LBL-18432

LBL-18482
SSC MAG Note-25

DEFLECTION MEASUREMENTS OF 25 mm ALUMINUM COLLARS*

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October 11, 1984

* This work was supported by the Office of Energy Research, Office of Basic Energy Sciences, Department of Energy under Contract No. DE-AC03-76SF00098.

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INTRODUCTION

This report is a summary of mechanical load-deflection tests performed on prototype collars. The individual collar plates were N.C. machined from 0.125 inch thick 7075-T6 aluminum alloy plate. Inside corners were finished by EDM and outside corners and keyways were finished with an end milling operation. The last step was done with all the individual collar plates (98 pieces) assembled on pins to form the cross section shown in Fig. 1. Figure 1 also shows some of the basic collar dimensions.

UNIAXIAL LOAD TESTS

The first set of tests performed measured the deflection of a 1-inch thick assembly of collar plates (16 pieces) under a uniaxial force. The collar plates were held together firmly with nuts on the threaded ends of the 0.25 inch dowel pins shown in Fig. 1.

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HYDRAULIC LOAD TESTS

The second series of tests were performed with a 5.875 inch long assembly of collar plates (98 pieces). The test set-up is shown in Fig. 2. The collar cavity was vacuum potted with Dow Corning Slygard 186 encapsulating resin. The collar assembly was hydraulically loaded by forcing a 1.125 inch diameter ram into the rubber with a known force provided by a hydraulic jack. The pressure guage shown on the fixture base was used in the last test to more accurately measure the pressure on the collar assembly.

The 2-inch end plates were restrained axially with 1-inch diameter tie rods. The axial tie rod force was varied between tests. Deflection measurements were taken with dial indicators and O.D. micrometer across the horizontal diameter (diameter "A") and the vertical diameter (diameter "B") as viewed in Fig. 1. The measurements were taken at the middle of the 6-inch assembly.

RESULTS

Measurement data for the Hydraulic Tests are shown in Figs. 3, 4, 5 and 6, and this data is shown plotted in Figs. 7, 8, 9 and 10.

Tables I and II show a tabulation of data for the final cycle of each test. The significant variation in vertical deflections in Table II is due to the tie rod preloading which was decreased from between 400 and 200 ft.-lbs. torque for tests 1 through 5 to 20 ft.-lbs. for tests 6 through 11.

TABLE I

Change in Collar Diameter Between 1000 and 6000 Pounds Uniaxial Load

Test	Diameter Deflections (in.) Horiz.	Vert.
Horiz. Pull	+0.0140	-0.0070
Vert. Pull	-0.0060	+0.0110
Vert. Push	+0.0060	-0.0100
Horiz. Push	-0.0100	+0.0050

TABLE II

Max. Deflections Produced by Collar Hydraulic Load

Test	Hyd. Load (Psi)	Diameter Deflections (in.) Horiz.	Vert.
#3	4900	+0.0028	+0.0042
#5	4900	+0.0019	+0.0055
#8	4900	+0.0017	+0.0120
#11	5600	+0.0021	+0.0116

DISASSEMBLY AND INSPECTION

Inspection of the silicon rubber after removing the end plates showed a small amount of crumbled and loose rubber at the location of the 1.125 inch ram. Disassembly of the collar plates showed that, except for near the ends, no rubber was extruded between plates. No deformation or brinelling was observed around the keyways or pin holes of any of the collar plates. Measurement of two of the plates on an optical comparater showed no deformation. All feature dimensions were within tolerances of original fabrication.

ACKNOWLEDGMENTS

The author wishes to acknowledge the care and effort of Jim O'Neill and John Russell in creating hardware and taking measurements.

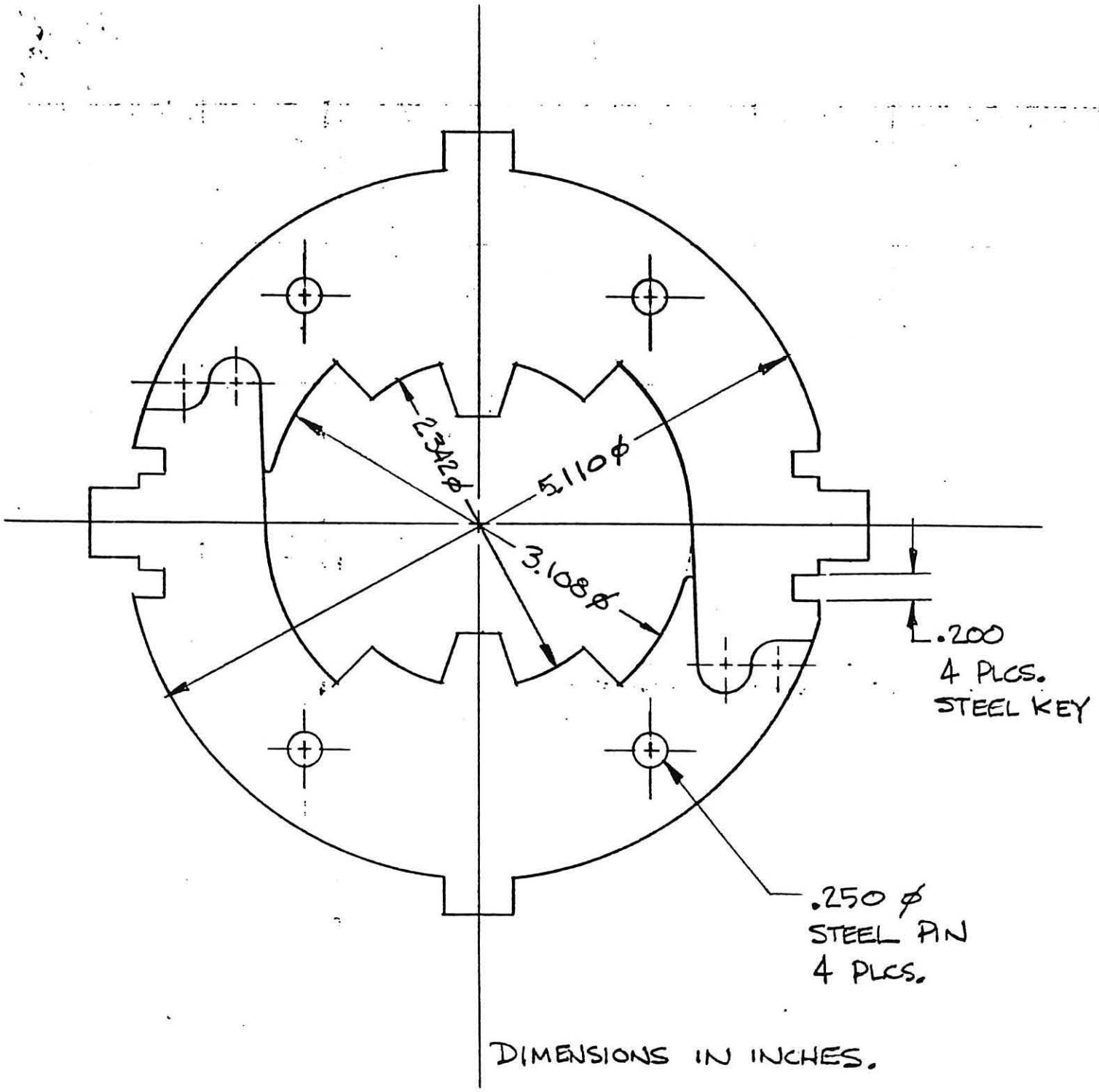

FIG. 1 25 mm ALUMINUM COLLAR

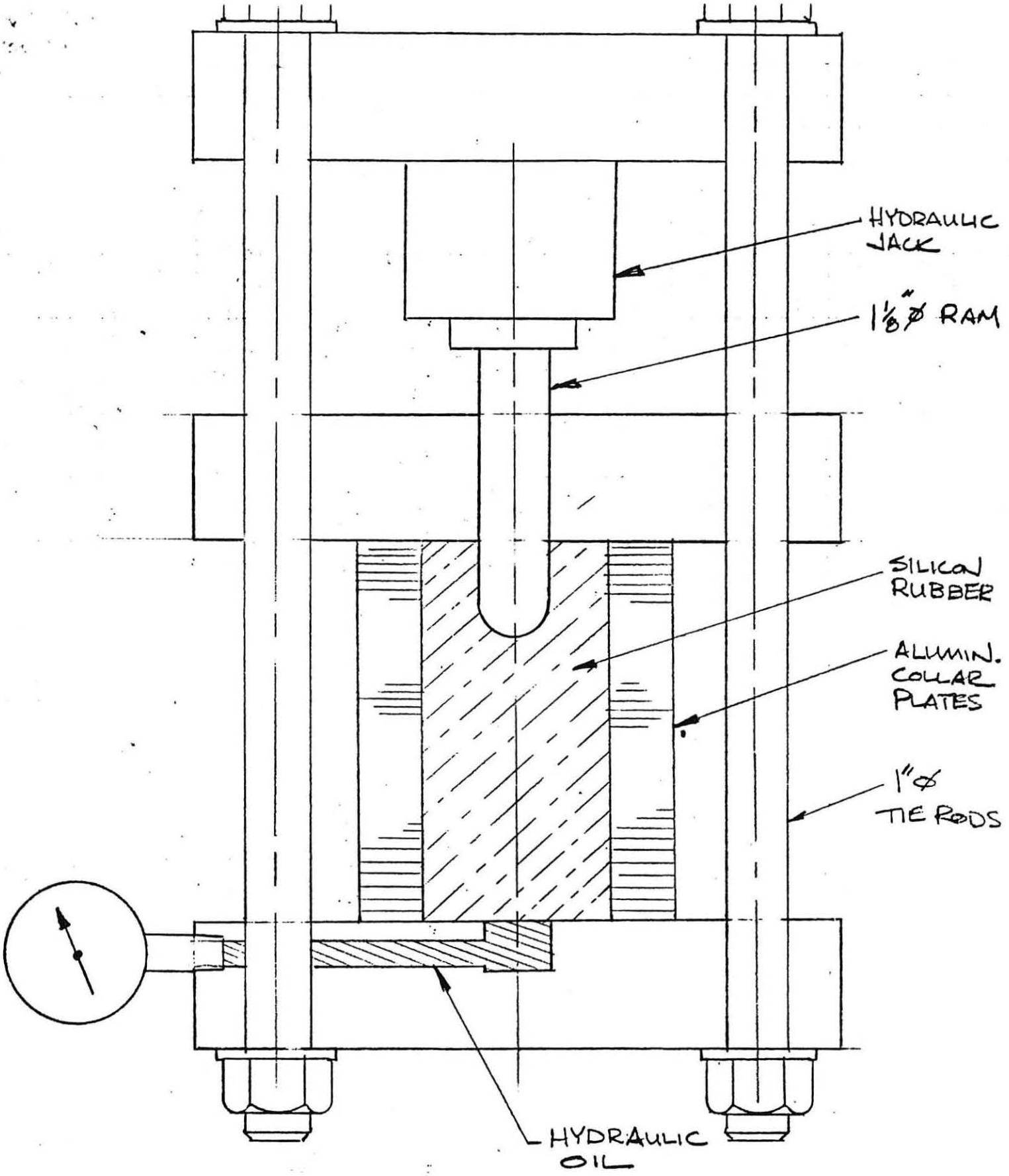

FIG.2 HYDRAULIC TEST SET-UP

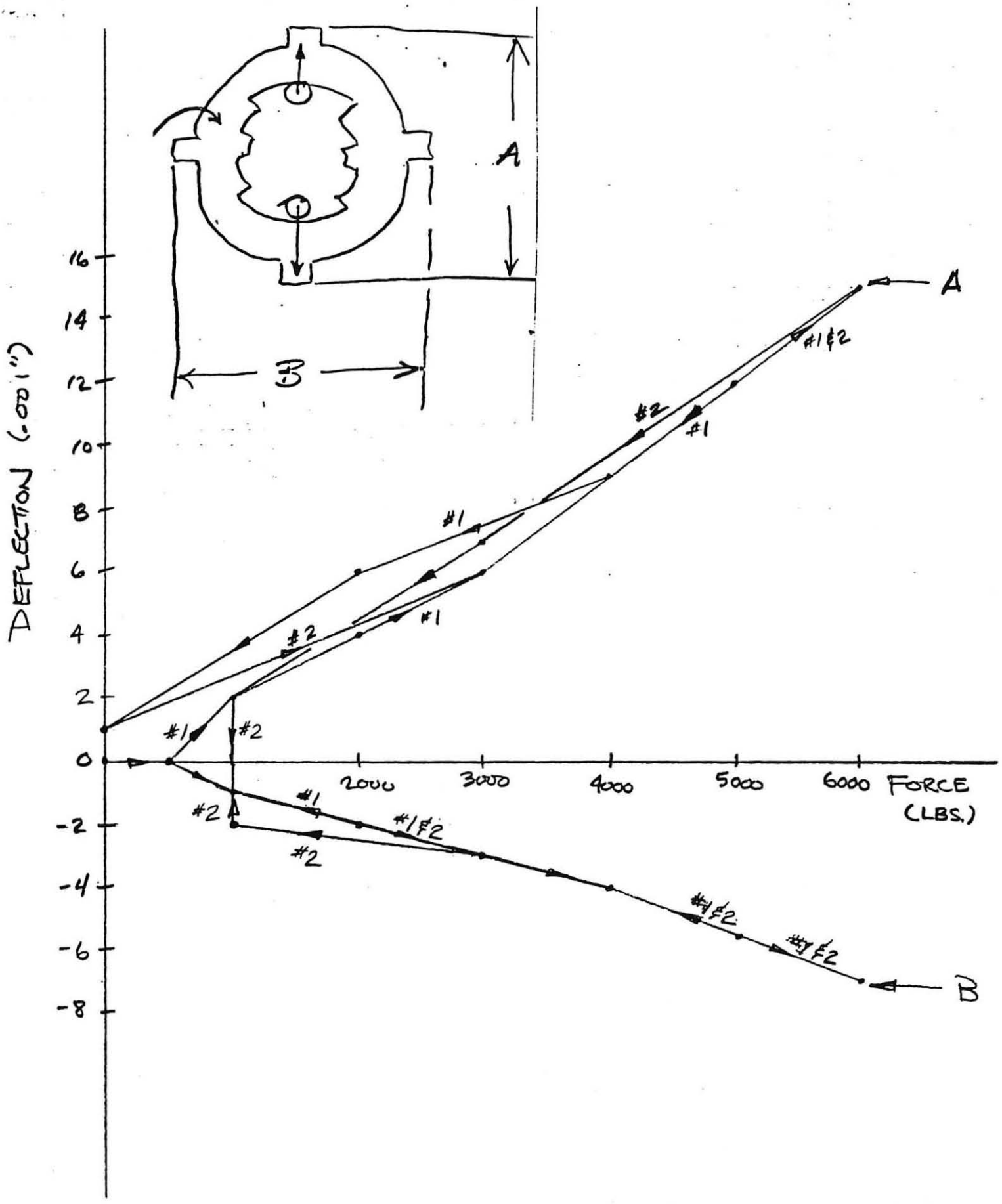
A
B
DEFLECTION (.001")
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
2000
3000
4000
5000
6000
FORCE
(LBS.)
#1
#2
#1&2

FIG. 3

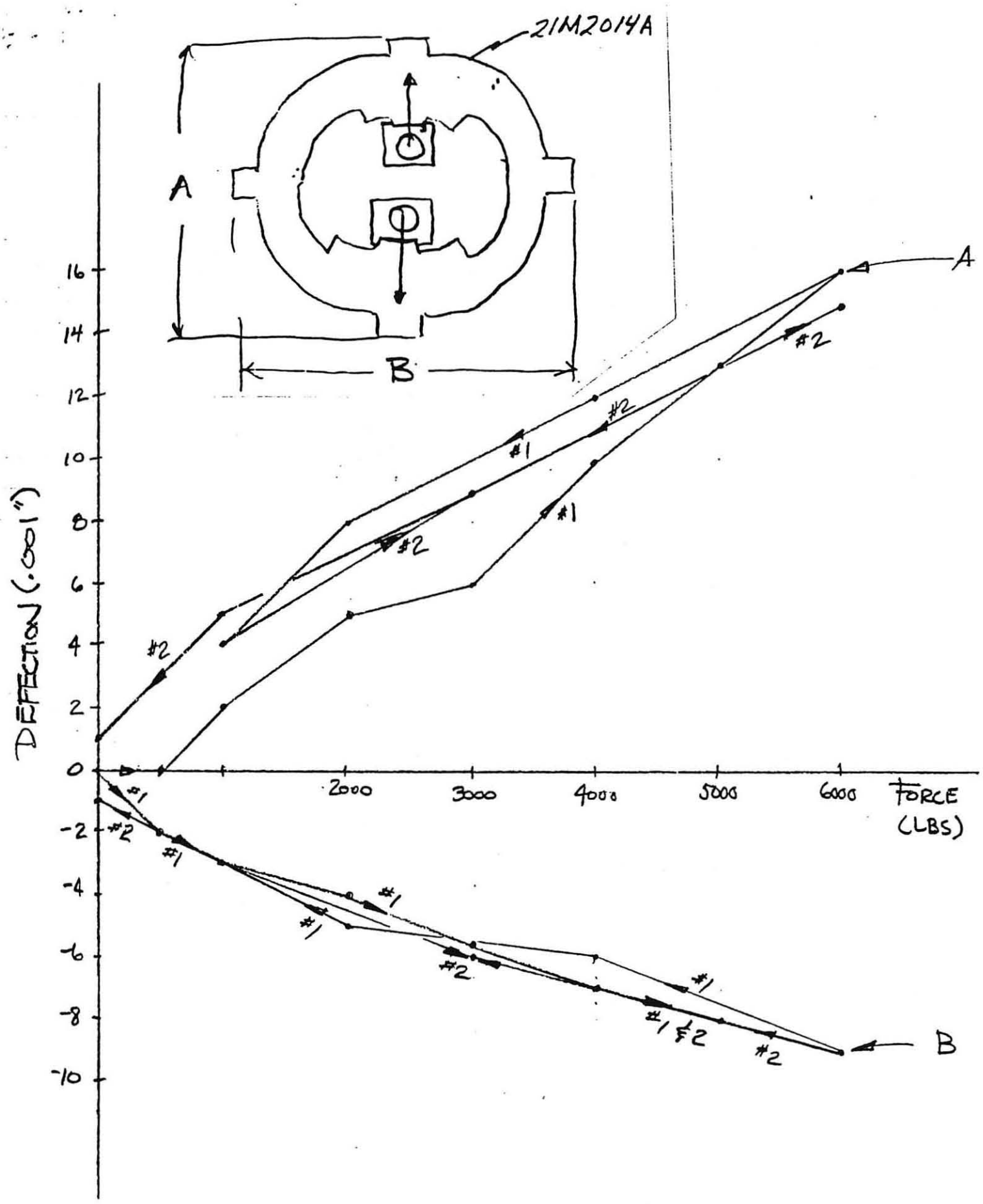
21M2014A
A
B
DEFLECTION (.001")
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
2000
3000
4000
5000
6000
FORCE (LBS)
#1
#2
A
B

FIG.4

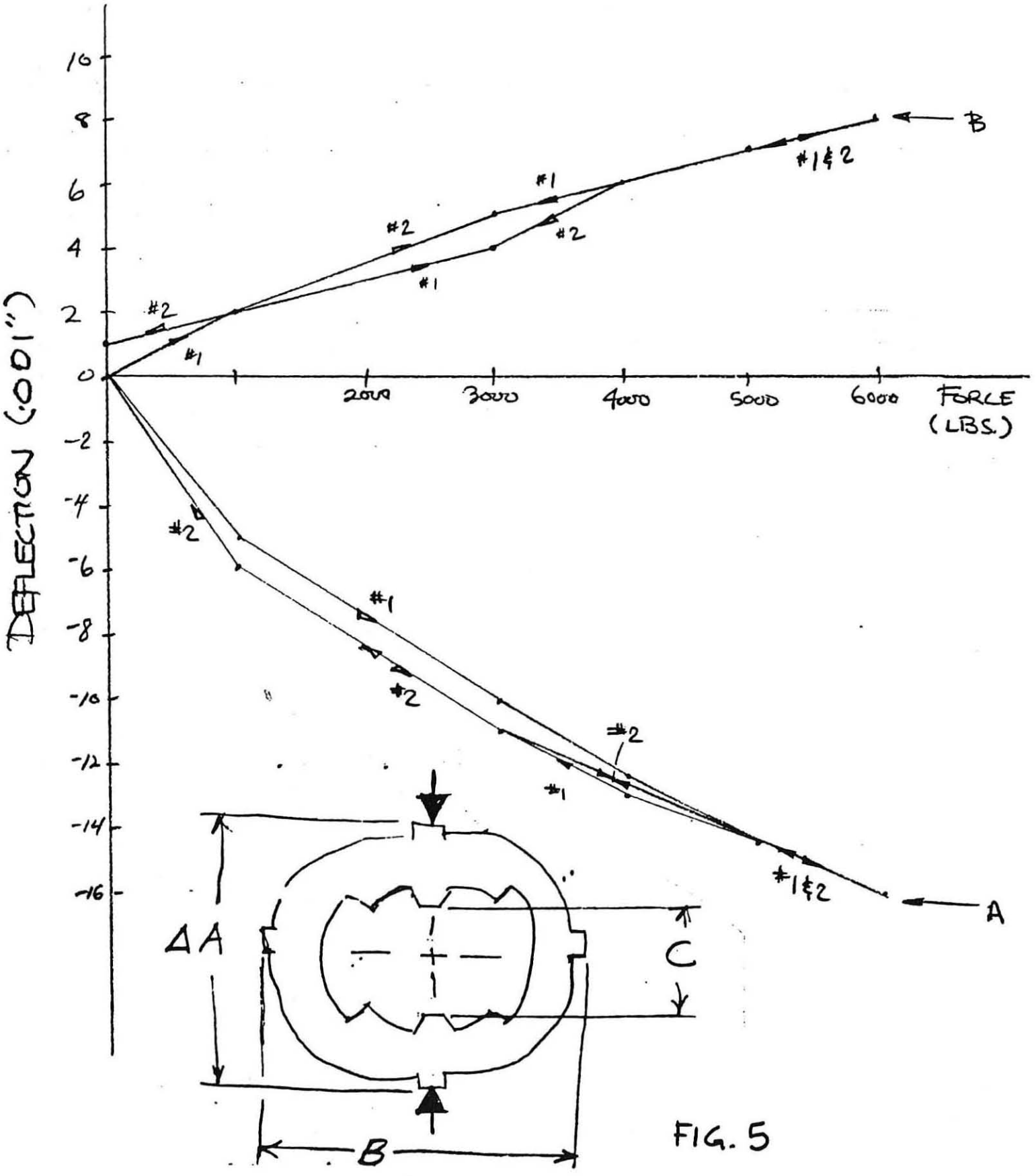
DEFLECTION (.001")
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
2000
3000
4000
5000
6000
FORCE (LBS.)
B
A
#1
#2
#1 & 2
ΔA
C
B

FIG. 5

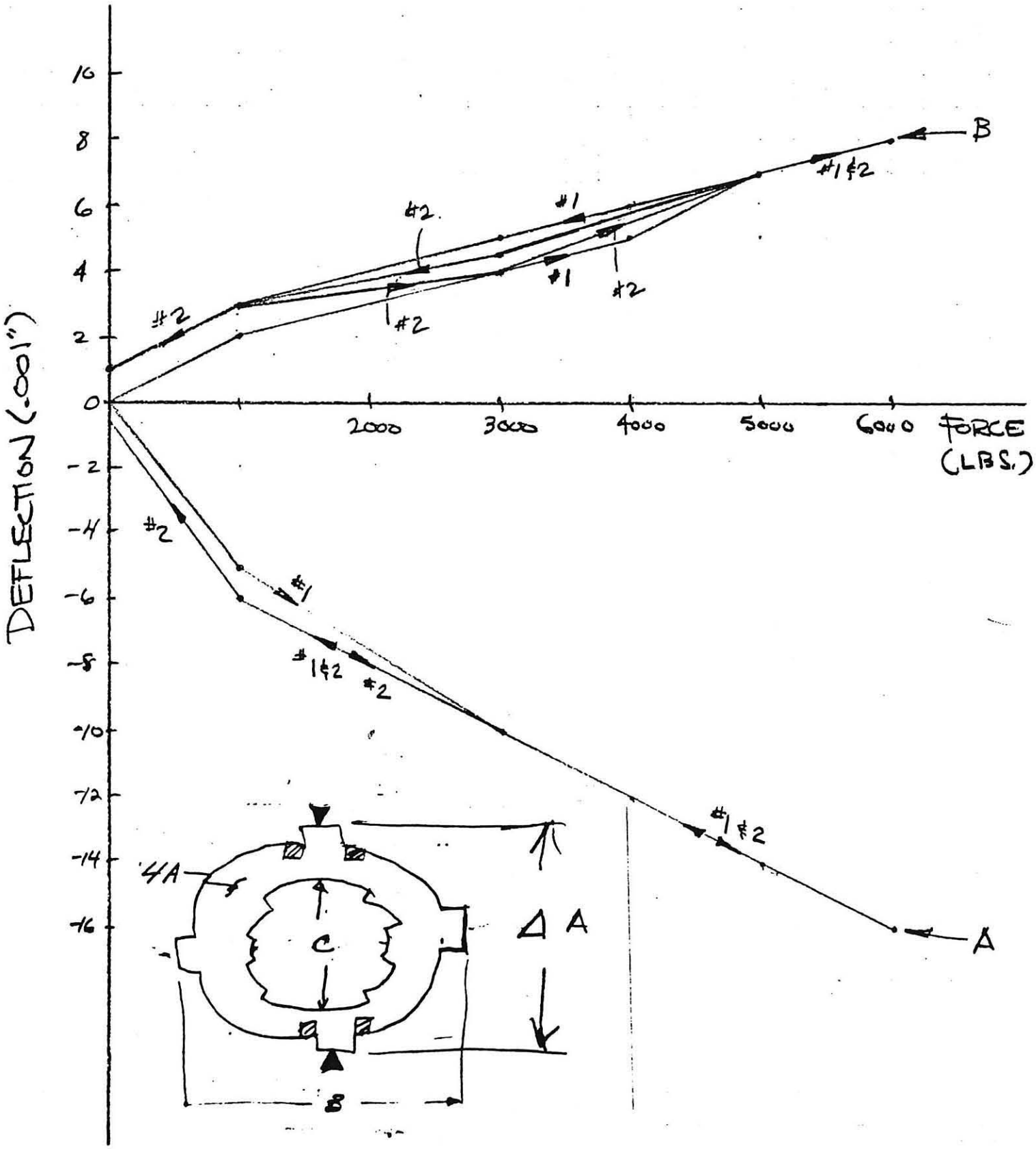
DEFLECTION (.001")
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
2000
3000
4000
5000
6000
FORCE (LBS.)
B
A
#1
#2
#1 & 2
4A
C
Δ A
8

FIG. 6

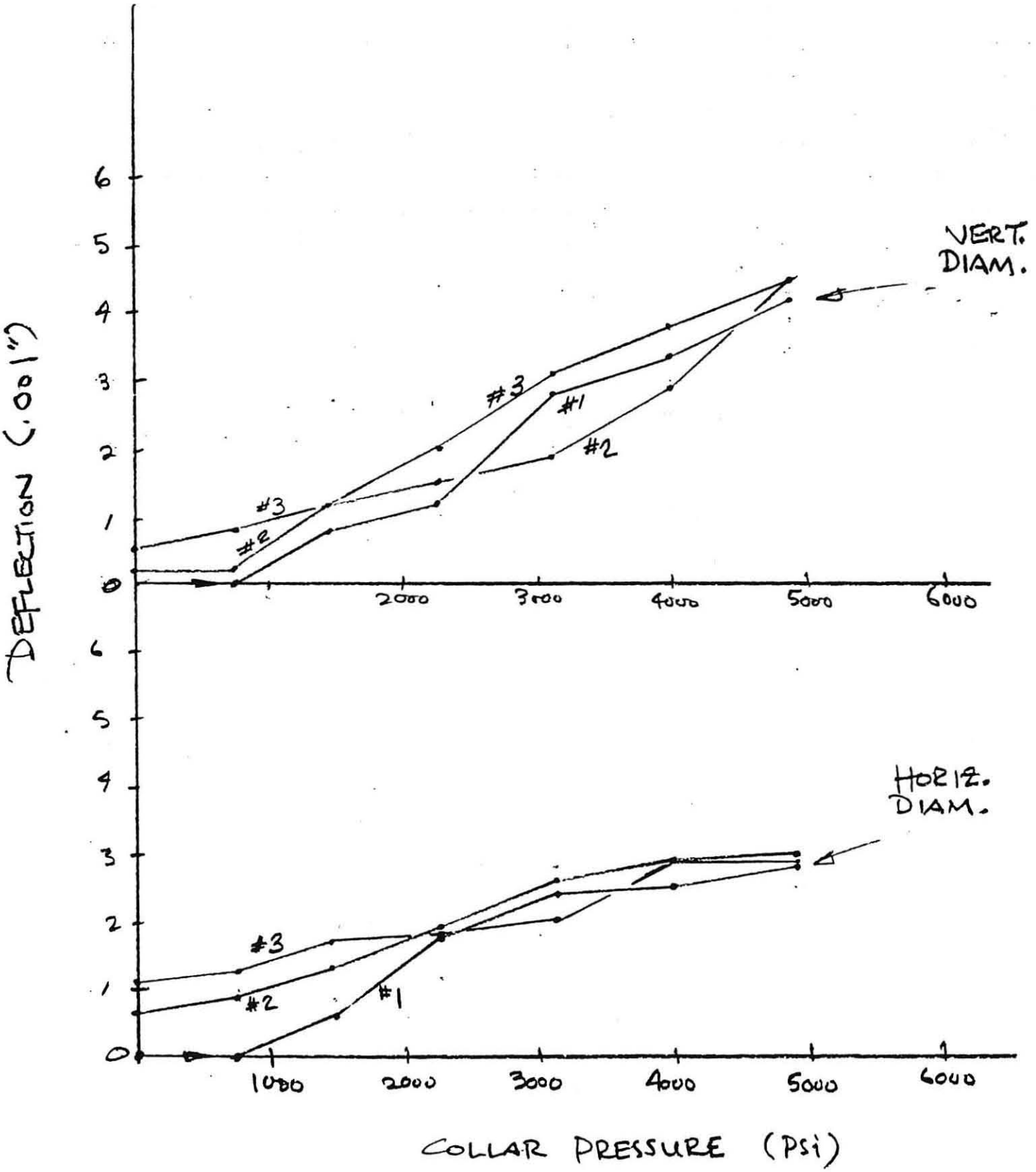

FIG. 7 HYDRAULIC TEST 1, 2 AND 3
400 FT-LB END LOAD

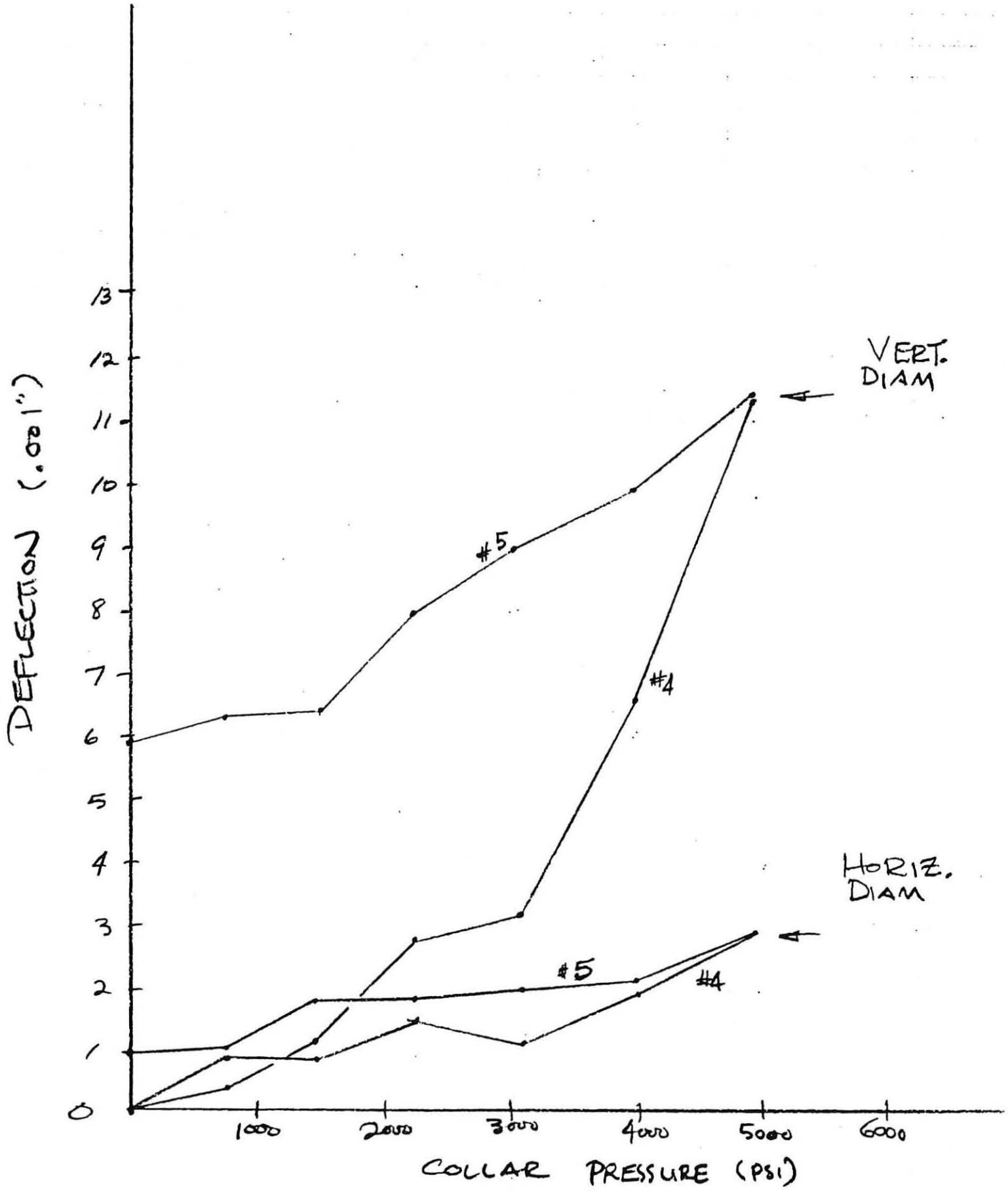

FIG. 8 HYDRAULIC TEST 4 AND 5
200 FT-LB END LOAD

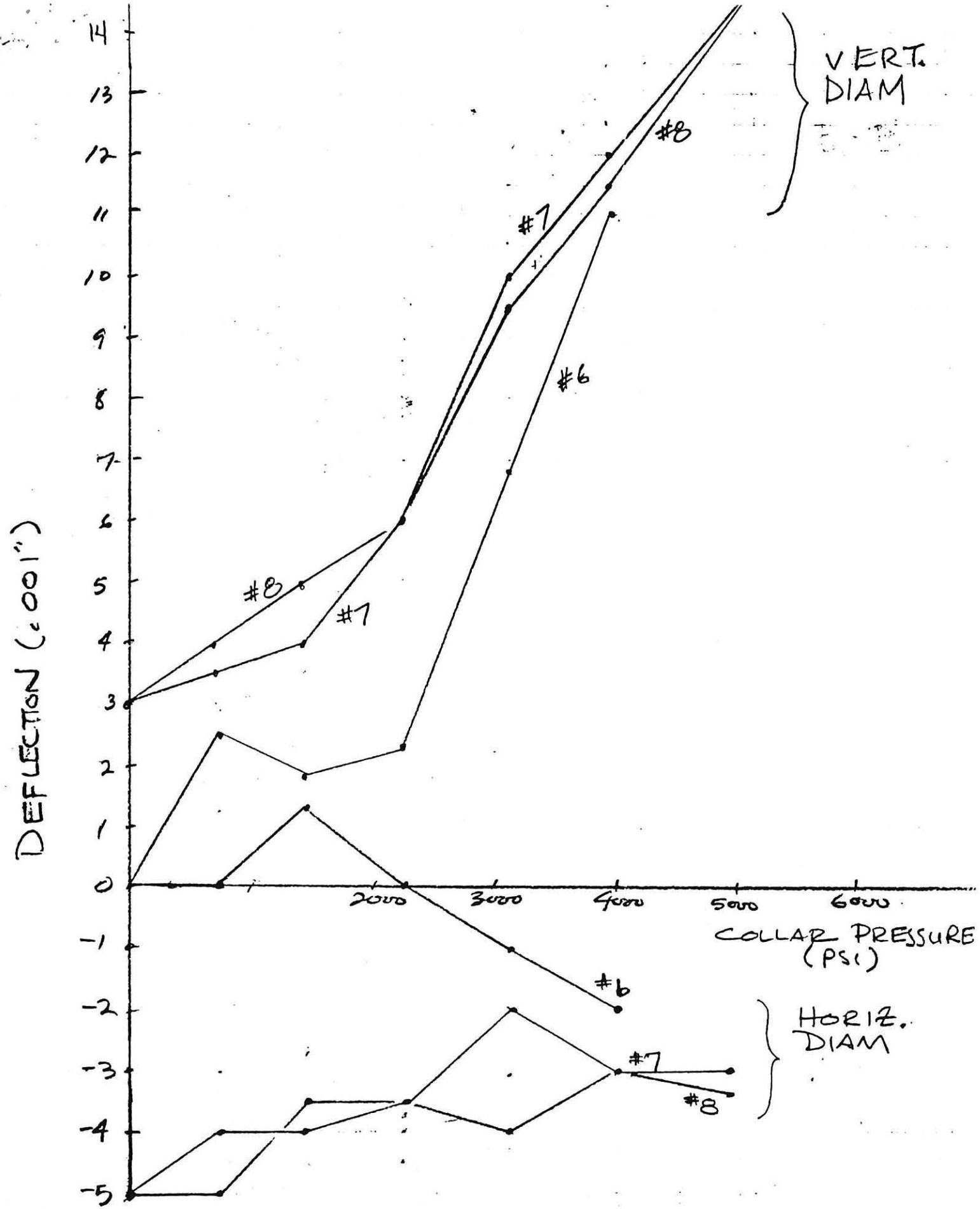

FIG. 9 HYDRAULIC TEST 6, 7 AND 8
20 FT-LB END LOAD

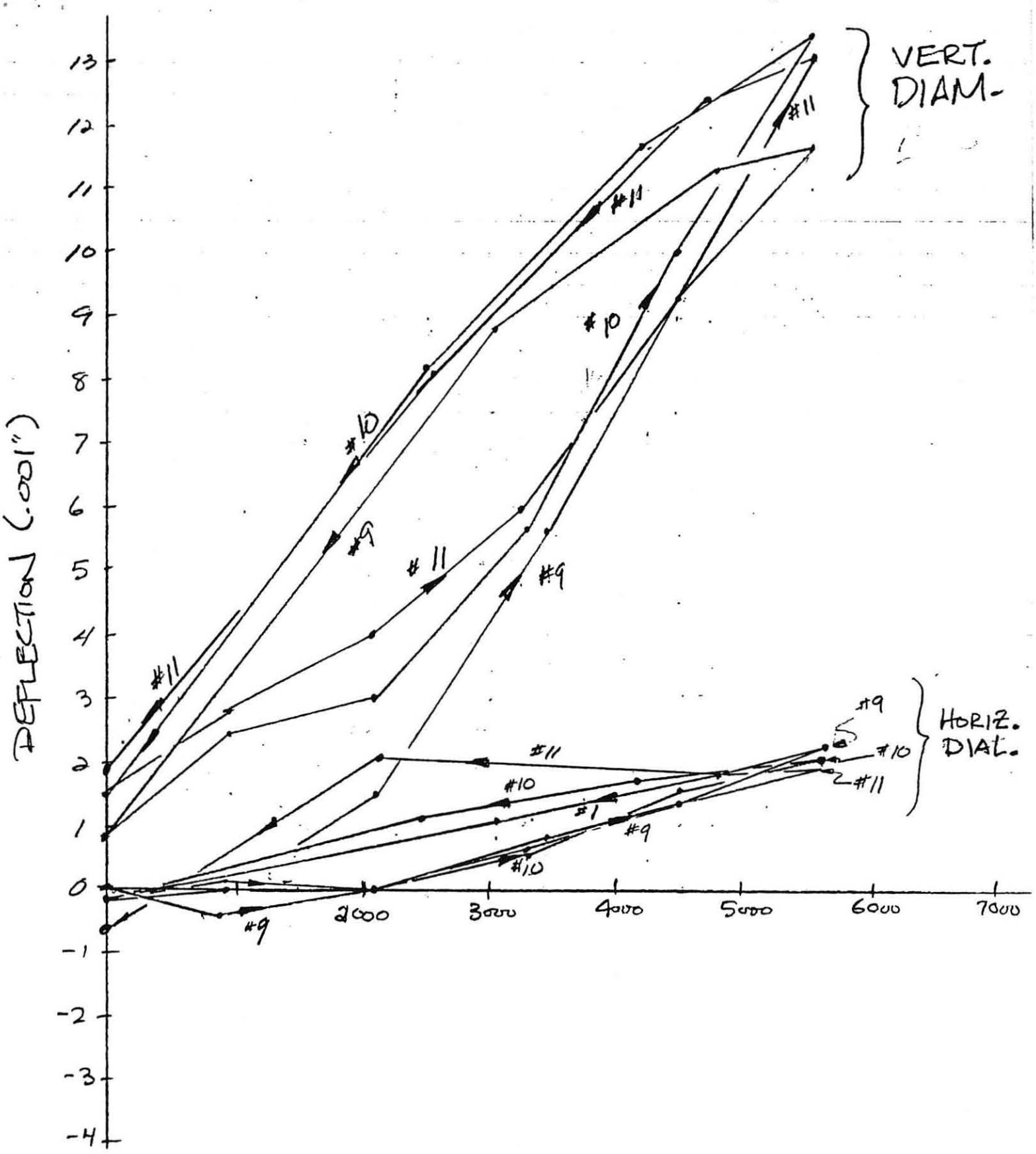

FIG. 10 HYDRAULIC TEST 9, 10 AND 11
20 FT-LB END LOAD.