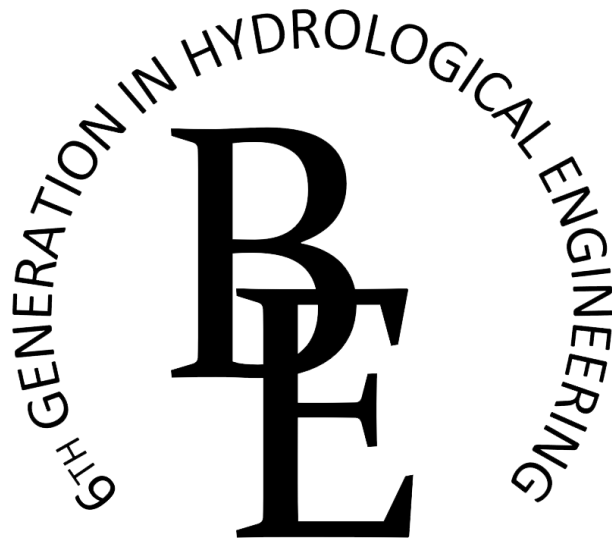




BROOM ENGINEERING

NEW VACUUM PLANT INSTALLATION REQUIREMENTS

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Abstract

This document is designed to explain the essential installation requirements when manufacturing/building a vacuum taker/plant, both as a new installation and check criteria for existing installations, any queries are welcomed and may be directed to Broom Engineering for Clarity.

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o. Introduction

Broom Engineering is a proudly South African manufacturing company that has been trading since 1973, and has dedicated years of development into the vacuum plant industry and prides itself on product reliability and extensive aftersales support to both new and existing clients, from any background.

Figure 1 illustrates a typical installation supplied by Broom Engineering, including all hardware to be discussed in this document, starting with the initial deliverables necessary for one to ensure the right vacuum exhauster is selected, followed by descriptive information about all the hardware that is essential to the manufacture of a reliable vacuum tanker.



Figure 1: Truck Installation

1. Vacuum Exhauster Sizing and Specification

The B-Range vacuum exhausters and low-pressure compressors are designed for specialised vacuum systems, most commonly used in the effluent industry for the collection of sewerage, oil, grease and chemicals.

The pumps utilise a lost oil process, it is recommended that the oil used in the product be any standard engine oil (i.e. not hydraulic oil or any other specialised lubricants).

It is important to ensure that the pump is accompanied by all the vacuum/pressure accessories relevant to the application of the product.



Figure 2: B-Range Vacuum Exhauster

Table 1: Product Sizing and Requirements

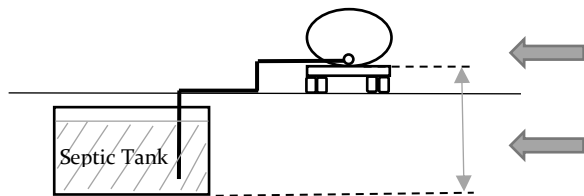
Tanker Size	B-Range Model	Suction Air at Up to -65kPa & 1500RPM	Power Required			Power Take-Off (PTO) Minimum Pulley Diameter
			Net	Diesel Gross	Petrol Gross	
Up to 3000L	B20	~21 L/sec	1.5 kW	2.0 kW	2.5 kW	120 mm
3000-6000L	B25	~26.5 L/sec	2 kW	2.7 kW	3.0 kW	140 mm
6000-10 000L	B35	~38.5 L/sec	3 kW	3.8 kW	4.2 kW	160 mm
Greater than 10 000L	B50	~51 L/sec	5 kW	6.7 kW	7.5 kW	180 mm

The operating speed of all units is between 900-1500 R.P.M

Collection & Dumping Times

It is important to note that when collecting and discharging effluent that there are several variables that influence the rate of flow (i.e. hydraulic head, depth, temperature, vessel geometry, altitude and effluent type).

Tables 2 & 3 are theoretical approximations for collection and discharge times expected for a round sewerage tanker utilising a 100mm (4") pipe at standard atmospheric conditions (i.e. 25°C, 45% RH, at the specified altitudes)



Note: Water can be lifted 1 meter for every -10kPa. Thus, it is essential to access the height of your tanker in relation to the maximum depth to ensure the tanker is filled

Table 2: Theoretical Discharge Time (Minutes) Against Closed Valve at -65kPa

Sea Level						1800 Meters Above Sea Level				
Model	4000L	6000L	8000L	10 000L	12 000L	4000L	6000L	8000L	10 000L	12 000L
B20	2.1	3.2	3.9	4.8	5.8	2.9	4.5	5.8	7.1	8.6
B25	1.8	2.7	3.6	4.5	5.4	2.5	3.8	5.0	6.3	7.5
B35	1.2	1.8	2.4	3.0	3.6	1.7	2.5	3.3	4.2	5.0
B50	0.9	1.4	1.8	2.3	2.7	1.3	2.0	2.5	3.3	3.8

Table 3: Approximate Collection Time (Minutes) Once Exhauster Starts

Sea Level						1800 Meters Above Sea Level				
Model	4000L	6000L	8000L	10 000L	12 000L	4000L	6000L	8000L	10 000L	12 000L
B20	4.9	6.8	9.0	12.5	13.8	5.8	9.4	10.9	15.4	18.7
B25	4.2	6.3	8.4	10.5	12.6	4.9	7.4	9.8	12.3	14.7
B35	2.8	4.2	5.6	7.0	8.4	3.3	5.0	6.5	8.2	10.0
B50	2.1	3.2	4.2	5.3	6.3	3.7	3.7	4.9	6.2	7.4

The times indicated above can be expected with the pipe connected and an open valve so that filling can begin as soon as the exhauster starts

2. Vacuum Pump Drive considerations

2.1. Engine driven units

When selecting an engine driven unit, the fuel-type (i.e. petrol or diesel) is primarily subject to client preference, and typically the same as the truck or vehicle carrying the vacuum plant.

2.1.1. Petrol Engines

- Broom Engineering supplies a hand-start Honda engine mounted on a base frame that can be directly coupled to the relevant exhauster.

2.1.2. Diesel Engines

- Typical installations are achieved using the relevant Hoffmann engine, available both in hand- and electric start, also supplied on a base frame and directly coupled to the relevant exhauster. The Hoffman range is an ideal consumable engine, costing less to maintain and replace when the servicing is no longer possible. There are other engines that offer a longer service life such as the Hatz-range, which is recommended for tankers expected to undergo extreme operating times.

2.2. Electric Motors

Electric motors are a convenient, quiet drive selection when grid power is readily available at collection sites.

Broom Engineering offers electric motors selected specifically for vacuum tankers in either 220V or 380-400V depending on client requirement, and are mounted on a base frame and coupled directly.

2.3. Hydraulics

Hydraulics are a reliable drive system when installed correctly, and ideal for prolonged operation when the necessary cooling hardware or designs are considered. It is essential to note that the vacuum exhauster operates at 1500 RPM and specified power requirement.

It is thus recommended that if hydraulics are to be installed, to contact Broom Engineering to discuss the necessary specifications, ensuring that the system operates correctly.

2.4. Power-Take-Off

PTO (or power-take-off) systems utilizing pullies may also be considered when selecting a drive. The installation may be discussed and carried out by Broom Engineering on request.

3. Vacuum Equipment

3.1. Essential vacuum plant equipment

3.1.1. Exhaust silencer

- The exhaust silencer is an essential hardware to ensure that the decibels produced by the vacuum exhauster are within health and safety regulations.
- 3.1.2. Swing/Non-return valve**
- The non-return valve acts as an essential vacuum protection hardware, preventing reverse rotation of the B-series vacuum exhauster and isolating the vacuum in the tanker.
- 3.1.3. Y-Cast Inline Strainer**
- The strainer ensures that debris passing through vacuum hardware does not enter the exhauster.
 - System protection hardware.
- 3.1.4. 63mm [-100kPa] glycerine vacuum gauge**
- The vacuum gauge ensures that an operator is aware of when the tanker is at the appropriate pressure for collection and acts as an essential troubleshooting indicator.
 - Essential operator inspection hardware
- 3.1.5. Vacuum control valve**
- The vacuum control valve ensures that the tanker pressure does not exceed -65kPa, safeguarding the B-range vacuum exhauster from overheat.
 - System protection hardware.
- 3.1.6. Moisture Separator**
- The Moisture Separator condenses water vapour and removes droplets that are sucked into the vacuum plant hardware before entering the B-Series vacuum exhauster.
 - System protection hardware.
- 3.1.7. Auto-drain**
- The auto-drain seals during operation, accumulating water. Once the vacuum is broken in tanker, the hardware allows accumulated water to drain from the vacuum plant.
 - The component mitigates potential erroneous operation, reducing the probability of system failure due to water overflow.
 - System protection hardware.
- 3.1.8. Snifting valve**
- The Snifting valve acts as an emergency stop, preventing septic effluent overflow.
- **not to be used as an indicator that the tank is full****
- Essential protection hardware.
- 3.1.9. Unloader ball valve**
- The unloader ball valve removes the pressure-load from the vacuum exhauster, reducing start-up power requirements and preventing drive and vacuum exhauster damages.

- System protection hardware.

3.1.10. Vacuum breaker valve

- The vacuum breaker is utilised when the dumping procedure is to take place. By opening the vacuum breaker valve, atmospheric pressure enters the vacuum tank, mobilizing effluent to the dumping hardware.
- Essential operator hardware.

3.1.11. Spare oil supply

- It is essential that an operator keep a spare oil supply on the vacuum system and forms part of the essential maintenance for the B-series vacuum exhauster.

3.2. Pit Collection Hardware

3.2.1. Quick acting suction valve

- The quick acting suction valve comes in various sizes (80mm, 100mm, and 150mm) depending on client requirements. Tankers ranging from 3000-15000 litres are recommended to fit a tanker with a 100mm (/or 4") valve. Larger valves are recommended for clients that require faster collections times.
- The valve utilises a basin when shut, mitigating damages typically present when operating with valves such as ball-valves.

3.2.2. Pipe extension

- The additional pipe is required to ensure that the quick acting suction valve can be manufactured and installed in the correct position.

3.2.3. Connecting flanges

- Flanges are manufactured to the same specification as the quick acting suction valve, ensuring accurate and timeous installation.

3.2.4. Suction valve gaskets

- Gaskets are also manufactured analogous to the connecting flanges and related hardware, preventing leakages during operation.

3.2.5. Flexible pipe joiner

- The flexible pipe joiner ensures that the quick acting suction valve moves freely from the tanker-vessel, preventing micro-fractures from occurring and vindicating effluent and air leaks.

3.2.6. High duty coupling pair

- Steel manufactured coupling between the quick acting suction valve and suction-hose. Highly recommended for the industrial and agricultural applications where frequent coupling is required.

3.2.7. Suction hose vacuum breaker valve

- Valve utilised when packing suction hose away. Removing negative pressure from the suction hose, removing effluent from the suction hose and preventing effluent spills.
 - Essential health and safety hardware.
- 3.2.8. **100mm Medium reinforced suction hose**
 - Recommended suction hose for effluent collection involving vacuum applications. The hose has been industry proven to withstand negative pressure and sun exposure, increasing product life and mitigating plant downtime.
- 3.2.9. **100 suction hose-clamp (bolt type)**
 - Bolt-type hose clamp to connect the suction hose and high-duty coupling pair.
- 3.3. **Disrupted/Toilet collection Hardware**
 - 3.3.1. **Suction manifold**
 - The suction manifold is an assembly of components constructed for access to the top of the tanker. Unlike the quick acting suction valve, the suction manifold utilises a ball-valve that is assembled perpendicular to the ground, ensuring that debris does not block/or damage the valve Teflon seal.
 - 3.3.2. **80mm medium reinforced suction hose**
 - Similar to the item discussed in 2.2.8, the 80mm suction hose is acquiescent to the suction manifold.
 - 3.3.3. **80mm suction hose clamp (bolt-type)**
 - Bolt-type hose clamp to connect the 80mm suction manifold hose and high-duty coupling pair.
- 3.4. **Rapid dumping hardware (highly recommended for reduced operating times)**
 - 3.4.1. **Quick-acting dump valve (200mm)**
 - The quick acting dump valve is uniquely developed and manufactured for rapid septic effluent discharge. The installation of the valve significantly reduces process-time when dumping. Moreover, due to the installation, debris and residue build-up is reduced as a result of fluid flow characteristics.
 - 3.4.2. **200mm pipe extension**
 - The additional pipe is required to ensure that the quick acting dump valve can be manufactured and installed in the correct position.
 - 3.4.3. **200mm connecting flanges**
 - Flanges are manufactured to the same specification as the quick acting dump valve, ensuring accurate and timeous installation.
 - 3.4.4. **200mm dump valve gasket**

- Gaskets are also manufactured analogous to the connecting flanges and related hardware, preventing leakages during operation.

3.4.5. **200mm long radius bend**

- The bend, as supplied, reduces hydraulic friction when dumping, improving flow characteristics.

3.5. **Essential Inspection Hardware**

3.5.1. **490mm 3CR12 vacuum manhole**

- The vacuum manhole is manufactured of 3CR12. The additional chromium in the material provides essential structural stability for periodic maintenance of the vacuum tanker. Furthermore, the specified vacuum manhole has been developed with a special forged rubber seal ensuring an air-tight access point, removing the necessity of silicone and other sealing consumables when carrying out maintenance.

3.5.2. **Site-glass**

- The site glass assembly is constructed of clear composite material, with remarkable chemical and thermal resistivity, allowing an operator to inspect the effluent level in the tanker clearly. Due to the nature of blockages when collecting septic effluent, the arrangement is premeditated to allow maintenance of the hardware. Moreover, the system is installed with a fracture-spill prevention valve to mitigate environmental and health casualties.

3.6. **Recommended assembly hardware (available from Broom Engineering)**

3.6.1. **Stag compound**

- The stage compound as supplied by Broom Engineering is highly recommended pipe and fitting installations due to the instantaneous air sealing properties when exposed heat.

3.6.2. **40mm medium reinforced suction hose**

- Recommended suction hose for connecting vacuum plant equipment. The installation of the flexible hose ensures that oscillations experienced by a septic tanker do not result in micro-fractures of connecting pipes, preventing leaks from occurring.

3.6.3. **System assembly fittings**

- 3.6.3.1. Fittings from Snifting valve to Moisture Separator.
- 3.6.3.2. Fittings from Moisture Separator to B-Series Vacuum Exhauster.
- 3.6.3.3. Fittings to vacuum breaker valve.

4. Spares and aftersales support

The B-Range vacuum exhausters and low-pressure compressors are fully serviceable. All parts are sold separately, mitigating downtime and ensuring effective after sales support.

Figure 2 illustrates the standard overhaul-kit required in the event of a system fault, comprising of rotary vane blades, various seals and bearings. All information regarding the servicing and longevity of the product are available in the product user manual.



Figure 3: Standard Overhaul Kit Items (Service Parts)

All vacuum plant equipment and installations are manufactured by Broom Engineering and are supplied based on client requirements; thus, servicing of parts and replacement of consumables are available.

Broom Engineering also offers training on system installations free of charge when booked via an appointment.