CC Technology pro-flo
LUBRICATION DIVISION

Calculating Lubrication Rates for Compressor Cylinders & Rod Packing

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INTRODUCTION

The optimum quantity of oil to lubricate compressor cylinders is calculated using several different formulas by compressor manufacturers with an end result of various lube rates. Even identical compressors will require different lube rates depending on application. The purpose of this outline is to provide the end user adequate means of finding a safe starting place for lubricating compressor cylinders and rod packing. A standard practice for new or freshly revamped compressors is to double the lube rates for an initial break-in period of 200 hours. Lubrication rates can also be affected by the condition of your compressor. Excessive lube rates may be necessary due to abnormal wear or overdue maintenance. Under average conditions the following formula will provide an oil film thickness of .002. **Note: Always consult the compressor manufacturer or lubrication system design engineer for specific lubrication rates and dependable system design.**

BASE LUBRICATION RATES

Cylinder: Lubrication rates for the average compressor cylinders moving pipeline quality gas with discharge pressures under 1000 psi should be 1 pint of oil for 2,000,000 ft^2 of cylinder surface in a 24 hour period. The following formula will give the cylinder an oil film thickness of approximately .002.

$$\frac{\text{Bore (in.)} \times \text{Stroke (in.)} \times \text{RPM}}{31{,}800} = \text{Pints Per Day}$$

This value is sufficient only with the previous criteria for gas stream components and pressures.

Example: 10" Bore x 5.5" Stroke x 1200 RPM ÷31,800

$$\frac{10 \times 5.5 \times 1200 = 66{,}000}{31{,}800} = 2.07 \text{ Pints Per Day (24 hours operation)}$$

The quantity of lubrication is distributed evenly between the number of lubrication points per cylinder.

Rod Packing: The following are baseline oil quantities. Lube quantities are influenced by gas stream components, pressure and packing materials. It is not recommended for rod lubrication to be less than .75 pint per day.

Rod Diameter	Quantity of Oil
1.125"	.90 Pint Per Day
1.50"	1.25 Pints Per Day
2.00"	1.50 Pints Per Day
2.50"	1.75 Pints Per Day

CALCULATING PUMP RATES in PINTS PER DAY

To determine the cycle time of the divider block assembly you must time the indicator from the start position until it returns to the same position. If you are timing using an LED, the time between blinks of the LED is the cycle time. Any type of a cycle indicator, mechanical counter or a blinking LED will provide means for determining the quantity of oil flowing through the lubrication system by the following formula:

Q = Flow Rate in Pints Per day
M= Total Value of the Divider Block Assembly

$$Q = \frac{6M}{T}$$

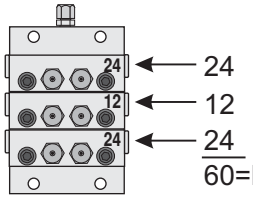
T = Time in seconds for one complete cycle of the divider block. Note: Cycle indicator pin must travel from full out position and return to full out to indicate one full cycle. Each blink of the LED on the DNFT indicates one full cycle of the divider block.

CALCULATING DIVIDER BLOCK LUBRICATION SYSTEM PUMP RATES (Cont'd)

6 = The constant resulting from converting cubic inches to pints and seconds to days.

Example: $\frac{2 \times 86{,}400 \text{ Sec / Day}}{1000 \times 28.8 \text{ Cu. In. / Pints}} = 6$

Example: Cycle time of the divider block is 22 seconds.
To find the quantity of oil currently flowing through the divider block in pints per day: (24 hours operation at current RPM)
1. Add the total of the numbers on the front of the individual divider blocks. Example:(24+12+24 =60)
2. Multiply the total value of the divider blocks x 6. Example:(6x60=360)
3. Divide the answer (360) by the cycle time in seconds. (360 ÷ 22=16.36 Pints Per Day Total to Compressor)



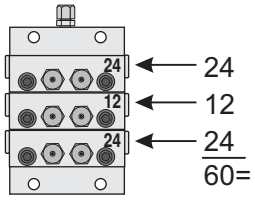
24
12
24
60=**M-**Total Value of Divider Block

$$Q = \frac{6M}{T}$$

M=60 x 6=360
T= 22

Q=16.36 Pints Per Day Total Pump Rate

If the flow rate is incorrect and the recommended oil consumption in Pints Per Day is known, use the following formula to adjust the lubricator pump for correct cycle time.
Example: Recommended oil consumption is 16.36 PPD.



24
12
24
60= **M-**Total Value of Divider Block

$$T = \frac{M \times 6}{Q}$$

M=60 x 6=360
Q= 16.36

T= 22 Cycle Time In Seconds

NOTICE: To determine correct cycle time for compressors running at reduced RPM: Multiply the recommended cycle time of the divider block system by the rated RPM of the compressor and divide by the actual RPM of the compressor.

Example:

Recom. Cycle Time= **22** Sec. **X** Rated RPM **1200** / Divided by Actual RPM **1000** = Cycle Time = **26** Sec.

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Cylinder / Packing Lube Oil Recommendations for Various Gas Stream Components

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GAS STREAM	< 1000 PSIG (<70 BAR_G)	1000 to 2000 PSIG (70 to 140 BAR_G)	2000 to 3500 PSIG A* (140 to 240 BAR_G)	3500 to 5000 PSIG A* (240 to 345 BAR_G)	> 5000 PSIG A* (> 345 BAR_G)
Pipeline Quality Natural Gas	SAE 40 Weight ISO 150	SAE 40-50 Weight ISO 150-220 1.25 x Base Rate	SAE 50 Weight W/Compounding ISO 220-320 1.50 x Base Rate	Cylinder Oil ISO 320-460 2.0 x Base Rate Or Synthetic Diester / Polyglycol	Cylinder Oil W/ compounding ISO 460-680 3.0 x Base Rate Or Synthetic Polyglycol
Natural Gas with Water B* & or Heavy Hydrocarbons Methane < 90% SG > 0.7 Propane > 8%	SAE 40-50 Weight ISO 150-220 1.25 x Base Rate	SAE 50-60 Weight W/Compounding ISO 220-320 1.50 x Base Rate	Cylinder Oil W/Compounding ISO 460-680 2.0 x Base Rate	Cylinder Oil W/Compounding ISO 680 3.0 x Base Rate Or Synthetic Diester / Polyglycol	Contact Lubricant Supplier
CNG Compressed Natural Gas	SAE 40 Weight ISO 150	SAE 40-50 Weight ISO 150-220	See Pipeline Quality Natural Gas or Synthetic Diester / Polyglycol	See Pipeline Quality Natural Gas or Synthetic Diester / Polyglycol	See Pipeline Quality Natural Gas or Synthetic Diester / Polyglycol
Air	SAE 40 Weight Compressor Oil ISO 150	SAE 50 Weight Air Compressor Oil W/Compounding ISO 220 1.50 x Base Rate	Synthetic Diester 1.50 x Base Rate	Contact Lubricant Supplier	Contact Lubricant Supplier
Wet Air	SAE 40-50 Weight Air Compressor Oil W/Compounding ISO 150-220	Synthetic Diester 1.50 x Base Rate	Synthetic Diester 2.0 x Base Rate	Contact Lubricant Supplier	Contact Lubricant Supplier
Carbon Dioxide 2% to 10%	SAE 40-50 Weight ISO 150-220 1.25 x Base Rate	SAE 50-60 Weight Or SAE 40 Weight W/Compounding ISO 220-320 1.50 x Base Rate	Cylinder Oil W/Compounding ISO 460-680 2.0 x Base Rate Or Synthetic PAG	Cylinder Oil W/Compounding ISO 680 3.0 x Base Rate Or Synthetic PAG	Contact Lubricant Supplier
Carbon Dioxide > 10%	SAE 40-50 Weight ISO 150-220 1.50 x Base Rate	SAE 50-60 Weight Or SAE 40 Weight W/Compounding ISO 220-320 2.0 x Base Rate	Cylinder Oil W/Compounding ISO 460-680 3.0 x Base Rate Or Synthetic PAG	Cylinder Oil W/Compounding ISO 680 4.0 x Base Rate Or Synthetic PAG	Contact Lubricant Supplier
Nitrogen	SAE 40 Weight ISO 150	SAE 40-50 Weight ISO 150-220	SAE 50 Weight ISO 220	SAE 60 Weight ISO 320	Cylinder Oil ISO 460-680
H_2S Hydrogen Sulfide 2% to 30%	SAE 40 Weight W/Compounding ISO 150 1.50 x Base Rate	SAE 40-50 Weight W/Compounding ISO 150-220 1.75 x Base Rate	SAE 50 Weight W/Compounding ISO 220 2.0 x Base Rate	SAE 60 Weight W/Compounding ISO 320 3.0 x Base Rate	SAE 60 Weight W/Compounding ISO 460-680 4.0 x Base Rate
H_2S Hydrogen Sulfide > 30%	SAE 40 Weight W/Compounding ISO 150 1.75 x Base Rate	SAE 40-50 Weight W/Compounding ISO 150-220 2.0 x Base Rate	SAE 50 Weight W/Compounding ISO 220 2.5 x Base Rate	SAE 60 Weight W/Compounding ISO 320 4.0 x Base Rate	Cylinder oil W/Compounding ISO 460-680 6.0 x Base Rate
Propane (Refrigerant) Notice: Verify oil pour point temperature is below inlet gas temperature.	SAE 40 Weight or Refrigerant Oil 0.5 x Base Rate	SAE 40 Weight or Refrigerant Oil 1.0 x Base Rate	Refrigerant Oil Contact Lubricant Supplier	Refrigerant Oil Contact Lubricant Supplier	Refrigerant Oil Contact Lubricant Supplier

CAUTION:

Always consult the compressor manufacturer for lube oil requirements. The formulas on the previous page and the lube oil recommendations are calculated quantities and influenced by several unknown factors which must be included in the calculations when designing the lubrication system. An easy method for detecting correct lubricant quantities is a visual inspection of internal surfaces of the compressor cylinder. The obvious sign of excessive lubrication is oil collecting in cylinder low spots or valve ports. Wipe the cylinder with a tissue paper. If oil appears evenly on the tissue paper you are close to optimum efficiency. If the tissue paper is dry or unevenly spotted the feed rate is too low. A few recommended steps for efficient compressor lubrication are: ★**Always consult the compressor manufacturer or lubrication system designer to insure existing divider blocks are designed correctly for the compressor cylinders and packing.** ★ **Pressure test divider blocks and lubricator pump for output volume annually to verify integrity.** ★**Use divider blocks with smaller pistons. This will regenerate oil film thickness more often.** ★**Use good quality oil formulated for the service of the compressor.** ★**When adjusting for optimum lubrication, reduce or increase oil rates by 10% and operate under existing conditions for 10 to 14 days before next inspection.**

A*: It is recommended to use water cooled packing for compressor cylinders operating with these pressures.

B*: Lean burn engine oils contain detergents, dispersants and ash additives which hold water in suspension. In certain applications this suspended condensate can cause problems with possible inadequate lubrication of the cylinders and packing.