Research Report
KTC-95-2

FIELD PERFORMANCE REPORT ON PVC PIPE CAMPBELL COUNTY

by

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Transportation Cabinet
Commonwealth of Kentucky

and

Federal Highway Administration
U.S. Department of Transportation

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16. Abstract

This report documents the installation and performance of PVC pipe installed on KY 9 in Campbell County. The pipe installed was Perma-Loc, manufactured by J-M Manufacturing Company, Inc.

Pipes appear to be performing well with the clean coarse sand backfill. It is apparent the pipe is brittle at lower temperatures, and caution should be exercised during cold weather construction.

It is apparent that the contractor achieved substantial compaction around the haunches and the side of the pipe which is helping to reduce pipe deflection.

In July 1995, the pipes will have been installed for approximately two years. Minor changes in pipe deflection are still occurring in approximately 40 percent of the pipes. The other 60 percent appear to be stabilized.

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EXECUTIVE SUMMARY

This report documents the installation and performance of PVC pipe installed during construction of KY 9 in Campbell County. The pipe installed was Perma-Loc pipe manufactured by J-M Manufacturing Company, Inc..

It is apparent the pipe is brittle at lower temperatures, and caution should be exercised during cold weather construction.

The pipes appear to be performing well with the clean coarse sand backfill. It is also apparent that the contractor achieved substantial compaction around the haunches and the side of the pipe which is likely helping to reduce pipe deflection.

In July of 1995, the pipes will have been installed for approximately 2 years. Minor changes in pipe deflection are still occurring in approximately 40 percent of the pipes. The other 60 percent appear to be stabilized.

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INTRODUCTION

The Kentucky Transportation Center was requested by the Kentucky Transportation Cabinet to monitor the field performance of Polyvinyl Chloride (PVC) Pipe on KY 9 in Campbell County (Project NO. FSP 019 0009 013-015 C-DE-STPM 0020 (804)).

Included in this report are construction and performance information. A video tape is also provided showing the final inspection of the pipe with a Cues Mini Camera.

CONSTRUCTION

Prior to installation, on December 11, 1992 the PVC pipe was inspected in the stockyard at the construction site on KY 9 shortly after delivery. Approximately 19 out of 65 pipe sections had been slightly to significantly damaged during delivery (Figures 1 and 2). The Resident Engineer indicated that several of the pipes had fallen off the truck during unloading. The pipes were fairly brittle at the time they were being unloaded due to the cold temperatures (approximately -9°C (15°F)). Figure 3 was derived from the Uni-Bell Handbook (1) and extrapolated to colder temperatures. Figure 3 indicates the impact strength of the pipe could be as much as 40 percent lower when comparing strength properties at 23°C and -9°C (73.4°F and 15°F).

The construction project was postponed due to unstable embankment conditions and only a portion of the pipes were installed. Prior to the project being postponed, six cross drains had been installed. The pipes were backfilled with a clean sand slightly over the crown of the pipe (Figures 4 and 5). Since the final fill elevations were not achieved, the fill heights were established by survey (Figure 6). The maximum fill height obtained during construction was approximately 4 meters (12 feet) at Station 160+00.

PERFORMANCE

The cross drains were monitored during construction, and have been visually inspected several times since installation. The pipes were last inspected in December 1994 with a Cues Mini Camera. A majority of the cross drains appear to performing well.. Significant distress was observed in one of the cross drains. The distress was observed in a 0.61 m (24 inch) cross drain at Station 129+72. Distress was observed toward the outlet end of the cross drain. During a visual inspection shortly after installation, approximately 2.4 meters (8 feet) of pipe on the outlet end was unsupported (Figure 7). It was apparent that the pipe had not been cut off and/or the fill around the pipe had eroded. In October, 1993, at a later inspection, it was apparent that this section of pipe had been covered during the reshaping of a sliding embankment (Figure 8). It appears that in this process the pipe was bent down causing the pipe to crack and deflect approximately 8.3 percent (Figure 9).

Pipe Deflections

Pipe deflection measurements have been taken on the six cross drains since installation (Appendix A). Pipe deflections were monitored at 29 locations. In approximately 67 percent of the pipes that were monitored, the vertical dimension was greater than the horizontal after installation. It is apparent that the pipe was compressed horizontally during the backfilling around the sides and haunches of the pipe. The average pipe deflection recorded was 2.74 percent.

CONCLUSIONS

It is apparent the pipe is brittle at lower temperatures, and caution should be exercised during cold weather construction.

The pipes appear to be performing well with the clean coarse sand backfill. It is also apparent that the contractor achieved substantial compaction around the haunches and the springline of the pipe. This has helped to keep pipe deflection at a minimum.

In July of 1995, the pipes will have been installed for approximately 2 years. Minor changes in pipe deflection are still occurring in approximately 40 percent of the pipes. The other 60 percent appear to be stabilized.

RECOMMENDATIONS

It is recommended that these pipes continue to be monitored for long-term performance.

It is recommended that this pipe be used as an alternative to concrete, steel, aluminum, and polyethylene pipe .

It is also recommended that future installations be monitored for short-and long-term performance.

REFERENCES

1. "Handbook of PVC Pipe, Design and Construction", Third Edition, Uni-Bell PVC Pipe Association, Dallas, September 1991, pp. 213.

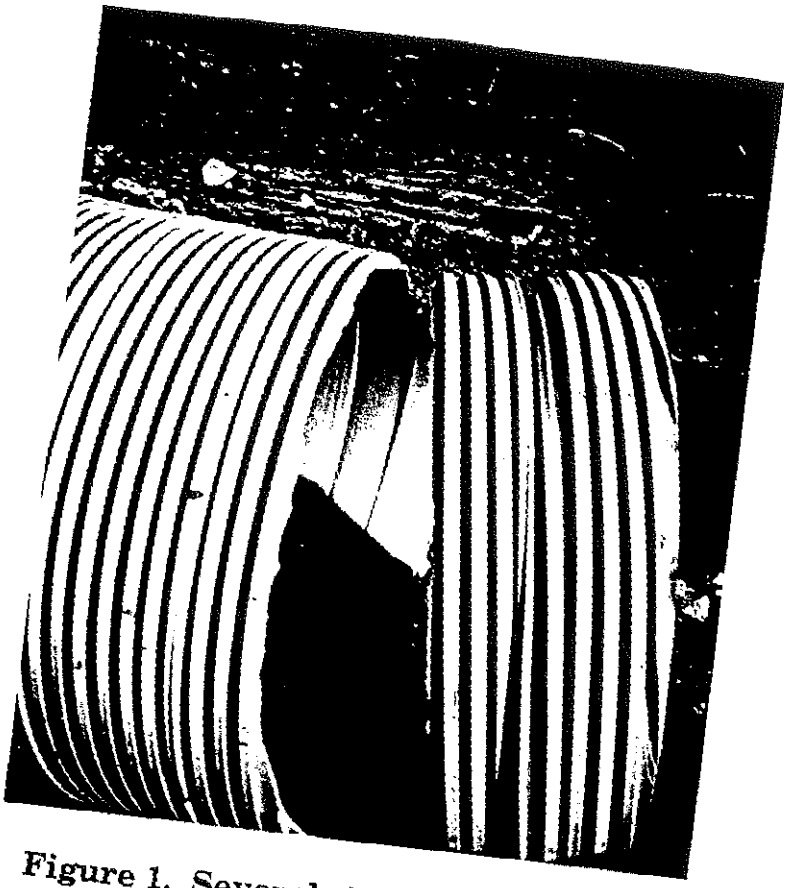


Figure 1. Severely Damaged PVC Pipe

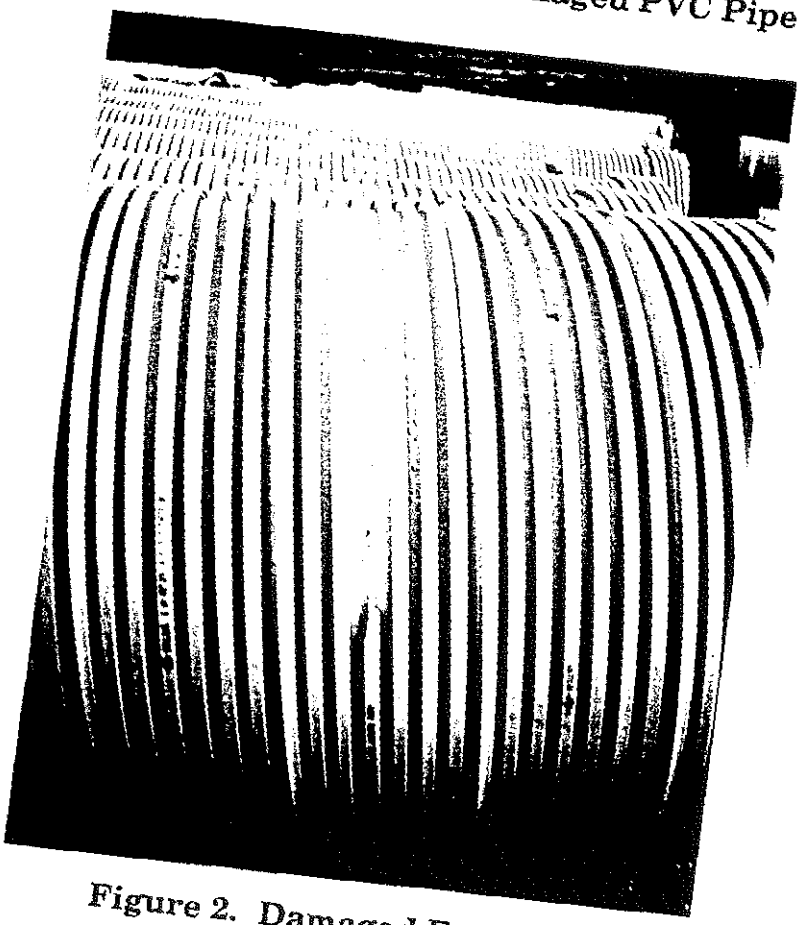


Figure 2. Damaged Exterior Rib

Figure 3. Effect of Cool Temperatures on Impact Strength of PVC Pipes

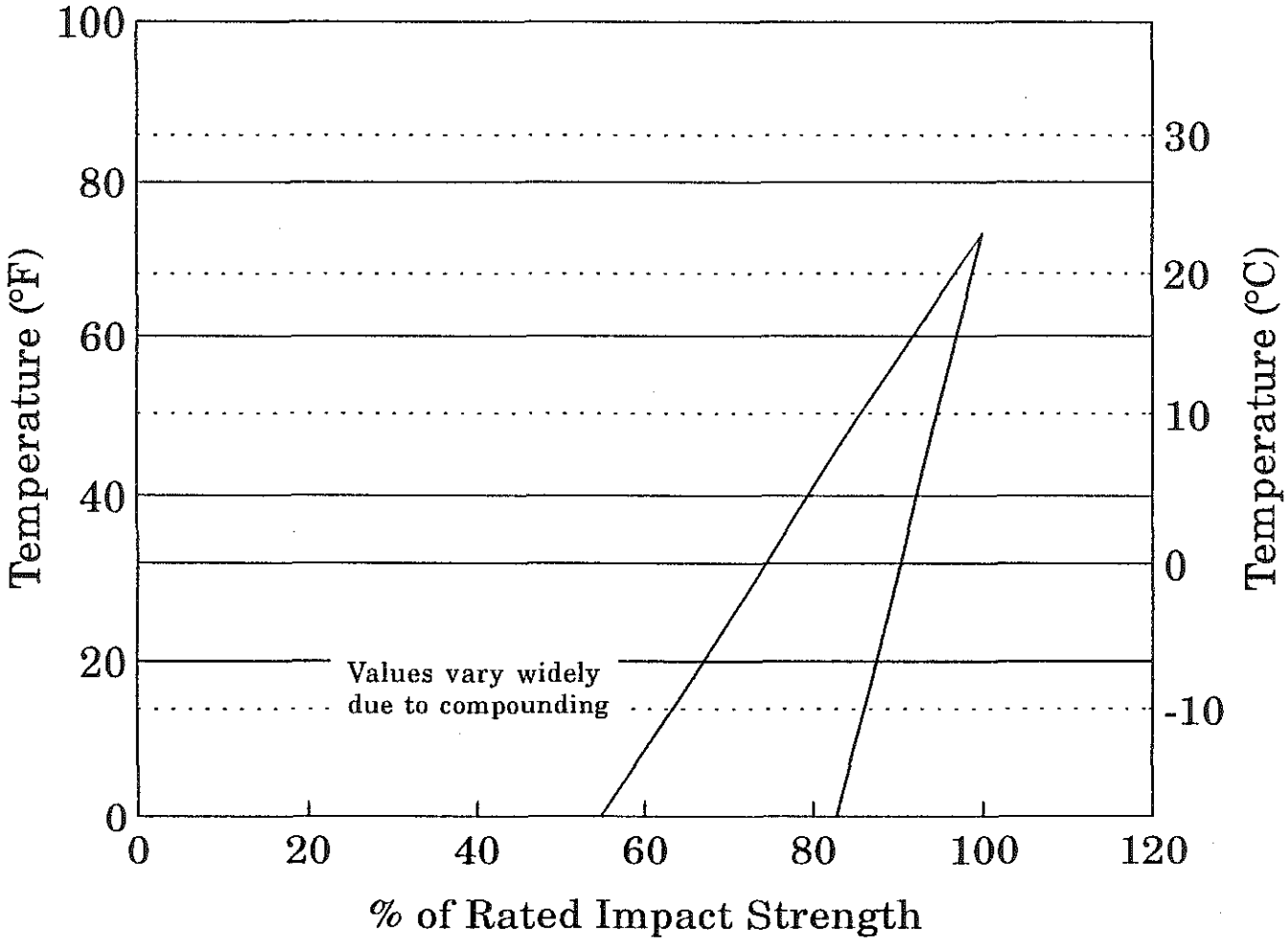
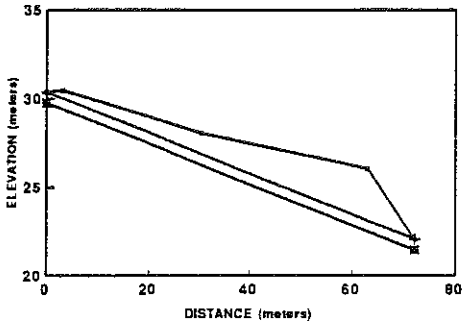


Figure 4. Installation of 1.2m Pipe at Station 104+70

Figure 5. Installation of 0.76 m Pipe at Station 162+00

Figure 6. Elevation Profiles

Station 100 + 72 (0.61 m pipe diameter)
(Installed 7-1-93)



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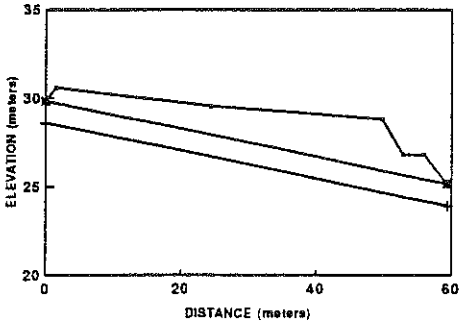

Station 129 + 72 (0.61 m pipe diameter)
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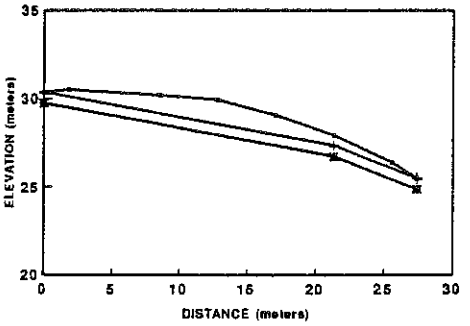

Station 132 + 94 (0.46 m pipe diameter)
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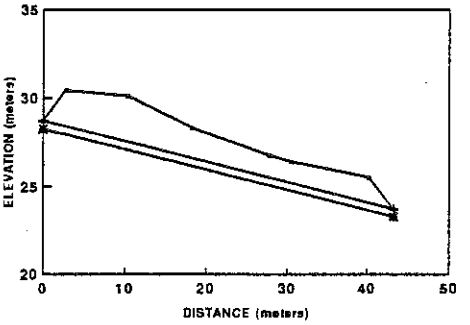

Station 160 + 00 (0.61 m pipe diameter)
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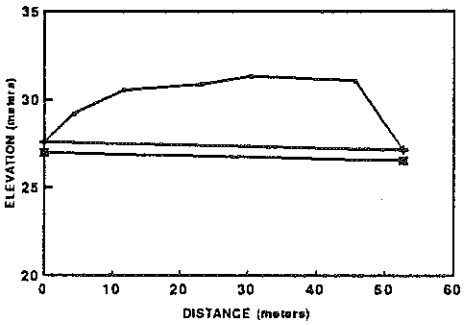

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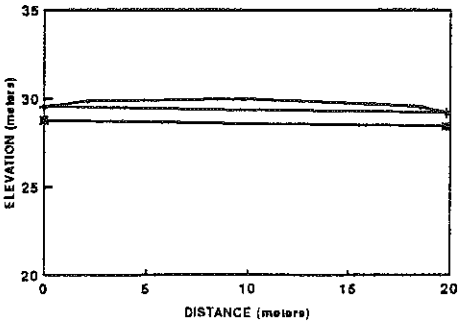


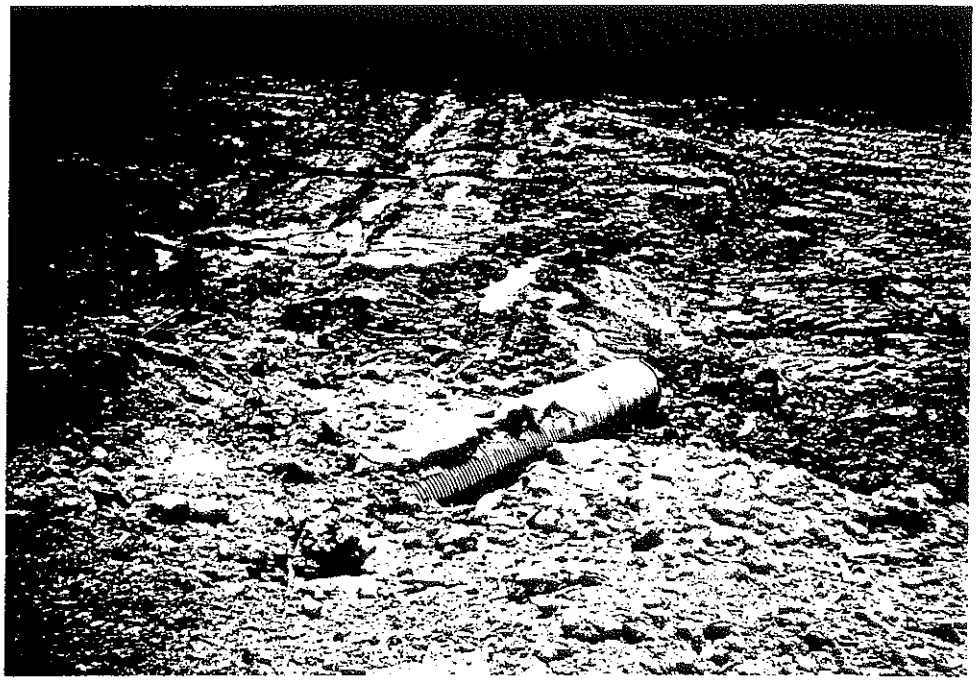


Figure 7. Outlet End of PVC Pipe at Station 129+72

Figure 8. Outlet End of PVC Pipe at Station 129+72

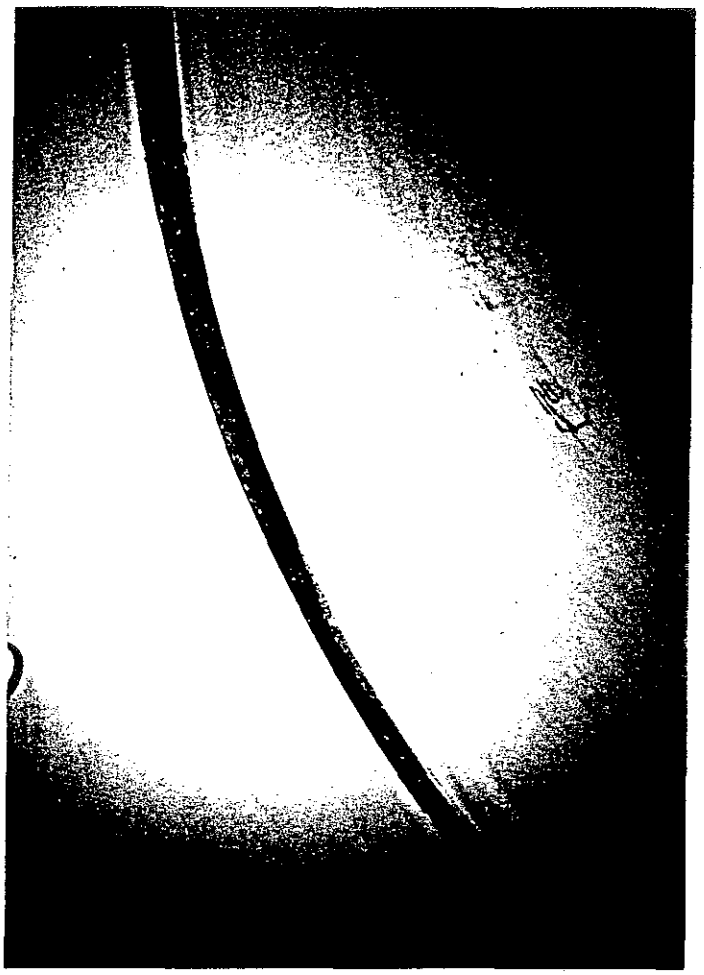
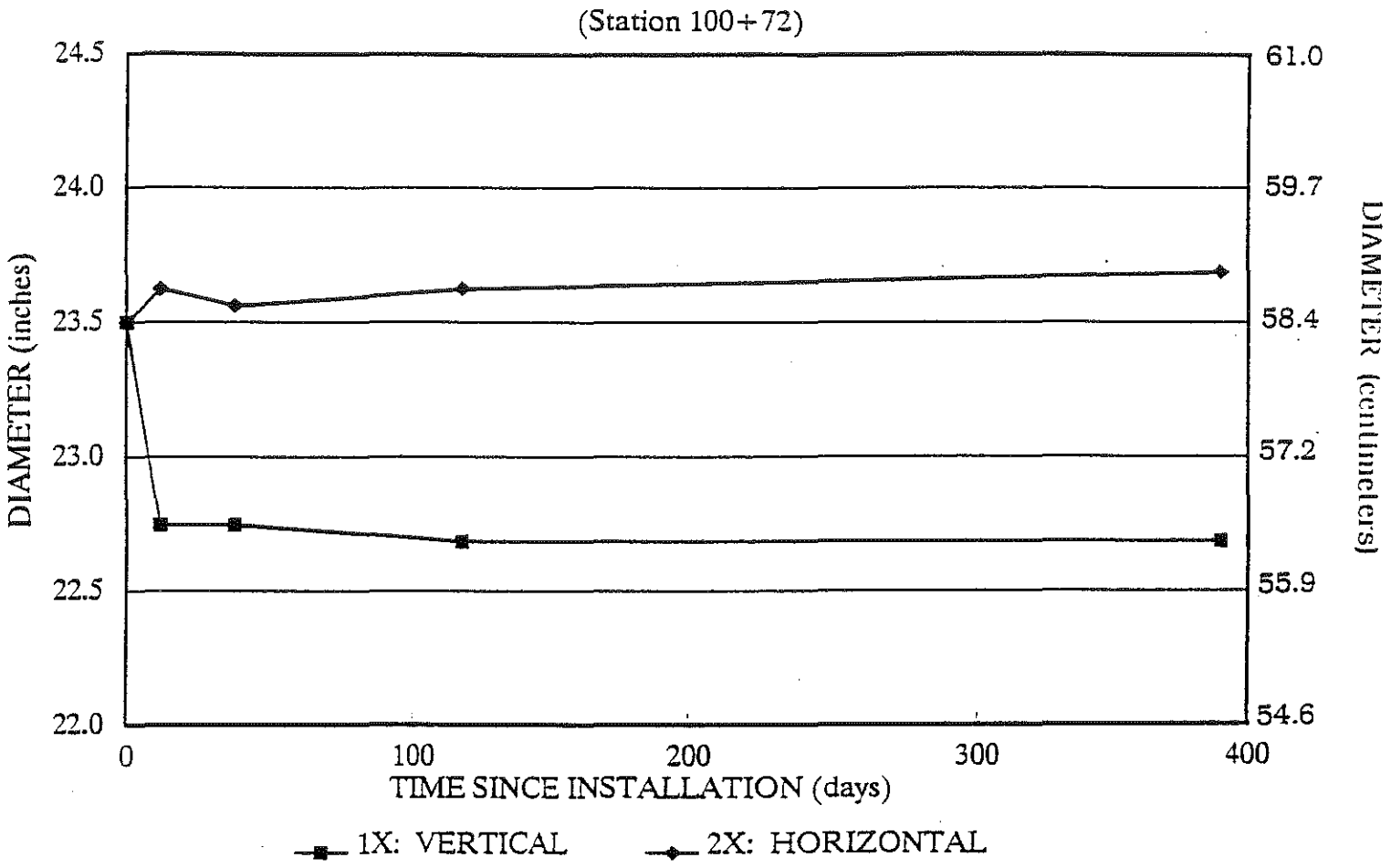


Figure 9. Crack in Interior Wall of Pipe at Station 129+72

APPENDIX A
(PIPE DEFLECTION MEASUREMENTS)



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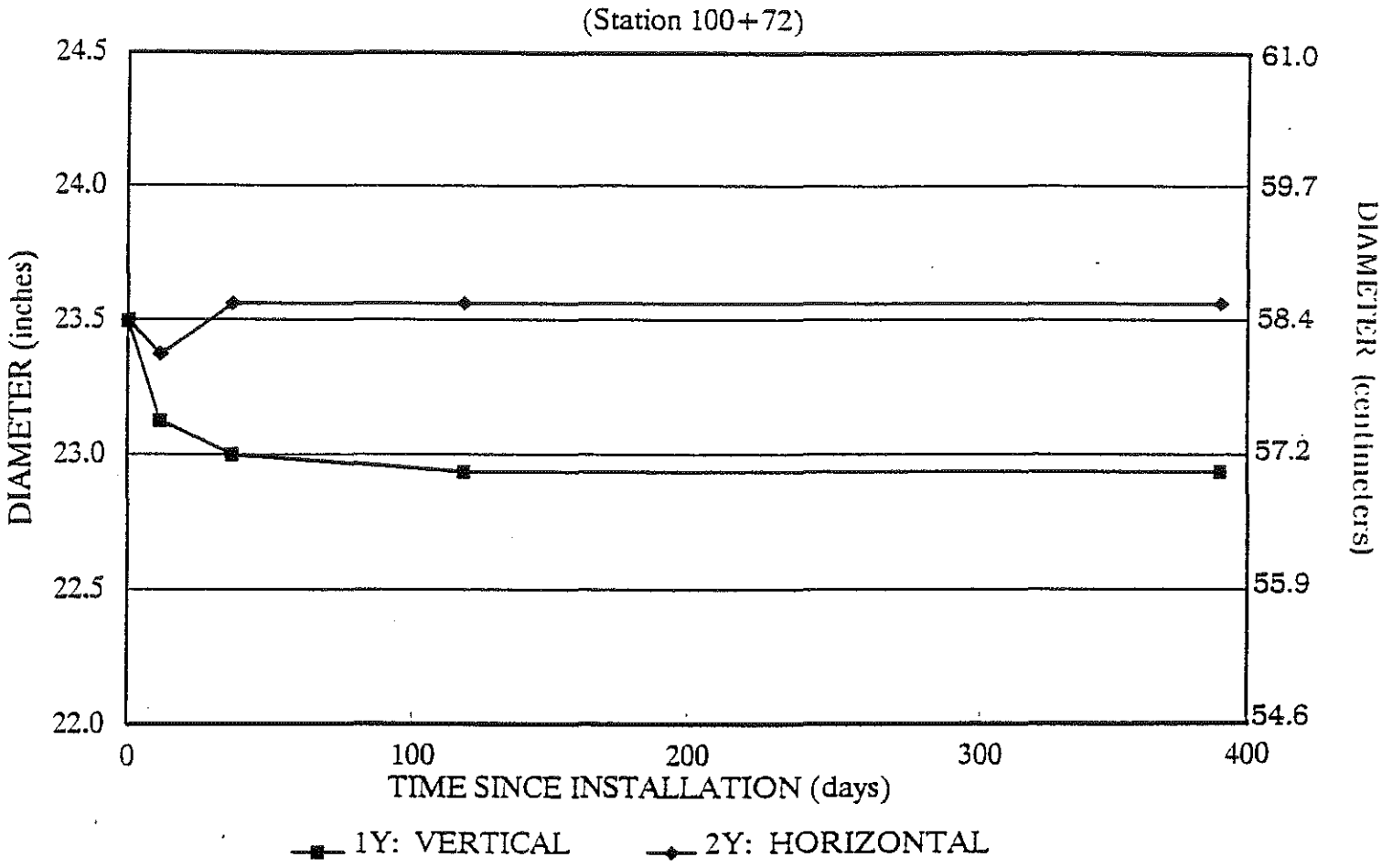

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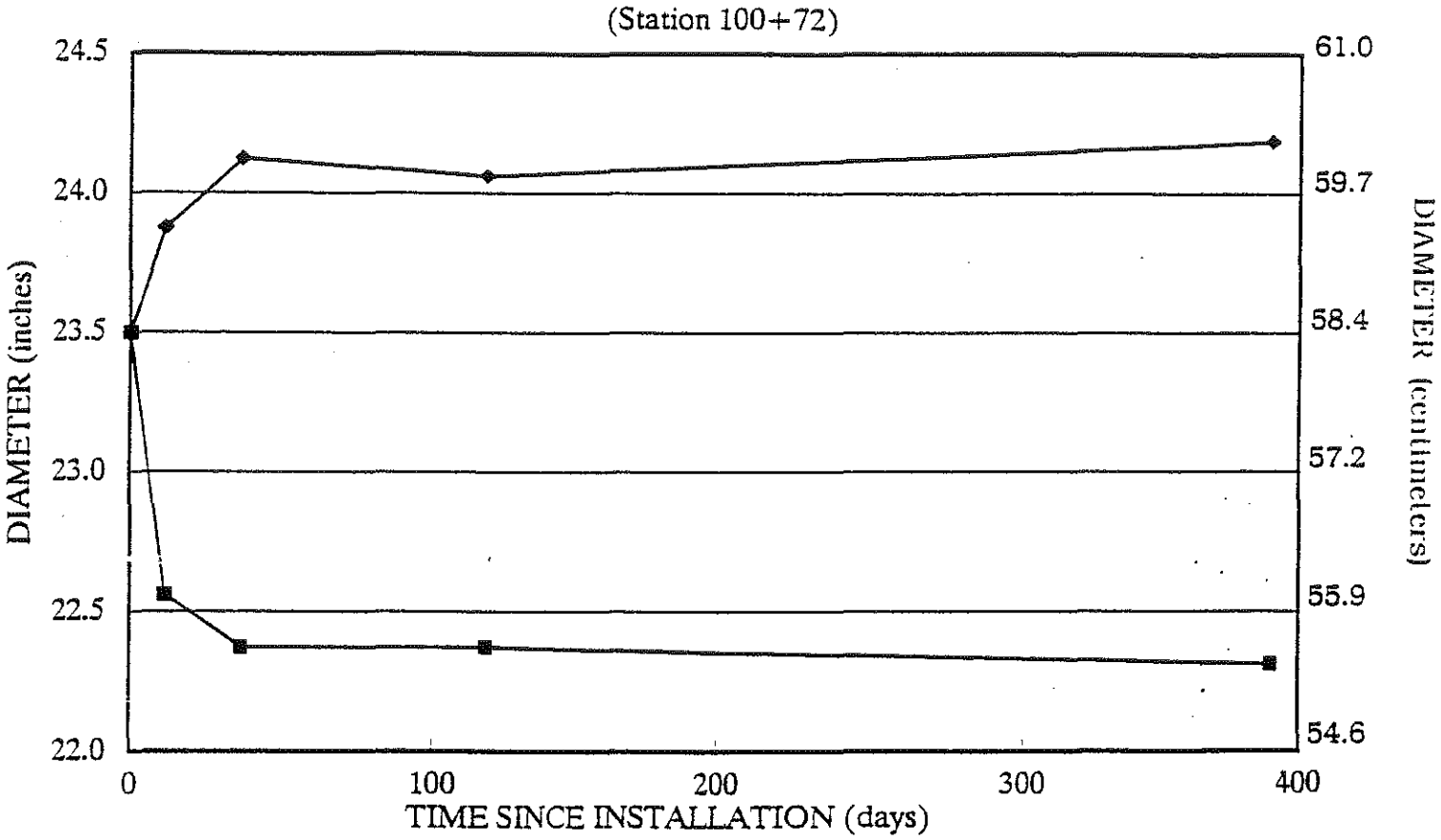

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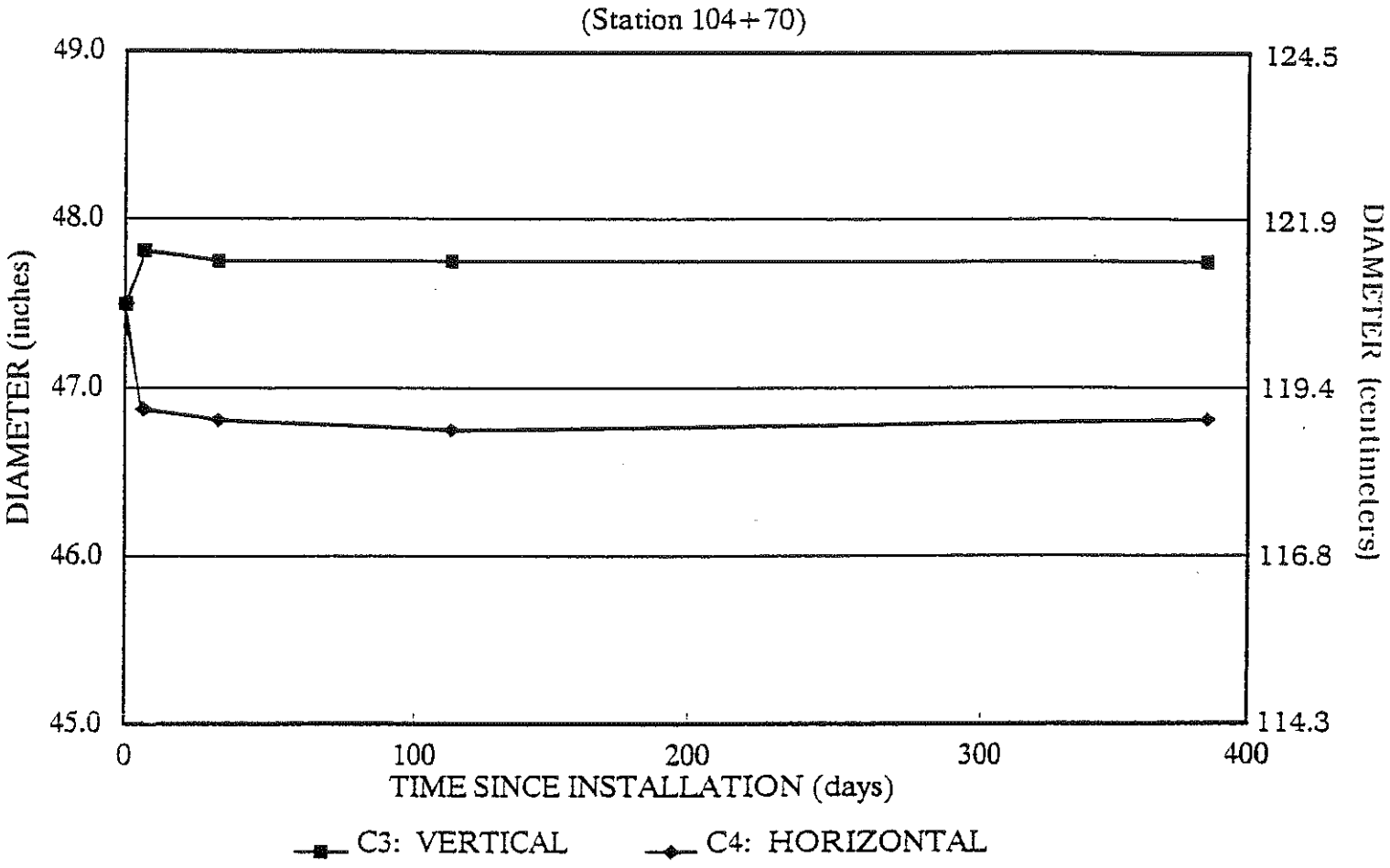

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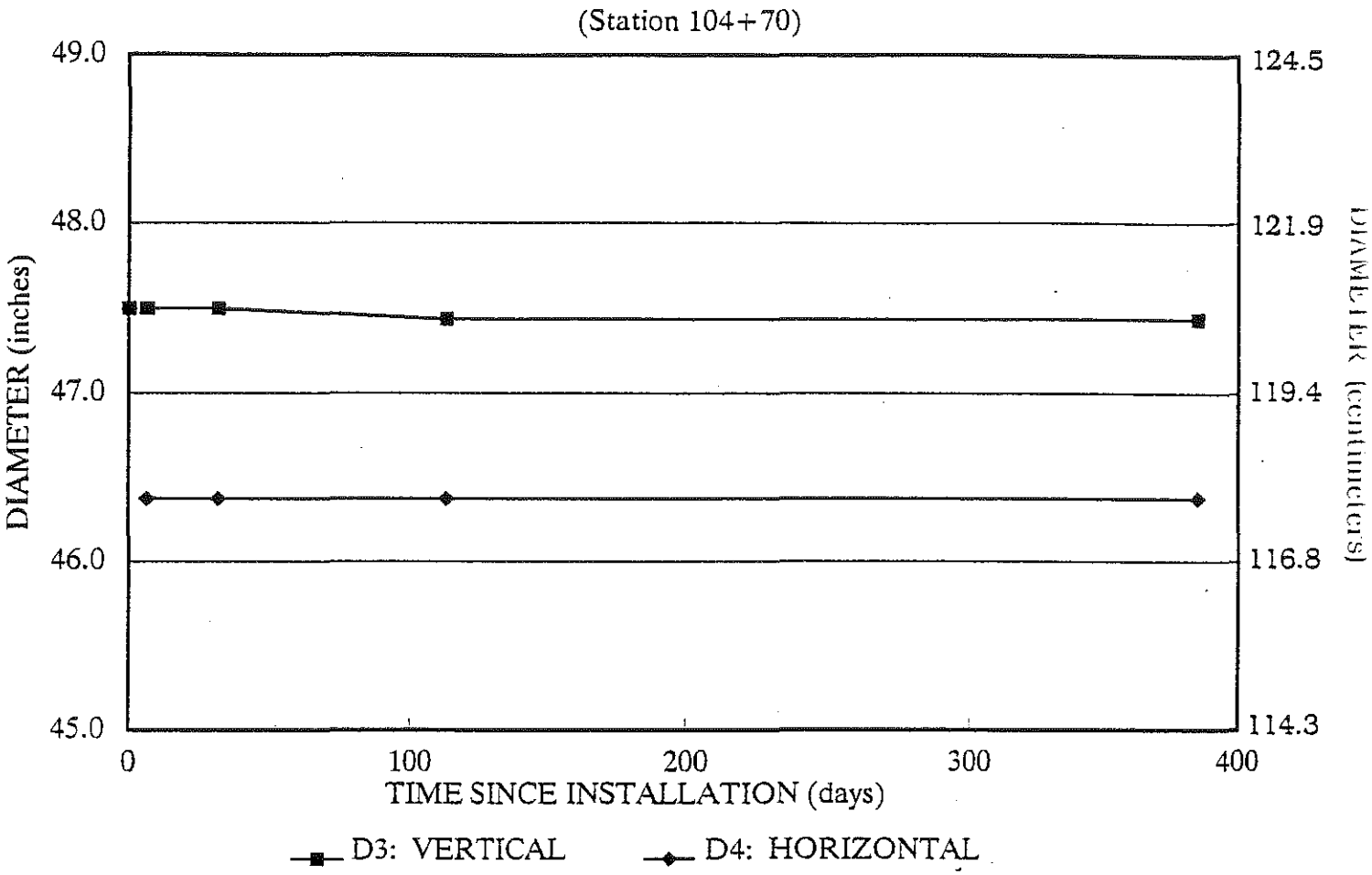
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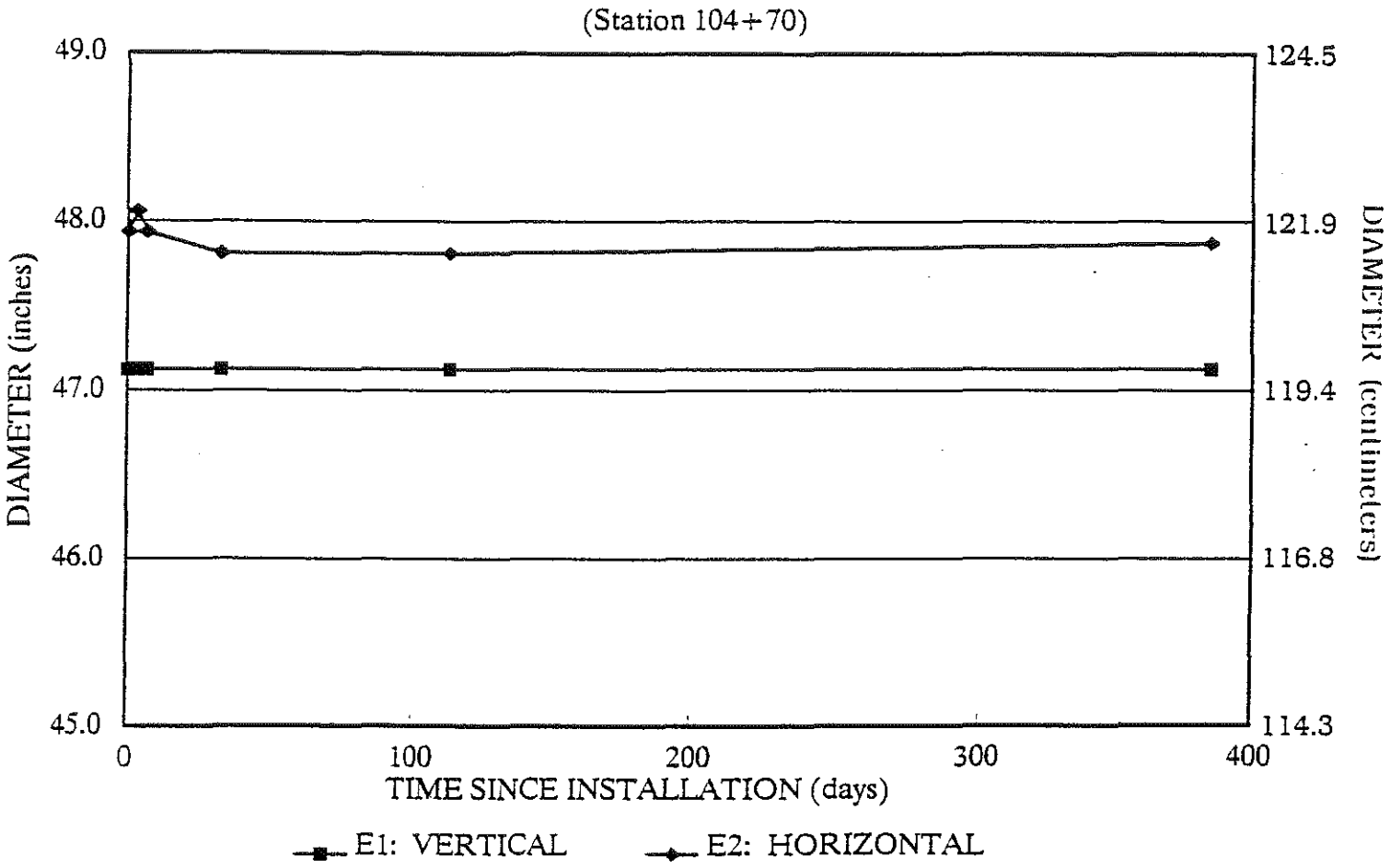
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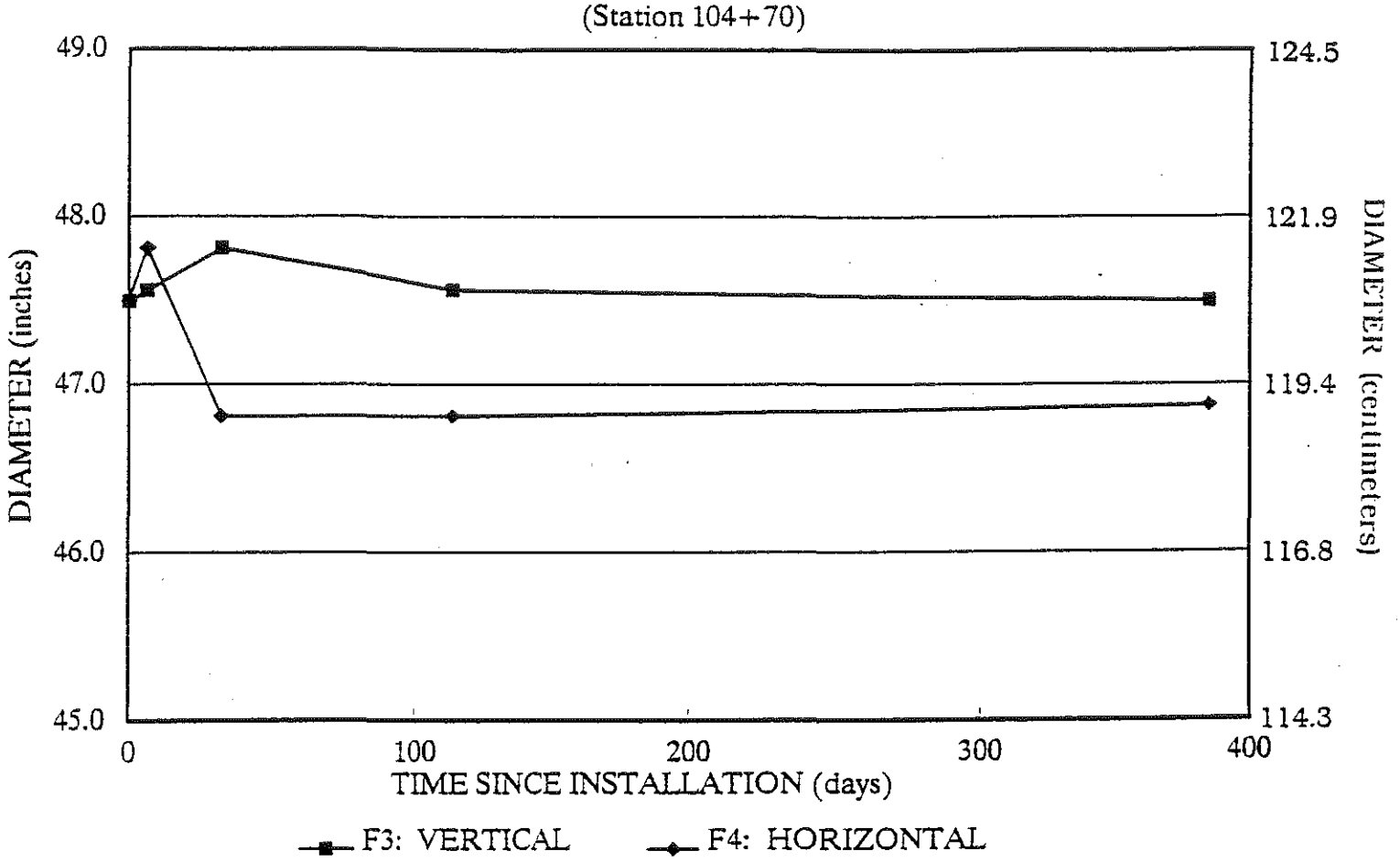

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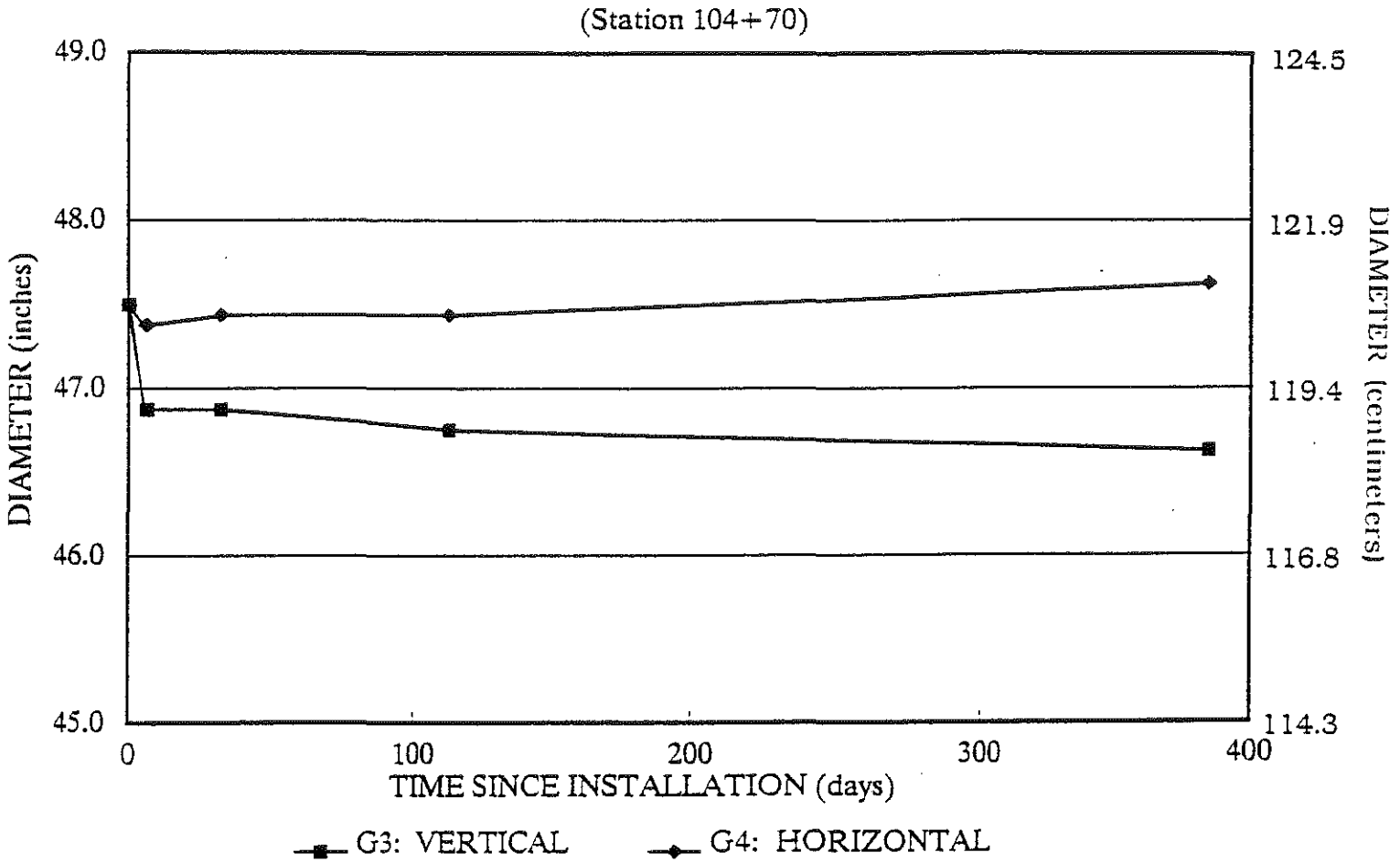

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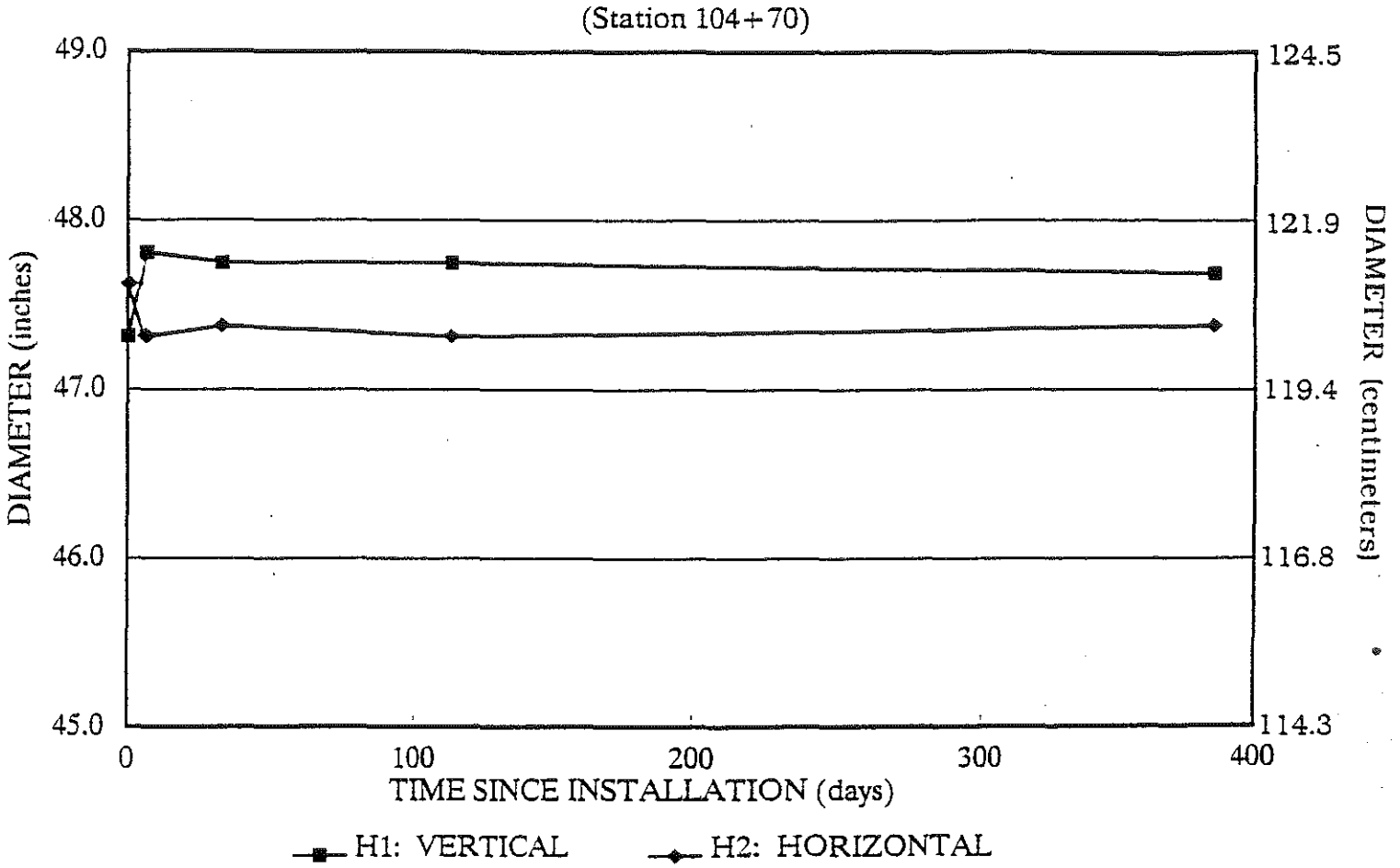
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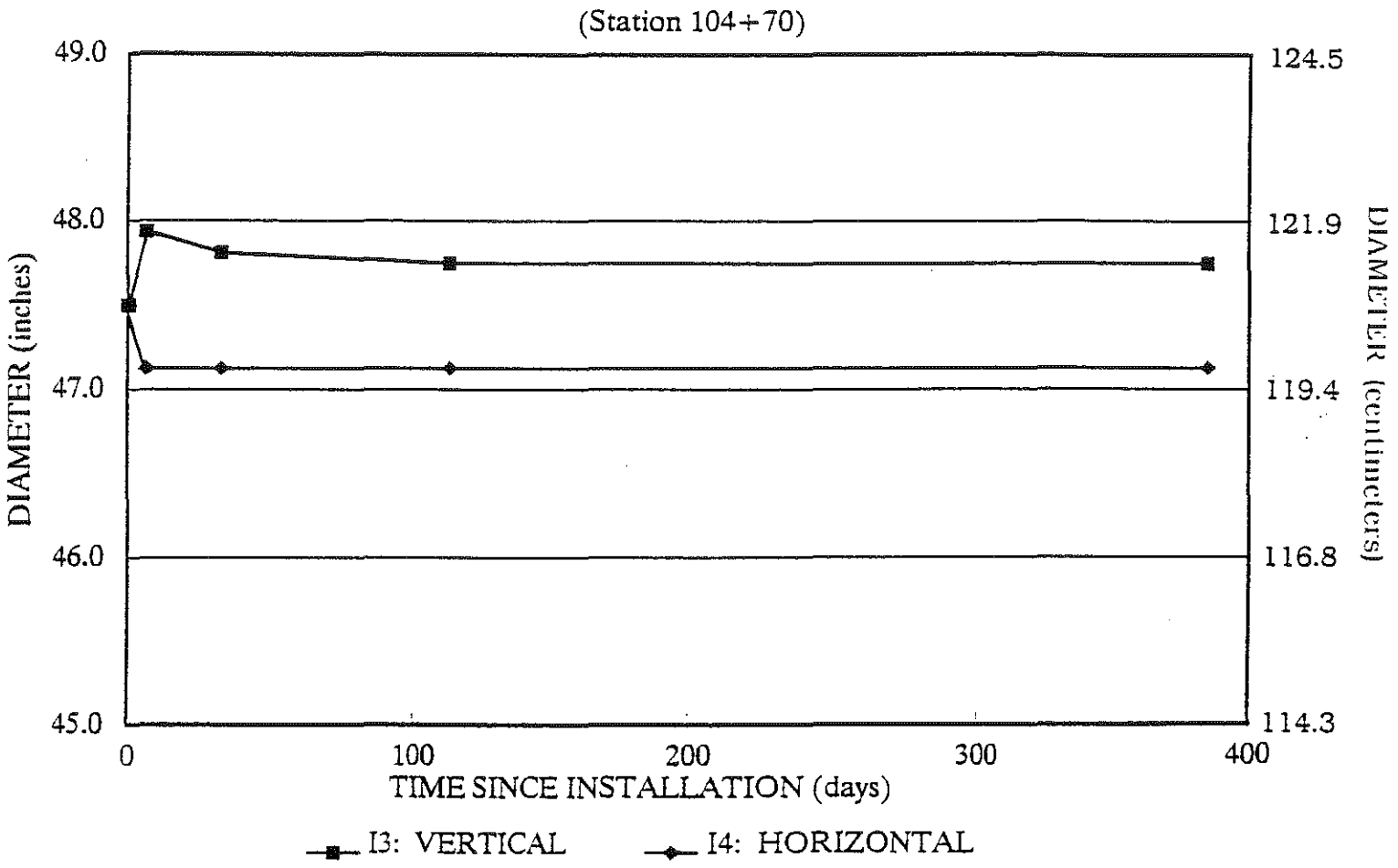
TIME SINCE INSTALLATION (days)
H1: VERTICAL
H2: HORIZONTAL



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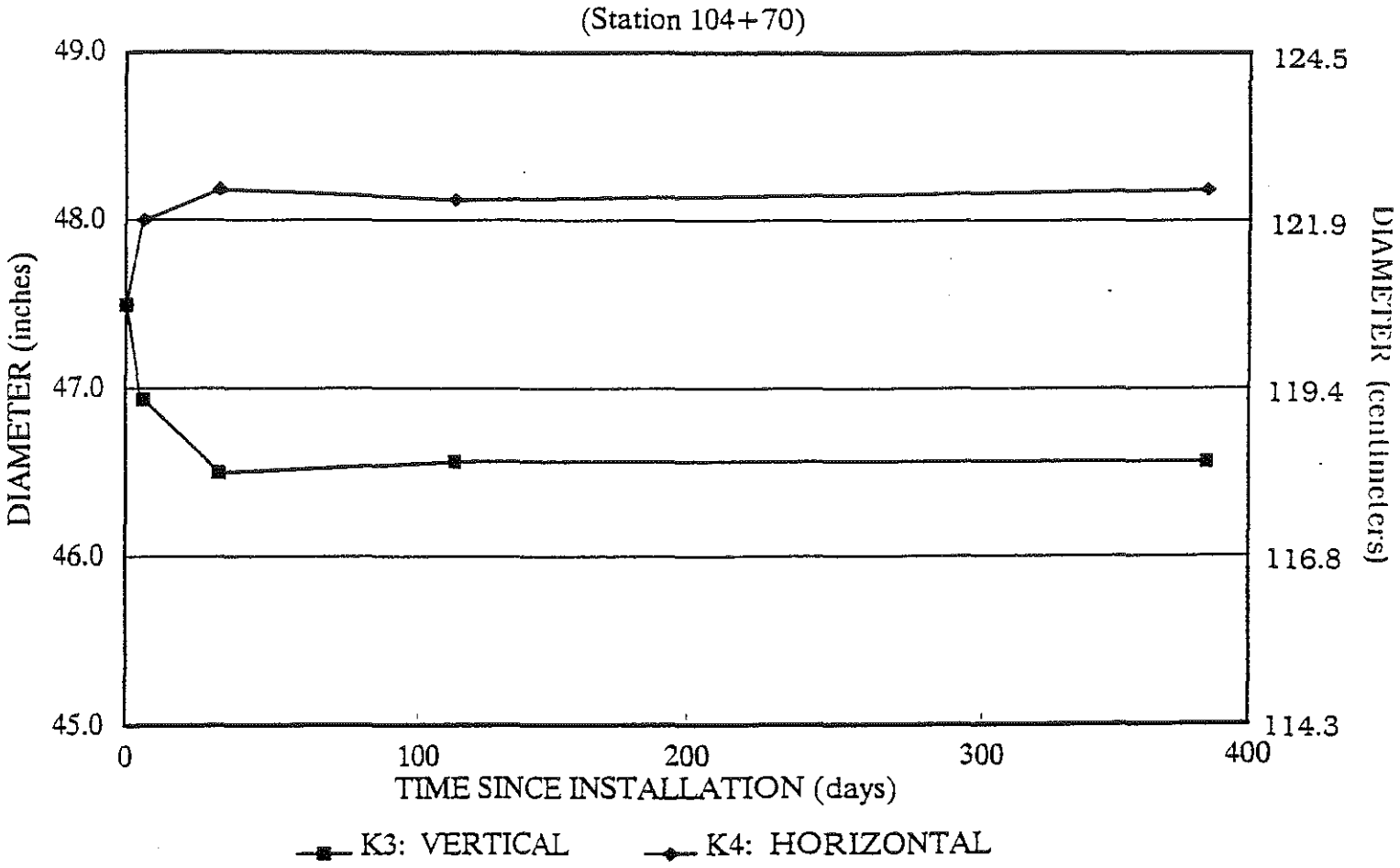

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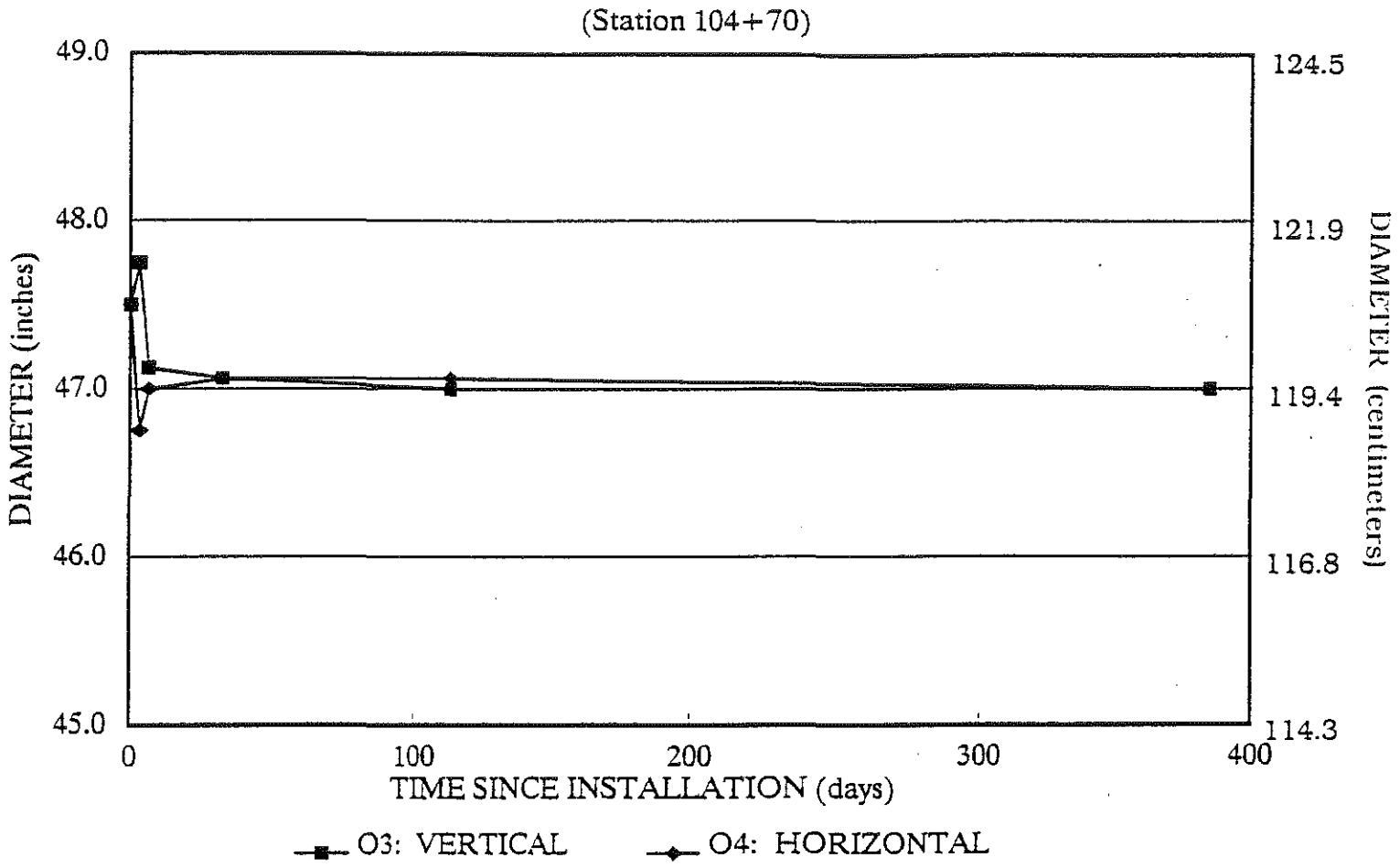

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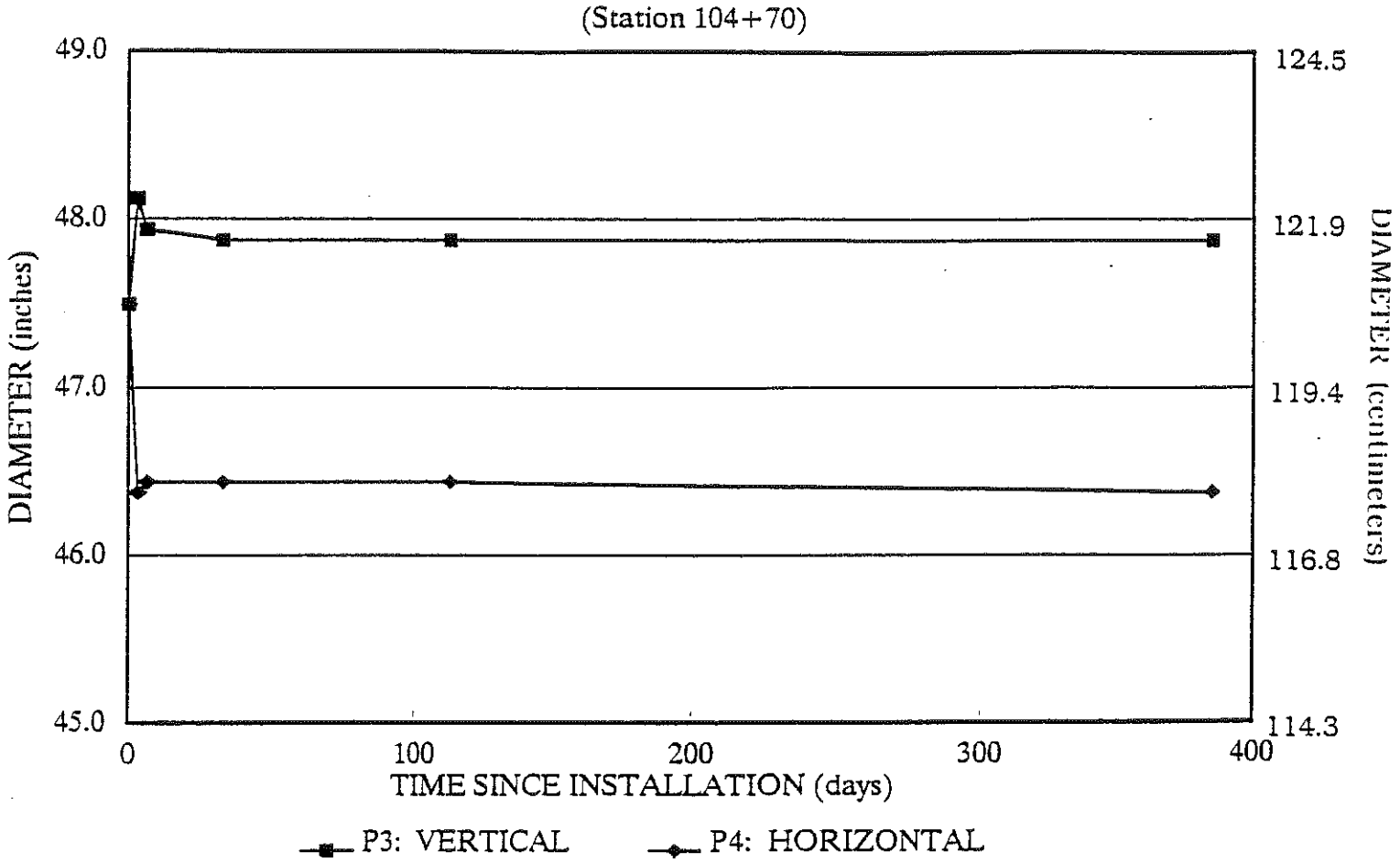

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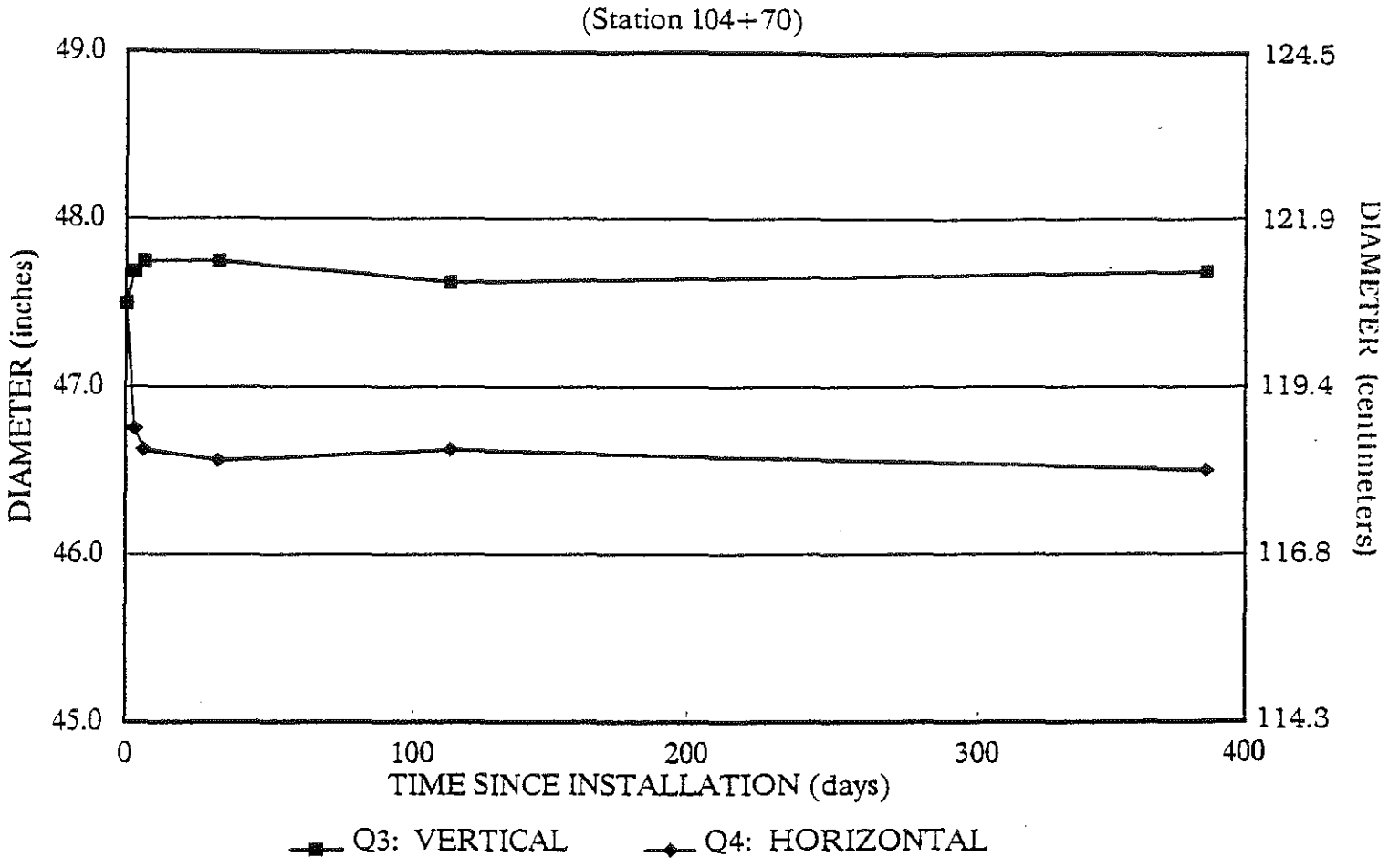

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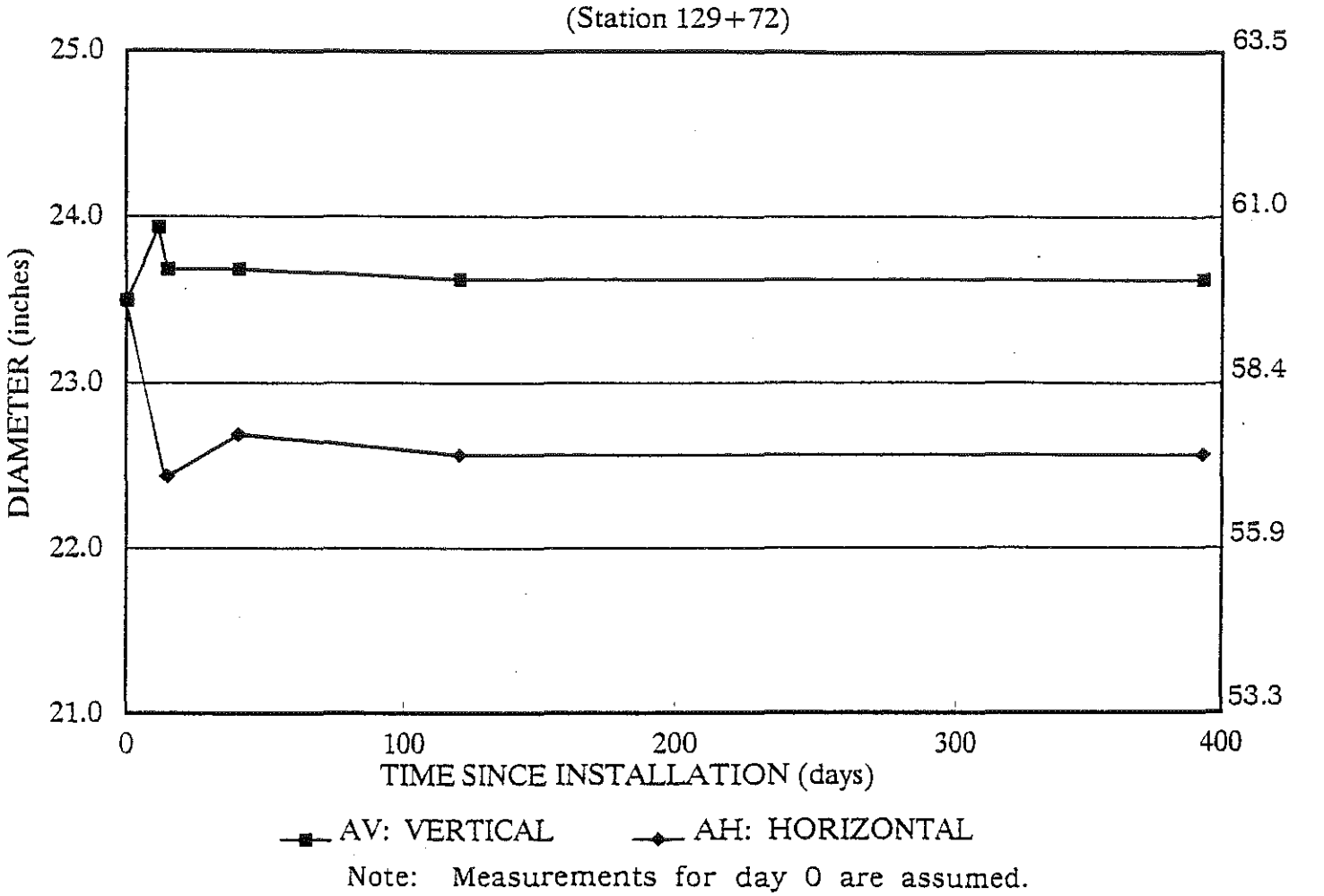

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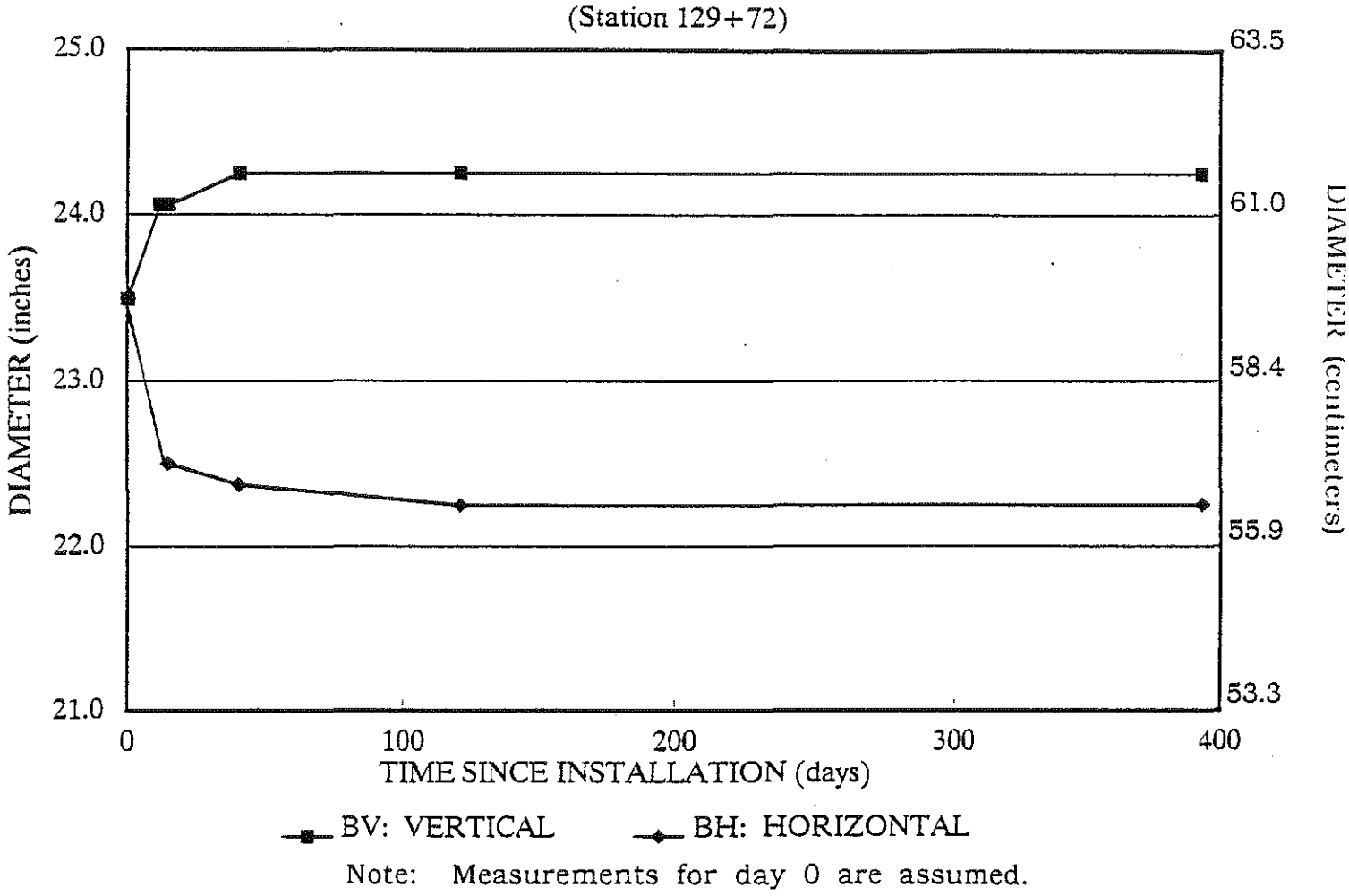

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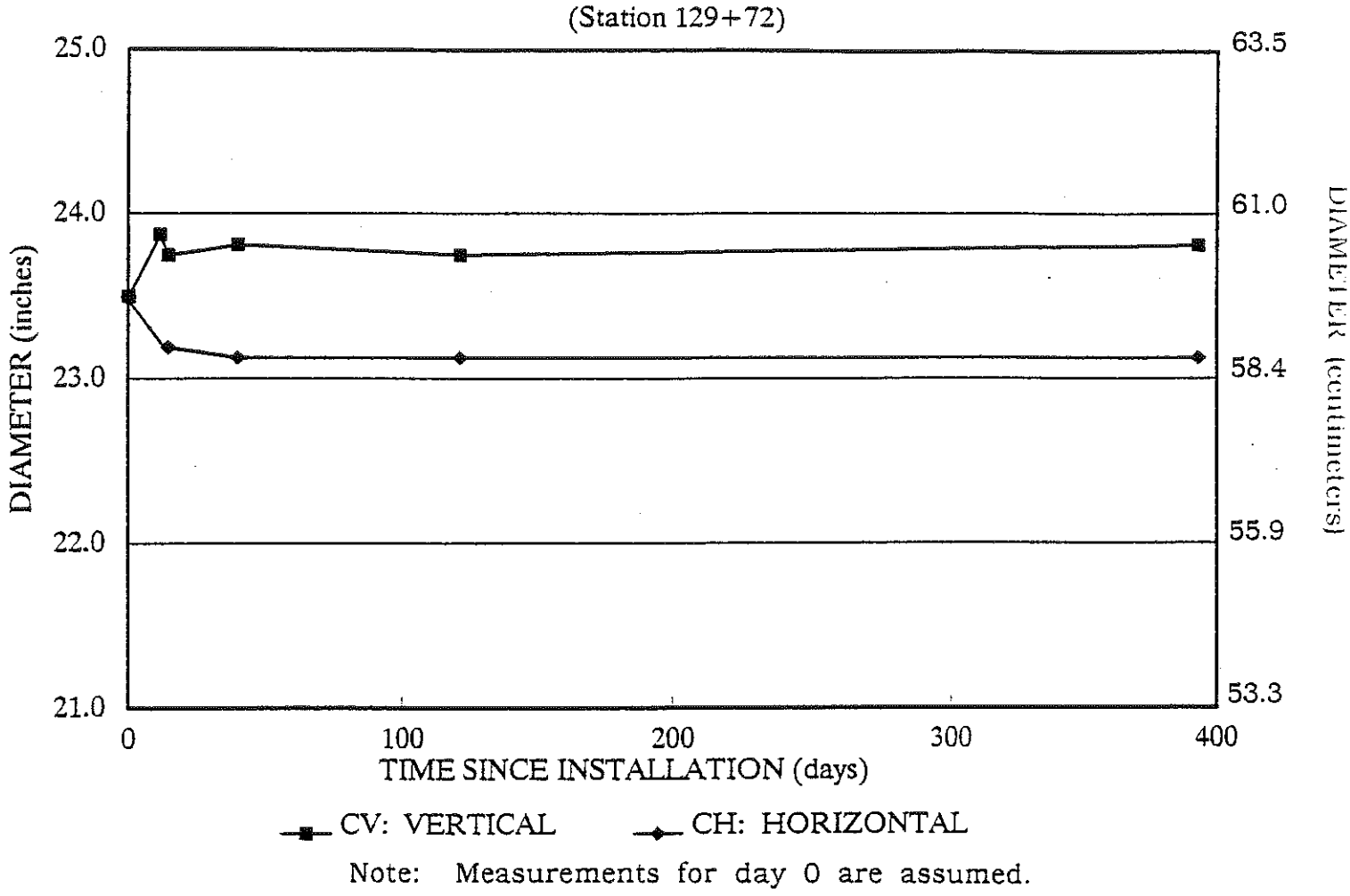

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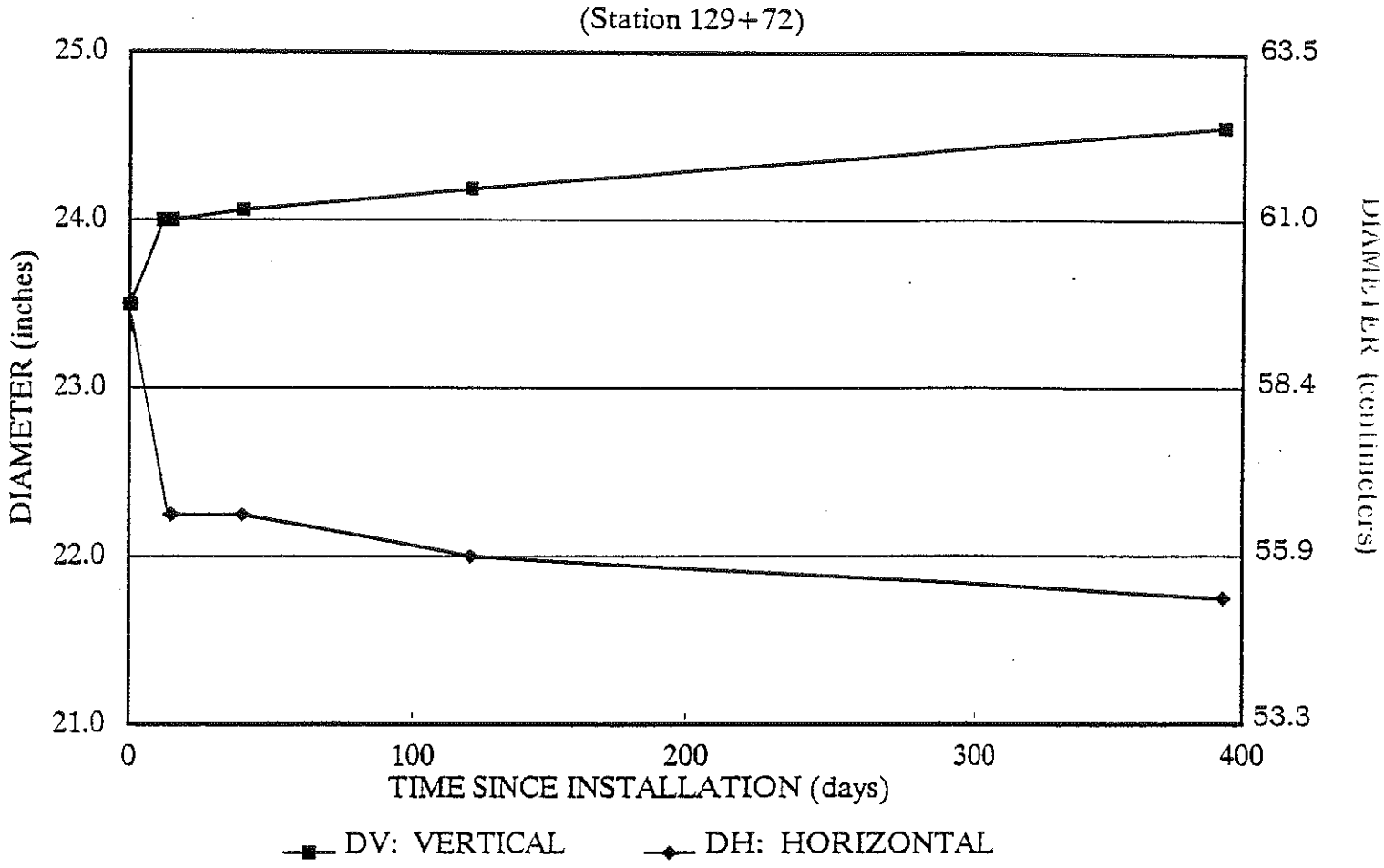

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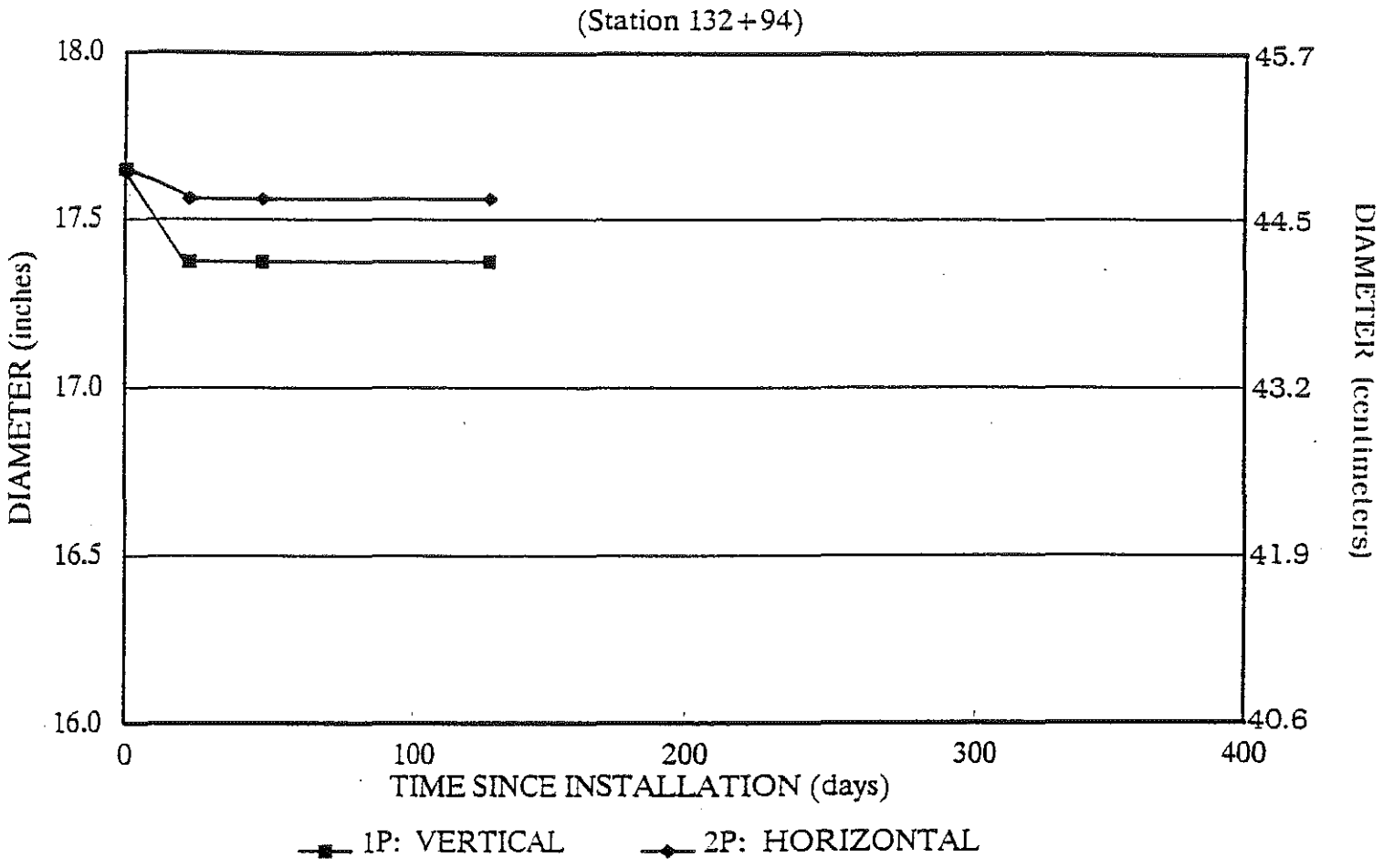

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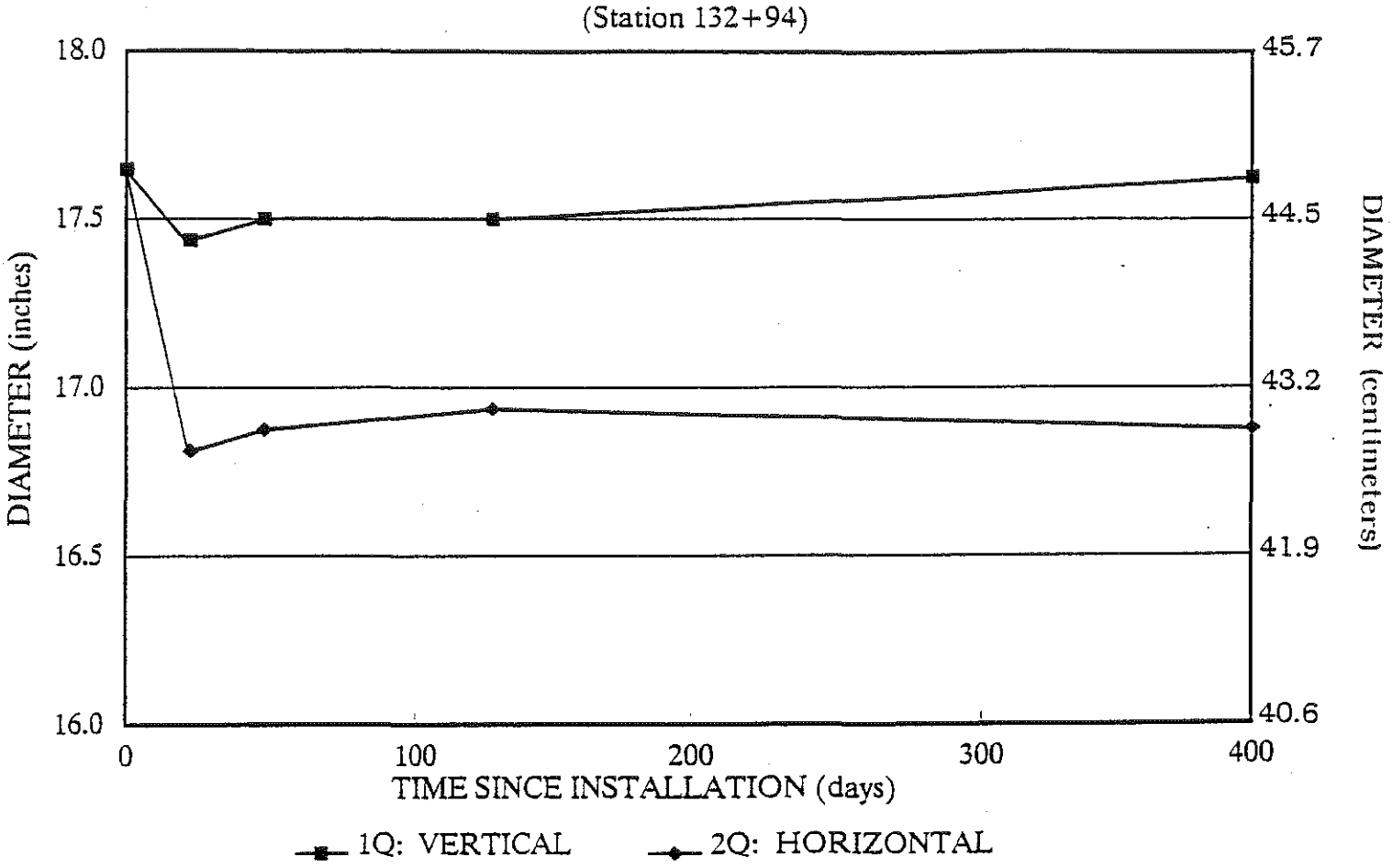

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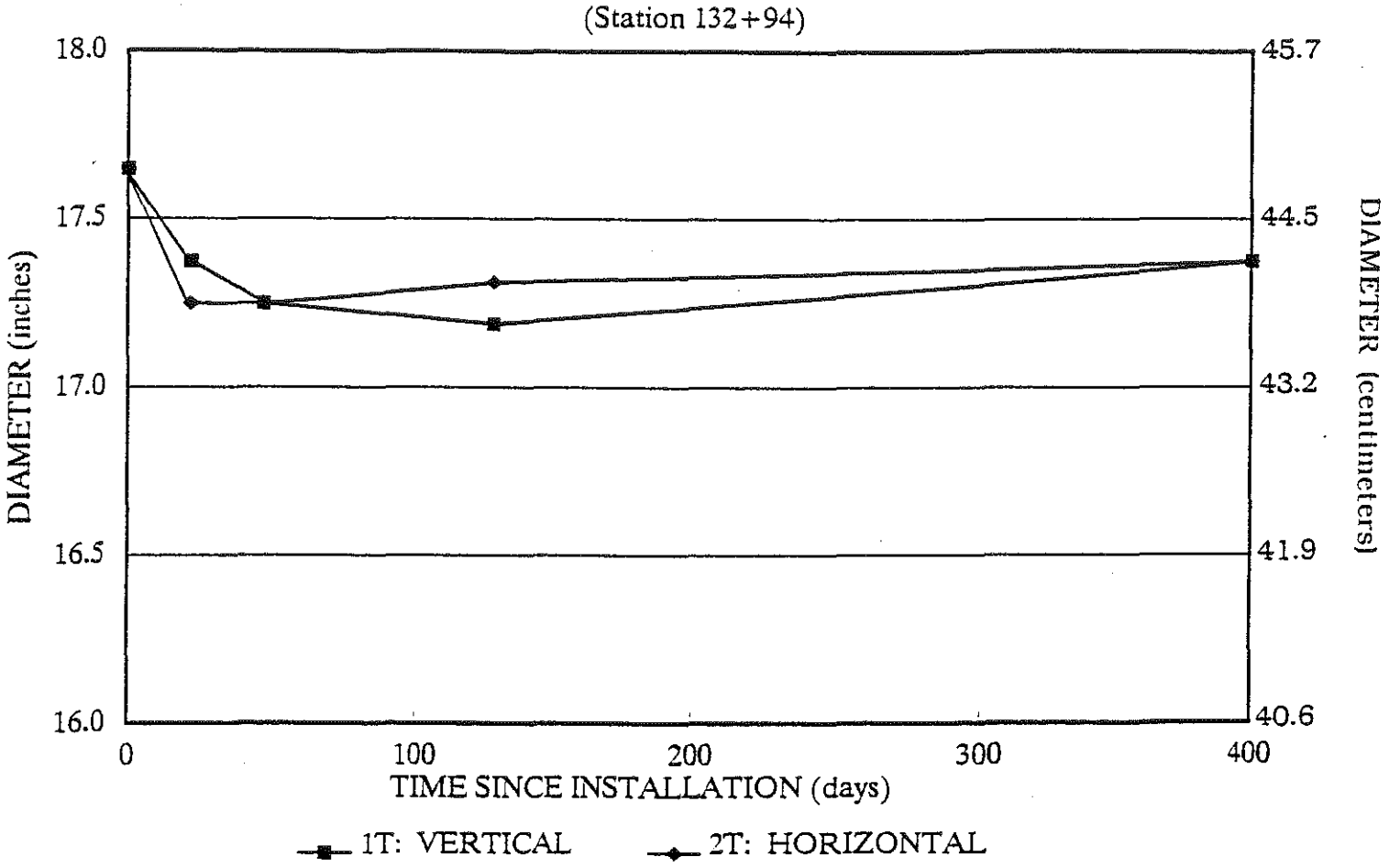

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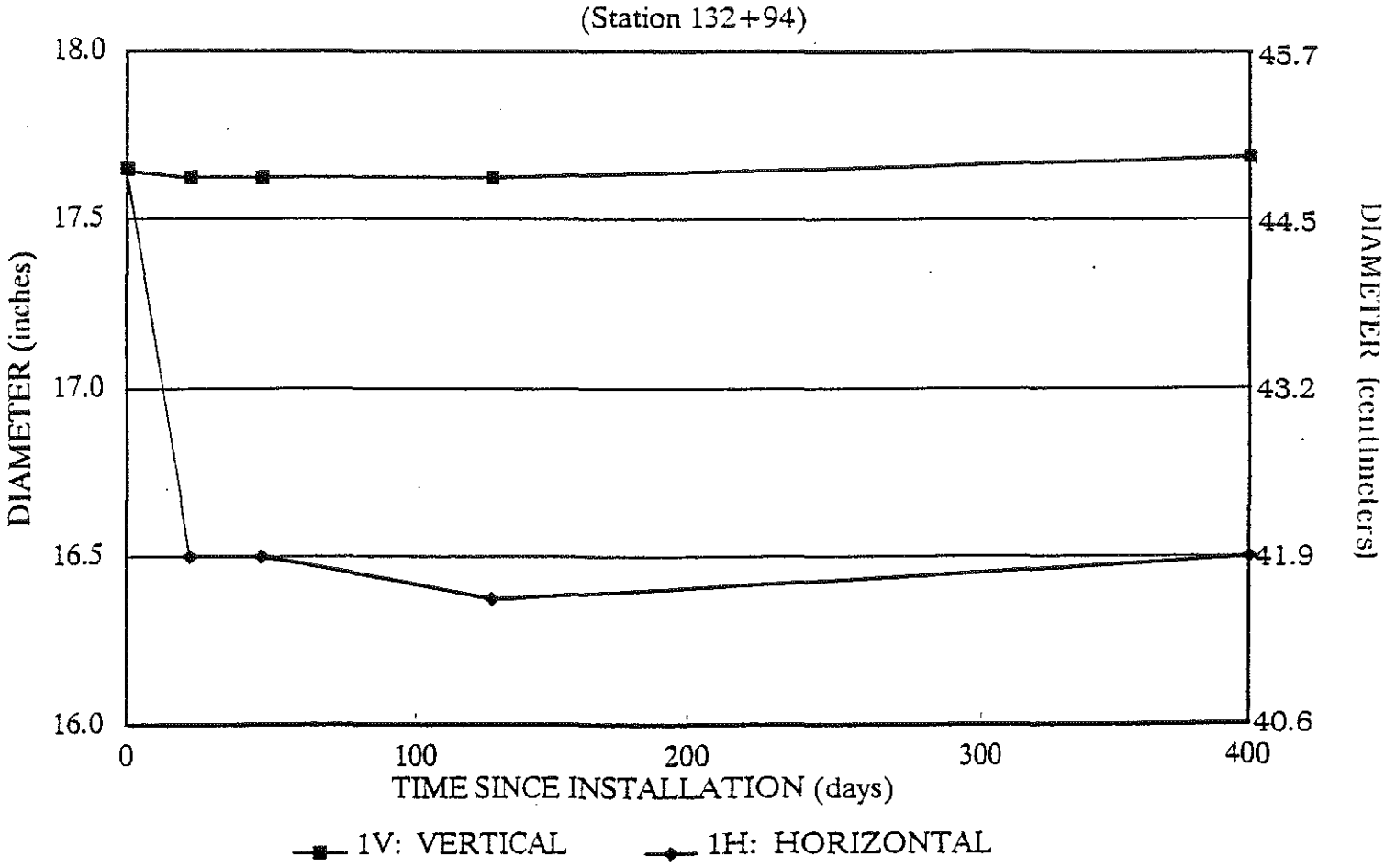

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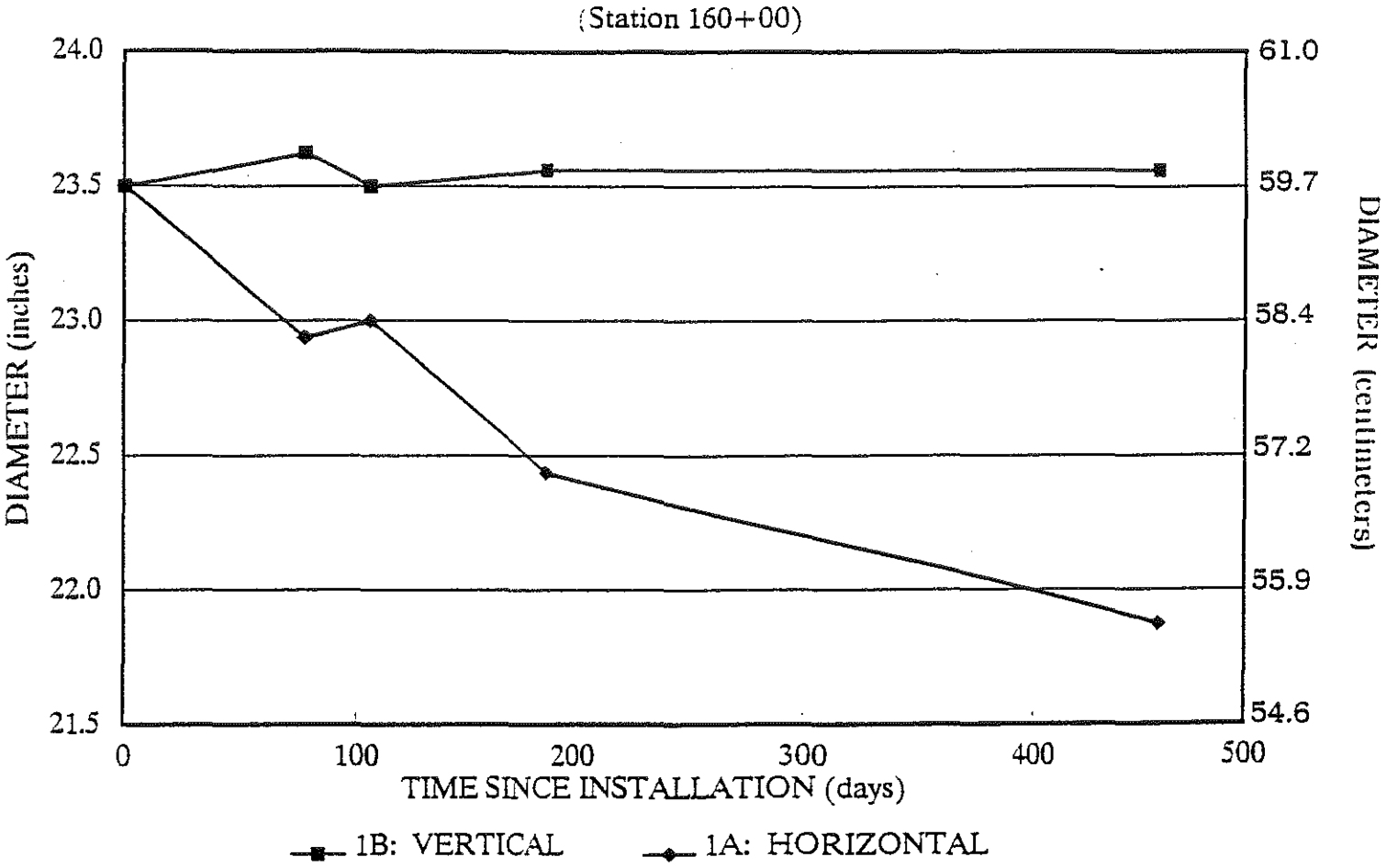

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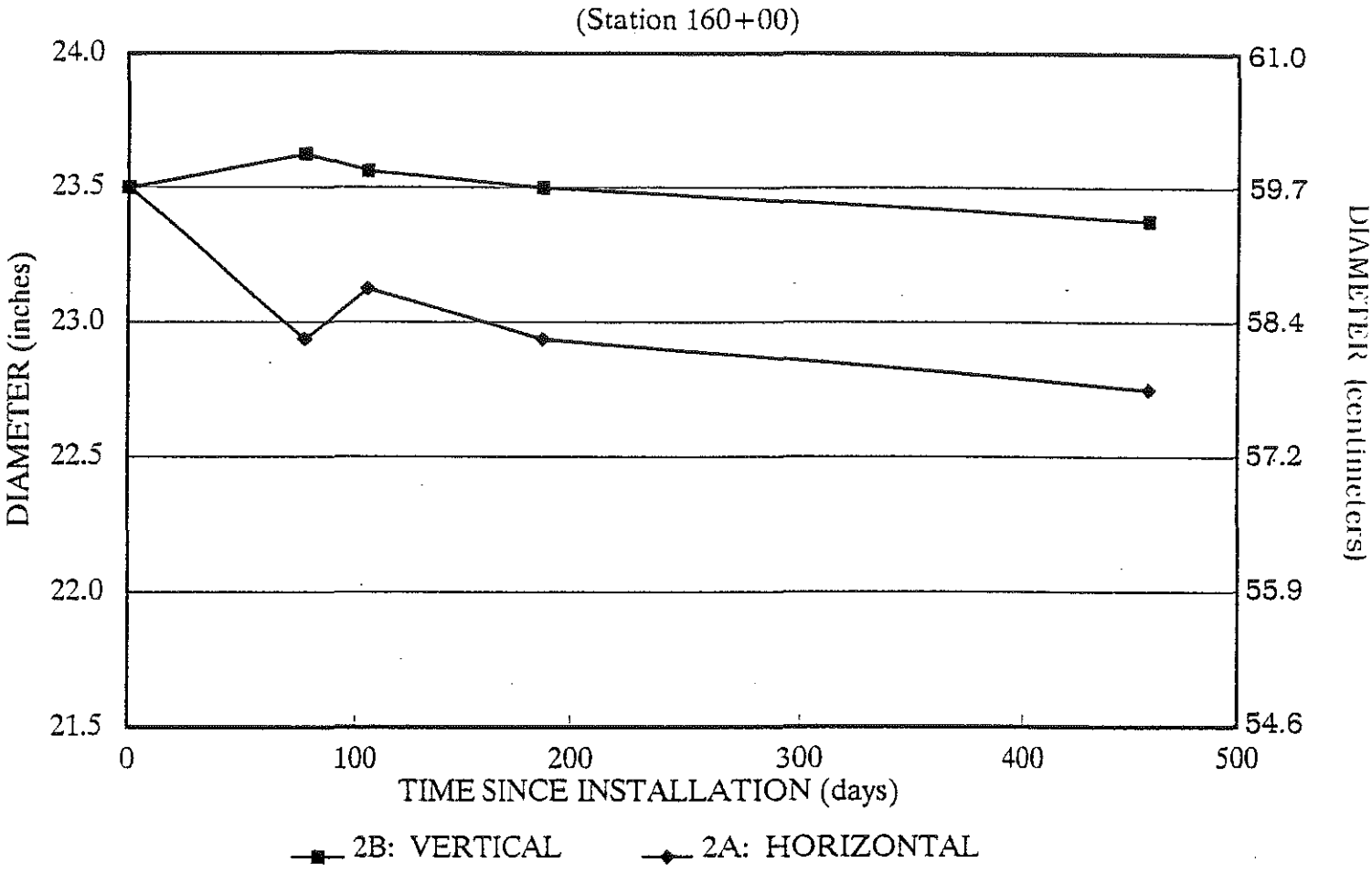

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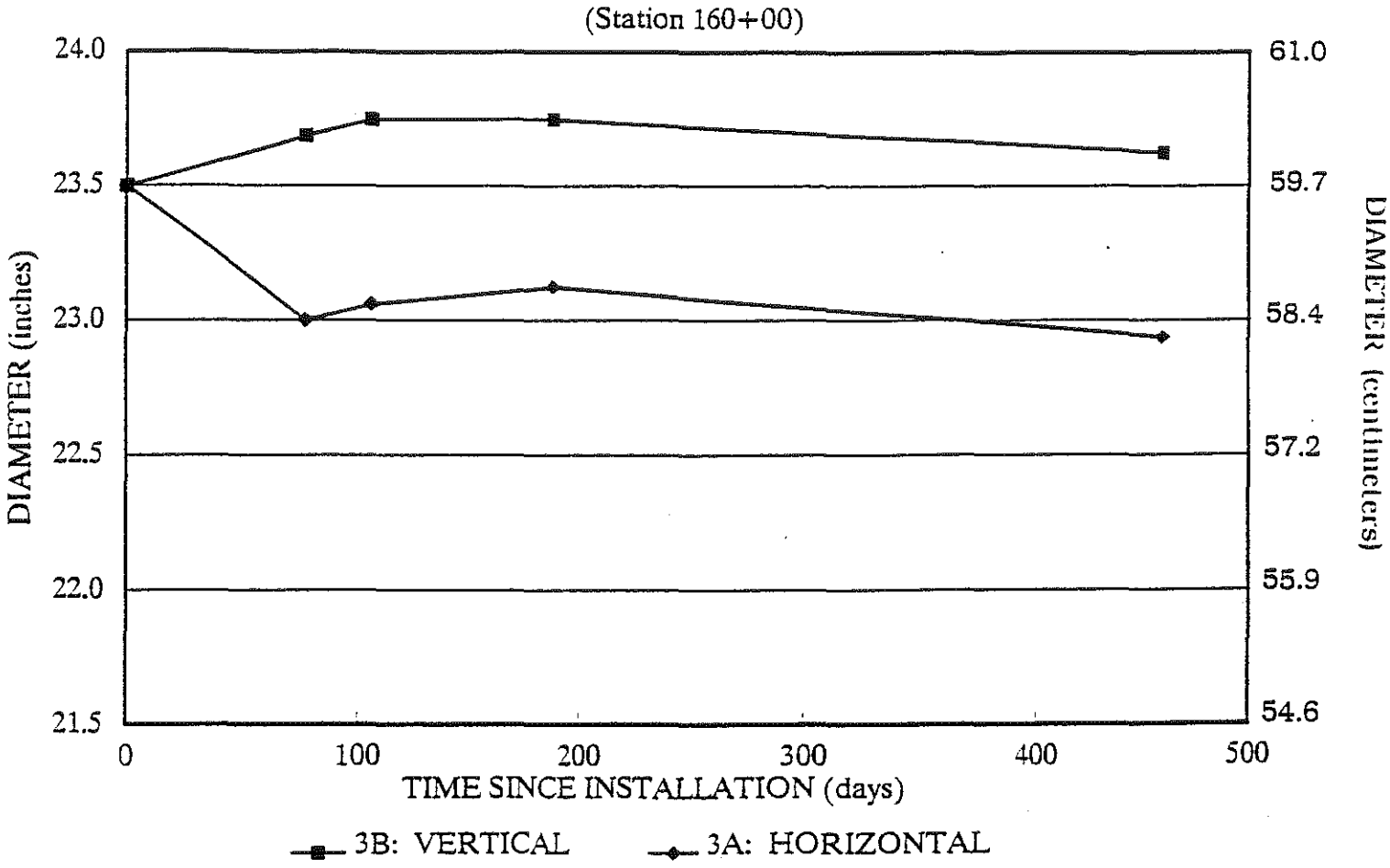

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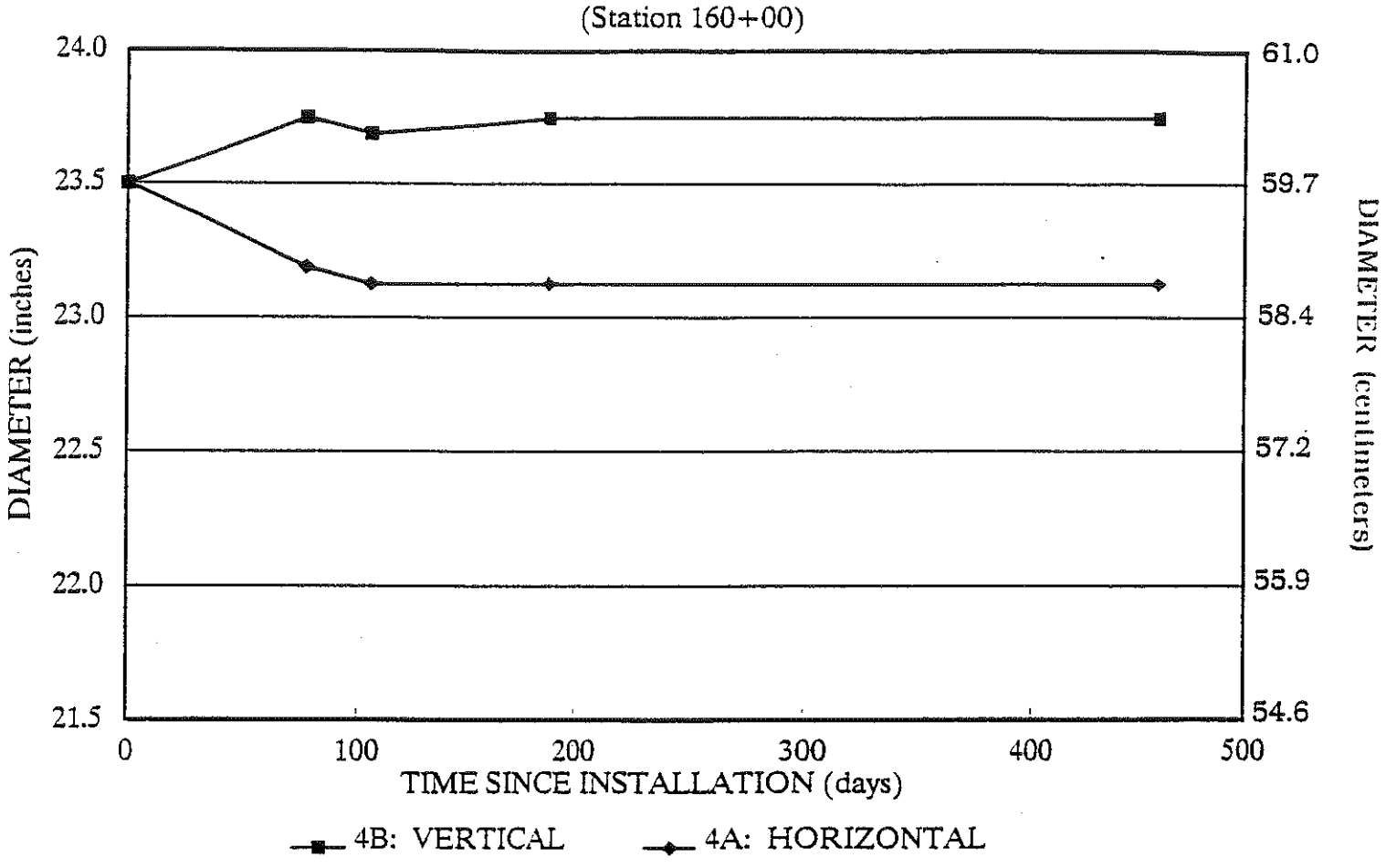

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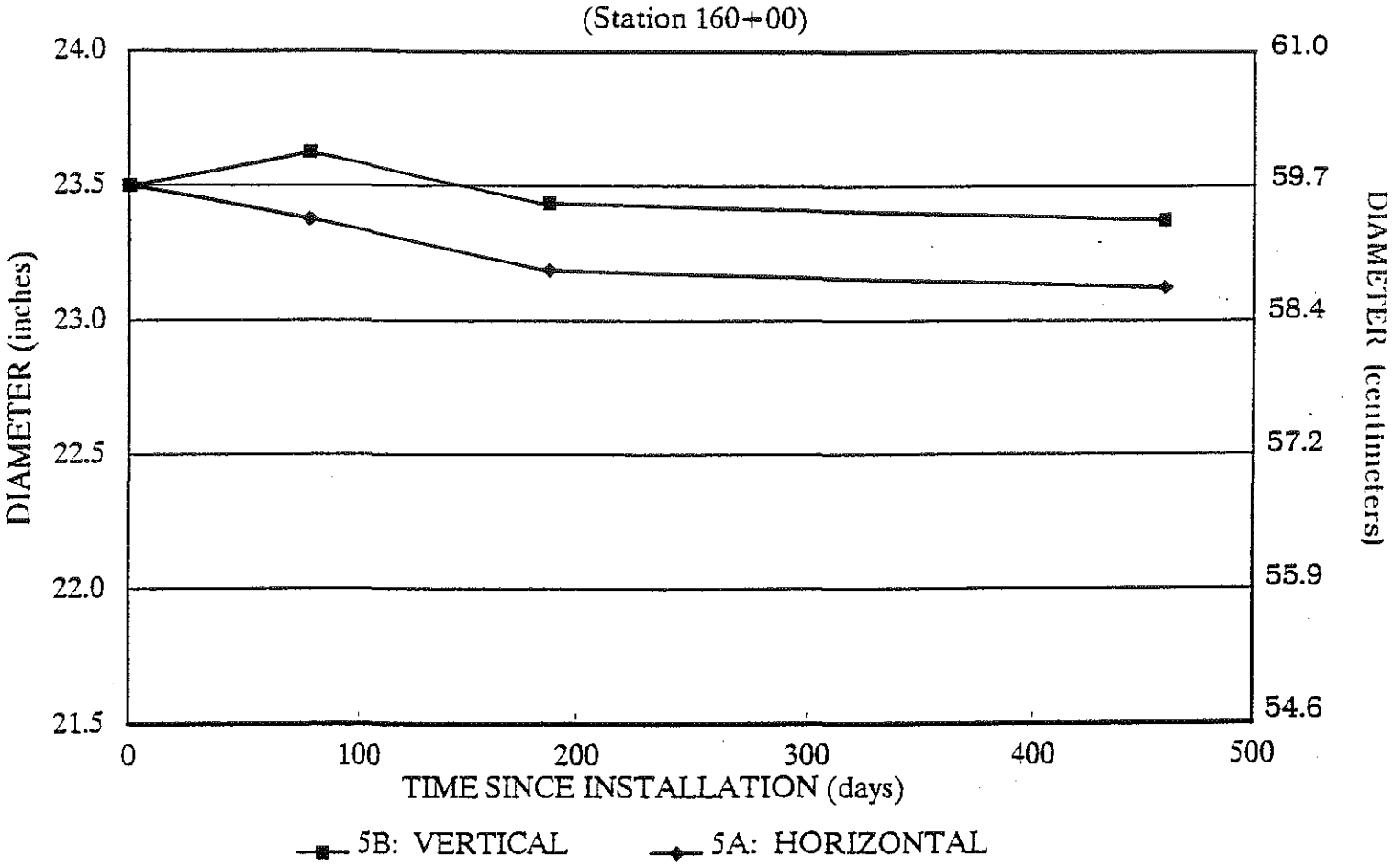

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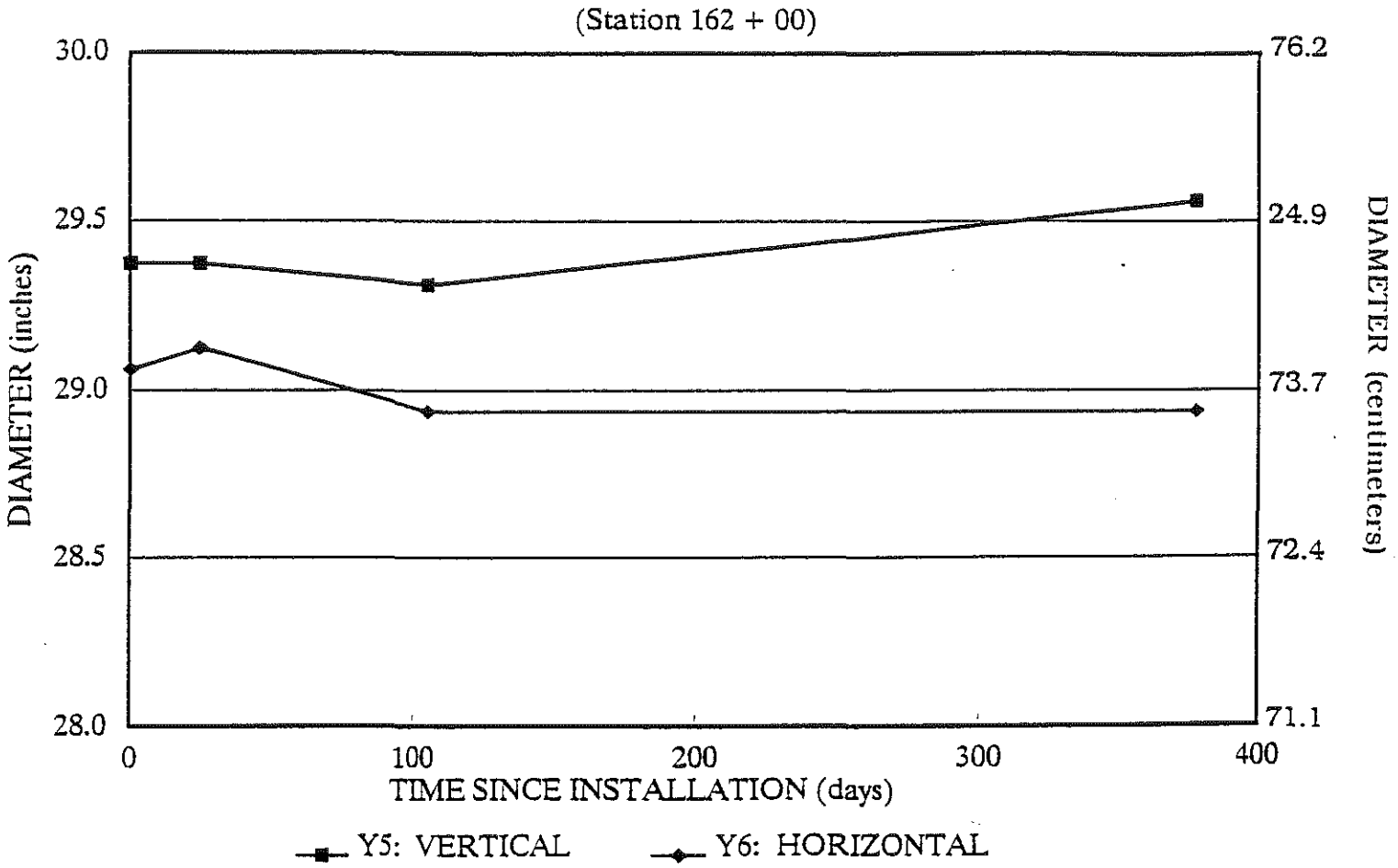
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73.7
72.4
71.1
DIAMETER (inches)
DIAMETER (centimeters)
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100
200
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400
TIME SINCE INSTALLATION (days)
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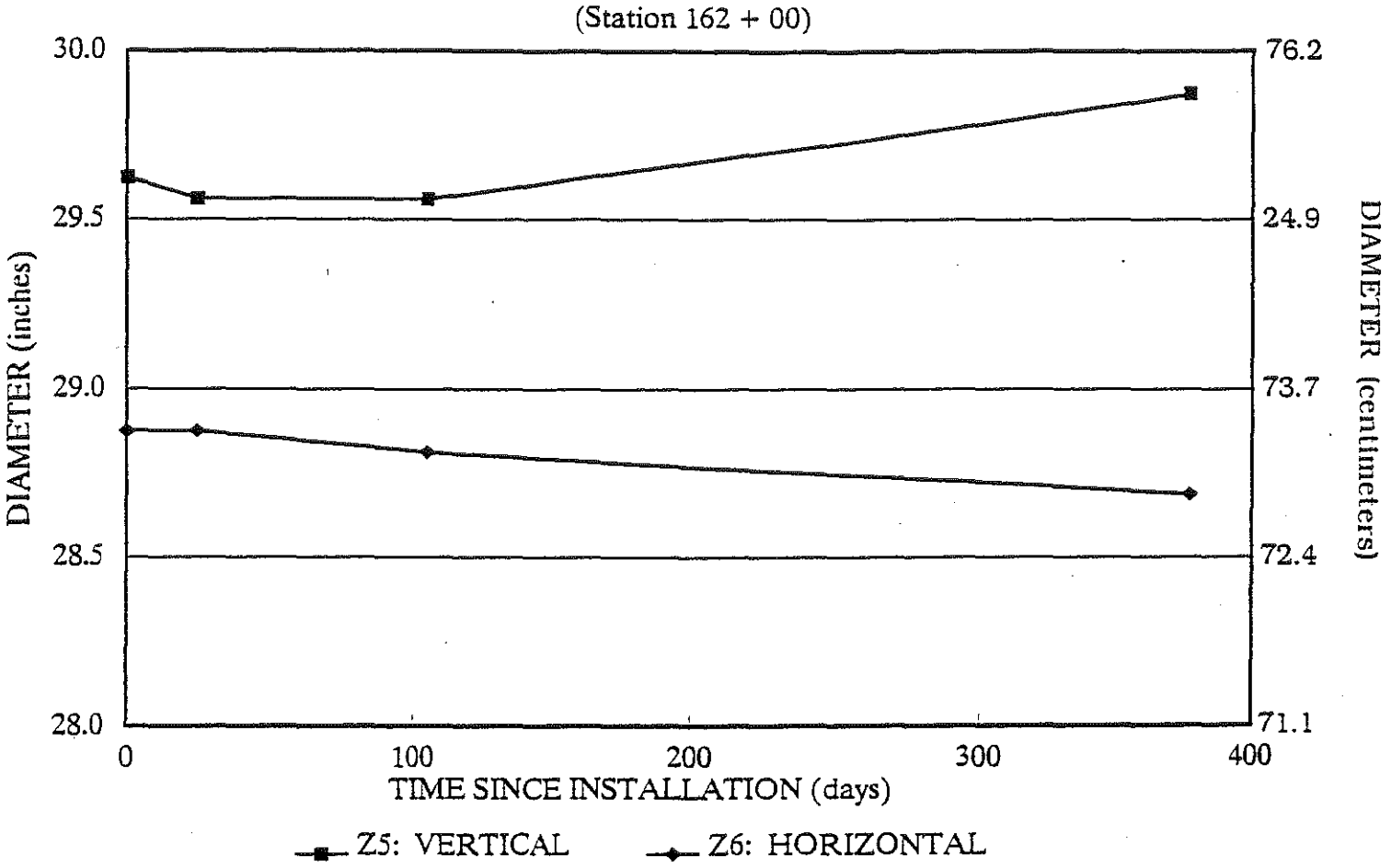
Y6: HORIZONTAL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DIAMETER (centimeters)
0
100
200
300
400
TIME SINCE INSTALLATION (days)
Z5: VERTICAL
Z6: HORIZONTAL