

COMPRESSOR SOLUTIONS FOR LNG TERMINAL APPLICATIONS

PROVEN TECHNOLOGIES FOR RELIABLE AND
EFFICIENT PLANT OPERATION



Compressors for a Lifetime™

LNG – PLAYING AN IMPORTANT ROLE IN THE FUTURE ENERGY MARKET

CHALLENGING THE INDUSTRY

GROWING NATURAL GAS MARKETS

Demand for environmentally friendly natural gas as a fossil fuel will continue to increase over the long term. Replacing the liquid fossil fuels of diesel, gasoline and oil with natural gas would reduce global carbon dioxide emissions by about 30%. Coal and nuclear energy are increasingly substituted by natural gas amid widespread efforts to decarbonize growing economies and to diversify energy supply in many regions of the world. The extraction of new sources of natural gas such as shale gas deposits and the resulting price pressure are increasing international trade in natural gas, so transport and storage volumes are likewise rising.

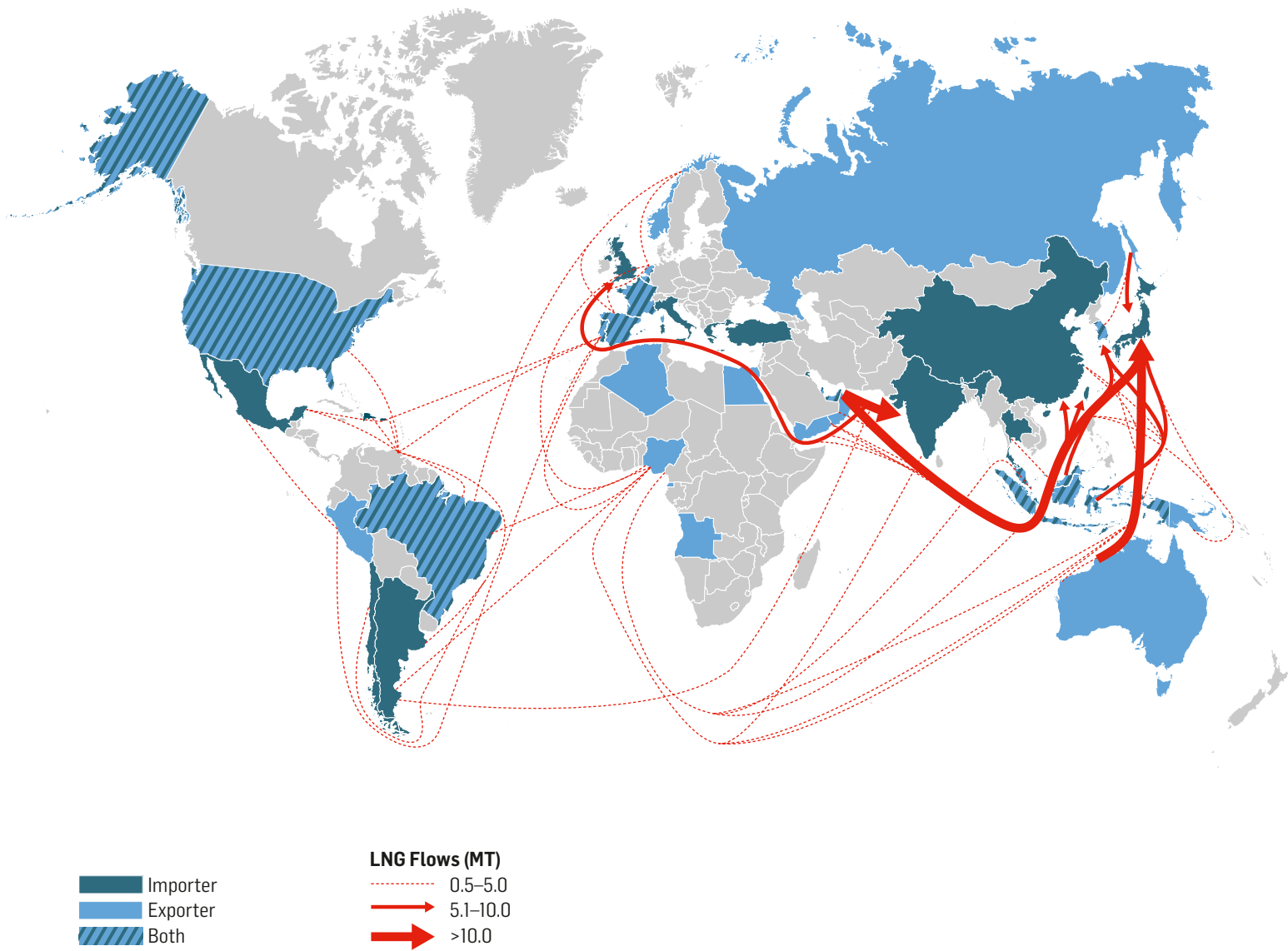
NON-PIPELINE TRANSPORT OF HIGH IMPORTANCE

A continuously increasing share of natural gas transport volumes traded worldwide is liquefied (abbreviated as LNG or Liquefied Natural Gas), which reduces transport volumes by a factor of 600. The cost-effective LNG transport and storage industry continues to grow rapidly with global demand for LNG expected to increase by approximately 5% per year.

CHALLENGING ENVIRONMENT FOR CONTRACTORS AND OPERATORS

Rising transport volumes, price pressure and growing supply networks present manifold challenges:

- Plant operating costs must be optimized and emissions minimized on a continual basis.
- Different sizes of LNG carriers cause different amounts of boil-off gas (BOG), which call for higher operational flexibility (varying mass flow, pressure and temperatures down to -160°C). It is crucial to handle these changing conditions as efficiently as possible.
- Price pressure requires continuous improvement of operation margins, equipment and personnel costs. Non-complex equipment that runs a long time without service has a high impact on these targets.
- Proven solutions and in-depth process know-how are required to meet high safety standards and ensure constant availability of plant.



UNIQUE COMPRESSOR SOLUTIONS FOR A WIDE RANGE OF APPLICATIONS

FROM LIQUEFACTION TO REGASIFICATION

The LNG process consists of natural gas production, purification and liquefaction, ship loading, transportation and subsequent off-loading, storage, and regasification and, ultimately, injection into a gas distribution grid or power plant.

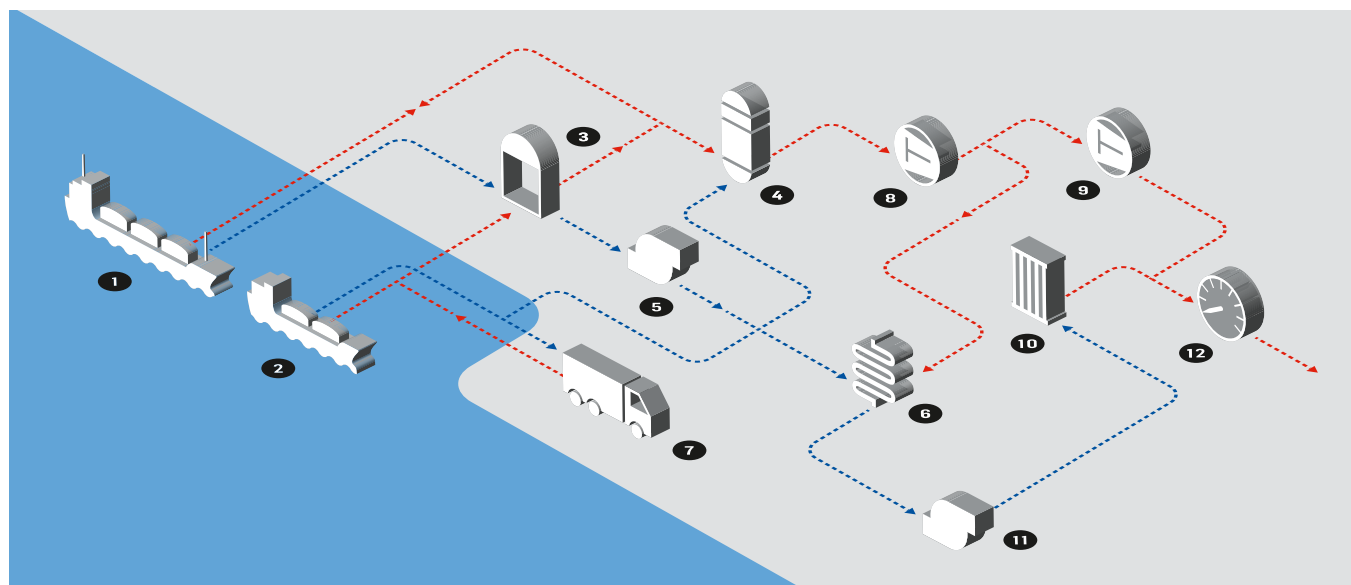
Burckhardt Compression offers unique, economical solutions for compressing and reliquefying boil-off gas from liquid gases.

LIQUEFACTION TERMINALS

Natural gas is generally received by pipeline. Before it is liquefied the gas must be cleaned of impurities and water that might interfere with the liquefaction process. Once liquefied the LNG is loaded to a LNG carrier or stored in tanks to await transport.

REGASIFICATION TERMINALS

Natural gas is received from LNG carriers. At a regasification terminal the LNG is temporarily stored. Once regasified, it is sent by pipeline for distribution.



- 1 LNG tanker large
- 2 LNG tanker small
- 3 LNG storage tank
- 4 Knockout drum
- 5 Primary LNG pump
- 6 BOG reliquefier
- 7 LNG truck loading

- 8 BOG compressor
- 9 MSO pipeline compressor
- 10 Vaporizer
- 11 Secondary LNG pump
- 12 Measuring station → Pipeline delivery
80–100 bar g or power plant delivery
40–50 bar

red = gas
blue = liquid

DEMANDING OPERATING CONDITIONS

MAIN EQUIPMENT AS A KEY SUCCESS FACTOR

CHANGING TEMPERATURES

Insensitivity to temperature changes from ambient temperature to -160° Celsius are crucial. Special materials are required to handle Boil-off gas (BOG) at ultra low temperatures.

OIL-FREE COMPRESSION

At such low temperatures, oil-free compression is required. Besides the non-conformity of oil with these temperatures, conventional sealing systems show low lifetime behavior under bone-dry cryogenic working conditions.

VARYING GAS CONDITIONS

Compression of different volumes of gas depending on the operation mode requires efficient operation with low power consumption at potential capacities from 100%–10%.

ECOLOGIC AND ECONOMIC ASPECTS

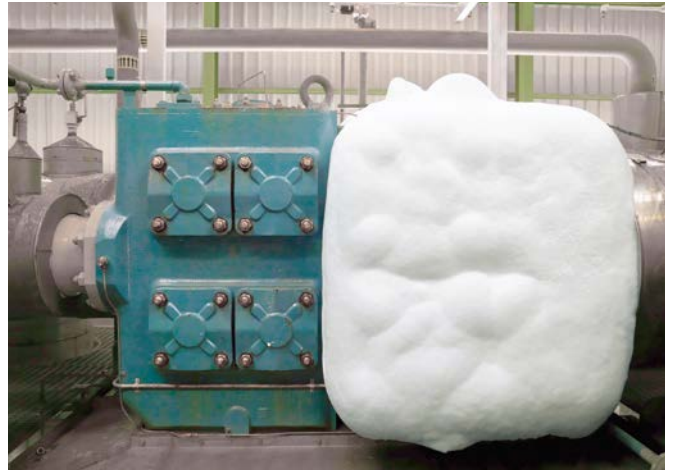
Gas losses must be avoided to protect the environment and save costs.

FLEXIBLE OPERATION

For most economic operation of your BOG handling solution, operational restrictions of your equipment must be minimized.

CONTINUOUS OPERATION

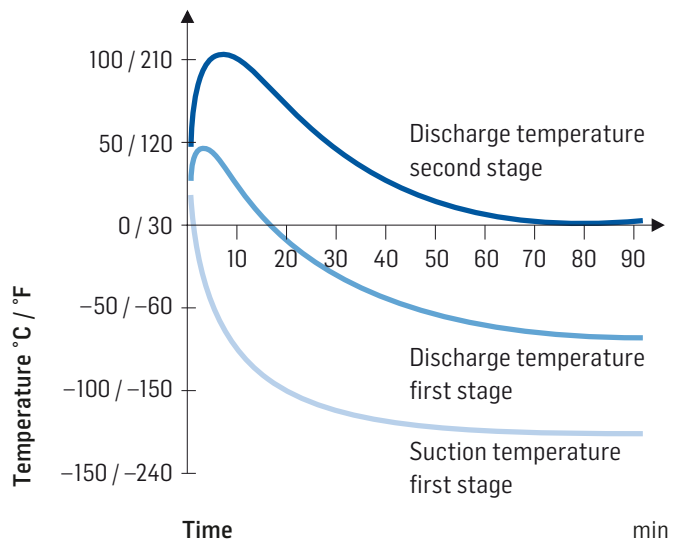
Continuous operation of power plants and natural gas supply grids, day and night, year-round, is crucial.



Icing of cylinders at temperatures down to minus 160°C

HIGHLY FLEXIBLE OPERATION –

SUCTION TEMPERATURES FROM $+40^{\circ}\text{C}$ / $+100^{\circ}\text{F}$ DOWN TO -160°C / -260°F



MOST ECONOMIC BOG HANDLING SOLUTIONS

75 YEARS OF EXPERIENCE IN OIL-FREE COMPRESSION OF CRYOGENIC GASES

EFFICIENT OPERATION

- Gas tight design
- No loss of valuable product
- No purge gas required
- No inefficient recycling or bypass control required due to temperature insensitive Laby® sealing technology.

SAFETY AND ENVIRONMENTAL STANDARDS

- No leakage of process gas to environment
- Proven design for highest safety standards

FLEXIBLE OPERATION

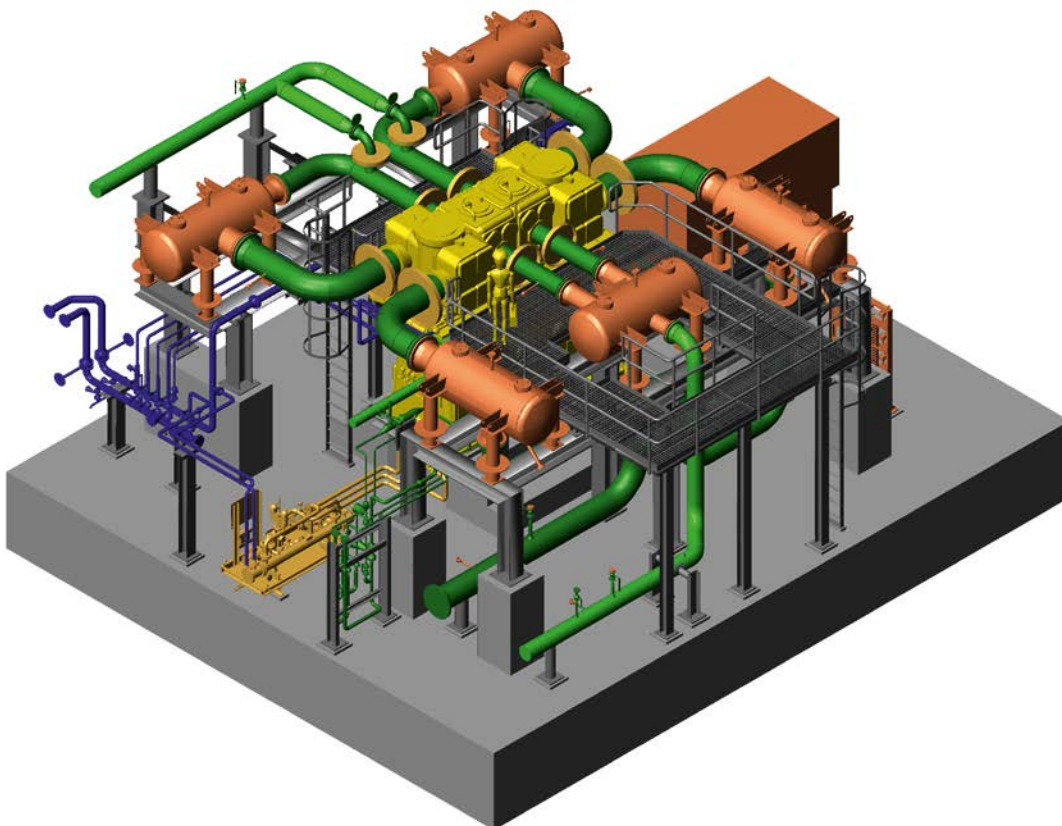
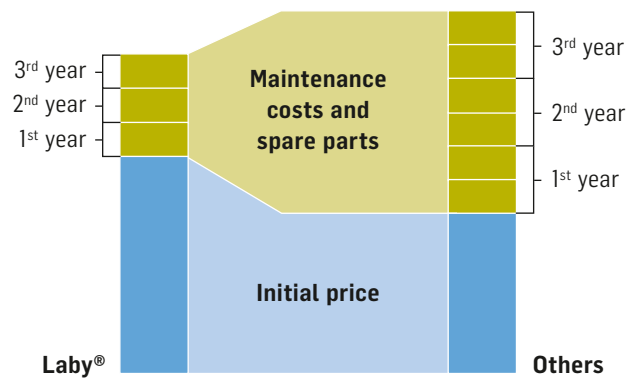
- No pre-heating/pre-cooling of gas required
- Insensitive to fluctuating suction conditions (pressure, temperature, mass flow and gas composition)

RELIABILITY AND AVAILABILITY

- High quality of in-house developed components for longest meantime between overhaul (MTBO)
- Proven reliability and availability with hundreds of references
- High availability of contactless Laby® sealing technology
- Optimization of your redundancy concept

LOWEST LIFE CYCLE COSTS

- Contactless labyrinth sealing system
- No friction, no wear on cylinders, pistons and piston rod/packings
- more than double MTBO compared to ring sealed compressors



Laby® Compressor system for BOG application

HIGHLY RELIABLE MINIMUM SEND-OUT PIPELINE COMPRESSION

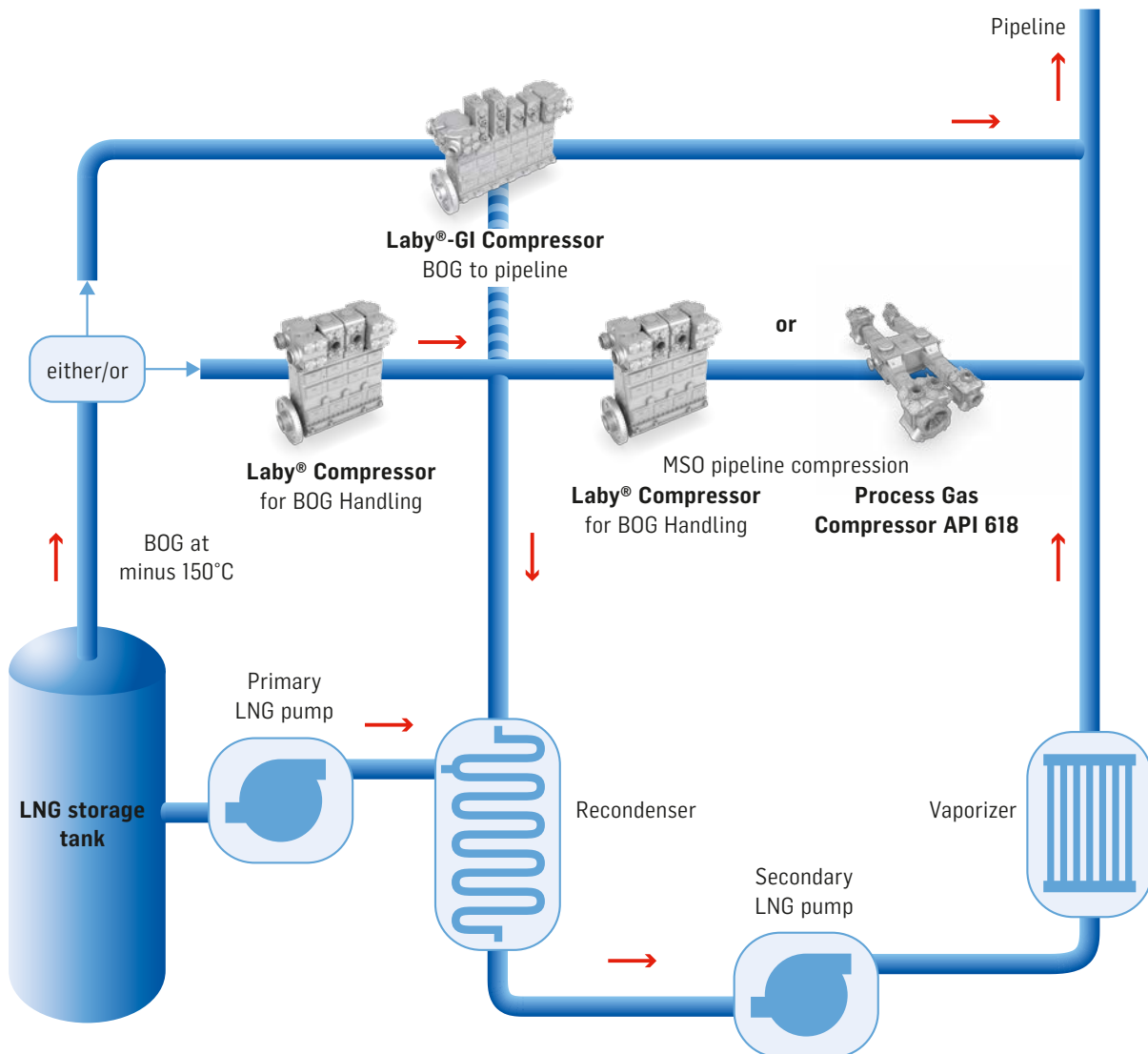
With a comprehensive range of proven compression technologies, Burckhardt Compression offers unique and reliable solutions for minimum send-out (MSO) pipeline compression. Depending on customer requirements, we develop specific compressor solutions in close cooperation with our customers.

TYPICAL APPLICATIONS

- BOG to pipeline (MSO/peak shaving)
- Recondenser to pipeline (MSO/peak shaving)

COMPRESSION SOLUTIONS FROM A SINGLE SOURCE

- BOG handling and pipeline compression from one manufacturer and service provider

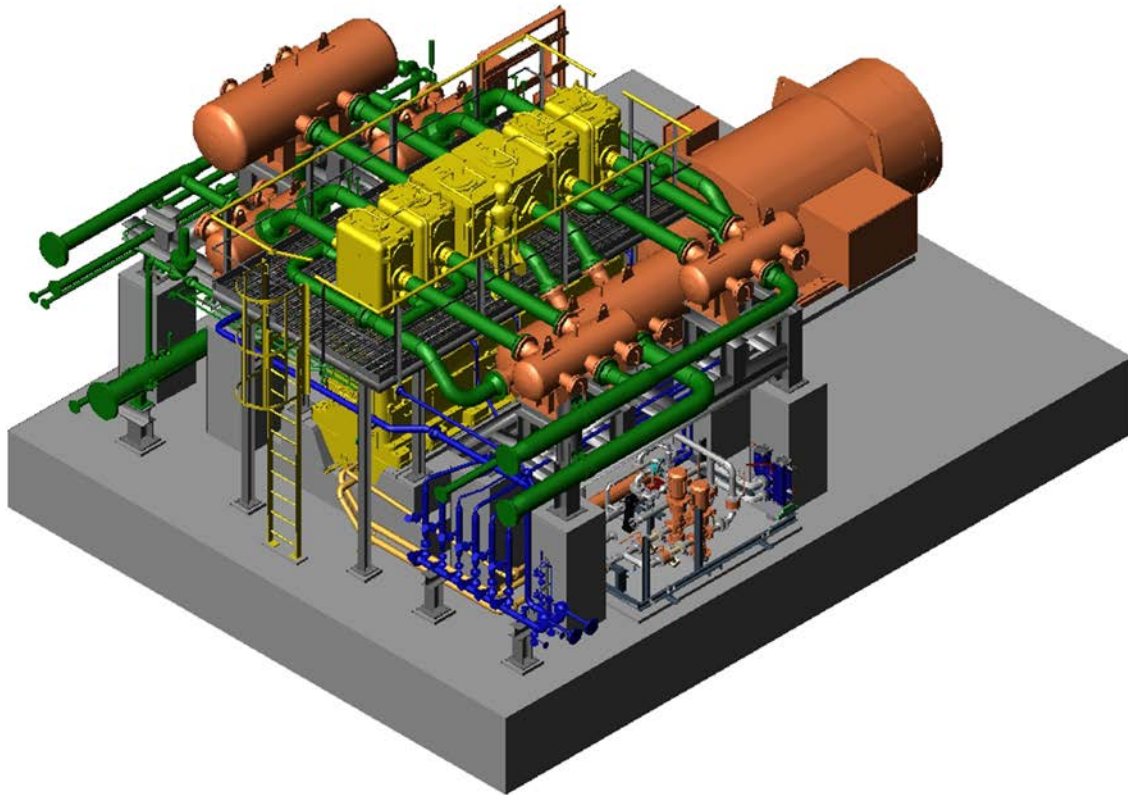


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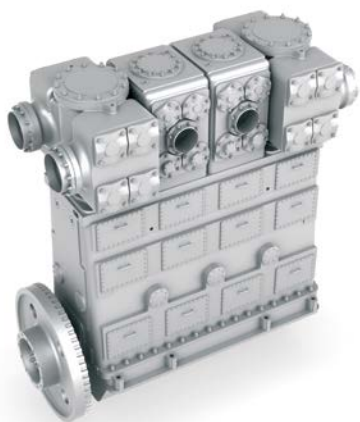
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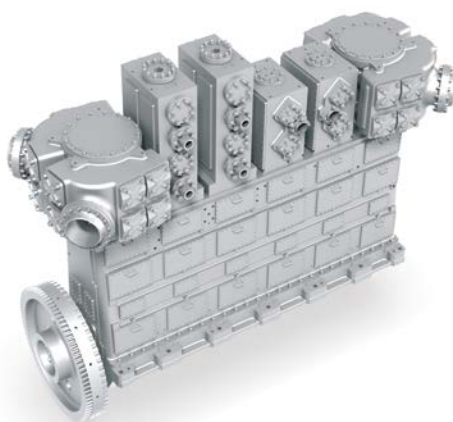


COMPLETE PORTFOLIO OF RECIPROCATING COMPRESSOR TECHNOLOGIES

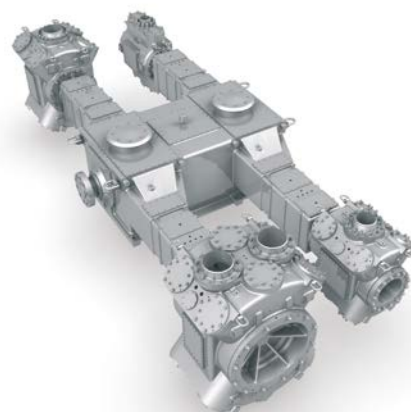
COMPRESSOR SOLUTIONS FOR LNG APPLICATIONS – ONSHORE AND OFFSHORE



Laby® Compressor

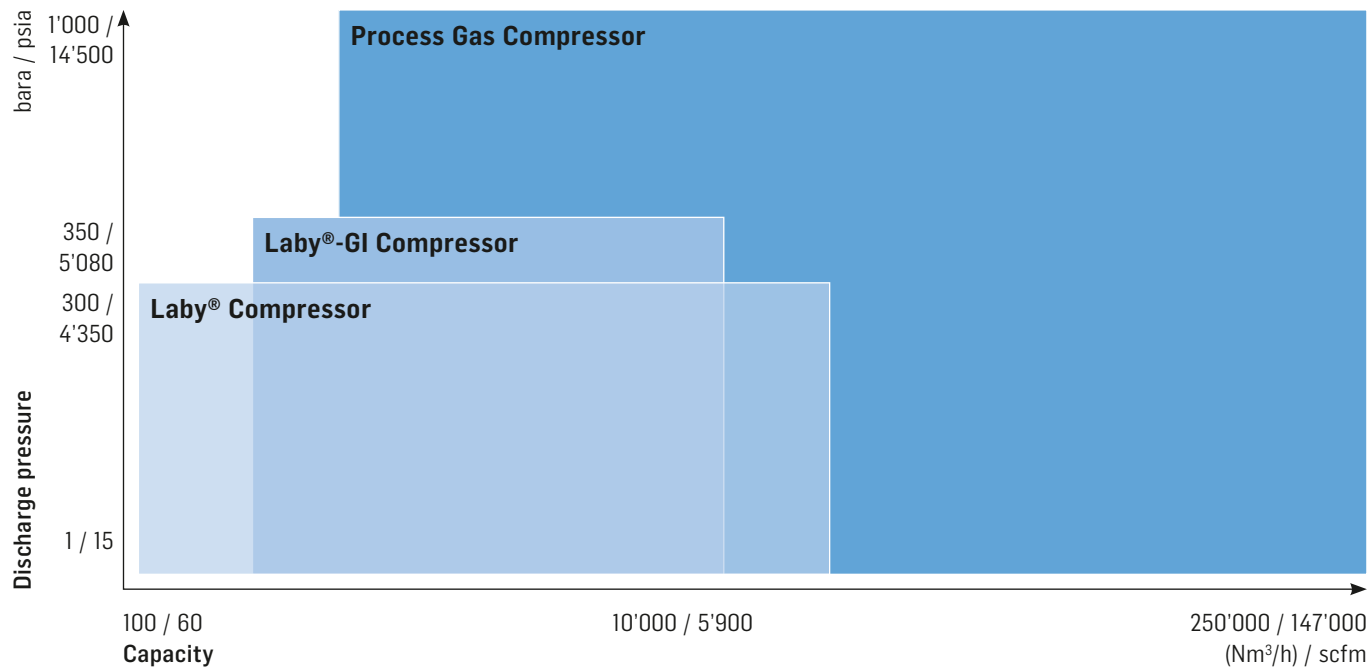


Laby®-GI Compressor



Process Gas Compressor

PERFORMANCE RANGE

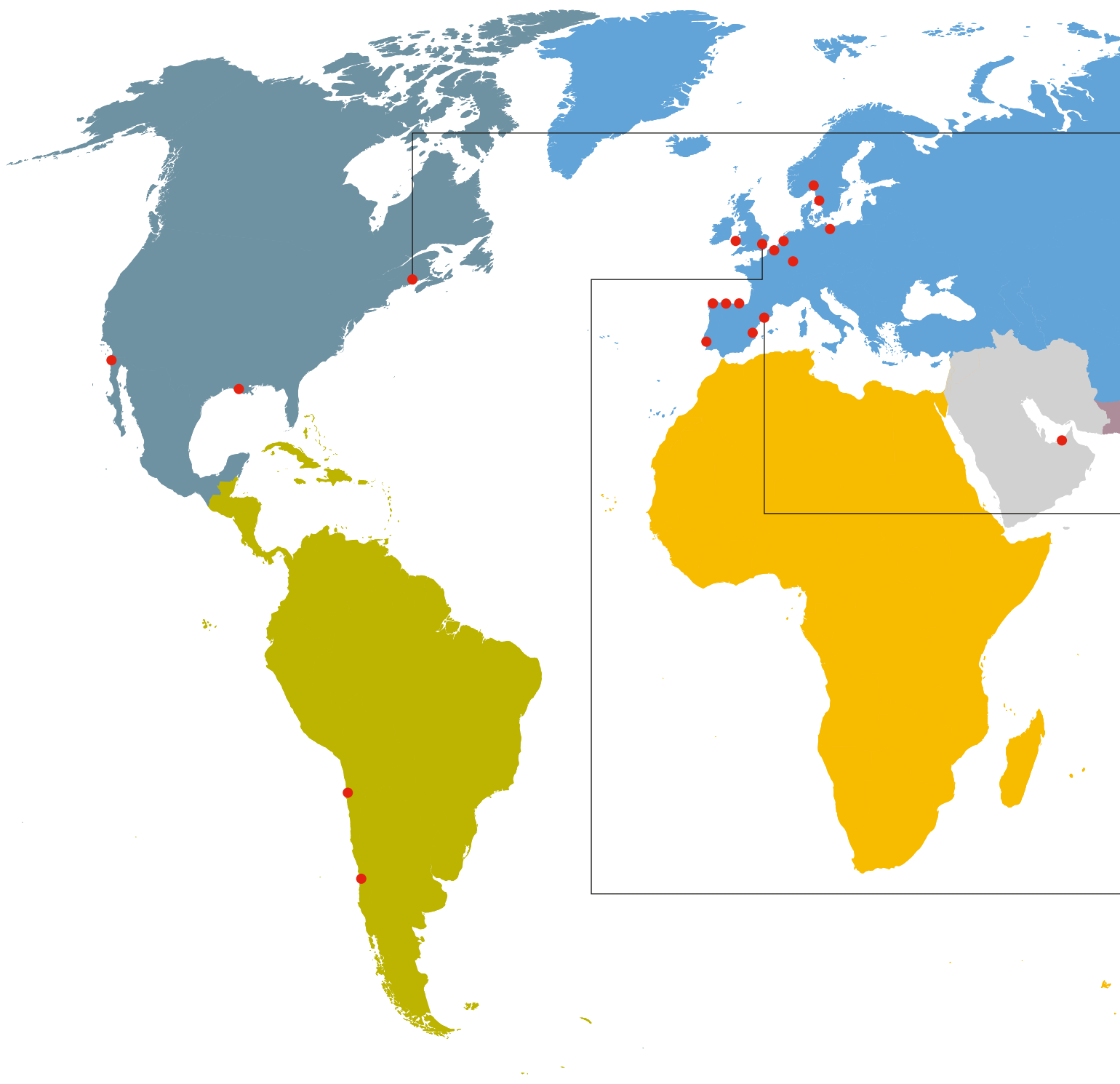




Three Laby® Compressor systems for BOG application at a Chinese LNG terminal

OUR REFERENCES

WORLDWIDE INSTALLATIONS
OF BC COMPRESSORS AT TERMINALS





CANAPORT
LNG TERMINAL
CANADA



FUJIAN
LNG TERMINAL
CHINA



BARCELONA
LNG TERMINAL
SPAIN



ISLE OF GRAIN
LNG TERMINAL
**UNITED
KINGDOM**

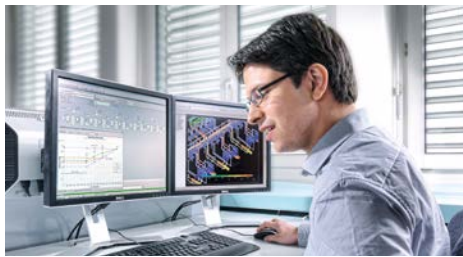




LNG tank at Bilbao LNG terminal

BURCKHARDT COMPRESSION

THE RECIPROCATING COMPRESSOR COMPANY WITH THOROUGH IN-HOUSE EXPERIENCE ...



... ENSURING COMPREHENSIVE SUPPORT BOTH FOR EPC CONTRACTORS AND PLANT OPERATORS

RESEARCH & DEVELOPMENT

Tribology incl. test beds
Finite element analysis
Mechatronics
Labyrinth sealing technology
Material research

COMPRESSOR DESIGN

Instationary fluid dynamics
Pre-sales support, incl. detailed documentation
Engineering analysis
Feasibility studies
Selection and sizing
Pulsation and vibration studies
3D CAD
Compressor valves
Material selection according to application requirements

SERVICES

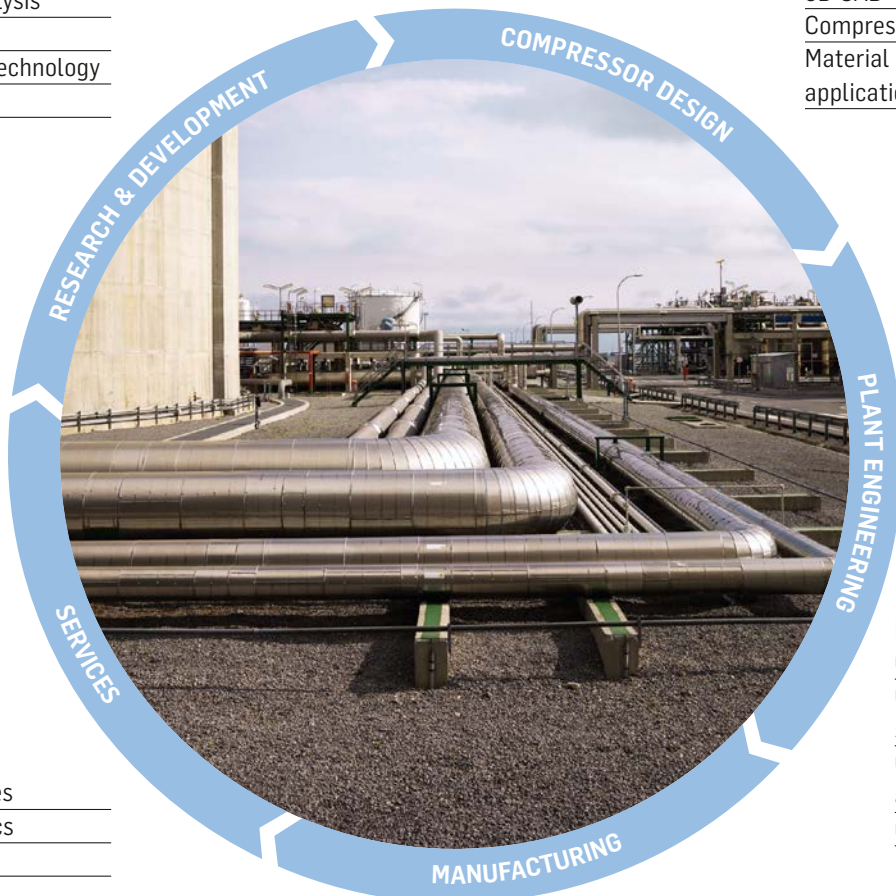
Engineering services
Spare parts logistics
Revamps
Field service
Valve service
Component repair
Technical support
Monitoring and diagnostics
Training

MANUFACTURING

State-of-the-art machining technology
CAM in-house machining
Purchasing
Assembly
Test beds
Quality assurance

PLANT ENGINEERING

Contracting
Customer and standard specifications
Compressor and auxiliaries on modules
Cooling water systems
Instrument and control, motors
PLC programming
Turn-key projects



SERVICES

WHEREVER, WHENEVER YOU NEED IT

BURCKHARDT VALVE SERVICE

FAST VALVE SERVICE WITH EXTENSIVE GUARANTEE

- Analysis of valve condition
- Tracking of valve history
- OEM valve engineering
- Valve cleaning and overhauls
- Complete quality inspection
- State-of-the-art leak test
- Root cause analysis
- Corrosion protection

SPARE PARTS LOGISTICS

OEM GUARANTEE AND BEST LIFE CYCLE COSTS

- Original spare parts with OEM guarantee
- Spare parts frame agreements
- Stock recommendations
- Express service for emergencies
- Over 16'000 parts on stock
- 12 month guarantee
- Save time and money: use the Burckhardt e-Shop™ – the easy spare parts identification and ordering system

FIELD SERVICE

BENEFIT FROM OUR SKILLED RECIP EXPERTS AND OUR OFF-SHORE EXPERIENCE

- On-site assembly and installation
- Erection/commissioning
- High safety standards – SCC and HUET certified
- Turn-key installations
- Start-up support
- Service contracts/preventive maintenance
- Plant overhaul/revision
- 12 month guarantee

TECHNICAL SUPPORT

PROFESSIONAL SUPPORT FROM OUR WELL TRAINED AND EXPERIENCED SPECIALISTS

- Performance analysis for optimized and efficient compressor operation
- Start-up support
- Troubleshooting
- Root cause analysis
- Emergency availability 24/7
- On-site failure analysis
- Online diagnostic support
- Consulting

COMPONENT REPAIR

SAVE MONEY AND GET "AS NEW" GUARANTEE

- Condition analysis
- Recommendations concerning which parts can be repaired or need to be replaced
- Incorporation of the latest technology where possible
- 12 month guarantee
- Repair of crossheads, piston rods, cylinder liners, bearings, pistons

ENGINEERING SERVICES

SOPHISTICATED IN-HOUSE SIZING AND ANALYSIS TOOLS

- State-of-the-art pulsation and vibration analysis
- Finite element analysis
- Unique analysis models for high pressure application
- Reverse engineering and reengineering for own as well as for other brand compressor systems
- Dynamic analysis for any compressor parts

REVAMPS

REJUVENATE OR TUNE
YOUR COMPRESSOR

- Modernizing
- Upgrades/retrofits
- Relocation of machines
- Debottlenecking
- Operation mode studies

- for own as well as for other brand compressor systems
- Conversion from lubricated to non-lubricated operation
- Turn-key installations

MONITORING AND DIAGNOSTICS

EXTEND MEANTIME
BETWEEN OVERHAUL

- Support for system evaluation
- Comprehensive customized service from diagnostic service to predictive maintenance
- Full service agreements for maximum availability
- Online diagnostic services

- Broad experience through compressor installations in various processes

Burckhardt Compression recommends  **PROGNOST**

COMPRESSOR TECHNOLOGY TRAINING

HAVE YOUR OWN
COMPRESSOR SPECIALISTS

- Theoretical and practical training from our compressor experts
- Training center with full size equipment (Laby®, Process Gas and Hyper Compressor)

- Standard trainings, customer specific programs on request

SERVICE CENTERS WORLDWIDE

- Service Center and field engineer base
- Burckhardt Compression Authorized Service Center

24 hour emergency:
+41 52 262 53 53



RECIPROCATING COMPRESSORS

LEADING TECHNOLOGY FOR
LOWEST LIFE CYCLE COSTS

**Laby®
Compressors**
Contactless
and oil-free



**Laby®-GI
Compressors**
Fully balanced



**Process Gas
Compressors**
API 618 – lowest life
cycle costs



Hyper Compressors
Safe and reliable
up to 3'500 bara /
51'000 psia



**Standard
High Pressure
Compressors**
Compact package for
demanding applications



UPDATE COMPONENTS

BEST PERFORMANCE
AND LONGEST LIFETIME

Compressor valves

Redura® rings & packings

Capacity control systems

Capital parts

Labyrinth piston compressor
components

Hyper/secondary compressor
components

SERVICES

THE FULL RANGE

Burckhardt Valve Service

Spare parts logistics

Field service

Technical support

Revamps & upgrades

Component repair

Condition monitoring &
diagnostics

Training

FOR ALL YOUR RECIPROCATING COMPRESSORS

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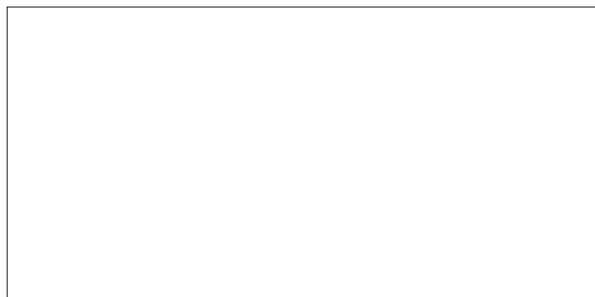
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Your local contact



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