

**PETERSEN INFLATABLE PIPE PLUGS
GENERIC OPERATING INSTRUCTION MANUAL**

SAFETY IS EVERYONE'S RESPONSIBILITY!

Read and understand before using Petersen® Pipe Plugs!

Failure to comply may result in property damage, serious injury or death!

Warning: Very high forces are involved in many pipeline-plugging situations. Forces increase dramatically as pressure and pipe diameter increase. Extreme care must be taken to assure the safe use of any Pipe Plug. Keep personnel out of area in line with plug ends, open plugged pipelines or manholes. This is any area near a line of sight to any part of the plug. Maximum rated back pressures assume plugs are inserted into clean dry pipes. Dirt in pipes (algae, grease, detergents, mildew, sand, etc.) can considerably decrease the back pressure values. Pipelines made of materials with lower coefficient of friction, e.g. polyethylene or new pipelines with remains of grease or agents directly decrease the coefficient of friction as well as the back pressure values. Never use where failure may result in injury or significant property damage. **Because of the many possible variables these general instructions must be adapted by a competent professional engineer for each specific project. Instructions and training must be provided to all plug users and workers on the job.**

1) BASIC RULES FOR USING ANY PIPE PLUG

- a) Wear eye protection, helmet, and protective clothing and use required safety equipment.
- b) Use confined space procedures and equipment during installation when necessary.
- c) Calculate the head pressure forces plug will be required to restrain; see calculation formulas below.
- d) Select a plug that is manufactured for the actual size, pressure, temperature, and chemical requirements.
- e) Thoroughly clean the pipeline before insertion of the plug.
- f) Insert the plug seal surface completely so it is fully supported by the pipeline.
- g) Always position the plug where there are no sharp edges or protrusions that may damage the plug.
- h) Stay clear of any area in line with any part of the plug, open pipeline or manhole when the plug is holding back pressure.
- i) Use accurate pressure gauges for measuring the pipeline head pressure.
- j) Never exceed the maximum rated head pressure for the plug at the pipe invert.
- k) Provide an anchor, support, and/or bracing to secure the plug when back pressure is present.
- l) Release the back pressure or equalize the pressure on both sides of the plug before deflating, relaxing or removing.
- m) Before and after each use, clean the plug and inspect for surface tears, cuts or any other damage.
- n) To protect the components, store in clean dry area, away from direct sunlight and in a manner that allows plug to remain dry. Rubber components are especially susceptible to deterioration from aging.
- o) Stop the pipeline flow before installing any type of plug.

2) ADDITIONAL RULES FOR OPERATION OF INFLATABLE PLUGS

- a) Read and understand the "PLUG INFLATION PRESSURE CALCULATIONS" below.
- b) Never inflate an inflatable plug outside of a pipe.
- c) Stay clear of any part of the plug when it is inflated.
- d) Always use two accurate calibrated air pressure gauges for monitoring the inflation pressure.
- e) Use a long enough hose to keep the inflation gauge(s) and valve(s) a safe distance from the plug.
- f) Check air line connections and hoses to make sure they are not damaged or leaking.
- g) Never exceed the maximum inflation pressure rating for the plug.
- h) Molded rubber plugs must be inflated to the rated pressure shown on plug
- i) Molded rubber plugs expand axially, so must be inserted at least one pipeline diameter beyond the end of the pipe.
- j) Use a Kevlar or protective sleeve to help protect the plug if debris in pipeline cannot be removed.
- k) Use a bleeding type pressure regulator and a relief valve to maintain the correct pressure with changing temperature and head pressure. A relieving style pressure regulator and/or pressure relief valve must compensate for these factors and prevent over-inflation that could rupture the plug.
- l) Inflate the plug slowly to carefully build up the pressure to the maximum rated inflation pressure. Check the inflation pressure every 15 minutes until the pressure stabilizes and then at least hourly thereafter.

- m) Molded rubber plugs and smaller Multi-Flex™ Plugs are generally inflated with air or an inert gas. Since gases are compressible it is often advisable to inflate larger diameter plugs with water. See water inflation calculations below.
- n) Never use positioning rings or eye bolts on the plug to anchor the plug, they are only intended for lowering and lifting of inflatable plugs. Only plugs with designated anchor lugs or straps may be used to restrain against the powerful forces initiated by back pressures.
- o) Never remove the inflation hose until all back pressure is released and the plug is deflated.
- p) Deflate the plug completely before removing from the pipeline.
- q) Water used for inflation may be pumped out or displaced with air.
- r) Install and remove the plug with a tether, do not pull on the air hose to remove the plug.

3) CALCULATION OF HEAD PRESSURE FORCE

- a) Use the calculated head pressure force to construct plug blocking and anchoring systems.
- b) Measure the inner diameter and determine the radius “r” of the pipeline to be blocked with the plug.
- c) Calculate the cross-sectional area “S” of the pipeline
 - i) $S = r^2 \times \pi$
 - ii) S = cross-sectional area
 - iii) $r = \frac{1}{2}$ the inside diameter
 - iv) $\pi = 3.14159$
- d) Now calculate the total force “F” that the plug must restrain
 - i) $F = P \times S$
 - ii) F = force on the plug
 - iii) P = pipeline pressure
 - iv) S = cross-sectional area
 - (1) Use the same unit of measure for pressure and cross-sectional area. If pressure is in pounds per square inch area must be in square inches, if the pressure is in bar/unit, it must be converted to the area unit of measure.
- e) Hydrostatic pressure (water column pressure) depends on the water level height above the measurement point and not on the shape. The back pressure “P” is determined by the water column height behind the plug, e.g. a 10 meter-high (32.8 ft) water column means a back pressure of 1 bar (14.5 PSI). The surface area and the water column shape are not important, only the water column height is important.
- f) Pressures being exerted on a plug—regardless of the medium (liquid, water or air)—are the same. Ten (10) PSI of water is the same as ten (10) PSI of air. However, air is a compressible media. Therefore when a plug dislodges under air back-pressure, it is much more dangerous than water pressure as the air will expand to its original atmospheric volume. Use extreme caution when conducting air tests!

4) PLUG INFLATION PRESSURE CALCULATIONS

- a) When the plug is inflated with air or inert gas read the inflation pressure directly from the air pressure gauge.
- b) **Water inflation** of a plug requires the pressure gauge reading to be corrected based on the plug depth.
 - i) Water inflation is often preferable in larger and higher pressure plugs because it is not compressible and reduces the risk of explosion. When inflating a plug with a liquid, calculating the actual inflation pressure at the invert is critically important. Obtain the approximate number of gallons of water required to fill the plug from the factory to estimate when to stop filling with water. The gallon capacity is only an estimate but the maximum pressure should not be exceeded.
 - (1) To monitor the inflation pressure with an air hose:
 - (a) When water is used to fill the plug, air is sometimes used to maintain the inflation pressure.
 - (b) To monitor the Inflation pressure with an air hose add to the air pressure gauge reading 1.42 psi per meter (.433 psi/foot) that the air hose connection on the Plug is above the invert. The air hose must be purged of all water.
 - (c) Verify the air hose does not have liquid in it by filling the hose completely with air. If partially filled with liquid, the pressure reading will not be valid.
 - (2) To monitor the inflation pressure with a water hose:
 - (a) Add to the water pressure gauge reading 1.42 psi per meter (.433 psi/foot) that the Plug water pressure gauge is above the invert. The water hose and plug must be completely filled with water. Bleed off any air in the hose.
- c) **Never exceed the maximum rated plug inflation and head pressure** at the pipeline invert.

Contact Petersen with any questions or suggestions relating to the use of any Petersen product.