CHILLVENTA eSPECIAL

Refrigeration | AC & Ventilation | Heat Pumps

13.–15.10.2020

CONNECTING EXPERTS.

NÜRNBERG MESSE

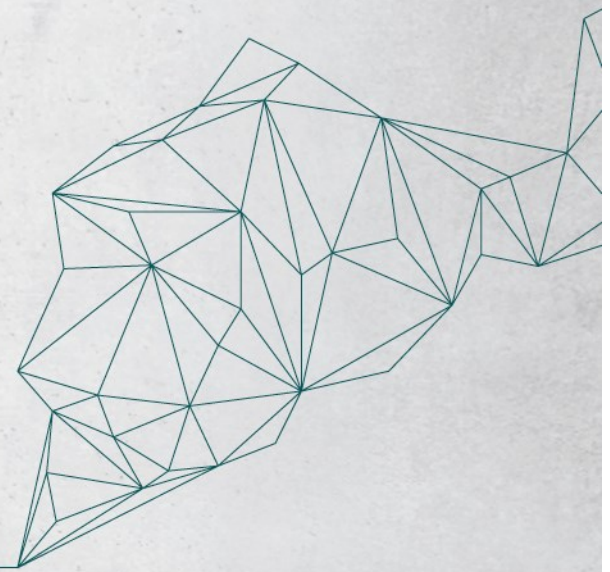
Semi-hermetic Screw Compressors

New developments

Rüdiger Rudischhauser

14.10.2020

CONNECTING EXPERTS.



Trends in Industry

30 years ago:

Transition of HCFC R12/R22 to R404A, R134a (Montreal Protocol 1987) to mitigate ozone depletion in the atmosphere

- New compressors, new oil
- Supermarkets started to use central systems instead of multiple of condensing units
- The sales channels were clearly defined:

Component Manufacturer

Condensing Unit/Rack Manufacturer

Wholesaler

Contractor

Trends in Industry

Transition of HFC‘s like R404A, R134a to Natural Refrigerants (Kyoto Protocol 1997) to reduce global warming.

- Remaining refrigerants R717, R744, R290 etc..
- Especially the high pressure CO2 gas needed new components => cost => erosion of margins => cost cutting
- The sales channels changed dramatically

Component Manufacturer

Condensing Unit/Rack Manufacturer

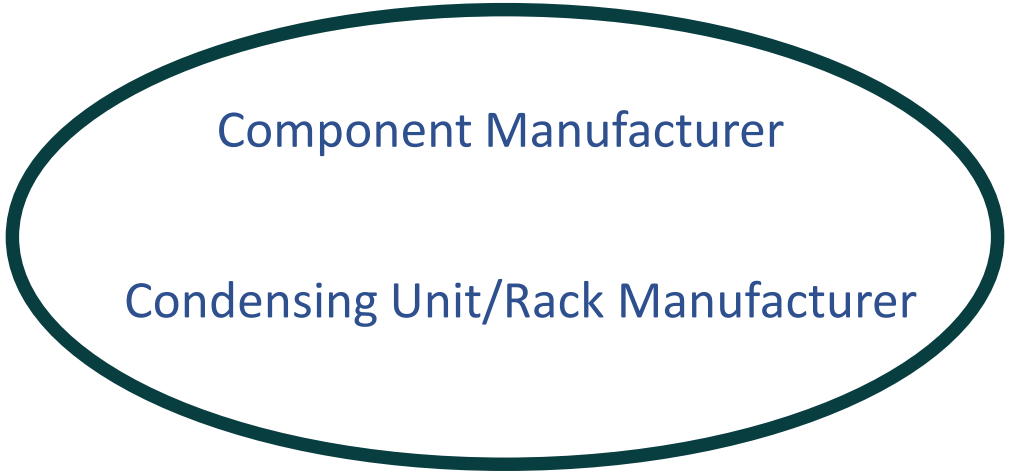
Wholesaler

Contractor

Trends in Industry: Commercial Market

Merging of Market Players:

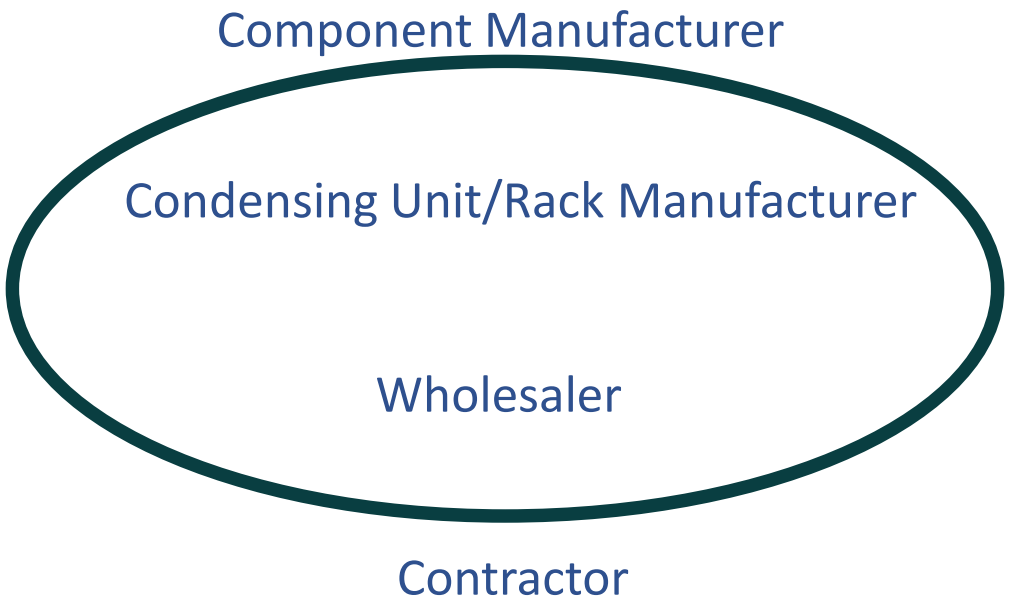
- Component manufacturers became Packagers



Trends in Industry: Commercial Market

Merging of Market Players:

- Component manufacturers become Packagers
- Wholesalers produce their own packages



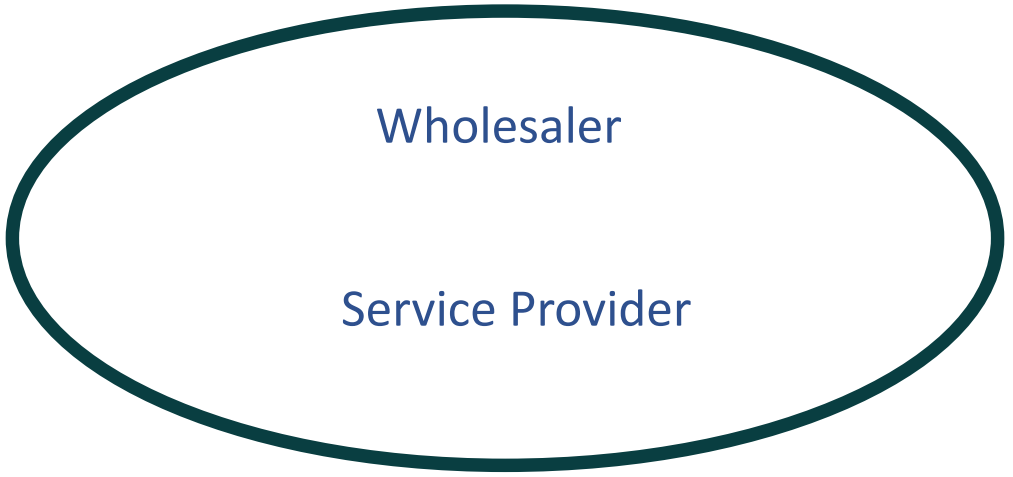
Trends in Industry: Commercial Market

Merging of Market Players:

- Component manufacturers become Packagers
- Wholesalers produce their own packages
- Wholesalers provide services

Component Manufacturer

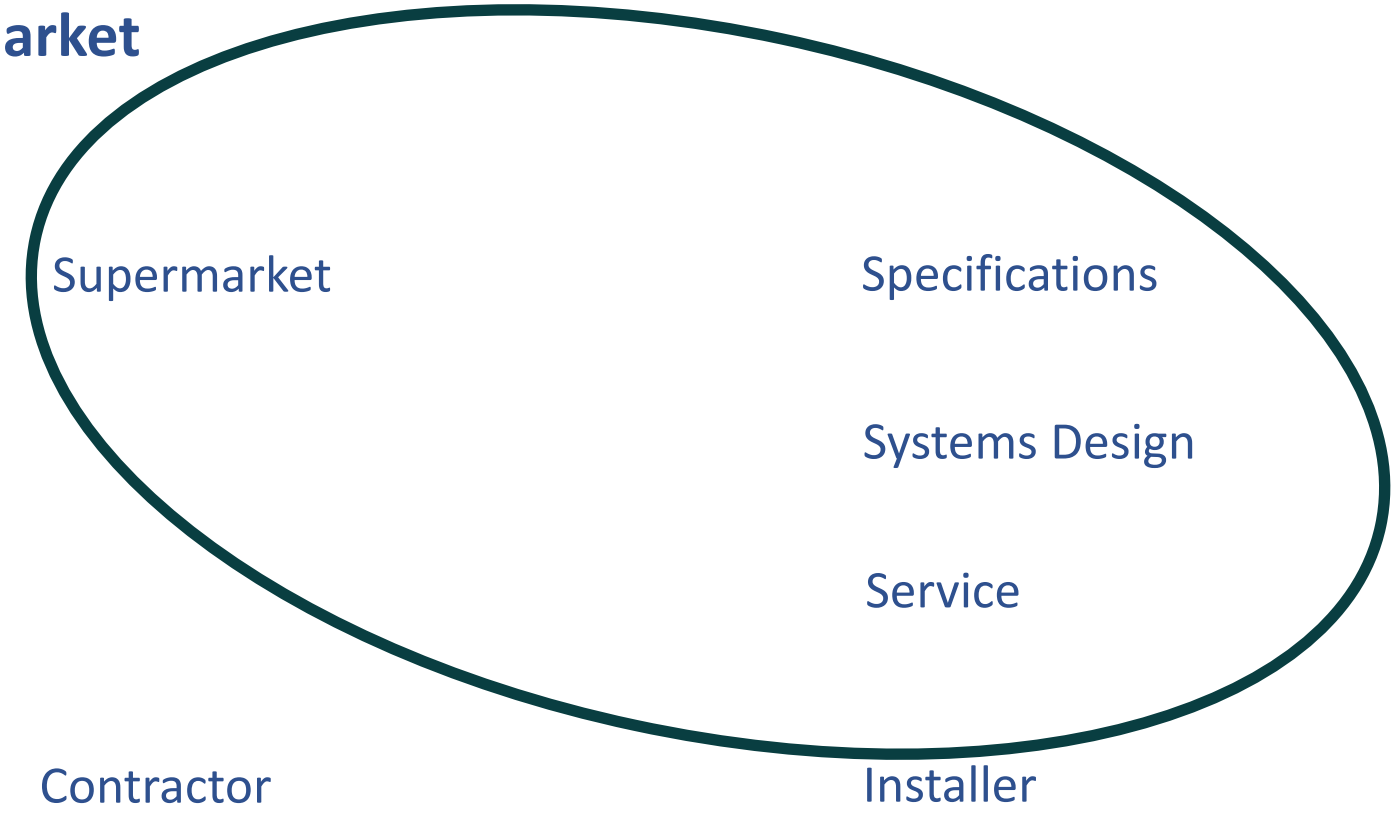
Condensing Unit/Rack Manufacturer



Trends in Industry: Commercial Market

Merging of Market Players:

- Supermarket chains design their own systems and do their own service & maintenance
- Supermarkets by-pass the contractors in purchasing the hard-ware
- Contractor remains to be an installer



Trends in Industry

Consequences:

- Freon compressors are more or less only for replacement
- Margins are slim
- Standardization of applications and products
- Specialization in Production = chiller, commercial rack systems, condensing units
- No room for on-site fixes => warranty of factory made modular systems
- Politics are currently accelerating:
  - Ammonia, Propane and CO2 are the only long term refrigerants
  - Heating/Cooling as integral part of Energy

  ⇒ holistic approach will change industry

  ⇒ border line between commercial and industrial refrigeration is getting blurred

  ⇒ trends are spilling over to Industrial Refrigeration

Trends in Industry

Industrial Refrigeration = PROCESS SECURITY

- Attitude of Commercial Refrigeration is affecting ***Industrial Market***
  - “cheap” attitude
  - No-service attitude
- Ex-Freon Contractors are moving towards Ammonia
- Ex-Freon dominated Compressor manufacturers are moving towards Industrial Market
  - “cheap” compressors with commercial features
  - second/third tiers of contractors need support with top technical documentation, selection and design-support, commissioning support to fill the gap in skills

  ⇒ Price

  ⇒ Complete Packages instead of Compressors as Components

  ⇒ Expected Life-Span is reduced from 25 (ASHRAE) to 10 to 15 years

  ⇒ Serviceability is reduced, R+M cost must be reduced

  ⇒ Tech documentation must be upgraded to cater for less experienced contractors

Semi-hermetic screw development

Properties of Ammonia

- No ozone depleting-, no direct GWP-potential => long term natural refrigerant
- Refrigeration efficiency at least as good as R22
- Low price
- High enthalpy difference => control of small systems can be difficult
- flammable, toxic => special safety precautions, dedicated plant rooms
- Oil miscibility => oil separation and oil return systems
- Copper/Ammonia incompatibility => steel piping, open-drive motors vs. special motors

Semi-hermetic screw development

Target Customers: “ex-Freon”- Contractors/OEM converting to Ammonia

- lower kW capacity market
- Less ammonia skills/experience
  - Oil = miscibility/heavier than ammonia
  - Shaft seal = leakage
  - Open drive = alignment
- no-shaft seal => technical leak proof = > no maintenance
- Optimized matching oil separators making frames obsolete for easy package building
- Chiller Applications: SRS-C with integrated oil separator, actiflow and auto-Vi

Semi-hermetic screw development

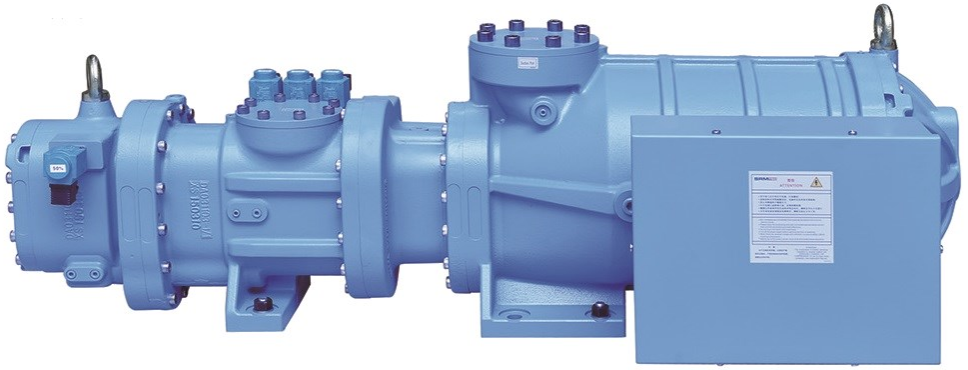
Target Applications:

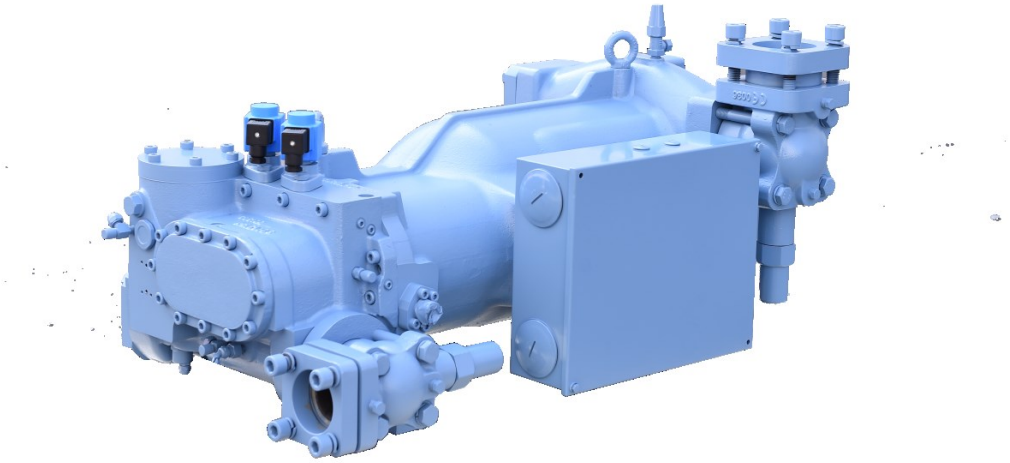
- compact footprint/mobile = > expansion projects
- semi-industrial / commercial projects => close to residential areas => apprehension against NH3
- process cooling
  - Food Industry
  - Chemical Industry
  - Data Centres
  - Air-Conditioning
- seasonal applications: wine industry, ice-rinks, snow-machines

Products SRS

SRS semi-hermetic screw compressor

- Refrigerant: Ammonia R717
- Permanent Magnetic Motor
- Single /Two-Stage





Applications:

- Cold Storage
- Air-Conditioning
- Process Cooling
- Freezers

Technology

Efficiency

- SRM”i”profile

  5+7 Optimal teeth ratio

  High efficiency, high stiffness, low noise, low vibrations

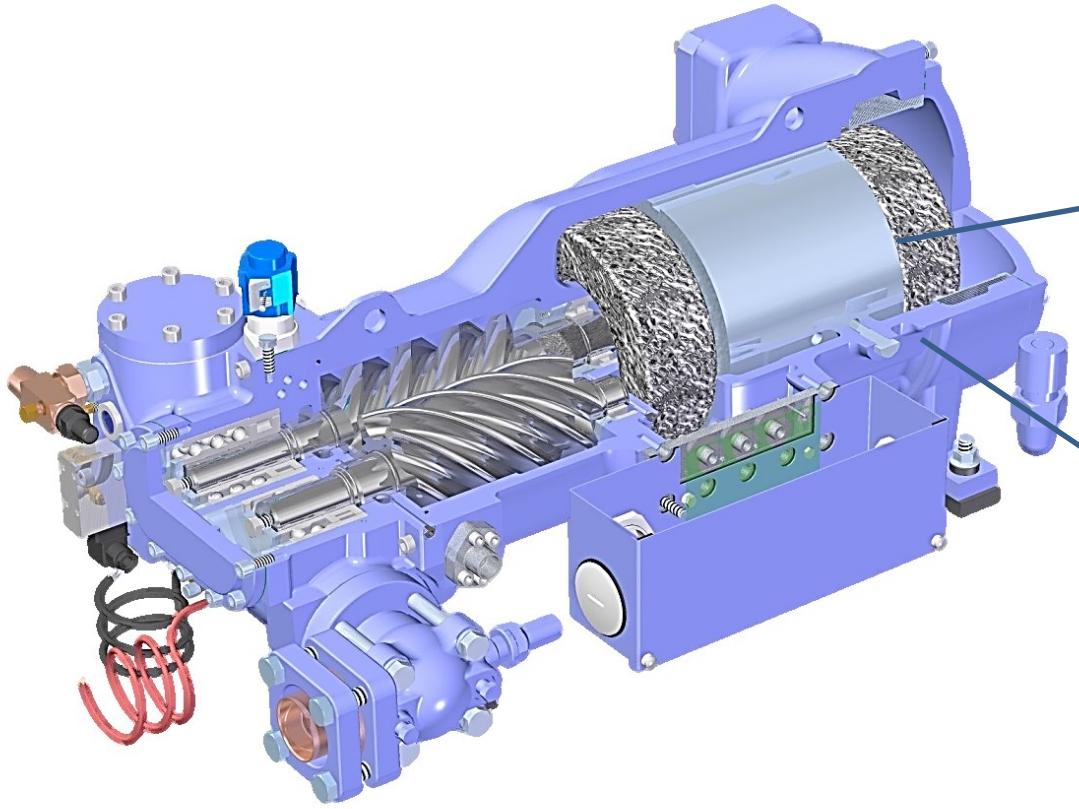
- Optimized L/D ratio for refrigeration

  Dedicated rotor design to increase the compression

  High efficiency in medium and low temperature applications

Technology

Natural Refrigerant: AMMONIA



PM motor with aluminum windings for ammonia (NH3)

Gaskets and seals adapted to ammonia

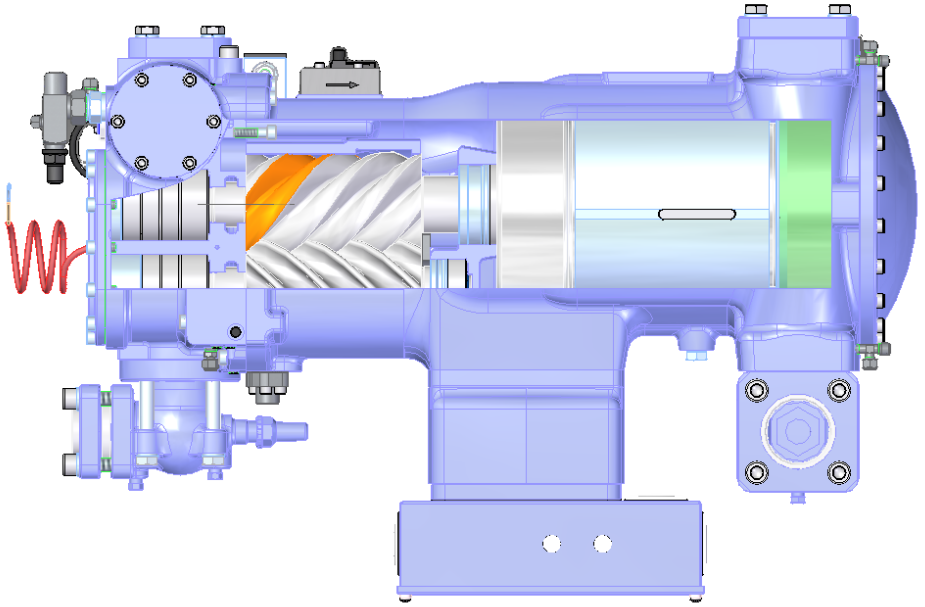
Technology

Efficiency

- optimized flow

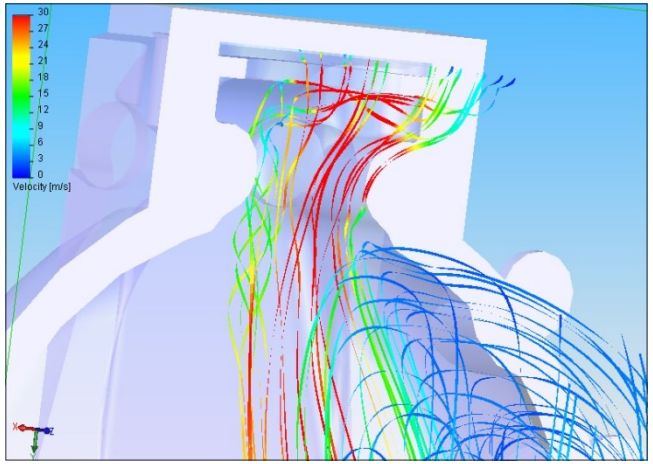
  CFD calculation of gas flow

  to optimize and reduce losses



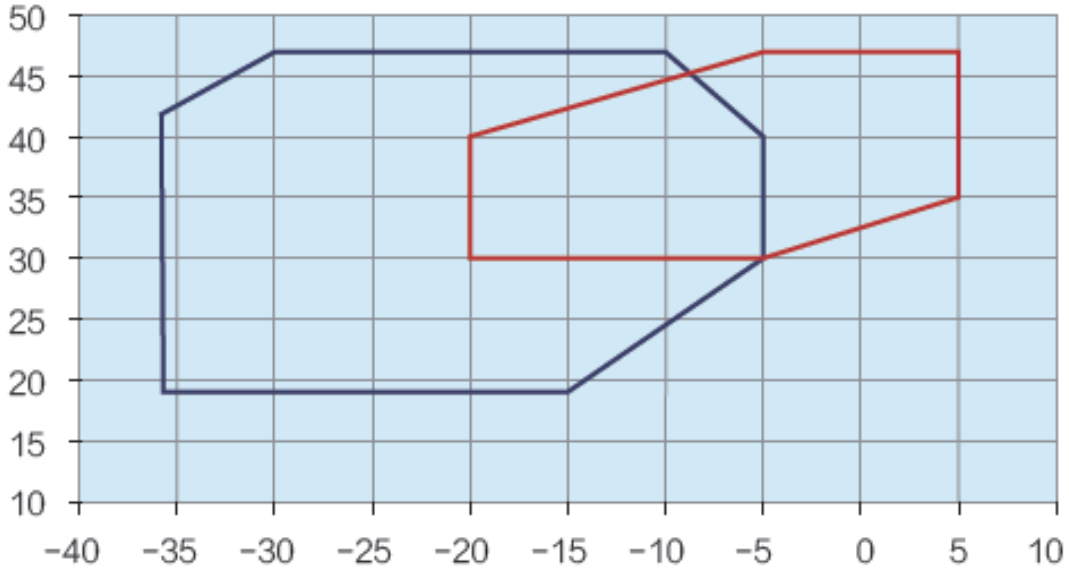
- high speed rotor design

  rotor design optimized for variable and high speed operations.



Operating Window

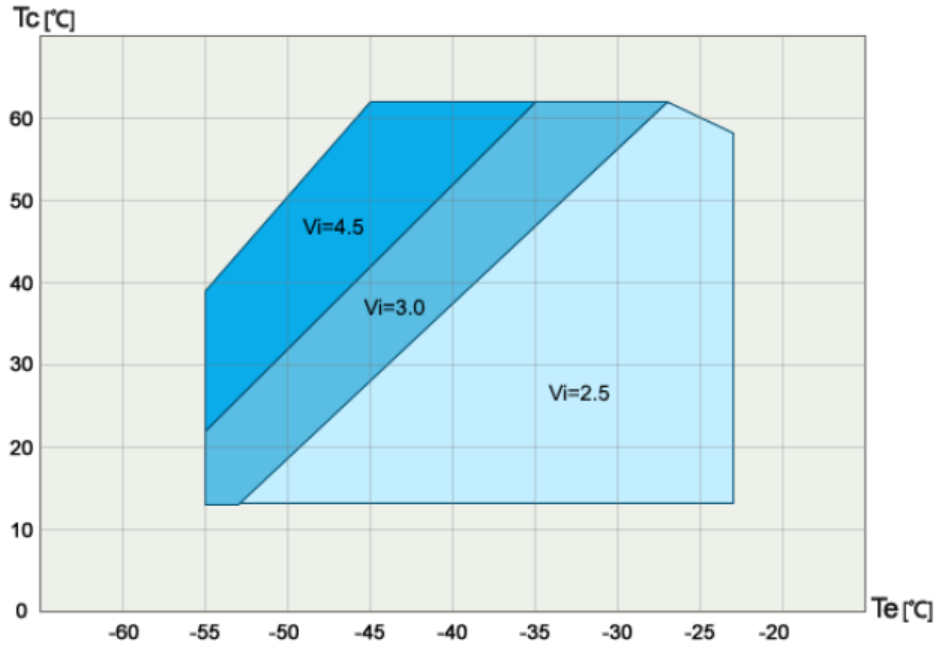
Work Range



single stage compressor

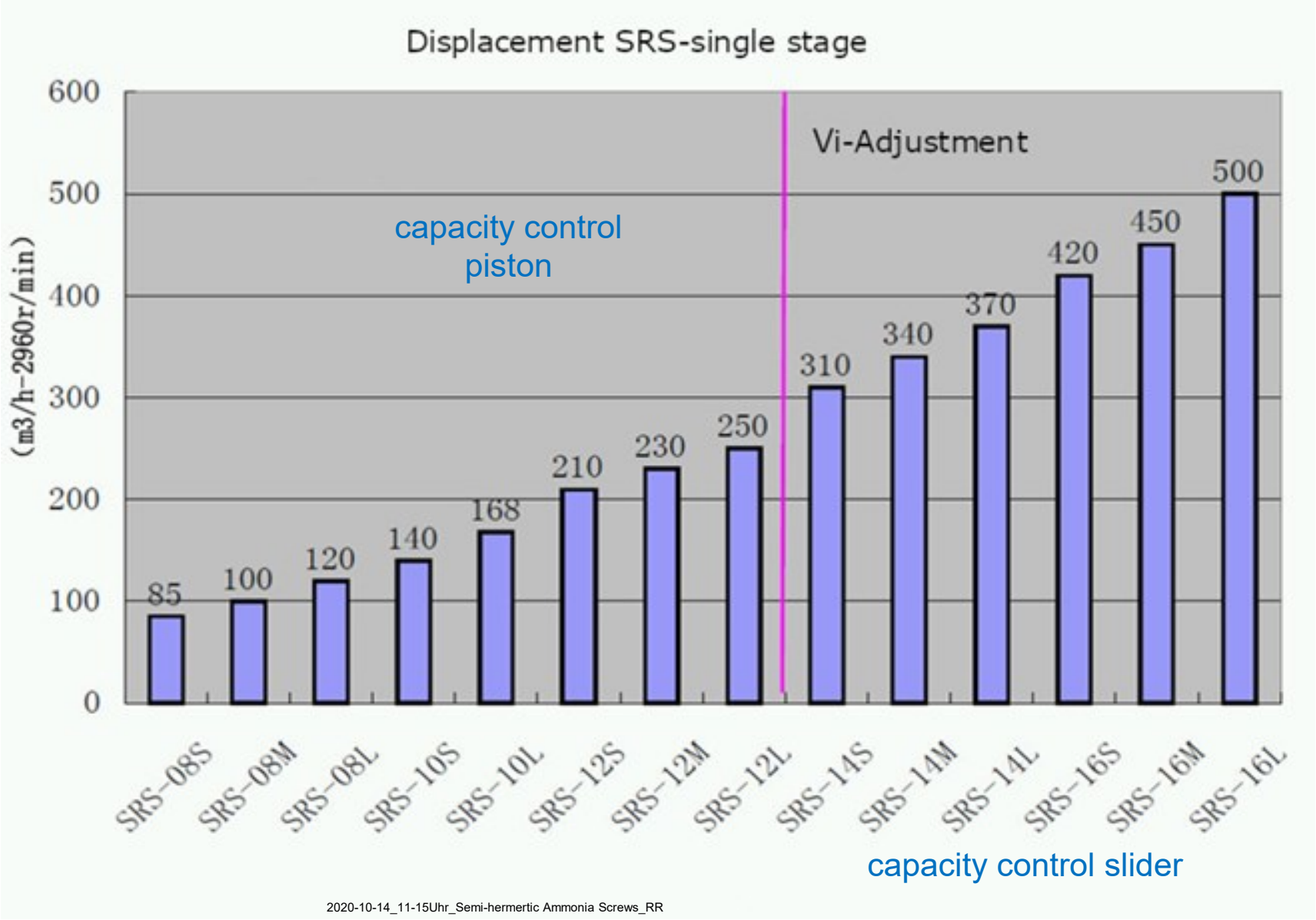
two-stage compressor

9.1 **Application envelop of SRS series model with R717 refrigerant**

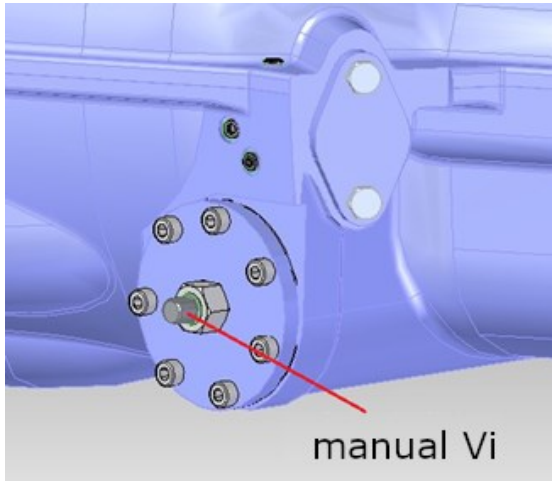


SRS Range

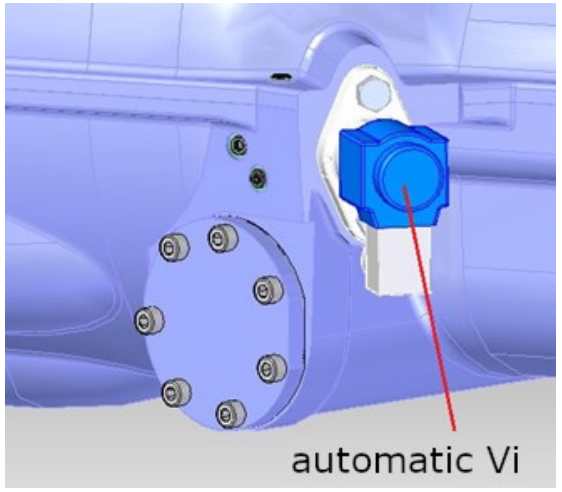
Range



Vi - Ratio



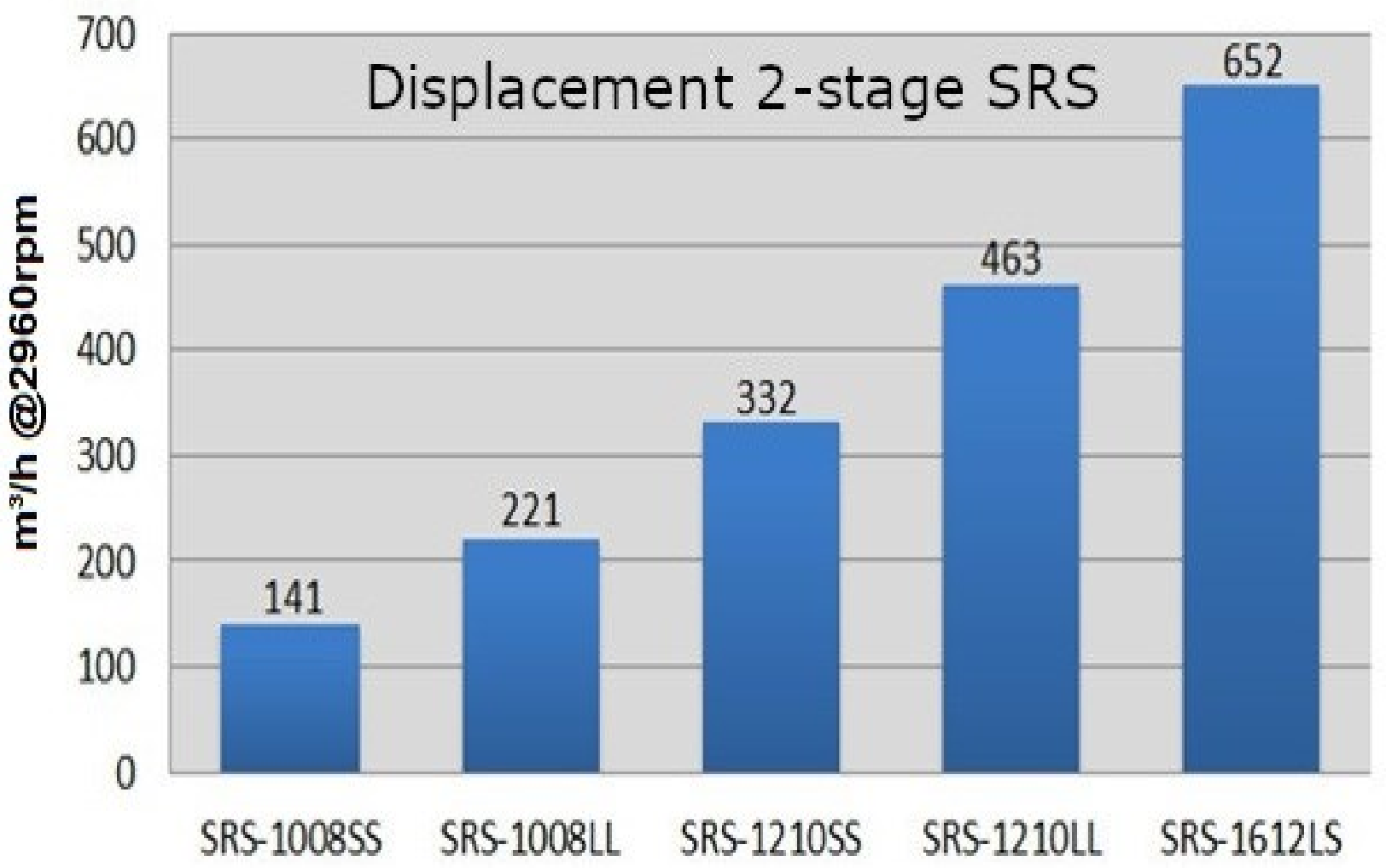
manual Vi control



automatic Vi control by solenoid

Compressor models	Vi Control range
SRS-08~SRS-12	
SRS-14S	3.3～4.6
SRS-14M	3.2～4.3
SRS-14L	3.3～4.2
SRS-16S	2.7～3.9
SRS-16M	2.9～4.2
SRS-16L	3～4.1

Range 2-stage

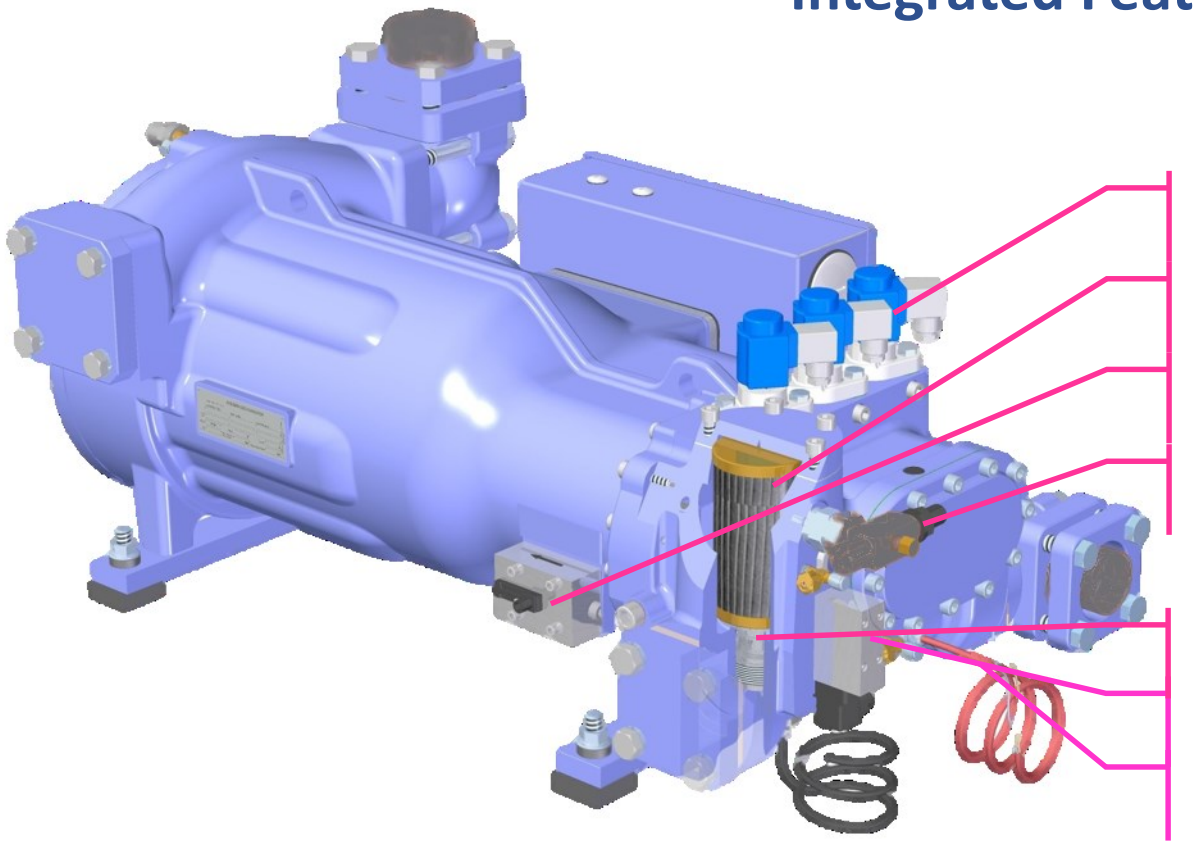


Reliability

- 60.000h = 10 years lifecycle bearing design
- Larger motor = lower motor ove
  temperature = long life

Integration and Service

Integrated Features for low installation cost



3 step partial load valves

Integrated oil filter cartridge

Oil flow switch

Oil shut-off valve

Integrated oil stop valve

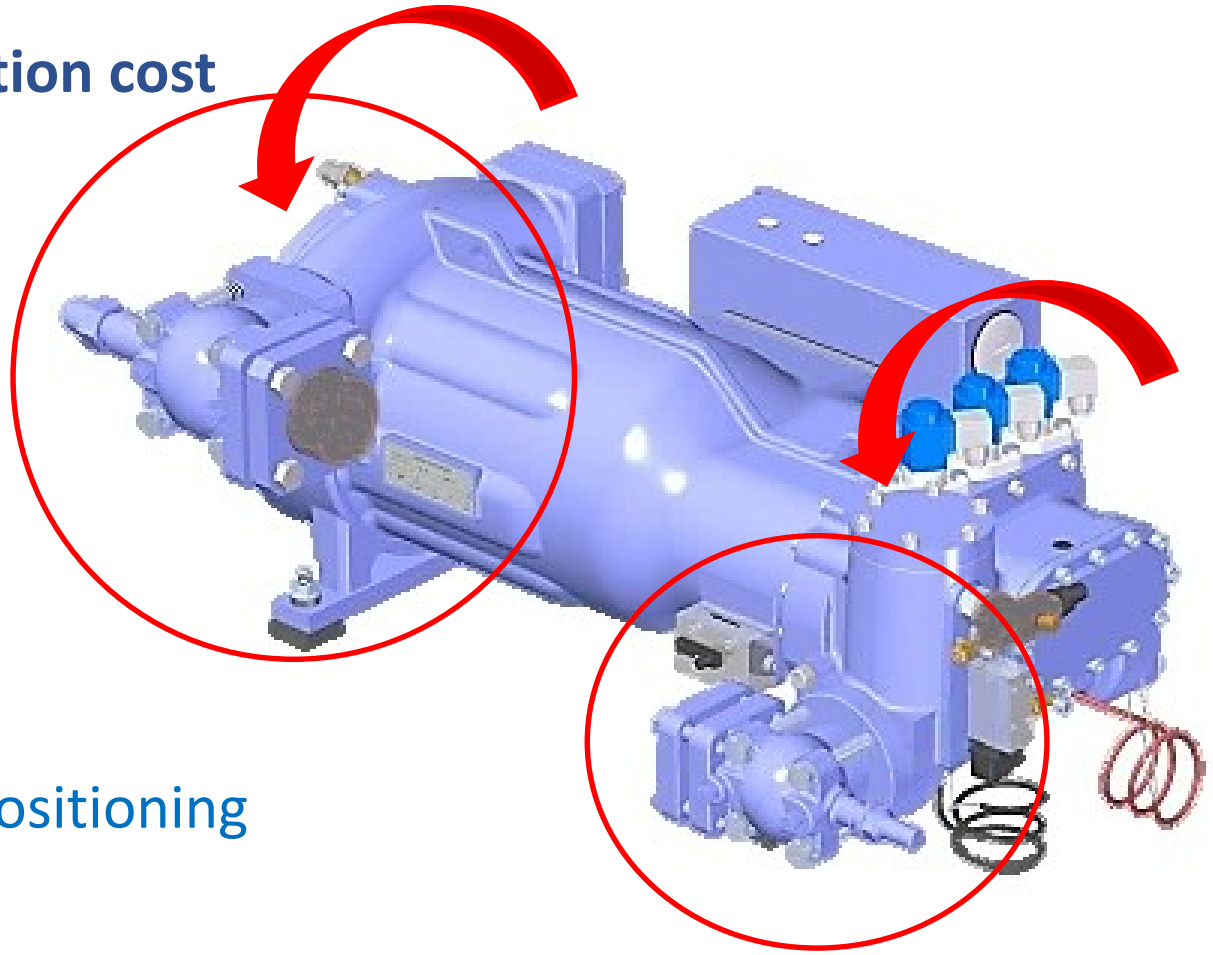
Oil filter differential pressure switch

Discharge temperature sensor

All significant components mounted on the compressor.

Integration and Service

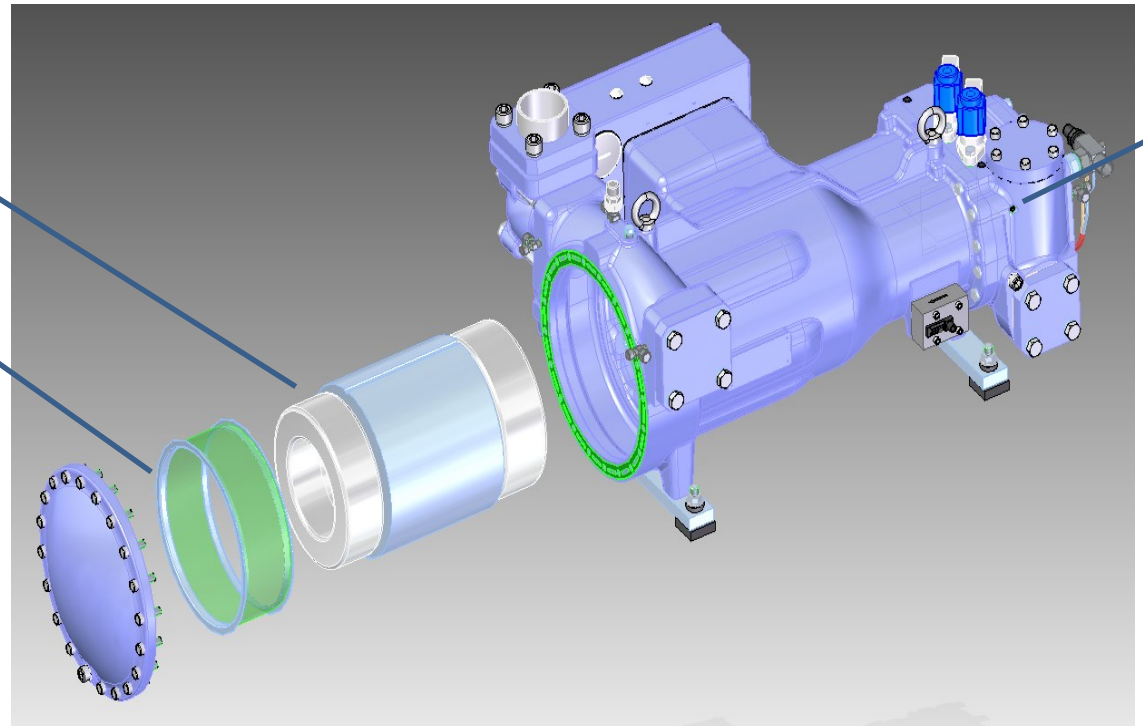
Flexible Ports for low installation cost



unique flexible valve repositioning system

Integration and Service

Service-ability



All maintenance operations can be done without removing the compressor

Integration by Optimized Oil Separators

Design Data according to PED

- Min. design pressure: -1 bar
- Max. design pressure: 25 bar
- Min. design temperature: 0°C
- Max. design temperature: 125°C

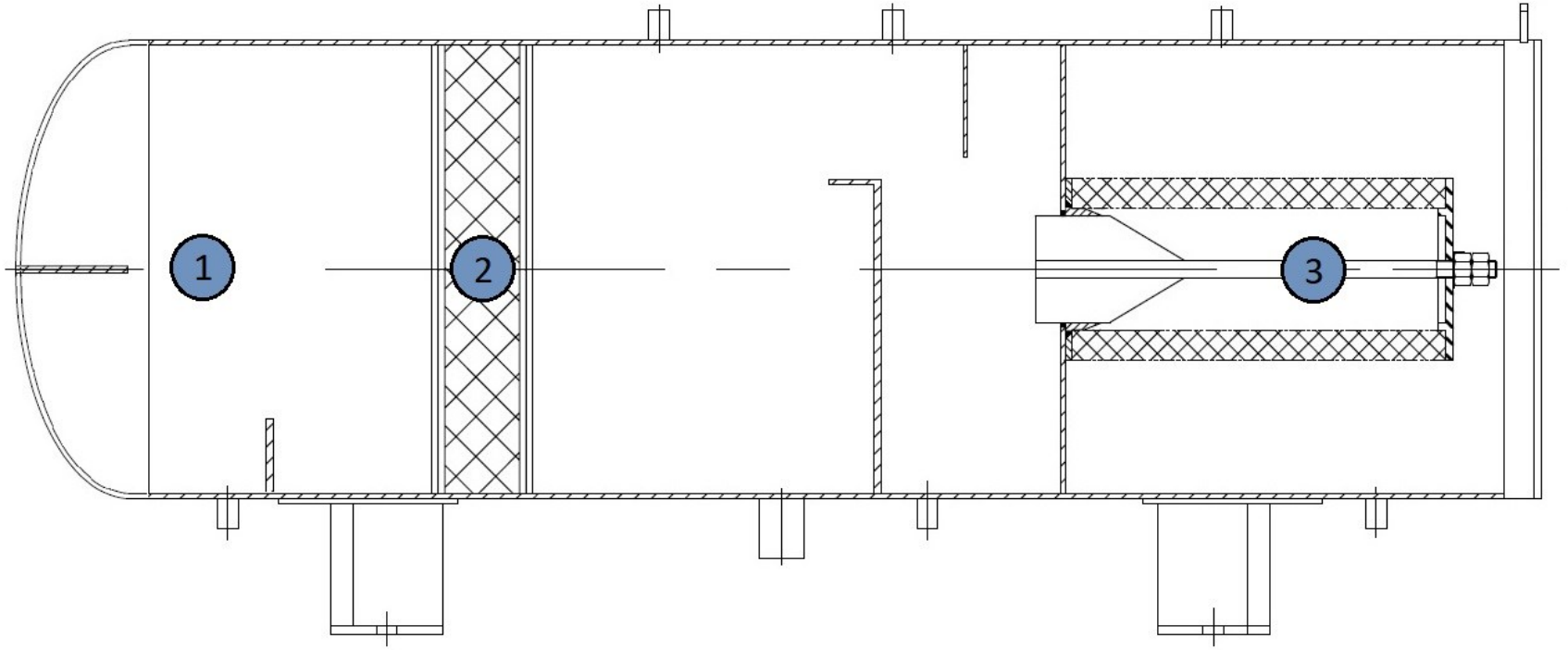
Design & Connections

- Main connections (refrigerant inlet, -outlet, safety valve connection, primary oil outlet) for butt welding (for pipes with EN nominal diameters)
- Other connections (service, pressure measurement etc.) as screw sockets with internal npt thread
- All service connections to one side => installation to a wall can be a possible option
- Coating according to ISO 12944 – C2 medium; Colour: Snowman blue

Oil Separators

High efficient, 3-phase Oil Separation

- Centrifugal separation on the inner wall of the vessel (1)
- Droplet separation by demister (2)
- Fine separation by fine filter (3)



Oil Separators

Optimization especially for semi-hermetic SRS-Compressors:

- 3 oil separator models (horizontal) with saddle (welding-) plates for easy compressor mounting
- Compressor consoles for flexible mounting arrangement across or along the vessel
- Compressor consoles for prepared for all SRS compressor types
- Prepared for mounting onto a frame or optionally with feet for direct floor installation

Benefits:

→Quick and easy oil separator selection for a wide range of applications of the SRS compressor series based on discharge volume and oil carry-over rate at the outlet (5ppm or 50ppm)

→No machine frame required for packages

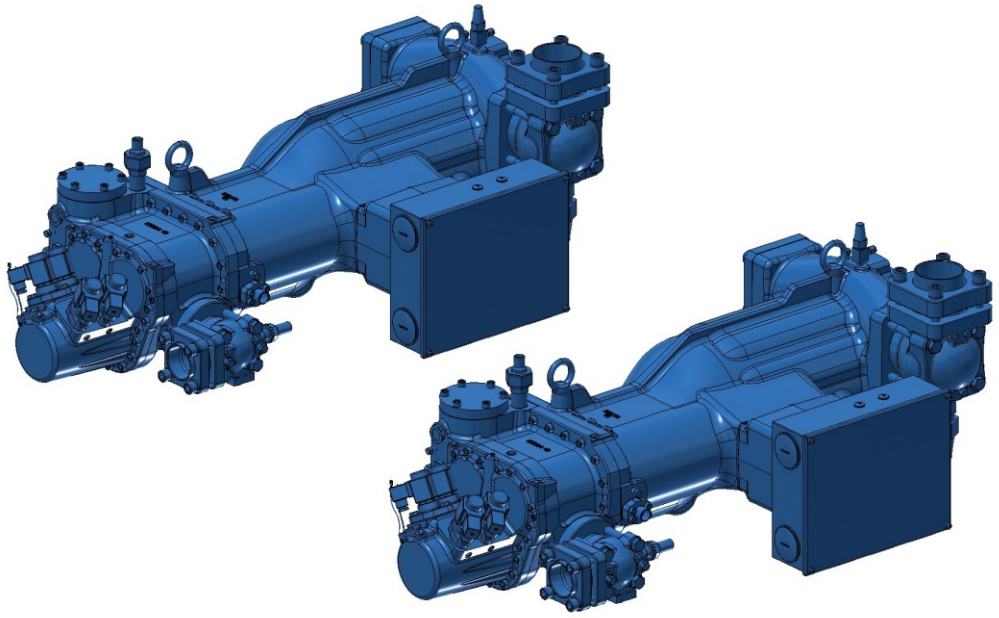
→Design documents and documentation available

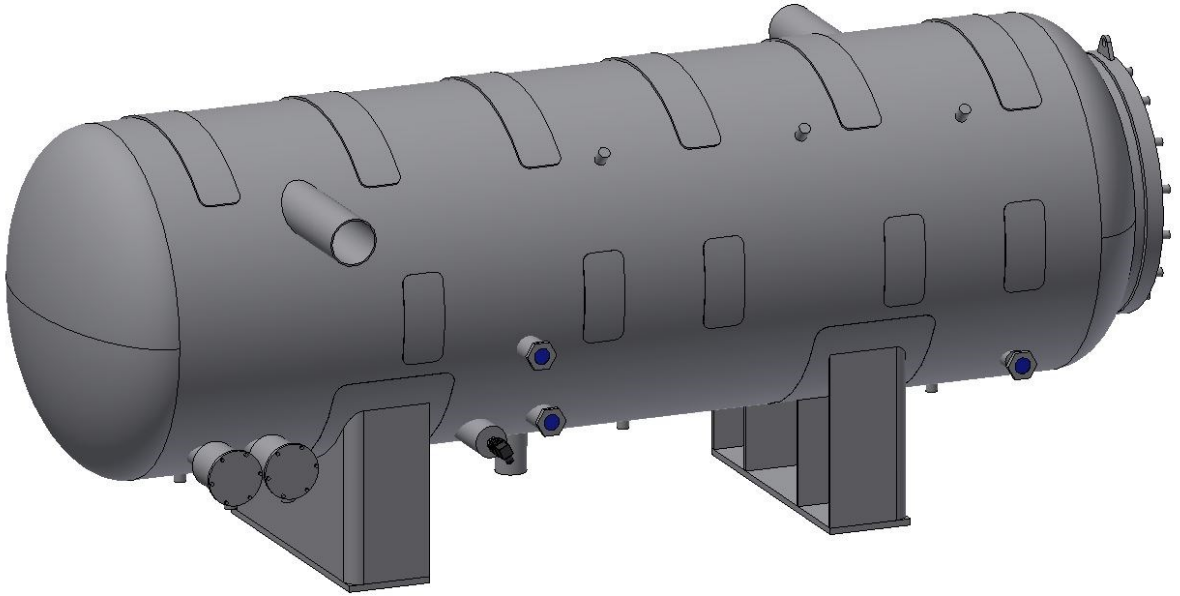
→Flexible design options for a wide range of applications

Oil Separators

Example of configuration

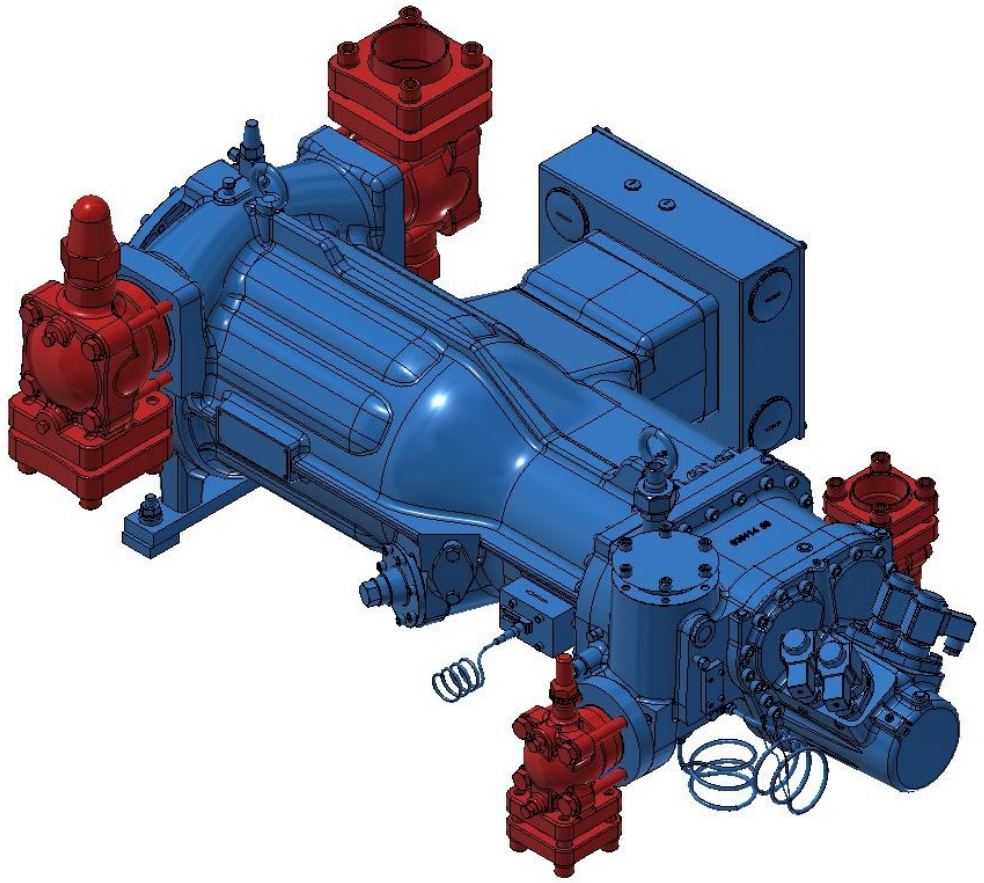
- Compressor quantity and type selection: e.g. 2x SRS-14
- Oil separator selection: e.g. 1x WYF800(CE)





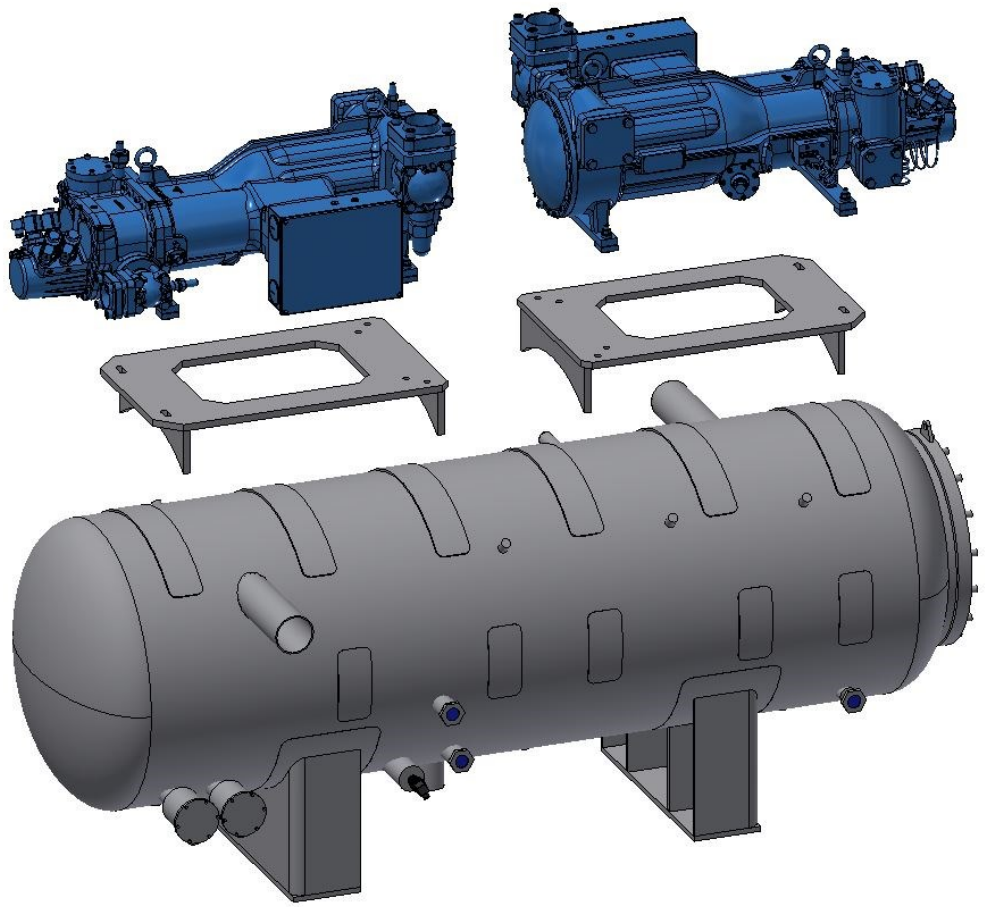
Oil Separators

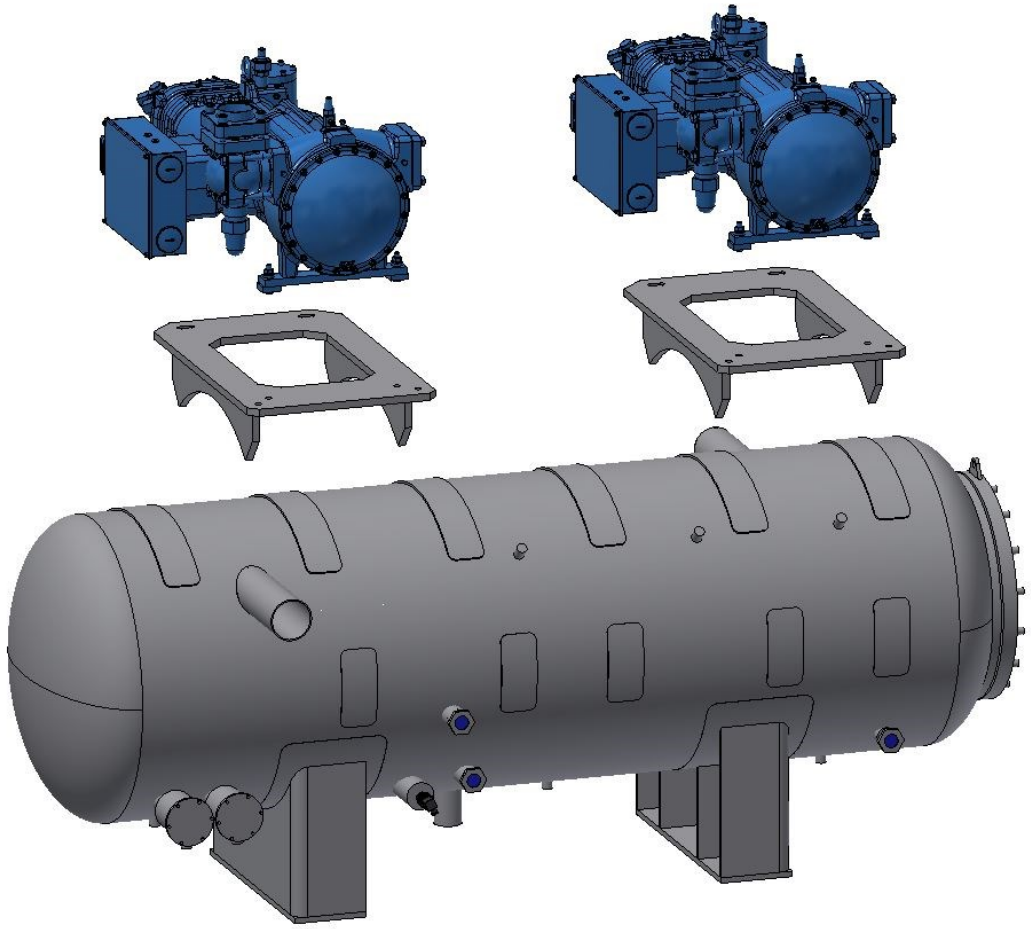
→ Options of Position and Arrangement of Shut-off valves



Oil Separators

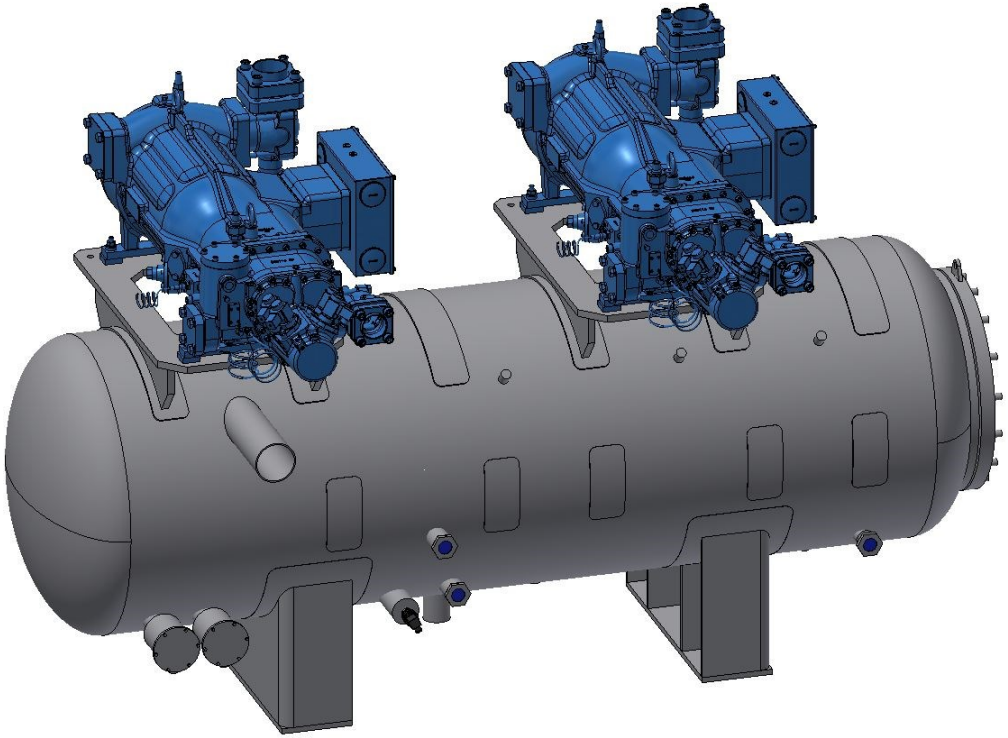
→ optional arrangement: lengthwise mounting (L) or across mounting (X) (here: across mounting)

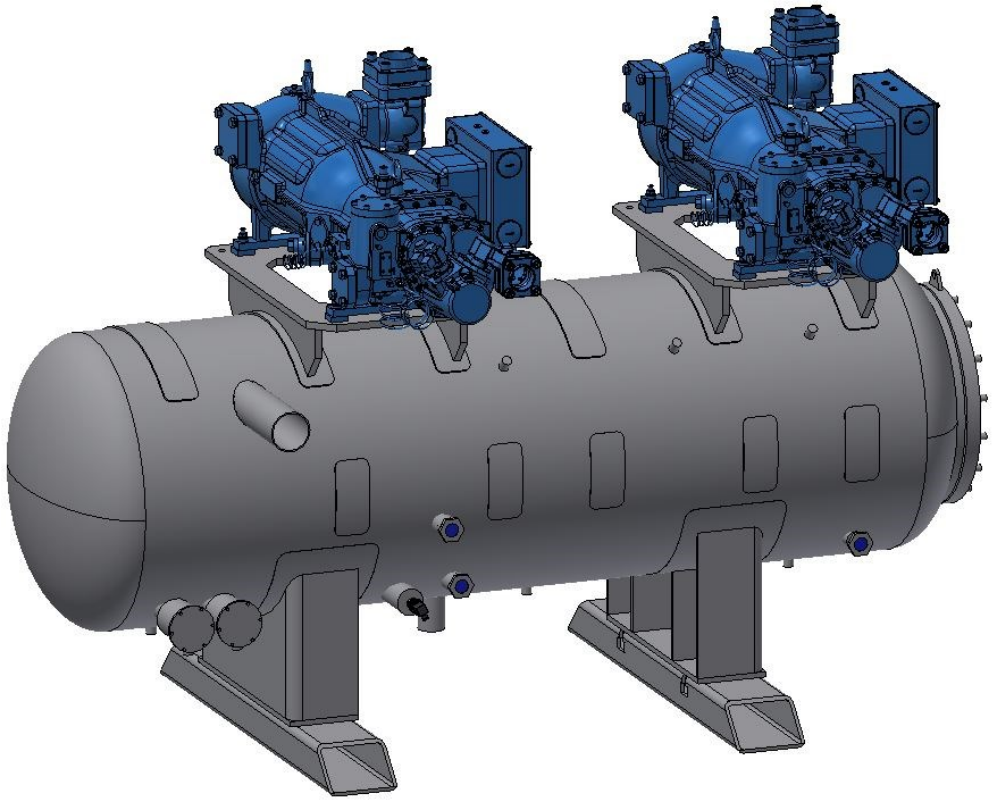




Oil Separators

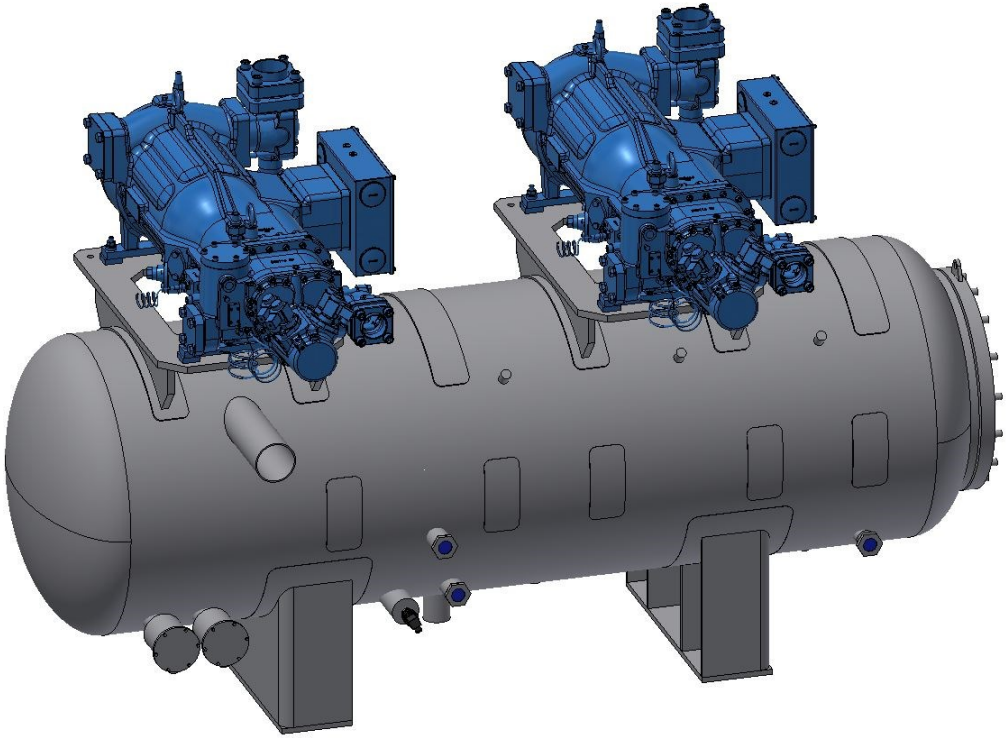
- → optional positioning of the compressors
- → optional vessel mounting
  - → frame installation (standard)
  - → direct installation (with floor profiles)

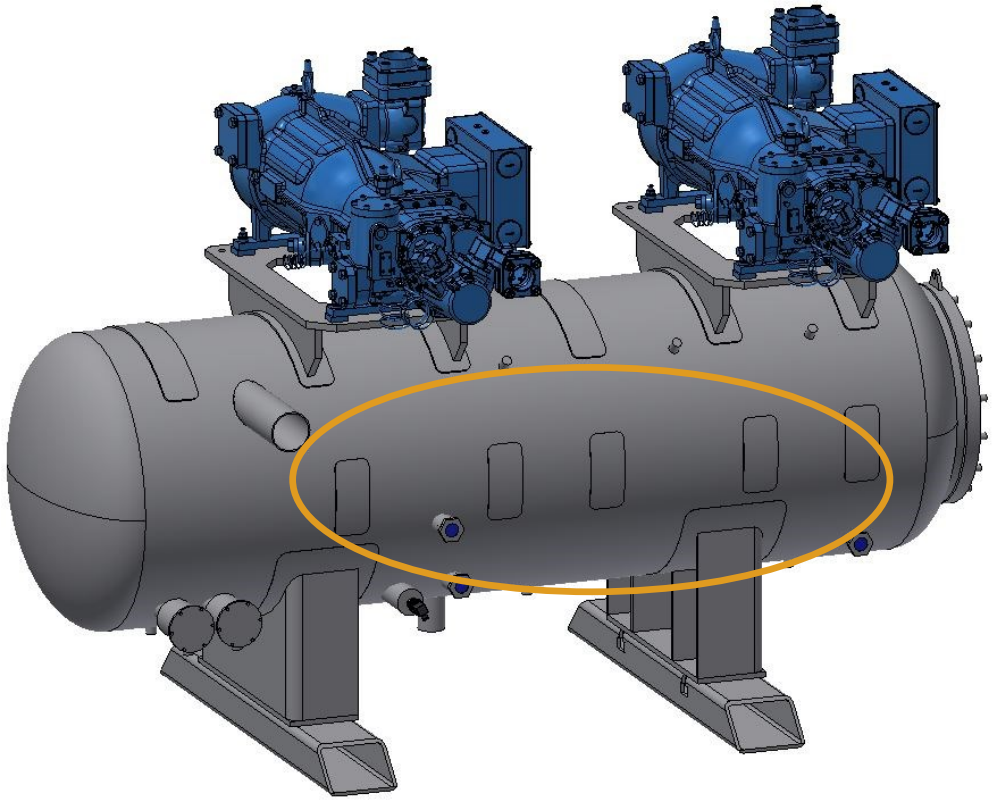




Oil Separators

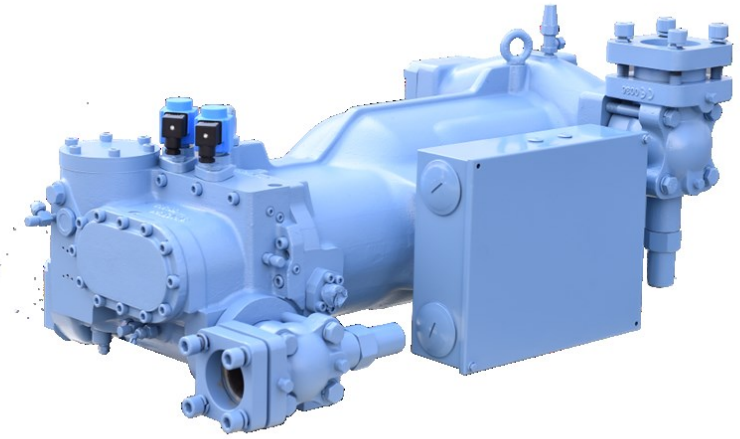
→ additional saddle (welding-)plates for easy and flexible mounting of pressure gauge panel, terminal box, pipe supports/brackets etc.





SRS-C, the new dimension

SRS Evolution/Expansion from SRS -> SRS-C



- PM Motor, Inverter driven
- Technically Leak-proof
  - ıtegrated Oil Separator
  - + 6 lobes Rotor
  - ctive Oil Management System
  - utomatic Vi
  - ıcreased Application Window

Technical Features

Oil Flow Management System

Screw compressors always need enough oil.

But normally there is far too much oil, as oil flow is defined for worst-case conditions.

Oil reduces efficiency:

- reduces refrigerant flow through screws
- reduces evaporator efficiency
- is “unnecessarily” cooled

Technical Features

ActiFlow

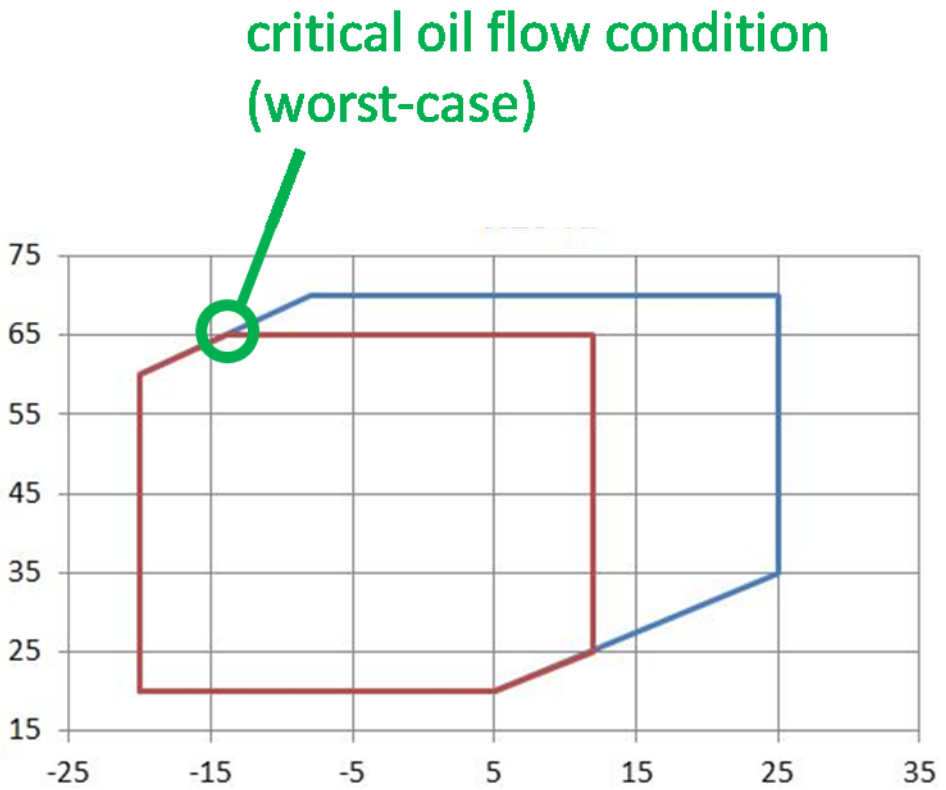
Oil charge and flow is calculated for worst-case conditions, which is generally far more than required.

The oil is “needlessly” carried through the entire circuit.

Actiflow (patent pending) continuously adjusts oil flow to the actual needs.

Fully automatic, without any external input.

Compressor efficiency and system performance are both improved.



Technical Features

SRS-C features a unique centrifugal separator:

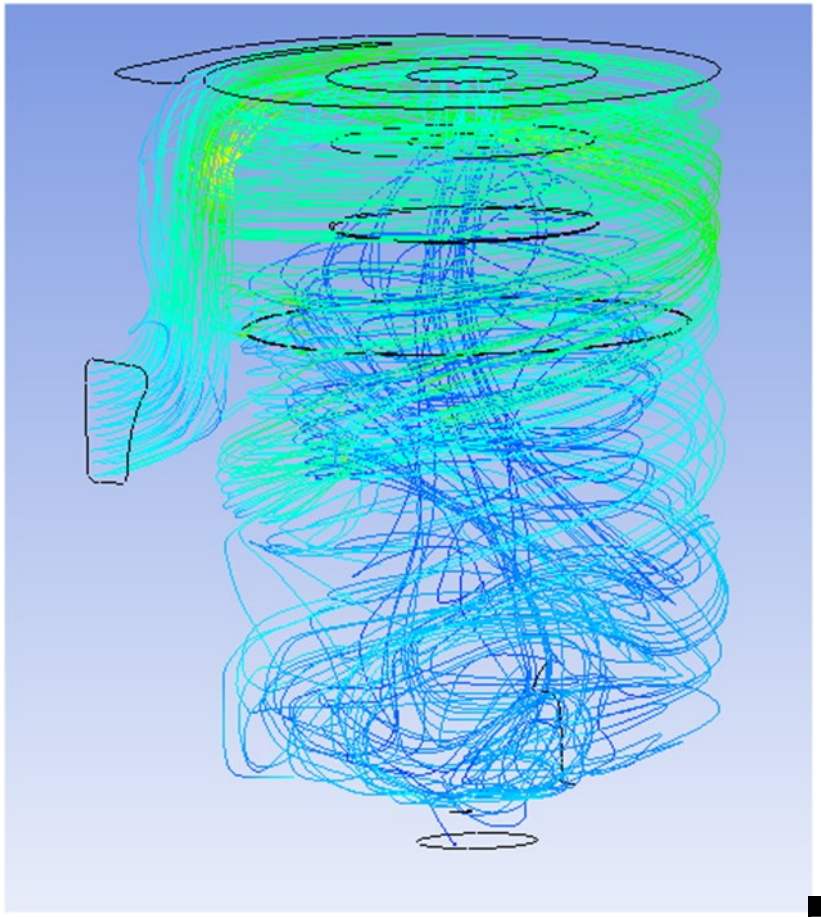
- Compact yet generously sized
- CFD optimised (improved separation, reduced pressure drops)
- Lower Δp as there is no demister

Coalescer Stage in Addition for Fine Separation

=> Oil carry-over is reduced by as much as 80% versus demisters, down to 0,2% of oil content

=> Overall system efficiency improves and a smaller evaporator can be applied

Integrated Oil separator



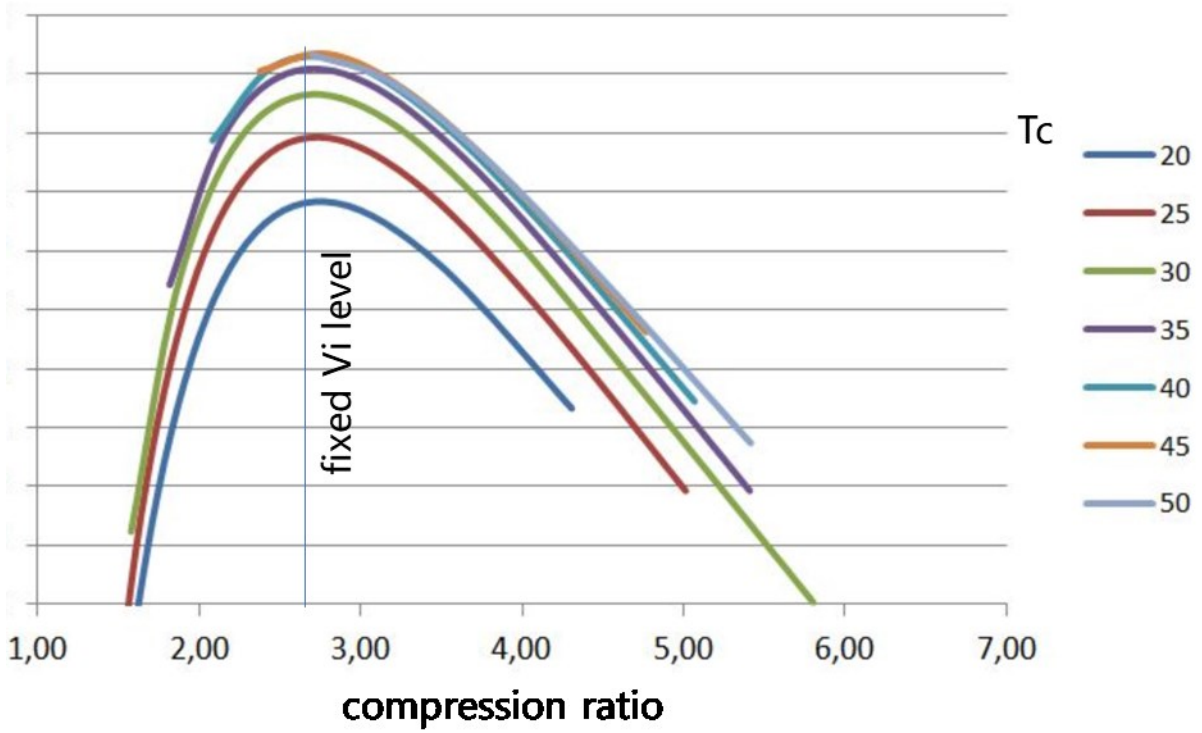
SRS-C, the new dimension

Technical Features

Standard compressors offer a specific Vi ratio

Whatever the condensing temperature, at that given compression ratio it offers maximum efficiency.

Auto-Vi



SRS-C, the new dimension

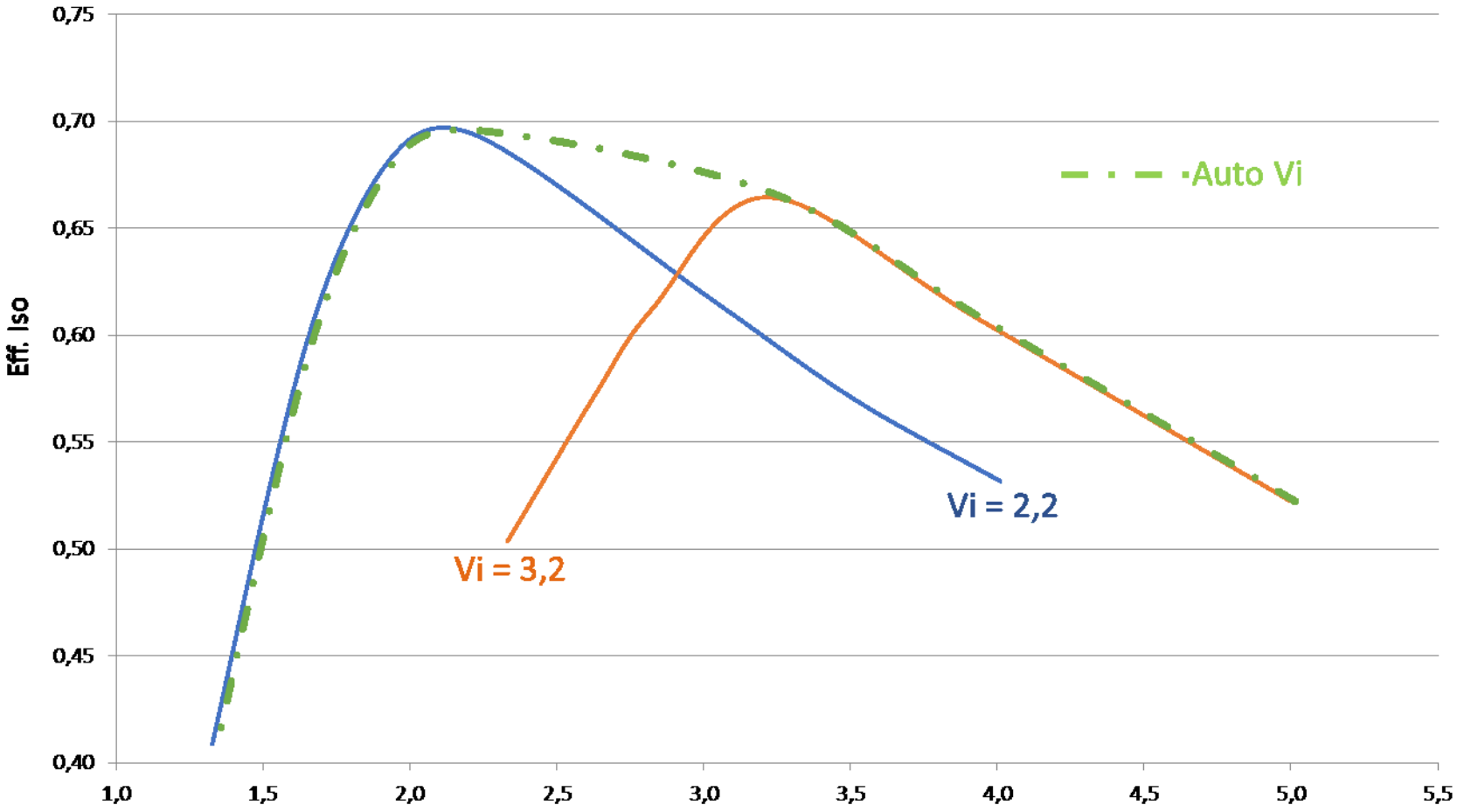
Technical Features

Std. compressors operate along the curve of the chosen Vi ratio.

Auto-Vi takes the extremes of the highest and lowest Vi ratios, and add infinite curves in between.

It continuously, in real time, adjusts the Vi ratio to optimize efficiency.

Auto-Vi



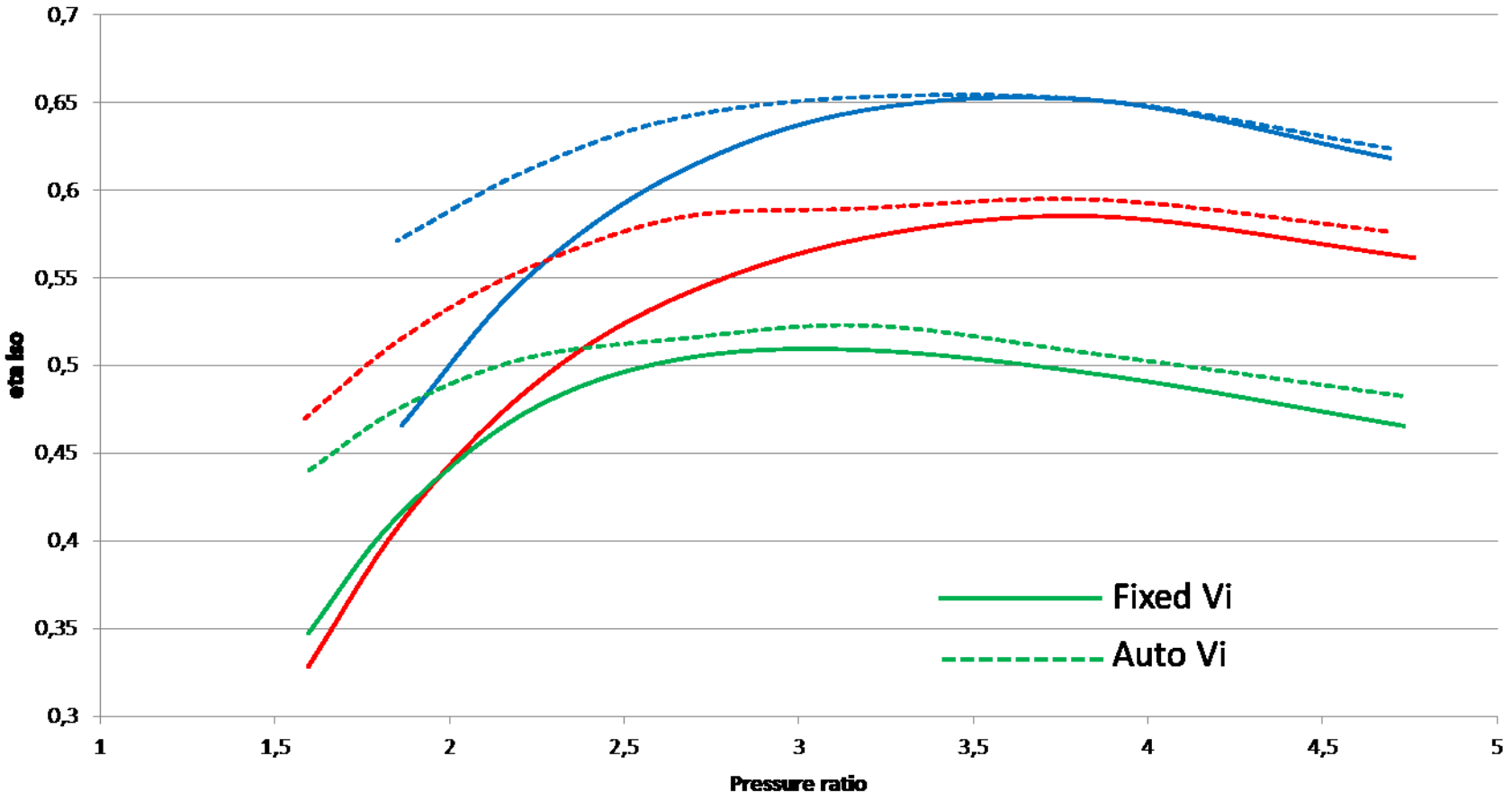
SRS-C, the new dimension

Technical Features

Auto Vi is most evident in Part Load

- highest efficiency in “real” operating conditions
- continuously
- without external input or control

Auto-Vi



Data refers to condensing temperature = 30°C

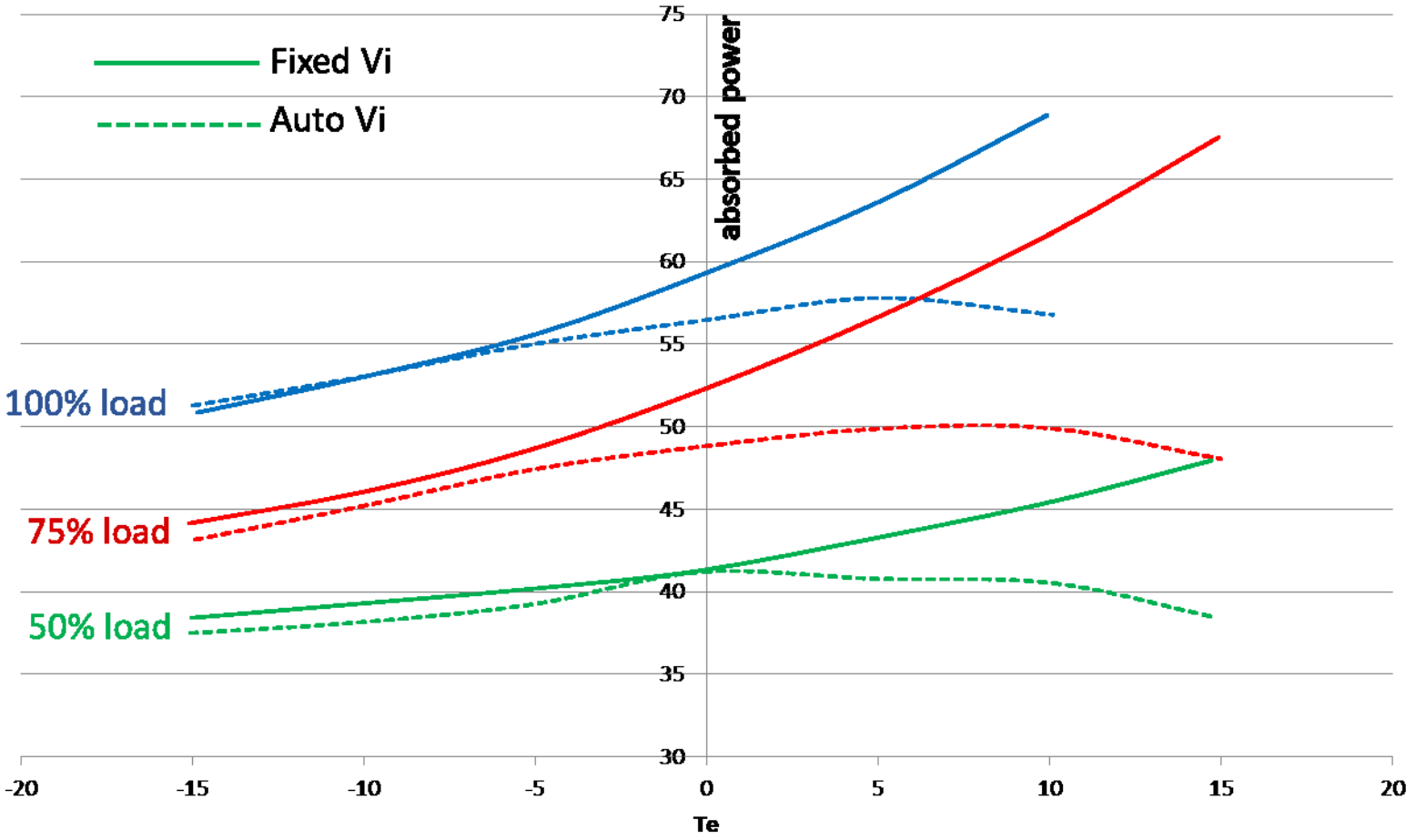
SRS-C, the new dimension

Technical Features

improved efficiency => notably absorbed power reductions at full and partial loads.

In combination with speed control by inverter => highest efficiency

Auto-Vi



Technical Features

SRS-C's Auto-Vi offers significant COP gains.

(data does not include added benefits from Actiflow oil management and oversized motor)

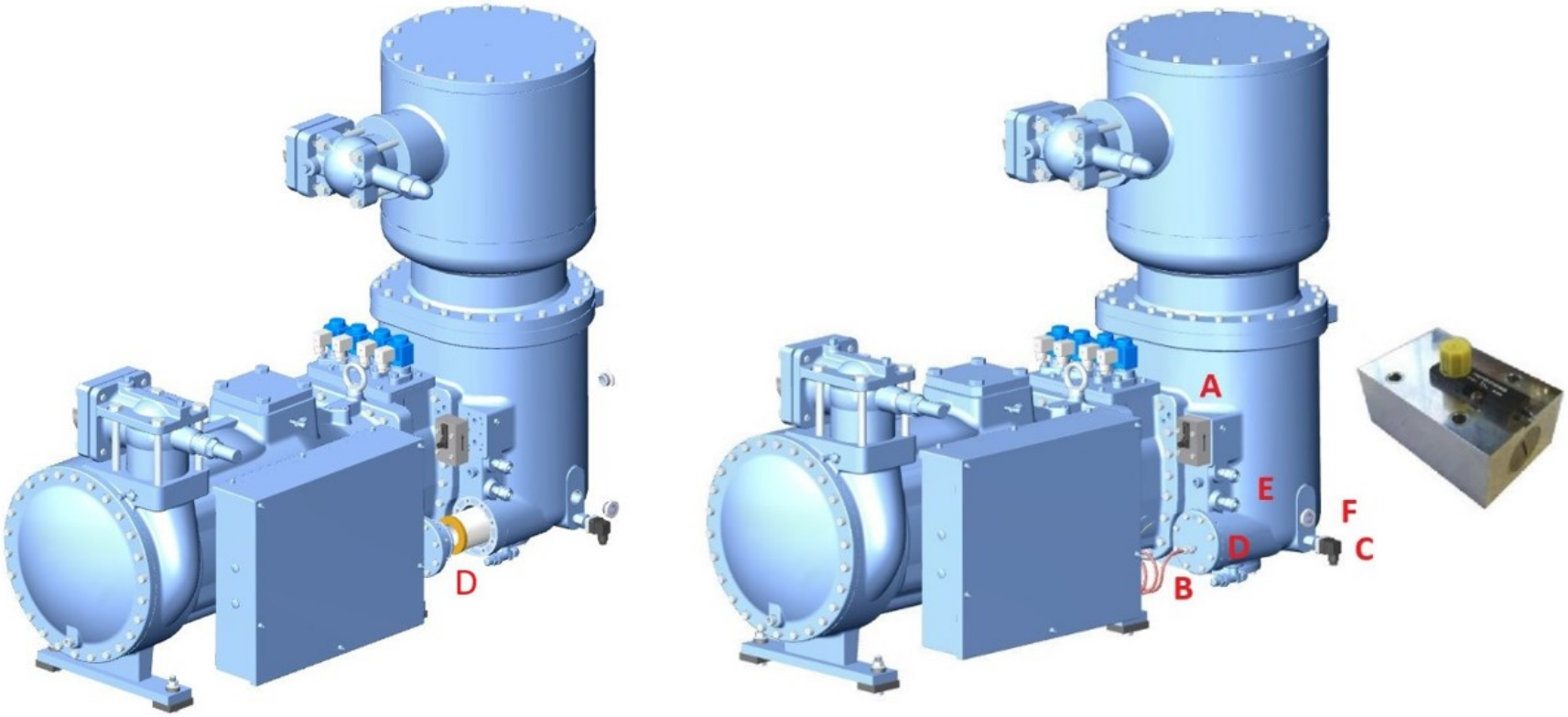
Auto-Vi

partialization	conditions		COP		
%	Tc	Te	std	Auto-Vi	% change
100%	30	-15	2,99	3,02	1,0%
		-5	4,33	4,35	0,6%
		5	5,57	6,17	10,8%
75%	30	-15	2,69	2,80	4,1%
		-5	3,84	3,98	3,6%
		5	4,90	5,66	15,5%
		15	5,86	8,48	44,7%
50%	30	-15	2,24	2,33	3,9%
		-5	3,42	3,56	4,1%
		5	4,78	5,10	6,6%
		15	6,20	7,87	27,0%

Std unit is with fixed Vi of 3,1.

SRS-C, the new dimension

Integration



A	Ölflusswächter oil flow switch	**C**	Ölniveausensor oil level sensor	**E**	Ölkühlung Ein-/Austritt oil cooling in-/ outlet
B	Druckgastemperatursensor discharge temp. sensor	**D**	Ölfilter oil filter	**F**	Schauglas sight glass

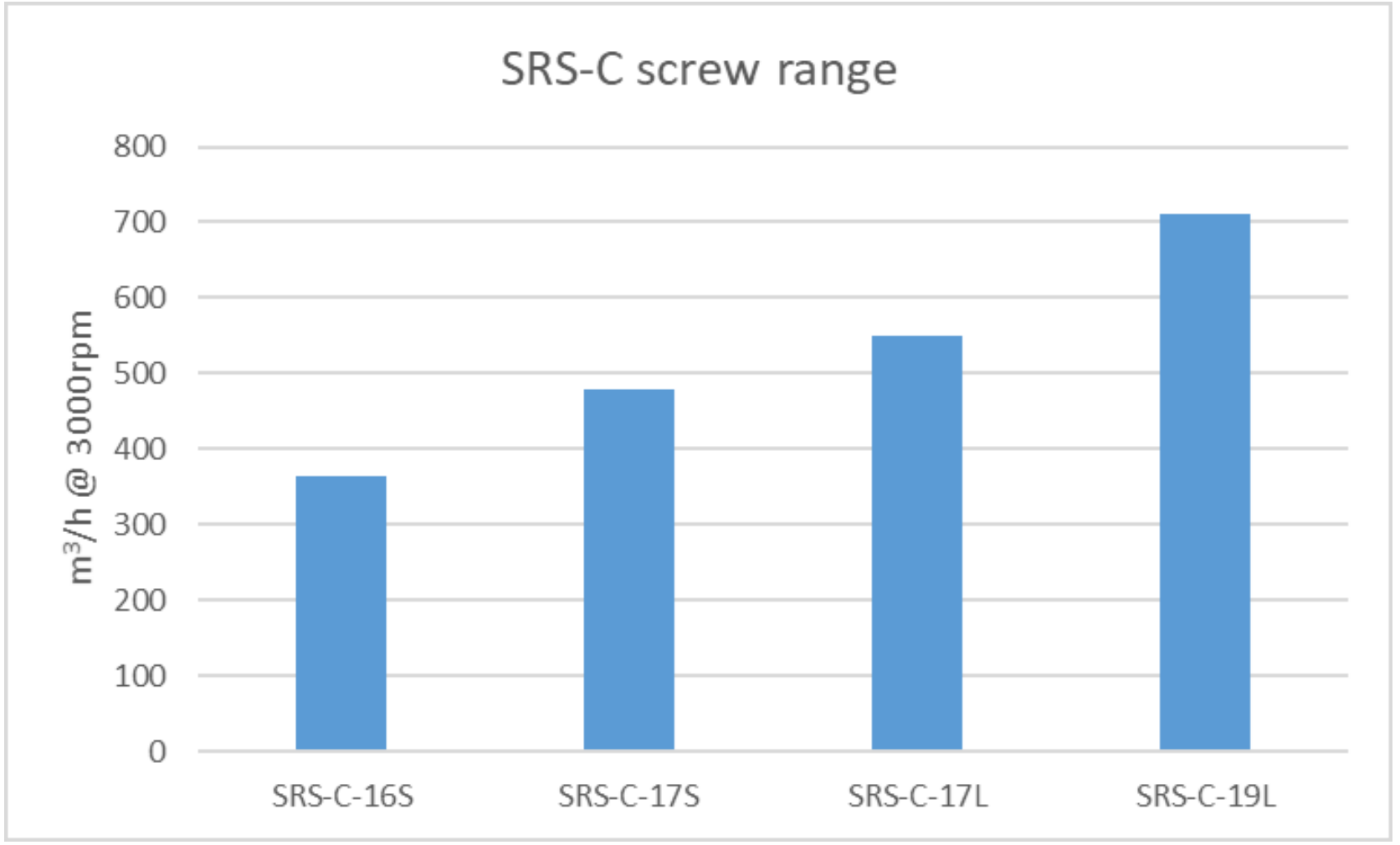
SRS-C, the new dimension

Range

	Code-Bezeichnung / Description	Darstellung / Display	Bedeutung / Explanation
1	Serie / series	SRS	Halbhermetischer NH3 Verdichter / semi-hermetic NH3 compressor
2	Klasse / class	C	Kompakt / compact
3	Rotor Durchmesser / rotor diameter	17	16, 17, 19, 21 etc
4	Rotorlänge / Rotor length	S	S, M, L

SRS-C, the new dimension

Range

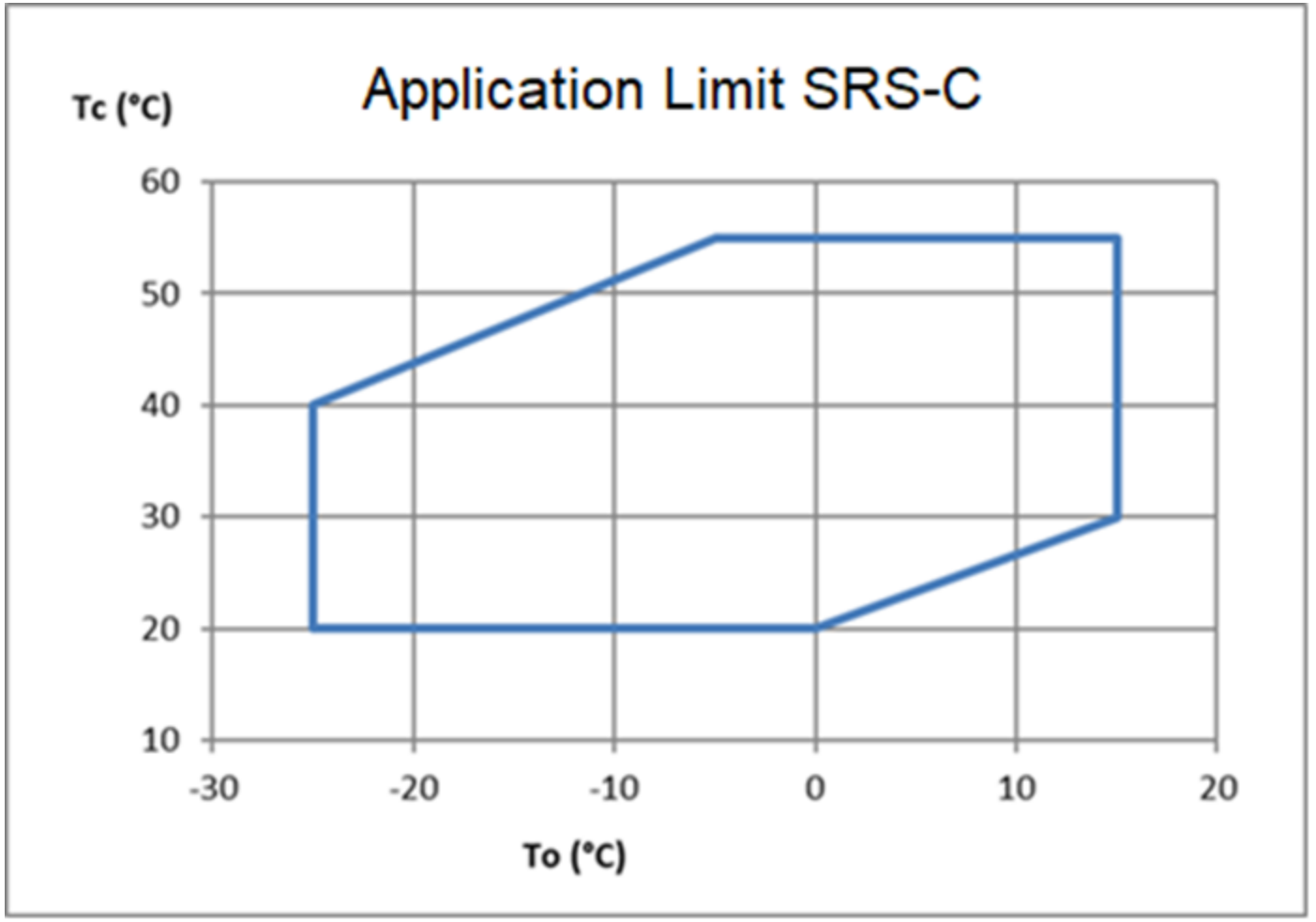


SRS-C, the new dimension

Technical Features

Application Limit

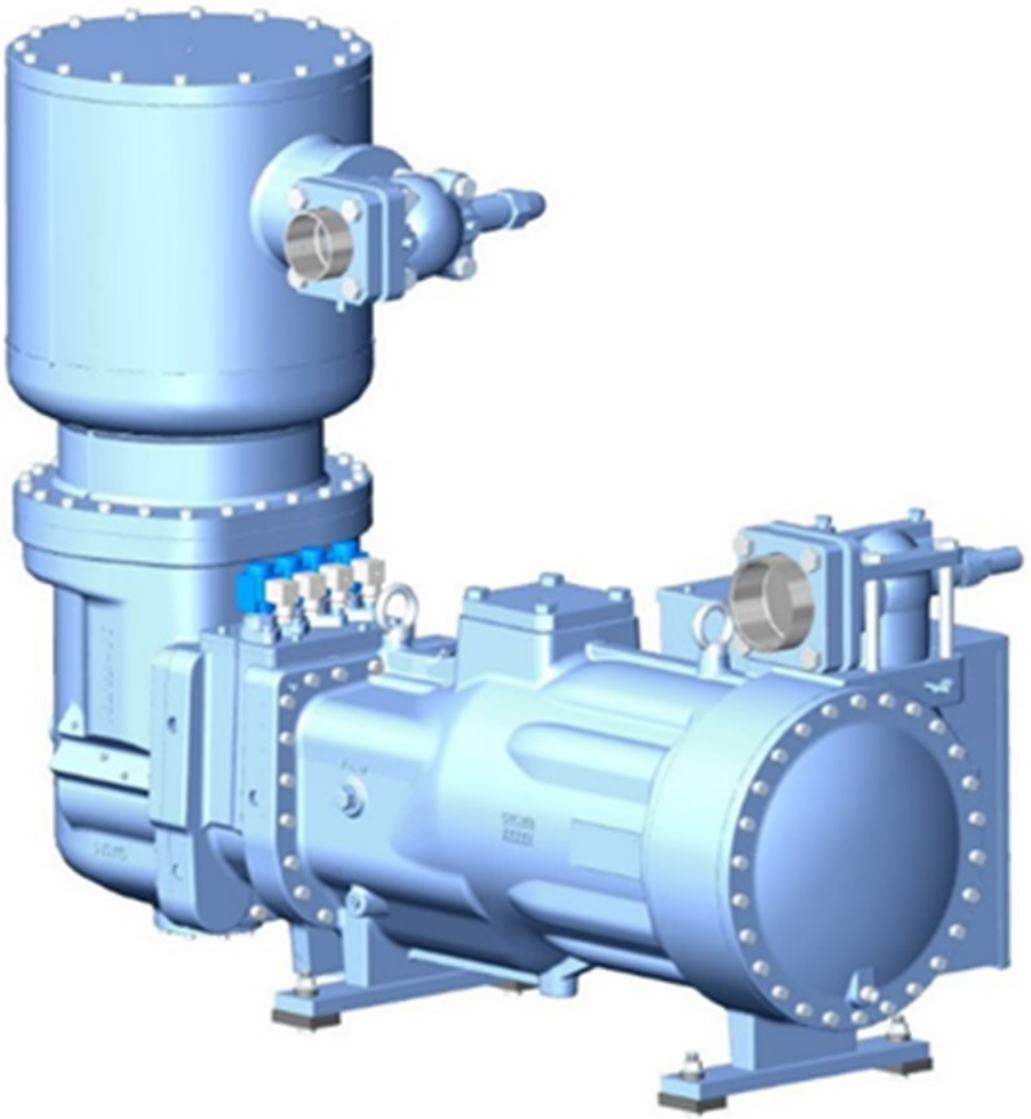
- Process Cooling
- A/C or Data Centre Cooling



SRS-C, the new dimension

Summary

- Natural Solution
- ActiFlow => efficiency increase
- Integrated Oil Separator
  - No extra oil separator => less cost
  - less piping => less cost
  - less welding points => less potential leakages
  - Less refrigerant charge
  - less space => small footprint of the chiller
- Integrated Features
  - Easy integration into chillers
  - Cost savings



Thank you for your attention.

Please contact me anytime by r.rudischhauser@srmtec.eu

CONNECTING EXPERTS.