



# Replace Compressor Cylinder Unloaders



## Technology/Practice Overview

### Description

Compressor cylinder unloaders are used to 1) reduce the machine's startup load, 2) prevent an overload when there is an upset in operating conditions, and 3) control gas volumes due to fluctuations in rate requirements. Many older reciprocating engine-powered compressors are equipped with outdated or worn cylinder unloaders that continuously leak natural gas even when regularly maintained. A useful tool to detect emissions and show that unloaders leak gas is regular surveys with infrared (IR) cameras. One Partner initiated a project to replace the cylinder unloaders at some of its compressor stations with a design that utilizes a balanced piston that avoids chatter and minimizes the pressure required for operation. Reduced chatter reduces the

contact, friction, and wear which results in reduced emissions. Reduced pressure means a reduced driving force for emissions.

Faulty unloaders can be a source of fugitive methane emissions to the atmosphere from leaking o-rings, covers, pressure packing, and frequent maintenance. Unloaders have also been identified as one of the top causes of unscheduled reciprocating compressor shutdowns. There is at least one vendor providing unloaders that utilize multiple sealing elements to reduce emissions while its plug-type design avoids the inherent operational problems and breakage associated with finger-type unloaders.

### Operating Requirements

Re-piping of control lines and personnel trained in the proper maintenance of the new unloaders.

- Compressors/Engines
- Dehydrators
- Directed Inspection & Maintenance
- Pipelines
- Pneumatics/Controls
- Tanks
- Valves
- Wells
- Other

### Applicable Sector(s)

- Production
- Processing
- Transmission
- Distribution

### Other Related Documents:

Replace Gas Starters with Air or Nitrogen, PRO No. 101

Reduce Gas Venting with Fewer Compressor Engine Startups & Improved Engine Ignition, PRO No. 102

Reducing Emissions When Taking Compressors Offline, Lessons Learned

## Economic and Environmental Benefits

### Methane Savings

Estimated annual methane emission reductions *3,500 Mcf per compressor unit*

### Economic Evaluation

Estimated Gas Price	Annual Methane Savings	Value of Annual Gas Savings*	Estimated Implementation Cost	Incremental Operating Cost	Payback
\$7.00/Mcf	3,500 Mcf	\$26,100	\$40,000 — \$50,000	\$0	1 to 2 years
\$5.00/Mcf	3,500 Mcf	\$18,600	\$40,000 — \$50,000	\$0	2 to 3 years
\$3.00/Mcf	3,500 Mcf	\$11,200	\$40,000 — \$50,000	\$0	3 to 5 years

\* Whole gas savings are calculated using a conversion factor of 94% methane in pipeline quality natural gas.

### Additional Benefits

- Cost of a new unloader is less expensive than repairing the manufacturer-equipped original ones
- Reduced safety risks and maintenance costs

# Replace Compressor Cylinder Unloaders (Cont'd)

## Applicability

Compressor cylinder unloader replacement is applicable to compressors equipped with unloaders that are experiencing maintenance problems.

## Methane Emissions

Faulty compressor cylinder unloaders require frequent maintenance and can vent significant methane emissions to the atmosphere. A Partner reported that a total of 14 MMcf per year of methane emissions were eliminated by replacing the worn unloaders on four compressors with those of a new design at one of their compressor stations.

## Economic Analysis

### Basis for Costs and Emissions Savings

The Partner realized estimated savings in excess of \$50,000 per unit per year. The savings include the value of the previously leaked gas, reduced safety risks, and maintenance costs. To be conservative, operating and maintenance (O&M) savings are assumed to be \$0. The capital and labor costs to replace and install the unloaders is \$40,000 to \$50,000 per unit.

### Discussion

The payback period for this project ranges from 1 to 5 years, depending on the capital cost, gas price at the time of implementation, and the volume of gas recovered. This payback period is conservative because it does not account for O&M savings. Capital costs to replace and install the new unloaders were reported to be \$40,000 to \$50,000 per unit. However, these costs are justified based on the relatively short payback period and reduced O&M costs. Replacement also resulted in fewer unscheduled shutdowns and reduced methane emissions. The Partner has plans to replace original unloaders on compressors at other stations.

EPA provides the suggested methane emissions estimating methods contained in this document as a tool to develop basic methane emissions estimates only. As regulatory reporting demands a higher-level of accuracy, the methane emission estimating methods and terminology contained in this document may not conform to the Greenhouse Gas Reporting Rule, 40 CFR Part 98, Subpart W methods or those in other EPA regulations.

## Methane Content of Natural Gas

*The average methane content of natural gas varies by natural gas industry sector. The Natural Gas STAR Program assumes the following methane content of natural gas when estimating methane savings for Partner Reported Opportunities.*

<b>Production</b>	79 %
<b>Processing</b>	87 %
<b>Transmission and Distribution</b>	94 %