaker.

### Barrel trap design

Barrel traps are often considered the conventional system for launching and receiving pipeline pigs as they have been widely used for decades.<sup>1</sup> A typical barrel-trap station is built around a cylindrical vessel (the barrel) consisting of a major barrel, a reducer, a minor barrel nominally sized to the mainline pipe, and a closure for loading and unloading pigs.<sup>2</sup> The trap also includes branch connections, piping, and valves/nozzles such as vent, drain, kicker, and pressure equalising connections that connect the trap to the mainline and support launching



Figure 2. Barrel trap pig launcher on a 28 in. crude line (Source: Wikimedia Commons).



Figure 3. 3D rendering of a typical pig trap launcher station set up.

and receiving operations.<sup>2</sup> In simple terms, barrel traps are an isolated side chamber connected to the mainline that operators can isolate and load/unload pigs into.

### Barrel trap operation

The operation of a barrel trap relies on the line pressure to move pigs in and out of the previously noted isolated chamber (or barrel). Exact steps and sequences vary depending on operating conditions, standards, codes, product-specific designs, pig types, and other variables; however, while there is not necessarily a universal SOP, there are some common steps for operating barrel traps found in most designs.<sup>3,4</sup> The following sections outline the general phases a barrel trap undergoes during its launch and receipt operations, respectively.

#### Barrel trap launching sequence

The objective of barrel trap launching operations is pig insertion. These four phases outline how operators send pigs inline using a barrel trap launcher.

- Isolate and make safe: the trap is first isolated from the mainline and then brought to a safe condition for opening by depressurization (gases) and/or draining (liquids) from the chamber.<sup>4</sup>
- Load and secure: with the trap at safe pressure, the closure is opened, and the pig is loaded into the main barrel, typically pushed nose-first all the way up against the reducer. The closure is closed and secured.<sup>4</sup>
- Pressurise and equalise: once the closure is secured, the trap is slowly refilled from the mainline and equalised to the same pressure as that mainline. During filling/equalising, trapped air is also removed from the trap through vent nozzles.<sup>4</sup>
- Establish flow behind the pig and launch: a pressure differential is then created using kicker/bypasses that push the pig through the major barrel, reducer, and the minor barrel, and into the mainline. Pig signallers are used to confirm that the pig has moved out of the traps and into the pipeline. Once confirmed, the station is returned to its normal set-up.<sup>4</sup>

#### Barrel trap receiving sequence

Receiving through a barrel trap is somewhat the reverse logic: catch the pig, isolate the chamber, make it safe and open, and remove the pig.

- Prepare the receiver and equalise: first, the receiver is brought to conditions compatible with the mainline so the pig can enter without issue (this differs by operators and how their station's normal configuration is set up).<sup>4</sup>
- Receive and retain: the pig enters the receiver and is held in the trap. Like launching, pig signallers are often used to indicate whether the pig has entered or not.<sup>4</sup>
- Isolation and depressurise: once the pig is confirmed to be inside the trap, the receiver is isolated from the mainline. The receiver is then depressurised and/or drained to a safe condition.<sup>4</sup>
- Opening and removal: once safe, the closure is opened, and the pig is removed. The closure is then secured, and the

station is returned to its regular configuration (whether left on-stream or isolated).<sup>4</sup>

### Pigging valve design

A pigging valve (also known as a scraper valve or simply pig valve) is an alternative to the barrel trap. The pig valve replaces the cylindrical vessel with a specialised hollow, trunnion-mounted, quarter-turn ball valve.<sup>5</sup> Like the major barrel, the ball is the cavity/chamber that the pig is inserted into or removed from. There is also a stopper plate in the valve, usually between the internal ball and tail pieces.<sup>5</sup> Whether the valve functions as a launcher or a receiver depends on the placement of the stopper plate. Launchers have the plate downstream of the flow (preventing the pig from accidentally moving in the wrong direction).<sup>5</sup> The receiver, on the other hand, has it upstream, preventing the pig from continuing down the line after it is received.<sup>5</sup> While there are more vital components that make up a pigging valve, these pieces provide the essential understanding of how the design works.

The main components consist of:

- The trunnion-mounted ball valve.
- An opening on either the side or top for pig extraction/introduction.
- A catcher/stopper plate located within the valve's body.<sup>5</sup>

One notable difference between trap and pig valve designs is that certain elements, such as bypass lines, are not always essential for pig valves to operate as they are for traps.<sup>3,5</sup> Many operations do install a bypass line to preserve flow during pig loading/unloading. Some operators also add upstream and downstream isolation valves to provide true double block and bleed.<sup>6</sup> While this article's scope does not cover an in-depth review of these different station setups, it is a noteworthy feature.

### Pigging valve operation

Pigging valves follow a similar operational logic to the barrel trap: create a safe cavity, load the pig, equalise, and then release the pipeline's flow to launch it into the mainline. How each phase is done, and the overall complexity of the operation, however, are inherently very different between the two stations because of their designs.

### Pigging valve launching sequence

The following are general steps for the pigging valve launch sequence. Like the trap, these steps may vary depending on operator codes, design layouts, and other factors.

- Preserve flow (if a bypass is installed): the first step is to note whether the station has a bypass line in its configuration, or not. When the station configuration includes one, the first step is to open the bypass to preserve flow during pig loading.<sup>5</sup>



Figure 4. Pigging valve on a 20 in. pipeline with a double-block and bleed set up.



Figure 5. 3D cutaway rendering of a pig valve launcher/receiver with bypass line.



Figure 6. 3D rendering of a station pigging valve (left) and a barrel trap (right).

- Isolate the cavity and make it safe: once the bypass is open (assuming one is present), the pig cavity is isolated from the mainline by rotating the valve to the manufacturer's defined 'closed' position. The valve is then depressurised and put to a safe condition using its vent and drain ports.<sup>5</sup>
- Load and secure: once safe, the access point is opened, any restrictor/restraining features are removed, the pig is inserted, and the restrictor is replaced. The access point is then closed and secured.<sup>5</sup>
- Equalise and launch: cavity pressure is equalised to the line pressure using the valve's equalisation feature (often a level). The valve is then opened, rotating it to its original position. The flow from the mainline will then push the pig into the pipeline, like a trap launch.<sup>5</sup>

Once the pig is in the line, the operator can close the bypass and return the valve to its normal configuration

### Pigging valve receiving sequence

Inverting the order, we have the receiving processes for the pigging valve.

- Capture: the pig is first caught within the valve using its stopper plate. The stopper plate prevents the pig from moving past the ball and down the line.<sup>5</sup>
- Isolate and make safe: once the pig is captured, the valve is rotated to its 'closed' position, isolating the cavity. Vent/drain ports are then used to bring the cavity to a safe pressure.<sup>5</sup>
- Remove and restore: once safe, the access point is opened, the restrictor is removed if applicable, and then the pig. The restricted is then placed back into the valve, and the entry point is closed. Once closed, the cavity is equalised back to line pressure, opened, and the valve is returned to normal operation.<sup>5</sup>

### Key differences and where each wins

As we have seen, although barrel traps and pigging valves serve a similar purpose, their architectures differ significantly. These differences create inherent differences in how operators use them, as we have seen. With those differences in mind, we will now examine how they shape each style's advantages and disadvantages, and, together, how these factors influence the operating conditions under which each is best suited.

#### Pig tool compatibility

The first notable difference is the pig tool compatibility of each style. Obviously, this is important to operators, as they may need to send a range of ILI or maintenance pigs through a specific line. Those tools can vary greatly in design and geometry, and they need a trap that can accommodate them. In this aspect, barrel traps clearly have an advantage. The large chamber that barrel traps use to house the pigs is specifically sized to accommodate the longest tools the operator expects to run.<sup>7</sup> Accordingly, the volume can be designed with relatively few practical limits on what pigs it can hold, beyond footprint and cost constraints. Pigging valves, on the other hand, are built with a much smaller internal cavity. The small cavity limits the variability in the pig geometry it can accommodate. Accordingly, this generally limits pig valves to accommodate maintenance pigs and single-module ILI tools.<sup>8</sup>

#### Footprint and installation flexibility

Ironically, the design aspect that enhances tool compatibility also limits the station's retrofitting versatility. As we have seen, the conventional launcher/receiver station typically includes a major barrel, minor barrel, reducer, closures, and connected lines, valves, and nozzles.<sup>2</sup> The complex layout and many components demand significant space to implement.<sup>2</sup> As a result, this can make them very challenging for operators, especially when they are up against footprint constraints in areas such as offshore, flow lines, facility piping, or some gathering lines. Pigging valves, however, are compact and can often be integrated anywhere an operator can reasonably install a shutoff valve.<sup>9,10</sup> This makes pigging valves attractive when the operating conditions have space limitations.

#### Venting volume and emissions

The cavity/barrel size also significantly influences the GHG emissions each produces. During loading/unloading, the

chambers housing the pigs must be depressurised through venting. Venting releases greenhouse and other toxic gases into the atmosphere, and the size of the chamber determines how much gas must be vented for safe depressurisation. The volume of venting required by the pig valve, therefore, is significantly smaller than that of a conventional barrel trap due to the smaller cavity.<sup>10</sup> The EPA supports this claim, reporting that using a pig valve instead of a conventional barrel trap can reduce the volume of gas vented during depressurisation by approximately 80 - 95%, specifically because the pig valve cavity is much smaller.<sup>10</sup> Therefore, for operators focusing on emissions reduction, pigging valves provide a clear advantage over barrel traps.<sup>10</sup>

#### Safety and risk

Somewhat related to the previous point is safety and risk. The volume captured inside each station's vessel poses inherent safety risks from the toxicity and flammability of what is vented, as well as the stored energy of the pressurised vessel. Larger volumes vented put operators at increased risk of exposure to flammable or toxic environments and to oxygen-deficient environments, which can lead to fatal incidents.<sup>11</sup> As for stored energy, the high-pressure volumes within traps, if not properly isolated and depressurised, can eject pigs or materials at high velocity.<sup>12</sup> The National Energy Board has several well-documented cases of such incidents happening.<sup>11</sup>

Both barrel traps and pigging valves can be operated safely when safety procedures are properly followed. However, the barrel trap houses a significantly larger volume of gas, which increases the risks noted above.<sup>10</sup> In addition, pigging valves are often designed for top-entry access.<sup>5</sup> Top-entry access puts operators in a safer position during loading and unloading, as the horizontal opening of a barrel trap can put workers in the line of fire in the event of an incident.<sup>4,9</sup> Altogether, pigging valves reduce operator exposure during launching and retrieving operations, providing clear safety benefits to workers and operators.<sup>9</sup>

#### Conclusion

Both barrel traps and pigging valves serve the same essential purpose of sending and retrieving pigs from inline. Their designs and procedures, however, are very different, leading to inherent differences in where their strengths and weaknesses lie. Barrel traps often offer more versatility in what pig geometries they can accommodate, but trade this for larger space and higher venting requirements. Pigging valves, on the other hand, sacrifice some tool compatibility for a compact valve design that allows for more versatility in installation and lower venting volumes, providing both safety and emission benefits. Ultimately, the right choice of station depends on your tool needs, available space, and operational priorities. 🔄

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