



## Podcast Transcript #26 Pipe Boots with Brendan Simbeck

**Brendan Simbeck** is Project Manager of Simbeck and Associates, in Monument, CO. Brendan has been installing geosynthetics since 1998 and has installed over 52 million square feet of geomembrane across the United States.

### Pipe Boot Questions from Live Webinar: Brendan

1. Ever consider a bellows in pipe boot design? Answer- I can't say that I have seen these successfully used before. If I am imagining correctly what "bellows" refers to... I would love to talk more about it if anyone has successful experience with these and would like to contact me.\_
2. How does the 90 degree pipe boot account for settlement in a landfill? The pipe may be for landfill gas extraction. Answer- Pipe boots for gas extraction on a L/F cap are not as critical to seal as in locations that will have hydraulic Head. L/F cap pipe boots really only need to shed rainwater and the banding can be left looser so it will slide before a material failure occurs. In past projects we have extended the Tubes for the pipe boot up beyond the cover soil so they would be accessible and it just becomes a maintenance Item for the L/F operators. As settlement occurs, they can make adjustments or re-band as the pipe boot moves. Other designs I have heard of do not band the pipe boot tube to the pipe at all, and instead have an overlapping outer sheath or tube that is fastened above to the pipe. This creates a slip joint which allows the Pipe boot tube to "telescope" within the outer sheath that sheds away any water.

3. I didn't notice any supports under the projecting pipes. At what length or diameter is a support for the cantilevered pipe necessary? Answer- I would say that depends on the pipe material, size, joint type and location relative to embankment. We see anywhere from 5'-20' spacing on pipe supports but I would suggest consulting with an expert. However, If the support or support pad rest on the geomembrane be sure to incorporate some sort of rub pad between the two.
4. For multiple pipe penetrations, what is the minimum distance that should be provided between the pipes? Answer- < 12" is tight, 18" minimum would be a good standard, but >18" is better.
5. When you are utilizing HDPE pipe, what is your opinion of extruding the sleeve to the pipe rather than banding? Answer- My personal opinion is that it is rarely better to do so, for the following reasons; 1) Access to underside of slope boots is usually not enough for most extrusion welders to maintain proper weld angles, 2) The difference in material thickness from thick wall pipe to thin geomembrane makes for different welding parameters, 3) Different resin compositions from the extrusion rod to the pipe can also cause weld failure or cracking. 4) No method to test the weld strength. BUT, If the conditions are appropriate for welding then you could also do both, you just have to move your butyl and banding back away from the weld.
6. How should you refer to the hybrid of pre-fabricated boot and field fabricated boot? Answer- We call them Open Tube or Split Tube or split boots, but prefabricated boots certainly should be used as much as possible.
7. When field fabricating a typical non-mechanical boot, what is the recommended order to weld the different pieces together (i.e., skirt, sleeve, throat, etc.) Answer- This will vary quite a bit but a general order of operations for most flexible membrane liner pipe boots built in place would be; the embankment side of Tube weld, throat and partway up the sides, rotate the boot throat down and finish the tube to skirt weld from both sides towards the apex, slide boot into place, attach skirt to primary, Install butyl tape and finish remaining tube weld.

8. For PE materials, can you extrude to a pipe in lieu of using band clamps? What would you recommend when the pipe is small (1"-2" diameter)?  
Answer- 1"-2" pipes can sometimes be more challenging than an 8" or 10" pipe boot. And yes, PE Tubes can be welded to PE piping, but I still lean towards a traditional banding.
9. For a pipe boot with a steel clamp, how well would the clamp and band hold up to MSW leachate? Would it eventually rust away? Answer- A steel clamp certainly would rust away, but stainless steel clamps are almost always used with 304 probably the most common but 316, 400 and other alloys are available for increased corrosion resistance if desired. We have also in the past welded a geomembrane sleeve over top the banding in Leachate collection sumps, or there are some corrosion resistant wraps available that could be incorporated as added protection.
10. Are you going to discuss non-destructive testing of pipe boots by spark testing with an embedded copper wire? Answer- I wish we had time to go over this more in the webinar since the development of this test method has improved the quality of pipe boots installed over the years. For some materials it really is the only standard test method that can be used to test the Tube to Skirt weld regardless of the slope angle or shape of the pipe boot. Perhaps FGI can cover this method one of their instructional videos posted on their website?
11. Have you ever installed boots over corrugated pipe? Answer- Yes, however it is not recommended for most applications because of the extra time and work involved and minimal confidence that the seal will hold when stressed or submerged. Spiral corrugated pipes are the worst, but corrugated pipes with independent grooves are a little better. The best method we have found is using a corrugated pipe adapter. These rubber adaptor rings are sized to the specific diameter of the pipe and fill the root between two ridges of the pipe providing a greater surface for banding. These can be used in conjunction with butyl strip(s) and SS strapping depending on the application.

**12.** How would you suggest constructing a pipe penetration through the slope at the sump (low point) of a landfill cell? How close can you get to the bottom of the cell before it really becomes a constructability issue?

Answer- First choice would be not to do it. Many L/F's we see use a riser pipe that run upslope from the sump area on top of the geomembrane. As a rule, you always want to minimize seaming and detail work through sump areas, especially in L/F leachate collection. That being said, if it has to be done, I suggest the Pipe be stubbed out of the embankment with no T's or flanges. Pipe boot be fabricated and the Tube to skirt weld tested, then retested, then installed over the pipe with the bottom edge of the skirt left long enough to extend past the stubbed-out pipe. By doing this It allows unobstructed access to the seam all around for welding and testing of skirt to primary weld. Doing this, the pipe can be as close as an inch, to just resting on the geomembrane (with a rub pad if needed) at the bottom of the sump.

**13.** What is water balance testing? Answer- A crude non-standard version of Water Balance testing of pipe boots is as simple as inverting the skirt perimeter of a pipe boot enough to fill with water to submerge the tube to skirt weld and observe any transfer through the weld area. True Water Balance testing is a test of the entire liner system after completion by filling with fluid and taking regular level readings over weeks or months and checking them against a control basin to adjust for environmental conditions like precipitation and evaporation.

**14.** Slide 13/62: Can you discuss this slide again further. why is the gasket on the outside of the liner material, i have typically seen the gasket it on the inside where the tape it located in your example. Answer- I think the use of the term "Gasket" may be misleading when referring to the Neoprene or EPDM placed beneath the Strapping. In the cut away photo of the basic banding components shown in the webinar, It is the Butyl that provides the (Secondary) water tight seal. I say secondary because it only sees fluid if the Caulking that seals the end of the tube fails. In this Configuration the purpose of the EPDM or Neoprene is 2-fold, 1) it provides protection from damage to the geomembrane by the strapping and clip, and 2) it provides additional Spring or compression if some of the butyl becomes displaced or Squeezes out over time. I have seen and heard of similar "gasket"

placement between the geomembrane and the Pipe OD, however in our opinion it would not provide a better seal than the Butyl Tape shown.

15. What is an Air lance test? Answer- FGI has produced a great video explaining ASTM D4437- Air Lance Testing Method. Please see Testing Videos on FGI Website.
16. Is lined attachment to a sloped pipe headwall prior to a pipe boot required, or strongly recommended? (liner over concrete situation). Sounds like it's recommended in order to limit stress on the boot seals in the event the membrane moves. Answer- Strongly recommended. Incorporating this feature greatly reduces the potential for leaks or failures in the boot areas which account for a high percentage of leaks in geomembrane systems.
17. Great presentation. Are there any considerations around cracking and contracting of concrete of the concrete pad during its curing period, especially at the pipe penetration periphery? Answer- Yes, certainly, there is always a good chance concrete will crack and a leak path will develop. As Pat Elliot said \_ “there are two kinds of concrete- cracked and going to crack” AND this is another instance where a pipe boot on top of the anchor or support pad is a more reliable configuration.
18. bootless pipe details. Works great for HDPE. Response-yes it can work well but relying on the water tightness of concrete over time does present some concern to me.
19. Considering a HDPE pipe and a HDPE geomembrane, is it possible/recommendable to weld the boot and the pipe at the pipe side instead of using a clamp? Clamping and welding would increase leakage tightness or is this just increasing work/cost? Answer- It is possible to do both if you move your banding and butyl back , we don't do this as a standard practice for reasons discussed earlier, but yes, it can be done. I just don't see much of a benefit in most situations that would outweigh the risk of doing this over the traditional caulking method.

20. What type of boot penetration do you recommend for double composite liner systems? Answer- For double lined systems a longer length of pipe is really helpful with the secondary Pipe boot tube banded short with a protective cover or sleeve over the banding to protect the inside of the Primary tube or sleeve which is banded 6" or 8" further out.

21. One of the slides had a picture showing a vertical pipe penetration near the top of a dike, close to the edge of the liner. A presenter mentioned that this vertical pipe should have been moved outside the liner if possible, due to the increased risk of failure that the penetration presents. Could you go into a bit more depth of why this type of penetration should be avoided? Does this type of penetration present less of a risk if the penetration is above the fill line of the area? Answer- Correct, a leak above water line is much better than a leak below waterline. Best yet is no leak at all. This picture was really to represent the idea of reduce the penetrations - reduce the risk. If there is no need for a feature to penetrate the liner and adequate space exists for the feature to be located outside the lined footprint of the cell why not design it for less work, cost, and risk?

Thanks to Brendan for joining us again and that is all the time that we have today.....

If you have any questions or would like additional information, please contact the me ([fabricatedgeomembrane@gmail.com](mailto:fabricatedgeomembrane@gmail.com)) & I will send your question to them or visit the FGI Website at [www.fabricatedgeomembrane.com](http://www.fabricatedgeomembrane.com).