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TO: VF P&PG SALES & MARKETING PERSONNEL
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FR: E. J. LAWLESS EJL

RE: TRUSS PIPE VS. A-C AND PVC

Truss Pipe was introduced in the mid 60's in Ohio and since then, has gained acceptance in many other areas. Because we can expect even greater penetration into our market areas, it would be well for our men to be familiar with the qualities of Truss Pipe. This bulletin is written for that reason.

Truss Pipe is made by Armco. There are two types of Armco Pipe; (a) the smaller sizes 4" and 6" are solid ABS Plastic and are not of the truss construction and (b) Truss Pipe in sizes of 8" through 15" which is of truss construction and consists of three elements -- an inner lining , an outer casing and a Perlite-cement filler.

Truss Pipe is made to Specification ASTM D 2680 and is considered by the manufacturer to be a flexible conduit. The inner lining is .060" thick and the outer casing is .035" thick (8" size), per ASTM 2680. The two elements are separated by a web or truss which is also quite thin and spaces in the truss construction are filled with a Perlite-cement aggregate. These three elements work in unison to give the pipe its characteristic flexibility and stiffness. We thus, have a rather complex, sophisticated pipe which was designed to be used under one of the most severe and demanding of all construction conditions; i.e., a sewer line that must perform for decades, buried in the ground under various relatively unknown conditions with the added burden of great earthload pressures. Should any one of these fragile elements fail, then the pipe fails.

The Perlite-cement aggregate serves the purpose of keeping the two shells apart. It contributes little, if any, strength of itself. Perlite-cement aggregate has a compressive strength of only 3-400 pounds per square inch (and is almost zero in tensile strength). As a frame of reference, compare this to PVC Plastic at 8500 psi, concrete at 3-400 psi, and A-C at 10-12,000 psi. Obviously, the Perlite contributes virtually nothing from a strength standpoint. Its purpose is as a "spacer". Nevertheless, its contribution as a spacer is extremely important. Should the Perlite fail--for example,

if there are voids in the Perlite, which would be undetectable after manufacturing (ASTM 2680 states, "Perlite--which essentially fills the truss...". Note the specification does not say "completely"), or if the inner liner is abraded away with use, then that section of the pipe will fail--if not immediately, then fail in time. Further, little is known about Perlite-cement mixtures relative to sewage. It is quite possible that sewage would adversely affect Perlite-cement (Perlite-cement is neither cement nor concrete as we know it). Perlite-cement absorbs about forty percent water. This means that if a leak should occur--particularly at an exposed end in a manhole or at a joint--then the sewage would migrate through the Perlite with unknown consequences (ASTM 2680 states under "Joint Tightness", that "Leakage through the inert filler shall not be considered a reason for rejection"). These are the risks the engineer takes when he specifies Truss Pipe.

The ABS Plastic of which the inner shell and the outer shell is composed is not only very thin, but it is not as inert as PVC. ABS is more readily attacked by more compounds than is PVC and it is an accepted fact that PVC is a superior product for sewer pipes. When plastic sewer pipe was first introduced in Germany, both ABS and polyethelene were the principal plastics used. After many years of experience, it was found that PVC was superior to both of these compounds. Accordingly, sewage systems abroad are now virtually all PVC and when plastic pipe was introduced in the United States for sewage systems, PVC quickly became the favored plastic. Please note that almost all the major manufacturers of large diameter sewer pipe produce PVC, not ABS--with the exception of the uniquely designed Armco product. ABS, on the other hand, is more widely used for DWV than is PVC. Conditions in DWV applications are far less severe than those in gravity sewer systems and for this use, ABS works quite well.

From a performance standpoint, we believe it is expecting far too much of the inner liner which can vary from only 1/16" to 3/32" to last for up to fifty years. Not only must it withstand abrasion for these many years, but it must in no way become separated from any of the other two elements. One cannot help but make the comparison between a 1/16" liner and the almost 1/4" thick PVC Sewer Pipe (SDR 35) and 3/4" thick A-C Pipe.

While Truss Pipe is considered a flexible conduit, at the same time, it is quite stiff; i.e., it has a stiffness of 200 as compared to a truly flexible conduit such as PVC at 46 (SDR 35). This would appear to be a plus for Truss; but it is not. Truss Pipe, while it is comparatively stiff, must at the same time be bedded and receive soil side support exactly the same as PVC Pipe. If Truss Pipe is bedded as a rigid conduit; that is, without side support from tamping (Armco recommended a Proctor Density of 90--the same as PVC), then it will deflect quite easily and rupture. The crushing strength of Truss Pipe is 1500 pounds per lineal foot when the pipe is vertically deflected to 7.5 percent. This means that when a Truss Pipe is placed under a load in excess of 1500 pounds, it can fail, for then the deflection would be greater than 7.5 percent. (ASTM 2680 sets 7.5 percent as a criteria and Armco recommends a maximum of 5 percent) Please note here that a trench 3

feet wide has a soil load of 1530 pounds at a burial depth of only 9 feet. In addition, if the pipe is buried without adequate side support, then due to its nature, the constant earth load will induce creeping and ultimately the pipe will rupture after a period of time. PVC, on the other hand, will not rupture under even the worst laying conditions (Our standard laboratory test requires that the sample be flattened 100 percent without splitting, cracking or other evidence of failure.).

In short, then, the stiffness of Truss Pipe is a distinct disadvantage--not an advantage as is claimed. Truss Pipe has all the disadvantages of a stiff pipe and none of the advantages of a flexible pipe. It has the disadvantages of both and the advantages of neither.

Insofar as contractor acceptance is concerned, Truss Pipe has serious drawbacks:

A. Air testing has grown extensively and we venture to say that soon virtually all sewer lines will be air tested. There are many pitfalls for Truss Pipe in air testing. The pipe as received from the manufacturer, has exposed ends. The contractor's workmen, when installing the sleeve type coupling, must be absolutely certain to thoroughly cover the exposed ends with cement. If a "holiday" is left, then air will leak through into the Perlite and depending upon the number of holidays, the line may or may not test. Additionally when saddles are placed and solvent welded on, a hole must be cut in the pipe with a saber saw. We need not point out how ragged this hole can be. The jagged edges must be thoroughly coated with cement or the line may not test. At the manholes--the exposed ends of the pipe, unless carefully coated, are subjected to sewage absorption and possible deterioration of the Perlite-cement. When an air leak or water leak does occur, due to the migration of the air or water through the truss, location of the leak is sometimes a virtual impossibility from a practical standpoint.

B. The sleeve couplings must be solvent welded. Solvent welding under laboratory or ideal conditions makes a good water-tight joint. However, in actual field conditions in wet trenches, a good solvent welded joint, in large size pipe, is at best very chancy. It is specifically for this reason that we no longer offer solvent welded joints in our sewer pipe line. A solvent welded joint is far from fool-proof and depends exclusively on the attention and care of the laborers.

C. Impact resistance is low. Truss Pipe has an impact strength of 100 ft. lbs. (per Truss literature) while PVC has an impact strength of 284 ft. lbs. (8" pipe) and 299 ft. lbs. (12" pipe)--almost three times higher. Impact resistance, for example, ability to withstand falling rocks and other rough conditions generally encountered during handling and installation, is extremely important to a contractor.

In summary, Truss Pipe does not have the inherent strength of A-C nor does it have the advantages of the flexibility of PVC. Its initial risk factor is greater and in the long term, it does not have the integrity of either. The sole advantage it does have is that of initial cost per foot--a very bad bargain for the engineer, the contractor, and the man who ultimately pays the bill--the taxpayer.

cc: R. S. Hartman VF P&PG #2
C. W. Peek, McPherson #278