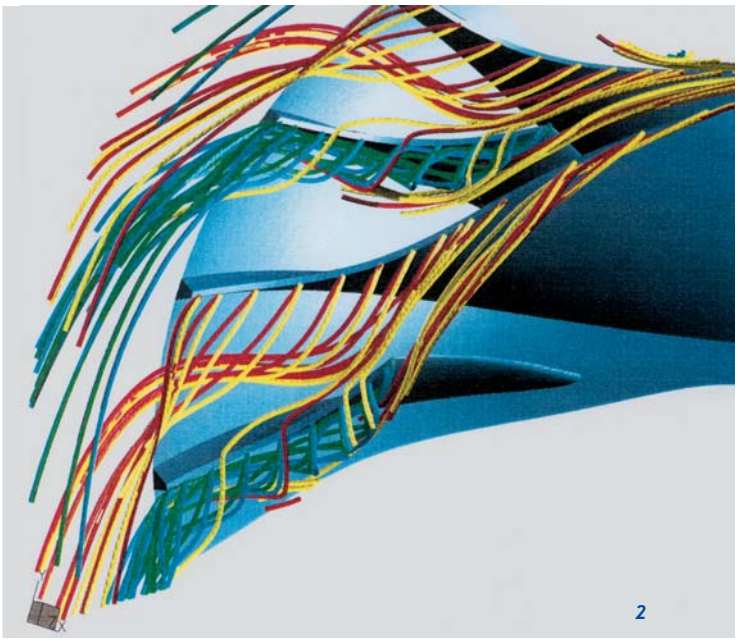
1



2

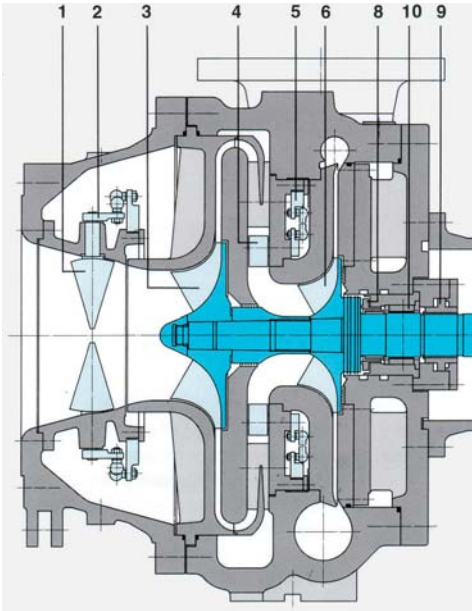
Uniturbo® 50FY – Centrifugal Compressor for large scale refrigeration plants and heat pumps

Main features

- Open-type two stage compressor for halocarbon and hydrocarbon refrigerants
- Open type impellers milled from high-alloy steel and mounted on a chromium-nickle steel shaft
- High efficiency, resulting in high refrigeration capacity to power input ratio (COP) over the entire performance range as both stages are equipped with independently actuated inlet guide vanes
- Impressive compression ratio, allowing low suction temperatures for refrigeration plants and very high condenser water outlet temperatures for heat pumps
- Heavy duty construction with vertically split casing for easy maintenance
- Suitable for all drive systems (electric motor, steam turbine, gas turbine, diesel engine or gas engine)
- Operating range –40°C / +90°C
- Large capacity – small floor space

General

The Uniturbo® 50FY is the result of extensive research and development combined with the experience gained in engineering and manufacturing refrigeration plants and heat pumps with turbo-compressors for over 70 years.



1 Inlet guide vanes (IGV), first stage
2 IGV adjustment mechanism, first stage
3 Impeller, first stage
4 IGV, second stage
5 IGV adjustment mechanism, second stage
6 Impeller, second stage
7 Impeller shaft
8 Mechanical seal
9 Mechanical seal
10 Radial bearing
11 Thrust bearing

3

Applications

The Uniturbo® 50FY is used for compressing refrigerants in refrigeration plants and in heat pumps for:

- industrial process applications with temperatures down to –40°C
- liquid chillers with high condensing temperatures (aircooled condenser)
- heat pumps with temperatures of 90°C

The high standard of performance and quality is the major reason why this design is of particular interest for applications with high requirements towards operating reliability and economy, e. g. in the chemical industry, the oil and gas industry, for district heating and district cooling as well as for air conditioning of large buildings and for special applications.

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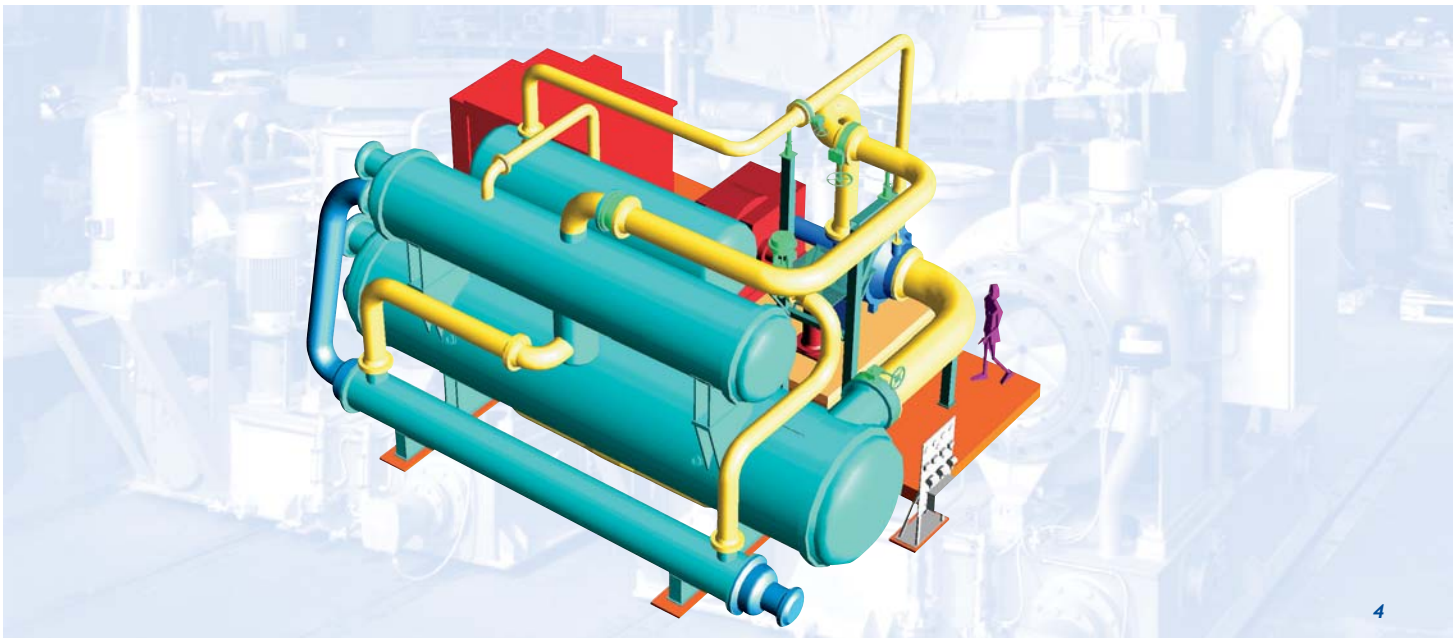


Compressor design

The two high-efficiency impellers are mounted at the free end of the shaft which is supported on the driver side only. This permits axial arrangement of the suction inlet, resulting in undisturbed refrigerant flow, thus increasing the overall efficiency of the compressor.

The open type impellers are milled from high-alloy steel and mounted on the shaft made from the same material by using the hydraulic fit technique. The advantage of this kind of connection is that a later iteration on site is easily possible. This is beneficial for major overhaul of the rotor assembly, which is dynamically balanced as one unit.

Each impeller is preceded by a row of guide vanes adjustable during operation, thus regulating mass flow and capacity of the compressor according to the demand. The guide vanes are actuated by electric or pneumatic servomotors.

The compressor casing made from nodular cast iron is of the vertically split type, which is beneficial with respect to distortion, clearance and stress distribution in the material. It further facilitates easy inspection and maintenance. The side stream and the discharge nozzle are located laterally on opposite sides and directed upwards.

The rotor assembly runs in two force-lubricated, low-loss tilting pad bearings, taking up the radial forces. The axial thrust is taken up by the same type of bearing located in between the two others.

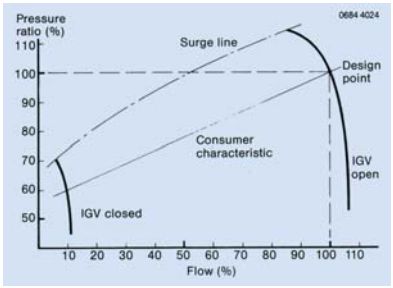
A double mechanical seal at the back of the second stage impeller separates the lube oil from the refrigerant circuit during operation. A steady flow of seal oil between the two mechanical seals is preventing refrigerant leakage to the atmosphere at all times. The bearings are supplied with lube oil from the oil system integrated on the base frame of the compressor assembly. The lube oil pressure is set at 2.5 bar and the seal oil pressure is maintained at 1.5 bar above the gas pressure. The seal oil system securely prevents the escape of refrigerant to the atmosphere. It also lubricates and cools the double shaft seal and the radial bearing placed between the two seals.

Performance

Economical operation of the refrigeration plant or of the heat pump is facilitated by the adaptation of the compressor to the very specific requirement of a particular plant. Therefore, a number of design variables like guide vane settings, impeller geometry and impeller speed are adjustable within a certain range.

Capacity control

Design capacity is usually identical with the maximum capacity required for a specific application and is representing a single operating point only. For most applications, the capacity demand varies between 10% and 100%. For economic reasons it is therefore mandatory to match the compressor capacity with the actual demand. This is achieved by adapting the refrigerant flow with the individually controlled



inlet guide vanes of both compressor stages, still maintaining the high efficiency of the unit.

Compressor package

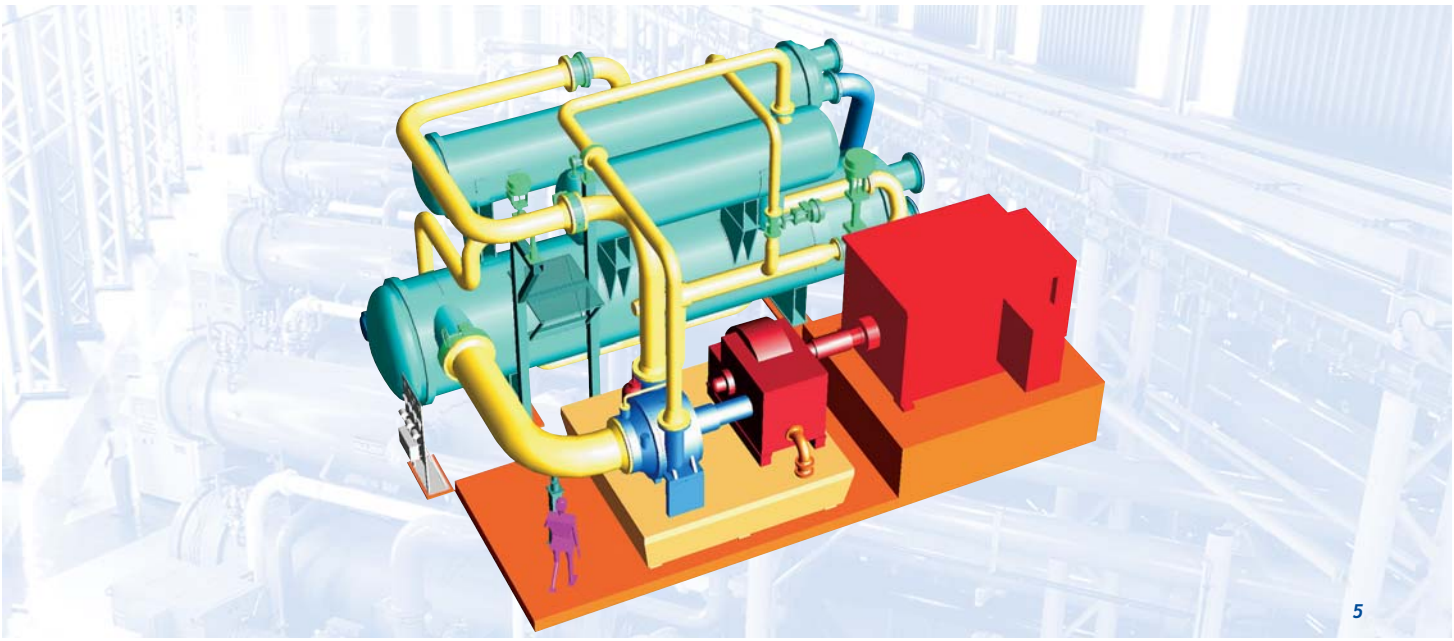
The compressor package is shipped as completely assembled unit, ready for operation.

It basically consists of:

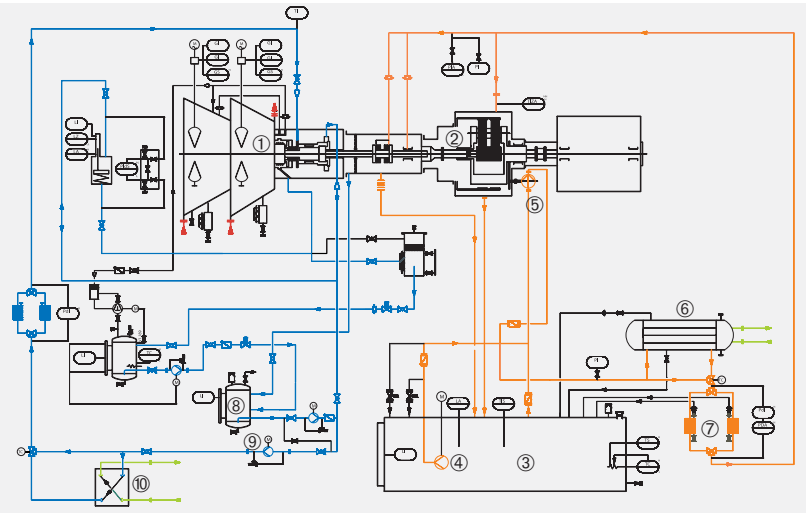
- the compressor
- an external spur-type gear or planetary type, if speed increase is required
- a mechanical coupling
- the oil tank, also used as base frame
- the lube oil system and the seal oil system

In cases the driver speed has to be increased to match with the compressor design, a spur-type or planetary type gear is incorporated. It is designed to meet power requirements and speed ratio with minimal mechanical losses.

The coupling between compressor and gear is of the solid type. Between gear and motor it is of the toothed or membrane type. Since the gear does not develop an axial thrust, there is no need to equip it with thrust bearings.



Typical lube and seal oil system



Components
① *Turbo compressor*
② *Spur type gear*
③ *Lube oil tank*
④ *Auxiliary lube oil pump*
⑤ *Main lube oil pump*
⑥ *Lube oil cooler*
⑦ *Lube oil filters*
⑧ *Seal oil tank*
⑨ *Seal oil pump*
⑩ *Seal oil cooler*

Media
Lube oil supply
Seal oil supply
Refrigerant
Cooling water

Lube oil and seal oil systems

A common lube oil system supplies bearings and gear. It comprises mainly of the oil tank with oil pumps, oil cooler, filters, heaters and the piping and controls required.

Oil tank and pumps are designed to ensure adequate lubrication of the compressor package at all times and conditions. During start up and shutdown, an electrically driven auxiliary oil pump is in operation. At full compressor speed the main oil pump, mechanically driven from the gear box is taking over. The oil cooler can either be designed to work with cooling water or with refrigerant. Twin oil coolers, for changeover during operation, retain solid particles from the oil flow, thus preventing damage to the equipment.

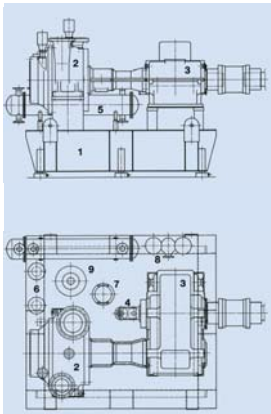
Unitop® 50FY units

Unitop® 50FY refrigeration plants or heat pumps basically consist of the Uniturbo® 50FY compressor package as described above.

Usually supplied as a second single-lift package are the heat exchangers (evaporator, condenser, subcooler), the intermediate stage pressure vessel and all related instruments, valves, piping and wiring.

The standard control system is designed for fully automatic operation of the plant.

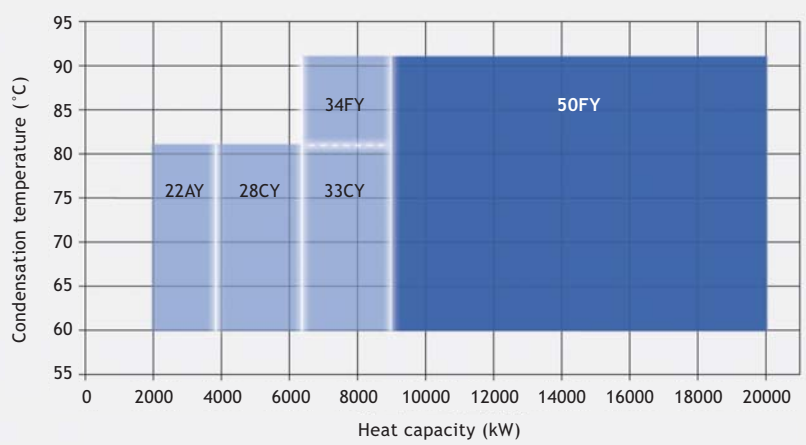
Many pre-engineered, modular plant concepts are available for various types of drivers and heat exchangers, such as plate evaporators or air-cooled condensers.



1 Base frame and lube oil tank
2 Centrifugal compressor
3 Spur gear
4 Main lube oil pump
5 Lube oil cooler
6 Refrigerant twin separator
7 Auxiliary lube oil pump
8 Lube oil twin filter
9 Seal oil accumulator

FRIOTHERM

Uniturbo® range of compressors, marked in dark blue the data for Uniturbo® 50FY



Legend

1 Uniturbo® 50FY compressor package, with base frame and integrated oil tank. Left the oil cooler and in the background, centre, the gear.

2 Optimisation of an inducer at high Mach numbers with numerical 3D-CDF-method.

3 Cross-section of a Unitop® 50FY compressor.

4 3D-front-view of a heat pump installation with a Unitop® 50FY compressor.

5 3D-back-view of a heat pump installation with a Unitop® 50FY compressor.

6 Machine room with a heat pump installation. Right the compressor assembly, left the heat exchangers.

Technical Data

Heating/cooling capacities	see chart
Compressor design pressure	25/40 bar
Max. compressor shaft input	9,500 kW
Size of suction flange, diameter	600 mm
Size of discharge flange, diameter	350 mm
Weight of complete package	20,000 kg
Weight of bare compressor	6,000 kg
Most heavy single part for service	1,100 kg

Construction materials

Compressor

• inlet housing	nodular cast iron
• casing parts	nodular cast iron
• guide vane carrier	nodular cast iron
• inlet guide vanes	high-alloy steel
• impellers	high-alloy steel
• compressor shaft	high-alloy steel

Coupling

• shaft	Cr steel, forged

Gear

• casing	cast iron
• shaft and wheels	Cr steel, forged

Other

• refrigerant pipe work	carbon steel
• oil pipe work	carbon steel and stainless steel

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