AIRVAC WEBINAR
FEB 23, 2011
Q&A

Q1: With respect to the design velocities of 15-18 fps: 1) Does pipe selection need to take into account possible scouring of pipe? and 2) Is thrust force design critical?

A: No. Standard SDR21 PVC has been used in our systems since the 70's with no reports of pipe failure due to scouring. We actually cut out a section of pipe in our East Point, FL project (installed in the mid-70's in very sandy soil) to see if there was any degradation of the pipe due to scour. We found none.

Some further clarification: The 15-18 fps velocity is not a constant velocity that occurs throughout the piping network. It only occurs for a short time and for a short distance. We see velocities in this range just as the valve fires (in other words, the sewage leaves the sump and is propelled into the main at these velocities). Eventually friction and gravity bring the sewage to rest at some distance from the valve pit. This may be 100 feet or it may be 1000 feet depending on the vacuum main profile.

Thrust blocking is generally not required due to the negative pressure within the system that is constantly pulling the pipe network together. However, proper compaction in the zone of abrupt change of direction is vital.

Q2: In regards to maintenance, how easy is it to locate a pipe or valve connection that needs to be repaired for proper operation?

A: On our largest systems, operators report that this can normally be accomplished in 30 minutes or less after arriving at the vacuum station.

The process for locating a problem vacuum main or valve starts the same way. The operator will be notified by an alarm system that there is a low vacuum situation and will go to the vacuum station to start the troubleshooting process. There each of the incoming lines into the vacuum tank has a division Valve and a vacuum gauge. By opening a closing each valve, he can quickly identify which of the vacuum mains is experiencing low vacuum. As an example, if there are 4 vacuum mains entering the station, the problem is essentially reduced to only 25% of the entire collection system. The other 75% remains in unaffected.

The problem is further isolated by closing division valves within the problem main within the collection system itself. Starting at a mid-point he operator can quickly identify whether the problem is upstream or downstream of that point. He then goes to the mid-point of this reduced section and the process is repeated until the problem is isolated to a very short section.

At that point the operator will check at the air intakes of the valve pits in that area. If he hears a constant rushing of air, he knows that vacuum valve is hung open. Then, he either corrects the problem on site or removes the valve (or controller) and re0places it with another one. The defective part is the taken to the shop where it can be rebuilt at a later date.

If the problem is not a vacuum valve but is a leaking vacuum main instead, the above process is still followed to the point where the problem is isolated to a short section of pipe. Normally the operator will see evidence of digging in the area, sunken ground, etc. to located the problem.

Q3: Does design utilizing 2/3 air in line eliminate or reduce need for odor control?

A: The induction of atmospheric air into the system as the valve fires does help with some pretreatment of the sewage. And, because the system is completely sealed from the valve pit to the vacuum station, there is no opportunity for odors to escape within the collection system.

There is a very, very slight chance of odors at the valve pit itself. But, with very small amounts of sewage in the sump at any one time (10 gallons) and with very short detention times (a typical valve will empty the sump 25-50 times a day), we rarely get reports of odor at the valve pit itself.

Finally, there also can be odors at the vacuum station, but compared to a gravity lift station, the situation with vacuum is much better. The only opportunity for odor is from the exhaust of the vacuum pumps. We design the vacuum pumps to cycle on and off (typically 3 minutes on and 15 minutes off). So, it is only for these short periods of time where odors are exhausted. Some of our smaller, older systems have no odor control whatsoever, but recent systems all employ some type of odor control. The most common type we see is a simple biomass filter using a mulch bed.

Q4: Can vacuum lines be installed by directional drilling? Grade control with directional drilling has never been that efficient.

A: You are correct. The directional drilling technology still is not to the point where a 0.20% grade can be held with any accuracy. For this reason, AIRVAC does not endorse the use of directional drilling for vacuum mains. On occasion we have seen directional drilling used for the short 3" vacuum lateral that connects the valve pit to the main (to avoid open cutting a decorative driveway for example).

Q5: How do you test and locate main line leakage after installation?

A: There is a vacuum chart recorder located on eh collection tank at the vacuum station which constantly records the vacuum levels within the system. Essentially, the entire system is under a "vacuum test" 24/7/365. If there is any vacuum loss, this can easily be seen by looking at the chart or by the operator noticing an increase in vacuum pump run time.

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Q6: How much higher can one expect an I \ I rate to increase when using a vacuum system ?

A: The opposite is true. Because vacuum systems are inherently tight, I/I is virtually non-existent.

There is a chance of I/I entering through the homeowner's plumbing. As with any other system, proper inspection of the home connection is need to ensure the elimination of floor drains, downspouts and any other extraneous flows.

Q7: How do work crews identify the location of a faulty air valve?

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Q8: How do elevation differences come to play when sizing the vacuum pumps?

A: The vacuum pumps are sized according to peak flow and connected pipe volume. Elevation differences only come into place when calculating line losses (i.e. – allowable "static loss" within the system on any given flow path).

Q9: Is there an indicator in the valve pit to let you know if it has failed in open position?

A: Currently there is not, but AIRVAC R&D is working on a valve monitoring system to do exactly that and more. Obviously there will be a cost-benefit analysis to consider as an entity will have to decide if it is worth the additional money for that convenience. Because most system have few problems with valve failures (maybe 2 or 3 callouts a month for every 500 valves), most cannot justify the additional expense.

Without such a monitoring system, the first indication that a valve is hung open will come either from a low vacuum alarm or an operator noticing an increase in vacuum pump run time. From that point, the troubleshooting method previously describe is followed (see answer to Q8).

Q10: How do you identify a pipe failure since it is always in vacuum stage?

A: The operator will either get a low vacuum alarm or will notice additional run time of the vacuum pumps. In both cases this signals the operator that something is wrong….either a hung vacuum valve or a line leak.

Q11: If a contractor hits a flexible pipe or mainline and break it, how will that affect the system?

A: Much depends on where this occurs within the collection system and how much "pipe volume" exists. The larger the system, the more pipe volume that exists and the less affect that 1 leak has on the overall system. Most systems are designed with enough safety factor due to redundant vacuum pumps as well as the inherent reserve capacity within the mains themselves (due to the 2/3rds air design). In these case, the vacuum pumps typically can keep up with leak while it is being repaired and the customer is unaffected.

As a side note, this is where proper design can really pay off. By designing the system such that multiple vacuum mains are connected to the station, one can essentially insure that the majority of the system is unaffected by such an occurrence. For example, if there are 4 vacuum mains and one is damage, the operator can valve off this main and keep 75% of his system in operation and totally unaffected by the break. Further, if the break occurs near the end of a flow path (i.e – near the end of the affected vacuum main), just this last section of main can be valved off meaning the other 3 lines as well as the vast majority of this problem line can still be operational.

Q12: Where does the City responsibility end in this system?

A: The City is responsible up to and including the valve pit. Typically the valve pit is located in a public R-O-W, but sometimes this is not possible an easement is necessary. The homeowner is responsible for the gravity lateral from their home to the valve pit.

Q13: Is this system an alternate to septic systems?

A: The system is used to eliminate septic systems.

Q14: What cold weather climate challenges might be expected? Is pipe freezing a problem with the shallow depths?

A: Local code determines minimum depth of pipe typically below frost line, just like water or other utilities. Freezing of vacuum mains has not been a problem.

While not a persistent problem, we have occasionally been notified of flash freezing of the vacuum valve inside the valve pit. This may occur in long durations of extreme cold temperatures where a valve pit is installed in a road and the snow has been removed. AIRVAC R&D is now testing a prototype valve pit with an insulated cover to address this situation.

Q15: What is maximum elevation rise of vacuum line?

A: In general a vacuum system can overcome about 15 to 20 feet of actual elevation difference.

Additional commentary: There is no single answer to this since vacuum design is based on "calculated static loss" and not actual elevation difference. Calculated static loss is dependent on several variables including pipe size, lift heights, # of lifts, etc. and is not easily explained in a short answer. For more information, the AIRVAC Design Manual describes this in great detail and is available upon request.

Q16: What max total lift do you use for design of the vacuum mains. Do you design for the full 20 ft capability? Or as a safety factor should one use less than 20-ft?

A: Our design requires that no more than 13' of ***calculated lift*** be on any one flow path. Calculated lift is determined by the lift height invert to invert minus the pipe diameter. For example a 1' lift in a 6" pipe is actually .5' of calculated loss. With that in mind you can have 26 of the 1' lifts in any one flow path and still stay within our 13 ft of calculated static loss limit.

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Q17: Why do you need at least 75 connections?

A: Historically, this seems to be the point where vacuum becomes cost-effective, most likely du to the economy of scale of the vacuum station. Systems with fewer than 75 connections typically cannot overcome the cost of the vacuum station in order to be cost-effective.

Q18: Why is there an allowable loss? Seems like there should be none on an new system.

A: We assume by “allowable loss” you are referring to our vacuum testing where we have an allowable vacuum loss of 1% per hour and not our allowable static loss of 13 ft.

As with all construction, there must be some reasonable tolerance for the contractor to meet. 1% per hour may sound like a lot, but in reality this is a very stringent test requirement. And because of fluctuations with atmospheric pressure and temperature, the actual vacuum level within the system can change during the course of a vacuum test so the tolerance allows for that as well.

For what it’s worth, the testing tolerances have served us well for 30+ years. They are stringent enough to ensure a well working system. Take our word…if the system passes the final vacuum test it will perform well. And remember that the system is being tested 24/7/365 so any major leak will not go unnoticed or unattended.

Q19: With regard to the plt valve, knowing the valve will allow passage of items smaller than 3", how does the system handle grease, sanitary napkins, small childrens' toys, and such items?

A: Grease historically has not been an issue because of the short detention time in the sump which prevents its formation. And, even if it does form, the violent action when valve fires and evacuates the sump typically will allow for it to be evacuated along with everything else.

As far as the other items, it is possible that they may be get stuck on the valve seat when it closes. However, the next time the sump fills with the 10 gallons the valve will fire again and the obstruction will get sucked away. Should it not free itself the upper housing of the valve itself can be unscrewed a few turns backing the plunger off of the seat freeing the obstruction. The operator then screws it back down and normal operation continues.

Q20: Do vacuum mains need to be installed below the frost line in northern states

A: Yes, local code will determine frost depth and minimum depth of pipe.