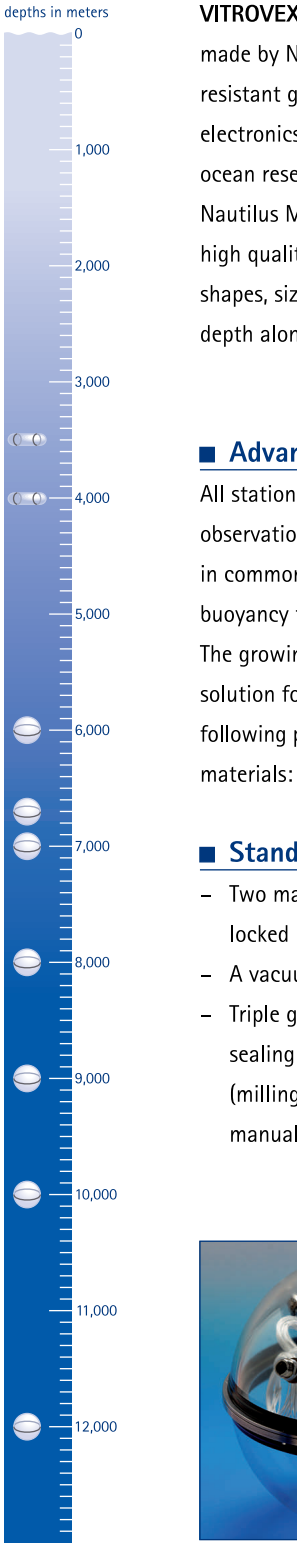
Nautilus
MARINE SERVICE GmbH

# VITROVEX® – glass instrumentation housings

## For deep ocean explorations to 12,000 meters




**VITROVEX® instrumentation housings** made by Nautilus Marine Service are pressure resistant glass casings to accommodate sensitive electronics for observational activities in deep ocean research.

Nautilus Marine Service provides **VITROVEX®** high quality glass instrument housings in different shapes, sizes and pressure ratings to full ocean depth along with associated services and accessories.

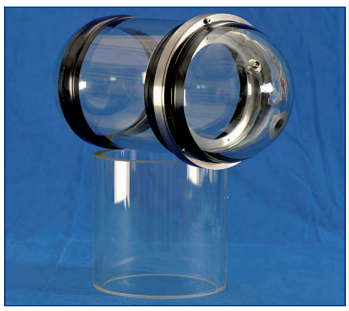
## ■ Advantages of VITROVEX® glass housings

All stationary and autonomous instrumentation for observational activities in ocean research have two things in common, they need pressure-resistant housings and buoyancy to bring instruments safely back to the surface. The growing use of **VITROVEX®** glass spheres as an ideal solution for such requirements is a direct result of the following properties when compared to other products and materials:

- Immense strength to weight ratio
- Resistant to breaking (low thermal expansion coefficient)
- Remarkable transparency and clarity with smooth, pore-free surface
- Inherently inexpensive
- Corrosion resistant, non-polluting and ecologically acceptable
- Non-magnetic and electrically non-conductive

## ■ Standard features of VITROVEX® instrument housings

- Two mated glass hemispheres that are evacuated and locked into position by a sealant and protective tape
- A vacuum port for easy sealing and closing is included
- Triple grinding process to ensure the parting plane sealing faces are honed to a precise flatness and finish (milling with diamond tools, manual smoothing and manual polishing)
- **VITROVEX®** hemispheres of the same outside diameter and wall thickness are completely interchangeable and can be replaced individually
- No need to rotate the hemispheres to find matching alignment markers during assembly
- The serial number and a production period are indicated on each hemisphere



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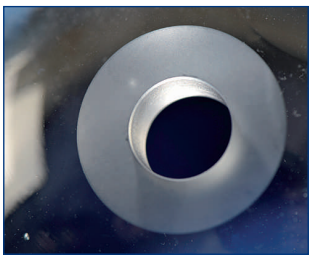
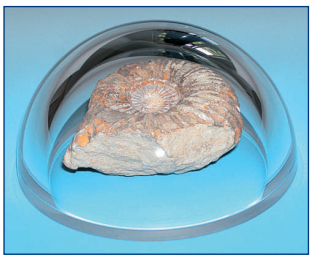
## Optional features of VITROVEX® instrument housings

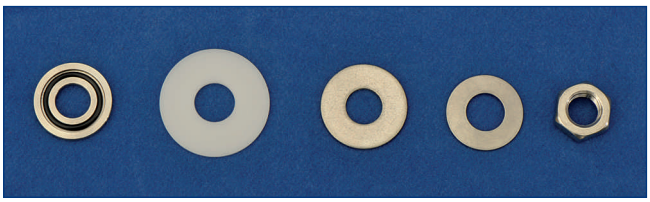
- Additional drill holes with standard (±0.2 mm) or high accuracy (±0.1 mm) to accommodate connectors, feedthroughs, and a vacuum port for connection to electronics and batteries inside, or releases, sensors or other packages on the outside
- Adapter plates to avoid bearing stresses for standard connectors
- Optical polishing for high-resolution digital cameras or sensors utilizing light
- Manometer to monitor vacuum
- Paint coating
- Pressure test prior to shipment to guarantee reliability during operation
- Mooring components (swivelling sphere attachments and ropes)
- Protective shells are available in smooth or ribbed design and bright orange colour. They may be used to simplify mounting and keeping or just to protect the sphere inside. Protective shells are neutrally buoyant and made of polyethylene



*Drill hole and ground flat*



*Optical polished VITROVEX® hemisphere*



*Adapter plate and bulkhead assembly set*

*Protective shells*

## Glass properties of VITROVEX®

**VITROVEX®** spheres are made of borosilicate glass 3.3 with standardized physical, chemical, electrical, and optical properties, also well known as **DURAN®**. Borosilicate glass has a very high physical strength and very low thermal expansion coefficient, about one third that of ordinary glass. This reduces material stresses caused by pressure and temperature gradients, thus making it more resistant to breaking. As a result, **VITROVEX®** flotation spheres and instrument housings show very little deviation in shape even under the high pressure found in ocean trenches.

**Thermal coefficient of expansion**: 3.3 x $10^{-6}$/°K
**Specific gravity at 25°C**: 2.23 g/cm³
**Young's modulus**: 63 GPa
**Poisson's ratio**: 0.20
**Refractive index $n_d$**: 1.472
**Thermal conductivity at 90°C**: 1.2 W/m x °K
**Specific heat**: 0.8 J/g x °K

## Models and dimensions

| Model | depth rating [m] | outer diameter [inch] | outer diameter [mm] | glass thickness [mm] | protective shell | weight in air [kg] | weight in air [lbs] | net buoyancy [N] |
|---|---|---|---|---|---|---|---|---|
| NMS-IS-6000-VP | 6,000 | 6.5 | 164 | 7 | not available | 1.50 | 3.3 | 12 |
| NMS-IS-6700-VP | 6,700 | 17.0 | 432 | 14 | not available | 22.15 | 38 | 260 |
| NMS-IS-6700-S | 6,700 | 17.0 | 432 | 14 | smooth, orange | 22.75 | 49 | 260 |
| NMS-IS-6700-RO | 6,700 | 17.0 | 432 | 14 | ribbed, orange | 22.75 | 50 | 260 |
| NMS-IS-6700-RW | 6,700 | 17.0 | 432 | 14 | ribbed, white | 22.75 | 50 | 260 |
| NMS-IS-7000-VP | 7,000 | 13.0 | 330 | 12 | not available | 8.50 | 19 | 107 |
| NMS-IS-7000-RO | 7,000 | 13.0 | 330 | 12 | ribbed, orange | 11.10 | 25 | 107 |
| NMS-IS-8000-VP | 8,000 | 4.5 | 114 | 7 | not available | 0.70 | 1.5 | 2 |
| NMS-IS-9000-VP | 9,000 | 17.0 | 432 | 18 | not available | 21.70 | 48 | 215 |
| NMS-IS-9000-S | 9,000 | 17.0 | 432 | 18 | smooth, orange | 26.65 | 59 | 215 |
| NMS-IS-9000-RO | 9,000 | 17.0 | 432 | 18 | ribbed, orange | 27.25 | 60 | 215 |
| NMS-IS-9000-RW | 9,000 | 17.0 | 432 | 18 | ribbed, white | 27.25 | 60 | 215 |
| NMS-IS-10000-VP | 10,000 | 7.5 | 192 | 16 | not available | 3.50 | 8 | 5 |
| NMS-IS-12000-VP | 12,000 | 17.0 | 432 | 21 | not available | 25.40 | 56 | 180 |
| NMS-IS-12000-S | 12,000 | 17.0 | 432 | 21 | smooth, orange | 30.35 | 67 | 180 |
| NMS-IS-12000-RO | 12,000 | 17.0 | 432 | 21 | ribbed, orange | 30.95 | 68 | 180 |
| NMS-IS-12000-RW | 12,000 | 17.0 | 432 | 21 | ribbed, white | 30.95 | 68 | 180 |
| NMS-IC-3500-VP * | 3,500 | 7.5 | 187 | 14 | not available | 17.00 | 37.5 | 115 |
| NMS-IC-4000-VP ** | 4,000 | 7.5 | 187 | 14 | not available | 8.50 | 18.7 | 60 |

* Length up to 500 mm  ** Length up to 1,000 mm

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