POLY PROCESSING COMPANY

Providing Solutions Through Innovation

Venting. . .

System Design for Pneumatic Fill!

Rev - January 2006

Table of Contents

Providing Solutions Through Innovation

SAFE-Surge™ Technology

Poly Processing Company

Emergency Air Surge Protection For Polyethylene Storage Tanks

Assumptions:

- Proper design compensates for air surge
- Vent capacity ≥ ACFM at line purge
- Adequate venting mitigates fitting leaks and increases tank life

Critical Issue . . . ACFM!

- Tanker Discharge Hose Size
- Tank Inlet Pipe Size
- Tank Vent Size

Plan for 30 p.s.i. at line purge!

POLYPROCESSING COMPANY

Providing Solutions Through Innovation

Helping Our Customers . . .

- ✓ ***Solve Problems***
  - ***Venting design deficiencies for pneumatic filling***
- ✓ ***Manage Risk***
  - ***ACFM at line purge*** *(AIR CUBIC FEET PER MINUTE)*
- ✓ ***Enhance Your Profits***
  - ***Continuous Operation***

In-Use Customer Values

- ✓ **Increased Safety Margin**
- ✓ **Increased Tank Life**
- ✓ **Peace of Mind**

<table>
<tr><th colspan="9">Venting Requirements For Polyethylene Tanks</th></tr>
<tr><th colspan="9">Pneumatic Fill</th></tr>
<tr><td colspan="3">IF - Vent length ≤ 3 feet</td><td colspan="3">IF - Vent length > 3' and ≤ 30'</td><td colspan="3">IF - Scrubber Application</td></tr>
<tr><td colspan="3" rowspan="2">AND - Vent screen mesh size ≥ 1/4" or no screen used</td><td colspan="3" rowspan="2">AND - 3 or less 90° elbows with no other restrictions or reduction in pipe size</td><td colspan="3">Pipe from vent to scrubber <u>CANNOT</u> be reduced!</td></tr>
<tr><td colspan="3">Centerline of dispersion pipe not to be submersed > 6 inches</td></tr>
<tr><td colspan="3">Emergency Pressure Relief Cover Required</td><td colspan="3">Emergency Pressure Relief Cover Required</td><td colspan="3">Perforated dispersion pipe must be same diameter or larger, as vent. Sum of perforations ≥ cross sectional area of pipe</td></tr>
<tr><td>Discharge Hose Size</td><td>Inlet/Fitting Size</td><td>Minimum Vent Size</td><td>Discharge Hose Size</td><td>Inlet/Fitting Size</td><td>Minimum Vent Size</td><td>Discharge Hose Size</td><td>Inlet/Fitting Size</td><td>Minimum Vent Size</td></tr>
<tr><td>2"</td><td>2"</td><td>4"</td><td>2"</td><td>2"</td><td>6"</td><td>2"</td><td>2"</td><td>6"</td></tr>
<tr><td>3"</td><td>2"</td><td>6"</td><td>3"</td><td>2"</td><td>6"</td><td>3"</td><td>2"</td><td>8"</td></tr>
<tr><td>3"</td><td>3"</td><td>6"</td><td>3"</td><td>3"</td><td>8"</td><td>3"</td><td>3"</td><td>10"</td></tr>
</table>

POLYPROCESSING COMPANY

Providing Solutions Through Innovation

Helping Our Customers . . .

✓ *Solve Problems*

- ***Proper design compensates for pneumatic filling***

✓ *Manage Risk*

- ***Vent capacity ≥ ACFM at line purge***

✓ *Enhance Your Profits*

- ***Continuous Operation***

SAFE-Surge™ Technology

Emergency Air Surge Protection for Polyethylene Chemical Tanks

NEW!

- ✓ **Designed for Pneumatic-Fill**
- ✓ **Adequate ACFM Consideration**
  (air cubic feet per minute)
- ✓ **Increased Tank Life**
- ✓ **Increased Margin of Safety**

Prepare for the Unexpected!

POLYPROCESSING COMPANY

Providing Solutions Through Innovation

www.polyprocessing.com

1-866-590-6845

Distributed By:

Rev. 1/2006

Poly Processing Company commissioned an engineering consulting firm to determine the proper venting requirements necessary for polyethylene storage tanks. Two methods of filling were considered, 1) mechanical pumping and 2) compressed air (pneumatic) from tanker trucks.

Filling by Mechanical Pump

Using mechanical pumps to fill your tank is a low impact process and typically does not cause excessive pressure to be placed upon the tank.

- ≤ 1000 gallons – vent size should equal the size of the largest fill or discharge fitting
- > 1000 gallons - vent size should exceed the largest fill or discharge fitting by one-inch.

Pneumatic Filling

The engineering study reviewed the pneumatic filling of a polyethylene storage tank for three common venting scenarios:

1. Short Vent (u-vent)
2. Long Vent (vented through the roof or into a common venting system)
3. Scrubber Vent (used where fume scrubbing is critical)

The following criteria were established for all three venting scenarios:

1. Maximum pressure used to unload tanker trailer was 30 psig.
2. Evaluate tanker hose impact; 1”, 2” & 3”.
3. Evaluate fill-line/fitting size impact; 1”, 2” & 3”.
4. Polyethylene tank internal pressure must not exceed 10” water column per ASTM D1998 section 1.1.3.

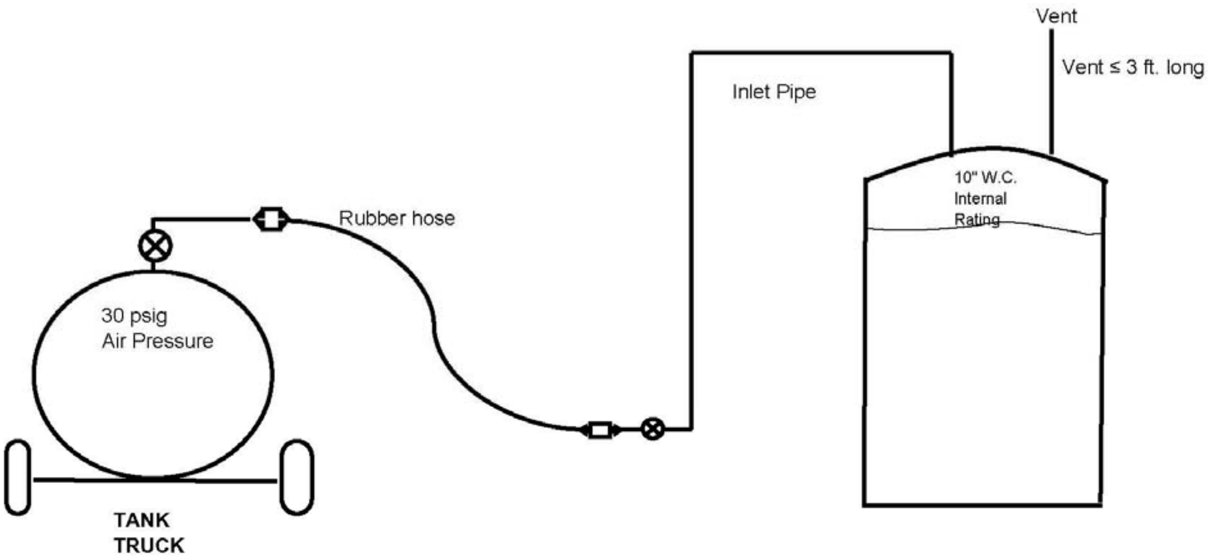
General Conclusions

1. Tanker trailer, once emptied of liquid, becomes large reservoir of compressed air at 30 psig.
2. Size of delivery hose from trailer to tank, 1 to 3 inches in diameter, impacts the volume of air delivered to the tank during line purge.
3. Size of fill line / fitting of the tank, 1 to 3 inches in diameter, impacts the volume of air delivered to the tank during line purge.
4. Vent size 2 inches larger than the fill assembly is sufficient to handle the delivery of the liquid product, but may **not** handle the volume of air released from the tanker trailer based on conclusions #2 and #3.
5. **Venting capacity must equal or exceed Air Cubic Feet per Minute (ACFM) coming from tanker truck for adequate margin of safety and increased tank life!**

Pneumatic Fill Scenario #1

Short Vent

- Vent length ≤ 3'
- Mesh size on bug screen ≥ ¼" or no screen
- Weighted hinged manway not required



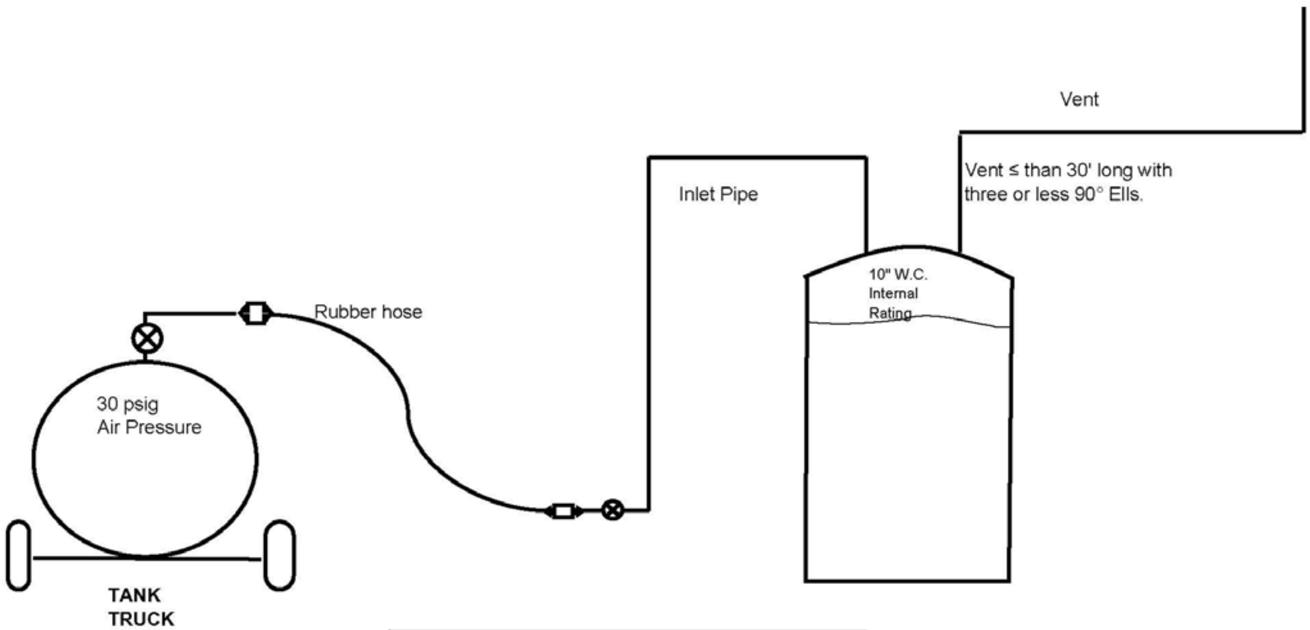
	Tank Vent Requirements				
	Hose	Inlet Pipe	Inlet Flow / ACFM	**Min. Vent Size**	Vent Flow / ACFM
A)	1"	1"	180	**3"**	600
B)	2"	1"	190	**3"**	600
C)	2"	2"	910	**4"**	1050
D)	3"	2"	1120	**6"**	2500
E)	3"	3"	2250	**6"**	2500

ACFM = air cubic feet per minute

Pneumatic Fill Scenario #2

Long Vent

- Vent length > 3’ and ≤ 30’
- Three or less 90° elbows and no other restrictions, i.e. smaller diameter pipe
- Weighted hinged manway not required



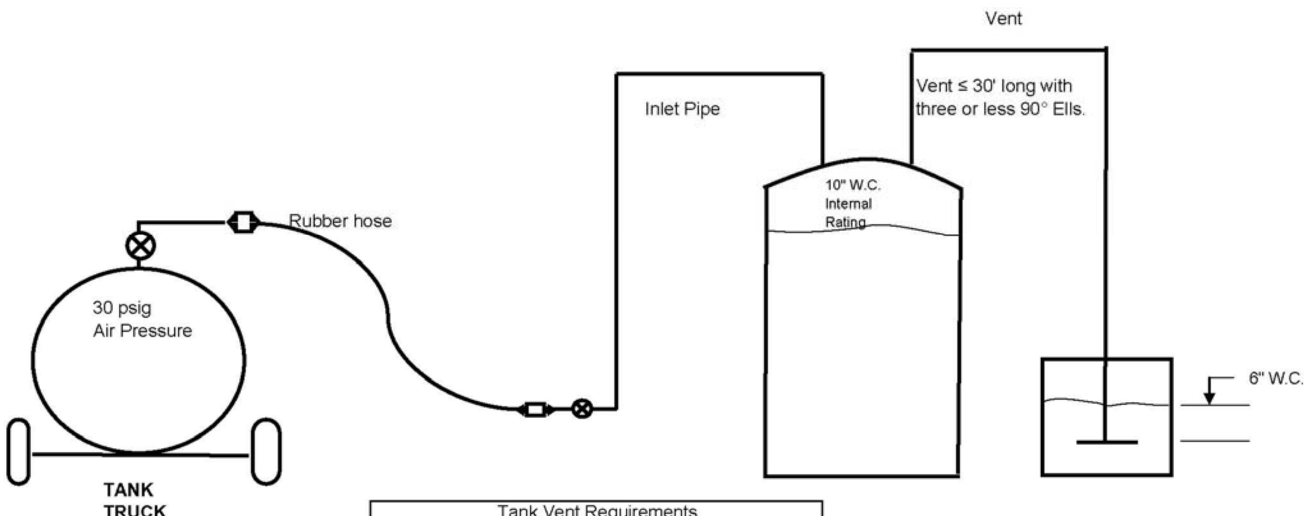
	Tank Vent Requirements				
	Hose	Inlet Pipe	Inlet Flow / ACFM	**Min. Vent Size**	Vent Flow / ACFM
A)	1"	1"	180	**4"**	715
B)	2"	1"	190	**4"**	715
C)	2"	2"	910	**6"**	1870
D)	3"	2"	1120	**6"**	1870
E)	3"	3"	2250	**8"**	3450

ACFM = air cubic feet per minute

Pneumatic Fill Scenario #3

Scrubber Vent

- Piping from vent to scrubber cannot be reduced
- Perforated dispersion pipe must be same diameter, or larger, as vent
- Centerline of dispersion pipe not to be submersed > 6 inches
- Sum of perforations ≥ cross sectional area of pipe



Tank Vent Requirements

	Hose	Inlet Pipe	Inlet Flow / ACFM	**Min. Vent Size**	Vent Flow / ACFM
A)	1"	1"	180	**4"**	380
B)	2"	1"	190	**4"**	380
C)	2"	2"	910	**6"**	970
D)	3"	2"	1120	**8"**	1780
E)	3"	3"	2250	**10"**	2935

ACFM = air cubic feet per minute

HCL UNLOADING STUDY

for

Poly Processing Company

By
R-S-H Engineering

June 14, 2005

An investigation was made into tank venting requirements for a tank being filled from a tank truck. The following data represents the typical case and is the basis for all calculations:

Tank – HD polyethylene material capable of 10” water column (w.c.) internal pressure. Capacity of 6,600 gallons normal. Dimensions of 12’ dia. by 10’ high or 10’ dia. by 13’-5” high. Total capacity to full includes the dome and adds 675 gallons additional for a total of 7,275 gallons.

Truck – 2 axle trailer with a 5,500 gallon capacity.

Air unloading equipment consisting of – 1” air line to pressurize truck trailer thereby forcing the liquid HCL up a 3” eductor tube to a hose connection.

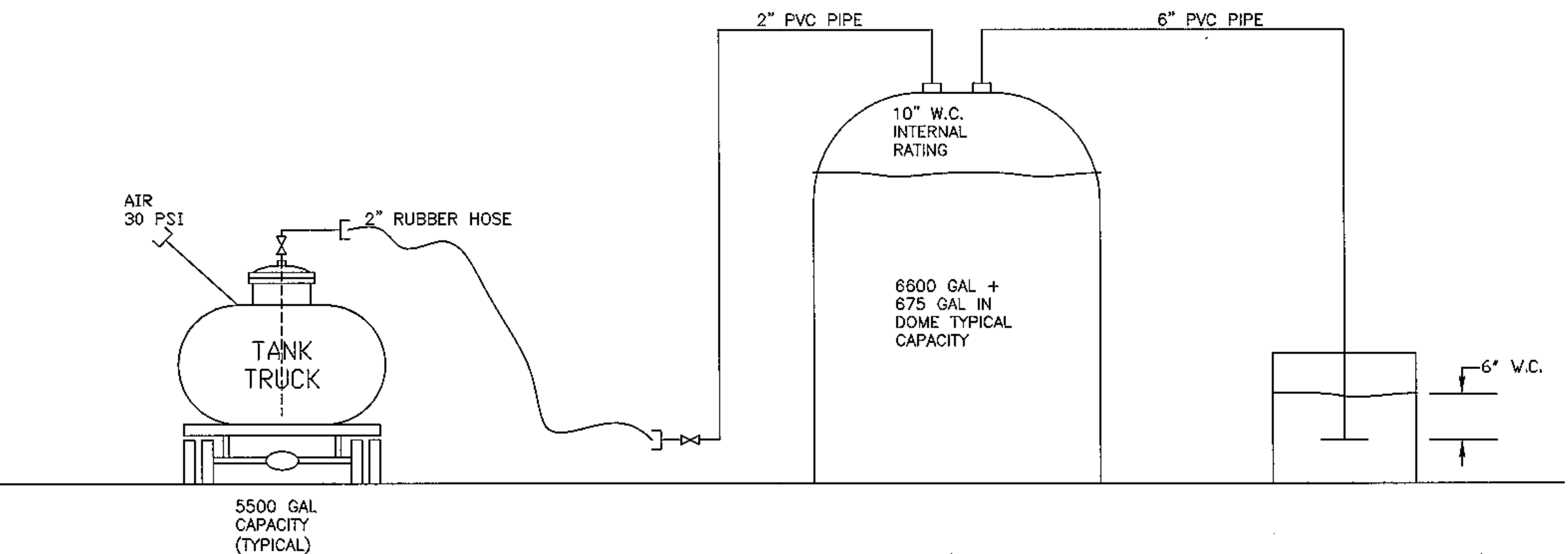
Fill hose – 2” hose from hose connection on truck trailer to the fill connection of the storage tank.

Tank Vent -- 6” diameter vent from the storage tank to a seal pot located at grade with 6” depth of water above the vent outlet (used to scrub HCL vapors from the venting air).

HCL acid -- Liquid being transferred from truck trailer to the storage tank. Properties are:

Specific gravity -- 1.19
Viscosity -- 1.9 centipoise
37% by weight HCL

Temperature -- 60 °F (tables only list properties at this temperature, variation in viscosity and specific gravity are not likely to vary much within the actual range).



SECTION 1
FROM TANK TRUCK TO STORAGE TANK

30 PSIG IN TANK TRUCK
3" EDUCTION PIPE 8' LONG
3" BALL VALVE
3" 90° ELL
30' OF 2" RUBBER HOSE
(3) 2" 90° ELLS
15' 2" PIPE TANK NOZZLE

SECTION 2
FROM STORAGE TANK TO SCRUBBER

6" TANK NOZZLE
(2) 6" 90° ELLS
20' 6" PVC PIPE
6" TEE, BRANCH FLOW
6" W.C. BACKPRESSURE

Methodology of the calculation is to determine the actual flow in cubic feet per minute through Section 1 of the system with liquid HCL and with air as the flowing medium in a 2” diameter hose and fill lines. The pressure in the storage tank for both HCL and air can be considered to be 10 inches of water column as this is the rated pressure for the tank. Pressure in the truck trailer is 30 psig determined by the setting on the relief valve. Normal operating procedure is to be a few psi below the maximum, but for calculation purposes it is necessary to use the maximum.

The cubic feet per minute determined in Section 1 is then the flow rate which must pass out of the storage tank vent without causing the pressure in the tank to “grow” beyond 10” w.c. There is a back pressure of 6” w.c. at the exit of the vent (seal pot) due to the height of the water. The total motive pressure for the vent is 10 inches w.c. minus 6” w.c. That delta pressure is only 4 inches w.c. (0.144 psi).

Results for the Section 1 calculations show that the following flow rates in cubic feet per minute are achieved from the truck to the storage tank with a motive force of 30 psi – 10” w.c. (0.361 psi) = 29.639 psi.

HCL

2”dia fill line -----------→ 28.8 cfm

Air

2”dia fill line -----------→ 920 cfm

Section 2 then must achieve vent flow rates equal to or better than those flow rates with a pressure differential of only 0.144 psi.

The calculated results for Section 2 flowing air and HCL vapor are as follows:

Vapor

4”dia vent line -----------→ 382 cfm

6” dia vent line ----------→ 968.8 cfm

This shows that the 4” vent is more than adequate for air pressure driving liquid HCL through the fill line. As long as there is total assurance that the unloading valve at the truck is closed before the truck is totally emptied, there would not be any problem with over pressurizing the Storage Tank. Resistance to flow due to the viscosity of the liquid HCL is sufficient to prevent a rapid displacement of the air inside the storage tank.

If, however, the valve at the truck is not closed before air enters the fill line, there will be a very rapid increase of the flow rate into the Storage Tank. The truck will have become a very large air receiver filled with 30 psig air. This air will rush through the fill line into the Storage Tank at the rate shown above of 920 cfm. That air will start leaving the

Tank at 382 cfm (4” dia vent) or 969 cfm (6” dia. vent) at the Tank’s maximum pressure of 10 inches w.c. With the 4” vent, pressure will then continue to build until equilibrium of flow is achieved or until the Tank fails. Calculations were made with 1 psig in the tank which showed that air would enter the tank at 890 cfm and would vent out of the tank at 878 cfm. Equilibrium would be established at slightly over 1.0 psig in the Tank (by extrapolation). This is also roughly at the failure point of the tank. Clearly, a 4 inch vent is not adequate.

As an example of how quickly a tank failure could happen, let's look at the case of a truck being emptied with a 2" line and hose to the Storage Tank and a 4" vent line to the water seal (scrubber). We can assume that the truck completely unloaded the typical capacity of 5,500 gallons. The Tank has a total volume of 7,275 gallons counting the dome.

Tank air space = (7,275 gallons – 5,500 gallons) / 7.48 gal/cu.ft. = 237 cu.ft.

From the previous calculations we know that an average flow rate of around 900 cfm would be achieved as the tank went from a few inches of water column to 1.0 psig internal pressure. Flow out through the 4” vent will vary from around 200 cfm immediately after air starts flowing to 878 at 1 psig. Using 550 cfm as the average vent flow, we have the tank being filled with 1 psig air at a rate of 350 cfm (900 – 550) into a space of 237 cu. ft. total. This indicates that the tank would reach 1 psig in less than 1 minute after air starts flowing through the fill line. (This approach to determining time to reach pressure is greatly simplified and certainly not mathematically rigorous, but it is sufficient to see that it would be a very short time before tank failure could potentially occur.)

That time would be significantly shortened if the tank was more than 3/4 full, thus reducing the available air space. Also we know that if a 3" fill hose were used instead of a 2" hose, the time before failure would again be shortened.

Conclusion: Unless secondary safety devices are in place to protect the Storage Tank from an internal pressure above 10” w.c., it would not be prudent to use a vent smaller than 6" diameter when unloading a tank truck using 30 psig air as the motive force. The margin of error is so small to protect the tank with only 10” w.c. internal pressure rating that a safety relief device, such as a weighted hinged lid on the tank, is strongly recommended.

APPENDIX A

CALCULATIONS

ONE-PAGE SUMMARY

37% HCL Flowing

File Name: POLY1-A

FLUID DESCRIPTION

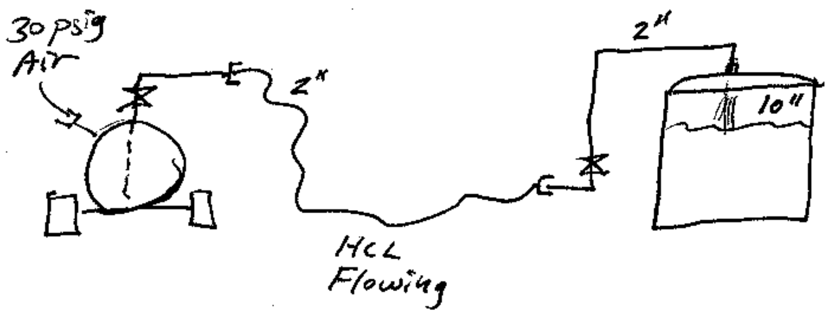
Asmpt:	Incompressible
Fluid:	Hydrochloric Acid Solution, 37.00 % Hydrochloric Acid
Temperature:	60.00 Fahrenheit
Density:	74.29 lb/cu ft
Specific Volume:	0.013 cu ft/lb
Specific Gravity:	1.190
Abs. Viscosity:	1.900 centipoise
Kin. Viscosity:	1.597 centistokes

HARDWARE DESCRIPTION

Number of Components:	11
Branch Inlet Diameter:	3.068 inches
Branch Outlet Diameter:	2.047 inches
Branch Elevational Change:	0.0 feet
Branch K Factor:	38.40

FLOW DESCRIPTION

Mass Flow Rate:	128,421.81 lb/hr
Volumetric Flow Rate:	28.81 cu ft/min = 215.52 US gal/min
Velocity:	9.35 ft/sec (FPS)
Differential Pressure:	29.64 PSID
Head Loss:	52.21 feet
Head Loss:	26.937 PSID



The low displacement rate of 28.8 acfm indicates a 3" vent would be acceptable as long as only HCL is flowing.

FLOW DESCRIPTION - TABLE

Mass Flow Rate: 128,421.81 lb/hr
Volumetric Flow Rate: 28.81 cu ft/min = 215.52 US gal/min
Units as follows:
Velocity: ft/sec (FPS)
Head Loss: feet
Differential Pressure: PSID

Component Name	Inl Vel	Out Vel	HL	DP
INLET	9.35		52.21	29.639
Entrance, 3" proj				
Pipe, NPS 3, sched 40, 8.00'				
Ball valve	9.35	9.35	0.07	0.036
Reducer, 3 X 2" sud	9.35	20.61	1.80	3.632
Pipe, NPS 2, 30.00'	22.01	22.01	25.00	12.896
Pipe, NPS 2, sched 40, 18.00'	21.01	21.01	12.61	6.504
Ball valve	21.01	21.01	0.39	0.202
[3] Elbow, 2" 90 LR flg/BW	21.01	21.01	5.48	2.830
Exit, 2" sharp-edged	21.01	21.01	6.86	3.539
OUTLET		21.01	52.21	29.639

ONE-PAGE SUMMARY

Air Flowing

File Name: POLY1-A

FLUID DESCRIPTION

Inlet Fluid Conditions	
Spec. Heat Ratio (Cp/Cv):	1.400
Molecular Weight:	28.96
Specific Gravity:	1.000
Temperature:	80.00 Fahrenheit
Pressure:	30.00 PSIG = 44.70 PSIA
Density:	0.22 lb/cu ft
Specific Volume:	4.471 cu ft/lb
Abs. Viscosity:	0.018 centipoise
Kin. Viscosity:	5.080 centistokes

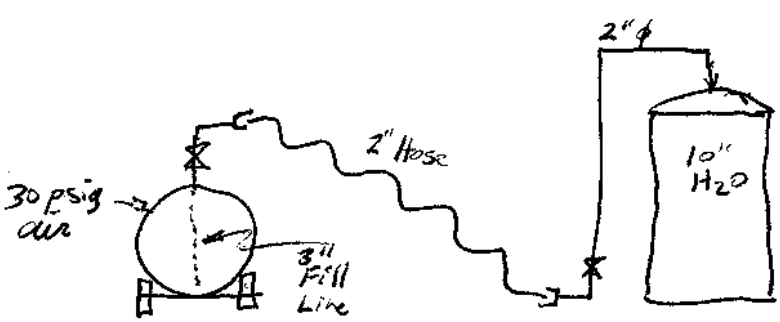
HARDWARE DESCRIPTION

Number of Components:	11
Branch Inlet Diameter:	3.068 inches
Branch Outlet Diameter:	2.047 inches
Branch Elevational Change:	0.0 feet
Branch K Factor:	37.04

FLOW DESCRIPTION

Mass Flow Rate:	5,675.26 lb/hr
Std Vol. Flow Rate:	1,239.224 SCFM
Inlet Vol. Flow Rate:	422.93 cu ft/min = 3,163.73 US gal/min
Inlet Velocity:	137.30 ft/sec (FPS)
Inlet Mach No.:	0.121
Outlet Vol. Flow Rate:	920.11 cu ft/min = 6,882.90 US gal/min
Outlet Velocity:	671.00 ft/sec (FPS)
Outlet Mach No.:	0.688
Differential Pressure:	29.64 PSID

volume flow into Tank 10" H_2O



air into storage Tank
30 psig at Truck, 10" H_2O in Tank

FLOW DESCRIPTION - TABLE

Mass Flow Rate: 5,675.26 lb/hr
Std Vol. Flow Rate: 1,239.224 SCFM
Units as follows:
Volumetric Flow Rate: cu ft/min
Velocity: ft/sec (FPS)
Differential Pressure: PSID

Component Name	Inl Vel	Inl Vol	DP	Exp Fact
INLET	137.30	422.93	29.640	
Entrance, 3" proj	137.30	422.93	0.361	NA
Pipe, NPS 3, sched 40, 8.00'	138.10	425.39	0.262	NA
Ball valve	138.69	427.19	0.024	NA
Reducer, 3 X 2" sud	138.74	427.36	2.426	NA
Pipe, NPS 2, 30.00'	339.96	445.01	9.948	NA
Pipe, NPS 2, sched 40, 18.00'	394.45	540.88	6.052	NA
Ball valve	458.95	629.34	0.242	NA
[3] Elbow, 2" 90 LR flg/BW	462.08	633.62	3.731	NA
Exit, 2" sharp-edged	517.65	709.82	6.594	NA
OUTLET	671.00	422.93	29.640	

ONE-PAGE SUMMARY

Air Flowing

File Name: POLY1-A

FLUID DESCRIPTION

Inlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

Temperature: 80.00 Fahrenheit
Pressure: 1,239.42 in water (68F) abs = 44.70 PSIA
Density: 0.22 lb/cu ft
Specific Volume: 4.471 cu ft/lb

Abs. Viscosity: 0.018 centipoise
Kin. Viscosity: 5.080 centistokes

HARDWARE DESCRIPTION

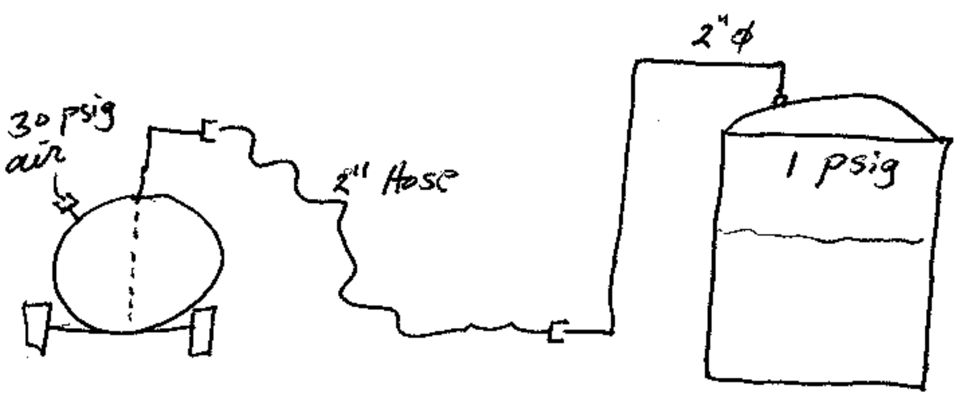
Number of Components: 11
Branch Inlet Diameter: 3.068 inches
Branch Outlet Diameter: 2.047 inches

Branch Elevational Change: 0.0 feet
Branch K Factor: 37.04

FLOW DESCRIPTION

Mass Flow Rate: 5,653.86 lb/hr
Std Vol. Flow Rate: 1,234.552 SCFM
Inlet Vol. Flow Rate: 421.33 cu ft/min = 3,151.80 US gal/min
Inlet Velocity: 136.78 ft/sec (FPS)
Inlet Mach No.: 0.120
Outlet Vol. Flow Rate: 889.73 cu ft/min = 6,655.71 US gal/min
Outlet Velocity: 648.85 ft/sec (FPS)
Outlet Mach No.: 0.662

Differential Pressure: 29.00 PSID



FLOW DESCRIPTION - TABLE

Mass Flow Rate: 5,653.86 lb/hr
Std Vol. Flow Rate: 1,234.552 SCFM
Units as follows:
Volumetric Flow Rate: cu ft/min
Velocity: ft/sec (FPS)
Differential Pressure: PSID

Component Name	Inl Vel	Inl Vol	DP	Exp Fact
INLET	136.78	421.33	29.000	
Entrance, 3" proj	136.78	421.33	0.358	NA
Pipe, NPS 3, sched 40, 8.00'	137.57	423.76	0.260	NA
Ball valve	138.15	425.55	0.024	NA
Reducer, 3 X 2" sud	138.21	425.71	2.407	NA
Pipe, NPS 2, 30.00'	338.54	443.15	9.846	NA
Pipe, NPS 2, sched 40, 18.00'	391.84	537.31	5.962	NA
Ball valve	454.49	623.22	0.238	NA
[3] Elbow, 2" 90 LR flg/BW	457.50	627.35	3.646	NA
Exit, 2" sharp-edged	510.56	700.11	6.258	NA
OUTLET	648.85	421.33	29.000	

ONE-PAGE SUMMARY

Air Flowing

File Name: POLY2-A

FLUID DESCRIPTION

Inlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

Temperature: 60.00 Fahrenheit
Pressure: 417.52 in water (68F) abs = 15.06 PSIA
Density: 0.08 lb/cu ft
Specific Volume: 12.787 cu ft/lb

Abs. Viscosity: 0.018 centipoise
Kin. Viscosity: 14.101 centistokes

HARDWARE DESCRIPTION

Number of Components: 5
Branch Inlet Diameter: 3.998 inches
Branch Outlet Diameter: 3.998 inches

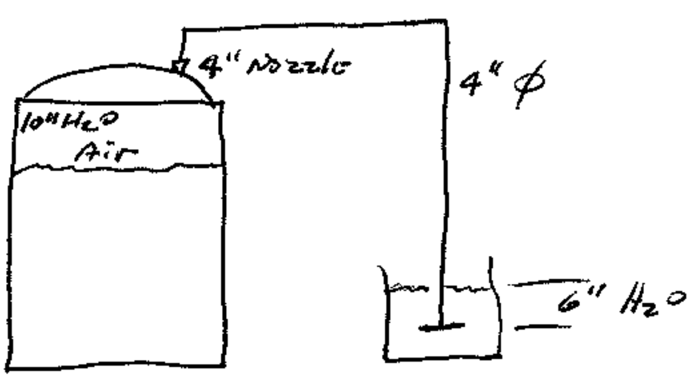
Branch Elevational Change: 0.0 feet
Branch K Factor: 3.18

FLOW DESCRIPTION

flow from volume tank, 10" H_2O

Mass Flow Rate: 1,792.65 lb/hr
Std Vol. Flow Rate: 391.436 SCFM
Inlet Vol. Flow Rate: 382.06 cu ft/min = 2,858.01 US gal/min
Inlet Velocity: 73.04 ft/sec (FPS)
Inlet Mach No.: 0.065
Outlet Vol. Flow Rate: 384.69 cu ft/min = 2,877.72 US gal/min
Outlet Velocity: 73.54 ft/sec (FPS)
Outlet Mach No.: 0.066

Differential Pressure: 0.14 PSID 4" H_2O



4" will not work
382 acfm is much less than the 920 acfm into tank

FLOW DESCRIPTION - TABLE

Mass Flow Rate: 1,792.65 lb/hr
Std Vol. Flow Rate: 391.436 SCFM
Units as follows:
Volumetric Flow Rate: cu ft/min
Velocity: ft/sec (FPS)
Differential Pressure: PSID

Component Name	Inl Vel	Inl Vol	DP	Exp Fact
INLET	73.04	382.06	0.144	
Entrance, 4" sharp-edged	73.04	382.06	0.023	NA
Pipe, NPS 4, sched 40, 24.00'	73.12	382.47	0.056	NA
[2] Elbow, 4" 90 LR flg/BW	73.32	383.50	0.021	NA
Tee, 4" Thru Branch	73.39	383.88	0.045	NA
OUTLET	73.54	382.06	0.144	

ONE-PAGE SUMMARY

Air Flowing

FLUID DESCRIPTION

Inlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

Temperature: 60.00 Fahrenheit
Pressure: 417.52 in water (68F) abs = 15.06 PSIA
Density: 0.08 lb/cu ft 10" H_2O
Specific Volume: 12.787 cu ft/lb

Abs. Viscosity: 0.018 centipoise
Kin. Viscosity: 14.101 centistokes

HARDWARE DESCRIPTION

Number of Components: 5
Branch Inlet Diameter: 6.031 inches
Branch Outlet Diameter: 6.031 inches

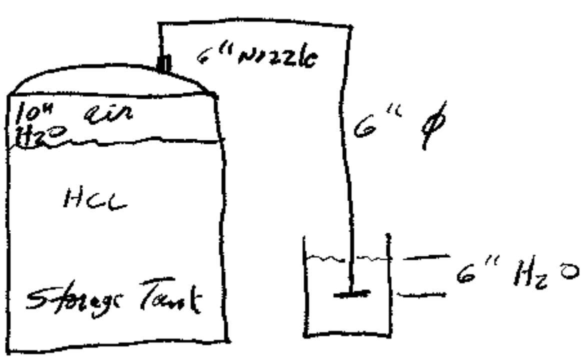
Branch Elevational Change: 0.0 feet
Branch K Factor: 2.56

FLOW DESCRIPTION

Volume flow from Tank 10" H_2O

Mass Flow Rate: 4,545.59 lb/hr
Std Vol. Flow Rate: 992.556 SCFM
Inlet Vol. Flow Rate: 968.78 cu ft/min = 7,246.99 US gal/min
Inlet Velocity: 81.39 ft/sec (FPS)
Inlet Mach No.: 0.073
Outlet Vol. Flow Rate: 975.46 cu ft/min = 7,296.99 US gal/min
Outlet Velocity: 81.95 ft/sec (FPS)
Outlet Mach No.: 0.073

Differential Pressure: 0.14 PSID 4" H_2O



6" will work

968.8 ACFM is greater than 920.11 acfm

Flow out of storage Tank exceeds Flow in

FLOW DESCRIPTION - TABLE

Mass Flow Rate: 4,545.59 lb/hr
Std Vol. Flow Rate: 992.556 SCFM
Units as follows:
Volumetric Flow Rate: cu ft/min
Velocity: ft/sec (FPS)
Differential Pressure: PSID

Component Name	Inl Vel	Inl Vol	DP	Exp Fact
INLET	81.39	968.78	0.144	
Entrance, 6" sharp-edged	81.39	968.78	0.028	NA
Pipe, NPS 6, sched 40, 24.00'	81.50	970.07	0.042	NA
[2] Elbow, 6" 90 LR flg/BW	81.66	972.01	0.024	NA
Tee, 6" Thru Branch	81.75	973.10	0.051	NA
OUTLET	81.95	968.78	0.144	

ONE-PAGE SUMMARY

Air Flowing

File Name: POLY2-A

FLUID DESCRIPTION

Inlet Fluid Conditions
Spec. Heat Ratio (Cp/Cv): 1.400
Molecular Weight: 28.96
Specific Gravity: 1.000

Temperature: 60.00 Fahrenheit
Pressure: 435.25 in water (68F) abs = 15.70 PSIA
Density: 0.08 lb/cu ft
Specific Volume: 12.266 cu ft/lb

Abs. Viscosity: 0.018 centipoise
Kin. Viscosity: 13.527 centistokes

HARDWARE DESCRIPTION

Number of Components: 5
Branch Inlet Diameter: 3.998 inches
Branch Outlet Diameter: 3.998 inches

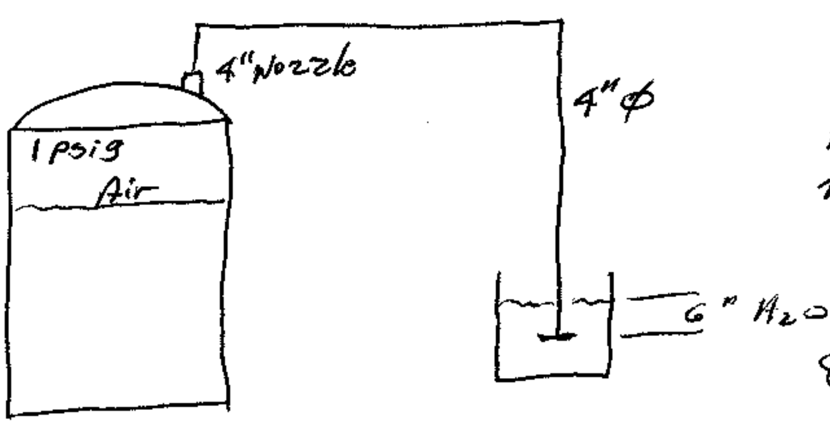
Branch Elevational Change: 0.0 feet
Branch K Factor: 3.03

FLOW DESCRIPTION

Volume Flow From Tank 1 psig

Mass Flow Rate: 4,292.73 lb/hr
Std Vol. Flow Rate: 937.341 SCFM
Inlet Vol. Flow Rate: 877.61 cu ft/min = 6,564.99 US gal/min
Inlet Velocity: 167.78 ft/sec (FPS)
Inlet Mach No.: 0.150
Outlet Vol. Flow Rate: 910.31 cu ft/min = 6,809.59 US gal/min
Outlet Velocity: 174.03 ft/sec (FPS)
Outlet Mach No.: 0.157

Differential Pressure: 0.78 PSID



With 1 psig in tank and a 4" Vent the flow out still does not quite equal flow in.

877.6 vs. 889.7

FLOW DESCRIPTION - TABLE

Mass Flow Rate: 4,292.73 lb/hr
Std Vol. Flow Rate: 937.341 SCFM
Units as follows:
Volumetric Flow Rate: cu ft/min
Velocity: ft/sec (FPS)
Differential Pressure: PSID

Component Name	Inl Vel	Inl Vol	DP	Exp Fact
INLET	167.78	877.61	0.784	
Entrance, 4" sharp-edged	167.78	877.61	0.127	NA
Pipe, NPS 4, sched 40, 24.00'	168.76	882.72	0.282	NA
[2] Elbow, 4" 90 LR flg/BW	170.97	894.32	0.118	NA
Tee, 4" Thru Branch	171.93	899.30	0.256	NA
OUTLET	174.03	877.61	0.784	

Engineering Study Assumptions

- Tank – Crosslinked PE capable of 10” water column internal pressure per ASTM D1998
- Tank Capacity – 6600 gallons nominal
- Delivery trailer – 2 axles w/ 5500 gal capacity
- Fill hoses – 2 and 3 inches
- Liquid properties
  - Specific Gravity 1.19
  - Viscosity – 1.9 centipoise
  - 37% by weight
- Temperature - 60°F
- Line purge < 15 seconds per purge
- Max trailer pressure rating – 30 psi