Centrifugal and Axial Compressors

Product line overview
50+ years of compression solutions

- First ammonia units
  - 1967
  - Italy

- First re-injection unit
  - 1973
  - Algeria

- First LNG train
  - 1985
  - Australia

- First sour gas re-injection
  - 1999
  - Kazakhstan

- World’s biggest LNG plant
  - 2003
  - Qatar

- Large ethylene 1.2 MTPA
  - 2009
  - Saudi Arabia

- Oil-free compression offshore
  - 2019
  - Denmark

Innovating with our customers
Serving multiple markets

**Refinery**
- Fluid catalytic cracking
- Reforming
- Hydrocracking

**Chem/petrochemical**
- Syngas and fertilizers
- CO₂ for urea plants
- Ammonia synthesis
- Methanol synthesis

**Upstream**
- Oil production
- Gas production
- Gas lift
- Gas re-injection
- Gas storage
- Subsea

**Downstream and distribution**
- Liquefied natural gas
- Gas to liquid
- Pipeline
Product line overview
Product line: between-bearing design

![Diagram showing product line and discharge pressure vs. inlet volume]
Product line: overhung design
Vertically split compressors

Sizes
- From 300 to 1,200 mm, in-line or back-to-back
- Pressure ratio up to 30:1

Pressure
- Up to 800 bar
- Highest running pressure: 760 bar

Applications
- Primarily for high-pressure applications such as ammonia, urea and methanol synthesis, refinery recycle, natural gas compression, gas injection, re-injection, and hazardous gases

Over 2,400 units installed worldwide
Versatile, reliable designs for high-pressure and corrosive conditions
Horizontally split compressors

Sizes
- From 300 to 1,800 mm, in-line or back-to-back
- Flanges up to 86 inches
- Largest diameter impeller 1,850 mm

Pressure
- Up to 50 bar

Applications
- Primarily for low and medium pressure applications including: ethylene and fertilizer plants, refineries and petrochemical plants, LNG for refrigeration and air compression (typically handling wet gas), hydrocarbon refrigerants or natural gas

Over 1,000 units installed worldwide
High performance in applications from high-temperature cracking to extreme cryogenics

Horizontally Split (MCL, V series)
Pipeline compressors

Sizes
- From 500 to 1,000 mm

Pressure
- Up to 100 bar

Applications
- For low and medium pressure ratio pipeline service

Over 500 units installed worldwide
High efficiency and power in a compact package and small footprint
Integrally geared compressors

- Sizes: Multistages up to 10 wheels
- Pressure: Up to 200 bar
- Applications: For low, medium, and high-pressure service for air, steam, and inert gas; fuel gas services; some petrochemical and CCS applications

Over 200 units installed worldwide
Compact designs for heavy-duty applications with air, steam and other gases
Single-stage overhung compressors

Sizes
- 1,000 mm

Pressure
- Up to 76 bar

Applications
- Booster or recycle compressors in many petrochemical applications including polyethylene, polypropylene, and ethylene oxide

Over 300 units installed worldwide
Best-in-class reliability for downstream applications
Axial compressors

Sizes
• Up to 25 bar
• Pressure ratio from 3:1 to 7:1

Applications
• Used for low-pressure, high-flow applications such as catalytic cracking plants, air service, air separation, LNG, nitric acid, and GTL

Over 20 units installed worldwide
Ideal for catalytic cracking, air compression, nitric acid, and gas to liquids
Integrated compressors

Sizes
• Up to 450 mm

Pressure
• Up to 300 bar

Applications
• Ideal solution for high efficiency, small footprint, low noise and minimized OPEX

26 units installed to date, mainly for pipeline and storage

Inlet volume (m$^3$/h)

Discharge pressure (bar)
Integrated compressors

Leveraging proven ICL technology to minimize topside footprint

Sizes
• Up to 6 stages

Pressure
• Up to 175 bar

Applications
• Subsea to minimize topside equipment

Inlet volume (m³/h)

Discharge pressure (bar)
Main components
Outer casing and head flanges

- Forging or plate carbon steel
- Martensitic stainless steel also applicable
- Coatings applicable on carbon steel for cost-effective corrosion resistance
Inner casing and diaphragms

- Forged carbon steel
- Cast iron or cast stainless steel
- Ni-alloys forged or casted
- Coatings applicable on carbon steel for cost-effective corrosion resistance or anti-fouling
Rotor

- Shaft: forged carbon steel or stainless steel
- Impellers: full milling, EDM or brazed; forged carbon steel, stainless steel, Ni-alloys
- Coatings applicable on full assembly for cost-effective corrosion resistance or anti-fouling
Seals

- Labyrinth seals in aluminum or thermoplastic materials suitable for acid and harsh environments
- Thermoplastic materials offer better performance than metallic options
- Abradable seals offer better efficiency

Bulk and hybrid design (with metallic carrier) for polymer labyrinth seals
Design with and without swirl brakes
Split assemblies

**BCL**
Vertically split

**MCL**
Horizontally split
Testing
Baker Hughes unique testing capabilities

<table>
<thead>
<tr>
<th>Type of test</th>
<th>Test beds capacity</th>
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</thead>
<tbody>
<tr>
<td>Standard mechanical and/or thermodynamic tests on centrifugal compressor &amp; steam turbine</td>
<td>18+1 4 -</td>
</tr>
<tr>
<td>Thermodynamic test for large compressors 25~61MW</td>
<td>2</td>
</tr>
<tr>
<td>Running-in and/or string tests on reciprocating compressors</td>
<td>6 1 -</td>
</tr>
<tr>
<td>Standard &amp; full load test (by electric generator)</td>
<td>4 2 -</td>
</tr>
<tr>
<td>Special string test</td>
<td>6+2 16 -</td>
</tr>
<tr>
<td>HSPT LM2500 spin test</td>
<td>2 -</td>
</tr>
<tr>
<td>LM2500 gas generator load test</td>
<td>- 1 -</td>
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<tr>
<td>Test on combined modules</td>
<td>- 1 10</td>
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