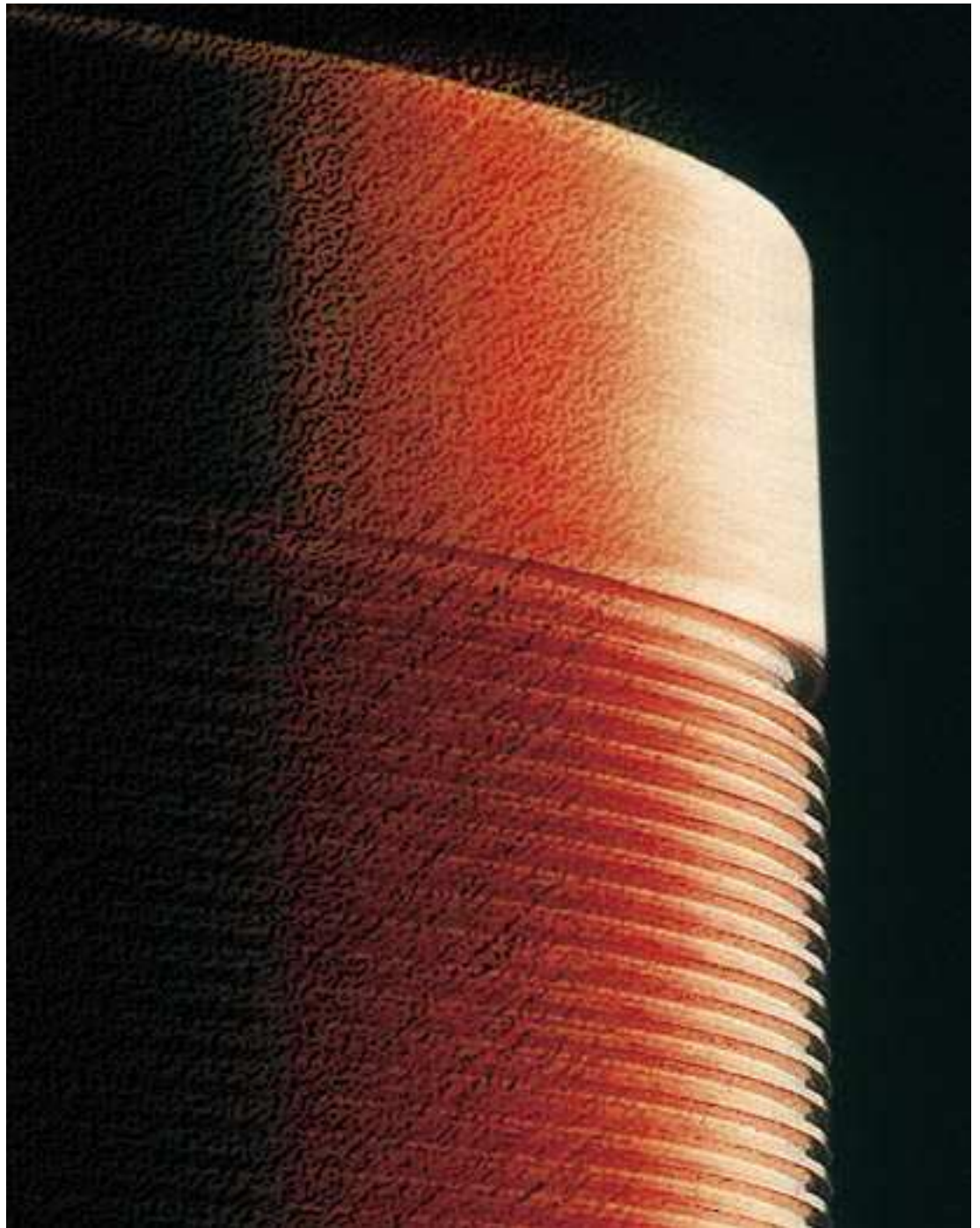




Burckhardt Compression

Laby®

The Ultimate Choice for Oil-free Compression



The Laby® Compressor from Burckhardt Compression

The Burckhardt Compression labyrinth piston compressor (Laby®) is a unique oil-free machine refined by more than 65 years' experience. There are to date more than 6500 installations of the Laby® for many different applications.

Renowned Swiss workmanship ensures

- High quality
- Reliable operation
- Easy maintenance
- Long service life

Independent research has revealed that the Laby® has higher availability and reliability than any other reciprocating compressor on the market. Burckhardt Compression is a company with a worldwide sales and service network.

What is the Laby®?

In brief, the Laby® is a compressor with a non-lubricated contact-free sealing system. Multiple tiny throttling points along the piston and piston rod gland create the seal. Small clearances are maintained between adjacent surfaces.

Competing systems use piston rings, which rub against adjacent surfaces, thereby generating friction losses and heat.

As the Laby® has no contact seals, there is no friction in compression areas, and there are no hot spots. The seals do not wear, and the system is therefore exceptionally durable and reliable.



Advantages of the Laby®

Reliability

- Simple and robust design
- Easy to operate and maintain
- Insensitive to solid impurities or bone-dry gases
- Customized system design
- Careful materials selection

Availability

- Minimal downtime, even under severe conditions
- Few wearing parts
- Minimal maintenance requirements

Safety

Safety is our prime concern. No compromises are allowed when compressing oxygen, carbon monoxide, flammable or toxic gases – and with the Laby®, no compromises are made.

Economy

- Process gas delivered oil-free
- Lower maintenance costs than any other sealing system, due to:
 - Fewer planned service shutdowns
 - Contact-free sealing system with extraordinary longevity
 - No cylinder lubricant
 - No oil removal system
 - Few parts require attention; all are easily accessible
- Design available for zero gas losses
- Small footprint – low space requirement



Here's What the Labyrinth System Is All about

The labyrinth sealing system is created by multiple tiny throttling points along the piston and the piston rod gland. At each of these throttling points, because of the flow restriction, pressure energy is transformed into kinetic energy.

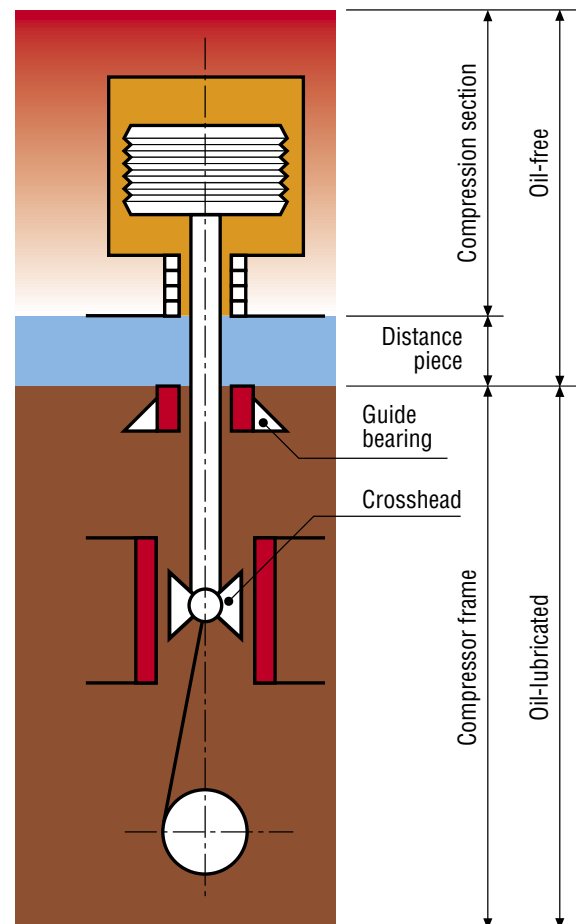
The process continues at each throttling point/volume chamber combination along the

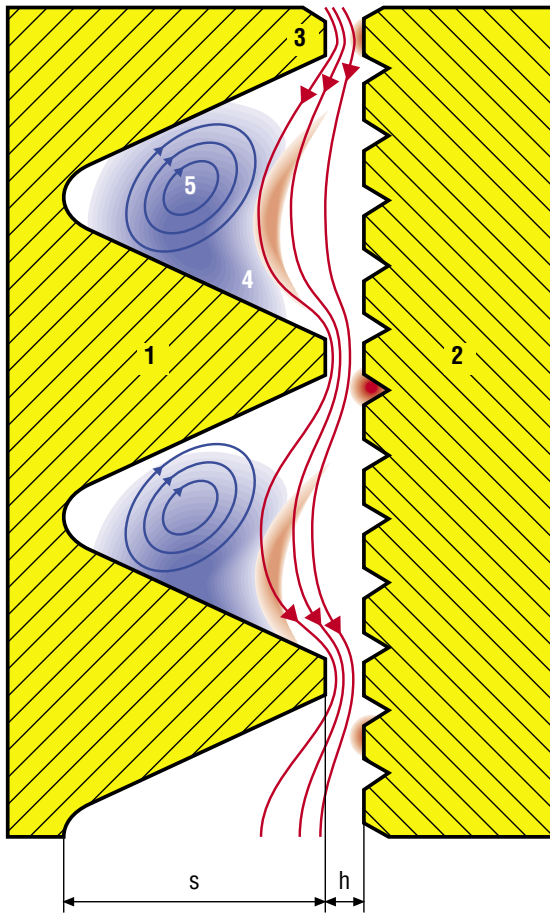
piston and piston rod gland until the required pressure drop is attained. The small amount of gas passing the sealing system is recovered internally.

Competing systems use piston and rider rings, which rub against adjacent surfaces and generate friction losses and heat.

What is outstanding about a labyrinth sealing system?

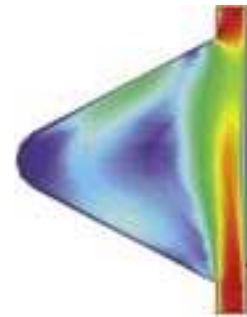
- No friction loss, no hot spots, and minimal wear and tear.
- The crosshead and a guide bearing maintain the precise linear movement of the piston for the labyrinth sealing system.
- Both of these heavy-duty guiding elements are metallic, and are located in the oil-lubricated section of the compressor. This contributes to the Laby®'s exceptionally long operational life.
- A distance piece, retaining ring and an oil scraper ring prevent oil from entering the compression area.



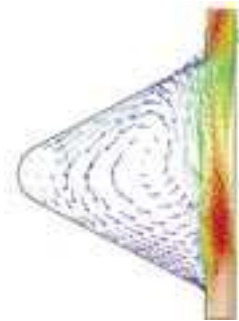


Flow within the sealing labyrinth

- 1 Labyrinth piston
- 2 Cylinder wall
- 3 Throttling point
- 4 Volume chamber
- 5 Vortex



Computer simulated velocity distribution



In addition to everyday application, the labyrinth sealing system excels

- Where cylinder lubricants are not allowed.
- Where abrasion products from sealing rings are unacceptable.
- Where friction-induced hot spots cause problems (fires with oxygen, decomposition of carbon monoxide, and melting or polymerization of hydrocarbons and other gases).
- Where process gases carry over polymer products, catalysts, or other small, or hard particles.
- Where cryogenic temperatures go down to minus 160 °C for boil-off gas.
- Where bone-dry gases are compressed.

Laby® - the Reliable Compressor for Boil-off Gases

Do you engineer, supply or operate complete reliquefaction systems? Profit from Burckhardt Compression's expertise as the world's most experienced manufacturer of boil-off gas reciprocating compression systems.

For liquefied gases and refrigeration cycles:

- In reliquefaction plants on liquid gas tankers
- In gas storage in petrochemical and chemical plants

For LNG at suction temperatures down to minus 160 °C:

- In production plants and receiving terminals
- Exceptionally fast cooling-down procedure at start up, from ambient temperature to minus 160 °C

The Laby®'s unique labyrinth sealing system is unbeatable for ultra-low gas temperatures.

The Laby® is the only compressor in the world with non-contact seals for both piston and piston rod.

The Laby® is widely used for low-temperature applications in liquid gas storage facilities across the globe.

Low gas temperature challenges the compressor in three ways:

1. Physical contact with very cold gas affects material behaviour.
2. Absence of humidity (low dew point) has a strong influence on tribological processes in non-lubricated (and lubricated) areas.
3. Due to low temperature, oil in the cylinder must be avoided.

The Laby® is the optimal solution.



Laby® - the Reliable Compressor for Industrial Gases



Oxygen

Compressing oxygen? Nothing easier than that for the Laby®. Due to the complete absence of oil in the compression area, the Laby® is the perfect choice. Absolutely oil-free compression is a must for handling oxygen. The Laby® design adheres to additional critical safety features:

- Careful design to ensure long component life
- Expert materials selection to suit the duty of the compressor
- Efficient cooling of the cylinder

Consequently, Burckhardt Compression is the world's leading supplier of reciprocating oxygen compressors.

Carbon monoxide

Many decades of experience and excellent compressor performance have made the Laby® the first choice for compressing carbon monoxide:

- No hot spots, minimizing CO decomposition.
- A completely closed and gas-tight frame avoids leakage to the atmosphere.
- Simplified compressor operation reduces operating cost.

Other industrial gases

Do you want to compress any other industrial gases oil-free? Use a Laby® for nitrogen, carbon dioxide, high pressure air and for other duties.

Laby® - the Reliable Compressor for Polyolefins

Recycle gas compression requirements are best handled with the Laby®. Due to its unique design features, the Laby® is particularly suited for polyethylene, polypropylene, ethylene oxide, ethylene glycol and other applications.







The benefits of the Laby® are obvious:

- Superior reliability
- Insensitive to impurities in the gas
- Excellent availability
- Continuous operation and long service intervals
- Gas-tight design



Laby® - the Compressor Design to Meet Your Specific Requirements

- Oil-free compression
- Large variety of standard sizes
- Suction volume up to 11'000 m³/h
- Suction temperature down to minus 160 °C
- Discharge pressure up to 300 bar

-  Area of gas compression and gas flow
-  Heat exchange medium (e.g. cooling water)
-  Lubricating oil
-  Area of stagnant gas
-  Purge gas
-  Oil separator

- 1 Labyrinth piston
- 2 Cylinder
- 3 Labyrinth piston rod gland
- 4 Distance piece
- 5 Oil scrapers
- 6 Piston rod
- 7 Guide bearing
- 8 Crosshead
- 9 Crankshaft

Description

- Crankcase under atmospheric pressure
- Open distance piece

Crankcase design features

- Strict separation between cylinder and crankcase

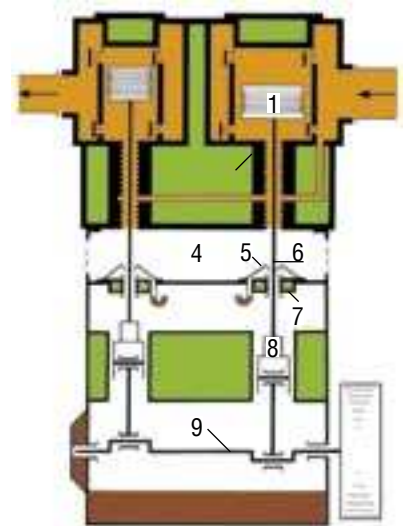
Applications

- Industrial gas industry

Gases

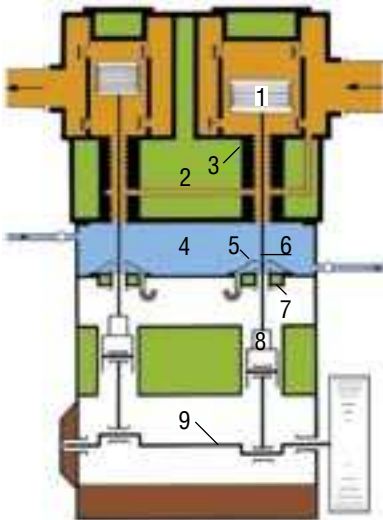
Industrial gases

Compressor type D



Polypropylene plant, Amoco, Belgium





Description

- Crankcase under atmospheric pressure
- Closed, purged distance piece

Crankcase design features

- Strict separation between cylinder and crankcase
- Distance piece purged with nitrogen or other suitable gas

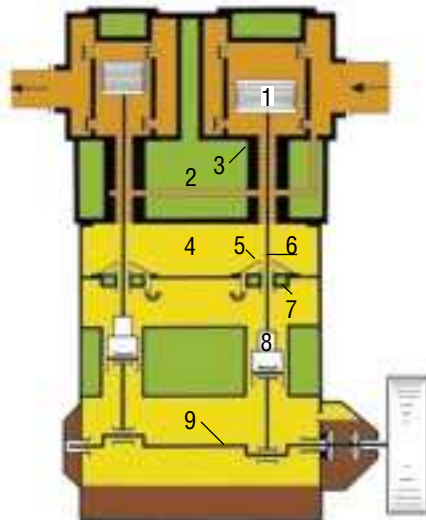
Applications

- Industrial gas industry
- Process gas

Gases

Industrial gases

Compressor type D



Description

- Gas-tight crankcase and distance piece

Crankcase design features

- Mechanical crankshaft seal
- No gas leakage to atmosphere
- Seal gas barrier possible

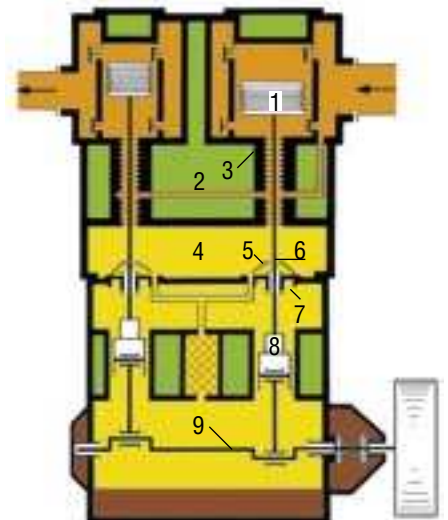
Applications

- Where no process gas leakage is allowed
- Boil-off gas
- Process gas

Gases

Hydrocarbons, CO and other gases with low suction pressure

Compressor type D



Description

- Gas- and pressure-tight crankcase and distance piece

Crankcase design features

- Mechanical crankshaft seal
- No gas leakage to atmosphere
- Seal gas barrier possible

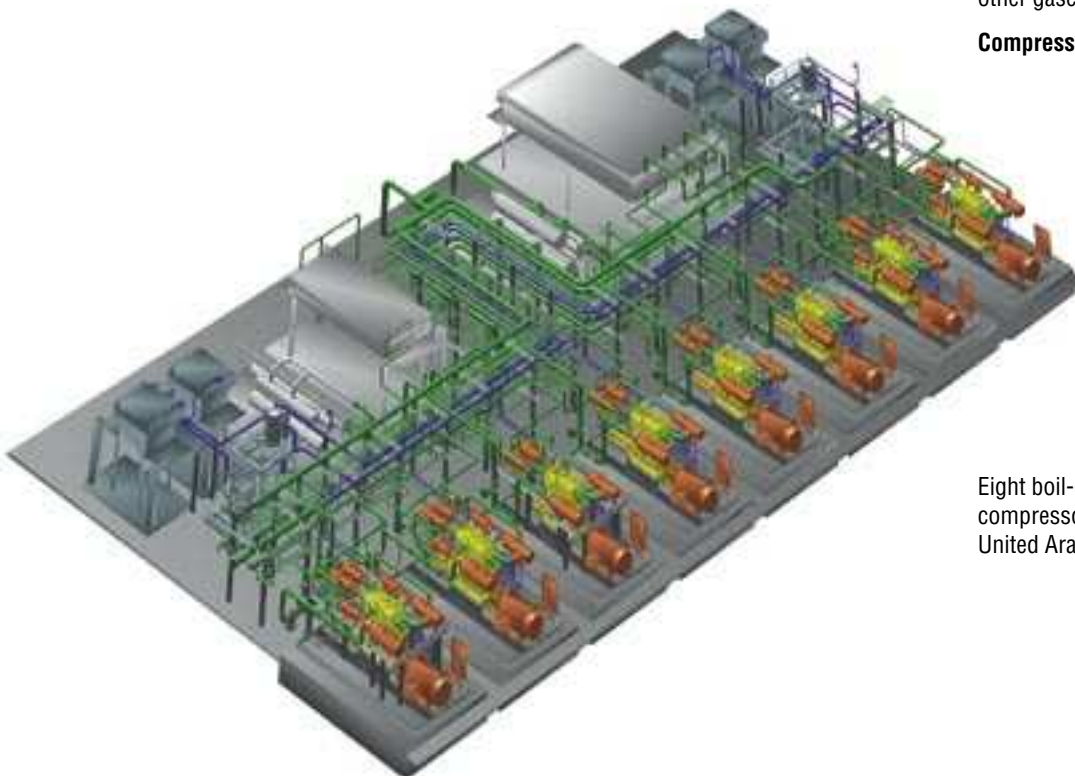
Applications

- Where no process gas leakage is allowed
- Suction pressure from vacuum to 15 bar or higher
- Boil-off gas
- Process gas
- Closed cycles

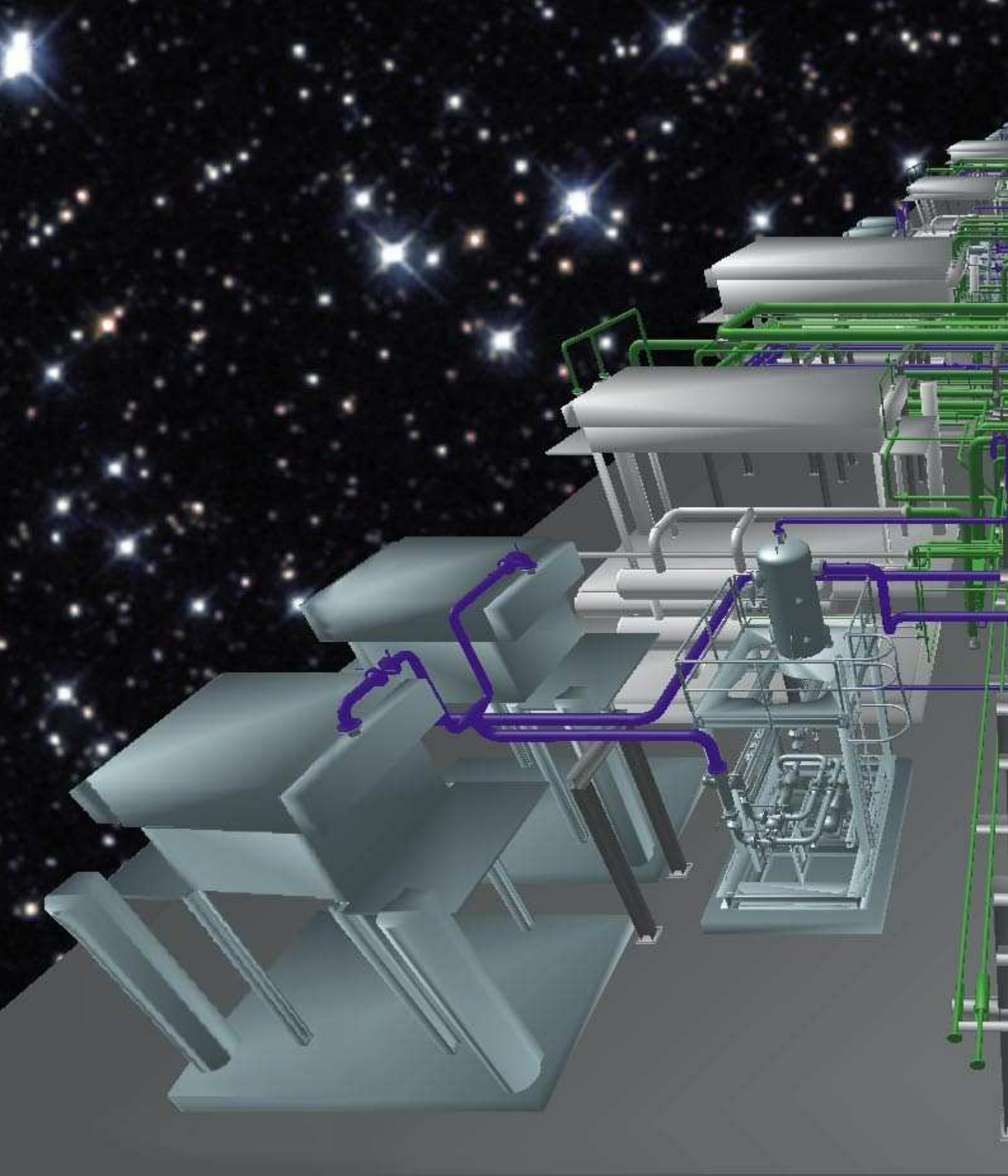
Gases

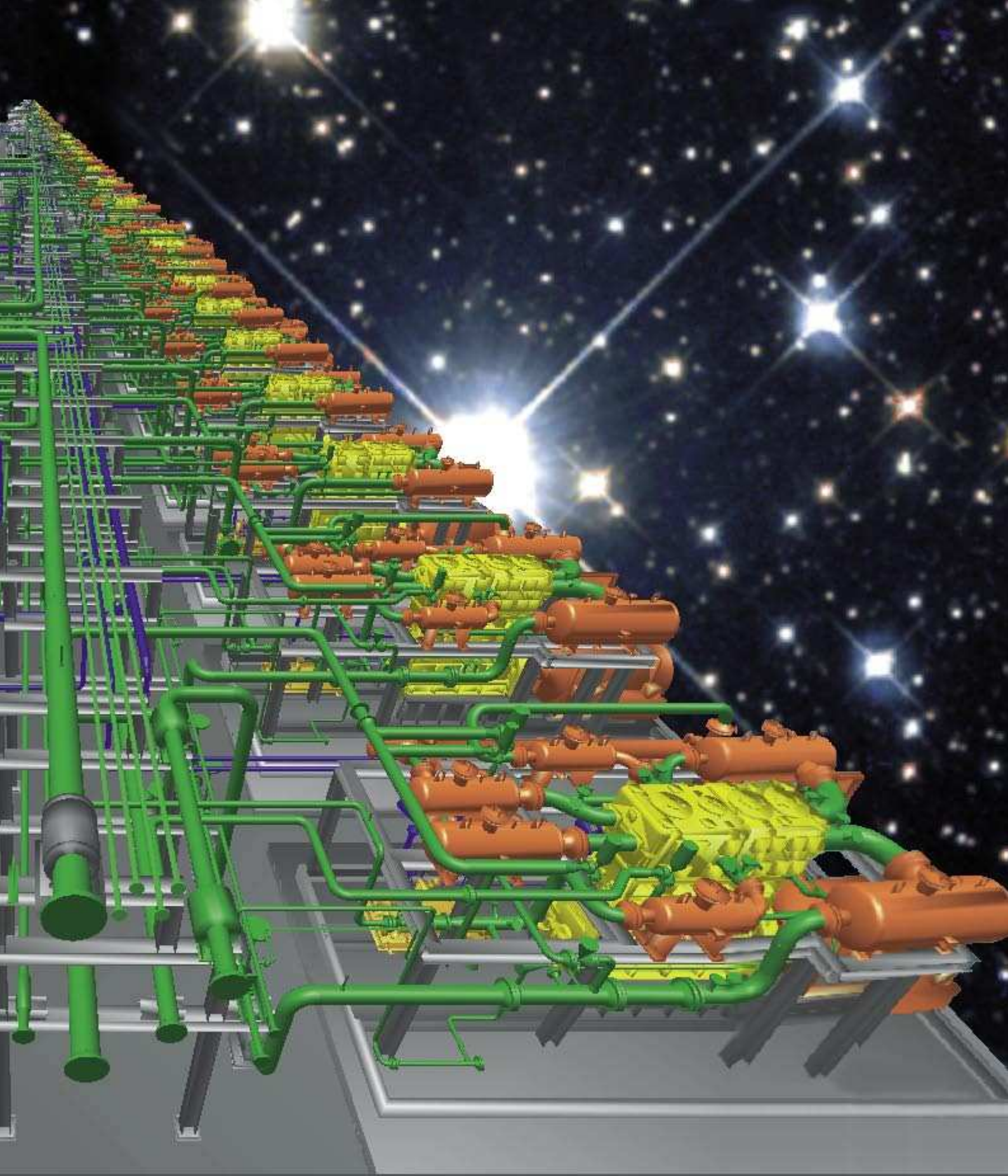
Hydrocarbons, refrigerants, CO and other gases

Compressor type K



Eight boil-off gas and refrigeration compressors for ethylene terminal, United Arab Emirates



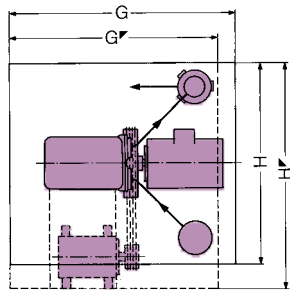
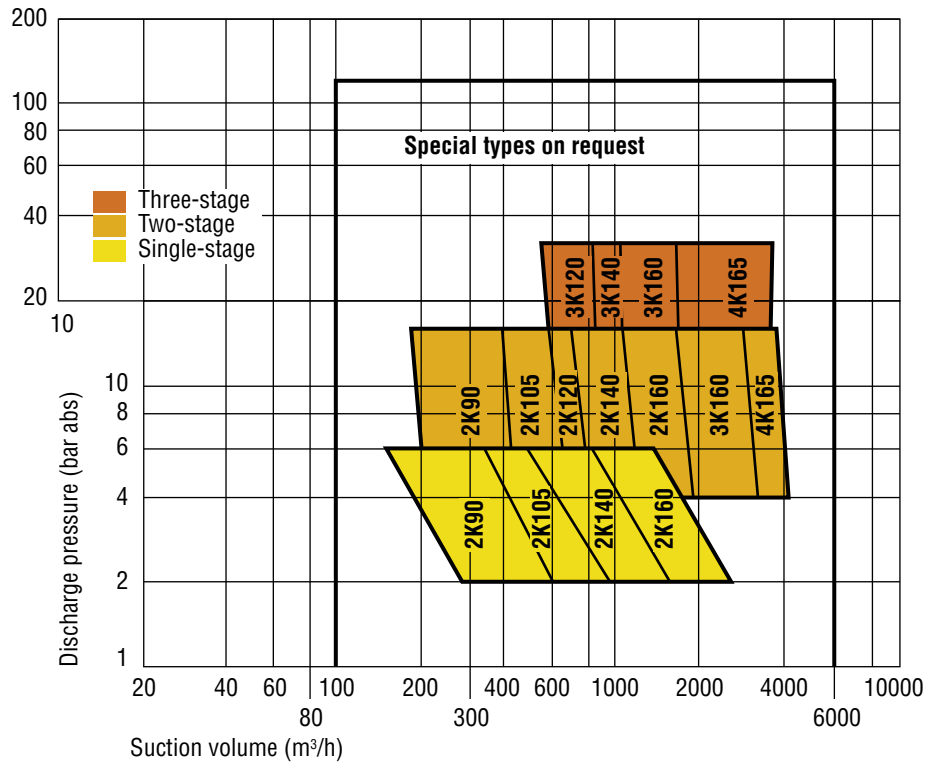
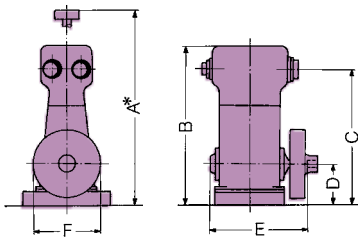


Laby® – Dimensions and Weights

K-Type compressors

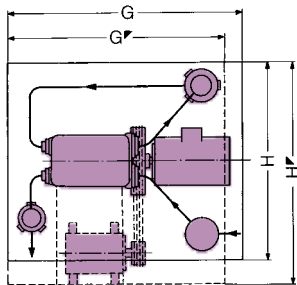
Performance range based on diatomic gases with molecular mass between 10 and 50 kg/kmol

Volume flow based on suction condition 1 bar abs, 20°C



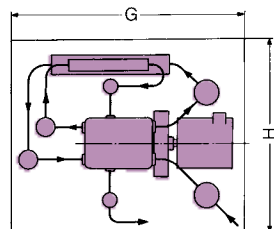
Single stage compressors

Type	Dimensions						Compr. weight kg	Foundation**			
	A* mm	B mm	C mm	D mm	E mm	F mm		G mm	H mm	G mm	H mm
2K90-1A	2600	1727	1499	500	800	Ø600	1350	3200	2500	2800	3200
2K105-1A	2850	1900	1594	550	1000	Ø660	2000	3800	2800	3200	3800
2K120-1A	2600	1970	1579	550	1000	Ø900	2300	4200	3200	3700	4200
2K140-1A	3400	2300	2022	600	1100	Ø900	3800	4200	3200	3500	4400
2K160-1A	3800	2557	2085	650	1300	Ø1240	5250	5200	3800		
3K160-1B	3500	2623	2098	600	1600	Ø1000	8100	8300	5500		



Two stage compressors

Type	Dimensions						Compr. weight kg	Foundation**			
	A* mm	B mm	C mm	D mm	E mm	F mm		G mm	H mm	G mm	H mm
2K90-2A	2700	1720	1553	500	800	Ø600	1400	4800	3500	2500	4800
2K105-2A	3140	1938	1654	550	1000	Ø660	2150	4000	3300	3200	4400
2K120-2A	2600	2013	1579	550	1000	Ø900	2300	4500	3500	3800	4500
2K140-2A	3500	2400	1933	600	1100	Ø900	3700	4500	3500	4000	7000
2K160-2A	3800	2573	2085	650	1300	Ø1000	5200	7000	5000		
3K160-2A	3500	2705	2208	700	1600	Ø1000	8100	7000	5000		
4K165-2H	4200	2832	2560	750	2400	Ø1000	13000	8500	6000		



Three stage compressors

Type	Dimensions						Compr. weight kg	Foundation**	
	A* mm	B mm	C mm	D mm	E mm	F mm		G mm	H mm
3K120-3A	3100	2290	1900	650	1750	Ø900	5350	5000	4000
3K140-3A	3600	2672	2074	700	1600	Ø1000	8250	8000	6000
3K160-3A	3500	2725	2098	700	1600	Ø1000	7700	8000	6000
4K165-3E	3850	2819	2310	750	2400	Ø1000	13000	9000	6000

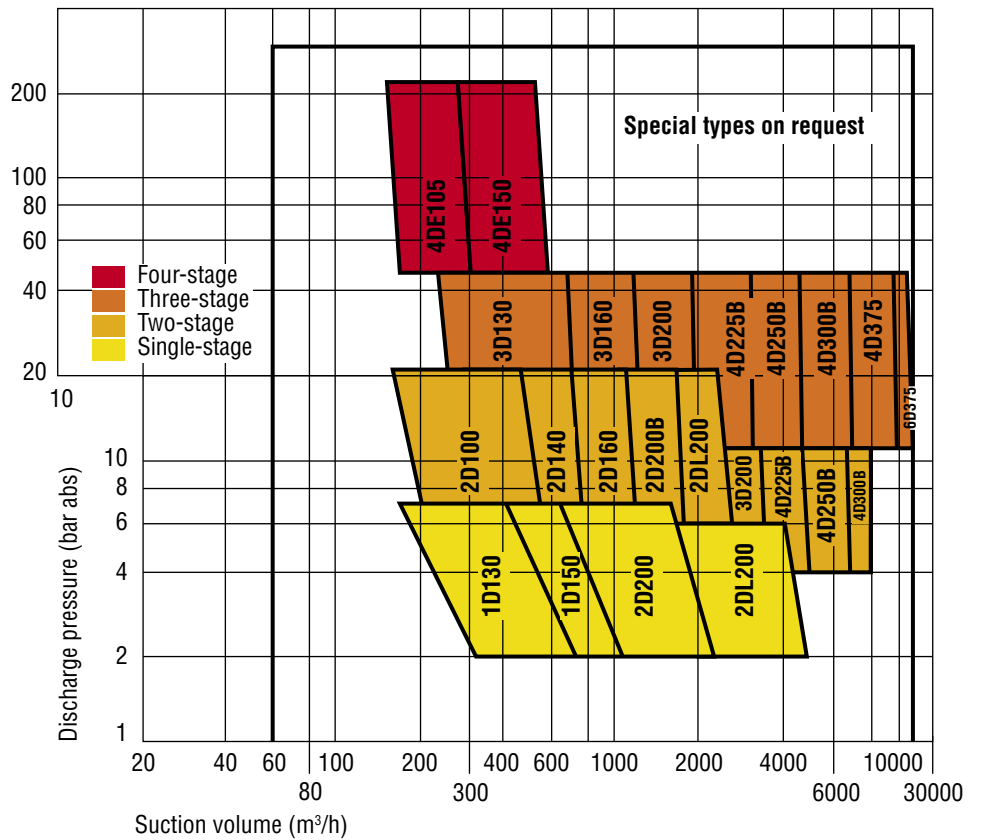
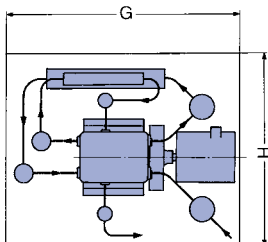
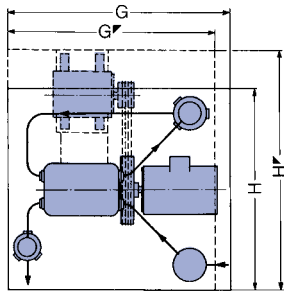
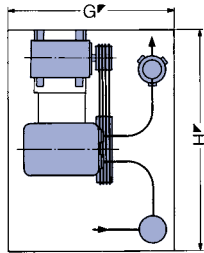
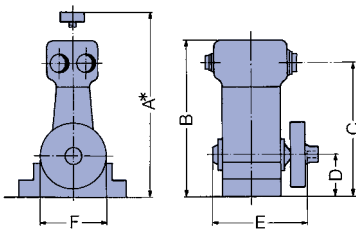
* Required height of room to install piston and piston rod

** Foundation dimensions are approximate values

D-Type compressors

Performance range based on diatomic gases with molecular mass between 10 and 50 kg/kmol

Volume flow based on suction condition 1 bar abs, 20°C



Single stage compressors

Type	Dimensions						Compr. weight kg	Direct drive Foundation**	
	A* mm	B mm	C mm	D mm	E mm	F mm		G mm	H mm
1D130-1A	3450	2385	2010	500	450	Ø910	1450	2500	3300
1D150-1A	3700	2570	2185	550	600	Ø915	2000	3500	4600
2D160-1A	3350	2570	2060	600	900	Ø1000	3050	4000	6500
2D200B-1E	4900	3090	2597	700	1100	Ø1300	4400	4000	7100
2DL200-1A	4250	3070	2582	750	1300	Ø1300	7000	6000	7500
2D205-1B	4250	3220	2675	750	1200	Ø1300	6500	5000	8000
2D250B-1A	6300	4000	3337	800	1600	Ø1500	13750	5000	9700

Two stage compressors

Type	Dimensions						Compr. weight kg	Foundation**			
	A* mm	B mm	C mm	D mm	E mm	F mm		G mm	H mm	G mm	H mm
2D100-2A	2750	1985	1604	450	900	Ø750	1950	6000	4000	3400	4000
2D140-2A	3160	2305	1844	500	800	Ø900	2350	5200	3800	4300	4500
2D160-2A	3510	2597	2108	600	900	Ø1000	3150	5000	4600	4000	5000
2D200B-2A	4700	3087	2597	700	1300	Ø1200	4500	7500	6600		
2DL200-2B	4250	3134	2582	750	1300	Ø1200	7000	7500	6000		
2D205-2E	4250	3260	2675	750	1200	Ø1300	6500	8200	6000		
2D250B-2B	6000	4006	3537	800	1400	Ø1700	14900	10000	6500		
3D200-2A	4400	3023	2532	700	1700	Ø1200	8800	6400	4800		
4D225B-2D	4850	3266	2745	700	2200	Ø1300	10500	11000	7200		
4D250B-2B	5300	3628	3227	800	2600	Ø1500	13600	14800	8500		
4D300B-2C	6300	4340	3595	1000	3000	Ø1500	24550	12000	8000		

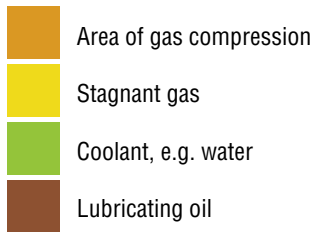
Three stage compressors

Type	Dimensions						Compr. weight kg	Direct drive Foundation**	
	A* mm	B mm	C mm	D mm	E mm	F mm		G mm	H mm
3D130-3A	3500	2323	1908	500	1100	Ø900	3400	4000	5000
3D160-3A	3680	2635	2164	600	1300	Ø1000	5700	5000	6400
3D200-3A	4400	3058	2532	700	1700	Ø1200	8150	6000	9000
4D225B-3E	4900	3266	2795	700	2200	Ø1300	12200	5200	9000
4D250B-3N	5300	3671	3227	800	2600	Ø1500	14800	8500	11200
4D300B-3R	6300	4260	3845	1000	3000	Ø1800	24850	9000	12150
4D375-3A	7400	4893	4375	1050	3400	Ø2000	34950	10000	13000
6D375-3A	7200	4790	3025	1200	4500	Ø2000	40850	10000	13000

* Required height of room to install piston and piston rod

** Foundation dimensions are approximate values

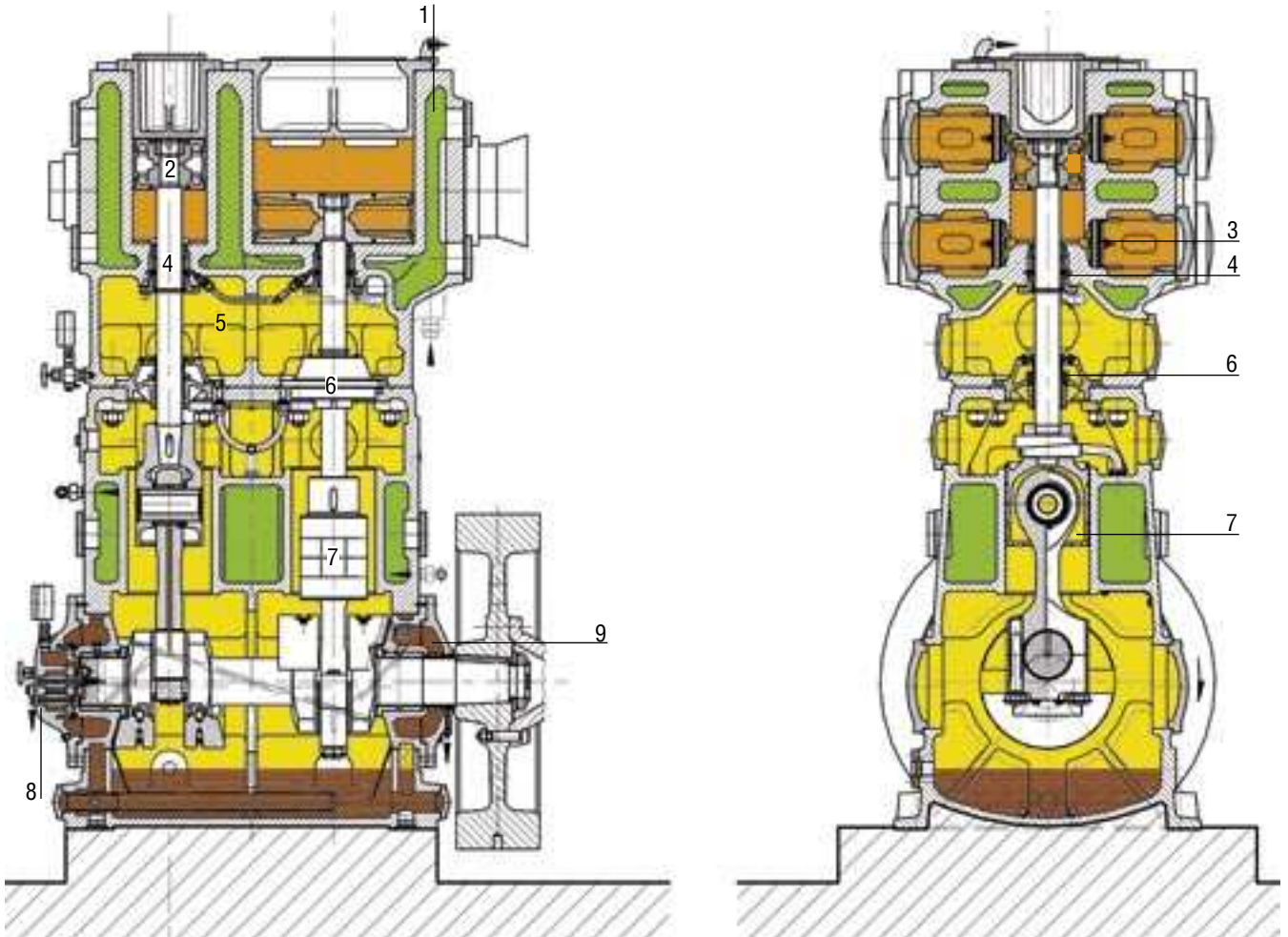
Laby® - the Vertical Compressor of Unique Design



Design features

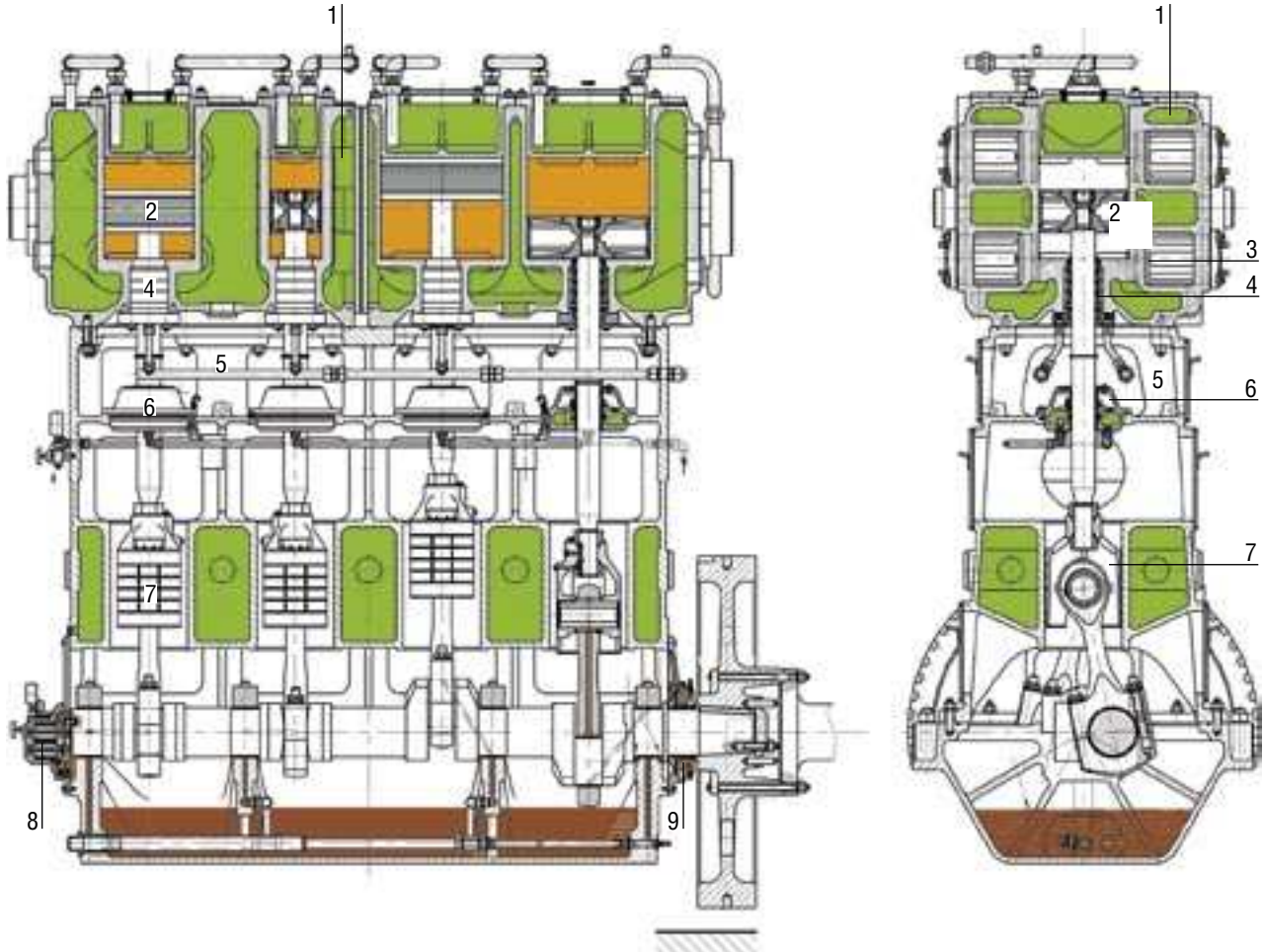
1. Cylinder jacket for cooling fluid, e.g. water
2. Labyrinth piston
3. Cylinder valve
4. Labyrinth piston rod gland
5. Extra-long distance piece to separate oil-lubricated crankcase from oil-free cylinder
6. Oil-lubricated guide bearing with oil scrapers
7. Crosshead guide with jacket for cooling fluid, e.g. water (oil cooler redundant on small compressors)
8. Crankshaft-driven oil pump for forced-feed lubrication of bearings and crossheads
9. Crankshaft seal

K - Type compressors, totally closed, with gas- and pressure-tight crankcase





D - Type compressors with open distance piece or gas-tight design



Laby® - Components Designed and Manufactured by Experts

Labyrinth piston

Design features

- Very few parts
- Metal materials only
- Sealing elements have an almost unlimited life and negligible maintenance

Specialties

- Double- or single-acting
- No friction contact
- Suction temperature range from minus 160 °C to plus 250 °C
- Unequaled reliability and safety in oxygen service
- Insensitive to gas impurities



Crankshaft seal for gas-tight compressors

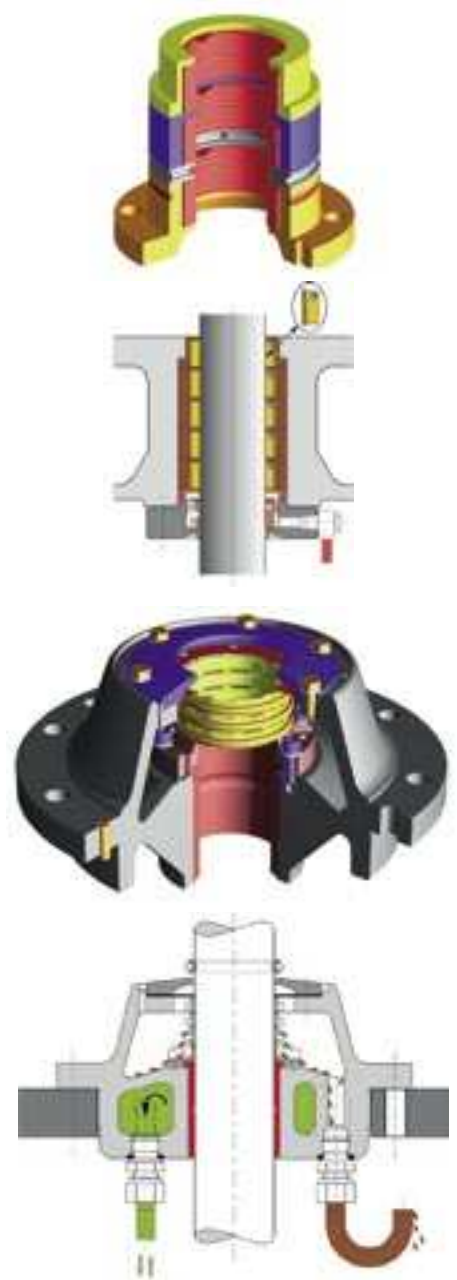
- Mechanical seals, oil-immersed
- Additional seal protects bearing from atmospheric dust
- Oil cannot drain to crankcase when compressor stops
- Keeps gas and oil in the crankcase

Piston rod gland

- Sealing rings are radially floating and self-centering
- Standard design: Solid one-piece ring
- Ring material: Graphite or plastic for special applications
- Sealing ring housing made of stainless steel
- Leak gas is collected in chamber at lower end and returned to first stage suction side
- Adaptable gas connections for special executions

Piston rod guide bearing

- Cooled or non-cooled, depends on compressor duty
- Replaceable bushing
- Splash-lubricated
- Oil scraper available as one-piece metal rings or three-piece plastic rings, designed to exclude oil from the distance piece, piston rod gland area or cylinder section. No need for additional oil-vapor removal equipment.



Crankshaft seal for open type compressors

- Shaft seal ring on both inner and outer sides, as well as oil thrower ring on crankshaft
- Keeps oil in the crankcase
- Keeps atmospheric dirt and dust out

Gas Flow under Control - Compressor Valves

To ensure long operating times, Burckhardt Compression offers the appropriate valve.

- Suction and discharge valve dimensions according to API specifications to prevent incorrect assembly in cylinder
- Valve plate or ring dynamics optimized by computer calculations
- State-of-the-art manufacturing process

Burckhardt Compression Plate Valve™

- Maximum availability and reliability for clean and dry gases
- Designed and manufactured by Burckhardt Compression (OEM)
- Frictionless valve plate guiding
- Identical internal parts for suction and discharge valves
- Seat and guard made of stainless steel or nickel alloy
- Plate materials made of heat treated stainless steel, nickel alloy or temperature-resistant plastic



Burckhardt Compression Poppet Valve™

- Maximum availability and reliability for gases bearing liquid or hard solid particles
- Designed and manufactured by Burckhardt Compression (OEM)
- Seat and guard made of stainless steel
- Poppets made of injecting molded plastic
- Tightness insensitive to thermal expansion of plastic material
- Easy maintenance
- Fully field repairable because of the removable seat plate



MANLEY® valves, licensed by Burckhardt Compression

- Maximum availability and reliability for gases bearing liquid or hard solid particles
- Original MANLEY® rings, buttons and springs
- Seat and guard made of stainless steel, manufactured in-house under Cook Manley®, USA license
- Different ring materials available to suit various operating conditions



Research and Development

The labyrinth piston compressor has seen 65 years of field experience and steady improvement. Further development continues through advances in:

- Information, production and materials technologies
- Measuring and testing devices and procedures

The labyrinth sealing effect

Constantly, we examine the flow behavior of gases in oscillating sealing labyrinths. Bench tests and computer simulations lead to constant refinements of:

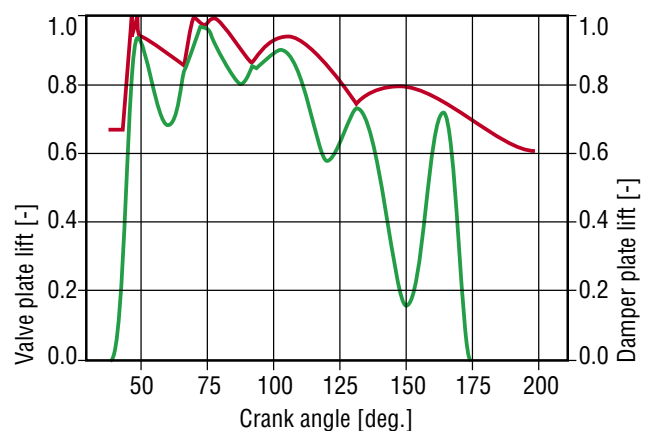
- Labyrinth shape and size
- Labyrinth clearance
- Other parameters

Compressor valves

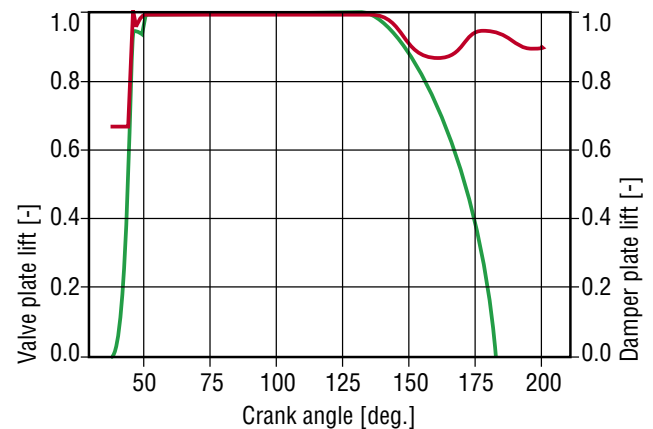
Valves have a tough life. They have to open and close automatically, quickly, and reliably with each crankshaft revolution, under severe temperature and pressure conditions. Trouble, excessive wear and losses are avoided by:

- Skilled selection and sizing of valve and compressor, using advanced computer programs, to match operating conditions
- Strict quality control in production

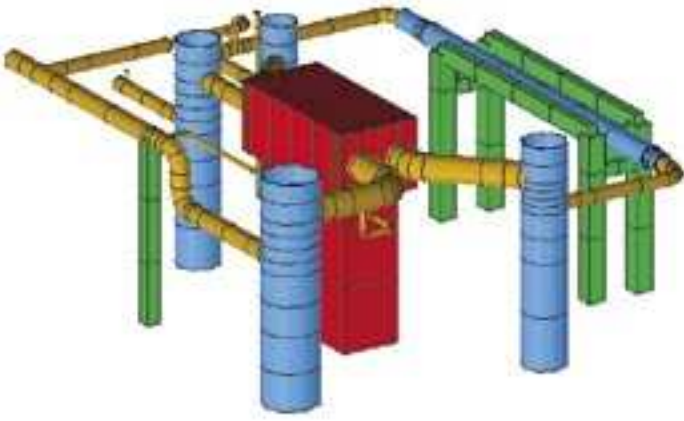
Valve dynamics before modification



Valve dynamics after modification



— Valve plate
— Damper plate

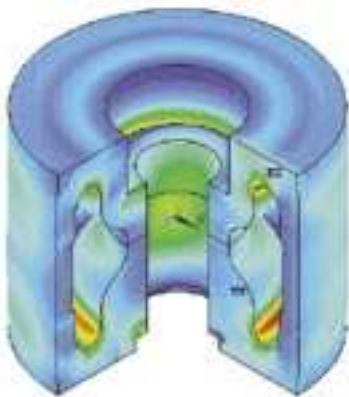


Pulsation and vibration studies

Gas pulsation and vibrations in pipes and vessels can lead to component failures and low operational efficiency. Use our specialists to analyze the plant in the design phase and implement measures to keep these fluctuating phenomena within permissible limits.

New materials

Customers' requirements evolve, new processes are developed, new materials become commercialized. We respond by analyses and tests to incorporate new materials in cylinders, pistons, piston rods and other parts.

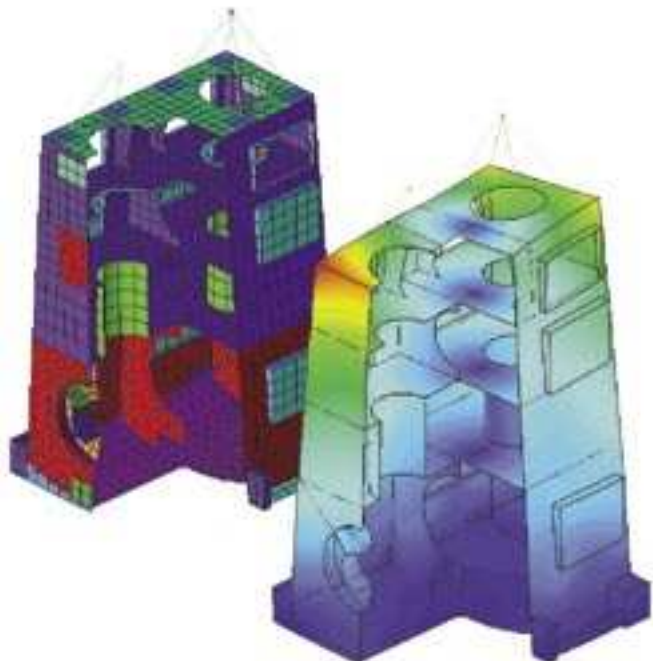


Compressor selection

Selection of the best compressor for a specific application depends not only on basic thermodynamic and mechanical principles but also, critically, on the compressor builder's experience. Burckhardt Compression offers an attractive compressor selection tool, available on the Internet. Customers will find it easy to make a preliminary selection of a suitable machine for feasibility studies, etc. For a precise selection for a specific plant, consult us.

Compressor design

Burckhardt Compression is one of the world's leading manufacturers of gas compressors and remains at the cutting edge of technological development. We use the most advanced calculation procedures for thermodynamic and mechanical events during the compression process. The range and complexity of complete plants that can be simulated is virtually unlimited.



Customer Support Service

- Compressor installation and commissioning
- Major and minor overhauls and retrofits
- Worldwide valve service
- Analyses of operation and maintenance
- Training courses for optimizing compressor operation and ensuring plant safety
- Trouble shooting

Downtime is a nightmare for every operator.

Our worldwide organization provides parts and service as and when required.



Quality Assurance

We aim to provide you with high quality products and services by cost-effective development, manufacture, marketing and maintenance. Swiss quality is our byword. All Burckhardt Compression products and services meet predefined standards. Our Total Quality Management system complies with ISO 9001:2000 issued by the International Standards Organization.



Milestones of our Company History

- | | | | |
|------|---|------|--|
| 1834 | Sulzer was founded | 1982 | First Laby [®] for lDdPE and PP |
| 1844 | Engineering works Burckhardt established in Basel | 1998 | First hermetically sealed, oil-free high-pressure compressor package for hydrogen |
| 1935 | First labyrinth piston compressor (Laby [®]) | 1999 | World's most powerful hyper compressor with 23'500 kW |
| 1940 | First Laby [®] for oxygen | 2000 | Consolidation of all business activities in Winterthur; manufacturing facilities and offices in Basel closed-down |
| 1951 | First hyper compressor for lDPE production at 1500 bar | 2002 | Legal independence through a management buyout, Sulzer-Burckhardt Engineering Works Ltd. becomes Burckhardt Compression AG |
| 1971 | First Laby [®] for LNG boil-off at minus 160 °C | | |
| 1982 | Merger of Sulzer and Burckhardt piston compressor businesses to form Sulzer-Burckhardt Engineering Works Ltd. | | |



Process compressor for polyethylene

Other products in our piston compressor range.

Burckhardt Compression services all types of oil-free and lubricated reciprocating compressors.

Your local contact



Hyper compressor for lDPE process

Compressors for a Lifetime



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