THE ORIGINAL WILLIAMS™

REROUNDER™

SYSTEM

PERFORMANCE AND TEST REPORT OF PNEUMATIC VIBRATOR COMPACTOR

PROCEDURE TO REROUND FLEXIBLE PVC PIPE AND CONSOLIDATE SOIL IN THE PIPE ZONE

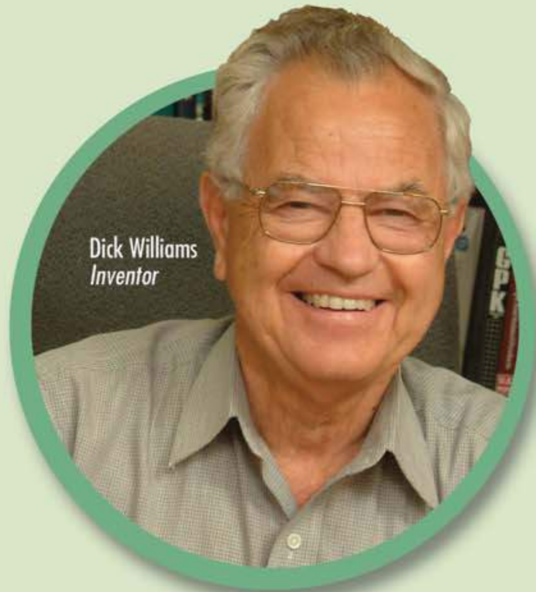
WILLIAMS TESTING, INC.

R. GERMANN PE PS
INSTRUCTOR
OWENS TECHNICAL COLLEGE

What Will You Do If You Fail A Deflection Test?

Don't Re-Excavate—

Reround!



Avoid Job Delays & Lost Revenue!

The Original Williams℠ Rerounder™ System

RELINING PROJECTS:
Rerounding allows you to install a larger pipe liner. Safer! More Reliable! Call us for details.

- ***Guaranteed to eliminate deflection in pipes up to 60" in diameter.***
- ***The best, fastest, most economical system you can use to reround your flexible sewer pipes.***
- ***Most rerounding projects take less than one day to complete.***
- ***We perform the mandrel test immediately afterwards to insure all deflection has been eliminated.***

Don't settle for imitators. Insist on the Original!

Call Toll-Free: 888-648-2200. Or go online at *www.williamsrerounder.com*

NECESSITY IS THE MOTHER OF INVENTION:

How The Original Williams℠ Rerounder™ System Was Born.

The Original Williams℠ Rerounder™ System Saves time & money—guaranteed!

Pipe deflection is caused by poor compacting of bedding material surrounding pipes. Most sewer contractors think the only way to correct deflection is to dig up the trench and start over.

But, Dick Williams, a sewer contractor himself, figured out an easier, less expensive way.

More than 25 years ago, he invented a system that could not only reround deflected sections of pipe, but also improve compaction of the bedding material around the pipe, permanently preventing further deflection.

The Original Williams℠ Rerounder™ System is a patented, proven process. It's the leading choice for solving deflection problems in PVC pipe.

Order the free DVD and see for yourself how it works.

The Original Williams℠ Rerounder™ System will save you time and money—guaranteed!

Dick Williams, Inventor

THE ORIGINAL WILLIAMS REROUNDER SYSTEM

HOW IT WORKS

Don't Re-Excavate—

Reround!

Avoid Job Delays & Lost Revenue!

Deflected pipe

The Original Williams℠ Rerounder™ System transmits vibrations outward through the pipe wall.

As the vibration compacts the bedding, the deflected pipe returns to its original round shape.

THE DEFLECTION IS PERMANENTLY FIXED!

The Original Williams℠ Rerounder™ System

is a patented process that eliminates deflection in PVC, polyethylene and other flexible pipes. The System is simple and effective.

Utilizing a pneumatic vibrator attached to an air hose, *The Original Williams℠ Rerounder™ System* transmits vibrations outward through the pipe wall and into the granular bedding and backfill surrounding the pipe.

The vibration compacts the bedding, allowing the backfill load to be evenly distributed around the pipe.

As the vibrator is pulled through the pipe and the bedding is compacted, the deflected pipe returns to its original round shape.

Creates an ideal, stable environment.

Safely limits deflection to less than three percent.

Guaranteed to work, permanently.

HERE'S WHAT CUSTOMERS AND EXPERTS SAY ABOUT THE ORIGINAL WILLIAMS REROUNDER SYSTEM

"The nice thing about the Rerounder is as it goes through, it not only reconditions the pipe, it made the backfill a better condition around the pipe and we had less settlement."

Bill Degen,
Sewer Contractor

RELINING PROJECTS:
Rerounding allows you to install a larger pipe liner.
Safer! More Reliable! Call us for details.

"It would definitely be more cost effective for the contractor to use The Original Williams℠ Rerounder™ System versus excavation and reinstalling the pipe."

Jim Myers, P.E., P.S.
Consulting Engineer

The rerounder operates at such a high RPM that it doesn't cause that type of deflection or deformation in the pipe. It redistributes the stone around the pipe, and, therefore, bringing the pipe back to its original shape.

Steve Kayatin, P.E.
Sanitary Engineer

Don't settle for imitators. Insist on the Original!

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PREFACE

This report has been prepared to provide both engineering and construction date for rerounding PVC pipe with a REROUNDER™ System. This device provides a mechanical method of compaction to take place after installation and backfill of the flexible pipe, thus attaining a uniform soil density in the pipe zone and along the pipe profile.

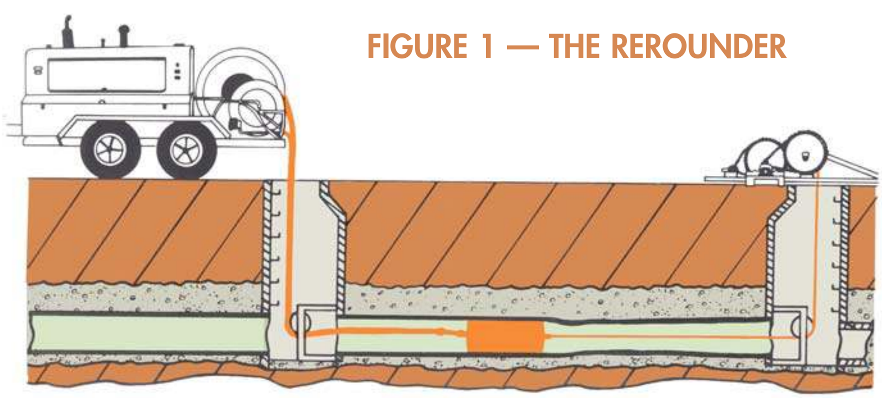
Data resulting from testing also indicates flexible pipe can be installed at far greater depths than previously recommended, with wall deflections maintained at acceptable levels.

Deflection of flexible sewer pipe (PVC) has been a problem for both the manufacturer and the contractor. The purpose of this report is to establish an economical method to eliminate deflection test failures. A secondary result of this operation is the increased bedding density, resulting in greater opportunity for PVC sewer pipe use at considerably greater depths.

Research and performance data for PVC pipe have been accumulated since 1970. This data outlines pipe wall strength compared to trench depth, with comparison to short-term deflection and long-term creep. Representative portions of this data have been incorporated into this report to insure an ongoing consistency and verification of design methods. This report, however, provides a solution to flexible pipe deflection.

PNEUMATIC VIBRATOR COMPACTOR

FIGURE 1 — THE REROUNDER



Patented by Richard L. Williams, U.S. Patent Office #4,309,128

The REROUNDER™ System (Rerounder) involves the same operation as a deflection test which employs Go=No Go cages. The difference is that the cage is replaced with Rerounder. Attached to the Rerounder is an air hose, through which compressed air is supplied to the unit. An above ground compressor furnishes an adequate air source. The Rerounder is designed with variable weight and vibration balance to generate the proper vibration frequency for each size of flexible pipe.

As the Rerounder is pulled through the sewer pipe, the vibrations are transmitted outward through the wall of the pipe and into the granular soil bedding and backfill. This vibratory action rearranges the soil particles into a more dense condition, increasing the percent of compaction.

After the Rerounder has pulled, the excessively deflected pipe will be true round to within 3 percent of the original diameter. Figure 1 illustrates the rerounding of a pipe.

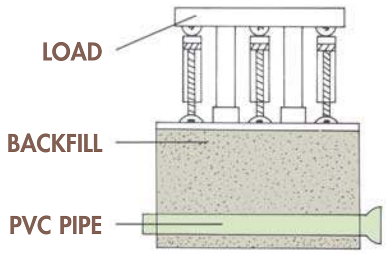
TESTING PROCEDURE

A test cell was constructed as shown in Figure 2. The bedding was placed with no compaction on the bottom of the test cell to the invert of the pipe. The flexible pipe was then placed in the bedding material, and granular backfill was placed to within 6 inches of the top of the cell. A rigid pressure plate assembly was secured to the hydraulic cylinders and positioned to apply a downward load on the bedding and pipe on the cell. The hydraulic cylinders were then activated and the load was applied to the test cell.

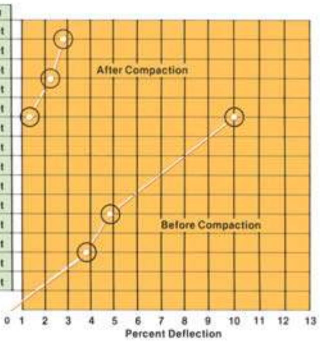
The first deflection check was made at 300 PSI or an equivalent trench depth of 9 feet. The pipe measured 4 percent deflection. (See Table 1) At 500 PSI or 15 feet trench depth equivalent, the pipe measured 5 percent deflection. The load was increased to an equivalent 27 feet depth and the deflection was 10 percent. The load was held constant and the Rerounder was passed through the pipe. With the PSI at 1,000, the pipe measured slightly more than 1 percent, as the table indicates. The load was then increased to 59 feet trench depth equivalent, with slightly more than 2 percent deflection. At 3,000 PSI or 88 feet trench depth equivalent, deflection measured slightly less than 3 percent.

This test procedure has been performed on various pipe sizes and backfill materials. One noticeable result has been that after compaction, deflection results are the same as in the test, regardless of whether the bedding material used is crushed limestone, back run gravel or sand.

FIGURE 2 — TEST CELL PROFILE



LOAD	PSI	DEPTH
254,340	3,000	88 feet
210,000	2,500	72 feet
169,400	2,000	59 feet
127,050	1,500	44 feet
87,780	1,000	30 feet
76,230	900	27 feet
67,760	800	24 feet
59,290	700	21 feet
50,820	600	18 feet
42,350	500	15 feet
33,912	400	12 feet
25,340	300	9 feet
16,956	200	6 feet
8,478	100	3 feet



LOAD is based on total pounds applied on plate under cylinders.

PSI is hydraulic pressure applied to cylinders.

DEPTH is vertical feet of backfill based on prism load formula.

TEST RESULTS

The test results relating to the Rerounder's effect on bedding in reference to compaction are found in Figures 3 and 4 below. In both test, the load was applied to the plate (1) by the hydraulic cylinders (2) with an adjustable PSI hydraulic pump to represent a trench depth of 30 vertical feet. The Rerounder was passed through the pipe, with the load held constant to represent a trench condition. Pins (3) were removed and the cylinders, upper frame and load plate were removed from the test cell.

A compaction test was taken at about 30 inches above the top of the pipe, with 95.46 percent density at 3.4 percent dry optimum (Figure 3) and 92.0 percent density at 3.1 percent dry of optimum (Figure 4). The bedding in both tests was removed to the spring line of the pipe and a compaction test was taken at about 12 inches off the centerline. These tests were with 91.0

percent density at 7.2 percent moisture on the 8-inch pipe, and 89.8 percent density at 5.3 percent moisture on the 15-inch pipe. Still another test was taken in the trench cradle after the pipe was removed, and that test was with 96.0 percent density at 4.3 percent moisture or 4.7 percent dry optimum.

The test of the trench cradle is actually the key to the success of the Rerounder. This is the area of the pipe zone which requires the highest percentage of compaction to reduce deflection and increase the structural strength of any pipe, regardless of materials.

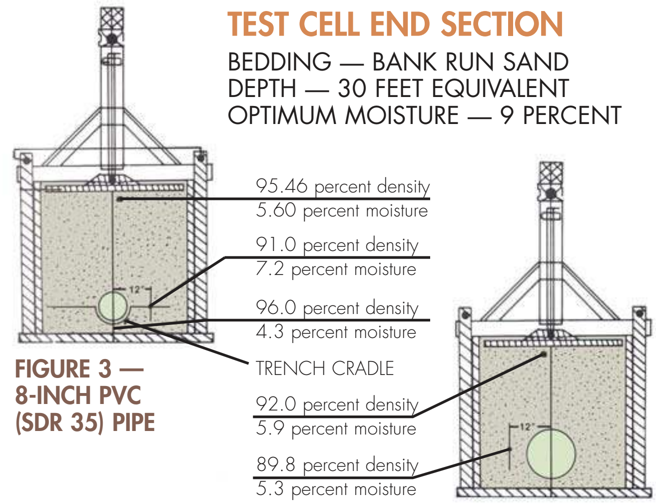


FIGURE 3 — 8-INCH PVC (SDR 35) PIPE

FIGURE 4 — 15-INCH PVC (SDR 35) PIPE

Because of the composition of rigid products, effective use of this process and machine would be impossible. The use if this equipment with flexible pipe allows the design engineer to confidently design systems that will outperform rigid products, regardless of depth.

BEDDING AND BACKFILL

ASTM D2321. This ASTM specification states that pipe stiffness greater than 25 PSI is suitable for installation in Class I, II or III embedment materials. It has since been shown that pipe with a pipe stiffness equal to or greater than 40 PSI is suitable for installation with Class I, II, III and IV are defined as follows:

Class I – Angular 1/4 to 1 1/2-inch graded stone including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone and crushed shells.

TABLE 2 — MAXIMUM LONG-TERM DEFLECTIONS OF PVC (SDR 35) PIPE IN PERCENT

SOURCE: UTAH STATE UNIVERSITY

ASTM EMBEDMENT MATERIAL CLASSIFICATION		DENSITY (PROCTOR) AASHO T-99	HEIGHT OF COVER IN FEET													
			3	5	8	10	12	14	16	18	20	22	24	26	28	30
Manufactured Granular Angular	CLASS I		0.2	0.3	0.4	0.5	0.6	0.7	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6
Clean Sand and Gravel	CLASS II	90%	0.2	0.3	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.4	1.6	1.7	1.8	2.0
		80%	0.9	1.4	2.3	3.2	3.6	4.1	5.0	5.5	6.0	6.4	7.3	7.7	8.2	9.1
Sand and Gravel With Fines	CLASS III	90%	0.2	0.4	0.6	0.8	0.9	1.1	1.2	1.4	1.6	1.7	1.9	2.1	2.2	2.3
		85%	0.7	0.9	1.7	2.2	2.6	3.0	3.5	3.9	4.3	4.8	5.2	5.6	6.0	6.5
		75%	1.1	1.8	2.9	3.8	4.5	5.5	6.8	8.5	9.9	11.3	12.7	14.1	15.5	16.8
		65%	1.3	2.4	3.6	4.7	5.5	6.8	8.5	9.6	11.4	13.0	14.5	16.0	17.3	18.0
Silt and Clay	CLASS IV	85%	0.65	0.9	1.7	2.2	2.6	3.0	3.5	3.9	4.3	4.8	5.2	5.6	6.0	6.5
		75%	1.3	2.3	3.3	4.3	5.0	6.5	7.8	9.5	10.6	12.2	13.5	15.0	16.3	17.0
		65%	1.3	2.4	3.6	4.7	5.5	8.0	10.5	12.5	15.0	17.6	20.0	22.0	24.0	26.0
Organic Soils and Peat	CLASS V	THIS SOIL CLASS NOT RECOMMENDED														

THESE ZONES NOT RECOMMENDED

1. No length of pipe installed under conditions specified will deflect more than is indicated; the pipe will deflect less than the amount indicated if specified density is obtained.

2. Embedment material classifications are as per ASTM designation D2321-72 "Underground Installation of Flexible Thermoplastic Sewer Pipe."

3. Deflections listed in this table are maximum long-term values. The suggested maximum long-term value is 7.5 percent which is approximately equal to a 5 percent short-term value.

This table clearly indicates excess deflection is realized when the soil compaction is less than 90 percent for most soils.

Class II – Coarse sands and gravels with ?-inch maximum particle size including variously graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil types GW, GP. SW and SP are included in this class.

Class III – Fine sand and clay gravels including fine sands, sand-clay mixtures and gravel-clay mixtures. Soil types GM, GC, SM and SC are included in this class.

Class IV – Silt, silty clays and clays including inorganic clays and silts of medium to high plasticity and liquid limits. Soil types MH, ML, CH and CL are included in this class.

The design engineer should refer to Table 2 below which readily correlates trench loading to deflection.

CREEP AND DESIGN TABLES

Creep is continuous during the time when flexible pipe is being subjected to additional loading. Soil loading in the trench will continue until soil is consolidated or compacted to its original density. Compaction will be immediately accomplished if the Rerounder is used. This will prevent further deflection of any consequence.

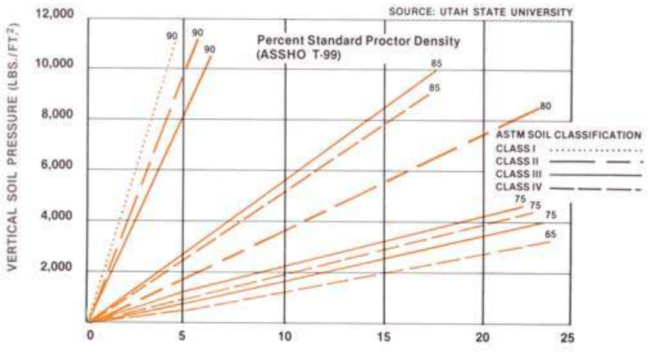
Figure 5 graphically shows loading-deflection data for PVC sewer pipe. It represents a compilation of both laboratory soil-box test data and actual field data. Each line represents the upper limit for a particular soil type and proctor density in the haunching zone. The maximum long-term deflection will be less than or equal to that shown.

Table 2 is a tubular representation of the same information. Again, the listed deflections are the predicted maximum long-term values. Thus, one need not include a deflection lag factor when this table is used for design. It is suggested that the maximum design deflection be limited to 7.5 percent which is approximately equal to a 5 percent initial deflection.

Again, since design is based on actual test data for deflection, the actual load on the pipe is academic and need not be considered. Thus, pipe diameter and trench width do not appear in the table. Many researchers have shown that the effective load on a flexible conduit lies somewhere between that predicted by the Marston load theory and the embankment load, and on a long-term basis may approach the embankment load. Therefore, if one desires to calculate effective load, the embankment (prism) load is suggested.

FIGURE 5 — VERTICAL RING DEFLECTION IN PERCENT

Load deflection curves for SDR 35 PVC sewer pipe buried with pipe zone soil compacted to a given proctor density.



This graph also indicates the material in the pipe zone must be compacted to 90 percent for best results. Density to prevent excessive deflection for flexible pipe in a relatively deep excavation can only be achieved with the internal REROUNDER™ System to attain proper results while offering a safe working environment.

THE ORIGINAL WILLIAMS™
REBOUNDER™
SYSTEM

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