

Methane Emission Reductions from Reciprocating Compressors

Lessons Learned
from Natural Gas STAR



EPA's Natural Gas STAR Program,
Pioneer Natural Resources USA, Inc., and
The Gas Processors Association

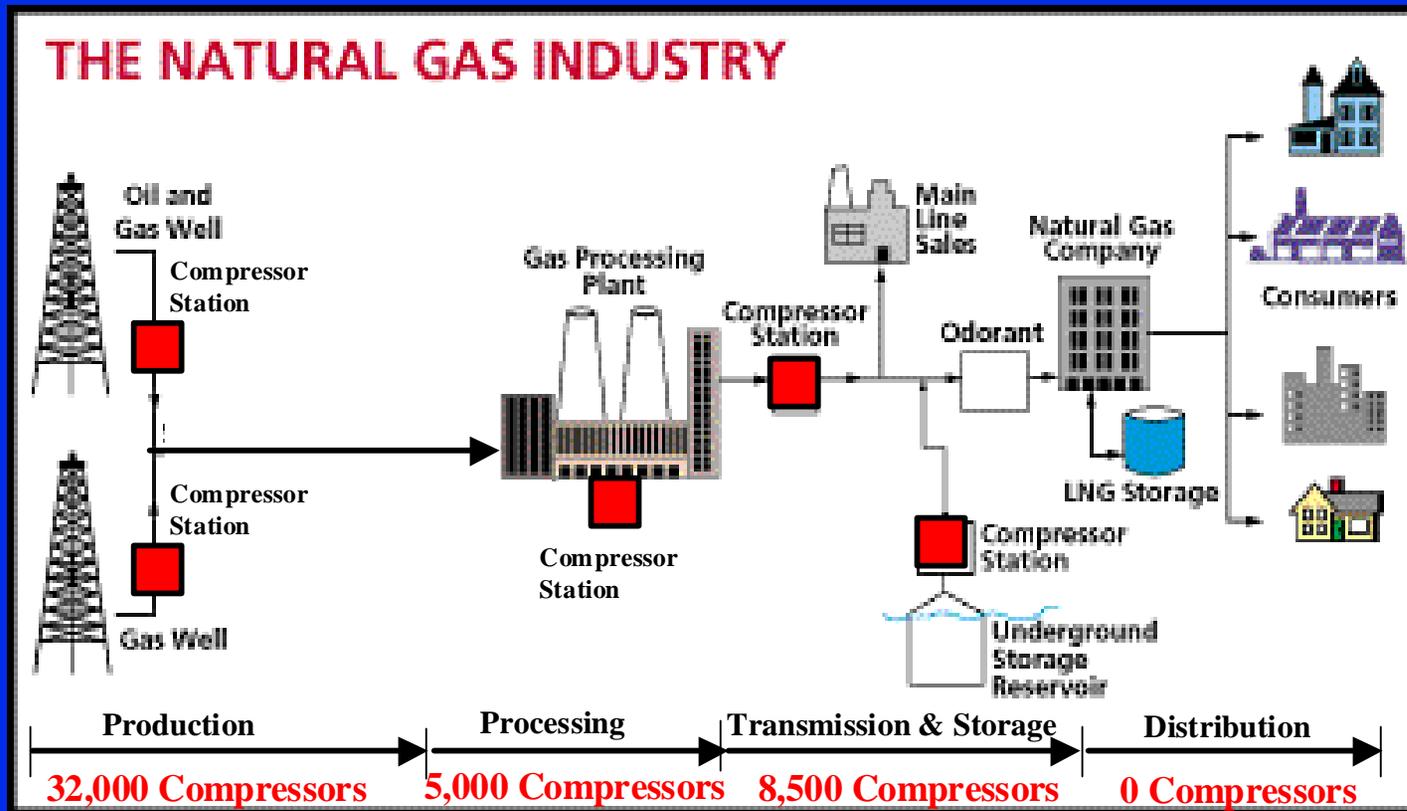
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- Introduction to Compressors
- Methane Losses
- Steps to Reduce Methane Losses
- Cost Effectiveness
- Future Trends



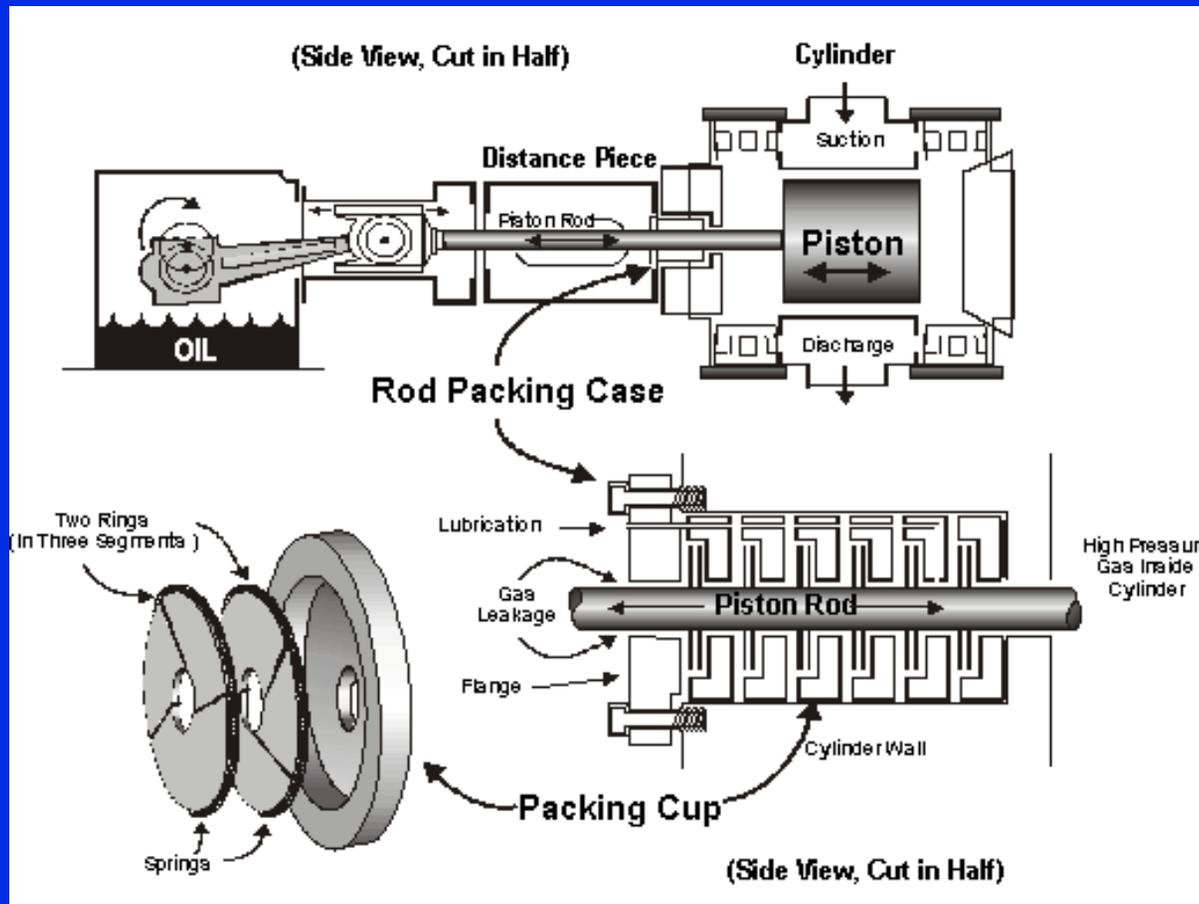
Location and Types of Compressors



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Reciprocating Compressor Rod Packing Systems



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Methane Losses

- Compressor seals are fourth largest emission source at 16 Bcf/yr
- Leakage typically occurs
 - ◆ Around the packing case nose gasket
 - ◆ Between the packing cups
 - ◆ Around rings from slight movement in the cup
 - ◆ Between the rings and shaft
- All packing systems normally leak
 - ◆ New systems lose ~ 60 scfh
 - ◆ Badly worn systems lose ~ 900 scfh



Steps to Reduce Methane Losses

- Leakage can be reduced through monitoring and economic replacement
 - ◆ Conventional packing rings need to be replaced every 3 to 5 years
- An economic leak rate can be determined based on costs and gas savings
- Replacing rings when it is economical
 - ◆ Saves gas and money
 - ◆ Extends the life of the compressor rod



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Economic Analysis

- Partners should develop an “economic replacement threshold” that defines the point when it is cost-effective to replace rings and rods

$$\text{Economic Replacement Threshold (scfh)} = \frac{(\text{CR} * \text{DF})}{[(\text{H} * \text{GP}) / 1,000]}$$

where:

CR = cost of replacement (\$)

DF = capital recovery

H = hours of compressor operation

GP = gas price (\$/Mcf)

$$\text{DF} = i(1+i)^n / [(1+i)^n - 1]$$



Economic Analysis Compressor Rod Packing System

Economic Replacement Threshold for Packing Rings

LRE (scfh)	Payback Period ¹ (yrs)
55	1
29	2
20	3
16	4
13	5

¹ Assumes packing ring replacement costs of \$1,200, \$3.00/Mcf gas and 8,000 hr/yr

Economic Replacement Threshold for Rod and Rings

LRE (scfh)	Payback Period ¹ (yrs)
376	1
197	2
137	3
108	4
90	5

¹ Assumes packing ring replacement costs of \$1,200, rod replacement cost of \$7,000, \$3.00/Mcf gas and 8,000 hr/yr



Partner Experience

- One partner conducted semi-annual inspections of compressor rod packing
 - ◆ Replaced packing cases at eight stations costing \$1,050 per case, installed
 - ◆ Saved 55 MMcf/yr valued at \$165,000

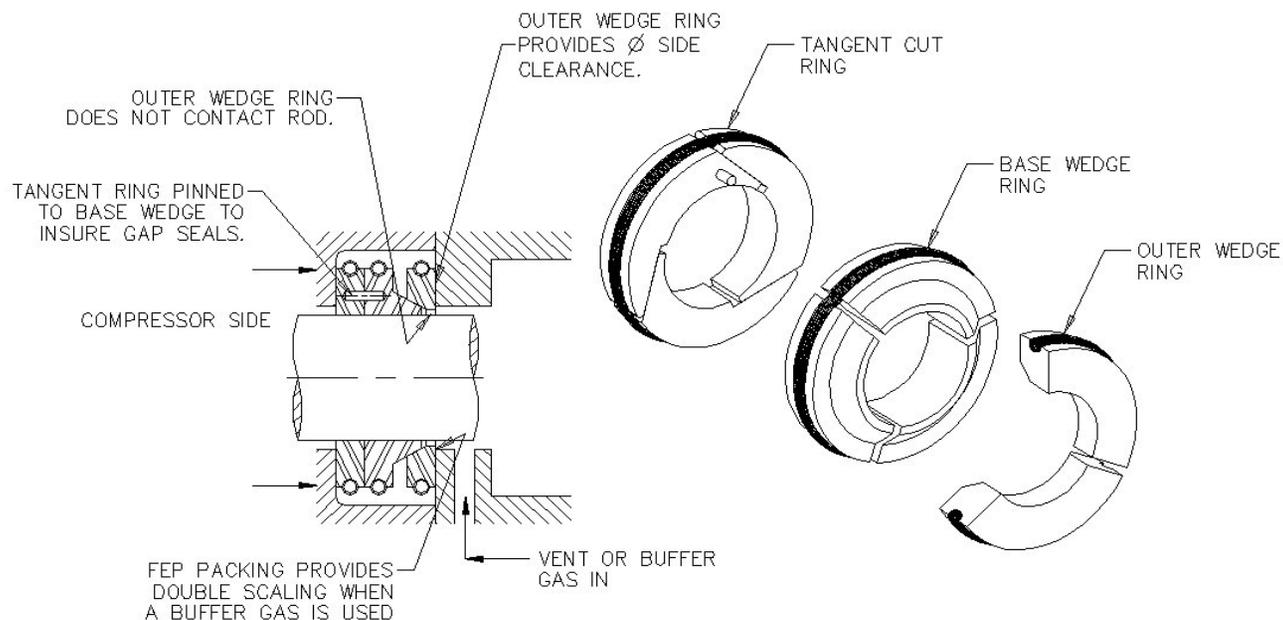


Future Trends

- ❑ Install axially loaded rings in reciprocating compressors
- ❑ Install combination rings that serve as a static seal when compressors are shut down and kept pressurized
- ❑ Vented and purged seals



Axially Loaded Rings



FEP STYLE PACKING

Source: Compressor Engineering Corporation



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Three Ring Rod Packing

- ❑ Three ring rod packing is becoming more wide spread
- ❑ The rings are typically installed in one of the last two cups
- ❑ This design could be installed without any replacement or modification on the packing case cup



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Discussion Questions

- ❑ To what extent are you implementing this Lesson Learned?
- ❑ How can this Lesson Learned be improved upon or altered for use in your operation(s)?
- ❑ What are the barriers (technological, economic, lack of information, regulatory, etc.) that are preventing you from implementing this technology?

