Dutypoint Systems

ScubaTANK™ VX2 *SERIES*

Combined Water Storage & Booster Package

FULL USER GUIDE

DUTYPOINT SYSTEMS
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SAFETY

Important Health & Safety Information

Please read this section before attempting to use or work on your* ScubaTANK™ VX2 Combined Water Storage & Booster Package *as it contains important Safety Information and the System Operating Limitations.

User Guide - Document Conventions

Throughout this manual, text may be accompanied by one of the following icons. Where these occur the conventions shown below are applied.

In general these conventions will also apply to OEM Manufacture's manuals that are included within this User Guide, however variations may occur, but these will be redefined at the beginning of their manual.

DANGER — **Denotes attention to the possibility of the risk of personal injury or damage to adjacent property if the information is ignored.**

ELECTRIC SHOCK — **Denotes attention to the possibility of life-threatening electric shock if the information is ignored.**

or

WARNING

WARNING — **Denotes attention to a condition that may result in under-performance or damage to the equipment if the information is ignored.**

NOTE — **Denotes attention to an important factor applicable to the action being performed.**

PLEASE READ THE FOLLOWING INFORMATION WHICH IS PROVIDED FOR YOUR SAFETY

United Kingdom Health & Safety at Work Act 1974

Dutypoint responsibility

Section 6(a) of this Act requires manufacturers to advise their customers on the safety and the handling precautions to be observed when installing, operating, maintaining and servicing their products. The user's attention is therefore drawn to the following:

- The appropriate sections of this manual must be read before working on the equipment.
- Installation, operating and maintenance must only be carried out by suitably trained/qualified personnel.
- Normal safety precautions must be taken and appropriate procedures observed to avoid accidents.

Refer to DUTYPOINT SYSTEMS for any technical advice or product information.

Customer / Contractor responsibility

It is the responsibility of the customer and/or the contractor:

- To ensure that anyone working on the equipment is wearing all necessary protective gear/clothing.
- Is aware of appropriate health & safety warnings
- has read the information in this section of the manual.

ScubaTANK™ Servicing

Before attempting to open any unit or service a pump:

- Familiarise yourself with the relevant contents of this manual.
- Installation, maintenance and repair work must only be carried out by trained, skilled and suitably qualified personnel.
- Disconnect or lock-out the power source to ensure that the pump(s) will remain inoperative.
  Locking out the equipment by switching off the release mechanism or set value WILL NOT prevent accidental starting of the motor.
- Allow the pump(s) to cool if over-heated.
- **CLOSE** the isolating valves on the suction and discharge connections of the affected pump(s).
- **VENT** the pump(s) slowly and cautiously – *Refer to Section 4 of this manual.*
- **DRAIN** the pump(s).

Electrical Safety

High voltages

Especially applicable when Variable Speed Controllers (Inverters) are fitted.

- When the inverter variable speed drive head is connected to the power supply the components of the power unit – as well as certain components of the master control unit – are also connected to the power supply.

TOUCHING THESE COMPONENTS CAN SERIOUSLY ENDANGER LIFE!

- Before removing the frequency inverter cover, the system must be disconnected from the power supply. After switching off the power supply **wait at least 5 minutes** before starting work on or in the inverter drive head – the capacitors in the intermediate circuit must be given time to discharge completely via the discharge resistors.
  Up to 800 volts can be present – if there are faults this can be higher.
- All work carried out when the frequency inverter is open must be performed only by suitably qualified and properly authorised personnel.
  When connecting external control wires care must be taken not to short circuit adjacent components. Bare cable ends which are not in use must be insulated.

THE SYSTEM MUST ONLY BE OPERATED WHEN IT HAS BEEN CORRECTLY EARTHED AND PIPES BONDED TO EARTH IN ACCORDANCE WITH IEE REGULATIONS

Electronic safety devices

- The inverter drive heads used in *Dutypoint Systems* Pumpsets contain electronic safety devices which switch off the control element in the event of a fault developing.
  The motor will have zero current but will remain energised as it stops.
- The motor can also be stopped by ‘mechanical blocking’.
- If it is switched off electronically, the motor is disconnected from the mains voltage supply via the electronics in the frequency converter.
  The motor is not voltage-free in the circuit itself.
- Voltage fluctuations and power failures (temporary outages) can cause the motor to switch itself off.
  Repair of faults can cause the motor to start up again unexpectedly!

High voltage testing may damage electronic components

- High voltage tests of the inverter or the motor may damage the electronic components.
  Bridge before the incoming/outgoing terminals L-L2-L3 and U-V-W.
- To avoid incorrect metering by capacitors incorporated in the electronic circuits, isolate the motor from the inverter drive head.

Operating Limits For The Standard *Dutypoint* ScubaTANK™ Range

Type of pumped liquids.	Water with no gas or aggressive substances.
Maximum pumped liquids temperature.	+23°C
Minimum pumped liquid temperature.	1°C to avoid icing.
Operating ambient temperature.	+5°C to 40°C for indoor installation. (CEI EN 60439-1).
Relative humidity.	Max 50% at 40°C.
Storage temperature.	+5°C to 50°C.

1

Introduction

This Section introduces the Dutypoint ScubaTANK™ VX2 Combined Water Storage & Booster Package and provides an overview of the Pumps and Controllers.

Welcome

Thank you for purchasing one of the ***DUTYPOINT*** range of **ScubaTANK™ VX2 Combined Water Storage & Booster Packages**.

Dutypoint Systems is a Division of Elmbridge Pumps Company and manufactures pressure boosting pump systems. Since its beginnings as a supplier of pumpsets to the water industry the name 'Dutypoint' has become synonymous with unrivalled quality, service and reliability.

This manual is compiled as a composite to include both the *Dutypoint* package information and the specific manufacturer's information necessary for the installation, safe operation and user maintenance of your ScubaTANK™.

Please read and familiarise yourself with the contents of this manual.

Overview

The ScubaTANK™VX2 is a space-saving dual-pump booster system designed to supply water to properties where mains pressure is insufficient.

The vented insulated tank incorporates two stainless steel submersible pumps variable speed inverter drives. A pressure vessel and required valves are also integrated into the assembly. The inlet water supply is controlled by a slow-close solenoid valve.

It is the Installer's responsibility to ensure that the Overflow and Warning Pipe (if fitted) are suitably piped.

The overall design, combining submersible pumps in an insulated tank, eliminates most of the noise associated with domestic booster systems. Also the internal pipework design has been optimised to minimise hydraulic noise, and the controllers selected for optimum reliability and low running costs.

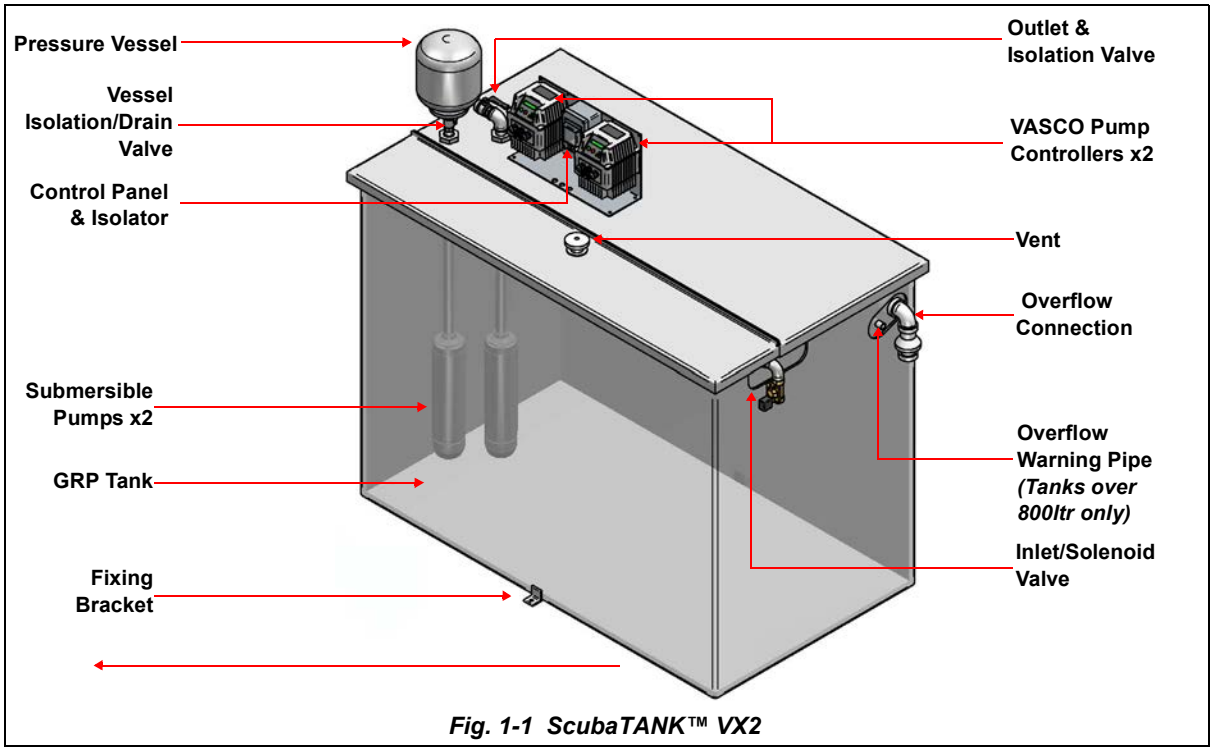


Fig. 1-1 ScubaTANK™ VX2

Technical features

- GRP construction tank, 25mm insulation (HCFC and CFC free). Reinforced base (encapsulated multi-ply board).
- Stainless steel submersible pumps.
- Stainless steel pressure vessel with drain valve.
- 1” Probe-controlled high-flow solenoid valve input.
- 1¼” BSP full-bore discharge connection (2” available on request).
- 2“Overflow pipe. Overflow warning pipe fitted to tanks above 800 litres.
- Low water level pump protection device.
- Stainless steel pumps.
- *2xVASCO* Inverter pump controllers (230 volt single phase).
- LED system status display.
- Control box with MCB protection.

Options

- Remote alarm panel with common fault volt-free contacts.
- Integral flow meter.

Full details of tank sizes and technical specifications are provided in Section 2 of this manual.

Pump

The ScubaTANK™ uses a pair of submersible pumps selected from the stainless steel *Modus* XPR range. Various pumps pressure and flow rate are available allowing selection to suit a wide usage range.

The specification curves for these pumps can be found in Section 2.

Fig. 1-2 Modus XPR Pump

VASCO variable speed controllers

The pumps are driven by VASCO *(variable speed controller)* units fitted to each pump. These are variable frequency drive units designed to control and protect pumping systems by varying the output frequency to the pump.

They manages the system operation to maintain a certain constant physical quantity (pressure, differential pressure, flow, temperature, etc.) regardless of the conditions of use. The pumps (configured in duty/assist or duty/standby mode) are operated only when needed thus avoiding unnecessary energy consumption and providing overall energy cost saving, longer pump life and improved reliability.

The design of the controller incorporates motor overload and dry-running protection with soft-start/stop functionality for increased system life and reduction in current surges. An indication of current consumption, voltage, and power is provided together with a run time record, and list any errors and/or failures reported by the system.

Dangerous induced surges associated with long power cables can be eliminated by using the units in association an optional inductive filter.

Full detail of operating display and setting up of the VASCO controller is given in the manufacturer's manuals republished in Appendix B of this manual.

Fig. 1-3 VASCO Controller

Control box

Power to the ScubaTANK™ pumps and controllers is connected through a control box mounted between the two VASCO pump controller units. Two MCBs in the box act as electrical isolators for each pump. The input power requirement varies from 5 to 12A @230v 50hz dependent upon tank/pump size.

The control box also houses the probe relay units which services the flow control system.

Fig. 1-4 Control Box

Pressure vessel

The ScubaTANK™ system has an integral stainless steel sealed pressurisation vessel of 12ltr capacity. An isolation/drain valve is provided below the vessel to facilitate maintenance.

Fig. 1-5 Pressure Vessel

2

Specifications, Configurations & Dimensions

This Section lists specifications and the specific details for available variants of the ScubaTANK™ VX2 Combined Water Storage & Booster Package.

- ***Identifying Your ScubaTANK™***
- ***Detailed Specifications***
- ***Arrangement & Dimensions***
- ***Pump Performance***

Identifying Your ScubaTANK™

Attached to each tank is a label (fig 2-1) that identifies the type and specification.

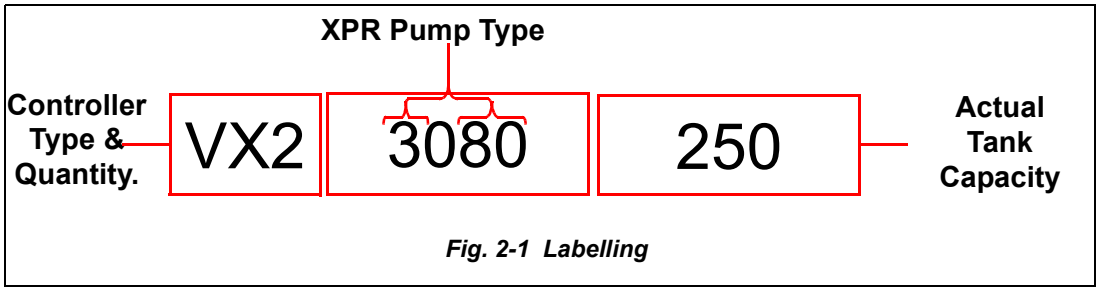


Fig. 2-1 Labelling

Detailed Specifications

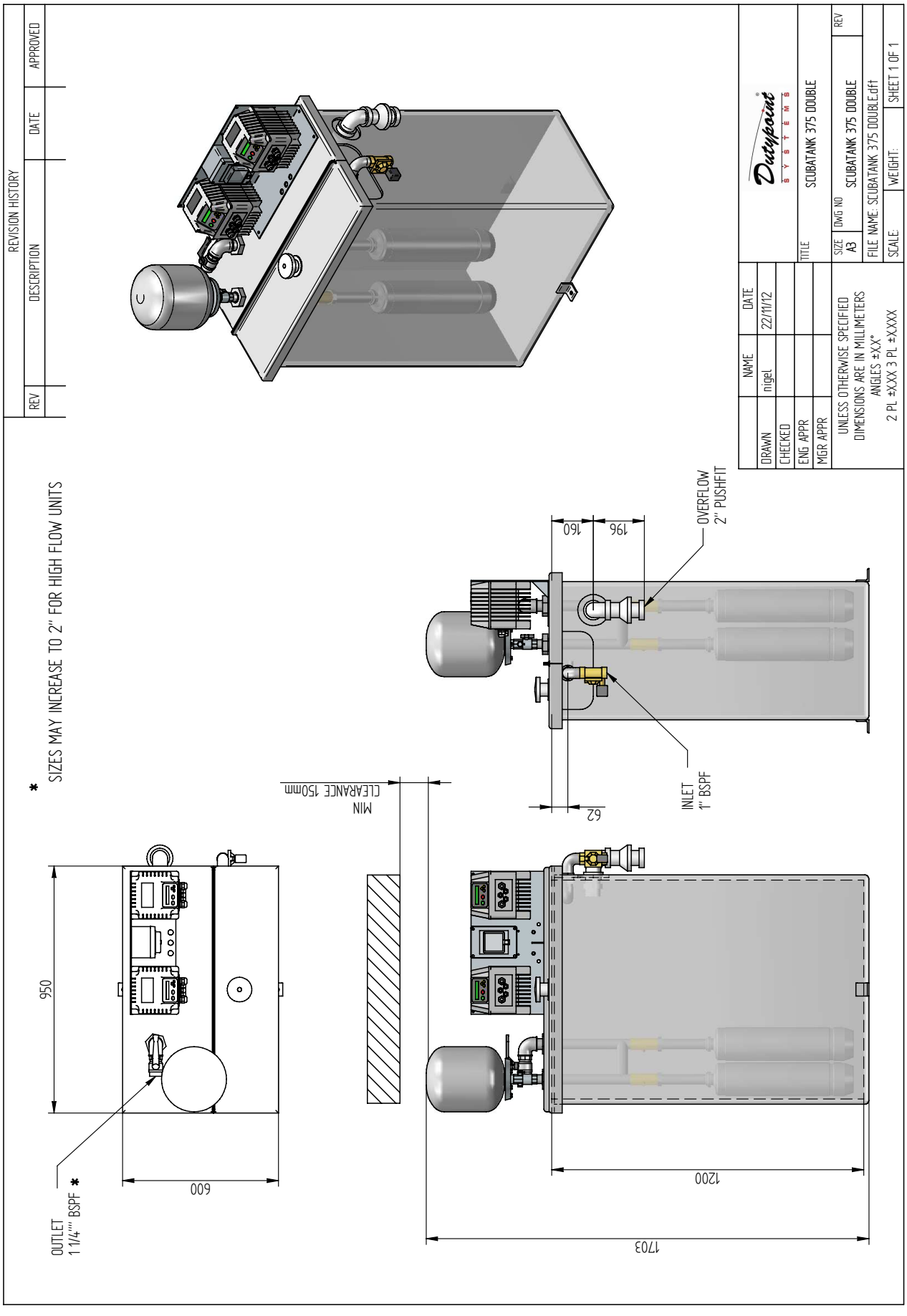
Suitability	Water with no gas or aggressive substances.
Flow range	1.2 - 3.1Litres/sec.
Pressure range	2.5 - 7.0 Bar.
Liquid temperature	Max +23°C for domestic uses. Min +1°C to avoid icing.
Operating temperature	+5 to 40°C for indoor installation. Relative humidity Max 50% @ +40°C.
Storage temperature	+5 to 50°C.
Controller type	Modus *VASCO (x2)*.
Protection	Low water level via probe control.
Tank construction	GRP construction. 25mm Insulation (HCFC and CFC free). Base reinforced with encapsulated multi-ply board and fitted with security fixing brackets.
Tank Capacity	375ltr, 650ltr, 800ltr, 1050ltr, 1250ltr, 1650ltr, 2250ltr.
Tank Dimensions	*Refer to page 17 to page 24 for details.*
Inlet Valve	1” Full bore solenoid valve
Discharge	1¼” BSP (2” available on request). Screened vent and overflow.
Pressure vessel	12ltr, Stainless steel construction.

Pump rating

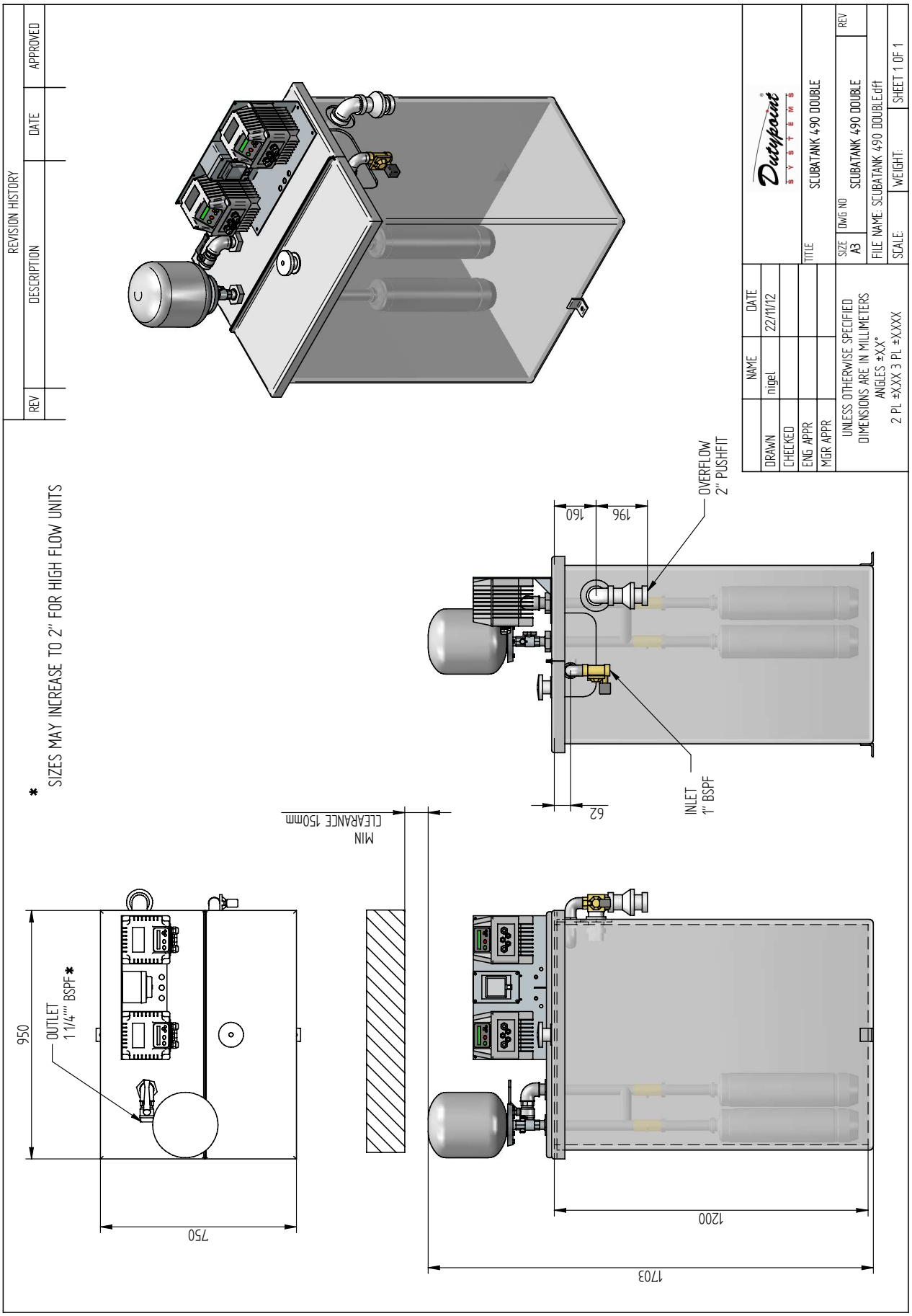
	Pump Type	Motor Power	Full Load Current
3040	XPR3040	0.55kW	4.1A
3060	XPR3060	0.75kW	5.2A
3080	XPR3080	1.10kW	7.4A
5040	XPR5040	0.75kW	5.0A
5060	XPR5060	1.10kW	7.4A
5080	XPR5080	1.50kW	10.5A
9040	XPR9040	1.50kW	10.5A
9060	XPR9060	2.20kW	11.9A

Arrangement & Dimensions

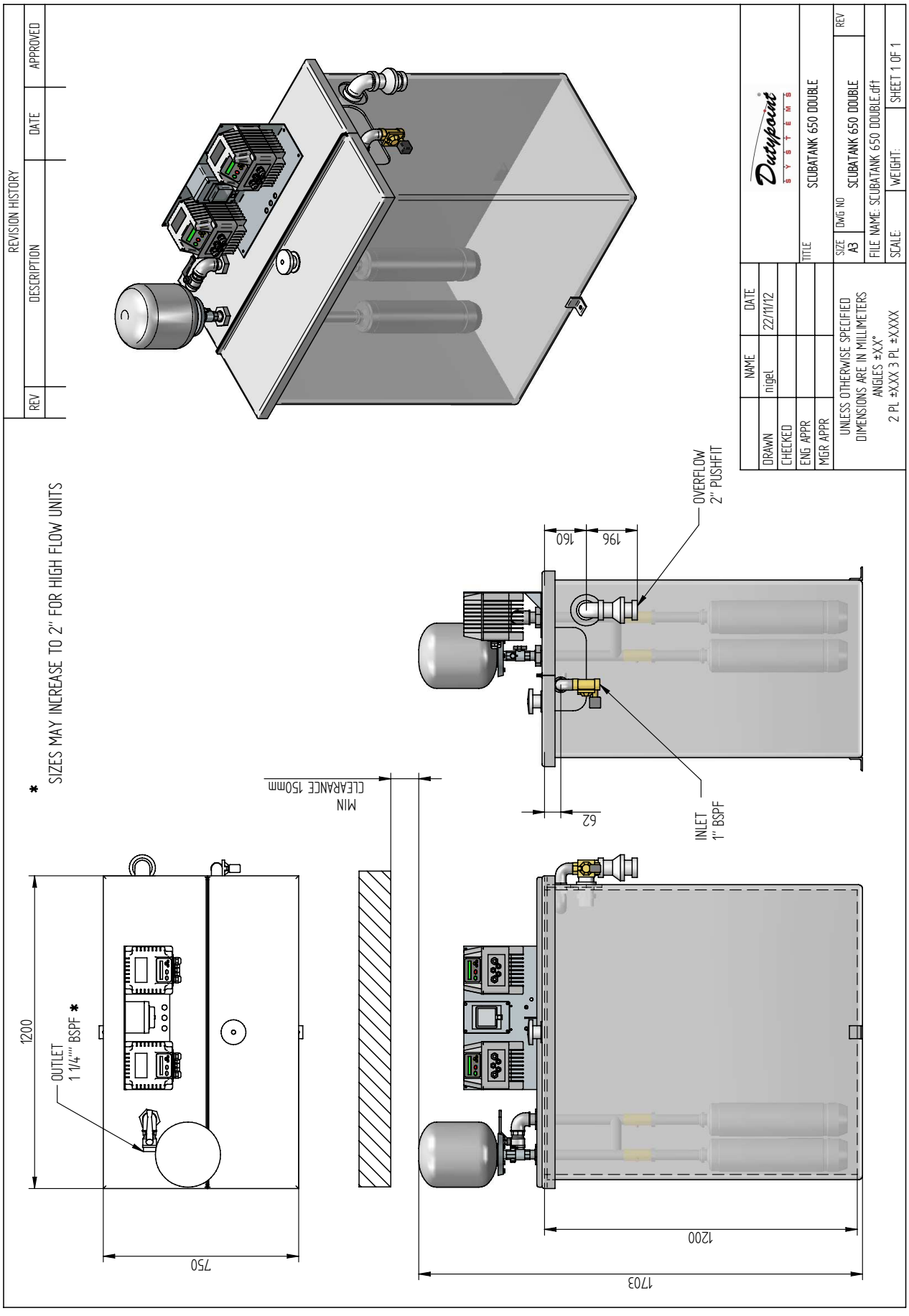
ScubaTANK™ VX2 375



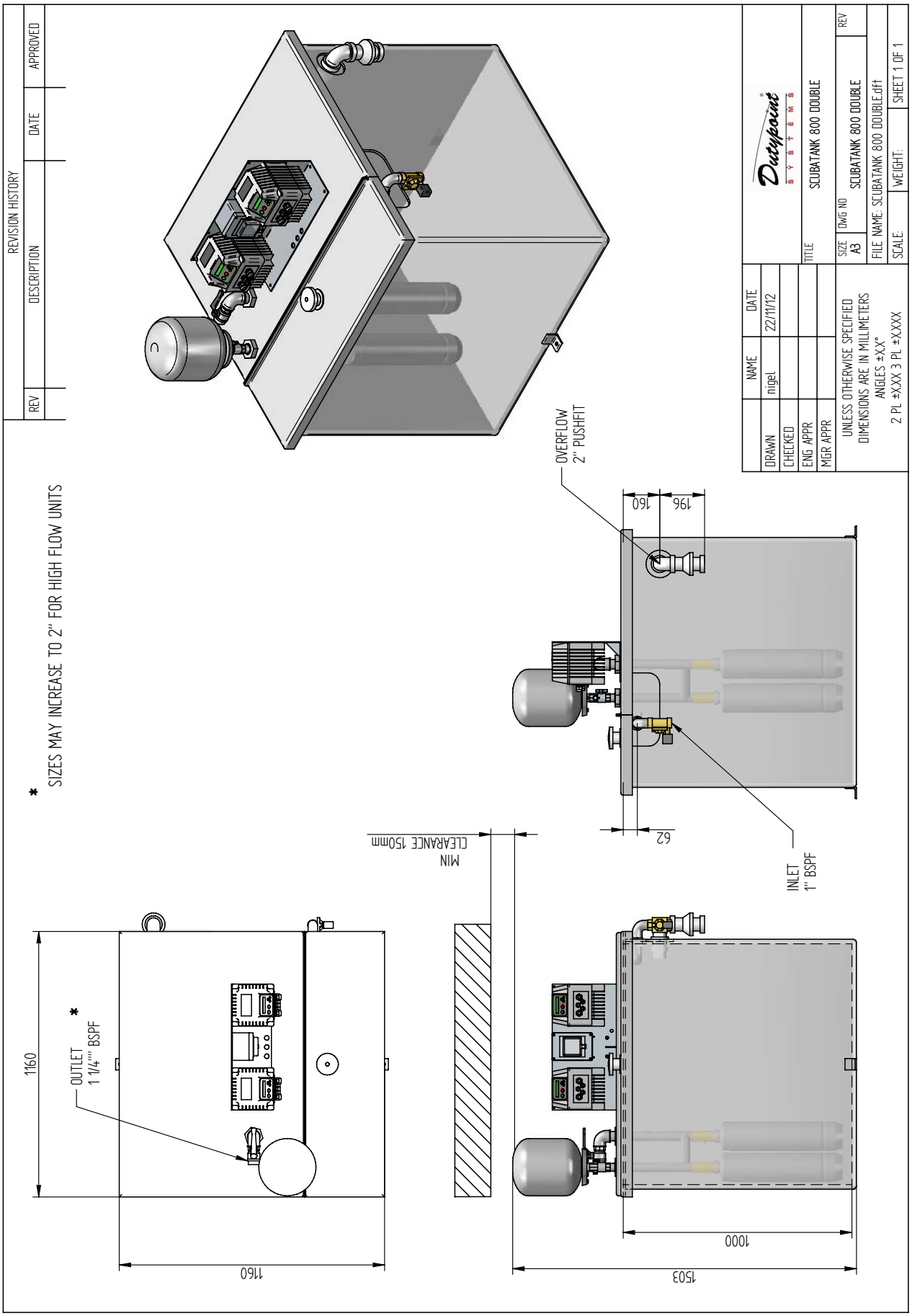
ScubaTANK™ VX2 490



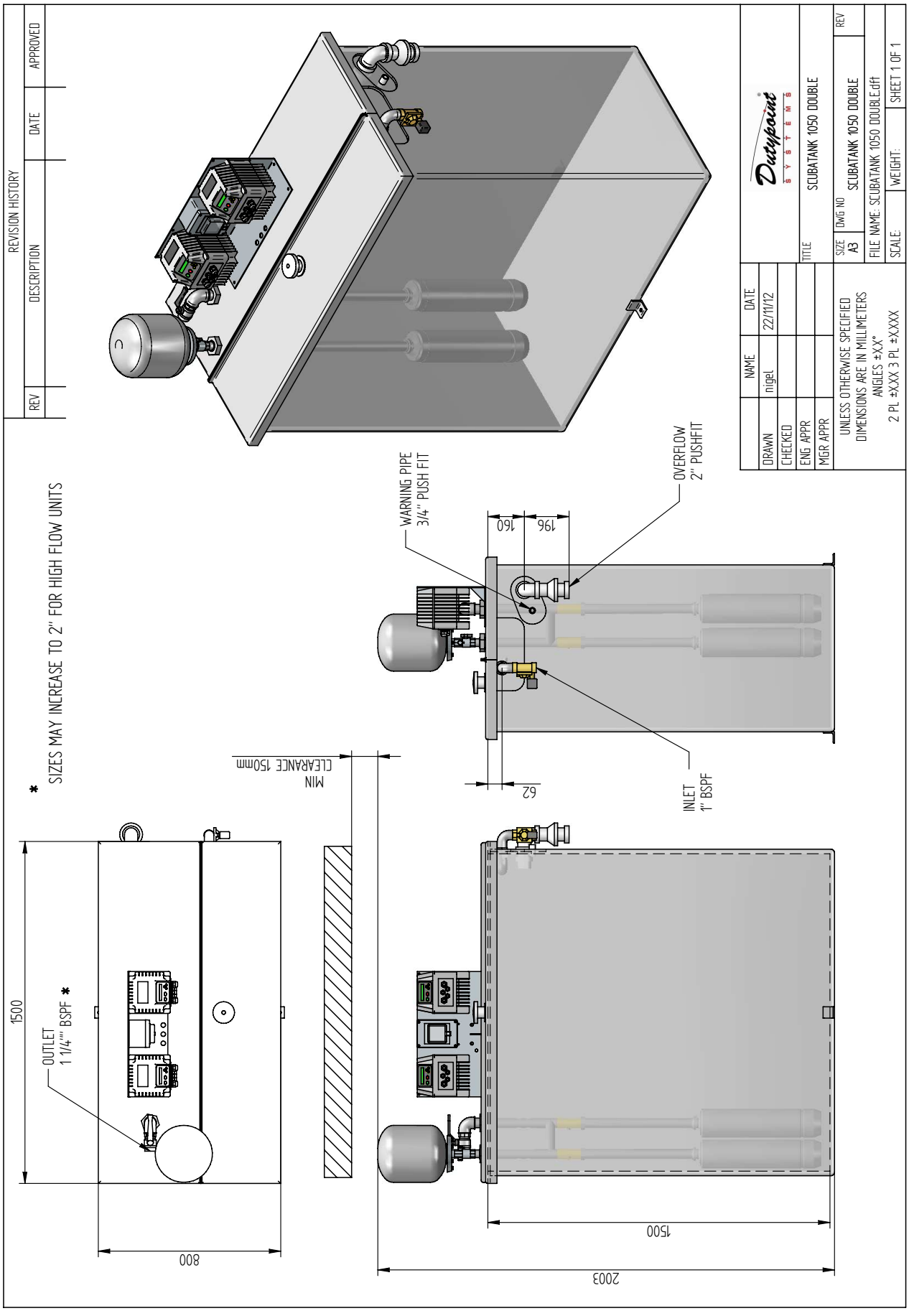
ScubaTANK™ VX2 650



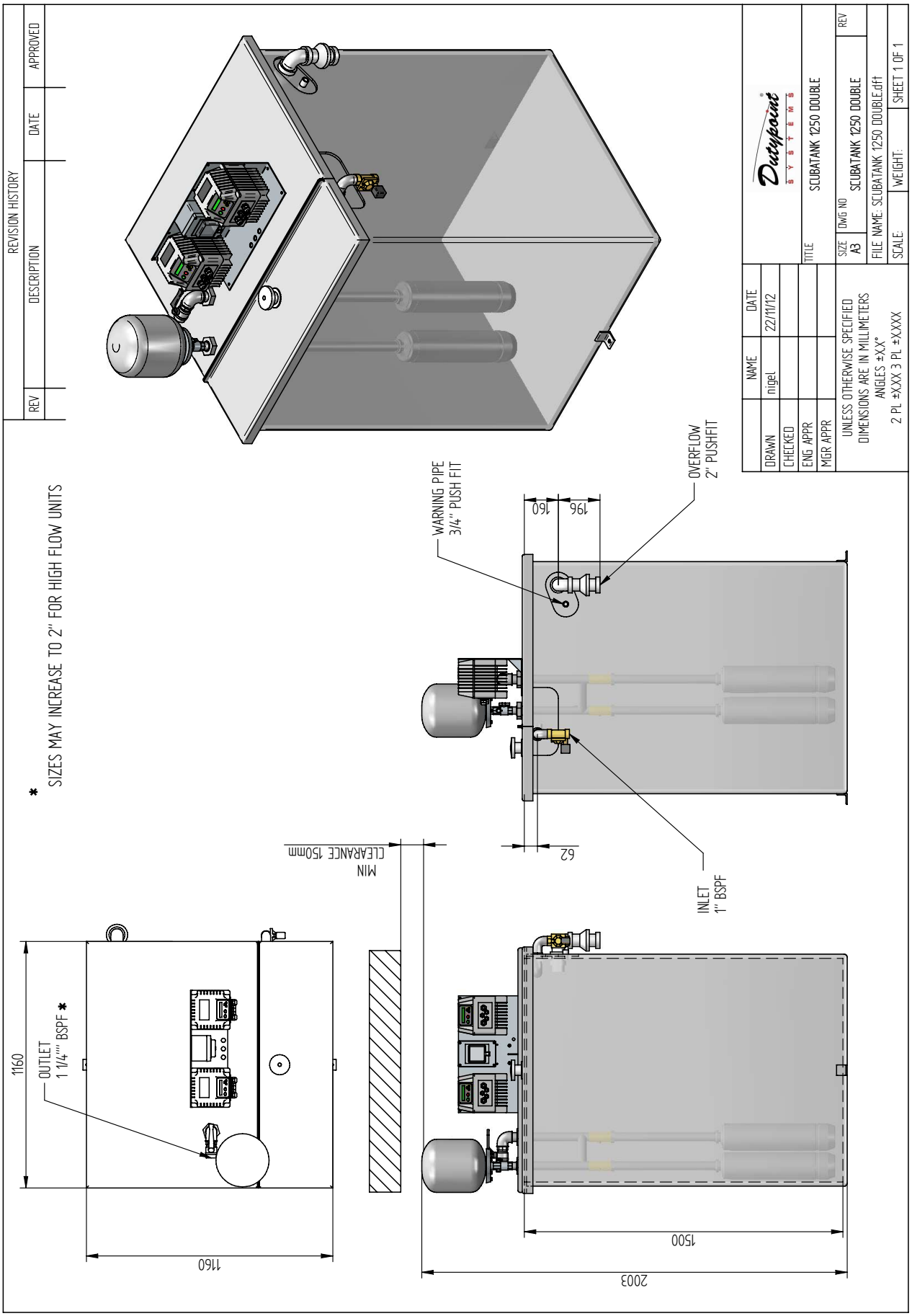
ScubaTANK™ VX2 800



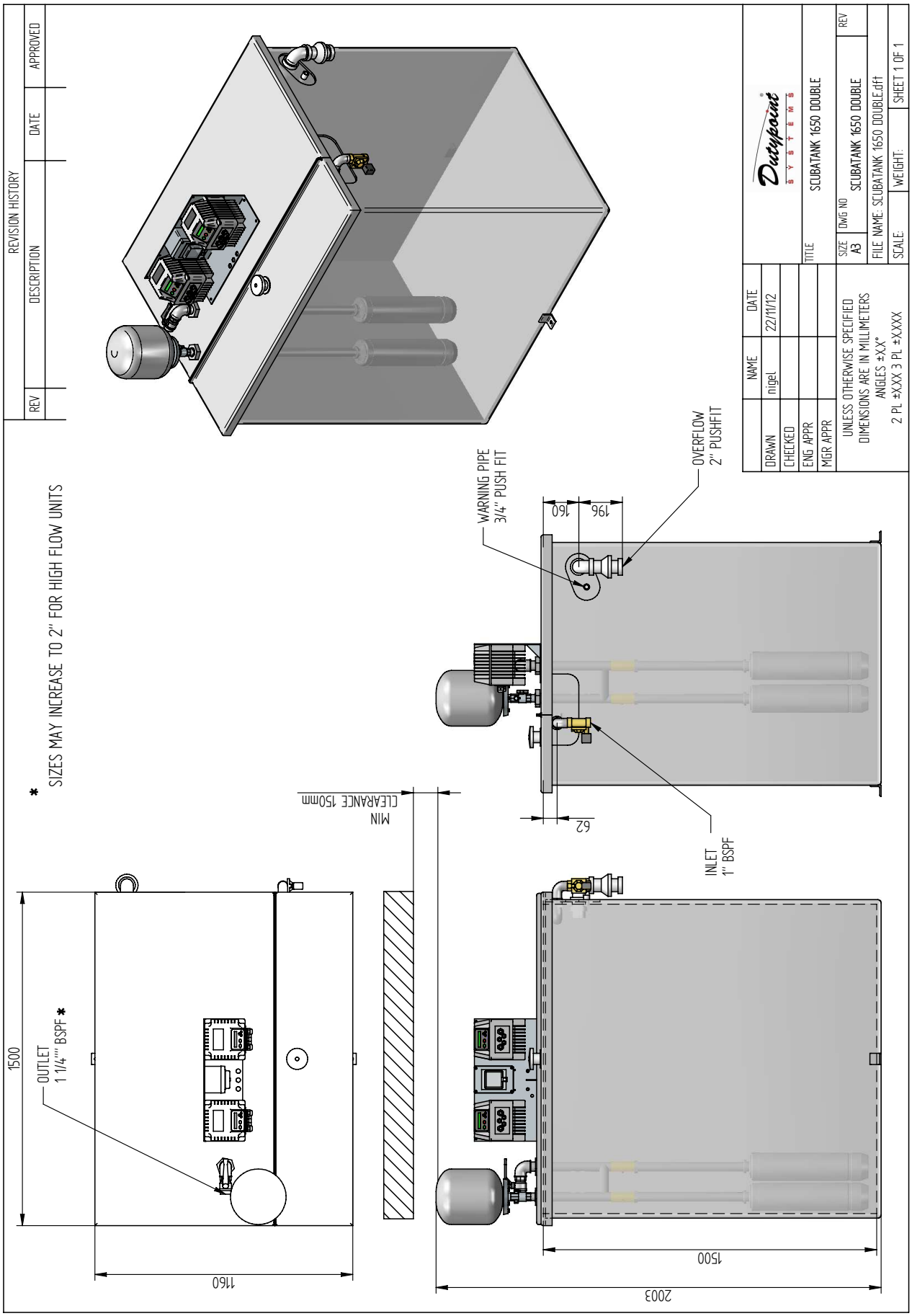
ScubaTANK™ VX2 1050



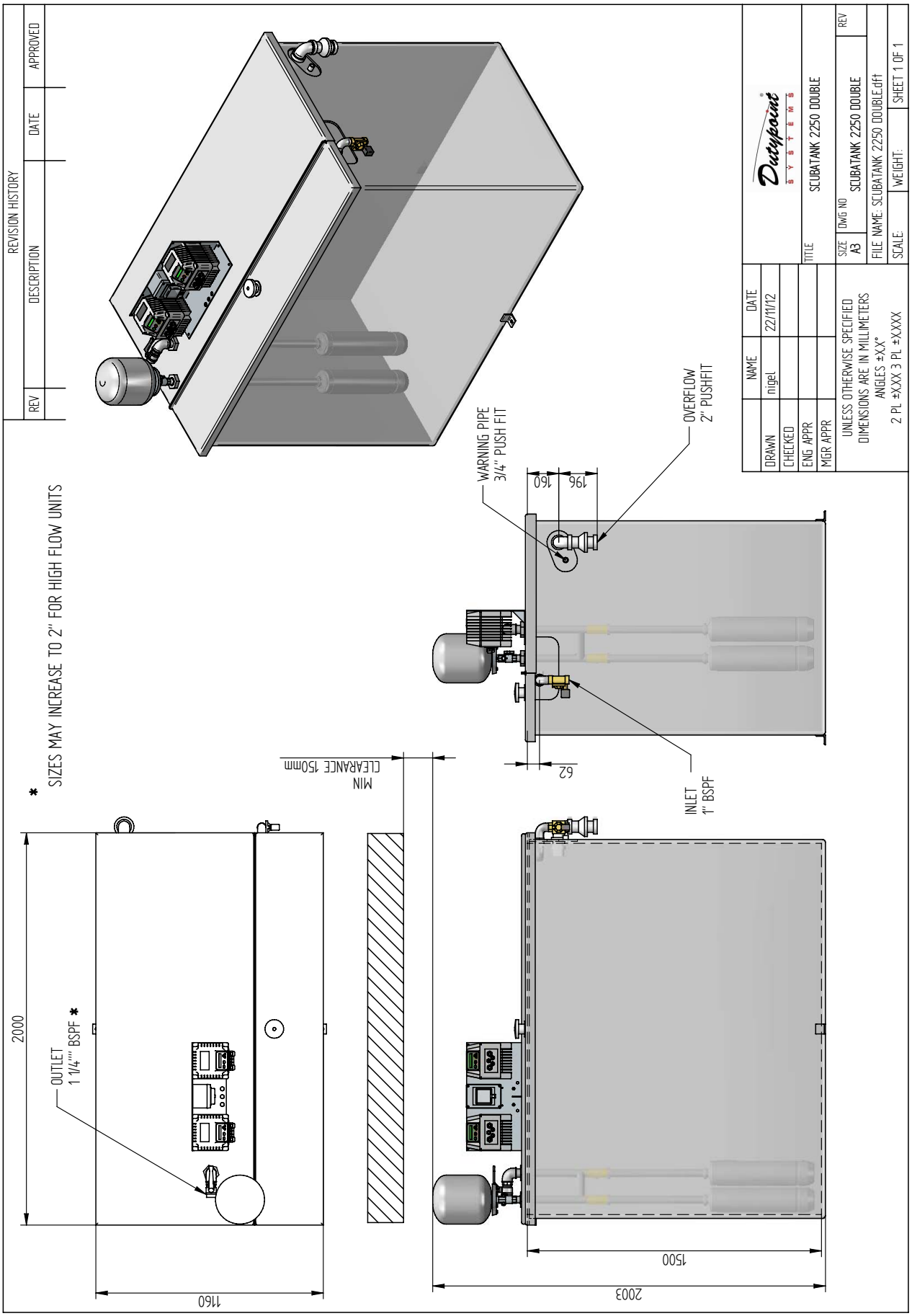
ScubaTANK™ VX2 1250



ScubaTANK™ VX2 1650

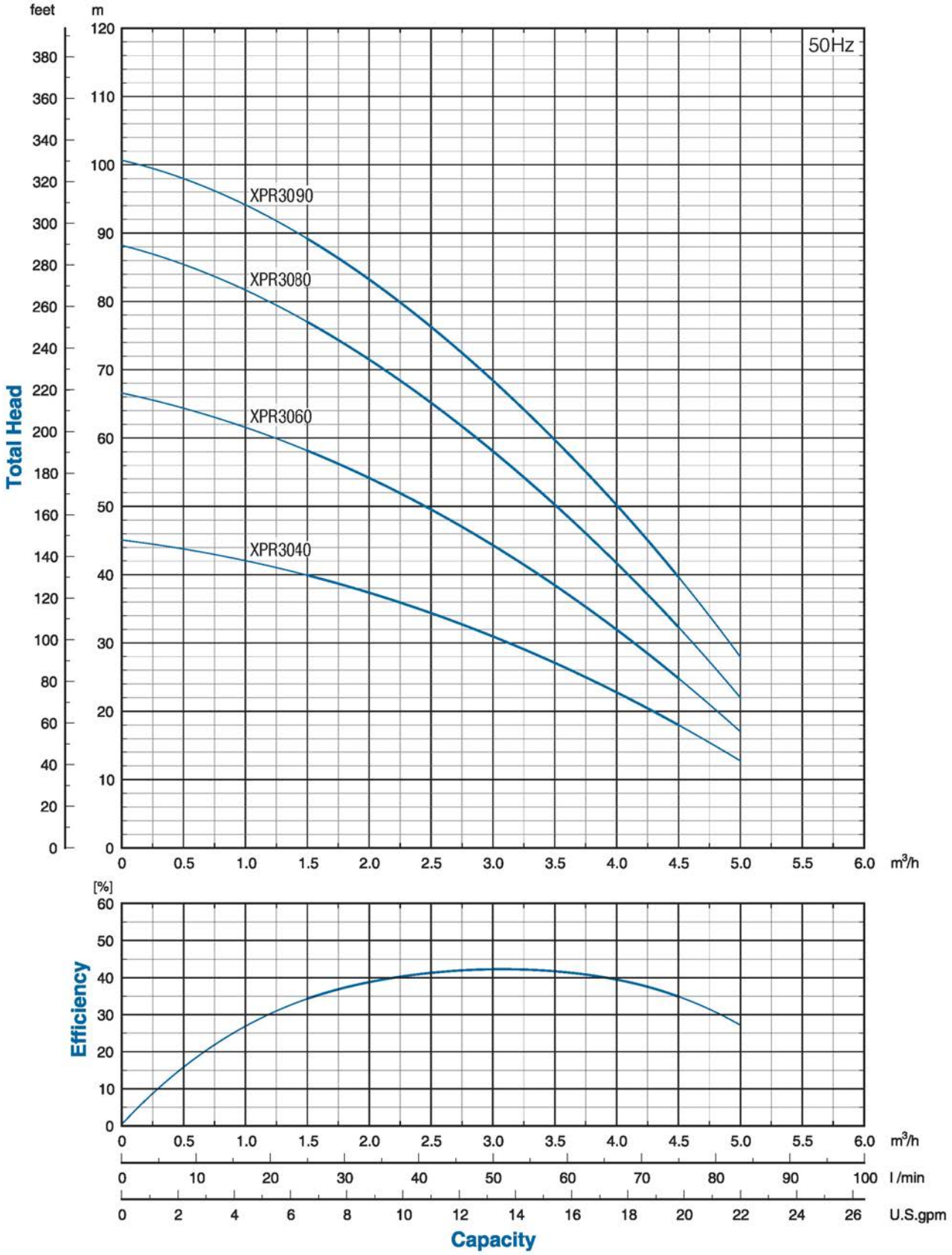


ScubaTANK™ VX2 2250

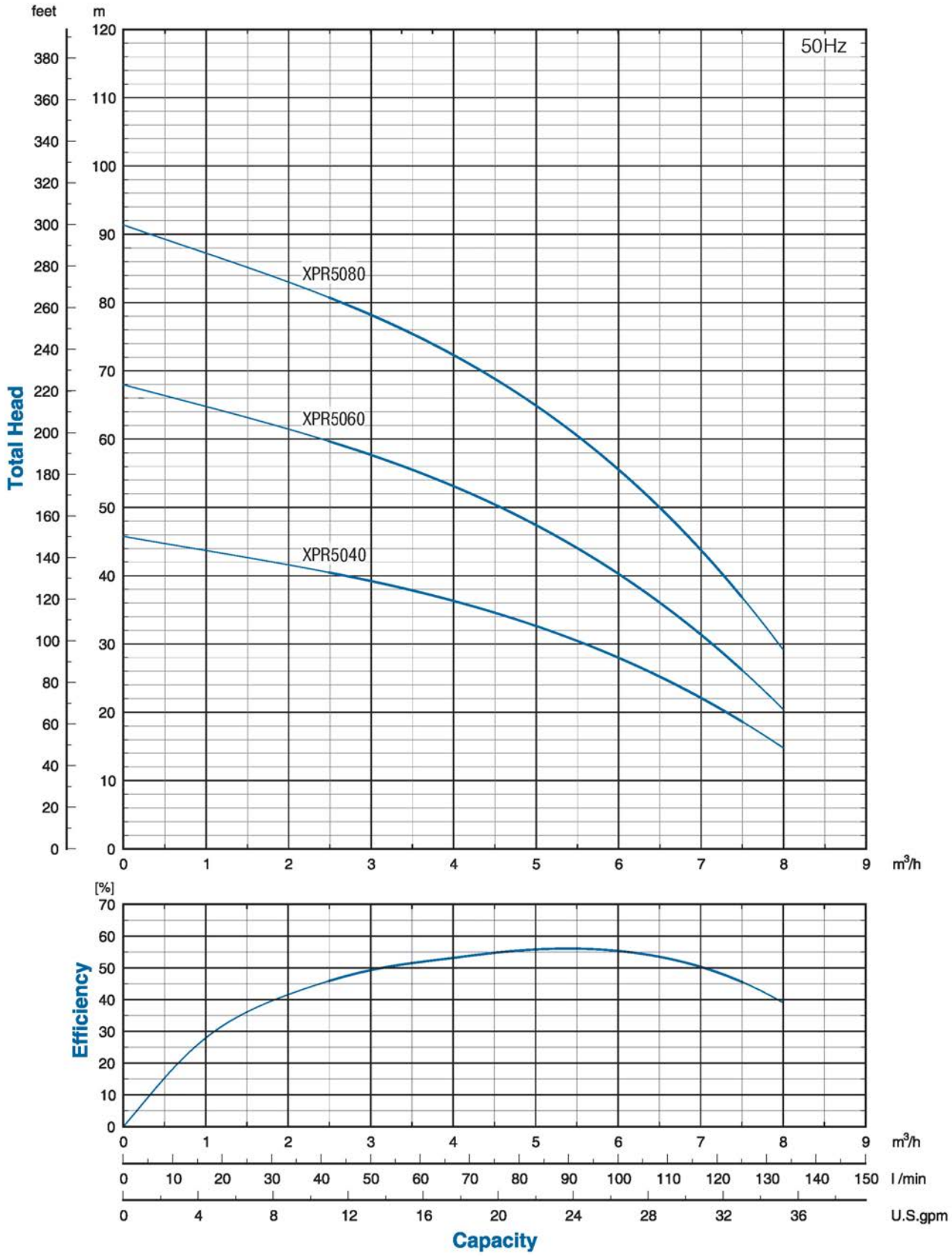


Pump Performance

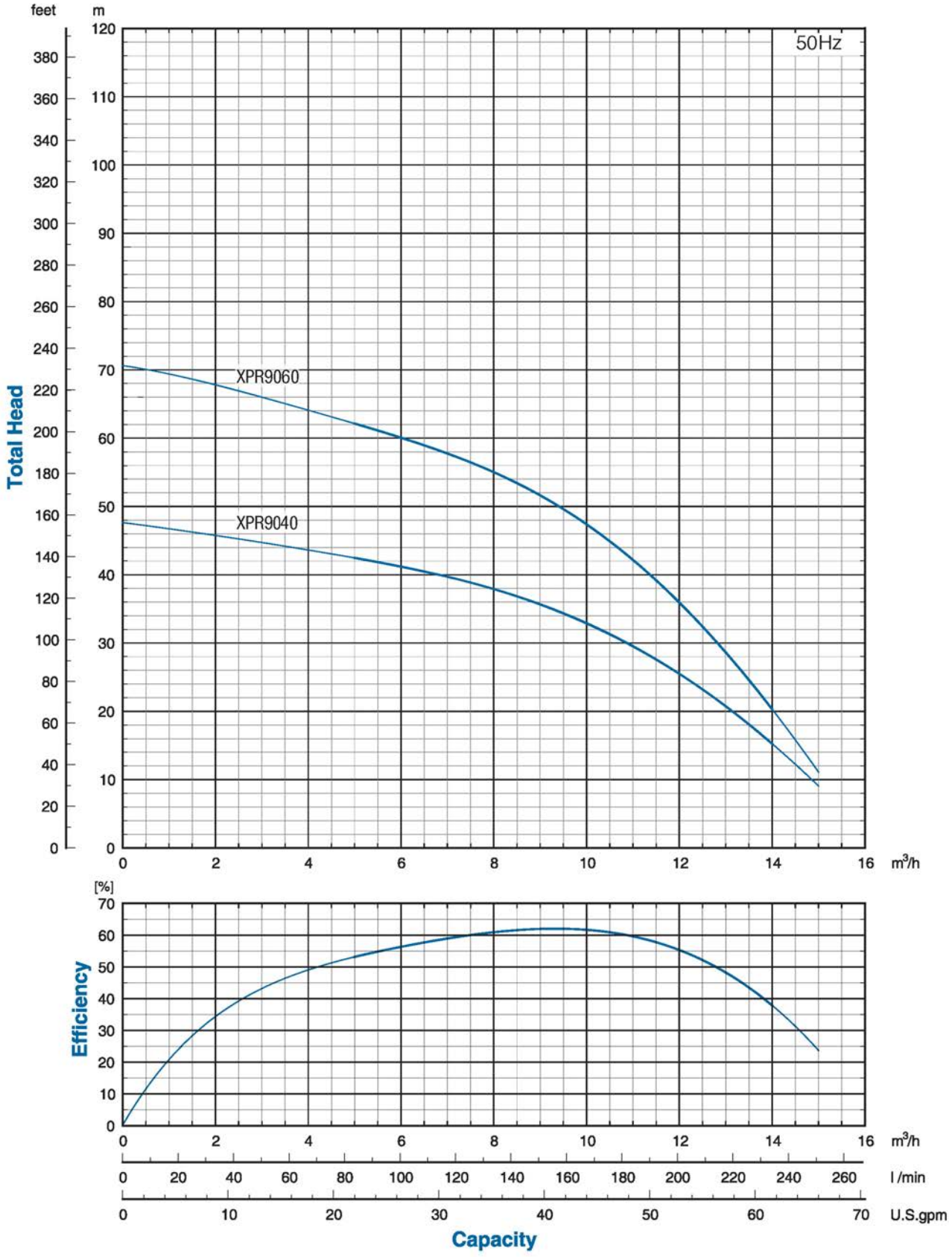
XPR3000 Series Pumps @ 2850rpm



XPR5000 Series Pumps @ 2850rpm



XPR9000 Series Pumps @ 2850rpm



Pump Controller Specification

Modus VASCO Type 209 or 214

- Input Voltage — Nominal 230Vac, single phase, 50/60 Hz.
- Max. Input Current — *[209]* 15A, *[214]* 20A
- Max. Motor Current — 230V ~1 9A / phase.
- Typical P2 Motor — 1.1KW, 1.5HP.
- Protection index — IP55 (NEMA 4).
- Max. altitude — 1000m @ nominal current.
- Max. ambient temperature — 40°C at nominal current.
- PWM configurable — 2.5, 4, 6, 8,10 kHz.
- Serial Comms — RS485.

VASCO is able to power the motor with a higher current for a short period of time according to the linear relation: 101% of the nominal current for 10min., 110% nominal current for 1 min.

3

Installation & Commissioning

This Section provides information on siting, connecting and commissioning the ScubaTANK™ VX2 Combined Water Storage & Booster Package.

- ***Basic Installation Information***
- ***Installation Sequence***
- ***Siting the ScubaTANK™***
- ***Hydraulic Connection***
- ***Electrical Supply***
- ***Commissioning***

Basic Installation Information

Installation help

Before shipment, all Dutypoint ScubaTANKs are run and pressure tested. Parameters including pressure settings and delay timers can be adjusted on commissioning to suit the site conditions. In practice, a system can almost invariably be made to perform more efficiently on site.

For pre or post-installation help, call the Dutypoint Technical Service Help line:

01452 300590

Identifying your ScubaTANK™ system

The label attached to the tank identifies the system, allowing the installation requirements to be clarified. The label information and resulting full specification can be found by referring to Section 2.

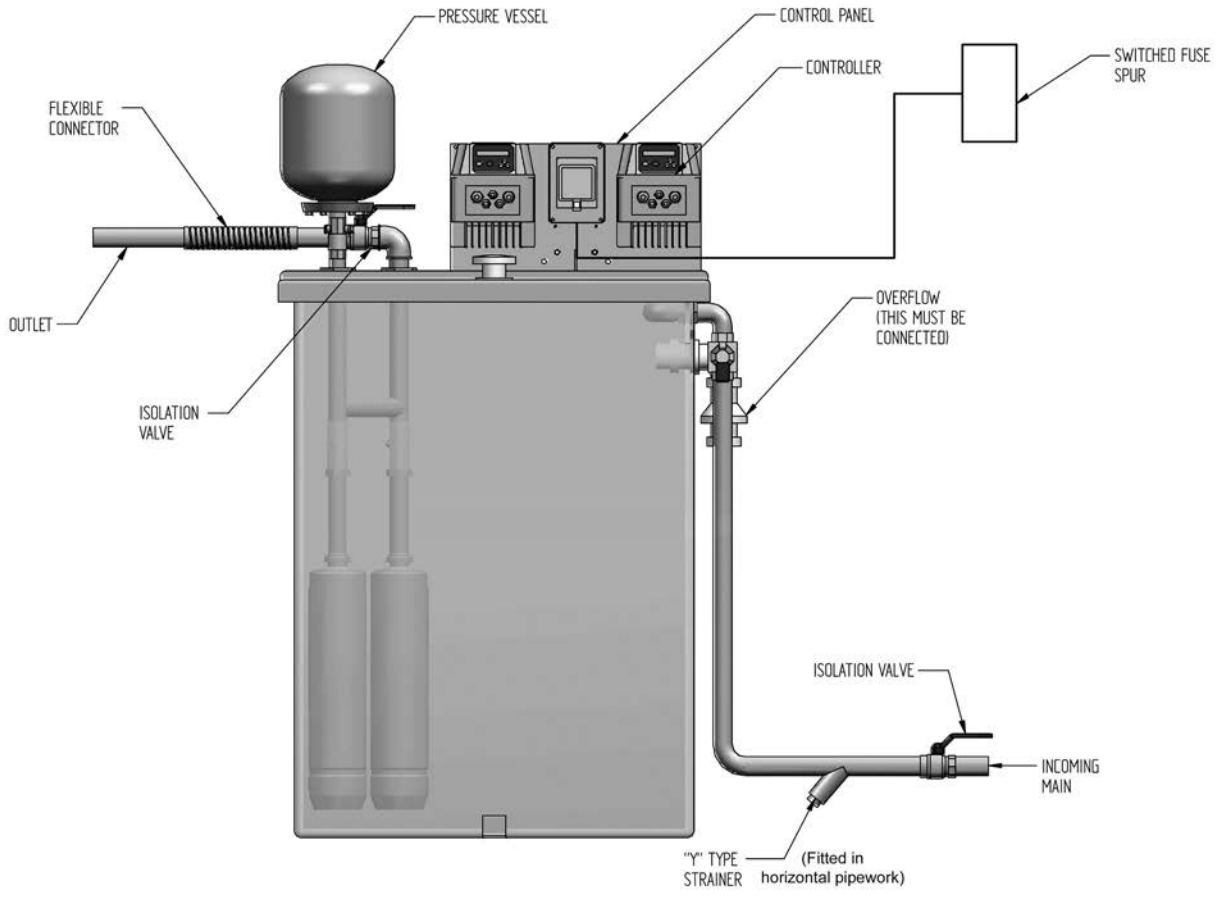


Fig. 3-1 ScubaTANK VX2 Typical Installation

Installation Sequence

- Position and secure the Tank.
- Connect the inlet water supply via a Y-type strainer and an isolation valve.
- Connect the overflow system.
- Connect the outlet pipe.
- Connect the electrical supply cable.
- Fill the system and vent the pump.
- Test and commission.

Siting the ScubaTANK™

The ScubaTANK VX2™ MUST be installed on a level stable floor or plinth capable of supporting the liquid weight of the full tank. (Details of the tank footprint and height are shown in fig 3-2.)

- Refer to fig 3-2 for an overview of tank dimensions and footprint or to Section 2 for full details.
  An additional 150mm MUST be allowed below any top surface to allow access for maintenance.
- The area should be dry, frost-free and well ventilated, away from extremes of temperature (refer to page 16 for temperature information). All pipe work must be adequately protected from freezing.
- Adequate provision should be made for drainage, leakage damage protection and service access
- The tank is freestanding and is provided with fixing feet for secure fastening to the floor.

Tank	Footprint (mm) D x W (mm)	Overall Height (mm) *	Height to Top of Open Tank (mm)
375	600 x 950	1703	1200
490	750 x 950	1703	1200
650	750 x 1200	1703	1200
800	1160 x 1160	1503	1000
1050 **	800 x 1500	2003	1500
1250 **	1160 x 1160	2003	1500
1650 **	1160 x 1500	2003	1500
2250 **	1160 x 2000	2003	1500

- * An additional 150mm minimum clearance is required above overall height.
- Inlet centre: 62mm below open tank top height.
- ** Additional Overflow Warning Pipe: ¾” pushfit

Fig. 3-2 ScubaTANK™ Dimensions

Hydraulic Connection

- All pipework must be in accordance with local Water Authority regulations.
- A Y-type strainer, fitted horizontally) and an isolation valve should be fitted to the mains water supply to the unit.
- The discharge pipework must be sized according to the system demand.
- All pipework must be securely supported and not over-stressed.
- The overflow and the warning pipe (if fitted) must be suitably piped.

The factory-set closing speed screw on the inlet solenoid valve adjusts the input flow rate and MUST NOT be re-adjusted except by a competent engineer following the procedure on page 49. Correct operation MUST be verified before leaving the unit unattended.

ADJUSTING WILL INVALIDATE THE WARRANTY.

The bypass screw is only for temporarily use in the event of an electrical failure.

Electrical Supply

ALL ELECTRICAL WORK MUST BE CARRIED OUT BY A SUITABLY QUALIFIED PERSON FOLLOWING THE LATEST IEE REGULATIONS

THE SYSTEM MUST ONLY BE OPERATED WHEN IT HAS BEEN CORRECTLY EARTHED AND PIPES BONDED TO EARTH IN ACCORDANCE WITH THE LATEST IEE REGULATIONS.

***VASCO*CONTROLLER ELECTRIC SHOCK DANGER**

The Controller contains high voltage. NEVER open the Controller or work with any electrical connections within it, unless the electrical supply to the unit is isolated. Wait a further 2 minutes after isolation for the internal circuitry to discharge.

Referring to fig 3-3:

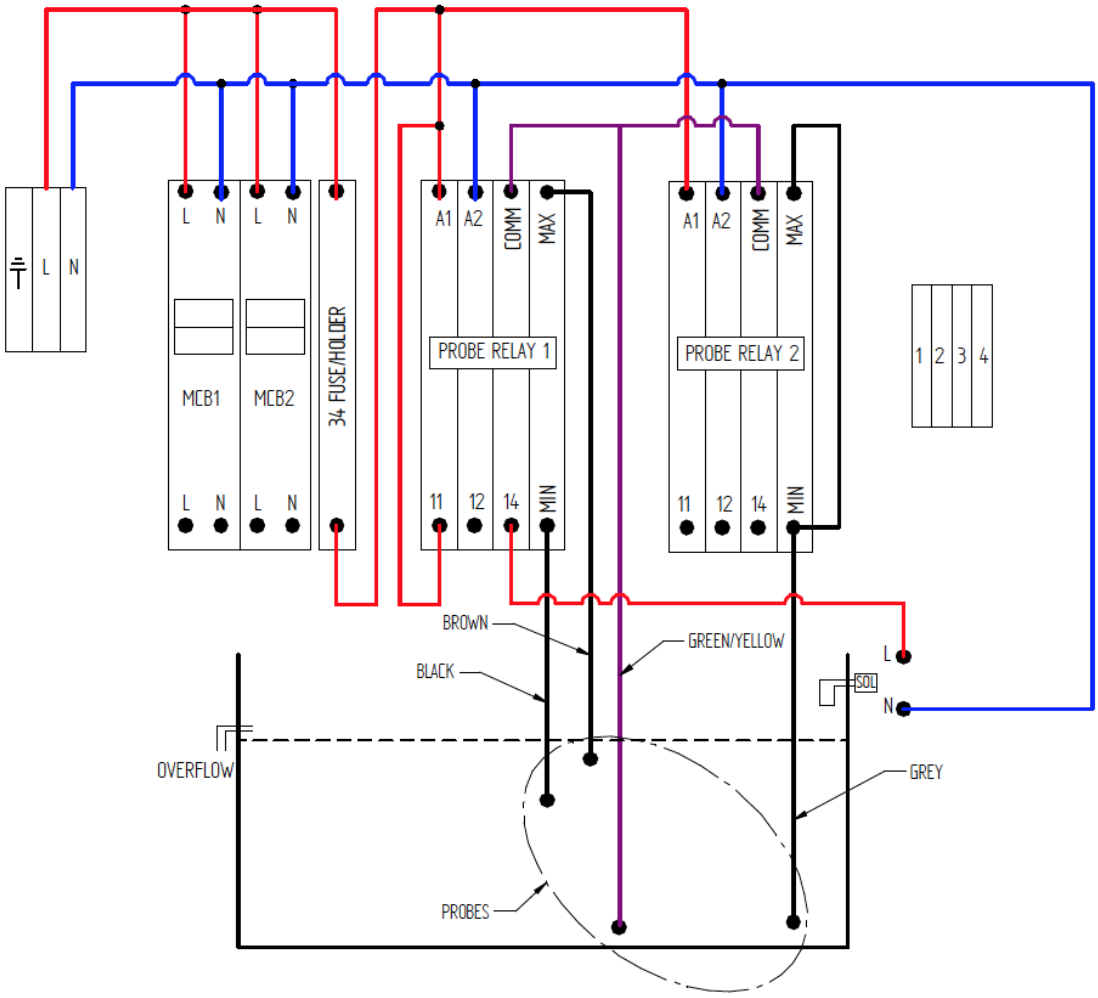
- The electrical supply feed to the ScubaTANK™ should be a dedicated line to minimise electromagnetic interference.
- The electrical supply rating can be ascertained from the inset pump rating table.
- The control panel isolator cable should be connected via a suitably rated external MCB.

The probe relay settings are factory preset and should conform with the inset information in fig 3-3.

ADJUSTMENT WILL INVALIDATE THE WARRANTY

Commissioning

- Refer to fig 3-3 and ensure that the probe relay is set correctly.
- Refer to Section 4, and run up the system to fill the tank.
- Verify that there are no leaks.
- Verify correct running.
- If required, refer to Appendix A to access the control parameters to optimise them.
- Advise the user on correct operation.



Electrical Supply Ratings

	Pump Type	Motor Power	Full Load Current
3040	XPR3040	0.55kW	4.1A
3060	XPR3060	0.75kW	5.2A
3080	XPR3080	1.10kW	7.4A
5040	XPR5040	0.75kW	5.0A
5060	XPR5060	1.10kW	7.4A
5080	XPR5080	1.50kW	10.5A
9040	XPR9040	1.50kW	10.5A
9060	XPR9060	2.20kW	11.9A

Probe Relay Settings

Time = 1

Sensitivity = 0.9

Mode = A

The probe relay settings are factory preset. ADJUSTMENT WILL INVALIDATE THE WARRANTY

Fig. 3-3 Electrical Connections & Probe Relay Settings

4

Using the ScubaTANK™

This Section provides information on controlling and adjusting the ScubaTANK™ VX2 Combined Water Storage & Booster Package.

- ***The User Control Panels***
- ***Basic Operational Information***
- ***Restoring the Controller Configuration***
- ***Starting and Running the ScubaTANK™***
- ***Protection and Fault Alarms***
- ***Accessing the Advanced Parameters***

The User Control Panels

System Isolation

The individual pump/controller system can be isolated using the MCBs located in the control box. All other pump control is carried out using the VASCO controllers.

The probe relay settings are factory preset and should conform with the inset information in fig 3-3.
ADJUSTMENT WILL INVALIDATE THE WARRANTY

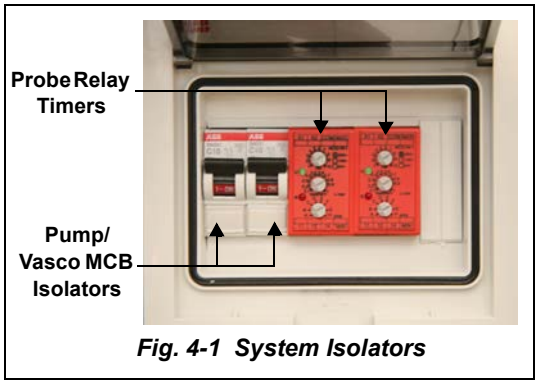


Fig. 4-1 System Isolators

Basic Operational Information

The VASCO display

The display screen on the VASCO is a back-lit LCD displaying 2 rows of 16 digits each. Alarms are indicated by an audible signal

Initial view

When first powering the VASCO, the display shows:

LCD = X.XX	Release of display software
INV = X.XX	Release of inverter software

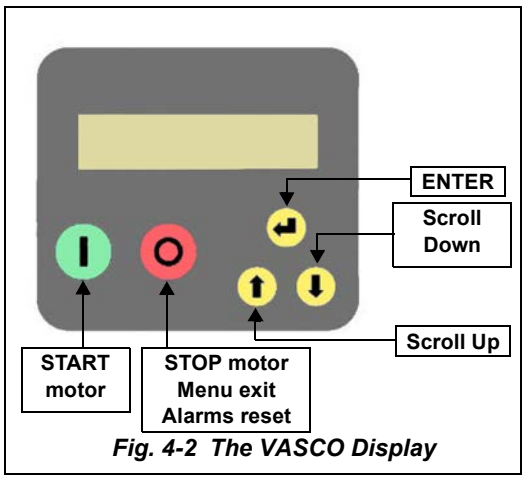


Fig. 4-2 The VASCO Display

One pump/VASCO combination will have been set as master (display name 00) and one as slave (display name 01). The term "INV:" will be replaced by the appropriate display name, "00:" or "01:"

Various End User messages are then displayed. Increment to the next by pushing the **Scroll** buttons:

The First Row of the display gives the VASCO/Pump status as follows:

- **Inv: ON XXX.X Hz** VASCO is powered and is powering the motor showing its frequency.
- **Inv: ON Mot: OFF** VASCO is powered but motor is not running (i.e. motor/pump was stopped due to minimum frequency being reached).
- **Inv: OFF Mot: OFF** VASCO is not powered.

The Second Row of the display provided the following information:

Inv: ON/OFF Mot: ON/OFF **p_m = XX.X [bar]**	**p_m** is the value read by the pressure transducer. By pressing ENTER the pressure set value is displayed. By keeping ENTER pressed for more than 5 seconds, it is possible to modify the set pressure in real time.

Inv: ON/OFF Mot: ON/OFF **f = XXX [Hz]**	**f** is the supply frequency to the motor. By pressing ENTER you can change the f value manually (the word “set” is displayed). Press ENTER again to exit parameter setting (the word “set” disappears).
Inv: ON/OFF Mot: ON/OFF **V = X.XX [V] I= XX.X [A]**	**V** is the voltage supplied to the motor. This value is displayed only if motor is OFF. If the motor is ON, a value **I** equal to the absorbed motor current is displayed.
Inv: ON/OFF Mot: ON/OFF **cosphi = XXX**	**cosphi** index means the phase angle phi between the voltage and current absorbed by the motor.
Inv: ON/OFF Mot: ON/OFF **P = XXXXX [W]**	**P** is the power in Watts supplied to the pump.
Inv: ON/OFF Mot: ON/OFF **STATUS: NORMAL**	**NORMAL** status means no alarms. If an alarm occurs, a message blinks on the display and an audible signal is activated. Pressing **ENTER** accesses: VASCO hours run, PUMP hours run, Consumption statistics, Alarm list. ***PUMP*** *hours refer to pump powered time.* To return to previous views, press **ENTER**.
Inverter Life **xxxxx h : xx m**	
Motor Life **xxxxx h : xx m**	
%f 25 50 75 100 **%h XX XX XX XX**	
XXXXXXXXXXXXXXX **XXXXXXX h : XX m**	
Menù **ENT to access**	

Menu view

Pressing **ENTER** when you are in initial display [MENU / ENT] will display the following sub MENUs to allow access to the installer and advanced options.

You should only access and adjust installation and advanced parameters if you are trained to do so, as improper setting of them could compromise the integrity and the life of the controller and the pump. A full description of the installation and advanced parameters is available in Appendix A of this manual.
Call the Dutypoint Technical Service Help line 01452 300590.

MENU’ **Install. param.**	Installer password required to enter level 1 (default 001)
MENU’ **Advanced. param.**	Advanced password required to enter level 2 (default 002)
MENU’ **Retrive init. set**	Installer password required to enter level 1 (default 001) Here it is possible to return to original set parameters.
MENU’ **Change init. set.**	Advanced password required to enter level 2 (default 002)

To exit the MENU level and return to initial display, press the **STOP** button.

Restoring the Controller Configuration

Your pumpset will have been tested and set to a default initial set of parameters to configure pump characteristics, pressure sensor range, and system characteristics. Without these initial settings it is impossible to run the pump.

If required, the initial settings can be restored using the 1st level password as described above.

A full description of these settings is available **in Appendix A of this manual.**

Call the Dutypoint Technical Service Help line 01452 300590.

Starting and Running the ScubaTANK™

Initial installation

As supplied the tank will have been tested and set to a default initial set of parameters configuring pump, sensor range, and system characteristics, allowing the user to run the pump on installation.
The master pump/VASCO will be identified as "00" and the slave as "01".

Ensure that the Outlet Valve is OFF (no demand).

Switch on the pumps as follows:

- Power On the *VASCOs* in turn using the control box contact breakers. Ensure that the LCD screens initially display the software issue, then reports *00:(or 01:) On Motor Off,* (refer to page 36).

The tank should start to fill.

- Turn on one pump by pressing the START MOTOR button on the associated *VASCO*.
  The LCD screen then reports *00:(or 01:) On Motor On* on the duty pump.
- Open the Tank outlet to create a demand.

The pump should respond to demand.

- Turn off the running pump using the STOP MOTOR button.
- Turn on the other pump by pressing the START MOTOR button on the associated *VASCO*.
  The LCD screen then reports *01:(or 00:) On Motor On on the duty pump*.
- Open the Tank outlet to create a demand.

The pump should respond to demand and confirms that both pumps are working.

- Turn the other pump back on by pressing the START MOTOR button on the associated *VASCO*.
  The LCD screen should only reports *00:(or 01:) On Motor On* on the duty pump.
- Open the Tank outlet to create a demand.
- Simulate a failure of the running pump by switching its main MCB isolator off.

The off -line pump should start to maintain output flow.

- Switch the "faulted" pump back on and repeat the test by turning off the other MCB isolator.

The standby pump should immediately come on to satisfy demand.

Normal running

Ensure that the tank is full before starting the *VASCOs*

Switch on the pumps as follows:

- Power On the *VASCOs* in turn using the control box contact breakers. Ensure that the LCD screens initially display the software issue, then reports *00:(or 01:) On Motor Off* (refer to page 36).
- Turn on both pumps by pressing the START MOTOR button on the *VASCOs*.
  The LCD screen then reports *00:(or 01:) On Motor On* on the duty pump; *01:(or 00:) On Motor Off* on the standby pump.

Both pump/*VASCO* combinations will have been configured to identical parameters. In case of an alarm or failure of a pump in a system, this pump's operation will be replaced (temporary or permanently) by the other pump.

Protection and Fault Alarms

Whenever a fault is detected, a flashing message is displayed on the Controller display together with an audible alarm.

The STATUS message in the initial view will display the fault.

- Pressing the **STOP** button will attempt to reset the alert. If the reset is unsuccessful the message is re-displayed and the alarm re-sounds.
- If dry-running occurs for over 2 seconds, the Controller will stop the pump. It will then attempt to re-run the pump at 10, 20, 40, 80, 160 minute intervals and then permanently stop it.

If dry-running occurs, the Controller will try to restart the pump automatically. ENSURE YOU SWITCH OFF THE POWER BEFORE ATTEMPTING MAINTENANCE.

- The Controller will stop the pump if the motor current is higher than the preset motor current for an extended time.
  By pressing the **START** button it is possible to run the pump again.
- The Controller will stop the pump if the input voltage goes higher than the preset voltage for an extended time.
  By pressing the **START** button it is possible to run the pump again.
- The Controller will stop the pump if the input voltage goes lower than the preset voltage for an extended time.
  By pressing the **START** button it is possible to run the pump again.

Other possible causes of general faults and their solutions can be found in Section 5.

Alert Messages and Possible Causes

You should only adjust attempt to rectify faults by accessing and adjusting installation and advanced parameters if you are trained to do so, as any improper setting of them could compromise the integrity and the life of the controller and the pump. A description of the installation and advanced parameters is available Appendix A of this manual.

Call the Dutypoint Technical Service Help line 01452 300590.

ALARM MESSAGE	ALARM DESCRIPTION	POSSIBILE SOLUTIONS
OVERCURRENT MOT.	Motor overload. The input current of the motor is higher than the rated motor current setting parameter. Motor voltage drop caused by the inverter causes the motor input current to be higher than the rated current. Contact the manufacturer to check if the motor is capable of accepting this current.	Make sure that the motor current setting parameter is higher than the rated current. Check for other possible causes of over current.
UNDER VOLTAGE	Supply voltage too low.	Check possible causes of undervoltage.
OVER VOLTAGE	Supply voltage too high.	Check possible causes of overvoltage.
OVER TEMP. INV.	Inverter over temperature.	Make sure than ambient temperature is less than 40 °C (104 °F). Check the cooling fan is working properly and providing proper cooling. Reduce the PWM value (*Advanced Parameter Menu*).
NO LOAD	No load.	Check if motor is properly connected to the VASCO terminals.
SENSOR FAULT	Sensor error.	Check the transducer. Check the wiring from the transducer.
NO WATER **(DRY RUN COSPHI)**	Motor cosphi is lower than the set value of the dry running cosphi.	Check if the pump is primed. Check the set value of dry running cosphi. *Dry running cosphi is approximately 60% of the rated cosphi (at rated frequency) listed on the motor plate.* If pump's cosphi is lower than the set dry-running cosphi for at least 2 seconds, the controller stops the pump. It then tries to run the pump again at 10, 20, 40, 80, 160 minute intervals and then the pump is stopped. *WARNING: If dry running protection occurs, the controller will try to start the pump automatically. Be sure to switch off the power source to before performing any maintenance*.
MAX.VALUE ALARM	Measured value has reached the maximum value accepted by the system.	Check possible causes of max value. Check max value parameter setting.
MIN.VALUE ALARM	Measured value has reached the lowest value accepted by the system.	Check possible causes of min value (e.g. broken pipe, open pressure relief valve, etc.). Check min alarm value parameter setting.

IGBT TRIP ALARM	The current drawn by the load exceeds the capacity of the fitted controller. *The controller is still able to continue to power the load for 10 minutes with an output current of 101% of nominal and for 1 minute with an output current of 110% of nominal.*	Increase the ramp-up time. Make sure that the load current is at least 10% below the controller nominal current. Check the voltage drop along the supply cable to the motor.
NO COMMUNICATION	Communication between Master and Slave(s) has been interrupted.	Check the wiring connections. Make sure the Master is not in the Menu level. If so, exit from the level. In STATUS on the Slave (where the alarm is displayed) try to reset the alarm by pushing STOP button.
ADDRESS ERROR	Same address as other Controllers in the group.	The address of each controller needs to be set differently.
KEYBOARD FAULT	A button on the keyboard has been pressed for more than 150 seconds.	Make sure buttons are not depressed. Call manufacturer's service assistance.
DIGITAL INPUT	Digital input opened/closed.	Check the input digital configuration (Located in Installer Parameters menu.)
ALARM SLAVE XX	Slave XX error detected by Master	Check the status of the Slave.

Accessing the Advanced Parameters

You should only adjust attempt to rectify faults by accessing and adjusting installation and advanced parameters if you are trained to do so, as any improper setting of them could compromise the integrity and the life of the controller and the pump. A description of the installation and advanced parameters is available Appendix A of this manual.

Call the Dutypoint Technical Service Help line 01452 300590.

5

Troubleshooting

This Section provides general troubleshooting tips applicable to the Dutypoint ScubaTANK™ VX2 Combined Water Storage & Booster Package.

When a fault first occurs, turning off the main power to the Tank, leaving off for around 1 minute before powering back on, may be sufficient to clear the fault.

Operational Alarms and Alerts *(VASCO Pump Controllers)*

The *VASCO* controllers continuously monitor and provide operational alarms and alerts. These are listed in this manual in Section 4 (page 39). Additional VASCO troubleshooting information can be found in the manufacturers manual in Appendix A.

General Tank Troubleshooting

Item/Fault	Possible Cause(s)	Recommended Action
Pump will not start.	1. No electrical power. 2. Blown fuse(s). 3. Overload trip. 4. Faulty Controller	1. Check and rectify. 2. Check and rectify. 3. Check and try to reset the overload trip. 4. Refer to controller operational troubleshooting in Section 4 (page 38).
Low (or zero) output (discharge rate).	1. The rotating part of the pump is partially or completely obstructed e.g: impeller obstructed by foreign matter. 2. Pump not primed. **WARNING**: running the pump 'dry' can cause serious damage to the mechanical seal. 3. Valve fully or partially closed. 4. Incorrect pump rotation direction. 5. Pump failing.	1. Open the tank to examine the pump to inspect and rectify. Refer to page 49. 2. Low water level. Check and rectify. 3. Check all appropriate valves are fully open. 4. Pump is either incorrectly wired or the controller is incorrectly programmed. Refer Section 6 to check and rectify. 5. Replace pump.
Pump vibrates and/ or is noisy	1. Pump is cavitating. 1. Motor bearings worn. 2. The rotating part of the pump is partially or completely obstructed e.g: impeller obstructed by foreign matter.	1. Increase the discharge back pressure slightly by progressively closing a manual isolating valve on the discharge side until the cavitation stops. 2. Replace pump. 3. Open the tank to examine the pump to inspect and rectify. Refer to page 49.
Pump running continuously	1. The pump is switched to "Hand" operation. 2. Controller fault.	1. Switch back to "Auto". 2. Arrange an immediate service visit.
Overload Trip	1. Pipework or the pump chamber has a partial blockage. 2. Momentary loss of power supply. 3. Discharge flow rate too high. 4. Incorrect overload trip value.	1. Check and rectify. Reset the trip and try again. 2. Reset the trip and try again. 3. Reduce by the discharge flow rate by increasing the discharge back pressure slightly by progressively closing the manual isolating valve on the discharge side. Reset the trip and try again. 4. Check value (Section 3) and if incorrect change the overload trip.

6

Routine Maintenance & Repair

This Section provides information on maintenance and repair ScubaTANK™ VX2 Combined Water Storage & Booster Package.

- ***Routine User Maintenance***
- ***Pressure Vessel Servicing***
- ***Pump Servicing***
- ***VASCO Controller Servicing***

Routine User Maintenance

Dutypoint Pumpsets have been designed to keep major maintenance requirements to a minimum. Planned maintenance of the pumps and other principal components should therefore be undertaken at the intervals recommended below.

In addition, the user should routinely make visual checks of the equipment during use, noting particularly any unusual noises or vibrations. This will give an immediate indication of any irregularity in the operation of the system.

It is essential that a full test following the Commissioning procedure (refer to Section 3) is carried out on an annual basis.

DO NOT COMMENCE ANY MAINTENANCE WORK UNLESS YOU ARE SUITABLY QUALIFIED TO SO AND HAVE READ THE SAFETY SECTION AT THE BEGINNING OF THIS MANUAL.

Refer to the information that is provided in this section for procedures.

Recommended user weekly checks

- Inspect the ScubaTANK™ and system for leaks, etc.
- Observe the running of the pump and note any unusual vibration, etc.

Recommended user monthly checks

- Switch off and visually check the security of the ScubaTANK™ hydraulic and electrical connections.
- Observe the running of the pump and note any unusual vibration, etc.
- Check the vents on the controller and clear any dust or other obstructions.
- Operate the manual isolating valve three times to ensure continued efficient working.

Recommended user 6 monthly checks

- The pressure vessel should be drained and the pre-charge pressure checked with a gauge and if necessary corrected (refer to page 47).
- Undo the tank lid (refer to page 49), and check the cleanliness of the pump inlet grating. Replace the lid.

Essential 12 monthly (maximum interval) service

Carry out the full Commissioning procedure to verify correct safe operation. Refer to Section 3 for details.

Pressure Vessel Servicing

Service information below is taken from the Manufacturer's Installation Manual.

Periodic maintenance

Periodic maintenance is recommended at least twice a year and should be carried out by authorised specialised personnel only.

1. First check that the expansion or pressure tank is totally drained of water, and that the system is switched off and no electrical parts are live.
2. Check and, if necessary reset the precharge pressure, using the following procedure. Ensure that the pressure does not exceed the value specified.

Precharge pressure check

The precharge air pressure for vessels should be 90% of the maximum pressure generated by the pump in the pipework system. *e.g: If the max. pressure generated by the pump in a system is 6 bar, the required pre-charge pressure is 5.4 bar.*

Refer to the following table:

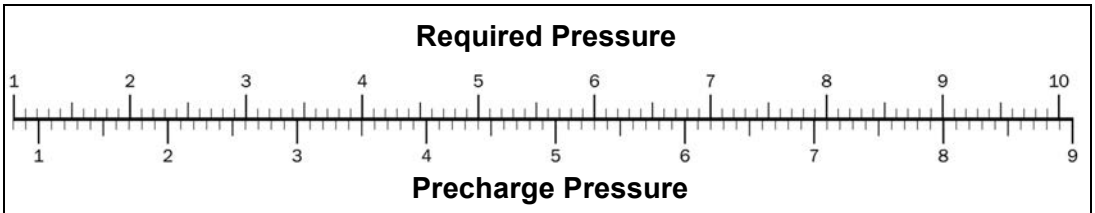


Fig. 6-1 Pump PreCharge Pressure Calculator

Refer to fig 6-2 to verify the precharge pressure:

1. First check that the expansion vessel is totally drained of water, and that the system is switched off and no electrical parts are live. Use the drain valve to drain the vessel.
2. Locate the vessel charging valve (either underneath or adjacent to the plastic cap on top of the vessel, and connect a portable pressure gauge which has a flexible hose and Schrader-type connector to the valve. (The gauge measuring range must be compatible with the expected pressures in your application.)
3. Verify that the pre-charge pressure above the diaphragm corresponds to the 90% criteria in fig 6-1.
4. If necessary, release or add air.

   To add air, inflate the diaphragm using a hand or footpump.
5. When the precharge pressure is correct replace the air valve cap and vent cover.

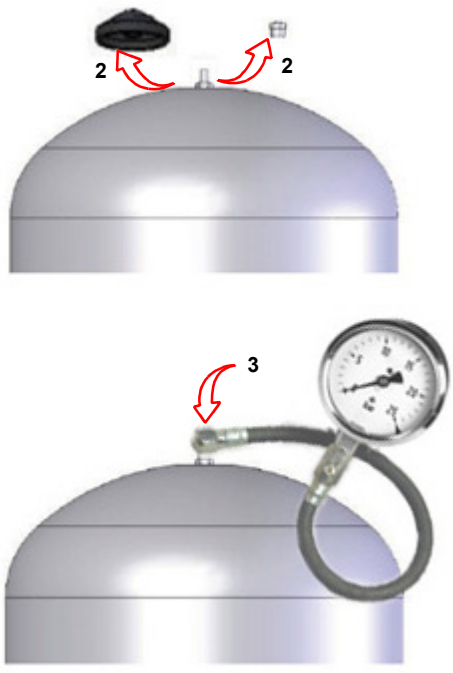


Fig. 6-2 Pre-charging a Vessel

General guidance notes for vessel repair & replacement

- Always ensure that the maximum working pressure and temperature is never exceed.
- During installation ensure adequate drainage to limit potential damage caused by leakage during draining.
- The vessel must be installed and regularly inspected to conform to current legislation by qualified personnel only.
- The appliance must be protected by an appropriate earthing systems or isolated from the system by a dielectric joint.
- The manufacturer shall not be held liable for any personal or material damage caused by the product or to the product if it is installed and/or used improperly or in way that differs from the manufacturer's specifications.

ELECTRIC SHOCK DANGER

Before beginning to work on the vessel you MUST isolate the Electrical Supply and make sure that it cannot be accidentally reconnected.

It is the installer's responsibility to perform the connection in compliance with local regulations and all electrical guidelines.

Replacing the diaphragm

To replace the diaphragm refer to fig 6-3.

1. Turn off the ScubaTANK™.
2. Empty the expansion tank.
3. Remove the pre-charging by releasing the air-vent.
4. Loosen the M8 screws fastening the flange.
5. Remove the flange.
6. Extract the diaphragm and replace it.

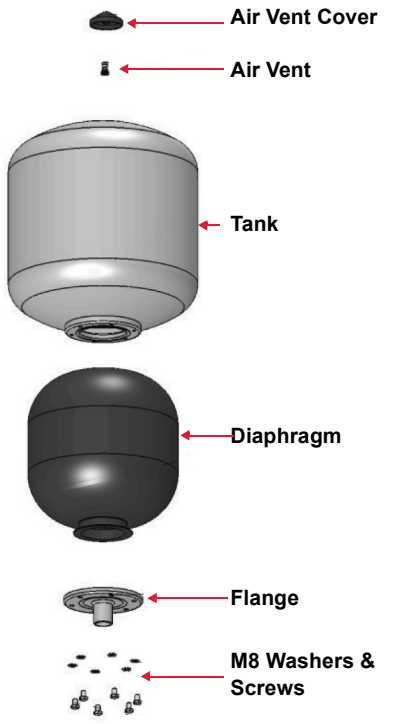


Fig. 6-3 Pressure Vessel Diaphragm

Installing a replacement vessel

1. Turn off the ScubaTANK™ and remove the old vessel
2. Make sure the replacement is in good condition. If the product is damaged do not start on installation.
3. The product must be installed in the same position as the original.
4. Set the precharge pressure, using the procedure given earlier in this section on page 47. Ensure that the pressure does not exceed the value specified in the procedure.
5. Make sure the cap of the valve is fitted tightly after pre-charging and that there is no leakage.

Inlet Solenoid Close Control & Bypass Screw Adjustment

The factory-set closing speed screw on the inlet solenoid valve adjusts the input flow rate and MUST NOT normally be re-adjusted except by a competent engineer following the procedure below. Correct operation MUST be verified before leaving the unit unattended.

ADJUSTING WILL INVALIDATE THE WARRANTY.

The bypass screw is only for temporarily use in the event of an electrical failure.

The closing speed screw alters the operating speed of the solenoid and is used to reduce water-hammer and flow noise.

If the input flow is set higher than the overflow discharge capability, there is a high possibility that the tank will overfill.

The bypass screw permanently opens the valve to temporarily allow tank use in the event of an electrical failure.

If either screws are adjusted, verify correct operation before leaving the unit unattended.

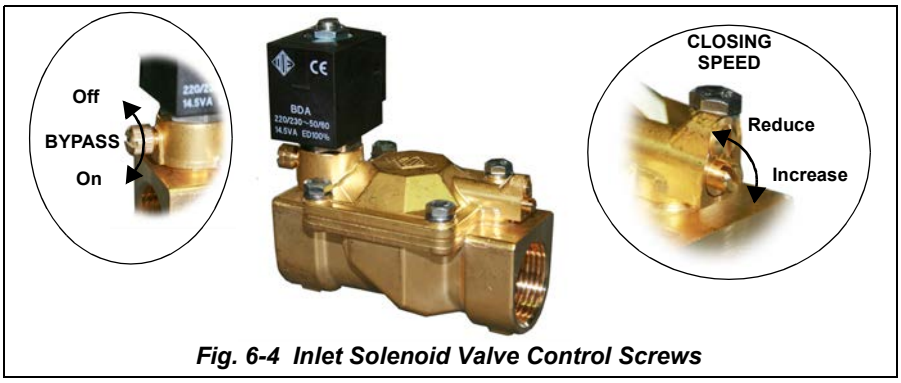


Fig. 6-4 Inlet Solenoid Valve Control Screws

Opening the Tank

To remove the tank lid:

1. Remove the 4x plastic covers to expose the M6 domed screws securing the lid.
2. Remove the screws to open the lid.
3. Replace the lid, screws and caps before returning the tank to use.

Pump Servicing

The following information is extracted from the manufacturer's documentation.

Routine maintenance

The pump requires no detailed maintenance except to:

- Periodically verify that the suction grate is clear
- Periodically **with the supply power turned off**, check the condition of the cables and electrical power and earth connections.

Pump replacement

The electrical pump must never be used outside the limitations described in the technical specifications. Replacement pumps should remain in their supplied original packing until installation.

1. Before installation, check the new pump and verify its integrity and that it is the correct type/rating. Contact the supplier if there are any anomalies.

ELECTRIC SHOCK DANGER

Before beginning to work on the pump, you MUST isolate the Electrical Supply and make sure that it cannot be accidentally reconnected.

Wait a further 2 minutes for the internal circuitry to discharge BEFORE opening or working with any electrical connections on the MODULATOR controller.

It is the installer's responsibility to perform the connection in compliance with local regulations and all electrical guidelines.

2. Locate the 4x plastic screw covers protecting the M6 screws securing the tank lid. Remove the covers and screws and lift off the tank lid to access the old pump.
3. Disconnect the pump pipework.
4. Referring to the instructions in Section A disconnect the pump electrical cable, noting the cable colour coding.
5. Insert the replacement pump into the tank and reconnect the pipework.

To avoid damage, do not use excessive force when screwing the pipe to the pump discharge outlet.

6. Feed the pump cable through the watertight glands and make the electrical connections to the controller as noted in step 4 above, verifying that the earth connection is securely made.
7. Fix the power cable to the delivery pipe using suitable strap.
8. Replace the covers on the controller.
9. Test the system, checking rotation direction (see below).
10. When testing is complete, replace the tank lid and screw it down, refitting the plastic caps.

Checking the direction of rotation

If the direction of rotation is reversed due to incorrect connection or controller programming, the pump performance will be significantly lower than the nominal values. To verify a correct connection, proceed as follows:

1. Start the electrical pump before it is submerged. Correct rotation is in a counter-clockwise direction as viewed from above.

This operation will be performed dry and MUST NOT last more than a few seconds.

2. With the pump operating, installed and submerged, use a clamp meter to measure the current. If the rotation is reversed, you will see values about double those indicated on the name plate.
3. Correct before using the system.

VASCO Controller Servicing

Maintenance, repair and replacement of the VASCO controllers is contained in the manufacturer's guide published in Appendix A of this manual.

A

Appendix A
Manufacturer's Guide - VASCO

This Section contains a facimile copy of the Installation, Safety and Configuration instructions provided by supplier of the VASCO Controller series:

All data is subject to change without notice.

VASCO PUMP CONTROLLER

Vasco 209, 214, 406, 409, 414, 418, 425, 430

User & Installation Guide

Contents

IMPORTANT SAFETY INFORMATION

BEFORE INSTALLING OR OPERATING ANY CONTROL SWITCH, ENSURE THAT YOU HAVE CAREFULLY READ AND UNDERSTOOD THIS MANUAL

This manual contains safety, installation and troubleshooting information for the Vasco 209, 214, 409, 414, 415, 425 Controllers current at the time of compilation. Do not throw away this manual after installation. The manufacturer declines all responsibility in the event of accident or damage due to negligence or failure to observe the instructions described in this manual or in conditions that differ from those indicated on the device. Failure to observe and follow the instructions in this manual may result in dangerous and potentially lethal electric shock.

Safety symbols are used in manual are:

Denotes attention to the possibility of the risk of personal injury or damage to the equipment or adjacent property if the information is ignored.

Denotes attention to the possibility of life-threatening electric shock if the information is ignored.

Hydraulic and electrical installations must be carried out by qualified personnel according to the local safety regulations, standards and legislation.

Disconnect the VASCO from the main power supply before commencing any work. The device must be connected to the main power supply via a switch to ensure provision for complete disconnection before any work is commenced (including visual inspection) on it or the connected load.

For the entire period VASCO is powered, high voltage is present on the output terminals of the inverter whether or not the pump is running. Do not remove the cover and the cable plate for any reason without having first disconnected the device from the main power supply and waiting at least a further 5 minutes.

The VASCO and pumping system must be grounded properly before operation. To eliminate the risk of electric shock or even death, before powering the device after installation or maintenance, it is recommended to retighten all 4 washered cover screws to ensure a maintained ground connection

Avoid any shock or significant impact when handling.
Check any replacement VASCO immediately upon delivery for damage and/or missing parts. If either occurs, immediately notify the supplier. Damages due to transport, incorrect installation, or improper use of the device will null and void the warranty. Tampering or disassembly of any component will automatically void the warranty.

Introduction

VASCO is a variable frequency drive designed to control and protect pumping systems by varying the output frequency to the pump. VASCO can be applied to both new and existing pumping systems, and provides:

- energy and cost savings.
- simplified installation and an overall lower pumping system cost.
- longer life of the pumping system and relevant components.
- improved reliability.

When connected to a pump, VASCO manages the system operation to maintain a certain constant physical quantity (pressure, differential pressure, flow, temperature, etc.) regardless of the conditions of use. The pump is operated only when needed thus avoiding unnecessary energy consumption. VASCO is able to:

- protect the motor from overload and dry running.
- implement soft start and soft stop to increase the system life and reduce current peaks.
- provide an indication of current consumption, voltage, and power.
- maintain a record of run time and display any errors and/or failures reported by the system.
- control up to two additional pumps at a constant speed (Direct On Line).
- connect to other VASCO units for combined operation.

To implement this each controller has a Control/Display panel which provides user access to general running information and allows user intervention and parameter modification under password protection.

Fig. 1-1 VASCO Single and 3 Phase Units

If supplied fitted to a pumpset it will have been tested and set to a default initial set of parameters to configure pump characteristics, pressure sensor range, and system characteristics. Without these initial settings it is impossible to run the pump.

Basic Operational Information

The VASCO Display

The display screen on the VASCO is a back-lit LCD displaying 2 rows of 16 digits each. Alarms are indicated by an audible signal

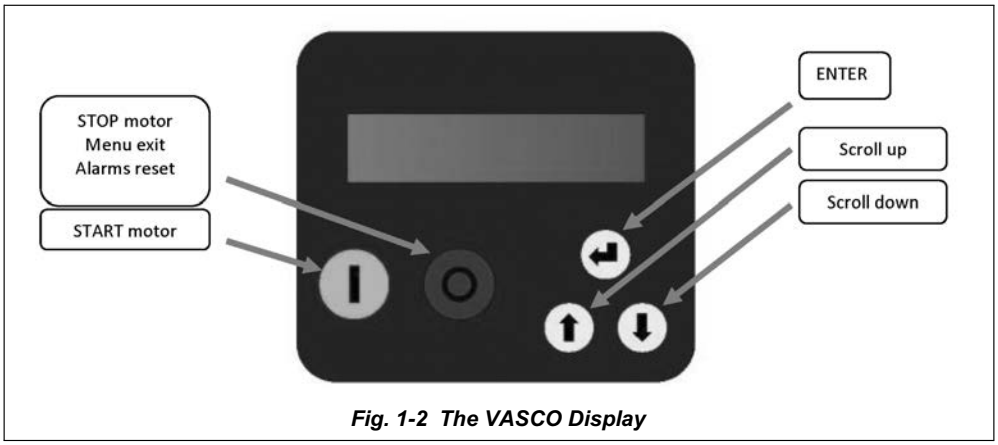


Fig. 1-2 The VASCO Display

Initial View

When first powering the VASCO, the display shows:

LCD = X.XX **INV = X.XX**	Release of display software Release of inverter software

Various End User messages are displayed. Increment to the next one by pushing the **Scroll** buttons:

The First Row of the display gives the VASCO/Pump status as follows:

- **Inv: ON XXX.X Hz** VASCO is powered and is powering the motor showing its frequency.
- **Inv: ON Mot: OFF** VASCO is powered but motor is not running (i.e. motor/pump was stopped due to minimum frequency being reached).
- **Inv: OFF Mot: OFF** VASCO is not powered.

If the Combo function is activated (e.g. Duty/Standby mode), the VASCO address is placed close to the word "Inv".

The Second Row of the display provided the following information:

Inv: ON/OFF Mot: ON/OFF **p_m = XX.X [bar]**	**p_m** is the value read by the pressure transducer. By pressing ENTER the pressure set value is displayed. By keeping ENTER pressed for more than 5 seconds, it is possible to modify the set pressure in real time.
Inv: ON/OFF Mot: ON/OFF **f = XXX [Hz]**	**f** is the supply frequency to the motor. By pressing ENTER you can change the f value manually (the word "set" is displayed). Press ENTER again to exit parameter setting (the word "set" disappears).
Inv: ON/OFF Mot: ON/OFF **V = X.XX [V] I= XX.X [A]**	**V** is the voltage supplied to the motor. This value is displayed only if motor is OFF. If the motor is ON, a value **I** equal to the absorbed motor current is displayed.
Inv: ON/OFF Mot: ON/OFF **cosphi = XXX**	**cosphi** index means the phase angle phi between the voltage and current absorbed by the motor.
Inv: ON/OFF Mot: ON/OFF **P = XXXXX [W]**	**P** is the power in Watts supplied to the pump.
Inv: ON/OFF Mot: ON/OFF **STATUS: NORMAL**	**NORMAL** status means no alarms. If an alarm occurs, a message blinks on the display and an audible signal is activated. Pressing **ENTER** accesses: VASCO hours run, PUMP hours run, Consumption statistics, Alarm list. ***PUMP*** *hours refer to pump powered time.* To return to previous views, press **ENTER**.
Inverter Life **xxxxx h : xx m**	
Motor Life **xxxxx h : xx m**	
%f 25 50 75 100 **%h XX XX XX XX**	
XXXXXXXXXXXXXXX **XXXXXXX h : XX m**	
Menù **ENT to access**	

Menu view

Pressing **ENTER** when you are in initial display [MENU / ENT] will display the following sub MENUs to allow access to the installer and advanced options, (refer to page 16 for further information).

You should only access and adjust these parameters if you are trained to do so.
Improper setting of these advanced parameters could compromise the integrity and the life of the controller and the pump.

MENU' **Install. param.**	Installer password required to enter level 1 (default 001)
MENU' **Advanced. param.**	Advanced password required to enter level 2 (default 002)
MENU' **Retrive init. set**	Installer password required to enter level 1 (default 001) Here it is possible to return to original set parameters.
MENU' **Change init. set.**	Advanced password required to enter level 2 (default 002)

To exit the MENU level and return to initial display, press the **STOP** button.

Restoring the Controller Configuration

Your pumpset will have been tested and set to a default initial set of parameters to configure pump characteristics, pressure sensor range, and system characteristics. Without these initial settings it is impossible to run the pump.

If required, the initial settings can be restored using the 1st level password as described above.

A full description of the parameters and their allowable settings can be found in the Advanced Parameter Section of this manual on page 16.

Protection and Fault Alarms

Whenever a fault is detected, a flashing message is displayed on the Controller display together with an audible alarm.

The STATUS message in the initial view will display the fault.

- Pressing the **STOP** button will attempt to reset the alert. If the reset is unsuccessful the message is re-displayed and the alarm re-sounds.
- If dry-running occurs for over 2 seconds, the Controller will stop the pump. It will then attempt to re-run the pump at 10, 20, 40, 80, 160 minute intervals and then permanently stop it.

If dry-running occurs, the Controller will try to restart the pump automatically.
ENSURE YOU SWITCH OFF THE POWER BEFORE ATTEMPTING MAINTENANCE.

- The Controller will stop the pump if the motor current is higher than the preset motor current for an extended time.
  By pressing the **START** button it is possible to run the pump again.
- The Controller will stop the pump if the input voltage goes higher than the preset voltage for an extended time.
  By pressing the **START** button it is possible to run the pump again.
- The Controller will stop the pump if the input voltage goes lower than the preset voltage for an extended time.
  By pressing the **START** button it is possible to run the pump again.

A full list of messages, together with possible causes and solutions can be found in this manual in the Troubleshooting Section on page 8.

Alert Messages and possible causes

ALARM MESSAGE	ALARM DESCRIPTION	POSSIBILE SOLUTIONS
OVERCURRENT MOT.	Motor overload. The input current of the motor is higher than the rated motor current setting parameter. Motor voltage drop caused by the inverter causes the motor input current to be higher than the rated current. Contact the manufacturer to check if the motor is capable of accepting this current.	Make sure that the motor current setting parameter is higher than the rated current. Check for other possible causes of over current.
UNDER VOLTAGE	Supply voltage too low.	Check possible causes of undervoltage.
OVER VOLTAGE	Supply voltage too high.	Check possible causes of overvoltage.
OVER TEMP. INV.	Inverter over temperature.	Make sure than ambient temperature is less than 40 °C (104 °F). Check the cooling fan is working properly and providing proper cooling. Reduce the PWM value (*Advanced Parameter Menu*).
NO LOAD	No load.	Check if motor is properly connected to the VASCO terminals.
SENSOR FAULT	Sensor error.	Check the transducer. Check the wiring from the transducer.

NO WATER **(DRY RUN COSPHI)**	Motor cosphi is lower than the set value of the dry running cosphi.	Check if the pump is primed. Check the set value of dry running cosphi. *Dry running cosphi is approximately 60% of the rated cosphi (at rated frequency) listed on the motor plate.* If pump's cosphi is lower than the set dry-running cosphi for at least 2 seconds, the controller stops the pump. It then tries to run the pump again at 10, 20, 40, 80, 160 minute intervals and then the pump is stopped. *WARNING: If dry running protection occurs, the controller will try to start the pump automatically. Be sure to switch off the power source to before performing any maintenance.*
MAX.VALUE ALARM	Measured value has reached the maximum value accepted by the system.	Check possible causes of max value. Check max value parameter setting.
MIN.VALUE ALARM	Measured value has reached the lowest value accepted by the system.	Check possible causes of min value (e.g. broken pipe, open pressure relief valve, etc.). Check min alarm value parameter setting.
IGBT TRIP ALARM	The current drawn by the load exceeds the capacity of the fitted controller. *The controller is still able to continue to power the load for 10 minutes with an output current of 101% of nominal and for 1 minute with an output current of 110% of nominal.*	Increase the ramp-up time. Make sure that the load current is at least 10% below the controller nominal current. Check the voltage drop along the supply cable to the motor.
NO COMMUNICATION	Communication between Master and Slave(s) has been interrupted.	Check the wiring connections. Make sure the Master is not in the Menu level. If so, exit from the level. In STATUS on the Slave (where the alarm is displayed) try to reset the alarm by pushing STOP button.
ADDRESS ERROR	Same address as other Controllers in the group.	The address of each controller needs to be set differently.
KEYBOARD FAULT	A button on the keyboard has been pressed for more than 150 seconds.	Make sure buttons are not depressed. Call manufacturer's service assistance.
DIGITAL INPUT	Digital input opened/closed.	Check the input digital configuration (Located in Installer Parameters menu.)
ALARM SLAVE XX	Slave XX error detected by Master	Check the status of the Slave.

Troubleshooting VASCO

Fault	Possible Cause / Solution
LCD does not switch on after powering the VASCO	Check the connecting flat cable between the LCD board (attached to the cover) and the control board.
	Check the fuses.
	Check that the power cables are properly connected.
Power line of VASCO is interrupted by the differential protection contactor	Check the EMC filter leakage current to ground.
	Following a rapid off/on the power supply, the differential contactor can interrupt the power. After turning off the VASCO it is recommended to wait at least 1 minute before restarting.
When performing the Offset operation of the pressure device, a SENS.PRESS.OFF alarm occurs	Check that the sensor cable is properly connected to the sensor device and to the VASCO.
	Make sure that the sensor and its cable are not damaged.
	Check that the operating range of pressure sensor is of 4 -20mA type and the value of 15V is within the voltage feed range of the sensor
Frequency and pressure oscillation on constant pressure control mode	Check that the pressure vessel and its air pressure is correctly set. It may be necessary to increase the tank volume or reduce the pre-charge pressure.
	Check the Ki & Kp parameters (Installer Parameters menu). At first, try increasing the Ki value. If there is still oscillation, try reducing the last digit of the Kp value by one.
DOL pump stops and starts continuously	Increase the delta start pressure (Installer Parameters menu)
	Check to see if the water tank and it's air pressure are correctly set. It may be necessary to increase the tank volume or reduce the pre-charge pressure.
Measured pressure drops too much before VASCO starts the pump	Decrease the delta start pressure (Installer Parameters menu)
	Check to see if the water tank and it's air pressure are correctly set. It may be necessary to increase the tank volume or reduce the pre-charge pressure.
	Modify the value of the Ki & Kp parameters (Installer Parameters menu). At first, try reducing the Ki value. If the start is still incorrect try increasing the last digit of the Kp value by one.

VASCO Installation, Replacement & Connection Details

Electrical Considerations

Protection

The protections required upstream of each VASCO depends on the type of installation and local regulations. We recommend to use overload protection with the characteristic curve of type C and type B circuit breaker, sensitive to both AC and DC current.

Electromagnetic compliance

To ensure electromagnetic compatibility (EMC) of the system, it is necessary to apply the following measures:

- ***Always*** ensure that the device connected to ground.
- Use shielded signal cables connecting the screen at one end only.
- Keep the motor cable as short as possible (<1 m / <3 ft). For longer lengths, it is recommended to use shielded cables, connecting the screen at both ends.
- Separate signal, motor, and power supply cables.

VASCO will periodically refresh the display to maintain the screen information in the event of electromagnetic corruption.

Installation with long motor cables

With long motor cables it's recommended to decrease the commutation frequency from 10 kHz (default) to 2.5 kHz (advanced parameters). This reduces the probability of voltage spikes in the motor windings which may damage the insulation.

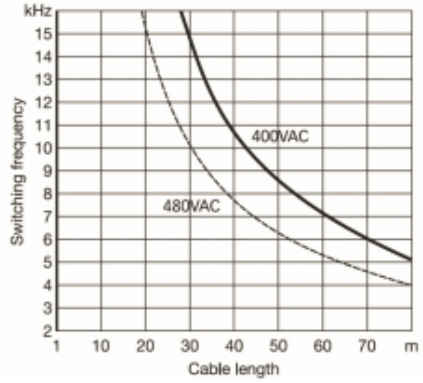


Fig. 1-3 Commutation Frequency

Technical Characteristics

Model	Vin+/-15% (V AC)	Vout max (V)	Line Current max (A)	Motor Current max (A)	Typical P2 Motor (KW	HP)
209	230 x 1 phase	1 x Vin	15	9	1.1	1.5
		3 x Vin		7	1.5	2
214	230 x 1 phase	1 x Vin	20	9	1.1	1.5
		3 x Vin		11	3	4
406	380 - 460 x 3 phase	3 x Vin	10	6	2.2	3
409	380 - 460 x 3 phase	3 x Vin	13.5	9	4	5.5
414	380 - 460 x 3 phase	3 x Vin	16	14	5.5	7.5
418	380 - 460 x 3 phase	3 x Vin	21	18	7.5	10
425	380 - 460 x 3 phase	3 x Vin	31	25	11	15
430	380 - 460 x 3 phase	3 x Vin	35	30	15	20

Power frequency: 50-60Hz, Max amb. temp at nom. current: 40°C (104 °F) Max altitude at nom. current: 1000m

Protection: IP55 (NEMA 4, Serial connect: RS485, PWM configurable: 2.5, 4, 6, 8, 10 kHz.

Mounting instructions

The VASCO is installed directly on the fan cover of the motor and is cooled by the motor fan. A supplied Motor Mounting Kit allows a solid coupling of the two units.

VASCO 209, 214, 406, 409
Motor Mounting Kit

Qty 4 x Rods
Qty 4 x M5 nuts
Qty 4 x Hooks
Qty 1 x Cooling ring

Use the cooling ring for best cooling of VASCO during operation.

Warning: when using the cooling ring, the cooling air of the motor is slightly warmer than without the VASCO; if the resulting motor temperature exceeds the indicated maximum allowable value, remove the cooling ring, leaving the VASCO to be cooled by itself.

If possible, coupling hooks should be attached to the motor shield instead of the cooling fan cover.

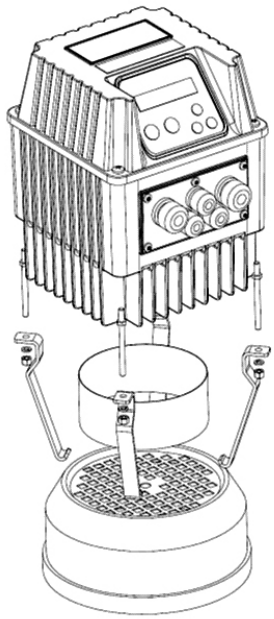
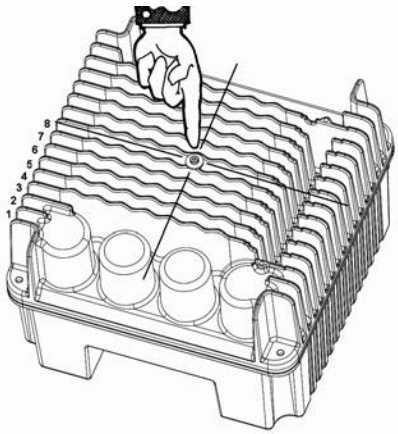


Fig. 1-4 VASCO 209 Motor Mounting

VASCO 414,418,425,430
Motor Mounting Kit

Qty 4 x M5 screws
Qty 4 x Clamps
Qty 1 x Centre pin



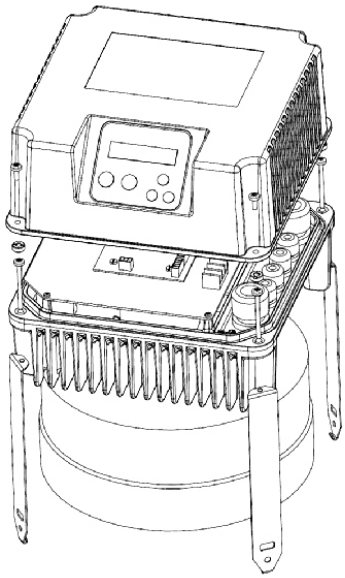
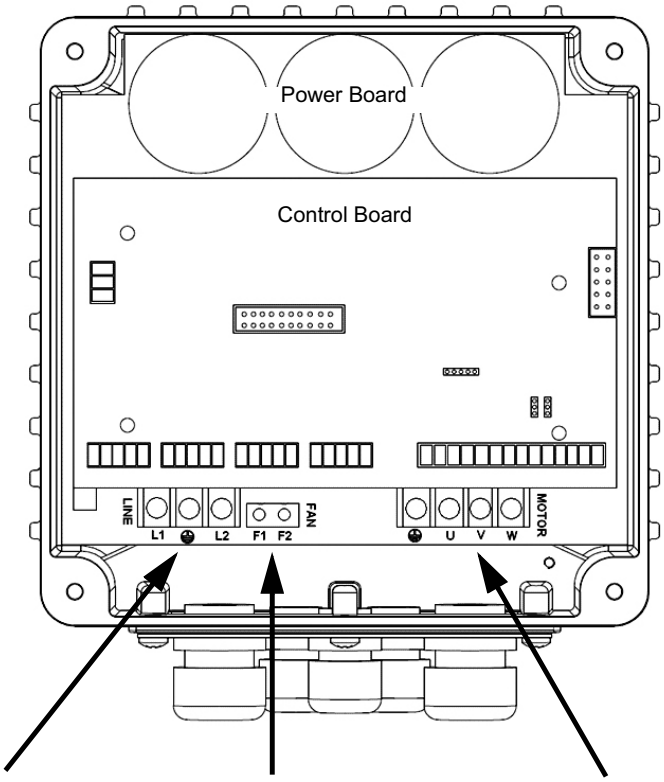


Fig. 1-5 VASCO 414,418,425 Motor Mounting

Electrical and signal connection

Power Connection to Model VASCO 209, 214



Power Supply In	Aux Fan Connection	Output to Motor
LINE: L1, earth, L2 It is recommended to use cable lugs	**FAN: F1, F2** 230VAC (Wall mounting kit)	***1 Phase Motor:*** **earth, U (common), V (running)** ***3 Phase Motor:*** **earth, U, V, W** It is recommended to use cable lugs

For Signal connections to the Control Board refer to fig 1-9
For Combo (multi-pump) RS485 connection to other VASCOs refer to fig 1-10

Recommended Line and Motor Cable Stripping

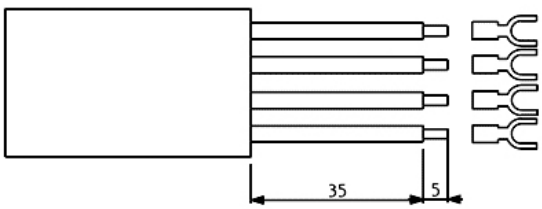
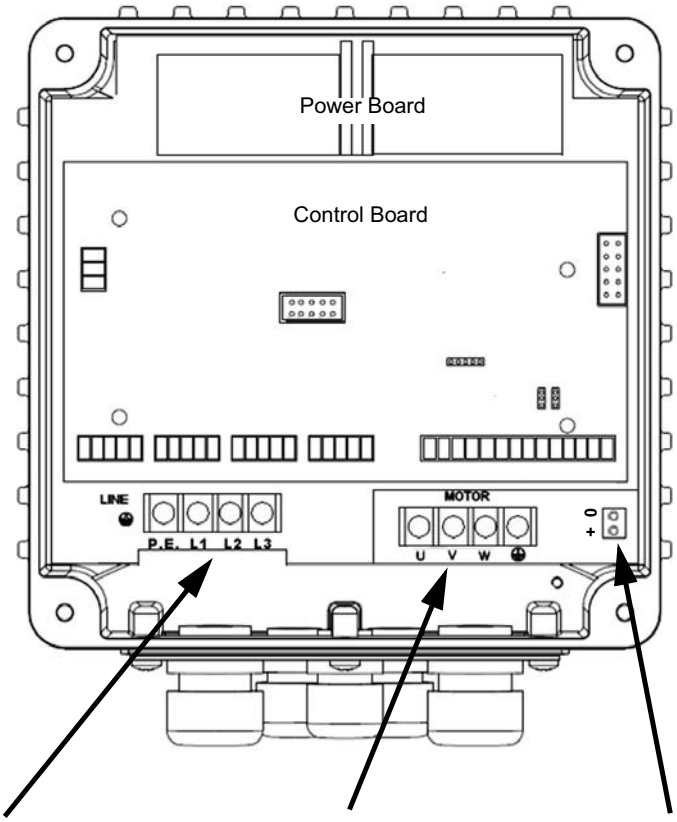


Fig. 1-6 VASCO 209, 214 Power Board Connection

Power & Signal Connection to three phase model VASCO 406, 409



Power Supply In	Output to Motor	Aux Fan Connection
LINE **Earth, L1, L2, L3** It is recommended to use cable lugs	**MOTOR U, V, W, Earth,** It is recommended to use cable lugs	**0VE, +VE** **12VDC** ***Warning: Respect Polarity***

For Signal connections to the Control Board refer to fig 1-9
For Combo (multi-pump) RS485 connection to other VASCOs refer to fig 1-10

Recommended Line and Motor Cable Stripping

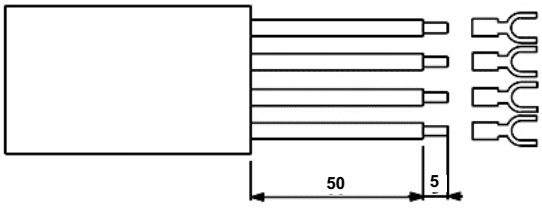
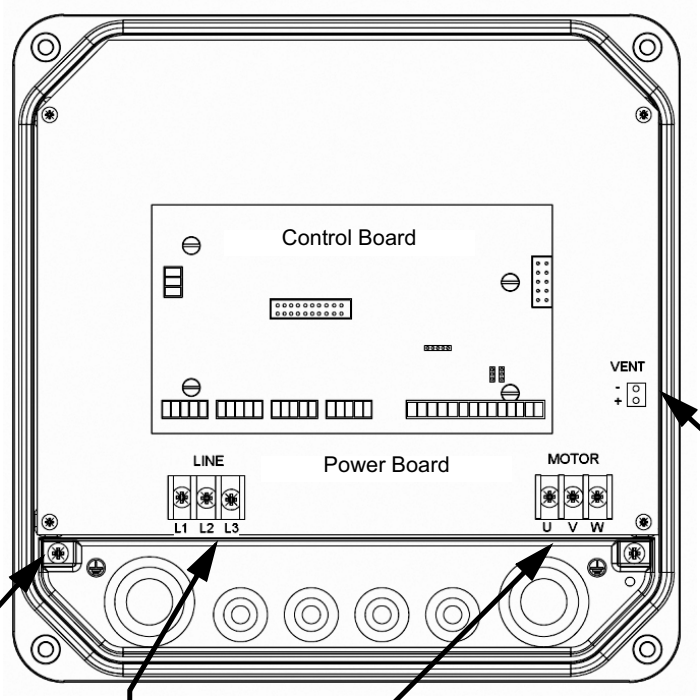
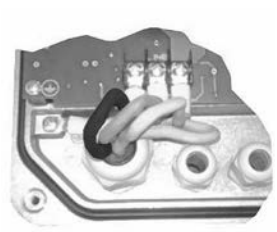


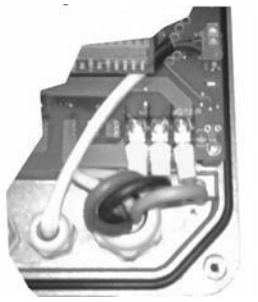
Fig. 1-7 VASCO 406, 409 Power Board Connection

Power Connection to three phase model VASCO, 414, 415, 425, 430



Power Supply In	Output to Motor	Aux Fan Connection
earth, LINE: L1, L2, L3 It is recommended to use cable lugs	**MOTOR: U, V, W, earth,** It is recommended to use cable lugs	**VENT: -, +** **12VDC** ***Warning: Respect Polarity***





For Signal connections to the Control Board refer to fig 1-9

For Combo (multi-pump) RS485 connection to other VASCOs refer to fig 1-10

Recommended Line and Motor Cable Stripping

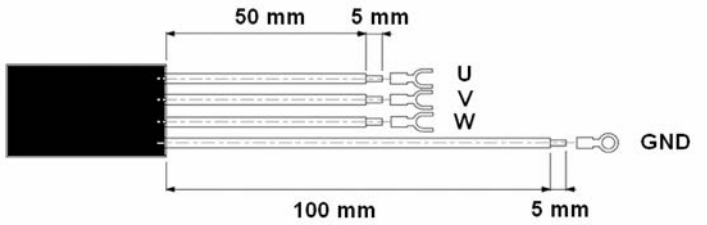
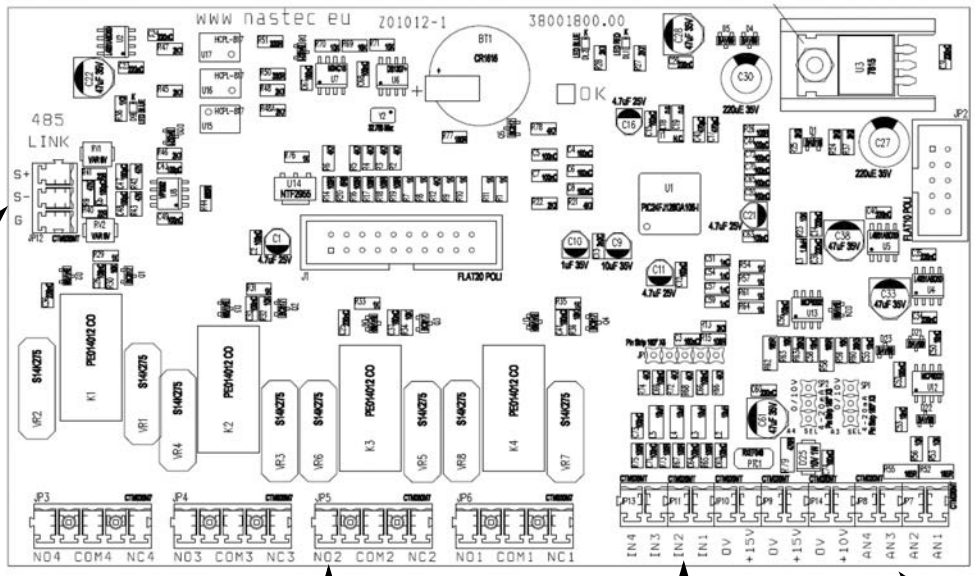


Fig. 1-8 VASCO 414, 418, 425, 430 Power Board Connection

Signal (Control Board) Connections



RS485

- S+
- S-
- G

It is recommended to respect the polarity linking more VASCOs in series.

Digital Outputs

Motor run signal:

- NO1, COM1: closed contact with motor running.
- NC1,COM1: closed contact with motor stopped.

Alarm signal

- NO2,COM2: opened contact without alarm.
- NC2,COM2: closed contact without alarm.

DOL1 pump relay:

- NO3,COM3: closed contact with DOL1 running.
- NC3,COM3: opened contact with DOL1 running.

DOL2 pump relay:

- NO4,COM4: closed contact with DOL2 running.
- NC4,COM4: opened contact with DOL2 running.

Relays are no voltage contacts. Max. voltage to the contacts is 250V with max current of 5A.

Digital Inputs

- IN1
- IN2
- IN3
- IN4
- 0V

We recommend using only no voltage contacts. Opening or closing the digital contacts (depending on software configuration set (see inst. parameters) you can start or stop the motor.

Analog Inputs (10 or 15 Vdc)

- AN1: 4-20 mA
- AN2: 4-20 mA
- AN3: 4-20 mA / 0 - 10 Vdc (settable by jumper C.C.)
- AN4: 4-20 mA / 0 - 10 Vdc (settable by C.C.)

Fig. 1-9 VASCO Control Board Connection

VASCO serial connection

For Combo (multi-pump) use, VASCO's communication is made through a protocol using the RS485 port. Each VASCO must be connected to each other by using a tripolar cable (0,5 mm2) wired on S+,S-,G pins on the control board, see fig 1-9.

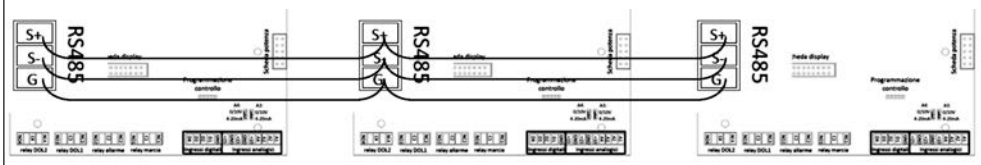


Fig. 1-10 RS485 Serial Connection

Pressure control

Vasco controls pump speed to maintain a constant pressure independent of water demand using a sensor, (see fig 1-11)

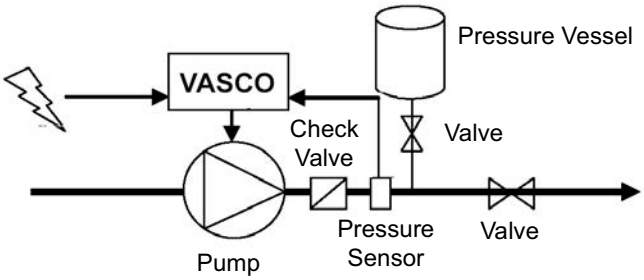


Fig. 1-11 Pressure Control

Pressure Vessel

Installation of a pressure tank in the hydraulic system is recommended to compensate leakage of water in the system (or during minimum water demand) and to avoid continuous start/stop cycling of the pump. Selecting the proper volume and pre-charge pressure of the tank is very important; smaller tank volumes will not compensate adequately for minimum water usage or leakage, while larger volumes make it more difficult for VASCO to control the pressure evenly.

Recommended tank volume is equal to the 10% of the maximum water flow of the system (expressed in volume unit/min) e.g. Flow = 50litres/min, Tank = 5 Litres

Pre-charge pressure of the pressure tank should be at least 80% than the set-pressure of the system. e.g. Set system pressure = 4 bar, Precharge pressure = 3.2 bar.

Sensor installation or replacement

To use the Combo (multi-pump) function in a system incorporating several interconnected VASCOs an individual pressure sensor must be connected to each VASCO. The value of the set pressure is communicated to the slaves via the serial port.

VASCO requires a pressure sensor with a linear output signal within the range 4 – 20 mA. The pressure transducer can be powered by any range of DC Voltage which includes the value 15VDC.

A 2nd pressure sensor can be connected to the VASCO:

- to prevent the shutdown of the system due to single pressure sensor failure.
- to action constant differential pressure (AN1 - AN2)
- switch pressure sensor by closing digital input 1N2

It will be necessary to set the pressure sensor characteristics in the initial configuration, or in the installer menu.

Referring fig 1-9, connect the sensor wires to the analogue input terminals as below:

Primary Sensor	**0V** GND signal (if available) **AN1** signal 4-20mA (-) **+15** Power supply 15Vdc (+)	**Secondary Sensor** (if fitted)	**0V** GND signal (if available) **AN2** signal 4-20mA (-) **+15** Power supply 15Vdc (+)

Parameter Setting

Accessing the VASCO Parameters

Although the VASCO software is extremely simple to use, it allows a wide variety of parameters to be set for ideal system configuration. A password is required to gain access to the set up parameters. Without a password it is impossible to set up and/or modify any parameters although they can however still be displayed.

You should only adjust these parameters if you are trained to do so.
Improper setting of these advanced parameters could compromise the integrity and the life of the controller and the pump.

Access Passwords

There are two levels of access to Parameter setting permitted, both requiring passwords:

- **Installer level** - Default password **001**
- **Advanced level** - Default password **002**

A different password can be set up if required once the menu is accessed.

Initial Controller Configuration

The pumpset will have been tested and set to a default initial set of parameters to configure pump characteristics, pressure sensor range, and system characteristics. Without these initial settings it is impossible to run the pump.

If required, the initial setting procedure can be repeated by accessing the controller using the 2rd level password. This will allow alteration of the parameters.

A brief description of the initial configuration parameters and their allowable ranges is as follows:

Parameter	Default	Description
Language **XXXXXX**	XXXXXXX	End user communication language.
Unit **bar/psi**	bar	Pressure unit.
Motor type **singlephase/threephase**	threephase	Type of motor connected. *(VASCO 209, 214)*
Rated motor Amp **I + XX.X [A]**	XX	Rated current of the motor on its nameplate plus 10%. *Note: The voltage drop caused by the inverter leads to higher input current than nominal. Make sure motor is capable of accepting increased current.*
Rated motor frequency **f + XX.X [Hz]**	50	Rated frequency of the motor on its nameplate.
Control mode: Constant pressure		
F.s press.sensor **20mA = XX.X [bar]**	16	Maximum pressure of pressure transducer. Set the upper value of the pressure transducer i.e. the 20mA output signal level. (i.e. 0 – 10 bars transducer range) 10 bars = 20 mA
Sensor test **Press ENT**		If the transducer is not connected or connected improperly, the signal SENS. PRESS OFF is displayed when pressing ENTER.
Max alarm press **p = XX.X [bar]**	10	Maximum pressure allowed in the system. If the pressure goes over this value, an alarm occurs and the pump is stopped. Pump is automatically restarted if the pressure goes below the maximum value for a at least 5 seconds.

Motor test **START / STOP**		Press START/STOP to run a test at rated frequency **Warning: This will start the system. Make sure it is safe to run without damage.**
Rotation sense **---> / <---**	--->	When testing the system, if the motor runs in reverse, it is possible to reverse the rotation via software without physically changing wires at the terminals.
Set pressure **p = XX.X [bar]**	3	The pressure value to be kept constant.
Autorestart **ON/OFF**	OFF	If ON is selected, VASCO automatically returns to its normal status after a voltage failure. i.e. if it was powering the pump before, it resumes powering the pump. **THIS MAY BE CONSIDERED HAZARDOUS**
INITIAL SETUP **COMPLETED**		Once the Setting procedure is completed you will get this indication on the display and the setting parameters are stored. These parameters can be individually changed later in either the INSTALLER Parameters menu or ADVANCED Parameters menu.

Installer Parameters

Many of the Installer Parameters are set during the Initial Configuration (page 16).

However, through the Installer Parameters menu, it is possible to change the set parameters or set others in order to perfect the calibration of VASCO to the pumping system.

Parameter	Default	Description	Constant Press	Fix Speed	Const.value.2val	Fix Speed 2 val	External Speed
Control Mode **Constant value.** **Fix Speed** **Const.value.2val** **Fix speed 2 val** **External speed**	Constant Value.	***Mode of control:*** *Constant value:* VASCO changes the speed of pump to keep the set value constant, independent of water demand. *Fixed frequency:* VASCO feeds the pump a set frequency, so the speed of motor is kept constant. *Constant pressure control with two values:* the two values are selected by opening or closing the digital input IN2. *Fixed frequency control with two values:* the two values to be selected by opening or closing the digital input IN2. *External speed:* control motor frequency by using analogue control signal AN4.					
Unit **bar/psi**	bar	Pressure unit	✓	✓	✓	✓	✓
F.scale.sensor **p = XX.X [bar]**	16	Sensor full scale value	✓	✓	✓	✓	✓
Min value sensor **20mA = XX.X [°C]**	0	Sensor minimum value	✓	✓	✓	✓	✓

Parameter	Default	Description	Constant Press	Fix Speed	Const.value.2val	Fix Speed 2 val	External Speed
Max alarm value p = XX.X [bar]	10	Maximum value allowed in the system. If the monitored value goes over this value, an alarm occurs and the pump is stopped. The pump is automatically restarted if the monitored value goes below the maximum value for at least 5 seconds.	✓	✓	✓	✓	✓
Min alarm value p = XX.X [bar]	0	Minimum pressure allowed in the system. If the monitored value goes lower than this value, an alarm occurs and the pump is stopped. The pump is automatically restarted if the monitored value goes higher than the minimum value for at least 5 seconds. *This parameter is particularly useful in the event a system pipe breaks. It is suggested to set a value higher than 0.*	✓	✓	✓	✓	✓
Ext set enabling ON/OFF	OFF	This enables the changing of Set Value via the analogue input AN3	✓		✓		
Set value p = XX.X [bar]	3	The set value to be kept constant.	✓				
Compensation p = XX.X [bar]	0	Value compensation at the maximum frequency for each pump. *See fig 1-12 on page 21.* You can reverse the sign (+/-) by pressing the green button.	✓		✓		
Set value 2 p = XX.X [bar]	3	The pressure value to be kept constant.			✓		
Compensation2 p = XX.X [bar]	0	Value compensation at the maximum frequency for each pump. *See fig 1-12 on page 21.* You can reverse the sign (+/-) by pressing the green button.			✓		
Set value update. t = XX [s]	5	Time to update the set value for compensation.	✓		✓		
Operating freq. f = xxx [Hz]	50	Set the frequency (speed) value to feed the pump.		✓			
Operating freq. 2 f = xxx [Hz]	50	Set the frequency value (or the speed) to feed the pump.				✓	
Freq min control fmin = xxx [Hz]	50	Minimum frequency at which the pump must stop.	✓		✓		✓
Stop delay t = XX [s]	5	Delay after which the pump will stop once the minimum frequency is reached (f min Q=0)	✓		✓		✓
Control Ramp t = XX [s]	20	Ramp time from freq min control to motor freq min. If, during this time, the p checked goes below the (set value - delta control), VASCO powers the motor again; otherwise, VASCO will stop the pump. *See fig 1-13 on page 21.*	✓		✓		✓

Parameter	Default	Description	Constant Press	Fix Speed	Const.value.2val	Fix Speed 2 val	External Speed
Delta control **p = XX.X [bar]**	0.1	This value represents the value drop below the set value required to restart the pump during the control ramp period.	✓		✓		
Delta start **p = XX.X [bar]**	0.5	This value represents the value drop below the set value required to start the pump from stopped.	✓		✓		
Delta stop **p = XX.X [bar]**	0.5	This value is the increase of value above the value set which must be passed so that there is a forced shutdown of the pump.	✓		✓		
Ki **XXX**		Kp and Ki parameters allow the dynamic control of system by VASCO. Set values (Ki=50, Kp=005) are usually enough to get a valid dynamic control. *If the set pressure do not provide a valid control, proceed as follows:* Increase or reduce Ki while keeping Kpconstant; if the problem persists, increase Kp value and increase or reduce the Ki value again till a good dynamic control is reached.	✓		✓		
Kp **XXX**							
Pump DOL 1 **ON/OFF**	OFF	Function to activate (ON) the second auxiliary pump DOL 1 (Direct On Line pump).	✓		✓		
Pump DOL 2 **ON/OFF**	OFF	Function to activate (ON) the second auxiliary pump DOL 2 (Direct On Line pump).	✓		✓		
Alternance **ON/OFF**	OFF	Function to allow alternating starting priority between the DOL pumps in order to allow equality of use.	✓		✓		
Start delay AUX **t = XX [s]**	1	Delay time for the DOL pumps start after the variable speed pump has reached the maximum speed and the pressure value has fallen below the set pressure (Delta start pressure).	✓		✓		
COMBO **ON/OFF**	OFF	Enable multiple VASCOs to work in parallel. *e.g. duty/standby /assist modes.Theoretically up to 8 VASCO units can be connected in parallel. Communication is RS485 by a private protocol.*	✓				
PI control **Direct/Reverse**	Direct	*Direct:* Increasing the measured pressure, VASCO decreases motor frequency. *Inverse:* Increasing the measured pressure, VASCO increase motor frequency.	✓		✓		
Rotation sense **---> / <---**	--->	When testing the system, if the motor runs in reverse, it is possible to reverse the rotation via software without physically changing wires at the terminals.	✓	✓	✓	✓	✓
Dry run cosphi **cosphi = X.XX**	0.65	If the pump goes into dry running, the cosphi reaches its lowest level. To set this value, contact the pump Manufacturer. Alternatively test by closing the suction and then checking the value on the VASCO display. A value can then be set by assuming a dry cosphi equivalent to 60% of the rated cosphi specified by the manufacturer.	✓	✓	✓	✓	✓

Parameter	Default	Description	Constant Press	Fix Speed	Const.value.2val	Fix Speed 2 val	External Speed
Restarts delay **t = XX [min]**	10	The restart delay after a dry running alarm. At each attempt (max 5) the restart delay will be doubled	✓	✓	✓	✓	✓
Digital input 1 **N.O. / N.C.**	N.O.	By selecting N.A. (normally open) the motor runs if the digital input 1 is open, and stops if the digital input 1 is closed. By selecting N.C. (normally closed) the motor runs if the digital input 1 is closed, and stops if the digital input 1 is opened.	✓	✓	✓	✓	✓
Digital input 2 **N.O. / N.C.**	N.O.	By selecting N.A. (normally open) the motor runs if the digital input 2 is open, and stops if the digital input 2 is closed. By selecting N.C. (normally closed) the motor runs if the digital input 2 is closed, and stops if the digital input 2 is opened.	✓	✓	✓	✓	✓
Digital input 3 **N.O. / N.C.**	N.O.	*Vasco 209, 214, 414, 418, 425 Only* By selecting N.A. (normally open) the motor runs if the digital input 3 is open, and stops if the digital input 3 is closed. By selecting N.C. (normally closed) the motor runs if the digital input 3 is closed, and stops if the digital input 3 is opened.	✓	✓	✓	✓	✓
Digital input 4 **N.O. / N.C.**	N.O.	*Vasco 209, 214, 414, 418, 425 Only* By selecting N.A. (normally open) the motor runs if the digital input 4 is open, and stops if the digital input 4 is closed. By selecting N.C. (normally closed) the motor runs if the digital input 4 is closed, and stops if the digital input 4 is opened.	✓	✓	✓	✓	✓
Dig.In2/3 delay **t = xx [s].**	1	Digital input IN2 and IN3 delay. *Digital input IN1 and IN4 have a 1 second fixed delay.*	✓	✓	✓	✓	✓
Change PASSWORD1 **ENT**		Pressing ENTER allows the installer level password (1st level) (default 001) to be changed.	✓	✓	✓	✓	✓

To ensure proper operation of pressure control is recommended to place the sensor near the pump.

To compensate the pressure loss in the pipes (proportional to flow) it is possible to vary the pressure set in a linear relation with respect to frequency.

Perform the following test to verify the correct value of compensation:

1. Install another pressure gauge away from the pressure sensor. Open the valve completely and read the gauge.

2. Set the value of *compensation* to equal to the difference of the values from the two gauges.

For a group of pumps, the pressure compensation to be applied to each pump is equal to the total pressure compensation (when all the pumps are running at full speed) divided by the number of pumps in the group.

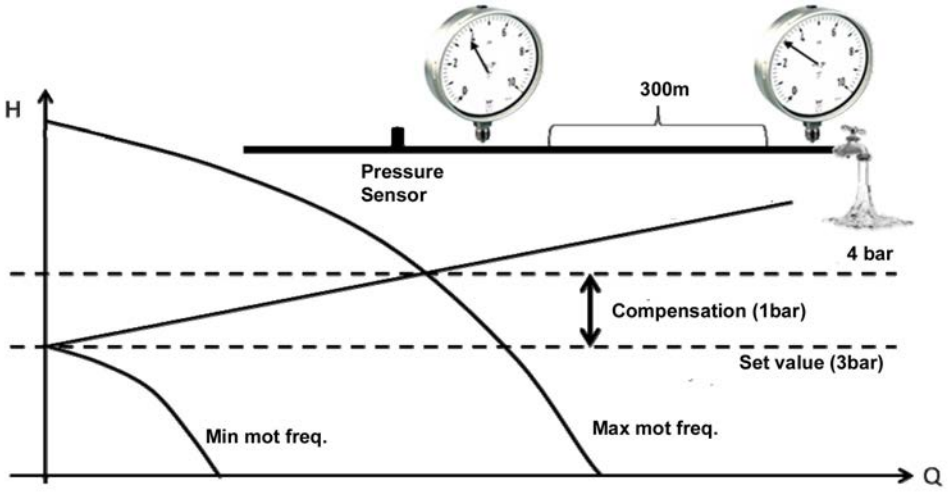


Fig. 1-12 Compensation Calculation

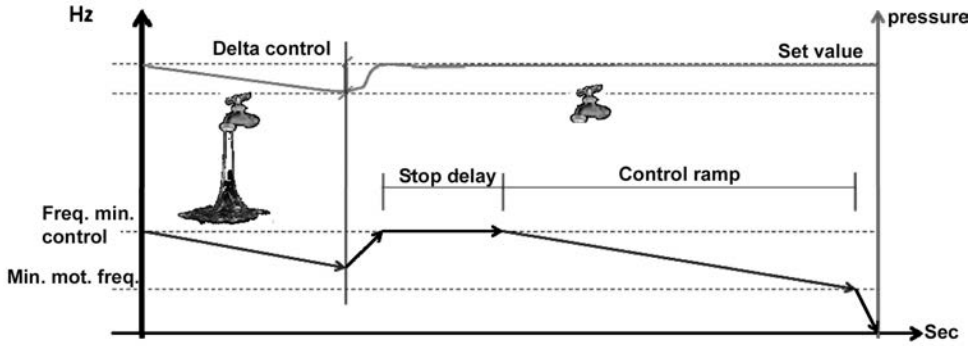


Fig. 1-13 Ramp Time Calculation

Advanced Parameters

All the advanced parameters, due to their importance, are already set during initial setup (see page 16), however it is always possible to modify individual parameters or modify the Advanced password from default 002.

Parameter	Default	Description
Rated motor Volt. **V = XXX [V]**	*Vasco 209,214* 230 or 400 *Vasco 409, 414,418,425* 400	Motor rated voltage (as shown on the motor plate) *Average voltage drop due to the inverter is between 20V and 30Vrms based on load condition.* *e.g. when the input voltage is 230V the average VASCO output voltage will be 200/210V.*
Voltage boost **V = XX [%]**	1%	This sets a voltage increase during the start up of the motor. **Warning: An excessive value can seriously damage the motor. Contact the manufacturer for information.** *If a single-phase motor is used, a value of 1% is suggested to increase the starting torque.*

Parameter	Default	Description
Rated motor Amp. **I = XX.X [A]**	XX	Rated current of the motor (as shown on the motor plate) increased by 10%. ***The voltage drop caused by the inverter leads to higher input current than nominal. Make sure motor is capable of accepting increased current.***
Rated motor freq **f = XXX [Hz]**	50	Rated frequency of the motor from its nameplate.
Max motor freq. **f = XXX [Hz]**	50	Maximum frequency of the motor. *Note: Reducing the maximum frequency of the motor, will also reduce the maximum current.*
Min motor freq. **f = XXX [Hz]**	30	Minimum frequency of the motor. *Note: It is not advisable to set minimum frequency lower than 30 Hz in order to protect the integrity of the thrust bearings.*
Ramp up time **t = XX [sec]**	4	Ramp-up time to reach the speed required to achieve the set pressure (or speed value). *Refer to fig 1-14 on page 24.* *Longer times delay the system reaching the preset value but better protect system components.* *Excessively long ramp-up times can create difficulties in setup, and can also cause false overload alarms.*
Ramp down time **t = XX [sec]**	4	Ramp-down time to reach zero speed. *Refer to fig 1-14 on page 24.* *Longer times keep the system pressurised, while still protecting the system components.* *Excessively long ramp-down times can create difficulties in setup. Excessively short ramp-down times can cause false overload alarms.*
Ramp f min mot. **t = XX [sec]**	1.5	Time to reach the minimum frequency (speed) of the motor and vice versa. *Refer to fig 1-14 on page 24.*
PWM **f = XX kHz]**	8	Carrier frequency (switching frequency). *Choose PWM in the range of 2.5, 4, 8, 10 kHz.* *Higher values give a more sinusoidal wave with fewer losses. Refer to fig 1-15 on page 24.* *If long cables are used (>20 m / >76 ft), it is recommended to install an inductive filter between the controller and the motor (available upon request) and to set the value of PWM to 2.5 kHz. This reduces the risk of voltage spikes, which can damage motor and cable insulation.*
V/f lin. --> quad. **XXX %**	85%	This parameter allows you to change the V/f characteristic with which VASCO feeds the pump. *The linear characteristic corresponds to constant torque with variable speed. The quadratic characteristic is normally used with centrifugal pumps. The selection of torque characteristic should be done to ensure a smooth operation, a reduction of energy consumption and a lower level of heat and acoustic* noise. *Refer to fig 1-15 on page 24.*
Autorestart **ON/OFF**	OFF	If ON is selected, VASCO automatically returns to its normal status after a voltage failure. i.e. if it was powering the pump before, it resumes powering the pump. **THIS MAY BE CONSIDERED HAZARDOUS**

Parameter	Default	Description
Rated motor Amp. **I = XX.X [A]**	XX	Rated current of the motor (as shown on the motor plate) increased by 10%. ***The voltage drop caused by the inverter leads to higher input current than nominal. Make sure motor is capable of accepting increased current.***
Rated motor freq **f = XXX [Hz]**	50	Rated frequency of the motor from its nameplate.
Max motor freq. **f = XXX [Hz]**	50	Maximum frequency of the motor. *Note: Reducing the maximum frequency of the motor, will also reduce the maximum current.*
Min motor freq. **f = XXX [Hz]**	30	Minimum frequency of the motor. *Note: It is not advisable to set minimum frequency lower than 30 Hz in order to protect the integrity of the thrust bearings.*
Ramp up time **t = XX [sec]**	4	Ramp-up time to reach the speed required to achieve the set pressure (or speed value). *Refer to fig 1-14 on page 24.* *Longer times delay the system reaching the preset value but better protect system components.* *Excessively long ramp-up times can create difficulties in setup, and can also cause false overload alarms.*
Ramp down time **t = XX [sec]**	4	Ramp-down time to reach zero speed. *Refer to fig 1-14 on page 24.* *Longer times keep the system pressurised, while still protecting the system components.* *Excessively long ramp-down times can create difficulties in setup. Excessively short ramp-down times can cause false overload alarms.*
Ramp f min mot. **t = XX [sec]**	1.5	Time to reach the minimum frequency (speed) of the motor and vice versa. *Refer to fig 1-14 on page 24.*
PWM **f = XX kHz]**	8	Carrier frequency (switching frequency). *Choose PWM in the range of 2.5, 4, 8, 10 kHz.* *Higher values give a more sinusoidal wave with fewer losses. Refer to fig 1-15 on page 24.* *If long cables are used (>20 m / >76 ft), it is recommended to install an inductive filter between the controller and the motor (available upon request) and to set the value of PWM to 2.5 kHz. This reduces the risk of voltage spikes, which can damage motor and cable insulation.*
V/f lin. --> quad. **XXX %**	85%	This parameter allows you to change the V/f characteristic with which VASCO feeds the pump. *The linear characteristic corresponds to constant torque with variable speed. The quadratic characteristic is normally used with centrifugal pumps. The selection of torque characteristic should be done to ensure a smooth operation, a reduction of energy consumption and a lower level of heat and acoustic* noise. *Refer to fig 1-15 on page 24.*
Autorestart **ON/OFF**	OFF	If ON is selected, VASCO automatically returns to its normal status after a voltage failure. i.e. if it was powering the pump before, it resumes powering the pump. **THIS MAY BE CONSIDERED HAZARDOUS**

Parameter	Default	Description
Periodic Autorun **t + xx[h]**	0	Pump periodic auto run after XX hours of inactivity. **THIS MAY BE CONSIDERED HAZARDOUS** A value 0 disables the function
AN1,AN2 function **ON/OFF**	Independent	Function logic for analogue AN1, AN2. *(VASCO 209, 214, 414, 418, 425 only)*
Offset input 1 **x = XX.X[%]**	20%	Zero correction for analogue input 1. *(20mA x20% =4mA)*
Offset input 2 **x = XX.X[%]**	20%	Zero correction for analogue input 2. *(20mA x20% =4mA)*
Offset input 3 **x = XX.X[%]**	20%	Zero correction for analogue input 3. *(20mA x20% =4mA)*
Offset input 4 **x = XX.X[%]**	00%	Zero correction for analogue input 4 (default 0-10). *(10v x00% = 0v)*
Change PASSWORD2 **ENT**		Pressing ENTER allows the advanced level password (2st level) (default 002) to be changed.

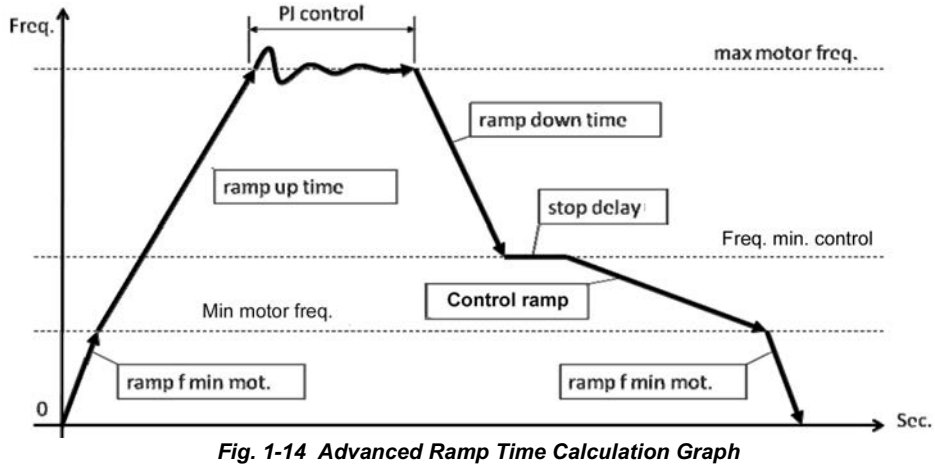


Fig. 1-14 Advanced Ramp Time Calculation Graph

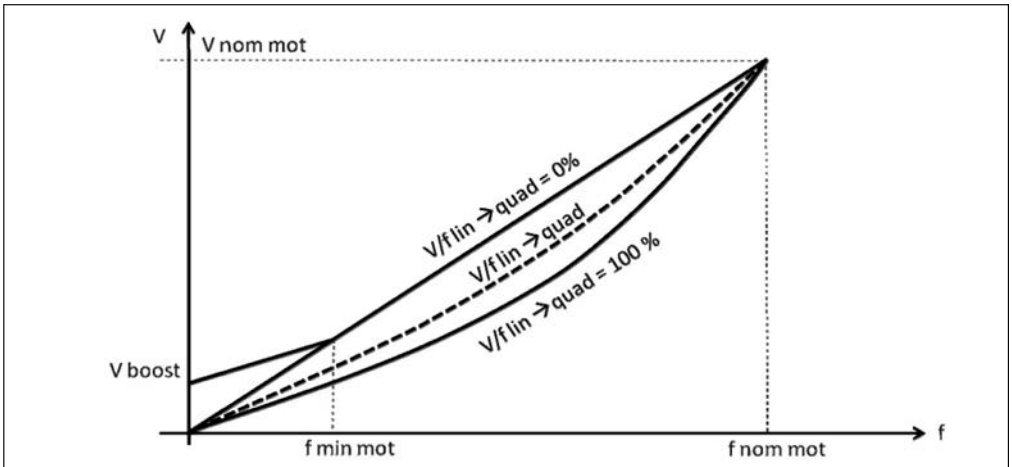


Fig. 1-15 Voltage/Frequency Graph

Setting Up a Multi-pump *COMBO* Function

For VASCOs to interact when used in multi-pump applications e.g in a duty/standby/assist mode, the Combo function in the *Installer Parameters* menu must be enabled. *(This Combo function will theoretically allows serial communication between up to 8 VASCO pumps)*. One pump will be designated as the Master and the others as Slaves. Communication is made through a protocol using the RS485 port. Refer to page 15 for connection details.

To achieve the *Combo* function in a system requires the use a pressure sensor connected to each VASCO. The value of the set pressure is then communicated to the slaves via the serial port. To prevent the shutdown of the system due to pressure sensor failure, a 2nd identical pressure sensor can also be connected to each VASCO.

The procedure below sets up the offset operation of the sensors in the *Combo* (multi-pump) system and MUST be done to EACH VASCO using the Installer Parameters menu.

Whenever the user accesses the Menu screen of the VASCO Master, the communication between VASCOs is automatically interrupted.

In case of alarm or failure of a pump in a *Combo* (multi-pump) system, this pump's operation will be replaced (temporary or permanently) by another pump.

In case of failure of the Master in a *Combo* (multi-pump) system, it will be replaced by the next Slave. To achieve this, all parameters must independently be setup as Master mode on each inverter.

Master setup

Supply power to the VASCO master and if not yet done, perform the initial configuration as described on page 16.

Initial View	**Inv: ON/OFF Mot: ON/OFF** **p_mis =XX.X [bar]**	
1. Scroll until	**Menu** **ENT to access**	
2. Press **ENTER**	**MENU** **Param. install.**	
3. Press **ENTER** 4. Insert password	**001**	Default 001
5. Scroll until 6. Set **ON**	**Combo** **ON/OFF**	
7. Set **00**	**Address** **XX**	Vasco's address in parallel operation. 00 = VASCO master
8. Set **OFF**	**Alternance** **ON/OFF**	This function allows alternating between the VASCOs connected in parallel.
9. Set **1**	**Start delay AUX** **t = XX [s]**	Sets the Delay time for the slaves to start after the variable speed pump has reached the maximum frequency and the pressure value has fallen below set pressure – delta start pressure.
10. Press **STOP** 11. Press **STOP**		*RED Button*

Slave setup

In case of a failure of the master in a Combo system, it will be replaced by slave. As a consequence, all master mode parameters must be setup independently on each inverter.

Follow Master setup until point 10 then, instead of exiting (Stop):

11. Set **01**	**Address** **XX**	Vasco's address in parallel operation. 01...07 = VASCO slave.
12. Press **STOP**		*RED Button*

This will be repeated to set other slaves - 02, etc.

Proceed to the advanced menu.

1. Scroll until	**Menu** **ENT to access**	
2. Press **ENTER**	**MENU** **Param. install.**	
3. Press **ENTER** 4. Insert password	**002**	Default 002 This enters the Advanced menu
5. Scroll until 6. Set **ON**	**Autorestart** **ON/OFF**	
7. Press **STOP** 8. Press **STOP**		*RED Button*

B

Appendix B Miscellaneous Technical Information

This Appendix contains miscellaneous technical information applicable to Dutypoint equipment.

- ***Net Positive Suction Head (NPSH)***
- ***Convertion Factors***
- ***Variable Speed Flow, Head and Power Calculations***
- ***General Operating Limits (Standard Dutypoint Pumpsets)***

Net Positive Suction Head (NPSH)

The minimum operating values that can be reached at the pump suction end are limited by the onset of cavitation.

Cavitation

Cavitation is the formation of vapour-filled cavities within liquids where the pressure is locally reduced to a critical value, or where the local pressure is equal to, or just below the vapour pressure of the liquid. The vapour-filled cavities flow with the current and when they reach a higher pressure area the vapour contained in the cavities condenses.

The cavities collide, generating pressure waves that are transmitted to the walls. These, being subjected to stress cycles, gradually become deformed and yield due to fatigue. This phenomenon, characterised by a metallic noise produced by the hammering on the pipe walls, is called incipient cavitation.

The damage caused by cavitation may be magnified by electro-chemical corrosion and a local rise in temperature due to the plastic deformation of the walls. The materials that offer the highest resistance to heat and corrosion are alloy steels, especially austenitic steel. The conditions that trigger cavitation may be assessed by calculating the total net suction head, referred to in technical literature with the code NPSH (Net Positive Suction Head).

Calculating NPSH

The NPSH represents the total energy (expressed in m) of the liquid measured at suction under conditions of incipient cavitation, excluding the vapour pressure (expressed in m.) that the liquid has at the pump inlet.

To find the static height $\mathbf{h_z}$ at which to install the machine under safe conditions, the following formula must be verified:

$$\mathbf{h_p + h_z \geq (NPSH_r + 0.5) + h_f + h_{pv}}$$

Where:

- $\mathbf{h_p}$ is the absolute pressure applied to the free liquid surface in the suction tank, expressed in m. of liquid; h_p is the quotient between the barometric pressure and the specific weight of the liquid.
- $\mathbf{h_z}$ is the difference in height between the pump axis and the free liquid surface in the suction tank, expressed in m; h_z is negative when the liquid level is lower than the pump axis.
- $\mathbf{h_f}$ is the friction loss in the suction line and its accessories, such as: fittings, foot valve, gate valve, elbows, etc.
- $\mathbf{hp_v}$ the vapour pressure of the liquid at the operating temperature, expressed in m of liquid. hpv is the quotient between the Pv vapour pressure and the liquid's specific weight.
  0.5 is the safety factor.

The maximum possible suction head for installation depends on the value of the atmospheric pressure (i.e. the elevation above sea level at which the pump is installed) and the temperature of the liquid.

To help the user, with reference to water temperature (4°C) and to the elevation above sea level, the following tables show the drop in hydraulic pressure head in relation to the elevation above sea level, and the suction loss in relation to temperature.

Water temp (°C)	20	40	60	80	90	110	120
Suction loss (m)	20	40	60	80	90	110	120

Elevation above sea level (m)	500	1000	1500	2000	2500	3000
Suction loss (m)	0,55	1,1	1,65	2,2	2,75	3,3

Friction loss must be calculated using a recognised formula. To reduce it to a minimum, especially in cases of high suction head (over 4-5m.) or within the operating limits with high delivery values, we recommend using a suction line having a larger diameter than that of the pump's suction inlet.

It is always a good idea to position the pump as close as possible to the liquid to be pumped.

Make the following calculation:

Liquid: water at ~ 15 °C g = 1 Kg/dm3

Delivery required: 30 m3/h

Head for required delivery: 43 m

Suction difference in height: 3,5 m

The selection is a FHE 40-200/75 pump whose NPSH required value is 2.5m @ 30 m^3/h

For water at 15°C the h_{pv} term is: Pv/g = 0.174 m (0.01701 bar)

eh = Pa/g = 10.33 m

The h_f friction loss in the suction line with foot valves is 1.2 m.

By substituting the parameters in formula with the numeric values above:

$$10.33 + (-3.5) \geq (2.5 + 0.5) + 1,2 + 0.17$$

6.8 > 4.4. The relation is therefore verified.

Convertion Factors

Flow conversion			Pressure conversion		
L/min.	÷ 60	= L/Sec	m Hd	÷ 10.2	= Bar
m_3/hr	÷ 3.6	= L/Sec	Psi	÷ 14.47	= Bar
Gpm	÷ 13.2	= L/Sec	Kpa	÷ 100	= Bar
Kg/Sec	÷ 1.0	= L/Sec	Kg/cm^3	÷ 1.02	= Bar

Variable Speed Flow, Head and Power Calculations

V_1 = Full speed
V_2 = Reduced speed
Q_1 = Flow rate at full speed
Q_2 = Flow rate at reduced speed
H_1 = Head at full speed
H_2 = Head at reduced speed
P_1 = Power at full speed
P_2 = Power at reduced speed

$$Q_2 = \left(\frac{V_2}{V_1}\right) Q_1$$

$$H_2 = \left(\frac{V_2}{V_1}\right)^2 H_1$$

$$P_2 = \left(\frac{V_2}{V_1}\right)^2 P_1$$

General Operating Limits (Standard *Dutypoint* Pumpsets)

Type of pumped liquids	Water with no gas or aggressive substances
Maximum pumped liquids temperature	+23°C
Minimum pumped liquid temperature	1°C to avoid icing
Operating ambient temperature	+5°C to 40°C for indoor installation (CEI EN 60439-1)
Relative humidity	Max 50% at 40°C
Air impurities	The air must be clean and free of acid vapours, corrosive gases and excessive amounts of dust
Storage temperature	+5°C to 50°C
Suction Conditions	Minimum positive pressure 0.1 Bar, Max 0.5 Bar

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