



# MAINTENANCE & OPERATIONS MANUAL

for the

## REGAN TYPE K BLOWOUT PREVENTER

ORIGINAL INSTRUCTIONS - May 4<sup>th</sup> 2022

### **Introduction:**

The Type K Annular Blowout Preventer was designed and first manufactured by Regan Forge & Engineering in San Pedro, California. Drawings date back to 1928, which makes it the earliest annular blowout preventer. The Type K has no moving mechanical parts such as pistons or dynamic seals that are easily damaged by foreign material in the closing fluid. The packer acts as a diaphragm, using the hydraulic pressure to close the BOP. It's 'pressure to close' and 'vent to open' operation make it one of the simplest designs in blowout preventer technology.

### **Features and Rig Up Instructions:**

Unlike other annular blowout preventers on the market, the Type K can be operated with any pressured media including nitrogen, water, or hydraulic fluid. Hydraulic fluid is preferred. One high pressure flexible hose (1" hose is recommended) is necessary to connect the pressure source to the inlet port on the Type K BOP.

On an accumulator closing unit that employs a 4-way, 3-position shear seal valve (typical hardware), the hydraulic hose should be connected to the "Close" port on the back of the closing unit. The "Open" port must be plugged.

Another feature of the Type "K" is that it employs a 1:1 closing ratio. That is, if the wellbore pressure is 1,000 psi for example, the hydraulic closing pressure necessary to shut off the wellbore pressure is 1,000 psi plus 100 psi(+/-). This is a desirable feature for stripping operations because the "fine-tuning" capability reduces the frictional force between the object(s) being stripped and the packing element of the Type "K". If stripping operations are to be an ongoing operation, a special hydraulic pressure regulator should be installed on the hydraulic closing unit that will more readily permit this infinite pressure control. Manual hydraulic regulators do not provide such precise control. Damage to the packer from stripping is not covered under the warranty.

### **Pressure Source:**

For most efficient operation, a self-contained hydraulic closing unit with sufficient accumulator capacity to close the Type "K" at least three times should be employed (see table below). Such closing units may be equipped with a triplex pump, powered by gasoline or diesel engine, and/or with an air driven hydraulic pump.

The closing unit should be equipped with a hydraulic pressure regulating valve for controlling the hydraulic closing pressure from the accumulator manifold. The recommended regulated pressure for the Type K is 50-80% of the rated working pressure of the BOP, but not to exceed the full rated working pressure. A 4-way, 3-position shear seal valve should be employed on the closing unit to close and open the Type "K" Annular BOP. The plate above this valve should identify the three positions as "Open", "Off" (or "Neutral"), and "Close".

The closing force to the Type "K" may be increased by manually adjusting the hydraulic pressure regulator until a seal is obtained or until the maximum rated working pressure is obtained. The hydraulic regulator for the annular BOP on many closing units has an operating range of 0 to 1,500 psi.

| Nom. Size | Gallons | Nom. Size   | Gallons | Nom. Size        | Gallons |
|-----------|---------|-------------|---------|------------------|---------|
| 3 inch    | .25     | 8-5/8 inch  | 3.5     | 11-3/4 & 13-3/8" | 10.5    |
| 4 inch    | .75     | 9-5/8 inch  | 5.75    | 13-3/4 inch      | 20      |
| 7 inch    | 1.5     | 10-3/4 inch | 7.5     | 16 inch          | 22.5    |

### Operating the Closing Unit:

During normal drilling and work over operations the 4-way shear seal valve should be placed in the "Open" position. As stated above, the Type "K" is a 'Pressure to Close' / 'Vent to Open' blowout preventer. Placing the 4-way/3-position shear seal valve in the "Open" position eliminates the possibility of pressure being trapped in the annular cavity of the BOP which may result in partial closure of the packing element while running tools in and out of the wellbore, resulting in unnecessary wear and possible damage to the packing element.

For routine closure of the Type "K":

1. Move the 4-way/3-position shear seal valve to the "Close" position. Closure is obtained when the audible sound of hydraulic fluid passing through the manifold of the closing unit ceases.
2. Move the 4-way/3-position shear seal valve to "Block" (or Neutral) position.
3. Verify closure by visual inspection of the packing element.

Moving the 4-way valve to the "Block" position traps hydraulic fluid in the annular cavity of the Type "K". The regulated hydraulic closing pressure to the Type "K" will typically be from 800 psi up to the rated working pressure of the unit.

The hydraulic fluid in the pressure cavity of the BOP will hold wellbore pressures that may build to the full rated working pressure of the BOP, because hydraulic fluid is non-compressible. Leaving the 4-way shear seal valve in the "Neutral" position after closing the BOP would provide isolation of wellbore pressures below the regulated hydraulic pressure. If you do not block (isolate by moving the 4 way valve to the neutral position) and the wellbore pressure builds up to a level above the regulated hydraulic pressure, hydraulic fluid would be vented to the hydraulic fluid reservoir, resulting in communication of wellbore fluids and wellbore pressure to atmosphere, causing possible injury or death.

To open the Type "K", move the 4-way/3-position shear seal valve to the "Open" position. Leave the valve in the open position until the packer has completely relaxed. If the valve is put in the neutral position before the packer has opened fully, you can damage the packer by unknowingly stripping through it.

### **Packer Characteristics**

The packing element of the Type "K", like all annular BOPs, requires time to open completely. The amount of time required depends on several factors:

1. Time of the closure.
2. Closure diameter
3. Temperature.
4. Age of the packer.

Under poorest conditions, it can take up to several hours for a packer to completely open. Under ideal conditions, it will take only a few minutes. We recommend heating the BOP in severe cold service. Leaving the BOP closed overnight voids the packer's warranty.

After each cycle, the blowout preventer bore should be inspected to determine the packer position. When completely open, the packer is shielded by the steel body of the blowout preventer and will not contact objects moving through the bore. Failure to allow the BOP to completely open can result in damage to the packer.

## Stripping Operations

Unlike other annular BOPs, the Type "K" closure is not assisted by wellbore pressure. Piston operated annular packers increase their engagement force on the object in the bore incrementally with increase in wellbore pressure. This increases friction between the pipe and packer and will dramatically reduce the packer life.

Because of its 1:1 closing ratio, and direct closure with hydraulic fluid, the Type "K" is ideal for stripping tubing, when necessary. When the Type "K" is closed around tubing with 1,200 psi hydraulic pressure, and there is 1,000 psi of well bore pressure, there is approximately 200 psi net force against the tubing. When done correctly, stripping with the Type "K" will cause far less damage to the element. The following procedures should be followed when stripping with the Type K BOP.

1. Be sure that the closing unit operating the Type "K" has a hydraulic regulator controlling the hydraulic pressure to the BOP. The hydraulic regulator has "back flow" capability that allows fluid to move from the Type "K" to the reservoir under pressure.
2. Close the Type "K" by moving the 4-way/3-position shear seal valve to the "Close" position and leave it in this position during stripping operations.
3. Decrease hydraulic pressure on the Type "K" slowly until slight leakage around the tubing occurs, then increase pressure 150 psi+ or- 50 psi, or until the leak stops.
4. Commence stripping operations. Be sure to monitor the wellbore pressure during stripping to make any necessary changes to the regulator pressure to keep the engagement force of the packing element at a minimum. Accelerated wear of the packer must be anticipated in any stripping operation, but maintaining engagement force of the packer to a minimum will reduce the accelerated wear.

TYPE K PREVENTERS OVER 7" ARE NOT RATED TO CLOSE OVER OPEN-HOLE. ANY ATTEMPT TO DO SO COULD DAMAGE THE PACKING ELEMENT, AND CONTAMINATE THE HYDRAULIC SYSTEM.

## OPERATING TIPS

All elastomeric materials used to mold packers are subject to fatigue. Fatigue occurs more rapidly when the packer is closed over open hole and with pressure from the well bore. When testing the blowout preventer, the operator is advised to close around pipe. Note: Type K Preventers over 7 inches are not rated to close over open-hole.

Spare packers should be stored so as to protect them from the direct rays of the sun. Elastomers lose their elasticity with age, and the service life of a packer that has been in storage for a long period of time will be reduced. We recommend stock rotation.

The packer serves as a diaphragm to contain the hydraulic fluid and control the wellbore. Its elasticity is affected by temperature extremes. We recommend that Preventers be heated in severe cold service.

Although body connection seal can be used more than one time, we advise that it be replaced at each service interval. Closely inspect the seal before reuse and replaced if there is any indication of wear or damage.

## Disassembly

1. **Be sure all pressure is purged from the BOP.** Carefully remove any hoses or plugs in the body ports.
2. Loosen, then remove the nuts from the bonnet studs.
3. **Using lifting aids as necessary,** remove the bonnet from the body.
4. Remove the packer.
5. Clean and inspect all parts for damage.

Note: The packer should be closely inspected for cuts, tears, or cracking. The packer may evidence some surface damage around it's inside diameter, and still perform satisfactorily. Replacement of the packer should be at the operator's discretion, or if the packer will not test.

## Assembly

1. Lubricate the inside of the BOP body and outside of the packer with a light oil. Do not use heavy grease.
2. Install the packer into the BOP body. Use care to align the port with a solid OD portion of the packer (not into a slot).
3. Replace the bonnet seal, either o-ring or square hydraulic packing. Over lap the ends of the packing on each other and trim to fit ( cut at a 45 degree angle).
4. Use Never-Seeze or equivalent on the stud threads. Make up the nuts on the bonnet studs. Torque the nuts to 800-1,000 ft-lbs..

## TEST PROCEDURE

We recommend that the Type "K" Annular Blowout Preventer be tested in accordance with applicable sections of API Specification I6A, for Drill-Through Equipment.

### Annular Packer / Element Function Test

General: Annular packing units will be tested using an appropriate size test pipe.

Plumb the BOP to the closure unit. Use a **calibrated pressure gauge** or equivalent to verify test pressure. **Use extreme caution when pressure testing.**

- Secure the test pipe in the bore of the BOP.
- Apply hydrostatic pressure (1/2 to full- rated working pressure) to the packing unit, closing the BOP around the test pipe. Block in fluid / pressure.
- Apply annular pressure, as required, **not to exceed full rated working pressure** of the BOP.
- Observe the BOP / Packing Unit for 5 minutes.

**Acceptance Criteria:** There shall be no visible leakage.

If leakage is detected, allow the packer to open, inspect for any issues, then re-apply - or increase closure pressure (**not to exceed rated working pressure**) and repeat the test.