

# COMPRESSORS CO2 DORIN

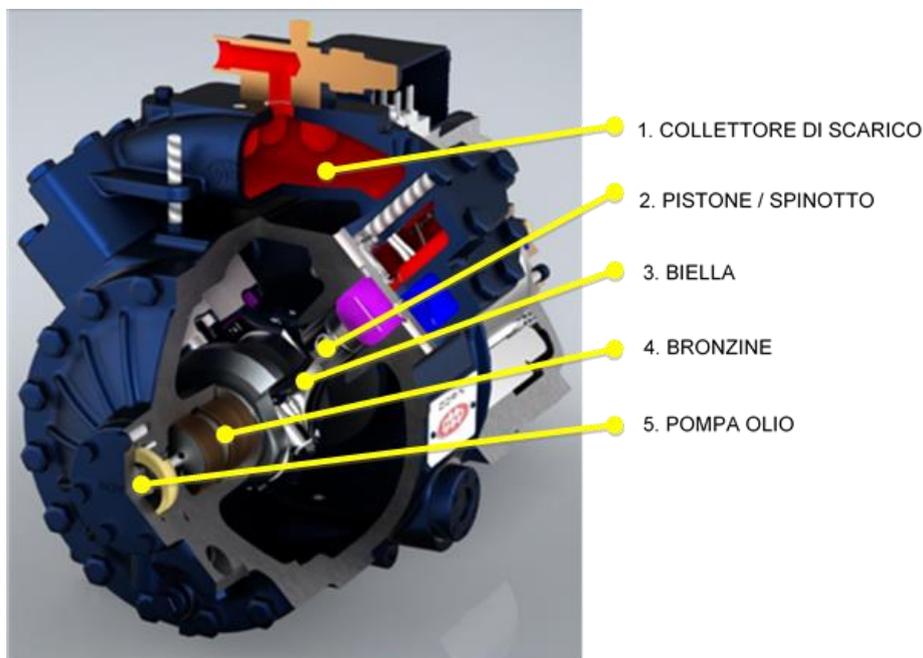
## the innovative choice - Part 2 -

Carbon dioxide (CO<sub>2</sub>) has nowadays become the standard refrigerant choice for many applications, often granting **better COP levels** than the previously adopted HFC technology: this trend is progressively leading to both a lower usage of high GWP refrigerants and a sensible Energy cost reduction for several industrial sectors.

Considering **thermal and fluid dynamic properties of CO<sub>2</sub>** it is clear that it is necessary to introduce advanced solutions in the refrigerating circuit, compared to a standard HFC's system. Talking about the **compressor**, the most stressed element of the system, it was **crucial to introduce some advanced design solutions**, most of them coming from other highly technically advanced industrial sectors, such as automotive.

**DORIN, undisputed global leader** in CO<sub>2</sub> technology and production of compressors, started from the very beginning to **design a new type of compressor completely focused on CO<sub>2</sub>**.

The purpose of this article is to analyse some of these **main technical solutions**, as reported in the sectional drawing below:



*Officine Mario Dorin is a company established in 1918, manufacturing compressors since 1932. Based in the area of Florence (Tuscany), Italy, OMD reaches all over the world thanks to its commercial partnerships and internal technical-commercial personnel. OMD is present in more than 90 countries supplying always perfect and reliable products, following the principle of its founder Mr Mario Dorin "...the main thing is that our products must always be perfect...".*

## 1. DISCHARGE MANIFOLD

Polytropic efficiency of carbon dioxide (CO<sub>2</sub>) causes extremely high discharge temperature (up to 200°C), not even close to the common values for HFC refrigerant (100°C). Adopting a common automotive solution, the discharge manifold allows a perfect thermal insulation between hot gases from the discharge side and the crank thrust. Thanks to this solution, the compressor can run with a lubricant at an optimal temperature and a perfect residual viscosity. Discharge temperatures are lower and therefore the efficiency increases and the dimensioning of the condenser can take advantage of the lower density of the hot refrigerant gas.

On the contrary, other brands are using the same technology already adopted for HFC refrigerants, designing the discharge manifold inside the crankcase body. In this way, higher discharge temperature and higher oil temperature occur due to thermal conduction from the cast iron crankcase.

The natural convection between ambient temperature and external discharge manifold allows lower thermal load to the discharge gas and therefore a better reliability of the compressor.

Another main advantage of the external discharge manifold is that it works as a plenum for the discharge gas, granting a smooth and regular compression of the gas with lower SPL and negligible pressure pulsations.

## 2. PISTON / WRIST PIN

As mentioned above, thermal loads are particularly intense in CO<sub>2</sub> application. Therefore, DORIN is adopting a special kind of piston made of the same material of the cylinder liner. In this way, the thermal expansion has the same behaviour for the piston and the cylinder, avoiding any chance of seizure.

On the contrary other brands have adopted an **aluminium piston** just like the once adopted for HFC application and with a higher thermal expansion compared to the cast iron cylinder liner.

Another main feature of the piston adopted by DORIN is the machining on the piston crown, specifically designed to fit with the suction valves when the piston is at the TDC. The dead space is reduced and therefore the efficiency of the cycle is increased.

**The wrist pin**, which attaches the connecting rod and the piston, is another component imported from automotive sector. The thermochemical treatment of this component increases the hardness and decreases the friction of the surface, introducing self-lubricating properties too. This is a winning solution for CO<sub>2</sub> compressors, where this component has to face a significant load caused by the combination of short strokes cylinder and high differential pressure.

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Nevertheless, other brands are still adopting a standard wrist pin as in HFC application.

### 3. CONNECTING ROD

Even the connecting rod design was inspired by automotive solutions; the viper head connecting rod allows a lower specific load during the compression phase.

Moreover, a lubricating duct, along the connecting rod, allows the oil to lubricate the small end increasing the reliability of the wrist pin, one of the most stressed component of the system.

### 4. BUSHES

The dilution of the oil into the refrigerant causes a dramatic decrease of the residual viscosity of the oil. When the compressor is running, the lubrication is affected by this phenomenon and the reliability of the mechanical elements in motion decreases.

To overcome this problem DORIN, once more, decided to adopt an automotive solution consisting of multi-layer bushes. The steel matrix of the bush is both resistant and tough and it is covered by a hard-plastic coating, characterized by an extremely low friction and self-lubricating properties. This solution also helps to overcome the problem of liquid slug.

### 5. OIL PUMP

As mentioned before, tribology is a crucial aspect due to the high dilution of the refrigerant into the oil, causing a rapid decrease of the residual viscosity.

To overcome this problem, DORIN is adopting a generously dimensioned oil pump that enable a proper lubrication in every part of the compressor, wrist pin included (see Section 3). In this way, DORIN is able to guarantee a long-term reliability of its compressors. On the contrary, other brands are still adopting an oil slinger on small/medium size CO<sub>2</sub> compressors, such as in HFC compressors.

As demonstrated in the above points, **DORIN was able to overcome all the technical challenges in CO<sub>2</sub> application** and nowadays is producing CO<sub>2</sub> compressors that grant to the end user an **extraordinary reliability and reduced operating cost**.

Furthermore, as desirable in every industrial production, **DORIN** has adopted many of the technical solutions used for **CO<sub>2</sub> application** in HFC compressors, granting even for this range of product a **better efficiency and reliability**.

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Considering all these aspects, **DORIN** is a **worldwide** known **market leader** and **reliable partner** in CO<sub>2</sub> compressor manufacturing, implementing new technologically advanced solutions and always ready to meet the ever-increasing market demands.

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