

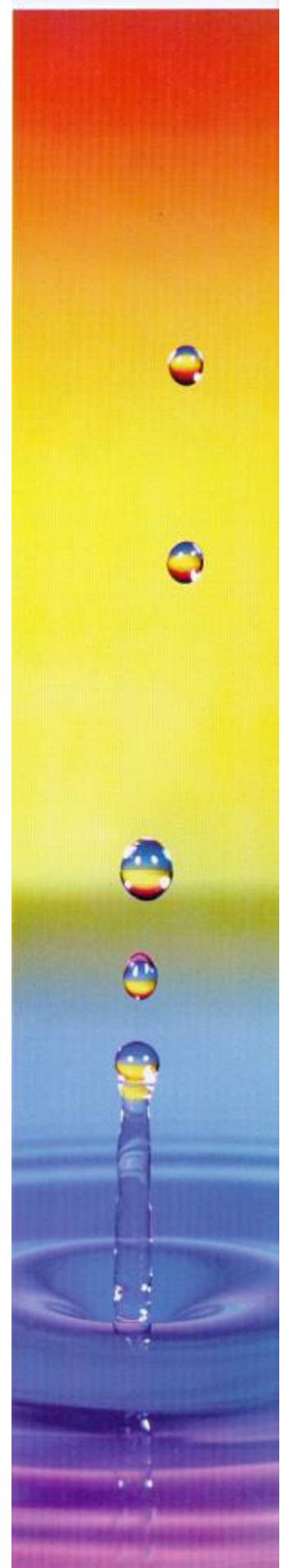


VGS

Oily Water Separator

Technical Manual

Version: OWS-Mono-JUL.05



Vertical Gravity Separators

are proudly manufactured in Australia by:

Industrial Separation Systems

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This Technical Manual has been produced to aid designers, engineers, plumbers and regulatory authorities in the identification, selection, installation & maintenance of the Vertical Gravity Separator (VGS)

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Introduction

Product Overview

The **Vertical Gravity Separator (VGS)** is an oil/water separator developed to effectively remove free oil, grease and low density suspended solids from wastewater.

The **VGS** operates by ingenious control of both fluid velocity and pressure. These forces gently coax non-emulsified impurities from water by allowing high density contaminants to fall into a sludge retaining area at the bottom of the vessel, and oil droplets and low density suspended solids to rise to the top of the vessel. The oil and suspended solids then drain off into a waste tank for disposal.

Acclaimed by major water authorities around the world as "the best technology of its kind", the **VGS** can be used as a stand-alone separator or to supplement the performance of existing systems.

Because it stays clean it maintains its performance!

Features & Benefits

Performance

Due to its ingenious design the **VGS** is capable of continually meeting the performance standards set by the Sydney Water Corporation, and other regulatory authorities, in respect to Petroleum Hydrocarbons, Total Oil & Grease, Suspended Solids and Flammability.

Suspended Solids

Low density suspended solids are encapsulated by the oil and progress to the top of the **VGS** for discharge to the waste tank. Heavy solids settle to the base of the unit and are removed from the system by the way of a control valve.

Flammability

The turbulent flow principle of the **VGS** ensures the vapour content of the wastewater being treated is reduced to safe levels.

Construction

By utilizing a vertical cylinder design the **VGS** requires far less floor space compared to a coalescing plate separator.

Maintenance

Unique design features enable quick, on-line cleaning of the unit; a feature only found on the **VGS**. There is no need to remove the oleophilic cones and use high pressure jets or chemicals to clean the **VGS**, as is the case with conventional separators.



Approvals

Since its invention in 1992 the **VGS** has progressively gained approval from water treatment authorities, local councils & other government bodies throughout Australia.

Current approvals include:

Authority	State
Sydney Water Corporation	NSW
Dept. Land & Water Conservation	NSW
Hunter Water Corporation Limited	NSW
A.C.T.E.W. Australian Capital Territory	ACT
South Australian Water Corporation	SA
Western Australian Water P.T.L	WA
Brisbane City Council	QLD
Townsville City Council	QLD
Ipswich City Council	QLD
Power & Water Authority	NT



The Technology

Principle of Operation

The Vertical Gravity Separator (VGS) is a flooded system in which the inlet and outlet columns form a U - tube configuration. The free oil and low density suspended solids are trapped on one side of the main body and the treated water flows out the other side.

The main body of the unit contains a continuous truncated conical spiral pack (SPAK) which is manufactured from an *oleophilic* material. Oily water is delivered into the bottom of the main body where it then flows upwards through the centre of the SPAK assembly.

At the top of the main body free oil and low density suspended solids are held and eventually they flow out of the system into a waste tank.

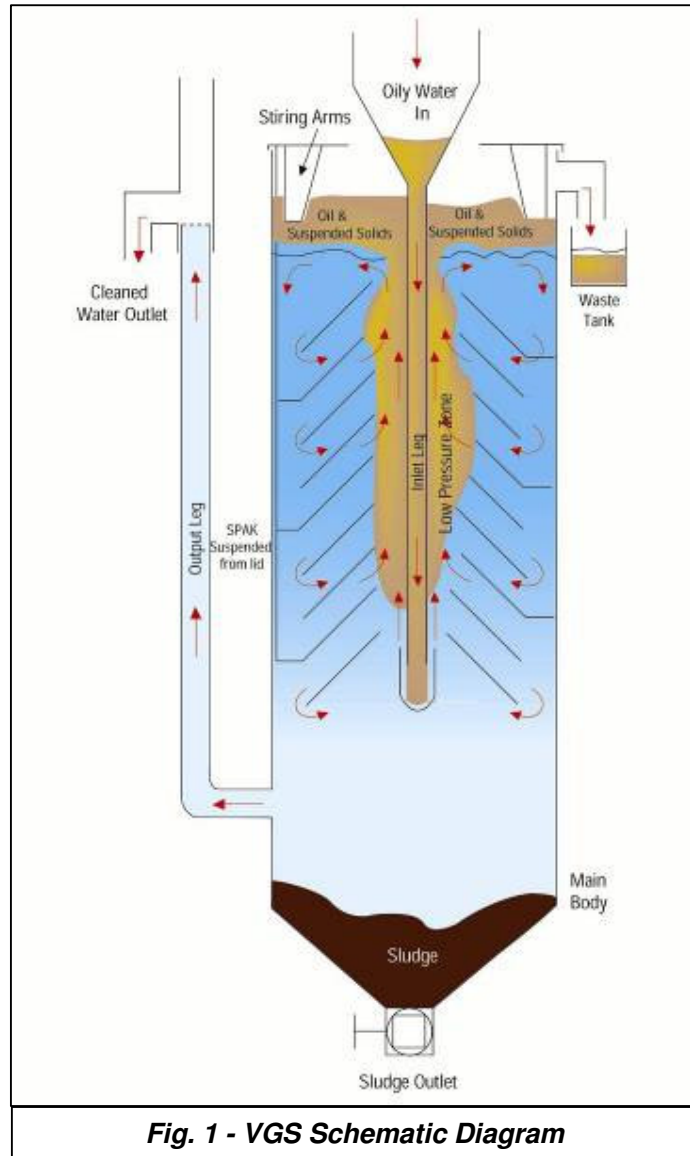
The partially cleaned water is directed to the outside perimeter of the conical SPAK. It then follows a tortuous path cascading down and around the SPAK.

Here the lower density fluid (oil) is drawn up the incline of the oleophilic surface of the SPAK and back into the low pressure centre of the VGS, where it co-mingles with the incoming fluid and is redirected to the top of the main body.

A convection current is thus created within the SPAK by the density variation down the fluid column and the upward flow of the incoming oily water.

The 'treated' water will enter the output leg, at a point when the fluid is most free of contaminants, and flow up and out of the system.

Heavy solids and sludge are removed from the system via a sludge valve at the base of the main body.



VGS Options

The modular design of the VGS allows for a variety of different options to be ordered depending on the specific site requirements.

Flow Rates

The range of VGS's covers flow rates from 1000 L/h up to 3000 L/h. Flow rates above this can be achieved by installing multiple units.

Please contact ISS or your local distributor for further assistance.

Material

The main body and the rotating lid of the VGS is manufactured from either:

- 6 mm High Density Polyethylene which has been roto-moulded using the latest production techniques.
- 1.6 mm 304 grade Stainless Steel, which is designed for installation in the most harsh environments.

Mounting

Where the amount of sludge within the waste water being treated is minimal, a flat bottom/free standing VGS is available. (1000 and 1500 L/h models only)

Standard VGS units have an extended cone shape bottom for sludge retention. A three post stand is supplied with the VGS

Oil Level Control

Two types of oil level control are available:

- **Pre-Set** Level of oil held within the VGS is pre-set in the factory.
- **Adjustable** Level of oil held within the VGS is adjustable on site.

Pumps

The "Pump Types for VGS Systems" table on page 8 lists the different types of pumps that can be utilised within a VGS system.

Electric Motor

Either single phase 240 V or three phase 415 V, standard or flameproof, motors are available depending on the application.

Control Panels

Built to specification, depending on the application.

Pump Types for VGS Systems

VGS Details		Pump Details				
Model	Flow Rate	Type	Brand	Model	Speed	kW
V10P0FP	700 L/h	Positive Displacement	Mono	CP11RJ	1450 rpm	0.18
V10P0FD	1000 L/h	Diaphragm	ASM	DS25	30 spm	0.25
V15P3FP	1600 L/h	Positive Displacement	Mono	CP25RJ	1450 rpm	0.37
V15P0FD	1500 L/h	Diaphragm	ASM	DS25	42 spm	0.37
V15P3FD						
V15P3AD						
V20P3AD	2000 L/h	Diaphragm	ASM	DS32	48 spm	0.37
V30P3AP	2700 L/h	Positive Displacement	Mono	CP800RJ	960 rpm	0.55
V30P3AD	3000 L/h	Diaphragm	ASM	DS38	36 spm	0.55
V30S0FD						

- **Minimum size pump well before VGS**

Sydney Water require that the pump well is to have a working volume of at least 500 litres, i.e. The volume held by the well between the high level (ON) switch and the low level (OFF) switch level.

- **Specifications for progressive cavity Mono CP range pumps**

Rotor: 316 Stainless steel, Hard Chrome Plated (HCP)

Stator: NB70HND Accelerated nitrile (RJ)

VGS Specifications

Model	Flow Rate in L/h	Material			Base	Valves	External Pipe & Fittings	Weight in kg
		Tank (Thickness/Type)	Lid (Thickness/Type)	SPAK				
V10P0F	1000	Polyethylene (6mm/H.D.)	Polyethylene (6mm/H.D.)	HD Polyethylene	(Free Standing)	Backwash - 50mm Poly. Sludge - 25mm Brass	Polypropylene & UPVC Class 12	25
V15P0F	1500	Polyethylene (6mm/H.D.)	Polyethylene (6mm/H.D.)	HD Polyethylene	(Free Standing)	Backwash - 50mm Poly. Sludge - 25mm Brass	Polypropylene & UPVC Class 12	25
V15P3F	1500	Polyethylene (6mm/H.D.)	Polyethylene (6mm/H.D.)	HD Polyethylene	Galvanised Stand	Backwash - 50mm Poly. Sludge - 50mm Brass	Polypropylene & UPVC Class 12	35
V15P3A	1500	Polyethylene (6mm/H.D.)	Polyethylene (6mm/H.D.)	HD Polyethylene	Galvanised Stand	Backwash - 50mm Poly. Sludge - 50mm Brass	Polypropylene & UPVC Class 12	35
V20P3A	2000	Polyethylene (6mm/H.D.)	Polyethylene (6mm/H.D.)	HD Polyethylene	Galvanised Stand	Backwash - 50mm Poly. Sludge - 50mm Brass	Polypropylene & UPVC Class 12	35
V30P3A	3000	Polyethylene (6mm/H.D.)	Polyethylene (6mm/H.D.)	HD Polyethylene	Galvanised Stand	Backwash - 50mm Poly. Sludge - 50mm Brass	Polypropylene & UPVC Class 12	38
V30S0F	3000	Stainless Steel (1.6mm/304)	Polyethylene (6mm/H.D.)	HD Polyethylene	(Free Standing)	Backwash - 50mm Poly. Sludge - 50mm Brass	Polypropylene & UPVC Class 12	43

Model Details

V – VGS
 10 – 1000 L/h
 15 – 1500 L/h
 20 – 2000 L/h
 30 – 3000 L/h
 P – H.D Polyethylene
 S - Stainless steel
 F - Fixed Adjuster
 A – Adjuster
 P- Positive displacement
 D- Diaphragm

VGS Coding

Features	Details	Basic Coding				Optional Extras			
Separator	Vertical Gravity Separator	V							
Nominal flow rate	1000 L/h		10						
	1500 L/h		15						
	2000 L/h		20						
	3000 L/h		30						
Material	Polyethylene - High Density			P					
	304 Stainless Steel			S					
Mounting	Free Standing (1000 & 1500 L/h flow only)				0				
	3 Post Galvanised Stand				3				
Oil level control	Adjustable					A			
	Fixed Pre-Set					F			
							/		
Pump	Progressive Cavity						P		
	Diaphragm Pump						D		
Electric Motor	Standard 240 volt							1	
	Standard 415 volt							3	
	Flameproof 415 volt - AS2380-1 & AS2380-2							4	
								/	
Control Panel	Polyethylene 240/24 VAC Starter w/- - Manual/Off/Auto - Pump & float terminals.								A
	Polyethylene 415/24 VAC Starter w/- - Manual/Off/Auto - Pump & float terminals.								B
	Metal 240/24 VAC Starter w/- - Manual/Off/Auto - Pump running light - Pump & float terminals								C
	Metal 415/24 VAC Starter w/- - Manual/Off/Auto - Pump running light - Pump & float terminals								D
	Metal 415/24 VAC INTRINSICALLY SAFE Starter - Manual/Off/Auto - Pump running light - Pump & float terminals								F
Control panel option	High level visual/audible alarm & mute button								1

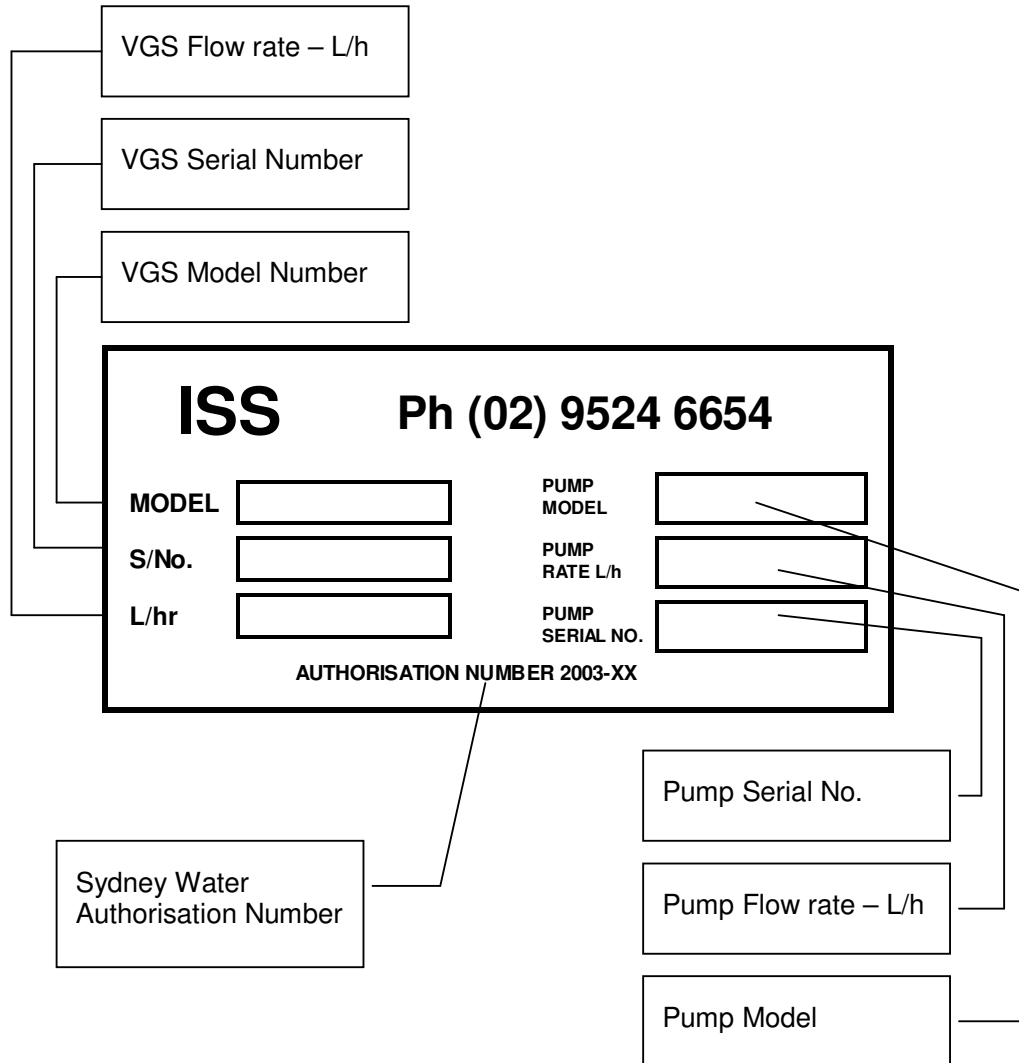
Compliance Plate Details

All VGS units have a “Compliance Plate” permanently attached to the tank.

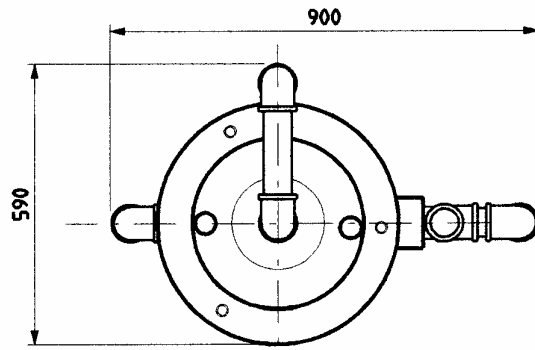
The details are as follows:

Material: 1.0 mm thick aluminium

Size: 80mm x 40mm



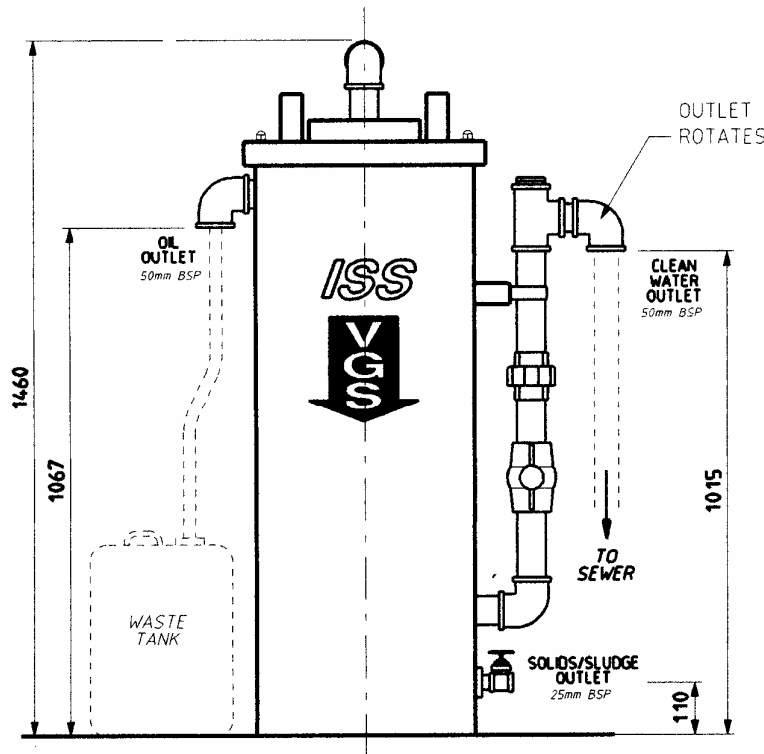
Dimensions



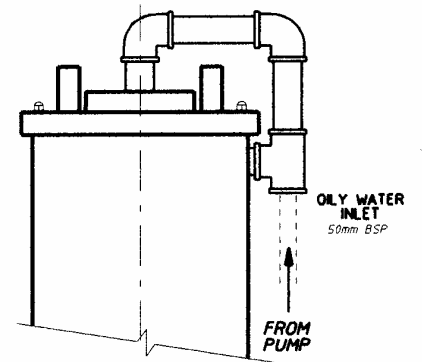
TOP VIEW

VGS Models:
V10P0FD
V10P0FP
V15P0FD

Free Standing
 Polyethylene
 Tank Thickness - 6 mm
 Tank Diameter - 450 mm

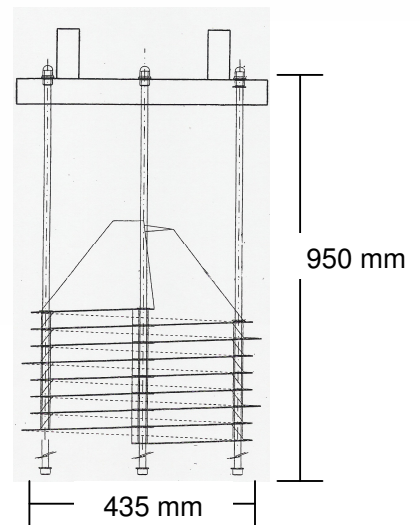


FRONT VIEW



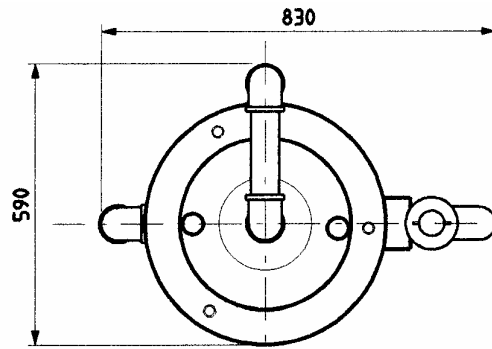
SIDE VIEW

(OILY WATER INLET)



SPAK Assembly

Dimensions

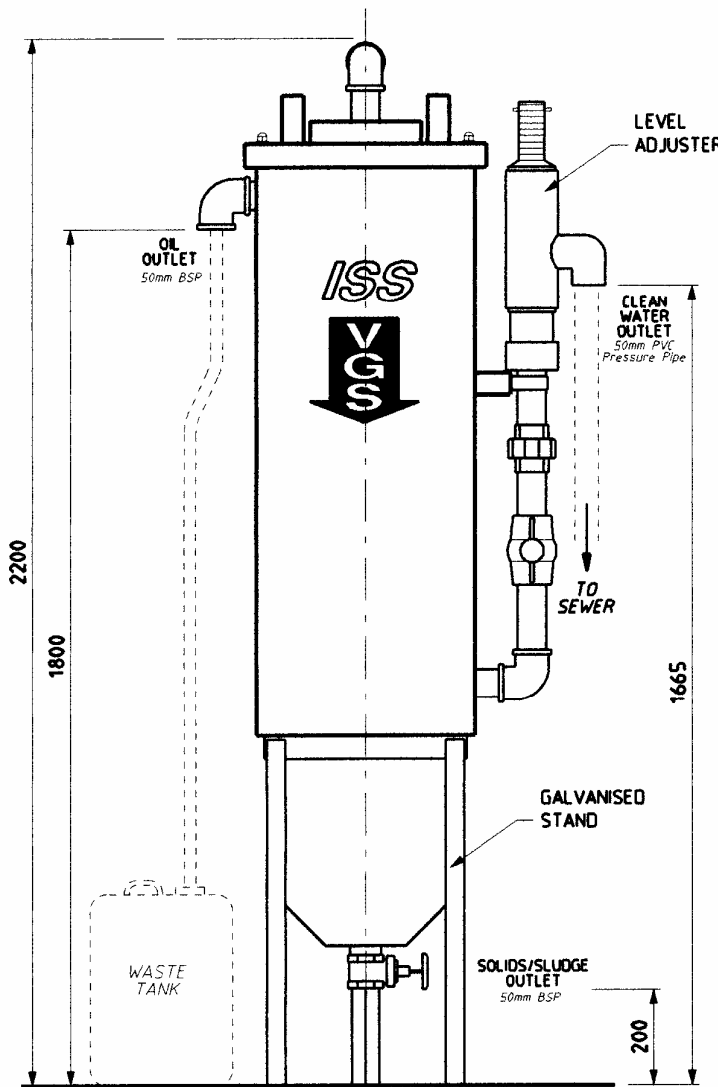


TOP VIEW

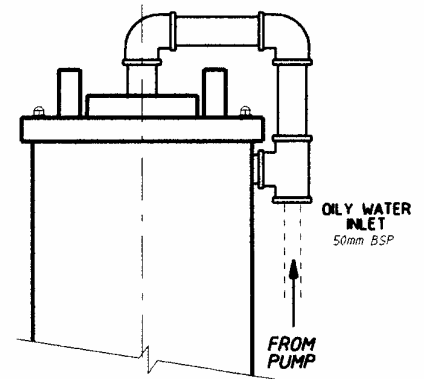
VGS Models:

- V15P3FD**
- V15P3FP**
- V15P3AD**
- V20P3AD**
- V30P3AD**
- V30P3AP**

Stand Mounted
Polyethylene
Tank Thickness - 6 mm
Tank Diameter - 450 mm

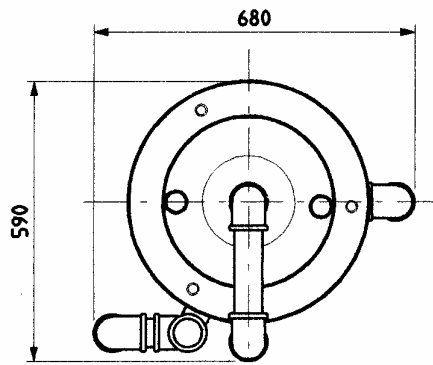


FRONT VIEW



**SIDE VIEW
(OILY WATER INLET)**

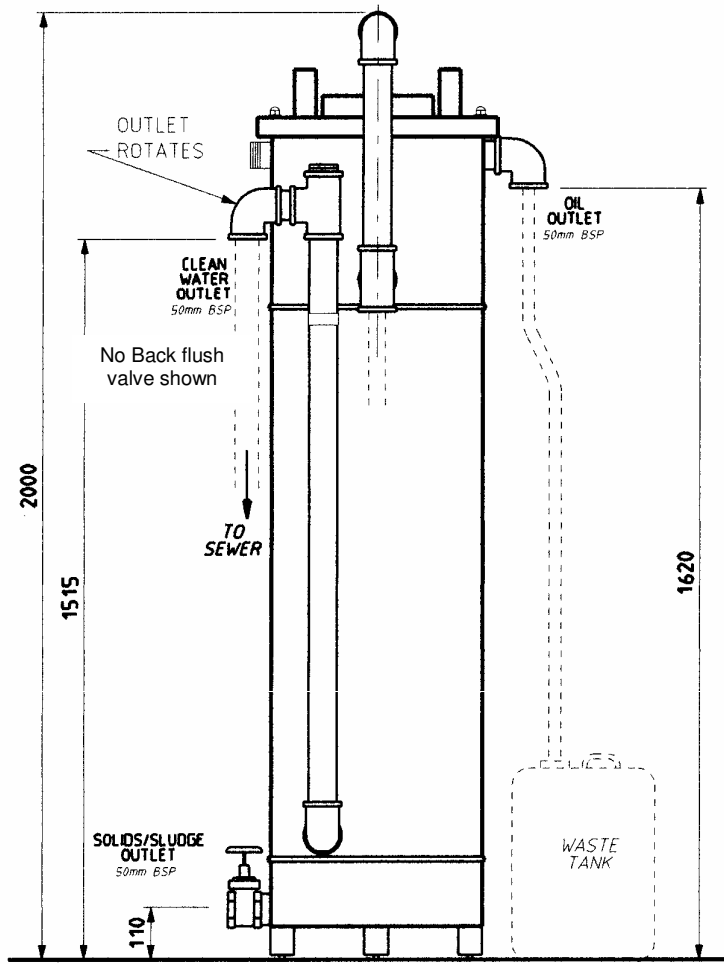
Dimensions



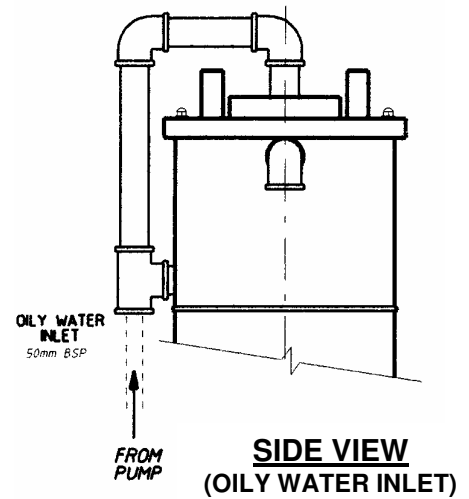
TOP VIEW

VGS Models:
V30SOFD

Free Standing
304 Stainless Steel
Tank Thickness - 1.6 mm
Tank Diameter - 450 mm



REAR VIEW



**SIDE VIEW
(OILY WATER INLET)**

Installation

Location

The VGS should be placed on a level concrete base to Australian Standard to support a minimum 250 kg.

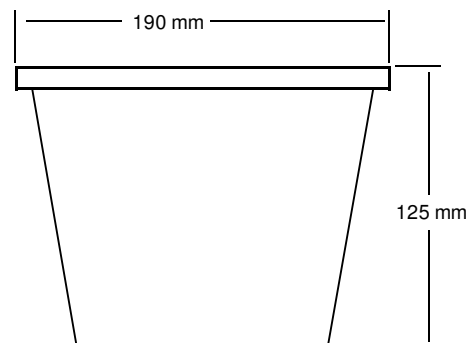
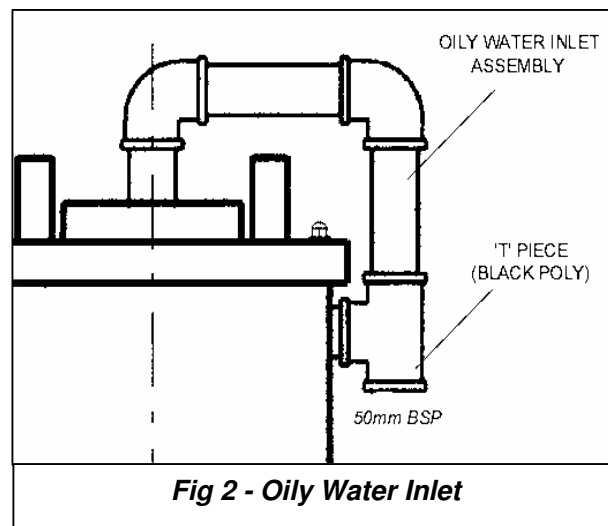
Note: **The VGS must be installed LEVEL**

Position the VGS in a location that has no less than 1100 mm of clear space above the unit to allow for future removal of the SPAK.

Assembly

The **Oily Water Inlet** ① must be assembled by:

1. Screwing the 'T' piece to the blanked off 50 mm male thread at the top of the main body labelled **OIL WATER INLET**.
2. Fixing the Oily Water Inlet assembly to the 'T' piece.



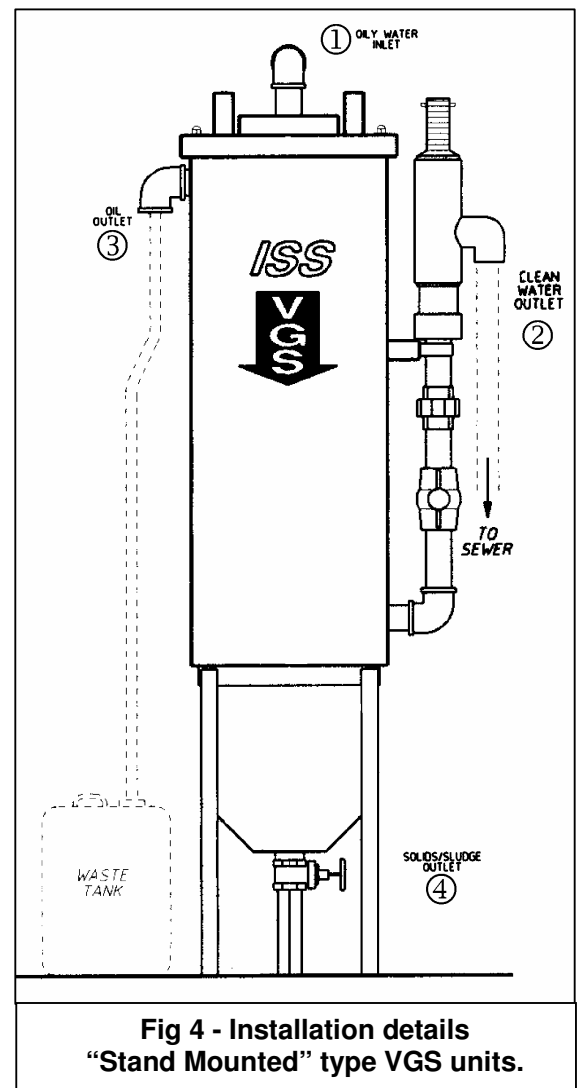
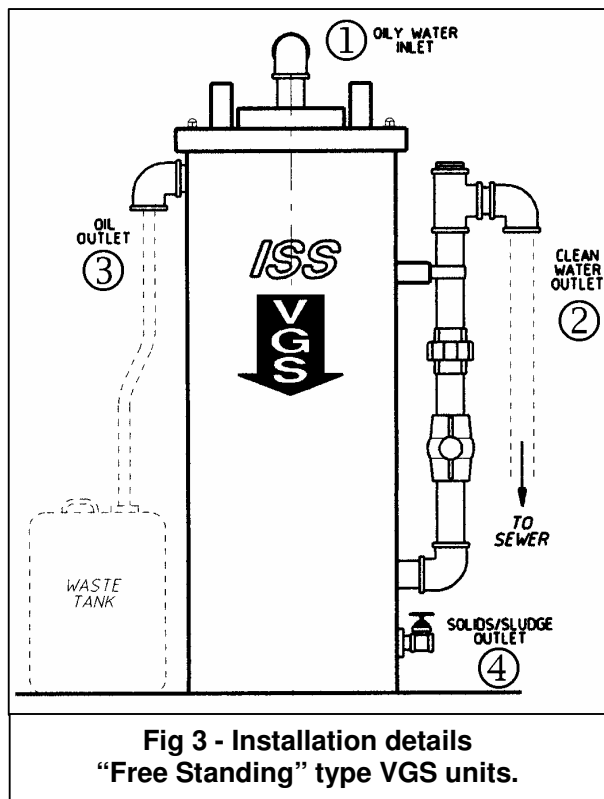
STRAINER BASKET FITTED IN THE TOP OF THE VGS UNIT

Pipe Connections

1. Connect the discharge pipe from the pump to the **Oily Water Inlet** ① (Fig 3 & 4) using class 6 PVC pressure pipe. Refer to ASM appendix A and Mono appendix B, pages 24 & 25 respectively.
2. Install a 50 mm DWV PVC discharge pipe between a sewer tundish (see Sewer Connection on page 17) and the **Clean Water Outlet** ②.

A minimum vertical fall of 600 mm from the Clean Water Outlet must be maintained to ensure correct operation of the VGS.

3. Install a suitable **oil resistant** discharge pipe from the **Oil Outlet** ③ to a waste tank. (Not supplied), same size as the pump discharge line. Polyethylene is a suitable material.
4. Fit the gate valve supplied with the VGS to the **Sludge/Solids Outlet** ④ at the base of the tank.



Sewer Connections

The treated water from the VGS should be discharged to sewer via an inlet riser to a gully as detailed in **Fig 5** below. This point can be used for sampling the quality of the effluent being discharged.

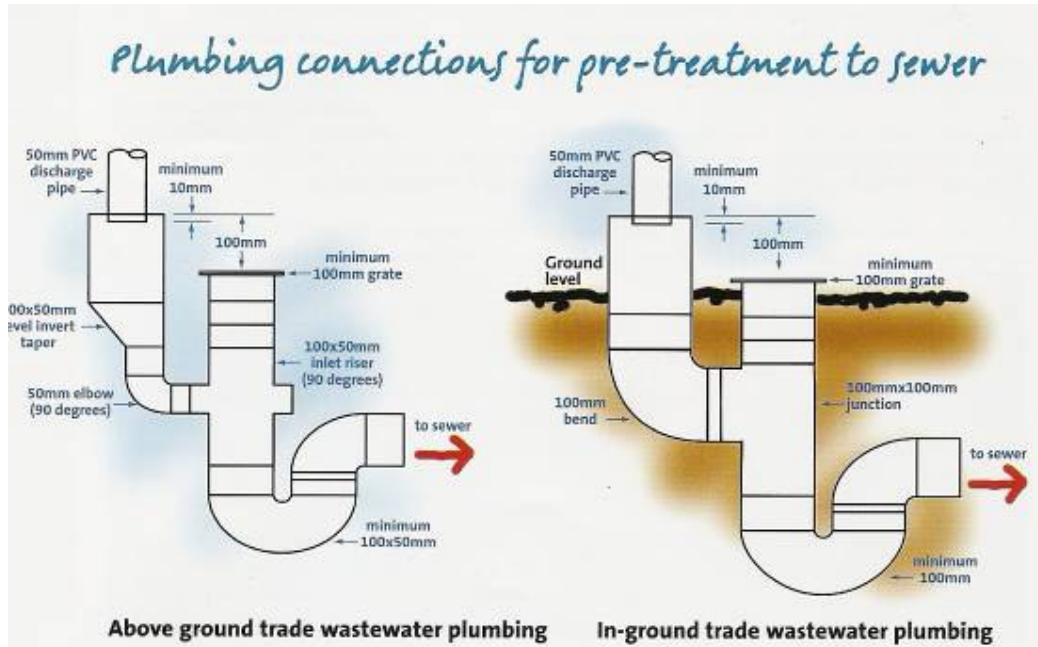


Fig 5 - VGS Sewer Connection Detail

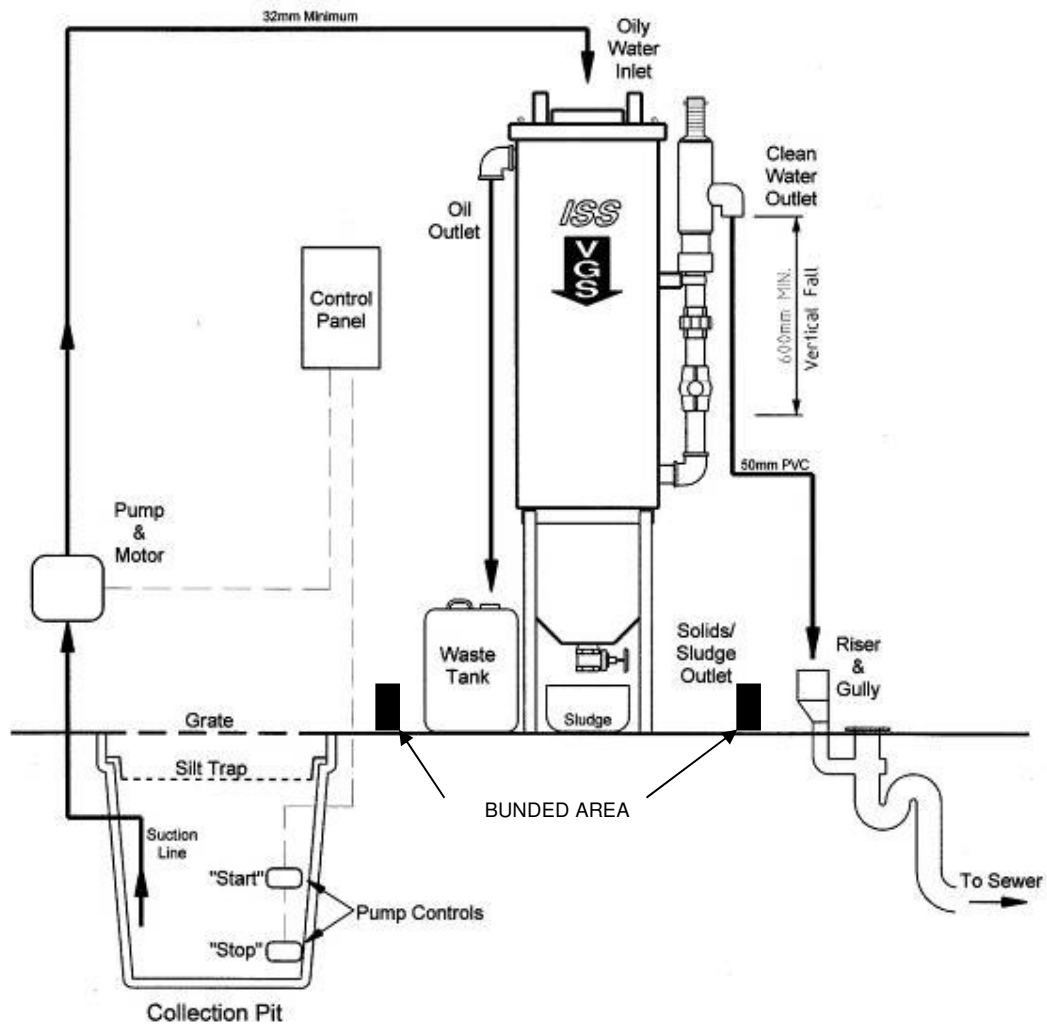
Extract from
Sydney Water
documentation

Electrical Connections

A licensed Electrical Contractor must connect the pump supplied with the VGS, to the electrical supply.

If the wastewater being treated has flammable Class 3 liquids present, such as petrol, kerosene or other solvents, all electrical equipment within a defined area must be suitably rated.

Typical Installation Schematic



Commissioning

Pre-Set Oil Level Models

The following procedure should be carried out when commissioning a VGS that has a **pre-set oil level**.

- Step 1** Place waste tank under the oil outlet.
- Step 2** Charge the VGS by filling the main body, via the opening in the lid, with clean tap water (using a hose). The VGS is full when water starts to flow out of the clean water outlet.
- Step 3** Prime the pump by filling both the suction and discharge lines with water then start the pump.

The VGS is now set correctly and will perform without further adjustment.

Note: Oil will not be seen to discharge from the oil outlet until sufficient oil has built up in the top of the unit. This may take some time depending on the quality of the wastewater being treated.

Adjustable Oil Level Models

The following procedure should be carried out when commissioning a VGS fitted with an **adjustable oil level** controller.

- Step 1** Place waste tank under the oil outlet.
- Step 2** Charge the VGS by filling the main body, via the opening in the lid, with clean tap water (using a hose).
- Step 3** Prime the pump by filling both the suction and discharge lines with water then start the pump.
- Step 4** Loosen the adjuster locking screw.
- Step 5** Rotate the 'T-Bar' in an **ANTICLOCKWISE** direction, thus raising the 'T-Bar', until water flows out of the oil outlet.
- Step 6** Rotate the 'T-Bar' in a **CLOCKWISE** direction, thus lowering the 'T-Bar', until the flow from the oil outlet is reduced to a 'drip'.
- Step 7** Using the 10 mm graduations as a guide continue to rotate the 'T-Bar' clockwise a further 10 mm lower.
- Step 8** Tighten the adjuster locking screw onto the 'T-Bar'.

The VGS is now set correctly and will perform without further adjustment.

Note: Oil will not be seen to discharge from the oil outlet until sufficient oil has built up in the top of the unit. This may take some time depending on the quality of the wastewater being treated.

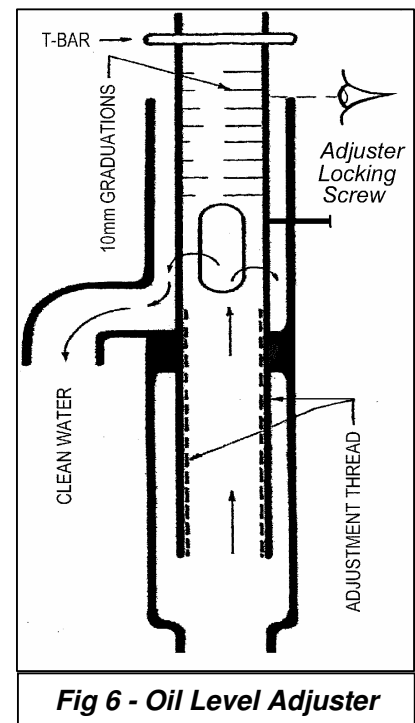


Fig 6 - Oil Level Adjuster

Maintenance

The objective of regular maintenance/cleaning of the VGS is to:

- Fluidise (break-up) any encrustation of surface sludge in the top of the unit.
- Remove any sludge that has become attached to the Continuous Spiral Pack (SPAK).
- Remove settled sludge from the bottom of the unit.

Daily

- 1) Check the level of the oily waste in the waste tank.
- 2) Check the operation of the VGS to ensure that there is no oil in the water flowing out of the CLEAN WATER OUTLET.

Monthly refer to Fig 7 for component recognition

- 1) Carry out a routine **Maintenance Procedure** as detailed below:

Step 1 Ensure the waste tank is empty and situated under the oil outlet.

Step 2 Start the pumping cycle by filling the collection pit or switch the Manual/Off/Auto switch to Manual, if fitted.

Step 3 Crack open the SLUDGE/SOLIDS OUTLET ④ valve at the base of the unit and drain until the sludge is removed. DO NOT EMPTY THE VGS.

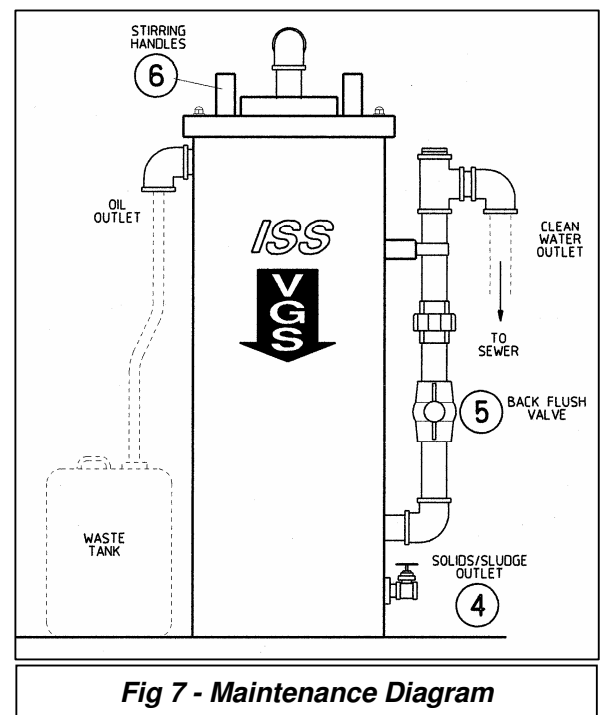
Step 4 Close the BACK FLUSH VALVE ⑤

Step 5 Grip the STIRRING HANDLES ⑥ on the lid of the unit & rotate the SPAK in an anti-clockwise direction for approximately 15 seconds. This will break up any encrusted surface sludge.

Step 6 Any waste oil will flow into the waste tank. Allow this to continue until only water flows into the waste tank. *This indicates that the unit is fully backwashed.*

Step 7 Open the BACK FLUSH VALVE ⑤

Step 8 Either allow the pit to empty or switch the Manual/Off/Auto switch back to the Auto position, if fitted.



- 2) Ensure that oil, sludge and water outlets are free of blockages at all times.

Maintenance Schedule

DAILY

1. Check the level of the oily waste in the waste tank.
2. Check the operation of the VGS to ensure that there is no oil in the water flowing out of the CLEAN WATER OUTLET.
3. Check the strainer in the top of the centre column is clear.

MONTHLY

Follow maintenance procedure. Sign off below.

MONTH	SIGNATURE	MONTH	SIGNATURE
January		July	
February		August	
March		September	
April		October	
May		November	
June		December	

YEARLY

Remove and inspect the plates of the SPAK.

Trouble Shooting

VGS Model	Problem	Cause	Solution
Adjustable Oil Level Models	Water flowing out of the oil outlet.	Adjustment set too high	Re-Adjust the 'T-Bar' as described in the commissioning section of the manual
	Oil, mixed with water, flowing from the clean water outlet.	Adjustment set too low	Re-Adjust the 'T-Bar' as described in the commissioning section of the manual
All VGS Models	Water flowing out of the oil outlet.	Back flush valve has been closed.	Open back flush valve.
		Build up of sludge within the VGS.	VGS requires servicing. Refer to maintenance section of the manual
	Odour/smell emanating from the VGS	Occurs when the VGS is not operated frequently - water becomes stagnant.	Run fresh water, from a hose, into the top of the VGS for 5 minutes.
	Waste water not being pumped into the VGS.	Float switch is not operating correctly.	Re-adjust the high & low setting of the float. - If faulty, contact an electrician to repair or replace.
		Blocked suction line.	Remove suction line and clean. (the holding pit is probably full of silt and requires cleaning)
		Pump is not working.	Over load tripped out - Re-set the overload switch on the motor. Cracked suction line - replace.

Warranty

- 1) Vertical Gravity Separators manufactured by ISS. are covered by warranty for a period of 5 years from installation.
- 2) ISS will make good by repair, or at their option, the replacement of faulty parts under warranty, provided always that:
 - The equipment was correctly installed and properly used in accordance with ISS installation and operating instructions and accepted codes of good engineering practice.
 - Any claim under warranty arises solely from faulty design, material or workmanship.
 - Repairs are carried out with the written approval of ISS who may choose to carry out the repairs themselves or at their option nominate an approved repairer for the purpose.
 - All costs other than the direct repair costs are borne by the purchaser.
- 3) Auxiliary equipment not of ISS manufacture but supplied by ISS as part of a package will be protected by the original manufacturers warranty. ISS warranty is limited to that extent. i.e ASM and Mono pumps warranty is currently 12 months.
- 4) ISS warranty does not cover any of the following:
 - Claims for third party liability for damage caused by the failure of any of the company's products.
 - Damage caused by abnormal operating conditions, war, violence, storm cataclysm or any other force.
 - Damage caused by equipment being used for an application for which the product is not recommended.
- 5) The decision of ISS in relation to any claims or disputes over warranty is final.
- 6) The warranty is in lieu of all other warranties and conditions expressed or implied, written or oral, statutory or otherwise, which are hereby negated and excluded.
- 7) This express warranty does not exclude any conditions or warranty implied by the Trade Practices Act 1974 or separate state laws and is in addition to any other right that the original purchasers or any subsequent purchaser may have at law.
- 8) In case of claim please contact your authorised ISS distributor or contact ISS Pty Ltd.

Appendix A

INSTALLATION INFORMATION FOR ASM DIAPHRAGM PUMPS

DIRECTION OF ROTATION




**CORRECT ROTATION OF MOTOR IS CLOCKWISE
VIEWED FROM THE FAN OR NON DRIVE END .
INCORRECT ROTATION WILL CAUSE DAMAGE TO
PUMP AND VOID WARRANTY. REFER TO MOTOR
MANUFACTURERS WIRING INSTRUCTIONS BEFORE
RUNNING PUMP.**

HOSE SIZES FOR ASM DIAPHRAGM PUMPS					
FOR CLEAN LIQUIDS WITH SAME VISCOSITY AS WATER					
	SUCTION LENGTH		DISCHARGE LENGTH		
MODEL	0-6M	6-10M	0-6M	6-15M	15-25M
D25	25mm	32mm	32mm	32mm	40mm
D32	32mm	40mm	40mm	40mm	50mm
D38	40mm	50mm	50mm	50mm	65mm
D50	50mm	65mm	50mm	65mm	80mm
D76	80mm	80mm	80mm	80mm	100mm

**IMPORTANT : USE OF HOSES SMALLER THAN THE
PORT SIZE OF THE PUMP WILL VOID WARRANTY**

**IF PUMP IS INSTALLED WITH RIGID PIPEWORK, FIT
AN ASM PULSATION DAMPENER .
USE REINFORCED HOSE ON BOTH SUCTION AND
DISCHARGE FOR FLEXIBLE INSTALLATIONS.
DO NOT USE LAYFLAT TYPE HOSE.
KEEP PIPE WORK AS SHORT AND DIRECT AS
POSSIBLE. NEVER THROTTLE OR DEAD HEAD
DISCHARGE OR SUCTION.**

Appendix B

 A National Oilwell® Company	Operating & Maintenance Manual	Page: 5 Date: August 2003
Introduction, Installation & Operation	CP Range	
<p>Introduction</p> <p>Mono CP pumps</p> <p>These pumps are designed for long, trouble-free service in many fields such as light industrial, domestic and agriculture. Their application include wine and beverage, filling machines, weak acid and alkali transfer, sump duties, septic and sullage disposal, brine injection, spear point, domestic water supply, garden reticulation and the like.</p> <p>The discharge port of the pump is nearest to the driving (motor) end on all models. The maximum temperature allowable is 80°C and should never be exceeded.</p> <p>For fluids other than water consult your dealer or Mono Pumps (Australia) Pty Ltd to ensure the correct stator and mechanical seal materials are used.</p> <p>Installation</p> <p>Location of Unit</p> <p>The pump should be bolted to a firm, flat base in a dry, well ventilated area. If mounted outside it is recommended that the motor be protected from the elements with a well ventilated cover. The pump should be accessible for inspection and repair.</p> <p>Pipe Connection</p> <p> When connecting pipework to the pump it is preferable to use thread tape. Care should be taken not to over-tighten connections to the pump, in particular when tapered thread fittings are used. Plastic fittings are preferable.</p> <p>Both the suction and discharge lines should be independently supported near the pump so that no strain is placed on the pump. The suction line should contain a minimum number of bends. Any bends necessary should have a large radii.</p> <p>The suction line diameter shall be at least equal to the diameter of the suction port. For pumps operating with a suction lift, no valves should be placed in the suction line. For long suction lines a foot valve should be fitted. It is very important to have the suction line airtight. Arrange the suction pipework so that the pump has minimal time before it is primed.</p> <p>Foot valves, when used, should have an open area of at least 1 1/2 times the area of the suction pipe. An efficient strainer should be provided to prevent foreign matter from being drawn into the pump and choking the foot valve. It is recommended that no foot valve or strainer be fitted for septic effluent duties.</p> <p>The discharge line will preferably be the same or one size larger than the pumps discharge port. The discharge line should be short and direct with the least number of bends and fittings, thus minimising the head lost by friction.</p> <p>A non-return valve should be fitted on the discharge side for high head, long discharge lines and auto pressure system applications. The non-return valve is to protect the pump from excessive back pressure. Where the pump is operating on a long suction line suitable valves should be fitted to ensure the pump does not run dry.</p> <p>Electrical Connection</p> <p>Single -phase pump units are supplied complete with a plug and lead. This can be plugged into any single-phase power outlet. Single-phase pump units are supplied fitted with a thermal overload. In the event of the motor overheating, the overload will activate and the motor will stop. Once the cause of the overheating has been identified and removed, the red button on the back of the capacitor box will reset the overload and the motor can be restarted.</p> <p> All three-phase motor connections must be conducted by a registered electrical contractor.</p> <p>Three-phase motors should be connected to the electrical supply as shown on the label in the terminal box.</p> <p>In three phase pumps, it is important to check the direction of rotation of the pump prior to running the pump. Running the pump in reverse could result in the rotor unscrewing from the motor shaft and damaging the pump. Remove the pump from the motor before checking the direction of the pump. Care must be taken while checking direction to ensure that nothing entangles in the pump.</p> <p>Three-phase motors should be protected through the installation of a thermal cut out of the non-self resetting type.</p> <p style="text-align: center;">Published information other than that marked CERTIFIED is to be used as a guide only.</p>		