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Introduction

These new systems have been manufactured from 316 Stainless Steel to reduce corrosion and time consuming maintenance requirements.

The TORNADO 4-inch dredge is designed for higher capacity hydraulic supplies that enable a dredge inlet vacuum up to 28 in/hg (97 kpa) at 2800 psi and 84lpm. The Vortex TORNADO ROV 4-inch is designed for Subsea excavation and disposal of seabed materials up to 99 millimetres in size. It can be mounted to any Work Class ROV and requires no ship deck space and sea fastening. The Vortex TORNADO 4-inch is very powerful, has no depth limitations and is quick and easy to mobilize and operate, it can also be run in air.

The Vortex TORNADO 4-inch equipment can be operated and maintained by the ROV crew, however it is advised Vortex personnel be involved in the initial set up and testing phase on each operation.

Vortex has developed a dredge kit with two primary considerations:
First priority is ease of mobilization. The client needs to see rapid deployment of hire gear. We have included a comprehensive range of the many brackets and fixtures the ROV operator commonly has to manufacture whilst offshore. Flotation is supplied as standard kit, again alleviating the need to source suitable buoyancy.
The entire kit is shipped in one single box.

Second priority is power. Our TORNADO 4-inch dredge has shown under real world conditions to provide removal rates well in excess of other 4-inch dredges and has been comparable to 6-inch dredges in performance.
We have included the option of a jetting head kit, after extensive development to ensure there is no reduction in water flow to the dredge unit which can reduce available working vacuum.
Wear components are replaceable and manufactured from very high grade, wear resistant stainless steel.
Our low hydraulic demand leaves extra flow available on many ROV hydraulic supplies to run a dedicated high pressure jetter.

Your safety is your responsibility. Please ask if you are unsure about anything.
Operating Limits
The operating limit for the Vortex TORNADO 4-inch, will be the responsibility of the Senior ROV person on-site. The limitation being the ability to safely deploy and recover the ROV system with the Vortex TORNADO 4-inch attached. Care must be taken whilst during launch and recovery operations to prevent damage to all components of the dredge system and the ROV.

Risks - Normal Operations
All personnel involved in deck operations shall be aware of the potential risk described hereafter.

- Crane Handling (possible danger of e.g. heavy falling object)
- Launch and recovery of equipment over the side of the vessel
- Personnel working over open sea (typical personnel working with launch and recovery of equipment from vessel deck or moon pool)
- Object falling down from height (rocks following the equipment when recovering)
- Working with equipment under pressure (hydraulics or water)
- Hydraulic oil spillage

Safety
Personal protection equipment recommended for use when working on ship/platform deck

- Hard Hat
- Safety glasses
- Gloves
- Safety Boots
- Overall

Vortex TORNADO 4-inch Introduction
The Vortex TORNADO 4-inch is designed for Subsea excavation and disposal of sediments and gravel up to 99 millimetres. It is easily mounted to the ROV and requires no ship deck space and sea fastening. The Vortex TORNADO 4-inch requires no specialist operator or additional cables between ship and sea floor.
The Vortex TORNADO 4-inch is characterized by the following advantages:

- No depth limitations
- Quick mobilization
- Easy operation

The Vortex TORNADO 4-inch equipment is easy to set up and use. However, if on site support is agreed in the contract, Vortex Personnel will assist during mobilization and demobilization and or support the project during the entire operation.

Vortex TORNADO 4-inch Dredge Capacity

*Based on ironsand and rocks at 2.375 kg per litre*

- Debris Removal rates (ton/hr): *60 ton per hour plus*
- Debris removal rates (mtr³/hr): *27 cubic meter per hour*  *15% solids by volume*
- Rated Maximum stone size: 100 mm
- Actual Maximum stone size: 99.5 mm
- Inlet suction hose length: 3800 mm standard to custom length
- Exhaust throw length: 1700 mm standard to custom length
- Hydraulic flow required: 75 lpm minimum (19 gpm minimum)  
  OPTIMUM FLOW IS 84 lpm (22 gpm)
- Coupling compensator: NO
- Hydraulic pressure required: 165 bar minimum (2400 psi minimum)  
  OPTIMUM PRESSURE IS 2800 psi (193 bar) (4500 psi max)
- Overrun valve std: YES
- Direction run valve std: YES
- Operating depths: Unrestricted
- Operate pump in air: YES
- Flotation provided in kit: YES, 95 kg of buoyancy
- Available suction at inlet: 28 in/hg (97 kpa) at 2800 psi and 84 lpm
# Main Components Weights and Measures

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump weight in air</td>
<td>45 kg</td>
</tr>
<tr>
<td>Venturi</td>
<td>18 kg</td>
</tr>
<tr>
<td>Water pump to Venturi U bend</td>
<td>6 kg</td>
</tr>
<tr>
<td>Bungee cord and carabiner</td>
<td>n/a</td>
</tr>
<tr>
<td>Cargo straps</td>
<td>1 kg each (5 units)</td>
</tr>
<tr>
<td>Exhaust hose</td>
<td>6 kg</td>
</tr>
<tr>
<td>Frame</td>
<td>9 kg</td>
</tr>
<tr>
<td>Hydraulic hoses</td>
<td>6 kg</td>
</tr>
<tr>
<td>Pipe bends for inlet and exhaust hose</td>
<td>6 kg (4 units)</td>
</tr>
<tr>
<td>Inlet hose</td>
<td>12 kg</td>
</tr>
<tr>
<td>Manipulator clamp</td>
<td>0.5 kg</td>
</tr>
<tr>
<td>Shipping box</td>
<td>120 kg empty, 392 kg full and ready to ship</td>
</tr>
<tr>
<td>Spare exhaust cone</td>
<td>3 kg</td>
</tr>
<tr>
<td>Spare gaskets</td>
<td>n/a</td>
</tr>
<tr>
<td>Spare hose clamps</td>
<td>1 kg</td>
</tr>
<tr>
<td>Spare inner wear liner</td>
<td>6 kg</td>
</tr>
<tr>
<td>Pipe clamp for U bend</td>
<td>0.5</td>
</tr>
<tr>
<td>Saddle clamp</td>
<td>1 kg each (2 units)</td>
</tr>
<tr>
<td>Brackets to mount pump</td>
<td>0.5 kg (2 units)</td>
</tr>
<tr>
<td>Water pump outlet 45 degree bend</td>
<td>2 kg</td>
</tr>
<tr>
<td>Spare cam locks</td>
<td>1 kg (2 units)</td>
</tr>
<tr>
<td>3 inch water pump to Venturi hose</td>
<td>4 kg</td>
</tr>
<tr>
<td>Manuals</td>
<td>n/a</td>
</tr>
<tr>
<td>Flotation x 6 pieces</td>
<td>Combined Weight 132 kg of mass</td>
</tr>
<tr>
<td>Buoyancy of flotation combination</td>
<td>Buoyancy = 95 kg of total lift (1000 mtr rated), 3000 mtr rated optional</td>
</tr>
<tr>
<td>Buoyancy tie rod</td>
<td>n/a</td>
</tr>
</tbody>
</table>

**VORTEX remote pump inlet filter kit** 1x flange with straight pipe, 1 x flange with 90 degree bend, 1 x 4 inch hose section.

**VORTEX pump spares kit** with spare over run check valve CXFA-XAN.

All items must be accounted for upon return to avoid damage / loss charges.
User Checklist BEFORE Dive

To prevent any damage to the equipment this checklist must be followed

Project:  .................................................................  Dredge No:  .................................................................

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Checked</th>
<th>Comments</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ensure ROV can and does supply 75 lpm minimum (19 gpm minimum) 165 bar minimum (2400 psi minimum) before fitting dredge kit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OPTIMUM FLOW IS 84 lpm (22 gpm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>OPTIMUM PRESSURE IS 2800 psi (193 bar) (4500 psi max) Follow hose directions as shown</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>All fittings are checked for leakage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>All hose clamps are checked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pumps are fastened, no loose screws</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Suction hose is fastened</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Dredge is fastened, no loose ends</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>All hoses are fastened and in proper condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Filter for induction is mounted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>No hoses are squeezed or bent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Inlet nozzle is mounted correctly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Case drain and coupling are filled with clean oil</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments: ...............................................................................................................................................................................................................................................
.......................................................................................................................................................................................................................................................
.......................................................................................................................................................................................................................................................

Dredge is checked by: .................................................................  Date:  .................................................................
# User Checklist AFTER Dive

To prevent any damage to the equipment this checklist must be followed.

**Project:** ..................................................  **Dredge No:** ..............................................................

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Checked</th>
<th>Comments</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equipment used in the sea must be properly cleaned with fresh water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>All fittings are checked for leakage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>All hose clamps are checked</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Pumps are fastened, no loose screws</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Suction hose is fastened</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Dredge is fastened and in proper condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>All hoses are fastened and in proper condition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>No hoses are squeezed or bent</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Hydraulic motor and coupling is filled with clean oil</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Broken parts are reported to vortex</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Comments:** ........................................................................................................................................................................................................
........................................................................................................................................................................................................

**Dredge is checked by:** ..................................................  **Date:** ..............................................................

**Comment Form:**

**What were the positives?** ........................................................................................................................................................................................................
........................................................................................................................................................................................................

**What were the negatives?** ........................................................................................................................................................................................................
........................................................................................................................................................................................................

**Suggestions to make this kit better for you to use in the field:** ........................................................................................................................................................................................................
........................................................................................................................................................................................................
Vortex TORNADO 4-inch Hydraulics

**Hose Connectors**

<table>
<thead>
<tr>
<th>Type</th>
<th>Hose</th>
<th>Fitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4” Pressure</td>
<td>Hydraulic Hose -12</td>
<td>JIC Female</td>
</tr>
<tr>
<td>3/4” Return</td>
<td>Hydraulic Hose -12</td>
<td>JIC Female</td>
</tr>
<tr>
<td>3/8” Case Drain</td>
<td>Hydraulic Hose -6</td>
<td>JIC Female</td>
</tr>
</tbody>
</table>

**Hydraulic Motor Requirements**

- **Capacity / Pressure:**
  - 75 lpm minimum (19 gpm minimum)
  - 165 bar minimum (2400 psi minimum)
  - **OPTIMUM FLOW IS 84 lpm (22 gpm)**
  - **OPTIMUM PRESSURE IS 2800 psi (193 bar) (4500 psi max)**

Vortex TORNADO 4-inch Pump and Motor

The pump must be mounted on the ROV with ample room for both hydraulic and water hose connections.

Hydraulic connections seen at the top. Fill hydraulic motor with clean oil before start up.

Pump can also be run in air.

Vortex TORNADO 4-inch Pipe Work

Vortex pipe-work with cam locks for suction hose and pressure hose (left) and exhaust tube (right). The pipework is easily fixed to the ROV using cargo straps or ropes.

Vortex TORNADO 4-inch Pressure Hose

Pressure hose between pipe-work and pump. Inlet filter for pump flexible hoses to simplify assembly and placement of equipment on the ROV.

Suction Hose and Handle

The suction head comes equipped with a fish-tail style handle for ROV manipulator. Other handle versions can be supplied. Depth markings supplied for ease of operation.
To facilitate mobilization times, the water pump hydraulic motor has an ‘over spin’ valve fitted as standard equipment so ROV crew do not need to find or adapt a check valve. ‘Reverse flow’ of hydraulic fluid through the motor will result in water pump not working, but will not damage components as hydraulic fluid will flow through ‘over spin’ valve back to tank.

**Important** - ensure motor case is filled with clean oil before start up. Failure to do this can cause hydraulic motor failure. Always ensure a high standard of cleanliness when connecting and disconnecting hoses and couplings.

OPTIMUM FLOW IS 84 lpm (22 gpm)

OPTIMUM PRESSURE IS 2800 psi (193 bar)

(4500 psi max)
Vortex TORNADO 4-inch Hydraulics

Hydraulic Schematics

Vortex TORNADO 4-inch Hydraulic Hoses

Hydraulic hoses for pump/motor connections.
Two 3 mtr lengths 3/4" hoses
One 3 mtr length 3/8"
Weight approx. 6 kg

Hydraulic hoses 3 mtr long each.
4250 psi (293 bar) pressure rating.
-12 jic Pressure, -12 jic tank, -6 jic case drain.
Ensure ROV can and does supply 75 lpm minimum
(19 gpm minimum) 165 bar minimum (2400 psi minimum)
before fitting dredge kit.
OPTIMUM FLOW IS 84 lpm (22 gpm)
PRESSURE IS 2800 psi (193 bar) (4500 psi max)
Installation - Component Placement

**WATER PUMP IN FRAME OPTION:**
This illustration depicts only one of many combinations that may be used to mount the water pump onto the ROV utilizing the supplied frame. If needed, the supplied buoyancy should be placed where it would be most effective to balance the weight of the dredge components to achieve neutral pitch and roll of the ROV when submerged.
Installation - Component Placement

**WATER PUMP MOUNTED AWAY FROM VENTURI INSTALLATION:**
This illustration depicts only one of many combinations that may be used to mount the water pump onto the ROV independently of the Venturi by using the supplied brackets, cargo straps and pipe clamps. Installation should have as few bends in hoses as possible.
If needed, the supplied buoyancy should be placed where it would be most effective to balance the weight of the dredge components to achieve neutral pitch and roll of the ROV when submerged.

Venturi will often fit inside ROV frame, greatly increasing A-Frame launching clearance.

Simple fast and secure installation options. Supplied, pre-made pump brackets greatly reduce mobilization time.
Cargo straps for general tie backs of hoses and mounting of Venturi to ROV frame if need be. Weight = 0.5 kg each

Bungee cord with carabiner used to tie back inlet hose on ROV frame and allow movement of inlet hose. Weight = N/A

Frame to mount water pump and Venturi. Bolt frame complete with water pump and Venturi directly to ROV frame, or strip components to mobilize as location allows. Weight = 9 kg Dimensions = 420 mm wide x 700 mm long x 600 mm high

Optional water jetter: Uses water taken from the water pump outlet and shown in tests not to affect dredge suction performance. Included in kit, ‘slip-on’ jetter head goes on end of suction inlet, diverter valve, hydraulic hoses.
Installation - Frame Configuration

Venturi bolted to right side of frame

Venturi can mount to frame in many configurations to suit your installation
Installation - Water Pump

Water pump shown with hydraulic hose marking tags. Hydraulic motor is fitted with over spin valve as standard equipment. Coupling has been engineered to operate without external compensator to avoid oil leakage. Water pump shown with 90 degree water outlet. Also supplied is a 45 degree water outlet. Both outlets have multi-position bolt holes to facilitate installation in ROV frame. Water pump with hydraulic hose marking tags for easy identification and mobilization.

Water pump shown mounted on brackets supplied as optional method for mounting on ROV frame. Weight in air = 46 kg

Ensure ROV can and does supply 75 lpm minimum (19 gpm minimum) 165 bar minimum (2400 psi minimum) before fitting dredge kit.

OPTIMUM FLOW IS 84 lpm (22 gpm)
OPTIMUM PRESSURE IS 2800 psi (193 bar) (4500 psi max)

Water pump mounted on generic brackets and motor ‘over spin’ valve block mounted on hydraulic motor. Weight in air = 46 kg including brackets

Brackets to mount water pump generically to ROV frame. Weight = 0.5 kg
Dimensions = 700 mm x 40 mm x 40 mm
Installation - Remote Water Pump Filter

Water pump inlet filter shown bolted to remote kit flange and hose from water pump. Route hose through ROV where convenient.

Water pump inlet filter removed from pump body, remote kit flange bolted to pump body and fitted with hose leading to filter placed in convenient location with access to ‘clean water’ away from sand and debris.

Vortex water pump, remote inlet filter kit.
Installation - Hose Connections

Water pump to Venturi hose cam locks for generic ROV installation. Field fit on supplied hose between water pump and Venturi use when mounting water pump and Venturi separately on ROV frame. Weight = 1 kg each

Venturi 4-inch
Weight = 18 kg, Length overall = 1066 mm

Water pump to Venturi hose for field fitting during generic ROV installation.
Weight = 4 kg
Length = 2500 mm
Installation - Hose Connections

Inlet and exhaust 4-inch hose bends for routing inlet and exhaust hoses.
45 degree = 1 kg each
90 degree = 2 kg each

Inlet hose with suction head and ROV manipulator handle.
Depth markings in 200 increments. Clip onto Venturi and attach to ROV using bungee cord or rope as required.
Weight = 12 kg
Length = 4000mm

Hydraulic hose fitted with clear markings to facilitate mobilization times. Pressure and return hoses have identical pressure rating to avoid chance of failure through incorrect assembly.

Ensure ROV can and does supply 75 lpm minimum (19 gpm minimum) 165 bar minimum (2400 psi minimum) before fitting dredge kit.

OPTIMUM FLOW IS 84 lpm (22 gpm)
OPTIMUM PRESSURE IS 2800 psi (193 bar) (4500 psi max)
Installation - Clamps

Pipe clamps to secure Venturi to frame and generically to ROV frame. Remove from frame and use to mount Venturi as desired.
Weight = 1 kg each

U bend to Venturi clamp - when used on frame
Weight = 0.5 kg

Installation - Hose Connections

Water pump to dredge Venturi U bend. Only used when pump installed in frame.
Weight = 6 kg

Exhaust hose fitted to rear of Venturi.
Weight = 6 kg
Length = 1700 mm
Installation - Flotation

Flotation shown mounted on top of frame. Blocks can be secured with threaded rod or rope lashing using holes provided in blocks and aligning holes in frame. Flotation blocks measure approximately 680 mm long x 400 mm wide x 110 to 170 mm high for varying options of buoyancy.

(Note: Flotation blocks may differ from kit to kit)

1000 mtr rated flotation blocks give total combined lift of 95 kg
3000 mtr rated flotations optional
Spare Components

Spare exhaust cone. Fit to Venturi as wear becomes prevalent in original cone.

Spare 4-inch and 3-inch hose clamps. Use as you see fit to mount hoses. Weight = 1 kg total.

Spare gaskets. Water pump, exhaust cone, cam locks.

Vortex pump spares kit.
Shipping Box and Correct Stowage of Components

Shipping box:
Weight = 120 kg empty, 392 kg full.
Dimensions = 1000 mm wide x 1620 mm long x 1020 mm high

Forklift slots fitted to alleviate need for certified lifting points. No protrusions from box reduce risk to box and surrounding equipment.
Lockable at two points. Aluminium construction for lightweight.

NOTE: It is the field crew’s responsibility to ensure the correct placement of components in box prior to return to avoid incurring damage / loss costs.

PLEASE RE-ASSEMBLE ALL COMPONENTS AS FOUND TO ENSURE SAFE SHIPPING TO BASE.
FAILURE TO DO SO MAY INCUR DAMAGE COSTS.
Shipping Box and Correct Stowage of Components

Photos show how kit is stacked for transit and shipping. Please ensure you check off inventory (shown on sticker inside lid) before transit and shipping.
Trouble Shooting

**Symptom: Water pump not operating**

Remedy:
1. Ensure that the hydraulic hoses are connected as per manual drawings and match connection labels.
2. Check that 75 lpm minimum (19 gpm minimum) 165 bar minimum (2400 psi minimum) can be seen directly at the Vortex water pump hydraulic motor. OPTIMUM FLOW IS 84 lpm (22 gpm) OPTIMUM PRESSURE IS 2800 psi (193 bar) (4500 psi max).
3. Check any quick connect fittings you may have in the circuit as they can sometimes be faulty.
4. Are your thrusters using most of the available system flow and starving your circuit feeding the Vortex water pump?
5. Ensure the Vortex case drain is connected directly to tank. It is preferable to connect as close as possible to the reservoir and not run any hoses through quick connects.
6. Has the water pump impeller been damaged by excessive silt or other dirt ingress? If so, please repair as necessary with accordance to supplied Vortex pump servicing handbook.
7. Check that the over spin valve is operating correctly and does not have dirt ingress causing fluid to bypass the check valve. Replace with SUN valve, part number HCV 2743 as necessary.

**Symptom: Debris removal slow**

Remedy:
1. Check the caged nozzle of inlet hose is not blocked. Stop hydraulic flow to water pump to allow rocks and debris to be cleared.
2. Check that all cam locks are fastened and secured correctly.
3. Check all cam lock o-rings are in place and in good condition.
4. Use steady and consistent movements when plunging suction hose inlet into seabed. Try side to side and up and down movements of suction hose inlet. Differing conditions may require changing methods.
5. Check all hydraulic remedies as seen in “water pump not operating” section of trouble shooting.
6. Check inlet and exhaust hoses are not bent or blocked.
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Email: joe@vortexdredge.com, www.vortexdredge.com

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ABERDEEN
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