



# Pipeline Purges

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## Introduction

It is very common for pipelines to be purged of their product (line fill). The reasons to purge a pipeline vary from preparation for repairs, line relocation, change in service, deactivation, or abandonment.

## Recommended Purge Fluid

The recommended fluid for purging a pipeline is nitrogen since it is inert and is appropriate whether the fluid is a hydrocarbon (natural gas, natural gas liquids, crude oil, refined products, petrochemicals) or industrial gases (carbon dioxide, hydrogen, oxygen, ammonia, chlorine).

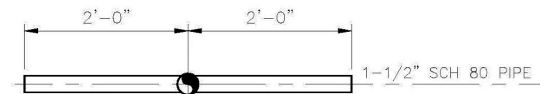
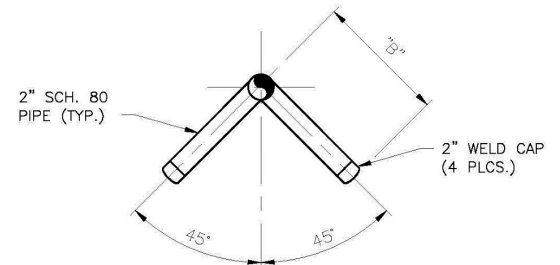
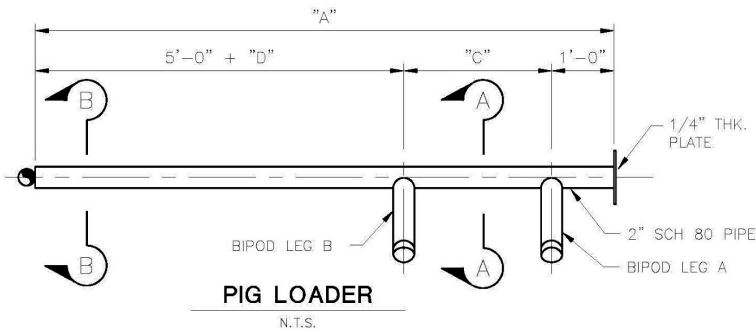
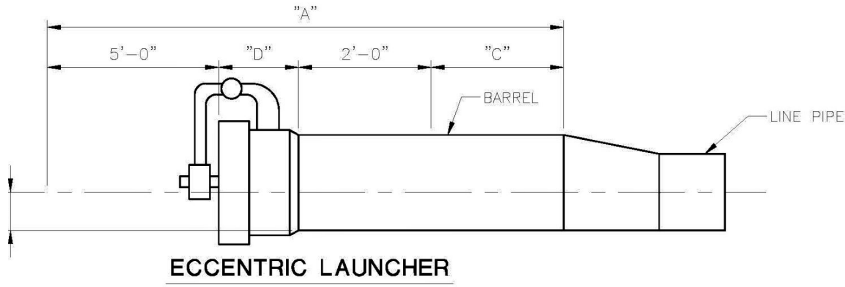
The use of air to displace a hydrocarbon pipeline is not recommended due to the potential for a combustible mixture of vapors to form in the pipeline.

## Safety Concerns Using Nitrogen

Nitrogen under pressure and at low temperature must be handled properly. Nitrogen in liquid form will freeze unprotected skin on contact. Approved hearing protection should be worn when nitrogen is being vented to atmosphere to prevent possible hearing loss. Nitrogen gas can gather in low lying areas and may cause an oxygen deficient environment.

## Equipment

A pig launcher and receiver is needed. The receiver should be long enough to receive 2 to 3 pigs. The nominal pipe section is the same diameter as the pipeline. The barrel is typically 2 diameters larger than the pipeline diameter. The image below includes a launcher and a pig loader. The launcher can be simplified by using a blind flange.



EQUATION FOR DIMENSIONS	ROUND TO
LENGTH OF BARREL PLUS CLOSURE + 6 FEET	FOOT
(O.D. OF LINE PIPE) / 2 MINUS WT OF LINE PIPE	1/4"

**NOTES:**

1. DIAMETER OF 1/4" PLATE DEPENDS ON DIAMETER OF PIPE AND DIAMETER OF PIG. MAY REQUIRE MODIFICATION IF TRANSMITTER IS ON THE PIG TAIL.
2. MAY NEED TO USE 1-1/2" SCH 80 OR 1" SCH 160 PIPE FOR LOADER ON SMALL DIAMETER PIPELINES.
3. BIPOD LEGS "B" MAY NOT BE NEEDED FOR SHORT TRAP.

The right pipeline pig is essential to a successful purge. The recommended pig is a 4-cup steel mandrel pig that requires mechanical assistance to load it into the nominal pipe on the pig launcher. If the pig can easily slip into the nominal pipe, then it will leave line fill behind in the pipeline causing an unsafe work condition.



The pressure and flow rate of nitrogen are key to a pipeline purge. The nitrogen will be injected using a nitrogen pumper truck to vaporize the nitrogen and cryogenic tankers of nitrogen to supply the pumper. The injection rate and pressure are dependent on the hydraulics of the pipeline. A purge of a short, small diameter pipeline may require a single pumper truck and a single tanker and be completed in a few hours. A purge of a long, large diameter pipeline may require multiple pumper trucks and round the clock tanker trucks and take weeks to accomplish.



**Typical Nitrogen Pumper Truck**



**Four Nitrogen Pumpers in operation on the purge of a 600-mile long 24-inch diameter pipeline.**



**Cryogenic nitrogen transports lined up to support the purge of a 600-mile long 24-inch diameter pipeline.**

## **Types of Pipelines and Options for Purging**

The type of pipeline to be purged and the specific operating conditions determines how a nitrogen displacement is planned and implemented.

Liquid pipelines, such as crude oil or refined products, may require downstream assistance from either permanent pumps or portable pumps to achieve the required displacement. The displaced liquid must be stored in either permanent storage tanks or frac tanks. Storing the displaced liquid in frac tanks is impractical for a large displacement. It may be necessary to hold back pressure at the delivery point to keep the pipeline "tight". A "tight pipeline" is more predictable and more controllable.

Highly volatile liquid (HVL) pipelines such as ethane, propane, natural gas liquids, etc. require back pressure (based on the fluid vapor pressure) on the pipeline to prevent the fluid from undergoing a phase change from liquid to gas. It is easier to control a purge with a single phase fluid.

Petrochemical pipelines might have the pressure "pulled down" with downstream pumps prior to the purge. There may be a mechanical or process limit (e.g. phase change) as to how low the pipeline pressure can be pulled down. A combination of pulling down the pipeline and purging could be used.

Natural gas or other gas pipelines might have the pressure “pulled down” with downstream compression. There may be a mechanical limit as to how low the pipeline pressure can be pulled down. The cost of portable compressors with a lower suction pressure capability (and associated equipment) may easily offset the cost of a purge. A combination of pulling down the pipeline and purging could be used.

It is common to leave a low pressure nitrogen blanket in a pipeline after a purge if it is being idled (deactivated) or abandoned.

### **Considerations for Designing the Purge Procedure**

The following list provides a high level look at some of the pipeline data to consider in designing a purge procedure. There are also logistics of nitrogen, personnel, etc. to manage.

- Pipeline Profile
- Length of pipe to be purged
- Line fill (fluid) to be purged
- Location of traps for launching and receiving pigs
- Location of main line block valves
- Pipe specifications
- Condition of pipe

### **Execution of a Purge**

There are many things to account for during the execution of a purge including but not limited to:

- Review and approval of the developed procedure
- Development of a schedule to set the expectations of the progress of the purge
- Management of the logistics of personnel and equipment
- Tracking the location of the pigs and the displaced fluid volume
- Blow down of the nitrogen in the pipeline in a safe and environmentally conscious manner

## UPI Capabilities

UPI offers a full complement of solutions including: Conceptual selection, FEED, Project development, including Total Installed Costs for funding, and EPC/EPCM. The EPC/EPCM solutions include Project Management, Engineering and Design Services, Procurement Services, Sub Contractors Management, Survey, Laser Scanning, Construction Management, Inspection, Mobile Inspection Platform, Systems Integration, Automation, and Controls.

UPI has a rich heritage of pipeline and facilities project experience for pipeline planning design and construction management. UPI has engineered over 35,000 miles of pipeline and installed over 5 million Hp of pumps and compressors.

UPI has designed the purge procedure and provided logistics and field support for hundreds of pipeline purges over thousands of miles of pipe. A representative list of UPI's purge projects includes:

- Prepared Company Standard Purge Manual for Major Pipeline Operator.
- Designed detailed procedure design and provided logistics and field execution support of 600-mile long 24-inch diameter crude oil pipeline. Purge used main line pump stations to assist the purge.
- Designed detailed purge procedure and provided logistics and field execution support of 360-mile long 6-inch diameter natural gas liquids pipeline. Purge used main line pump stations to assist the purge.
- Designed purge procedure for deactivation of a 988-mile long 34-inch diameter crude oil pipeline.
- Designed purge procedure and provided logistics and field execution support for 40 miles of un-piggable natural gas liquids pipeline system. Used pressure draw down, vapor recovery, portable compression, and portable filter-separator followed by nitrogen sweeps to achieve a safe condition for deactivation.
- Designed purge procedure, provided logistics and field execution support for a purge of a 218-mile long 1930-1940's era pipeline, and mitigated the risk for areas with greater than 80% wall loss.
- Designed purge procedures and provided logistics and field execution support for a program of upgrading over 150 petrochemical pipelines.

## Closing

UPI looks forward to talking with you about how we can help you with your project.