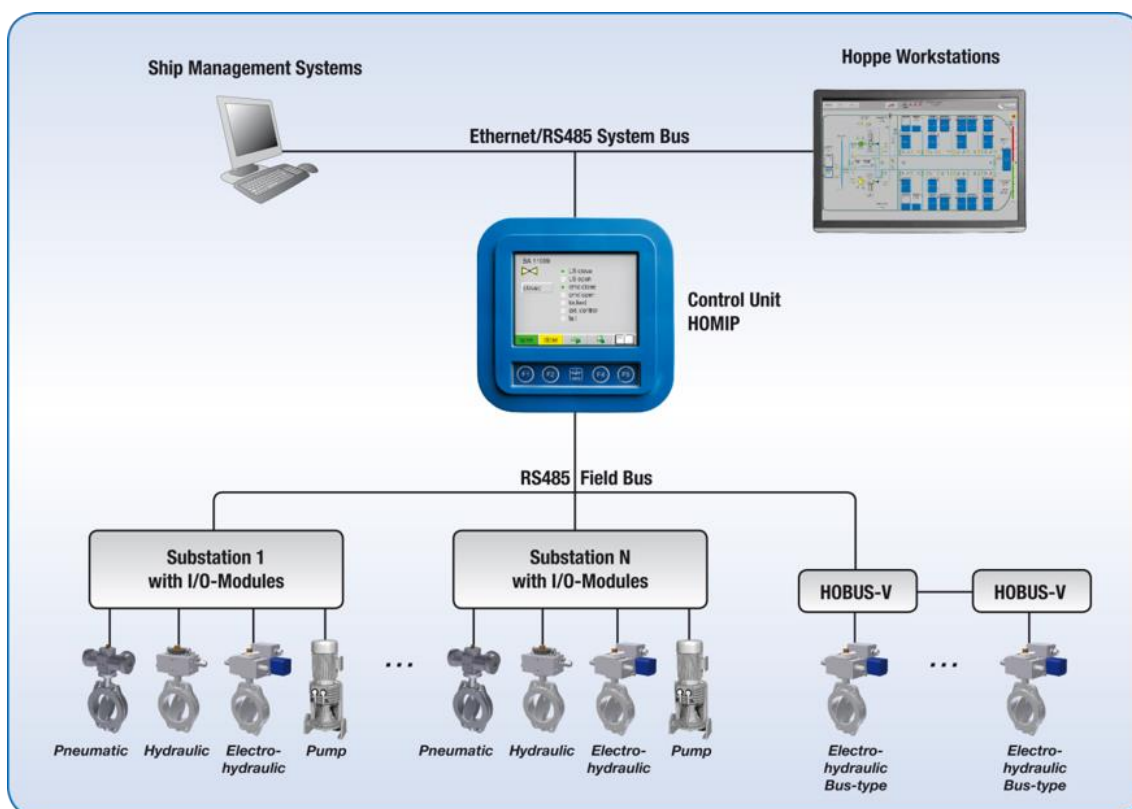


SYSTEM OVERVIEW

The **Hoppe Marine Pneumatic Valve Remote Control System (VRC)** is the state of the art solution for remote valve operation on board of all types of ships and offshore installations. It combines technical advantages and operational reliability with saving investment (CAPEX) and ownership cost (OPEX), compared to other, more traditional VRC principles.



The Hoppe VRC system with its substations can be arranged in a smart way to minimize cabling, according to the valve positions. The complete data handling and system control is managed by Hoppe's in-house developed PLC unit HOMIP which is usually installed in an engine room control cabinet. The HOMIP serial system allows bus connections to Hoppe's computer workstations for visualization and operation of the VRC system as well as to the main ship automation, management and control system. If the Hoppe VRC is connected to a main automation system (AMS), the valves can be operated both, by the AMS control mimics or screens and redundantly also by the Hoppe control (sub-) stations.

The Hoppe Marine pneumatic VRC system bases on Hoppe Marine's pneumatic rotary type (HOPAC) and linear type (HOLIP) actuators, which are especially designed for robust and long term operation in challenging marine environments. The actuators are driven via Hoppe PLC control (sub) stations. The connection between actuators and control station should be optimized by using Hoppe's hybrid cable invention HOCAB that contains both, the two PA-hoses for air supply and the electrical cable for direct feedback indication. The control cabinets / substations contain solenoid valves for the air flow control as well as input / output units for system control and feedback signal handling.

The control cabinets / substations are connected to the vessel standard working compressed air supply line and linked by field bus data cable.

The Hoppe Marine pneumatic VRC system has been developed according to the Hoppe “Vertical Responsibility Concept”. All relevant control system components, from PLC unit to actuators, are designed by Hoppe and supplied by “one hand”, which is a substantial advantage for the ship operator. The interfaces between the components are standardized and adapted for a wide range of different configurations.

HOPPE MARINE’S PNEUMATIC ACTUATORS (HOPAC, HOLIP)

HOPAC actuators are available as 90° rotating type (HOPAC) for butterfly valve operation as well as linear type (HOLIP) for globe valve operation. Their special design for marine operation is tailored for heavy duty work during vessel’s lifetime, for all kinds of on-board installations ranging from dry engine room, cargo holds, pipe ducts, void spaces and submerged position in tank locations.



HOPAC dry (aluminum)



HOPAC submerged (bronze)



HOLIP dry (aluminum)

The compact Hoppe actuator design includes an internal and protected direct feedback signal source. There is no need for additional connection boxes and mechanical limit switch application. All parts are made of high quality aluminum, brass or bronze material, depending to location of application. The actuators can be operated with 7-10 bar standard working compressed air available on the vessel. Contrary to simple industrial actuators, HOPAC and HOLIP actuators can cope with the moisture which may remain in such systems despite the main compressed air supply system dryer unit, thus in almost all applications there is no need for additional air treatment. However, Hoppe Marine offers optional additional dryer units on request.

The following information on actuator application range is based on forces / torque necessary for Wouter Witzel Eurovalve at medium pressure 4 bar, it may slightly deviate for other valves/pressure.

Hoppe Rotary Actuators (HOPAC, single and double acting)

HOPAC 1: DN 50 - 125

HOPAC 2: DN 150 - 300

HOPAC 3: DN 350 - 500

Hoppe Linear Actuators (HOLIP, double acting)

HOLIP 63: DN 15 – 65

HOLIP 90: DN 80 – 100

HOLIP 160: DN 125 – DN 150

Hoppe Linear Actuators (HOLIP, single acting)

HOLIP 63: DN 15 – 40

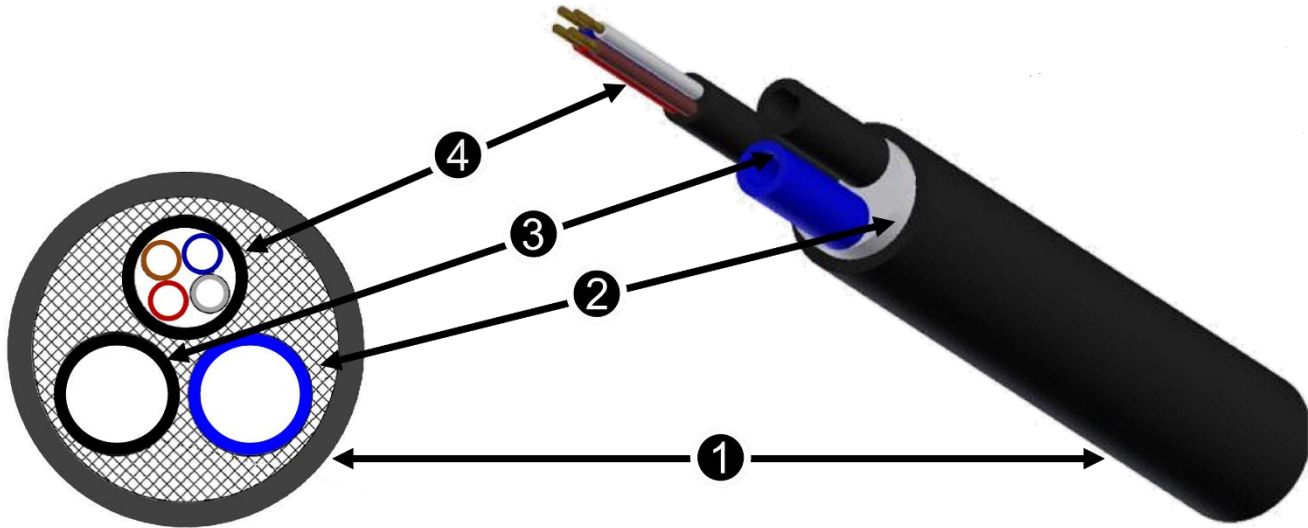
HOLIP 90: DN 65 – 80

HOLIP 160: DN 100 – 125

The HOPAC and HOLIP actuators can be “married” with valves of all quality valve makers.

HOPPE HYBRID CABLE – HOCAB

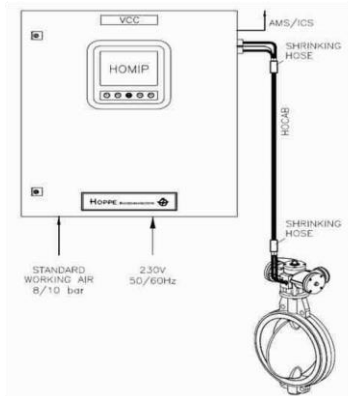
For its pneumatic VRC system Hoppe invented the hybrid cable HOCAB. It contains two PA-hoses for air supply as well as an electric cable for feedback indication, protected by a fire retardant PVC jacket. The outer diameter is 16 / 21 mm (optional halogen free version with TMPU Jacket and PUR tubes).



- ❶ Jacket
- ❷ Filling
- ❸ PA/PUR-Tubes
- ❹ Inner cable with 4 shielded conductors

Blue PA or PUR-tube for air (close) | Black PA or PUR-tube for air (open) | Signal cable for remote position indication (standard or under water protected (UW))

The connection to the actuator and to the cabinet is done by special plug connectors which are protected against unwanted decoupling but can be closed and opened easily without any tools.

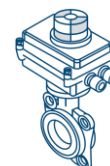
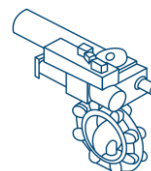
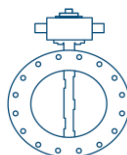


Connection to actuator

The hybrid cable HOCAB is type approved by leading classification societies. It gives a Hoppe pneumatic VRC the same easy installation characteristics as an electro-hydraulic VRC, avoiding any piping work. For HOCAB there is no need for bulkhead penetrations, which are necessary for pipes and which increase shipyard mounting efforts and cost. In case of accidental mechanical damages an easy-to-use repair kit is provided.

COMPARISON OF PNEUMATIC VRC WITH OTHER VRC TYPES

Hoppe Marine supplies all VRC types mentioned in the table below. According to our experience the pneumatic VRC has a number of advantages and is overall the most advantageous system both in CAPEX and OPEX terms.



	Pneumatic		Hydraulic		Electro Hydraulic		Electric	
Design actuator	robust, compact	++	robust, compact	++	sensitive, compact	-	sensitive, many components	--
Installation / Service	HOCAB cable or copper piping	+/-	st. steel piping	-	electric cable	+	electric cable	+
Environment	no pollution possible	++	risk of pollution	--	risk of local pollution	-	no pollution possible	++
Ex Proof	intrinsically safe	++	intrinsically safe	++	pressure resistant casing	-	pressure resistant casing	-
Submerged	bronze execution	+	special coating	-	not recommended	--	not recommended	--
Costs	low priced	+	middle priced	-	middle priced	-	low priced	+
Power Supply	vessel air supply	+	hydraulic power unit	-	integrated power pack	+	vessel power supply	+

In general terms both, central hydraulic and pneumatic actuators, are more reliable than electrohydraulic actuators because their design is much more simple and robust. They consist mainly of solid mechanical parts whereas electro-hydraulic actuators need an attached power pack with more sensitive elements such as motor, pump and other small parts. However, a hydraulic VRC system is significantly more expensive than a pneumatic VRC. Electro-hydraulic actuators are more likely subject to damage in operation as well as wear and tear and are thus less suitable for applications in rough environment. They cannot be used at all for submerged valve positions, while Hoppe pneumatic actuators in Bronze version can be applied in such conditions.

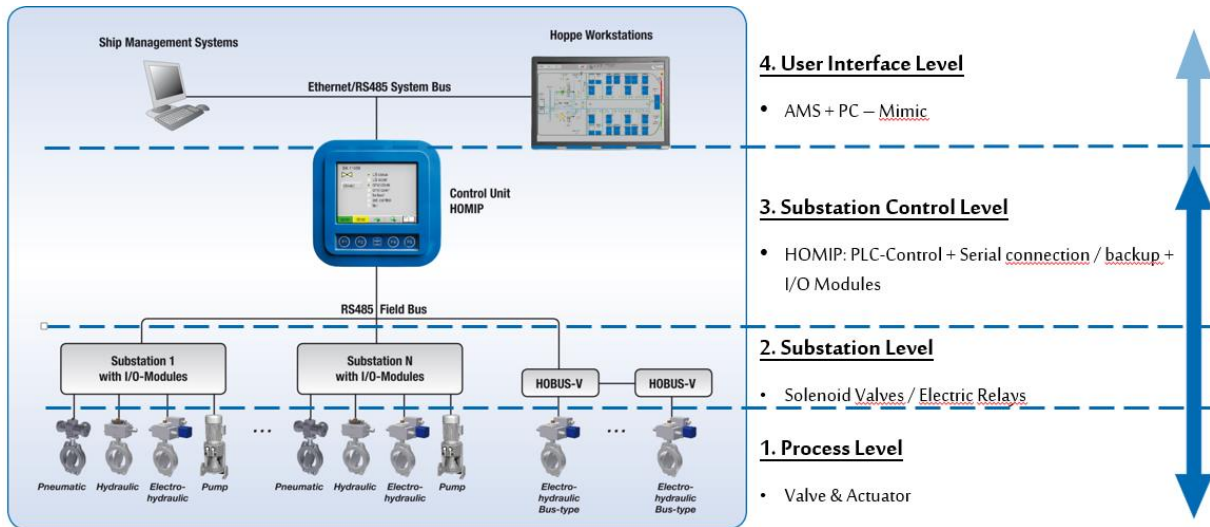
The main advantage of the electro-hydraulic system is the avoidance of oil (or air) supply piping work. No piping and only one cable for power supply and feedback indication is required, since each actuator has its own local power pack. However, for its pneumatic VRC system Hoppe invented the hybrid cable HOCAB which gives a Hoppe pneumatic VC the same easy installation characteristics as an electro-hydraulic VRC by avoiding any piping work.

Compared to a central hydraulic VRC the less costly pneumatic system does not have any risk of oil spill due to leakages, a significant enabler for clean shipping. For explosion zones a pneumatic VRC is also

much more cost effective than an electro-hydraulic system, which needs EExD protection at any actuator. Pneumatic VRC does not require specialized Ex-certified service staff.

The use of air as control medium is well proven for long term operations of more than 20 years. Hoppe's pneumatic actuators HOPAC and HOLIP can even tolerate humidity inside the system, without risk of long term failure.

ADVANTAGES OF THE HOPPE SUBSYSTEM APPROACH



With smart placement of substations cable installation lengths can be reduced significantly.

- Substations can be placed in accessible locations
- Manual emergency operation by pneumatic hand pump connection can also be done at substations which are often much better accessible than actuators
- Substations with Hoppe I/O units only need to be connected by one field bus line as well as one connection for air supply from standard working air

SUMMARY OF ADVANTAGES OF THE HOPPE PNEUMATIC VRC WITH HYBRID CABLE HOCAB

- **For the shipyard:**
 - **Ship Price / CAPEX:** Hoppe pneumatic VRC with HOCAB gives the yard some leeway for a competitive price, due to lower installation and system costs compared to other VRC types
 - **Less Installation work:** Hoppe pneumatic VRC with HOCAB requires only one system (cable) not two (cable + pipe) to be installed, no bulkhead penetrations to be considered (HOCAB goes with the electric cable routes), this enables significant savings in man hours / installation and overall material costs
 - **Less installation work:** No flushing of oil or air supply pipes needed before commissioning
 - **Less installation work:** Easy HOCAB connection to actuators and cabinets by special plug connectors (electricians can do)

- **Smart Ship Design:** Hoppe pneumatic VRC provides weight and space advantages
- **Smart Ship Design:** Easy operation can be enhanced and installation material and work can be further reduced by applying a smart substation concept
- **For the ship owner / operator:**
 - **OPEX / Cost of ownership:** significantly lower than for other VRC types due to high reliability, easy operation, low maintenance demand and significantly lower spare parts costs (in particular compared to the more complex electro-hydraulic actuators).
 - **Reliability:** HOCAB eliminates risk of air leakages due to straight connection between cabinet and actuators (no interruption due to bulkhead penetration interfaces)
 - **Reliability:** no risk of leakages in multicore pipes and damages caused by fatigue (vibration) and deformations of pipes
 - **Reliability:** robust marine environment proof HOPAC and HOLIP actuators designed for vessel's lifetime, failure rates in low single digit percentages.
 - **Reliability:** applicable also in submerged positions and no risk of accidental damaging of devices attached to the actuators (contrary to electro-hydraulic VRC)
 - **Clean Shipping:** no risk of hydraulic oil leakages, especially in ballast tanks
 - **Low Maintenance:** almost maintenance free, easy connection by plug type connectors
 - **Low Maintenance:** easy to use repair kit in case of mechanical damages of cable
 - **Easy Operation:** convenient manual emergency operation by pneumatic hand pump connection can also be done located at the cabinets (substations), which are often much better accessible than actuators, there is no need to go under the floor plates (as for electro-hydraulic VRC type)

REFERENCES

Hoppe pneumatic VRC systems and actuators are demonstrating their reliability on board of more than 400 vessels and since 20 years. In addition to applications in the VRC systems, HOPAC actuators are also used in Hoppe Anti Heeling Systems on more than 2.500 vessels. These pneumatic AH actuators are usually the most frequently used actuators.

Until May 2015 more than 950 km of HOCAB hybrid cable have been laid on nearly 400 vessels.

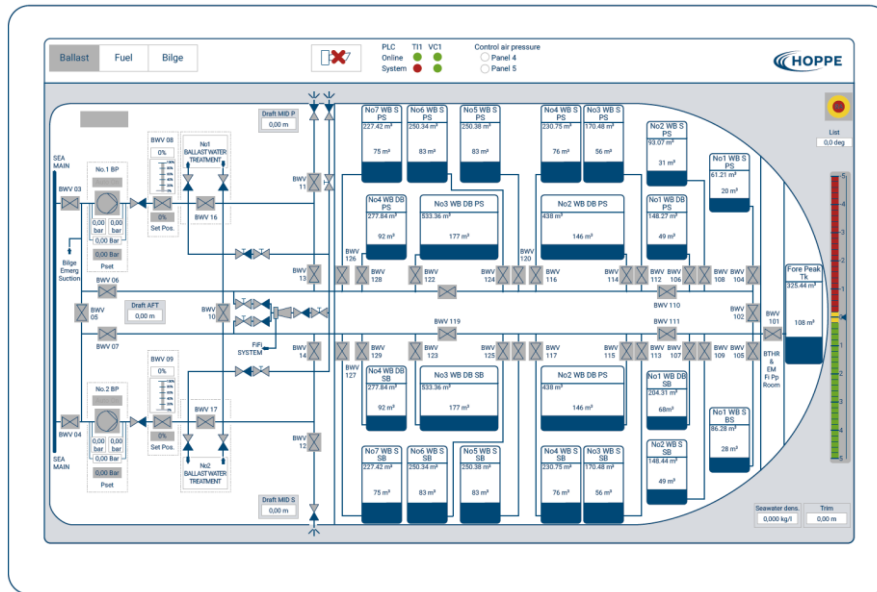
The Hoppe HOCAB solution for pneumatic VRC has been well accepted by leading shipyards such as e.g. Hyundai HI / Korea, Samsung HI / Korea, New Yangtzjiang / China, and others.

Among the users of Hoppe pneumatic VRC with HOCAB are prime ship operators as CMA CGM, CSAV, COSCO, Peter Döhle / Hammonia, B. Rickmers, NSC, Bernhard Schulte, Seaspan and more.

UPGRADE OPTIONS FOR HOPPE PNEUMATIC VRC

- Ballast Management**

Hoppe Marine can provide a sophisticated PC based software, which is connected with the VRC system and a loading computer and supports and enhances all ballast water operations and contributes thus to enhanced vessel efficiency.



When requesting a change of ballast condition, the software computes ballast operation job lists, considering the actual load case as well as limitation by stability and strength of the vessel and furthermore the goal to minimize the operation time of the ballast water treatment plant (BWT). From the so computed job lists the most feasible and advantageous one can be selected by the officer in charge and then forwarded to the Hoppe VRC system for automatic or manual processing of the selected list of ballast operations.

Ballast operation reports can be compiled. Printed and stored, using data of valve operation and position, pump operation, tank contents (provided by a Hoppe Marine Tank Content Measuring System) and the BWT plant as well as GPS input provided, all these additional data sources are linked with the Hoppe Ballast Management System.

- Integration of the BWT plant**

Hoppe Marine offers the integration of all kinds of BWT plants into its VRC system. With such integration the BWT plant is automatically started as necessary according to the rules, if the respective ballast operation is selected by the ship's AMS via the Hoppe VRC or the Hoppe VRC directly. Hoppe Marine has already realized such integration with several BWT makers.