United States
Environmental Protection
Agency

Region II Office
26 Federal Plaza
New York, N.Y. 10007

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Air

EPA

STUDY OF CONTROL STRATEGIES FOR IN-USE HEAVY DUTY VEHICLES

APPENDIX I & II

APPENDIX I

THE TEST DATA TAPE

STUDY OF CONTROL STRATEGIES FOR IN-USE HEAVY DUTY VEHICLES

Environmental Protection Agency Contract Number 68-01-4319

Submitted by
John J Pinto
Assistant Director, Mobile Systems
NYC Department of Environmental Protection
Bureau of Science & Technology

This report was furnished to the Environmental Protection Agency by the N.Y.City Department of Environmental Protection, Mobile Systems Division, Brooklyn,New York in fulfillment of EPA Contract No. 68-01-4319. This report has been reviewed by Region II, EPA and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products consitutute endorsement or recommendation for use.

Region II publication No. 902/4-81-001 b

APPENDIX I

TABLES OF CODES

TEST CODES

NYQ	New York City Quick Driving Cycle
C39, C39H	New York City Traffic Driving Cycles

PCV VALVE/AIR FILTER CONDITION CODES

0 Missing
1 New
2 Good
3 Fair
4 Poor
5 Not Applicable

TRANSMISSION CODE

A/M	Automatic/Manual
Digit	Number of Forward Gears

ANALYZER INSTRUMENT CODES

2 SCOTT
4 SUN
5 OLSON-HORIBA

APPENDIX I

THE TEST DATA TAPE

Description Of The Tape.

Data from the tests performed for the contract are entered in a single file on magnetic tape.

The tape was prepared by the New York City Department of Environmental Protection on an IBM-VS1 system. Table A lists the parameters for processing the tape.

The tape was delivered to

Mr. Paul Truchan
U.S. Environmental Protection Agency
Air Program Branch
26 Federal Plaza
New York,N.Y.10278

Types Of Records In The File.

Each record in the files is an 80 column card image and is one of the following types:

Type 1. Header
2. Test Result
3. Atmospheric Data
4. Keymode Test Results - I
5. Keymode Test Results - II
6. Tune Up Data - I
7. Tune Up Data - II
8. Comment Continuation
9. Warning Record

The formats of the nine types are shown in Tables B thru J.

Record Sets.

Records are grouped into sets, each set containing the results from a series of tests performed on a vehicle.

Individual sets are identified by a unique four digit test series number entered in column 74 thru 78 of each record in the set. Test series numbers were assigned in chronological order. The records in a set are numbered consecutive starting with 001. The record number is entered in column 78 thru 80.

Sets belonging to the Inspection/Maintenance (I/M) study appear first in the file followed by sets from the Retrofit study. The I/M sets appear in pairs consisting of a "before tune up" followed by an "after tune up" set for the same vehicle. The pairs are ordered according to the ascending sequence of "before tune up" test series numbers. (Note there are no "after tune up" sets to match the "before tune up" set 2367 and 2798). The Retrofit set are arranged in ascending order by vehicle identification number (on the Header record) and test series number. Some sets are part of both the I/M and Retrofit studies. The test series number is the same for both occurances of the set.

Description Of The Sets.

The first record in every set is a Type 1 Header record. I/M sets are identified by a "1" in column 5. Retrofit sets have a blank in column 5. A typical set contains one or two Type 2 records giving the results of N.Y. Quick tests and one or two Type 2 records giving the results of C39 or C39H tests. Each Type 2 record is followed by a Type 3 record giving the ambient atmospheric data taken during the test.

The set contain results of a Keymode test. There is some variability in the way Keymode tests were coded. At the beginning of the study they were coded on a single Type 4 record. However, during the study it was decided to make additional kinds of measurements. The Type 4 record could not accommodate the additional readings and the Type 5 record was created to hold them. Also during the study a second analyzer system became available and it was decided to record measurements from both systems. Thus as many as four records are required to hold the Keymode results, a Type 4 record and a Type 5 record for each analyzer. The set may contain tune up data. These data are recorded on a Type 6 and a Type 7 record. For I/M sets the tune up records are included in the "before tune up" sets.

Comments may be included in Type 1,2,5 and 7 records. If a comment is too long to fit it is continued on one or more Type 8 records. Comments for Type 4 records are entirely contained on Type 8 records. As a convenience for programming the I/M printouts that are contained in Appendix III, Type 9 records were inserted at the end of I/M sets containing fewer than two C39 or C39H test records.

TABLE A

TAPE PARAMETERS

EXTERNAL LABEL	1 EPA
INTERNAL LABEL RECORDS	none
TRACKS	9 track
PARITY	odd
CHARACTER CODE	EBCDIC
DENSITY	1600 BPI
RECORD LENGTH	80 BYTES (fixed length)
BLOCK LENGTH	80 BYTES
NUMBER OF FILES	one
NUMBER OF RECORDS	7272

Note: Ten blank records were inserted at the beginning of the file to permit insertion of job control records. These records are included in the NUMBER OF RECORDS count.

TABLE B

HEADER RECORD - TYPE 1

COLUMN	CONTENT
thru 4	HDVR-These characters identify the set as part of the contract study
5	blank=Retrofit test set, 1=I/M test set
6,7	month
8,9	day Date of test
10,11	year
thru 17	owner's identification number for vehicle
thru 23	odometer reading
thru 29	hour meter reading, if any. Decimal point in column 28
thru 34	dynamometer inertia setting (unit=pounds)
thru 38	dynamometer power setting (unit=horsepower).Decimal point in column 37
39,40	speed corresponding to power setting (unit=m.p.h.)
41,42	not used
43	analyzer code(see Tables Of Codes)
44	constant volume sampler code (see Tables Of Codes)
45	not used
46,47	number of header comments
thru 72	first header comment, if any
73	not used
thru 80	test series number and record number

On the types of records that can contain comments the number of comments, including comment continuations, is entered. A zero is entered if there is no comments, a "1" is entered if the comment is entirely contained on the record, a "2" is entered if the comment is continued on a single Type 8 record, etc. However, becuase of an inconsistancy in coding, a zero instead of a "1" is coded on Header records for a comment entirely contained on the record.

TABLE C

TEST RESULT RECORD - TYPE 2

COLUMN	CONTENT
1,2	initials of test driver
3,4	initials of equipment operator
5,6	initials of data reducer
7 thru 10	test type (see TABLES OF CODES)
11	not used
12 thru 17	hydrocarbon reading (unit=gram/mile).Decimal point in column 15
18 thru 24	carbon monoxide reading (unit=gram/mile).Decimal point in column 22
25 thru 30	carbon dioxide reading (unit=gram/mile).Decimal point in column 29
31 thru 35	oxides of nitrogen reading (unit=gram/mile).Decimal point in column 33
36 thru 40	miles-per-gallon reading.Decimal point in column 39
41	atmospheric data taken? blank or zero=no, 1=yes
42	Keymode data taken? blank or zero=no, 1=yes
43	tune up data taken? blank or zero=no, 1=yes
44,45	number of comment records
46 thru 72	first comment, if any
73	not used
74 thru 80	test series number and record number

The values in column 42 and 43 are given only on the first Test Result record in the set. In the subsequent Test Result records of the set these columns are blank.

Carbon dioxide is not of interest in the study and is not included in the contract. However, carbon dioxide measurements were taken and coded. The carbon dioxide results on Retrofit Test Result records were edited for keypunch errors. The results on I/M records were not edited and may contain keypunch errors.

TABLE D

ATMOSPHERIC DATA RECORD - TYPE 3

COLUMN	CONTENT
thru 5	barometer reading (unit=inches of mercury).Decimal point in column 3
thru 10	dry bulb temperture (unit=^{0}F). Decimal point in column 9
thru 15	wet bulb temperature (unit=^{0}F). Decimal point in column 14
thru 19	not used
thru 24	absolute humidity (unit=grains/pound). Decimal point in column 23
thru 73	not used
thru 80	test series number and record number

TABLE E

KEYMODE TEST RECORD-I - TYPE 4

COLUMN	CONTENT
thru 4	dynamometer power setting (unit=horsepower). Decimal point in column 3
5,6	speed corresponding to power setting (unit=m.p.h.)
7	analyzer code (see TABLES OF CODES)
thru 12	hydrocarbon reading at idle
13	see note
4 thru 17	carbon monoxide reading at idle. Decimal point in column 16
8 thru 21	not used
2 thru 26	hydrocarbon reading at 2500 r.p.m.
27	see note
8 thru 31	carbon monoxide reading at 2500 r.p.m. Decimal point in column 30
2 thru 35	not used
36,37	low cruise speed (unit=m.p.h.)
8 thru 42	hydrocarbon reading at low cruise speed
43	see note
4 thru 47	carbon monoxide reading at low cruise speed. Decimal point in column 46
8 thru 51	not used
52,53	high cruise speed (unit=m.p.h.)
4 thru 58	hydrocarbon reading at high cruise speed
59	see note
0 thru 63	carbon monoxide reading at high cruise speed. Decimal point in column 62
4 thru 67	not used
68,69	number of comment records
70	see note
1 thru 73	not used
4 thru 80	test series number and record number

The units for hydrocarbon and oxides of nitrogen reading are ppm. arbon monoxide readings are in percent. However, in a very few of the arliest Keymode test the carbon monoxide reading are coded in ppm. If the arbon monoxide reading is in percent a "1" is coded in the column preceeding he reading, if the carbon monoxide reading is in ppm a blank or a zero is oded in the perceeding column.

As explained in the text some Keymode test results are coded on a ingle record while others are coded on four records. When four records re present a "1" is coded in column 70 of the first Keymode record. If here is only a single Keymode record the column is left blank.

TABLE F

KEYMODE TEST RECORD-II - TYPE 5

COLUMN	CONTENT
1	analyzer code (see TABLES OF CODES)
2 thru 6	hydrocarbon reading during motoring (unit=ppm)
7 thru 10	carbon monoxide reading during motoring (in percent) . Decimal point in column 9
11 thru 14	engine R.P.M. during 11 inch vacuum test
15 thru 19	hydrocarbon reading for 11 inch vacuum test
20 thru 23	carbon monoxide reading for 11 inch vacuum test (in percent) . Decimal point in column 22
24 thru 27	engine R.P.M. during low vacuum test
28,29	low vacuum pressure (unit=inches of mercury)
30 thru 34	hydrocarbon reading for low vacuum (unit=ppm)
35 thru 38	carbon monoxide reading for low vacuum (in percent) . Decimal point in column 37
39,40	number of comment records
41 thru 72	first comment, if any
73	not used
74 thru 80	test series number and record number

TABLE G

TUNE UP RECORD-I - TYPE 6

COLUMN	CONTENT
1,2	month
3,4	day Date of tune up
5,6	year
7 thru 12	odometer reading
13 thru 18	hour meter reading, if any. Decimal point in column 17
	COLUMNS 19 THRU 58 CONTAIN BEFORE-TUNE-UP DATA
19 thru 22	r.p.m. at idle
23	not used
24 thru 27	carbon monoxide reading at idle(in percent) . Decimal point in column 26
28 thru 31	hydrocarbon reading at idle (unit=ppm)
32 thru 35	air/fuel ratio at idle. Decimal point in column 34
36 thru 39	carbon monoxide reading at 2500 r.p.m. (in percent) . Decimal point in column 38
40 thru 43	hydrocarbon reading at 2500 r.p.m. (unit ppm)
44 thru 47	air/fuel ration at 2500 r.p.m. Decimal point in column 46
48,49	dwell (degrees)
50,51	timing (degrees) see column 56
52 thru 55	spark plug gap. Decimal point in column 52
56	0=after top dead center, 1=before top dead center
57	PCV valve condition code (see TABLES OF CODES)
58	air filter condition code (see TABLES OF CODES)
	COLUMN 59 THRU 71 CONTAINS AFTER-TUNE-UP DATA
59 thru 62	r.p.m. at idle
63	not used
64 thru 67	carbon monoxide reading at idle (in percent). Decimal point in column 66
68 thru 71	hydrocarbon reading at idle (unit=ppm)
72,73	not used
74 thru 80	test series number and record number

TABLE H

TUNE UP RECORD-II - TYPE 7

COLUMN	CONTENT
	THE RECORD CONTAINS AFTER-TUNE-UP DATA
1 thru 4	air/fuel ratio at idle. Decimal point in column 3
5 thru 8	carbon monoxide reading at 2500 R.P.M. (in percent) . Decimal point in column 7
9 thru 12	hydrocarbon reading at 2500 R.P.M. (unit=ppm)
13 thru 16	air/fuel ratio at 2500 R.P.M. Decimal point in column 15
17,18	dwell (degrees)
19,20	timing (degrees) see column 25
21 thru 24	spark plug gap. Decimal point in column 21
25	0=after top dead center, 1=before top dead center
26	PCV valve condition code (see TABLES OF CODES)
27	air filter condition code (see TABLES OF CODES)
28,29	number of comment records
30 thru 72	first comment, if any
73	not used
74 thru 80	test series number and record number

TABLE I

COMMENT CONTINUATION RECORD - TYPE 8

COLUMN	CONTENT
1 thru 72	comment continuation
73	not used
74 thru 80	test series number and record number

TABLE J

WARNING RECORD - TYPE 9

COLUMN	CONTENT
1 thru 6	I/M test sets generally contain two N.Y. Traffic Cycle test records. If an I/M set contains only one of the test records a Warning Record is placed at the end of the set and this area is filled with asterisks. If the set contains no N.Y. Traffic Cycle record the area is filled with dollar signs.
7 thru 73	blanks
74 thru 80	test series number and record number

APPENDIX II

GRAPHS OF RETROFIT TEST DATA

STUDY OF CONTROL STRATEGIES FOR IN-USE HEAVY DUTY VEHICLES

Environmental Protection Agency Contract Number 68-01-4319

Submitted by
John J. Pinto
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NYC Department of Environmental Protection
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Region II publication No. 902/4-81-001 b

All the results shown in Appendix II were obtained from New York Quick cycle tests.

APPENDIX II
CONTENTS

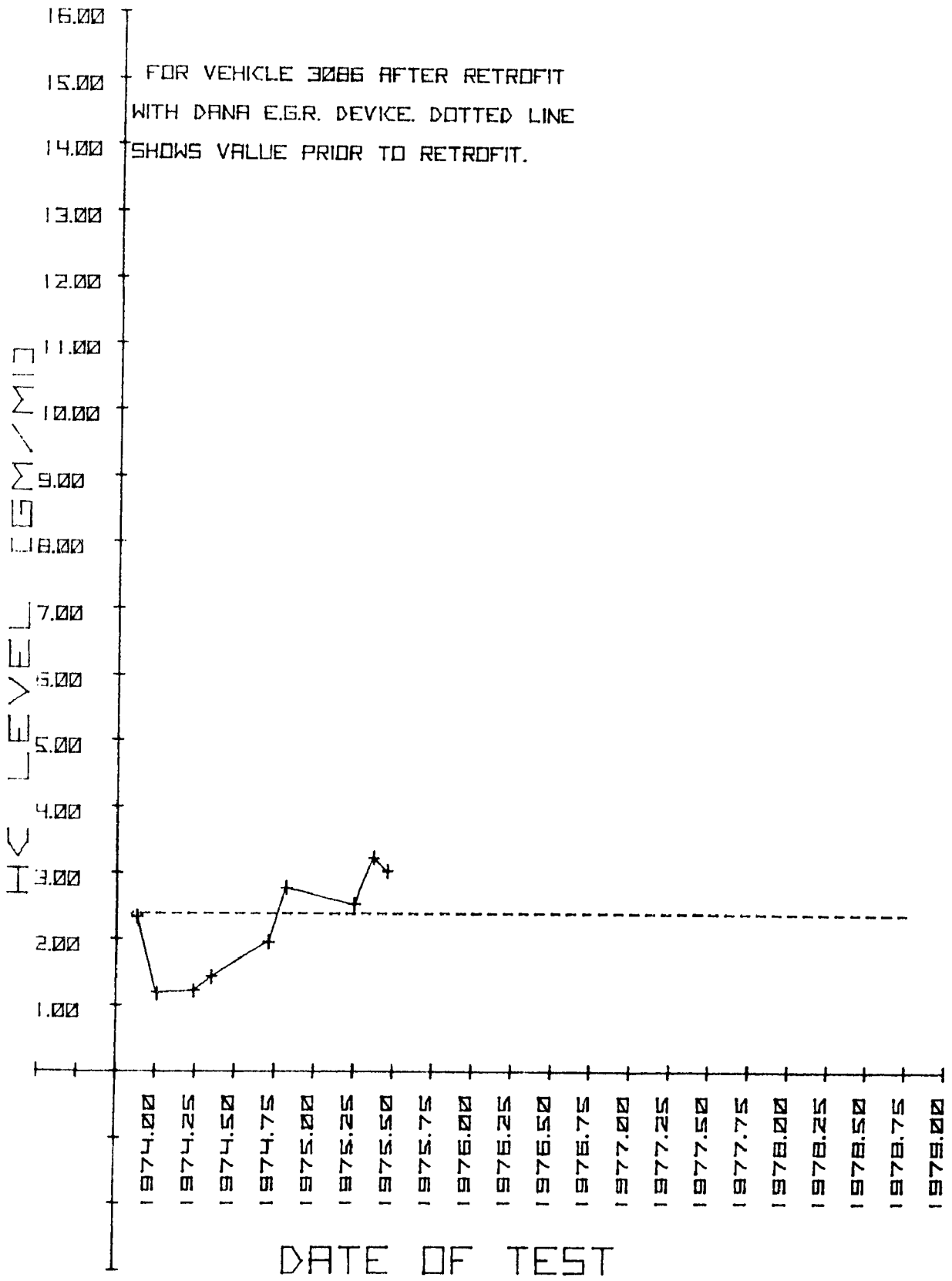
II-A. Retrofit With DANA Exhaust Gas Recirculation Device.

II-B. Retrofit With ADAKS Air Bleed Device.

II-C. Retrofit With Lean Carburetors.

APPENDIX II-A

RETROFIT WITH DANA EXHAUST GAS RECIRCULATION DEVICE


FOR VEHICLE 3086 AFTER RETROFIT
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
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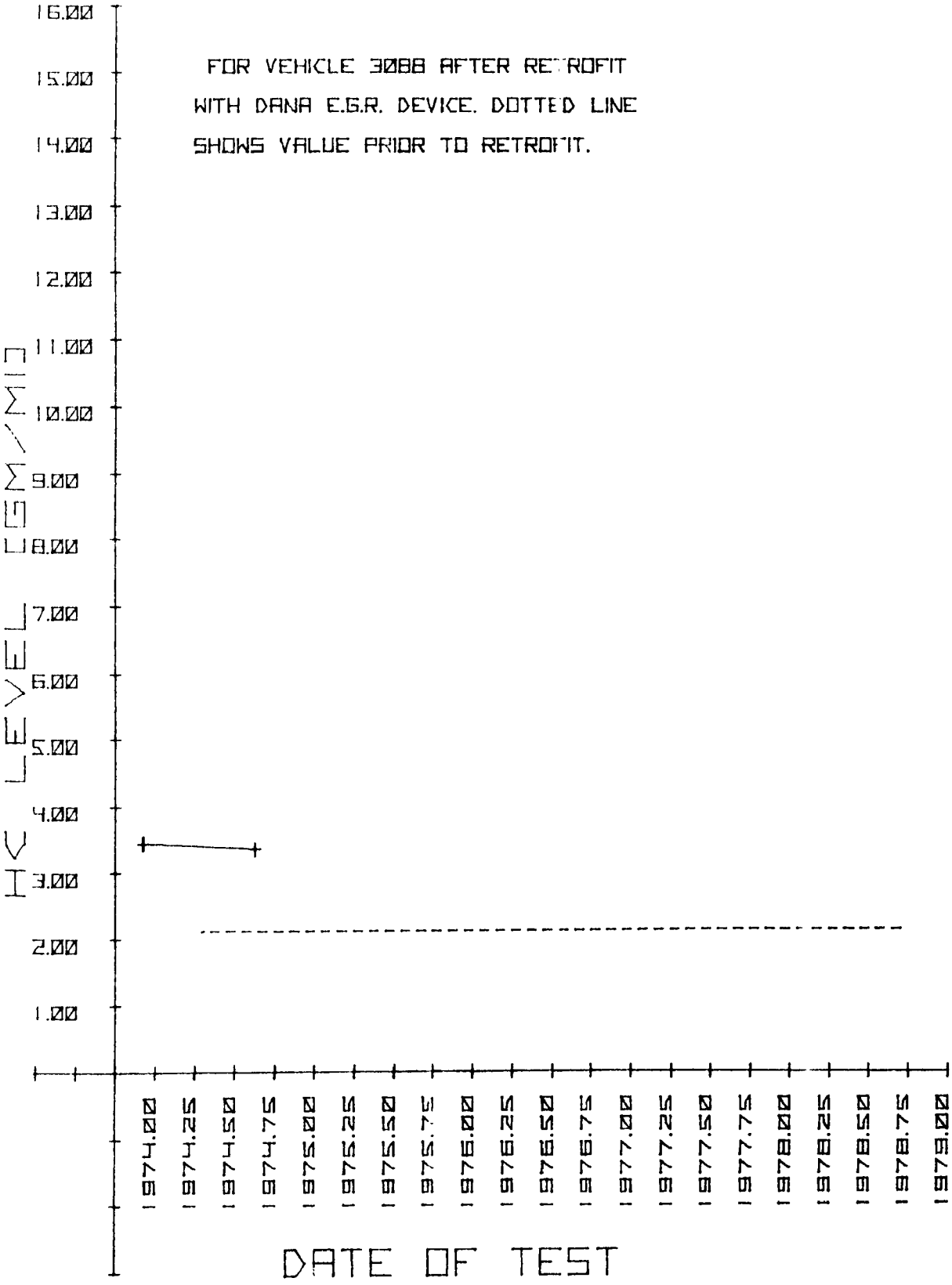
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
HC LEVEL G/MI
DATE OF TEST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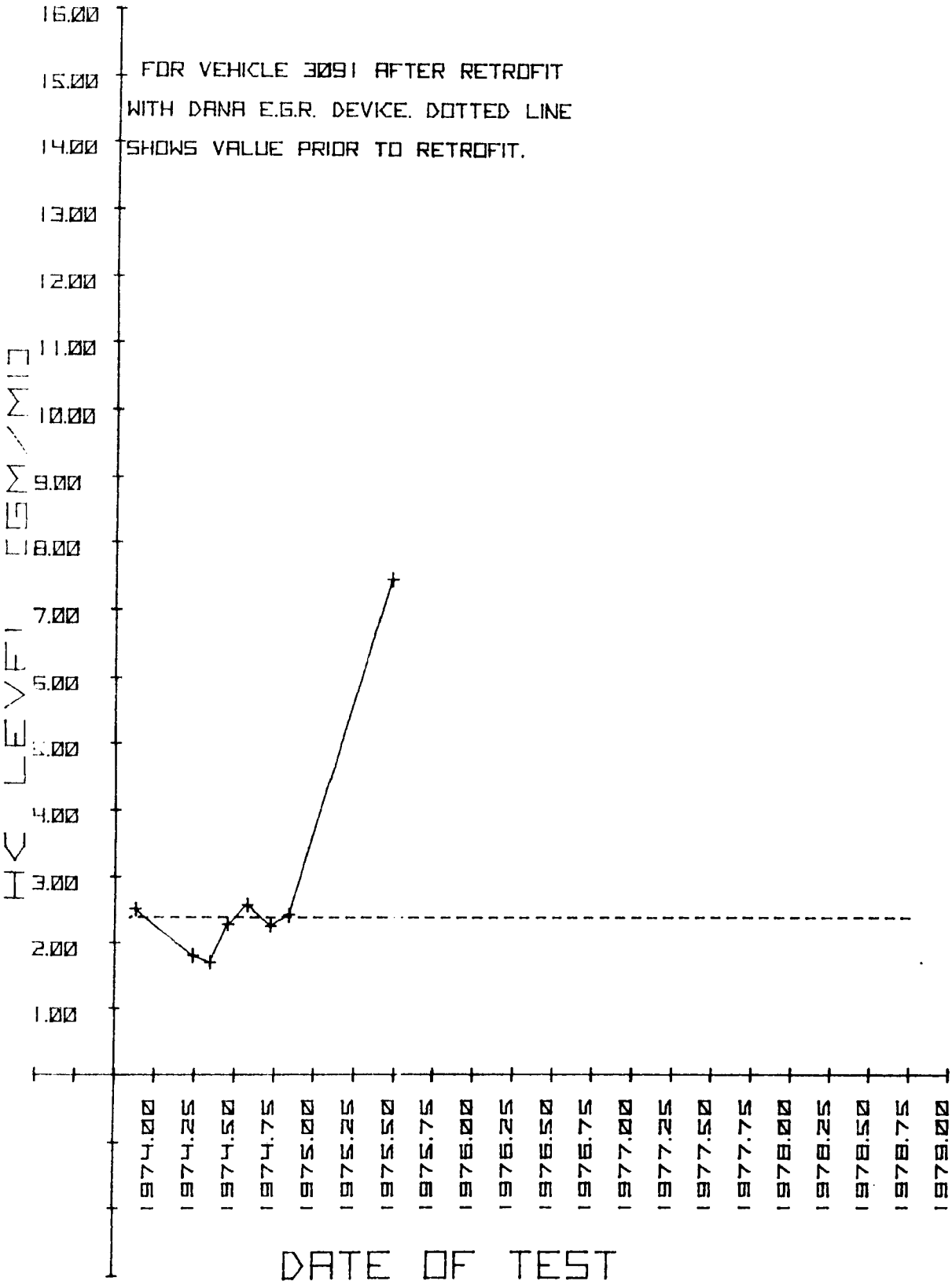
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
HC LEVEL GM/MI
DATE OF TEST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14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
HC LEVEL GM/MI
1974.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
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1977.75
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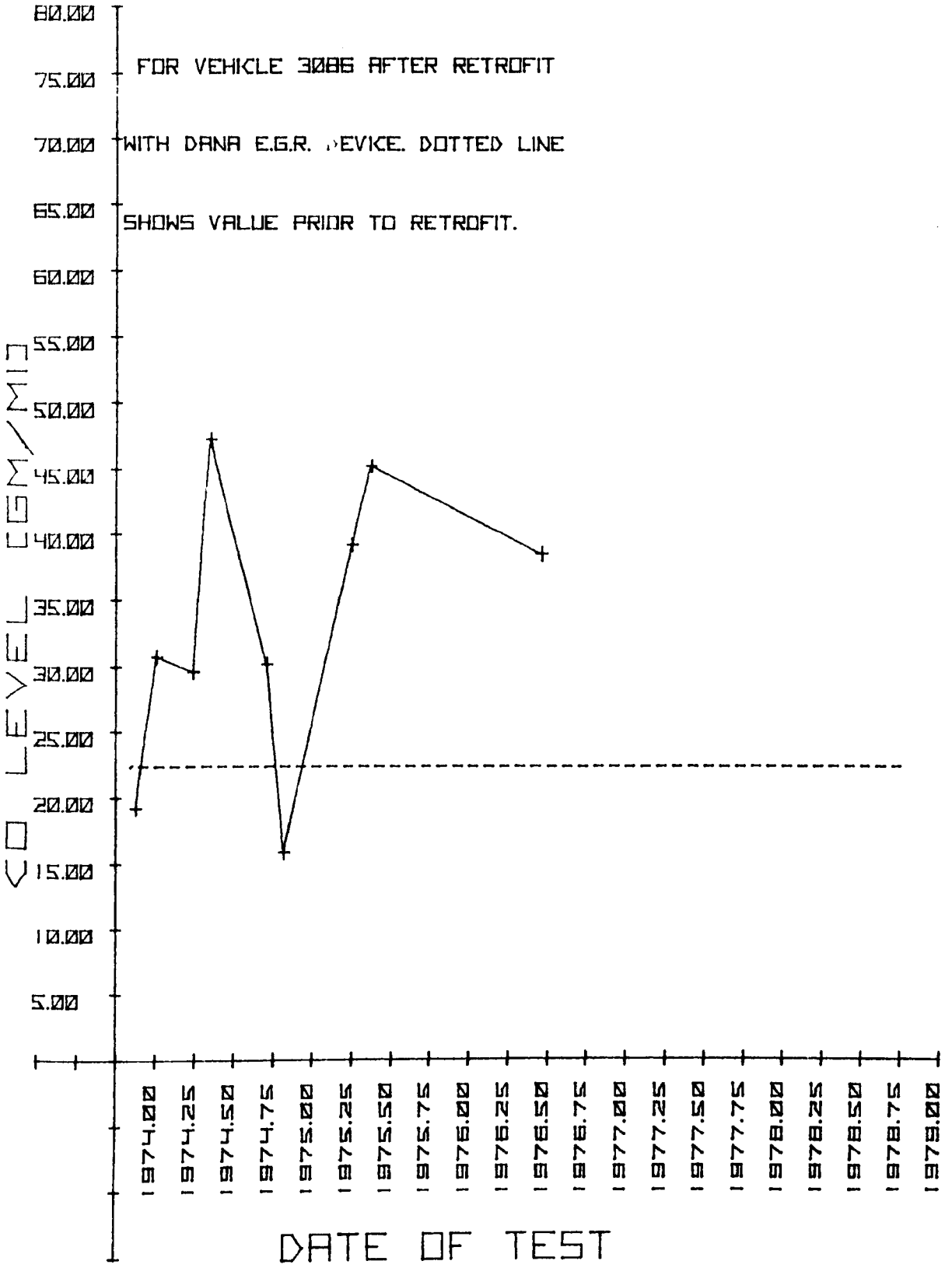
1978.25
1978.50
1978.75
1979.00
DATE OF TEST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WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
CO LEVEL GM/MI
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75.00
70.00
65.00
60.00
55.00
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30.00
25.00
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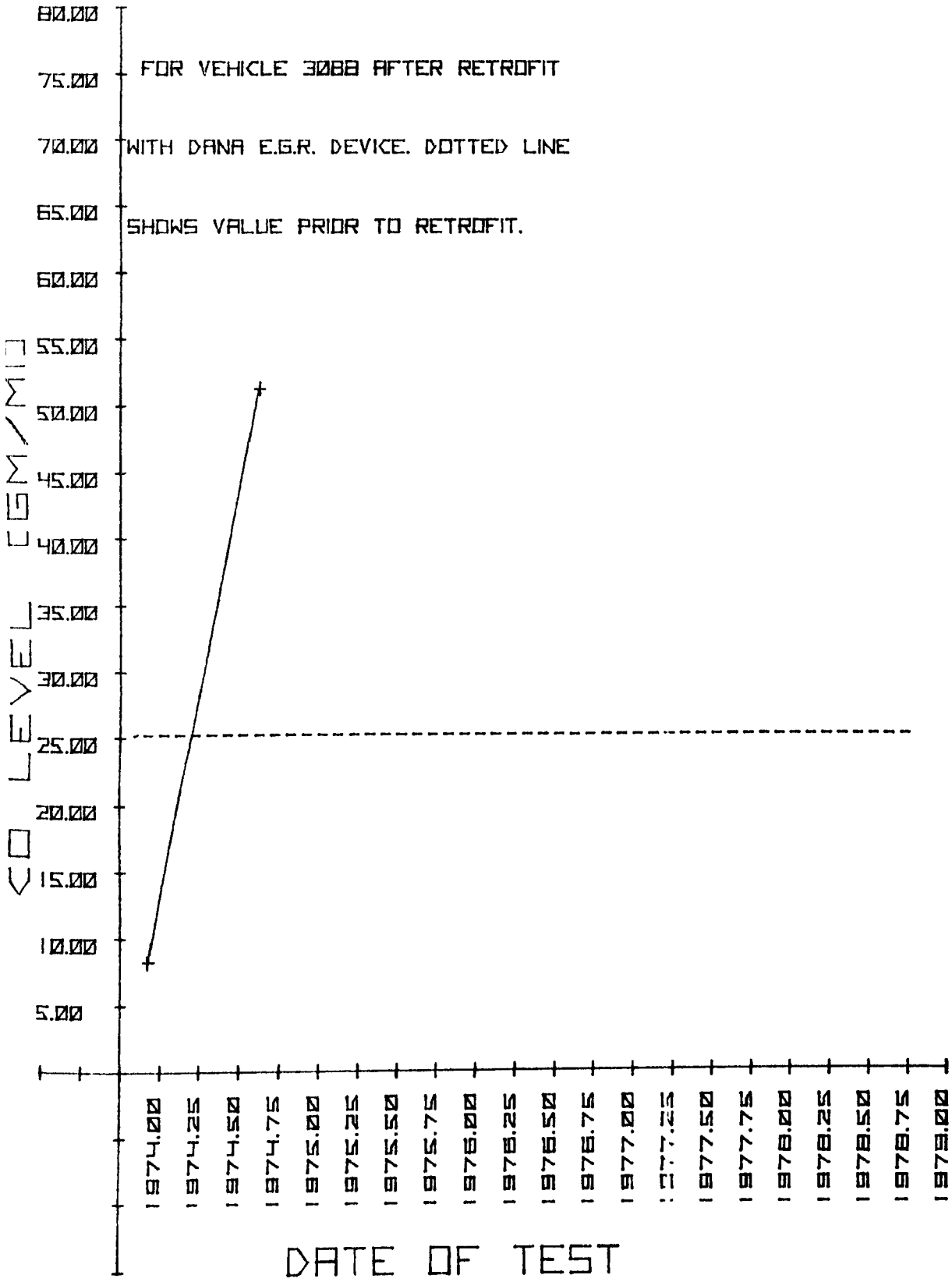
15.00
10.00
5.00
DATE OF TEST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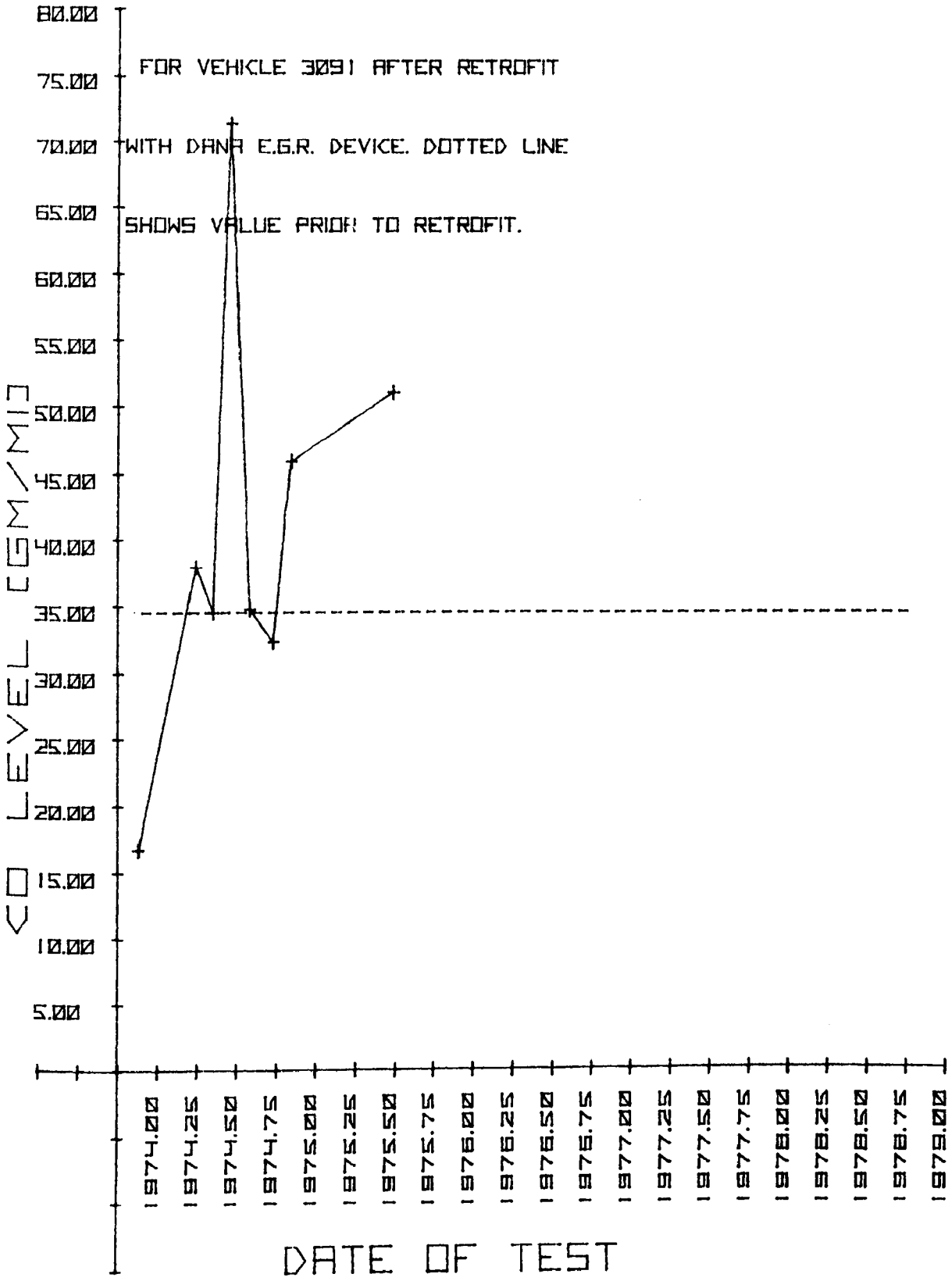
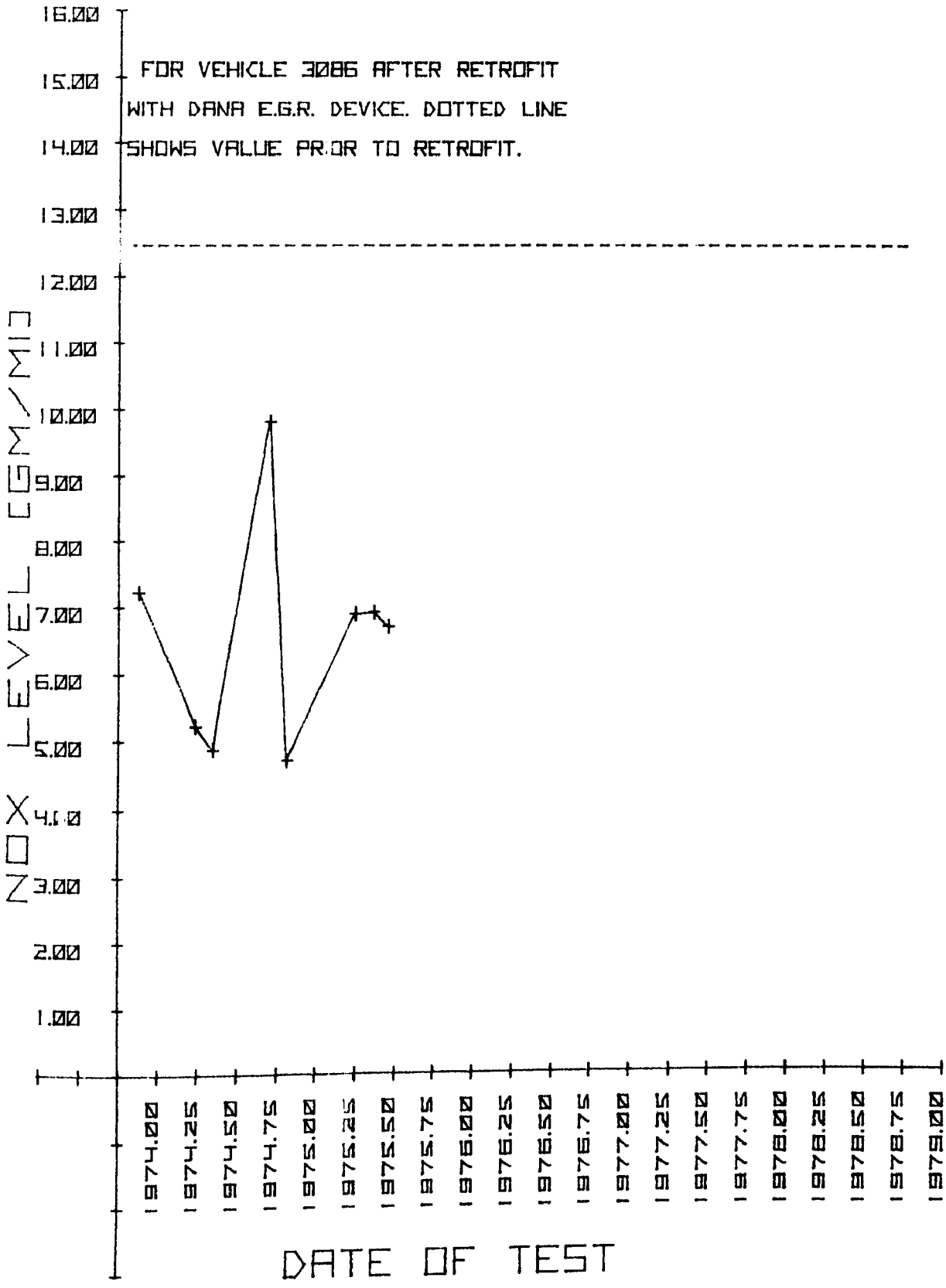
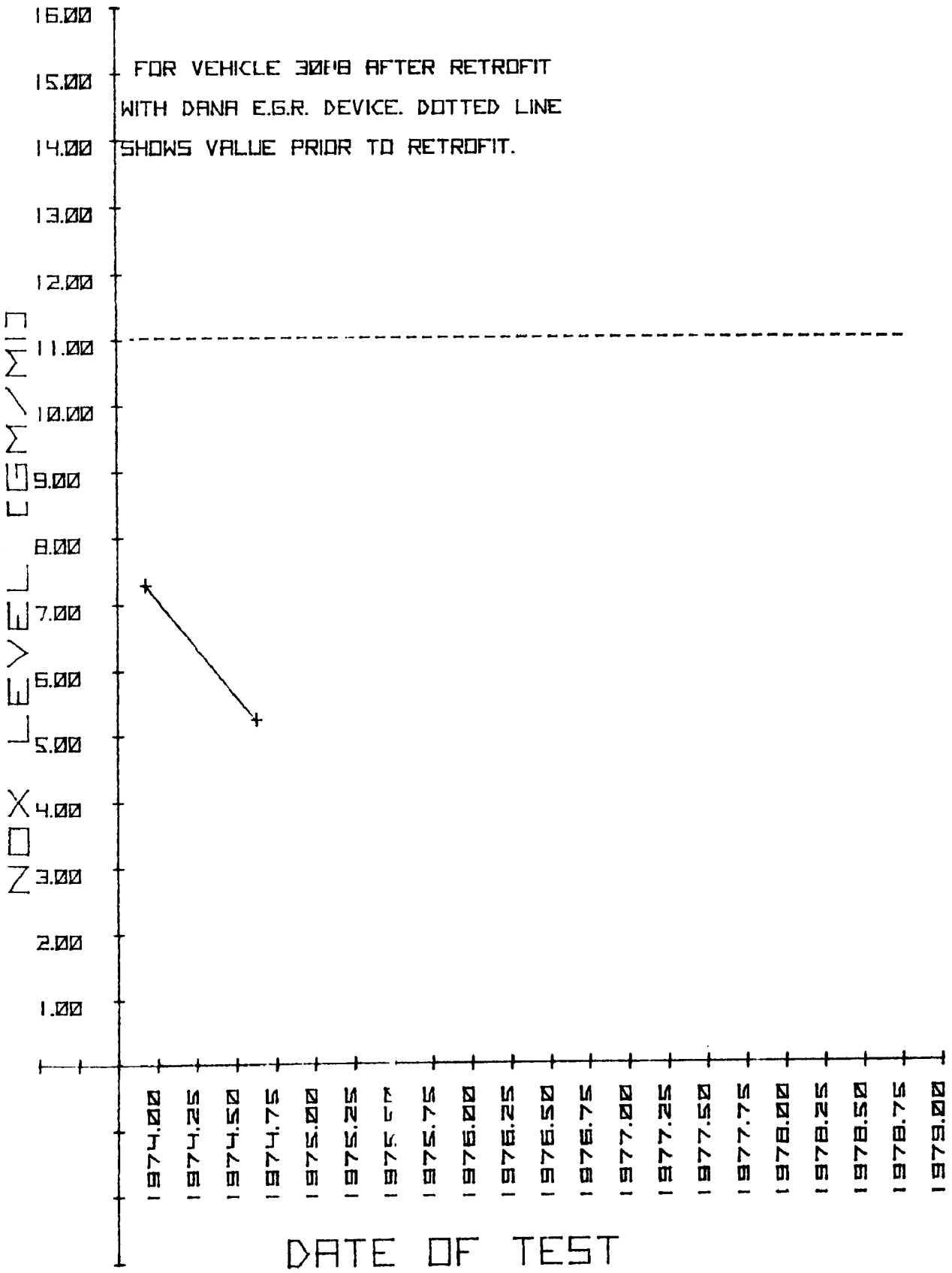
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
CO LEVEL GM/MI
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
DATE OF TEST


FOR VEHICLE 3091 AFTER RETROFIT
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
CO LEVEL (GM/MI)
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
DATE OF TEST


FOR VEHICLE 3086 AFTER RETROFIT
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
NOX LEVEL GM/MI
DATE OF TEST


FOR VEHICLE 30P8 AFTER RETROFIT
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
NOX LEVEL GM/MI
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15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
DATE OF TEST
1974.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
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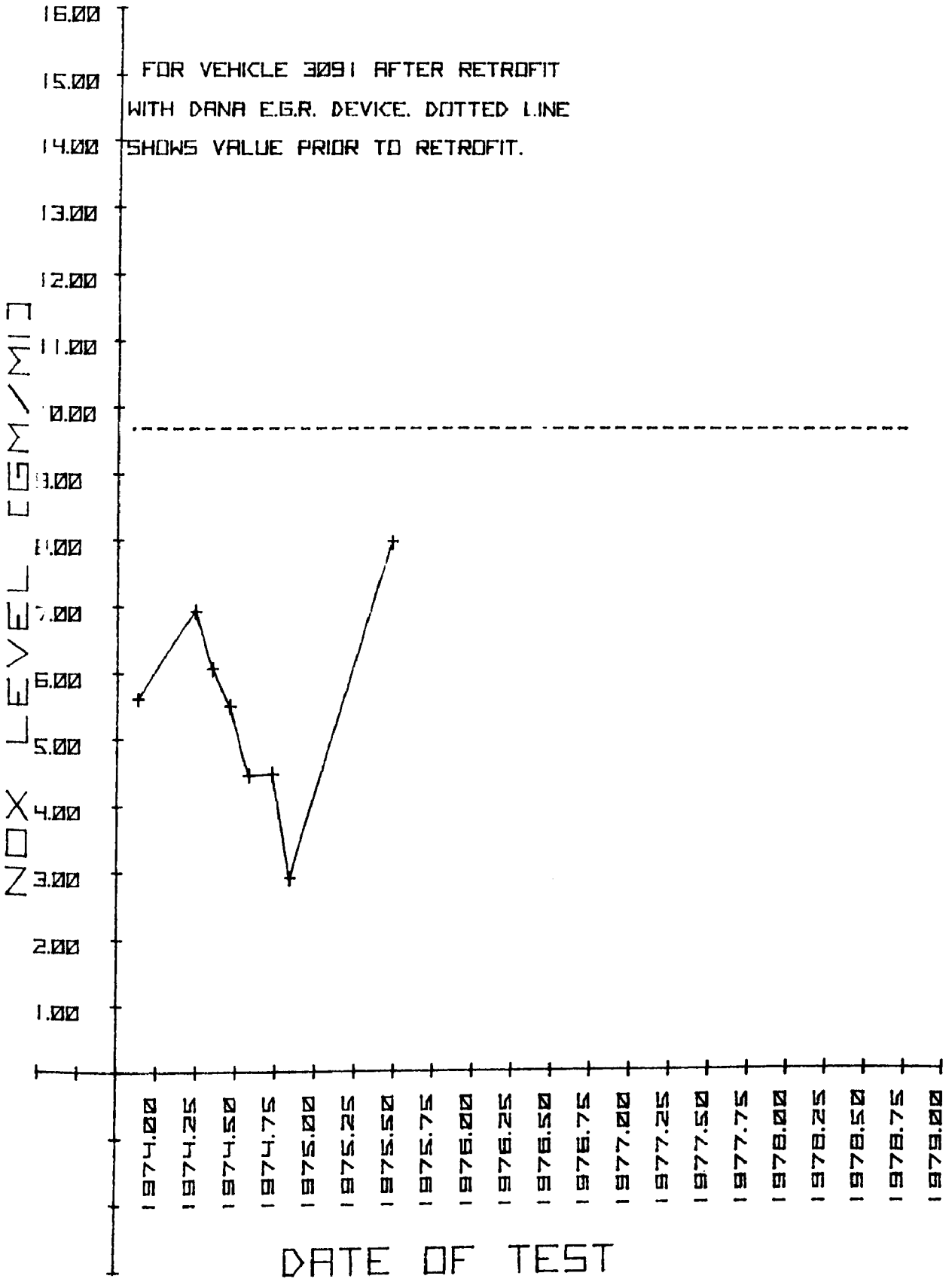
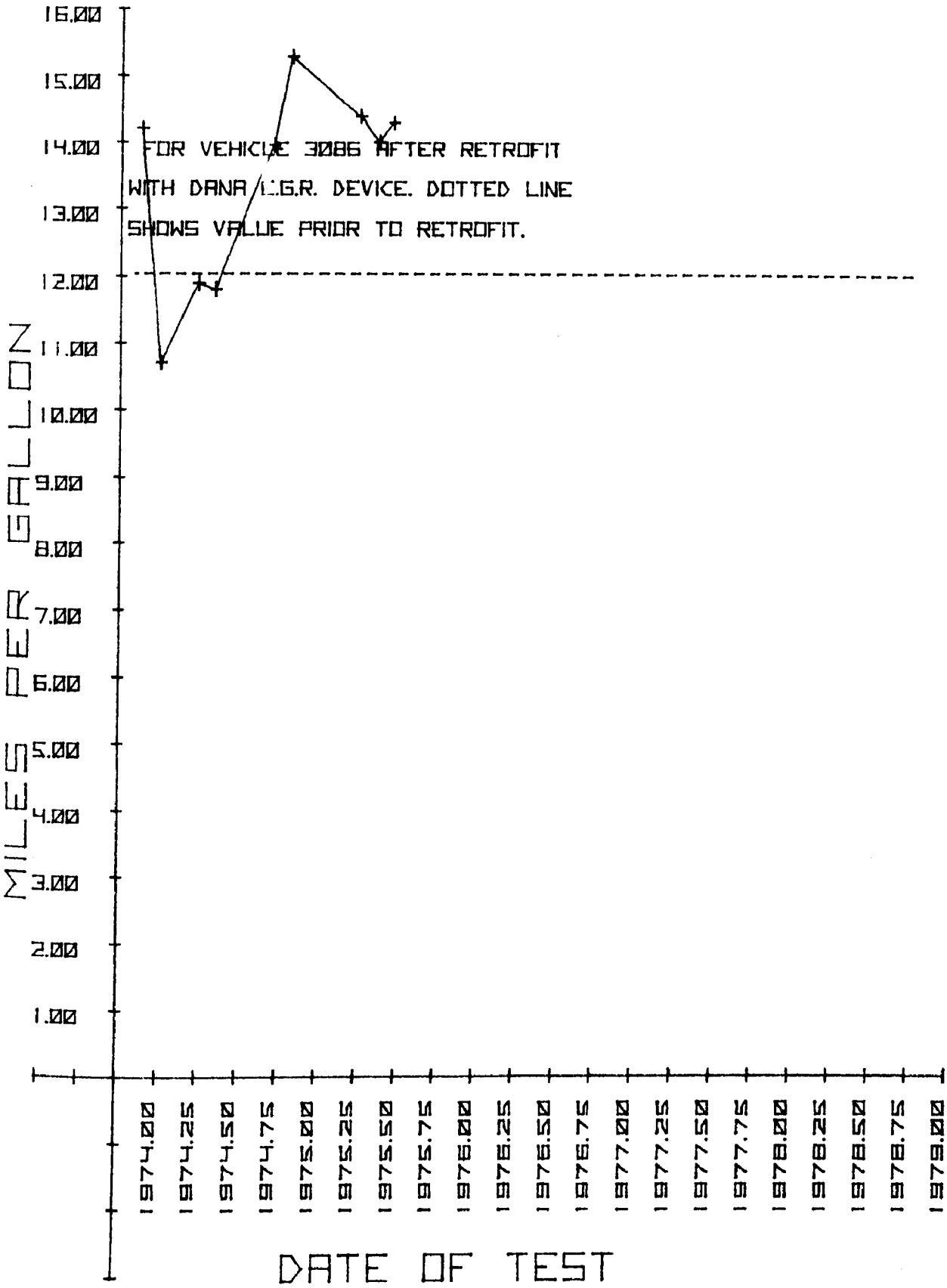
1979.00


FOR VEHICLE 3091 AFTER RETROFIT
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
NOX LEVEL GM/MI
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
DATE OF TEST


FOR VEHICLE 3086 AFTER RETROFIT
WITH DANA/E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MILES PER GALLON
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15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
1974.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
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1978.00
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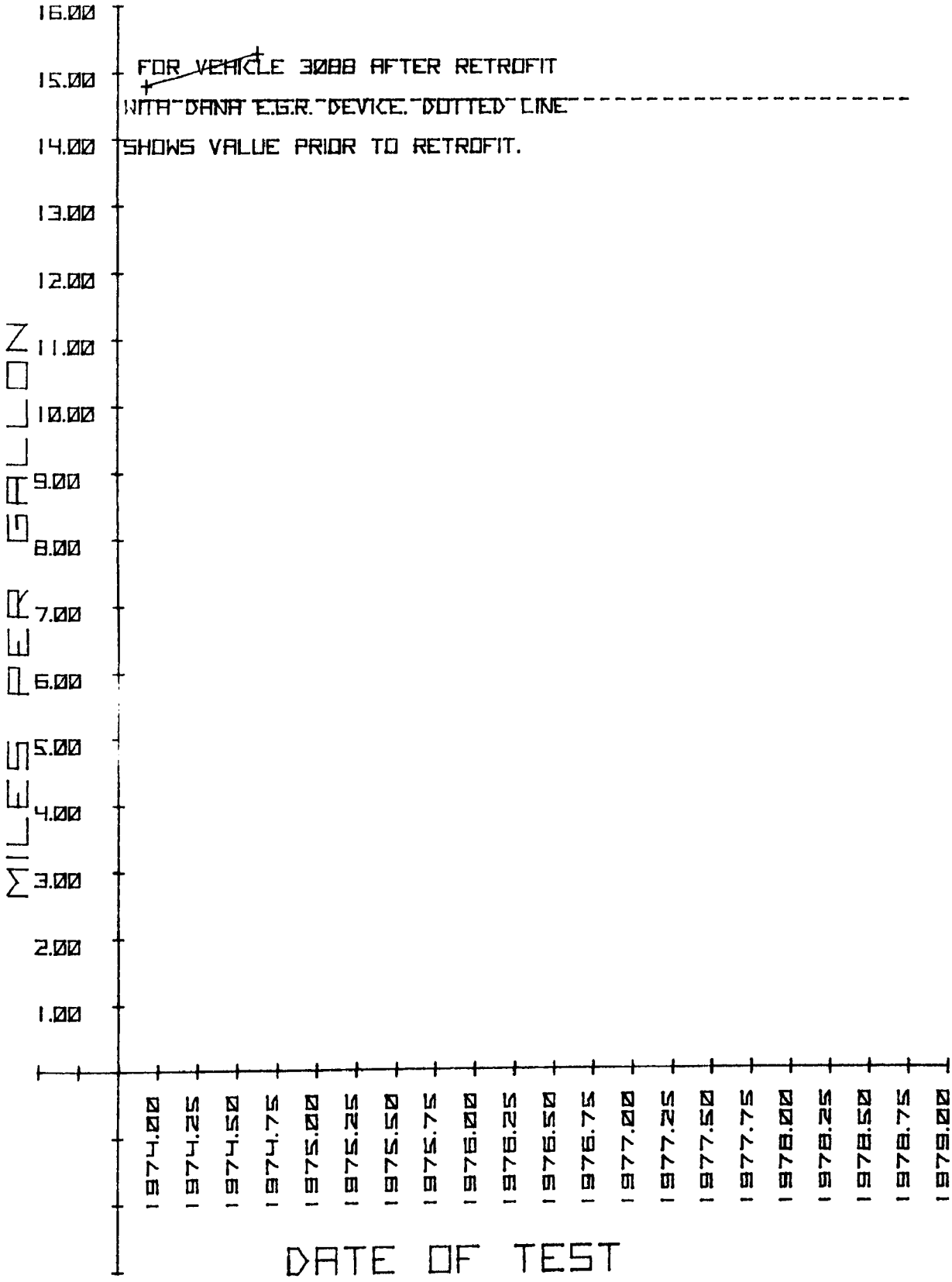
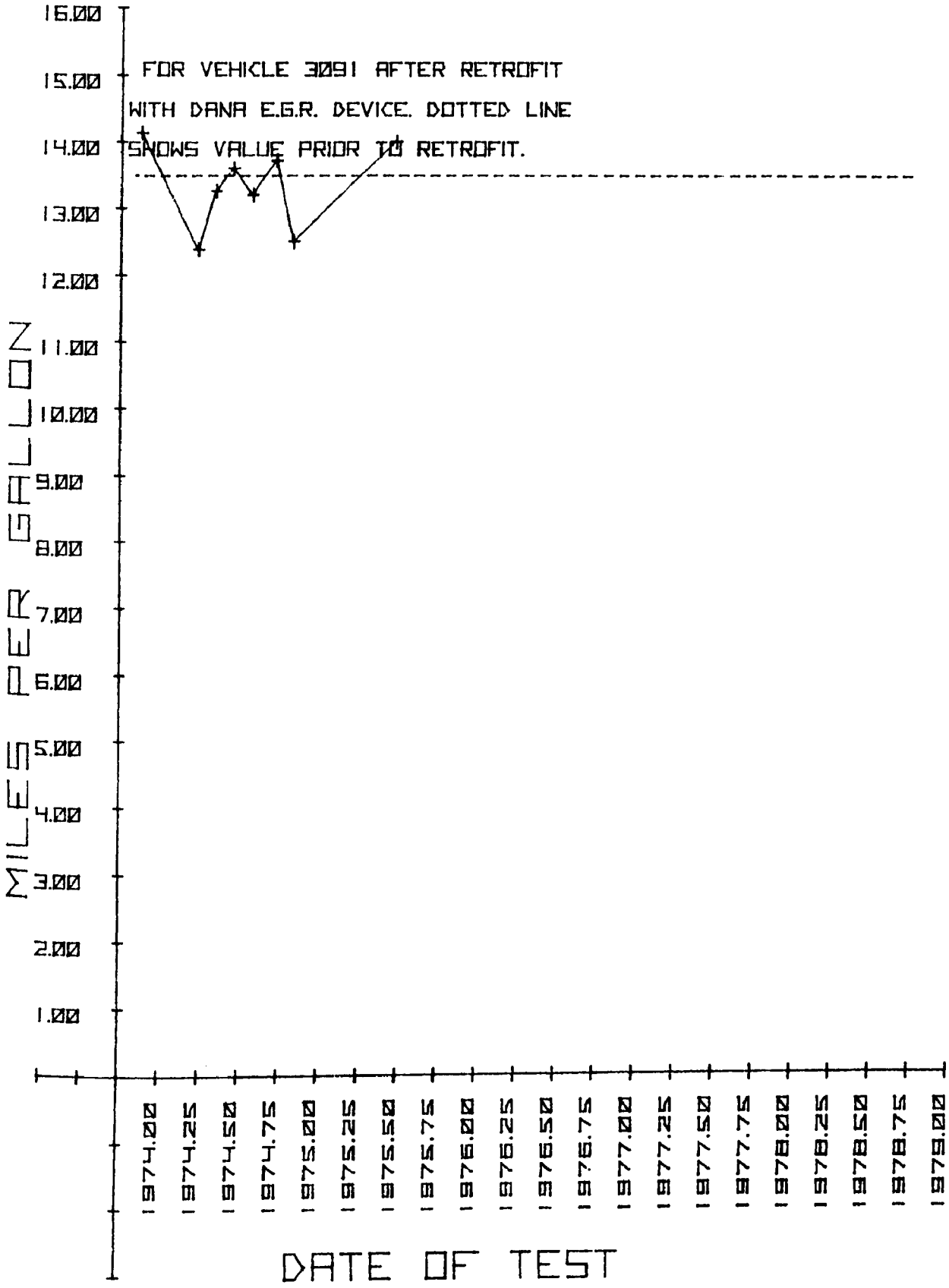
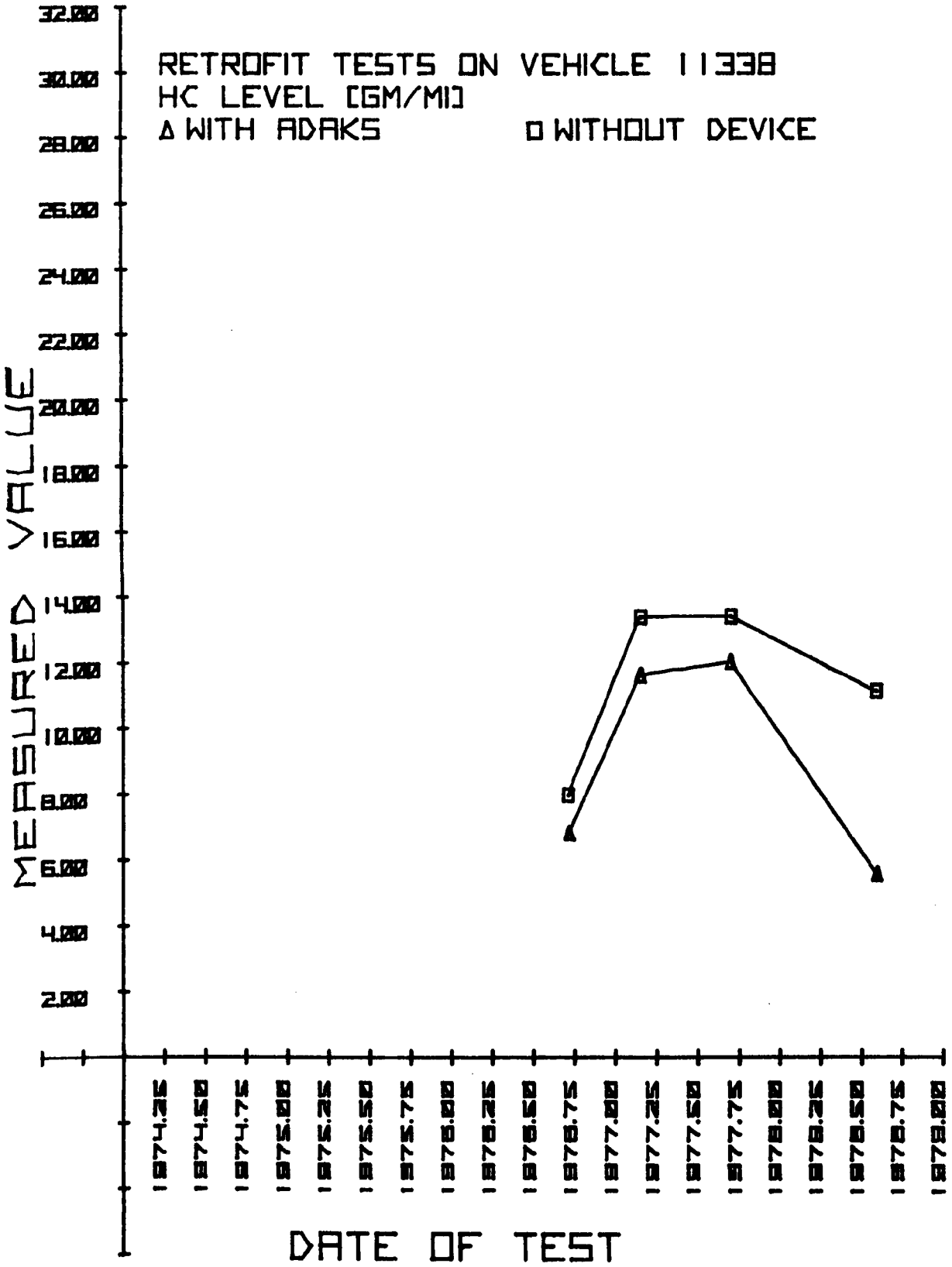
1978.75
1979.00
DATE OF TEST

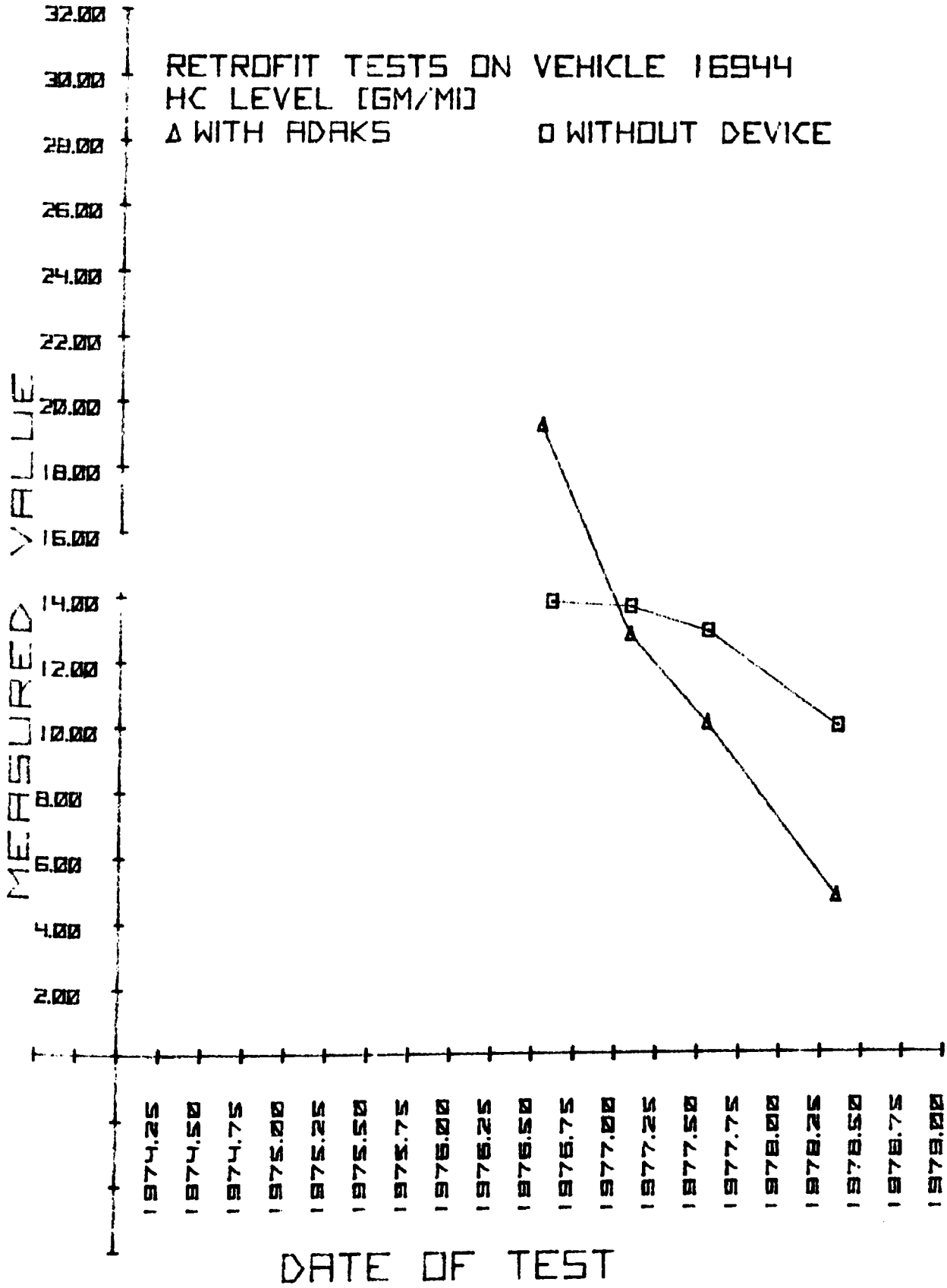

FOR VEHICLE 3088 AFTER RETROFIT
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MILES PER GALLON
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
1974.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

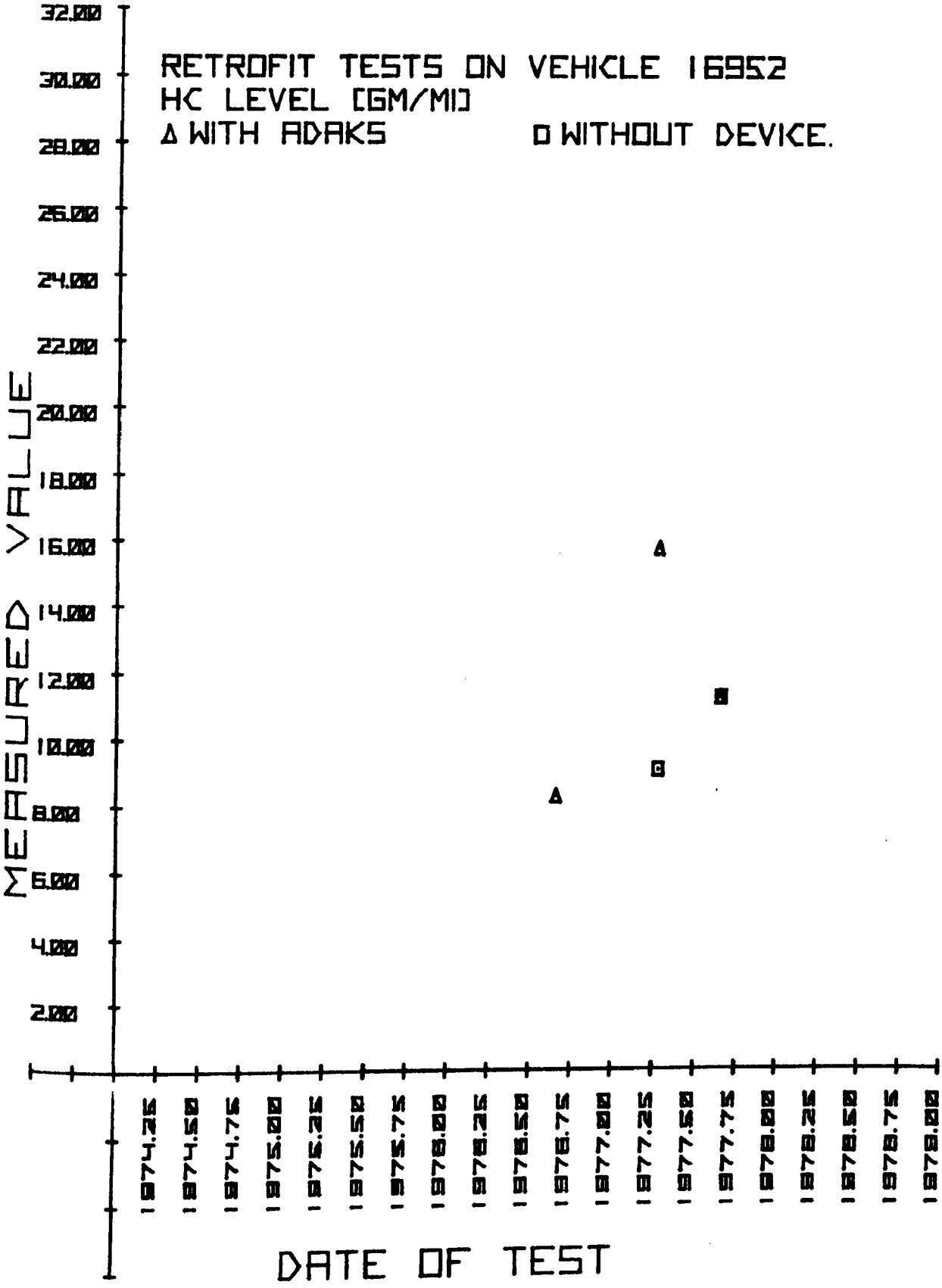

FOR VEHICLE 3091 AFTER RETROFIT
WITH DANA E.G.R. DEVICE. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MILES PER GALLON
16.00
15.00
14.00
13.00
12.00
11.00
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
DATE OF TEST

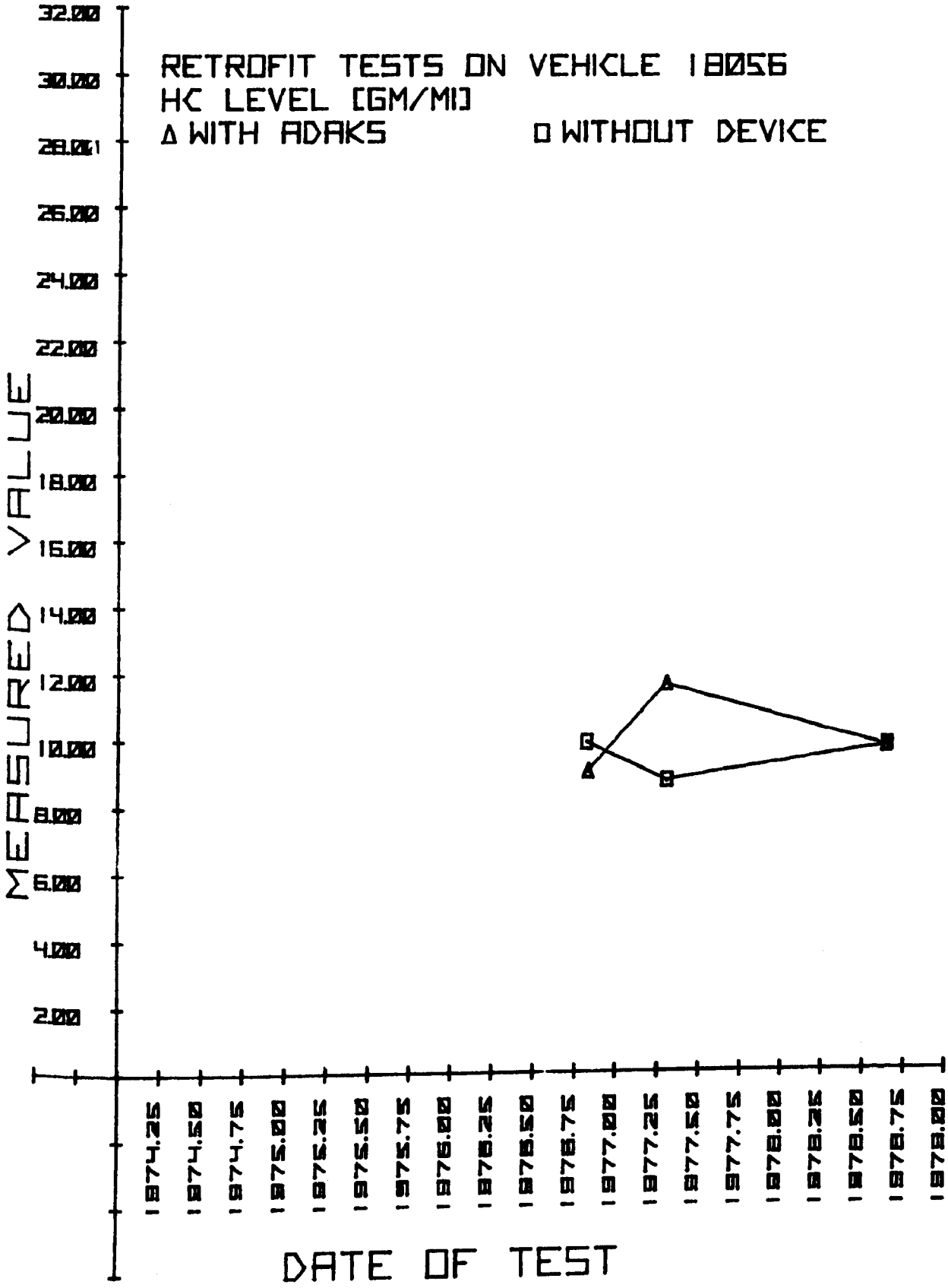
APPENDIX II-B

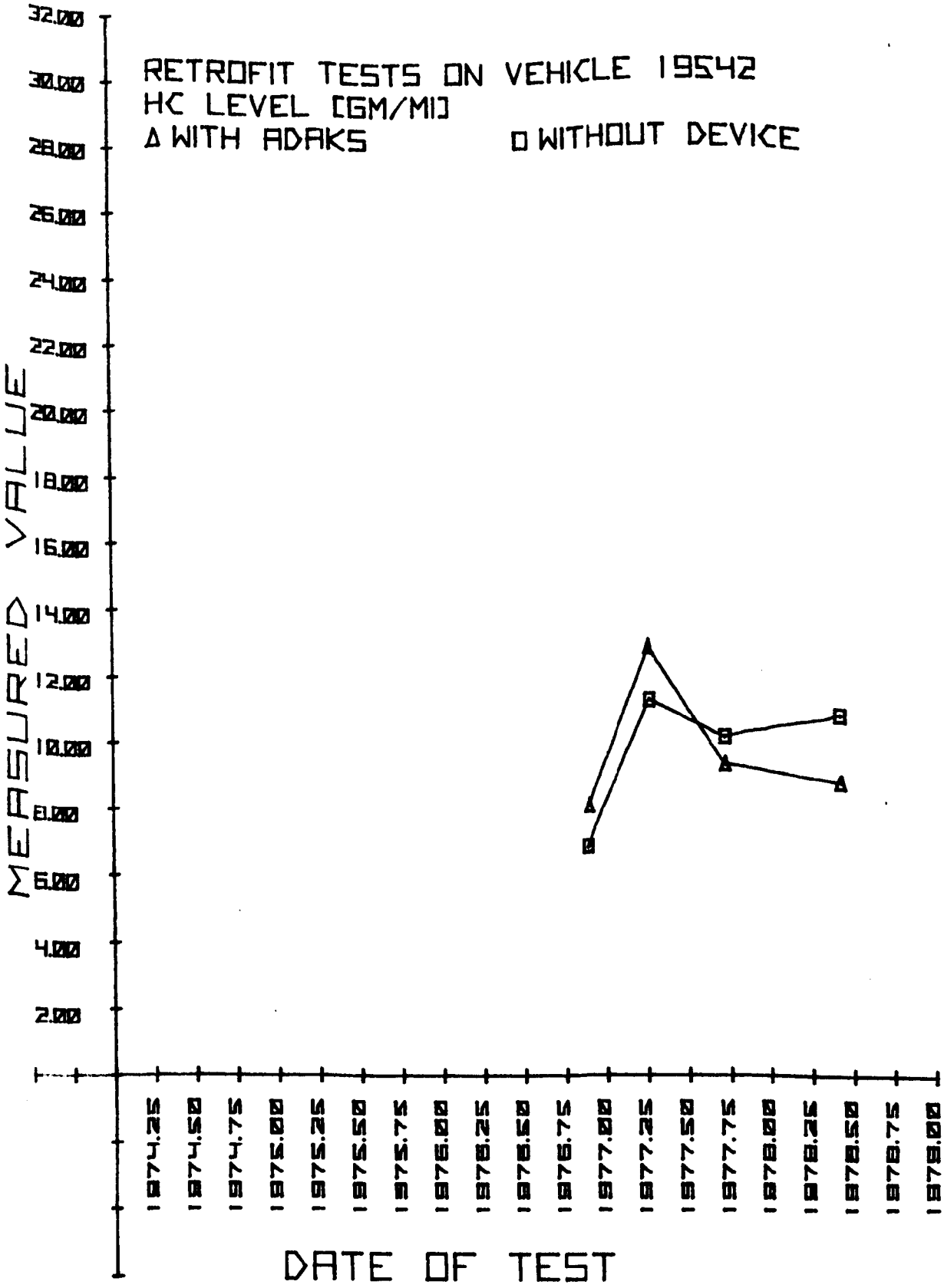
RETROFIT WITH ADAKS AIR BLEED DEVICE

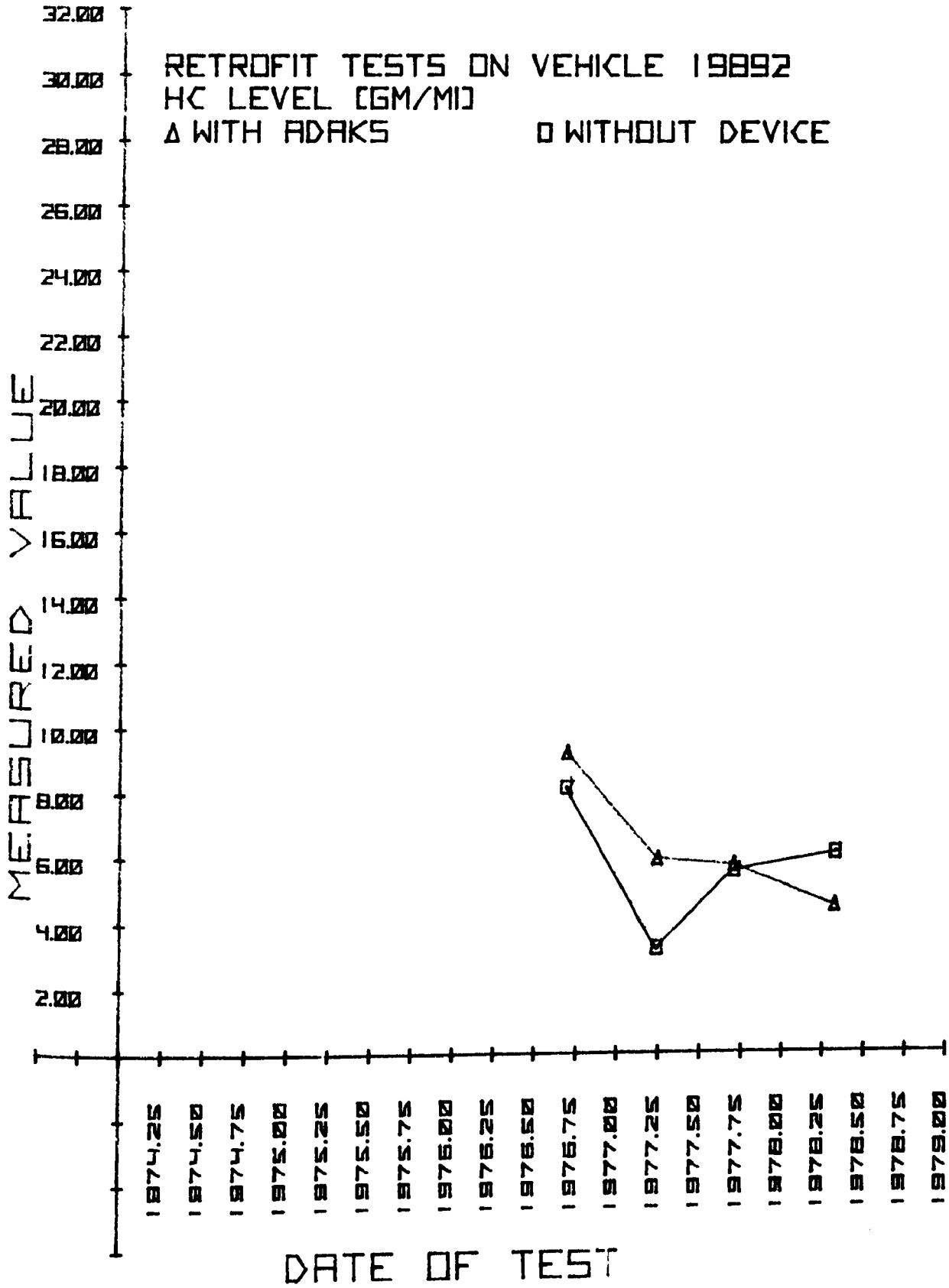

RETROFIT TESTS ON VEHICLE 11338
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

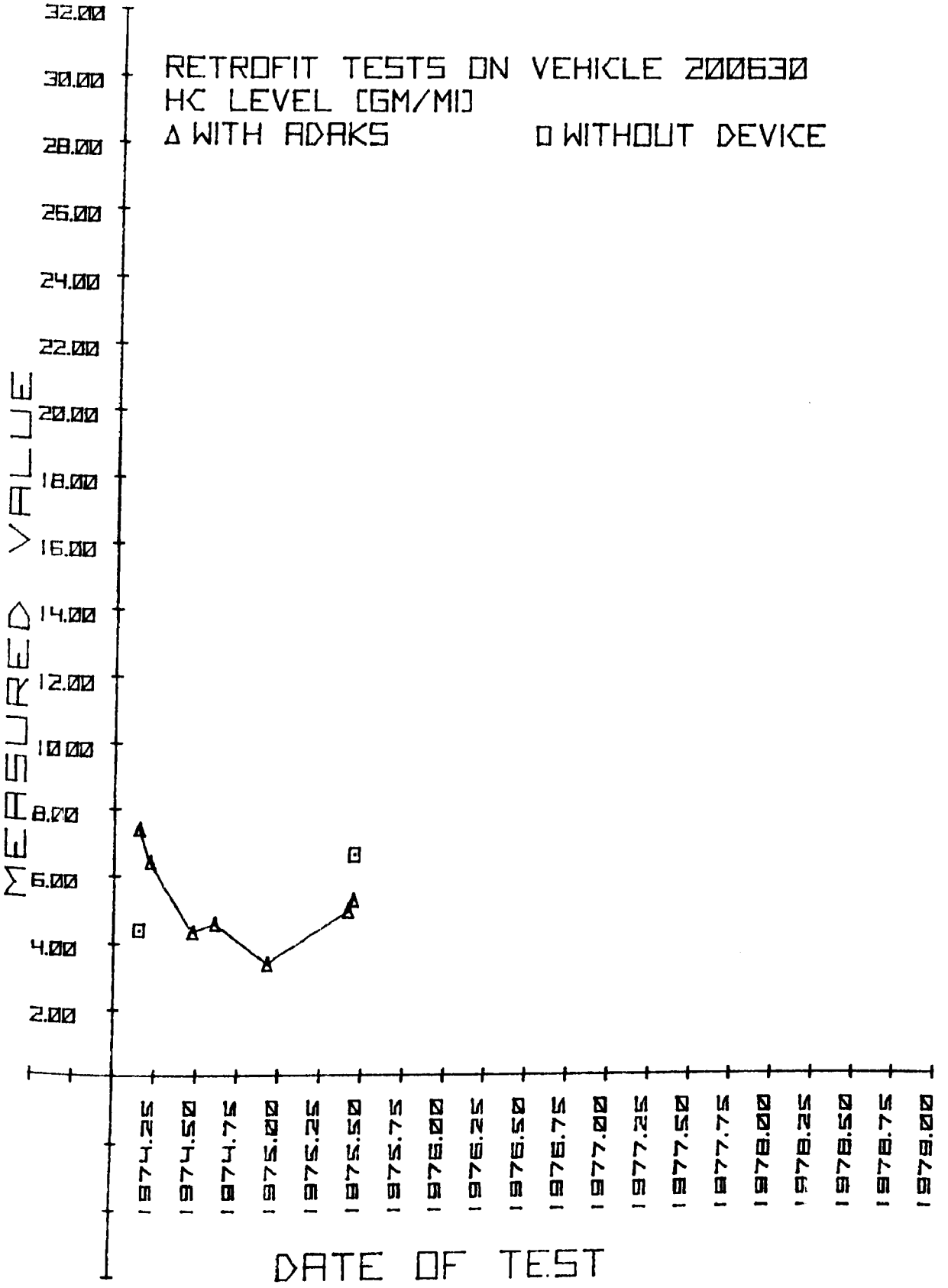

RETROFIT TESTS ON VEHICLE 16944
HC LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

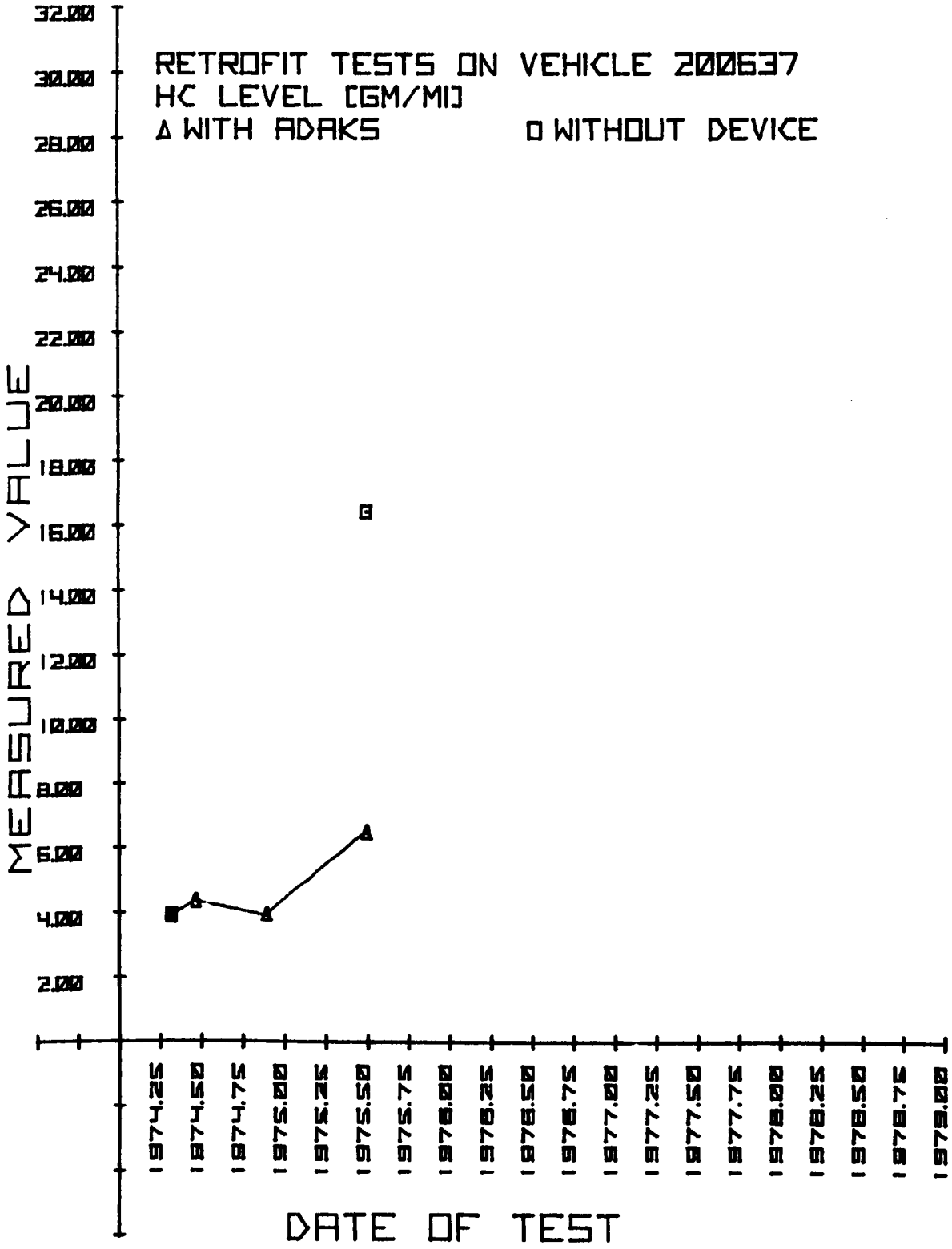

RETROFIT TESTS ON VEHICLE 16952
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

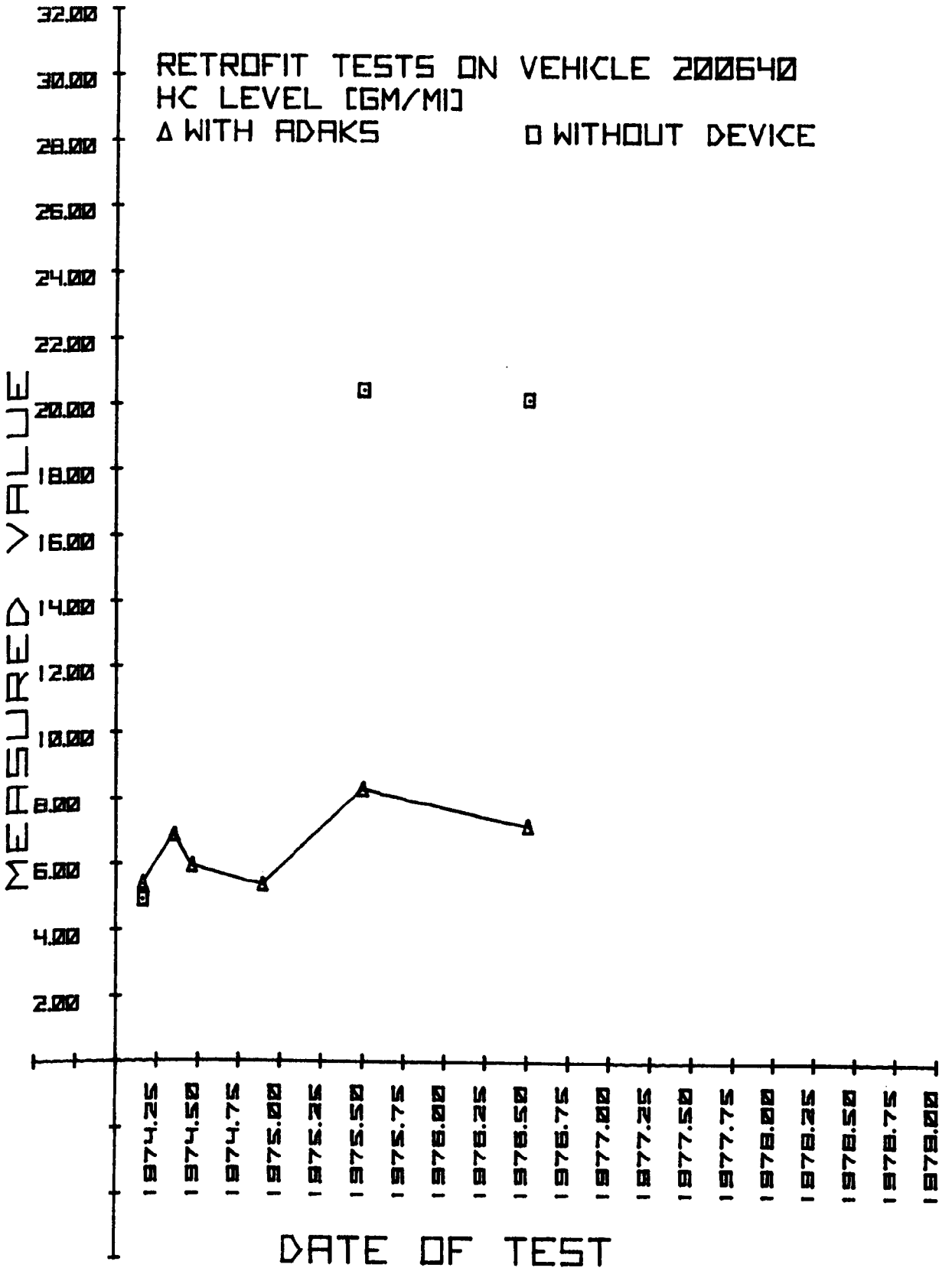

RETROFIT TESTS ON VEHICLE 18056
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST
1874.25
1874.50
1874.75
1875.00
1875.25
1875.50
1875.75
1876.00
1876.25
1876.50
1876.75
1877.00
1877.25
1877.50
1877.75
1878.00
1878.25
1878.50
1878.75
1879.00

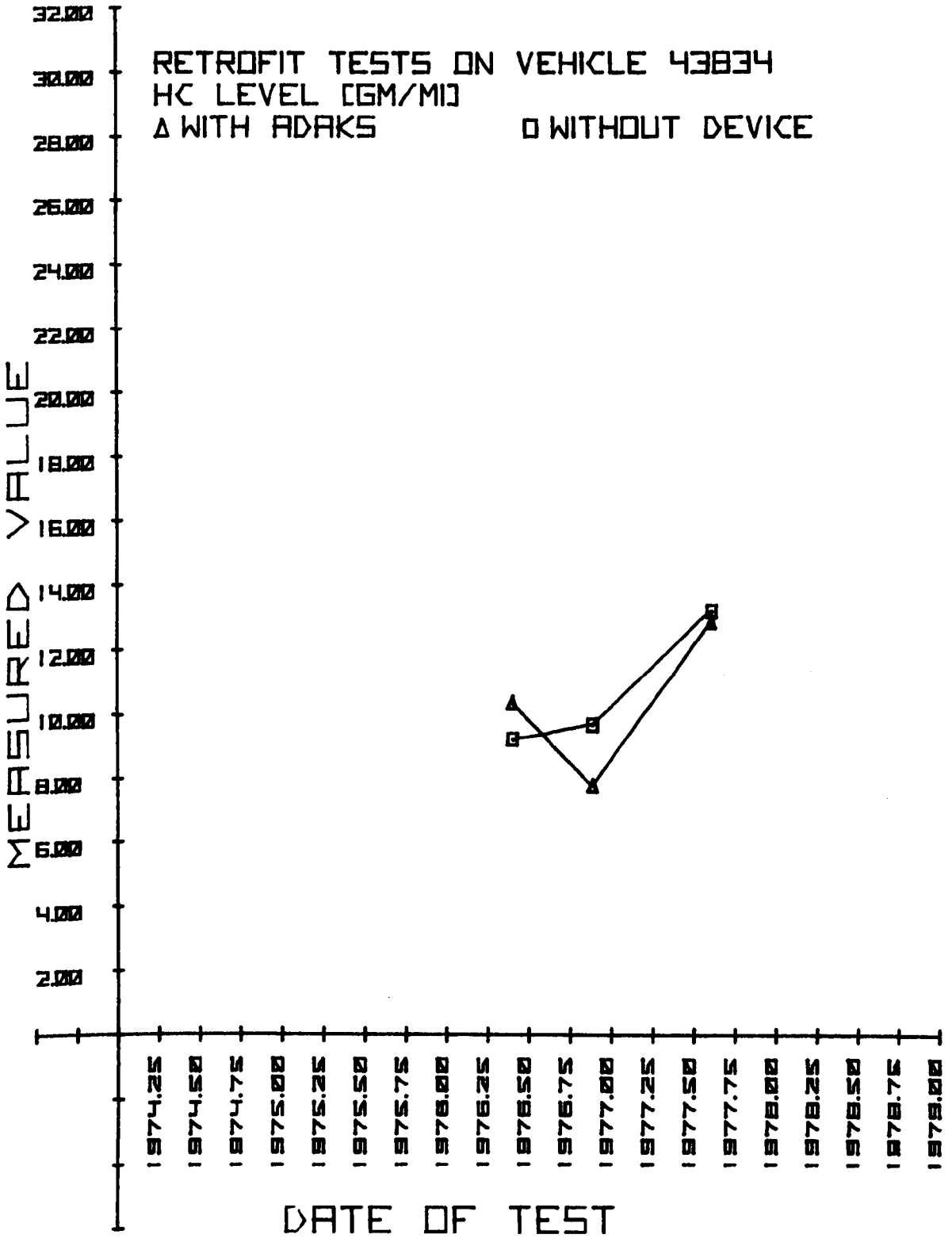

RETROFIT TESTS ON VEHICLE 19542
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

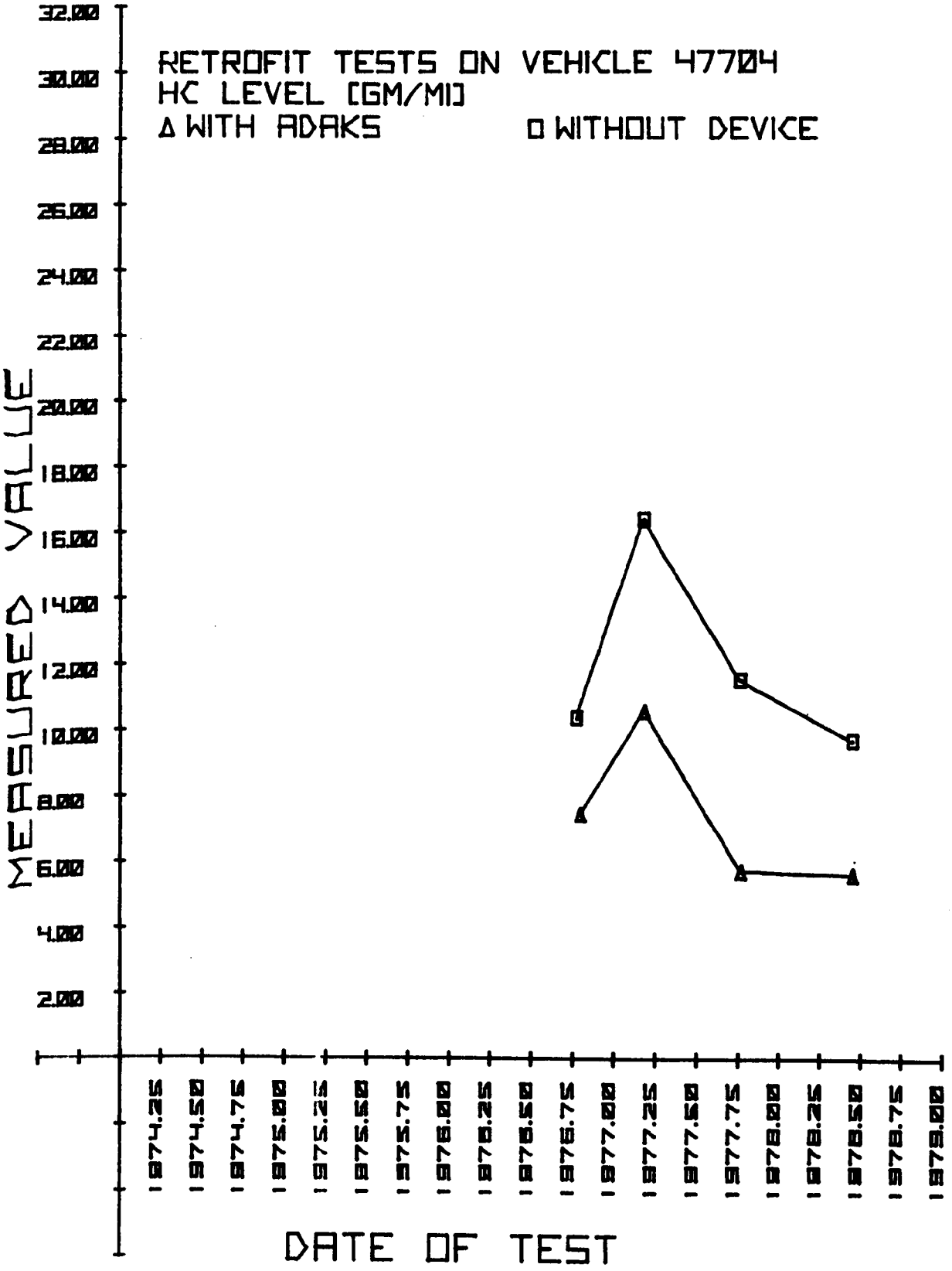

RETROFIT TESTS ON VEHICLE 19892
HC LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

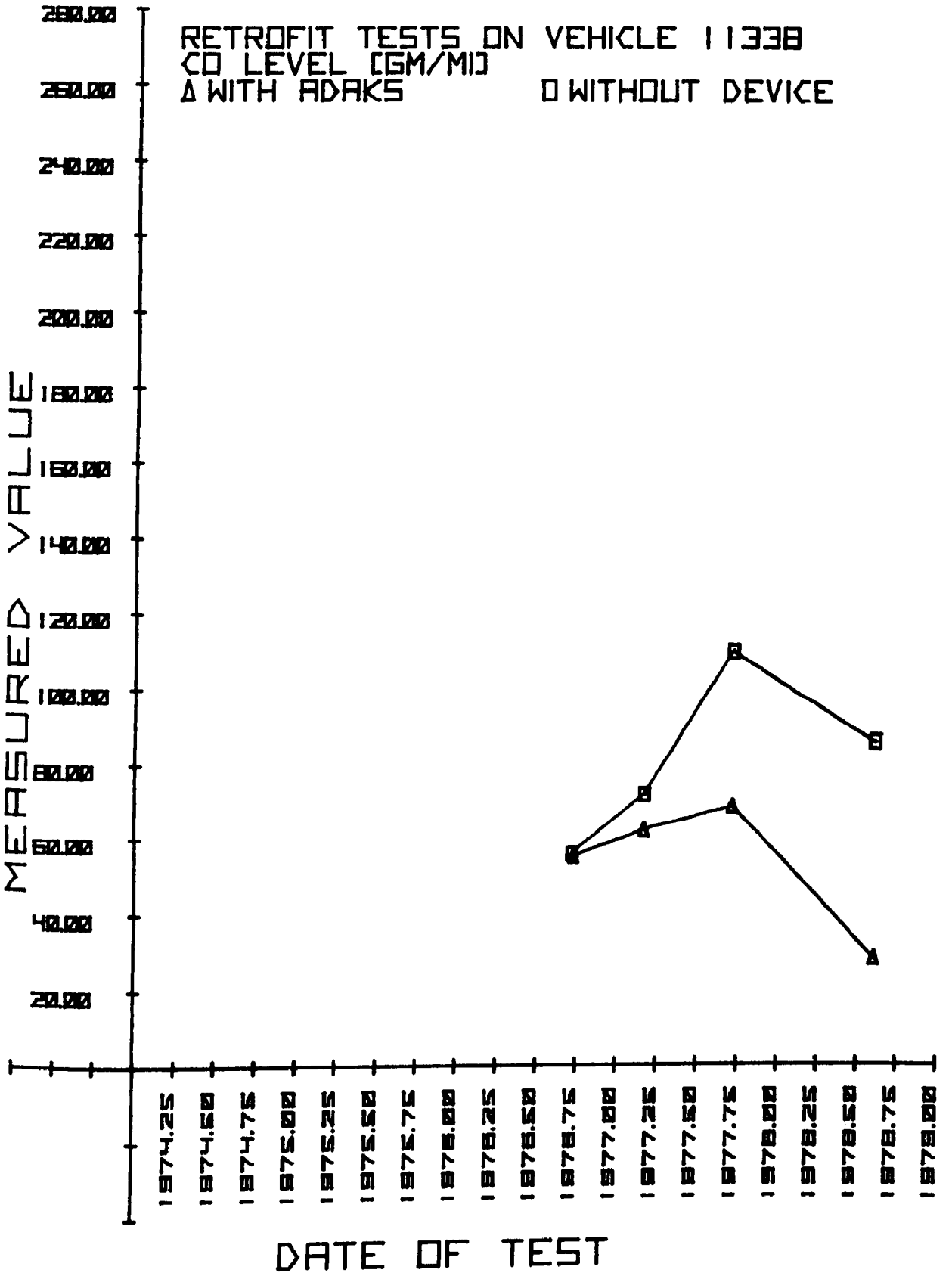

RETROFIT TESTS ON VEHICLE 200630
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

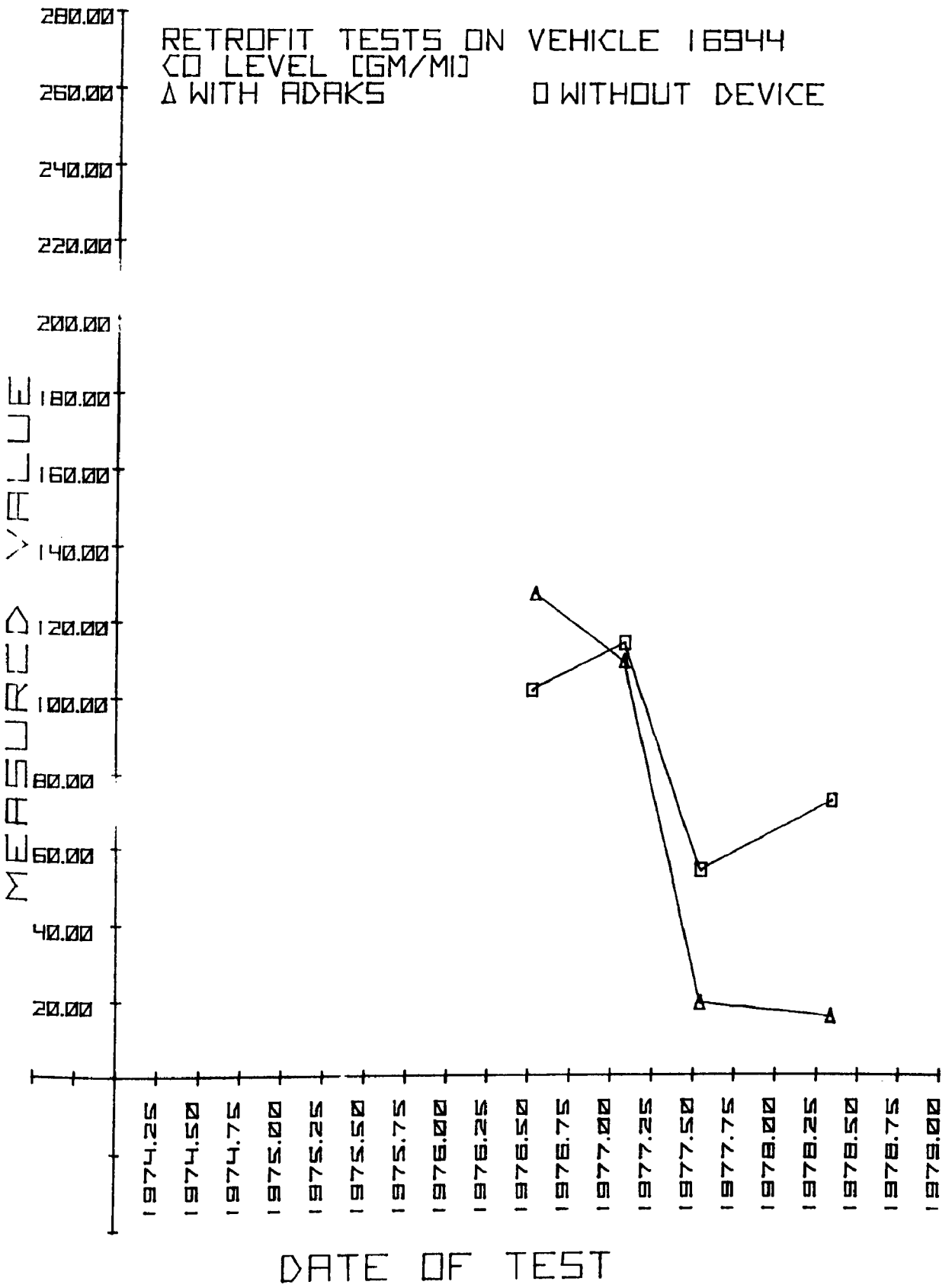

RETROFIT TESTS ON VEHICLE 200637
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

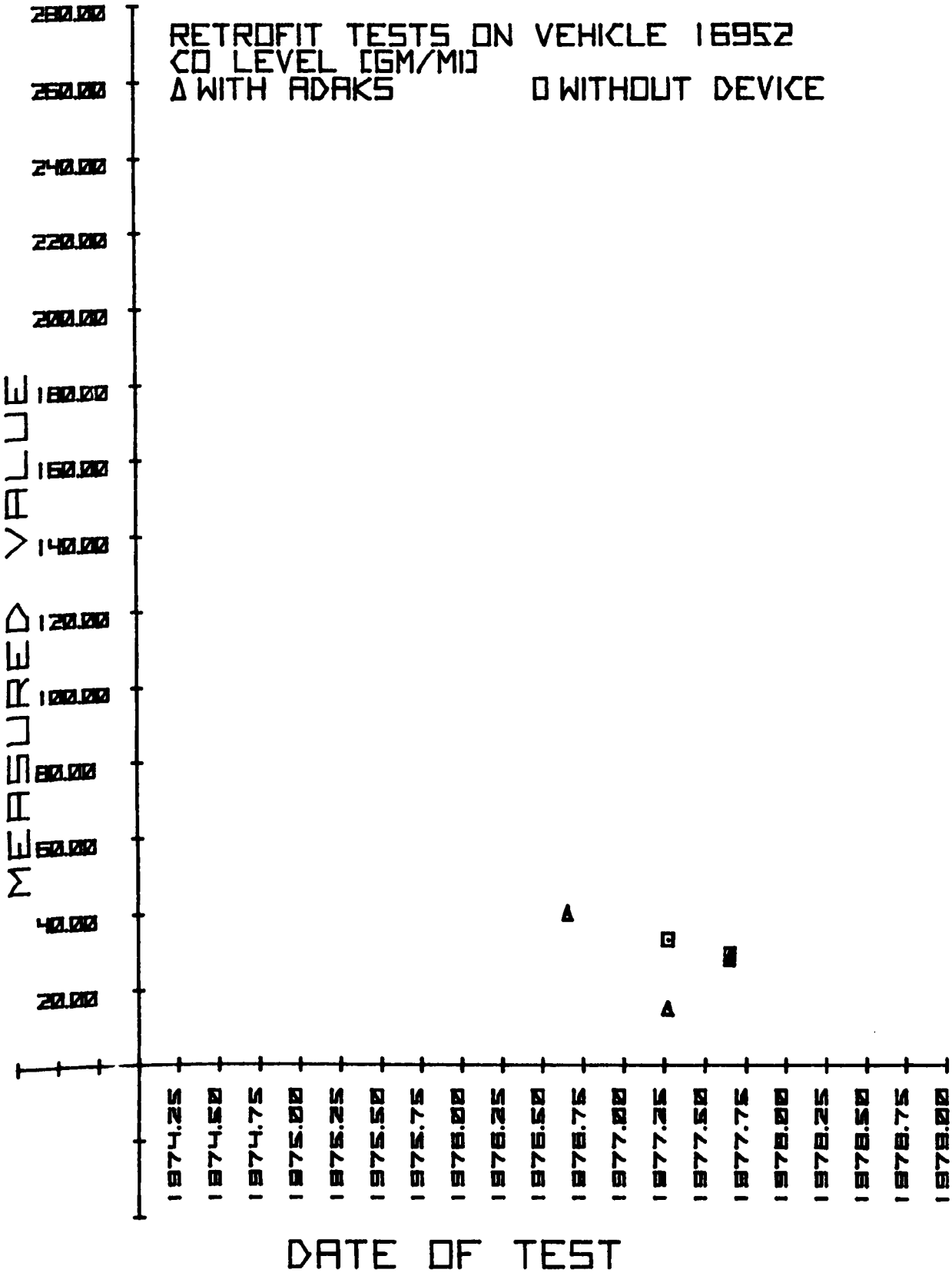

RETROFIT TESTS ON VEHICLE 200640
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

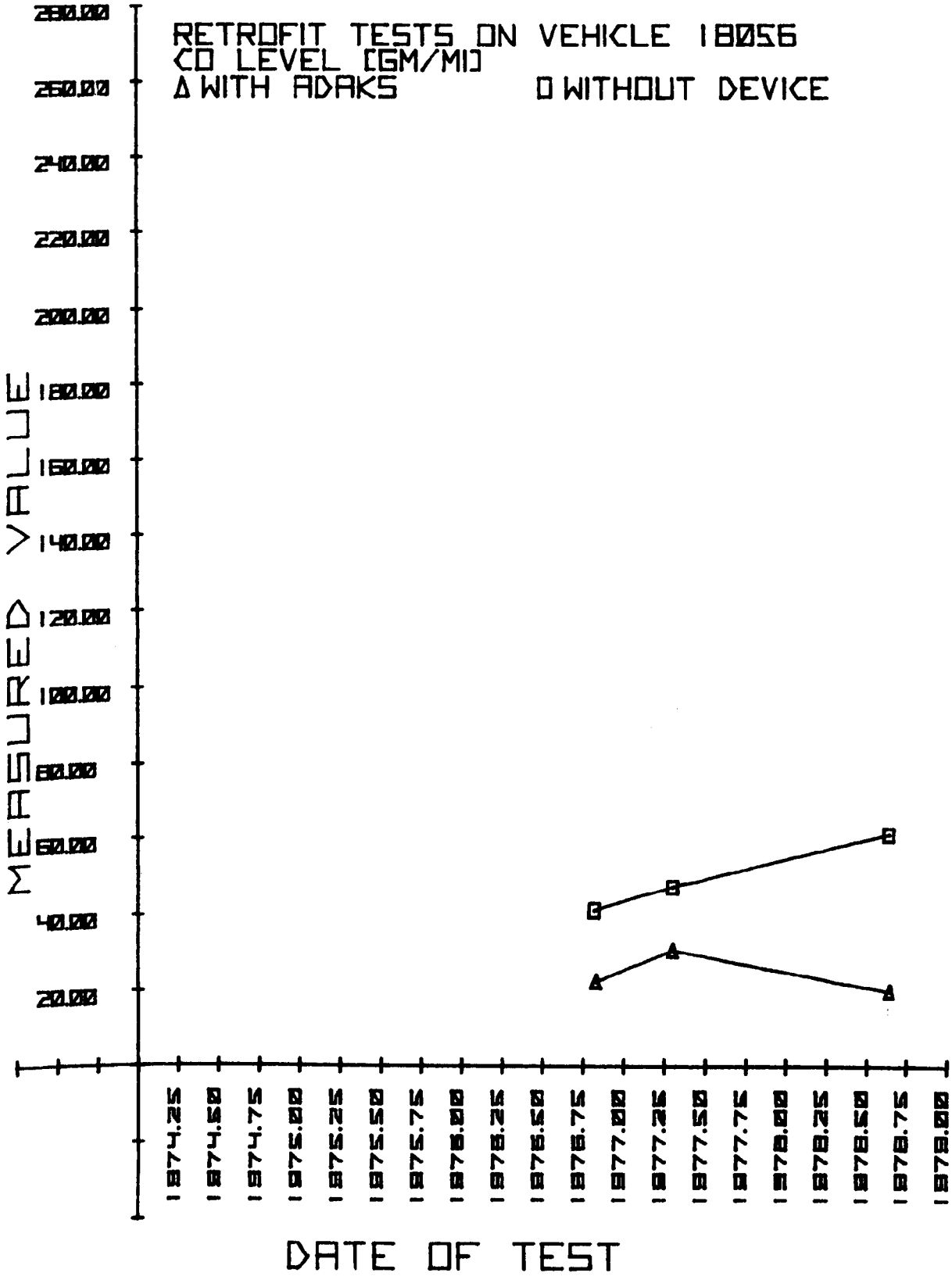

RETROFIT TESTS ON VEHICLE 43834
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

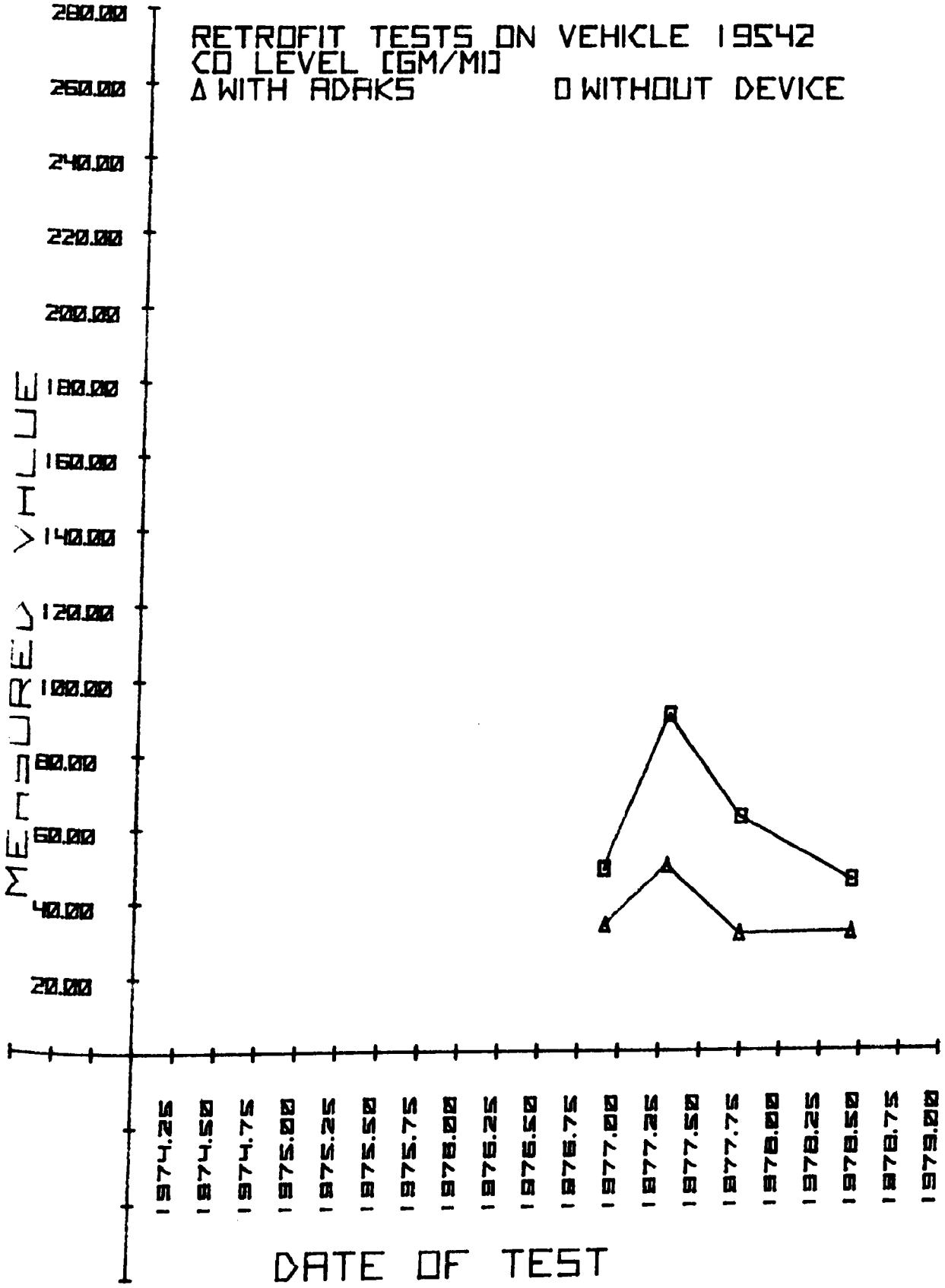

RETROFIT TESTS ON VEHICLE 47704
HC LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

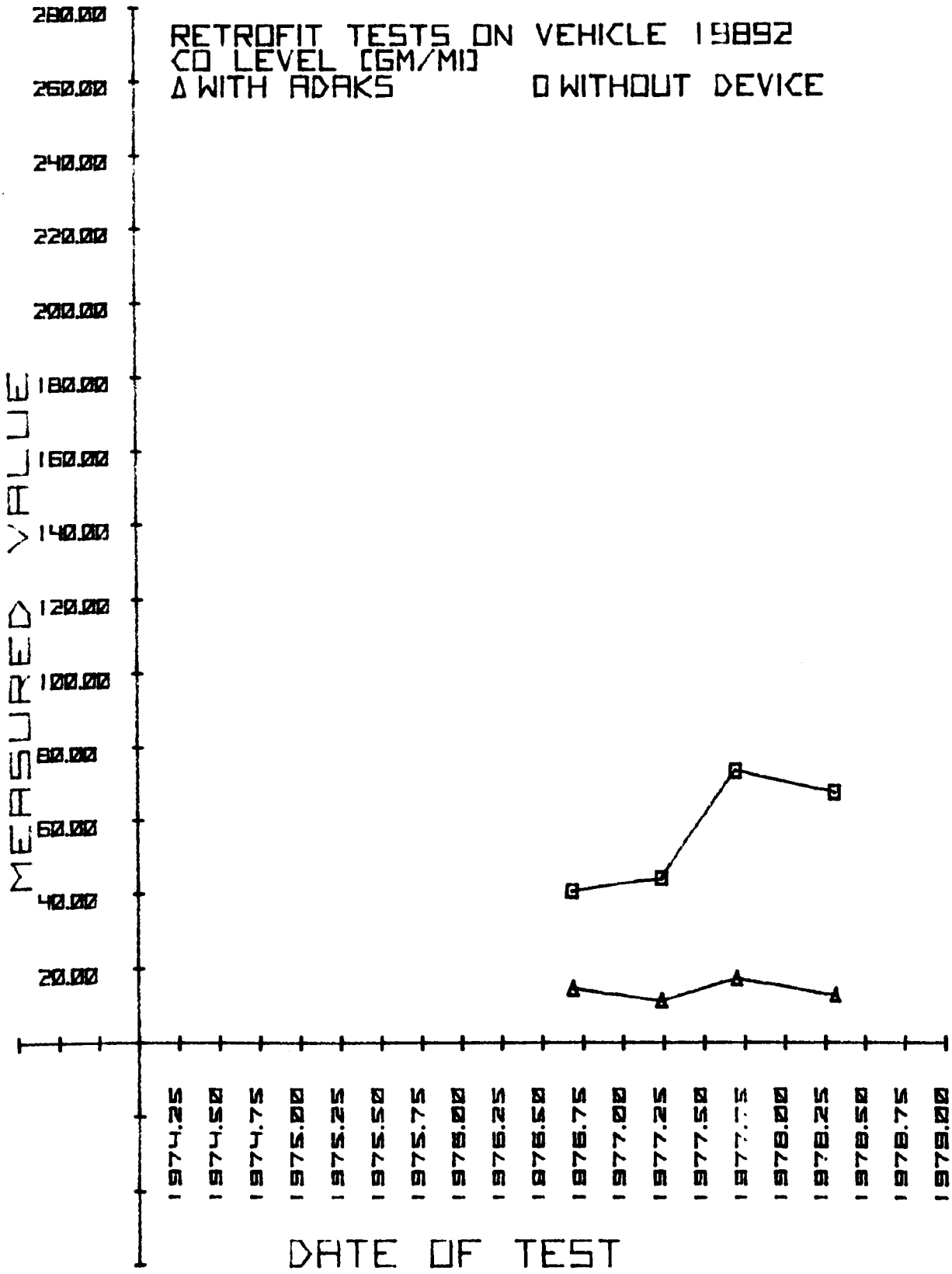

RETROFIT TESTS ON VEHICLE 11338
CO LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

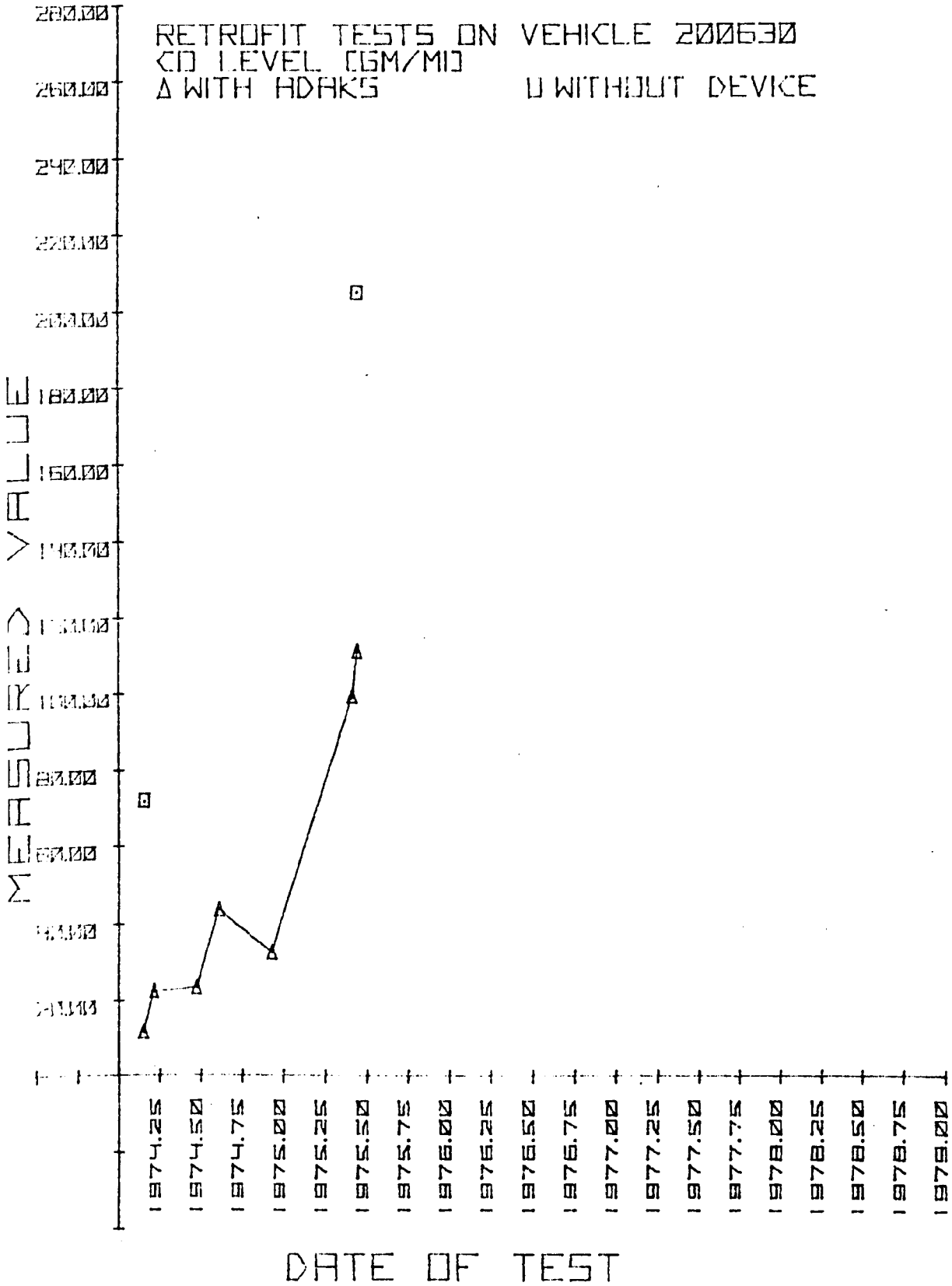

RETROFIT TESTS ON VEHICLE 16944
CO LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
MEASURED VALUE
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

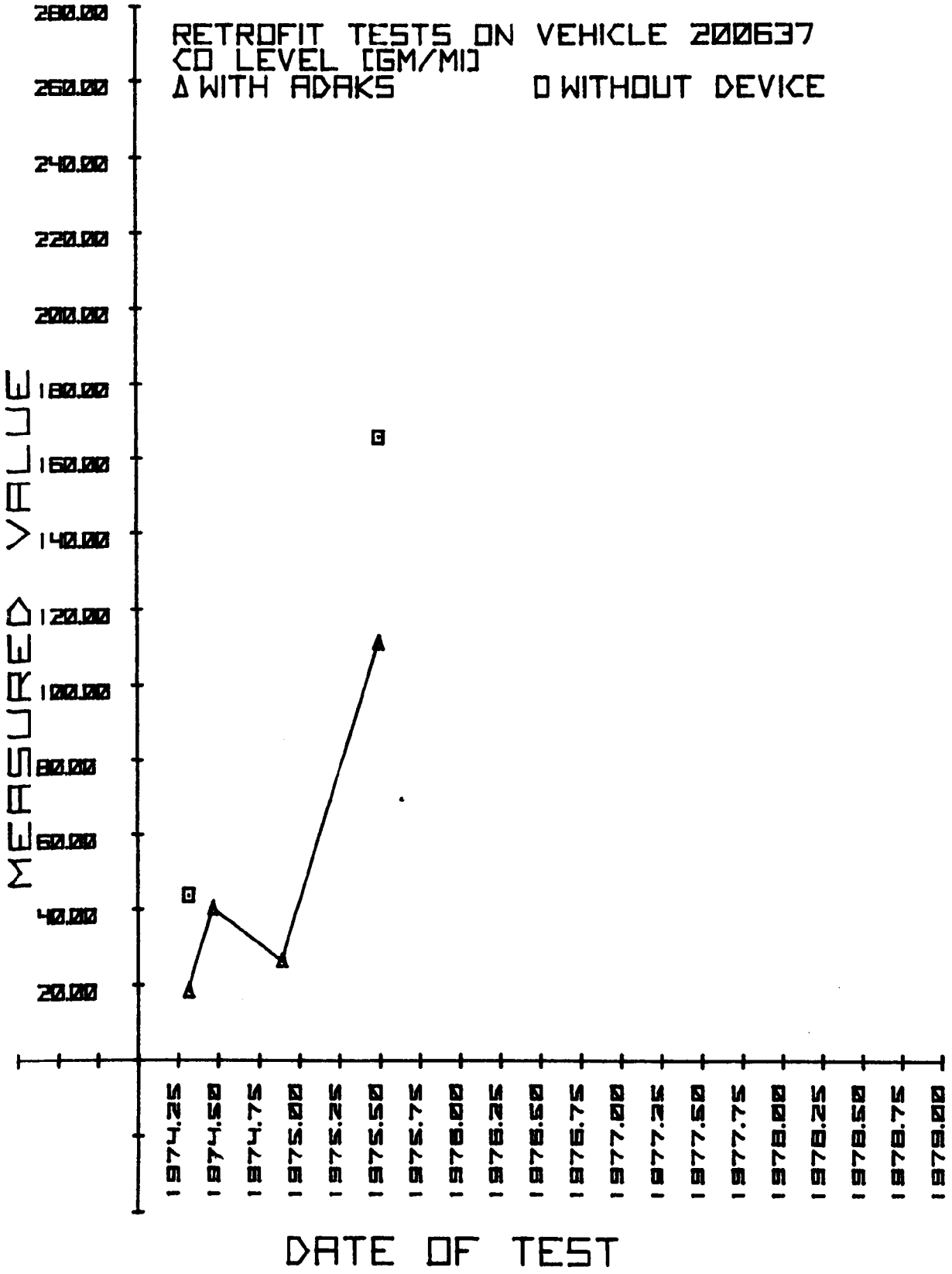

RETROFIT TESTS ON VEHICLE 16952
CO LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
DATE OF TEST

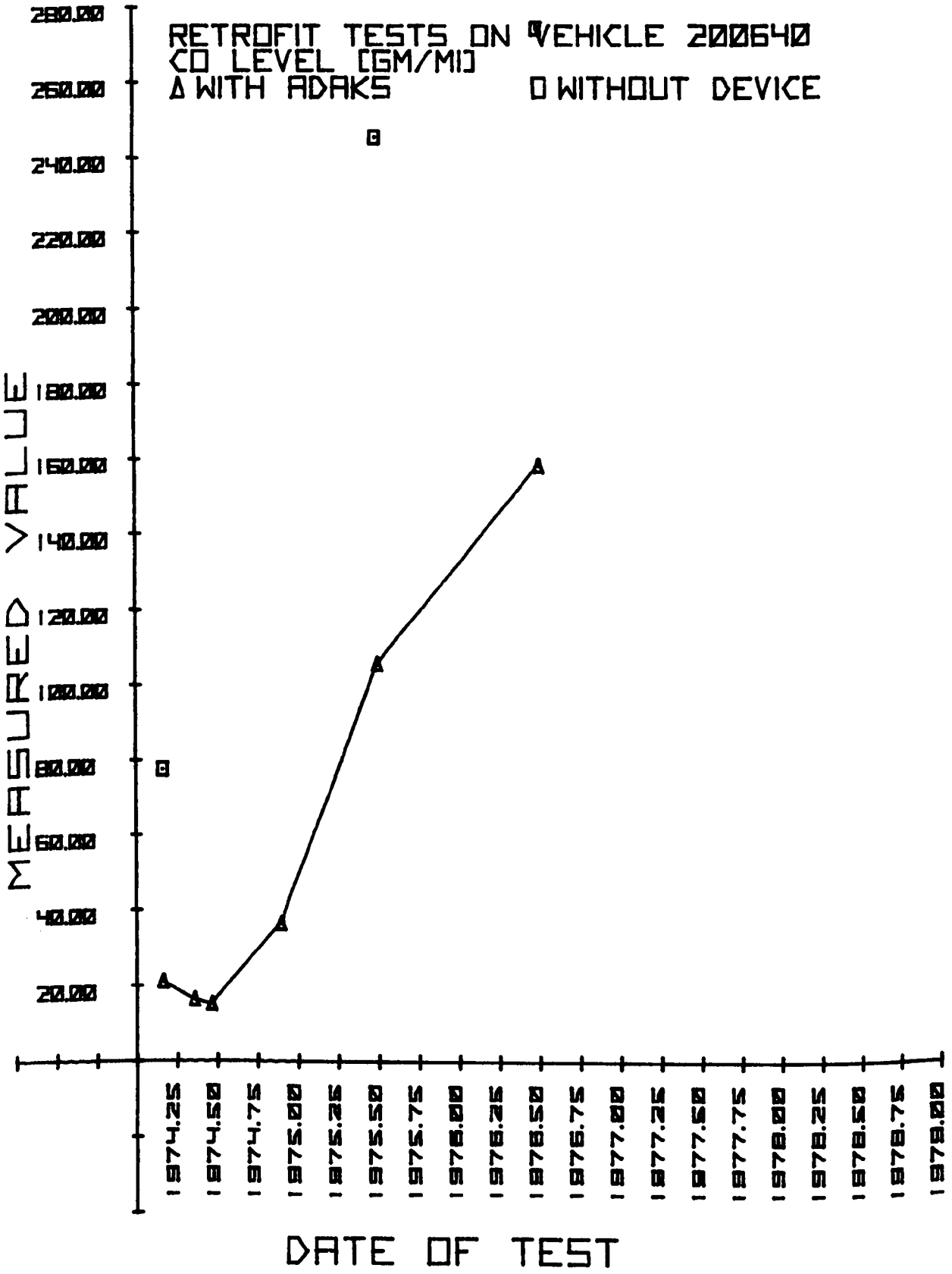

RETROFIT TESTS ON VEHICLE 18056
CO LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

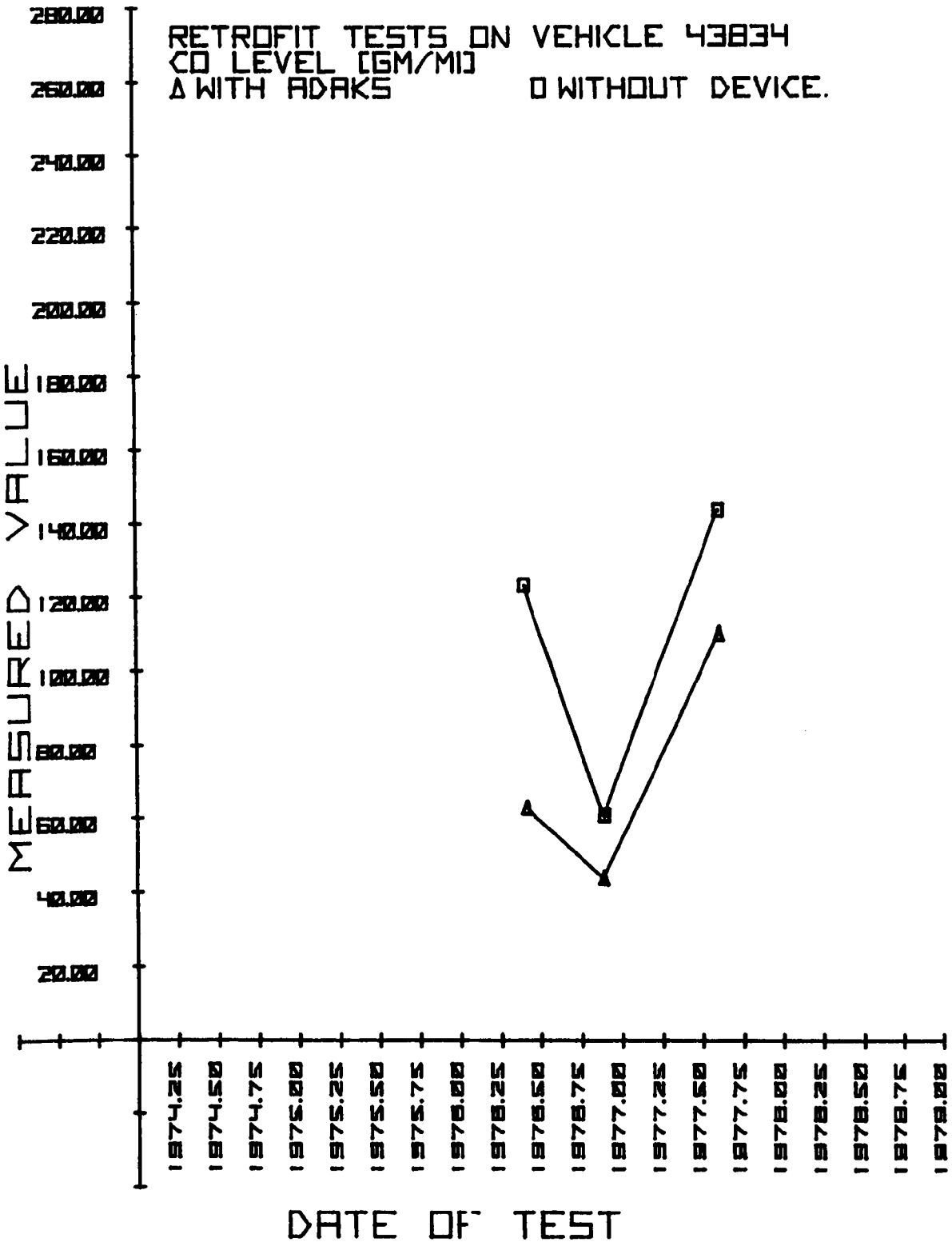

RETROFIT TESTS ON VEHICLE 19542
CO LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

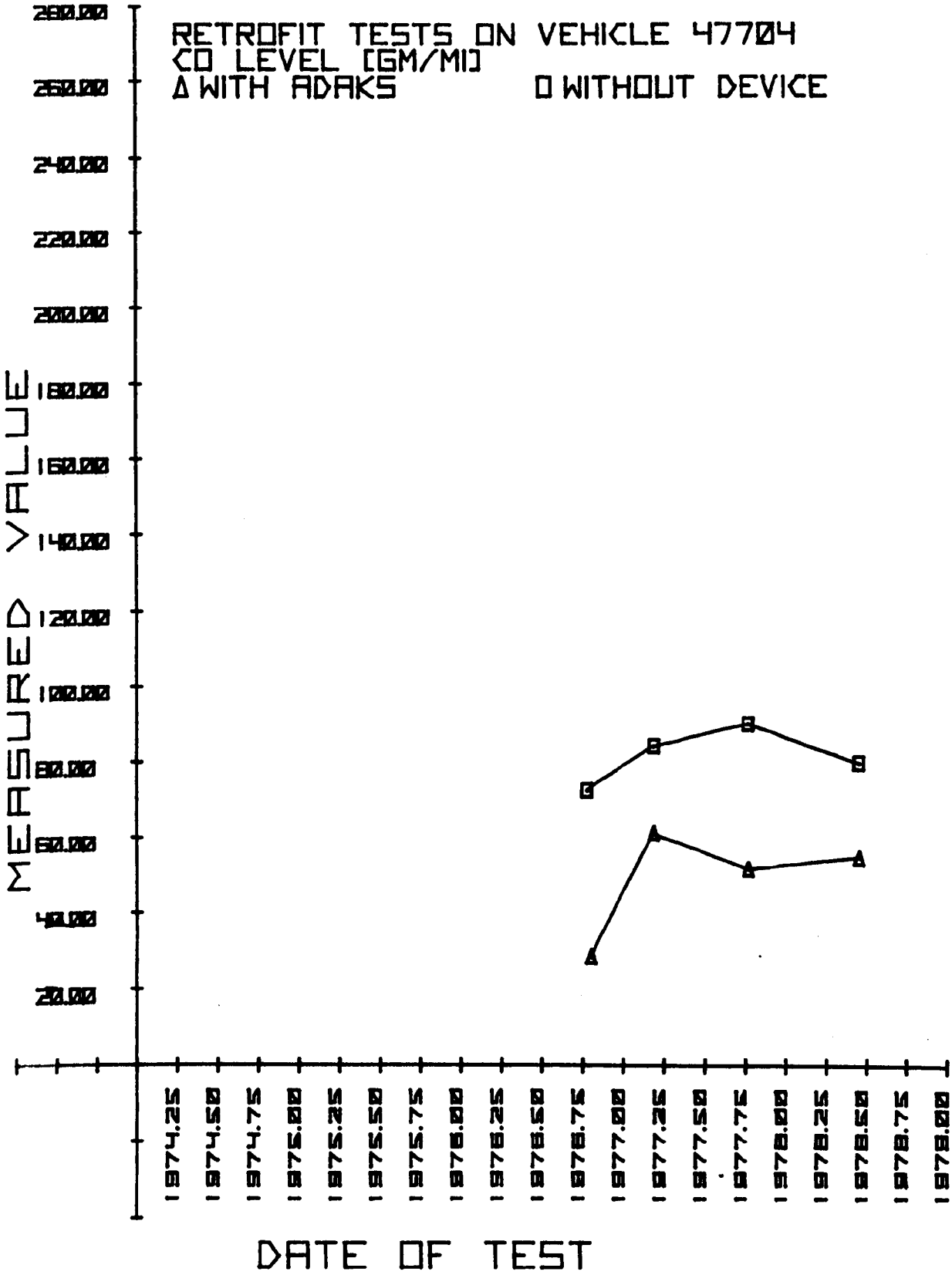

RETROFIT TESTS ON VEHICLE 19892
CO LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
DATE OF TEST

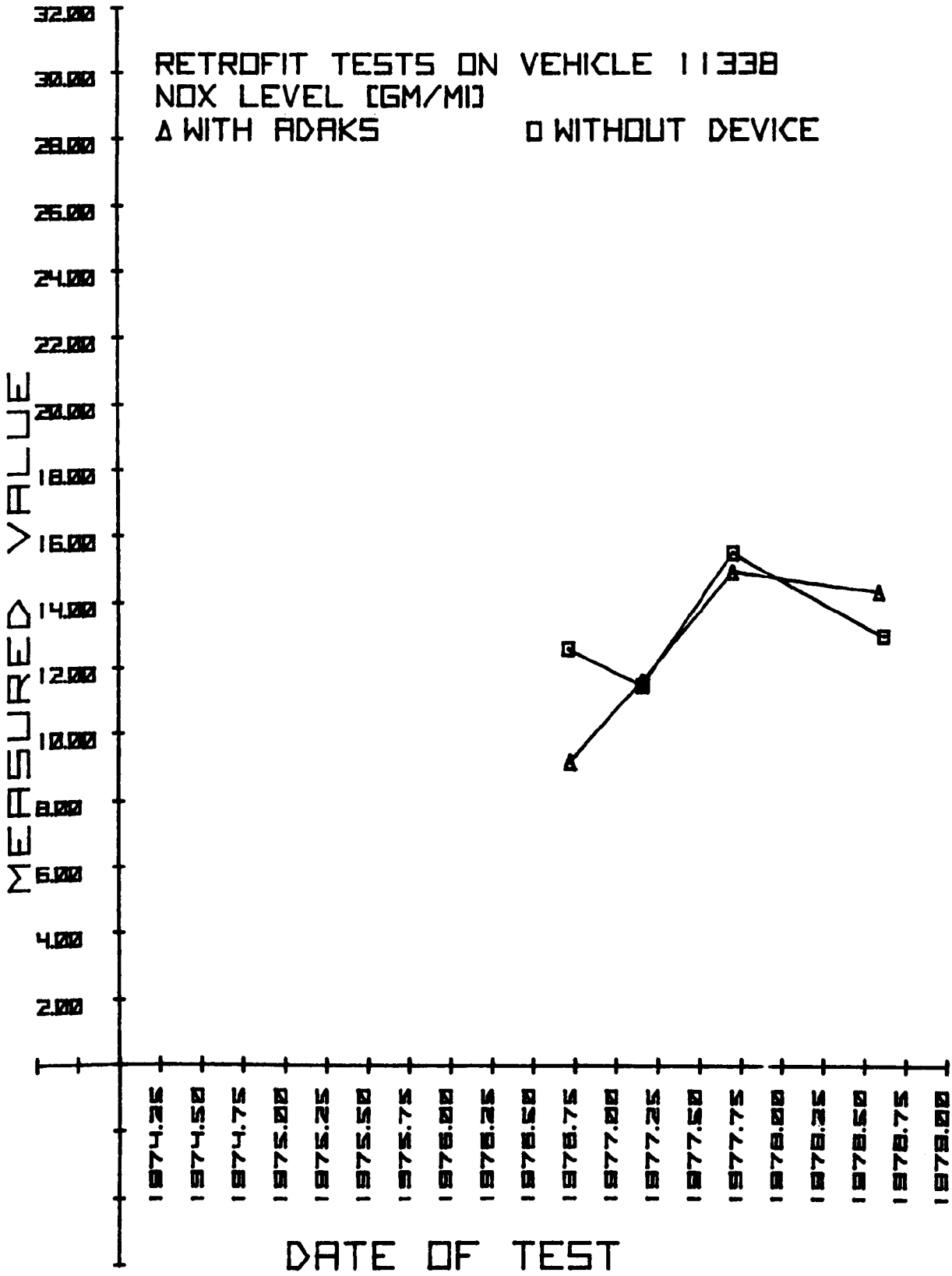

RETROFIT TESTS ON VEHICLE 200630
CO LEVEL (GM/MI)
Δ WITH HDAKS
U WITHOUT DEVICE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
CO LEVEL (GM/MI)
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

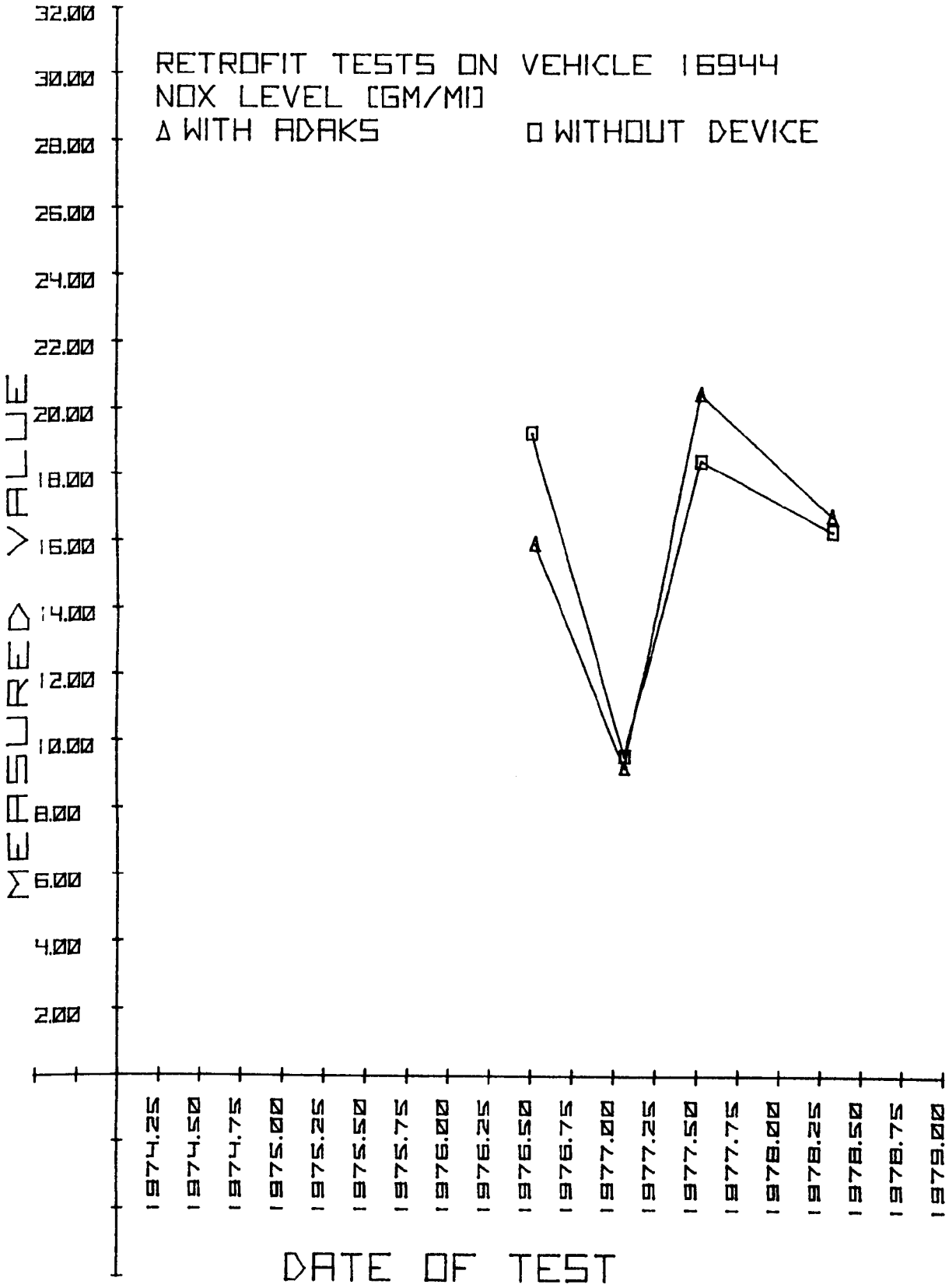

RETROFIT TESTS ON VEHICLE 200637
CO LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
DATE OF TEST

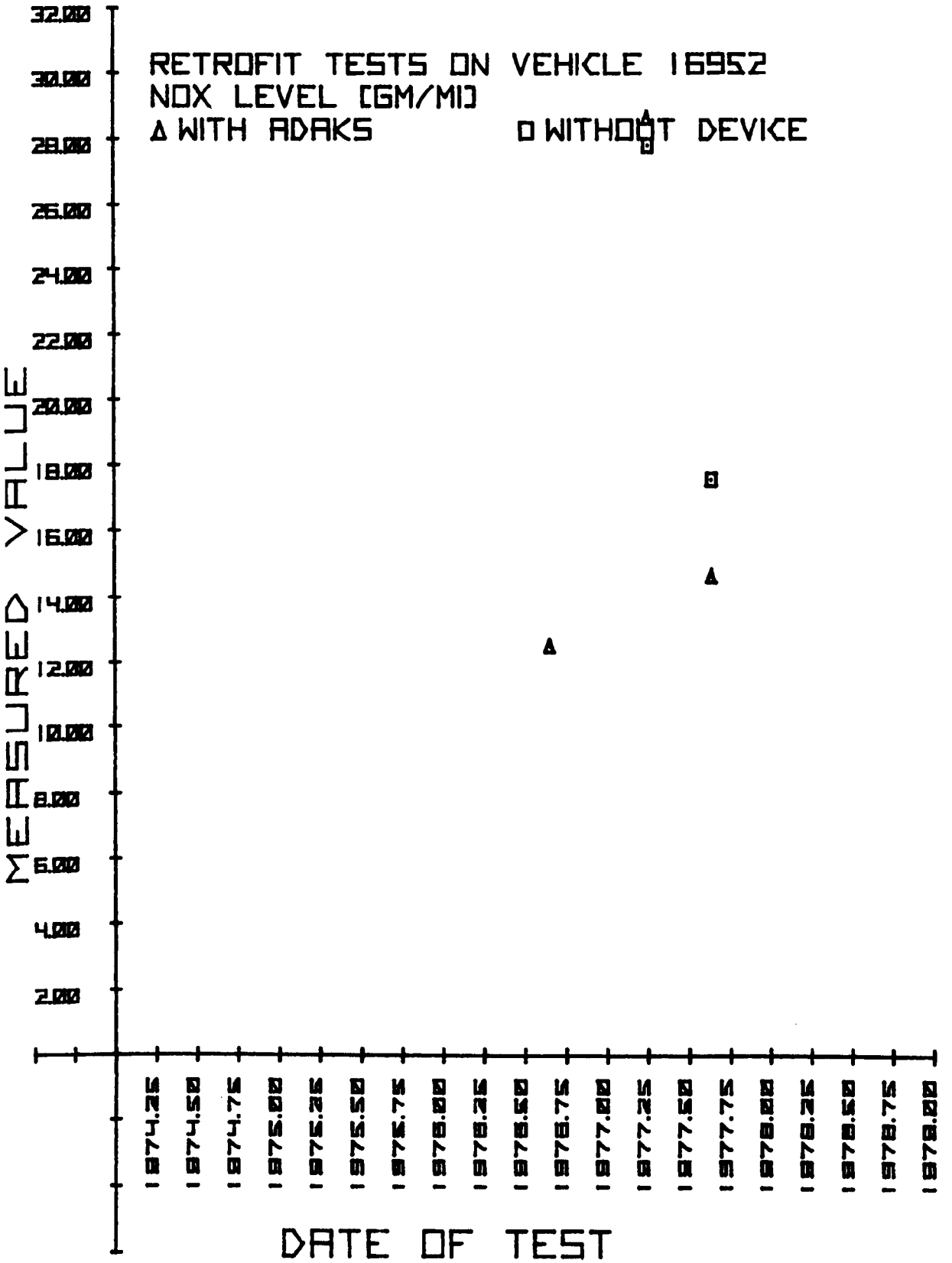

RETROFIT TESTS ON VEHICLE 200640
CO LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

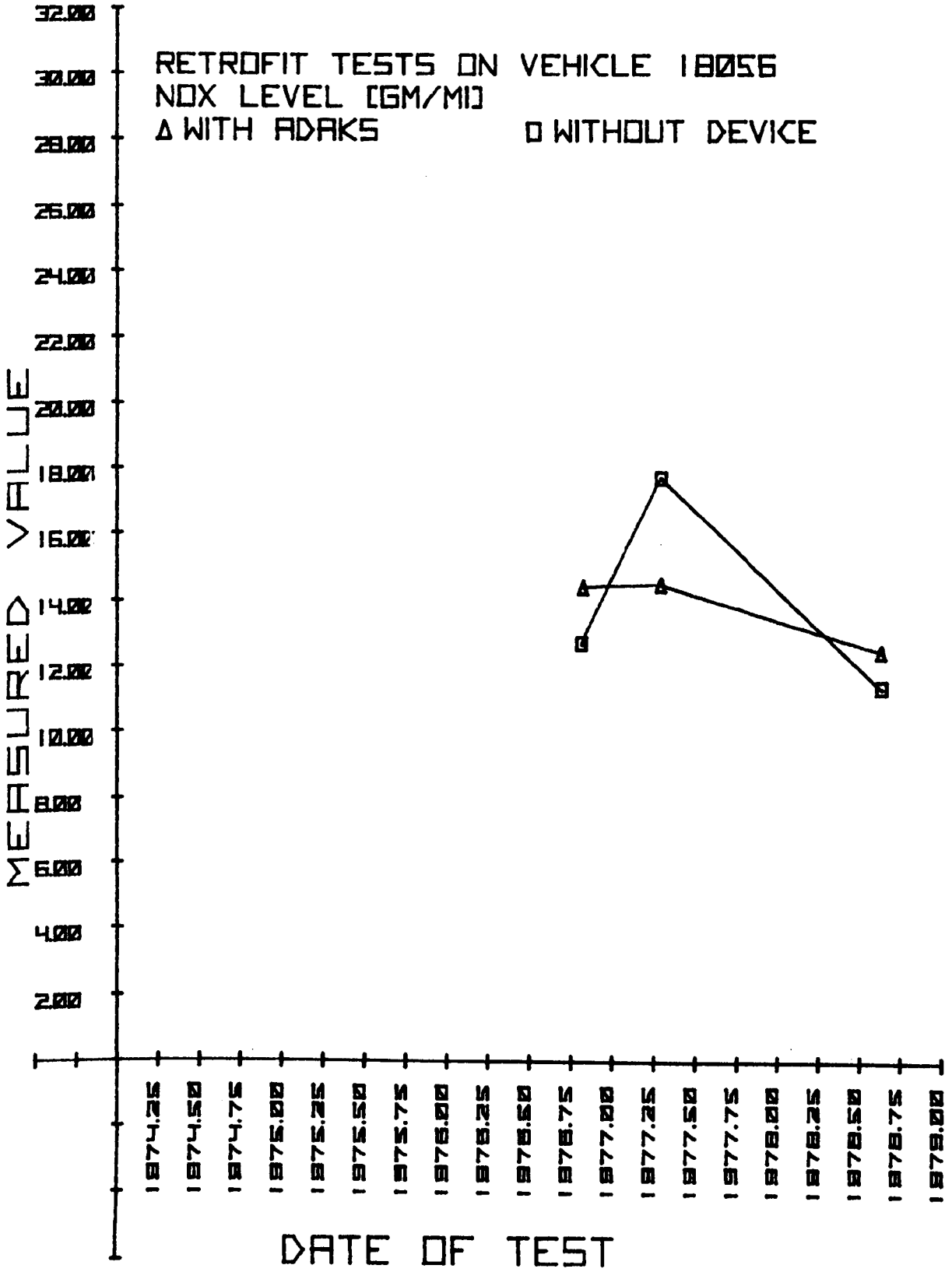

RETROFIT TESTS ON VEHICLE 43834
CO LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE.
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

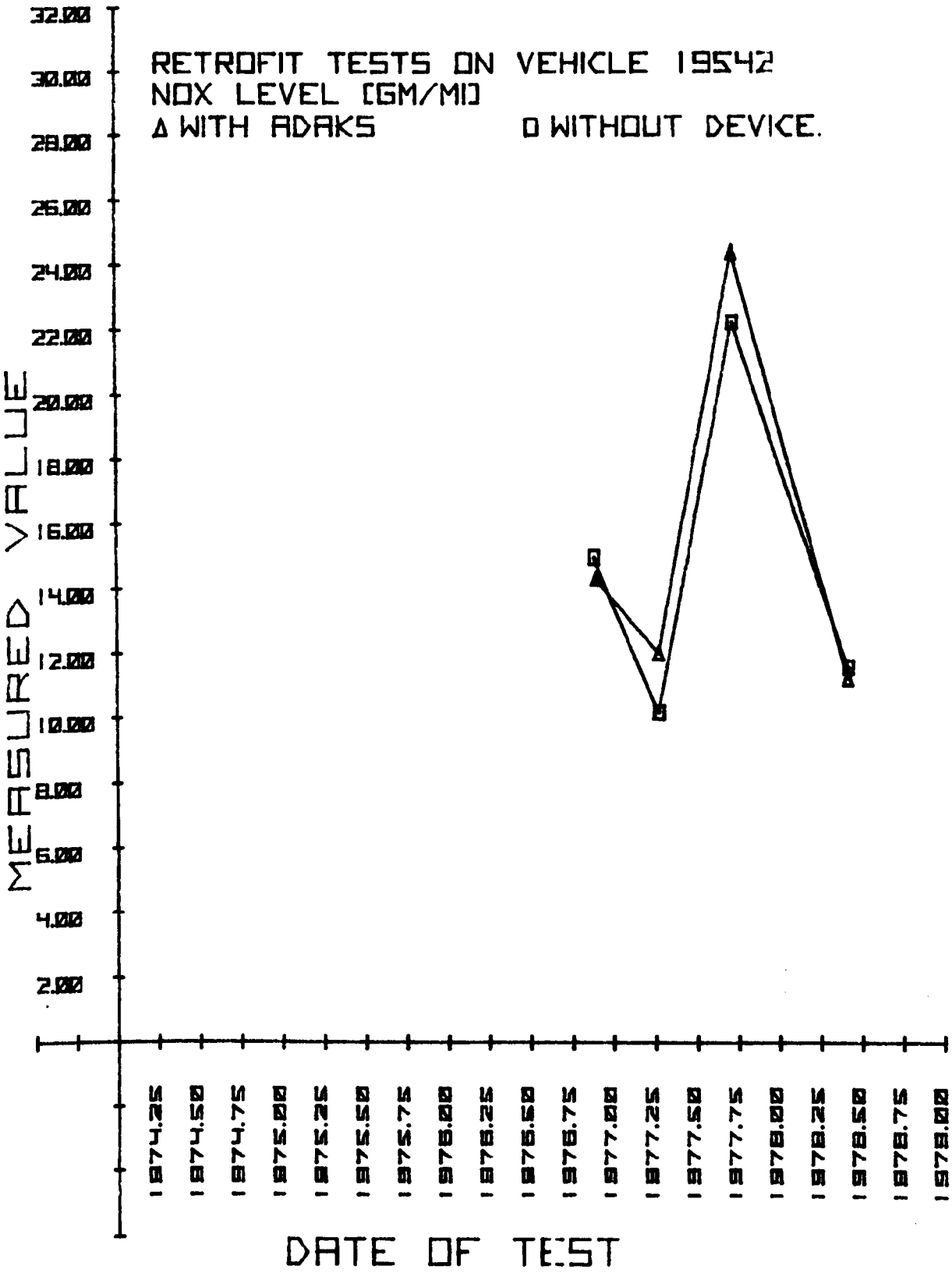

RETROFIT TESTS ON VEHICLE 47704
CO LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

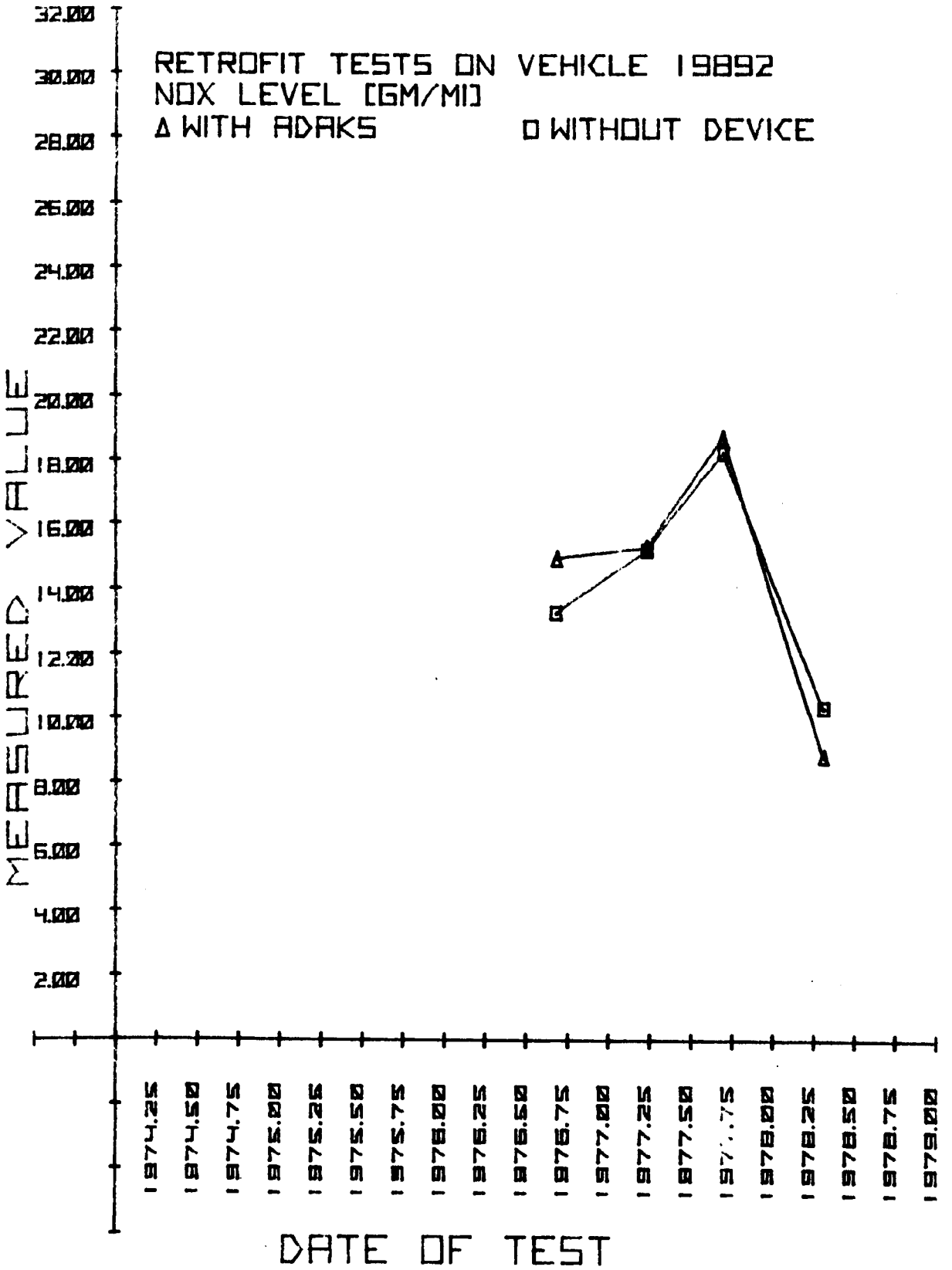

RETROFIT TESTS ON VEHICLE 11338
NOX LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

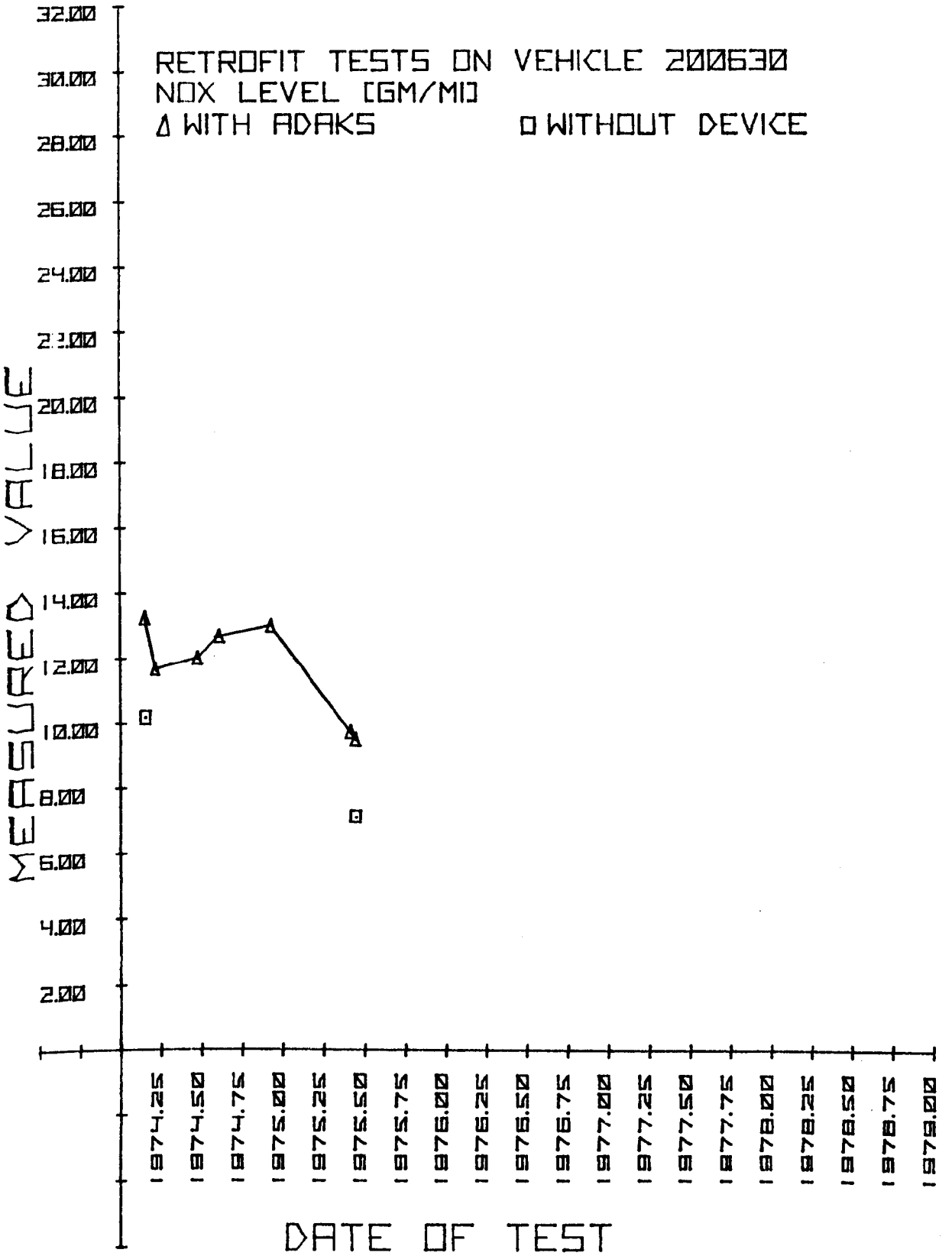

RETROFIT TESTS ON VEHICLE 16944
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

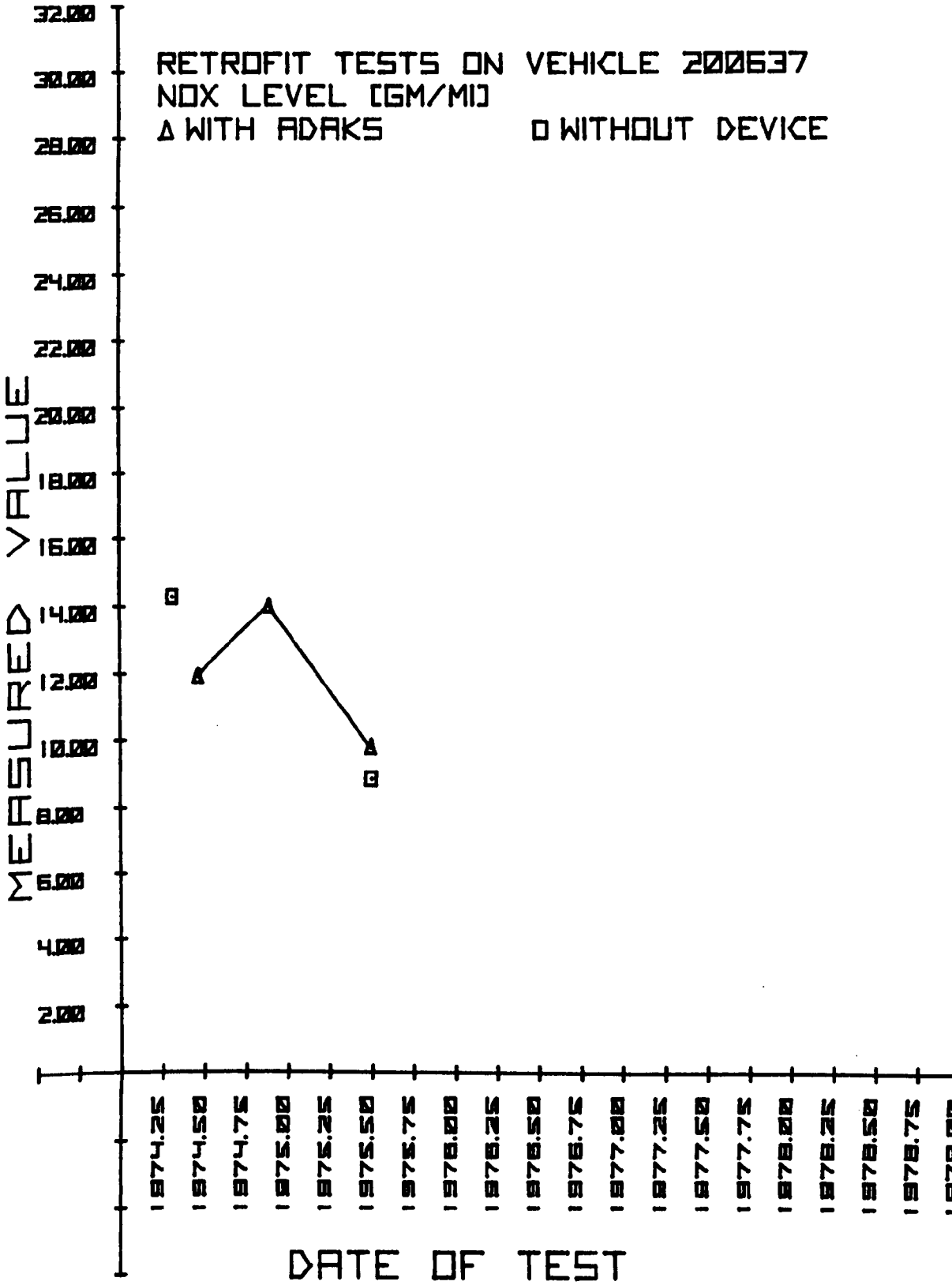

RETROFIT TESTS ON VEHICLE 16952
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

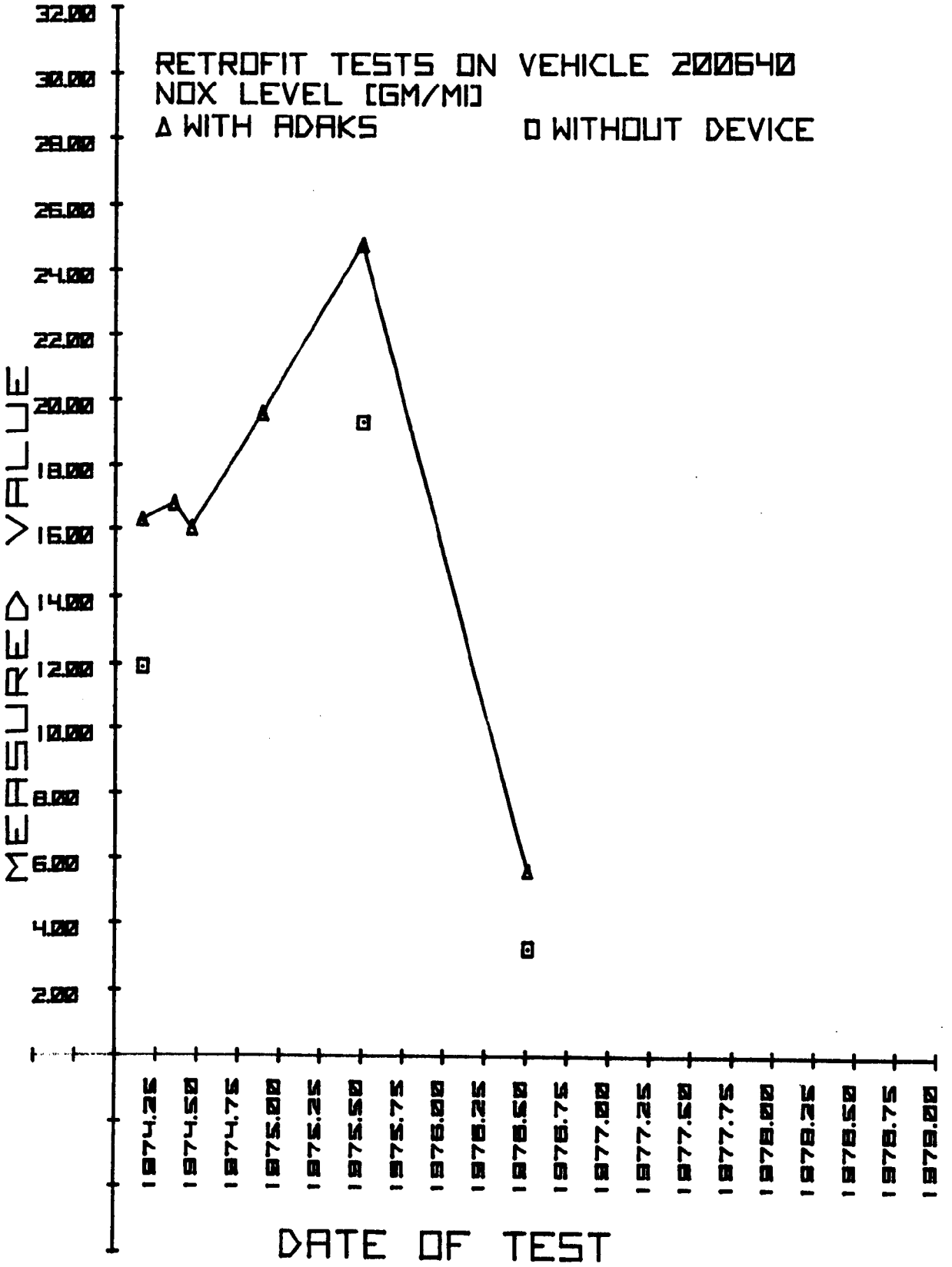

RETROFIT TESTS ON VEHICLE 18056
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

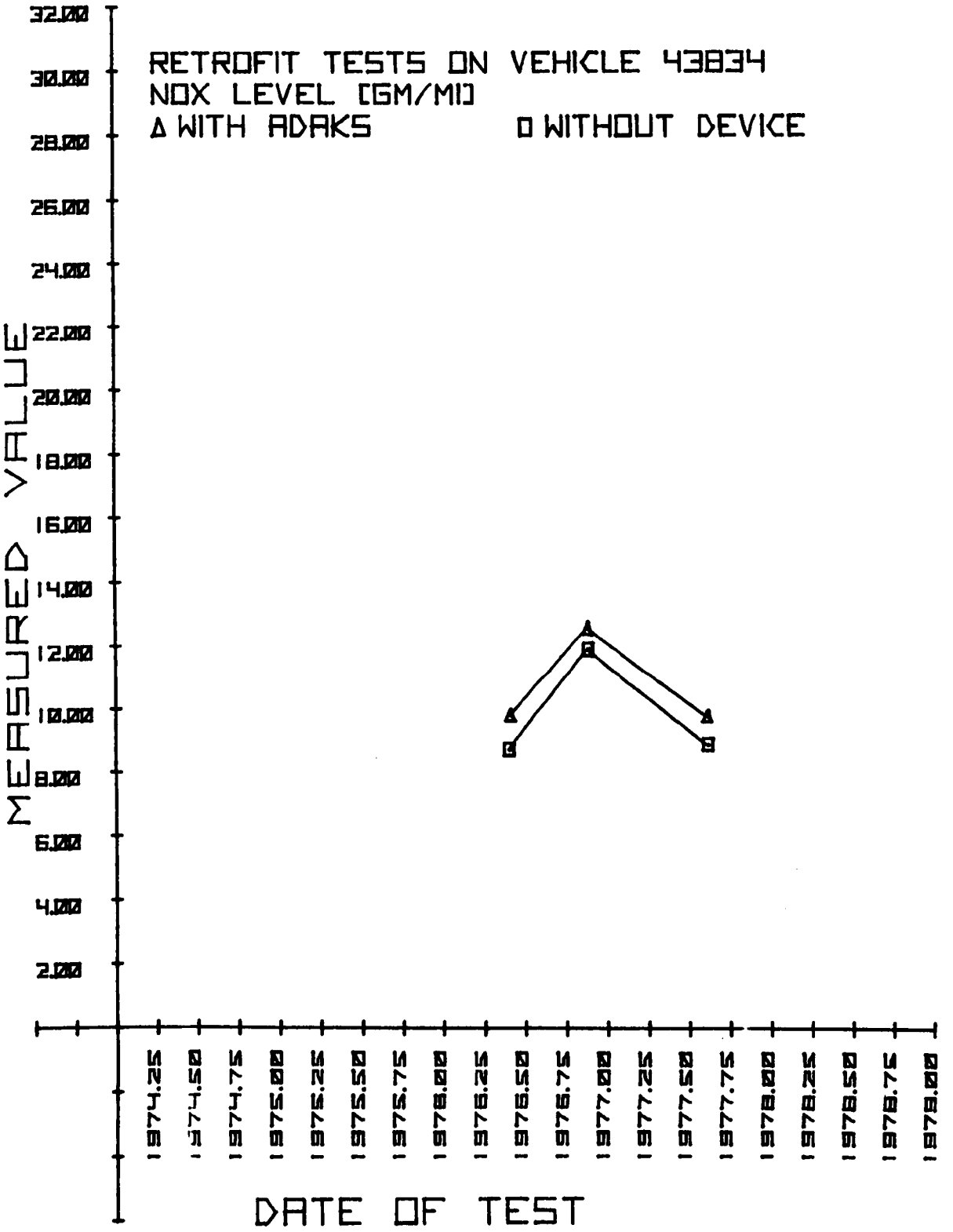

RETROFIT TESTS ON VEHICLE 19542
NOX LEVEL [GM/MI]
Δ WITH ADAKS
O WITHOUT DEVICE.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

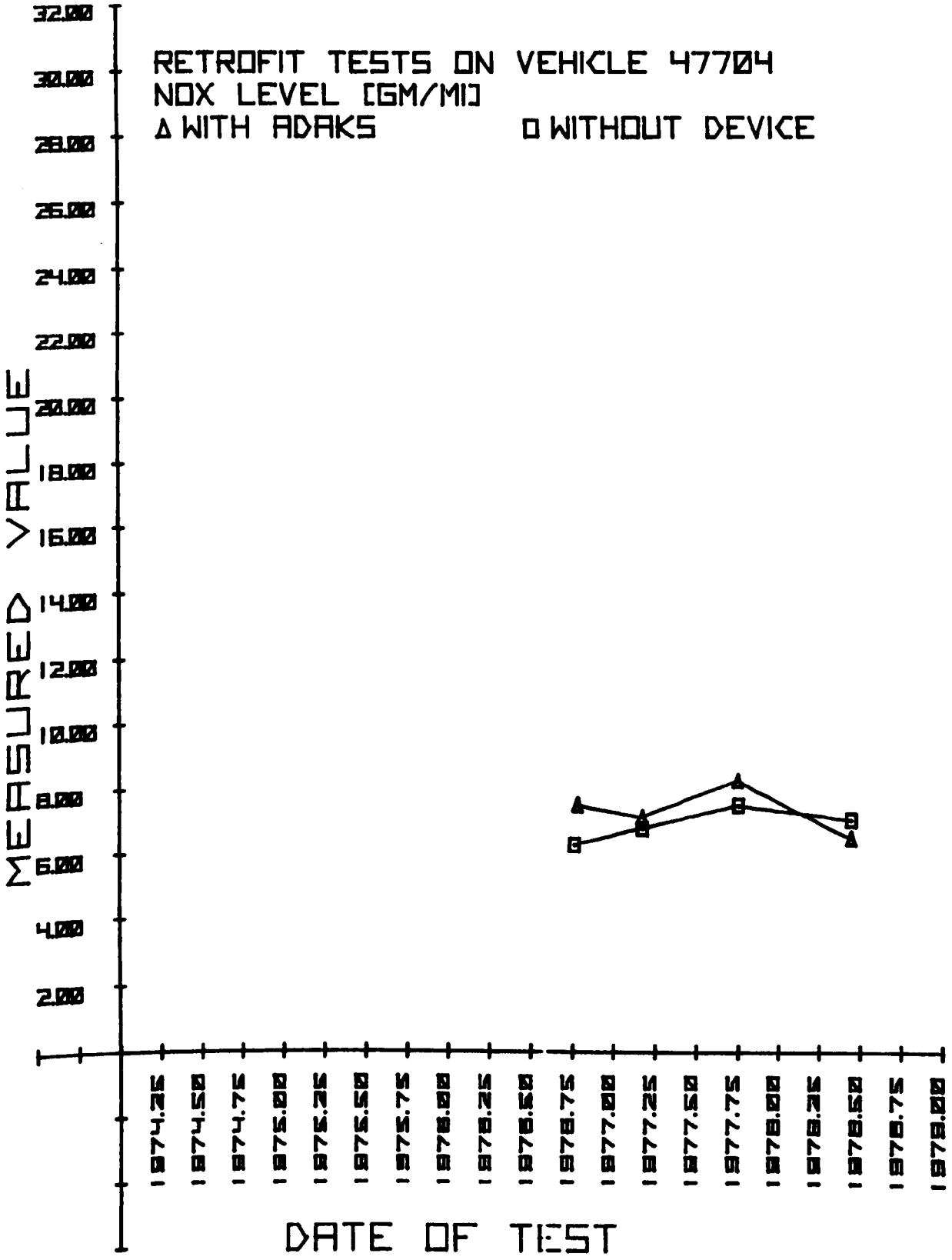

RETROFIT TESTS ON VEHICLE 19892
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

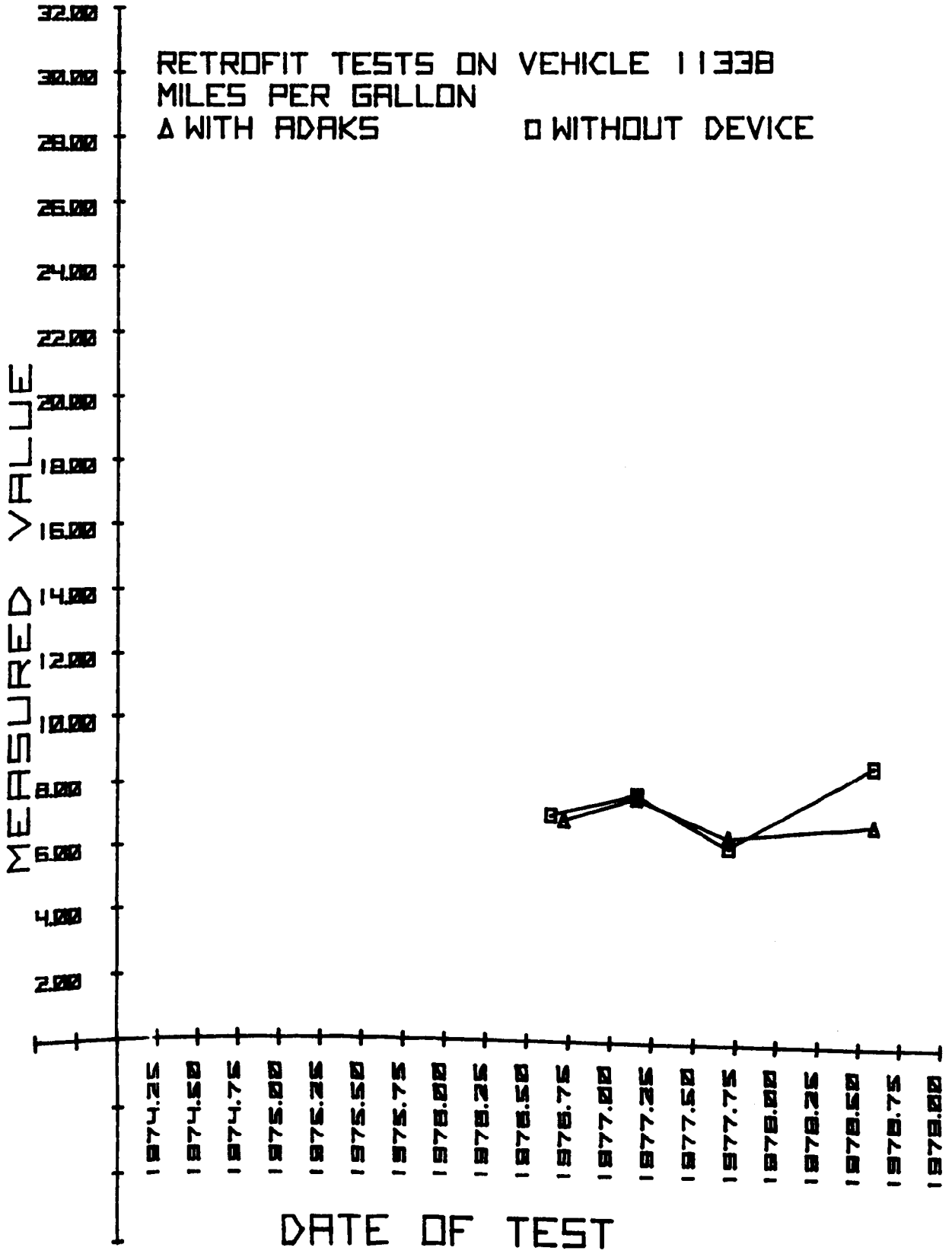

RETROFIT TESTS ON VEHICLE 200630
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

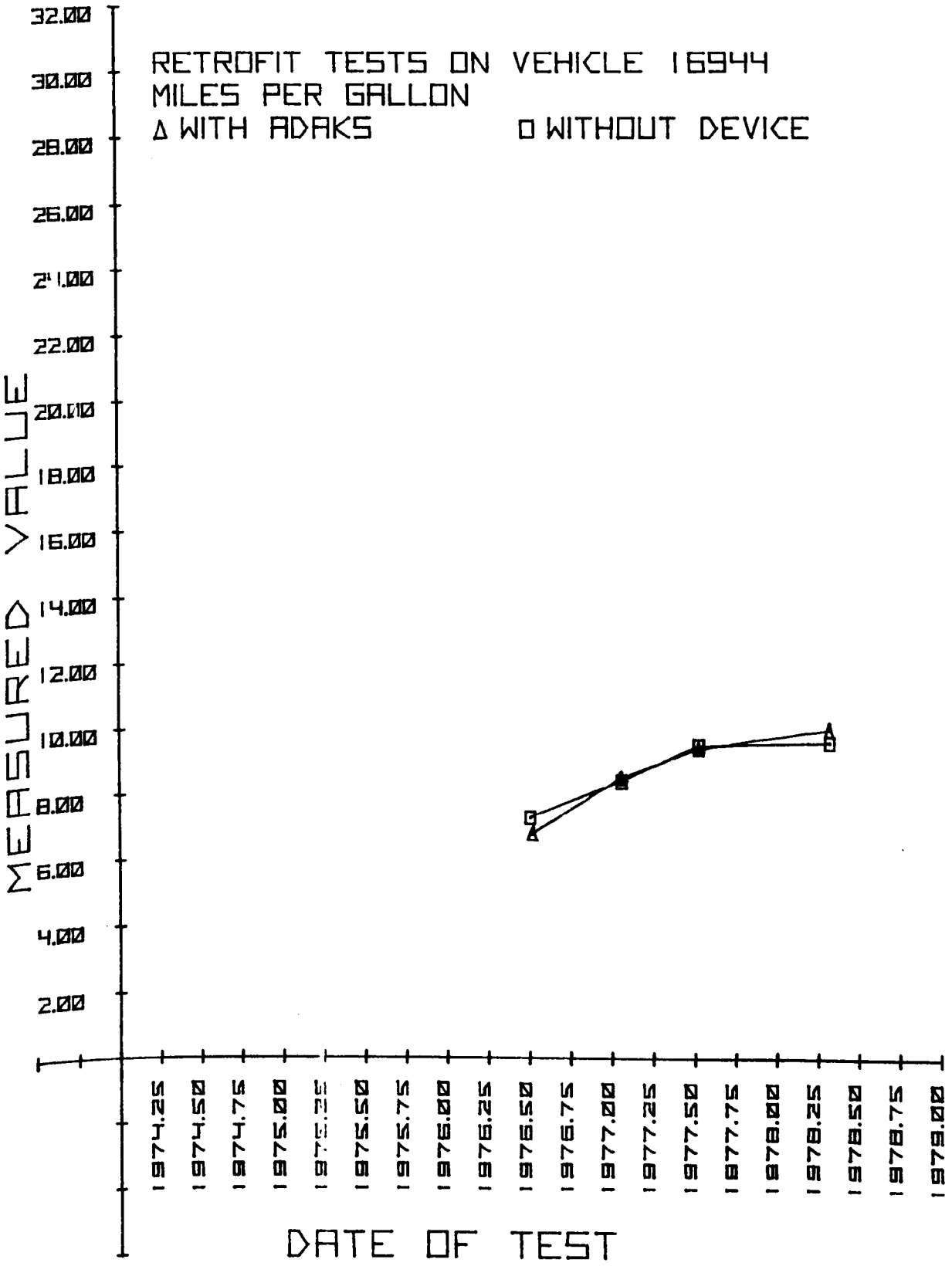

RETROFIT TESTS ON VEHICLE 200637
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

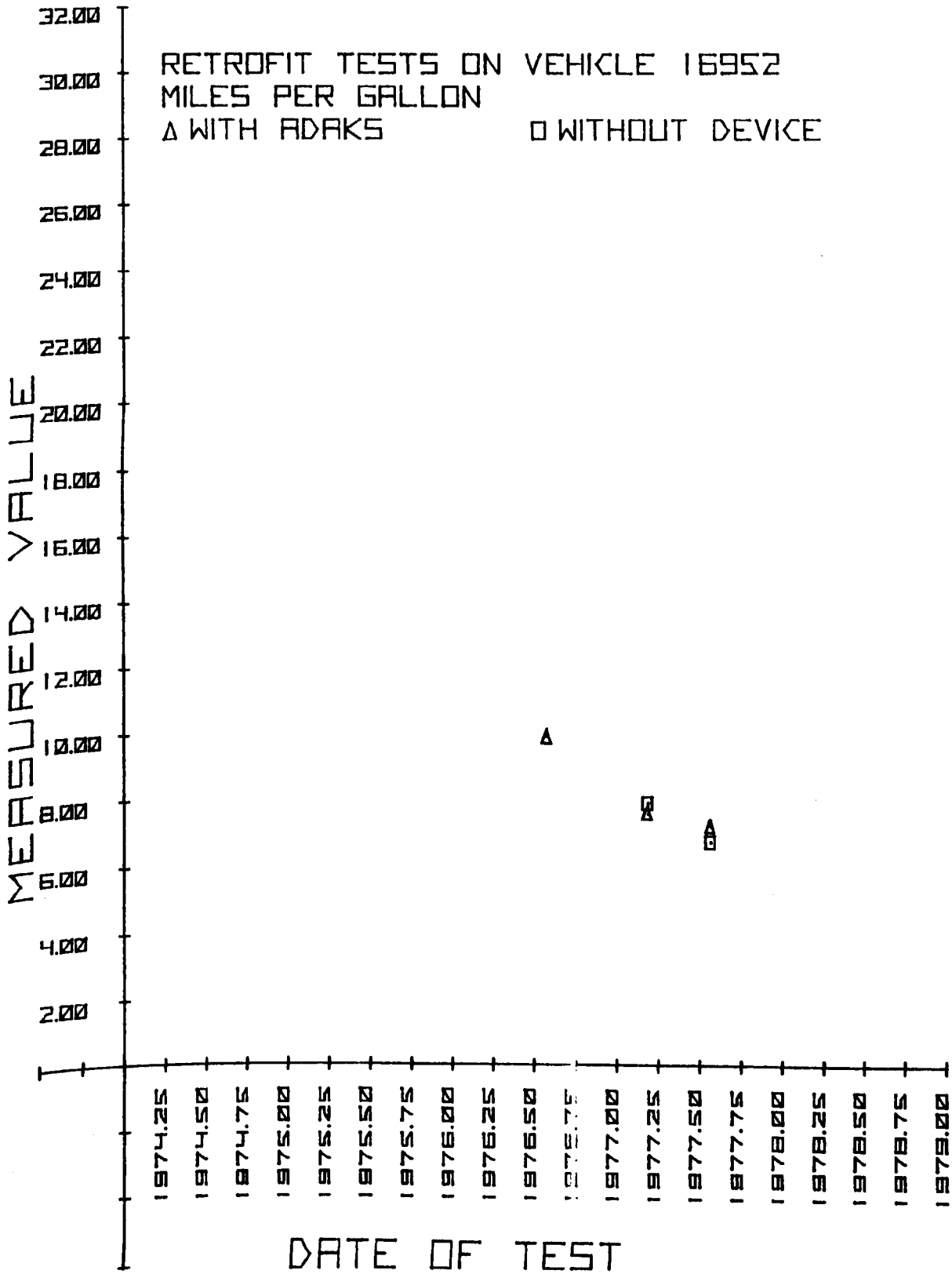

RETROFIT TESTS ON VEHICLE 200640
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

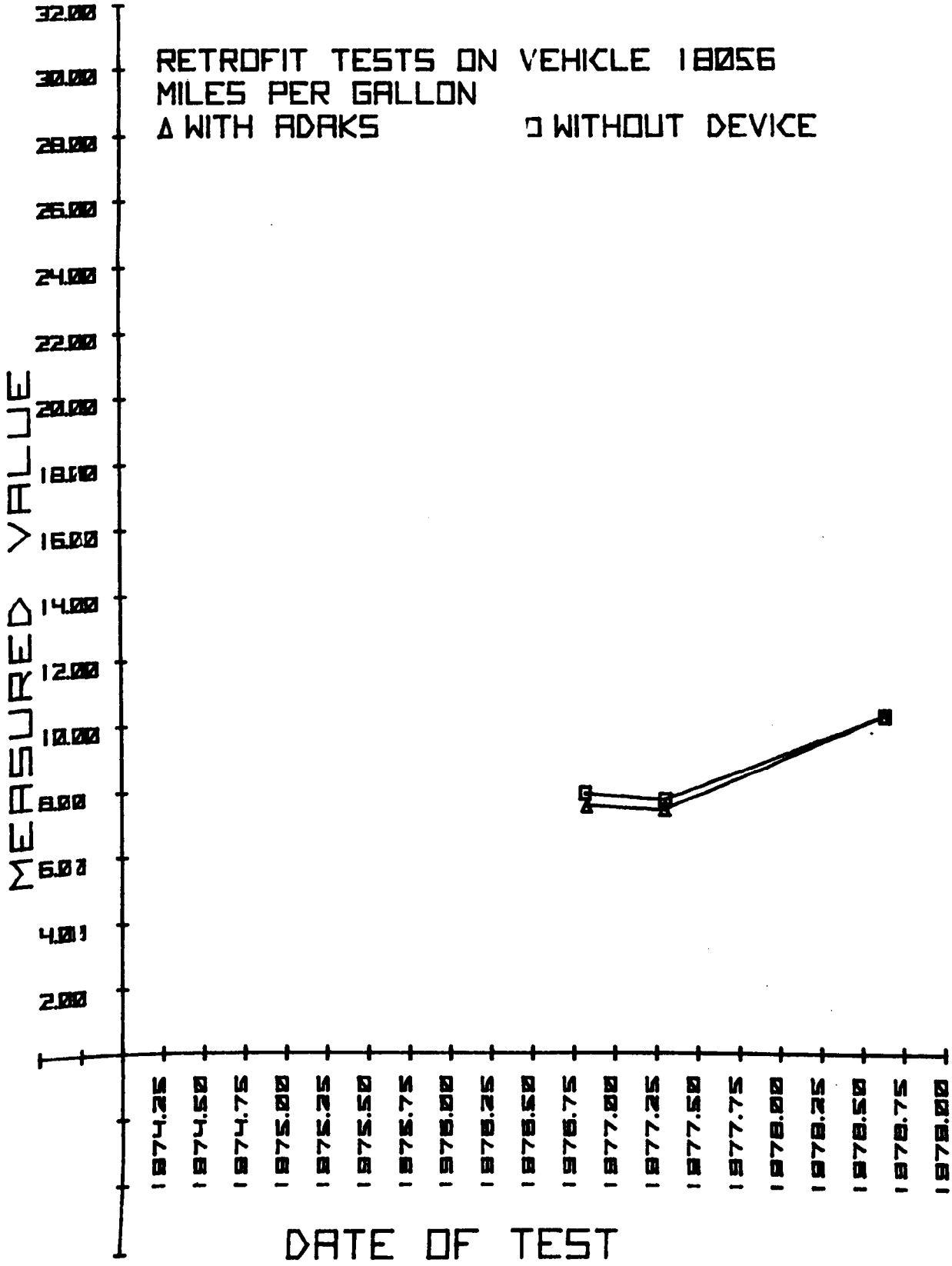

RETROFIT TESTS ON VEHICLE 43834
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

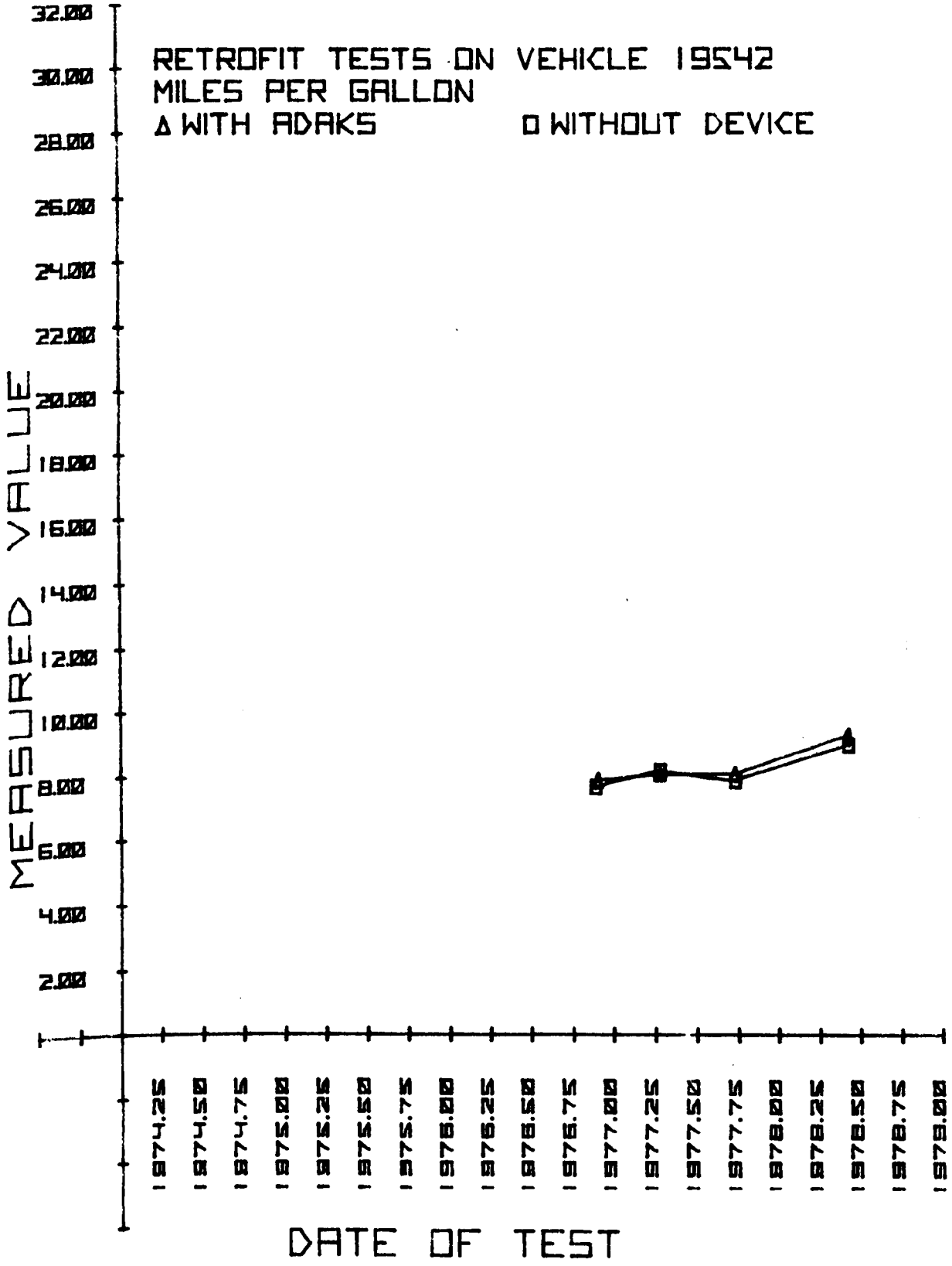

RETROFIT TESTS ON VEHICLE 47704
NOX LEVEL [GM/MI]
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

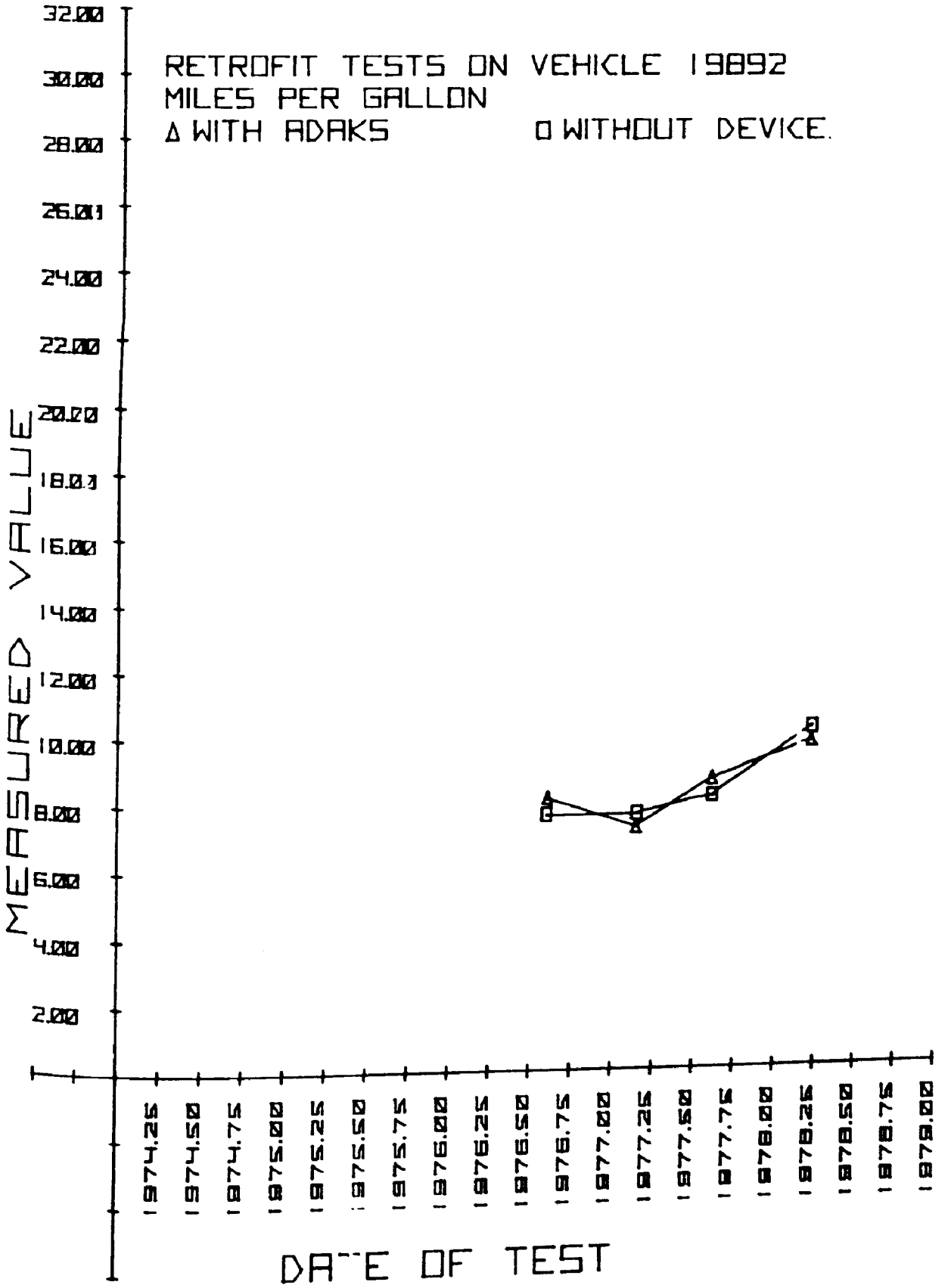

RETROFIT TESTS ON VEHICLE 11338
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

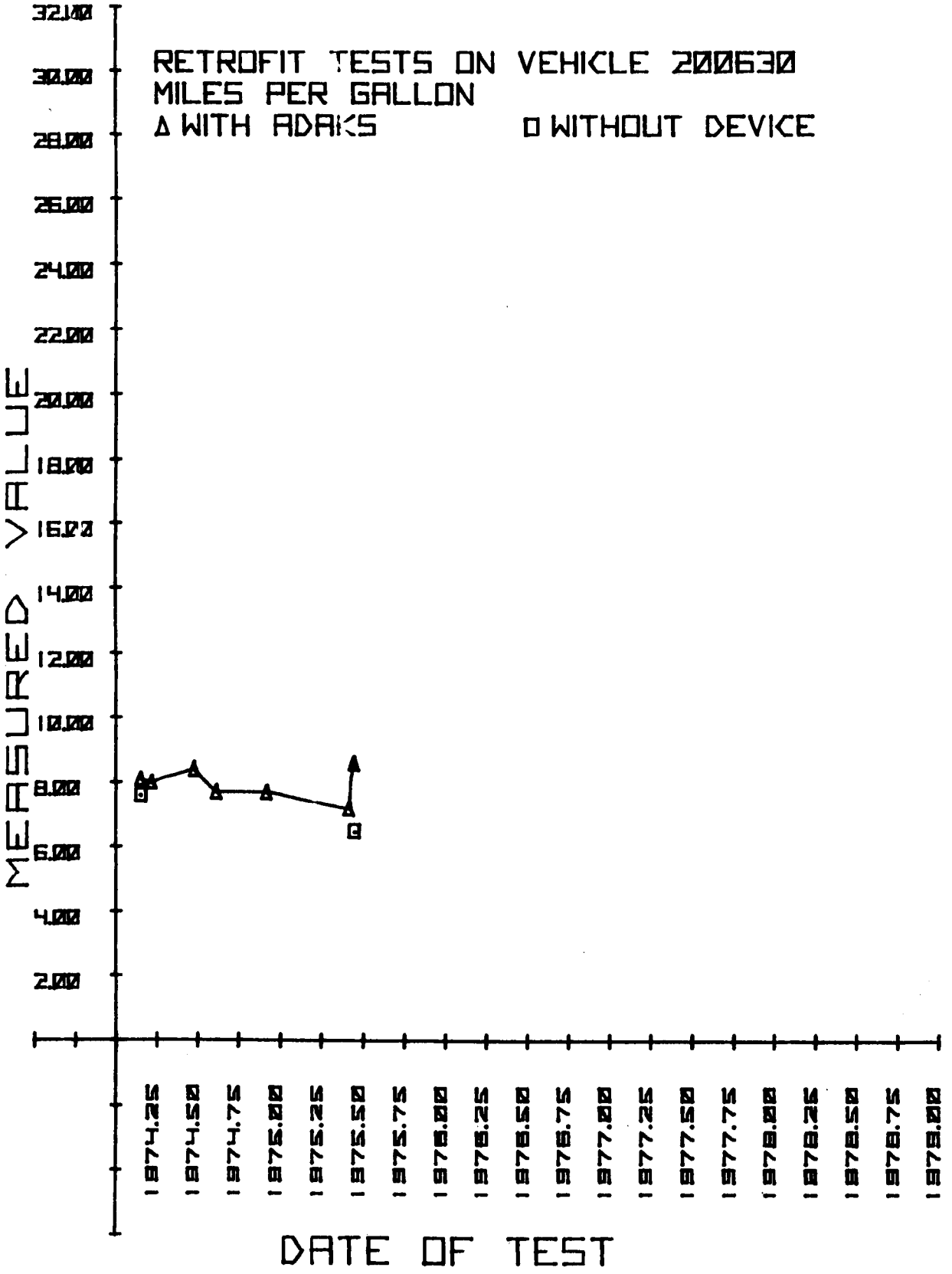

RETROFIT TESTS ON VEHICLE 16944
MILES PER GALLON
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

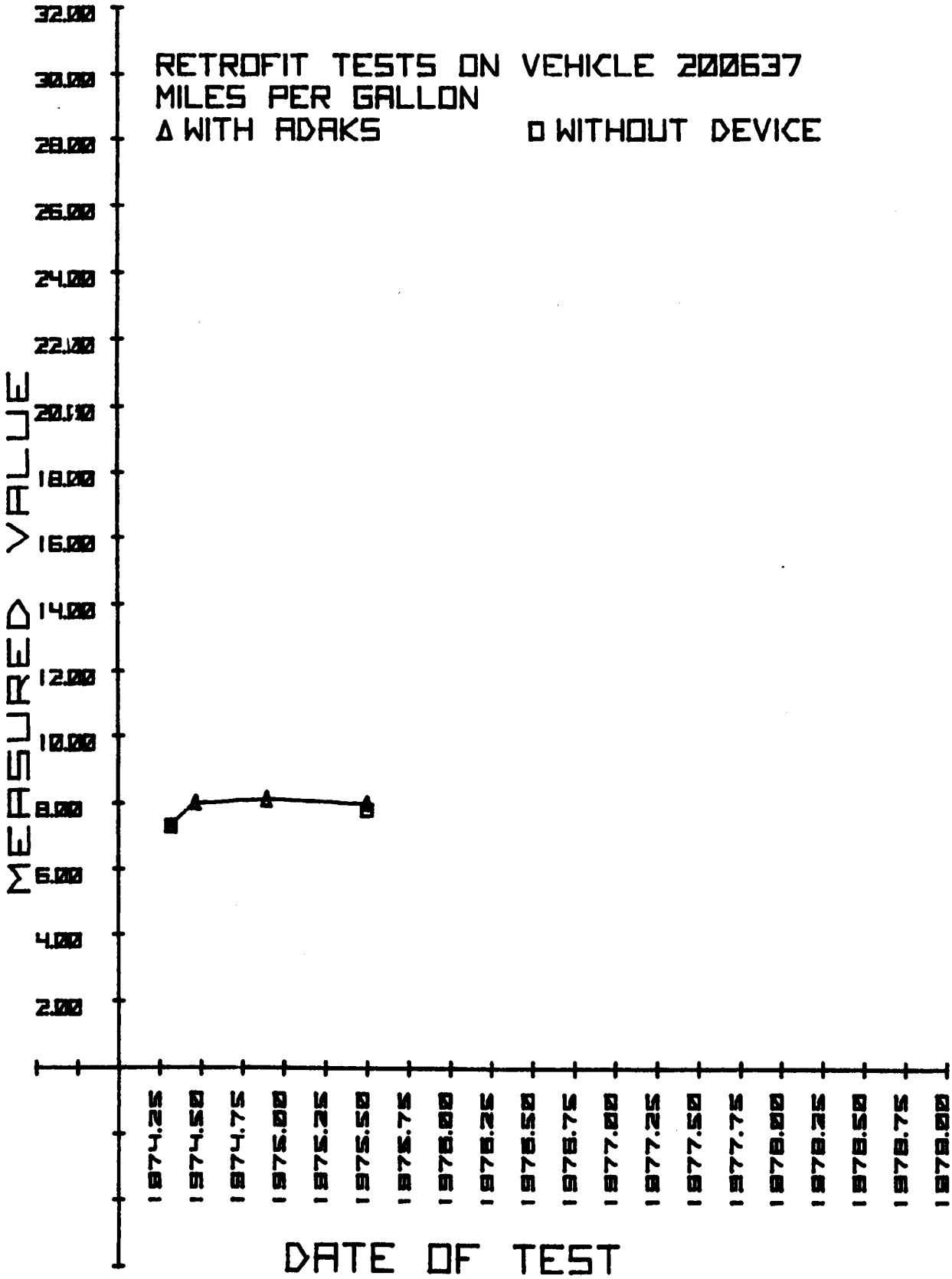

RETROFIT TESTS ON VEHICLE 16952
MILES PER GALLON
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

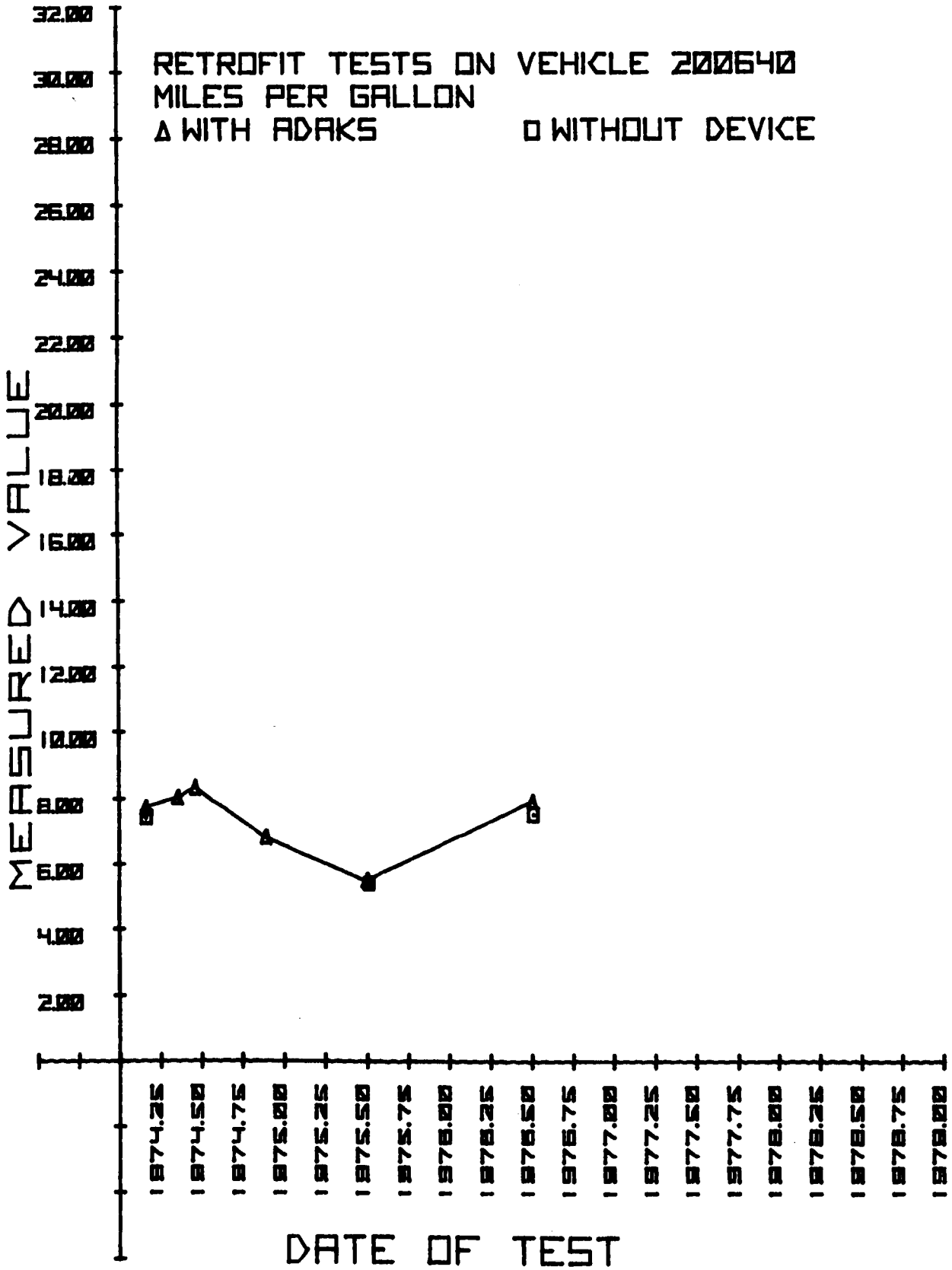

RETROFIT TESTS ON VEHICLE 18056
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

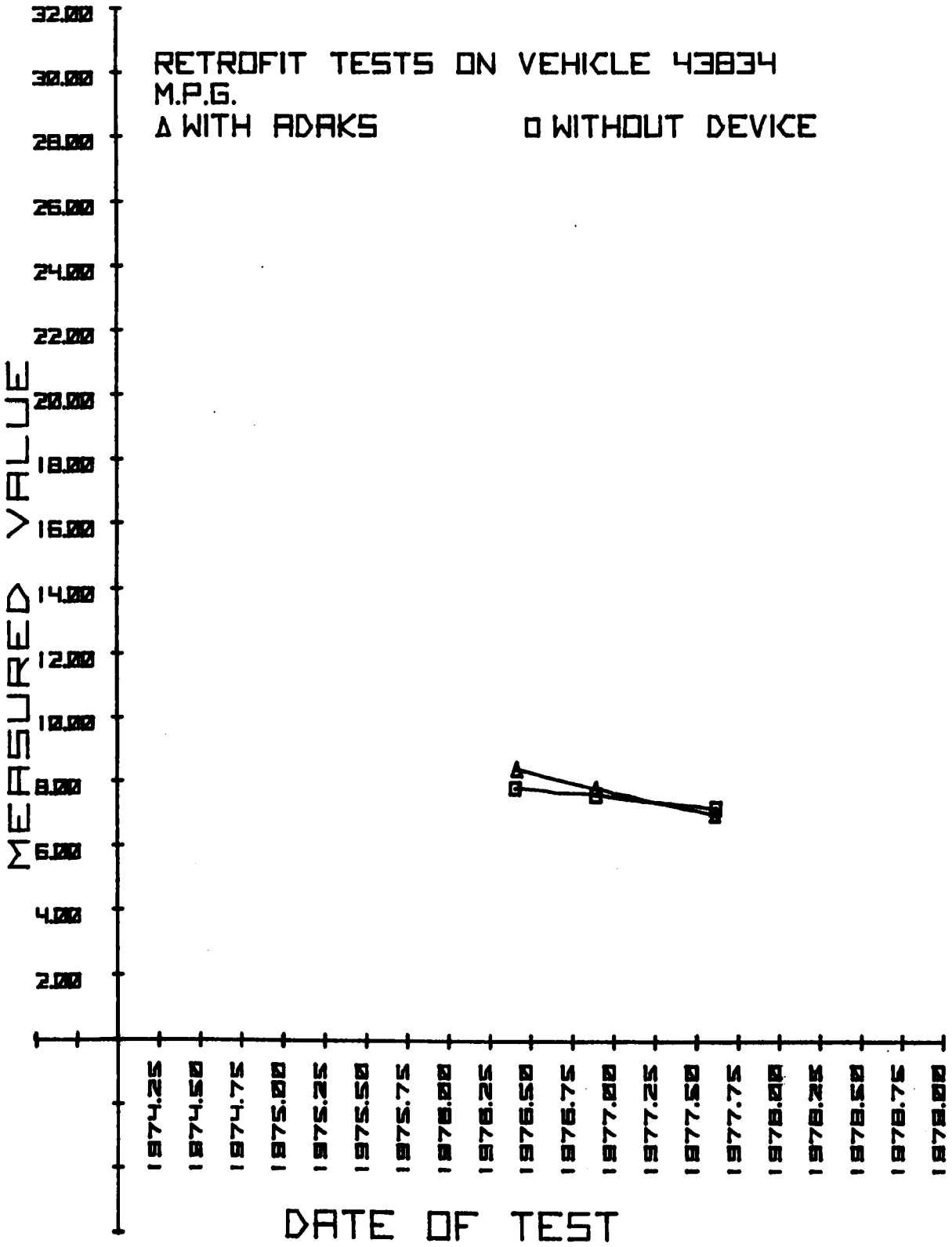

RETROFIT TESTS ON VEHICLE 19542
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

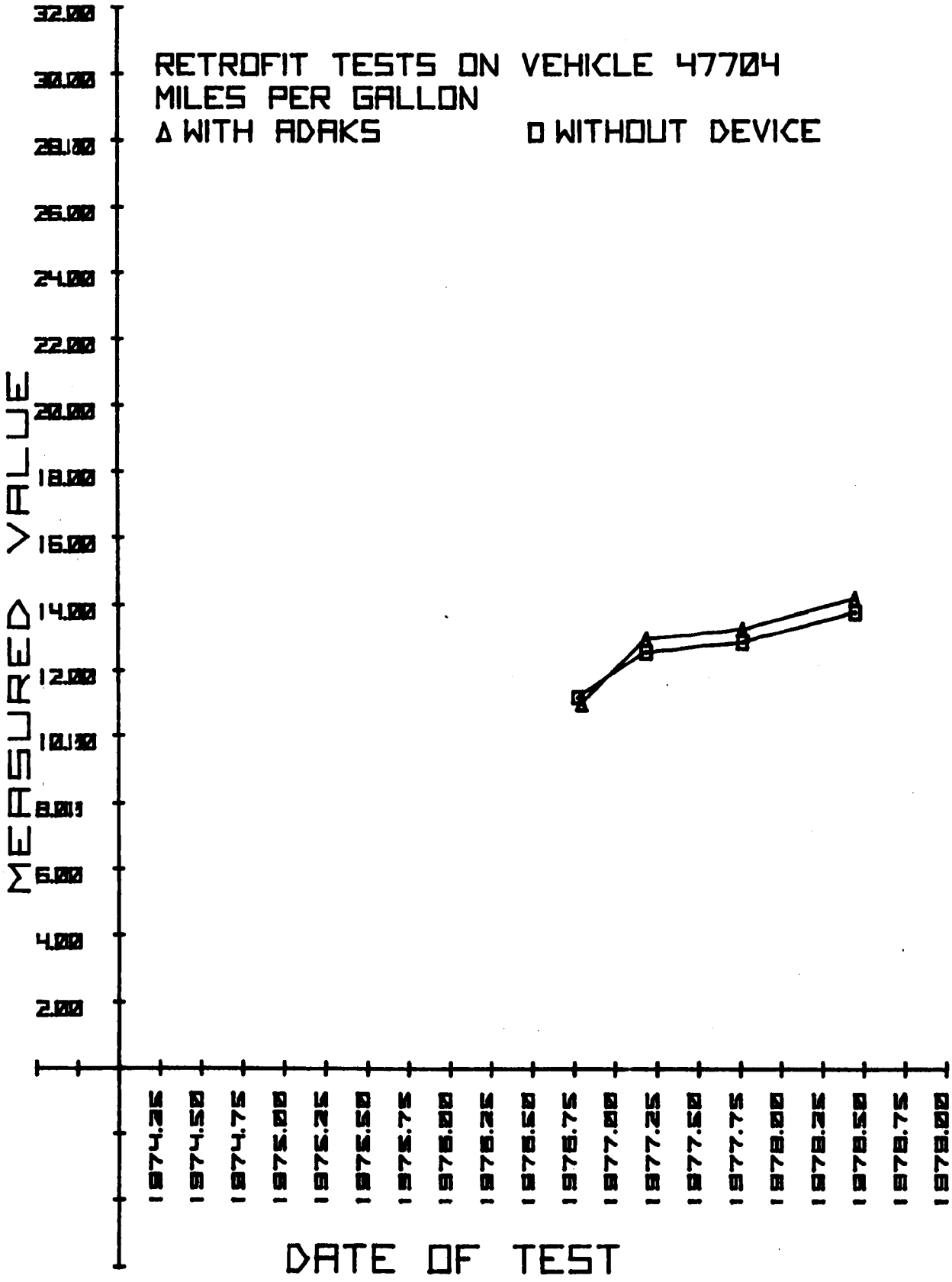

RETROFIT TESTS ON VEHICLE 19892
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST


RETROFIT TESTS ON VEHICLE 200630
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST


RETROFIT TESTS ON VEHICLE 200637
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

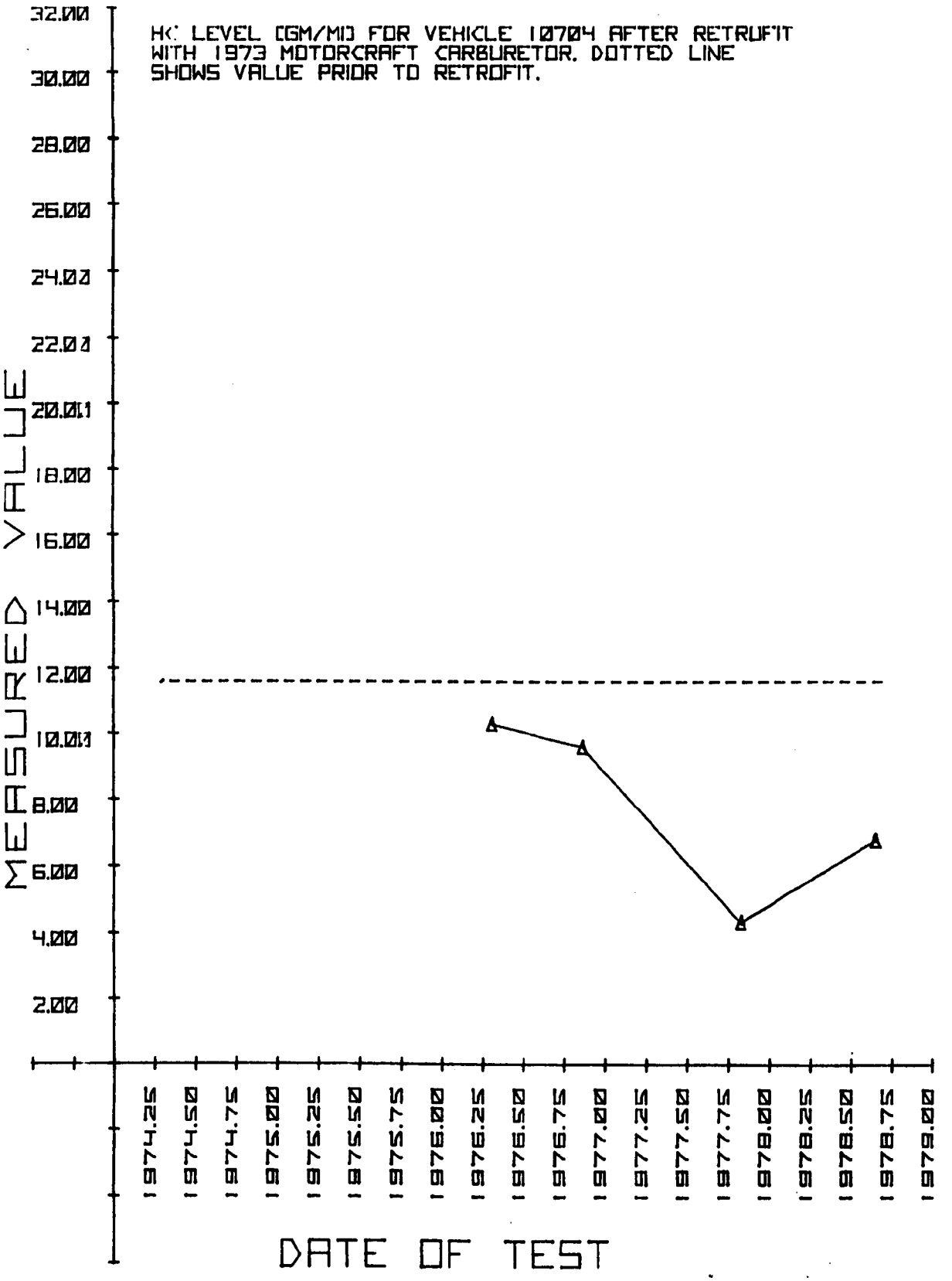

RETROFIT TESTS ON VEHICLE 200640
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

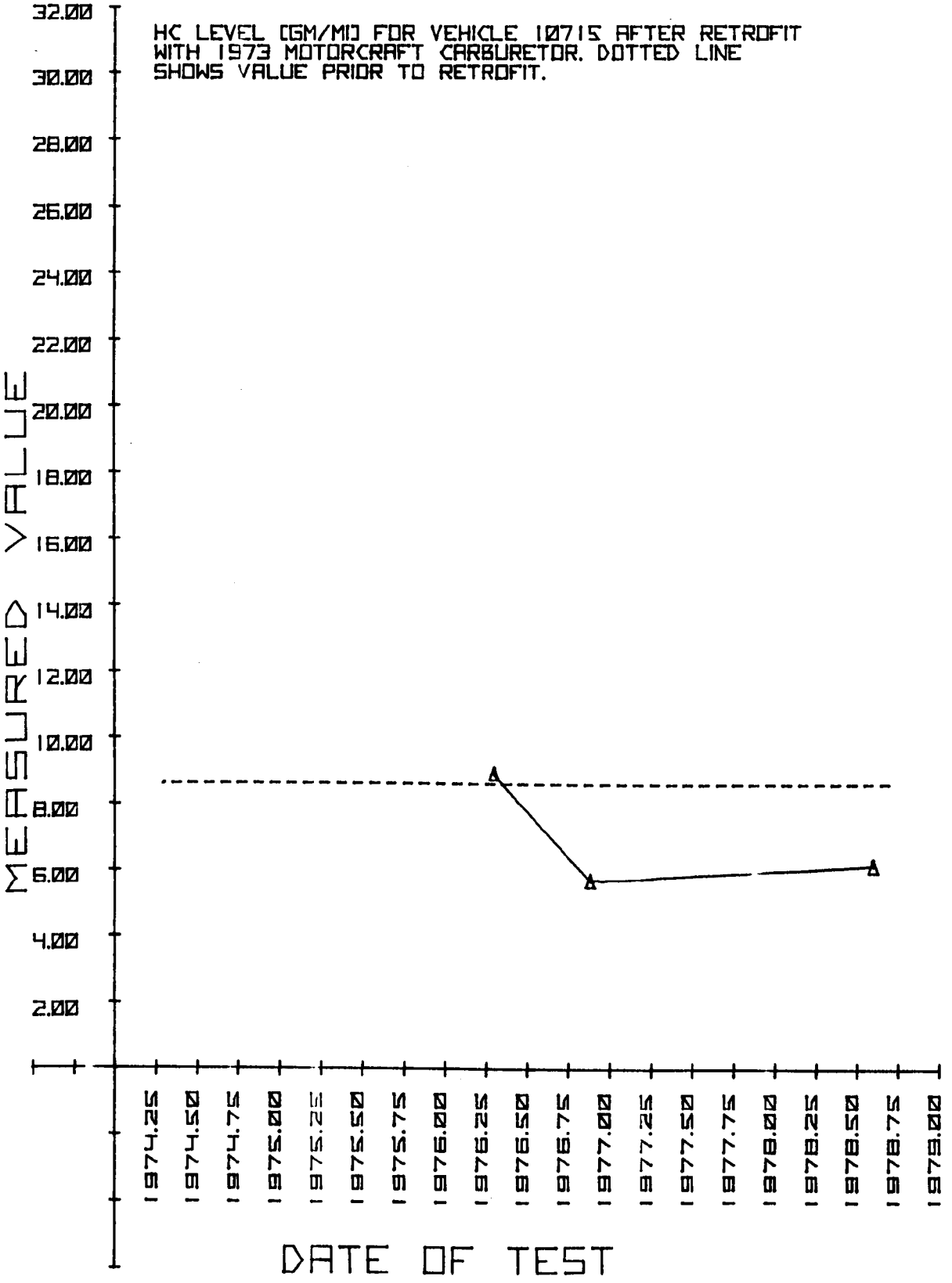

RETROFIT TESTS ON VEHICLE 43834
M.P.G.
Δ WITH ADAKS
O WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

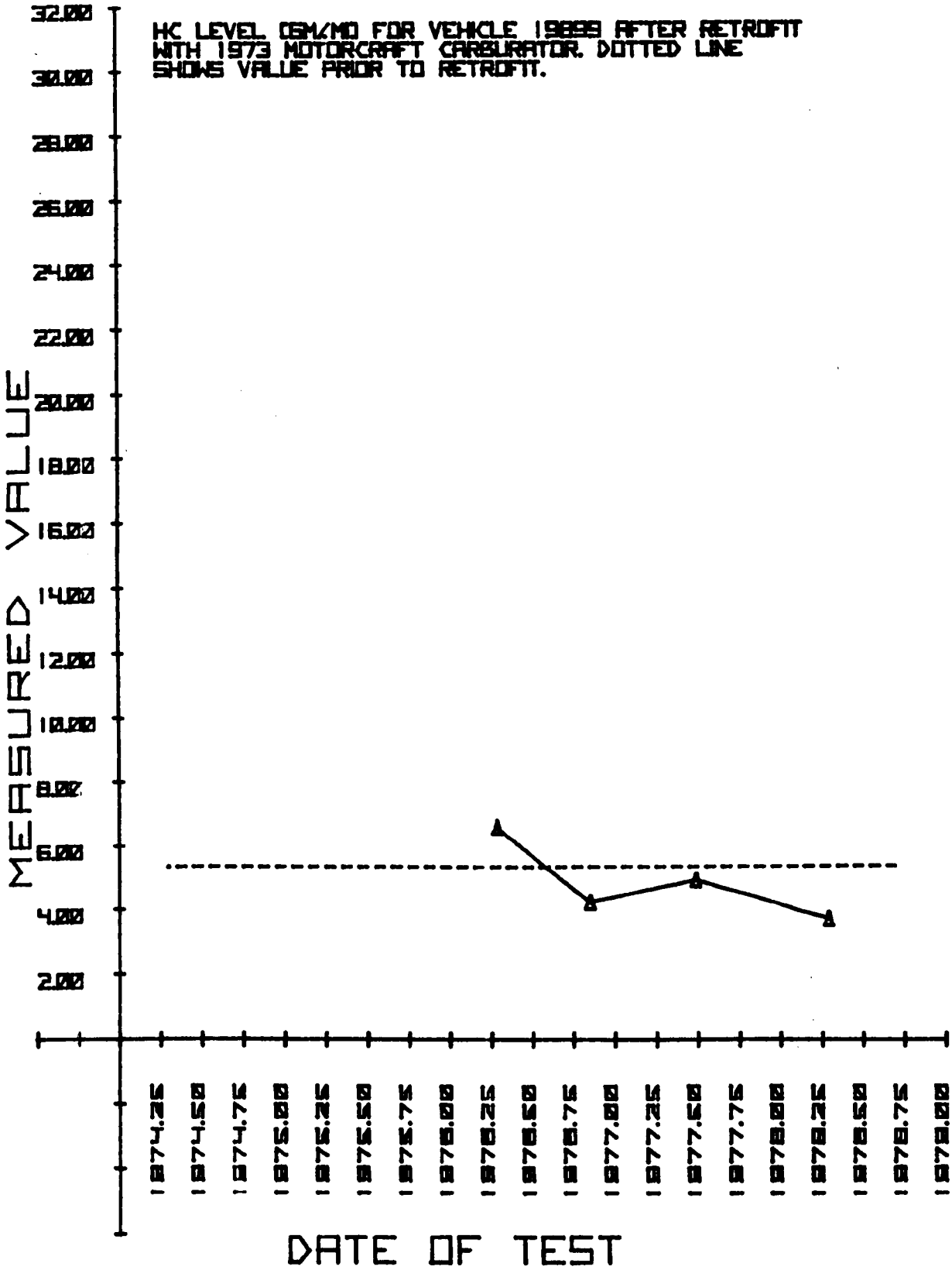

RETROFIT TESTS ON VEHICLE 47704
MILES PER GALLON
Δ WITH ADAKS
□ WITHOUT DEVICE
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

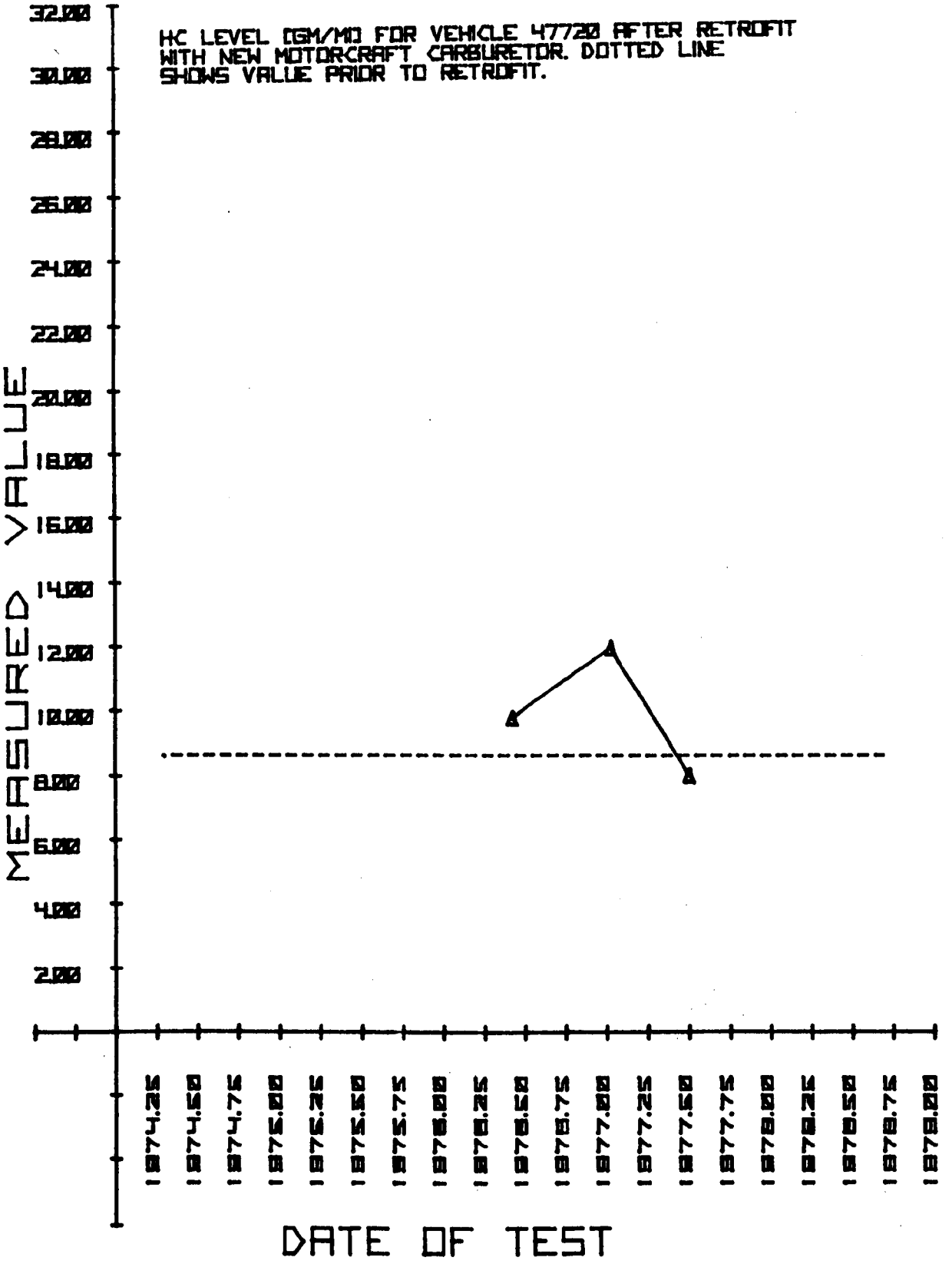
APPENDIX II-C

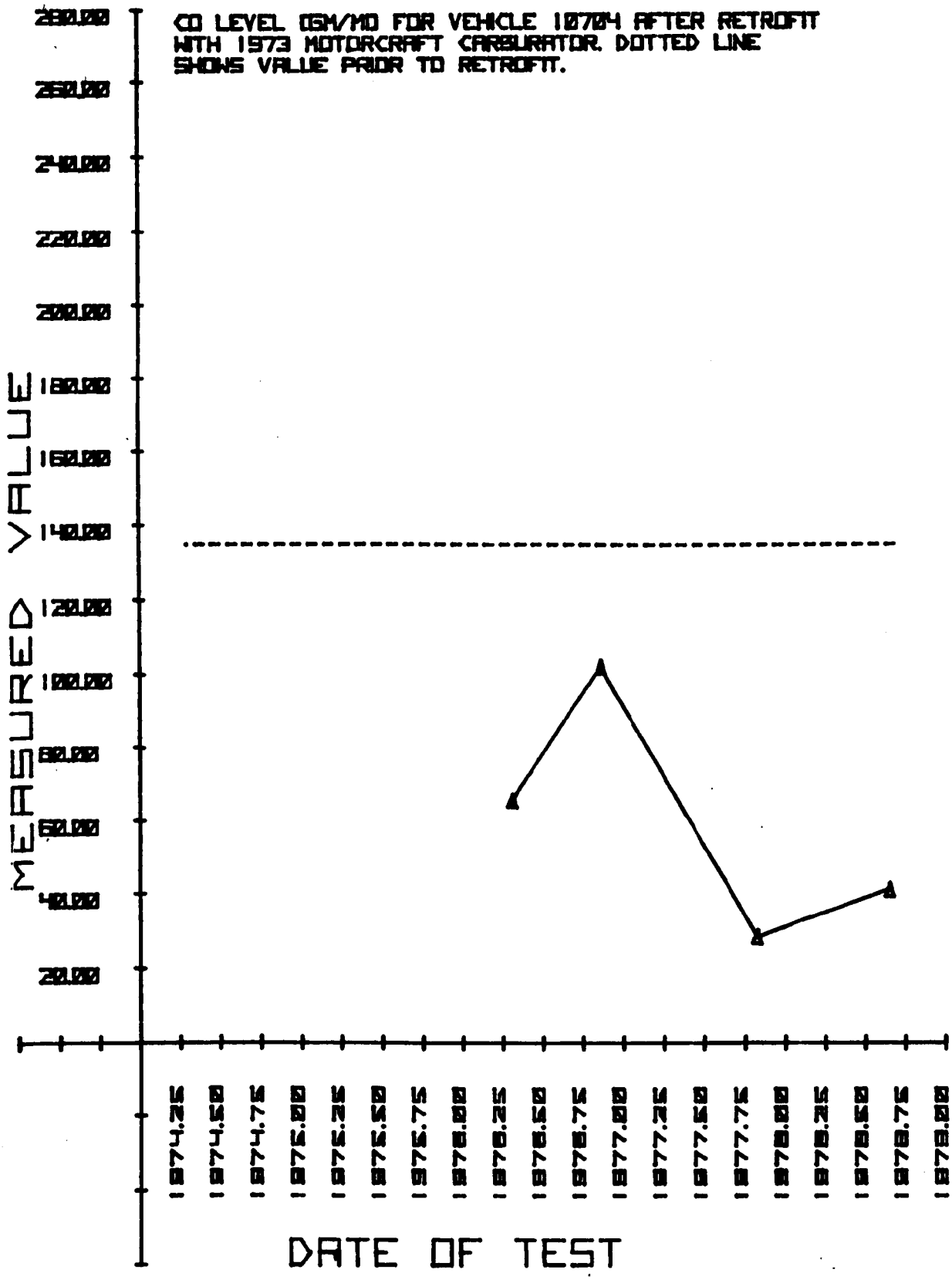
RETROFIT WITH LEAN CARBURETORS

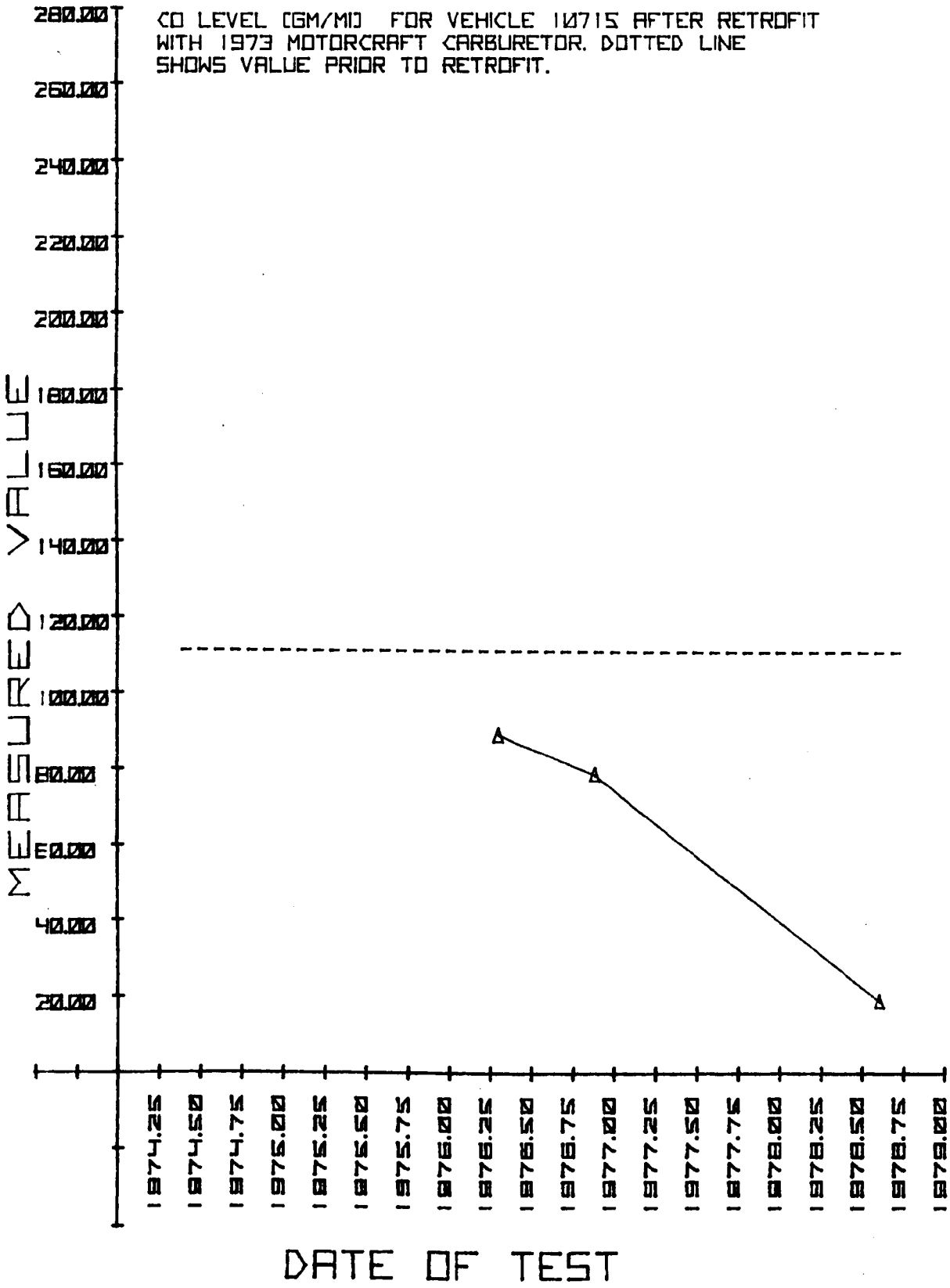

HC LEVEL (GM/MI) FOR VEHICLE 10704 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

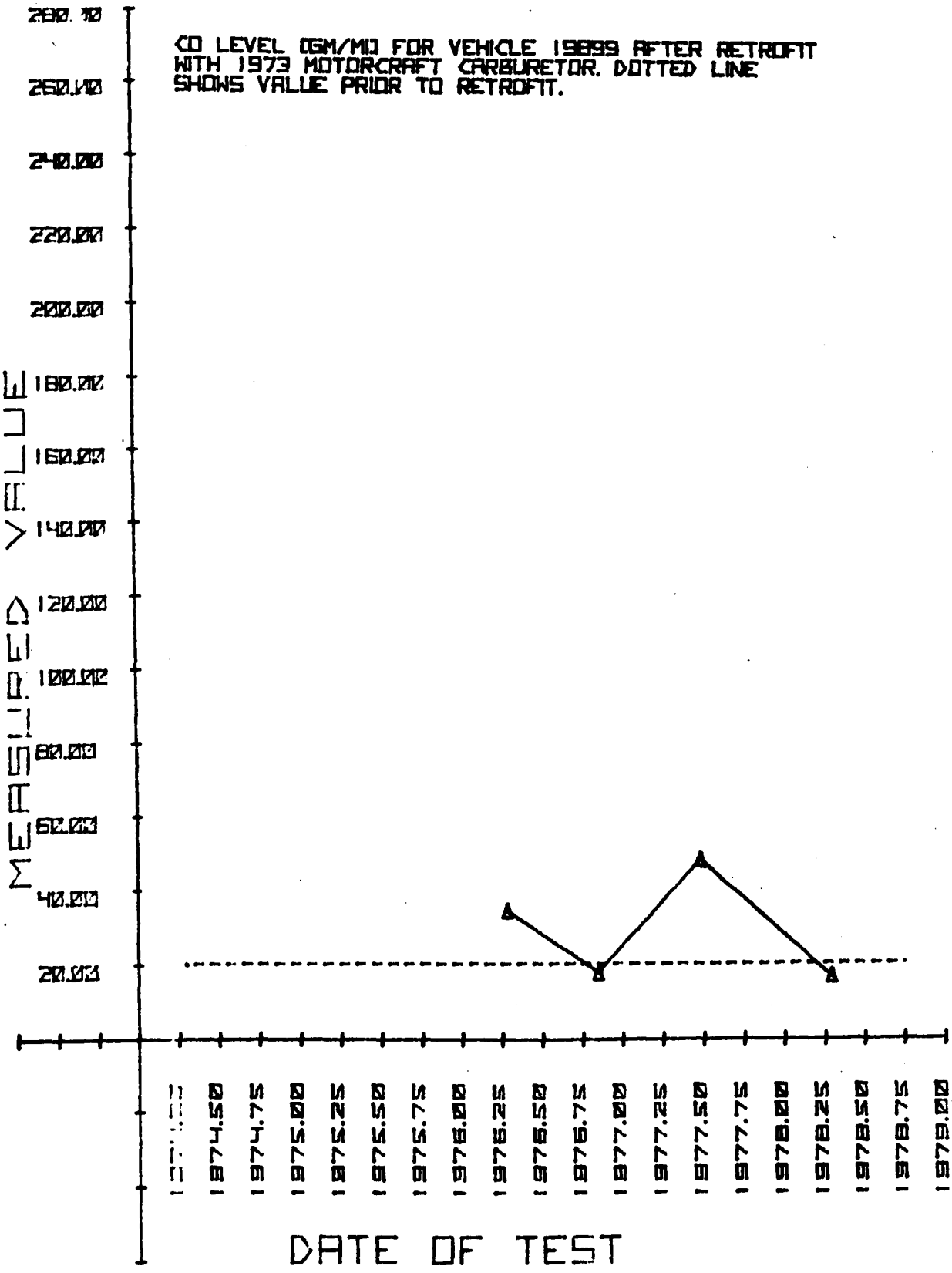

HC LEVEL [GM/MI] FOR VEHICLE 10715 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
MEASURED VALUE
DATE OF TEST


HC LEVEL GM/MO FOR VEHICLE 19899 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURATOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST


HC LEVEL (GM/MI) FOR VEHICLE 47720 AFTER RETROFIT
WITH NEW MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST


CO LEVEL GSM/MD FOR VEHICLE 10704 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURATOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
DATE OF TEST


CO LEVEL [GM/MI] FOR VEHICLE 10715 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
MEASURED VALUE
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST


CO LEVEL (GM/MI) FOR VEHICLE 19899 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
280.00
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
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1977.75
1978.00
1978.25
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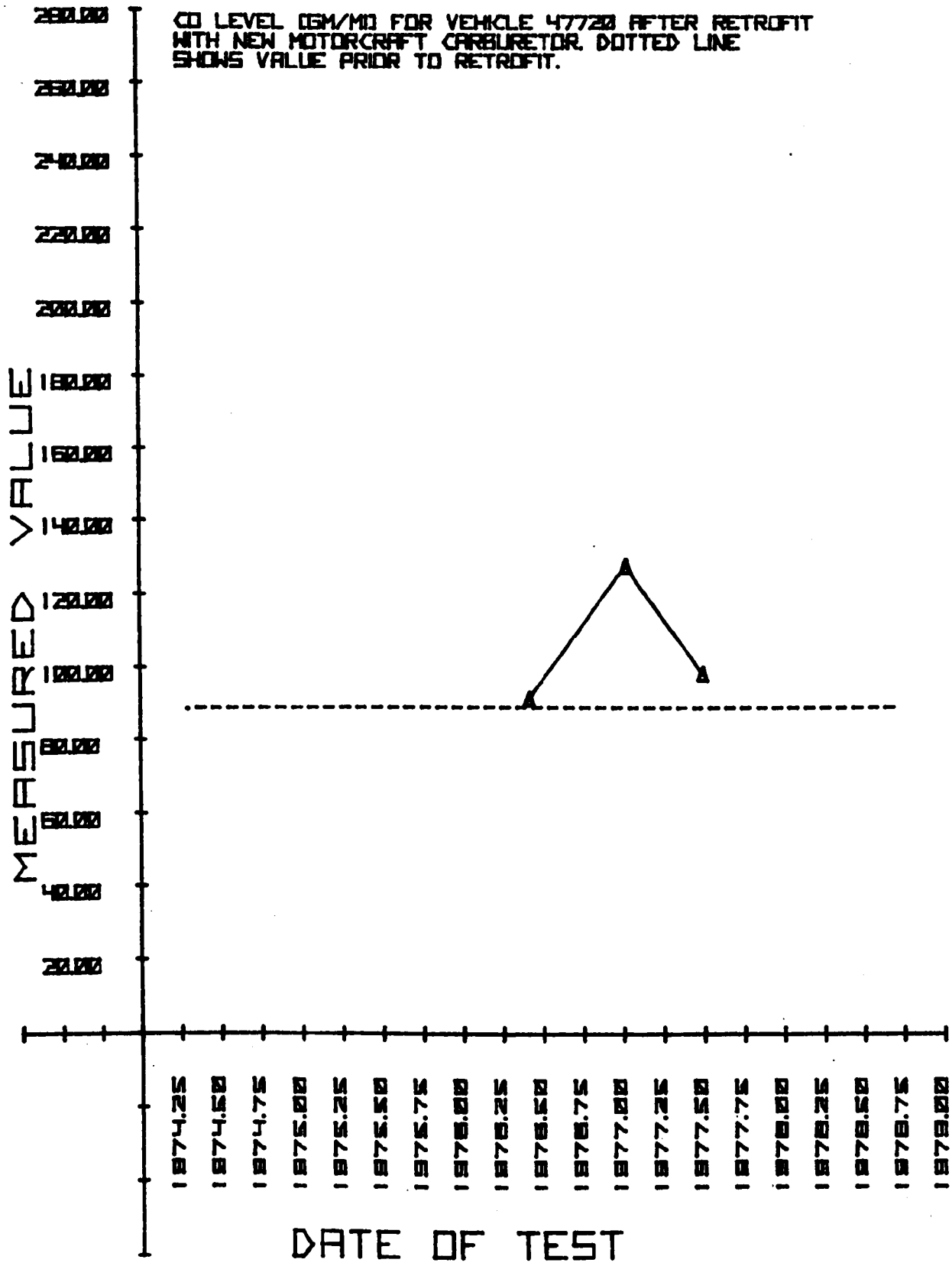
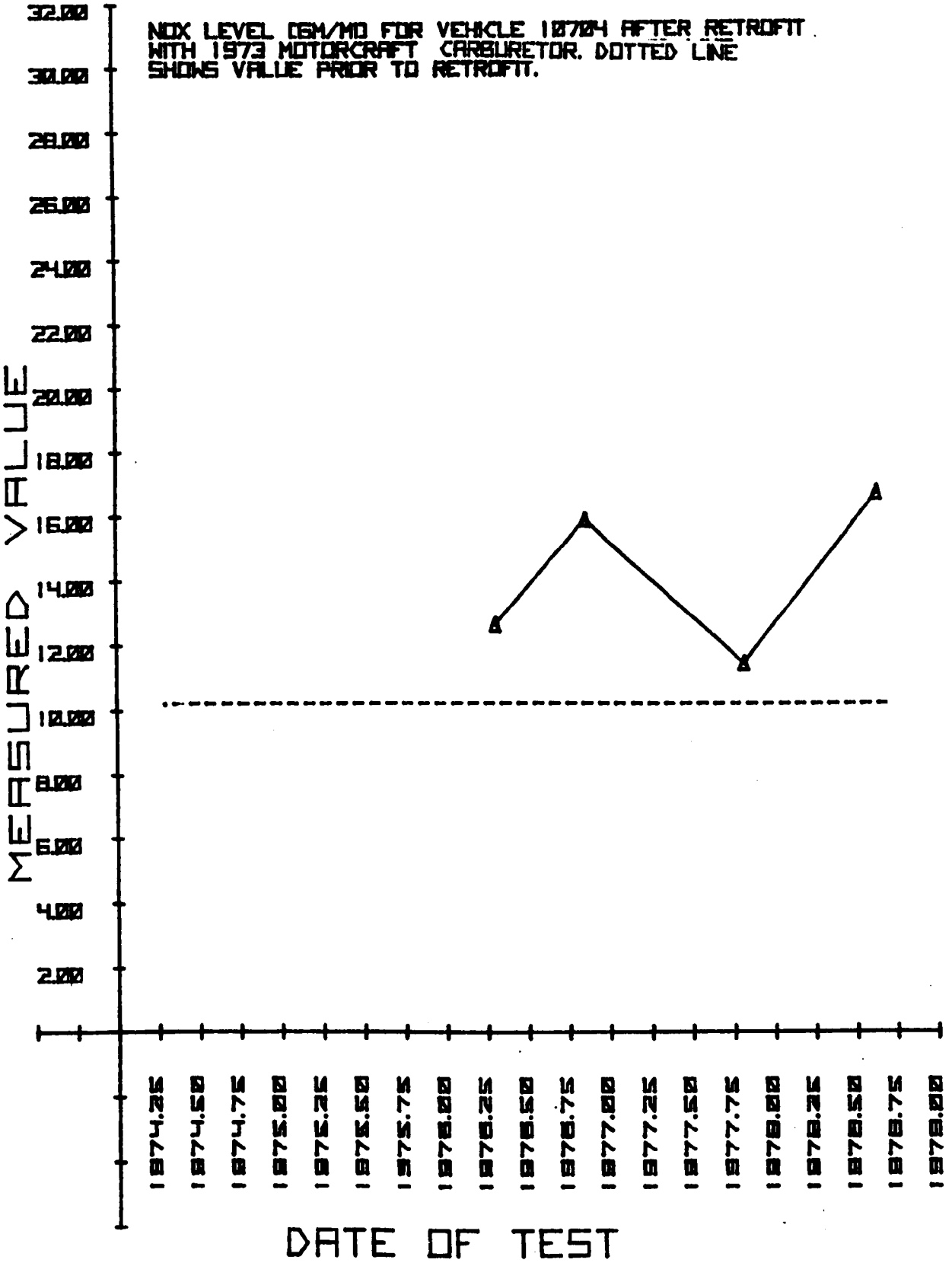
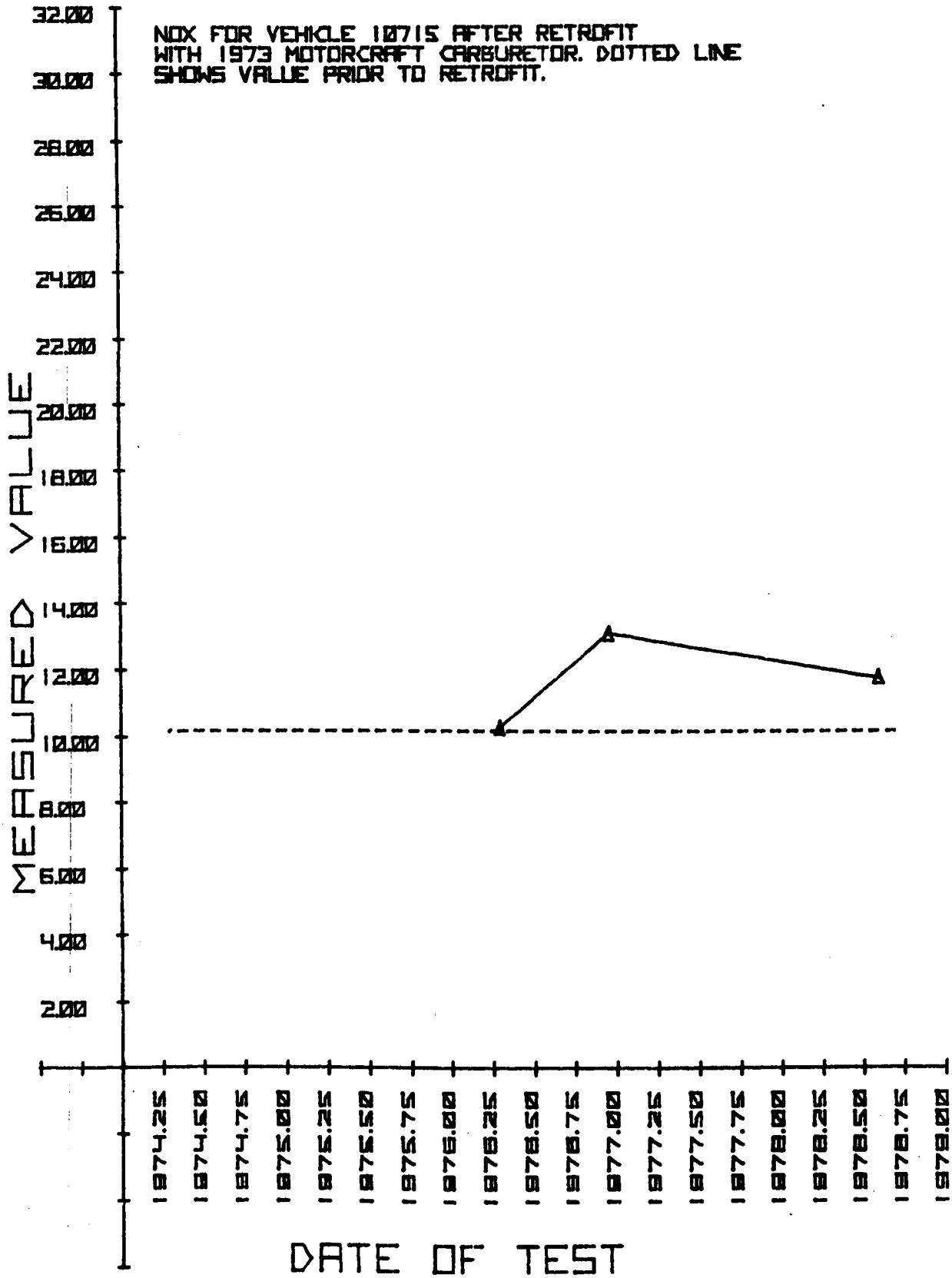
1978.75
1979.00
DATE OF TEST


CO LEVEL DGM/MI FOR VEHICLE 47720 AFTER RETROFIT
WITH NEW MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
260.00
240.00
220.00
200.00
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
DATE OF TEST


NOX LEVEL (GM/MI) FOR VEHICLE 107014 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST


NOX FOR VEHICLE 10715 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
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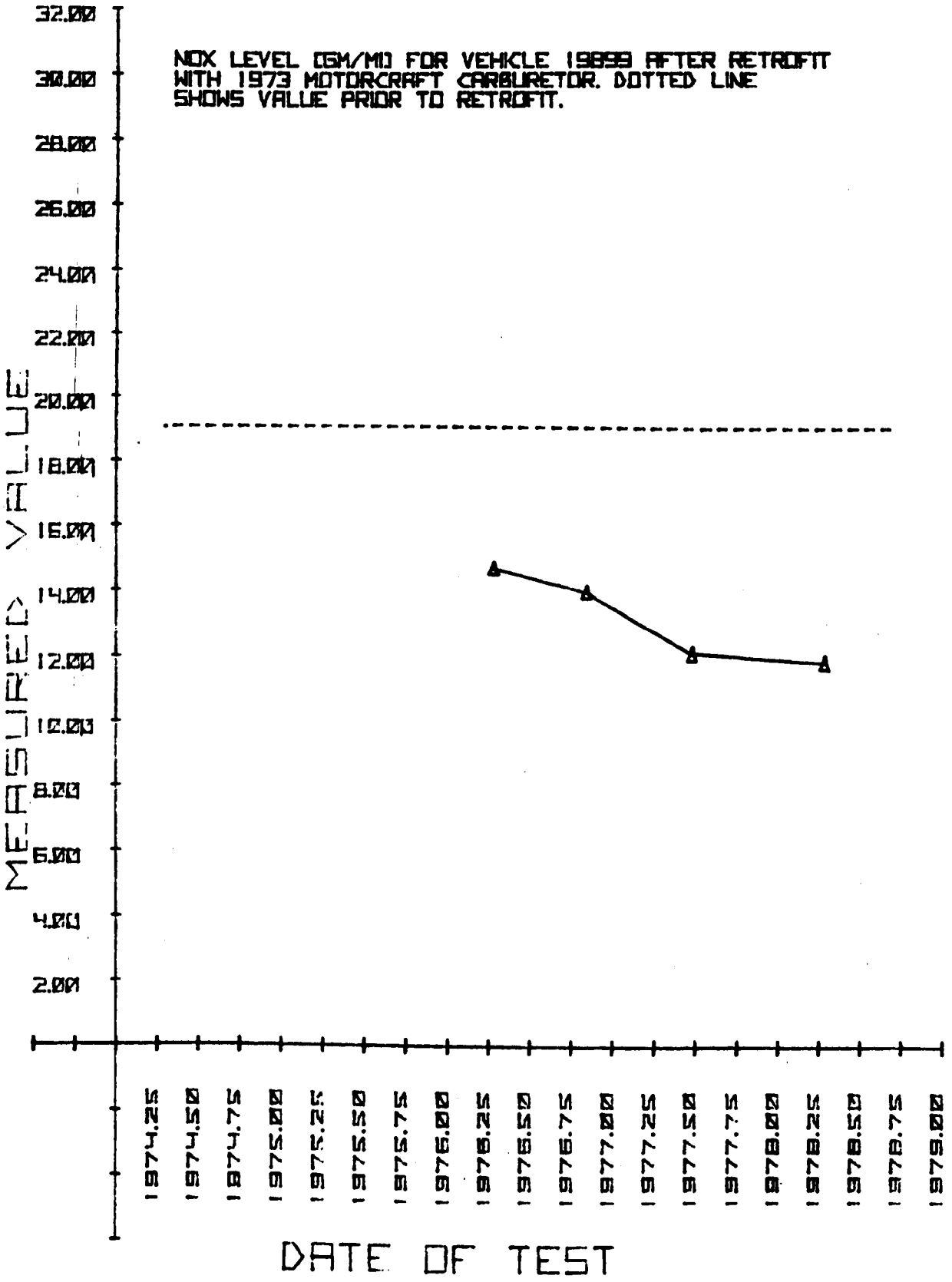
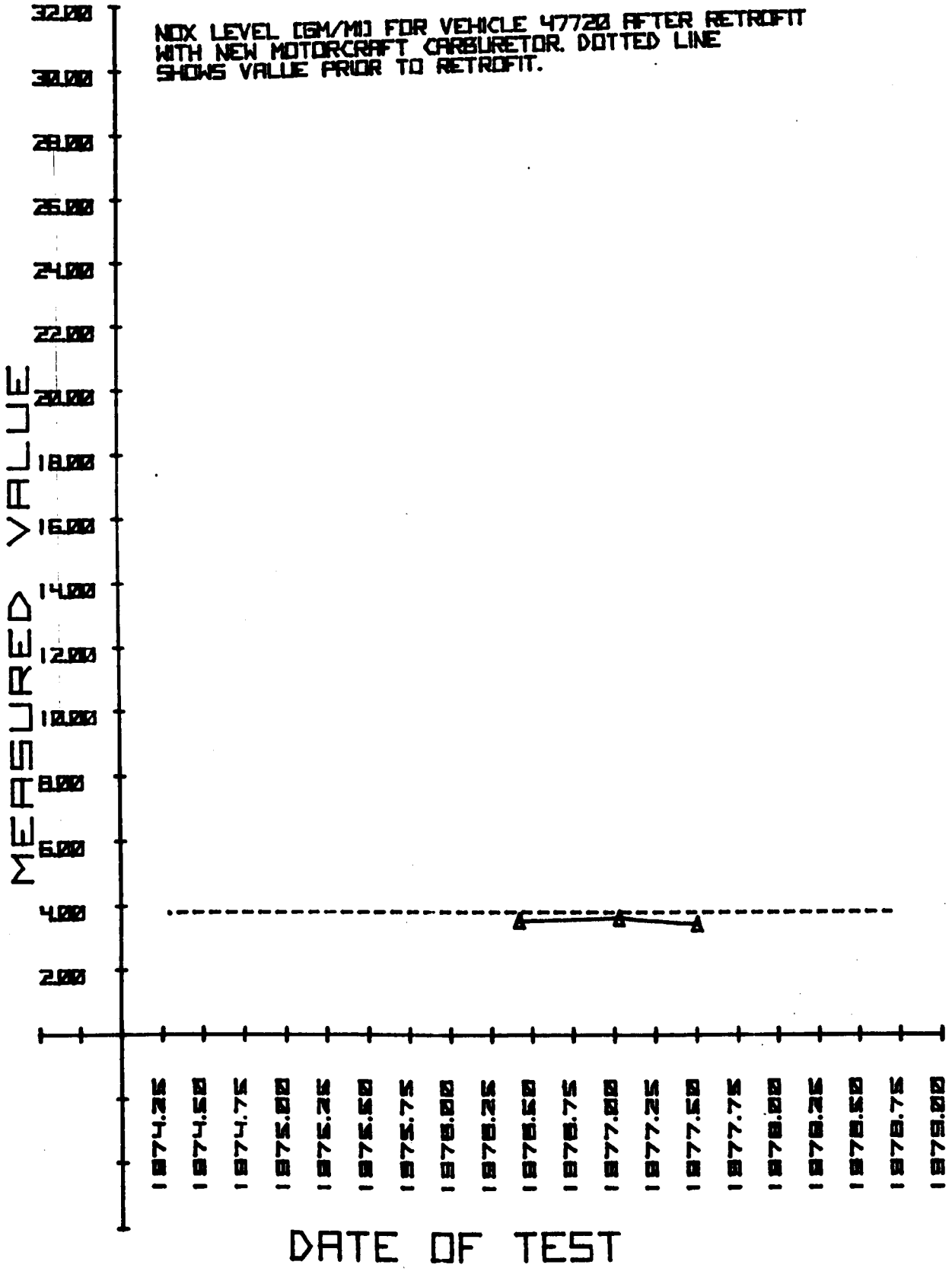
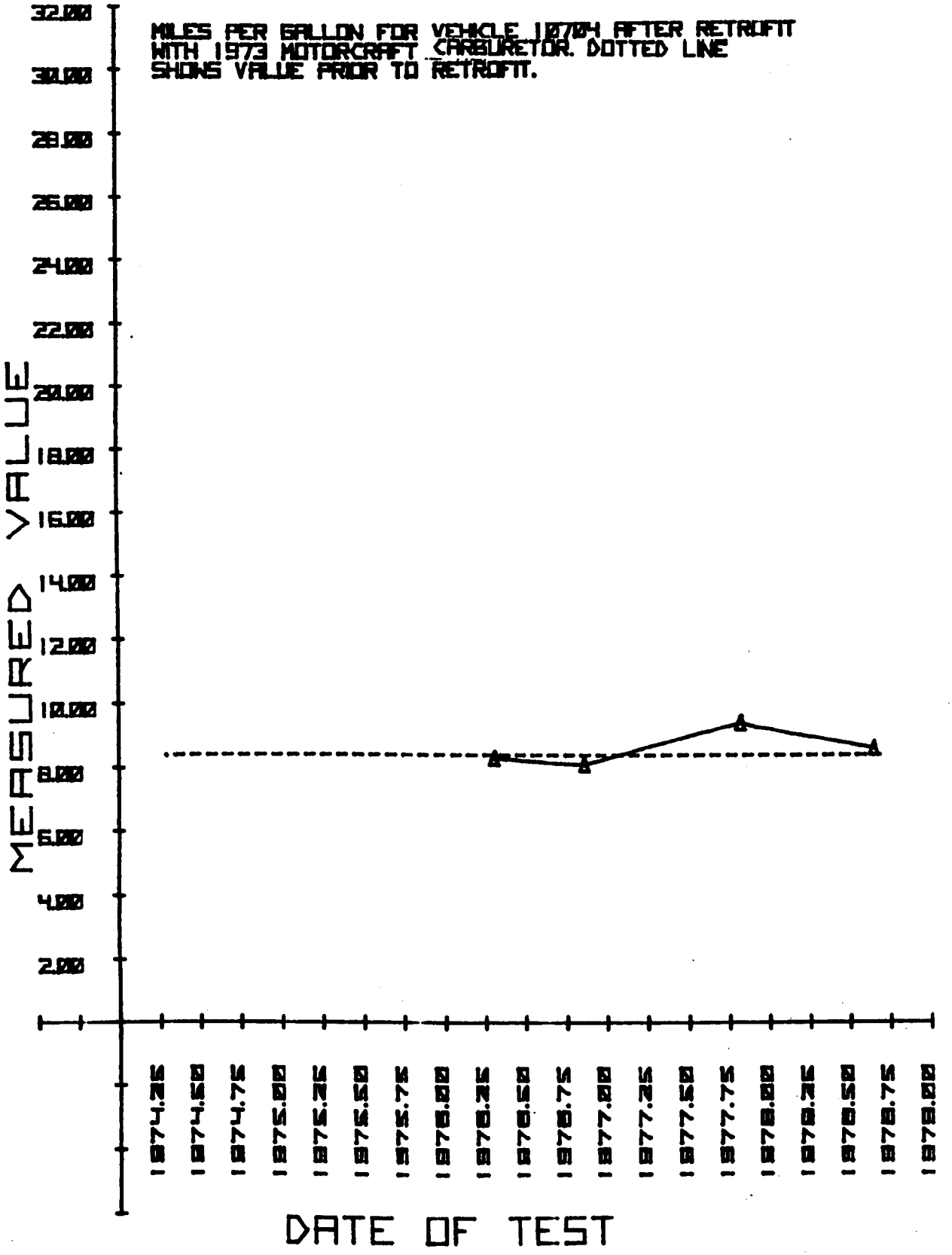
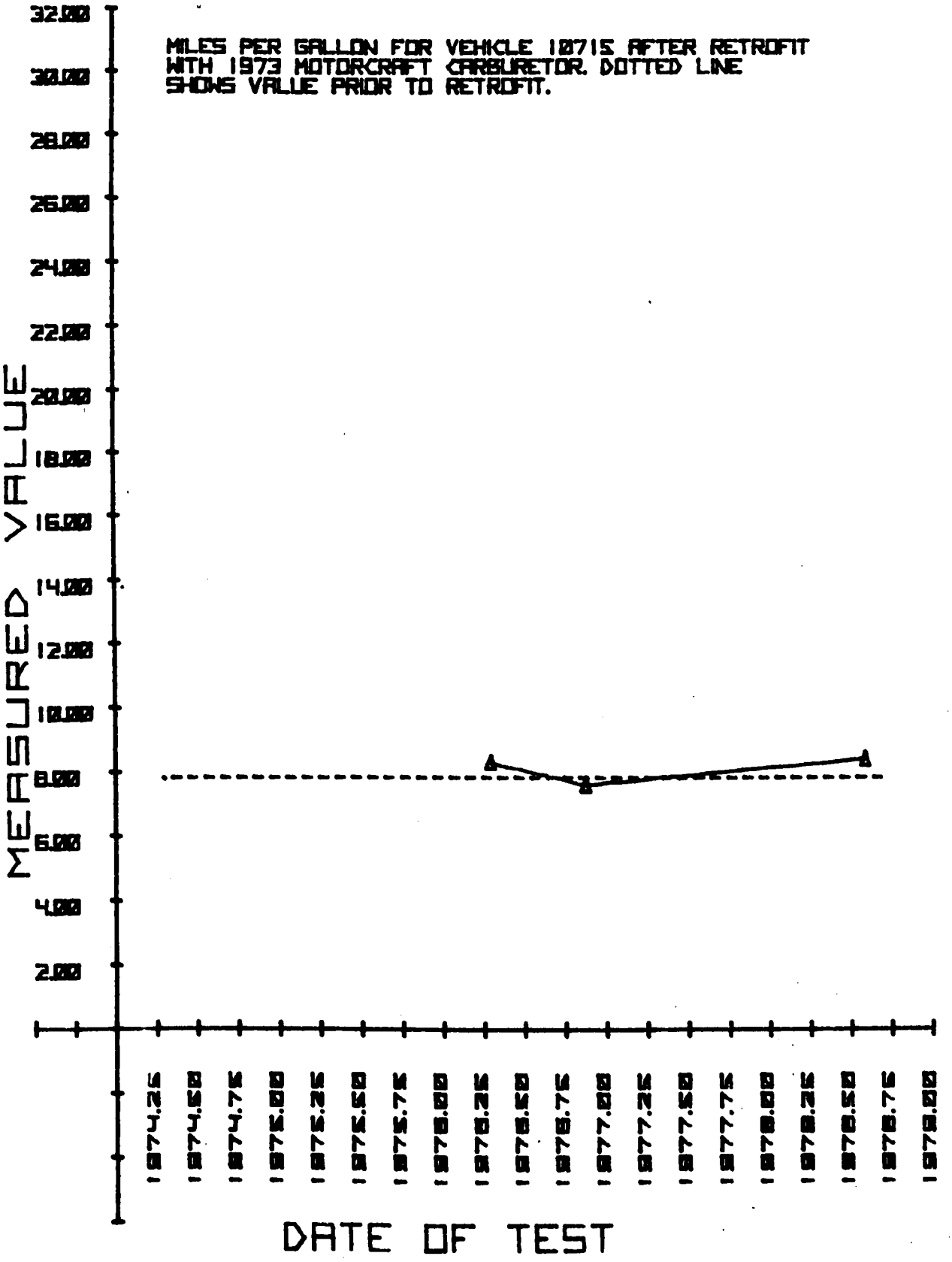
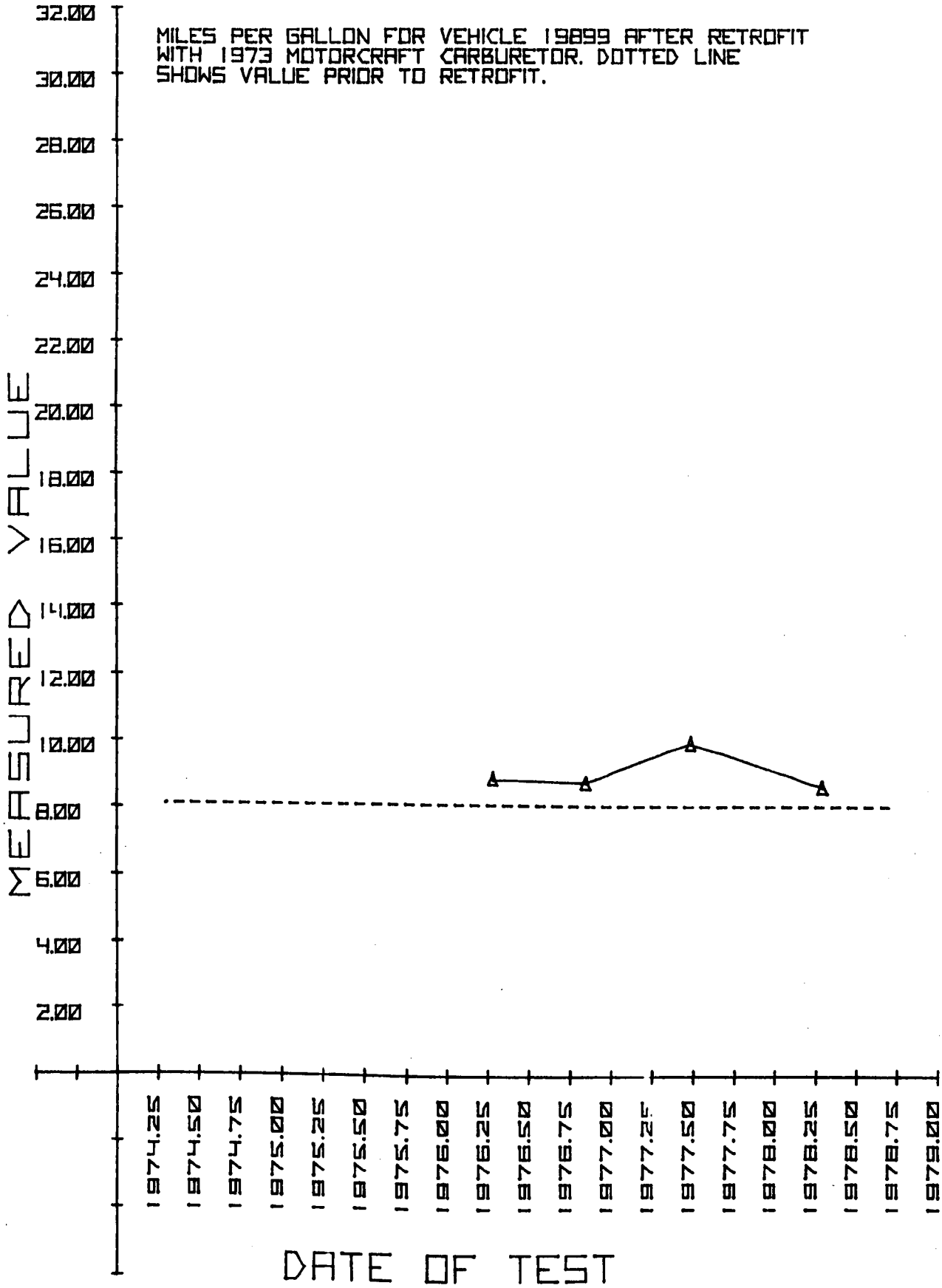
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST

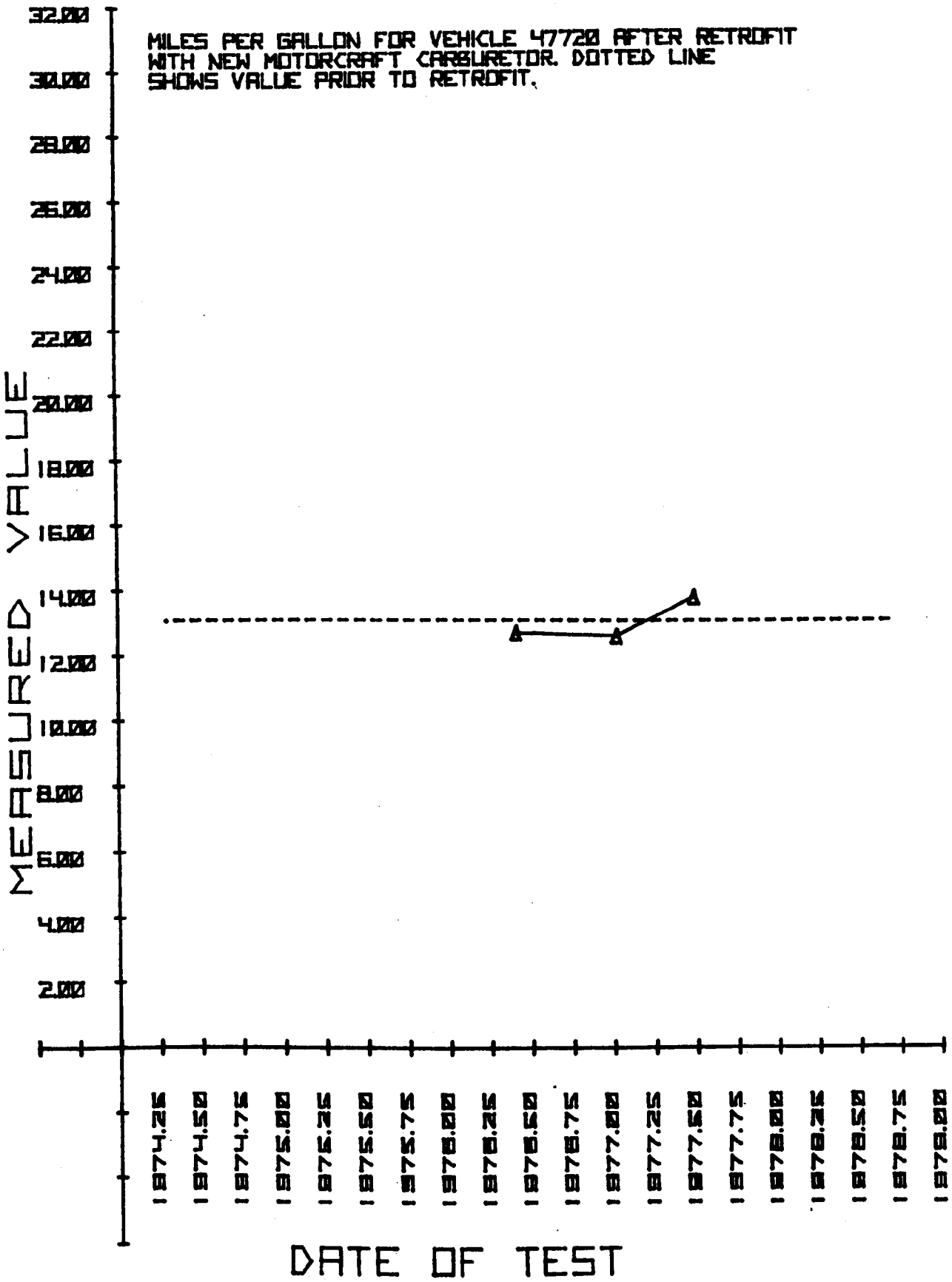

NOX LEVEL (GM/MI) FOR VEHICLE 19899 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
MEASURED VALUE
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST


NOX LEVEL [GM/MI] FOR VEHICLE 47720 AFTER RETROFIT
WITH NEW MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST


MILES PER GALLON FOR VEHICLE 10704 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
1974.25
1974.50
1974.75
1975.00
1975.25
1975.50
1975.75
1976.00
1976.25
1976.50
1976.75
1977.00
1977.25
1977.50
1977.75
1978.00
1978.25
1978.50
1978.75
1979.00
DATE OF TEST


MILES PER GALLON FOR VEHICLE 10715 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST


MILES PER GALLON FOR VEHICLE 19899 AFTER RETROFIT
WITH 1973 MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST


MILES PER GALLON FOR VEHICLE 47720 AFTER RETROFIT
WITH NEW MOTORCRAFT CARBURETOR. DOTTED LINE
SHOWS VALUE PRIOR TO RETROFIT.
MEASURED VALUE
32.00
30.00
28.00
26.00
24.00
22.00
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
DATE OF TEST

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA 902/4-81-001 b	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Study Of Control Strategies For In-Use Heavy Duty Vehicles. Appendix I & II of Final Report.		5. REPORT DATE Approved 5/81
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) John J. Pinto		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS NYC Department of Environmental Protection Mobile Systems Division 75 Frost Street Brooklyn, N.Y. 11211		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO. Contract 68-01-4319
12. SPONSORING AGENCY NAME AND ADDRESS United States Environmental Protection Agency Region II 26 Federal Plaza New York, N.Y. 10278		13. TYPE OF REPORT AND PERIOD COVERED Final
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

Appendix I. Data from the tests performed for the contract are entered in a single file on magnetic tape. The Appendix describes the tape.

Appendix II. Graphs of Retrofit Test Data.
- II-A. Retrofit with DANA Exhaust Gas Recirculation Device.
- II-B. Retrofit with ADAKS Air Bleed Device.
- II-C. Retrofit with Lean Carburetors.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES 93
	20. SECURITY CLASS *(This page)*	22. PRICE

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