



# CO<sub>2</sub> PAG

## Lubricants for A/C and Refrigeration Systems

PAG 46 and 68 are new polyalkylene glycol that guarantee high-performances in AC/R systems with CO<sub>2</sub>.

CO<sub>2</sub> is a refrigerant with a complex and delicate balance, which requires outstanding performances to the lubricant.

PAG 46 and 68 for CO<sub>2</sub> offer a better miscibility with CO<sub>2</sub> in a wide range of concentrations and temperatures. This means: excellent lubricating properties and higher efficiency for the refrigeration system.

PAG 46 and 68 for CO<sub>2</sub> have a reduced hygroscopicity (if compared to normal PAG, which is unprotected to hydroxyl and used with other refrigerants). These oils also have high chemical stability, thermal and hydrolysis resistance.

CO<sub>2</sub> offers unfavorable characteristics in normal refrigeration applications, with a very high discharging pressure and a very low critical temperature (31°C - 74 bar). This situation requires sub and supercritical operating conditions in single-stage systems with delivery pressure exceeding 100 bar. In addition, the energy performance is lower than the conventional vapor compression process.

However, in applications with potentially high rates of dispersion and where flammable refrigerants cannot be used for safety reasons, there are opportunities to use CO<sub>2</sub>. For example, CO<sub>2</sub> is a valid option for air conditioning systems in automotive. For commercial and industrial refrigeration units, CO<sub>2</sub> can be used as a secondary fluid in a cascade system.

### Protection terminals technology and protective element choice (Capped or multi-capped)

Several performance advantages are associated with the use of PAG 46 and 68 for CO<sub>2</sub> as synthetic lubricants for refrigeration with CO<sub>2</sub>. A typical polyalkylene glycol generally consists of polymer chains terminated with a hydroxyl group that is chemically active at one end. On the contrary, a protected PAG is a chemically inactive group at both ends of the molecule. PAG 46 and 68 for CO<sub>2</sub>, based on the "capped PAG" technology, provide effective lubrication for refrigeration units and compression. Protection technology ("capped" technology) also provides improved lubricity for CO<sub>2</sub> systems.

High efficiency of the process typically results in ~ 95% for PAG 46 and 68 for the CO<sub>2</sub> range.

- Miscibility with CO<sub>2</sub> in a wide range of lubricant concentration and temperature.
- Reduced hygroscopic than a PAG without protection in the process of absorbing water.
- High chemical stability to heat and hydrolysis.
- Excellent lubricating capacity.

## PAG ISO 46

Method and reference unit	VALUE	Reference Method
<b>ISO VG</b>	46	
<b>Kinematic viscosity @ 40°C (cSt)</b>	49,7	ASTM-D445
<b>Kinematic viscosity @ 100°C (cSt)</b>	10,7	ASTM-D445
<b>Kinematic index</b>	213	ASTM-D2270
<b>Pour point (°C)</b>	-49	ASTM-D 97
<b>Flash point (°C)</b>	>200	ASTM-D 92
<b>Density @ 15°C (g/cm<sup>3</sup>)</b>	998	ASTM-D4052
<b>Humidity content (ppm)</b>	300	ASTM-E1064
<b>Total acidity (mg KOH/g)</b>	0,02	ASTM-D 974
<b>Color (APHA)</b>	20	ASTM-D1209
<b>Capping efficiency (%)</b>	95	IM
<b>4-Ball wear scar -40kg/1hr (mm)</b>	0,53	ASTM-D4172
<b>Cu corrosion test</b>	1a	ASTM-D130
<b>Stream turbine corrosion test</b>	Pass	ASTM-D665(a)
<b>Miscibility in CO<sub>2</sub>:</b>		
<b>Upper CST: 1% RFL-X in CO<sub>2</sub></b>	30.9	ASHRAE 86
<b>5% RFL-X in CO<sub>2</sub></b>	30.9	
<b>30% RFL-X in CO<sub>2</sub></b>	26.0	
<b>50% RFL-x in CO<sub>2</sub></b>	13.0	
<b>Density Inversion temp: 1% RFL-X in CO<sub>2</sub></b>	-31.0	
<b>5% RFL-X in CO<sub>2</sub></b>	-31.0	
<b>30% RFL-X in CO<sub>2</sub></b>	-31.0	
<b>50% RFL-x in CO<sub>2</sub></b>	-29.2	

## PAG ISO 68

Method and reference unit	VALUE	Reference Method
<b>ISO VG</b>	68	
<b>Kinematic viscosity @ 40°C (cSt)</b>	70	ASTM-D445
<b>Kinematic viscosity @ 100°C (cSt)</b>	14	ASTM-D445
<b>Kinematic index</b>	210	ASTM-D2270
<b>Pour point (°C)</b>	-46	ASTM-D 97
<b>Flash point (°C)</b>	>200	ASTM-D 92
<b>Density @ 15°C (g/cm<sup>3</sup>)</b>	998	ASTM-D4052
<b>Humidity content (ppm)</b>	300	ASTM-E1064
<b>Total acidity (mg KOH/g)</b>	0,02	ASTM-D 974
<b>Color (APHA)</b>	20	ASTM-D1209
<b>Capping efficiency (%)</b>	95	IM
<b>4-Ball wear scar -40kg/1hr (mm)</b>	0.5	ASTM-D4172
<b>Cu corrosion test</b>	1a	ASTM-D130
<b>Stream turbine corrosion test</b>	Pass	ASTM-D665(a)

It is suggested a dosage as close as possible to the quantity needed. For the biggest formats, it is recommended to quickly close the container and keep it in a cool and dry place in order to avoid the formation of moisture.

Keep the product between -40 ° C and + 60 ° C.

Do not expose to sunlight.

