HOWDEN COMPRESSIONS

WORLD pioneers of twin rotary screw compressors
Today in thousands of application worldwide, Howden oil injected screw compressors are regularly applied to provide high integrity, low maintenance solutions for liquid chilling, direct refrigeration and gas compression applications.

Howden not only introduced the concept of the operational twin screw compressor to the world market more than 50 years ago, but have been instrumental in the development of the oil injected twin screw compressor concept, which has revolutionised world designs of refrigeration and gas handling plants.

The international installed base of Howden Compressors in a wide and varied range of applications is unparalleled.

**DESIGN CONCEPT**

Compression is achieved by the intermeshing of two helical rotors contained in a suitable casing. Figures 1-4 give details of the compression cycle.

The Howden twin screw compressor is a positive displacement rotary design. As such, Howden compressors have the characteristics and stability of reciprocating compressors by offer particular advantages of:

- Reduced Physical Size
- Low Vibration
- Reduced Moving Parts
- Extended Operating Life Cycle

**CONSTRUCTION**

All Howden twin screw compressors have paired rotors, machined from solid bar or forgings which involves a high degree of complexity and accuracy.

Normally casings will be cast iron, machined to close tolerance levels. However, to match particular gas requirements, high discharge pressure applications, or applicable international standards and codes, alternative casing construction in spheroidal graphite iron or various grades of steel will be offered when appropriate.

Alternative designs of compressors from the Howden product range are available as required. Some typical examples of alternatives are given below:

- Twin Wall Construction with Sleeve Bearings
- Single Wall Construction with Roller Bearings
- Slide Valve Capacity Control from 100-10 percent
- Inverter Speed Control
- Variable Volume Ratio
- Superfeed
- Oil cooling
- Liquid Refrigeration Injection
- Specialist Sealing Systems

**FEATURES AND BENEFITS**

- Positive Displacement
  Cannot surge. High compression ratios per stage.
- Rotary Action
  Vibration free running.
  Extreme reliability & on-line availability.
  Smooth gas flow, low pulsation.
  Lightweight foundations.
- Stiff Action Rotors
  Ability to withstand high pressure differences.
- No Inlet or Outlet Valves
  Lower maintenance costs
- Compact Size & Light Weight
  Minimal space and foundation requirement, resulting in low installation costs.
- Designed for Long Periods of Continuous Running
  Maximum on-line availability
  Minimal service requirements
DEVELOPMENT

Howden’s technology lead has been maintained over many years by total commitment to continuous product development. Market requirements are continuously reviewed, in order that the Development Department can not only monitor ever changing operating conditions, but ensure that production capability will always reflect current or anticipated system demands worldwide.

In particular, Howden is totally committed to ensure that products meet current or future demands for environmental protection, in terms of CFC free refrigerants, secure captivity of hazardous gases, and the best possible energy efficiency.

All Howden Compressors’ products are capable of operation on CFC free refrigerants, with the fullest possible attention being given to energy conservation. In the development of our new XRV range of compressors, for example, both full capacity and volume ratio control are available.

QUALITY CONTROL

Howden Compressors recognise the importance of a controlled manufacturing environment, where design, development, procurement, production and test are controlled in such a way as to ensure the highest possible standards of production and performance, demanded by Howden and their customers, are consistently achieved.

To this end, the company operates to the requirements of ISO 9001 (BS5750-Part 1, EN 29001) and has been accredited by Lloyds Register Quality Assurance as complying with this standard.

Ongoing internal and external audits of quality control systems are applied to ensure continued compliance with necessary control procedures.

Quality Plans can also be prepared to match project requirements, where we are required to manufacture to specific customer requirements, which may apply in particular applications.

DESIGN

Howden twin screw compressors are designed to match the exacting specifications required by our customers and comply with International Standards and Codes.

Howden ensure that their compressors go beyond the normal operating technical performance parameters required to give customers wide margins in terms of operational capability and efficiency.

Compressors are generally Lloyds approved and installations have been accepted by many major authorities, such as Lloyds, Bureau Veritas, Norske Veritas, RINA, DSRK, Bureau de Mines, Germanischer Lloyd and NKK.

TEST

At Howden Compressors, test is considered to be a vital function, both in terms of product development and to ensure specification compliance.

All new products are comprehensively tested, to ensure that design is fully optimised and performance data provided by the company, particularly in the form of computer selection programs for standard gases and refrigerants, is as accurate as possible.

In addition, all compressors are hydrostatically tested to a minimum of 1.5 times maximum working pressure, and are also subjected to mechanical run function test on one of Howden’s air test rigs, to ensure that volumetric efficiency, mechanical function, and vibration fall within stringent acceptance standards.
ROTORS

All Howden twin screw rotors are machined from solid bar or forgings. Standard material is carbon steel, but for more arduous applications, special alloys or stainless steels are utilised.

Rotors are machined on specialist machining centres, to the exacting tolerances necessary to ensure the highest possible operating efficiency.

A feature of Howden rotors is that sealing strips are machined on the crown of the male rotor lobes, and matching grooves are incorporated in the root of the female rotor to maximise the gas seal.

Following machining and balancing to ISO standards, male and female rotors are paired for assembly to ensure the ideal combination for maximum efficiency.

CASINGS

Casings are precision machined from castings, which will normally be graphite cast iron, but may be nodular iron, carbon steels, or stainless steel, depending on the application.

As with the twin screw rotors, precision machining of compression path components is critical, to ensure that Howden standards are maintained in terms of operational efficiency.

Components such as the main casing and inlet and outlet end covers are flanged, bolted and dowelled through flanges to ensure correct alignment. Removal of the end covers provides ready access for maintenance when required.

COMPRESSOR ASSEMBLY

All oil injected twin screw compressors are assembled in the Glasgow production facility by skilled engineers, who ensure that Howden quality control requirements, which conform with ISO 9001, are strictly maintained.

During the manufacturing process, all casing components are subjected to hydraulic test, to a minimum of 1.5 times maximum operating pressure, to ensure integrity.

Additionally, all oil injected compressors are tested with air under water following final assembly. Compressors are then mechanically run, to confirm that volumetric efficiency, absorbed power, oil flows and vibration are to Howden acceptance standards.

PRODUCT SUPPORT – SPARE PARTS AND RE-BUILD CAPACITY

In partnership with its global alliance of gas and refrigeration package manufacturers and distributors, Howden offers a fast and efficient parts supply service.

Parts are generally pre-packaged in kits which, in addition to being readily available from Howden facilities in the UK and the USA, will normally be available from locally based Howden compressor package distributors.

Following many years’ operation, a full service re-build of the compressor may be appropriate. A full re-build and re-test capability is offered by Howden in both their UK and USA service shops.

A full warranty, equivalent to new product warranty, is available to Howden customers following a full compressor re-build.
Howden oil injected twin screw compressors are used for liquid chilling, direct refrigeration, and for hydrocarbon gas applications involving hydrocarbons, fuel gas, or other specialist applications.

In some instances, hydrocarbon gases such as propane, butane or propylene, will be used as an industrial refrigerant.

**TYPICAL APPLICATIONS**
- Industrial Refrigeration
- Fuel Gas Compression
- Liquid Chillers
- Food Processing
- Marine Air Conditioning & Refrigeration
- Breweries
- Mine Cooling
- Hydrocarbon Processing
- Gas Liquefaction
- Petrochemical and Chemical Processing
- Natural Gas Gathering
- Carbon Dioxide Recovery
- Coke Oven Gas

**UNIQUE FEATURES AND BENEFITS OF OIL INJECTED DESIGN**
- Slide Valve Capacity Control
- Variable Volume Ratio
- Liquid Refrigerant Injection
- Capacity and energy absorbed match system demand.
- Maximises energy efficiency.
- Reduces capital cost with minimal reduction in operating efficiency.

**GAS HANDLING**
Typical gases or refrigerants handled by the Howden range of oil injected screw compressors include:

**Refrigerants**
- NH3
- R12/R134a
- R22/KLEA 66/AZ5000
- R502/R404A/R407A/AZ 50
- Propane
- Butane
- Propylene
- Ammonia
- Butane
- Coke Oven Gas
- Fuel Gas
- Helium
- Hydrocarbon (Wet & Mixed)
- Hydrogen

**Gases**
- Methane
- Natural Gas
- Nitrogen
- Propane
- Propylene
- Sour Gas
- Town Gas

**OIL INJECTED COMPRESSOR RANGE**
Howden offer a range of capability which is unparalleled

N.B: In some cases, for example in refineries, hydrocarbon gases will be used as refrigerants.
WRV COMPRESSORS

WRV compressors represent the “bench mark” against which industry comparison is made for both gas and refrigeration applications.

Features and benefits of WRV compressors include:

- Plain-Shell Type Journal Bearings
- Double Wall Construction
- Optional Material of Construction
- Oil Injected Seal/Bearing Construction
- Range of Capability
- Installed Compressors

Long operational life span

Suitable for high pressure application

Flexibility to match project specification (e.g. API 619)

High quality gas seal from simple construction

Probably the most comprehensive range of capacity available

More than 20,000 WRV compressors installed worldwide

All WRV range compressors are of double wall construction and utilise white metal, sleeve type journal bearings with pressurised shaft seal.

A full range of Vi options from 2.1 to 5.8 is offered for each compressor while slide valve capacity control is a standard feature on all compressors.

Many options to standard design are available, some of which are indicated below:

C “Conditioning” version with reduced oil flow for dense gases such as R22

M “Mirror” version for reverse rotation with double ended motor drive and two stage design.

H “Higher pressure” version for high discharge pressure.

X “eXtra high” discharge design.

T “Tilting pad” thrust bearing design, e.g. to comply with API 619.

S “Steel casings” for high pressure or to match specification.

N “Nodular cast iron design” again for specific project specification.
XRV compressors have been developed specially for the refrigeration market.

Features and benefits of XRV compressors include:

- **Ease of Installation**: Ideal for horizontal separator applications
- **Use of Roller Bearings**: No oil pump for over 90% of installations
- **Variable Vi**: Available with either adjustable or fully automatic Vi system
- **Stepless Capacity Control**: Combined with variable Vi, gives maximum energy saving
- **Ease of Service**: Separate end covers give easy access to rolling elements

**VARIABLE VOLUME RATIO**

Two forms of variable volume control are available.

1. **ADJUSTABLE VOLUME RATIO (MVi)**
2. **AUTOMATIC VARIABLE VOLUME RATIO (AVi)**

As is known, care is taken during compressor selection to ensure that the correct volume ratio is selected by comparison to the chosen operating conditions.

However, in many instances the compressor is selected against peak conditions which may only apply for a very few days each year.

While it is essential to select hardware which is capable of operating in the most extreme environment, it does not follow that the compressor will necessarily always perform at the highest possible efficiency.

The Howden variable Vi concept, coupled to slide valve capacity control, offers alternative methods of controlling capacity and volume ratio to suit site conditions.

Where the pressure ratio across the compressor is consistently high or changes in pressure ratio are infrequent (e.g., the change from winter to summer conditions) then the MVi manually adjustable system will be entirely satisfactory.

With lower pressure ratios, or where condensing conditions vary frequently, the Howden automatic control AVi system is ideal.

### VARIABLE VOLUME RATIO

**TYPICAL OPERATING ENVELOPE - R134A REFRIGERANT**

**TYPICAL OPERATING ENVELOPE - R22 REFRIGERANT**

**SECTION THROUGH AUTO VI CONTROL MECHANISM ON XRV160 AND 240 COMPRESSORS**

**XRV RANGE COMPRESSOR**
**WRV TECHNICAL DATA**

**TYPICAL PERFORMANCE**

**AMMONIA**

**TYPICAL PERFORMANCE**

**R22**

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**EVAPORATION TEMPERATURE**

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**CONDENSING TEMPERATURE 95°F (35°C)**

**REFRIGERATION CAPACITY**

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**TYPICAL EFFECT OF SUPERFEED**

**EVAPORATION TEMPERATURE**

---

**TYPICAL EFFECT OF SUPERFEED**

**EVAPORATION TEMPERATURE**

---

**KEY TO GRAPHS**

- Full Duty 50 Hz (Excluding Superfeed)
- Condensing Temperature 95°F (35°C)

**NOTES**

- Refrigeration capacity based on 5.6°C (10°F) superheat at compressor suction and no sub-cooling of condensed liquid
- No allowance has been made for pressure losses between the evaporator and the compressor suction flange

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## WRV TECHNICAL DATA

### HOWDEN COMPRESSOR SPECIFICATION

<table>
<thead>
<tr>
<th>Model</th>
<th>Swept Volume 50Hz</th>
<th>Swept Volume 60Hz</th>
<th>Suction Port Ø</th>
<th>Discharge Port Ø</th>
<th>Dimension A</th>
<th>Dimension B</th>
<th>Dimension C</th>
<th>Dimension D</th>
<th>Weight Approx</th>
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<tbody>
<tr>
<td>WRV 163/1.45</td>
<td>550 m³/hr</td>
<td>660 cfm</td>
<td>125 mm</td>
<td>75 mm</td>
<td>1063 mm</td>
<td>490 in</td>
<td>1 7/8 in</td>
<td>248 lb</td>
<td>125 Kg</td>
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<td>820 cfm</td>
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<td>75 mm</td>
<td>1120 mm</td>
<td>490 in</td>
<td>1 7/8 in</td>
<td>248 lb</td>
<td>125 Kg</td>
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<td>WRV 204/1.10</td>
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<td>975 cfm</td>
<td>150 mm</td>
<td>100 mm</td>
<td>1201 mm</td>
<td>640 in</td>
<td>2 1/4 in</td>
<td>310 lb</td>
<td>150 Kg</td>
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<tr>
<td>WRV 204/1.45</td>
<td>1095 m³/hr</td>
<td>1315 cfm</td>
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<td>125 mm</td>
<td>1273 mm</td>
<td>640 in</td>
<td>2 1/4 in</td>
<td>310 lb</td>
<td>150 Kg</td>
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<td>WRV 204/1.65</td>
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<td>125 mm</td>
<td>1370 mm</td>
<td>640 in</td>
<td>2 1/4 in</td>
<td>310 lb</td>
<td>150 Kg</td>
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<td>WRV 255/1.10</td>
<td>1755 m³/hr</td>
<td>2105 cfm</td>
<td>200 mm</td>
<td>150 mm</td>
<td>1448 mm</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
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<td>WRV 255/1.30</td>
<td>2150 m³/hr</td>
<td>2580 cfm</td>
<td>255 mm</td>
<td>200 mm</td>
<td>1487 mm</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
</tr>
<tr>
<td>WRV 255/1.45</td>
<td>2395 m³/hr</td>
<td>2870 cfm</td>
<td>255 mm</td>
<td>200 mm</td>
<td>1537 m</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
</tr>
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<td>WRV 255/1.65</td>
<td>2630 m³/hr</td>
<td>3155 cfm</td>
<td>255 mm</td>
<td>200 mm</td>
<td>1604 m</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
</tr>
<tr>
<td>WRV 255/1.93</td>
<td>2870 m³/hr</td>
<td>3425 cfm</td>
<td>255 mm</td>
<td>200 mm</td>
<td>1673 m</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
</tr>
<tr>
<td>WRV 321/1.32</td>
<td>3830 m³/hr</td>
<td>3830 cfm</td>
<td>300 mm</td>
<td>255 mm</td>
<td>1815 m</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
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<td>WRV 321/1.65</td>
<td>4790 m³/hr</td>
<td>4595 cfm</td>
<td>300 mm</td>
<td>255 mm</td>
<td>2020 m</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
</tr>
<tr>
<td>WRV 321/1.93</td>
<td>5260 m³/hr</td>
<td>5100 cfm</td>
<td>300 mm</td>
<td>255 mm</td>
<td>2110 m</td>
<td>692 in</td>
<td>2 3/4 in</td>
<td>349 lb</td>
<td>170 Kg</td>
</tr>
<tr>
<td>WRV 510/1.32</td>
<td>7500 m³/hr</td>
<td>7500 cfm</td>
<td>350 mm</td>
<td>300 mm</td>
<td>2345 m</td>
<td>940 in</td>
<td>3 1/8 in</td>
<td>471 lb</td>
<td>200 Kg</td>
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<tr>
<td>WRV 510/1.65</td>
<td>9575 m³/hr</td>
<td>9190 cfm</td>
<td>350 mm</td>
<td>300 mm</td>
<td>2920 m</td>
<td>1560 in</td>
<td>5 1/8 in</td>
<td>750 lb</td>
<td>330 Kg</td>
</tr>
<tr>
<td>WRV 510/1.93</td>
<td>10510 m³/hr</td>
<td>12615 cfm</td>
<td>350 mm</td>
<td>300 mm</td>
<td>3233 m</td>
<td>1560 in</td>
<td>5 1/8 in</td>
<td>750 lb</td>
<td>330 Kg</td>
</tr>
</tbody>
</table>

*Typical gases & refrigerants handled by Howden Oil Injected Compressors

<table>
<thead>
<tr>
<th>Gas</th>
<th>Refrigerant</th>
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<tbody>
<tr>
<td>Ammonia</td>
<td>NH3</td>
</tr>
<tr>
<td>Butane</td>
<td>R22/KLEA66/AZ5000</td>
</tr>
<tr>
<td>Natural</td>
<td>R12/R134a</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>R502/R404A/R407A</td>
</tr>
<tr>
<td>Fuel gas</td>
<td>Butane</td>
</tr>
<tr>
<td>Methane</td>
<td>Capable of using all new refrigerants</td>
</tr>
<tr>
<td>Propylene</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Source gas</td>
<td>Town gas</td>
</tr>
<tr>
<td>Helium</td>
<td>Hydrocarbon</td>
</tr>
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</table>

The company operates a policy of continuous product development and reserves the right to alter the data provided without notice.

*Swept volume at 3,000 rpm except WRV510 range which is measured at 1,500rpm  
**Swept volume at 3,600 rpm except WRV510 which is measured at 1,800 rpm
XRV TECHNICAL DATA

TYPICAL PERFORMANCE

AMMONIA

TYPICAL PERFORMANCE

R22

KEY TO GRAPHS

- Full Duty 50 Hz (Excluding Superfeed)
  Condensing Temperature 95°F (35°C)

- Full Duty 60Hz (Excluding Superfeed)
  Condensing Temperature 95°F (35°C)

NOTES

- Refrigeration capacity based on 5.6°C (10°F) superheat at compressor suction and no sub-cooling of condensed liquid
- No allowance has been made for pressure losses between the evaporator and the compressor suction flange
XRV TECHNICAL DATA

XRV 127/1.65 Compressor (with Anti-Clockwise Rotation)

<table>
<thead>
<tr>
<th>HOWDEN COMPRESSOR SPECIFICATION</th>
<th>SWEPT VOLUME 50Hz m³/hr</th>
<th>SWEPT VOLUME 60Hz m³/hr</th>
<th>SUCTION PORT Ø mm</th>
<th>SUCTION PORT Ø in</th>
<th>DISCHARGE PORT Ø mm</th>
<th>DISCHARGE PORT Ø in</th>
<th>DIMENSION A mm</th>
<th>DIMENSION A ft</th>
<th>DIMENSION B mm</th>
<th>DIMENSION B ft</th>
<th>DIMENSION C mm</th>
<th>DIMENSION C in</th>
<th>DIMENSION D mm</th>
<th>DIMENSION D ft</th>
<th>WEIGHT APPROX Kg</th>
<th>WEIGHT APPROX lb</th>
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<tr>
<td>XRV 127-R1*</td>
<td>293</td>
<td>172</td>
<td>352</td>
<td>207</td>
<td>100</td>
<td>4</td>
<td>50</td>
<td>2</td>
<td>850</td>
<td>2 ft/18</td>
<td>390</td>
<td>1 ft 3½</td>
<td>299</td>
<td>0 ft 11¾</td>
<td>201</td>
<td>0 7/8</td>
</tr>
<tr>
<td>XRV 127-R3</td>
<td>397</td>
<td>234</td>
<td>476</td>
<td>280</td>
<td>100</td>
<td>4</td>
<td>50</td>
<td>2</td>
<td>900</td>
<td>2 ft 11/16</td>
<td>390</td>
<td>1 ft 3½</td>
<td>291</td>
<td>0 ft 11½</td>
<td>291</td>
<td>0 11½</td>
</tr>
<tr>
<td>XRV 127-R4</td>
<td>489</td>
<td>288</td>
<td>586</td>
<td>345</td>
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<td>4</td>
<td>50</td>
<td>2</td>
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<td>1 ft 3½</td>
<td>291</td>
<td>0 ft 11½</td>
<td>291</td>
<td>0 11½</td>
</tr>
</tbody>
</table>

*With clockwise rotation

The company operates a policy of continuous product development and reserves the right to alter the data provided without notice.
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