

# HOFIM™

## Hermetically-sealed motor-compressor system



Engineering the Future – since 1758.

**MAN Diesel & Turbo**



For more than a decade, MAN Diesel & Turbo has pioneered the development of turbocompressor systems using high-frequency motor drives and magnetic bearings. Starting with the dedicated pipeliner MOPICO® (Motor Pipeline Compressor) in the early 1990s, the use of these state-of-the-art technologies has been further applied to process compressors for use in a wide range of applications in the oil, gas and process industries.

### A consequent and logical ongoing development

The technologies applied to the unique, hermetically sealed MOPICO® concept were further developed into the HOFIM™. The HOFIM™ is an integrated motor-compressor unit, offering a wide capacity range for various types of process applications. The ultimate in process compressor technology:

- Simple, robust, wear-free design
- High efficiency, low energy consumption over a wide operating range
- Discharge pressures up to 303 bar
- Oil-free, emission-free
- Minimized footprint and weight
- Unattended remote operation
- Minimum maintenance

### Oil-free compression

Oil-free compression systems can offer the user considerable advantages compared with conventional compression systems. Conditional upon the availability of an adequate and secure power supply, the electric drive is always more efficient than an equivalent combustion engine drive. Maintenance costs become insignificant due to the inherent simplicity of the electric motor,

especially in combination with magnetic suspension. The undisputed reliability of state-of-the-art magnetic bearings and solid state frequency converters ensure reliability and availability levels which are unachievable with conventional systems.

Remote control of an electric system is much simpler and requires significantly less local manning than a system with a combustion engine drive.

### Technical features

- Fully integrated, skid-mounted high-frequency motor/compressor system
- Motor power range from 3 MW (4,000 HP) to 18 MW (24,000 HP)
- Wide operating range
- “Soft start” via variable frequency drive
- Unrestricted number of starts
- Immediate availability, no warm-up required
- Minimum footprint, minimum weight
- Oil-free
- Lowest noise levels
- Largely wear-free requiring minimum maintenance

### Integration technology

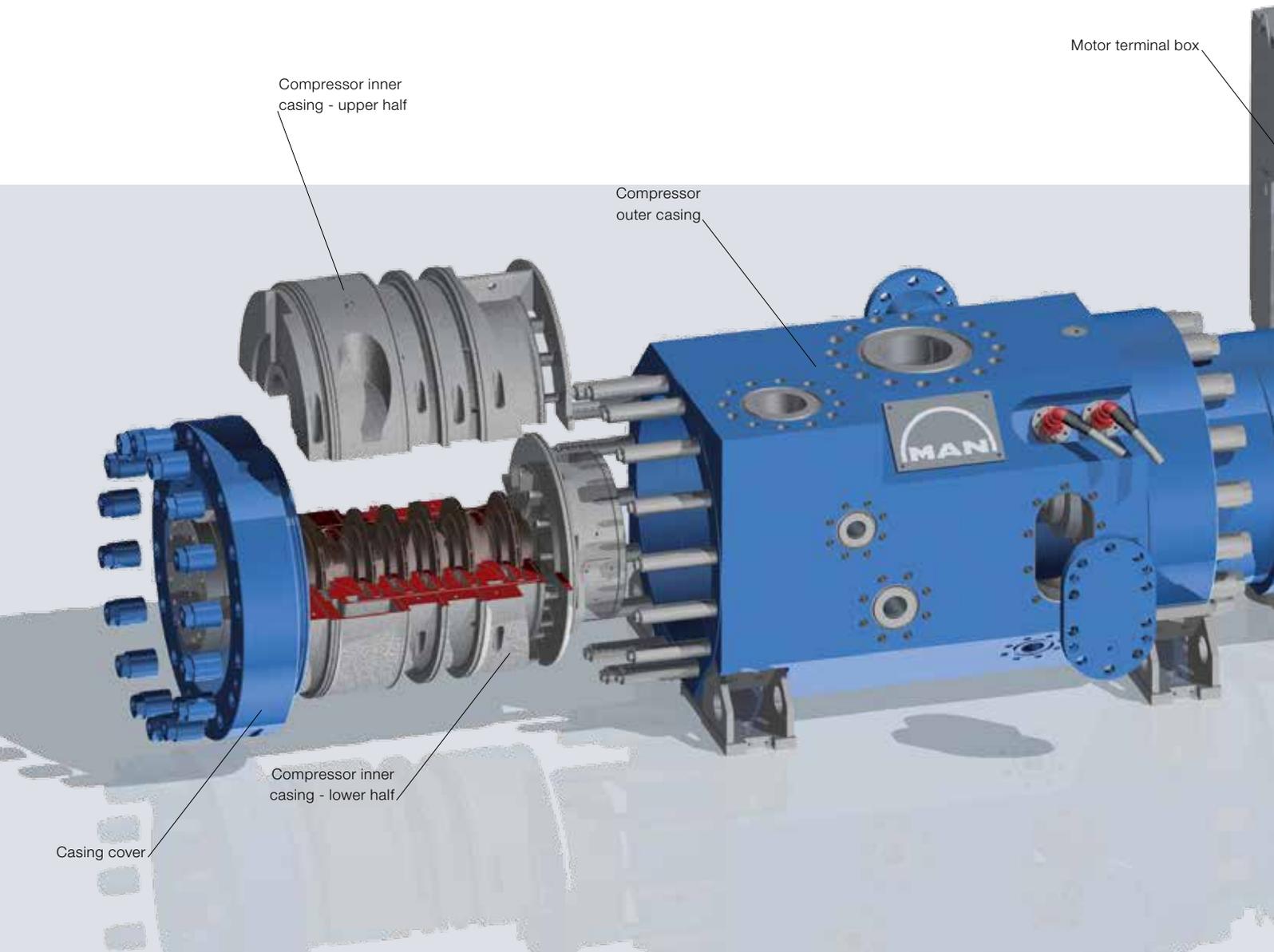
The development of integrated, hermetically sealed, electric compression systems presented the development team with completely new, multi-discipline technical challenges.

- Dynamics of large, magnetically levitated rotating elements at the rotational speeds required by high-pressure process compressors
- Cooling of power-intensive high-frequency motors with high-pressure hydrocarbon gases
- The further development of solid state frequency converters for the combination of power and frequencies required

These challenges were successfully overcome by a multi-company team of engineers with intimate knowledge of their respective disciplines, as well as a clear understanding of the complexities of integrating multiple technologies into a single system in compliance with market requirements.

### Magnetic bearings

Thanks to the use of active magnetic bearing systems, complex and space-consuming oil systems have been elimi-



nated. Magnetic bearings provide contact- and wear-free operation over a wide speed range.

### High-frequency motors

The high-frequency motor is of the squirrel cage induction type with a solid rotor design. The motor is cooled by filtered high-pressure working gas providing intensive cooling thus enhancing efficiency levels. This type of motor design results in a high power density and consequent reduced weight and space requirements.

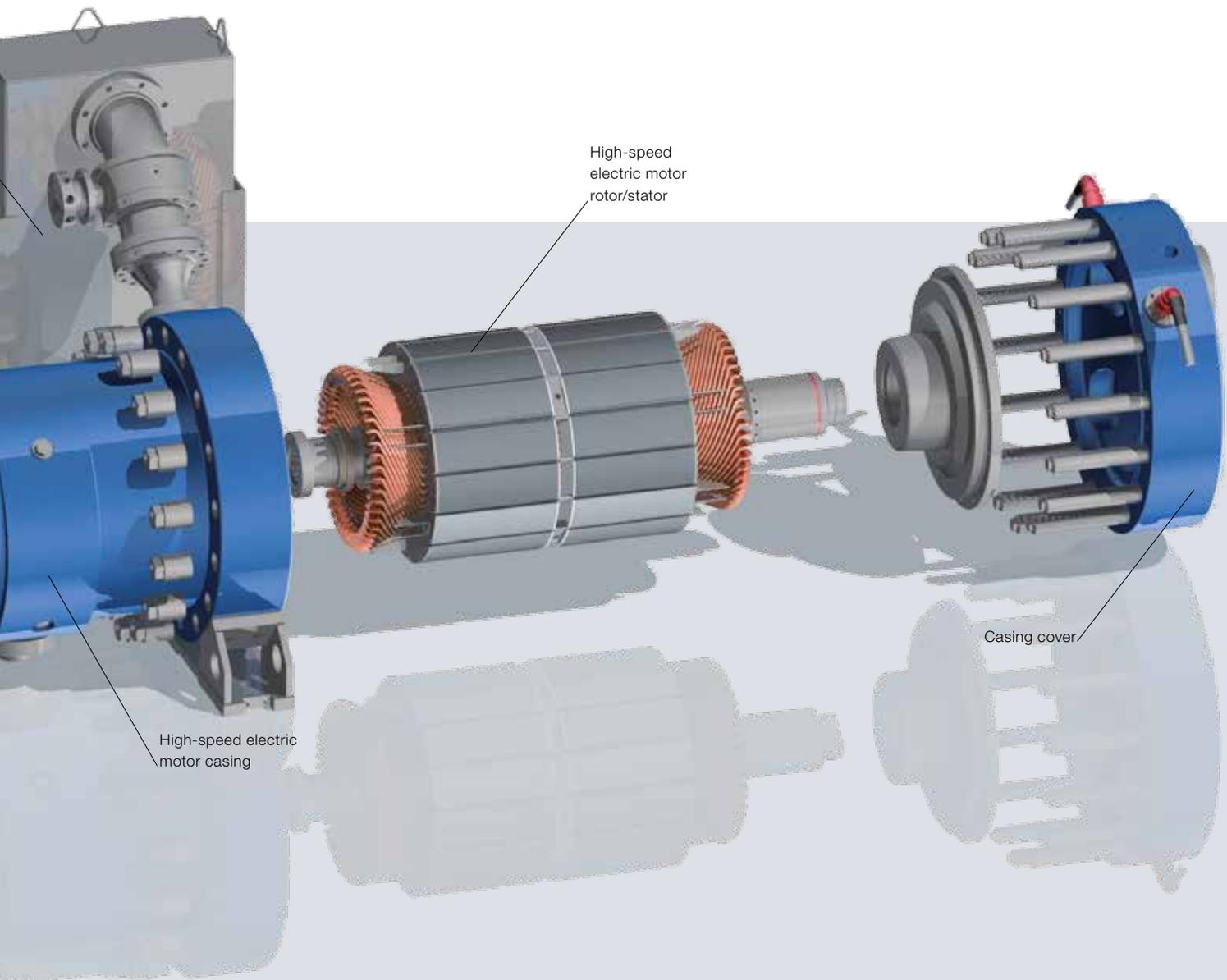
### Variable frequency drive

The frequency converter takes power from the grid at a standard frequency and provides the motor with a controlled variable frequency supply via a unit input transformer and a solid state rectifier/inverter system. Alternative systems can be supplied according to specific customer requirements.

### HOFIM™

The HOFIM™ combines the advantages of the MOPICO® in a hermetically-sealed, environmentally neutral motor com-

pressor system, suitable for use in a wide range of process compression applications. Due to the sealed concept, the motor is cooled by process gas bled from the compressor and then returned into the suction header. With this unique concept, most of the traditional sources of turbomachinery failures, namely gear boxes, couplings, shaft seals and lube oil systems, have been completely eliminated. The system can be supplied either in the single casing or the twin casing tandem HOFIM™ version.



The HOFIM™ offers a much smaller footprint and lower weight than a conventional compressor train. The elimination of the dry gas seal system, gear unit and lubrication system significantly simplifies the overall system. This is a major contributing factor to the enhanced reliability and reduced service and maintenance requirements offered by the HOFIM™.

#### Advantages of the HOFIM™

- Smallest footprint and lowest weight due to high motor power density and integrated system
- Simplified plant layout thanks to oil-free concept without shaft seals
- Emission-free, environmentally neutral system
- Minimum service and maintenance requirements due to the wear-free concept
- Ideally suitable for remote control and reduced plant manning requirements

#### Typical applications

- Oil and gas production and processing
- Gas transport
- Gas storage
- Subsea

**1** A single HOFIM™ in gas depletion service. The motor is rated at 4.7 MW and 14,700 rpm. In the initial layout the system was comprised of a single compressor casing taking gas from approximately 41 bar to 96.5 bar. The system was later converted into a tandem train to accommodate suction pressures down to 13.1 bar.

**2** A tandem HOFIM™ system in gas injection service in a natural gas liquids plant on the Alaska North Slope.

**3** A tandem HOFIM™ for gas storage application in Poland. The motor is rated at approximately 11.7 MW at 12,000 rpm. The gas is compressed from 45 bar to 138 bar.



**4** The first three HOFIM™ units operating in a gas storage facility in New York State. The plant layout allows the three units to operate in parallel, but also two units in parallel, feeding the third unit in series for high-pressure ratio requirements. Each motor is rated at approximately 7 MW. Gas can be compressed from 55.2 bar up to a maximum of 220.6 bar.



**5** The tandem HOFIM™ offers the added capability of operating the two casings either in the series or in the parallel mode. This allows the operator to cover the widest possible duty range at high efficiencies. Switching from one mode to the other can be effected during operation without shutdown.

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