EFRC Training Workshop Basic training

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Introduction

- Reciprocating compressors and their drivers require a variety of auxiliary equipment to support their operation.
- The equipment for these compressors is described as an overview in this presentation.



Guidelines & standards for recip. compressors

- 1. MFG. / OEM Standard acc. ATEX and CE
- 2. ISO 13631 (former API11P, up & mid stream industry)
- **3.** API 618, 5th Edition (downstream, petro & chemical industry)
 - Fig G-1 Cylinder Cooling System
 - Fig G-4 Typ. Self contained CW System for piston rod packing
 - Fig. G-5 Typ. Pressurized Frame Lube Oil System



Guidelines & standards

API (AMERICAN PETROLEUM INSTITUTE)

API Standard 610 "Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries"

- API Standard 660 "Shell-and-Tube Heat Exchangers for General Refinery Services"
- API Standard 661 "Air-Cooled Heat Exchangers for General Refinery Services"



Typical Heat Losses in Recip. Compressors





How to calculate the heat duty for heat exchangers? $\mathbf{Q} = \mathbf{M} * \mathbf{Cp} * \Delta \mathbf{T}$

Where:

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- Q is the heat duty or the total heat transferred. Btu/hr or W
- M is the Mass flow rate for the fluid (Air, water, oil) undergoing the temperature change. Ib/hr or kg/s
- Cp is the heat capacity of the fluid undergoing the temperature change. Btu/lb.°F or J/kg.°K
- ∆T is the temperature change in fluid normally calculated as the difference between outlet and inlet temperatures. °F or °K(°C)

- Shell and tube heat exchanger
 Process gas, cooling water, lube-oil
- Bolted plate heat exchanger
 Cooling water and lube-oil
- Air heat exchanger
 - Cooling water & lube-oil,





• Air heat exchanger

- Process gas and / or cooling water,



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Lubrication systems

CYLINDER AND CRANK MECHANISM LUBE CIRCUITS



Frame lubrication paths



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Frame Iubrication

Auxiliary End Lubrication Components

Auxiliary End Lubrication Components





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Frame lubrication Spin-On Oil Filters

Auxiliary End Lubrication Components

Maximum pressure differential for spin-on filters: 10 psid

Oil pressure downstream from filters: 60 psig



After Before Filter Filter

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Frame Iubrication P&ID



Cylinder & packing lubrication

• 6.12.1 Cylinder lubrication (ISO 13631)

Either block-distribution lubrication systems or pump-to-point lubrication systems shall be furnished for lubrication of compressor cylinder ring travel bore and piston rod packing. The force-feed lubricator shall be suited for variable flow.



Cylinder lubrication calculation



Mineral Qil and Synthetic Qil consumption during normal operation for Applied Speed of 742 RPM

| \succ | \mathcal{L} | | Recommended Liters/day | | | | |
|---------|---------------|--|------------------------|-------------|---------|--|--|
| Y | Minimum F | Recommended Mineral Oil ISO Grade and Type | Packing | Cylinder | Total 🖌 | | |
| | Throw 1 | SAE 50-60 wt (ISO 220-320) or SAE 40 wt (ISO 150) w/ Compounding | 1.76 | 2.07 | 3.83 | | |
| ſ | Throw 2 | SAE 50-60 wt (ISO 220-320) or SAE 40 wt (ISO 150) w/ Compounding | 1.76 | 2.07 | 3.83 | | |
| ٢ | | | | Normal: | 7.66 | | |
| 7 | | | | Break-In*: | 13.78 🖌 | | |
| | | | 7 7 7 7 | 7777 | 7 2 2 2 | | |



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Cylinder Iubrication



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Cylinder lubrication

Force Feed System Components



Cylinder lubrication Separate Oil Supply Force Feed System



Cylinder lubrication



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Lube Oil Recovery system (ORS)

Oil Recovery System Installation Details



Lube Oil Recovery system (ORS)

The oil recovery system is designed to automate the recovery and reuse or disposal of oil from distance piece and packing

- Recovers oil from packing and distance piece drain lines
- Reuse oil by returning to suppy, or send to existing waste tank
- 20-40% potential oil reuse on typical compressor packages
- Eliminates mistakes made when manually venting storage vessels
- Vent to atmosphere, VRU, or flare system
- 5 gallon tank capacity, powder coated inside and out
- Instrument gas or air operated, up to 300 PSI supply, integrated regulator
- Integrated float control in tank, 2.75 gallon "swing"
- Slow speed piston pump, low air or gas usage







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Cooling water unit API 618, Plan A&B



Cooling water unit, API 618, D



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Cooling water unit, CAD / as built







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- In the natural gas industry, compressors are used for various applications. Natural gas leakages from these compressors represent a major source of methane emission. In the methane emission reduction field sometimes local regulations and End Users ask for the recovery of leaks.
- When the re-injection in the compressor suction is not possible a leak recovery system is recommended. Seal gas recovery units use special oil-free compressors specially designed for continuous operation.







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| Compressor-Data | | min. | max. |
|-------------------------------------|----------|------|------|
| Compressor housing over pressure ma | | 3,5 | |
| Suction pressure p1 | bar(abs) | 1 | 2,5 |
| Discharge pressure p2 | bar(abs) | | 91 |
| Suction temperature | °C | 0 | 35 |
| Ambient temperature | °C | 0 | 40 |

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Conclusions

- All process, compressor and ambient related conditions must be available for sizing the related equipment
- Selection of good engineered auxiliary systems is essential for the trouble free, long term operation of the reciprocating compression sytems.
- Regular maintenance according to the operation instructions is mandatory to maintain high availability and reliability of the auxiliary sytems

Keep the pistons running © Thank you



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