COMPRESSOR SOLUTIONS FOR LNG TERMINAL APPLICATIONS

PROVEN TECHNOLOGIES FOR RELIABLE AND EFFICIENT PLANT OPERATION
LNG – PLAYING AN IMPORTANT ROLE IN THE FUTURE ENERGY MARKET

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.
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.

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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 safe 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.
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.

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

SAFETY AND ENVIRONMENTAL STANDARDS
- No leakage of process gas to environment
- Proven design for highest safety standards

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
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
RELIABILITY AND AVAILABILITY
- High quality of in-house developed components for longest MTBO
- Proven reliability and availability with hundreds of references

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

Laby®-GI Compressor system for MSO application
COMPLETE PORTFOLIO OF RECIPROCATING COMPRESSOR TECHNOLOGIES

COMPRESSOR SOLUTIONS FOR LNG APPLICATIONS – ONSHORE AND OFFSHORE

Laby® Compressor
Laby®-GI Compressor
Process Gas Compressor

PERFORMANCE RANGE

Discharge pressure

1 / 15
100 / 60
10'000 / 5'900
250'000 / 147'000
(Nm³/h) / scfm

Capacity

1'000 / 14'500
350 / 5'080
300 / 4'350

Process Gas Compressor
Laby®-GI Compressor
Laby® Compressor
Three Laby® Compressor systems for BOG application at a Chinese LNG terminal
OUR REFERENCES
WORLDWIDE INSTALLATIONS
OF BC COMPRESSORS AT TERMINALS
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

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

**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

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

**MANUFACTURING**
- State-of-the-art machining technology
- CAM in-house machining
- Purchasing
- Assembly
- Test beds
- Quality assurance
## SERVICES
WHEREVER, WHENEVER YOU NEED IT

<table>
<thead>
<tr>
<th>BURCKHARDT VALVE SERVICE</th>
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<tbody>
<tr>
<td>FAST VALVE SERVICE WITH EXTENSIVE GUARANTEE</td>
<td>Analysis of valve condition</td>
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<td>Tracking of valve history</td>
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<td>OEM valve engineering</td>
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<td>Valve cleaning and overhauls</td>
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<td>Complete quality inspection</td>
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<td>State-of-the-art leak test</td>
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<td>Root cause analysis</td>
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<td>Corrosion protection</td>
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<th>SPARE PARTS LOGISTICS</th>
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<tr>
<td>OEM GUARANTEE AND BEST LIFE CYCLE COSTS</td>
<td>Original spare parts with OEM guarantee</td>
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<td>Spare parts frame agreements</td>
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<td>Stock recommendations</td>
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<td>Express service for emergencies</td>
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<td>Over 16'000 parts on stock</td>
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<td>12 month guarantee</td>
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<td>Save time and money: use the Burckhardt e-Shop™ – the easy spare parts identification and ordering system</td>
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<tr>
<th>FIELD SERVICE</th>
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<tr>
<td>BENEFIT FROM OUR SKILLED RECIP EXPERTS AND OUR OFF-SHORE EXPERIENCE</td>
<td>On-site assembly and installation</td>
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<td>Erection/commissioning</td>
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<td>High safety standards – SCC and HUET certified</td>
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<td>Turn-key installations</td>
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<td>Start-up support</td>
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<td>Service contracts/preventive maintenance</td>
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<td>Plant overhaul/revision</td>
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<td>12 month guarantee</td>
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<tr>
<th>TECHNICAL SUPPORT</th>
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<tr>
<td>PROFESSIONAL SUPPORT FROM OUR WELL TRAINED AND EXPERIENCED SPECIALISTS</td>
<td>Performance analysis for optimized and efficient compressor operation</td>
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<td>Start-up support</td>
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<td>Troubleshooting</td>
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<td>Root cause analysis</td>
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<td>Emergency availability 24/7</td>
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<td>On-site failure analysis</td>
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<td>Online diagnostic support</td>
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<td>Consulting</td>
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<th>COMPONENT REPAIR</th>
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<tr>
<td>SAVE MONEY AND GET “AS NEW” GUARANTEE</td>
<td>Condition analysis</td>
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<td>Recommendations concerning which parts can be repaired or need to be replaced</td>
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<td>Incorporation of the latest technology where possible</td>
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<td>12 month guarantee</td>
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<td>Repair of crossheads, piston rods, cylinder liners, bearings, pistons</td>
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<th>ENGINEERING SERVICES</th>
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<tr>
<td>SOPHISTICATED IN-HOUSE SIZING AND ANALYSIS TOOLS</td>
<td>State-of-the-art pulsation and vibration analysis</td>
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<td>Finite element analysis</td>
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<td>Unique analysis models for high pressure application</td>
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<td>Reverse engineering and reengineering for own as well as for other brand compressor systems</td>
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<td></td>
<td>Dynamic analysis for any compressor parts</td>
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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  

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

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**For all your Reciprocating Compressors**