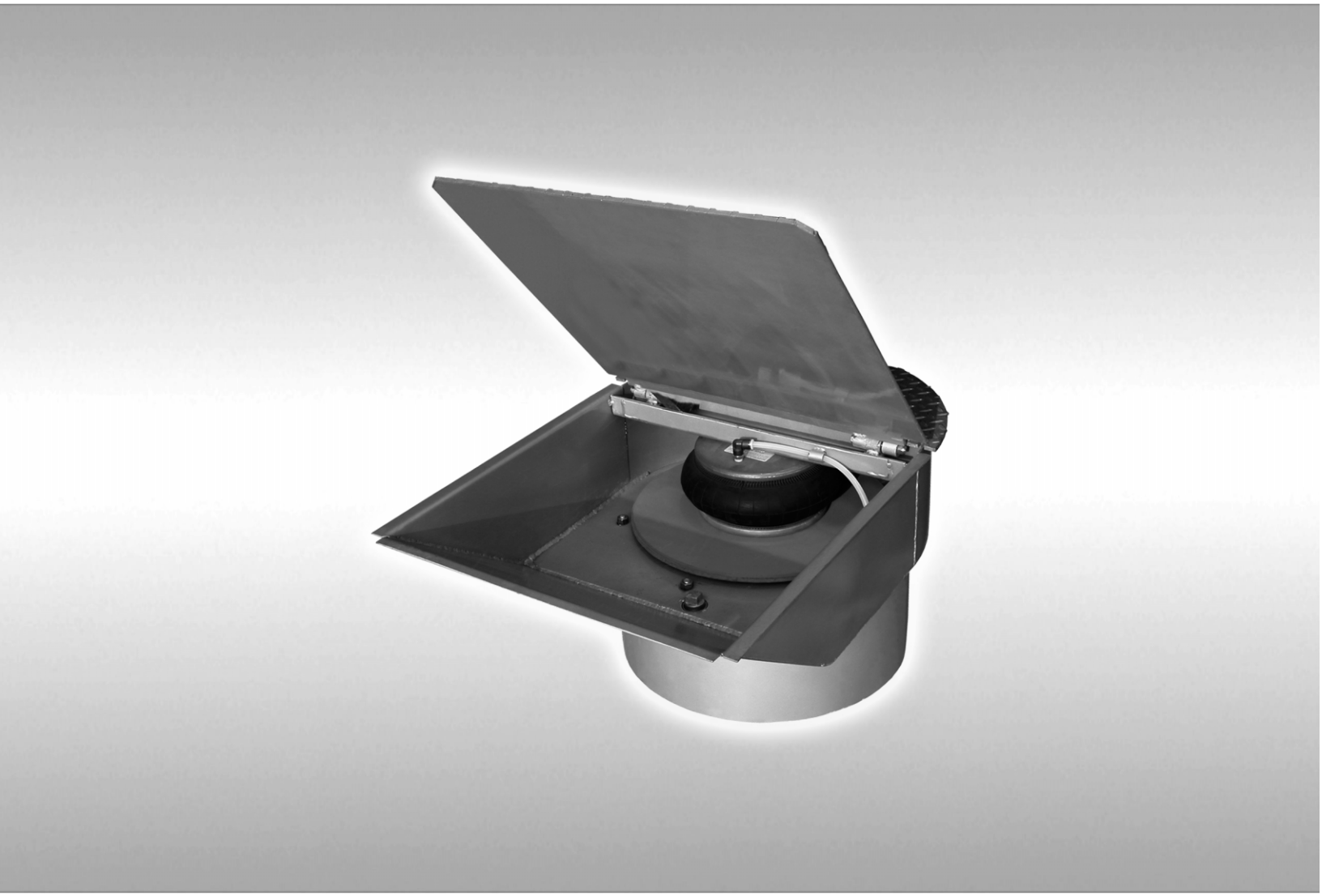


Flush Valve

Flush System

Instruction Manual / Installation Instructions
(Original instructions)

2019-9015-008
09-2015

engineering for a better world

GEA Farm Technologies

Contents

1 Preface

This is a GEA product. GEA is the manufacturer of the Houle product line. This product was formerly known under HOULE trademark.

1.1 About this manual

The manufacturer reserves the right to make changes due to technical developments in the data and images given in this manual.

Reproductions, translations and copies of any kind, even of extracts, require written authorization from the manufacturer.

Abbreviations, units, specialist terms, special names or terminology are explained in detail in section Appendix.

This manual is supplied with the product.

- This manual should be kept close at hand and remain with the equipment even if the equipment is sold.
- This manual is not subject to an amendment service. The most recent version can be obtained through the dealer or directly from the manufacturer.

Pictograms used

This pictogram indicates information that will be helpful toward a better understanding of the working processes.

This symbol indicates another document or section to refer to.

All manuals have a reference number. The 4 middle digits specify the language of the instruction manual:

	language		**language**		**language**
-9000-	German	-9013-	Dutch	-9032-	Serbian
-9001-	English (United Kingdom)	-9015-	English (North America)	-9034-	Slovak
-9002-	French (France)	-9016-	Polish	-9035-	Chinese
-9003-	Italian	-9018-	Japanese	-9036-	Lithuanian
-9004-	Romanian	-9021-	Danish	-9038-	Portuguese (Brazil)
-9005-	Spanish (Spain)	-9022-	Hungarian	-9039-	French (Canada)
-9007-	Swedish	-9023-	Czech	-9040-	Latvian
-9008-	Norwegian	-9024-	Finnish	-9041-	Estonian
-9009-	Russian	-9025-	Croatian	-9043-	Spanish (Central America)
-9010-	Greek	-9027-	Bulgarian		
-9012-	Turkish	-9029-	Slovenian		
The instruction manuals may not be available in all the listed languages.					

1.2 Manufacturer's address

GEA Farm Technologies Canada Inc. / Division GEA Houle
4591 boul. St-Joseph
Drummondville, Qc, J2A 0C6

☎ +1 819 477 - 7444
🖷 +1 819 477 - 5565
✉ geahoule@gea.com
@ www.gea.com

1.3 Customer service

Dealer

If necessary, please contact your nearest dealer.

There is a comprehensive dealer Internet search function on our website at the following address:

www.gea.com

European contact information:

GEA Farm Technologies GmbH
Siemensstraße 25-27
D-59199 Bönen

☎ +49 (0) 2383 / 93-70
🖷 +49 (0) 2383 / 93-80
✉ contact@gea.com
@ www.gea.com

US contact information:

GEA Farm Technologies, Inc.
1880 Country Farm Dr.
Naperville, IL 60563

☎ +1 630 369 - 8100
🖷 +1 630 369 - 9875
✉ contact_us@gea.com
@ www.gea.com

1.4 Declaration of conformity

Manufacturer:	**GEA Farm Technologies Canada Inc. / Division GEA Houle** **4591 boul. St-Joseph** **Drummondville, Qc, J2A 0C6**
Product category:	**Flush system**
Type of product:	**Flush valve**

The named product is in conformity with the requirements of the following European directives:

2006/42/EC Machinery Directive

Conformity with the requirements of these directives is testified by complete adherence to the following standards:

- Harmonized European standards

NF EN ISO 12100-2 (2004-01)	Safety of machinery - Basic concepts, general principles for design Part 2: Technical principles
NF EN ISO 14121-1 (2007-11)	Safety of machinery - Risk assessment Part 1: Principles
FD ISO/TR 14121-2 (2008-02)	Safety of machinery - Risk assessment Part 2: Practical guidance and examples of methods

Person responsible for compiling the relevant technical documents:	Josef Schröer GEA Farm Technologies GmbH Siemensstraße 25-27 D-59199 Bönen ☏ +49 (0) 2383 / 93-70
Drummondville, 07 January 2010	Yann Desrochers (Head of Research and Development)

The undersigned is acting by virtue of power of attorney from the management of:
GEA Farm Technologies Canada Inc. / Division GEA Houle, 4591 boul. St-Joseph, Drummondville, Qc, J2A 0C6

This declaration certifies compliance with the guidelines indicated, but does not establish any guarantee in the sense of paragraphs 443, 444 of the BGB.
This declaration of conformity becomes invalid if design changes are made which affect the technical data given in the instructions and the correct use of the product, thereby significantly altering the machine!

1.5 GEA Farm Technologies Canada Inc. - general equipment warranty

Important notice!
THIS GENERAL WARRANTY APPLIES TO ALL EQUIPMENT SOLD UNDER THE GEA HOULE TRADEMARK.

1.5.1 Limited warranty

GEA Farm Technologies Canada Inc. / Division GEA Houle (hereinafter referred to as ”the Company”) warrants to the original buyer and end user (hereinafter referred to as the ”Purchaser”) that the parts of all equipment sold under the Company trademark are free from defects in material or workmanship for a period of twelve (12) months from the date of delivery of the equipment to the Purchaser. This written warranty takes precedence over any other written warranty included in previous versions of the Company's manuals. Any equipment used for commercial usage, commercial lease on one or more farms is warranted for a reduced period of thirty (30) days only.

Components from third-party manufacturers that are not built by the Company, and which are accessory to the equipment sold under the Company trademark (including, without limitation, the motors and tires), are subject to such third-party manufacturers' specific warranty coverage.

THIS WARRANTY EXTENDS ONLY TO THE PURCHASER AND DOES NOT APPLY IN THE EVENT THAT THE EQUIPMENT IS SOLD OR OTHERWISE TRANSFERRED.

1.5.2 Condition of the limited warranty

The Company, through its GEA authorized dealers only (hereinafter referred to as ”Dealer”), reserves the right to either repair or replace all parts deemed defective under the following conditions:

1. That the equipment is installed, operated and maintained in accordance with the Company directives;
2. That the Purchaser uses the equipment in accordance with specific instructions, under normal conditions, for the sole purpose for which the equipment was designed;
3. That the Purchaser notifies in writing his Dealer or the Company (whichever the case may be) of any defect of the equipment. In either case the notification must be made within the twelve (12) months following the date of the delivery to the Purchaser;
4. The Purchaser or the Dealer must keep the defective parts or equipment for inspection by the Company and return such defective parts or equipment prepaid to the Company, if requested;
5. That the Purchaser does not modify the equipment, nor attempt to repair any equipment or parts without proper authorization from the Company;
6. Depending on the nature of the equipment involved and whether it is fixed or transportable, the Company will repair or replace the defective parts of the equipment free of charge where installed, or at the business place of the Dealer or the Company, at its sole discretion.

1.5.3 Extent of limited warranty

This limited warranty DOES NOT cover:

- Defects caused by negligence of the Purchaser in the maintenance of the equipment, improper use resulting from failure to adhere strictly to the Company's manuals or non-compliance with prescribed maintenance instructions provided by the Company (including, without limitation, lack of lubrication of the equipment), as well as damages arising from non-conforming installation of the equipment, or ambient temperature or conditions of storage of the equipment that do not comply with the Company's recommendations (including, without limitation, any damages resulting from storage or operation of the equipment at a temperature equal or below (5°C/41°F));
- Damages to equipment due to normal wear and tear or to external causes, including issues of power or inadequate electrical conditions (including, without limitation, inadequate tension (neutral/ground), abnormal mechanical or environmental conditions (including, without limitation, damages caused by fire, lightning, flood or other natural disaster), damages caused by the use of sand litter or other abrasive or inadequate material (including, without limitation, damages caused by solids in the manure, such as stone, wood, iron, concrete, and strings), as well as damages caused by ice or frozen manure blocking the evacuation line of the equipment or the introduction of such solids in the equipment;
- Freight and shipping associated with repair or replacement of equipment under this limited warranty, as well as all costs relating to removal or replacement of any equipment that is welded or affixed permanently to the ground or a building (including, without limitation, labor costs, and costs related to concrete or excavation);
- Claims arising from repairs or replacements made by the Purchaser without the prior written consent of the Company. The Purchaser shall not remove or alter any safety device, guard, or warning sign.

If the Purchaser fails to comply with any of its obligations referred to in this paragraph, the Purchaser agrees to save the Company and the Dealer harmless in respect of any liability or obligation incurred by the Company or the Dealer resulting from such failure of the Purchaser.

1.5.4 Warranty limitations and exclusion

NO WARRANTY, ORAL OR WRITTEN, EXPRESS OR IMPLIED, OTHER THAN THE ABOVE WARRANTY IS PROVIDED IN RESPECT OF THE EQUIPMENT SOLD.

Some states (or jurisdictions) do not allow the exclusion of implied warranties so it is possible that this limitation may not apply.

THE COMPANY DISCLAIMS ALL IMPLIED WARRANTIES, INCLUDING THE WARRANTIES OF MERCHANTABILITY, ADAPTABILITY OR OF PERFORMANCE, PROVIDED THAT SUCH EXCLUSION OF LIABILITY COMPLIES WITH THE LAWS HAVING APPLICABLE REGULATORY JURISDICTION.

THE LIABILITY OF THE COMPANY AND ITS DEALERS UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF DEFECTIVE PARTS UP TO THE CONTRACT VALUE FOR THE PURCHASED EQUIPMENT. IN NO EVENT SHALL THE COMPANY BE LIABLE FOR ANY SPECIAL, INDIRECT, CONSEQUENTIAL, INCIDENTAL, PUNITIVE OR EXEMPLARY DAMAGES IN ANY KIND OR CHARACTER, INCLUDING INDIRECT COSTS, LOSS OF PRODUCTION, LOSS OF REVENUES OR PROFITS, AND OTHER DISBURSEMENTS WHICH MAY OCCUR.

Some states (or jurisdictions) do not allow the exclusion or limitation of incidental or consequential damages and so it is possible that these limitations or exclusions may not apply.

1.5.5 General statements

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS AND YOU MAY ALSO HAVE OTHER RIGHTS THAT VARY BY JURISDICTION.

THE DEALER IS NOT AUTHORIZED TO MAKE ANY ADDITIONAL REPRESENTATIONS OR PROMISES THAT DIFFER IN ANY WAY FROM THE TERM OF THIS LIMITED WARRANTY, OR MODIFY THE PROVISIONS, DURATION AND CONDITIONS OF THIS LIMITED WARRANTY. NO WAIVER OR MODIFICATION OF THIS LIMITED WARRANTY IS VALID UNLESS AGREED TO IN WRITING AND SIGNED BY THE AUTHORIZED REPRESENTATIVES OF THE COMPANY.

IN THE EVENT OF ANY CONFLICT BETWEEN THE ENGLISH LANGUAGE VERSION AND ANY OTHER TRANSLATED VERSION OF THIS LIMITED WARRANTY (WITH THE EXCEPTION OF THE FRENCH LANGUAGE VERSION) THE ENGLISH VERSION SHALL PREVAIL.

2 Safety

2.1 Owner's obligation of care

This product is designed and constructed while taking into account a potential risk analysis, a selection of harmonized standards and other technical specifications to be complied with in order to guarantee a maximum level of safety.

Safety is achieved when the safety instructions are followed. It is part of the owner's obligation of care to implement these safety measures and make sure they are carried out at all times.

In particular, the owner must ensure that:

- everyone working with or performing activities in connection with this product, including himself, read the instructions contained in this instruction manual and follows those instructions;
- everyone is regularly instructed on relevant matters.

The owner must ensure a safe environment by providing:

- this instruction manual with this product;
- adequate lighting in all areas where activities in connection with this product are performed. A minimum of 200 lux is required to ensure visibility of the equipment, the controls and the safety labels;
- all required personal safety gear such as hearing, eye, feet protection, etc. in all areas where activities in connection with this product are performed;
- supervision for inexperienced personnel working or performing activities in connection with this product;
- the tools listed in this manual to perform activities in connection with this product;
- an adequate installation of the product in order to use it only for the sole purpose for which it was designed;
- new parts to replace any defective, worn or damaged parts on this product;
- appropriate devices such as motor, engine, hydraulic unit, etc. to safely operate this product. To meet the technical requirements, refer to section Technical data;
- a product meeting the local rules and regulations.

2.2 Explanation of safety symbols

Safety symbols draw attention to the importance of the adjacent text.

The design of the warnings is based on ISO 3864-2 and ANSI535.6.

Safety symbols and key words

Danger!
The indication ”Danger” signals immediate danger to life or health of personnel.
Death or serious injury will result if the danger is not avoided.

Warning!
The indication ”Warning” signals potential danger to life or health of personnel.
Death or serious injury may result if the danger is not avoided.

Caution!
The indication ”Caution” signals dangerous situations.
Minor or moderate injury may result if the danger is not avoided.

Attention!
The indication ”Attention” signals important information on risks for the product or the environment.

2.3 Basic safety instructions

Safety procedures in confined spaces


Danger!
Manure produces toxic gases that may cause death in a few seconds. When agitated, the manure produces heavy toxic gases such as hydrogen sulfide (H_2S), carbon dioxide (CO_2), methane (CH_4) and ammonia (NH_3). It is MANDATORY to follow the Safety Procedures for Confined Spaces before operating or servicing the equipment. These safety procedures clearly explain the risks associated with manure, procedures for a safe access to workspaces and the minimum ventilation requirements to ensure the safety of humans and livestock. Find local safety procedures for confined spaces in Web Sites below.

Location	Administrated by	Web site
Canada	Canadian Centre for Occupational Health and Safety	**www.ccohs.ca**
USA	Occupational Safety and Health Administration	**www.osha.gov**
European Union	European Agency for Safety and Health at Work	**www.osha.europa.eu**


Danger!
As manure produces toxic gases that can cause death, it is imperative to follow safety instructions below before attempting to install the equipment:

- Never enter into a manure pit.
- Never attempt to rescue people without the help of qualified personnel. 40% of death caused by intoxication are due to rescue attempts.
- Access to the main storage must be limited to qualified personnel having knowledge on safety procedures in confined spaces.
- Permanent ventilation must be active in each structure surrounding the main storage to evacuate toxic gases.
- Smoking inside or around buildings and manure storage is prohibited.
- Make sure all access to the reservoir and confined space are closed and locked.


Warning!
Always shut off and lock the main electric power supply before installing, adjusting and servicing this equipment.

- Read and follow the instructions of this instruction manual before performing activities in connection with this product. Keep the instruction manual with this product allowing anyone to refer to it at any time.
- Only trained personnel can operate this product to ensure safe operating methods. Make sure the personnel performing activities in connection with this product have the skills when special qualifications are required. Read the section Safety - Personnel qualifications.
- Always wear personal safety gear such as hearing, eye, feet protection, etc. when performing activities in connection with this product. Inspect the personal gear and replace if worn and/or defective.
- Make sure the environment is safe through all steps listed in this manual. Always be familiar with the environment surrounding the working area. Locate the elements that can be dangerous in order to avoid them. Beware of leaks and spills such as grease, oil, water, etc. which can make a surface slippery causing injuries.
- No one stands near this product unless they are performing instructions included in this manual. When near this product, keep body parts such as hands, feet, hair as well as clothing away from dangerous parts such as rotating parts, articulated parts, sharp edges, etc.
- Use this product only when in perfect working condition and for the sole purpose for which it was designed. Do not use damaged, worn or defective parts on this product, replace immediately to avoid serious damages and injuries.
- Use only the tools listed in this manual to perform activities in connection with this product in order to avoid injuries.
- Do not stand underneath suspended loads when handling this product or parts: there is a potential risk of fall, damage and/or loss of stability. Handling can only be performed by a qualified forklift operator.
- Never remove the safety devices such as guards, covers, chains, labels, etc. from this product to ensure safety unless otherwise indicated in this instruction manual. Refer to section Safety - Protective devices. Read and follow the instructions of the safety labels affixed on this product and make sure the safety labels are legible.
- The devices supplied by the owner to operate this product such as a motor, an engine, a hydraulic unit, etc. must meet the technical requirements indicated in section Technical data.

2.4 Personnel qualifications

The manufacturer intends to determine the difference between trained personnel and qualified personnel.

Trained personnel

The operator was trained by the manufacturer or its legal representative to follow all safety rules, cleaning method, general maintenance as well as the operating methods.

It is the operator's responsibility to inform the farm workers of those rules, maintenance and methods.

Qualified personnel

Qualified personnel refers to those having obtained the academic knowledge of a specific field of work.

This personnel has followed a training and subsequently obtained a certification, diploma or any other official document provided by a recognized academic facility in the country of study.

An equivalence may be required when operating in other countries.

The special qualifications required in the following activities will be specified in each section when applicable:

- Handling and installation
- Initial commissioning
- Operating
- Troubleshooting
- Maintenance
- Decommissioning

3 Description (overview)

3.1 Product applications

The Flush valve is exclusively designed to:

- clean alleys and holding area of a dairy farm using water discharge that may contain liquid manure or dairy waste.

Functional description

Two Flush valve models are available: one for manure alley cleaning and one for holding area cleaning.

Both models work similarly. The main difference is the cleaning width.

Between flush cycles, the Flush valves remain closed thanks to an air balloon maintained at a specific pressure.

When a flush cycle is initiated by the control panel, air pressure is quickly released to allow the first Flush valve opening for the cleaning time period. Then the first Flush valve balloon is gradually inflated to close the Flush valve. Meanwhile, the second Flush valve opens to continue the flush cycle.

Depending on the installation layout, Flush valves can either be connected to a flush tank or to a pump. When connected to a flush tank, the liquid is transferred by gravity. When connected to a pump, the liquid is transferred by pumping pressure at a minimum rate of 1800 GPM (6800 LPM).

☞ **Note!**
This product and its equipment are designed for agricultural purposes only. Any applications not listed above are considered as improper use and will void the warranty!

The manufacturer is not liable for any resulting damages due to improper use of this product. The user carries the risk. Proper use also includes reading and following the instructions of this instruction manual.

- Original GEA parts and accessories are specially designed for GEA products and equipment.
- The manufacturer expressly points out that only original parts and original accessories supplied by GEA are adapted, tested and authorized to be used with this product or equipment. Do not use other supplier's parts or equipment with GEA product unless otherwise approved in writing by GEA.
- The manufacturer does not accept any liability toward injured people or animals or damaged products and equipment caused by the use of other manufacturers products.

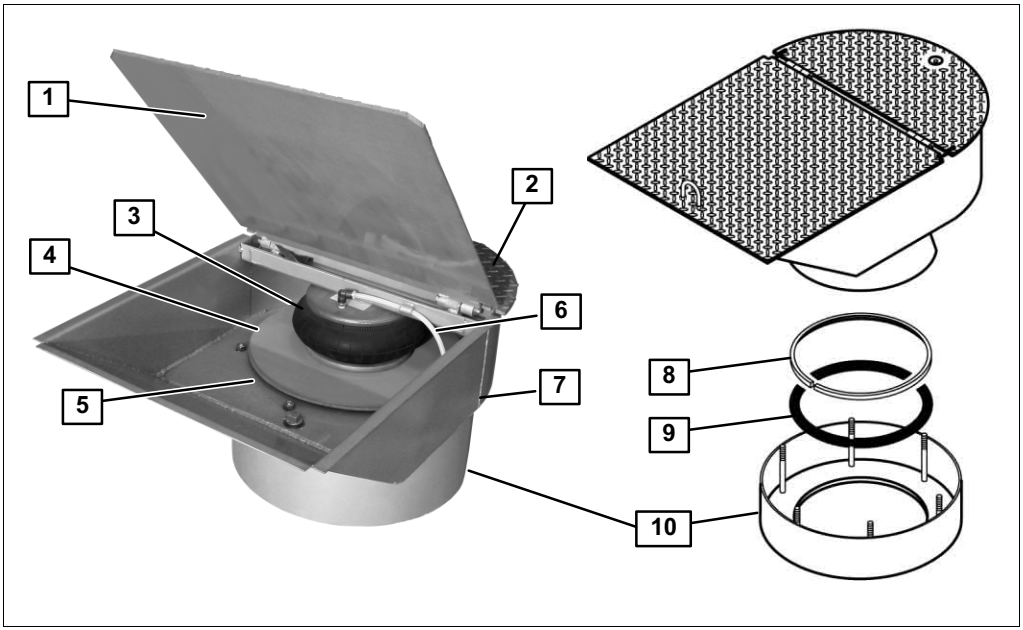
3.2 Modification made to this product

For safety reasons, do not carry out any unauthorized modification to this product!

Any modification must be approved by the manufacturer in writing prior to the change otherwise the warranty will be voided.

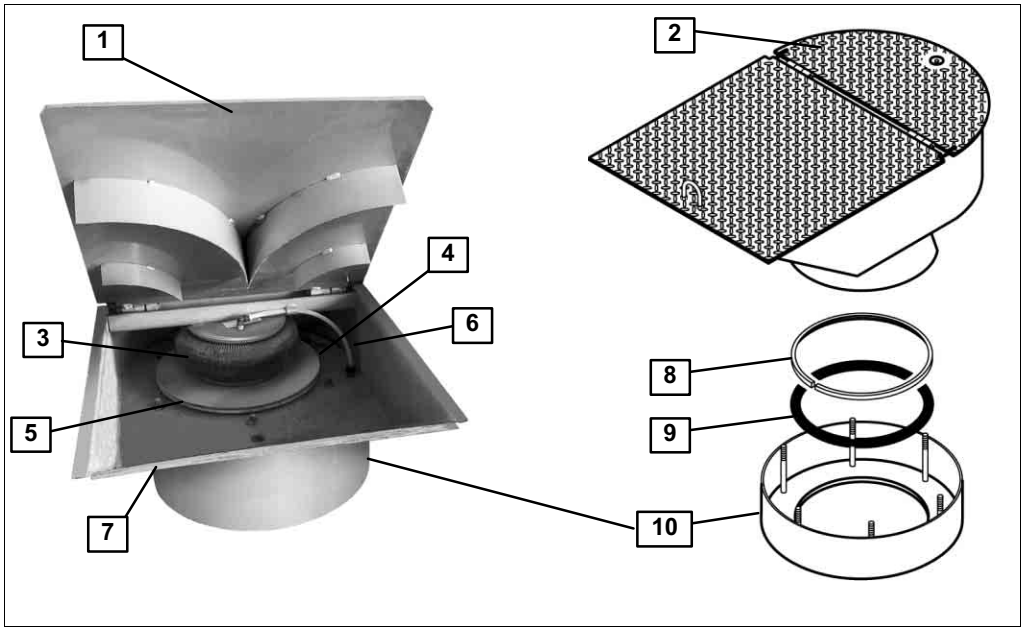
4 Main view

4.1 Flush valve (alley Flush valve model)



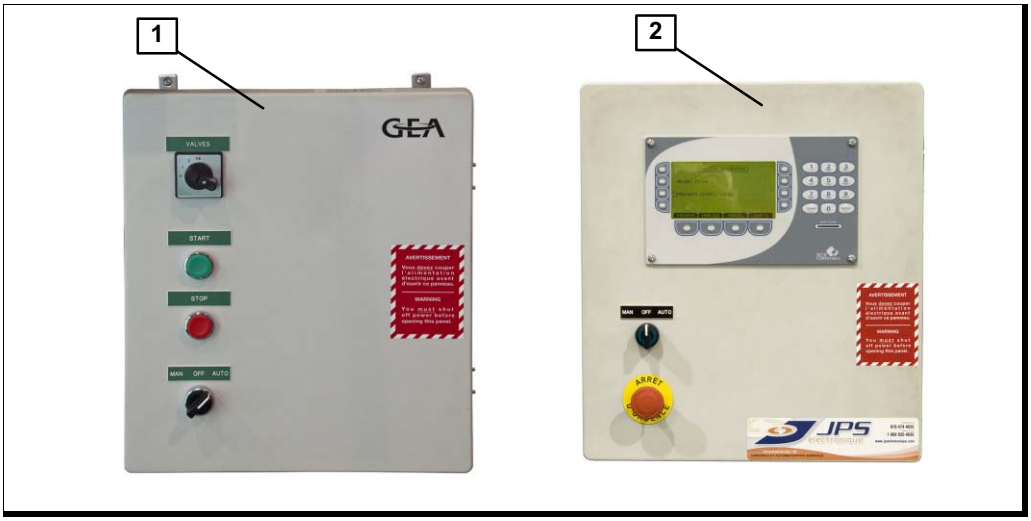
Legend:			
1	Front lid	**2**	Rear lid
3	Air balloon	**4**	Valve
5	Rubber gasket	**6**	3/8 in [10 mm] flexible hose
7	Main frame	**8**	Gripper ring
9	O-ring	**10**	Circular bottom half of Flush valve

4.2 Flush valve (holding area Flush valve model)



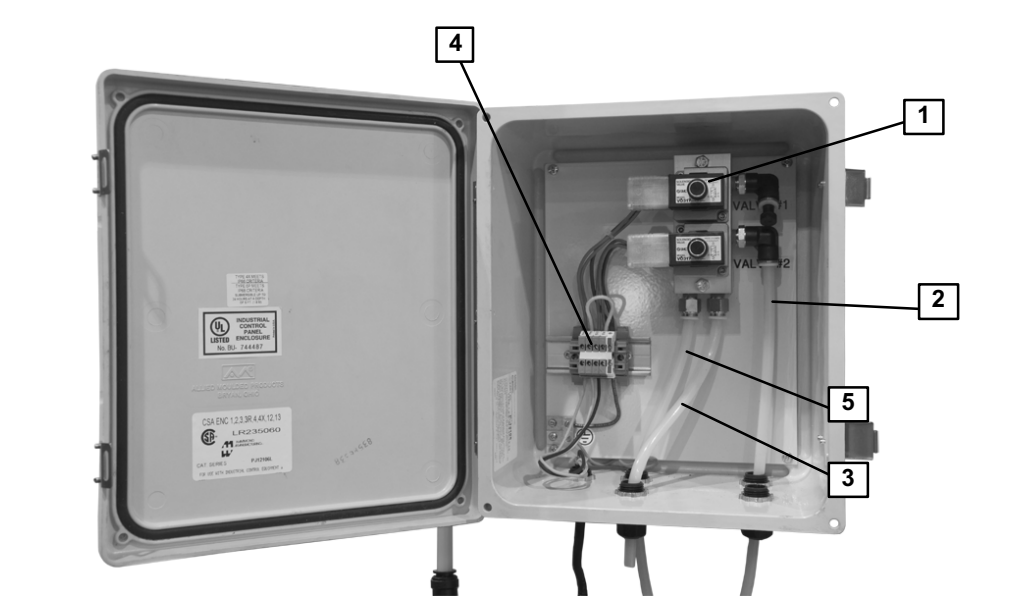
Legend:			
1	Front lid	**2**	Rear lid
3	Air balloon	**4**	Valve
5	Rubber gasket	**6**	3/8 in [10 mm] flexible hose
7	Main frame	**8**	Gripper ring
9	O-ring	**10**	Circular bottom half of Flush valve

4.3 Main control panel



Legend:			
1	Manual / Semi-automatic control panel	**2**	Sequencer control panel (UCC-800)

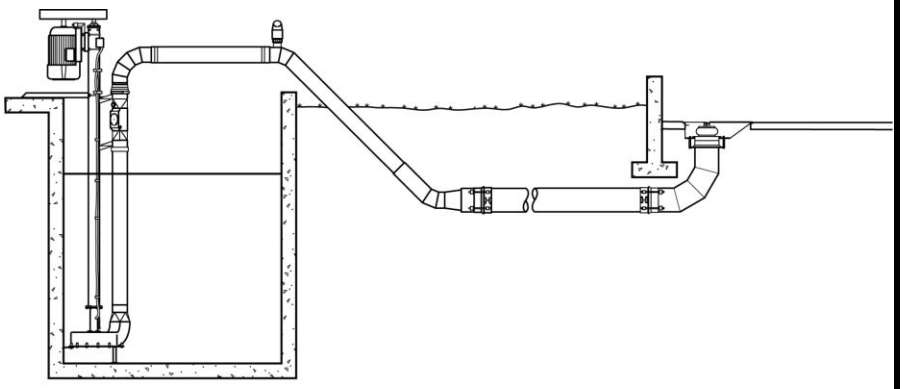
4.4 Auxiliary control panel



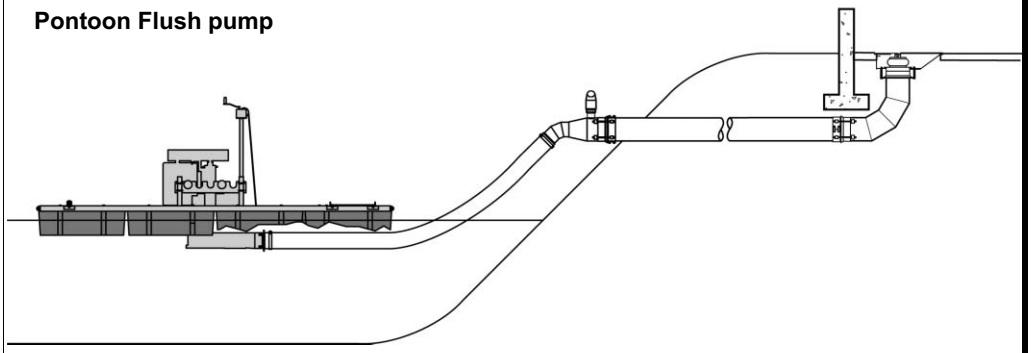
Legend:			
1	Solenoid air valve	**2**	⅜ in (10 mm) flexible hose (connected to the Flush valve)
3	Air exhaust	**4**	24 V connection terminal (connected from the main control panel)
5	Air intake		

4.5 Typical layout

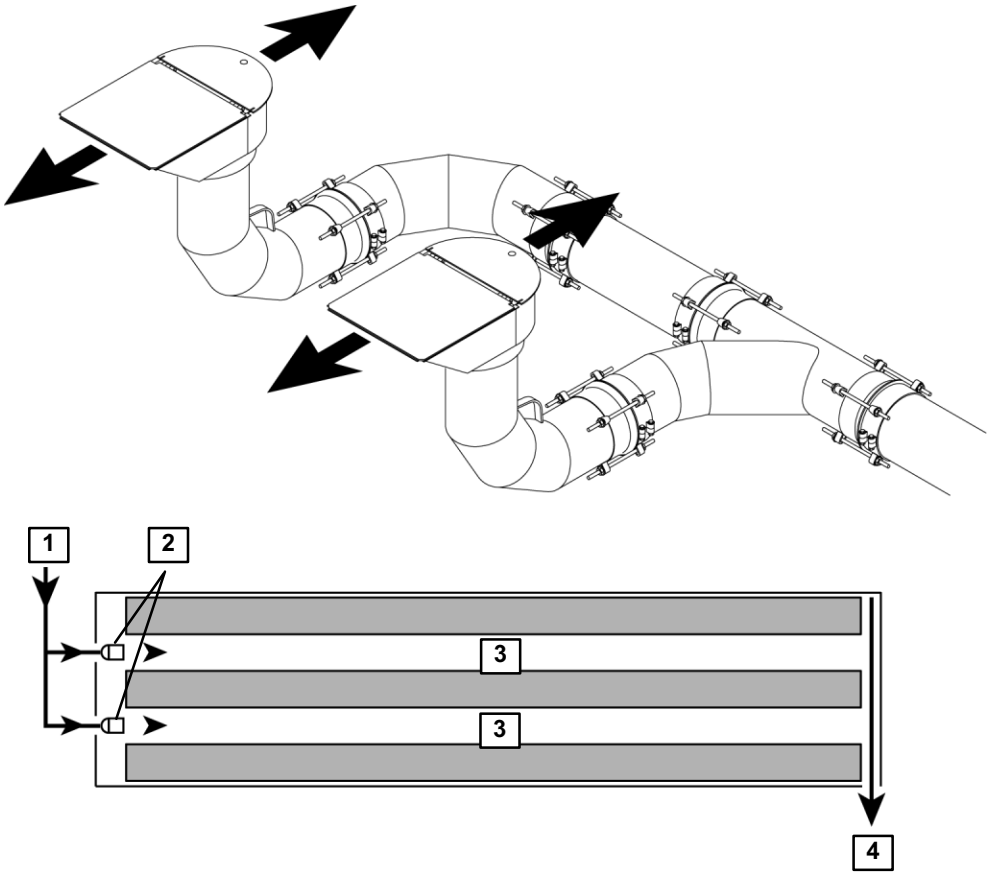
Vertical Flush pump



Pontoon Flush pump

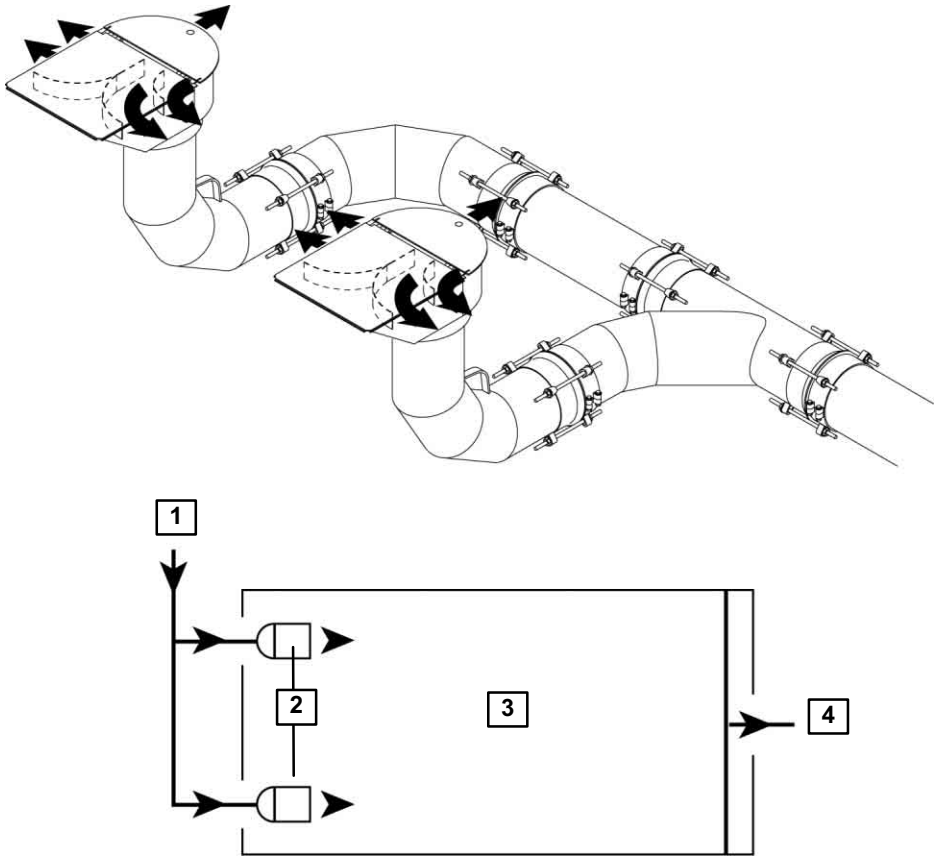


Alley Flush valve



Legend:			
1	Flush in	2	Flush valve
3	Alley	4	Flush out

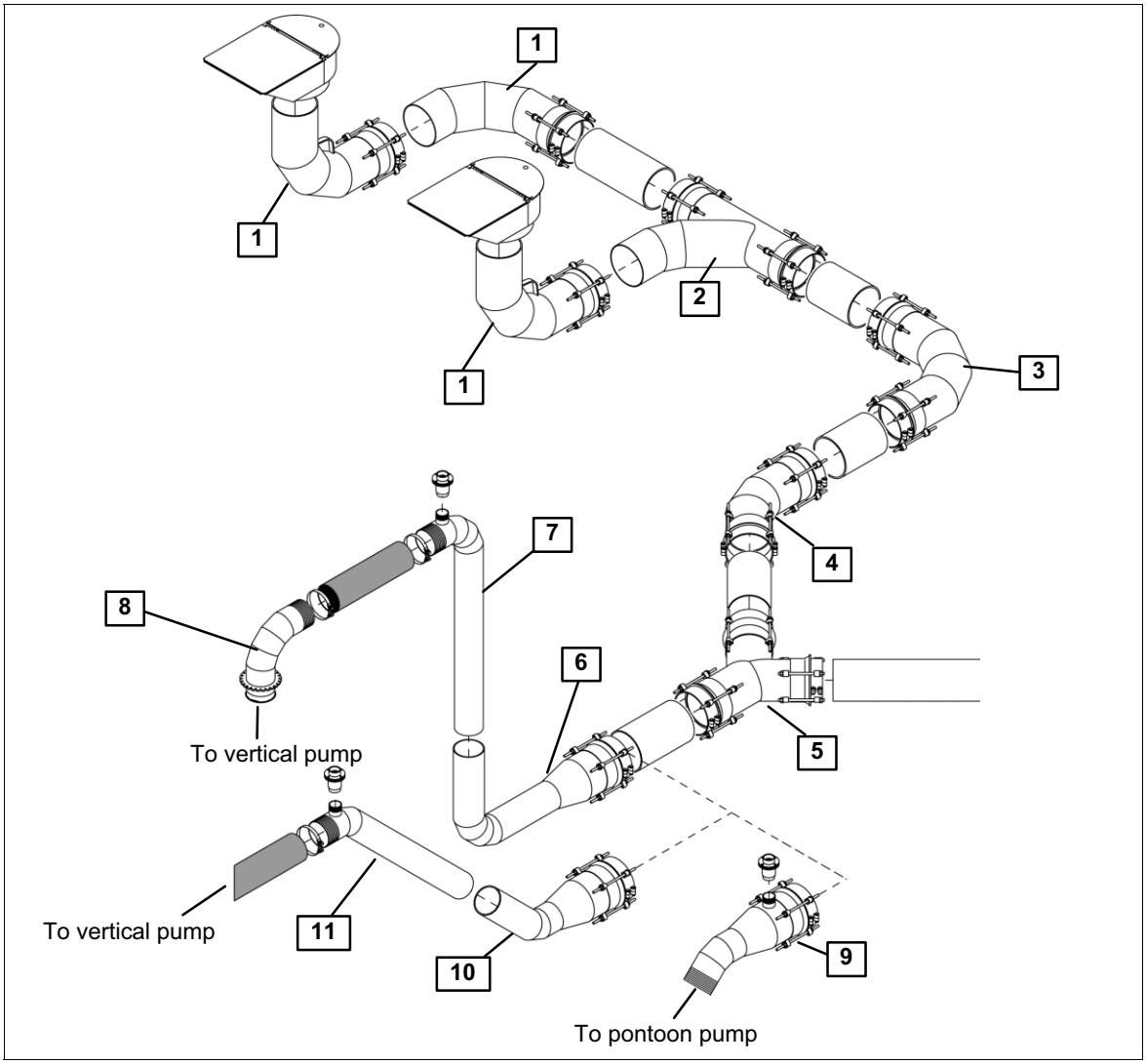
Holding area Flush valve



Legend:			
1	Flush in	2	Flush valve
3	Holding area	4	Flush out

4.6 Typical piping layout

Note!
Most of the piping sizes available are designed for 12 3/4” [315 mm] Flush valves. When using a 15.3” [355 mm] Flush valve, all piping components must be purchased locally.



Legend:			
1	90º elbow with 1 anti-slip collar	2	"Y" adapter with 2 anti-slip collars
3	90º elbow with 2 anti-slip collars	4	45º elbow with 2 anti-slip collars
5	"Y" adapter with 3 anti-slip collars	6	90º elbow with 2 anti-slip collars
7	90º elbow 8" O.D.	8	90º high velocity elbow with notched disk 8" O.D.
9	45º elbow with 1 anti-slip collar	10	45º elbow with 1 anti-slip collar
11	45º high velocity elbow 8" O.D.		

5 Technical data

Geometric data

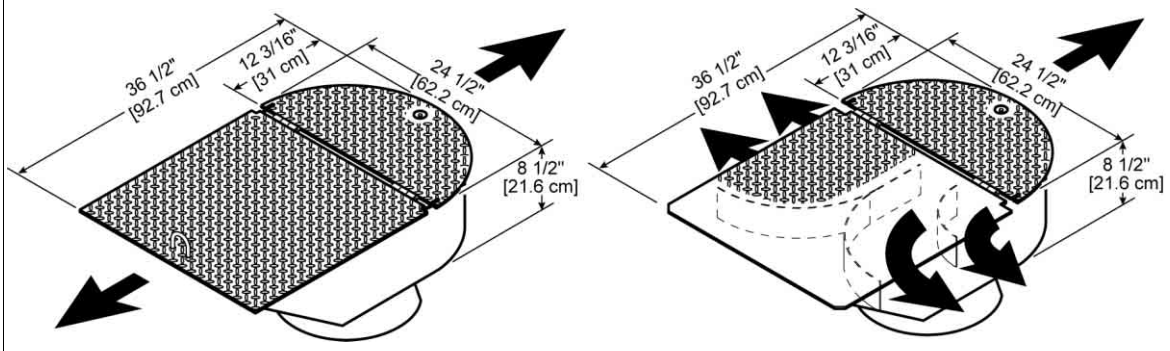
SAE model

	15” alley Flush valve	12” alley Flush valve	12” holding area Flush valve
Front lid model	straight	straight	with deflectors
Intake line diameter	15.3” O.D.	12 3/4” O.D.	
Operating air pressure	40 psi [276 kPa]		
Air hose type required	3/8” O.D. quick connect hose		
Weight	247 lbs [112 kg]	192 lbs [87 kg]	150 lbs [68 kg]

Metric model

	355 mm alley Flush valve	315 mm alley Flush valve	315 mm holding area Flush valve
Front lid model	straight	straight	with deflectors
Intake line diameter	355 mm O.D.	315 mm O.D.	
Operating air pressure	40 psi [276 kPa]		
Air hose type required	3/8” O.D. quick connect hose		
Weight	247 lbs [112 kg]	192 lbs [87 kg]	150 lbs [68 kg]

Overall dimensions



Alley Flush valve **Holding area Flush valve**

Auxiliary control panel specifications

Electrical data	
Operating voltage	24 VAC
Frequency	50Hz or 60Hz
General data	
Operating air pressure	40 psi [276 kPa]
Hose type required	3/8” O.D. quick connect hose

Control panel specifications

The control panel must:

- comply with the following requirements:
  2006/95/CE directives (Electrical equipment designed for use within certain voltage limits)
  92/31/CEE directives (Electromagnetic compatibility)
- comply with the following harmonized standards:
  EN 60204-1 (Safety of machinery - Electrical equipment of machines);
  EN 61082-1 (Documents used in electrotechnology);
  EN 60617 (Graphical symbols).
- be equipped with an emergency stop.
- be protected by a lockable disconnect switch (cut-off switch).
- meet auxiliary air valve panel specifications provided in this manual.
- meet local electrical requirements.

Special specifications:

- The control panel protection devices must be designed to avoid any unexpected start.

Electrical pump specifications

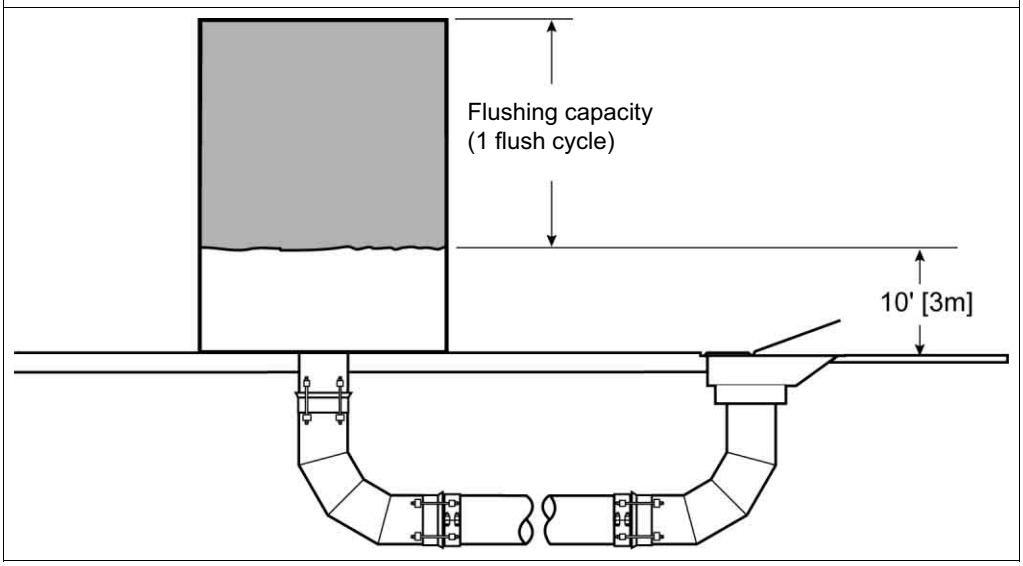
The electrical pump must:

- transfer liquid at a minimum of 1800 GPM [6800 LPM].
- meet performance required in accordance with the installation layout.

Flush tank specifications

The flush tank must:

- be designed as per the local regulations.
- be equipped with a manual gate valve on flush tank discharge*.
- be designed to contain liquid for 1 flush cycle at 10' [3 m] from the top of flush valve to ensure a minimum head pressure. Difference in elevation between the top of flush valve and the flush tank liquid level at the end of flush cycle have to be considered.



* Not necessary when the collecting pit can contain the full capacity of the flush tank.

Performance data

	15” alley Flush valve 355 mm alley Flush valve	12” alley Flush valve 315 mm alley Flush valve	12” holding area Flush valve 315 mm holding area Flush valve
Cleaning type	Standard	Standard	Wide cleaning pattern
Cleaning pattern width (maximum)	14' [4.3 m]	14' [4.3 m]	20' [6.1 m]
Rear lid flow pattern adjustment	Yes	Yes	Yes
Pump minimum transfer rate*	1800 GPM [6800 LPM]		
Volume of liquid needed	Depends directly on manure alley or holding area dimensions. Refer to section on Flush Cycle Calculation.		
Compressed air reservoir capacity	10 US gal. (40 l)		
Operating temperature	5°C [41°F] minimum		

* Minimum transfer rate required to flush 1 alley when using an electrical pump.

Bolt torque chart

Bolt	Mat.	Bolt diameter									
		1/4”	5/16”	3/8”	7/16”	1/2”	9/16”	5/8”	3/4”	7/8”	1”
SAE 2 	LCS	8Nm (6ft-lb)	16Nm (12ft-lb)	27Nm (20ft-lb)	44Nm (32ft-lb)	64Nm (47ft-lb)	94Nm (69ft-lb)	130Nm (96ft-lb)	210Nm (155ft-lb)	279Nm (206ft-lb)	420Nm (310ft-lb)
SAE 5 	MCS HT	14Nm (10ft-lb)	26Nm (19ft-lb)	45Nm (33ft-lb)	73Nm (54ft-lb)	106Nm (78ft-lb)	155Nm (114ft-lb)	209Nm (154ft-lb)	349Nm (257ft-lb)	518Nm (382ft-lb)	796Nm (587ft-lb)
SAE 8 	MCAS	19Nm (14ft-lb)	39Nm (29ft-lb)	64Nm (47ft-lb)	106Nm (78ft-lb)	161Nm (119ft-lb)	229Nm (169ft-lb)	312Nm (230ft-lb)	515Nm (380ft-lb)	814Nm (600ft-lb)	949Nm (700ft-lb)
Socket Head Cap Screw	AS HT	22Nm (16ft-lb)	45Nm (33ft-lb)	73Nm (54ft-lb)	114Nm (84ft-lb)	170Nm (125ft-lb)	244Nm (180ft-lb)	339Nm (250ft-lb)	542Nm (400ft-lb)	868Nm (640ft-lb)	1315Nm (970ft-lb)

6 Handling and assembly

6.1 Special personnel qualification required for handling

Handling must be performed by a qualified forklift operator and/or qualified overhead crane or hoist operator.

Installation work must be performed by trained personnel in accordance with the safety instructions.

Electric work and electric maintenance must be performed by a certified electrician.

Welding work must be performed by a qualified welder.

Read the section Safety - Personnel qualifications.

6.2 Safety instructions for handling and assembly

Warning!
Do not stand under suspended loads. Falling loads can cause fatal injuries!

Read the section Safety.

6.3 Preparation

6.3.1 Handling tools

Attention!
To lift the equipment, use a lifting device with a minimum capacity of 350 lbs (150 kg)

	Description	Purpose
	Forklift truck	To lift the Flush valve
	Safety chains	To lift the Flush valve

6.3.2 Installation tools

	Description	Purpose
	Wrench set	To tighten bolts
	Ratchet tool set	To tighten bolts

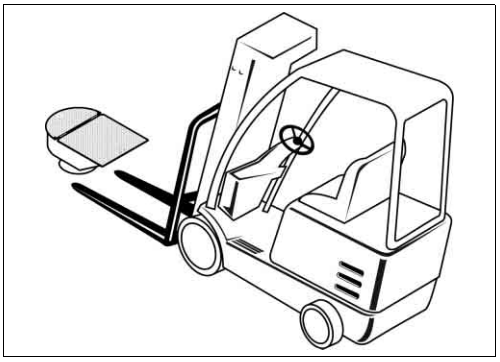
6.4 Packing material disposal

Handle the packing material properly and dispose according to your local rules and regulations on waste disposal. Please refer to your local resources for any questions. Recycle if possible.

6.5 Lifting the Flush valve

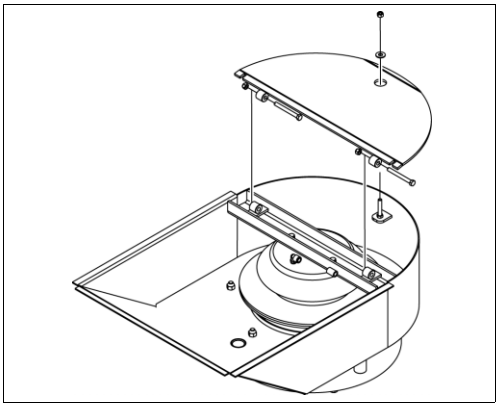
Using a forklift truck

- Insert forks under the Flush valve frame to lift it.

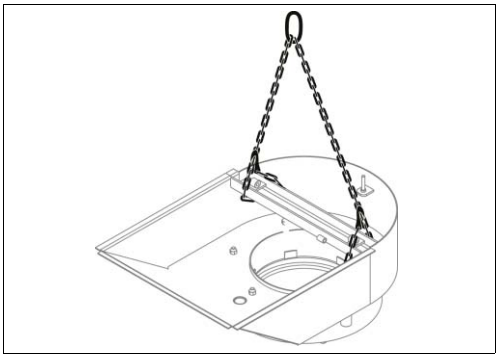


Using safety chains

- Remove the Flush valve rear lid as illustrated hereafter.



- Remove the air balloon.
- Install safety chains as illustrated hereafter.
- Lift the Flush valve using the forklift.



7 Installation

7.1 Special personnel qualification required for installation

Installation must be performed by qualified personnel in accordance with the safety instructions.

 Read the section Safety - Personnel qualifications.

7.2 Safety instructions for installation

 Read the section Safety.

7.3 Preparation

Necessary documents

- Foundation plan
- Electrical wiring diagrams of the control panel

7.4 Flush valve installation

7.4.1 Typical installation

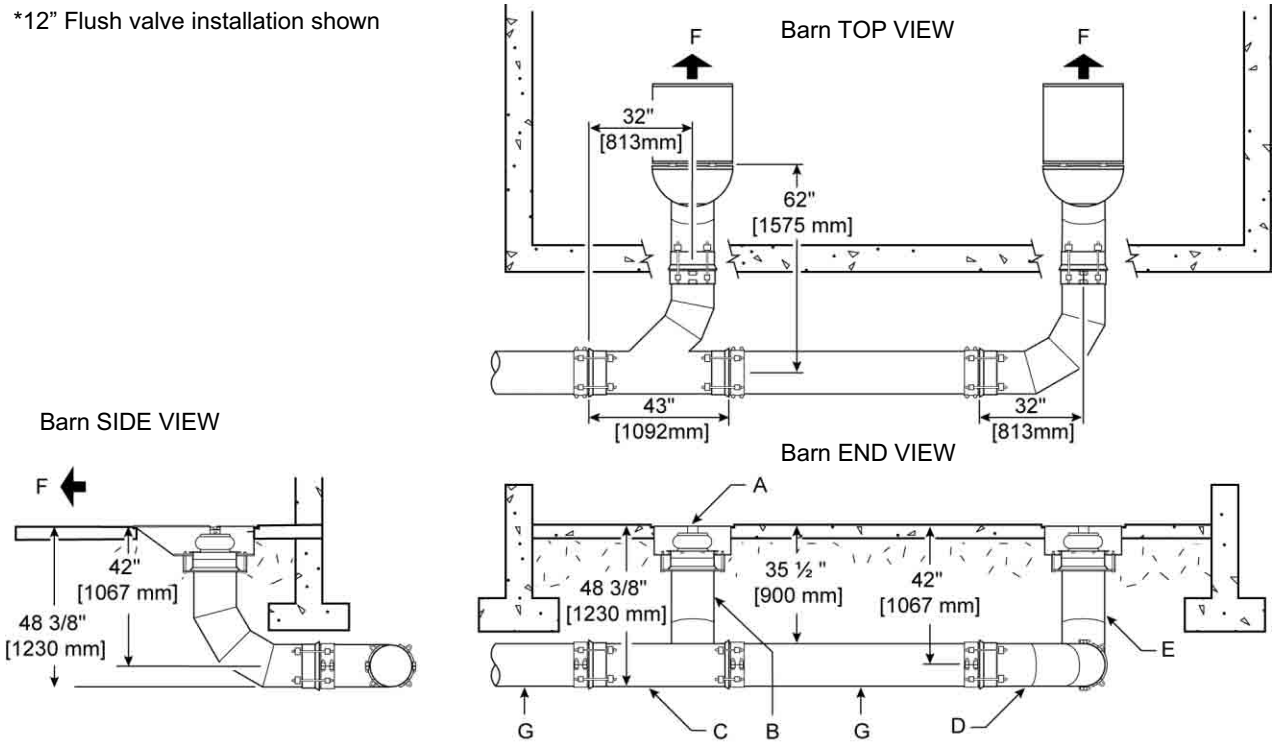
Note!
Flush valve line can be installed aside the barn or under the barn floor.

Note!

- 12” Flush valve can either be installed over a 12 3/4” O.D. PVC pipe, 12 3/4” O.D. steel pipe.
- 15” Flush valve is usually installed over a 15,3” PVC pipe.
- 315 mm Flush valve can either be installed over a 315 mm PVC pipe or steel pipe.
- 355 mm Flush valve is usually installed over a 355 mm PVC pipe.

Installation aside the barn

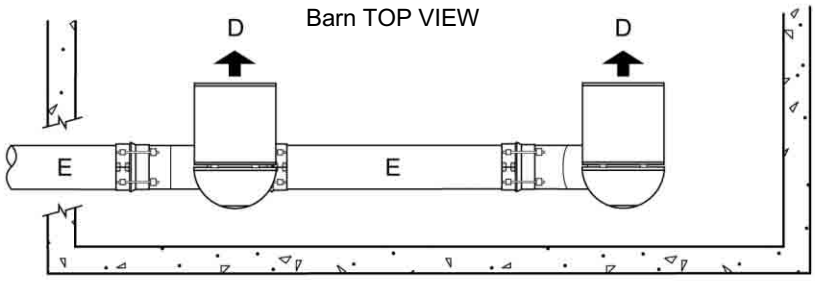
*12” Flush valve installation shown

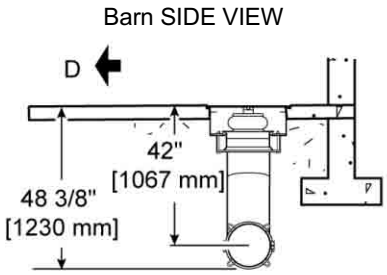


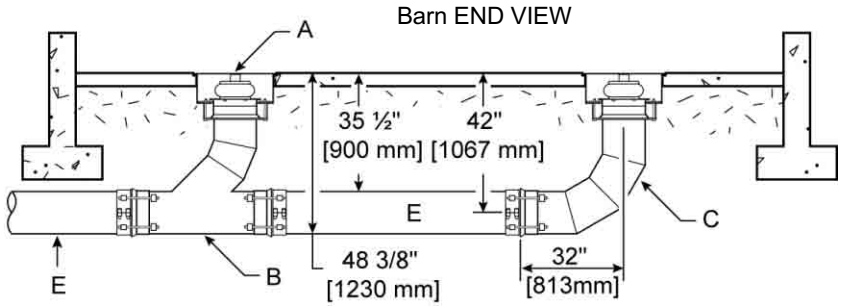
Legend:			
A	Flush valve	B	90° elbow with 1 anti-slip collar
C	"Y” adapter with anti-slip collars	D	90° elbow with 1 anti-slip collar
E	90° elbow with 1 anti-slip collar	F	Sloped flush alley
G	12 3/4” O.D. PVC pipe		

Installation under the barn floor

*12” Flush valve installation shown







Legend:			
A	Flush valve	B	"Y” adapter with anti-slip collars
C	90° elbow with 1 anti-slip collar	D	Sloped flush alley
E	PVC pipe		

7.4.2 Auxiliary control panel installation

- Install the auxiliary control panel next to the main control panel.
- Wire the auxiliary control panel to the main control panel.

Refer to section Appendix - Auxiliary control panel electrical diagram

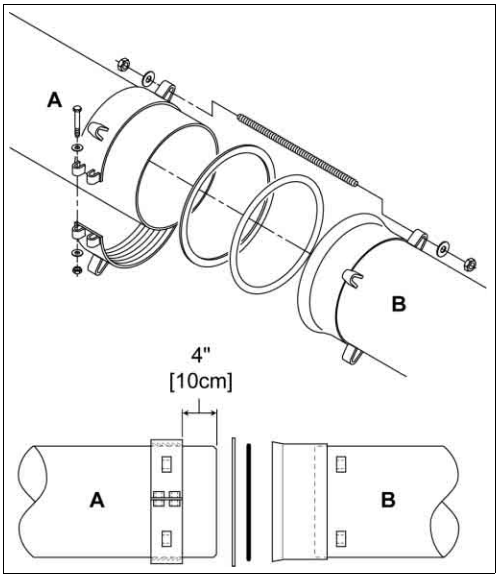
- Install the air filter with manometer next to the auxiliary panel.
- Connect the air filter to the auxiliary control panel.
- Connect the air filter to the air line.

Refer to section Appendix - Auxiliary control panel pneumatic diagram

- Apply air pressure temporarily in order to adjust the regulator at 40 psi [276 kPa].
- Once adjusted, remove air pressure from the air line to complete installation.

7.4.3 Connecting pipe using anti-slip collar

- Using 4 bolts, install the anti-slip collar over the pipe (A) at 4” [10 cm] from the edge.
- Position the retaining ring and O-ring over the pipe end (A). Make sure it leans on the anti-slip collar.
- Insert pipe end (A) in the component (B). Make sure both collar and component rings are in line.
- Using 8 nuts and 8 washers, install 4 threaded rods to maintain pipes together.
- Tighten rods at the same torque to seal adequately.

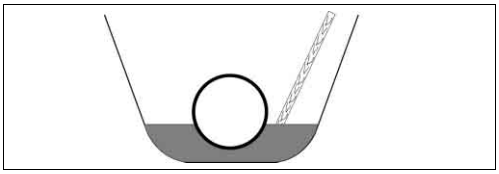


7.4.4 Installation of evacuation line

Preparation

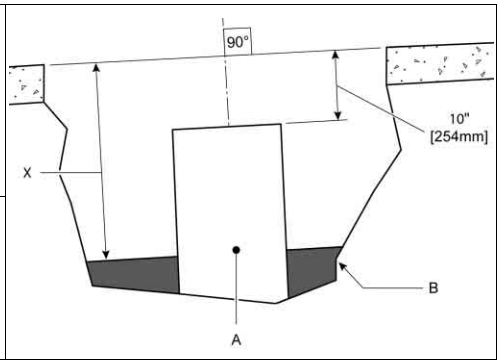
Refer to the Typical installation section and/or installation plan.

- Lay the pipes on 6” [15 cm] of compacted sand.
- Using pipes and components, assemble temporarily the evacuation line. Refer to section above to connect pipe using anti-slip collar.
- Install the vertical pipe (A) so its male end is at 10” [254 mm] below the concrete level. The vertical pipe must be perpendicular to the flushed surface.
- Perform a leak test according to the local regulation.
- Surround pipes with sand and compact it using a piece of wood, as illustrated.

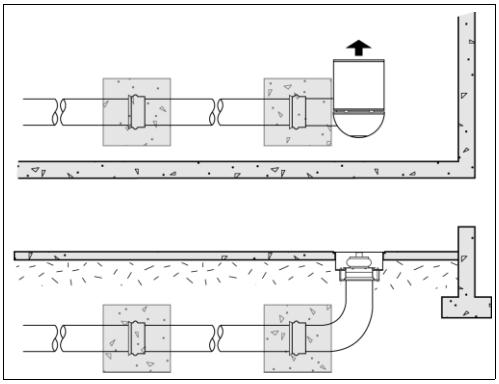


- Depending on Flush valve model, compact a flat bed surface of sand (B) around the vertical pipe at the appropriate dimension (X) below the concrete level. The flat surface of sand must be parallel to the surface to flush.

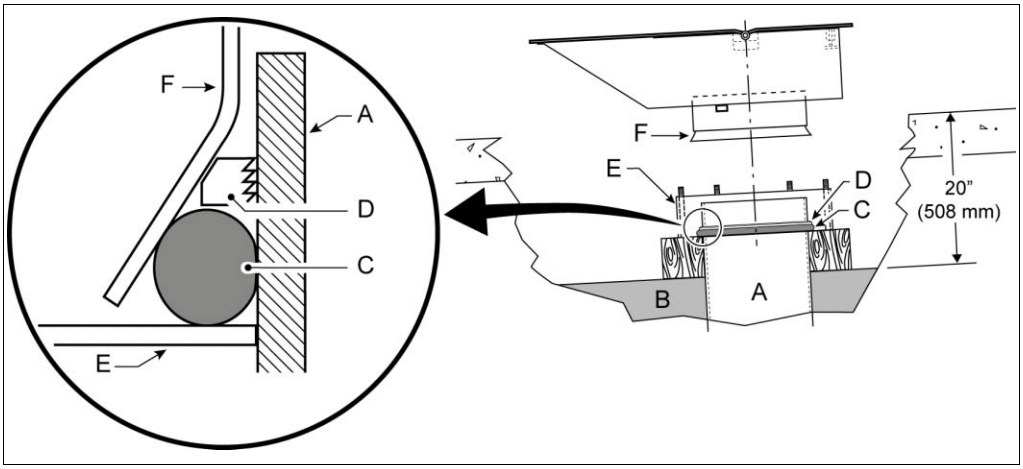
	12” / 315 mm Flush valve	**15” / 355 mm Flush valve**
X	20” [508 mm]	28” [711 mm]



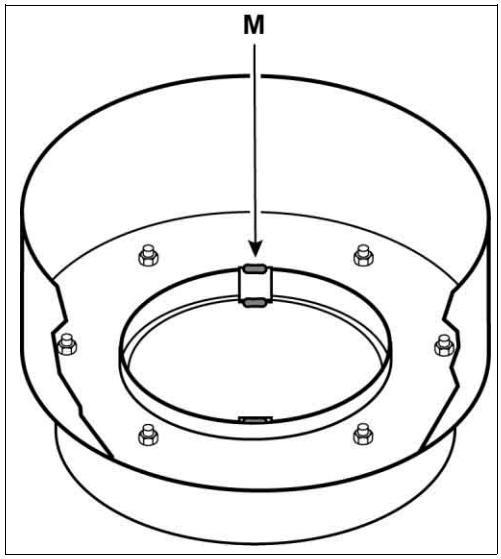
- When using PVC to PVC connection, it is strongly recommended to install concrete thrust blocks around the pipe connections.



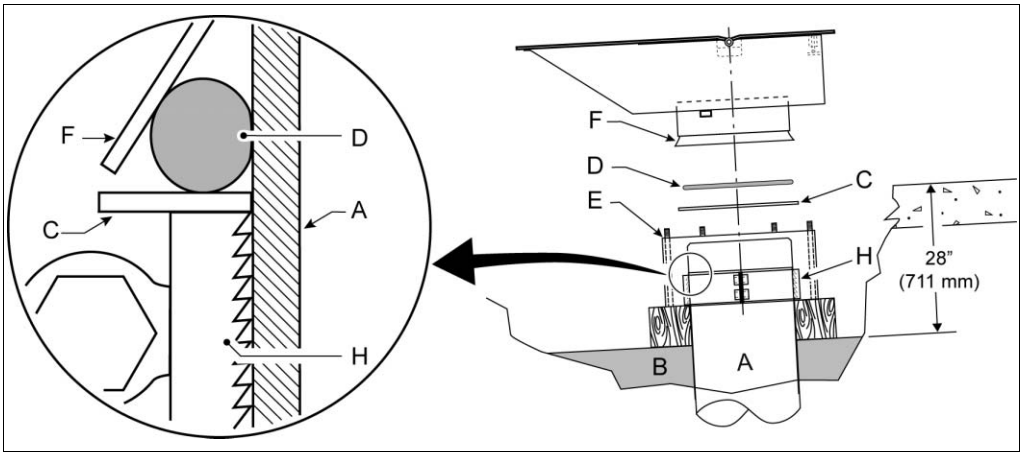
7.4.5 Assembling a 12” / 315mm Flush valve on vertical pipe



- Temporarily set 2 wood blocks of 6" (15 cm) X 6" (15 cm) on both sides of the vertical pipe (A).
- Set the circular bottom half (E) of the Flush valve on the vertical pipe (A).
- Rotate the circular bottom half to align 2 bolts with the direction to flush.
- Install the O-ring (C) around the vertical pipe (A), down to the bottom half of the Flush valve.
- Set the gripper ring (D) down on the O-ring (C) around the vertical pipe (A). Make sure the slanted edge of the gripper ring is facing upward. See Detail.
- Lower the Flush valve housing (F) on its bottom half.
- Remove the wood blocks.
- If 12 ¾" O.D. vertical steel pipe is used instead of a PVC pipe, weld 2 flat bars (M) to attach the main frame of valve to the extremity of line.



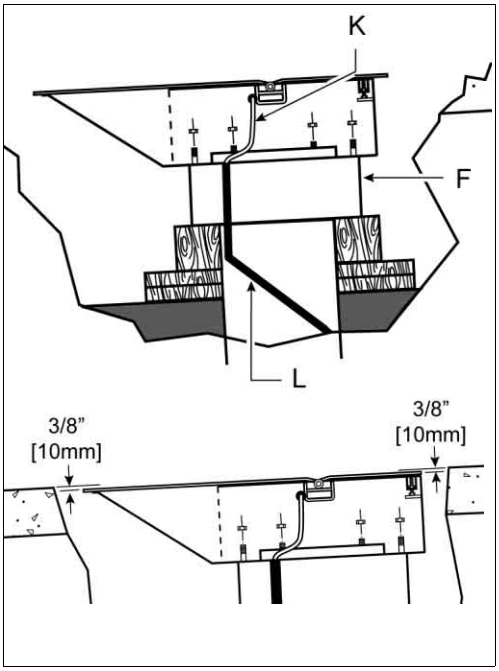
7.4.6 Assembling a 15” / 355mm Flush valve on vertical pipe



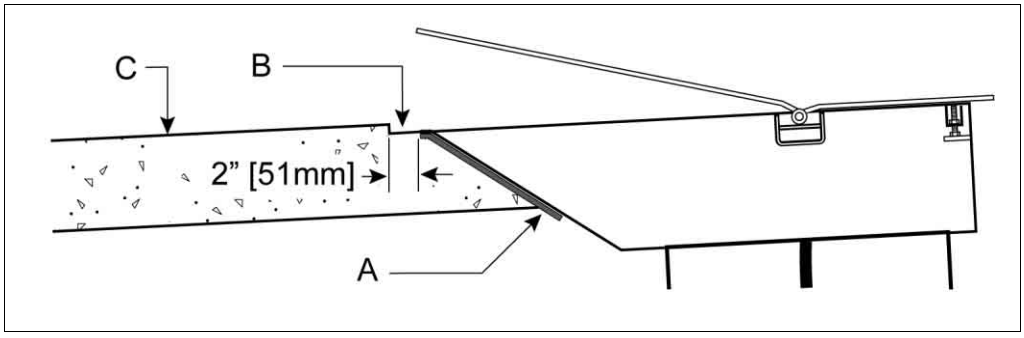
- Set the circular bottom half (E) of the Flush valve on the vertical PVC pipe (A).
- Rotate the circular bottom half to align 2 bolts with the direction to flush.
- Using 4 bolts, install an anti-slip collar (H) on the vertical PVC pipe so the top of collar is set at 14” [355 mm] from the manure alley surface. Make sure the collar teeth are facing upward. See Detail.
- Install the retaining ring (C) and the O-ring (D) around the vertical PVC pipe (A), down against the anti-slip collar (H).
- Tighten anti-slip collar bolts.
- Use wood blocks to shim and support, lift the bottom half of Flush valve against the anti-slip collar.
- Lower the Flush valve housing (F) on its bottom half.
- Remove the wood blocks.

7.4.7 Installing flush valve housing

- Install 6 nuts temporarily inside the Flush valve.
- Position the Flush valve discharge in the appropriate direction.
- Adjust the Flush valve level so the top lid is 3/8” [10 mm] lower than the concrete level before tightening nuts.
- Tighten the 6 nuts inside the Flush valve in a cross pattern. After being tightened, the Flush valve should be in a ¼" [6 mm] recess with reference to the manure alley surface.
- Slide the ⅜" air hose (K) into the conduit (L). Allow approximately 16” [406 mm] of hose inside the flush housing.



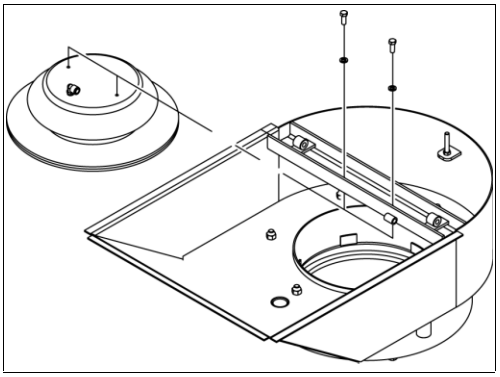
- Remove plugs and blow the air hose to ensure that no sand remains in the line.
- Slide the air hose through the hose holders and connect it to the air balloon.
- Glue some ¼" [6 mm] insulation foam strip (A) all around the Flush valve housing in order to be able to remove it from the concrete.
- Fill the gap around the valve with sand, then pour concrete around the Flush valve. The concrete within 2” [51 mm] around the Flush valve must be leveled with the edge of housing for the lids to be seated flush with the manure alley.



Legend:			
A	Foam strip	B	Recess
C	Concrete floor		

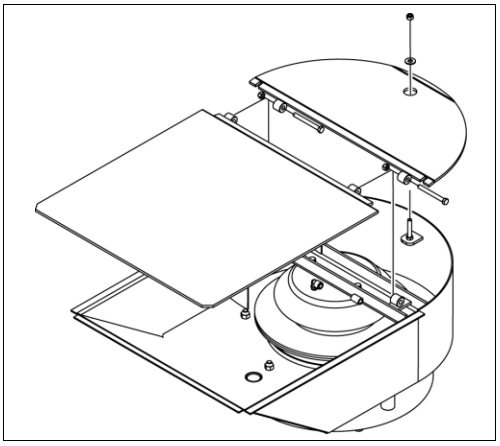
7.4.8 Air balloon assembly

- Install the air balloon using provided hardware, as illustrated hereafter.



7.4.9 Lids assembly

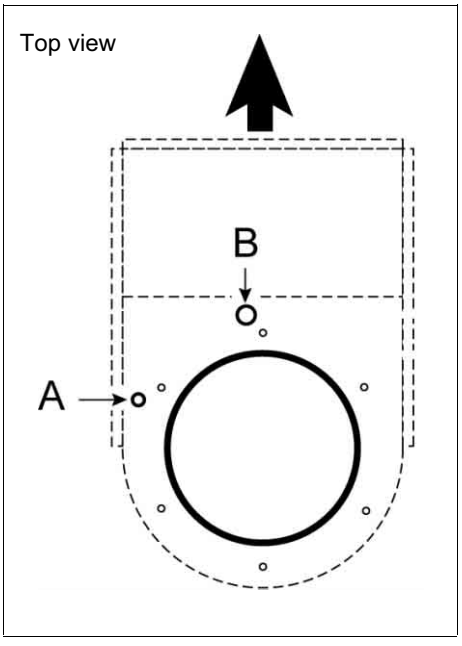
- Install the rear lid and the front lid using provided hardware, as illustrated hereafter.



7.4.10 Installing drain and air hose

Note!
When installing air hoses, plug both ends of air hose to ensure no sand enters the line.

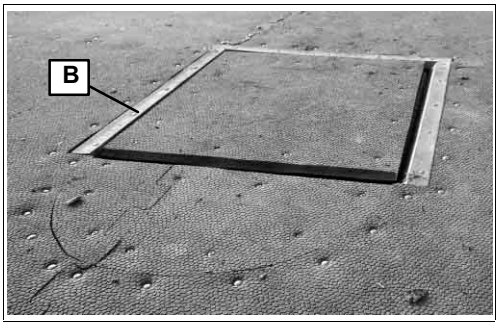
- If the Flush valve has to be drained to prevent freezing, install a drain pipe under the Flush valve drain hole (B). If no drain pipe is installed, make sure the drain is plugged.
- Air is supplied to the Flush valve by a ⅜" PVC air hose coming from the auxiliary control panel. Length of line between panel and valve must not exceed 100' [30 m].
- Under the concrete, the air hose must be protected by a 1 1/2” [4 cm] rigid conduit (L). Use only 45° elbows for bends to ensure the air line easily slides inside the conduit. Use the Flush valve opening (A) to insert hose into main frame.

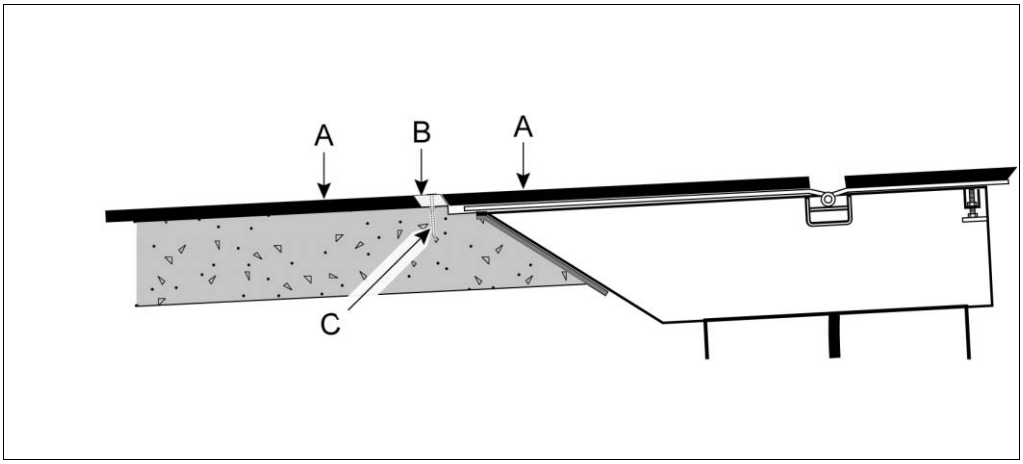


- Install rigid conduits connecting to Flush valves. The top of the rigid conduit must be set at 8" [20 cm] under the concrete level in order to fit with opening (A).

7.4.11 Rubber mat installation

- Use wedge shaped nylon parts (B) to hold rubber mats (A).
- Use concrete nails (C) to fix the nylon parts (B) to the concrete.





8 Initial commissioning

8.1 Special personnel qualification required for initial commissioning

Initial commissioning must be performed by trained personnel in accordance with the safety instructions.

Read the section Safety - Personnel qualifications.

8.2 Safety instructions for initial commissioning

Warning!
Do not start this product until the initial commissioning checklist is completed.

The first start steps intend to test the product in order to validate its functionality and efficiency before handing it over to the customer. Therefore, the dealer along with the customer must operate the product as well as the operating elements.

8.3 Initial commissioning checklist

This checklist must be completed by the dealer and the customer to validate that the product is assembled and/or installed according to the manufacturer's instructions and that it is safe for use.

Note!
Additional information necessary to complete the checklist can be found in this instruction manual.

General	DONE	N/A
The owner received the instruction manual from the dealer and commits to read it.		
The owner is instructed by the dealer on how to operate and maintain the product.		
All bolts are torqued.		
All electrical connections are secured.		
The main control panel works properly (all functions are operating).		
All pneumatic connections are secured.		
A visual inspection is performed to ensure there are no leaks, signs of distortion or defective parts.		
The equipment/component provided by the owner comply with the specifications contained in section Technical data.		

Note!
The dealer and the owner must fill the warranty registration form when the checklist is completed.

Dealer's signature: _____

Owner's signature: _____

Date: _____

8.4 Checks after initial commissioning

The owner must make sure that:

- there are no damaged, worn, defective parts or signs of distortion;
- there are no leaks;
- all bolts are tight. Refer to section Technical data - Bolt torque chart;
- the product works perfectly;

8.5 Handing over to the owner

Hand over warranty registration form

The warranty registration form must be completed and signed by the customer and the dealer. The warranty registration form must be returned to GEA Farm Technologies Canada Inc. to validate the warranty.

9 Operating

9.1 Special personnel qualification required for operation

Operation must be performed by qualified personnel in accordance with the safety instructions.


Read the section Safety - Personnel qualifications.

9.2 Safety instructions for operation


Read the section Safety.

9.3 Checks before operating

- The product is in perfect condition. There is no visible damage;
- Only authorized personnel are in the working area of the equipment;
- No unnecessary object or material is located in the working area of the equipment.

9.4 Description of the operating elements


Note!
The primary operating element for a flush system is the control (see Control panel operator's manual for details).

The Flush valve may be operated:

- in conjunction with a pump or a flush tank by manually or automatically controlled time settings of the control panel.

10 Troubleshooting

10.1 Special personnel qualification required for troubleshooting

Troubleshooting must be performed by trained personnel in accordance with the safety instructions.


Read the section Safety - Personnel qualifications.

10.2 Safety instructions for troubleshooting


Read the section Safety.

10.3 Troubleshooting possible faults

Symptom	Possible cause	Solution
Flush valve does not flush.	Control panel power supply has been disconnected.	Check all connections and wires.
	Control panel emergency stop switch has been pressed.	Check the protection stop switch and activate if necessary.
	Pump transferring water does not work.	Check the pump and the control panel.
	Evacuation line plugged.	Unplug the line.
	Auxiliary panel air valve defective or incorrectly wired.	Repair.
Flush valve does not close.	Balloon air pressure too low.	Check air supply compressor and air line. Adjust pressure at 40 psi [276 kPa].
	Electrical power shut down.	Check control panel electrical supply.
	Obstruction in the flush valve.	Clear the obstruction.
	Valve gasket is broken.	Replace gasket.
	Air line of Flush valve is broken.	Replace the air line pipe.
	Air line fitting disconnected.	Repair.
	Air balloon is leaking.	Repair.
	Auxiliary panel air valve defective or incorrectly wired.	Repair.
Flush valve does not open.	Auxiliary panel air valve defective or incorrectly wired.	Repair.

11 Maintenance

11.1 Special personnel qualification required for maintenance work

Maintenance work must be performed by trained personnel in accordance with the safety instructions.

Read the section Safety - Personnel qualifications.

11.2 Safety instructions for maintenance

Warning!
Always shut off and lock the power supply before installing, adjusting and servicing the equipment. Make sure the control panel and the electric pump are turned off to prevent injuries.

Warning!
Always remove air pressure from the air line before servicing the equipment.

Read the section Safety.

11.3 Scheduled maintenance responsibilities

11.3.1 GEA Farm Technologies Canada Inc. maintenance schedule

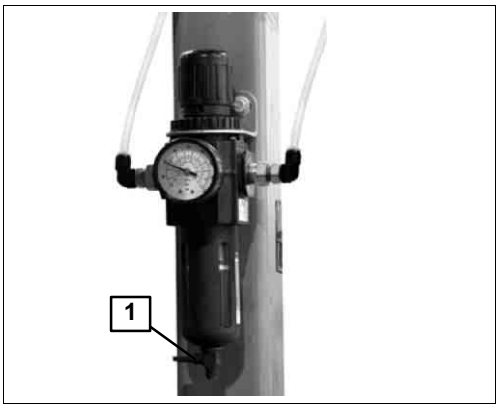
Task	Every 6 months	Once a year	Action by
Bleed air system	X		Trained personnel
Tighten any loose connections		X	

Attention!
When operating this GEA product using other manufacturer's components and/or products such as a PTO, a tractor, a motor, a pump, etc., ALWAYS perform maintenance of the component and/or product as recommended by its manufacturer.

11.4 Bleed air system

Every 6 months

- Open the drain (1).
- Let the drain open until the air/liquid came out.
- Close the drain (1).



11.5 Tighten any loose connections

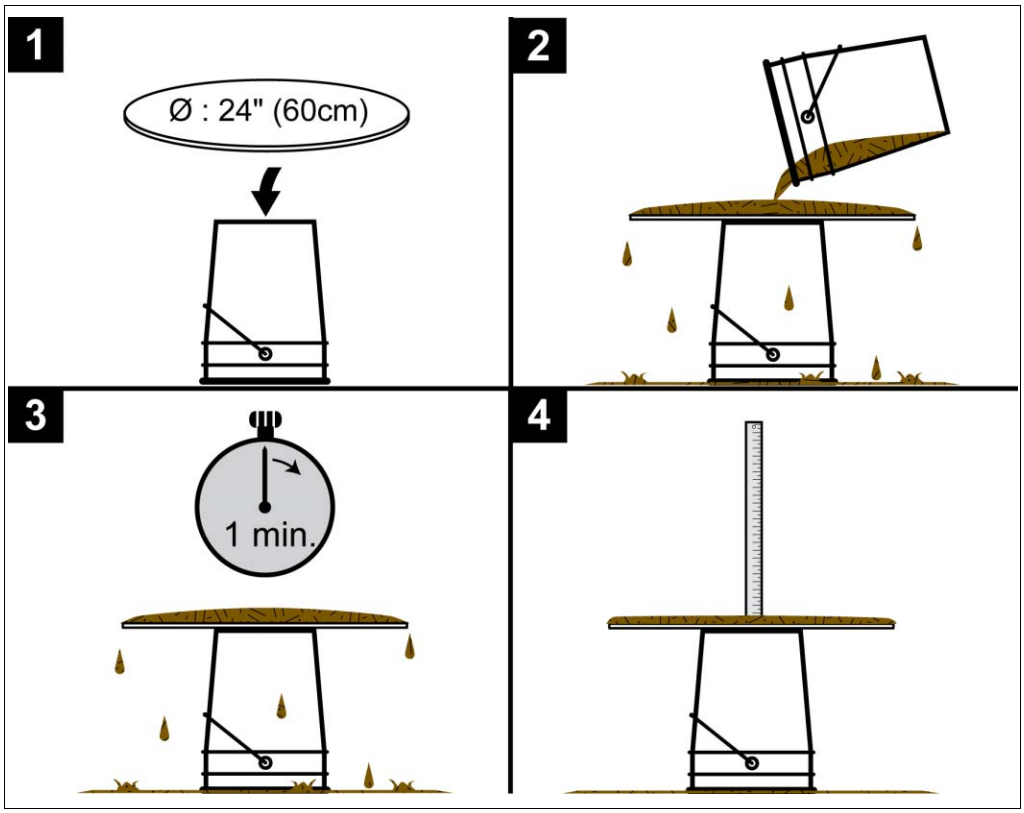
Once a year

- Check for any loose connections in the control panel. Tighten if needed.

12 Appendix

12.1 Consistency test

GEA determined the following method to verify if the viscosity of the liquid manure is suitable for this product.



1. Set a pail on a level surface and install a 24” [60cm] round plate at the center of the pail.
2. Fill a second pail with homogenized liquid manure and slowly pour it in the center of the plate until it overflows all around the plate. Remain close to the plate when pouring the liquid manure.
3. Wait for one minute.
4. Measure the thickness of the liquid manure at the center of the plate.

12.2 Flush cycle calculation

☞ **Note!**
Specifications given below have been calculated when using an Alley Flush valve. When using the Holding area Flush valve model, it will be necessary to evaluate the volume as per the holding area dimensions.

- When using a flush tank, the flush cycle must be calculated to supply the amount of liquid required to flush all alleys by gravity.
- When using a high flow rate pump, the flush cycle must be calculated to supply the amount of liquid required to flush one manure alley at a time. Depending on the size of the barn, several manure alleys could have to be flushed subsequently without turning the pump off during the transition from one flush valve to another. The pump is turned off only when the last alley has been flushed.

☞ **Note!**
One flush cycle equals to the volume of liquid required to flush a given number of alleys.

Quantity of liquid needed to flush 1 alley

- The specifications below are for a 1% sloped alley that is flushed 4 times a day as per flush basis.
- For a slope other than 1%, check with your dealer.
- Use of sand for bedding can increase up to 50% the quantity of liquid needed to flush.

Quantity of liquid per flush in relation with alley dimensions

The volume of water in US gallon and liter (indicated below) is given for flush liquid that is relatively clean.

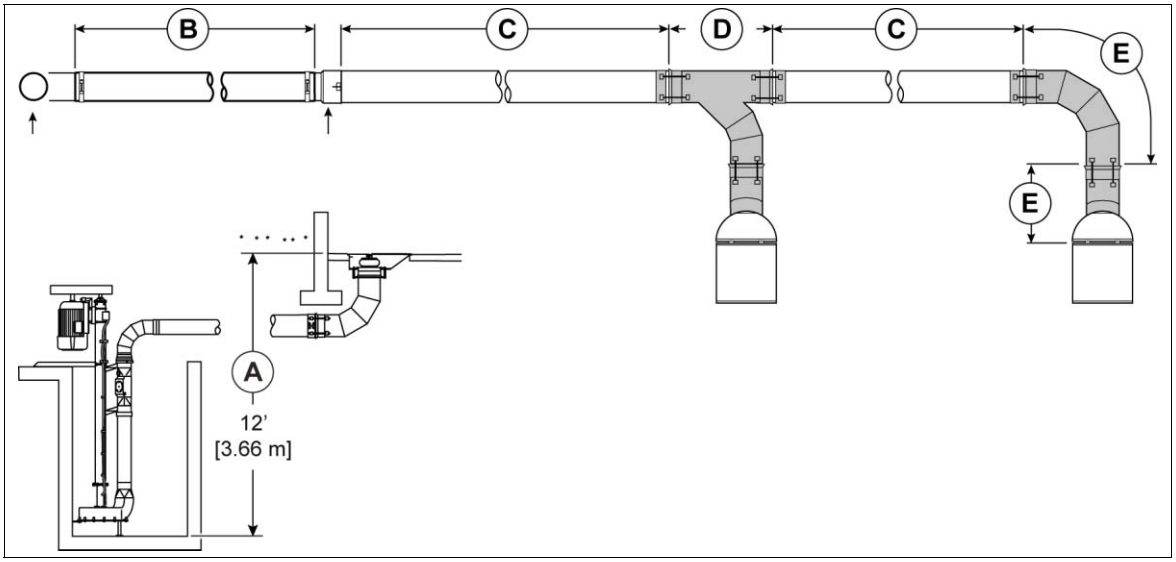
	Width of alley								
Length	**8' [2.3 m]**	**9' [2.6 m]**	**10' [3 m]**	**11' [3.3 m]**	**12' [3.6 m]**	**13' [4 m]**	**14' [4.3 m]**	**15' [4.6 m]**	**16' [5 m]**
100' [30 m]	1 419 [5 372 l]	1 597 [6 046 l]	1 774 [6 716 l]	1 952 [7 390 l]	2 129 [8 060 l]	2 306 [8 731 l]	2 484 [9 404 l]	2 661 [10 075 l]	2 839 [10 748 l]
200' [60 m]	2 743 [10 385 l]	3 086 [11 684 l]	3 429 [12 982 l]	3 771 [14 277 l]	4 114 [15 576 l]	4 457 [16 874 l]	4 800 [18 173 l]	5 143 [19 471 l]	5 486 [20 770 l]
300' [90 m]	3 971 [15 034 l]	4 467 [16 912 l]	4 963 [18 790 l]	5 460 [20 672 l]	5 956 [22 549 l]	6 452 [24 427 l]	6 949 [26 309 l]	7 445 [28 187 l]	7 941 [30 065 l]
400' [120 m]	5 103 [19 320 l]	5 741 [21 735 l]	6 378 [24 147 l]	7 016 [26 563 l]	7 654 [28 978 l]	8 292 [31 394 l]	8 930 [33 809 l]	9 568 [36 224 l]	10 205 [38 636 l]
500' [150 m]	6 139 [23 242 l]	6 906 [26 146 l]	7 674 [29 054 l]	8 441 [31 958 l]	9 209 [34 865 l]	9 976 [37 769 l]	10 743 [40 673 l]	11 511 [43 581 l]	12 278 [46 485 l]
600' [180 m]	7 080 [26 805 l]	7 965 [30 155 l]	8 849 [33 502 l]	9 734 [36 853 l]	10 619 [40 204 l]	11 504 [43 554 l]	12 389 [46 905 l]	13 274 [50 255 l]	14 159 [53 606 l]
700' [210 m]	7 924 [30 000 l]	8 915 [33 752 l]	9 905 [37 500 l]	10 896 [41 252 l]	11 887 [45 004 l]	12 877 [48 752 l]	13 868 [52 504 l]	14 858 [56 252 l]	15 849 [60 004 l]
800' [240 m]	8 673 [32 836 l]	9 758 [36 944 l]	10 842 [41 048 l]	11 926 [45 152 l]	13 010 [49 256 l]	14 094 [53 360 l]	15 178 [57 464 l]	16 263 [61 572 l]	17 347 [65 676 l]
900' [270 m]	9 327 [35 312 l]	10 493 [39 726 l]	11 658 [44 137 l]	12 824 [48 552 l]	13 990 [52 966 l]	15 156 [57 381 l]	16 322 [61 795 l]	17 488 [66 210 l]	18 653 [70 620 l]
1000' [300 m]	9 884 [37 421 l]	11 120 [42 100 l]	12 355 [46 776 l]	13 591 [51 456 l]	14 826 [56 131 l]	16 062 [60 811 l]	17 297 [65 486 l]	18 533 [70 166 l]	19 769 [74 845 l]
1100' [330 m]	10 346 [39 170 l]	11 639 [44 065 l]	12 933 [48 964 l]	14 226 [53 860 l]	15 519 [58 755 l]	16 812 [63 650 l]	18 106 [68 549 l]	19 399 [73 445 l]	20 692 [78 340 l]
1200' [360 m]	10 712 [40 556 l]	12 051 [45 625 l]	13 390 [50 695 l]	14 729 [55 764 l]	16 068 [60 833 l]	17 407 [65 903 l]	18 746 [70 972 l]	20 085 [76 042 l]	21 424 [81 111 l]
1300' [390 m]	10 982 [41 578 l]	12 355 [46 776 l]	13 728 [51 974 l]	15 101 [57 172 l]	16 474 [62 371 l]	17 846 [67 565 l]	19 219 [72 763 l]	20 592 [77 961 l]	21 965 [83 159 l]
1400' [420 m]	11 157 [42 240 l]	12 552 [47 522 l]	13 946 [52 800 l]	15 341 [58 081 l]	16 735 [63 359 l]	18 130 [68 640 l]	19 525 [73 922 l]	20 919 [79 199 l]	22 314 [84 481 l]
1500' [450 m]	11 236 [42 539 l]	12 640 [47 855 l]	14 045 [53 174 l]	15 449 [58 490 l]	16 854 [63 809 l]	18 258 [69 125 l]	19 663 [74 444 l]	21 067 [79 760 l]	22 471 [85 075 l]

12.3 Pumping head calculation

Transfer lines can be of different type and diameter. Total pumping head of the line has to be calculated in 7 steps:

1. Determine the wanted Transfer rate of the transfer line;
2. Measure the difference in Elevation;
3. Perform the Consistency test;
4. Sketch the transfer line with all lengths, diameters, elbows, valves, adapters, elevation and type (refer to section Appendix - Piping length as per pipe diameter);
5. Add the length of pipes of same type and components of same diameter;
6. Multiply the total length of each section by its corresponding friction loss coefficient (refer to section Appendix - Friction loss coefficient for PVC pipes or Friction loss coefficient for flexible hoses and steel pipes);
7. Add each pumping head section and compare the result with the maximum pumping head allowed for the selected pump.

12.3.1 Total Pumping Head Formula



SAE example

	Information					Formula				
	Wanted transfer rate	Consistency	Pipe diameter	Type of pipe or component		Evacuation line total or equivalent length		Friction loss coefficient		Results for each component
A	-	-	-	elevation	→	12'	→	-	=	12'
B	1200 gpm	water	8”	hose	→	10'	**X**	0.0268	=	0.27'
C	1200 gpm	water	12”	PVC pipe	→	240'	**X**	0.0029	=	0.7'
D	1200 gpm	water	12”	"Y" steel	→	48'	**X**	0.0268	=	1.29'
E	1200 gpm	water	12”	90º steel elbow	→	96'	**X**	0.0029	=	0.28'
								Total pumping head of transfer line (Add all components length to obtain the total pumping head)	=	**14.54'**

Metric example

	Information					Formula				
	Wanted transfer rate	Consistency	Pipe diameter	Type of pipe or component		Evacuation line total or equivalent length		Friction loss coefficient		Results for each component
A	-	-	-	elevation	→	3.66 m	→	-	=	3.66 m
B	4540 lpm	water	200mm	hose	→	3.05 m	**X**	0.0268	=	0.08 m
C	4540 lpm	water	300mm	PVC pipe	→	73.15 m	**X**	0.0029	=	0.21. m
D	4540 lpm	water	300mm	"Y" steel	→	14.5 m	**X**	0.0268	=	0.39 m
E	4540 lpm	water	300mm	90º steel elbow	→	29 m	**X**	0.0029	=	0.09 m
								Total pumping head of transfer line (Add all components length to obtain the total pumping head)	=	**4.43 m**

12.3.2 Piping length as per pipe diameter

Components	Pipe diameter													
	SAE							METRIC						
	3”	4”	6”	8”	10”	12”	15”	75mm	100mm	150mm	200mm	250mm	300mm	350mm
45° PVC elbow	9 '	12 '	18 '	24 '	30 '	36 '	45 '	3 m	3,5 m	5,5 m	7,5 m	9 m	11 m	14 m
90° PVC elbow	9 '	32 '	48 '	64 '				7,5 m	10 m	14,5 m	19,5 m			
45° steel elbow *		8 '	12 '	16 '		24 '			2,5 m	3,5 m	5 m		7,5 m	
90° steel elbow *		22 '	32 '	42 '		48 '			7 m	10 m	13 m		14,5 m	
”Y” steel *						48 '							14,5 m	
Valve	8 '		15 '	20 '				2,5 m		4,5 m	6 m			
Flush tank adapter *						48 '							14,5 m	
PVC adapter from 12¾” to 15” diameter						45 '								
PVC adapter from 304,8 mm to 381 mm diameter													14 m	

* For 12” [300 mm] steel components, use the friction loss coefficient for PVC pipes.

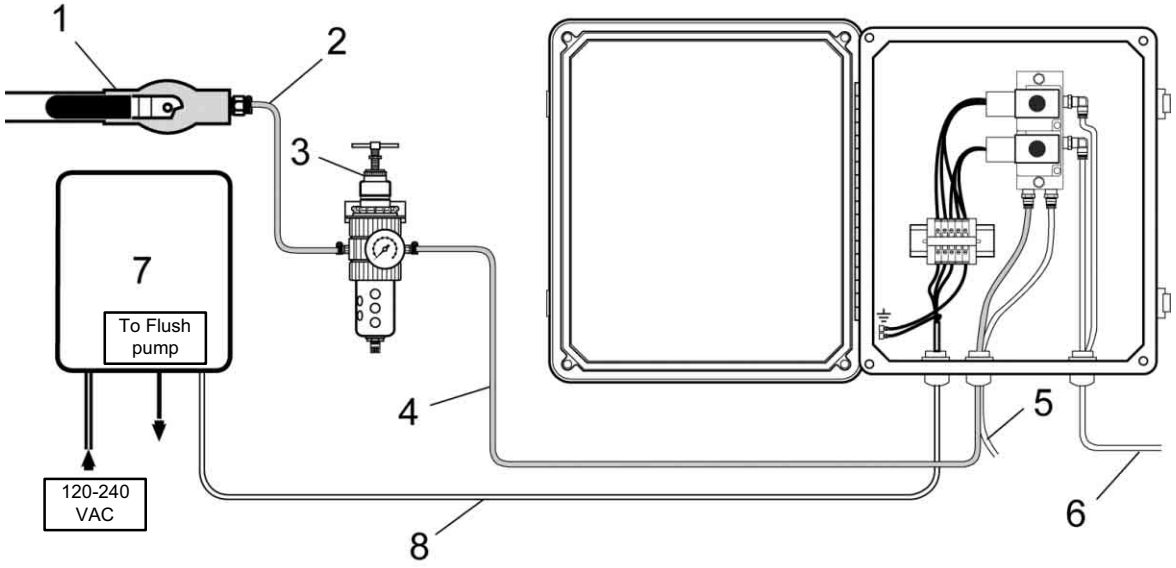
12.3.3 Friction loss coefficient for PVC pipes

Diameter	US Gallons per minute	Liters per minute	Liquid and manure consistency				
			Water	1/8" (3mm)	1/4" (6mm)	1/2" (12mm)	3/4" (18mm)
3" (75mm)	150	570	0.0526	0.0599	0.0710	0.1041	0.1519
	210	800	0.0980	0.1117	0.1323	0.1940	0.2832
	270	1020	0.1560	0.1778	0.2106	0.3088	0.4508
	330	1250	0.2261	0.2577	0.3052	0.4477	0.6534
4" (100mm)	200	760	0.0220	0.0251	0.0297	0.0436	0.0636
	280	1060	0.0410	0.0468	0.0554	0.0813	0.1186
	360	1360	0.0653	0.0745	0.0882	0.1294	0.1888
	440	1670	0.0947	0.1080	0.1278	0.1875	0.2737
	520	1970	0.1290	0.1470	0.1741	0.2554	0.3728
6" (150mm)	400	1510	0.0110	0.0125	0.0148	0.0218	0.0318
	500	1890	0.0166	0.0189	0.0224	0.0329	0.0480
	600	2280	0.0233	0.0265	0.0314	0.0461	0.0673
	700	2650	0.0310	0.0353	0.0418	0.0613	0.0895
8" (200mm)	500	1890	0.0041	0.0047	0.0055	0.0081	0.0118
	700	2650	0.0076	0.0087	0.0103	0.0151	0.0220
	900	3410	0.0121	0.0138	0.0164	0.0240	0.0350
	1100	4160	0.0176	0.0200	0.0237	0.0348	0.0508
10" (250mm)	800	3030	0.0033	0.0037	0.0044	0.0065	0.0095
	1100	4160	0.0059	0.0068	0.0080	0.0117	0.0171
	1400	5300	0.0093	0.0105	0.0125	0.0183	0.0267
	1700	6440	0.0133	0.0151	0.0179	0.0262	0.0383
12" (300mm)	1200	4540	0.0029	0.0033	0.0039	0.0057	0.0083
	1600	6060	0.0049	0.0056	0.0066	0.0096	0.0141
	2000	7570	0.0074	0.0084	0.0099	0.0146	0.0213
	2400	9480	0.0103	0.0118	0.0139	0.0204	0.0298
	2800	10600	0.0137	0.0156	0.0185	0.0272	0.0396
15" (350mm)	1500	5680	0.0015	0.0017	0.0020	0.0029	0.0042
	2000	7570	0.0025	0.0028	0.0033	0.0049	0.0072
	2500	9460	0.0037	0.0043	0.0051	0.0074	0.0108
	3000	11360	0.0053	0.0060	0.0071	0.0104	0.0152

12.3.4 Friction loss coefficient for flexible hoses and steel pipes

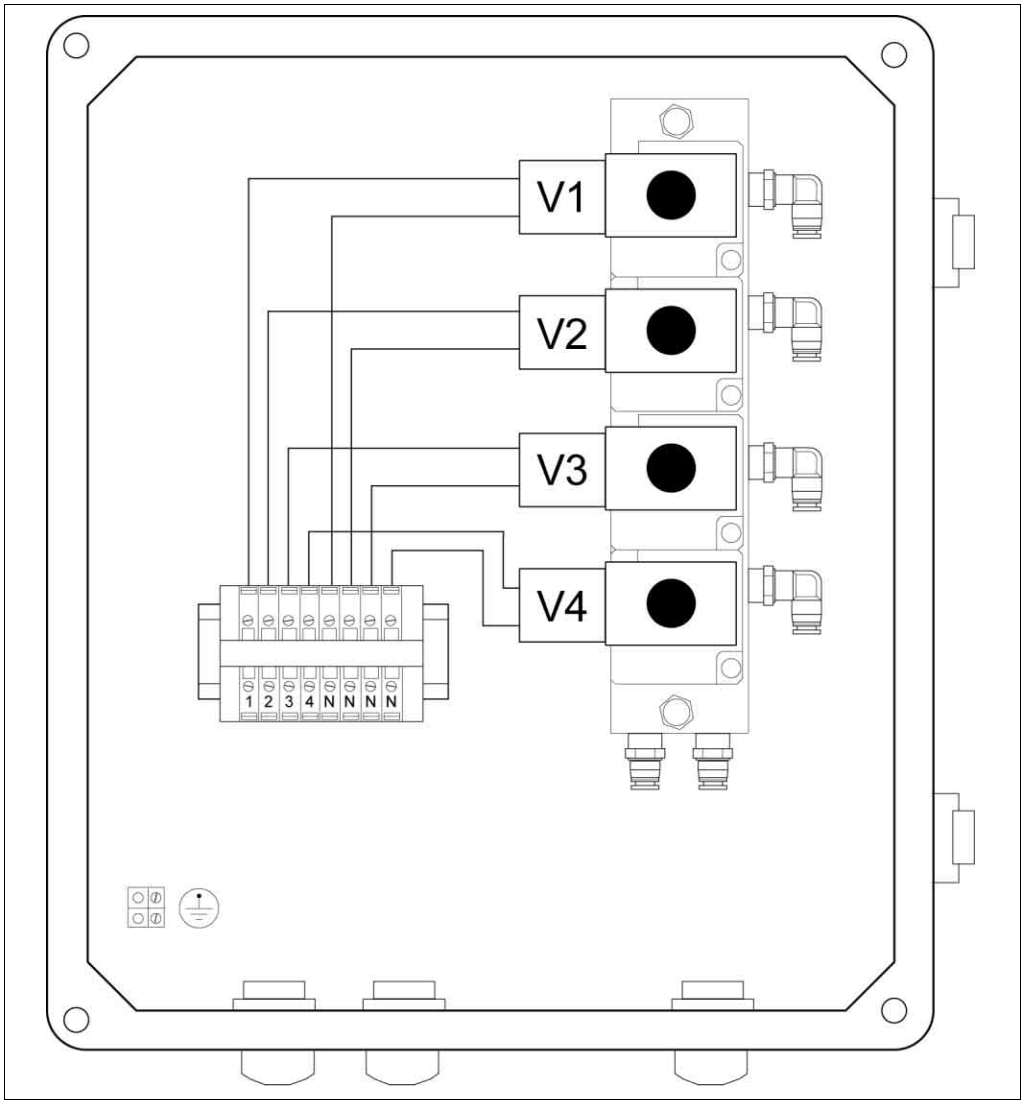
Diameter	US Gallons per minute	Liters per minute	Liquid and manure consistency				
			Water	1/8” (3mm)	1/4” (6mm)	1/2” (12mm)	3/4” (18mm)
3” (75mm)	150	570	0.0682	0.0777	0.0920	0.1350	0.1970
	210	800	0.1271	0.1448	0.1715	0.2516	0.3672
	270	1020	0.2023	0.2306	0.2730	0.4005	0.5845
	330	1250	0.2932	0.3342	0.3958	0.5805	0.8473
4” (100mm)	200	760	0.0286	0.0326	0.0386	0.0565	0.0825
	280	1060	0.0532	0.0607	0.0718	0.1054	0.1538
	360	1360	0.0847	0.0966	0.1144	0.1677	0.2448
	440	1670	0.1228	0.1400	0.1658	0.2431	0.3549
	520	1970	0.1673	0.1907	0.2258	0.3312	0.4834
6” (150mm)	400	1510	0.0143	0.0163	0.0193	0.0282	0.0412
	500	1890	0.0215	0.0246	0.0291	0.0427	0.0623
	600	2280	0.0302	0.0344	0.0408	0.0598	0.0873
	700	2650	0.0402	0.0458	0.0542	0.0795	0.1161
	800	3030	0.0514	0.0586	0.0694	0.1018	0.1486
	900	3410	0.0639	0.0729	0.0863	0.1266	0.1848
	1000	3790	0.0777	0.0886	0.1049	0.1538	0.2245
	1100	4160	0.0927	0.1056	0.1251	0.1835	0.2678
8” (200mm)	600	2280	0.0074	0.0085	0.0100	0.0147	0.0215
	800	3030	0.0126	0.0144	0.0171	0.0250	0.0365
	1000	3790	0.0191	0.0218	0.0258	0.0378	0.0552
	1200	4540	0.0268	0.0305	0.0361	0.0530	0.0774
	1400	5300	0.0356	0.0406	0.0481	0.0705	0.1029
	1600	6060	0.0456	0.0520	0.0616	0.0903	0.1318
	1800	6810	0.0567	0.0646	0.0765	0.1123	0.1638
	2000	7570	0.0689	0.0785	0.0930	0.1364	0.1991
	2200	8330	0.0822	0.0937	0.1109	0.1627	0.2375
	2400	9480	0.0965	0.1100	0.1303	0.1911	0.2790
	2600	9840	0.1119	0.1276	0.1511	0.2216	0.3235
	2800	10600	0.1284	0.1464	0.1733	0.2542	0.3710
	3000	11360	0.1459	0.1663	0.1969	0.2888	0.4215

12.4 Auxiliary control panel pneumatic diagram



Legend:			
1	Ball valve	2	3/8” [10 mm] O.D. quick connect hose (30' [9.14m] maximum)
3	Air filter with manometer (40 PSI[2.75 bar] maximum)	4	3/8” [10 mm] O.D. quick connect hose (4' [1.22m] maximum)
5	Exhaust	6	3/8” [10 mm] O.D. quick connect hose (100' [30.5m] maximum)
7	Main control panel	8	24 VAC (Wire #14)

12.5 Auxiliary control panel electrical diagram



Legend:			
1	Solenoid valve #1 terminal	2	Solenoid valve #2 terminal
3	Solenoid valve #3 terminal	4	Solenoid valve #4 terminal
N	Neutral	V1	Valve #1
V2	Valve #2	V3	Valve #3
V4	Valve #4		

12.6 Abbreviations

Terms	Explanation	Terms	Explanation
Ø	diameter	CW	clockwise
CCW	counterclockwise	I.D.	inside diameter
NC	national coarse	O.D.	outside diameter
PTO	power take off	PVC	polyvinyl chloride
SAE	Society of Automotive Engineers		

Units	Explanation	Units	Explanation
A	ampere	kg	kilogram
AC	alternative current	kPa	kilopascal
cm	centimeter	kW	kilowatt
°	degree	km/h	kilometres per hour
°C	degree Celsius	lpm	liter per minute
°F	degree Fahrenheit	lb	pound
DC	direct current	m	meter
ft	foot	min	minute
ft-lb	foot-pound	mph	miles per hour
gal	gallon	mm	millimeter
gpm	gallons per minute	NM	newton meter
HP	horsepower	psi	pounds per square inch
hr	hour	RPM	revolutions per minute
Hz	hertz	s	second
in.	inch	v	volt

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2019-9015-008 09-2015

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