PURPOSE

The **PISTA**® Grit Removal System is a complete grit removal system that includes the **PISTA**® Grit Chamber, the **PISTA**® **TURBO™** Grit Pump, the **PISTA**® Grit Concentrator, and the **PISTA**® **TURBO™** Grit Washer (or the **PISTA**® Grit Screw Conveyor). Each component has been specifically designed for the capture, washing and dewatering of fine grit.

The **PISTA**® Grit Chamber solves grit removal problems whether it is sewage, water, or an industrial liquid flow application. It removes grit from an incoming water or wastewater stream. It is designed to remove grit in its standard configuration down to 0.105 mm or 105 microns in size (140 mesh). The **PISTA**® Grit Chamber also does an excellent job separating organics from the grit. Ideally, the upper magnitude for the grit would be approximately 2.0 mm or 2,000 microns (10 mesh). Larger sizes would be collected as long as the specific gravity is around 2.5 or greater. Organics are kept in suspension in the waste by means of the density difference. Where other grit removal devices are sensitive to flow variations, the **PISTA**® Grit Chamber's velocities at the middle of the unit, where organics are separated from the grit, are maintained near an optimum design value at all flows.

Organics are kept in suspension because of their lighter density or specific gravity. The grit and any organics that are captured in the **PISTA**® Grit Chamber are moved along the flat bottom of the grit chamber. As they near the center, the particle velocity is increased by a specially designed axial flow propeller and resultant induced spiral flow. The lifting force on the particle attached to the bottom is a function of the cross-sectional area and the velocity squared. The lighter and larger organics are fluidized into the main stream through the **PISTA**® Grit Chamber. Only a small gap is provided between the torque tube and the floor plate to allow the grit to enter the storage hopper while the lighter organics are detached from the flat bottom and drawn upward to the effluent flume.

Because no device is 100% efficient, a small percentage of organics will be trapped with the grit. The second stage **PISTA**® Grit Concentrator, located on the grit discharge line, is designed for ultimate separation of organics. This second stage concentrator returns virtually all organics and most of the excess water to the inlet channel of the **PISTA**® Grit Chamber. Final dewatering may be accomplished by discharging directly into the Smith & Loveless dewatering screw, with parallel plate separator.

POSITION IN THE TREATMENT PROCESS

The nature of the operation of the **PISTA**® Grit Chamber dictates where it should be installed. Our general recommendation is that it should be placed before anything else in the treatment plant except a suitable bar rack to prevent sticks and other foreign objects from entering the **PISTA**® Grit Chamber. Being located ahead of all other equipment in a treatment plant, it will remove the grit which can quickly cause mechanical failure, excessive wear on downstream mechanical devices, or accumulate in basins and channels.

The head loss in the **PISTA**® Grit Chamber (1/4" or 6 mm maximum, except for **PISTA**® **360™** with **V-FORCE BAFFLE™**) is no more than in an open flume. Consult the factory for **PISTA**® **360™** with **V-FORCE BAFFLE™** head loss, as it differs per application. This makes it ideal for installation as an initial phase of a treatment process. It also makes it ideal for the insertion into an already existing flow scheme.

PISTA® Grit Chambers can be installed above ground or below ground. They can be supplied in steel for easy installation and/or attachment to a concrete channel. They can be installed in multiples for added flow and reliability. Their low cost and small space requirement make it possible to protect almost any size plant from the detrimental effects of grit. The low power usage requirements for the **PISTA**® Grit Chamber also make it ideal for any size plant.

The **PISTA**® Grit Chamber can be applied in the municipal or industrial process schemes for pretreatment of raw water or wastewater. Industrially, there are many applications. Independent tests have, for example, proven the Smith & Loveless, Inc. **PISTA**® Grit Chamber to be far superior to other grit removal devices in the handling of fly ash from power generating plants. Smith & Loveless, Inc. has the technical expertise and laboratory facilities to test samples and we are anxious to assist you in utilizing this cost effective separation system.

OPERATION

The **PISTA**® Grit Chamber operates on the vortex principle. The hydraulics force the grit to the chamber floor. The grit is propelled to the floor sufficiently in one revolution of the chamber's contents so as not to be within the influence of the outlet of the chamber. The grit on the bottom, along with other material, is propelled along the bottom towards the center. The flow moves circumferentially and downward to the bottom, across the bottom still moving in a circle, up the middle to the top, across the top still moving in a circle to the outside. As the captured solids move towards the center, they pick up velocity because the area of flow is decreasing. When the solids approach the middle, the propeller increases the velocity to the point where lighter organics are lifted and returned to the flow passing through the **PISTA®** Grit Chamber. The grit moves inward and drops into the center storage hopper.

Each feature of the **PISTA®** Grit Chamber makes an important contribution to the overall performance. Any alteration in dimension or placement can seriously affect the efficiency of grit removal. The **PISTA®** Grit Chamber offers more discrete separation and superior handling of organics. Specific design features surrounding the inlet baffle when used in conjunction with the coanda ramp, upper chamber and other velocity control mechanisms should not be altered.

When sufficient grit is accumulated in the storage hopper, the grit must be removed. Grit removal may be performed manually or automatically.

Manual operation involves only the following steps:

1. Close the discharge plug valve.
2. Turn the switch for the **PISTA® TURBO™** Grit Pump to the "On" position. This will initiate the pump priming cycle. When the vacuum pump stops running the **PISTA® TURBO™** Grit Pump is primed and will start.
3. Open the discharge plug valve and operate the pump until all the grit is removed.
4. Shut off the pump and leave the discharge plug valve open so that the contents of the discharge pipe and pump can drain back into the **PISTA®** Grit Chamber. In cold weather, the discharge valve should be left open to prevent freezing in the closed position.

The manual grit removal operation is now completed.

Automatic operation is as follows:

1. The 24-hour timer, or push to initiate button, initiates the grit removal cycle.
2. When the grit removal cycle is initiated, the pneumatically operated pinch valve on the pump discharge closes.
3. The vacuum pump starts simultaneously with the pneumatic valve operator and draws water up into the pump. The vacuum pump runs until the liquid level reaches the **SONIC START®** sensor.
4. The liquid touches the **SONIC START®** sensor, which signals the control system to close the priming solenoid valve and shut-off the vacuum pump.
5. The **PISTA® TURBO™** Grit Pump starts and the pneumatically operated valve opens. The **PISTA® TURBO™** Grit Pump operates for an adjustable period set for the amount of time for the grit to be removed. This should be set for the early morning period and other such times during the day as may be necessary.
6. When the **PISTA® TURBO™** Grit Pump stops, the valve remains open to allow the contents of the discharge pipe and pump to drain back into the **PISTA®** Grit Chamber.

This completes the automatic grit removal cycle.

The second stage **PISTA®** Grit Concentrator operates on the constant flow principle and is sized to match the discharge from the **PISTA® TURBO™** Grit Pump. The grit is discharged out the bottom, while most of the water and organic material are returned to the inlet of the **PISTA®** Grit Chamber via a return line connected at the top of the second stage concentrator.

The pressure required to effectively operate the second stage concentrator is readily available from the **PISTA® TURBO™** Grit Pump. An airlift device is not adequate for this purpose.

HYDRAULICS

The influent flow, in a typical wastewater treatment system, is subjected to a significant degree of variation during the day and from start-up to design conditions. The Smith & Loveless, Inc. **PISTA®** Grit Chamber should be selected so that the peak design flow rate is within the recommended maximum flow of the unit. An important feature of the **PISTA®** Grit Chamber is that no decrease in efficiency is experienced at flows less than the design rate.

PISTA® Model	Recommended Maximum Flow English	Recommended Maximum Flow Metric
0.5/0.5A/0.5B	0.5 MGD	1,892 CMD
1.0/1.0A/1.0B	1.0 MGD	3,785 CMD
2.5/2.5A/2.5B	2.5 MGD	9,465 CMD
4.0/4.0A/4.0B	4.0 MGD	15,140 CMD
7.0/7.0A/7.0B	7.0 MGD	26,495 CMD
12.0/12.0A/12.0B	12.0 MGD	45,420 CMD
20.0/20.0A/20.0B	20.0 MGD	75,700 CMD
30.0/30.0A/30.0B	30.0 MGD	113,550 CMD
50.0/50.0A/50.0B	50.0 MGD	189,250 CMD
70.0/70.0A/70.0B	70.0 MGD	265,000 CMD
100.0/100.0A/100.0B	100.0 MGD	378,500 CMD

Specific dimensional data dealing with each size **PISTA®** Grit Chamber is provided with the drawings. It is important to adhere to the recommendations in these tables. Liquid levels tabulated are for peak design flow rates. Since the design flow rate is normally not present during the initial installation, the velocity envelope, Figure 1, is provided to assist you in optimizing influent channel velocities. It at all possible, the velocities in the influent channel should fall within these guidelines, when used in conjunction with the influent channel widths given in the tables.

Ideal inlet channel velocities at average flow and acceptable for all flows – 2 to 3 fps (0.6 to 0.9 m/s).
Absolute maximum inlet channel velocity at peak flow – 3.5 fps (1.07 m/s).

Initial minimum inlet channel velocity must exceed – 0.5 fps (0.15 m/s).

Initial peak flows must exceed 2 fps (0.6 m/s) to wash any grit that may have accumulated in the inlet flume at the lower flows into the **PISTA®** Grit Chamber for removal. The **PISTA®** can pass higher flow volumes than the rated peak, however the removal efficiency of the unit may decrease. The use of flow control baffles provides proper velocities over the widest range of flows, and reduces the outlet channel length.

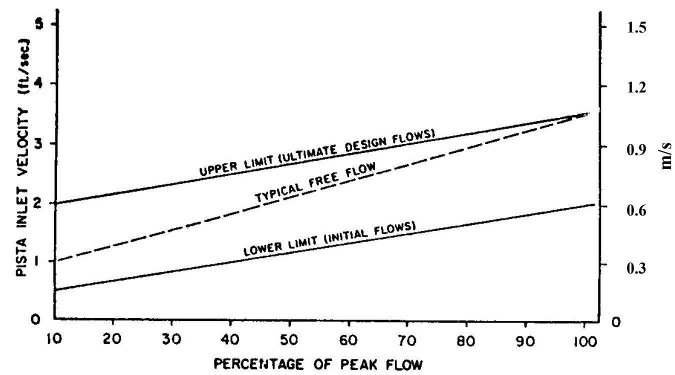


FIGURE 1

2 fps (0.6 m/s) is required to wash any grit that may have accumulated in the inlet flume at the lower flows into the grit chamber for removal.

The entrance flume or pipe into the **PISTA®** Grit Chamber should provide for a smooth laminar type flow with little turbulence. To optimize this, we recommend a straight run into the **PISTA®** Grit Chamber as shown on the drawings. Note this requirement is greatly reduced in the **PISTA® 360™** with **V-FORCE BAFFLE™** and **PISTA® 360™** without baffle.

If at all possible, the entrance to the **PISTA®** Grit Chamber should be exactly as shown on the drawings. Please contact Smith & Loveless for any needed assistance.

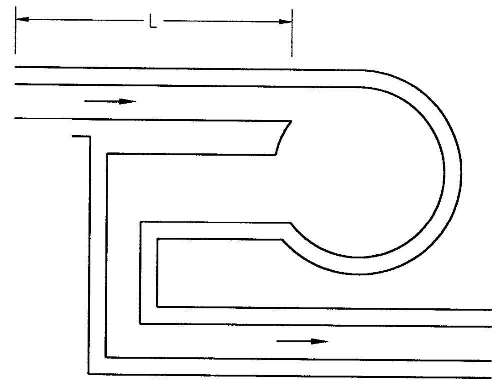
The downstream channel should maintain a constant elevation and be without 90° bends or channel narrowing that is not shown on the drawings. The **PISTA® 270™** unit needs the channel raised and narrowed for flow control. The use of the **V-FORCE BAFFLE™** or the **PISTA® 360™** eliminates the required downstream channel. To maintain proper water velocities in the **PISTA®**, there can be no downstream restrictions that would cause the water levels in the effluent channel to be higher than it would be with a free-flowing flume. We again ask that you contact us if there are any questions, or it is not possible to optimize the installation using these guidelines.

PISTA® GRIT CHAMBER LAYOUT

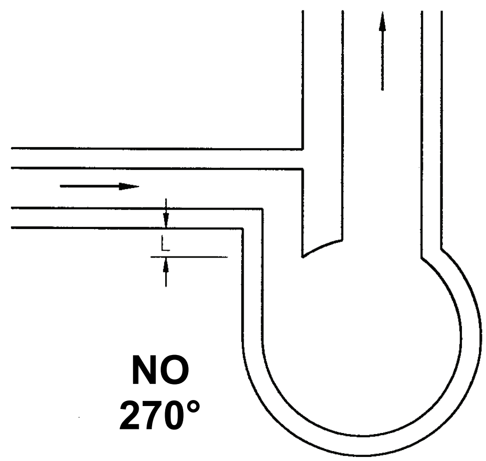
The **PISTA®** Grit Chamber is designed such that the most ideal velocity arrangement is if the downstream channel is a free flowing flume. On certain larger **PISTA® 360™** Model A units, the level is controlled by a submerged weir located in the discharge channel. The downstream side of the weir should be a free flowing flume.

The straight length of influent channel required varies according to the model and type of chamber configuration. The **PISTA® 360™** with **V-FORCE BAFFLE™** and without baffle units have greatly reduced influent channel straight lengths, as shown on the drawings. If obtaining the necessary influent channel length becomes a problem for the **PISTA® 270™**, consider rotating the chamber such that any required bends are placed in the effluent flume, in accordance with the downstream channel limitations.

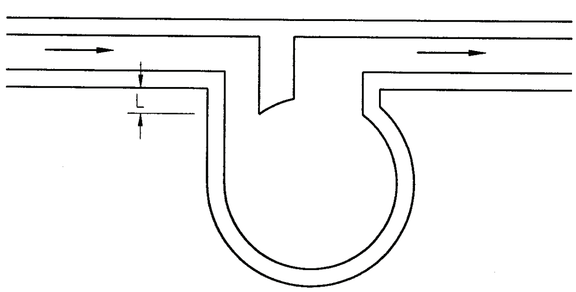
The straight-in arrangement (seen on this page) for **PISTA® 270™** units offer increased length of the influent channel having virtually the same space requirement, and an equivalent number of 90° bends.



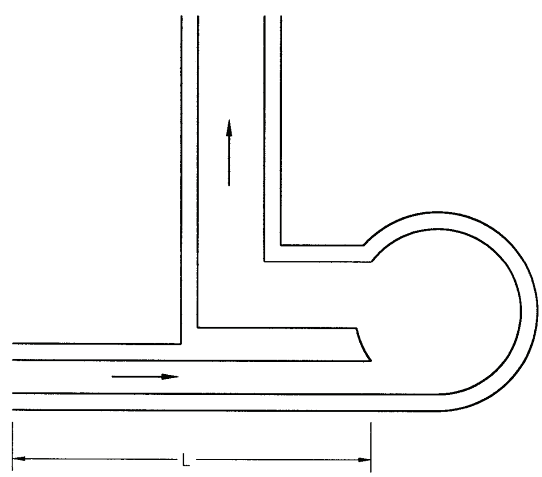
YES
270°



NO
270°



NO
270°



YES
270°

PISTA® TURBO™ GRIT REMOVAL PUMP

The Smith & Loveless, Inc. **PISTA® TURBO™** Grit Pump is mounted directly on top of the flanged center pipe for discharging the grit from the storage hopper of the **PISTA®** Grit Chamber. Remote Mounted arrangements are available, but the Top-Mounted configuration is best. The **PISTA® TURBO™** Grit Pump, when used in conjunction with the **PISTA®** Grit Concentrator, eliminates the necessity for air blowers for lifting and provides the pumping head and capacity necessary for optimizing the efficiency of the second stage **PISTA®** Grit Concentrator. The reduced discharge rate/underflow from the second stage concentrator greatly improves the performance of the final dewatering screw or other device.

PISTA® TURBO™ GRIT PUMP SELECTION

The Smith & Loveless, Inc. **PISTA® TURBO™** Grit Pump is an excellent grit pumping device, and in most cases, will satisfy the need for lifting the grit to the required elevation. Suction lift, of course, should be held to a minimum, placing the **PISTA® TURBO™** Grit Pump directly on top of the **PISTA®** Grit Chamber whenever possible.

The **PISTA® TURBO™** Grit Pump discharge line should be as short as practical and will need to contain a full opening eccentric plug valve as shown on the drawings. The plug valve is required for priming and if automatic grit removal is desired, it will need to be a pneumatically operated pinch valve.

The vacuum priming system should be located adjacent to the **PISTA® TURBO™** Grit Pump. It will normally be provided in a weatherproof enclosure mounted on the drive unit for the **PISTA®** Grit Chamber.

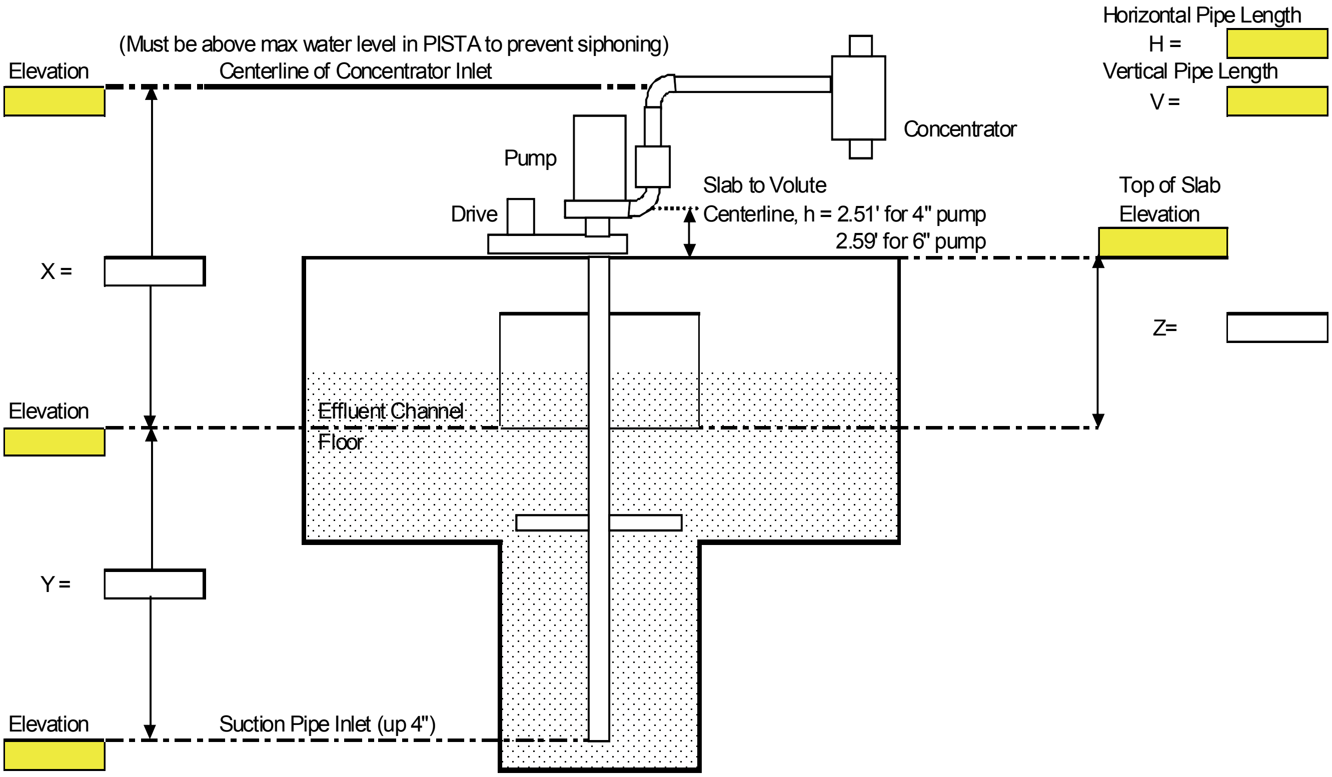
The Top-Mounted vacuum primed **PISTA® TURBO™** Grit Pump should always be employed in conjunction with the Smith & Loveless, Inc. second stage **PISTA®** Grit Concentrator. The optimum rate through the **PISTA®** Grit Concentrator is established by selecting the pump for 250 GPM (15.8 lps) based on the following friction coefficients applicable to Schedule 40 steel pipe. Typically, Models 0.5 to 20.0 will use a four-inch (4”) (100 mm) pump and a 250 GPM (15.8 lps) concentrator. Typically, Models 30.0 and larger will use a six-inch (6”) (150 mm) pump and 500 GPM (31.5 lps) concentrator.

Nominal Pipe Size		Flow		Velocity		Friction Loss	
Inch	mm	GPM	lps	Ft/Sec	m/sec	Ft/100 Ft	m/100 m
4”	100	250	15.8	6.3	1.9	4.6	4.6
6”	150	500	31.5	5.7	1.7	2.4	2.4

When selecting the **PISTA® TURBO™** Grit Pump, the first thing to consider is the allowable static suction lift. Referring to the pump performance rating curves in this section, you will note that the allowable static suction lift varies from 0’ to 20’ (0 to 6.1 m). These static suction lift ratings shown should be reduced one-foot (0.3 m) for each 1000’ (305 m) elevation above mean sea level. They relate to the physical lift as shown on the drawings and the friction loss in the 4” (100 mm) suction pipe need not be considered.

However, to compensate for lifting the grit, it will be necessary to correct the actual elevation difference between the centerline of the pump casing and the low water level in the **PISTA®** Grit Chamber, for the specific gravity of the slurry. See Pages C6 and C7 for Pump Design Calculations.

TOP MOUNTED PISTA® TURBO™ GRIT PUMP CALCULATIONS



Formula Constants Dependent on Design of Plant:

Friction Factor f =	4.6'/100' pipe for 4" grit piping	
	2.4'/100' pipe for 6" grit piping	
Concentrator C =	12' for 250 GPM concentrator	
	28' for 500 GPM concentrator	

To Calculate Equivalent Pipe Length:

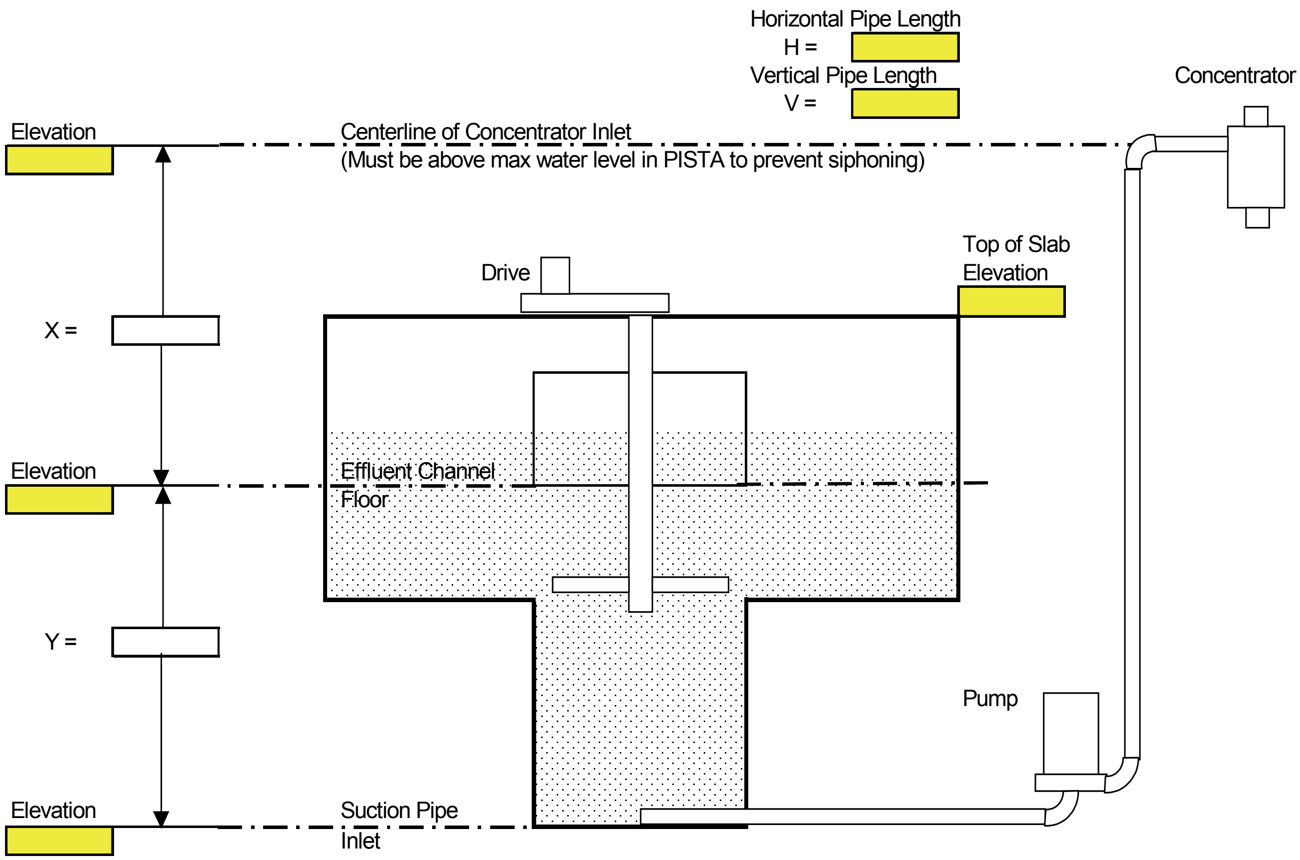
EPL = H + V + (Qty elbow * EPL elbow) =

90 deg elbow	11' for 4" piping
	16' for 6" piping
90 deg long radius	7' for 4" piping
	11' for 6" piping
45 deg elbows	5' for 4" piping
	7.7' for 6" piping

TOTAL DYNAMIC HEAD (TDH)

Static Head A =	(X) (1.4) =	
Static Head B =	(Y) (0.4) =	
Friction Head F =	(EPL) (f) (1.4) =	
Pump P =		2.0
Concentrator C =		
TDH =	**A + B + F + P + C =**	
Suction Lift (MSL) = (Z + h)(1.4) + (Y)(0.4) =		
Pump Pick		
RPM	BHP from curve	
(BHP from curve)(1.4) = HP draw at design		
	Impeller Size	

REMOTE MOUNTED PISTA® TURBO™ GRIT PUMP CALCULATIONS



Formula Constants Dependent on Design of Plant:

Friction Factor f =	4.6'/100' pipe for 4" grit piping
	2.4'/100' pipe for 6" grit piping
Concentrator C =	12' for 250 GPM concentrator
	25' for 500 GPM concentrator

To Calculate Equivalent Pipe Length:

EPL = H + V + (Qty elbow * EPL elbow) =

90 deg elbow	11' for 4" piping
	16' for 6" piping
90 deg long radius	7' for 4" piping
	11' for 6" piping
45 deg elbows	5' for 4" piping
	7.7' for 6" piping

Static Head A =	(X) (1.4) =	
Static Head B =	(Y) (0.4) =	
Friction Head F =	(EPL) (f) (1.4) =	
Pump P =		2.0
Concentrator C =		
TDH =	A + B + F + P + C =	

Pump Pick

RPM   BHP from curve

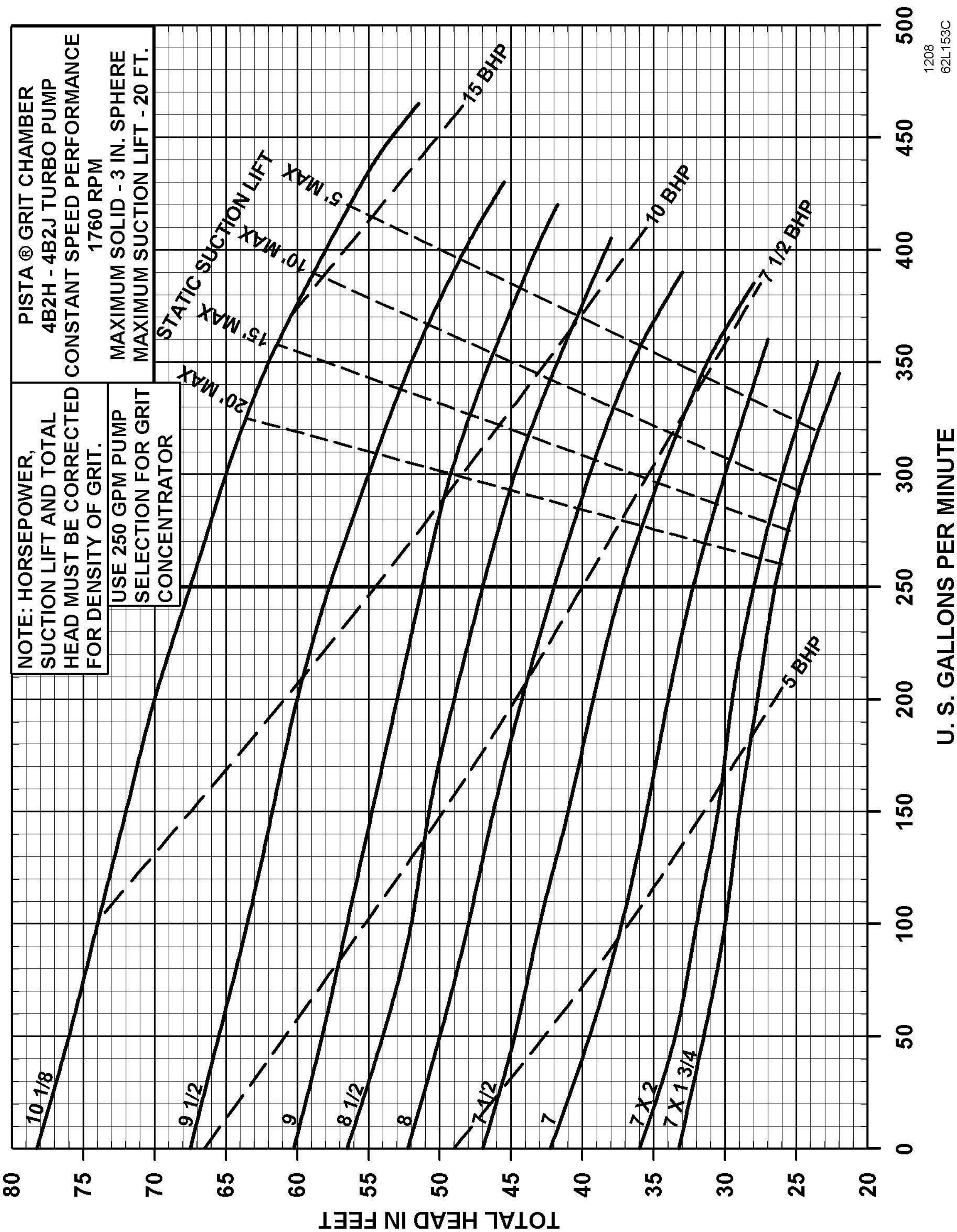
(BHP from curve) (1.4) = HP draw at design

Impeller Size

PISTA GRIT REMOVAL SYSTEM ®

ENGINEERING DATA

Smith & Loveless, Inc.®
14040 Santa Fe Trail Drive
Lenexa, Kansas 66215-1284

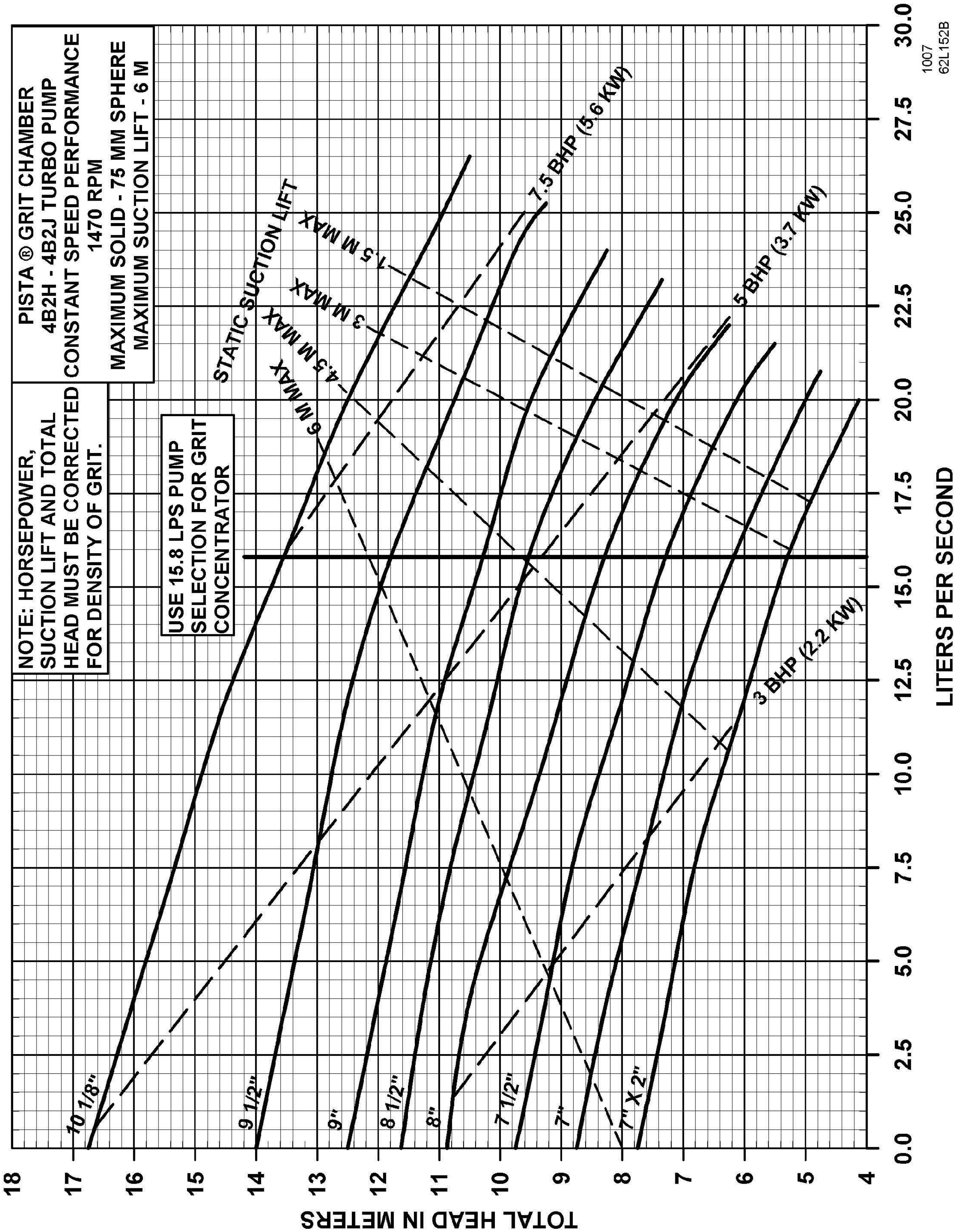


PISTA Grit Removal System ®

ENGINEERING DATA

Smith &
Loveless, Inc.®

14040 Santa Fe Trail Drive
Lenexa, Kansas 66215-1284



PISTA
Grit Removal System ®

ENGINEERING DATA

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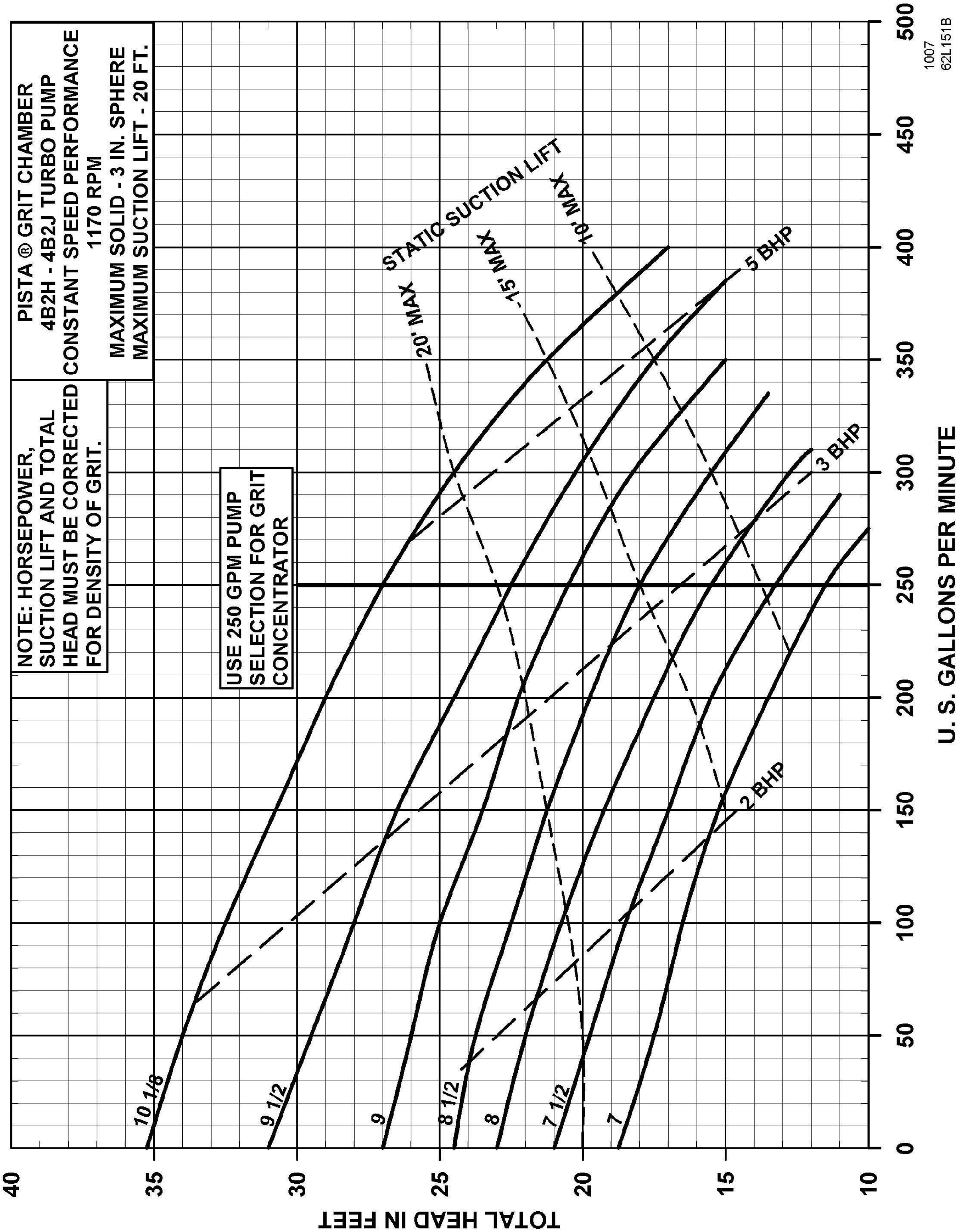

PISTA Grit Removal System ®

ENGINEERING DATA

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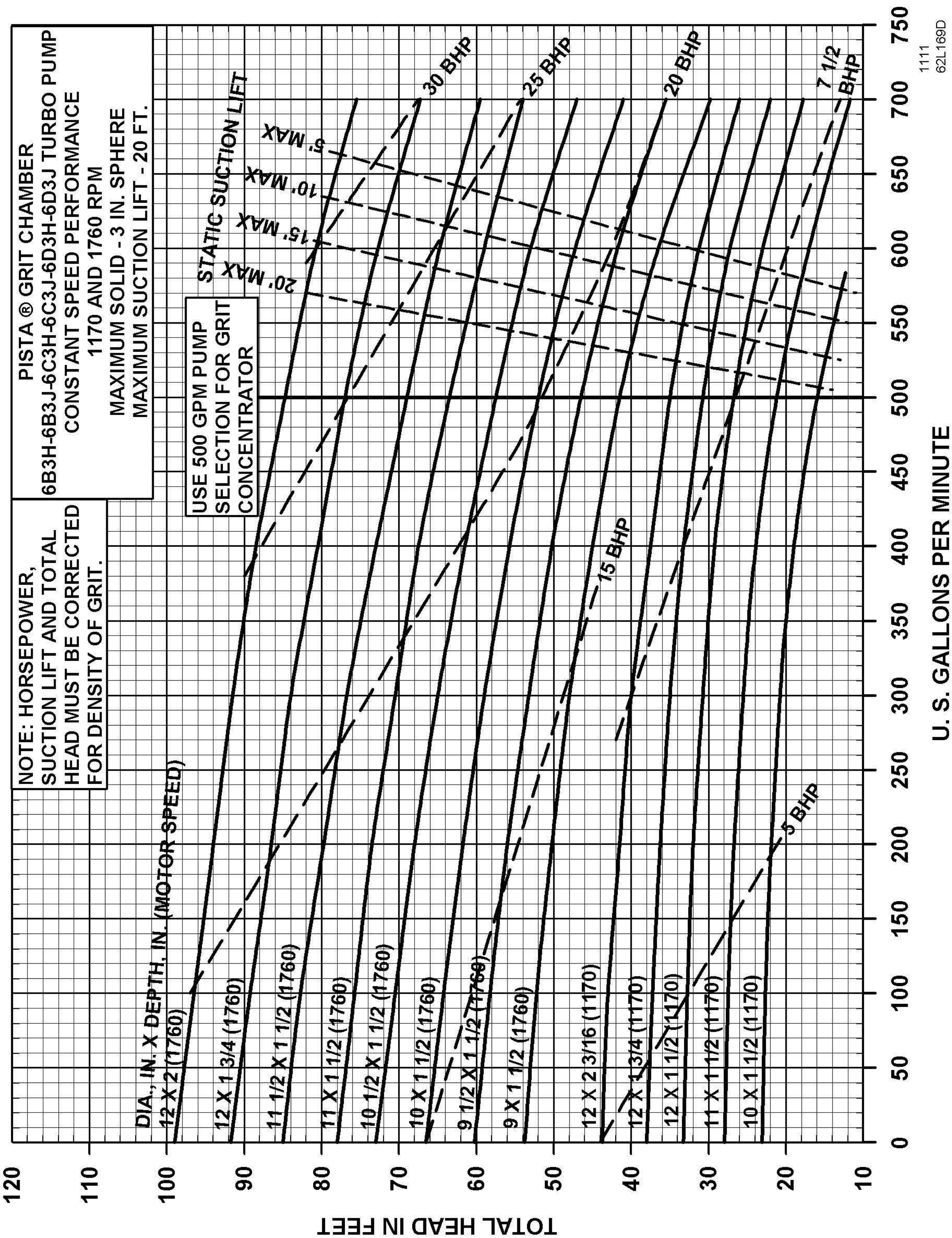

PISTA
GRIT REMOVAL SYSTEM ®

ENGINEERING DATA

Smith &
Loveless, Inc.®

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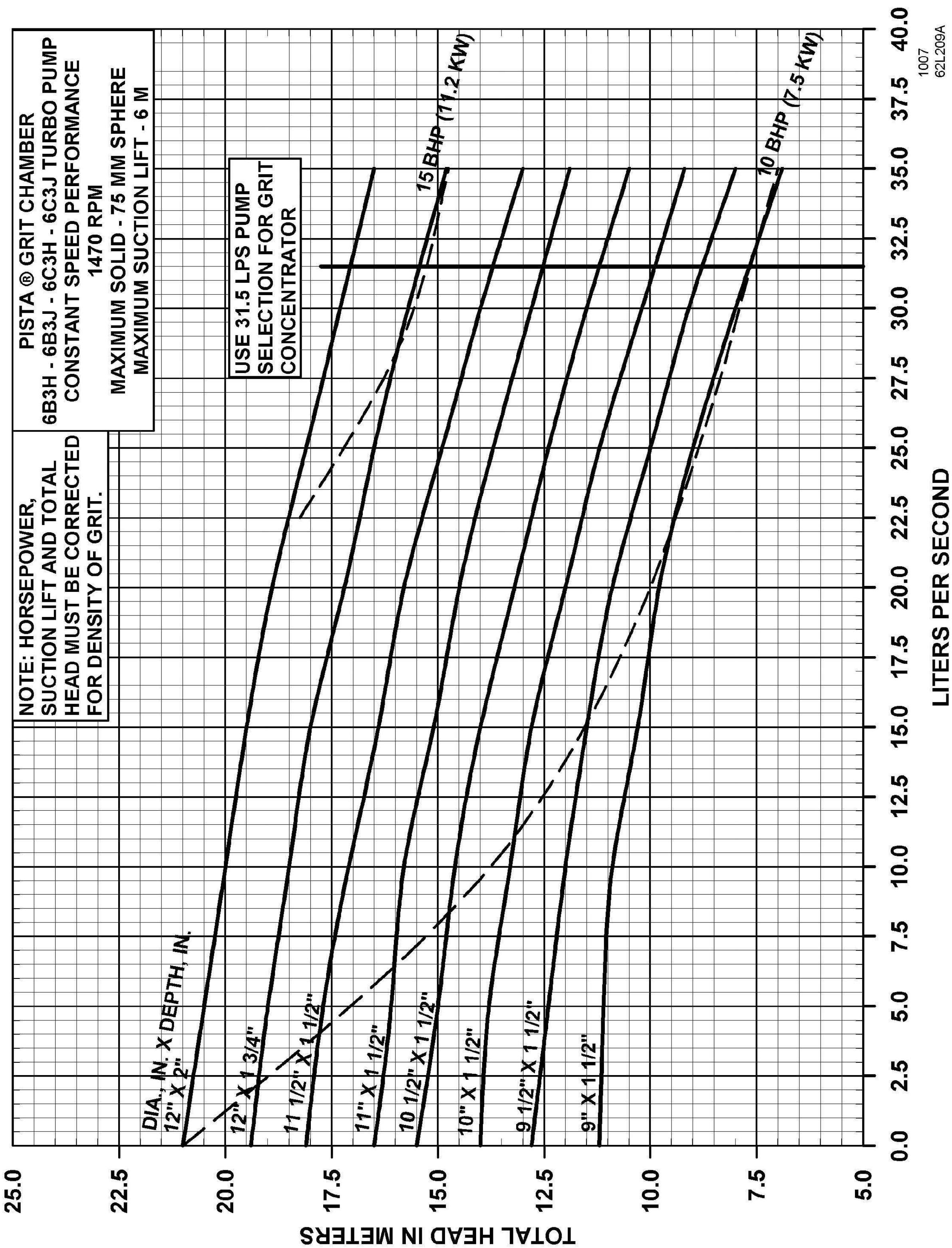
PISTA® Grit Removal System
Notes on Design
62L209
6B3H - 6B3J - 6C3H - 6C3J
1470 RPM
August 2012
Page C12



PISTA
GRIT REMOVAL SYSTEM ®

BAR SCREEN

A suitable bar screen is recommended ahead of the **PISTA®** Grit Chamber to prevent sticks and other foreign objects from entering the unit. This bar screen should preclude material that might cause clogging in the grit storage hopper.

A mechanically cleaned bar screen, ahead of the **PISTA®** Grit Chamber, requires consideration in placement and operation. The mechanically cleaned bar screen that is used continually should be placed so that its flume centerline is in line with the **PISTA®** Grit Chamber influent centerline. A manually cleaned bypass bar screen should be placed to one side when the intent is to use it infrequently during maintenance of the mechanically cleaned screen.

The mechanically cleaned bar screen builds up a dam of debris when it is not operating. This dam traps water and grit, surcharging the influent sewer. When the bar screen starts its cleaning process the dam is immediately removed and a surge of water and grit from the sewer passes through the **PISTA®** Grit Chamber. The solution to this problem is to operate the bar screen often with a timer to prevent a high dam of debris on the screen. The bar screen should not be considered as part of the **PISTA®** Grit Chamber influent channel.

GRIT PUMPING

The location of the second stage **PISTA®** Grit Concentrator should be adjacent to the **PISTA®** Grit Chamber. The grit discharge line from the **PISTA® TURBO™** Grit Pump should be 4” (100 mm) diameter to minimize clogging for 250 GPM (15.81 lps) flow, and 6” (150 mm) for 500 GPM (31.51 lps) flow.

The second stage **PISTA®** Grit Concentrator should always be employed and it is necessary to use the **PISTA® TURBO™** Grit Pump for optimum flow and pressure to this device. The grit discharge line must be run as direct as possible, minimizing the number of bends and elbows.

The length of the grit discharge line should not exceed 50’ (15 m). Consult the factory if more than 50’ (15 m) is required. Arrangement drawings 67C176, 67C177 AND 67C178 depict typical routing of the discharge line for various final dewatering devices. The return line, from the second stage **PISTA®** Grit Concentrator to the **PISTA®** Grit Chamber inlet channel, should be a minimum of 6” (150 mm) diameter.

Airlift type grit removal devices are not recommended, as the **PISTA® TURBO™** Grit Pump and **PISTA®** Grit Concentrator combination provide much cleaner grit and allow for the dewatering unit to do a much better job.

ENVIRONMENTAL CONSIDERATIONS

The grit discharge line will need to contain a 4” (100 mm) or 6” (150 mm) valve as shown on the drawings. When the Top-Mounted **PISTA® TURBO™** Grit Pump is used, this valve may be manually or automatically controlled. Regardless of how employed, when the **PISTA® TURBO™** Grit Pump is used we recommend the valve be left open when the pump is not operating. This keeps the discharge line free from grit and water and prevents freezing. The vacuum line should be heat taped where freezing is a consideration.

The second stage **PISTA®** Grit Concentrator is self-draining and should not be a problem in freezing temperatures. However, since the final dewatering device (**PISTA®** Grit Screw Conveyors, etc.) will set above grade, they will be totally exposed to the environment, and hence, subject to freezing problems encountered in cold climates. Depending on the climate, one well engineered solution may be a heated housing around the entire **PISTA®** unit or location inside a building. Another option for weather and freeze protection is the **PISTA® PRO-PAK™**, a cost-saving alternative to a building. The custom-engineered **PISTA® PRO-PAK™** features a factory-assembled **PISTA®** drive assembly, vacuum priming system and controls mounted to a steel base and housed within a retractable fiberglass enclosure. Please consult the factory for any needed assistance in this area.

A suitable floor drain should be provided in the area of the final dewatering equipment to facilitate runoff and wash down. It is suggested that this drain be sized to handle a maximum flow of 200 GPM (12.61 lps). A hose bib for wash-down is also recommended.

PISTA® GRIT CHAMBER VARIABLE AND FIXED DIMENSIONS

The following dimensions are fixed for each model:

Steel Tank	Models 0.5 – 7.0 *	Models 0.5A – 7.0A **
ID Upper Chamber	A	A
Width of Discharge Flume	B	B
Width of Inlet Flume	C	B
ID Storage Hopper	F	36” or 914 mm

*** Refer to Drawing 67D168.**

**** Refer to Drawing 67D133.**

Concrete Tank	Models 0.5 – 100.0 *	Models 0.5A – 100.0A **	Models 0.5B – 100.0B ***
ID Upper Chamber	A	A	A
Width of Discharge Flume	B	B	B
Width of Inlet Flume	C	B	B
ID Storage Hopper	F	--	--

*** For 4” (100 mm) pump, reference Drawing 67D132 or 67D135.**
For 6” (150 mm) pump, reference Drawing 67B252 or 67B254.

**** For 4” (100 mm) pump, reference Drawing 67D167 or 67D179.**
For 6” (150 mm) pump, reference Drawing 67B246 or 67B248.

***** For 4” (100 mm) pump, reference Drawing 67B310 or 67B315.**
For 6” (150 mm) pump, reference Drawing 67B316 or 67B317.

The upper chamber height and storage hopper depth may be increased, but affect **PISTA® TURBO™** Grit Pump suction lift. See Notes on Design applicable to selection of the **PISTA® TURBO™** Grit Pump.

Dimension L (C – on Models 0.5A – 100.0A and 0.5B – 100B) is a maximum water level at the design peak flow of the unit for a specific downstream condition. This level should not be exceeded, as bridge interference or other problems may occur. The most important thing is to make sure the inlet channel velocities are in accordance with the described requirements.