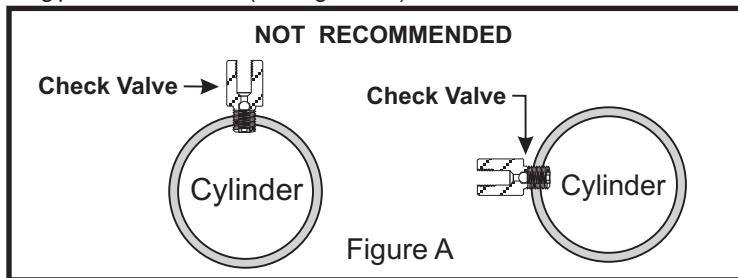


## Extending Reliability of Injection Check Valves & Protecting Compressor Components

For many years the compressor industry has replaced compressor check valves that have failed but cause of failure was never investigated. CC Technology's expertise in the compressor lubrication system field has enabled us to research causes of check valve failure. Final testing allowed CCT to provide the industry with a proven, method to extend the life of not only gas compressor check valves but any application using check valves in natural gas or air service.

For reliable operation, check valves should never be installed in a vertical or horizontal position. Check valves should be installed in a manner as to permit an oil head between the check valve and hot gas/debris in the compressor cylinder. The oil head will maintain a liquid seal in the check valve and keep the heated gas and debris separated from the check valve seat to increase reliability. Vertical installation can allow the introduction of hot, contaminated gas into the check valve each time the valve opens to inject oil into the lubrication point. Gas migrating into the check valve as it opens and closes can also create coking of oil on the ball and seat of the check valve due to heat from the compressed gas or air causing premature failure. (See figure "A")



**Two methods to permit an oil head seal between the check valve and gas/debris in the cylinder:**

**1. Standard Tubing and Fittings:** Create a bend in the tubing between the injection point and the check valve to allow an oil seal (See Figure B). The use of tubing between the check valve and injection point is questionable due to the added leak paths of extra tube connections and weight of the check valve and tube fittings. This additional weight combined with vibration of the compressor could possibly cause cracks in the tubing allowing hazardous gases to escape into the atmosphere posing a threat to persons in the area. Using this method also increases the cost of the compressor when you consider extra components, tubing, tube connections and labor costs multiplied by the number of compressors manufactured each year. (see figure B)

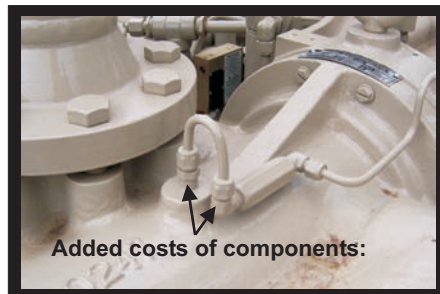


Figure B



**ENGINEERING NOTE:** The female by female check valve installed on thousands of gas and air compressors incorporates 1/4" NPS (national pipe straight) thread connections. The tube fitting and male pipe nipple used to assemble the check valve and components is an NPT (national pipe tapered thread). When combining these different types of threads the result is 1 1/2 to 2 threads for sealing area which is unacceptable in most engineering circles. Although this is unacceptable it is used by some compressor manufacturers. The correct threads to use in all applications to enable reliable sealing between the threads is to use industry standard NPTF to NPTM connections. Excessive issues with leakage between the NPT and NPS could possibly be compounded by the use of incorrect threads. (See figure C)

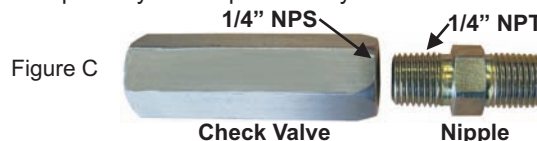


Figure C

## Extending Reliability of Injection Check Valves & Protecting Compressor Components

**2. Prior Product, the Omni Trap:** The product termed the Omni Trap will allow an oil seal, but has several issues:

**A. Volume of Oil:** The volume of oil needed to fill the check valve cavity on the discharge end, the 1/4" x 1/4" nipple that couples the check valve to the Omni Trap and the Omni Trap void, is approximately .183 cubic inches. If the divider block system cycles every 30 seconds with a .006 piston size, the compressor could operate for 15 minutes before lubrication is injected into the lubrication point. Due to the start/stop and limited run time of CNG compressors, this will cause premature wear or failure of cylinder and packing components. The CNG compressor can start as many as 150 times each day and run for only a short period of time (five to fifteen minutes). Of course this issue is escalated with longer divider block system cycle times. Add to this the time needed to fill the void in the Omni Trap after replacement of parts on the lube system and you have major problems providing lubrication to the compressor components. (See Figure C)

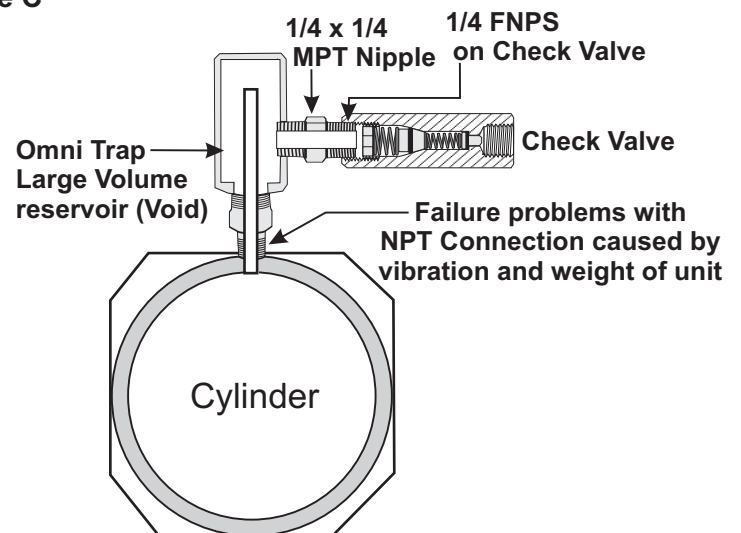
**B. Dilution of Oil by Natural Gas:** After start-up of the compressor, the compressor fills the CNG storage bottles with the compressed gas to a given pressure normally 3600 PSI, and then is automatically shut down. The remaining gas in the cylinder is released (blown down) to allow the unit to start again in an unloaded state. As the cylinder compresses gas the volume of oil in the Omni Trap is experiencing gas saturation. The oil saturated with gas creates a problem when the compressor stops and the cylinder is blown down. At that point the gas comes out of solution due to rapid decompressing (see Henry's Law) of the oil and creates foaming of the oil (entrained air) which in turn removes the oil in the Omni Trap with the gas. This forces the oil contained in the check valve cavity, the oil in the 1/4" x 1/4" nipple and the oil in the Omni Trap out with the gas blow down. At start-up the divider block system must fill all of these voids before lubrication is introduced into the injection point to lubricate the cylinder and packing. This is a definite casue of premature wear or failure of the compressor components.

**C. Weight of Components:** The combined weight of the Omni Trap, double female check valve, 1/4" x 1/4" MPT nipple and the tubing fitting is approximately 14 ounces. (See page 3 figure D)

**D. Failure of Omni Trap:** The compressor experiences extreme vibration during normal operation. Vibration combined with the weight of the check valve/Omni Trap combination creates premature failure of the 1/8" or 1/4" NPT male pipe connector threaded into the injection point. This failure results in compressed gas in the cylinder or packing point to immediately escape to the atmosphere creating an explosion or fire safety hazard and possible injury to operators standing near the compressor.

**E. Premature Failure of Cylinders/Packing:** When the NPT connector of the Omni Trap cracks, the oil needed to lubricate the compressor components leaks to atmosphere with the gas and the compressor will continue to operate causing the Compressor components (cylinders/packing) to suffer premature wear and failure due to lack of lubrication.

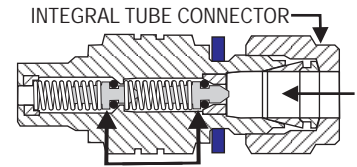
Figure C



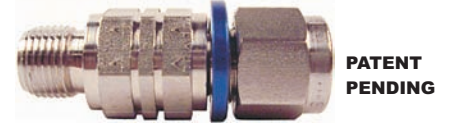
**INCREASING LONGEVITY & RELIABILITY  
OF LUBE SYSTEM CHECK VALVES AND OPERATOR SAFETY**

**CONCLUSION:** Develop a product that will address safety issues, protect compressor components and increase reliability of the check valve:

**“XDC” Double Poppet Check Valve  
with Integral Tube Connection**



Self Guiding Double Poppet Seals with Viton O-Rings



**PATENT PENDING**

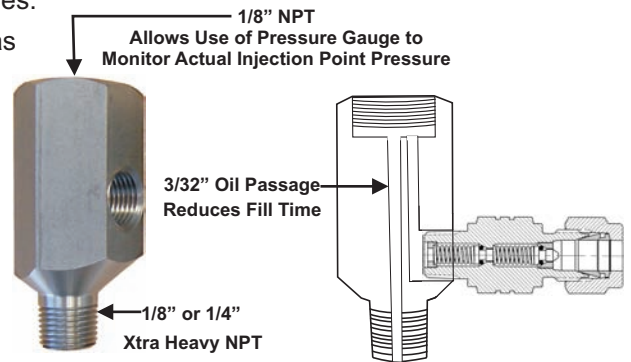
**PART # 422P-NPT**

**1/4" Tube x 1/8" NPT-Double Poppet**

1. Engineer a stainless steel check valve with the following features:
  - A. Lightweight to reduce failure caused by vibration.
  - B. Utilize time proven check vane design with improved self guiding double poppet to eliminate sealing issues.
  - C. 8,000 PSI operating pressure and temperature rating of 400 degrees F.
  - D. Integral tube connector to eliminate leak paths and permit simple installation.

2. Engineer a device to protect the check valve with the following features:
  - A. Allow for an oil head seal to protect the check valve from heated gas and gas stream contamination.
  - B. Minimum fill capacity to reduce the effects of gas saturation and time needed to inject lubricant to the cylinder or packing.
  - C. 8,000 PSI operating pressure.
  - D. Enable installation of a pressure gauge at the injection point to check actual injection pressure for field troubleshooting.
  - E. Light weight eliminates vibration failure

**“CVP” Check Valve Protector**



The CCT “XDC” Injection Check valve and the “CVP” Check Valve protector will address the compressor industry needs for a dependable, solution to extend the longevity and reliability of divider block system injection check valve.

Total weight of the combination “XDC” and “CVP” is 4 OZ. reducing possibility of failure caused by vibration. Fill capacity of .010 will require less than two (2) cycles of a number 6 (.006) piston to begin lubrication at the injection point. With an operating pressure of 8,000 PSI and 400 degrees F., this combination addresses the need for dependable check valve operation, protection of compressor components and operator safety.

**Figure D: ACTUAL SIZE OF BOTH UNITS**

**Omni Trap Specs:  
Total Weight 14 OZ  
Fill Capacity: .183 cubic inches**

**Oil Head Fitting Specs:  
Total Weight 4 OZ.  
Fill Capacity: .010 cubic inches**

