

PVC SANITARY SEWER CONTINUES TO DEFLECT A 13 YEAR STUDY

One of the important physical properties that should be stressed to engineers and designers is the long-term strength characteristics of PVC pipe.

The article below describes a sanitary sewer project that was mandrel tested 8 months after installation, 6 years later, and again 13 years after installation.

The first test indicated all 14 lines had passed the 5% mandrel test; the second test showed that only one line could still pass a 5% mandrel; and the last test, which was 13 years after installation, showed that none of the 14 lines could pass the 5% mandrel test and that 10 of the 14 lines exceeded 8½% deflection.

This illustrates the need for quality resins that can provide long-term strength characteristics. Only those resins that can meet the Hydrostatic Design Basis (HDB) rating of 1,250 psi or greater will provide the necessary long-term properties needed.

CONCLUSION: The design of plastic pipe must be based on initial and long-term strength characteristics and should include deflection and strain evaluation. Calculated initial deflection should be checked by mandrel testing 30 days after installation and again one year later (or just prior to acceptance of the project).

PVC SEWER LINE CONTINUES TO DEFLECT IN LIMA, OHIO (A 13 YEAR STUDY)*

In 1976, when the Vernon Heights PVC sanitary sewer system was designed and constructed for Allen County, Lima, Ohio; Henry Hollinger, Project Manager of Construction, wanted to be sure that the installation conformed to the best available industry procedures and recommendations. A review of the latest technical information on PVC pipe performance from Utah State University indicated that only minimum deflections of PVC sewer pipe would be expected in the long term. With the Vernon Heights line, the most desirable installation conditions were possible since the area had stable native soil and 12-inches of crushed stone bedding over the top of the pipe was specified.

To be extra sure, Mr. Hollinger required the contractor to pass a 5% Go/No-Go mandrel through all of the PVC lines. Eight months after the installation and just prior to the lines going into service, Hollinger reported that all fourteen sewer sections in the test area passed the 5% mandrel¹.

In July of 1982, six years following the original tests, Mr. Hollinger retested the fourteen lines using 5%, 6½% and 8½% mandrels.¹ This time, only one line allowed a 5% mandrel to pass. Deflection exceeded 5% in the remaining thirteen lines. Seven years later, in August of 1989, the National Clay Pipe Institute, in cooperation with Mr. Hollinger and the city of Lima, again mandrel tested the fourteen lines. Go/No-Go gages based upon average inside diameters for ASTM D 3034 SDR 35 PVC Sewer Pipe of 5%, 6½% and 8½% deflection were used. None of the fourteen lines which originally passed would allow a 5% mandrel to pass. None of the lines would pass the smaller 6½% mandrel and the 8½% mandrel became stopped in ten of the lines. Only four lines allowed the 8½% mandrel to pass indicating that the deflection was between 6½% and 8½%.

The table below summarizes the findings of all three tests:

**MANDREL, DEFLECTION TESTS OF 8-INCH PVC SEWER PIPE
14 LINES - LIMA, OHIO**

| Deflection | 8 Months | 6 Years | 13 Years |
|------------|----------|---------|----------|
| 0 - 5% | 14 | 1 | 0 |
| 5- 6½% | 0 | 10 | 0 |
| 6½ – 8½% | 0 | 3 | 4 |
| + 8½% | 0 | 0 | 10 |

Extensive studies of the influence of time on the performance of thermoplastic pipe materials have been made by NCPI and others. Without exception, these studies have shown that the thermoplastic PVC material continues to deform (creep) under load with time. Only the magnitude of deformation varies as a function of stress level, initial deflection, temperature, environment and body composition.

What is the future for the Lima sewers and other similar sewers around the country? No one really knows for sure. What can be said is that the actual deflections have long since exceeded the design predictions and only time will reveal the final outcome.

Four years after the Lima PVC sewers were installed, a report issued by the American Association of State Highway and Transportation Officials in cooperation with the Federal Highway Administration stated "Present ASTM specifications do not provide assurance that plastic pipe materials can sustain stress or strain for the long term, which is a performance requirement for buried pipe²." The ASTM Standards governing the manufacture of these products still do not contain long-term test requirements.

*Reprint from the National Clay Pipe Institute's "Sewer Sense - No. 25".

¹Hollinger Test Report of Vernon Heights, Ohio, Sanitary Sewers, August 4, 1982.

²Highway Research Report No. 225 "Plastic Pipe For Subsurface Drainage of Transportation Facilities.