



# SIHI<sup>®</sup> Dry Dry-running vacuum pumps for chemical and pharmaceutical applications

M, Mi and H Series models



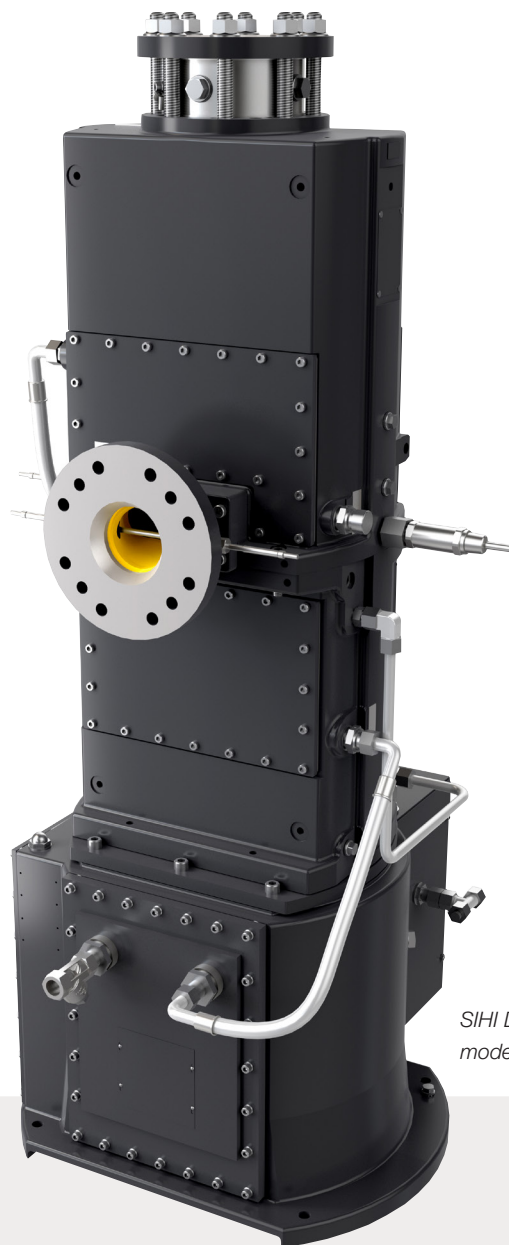
*Experience In Motion*

## SIHI Dry: simple, dry and reliable

The SIHI Dry pump from Flowserve is a vertically oriented and self-draining vacuum pump with no mechanical contact shaft seals. It is an ideal choice for chemically related processes where there is a high possibility of liquids or solids carryover. This award-winning solution can accommodate corrosive gases and vapors and has superior resistance to heat-accelerated deposition. The basic layout provides the platform for an extensive range of intelligent modules which can be incorporated in order to match dynamic process requirements, simple DCS integration and remote monitoring.

Integrated within the pump is the intelligent drive system that performs ongoing rotor diagnostics, while giving an energy-efficient platform for variable-speed/pressure control. Moreover, this method of rotor synchronization permits gearbox-free operation which runs extremely quietly and without any lubrication.

Eleven SIHI Dry pump sizes were developed for operation with explosive media, both internally and externally, and offer volumetric flow rates up to 1,000 m<sup>3</sup>/h (589 cfm). Dramatic increases to flow and pressure are available with integrated lobular blowers.



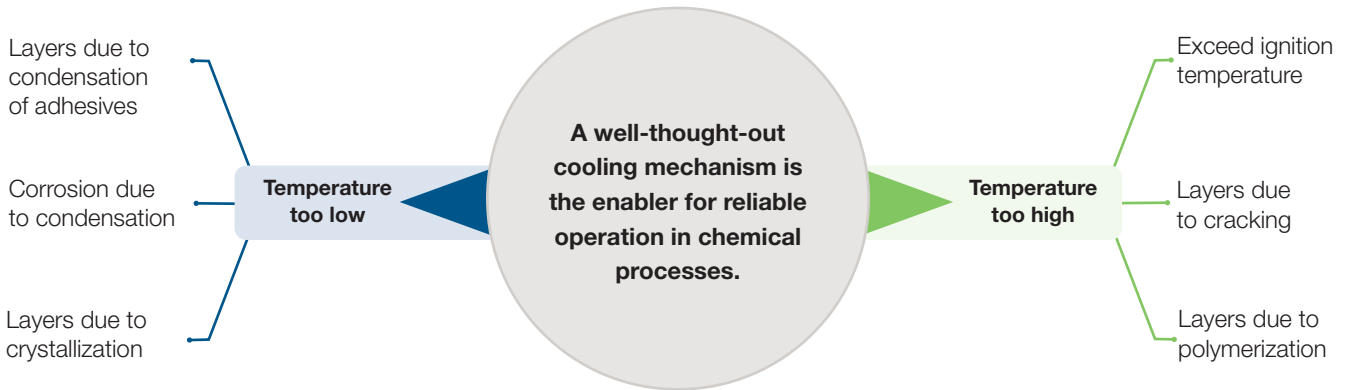
SIHI Dry  
model Mi450

- **High reliability**, even under harsh process conditions, due to particle and liquid carryover possibility and safe handling of condensable, corrosive or toxic media
- **High availability** due to integrated condition monitoring with pre-failure detection and data logging
- **Minimal downtime** due to self-draining, top-down flow and simple on-site serviceability by own staff
- **Low total cost of ownership** due to elimination of lubrication and mechanical seals, low-maintenance costs and energy-efficient design

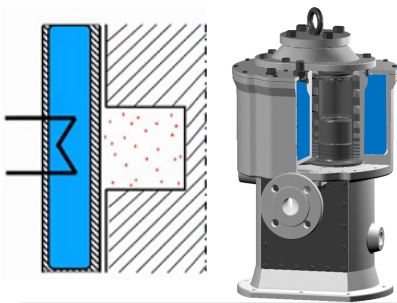
### Key vacuum applications

- Distillation
- Drying
- Batch reactors
- Chemical deposition

# High reliability, even under harsh process conditions



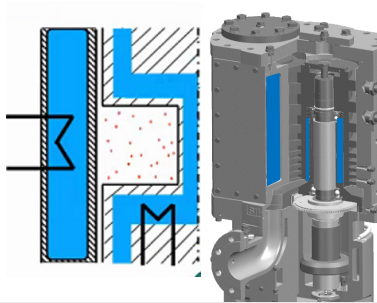
## M and Mi Pumps



### Cooling jacket:

Remove heat from the pumping chamber to keep the gas temperature low.

## H250 to H630

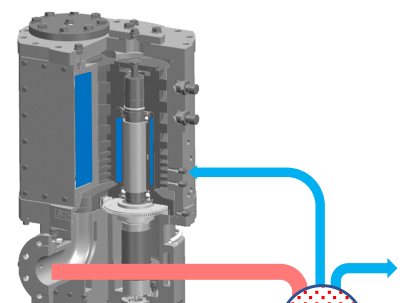


### Cooling jacket plus internal spindle cooling:

Increasing the pump size leads to a lower cooling surface in relation to the inner volume. SIHI Dry H Series pumps offer an increased cooling surface by internal spindle cooling.

- Lower max. temperature
- Homogeneous temperature profile

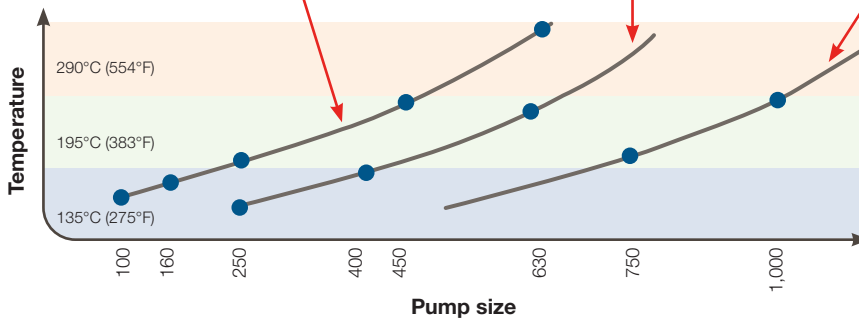
## H750 to H1000



### Cooling jacket plus internal spindle cooling plus direct gas cooling:

Further increase of pump size requires more measures to keep the gas temperature low. The SIHI Dry H Series pumps offer the opportunity of direct injection of cold gas into the compression room without affecting the suction capacity.

- Lower max. temperature
- Homogeneous temperature profile







## Operational benefits

### Built for harsh processes

#### Tolerates particle and liquid carryover without any suction side filter

- Top-down flow avoids particle deposits inside of the pump
- No wear caused by particle carryover due to contact-free principle
- Optional integrated liquid cleaning by flushing module
- Particle carryover and pump drying by optional integrated gas flushing module

#### Handling of condensable and corrosive media

- Prevention of condensation inside of the pump by optional integrated gas dilution module
- Optional integrated liquid cleaning by flushing module
- Reduction of condensation by temperature-controlled operation

#### Safe handling of toxic media

- Hermetical, tight execution
- Pump internal secondary cooling loop, decoupled from customer cooling water

### Easy to clean and service

#### Only cleaning on demand

- Condition monitoring by independent data record of both shafts
- Pre-failure detection

#### Designed for in situ cleaning and on-site service

- Easy dismantling of the pump casing without bearing removal
- No high-tech workshop required
- Can be done on-site by own staff
- Independency on third party service

### Lower operating costs

#### Lower power consumption

- High-tech screws' design optimized for highest efficiency
- Frequency control allows to improve energy-efficient operation by operator

## Engineered for easy system integration

### Certified explosion protection

- ATEX-certified, even without flame arrester in Category 2 systems
- No source of ignition due to consequential contact-free operation

### Customized vacuum system solutions

- Pre-engineered modules match all individual process needs

### No pressure control valve necessary

- Adjustable suction capacity due to variable rotational speed

### An integrated solution

- Pre-engineered modules are completely mounted and tested
- Small-footprint design saves useful space

## Improved product quality

### High pumping performance

- Remarkably high pump speed at low pressure allows higher flow rate of process gases
- Lower final pressure

### Zero process contamination

- Truly dry and contact-free principle free of any service liquids
- Absolutely free of gear oil due to electronically synchronized shafts

### No PLC control

- Self-controlled, pre-engineered modules
- Local control via human machine interface (HMI) panel
- Data access via Ethernet

### Easy communication

- Availability of bus standards as well as I/O interface
- Equipped with HMI

### Pre-configured systems

- Three different fully tested and documented pre-engineered systems available

## Fast installation and startup

### Self-controlled vacuum system

- Completely assembled, wired, tested and self-controlled vacuum system allows easiest commissioning

## Lower maintenance costs and downtime

### No oil checks, exchanges and disposals required

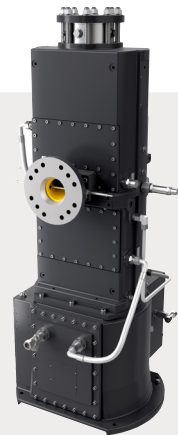
- Free of oil as service liquid
- No gear oil

### No wearing

- Consequent contact-free principle
- Long-life bearings
- Contact-free sealings

### Continuous condition analysis

- Data logging
- Online monitoring of pump status
- Simple failure codes



### Standard

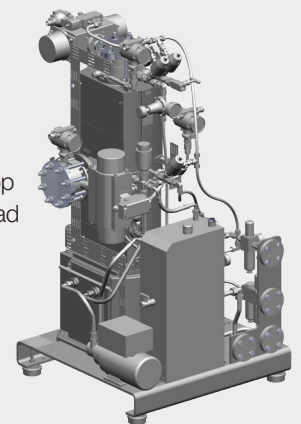
Dry screw vacuum pump:

- Variable-speed drive onboard
- Purge gas system with ex-certificate
- Temperature switch
- Pressure switch discharge
- Strainer with insert

### Configured

Standard plus:

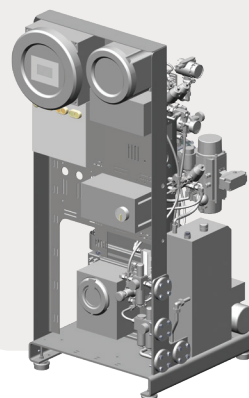
- Valves
- Pressure transmitter
- Gas dilution
- Coolant loop with overload protection
- Frame



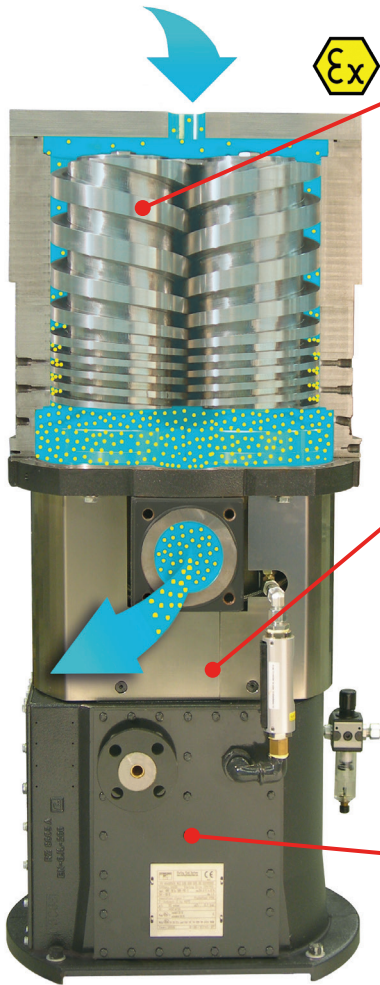
### Premium

Configured plus:

- Advanced sensoric
- Full controlled
- HMI (human machine interface) display



## Proven technology



### Optimized gas temperature

A key requirement for the effective and safe evacuation of corrosive media is the prevention of condensation in the pump. This requires the gas temperature to be maintained above its dewpoint. Conversely, many gases polymerize or 'crack' at elevated temperatures.

This can lead to deposition inside the pump, which seriously compromises pump performance. For reliable pump operation, it is necessary to have a stable temperature profile within the operating chamber, avoiding both 'hot spots' and 'quench' zones. The SIHI Dry pump achieves this by cooling both the pump casing and the rotors.

### Explosion-proof design

Designed to Class 1, Division 1 and 2, and Zone 1 requirements, the explosion-proof guidelines on risk assessment were a key element in developing SIHI Dry M, Mi and H Series vacuum pumps. With non-contacting spindles, temperature control, inert purge gas and integral electronic diagnosis, the design of SIHI Dry M, Mi and H Series vacuum pumps eliminates potential ignition sources. Certified as a Category 2 machine, the standard SIHI Dry pump can be used without flame arresters.

Where potential sources of ignition must be eliminated for occasional upset conditions, Category 1 units are available with EC type-test certification.

### Integrated drive control

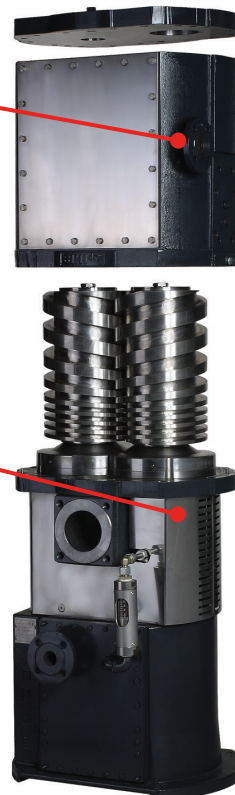
The innovative drive concept of SIHI Dry pumps and its modular design enable the pumps to be configured to operate in a basic on/off fashion or provide fully integrated control for the needs of specific processes.

### Simple on-site service

The vertical design and cantilevered mounting of the spindle assembly enable SIHI Dry vacuum pumps to be cleaned without dismantling. SIHI Dry pump units can be flushed during operation and are specifically designed to be easy to strip and clean. Most repairs can also be performed without removing the pump from the system. The pump casing is easily removed without disturbing the bearings by loosening a few bolts, providing easy access to the spindles. The spindles are easily accessed on-site — often in just a few minutes — for steam cleaning or other basic service.

### Zero scheduled maintenance

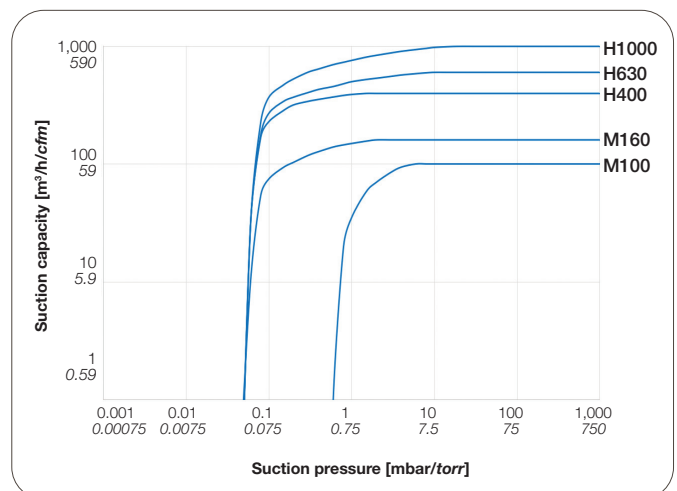
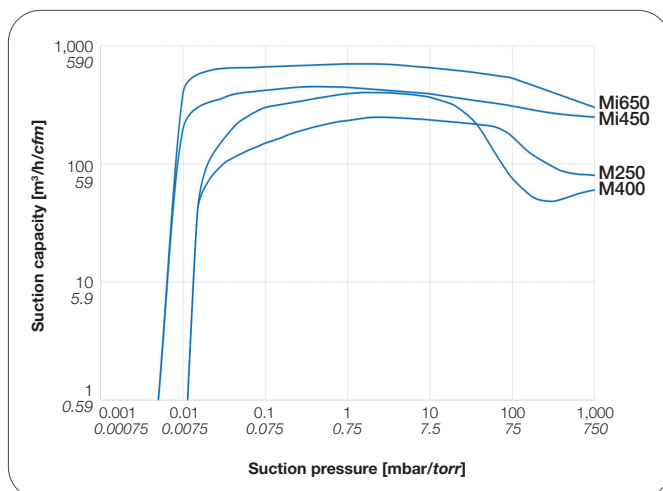
SIHI Dry vacuum pumps don't require scheduled maintenance because their integrated VFD and load control continuously monitor and adjust to key conditions. Temperature, torque and other parameters are tracked in real time. This enables you to incorporate remedial actions such as automatic flushing into the process, maximizing uptime. In the event excessive process carryover or condensation enters the spindle assembly, the pump automatically senses unusual process loading through changes in torque. The system reduces speed, allowing a potential blockage to clear without danger of damage.



## General technical data

| Parameter                                     | Unit                    | Model        |              |                |                |                |                |
|---|-------------------------|--------------|--------------|----------------|----------------|----------------|----------------|
|   |                         | M100         | M160         | M250           | M400           | Mi450          | Mi650          |
| <b>Max. suction capacity</b>                  | m <sup>3</sup> /h (cfm) | 100 (59)     | 160 (95)     | 250 (147)      | 400 (235)      | 450 (265)      | 680 (383)      |
| <b>Ultimate pressure</b>                      | mbar (Torr)             | < 0.7 (0.52) | < 0.1 (0.07) | < 0.02 (0.015) | < 0.02 (0.015) | < 0.01 (0.007) | < 0.01 (0.007) |
| <b>Temperature class</b>                      | -                       | T4           | T4           | T4             | T4 (T5/T6)     | T3             | T2             |
| <b>Sound pressure level</b>                   | dB(A)                   | ≤ 54         | ≤ 54         | ≤ 54           | ≤ 54           | ≤ 70           | ≤ 75           |
| <b>Power consumption at ultimate pressure</b> | kW (hp)                 | 2.5 (3.3)    | 3.5 (4.7)    | 2 (2.7)        | 2.5 (3.3)      | 4 (5.4)        | 6 (8)          |

| Parameter                                     | Unit                    | Model        |              |              |              |              |
|---|-------------------------|--------------|--------------|--------------|--------------|--------------|
|   |                         | H250         | H400         | H630         | H750         | H1000        |
| <b>Max. suction capacity</b>                  | m <sup>3</sup> /h (cfm) | 270 (159)    | 400 (235)    | 600 (353)    | 750 (441)    | 1,000 (585)  |
| <b>Ultimate pressure</b>                      | mbar (Torr)             | < 0.1 (0.07) | < 0.1 (0.07) | < 0.1 (0.07) | < 0.1 (0.07) | < 0.1 (0.07) |
| <b>Temperature class</b>                      | -                       | T4           | T4           | T3           | T3           | T3           |
| <b>Sound pressure level</b>                   | dB(A)                   | ≤ 63         | ≤ 64         | ≤ 70         | ≤ 74         | ≤ 74         |
| <b>Power consumption at ultimate pressure</b> | kW (hp)                 | 5 (6.7)      | 7 (9.4)      | 10 (13.4)    | 18 (24.1)    | 18 (24.1)    |







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