



Internal Memorandum

TO: DISTRIBUTION

FROM: M. T. McDonough

RE: MINUTES PRE-PRODUCTION MEETING
SMITHVILLE, TENNESSEE
FRIDAY, JANUARY 15, 1982

DATE: January 19, 1982

DISTRIBUTION:

R.L. Armer
W.N. Bockay
T.P. Conroy
E.R. Koss
D.R. Loftis
F.C. Skelton
T.L. McKenzie

PLAINTIFF'S EXHIBIT

MAR-559

I. SEMI-METALLICS

It was decided that in preparation for our meeting on January 20 with Sears, we would attempt to determine field data relative to competitive pricing of Semi-Metallics. This was the responsibility of M.T.M. and will be reported to the Sears people on January 20.

II. REBUILTS

We were advised by W.N.B. that the analysis on rebuilts presented at the December production meeting (copy attached) was not sufficient for a total analysis from Sears viewpoint on the above. D.R.L. was given the project of a deeper study on a rebuilt OTC program including equipment ramification, freight, cost impacts of same, etc. We would like this information available for the February meeting. Loftis to advise date when information can be available.

III. COMPLAINTS

All sequentially numbered field complaints are to be sent to D.R.L. with copies sent to M.T.M. and T.P.C.

IV. ENGINEERING

When W.N.B. deems appropriate, defective material for engineering inspection is to be sent to M.T.M. at the Plus Park office for forwarding to Koss' department. The rationale for handling in this manner is to minimize confusion at the product receiving area in Smithville.

Minutes Pre-Production Meeting
Smithville, Tennessee
January 15, 1982

Page Two

V. AIO KIT CONSOLIDATION

An analysis on the above is to be broken down as follows:

- 1) How many kits can we drop from the Sears AIO line maintaining essentially the same vehicle coverage?
- 2) How many kits would we recommend dropping, coverage sacrificed, and annualized sales figures for recommended drops.
 - (a) Time schedules and checkpoints to be published by D.R.L. on January 22nd.
 - (b) Tentative worst case for complete project completion is July 1, 1982.

VI. EQUIPMENT

W.N.B. is assuming responsibility of responding to F.F. Andelbrat relative to new equipment recommendations because of down-sized vehicles.

VII. BRAKE SELLING STATION

W.N.B. to assume responsibility of developing same.

VIII. WARRANTY

It was decided Ed Koss should develop response to Sears through M.T.M. and W.N.B. on Point #5 on the attached letter. Included in Point #5 would be Ed's evaluation on future market trends in axle set replacement and specifically the impact on Sears. It is hoped necessary information in this category to be available by February production meeting.

IX. BRAKE SERVICE LOGO

W.N.B. and M.T.M. to discuss with F. F. Andelbrat and perhaps obtain agency assistance if deemed appropriate.

X. SEMI-METALLIC FORMULATION

Maremont/Sears expecting final formulation to be determined and signed off by E. R. Koss prior to February 1, 1982.

Minutes Pre-Production Meeting
Smithville, Tennessee
January 15, 1982

Page Three

XI. CALIBER PISTONS

M.T.M. to begin analysis of Caliber Piston line definition,
steel vs. phenolics. Project to begin immediately with completion
deadline - February production meeting.

M. T. McDonough

MTM/skb

To develop a cost comparison of new versus rebuilt brake sets, the following summary of incremental cost for shoes only was developed. Shoes only is considered due to assumption that all other cost is the same in new and rebuilt.

	<u>Purchase New</u>	<u>Purchase Used</u>	<u>Core Exchange Program</u>
LIST PRICE	\$5.09	\$5.09	\$1.20
DISCOUNT	1.45 (28.5%)	2.04 (40%)	-
NET	<u>\$3.64</u>	<u>\$3.05</u>	<u>\$1.20</u>
HANDLING & FREIGHT IN	-	-	.80
REFURBISH	-	.24	.32
SCRAP	-	.32 (10%)	.70 (30%)
TOTAL	<u>\$3.64</u>	<u>\$3.61</u>	<u>\$3.02</u>
NEW SHOES REQUIRED TO FILL IN FOR NON AVAILABLE CORES:			
New 30%		1.09	1.09
Used 70%		2.53	2.11
ACTUAL NET COST	<u>\$3.64</u>	<u>\$3.62</u>	<u>\$3.20</u>

List Price - Current Aimco average list price used for purchase new and used. Core list obtained from inquiries to rebuilders.

Discount - Nuturn's discount from Aimco is 28.5%. Vendors of used cores quoted 40% off current Aimco list. This seems to be a common pricing policy within the industry.

Handling and Freight In - No additional cost for purchased new and used. Core cost arrived by using actual freight rates and admitted cost from rebuilders.

Refurbish - No additional cost on purchased new but used can only be purchased sorted with lining still attached. They must be burned or stripped, wheelabrated, and straightened. A core program would include sorting and storing in addition to burn or strip, wheelabrate, and straighten.

Scrap - Only 10% factor used for purchased used due to the fact that they are purchased to demand, and have been sorted. In the core program a 30% factor was used due to many cores received would not be numbers used in line and many are damaged or worn, to the point they are not usable. The 30% was Nuturn's estimation and was also confirmed as being accurate by rebuilders.

New Shoes Required to fill in for nonavailable cores - Used cores are not available for new numbers, in quantity, for several years. New shoes must be used to fill in the gap. In addition, cores are not always available for current demand, therefore, requiring new shoes to be used.

NUTURN CORPORATION
SEMI-METALLIC DISC PAD
REPORT

2-18-82/F. C. SKELTON

MAR 004279

SEMI-METALLIC DISC PAD REPORT

A. 3401N (NF-10-FE) "FINE TUNING" MODIFICATIONS

1. 3401N1
2. 3401N2
3. 3401N3
4. 3401N4
5. 3401N5
6. 3401N6
7. 3401N7
8. 3401N8 - BEST/FINAL SOLUTION

B. FRICTION MATERIALS TEST MACHINE EVALUATION

	<u>3401N</u>	<u>3401N8</u>	<u>% CHANGE</u>
NORMAL FRICTION	.366(F)	.351(F)	- 4
HOT FRICTION	.349(E)	.332(E)	- 4.9
WEAR (INCHES)	.0089	.0058	-34.8

TEST GRAPHS ARE SHOWN ON PAGES 8 AND 9.

C. INERTIA DYNAMOMETER EVALUATION

1. WE HAVE PREVIOUSLY ANNOUNCED THAT THERE WOULD BE A SHIFT OF TESTING EMPHASIS FROM VEHICLE ROAD TESTING TO DYNAMOMETER TESTING.
2. THIS SHIFT IN TESTING EMPHASIS ENHANCES OUR TESTING IN SEVERAL AREAS.
 - A. INCREASED CONTROL OVER THE TEST CONDITIONS WHICH YIELDS MORE ACCURATE RESULTS.

SEMI-METALLIC DISC PAD REPORT
PAGE TWO

B. TEST TIME AND COST REDUCTION - WE ESTIMATE THAT 70% OF ALL FRICTION MATERIAL TESTING WILL BE BY DYNAMOMETER AND 30% BY VEHICLE TESTING.

C. TEST TIME COMPARISONS -

	<u>TEST/HOURS</u>
SAE - J843B Road Test	28
SAE - J212 DYNAMOMETER TEST	15

NOTE: APPROXIMATELY 30% OF THE ROAD TEST EXECUTION REQUIRES BOTH A TEST DRIVER AND AN OBSERVER. ADDITIONALLY, ROAD TESTING CAN ONLY BE ACCOMPLISHED DURING DAYLIGHT HOURS AND OUR TEST "SITE" IS APPROXIMATELY 20 MILES FROM OUR SMITHVILLE FACILITY. THE INERTIA DYNAMOMETER IS PROGRAMMED TO RUN ON A 24 HOUR BASIS WITH ONLY MINIMUM TECHNICAL OBSERVATION/ SUPERVISION.

D. INERTIA DYNAMOMETER DURABILITY TEST SCHEDULE

1. OUR DYNAMOMETER DURABILITY TEST SCHEDULES ARE ADAPTATIONS OF A FORD MOTOR COMPANY ACCELERATED, HIGH TEMPERATURE, HIGHLY ABUSIVE BRAKE TEST PROCEDURE P3-37M, A COPY OF WHICH IS ATTACHED TO THIS REPORT.
2. TO ILLUSTRATE THE SEVERE NATURE OF THIS DURABILITY TEST, THE EXPECTED DISC PAD LIFE AS DEFINED IN THE FORD SPECIFICATION GEN 6.02 (COPY ATTACHED) IS:

- SEMI-METALLIC MATERIALS 11,000 MILES
- ASBESTOS MATERIALS 13,000 MILES

SEMI-METALLIC DISC PAD REPORT

PAGE THREE

3. MODIFICATION OF FORD HIGH TEMPERATURE DURABILITY SCHEDULE TO NORMAL (CONSUMER USE) TEMPERATURE DURABILITY —

WITH INPUT FROM FORD WE UTILIZED THEIR P3-37M DURABILITY SCHEDULE THROUGH THE 21.6 MILE POINT PLUS 1.4 MILES (ESTIMATED DISTANCE) ON HIGH SPEED TRACK UNTIL FIRST BRAKE APPLICATION, AS A NORMAL (CUSTOMER USE) DURABILITY SCHEDULE.

THIS MODIFICATION RESULTS IN A DYNAMOMETER TEST SCHEDULE EQUIVALENT TO A TWENTY-THREE MILE TEST LOOP CONSISTING OF THIRTY-FOUR BRAKE APPLICATIONS (STOPS) PER TEST LOOP. THIS BASIC CYCLE WAS REPEATED ONE HUNDRED AND THIRTY-ONE TIMES WHICH RESULTS IN A TEST OF 3,013 MILES CONSISTING OF 4,454 STOPS.

RESULTS OF THIS DYNAMOMETER TESTING ON FOUR MATERIALS: MG-28 (THE ASBESTOS PAD FORMERLY SUPPLIED TO SEARS); 3401N (NF-10-FE, THE INITIALLY RELEASED HUTURN SEMI-METALLIC PAD); BENDIX-XO-EE (THE TEMPORARY SEMI-METALLIC MATERIAL BEING FURNISHED TO SEARS), AND; 3401N8 (FINAL "TUNED" MODIFICATION TO BE FURNISHED TO SEARS), ARE SHOWN IN TABULATED FORM ON PAGE 10.

IT SHOULD BE NOTED THAT THE BENDIX DISC PAD (BENDIX-XO-EE) IS THE PREDOMINANT OEM ACCEPTED AND APPROVED SEMI-METALLIC MATERIAL USED BY THE MAJORITY OF VEHICLE MANUFACTURERS.

THE EXPECTED CONSUMER LIFE IS PROJECTED FROM THE WORST CASE CONDITIONS, USING THE MINIMUM AVAILABLE PAD WEAR (FROM THE TOLERANCE STACK - SEE PAGE 11) AND THE MAXIMUM MEASURED WEAR POINT (NOT AVERAGE).

SEMI-METALLIC DISC PAD REPORT

PAGE FOUR

OF SIGNIFICANT INTEREST IN THE TABULATED DATA IS THAT THE PROJECTED CONSUMER LIFE FOR 3401N8 IS 49% BETTER THAN THAT OF 3401N AND COMPARES WITH THE RIGHT ORDER OF THE FMTM TESTING, WHERE A LIFE INCREASE OF 34.8% WAS NOTED.

AS AN EXERCISE ONLY, THREE OF THE MATERIALS: 3401N, BENDIX-XO-EE AND 3401N8 WERE TESTED ON AN ABBREVIATED VERSION OF THE FORD HIGH TEMPERATURE DURABILITY SCHEDULE. TEST RESULTS ARE TABULATED ON PAGE 12. THE DECREASE IN WEAR FOR 3401N8 OVER 3401N WAS 43.3%, WHICH CORRESPONDS VERY WELL WITH THE NORMAL DURABILITY TEST RESULTS.

4. EFFECTIVENESS TESTING -

THE TEST GRAPHS SHOWN ON PAGES 13, 14 AND 15 ARE 30, 60 AND 80 MPH EFFECTIVENESS PLOTS. EFFECTIVENESS TESTS ARE ESSENTIALLY INPUT VS. OUTPUT RESULTS. IN BRAKE TESTING THE INPUT IS EITHER HYDRAULIC LINE PRESSURE OR PEDAL EFFORT. THE OUTPUT CAN BE DECELERATION, TIME OR STOP DISTANCE. FOR THIS REPORT THE INPUT IS HYDRAULIC LINE PRESSURE IN LBS/IN² AND THE OUTPUT IS STOPPING DISTANCE.

THE 30 MPH EFFECTIVENESS PLOT, PAGE 13, SHOWS VERY LITTLE DIFFERENCE BETWEEN THE FOUR MATERIALS BUT ILLUSTRATE THAT SEMI-METALLIC MATERIALS DISPLAY BETTER EFFECTIVENESS THAN THE MG-28 ASBESTOS MATERIAL.

THE 60 MPH EFFECTIVENESS GRAPH, PAGE 14, ALSO SHOWS THE SUPERIOR EFFECTIVENESS OF SEMI-METALLICS OVER ASBESTOS BASED MATERIALS. THIS GRAPH ALSO SHOWS THAT THE 3401N8 IS SLIGHTLY LESS EFFECTIVE THAN THE 3401N, WHICH WAS EXPECTED SINCE THE 3401N8 WAS FORMULATED TO SUBSTANTIALLY INCREASE WEAR DURABILITY AT A SLIGHT SACRIFICE IN EFFECTIVENESS. AT LINE PRESSURES AT AND ABOVE 500 PSI THE EFFECTIVENESS OF ALL THREE SEMI-METALLICS

SEMI-METALLIC DISC PAD REPORT

PAGE FIVE

TEND TO CONVERGE, AND ON A PERCENTAGE DIFFERENCE BASIS NONE OF THESE MATERIALS SHOW ANY REAL SUPERIORITY OVER THE OTHER TWO.

THE 80 MPH EFFECTIVENESS GRAPHS ARE SHOWN ON PAGE 15. EIGHTY MPH EFFECTIVENESS TESTING HAS LOST A LOT OF ITS SIGNIFICANCE SINCE THE INTRODUCTION OF THE FEDERAL MANDATED 55 MPH SPEED LIMIT. SIXTY MPH IS 9% OVER THE LEGAL SPEED LIMIT BUT 80 MPH IS 45% OVER 55 MPH. THE 80 MPH EFFECTIVENESS GRAPHS ALSO SHOW THE TENDENCY FOR THE SEMI-METALLIC MATERIALS TO CONVERGE AT HIGHER LINE PRESSURES AND ALSO INDICATE A LACK OF CONSISTENCY WITH ASBESTOS BASED MATERIALS AT THESE SPEEDS.

E. ROAD TESTING

1. THE FINAL TESTING IN THE 3401N8 FINE-TUNING WAS OF COURSE BY MEANS OF ROAD TESTING.
2. ROAD TEST GRAPHS T-832, PAGE 16, FOR THE 3401N MATERIAL; TEST GRAPH T-878 FOR THE BENDIX-X0-EE MATERIAL, PAGE 17; AND TEST GRAPH T-954, PAGE 18, FOR THE 3401N8 MATERIAL AS TESTED IN ACCORDANCE WITH THE SAE-J843B TEST PROCEDURE ARE SHOWN FOR COMPARISON. THIS GROUP OF GRAPHS ILLUSTRATE THAT THE FINE TUNING OF THE 3401N8 WAS ACCOMPLISHED WITH NO SUBSTANTIAL SACRIFICE IN THE FADE AND RECOVERY TEST PHASES. THESE TESTS WERE CONDUCTED ON OUR 1978 CHEVROLET STATION WAGON.
3. AS A COMPANION COMPARISON OF ROAD TEST RESULTS, TEST GRAPH T-913, PAGE 19, FOR THE DELCO OEM SEMI-METALLIC DISC PAD; TEST GRAPH T-893, PAGE 20, FOR THE 3401N MATERIAL, AND; TEST GRAPH T-955, PAGE 21, FOR THE 3401N8 MATERIAL AS TESTED ON OUR 1930 CHEVROLET CITATION VEHICLE ARE SHOWN. TEST RESULTS ARE CONSISTENT

SEMI-METALLIC DISC PAD REPORT

PAGE SIX

WITH THE DATA FROM THE CHEVROLET STATION WAGON AND SHOW THAT THE 3401N8 "TUNED" MATERIAL RESULTS IN NO SACRIFICE IN FADE OR RECOVERY CHARACTERISTICS.

F. CONCLUSIONS

1. THE ORIGINALLY RELEASED NUTURN SEMI-METALLIC DISC PAD MATERIAL 3401N, WAS RECALLED DUE TO ANTICIPATED HIGHER THAN DESIRABLE PAD AND ROTOR WEAR AND THE POSSIBILITY OF THE OCCURRENCE OF LONG TERM USAGE "JUDDER" ON CERTAIN APPLICATIONS.
2. THE 3401N (NF-10-FE) MATERIAL WAS "FINE TUNED" BY AN ADJUSTMENT (IN SEVERAL STEPS) IN THE AMOUNTS OF A HIGHLY AGGRESSIVE FRICTION MODIFIER AND A FRICTION MODIFIER FOR ADDED LUBRICITY.
3. THIS "FINE TUNING" HAS RESULTED IN A MATERIAL OF SUBSTANTIALLY INCREASED WEAR LIFE FOR THE DISC PAD AND REDUCED ROTOR WEAR. THE ADJUSTMENT IN THE FRICTION MODIFIERS WILL ALSO REDUCE THE POSSIBILITY OF THE LONG TERM USAGE "JUDDER" CONDITION.
4. THIS FINE TUNING WAS VERIFIED BY INERTIA DYNAMOMETER TESTING WHERE THE TEST VARIABLES CAN BE ACCURATELY CONTROLLED FOR MORE RELIABLE AND CONSISTENT RESULTS.
5. THE FINE TUNING HAS SLIGHTLY REDUCED THE FRICTION LEVEL, BUT AT NO SUBSTANTIAL SACRIFICE IN EFFECTIVENESS AS COMPARED TO THE PRIOR MATERIAL, THE MAJOR OEM SEMI-METALLIC DISC PAD MATERIAL, AND DISPLAYS BETTER FUNCTIONAL OPERATING CONDITIONS OVER ASBESTOS BASED MATERIALS.

SEMI-METALLIC DISC PAD REPORT

PAGE SEVEN

6. THE 3401N8 MATERIAL WAS LAST TESTED ON ACTUAL VEHICLES AND DISPLAYED NO SIGNIFICANT LOSS IN FADE OR RECOVERY CHARACTERISTICS. VEHICLE TESTING (SUBJECTIVE) ADDITIONALLY INDICATES THE 3401N8 MATERIAL TO BE LESS PRONE TO NOISE GENERATION.

ATTACHMENTS

DISTRIBUTION

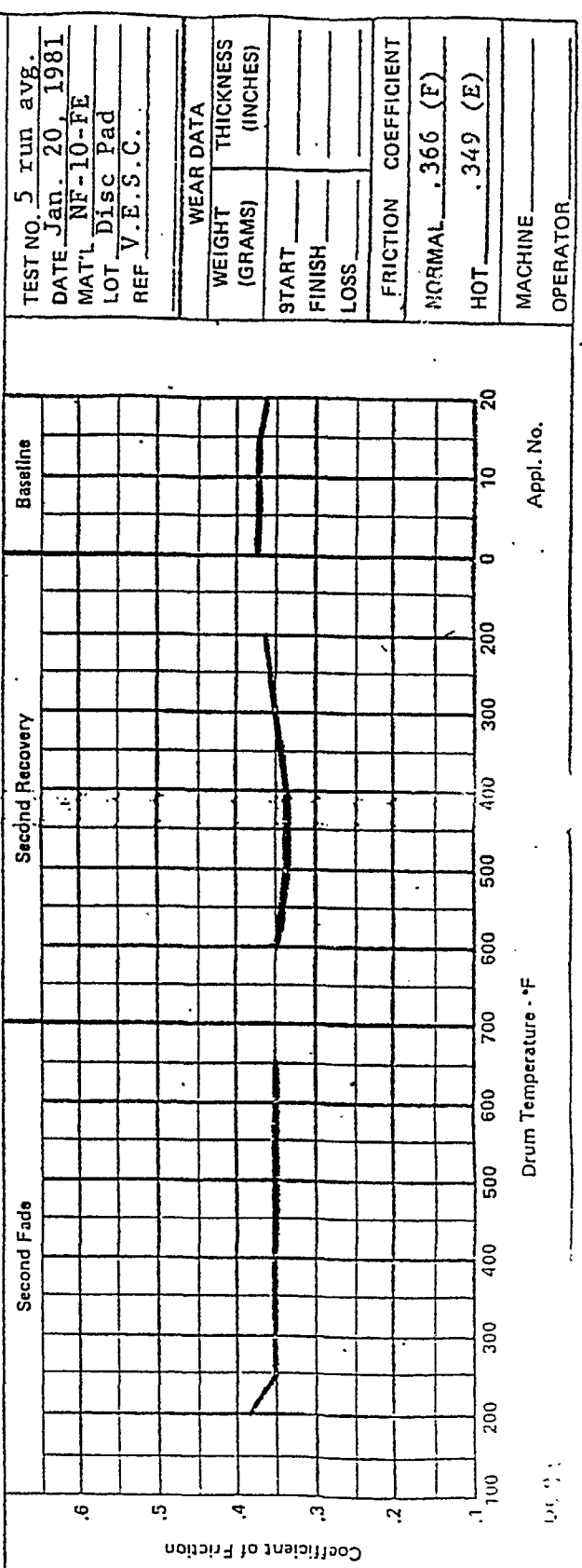
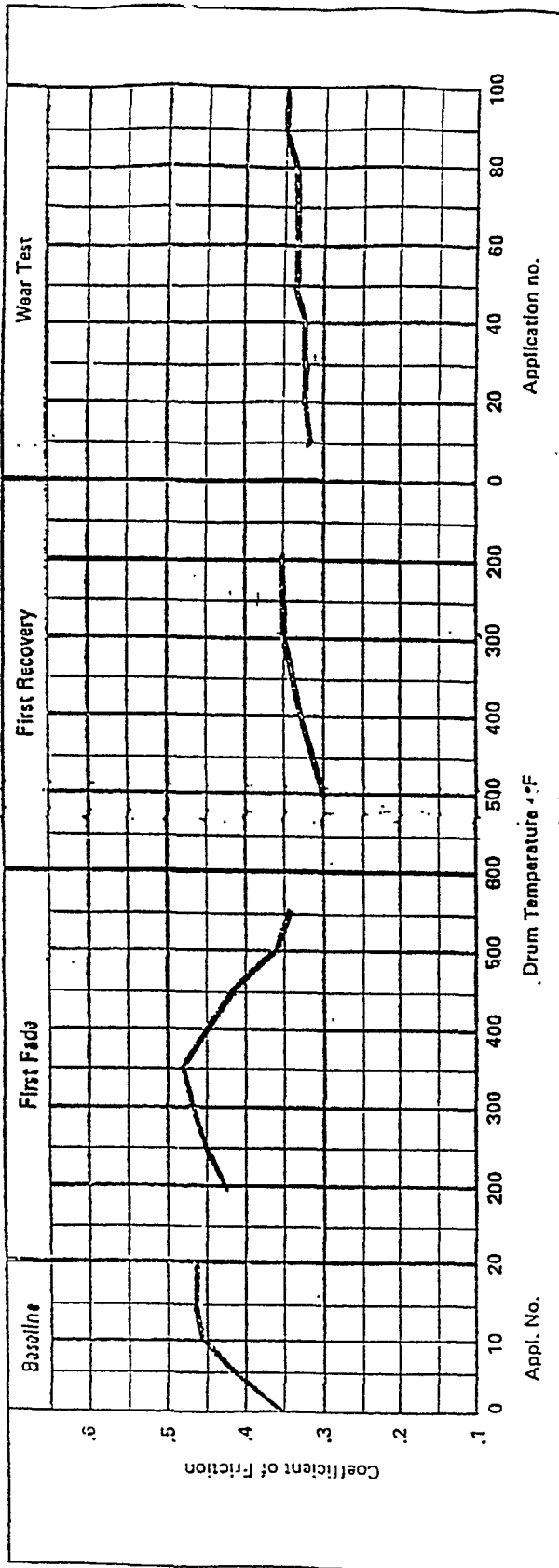
R. L. ARMER
F. F. ANDLEBRAT
W. N. BOCKAY
C. W. BURKHEAD
T. P. CONROY
E. R. KOSS
M. T. MCDONOUGH
R. H. NELSON
E. M. STEFFAN
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GRIZZLY

FRICTION PRODUCTS

S.A.E. J661A BRAKE LINING DATA SHEET

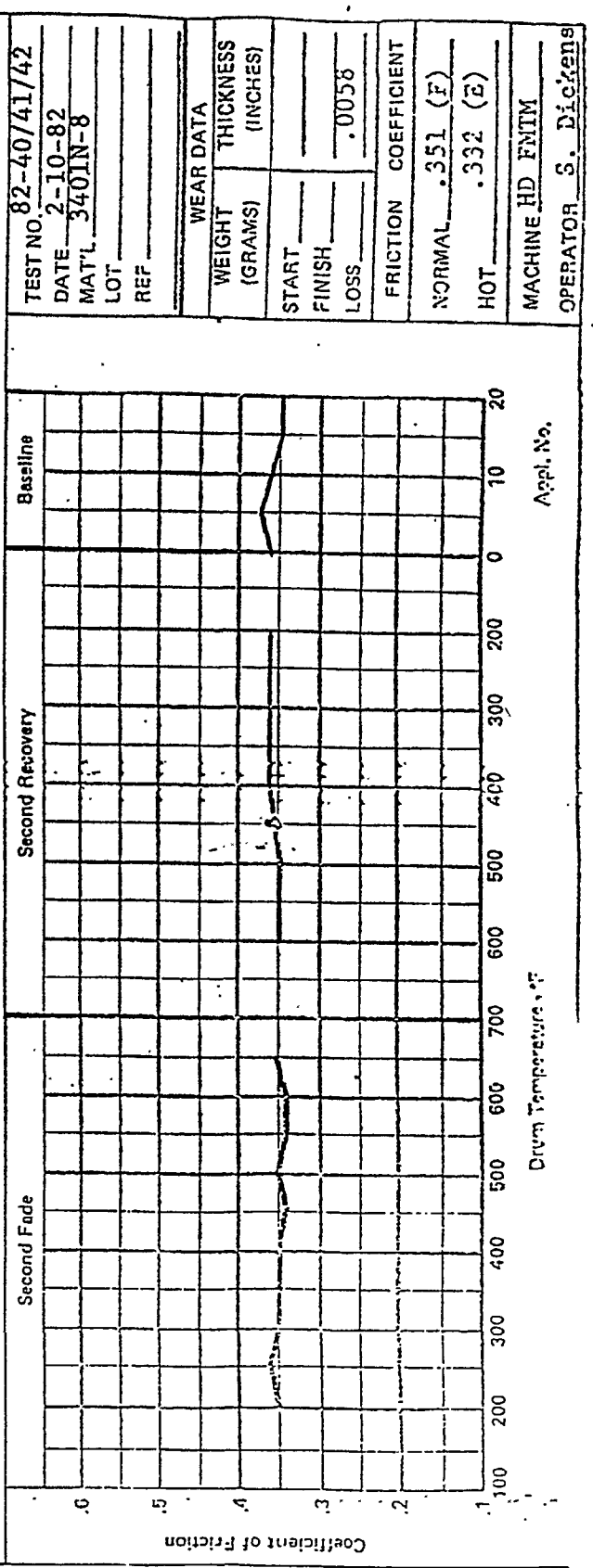
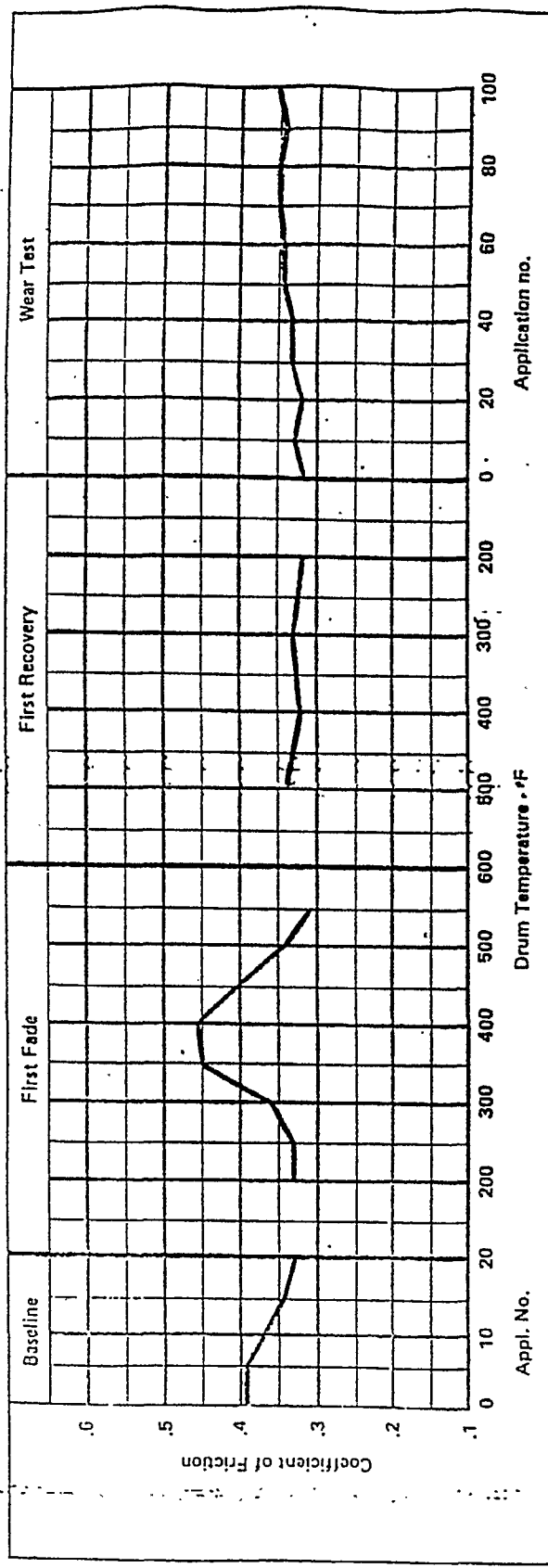
PAGE EIGHT



GAZZI

FRICTION PRODUCTS

S.A.E. J661A BRAKE LINING DATA SHEET



TEST NO. 82-40/41/42
 DATE 2-10-82
 MAT'L 3401N-8
 LOT _____
 REF _____

WEAR DATA	
WEIGHT (GRAMS)	THICKNESS (INCHES)
START _____	START _____
FINISH _____	FINISH _____
LOSS _____	LOSS <u>.0058</u>

FRICTION COEFFICIENT
 NORMAL .351 (F)
 HOT .332 (E)

MACHINE HD FNTM
 OPERATOR S. Dickens

NORMAL TEMPERATURE DURABILITY :(CONSUMER USAGE)

MATERIAL	MG-28	3401N	BENDIX XO-EE	3401N8
NUMBER OF STOPS	2788	4454	4454	4454
MAXIMUM WEAR POINT (INCHES)	.015	.059	.028	.030
MAXIMUM ROTOR WEAR (INCHES)	---	.0072	.0019	.001
NUMBER OF MILES	1886	3013	3013	3013
PROJECTED CONSUMER WEAR LIFE (MILES)	38349	15576	32820	30632

$$\text{PROJECTED LIFE} = \frac{\text{MINIMUM AVAILABLE WEAR} \times \text{TEST MILES}}{\text{MAXIMUM POINT WEAR}}$$

728A DISC PADAVAILABLE WEAR

PAD THICKNESS	.405/.415
COUNTERBORE THICKNESS	.050/.060
EYELET HEAD	.034/.040

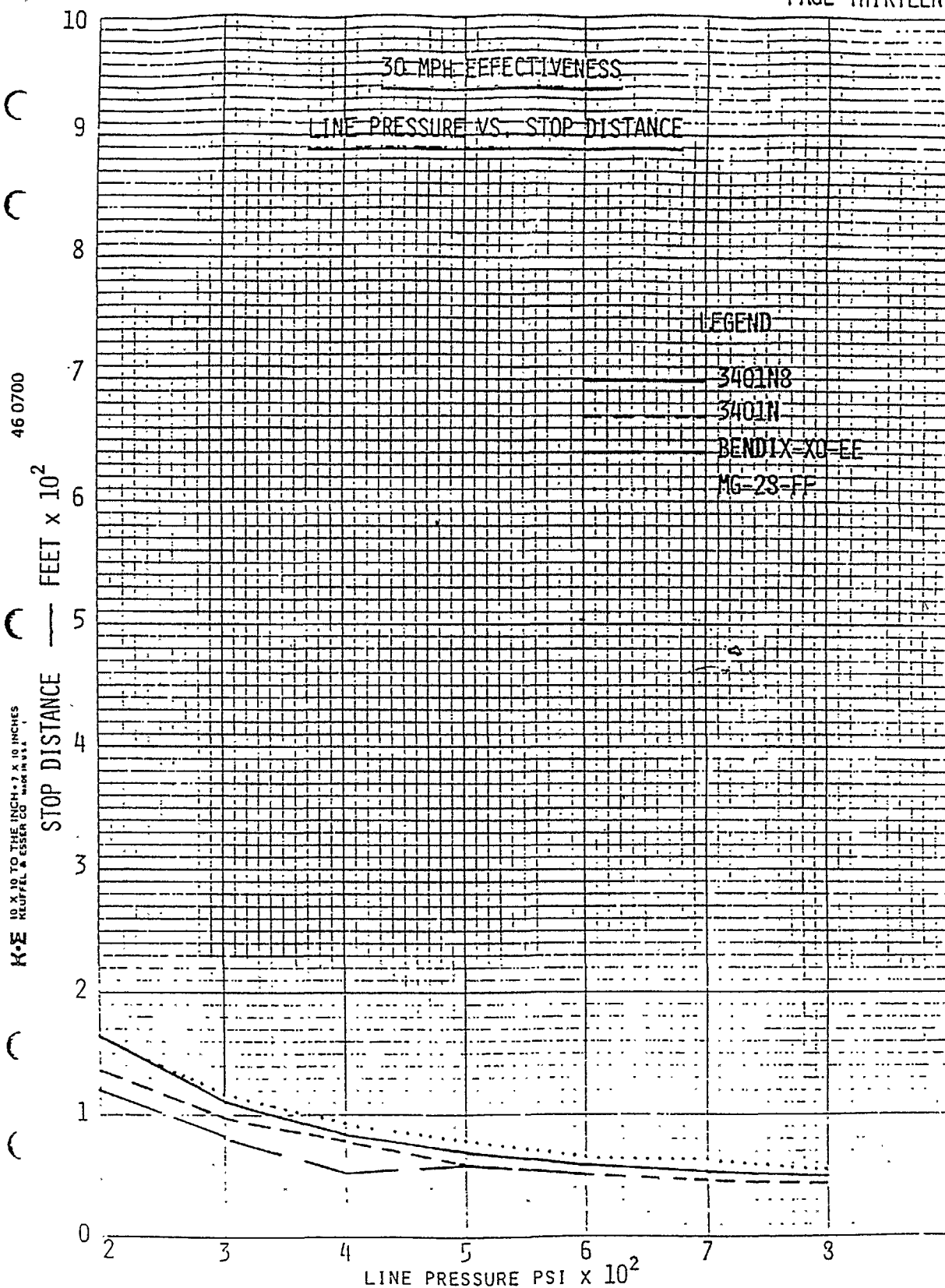
<u>MAXIMUM</u>	<u>NOMINAL</u>	<u>MINIMUM</u>
.415	.410	.405
-.050	-.055	-.060
<u>.365</u>	<u>.355</u>	<u>.345</u>
-.034	-.037	-.040
<u>.331</u>	<u>.318</u>	<u>.305</u>

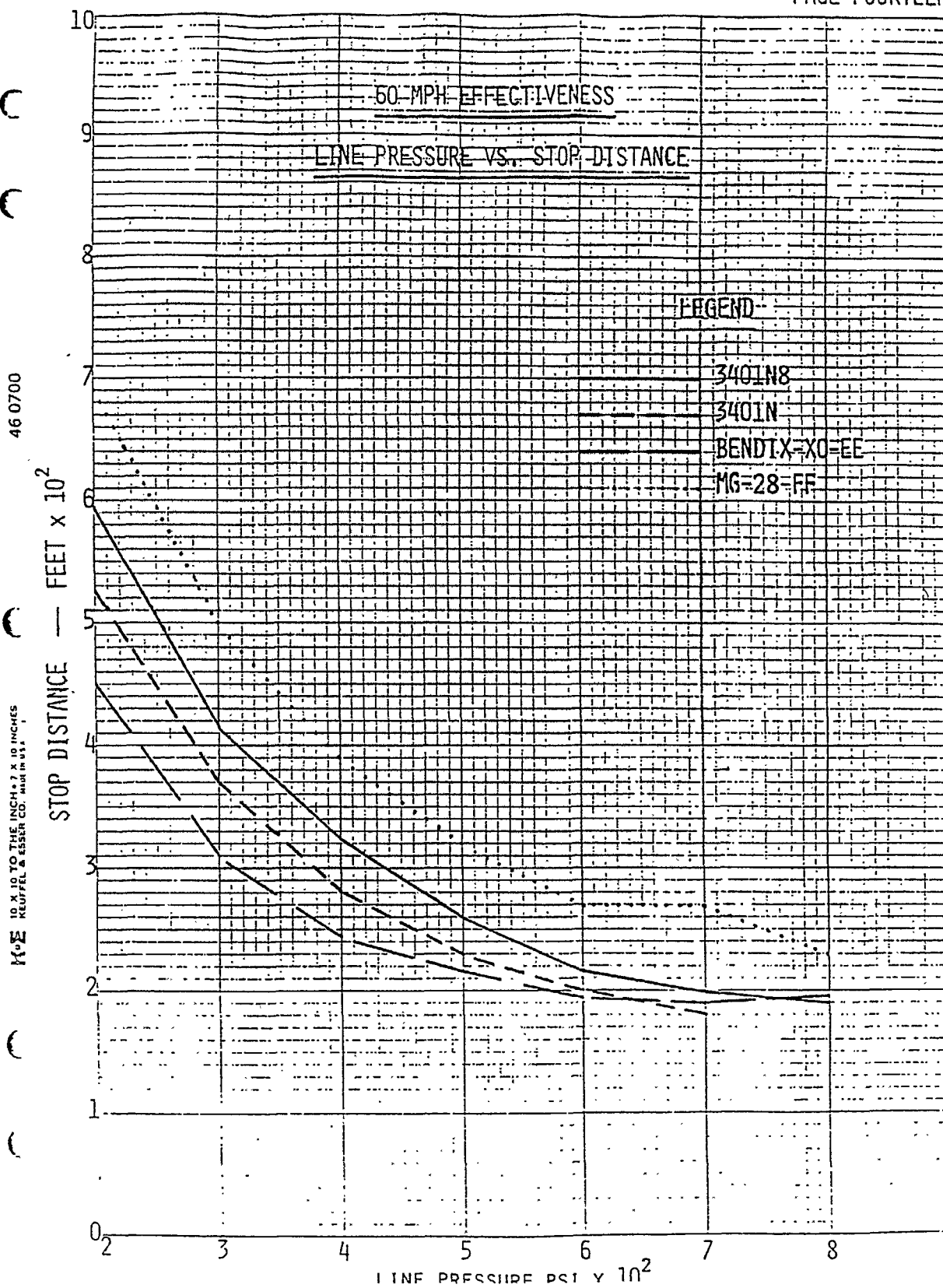
HIGH TEMPERATURE DURABILITY*

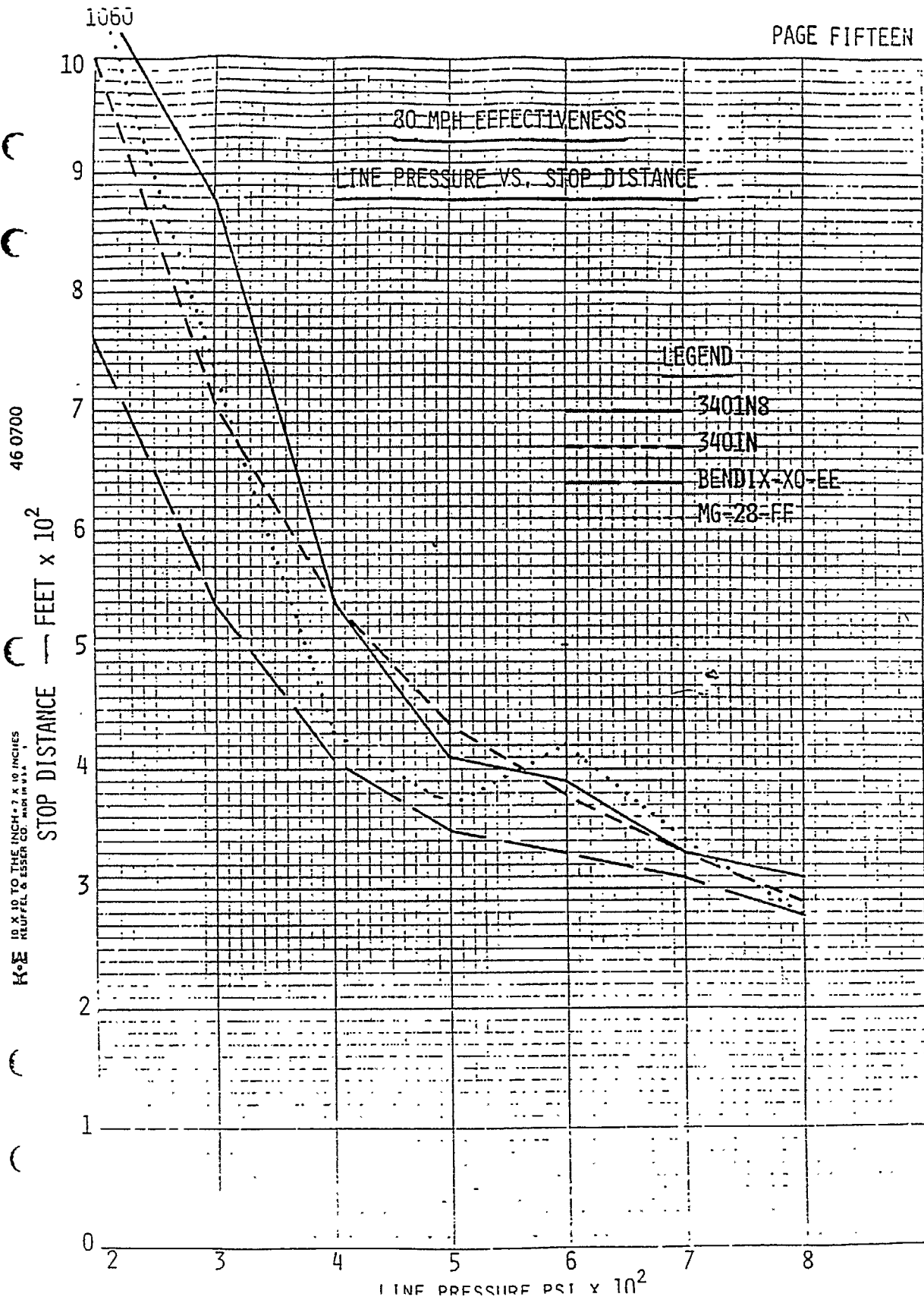
MATERIAL	3401N	BENDIX- XO-EE	3401N8
NUMBER OF STOPS	3526	3526	3526
MAXIMUM WEAR POINT (INCHES)	.1295	.0969	.0873
MAXIMUM ROTOR WEAR (INCHES)	.0080	.0034	.0009
NUMBER OF MILES	3034	3034	3034
PROJECTED CONSUMER WEAR LIFE (MILES)	7145	9550	10556

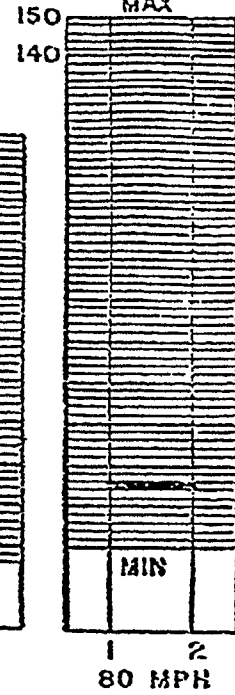
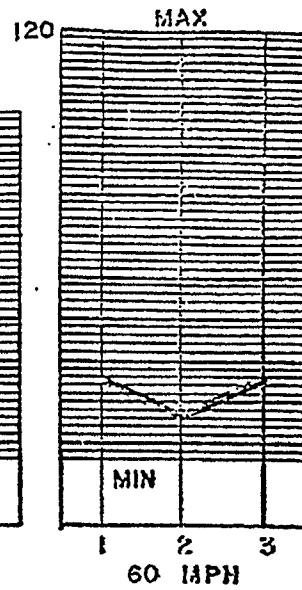
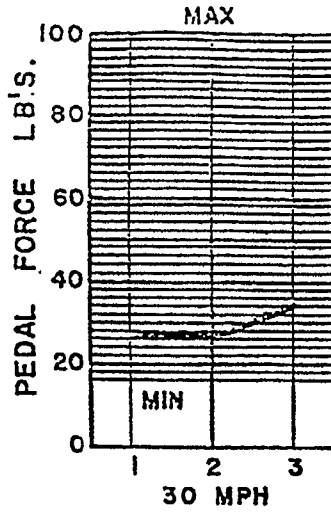
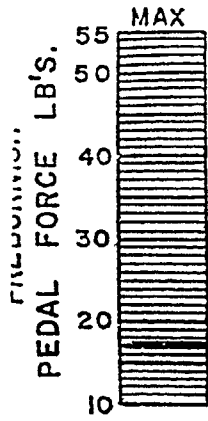
$$\text{PROJECTED LIFE} = \frac{\text{MINIMUM AVAILABLE WEAR} \times \text{TEST MILES}}{\text{MAXIMUM POINT WEAR}}$$

*ACCELERATED (AND ABBREVIATED) HIGH TEMPERATURE -
HIGHLY ABUSIVE TEST NOT TYPICAL OF CONSUMER USAGE.

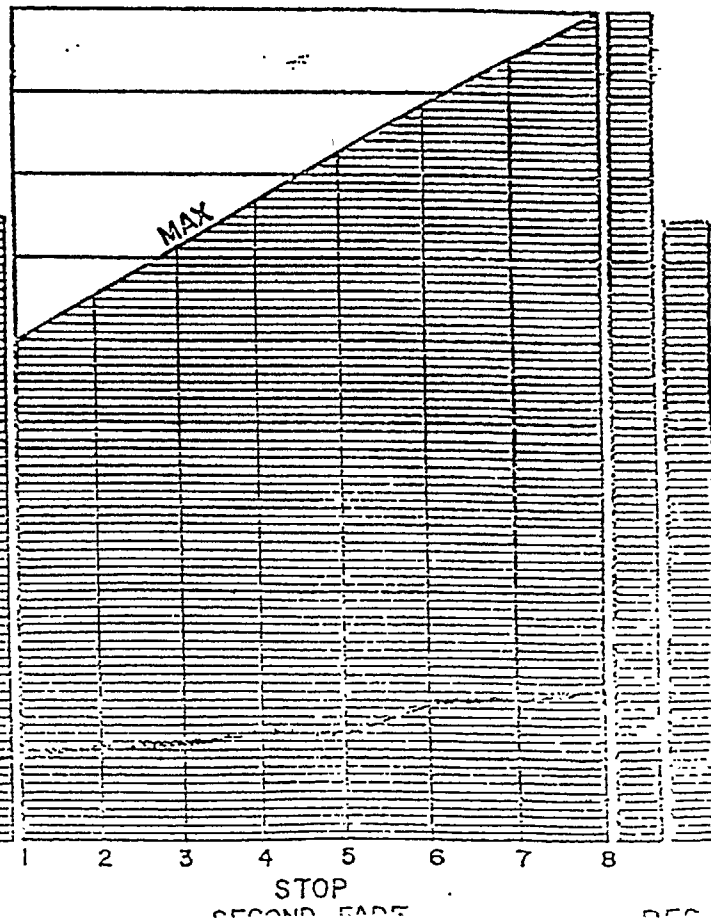
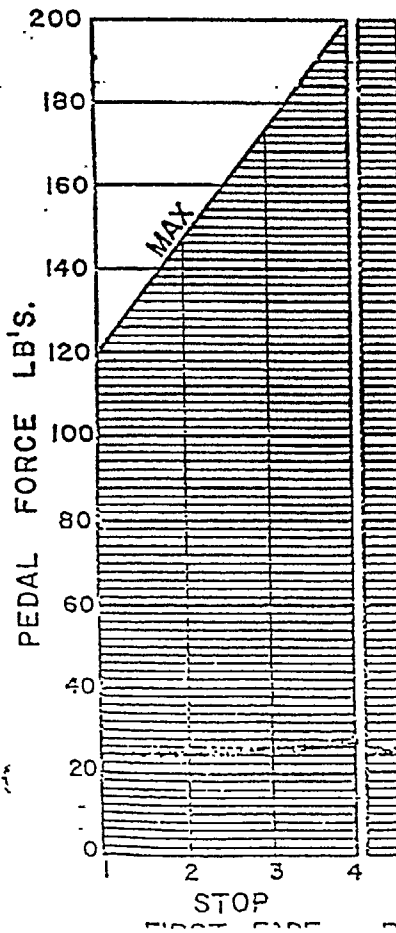


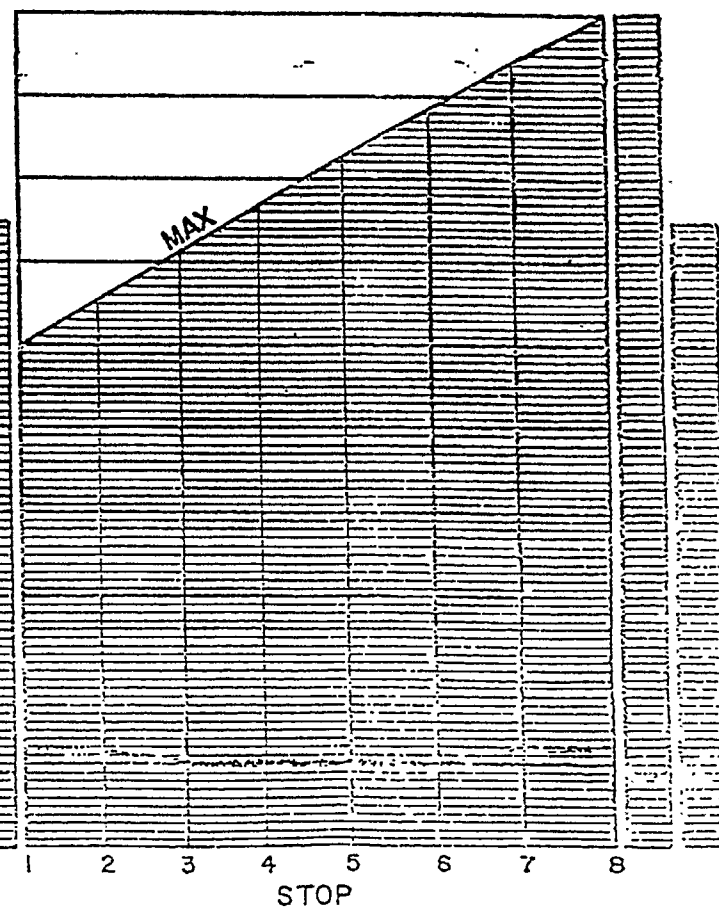
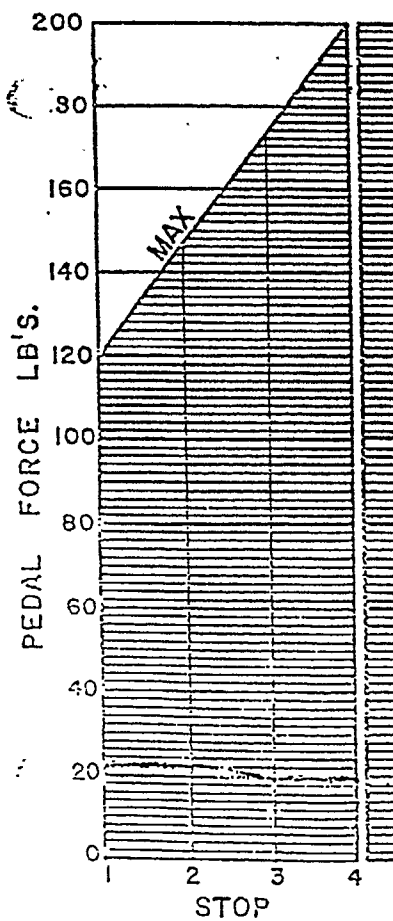
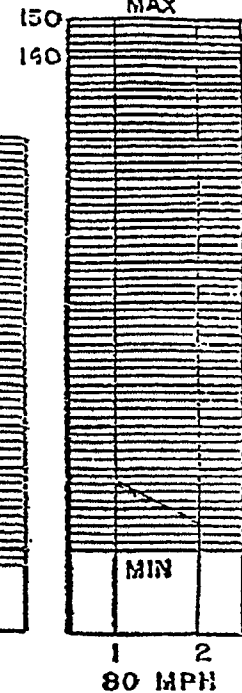
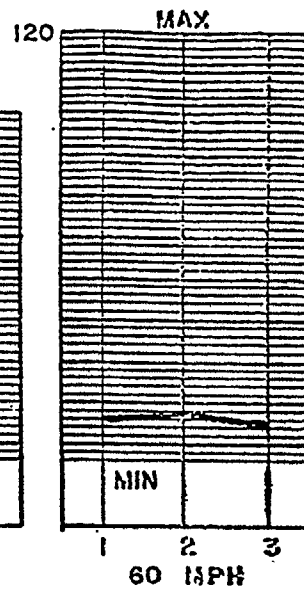
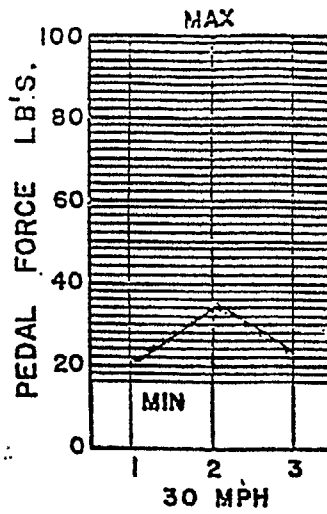
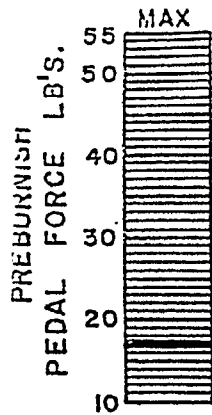


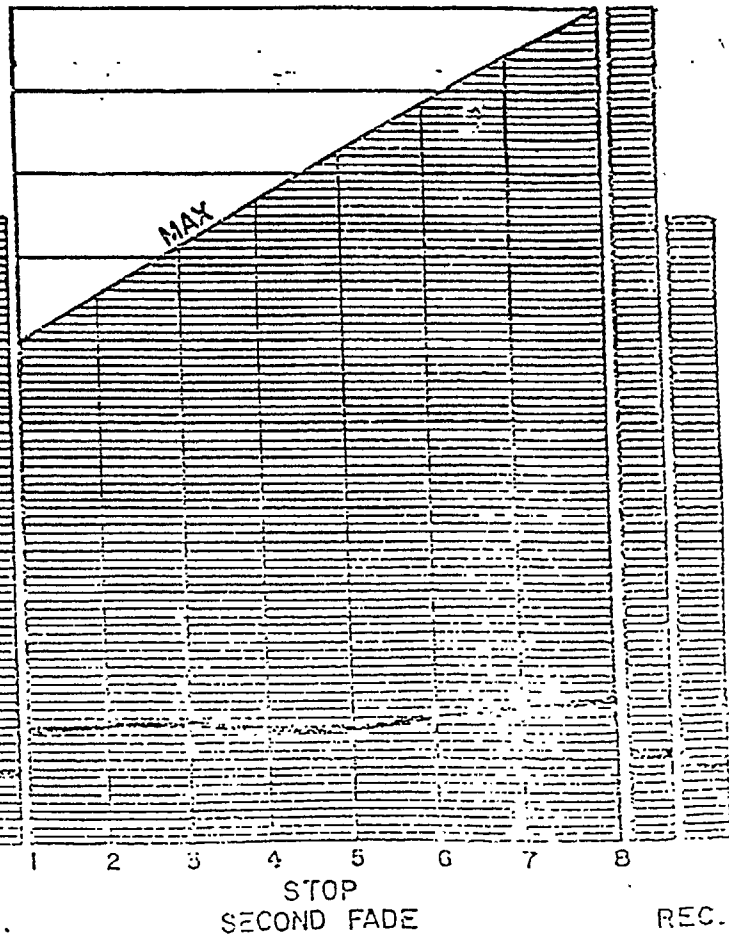
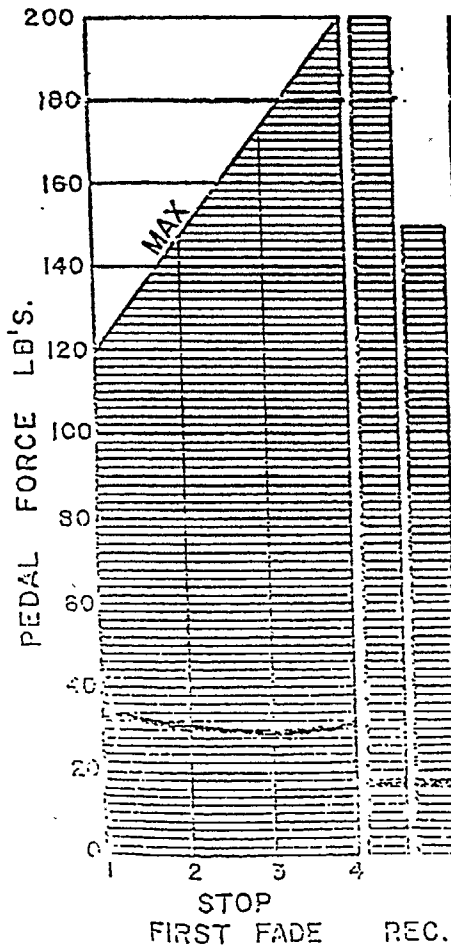
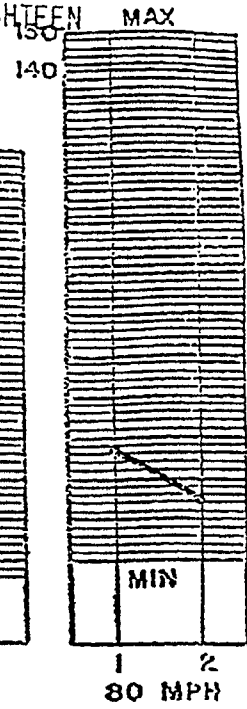
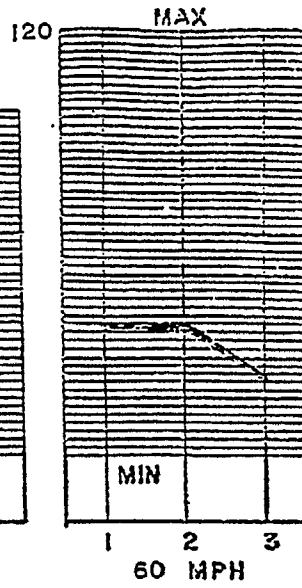
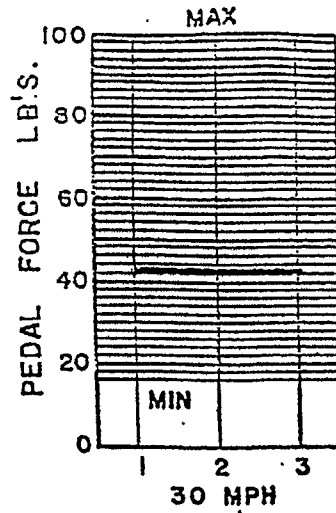
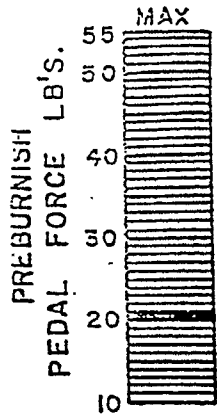




EFFECTIVENESS



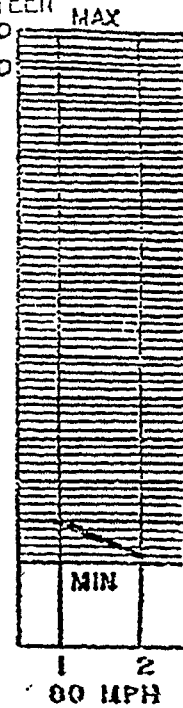
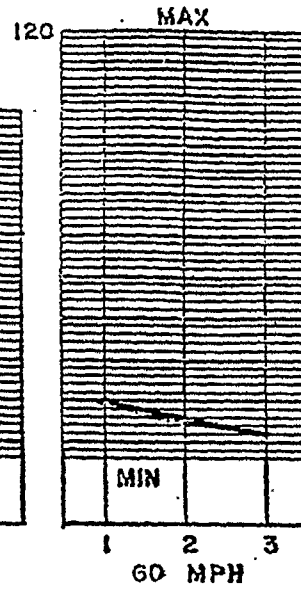
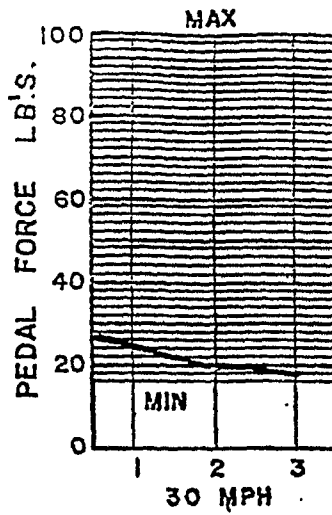
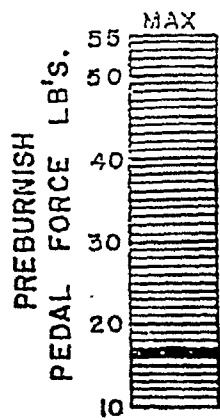




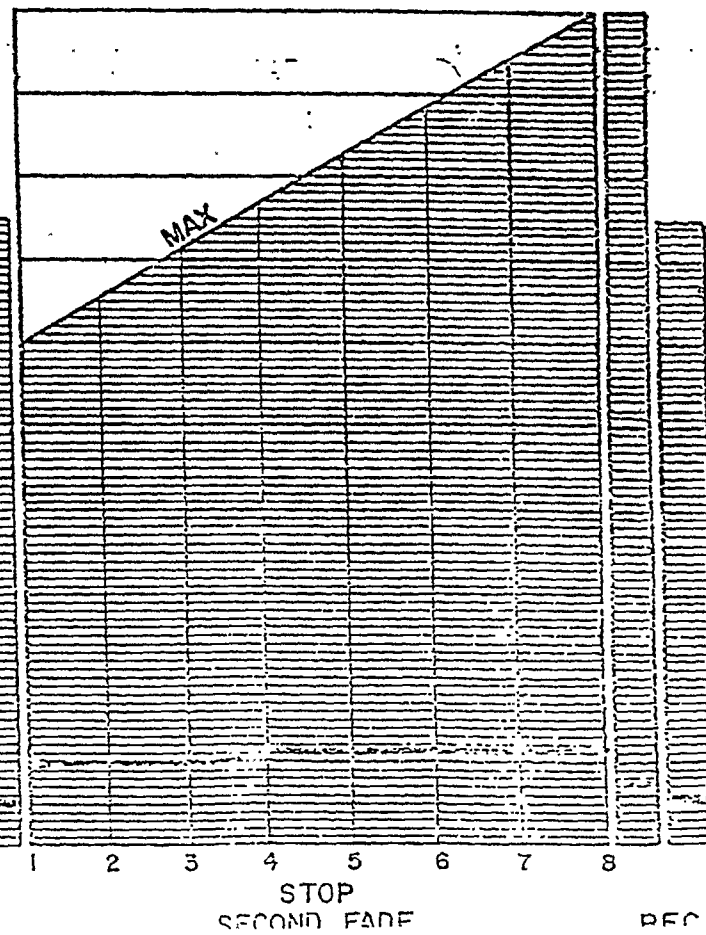
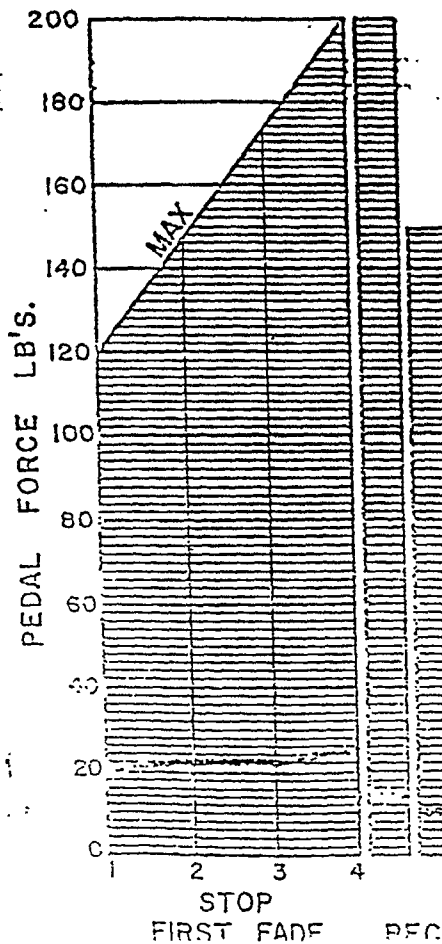
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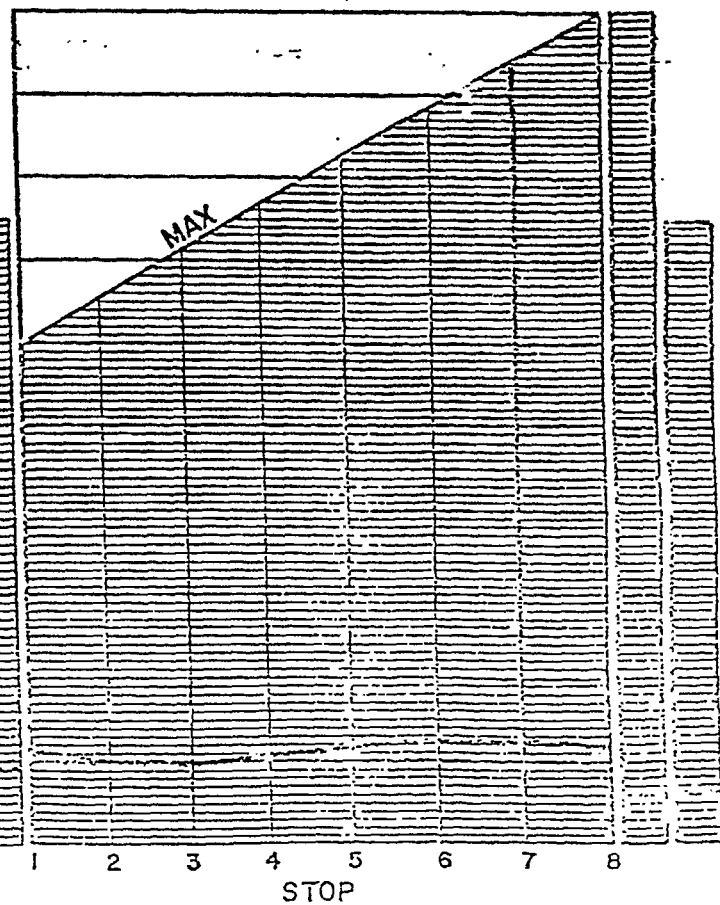
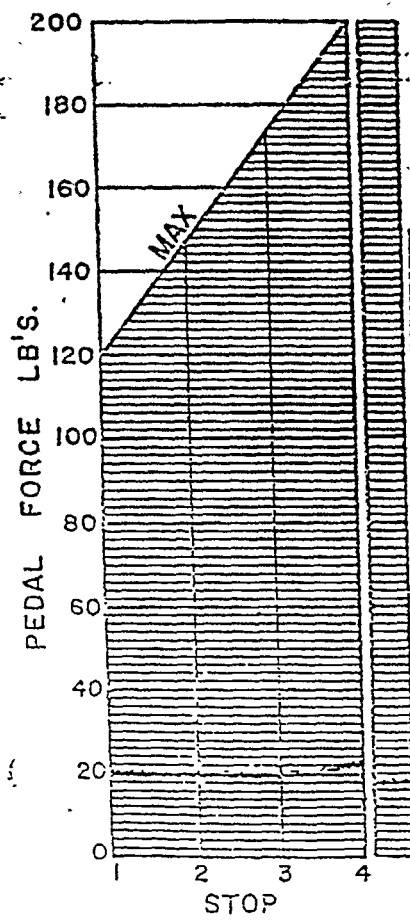
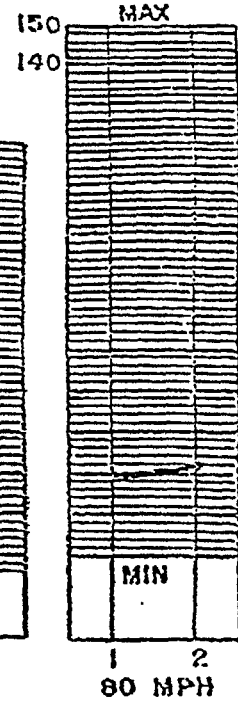
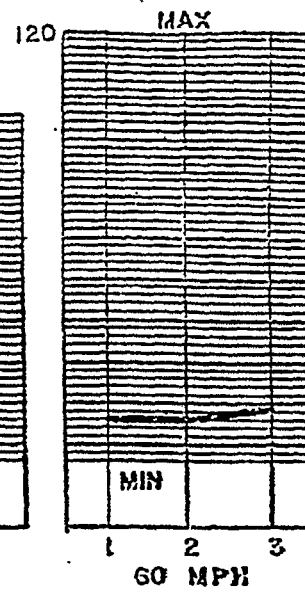
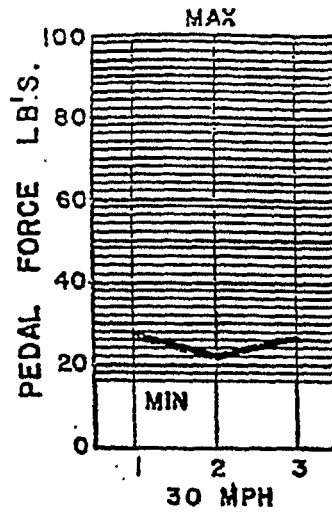
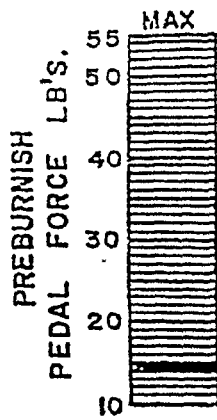
MG-30 & 31

1978 CHEVROLET
STATION WAGON



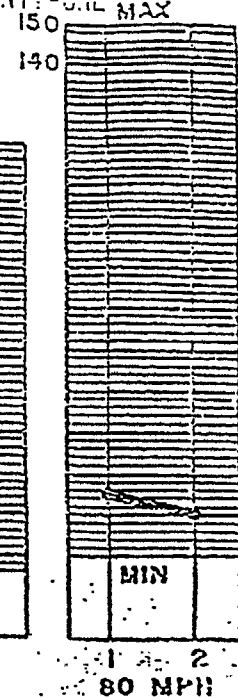
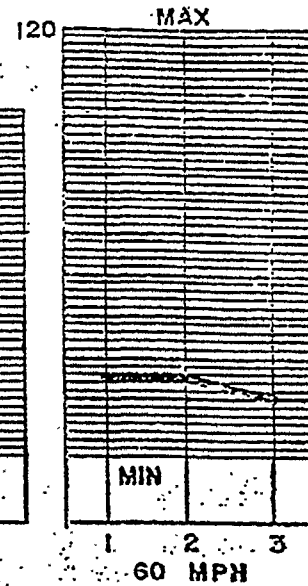
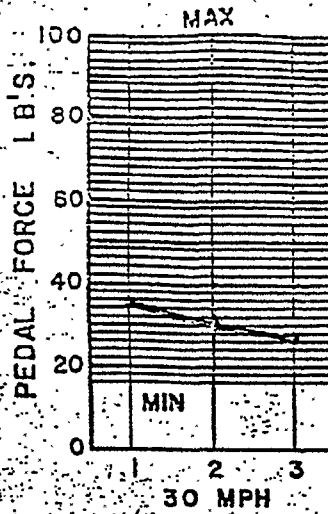
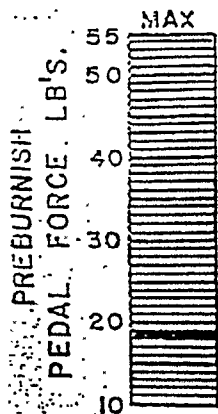
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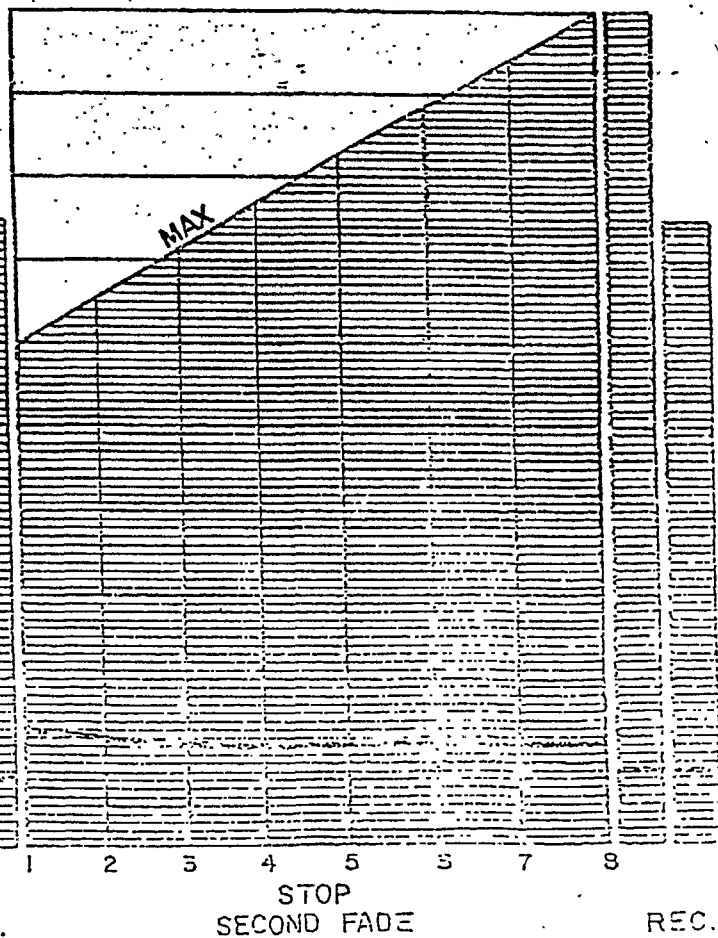
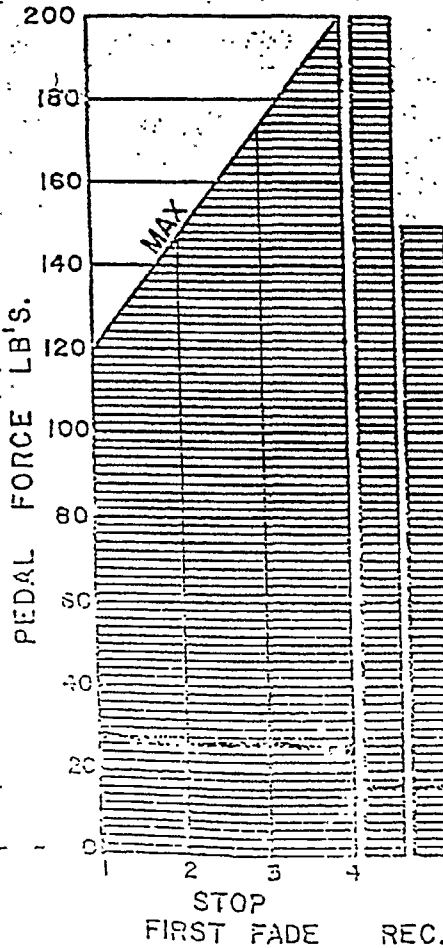


SAE 937b

PAUL HILL: "GUILTY MAX"



EFFECTIVENESS



TEST NO. 955-29

MG-36 & 37

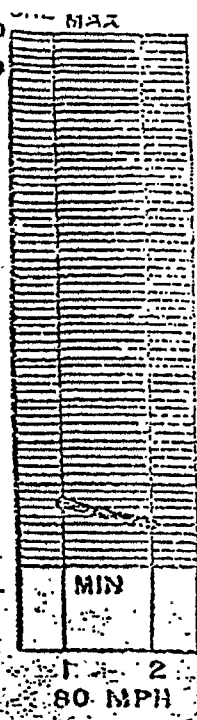
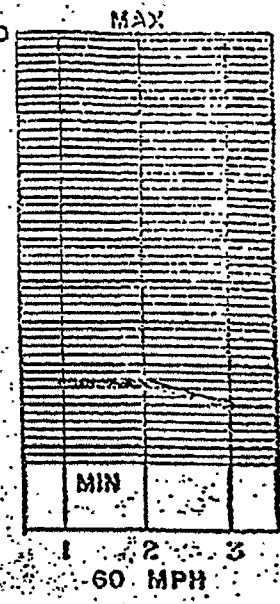
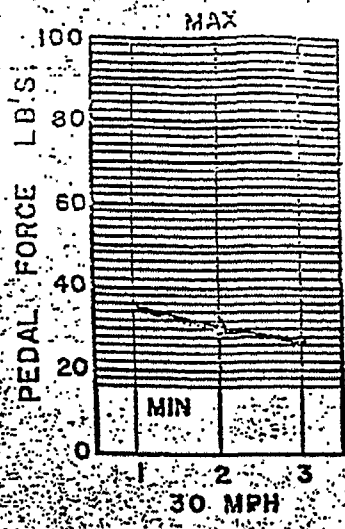
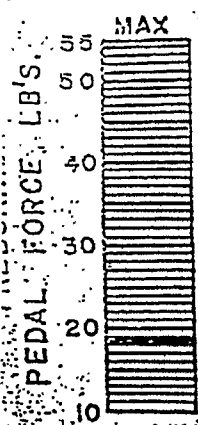
24-1012

1980 CHEVROLET
CORVETTE

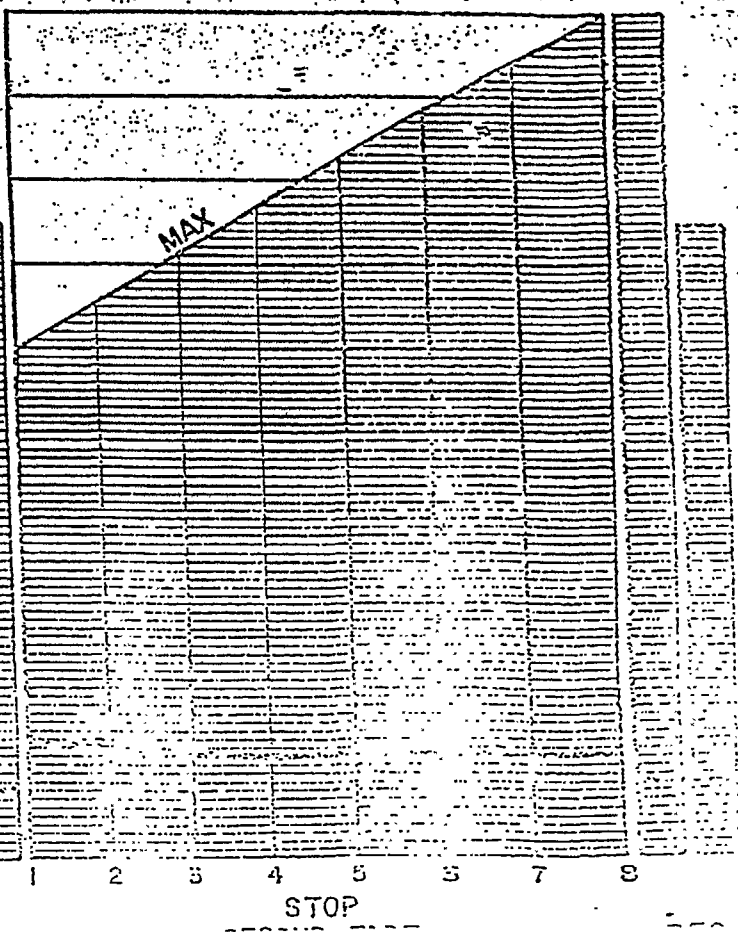
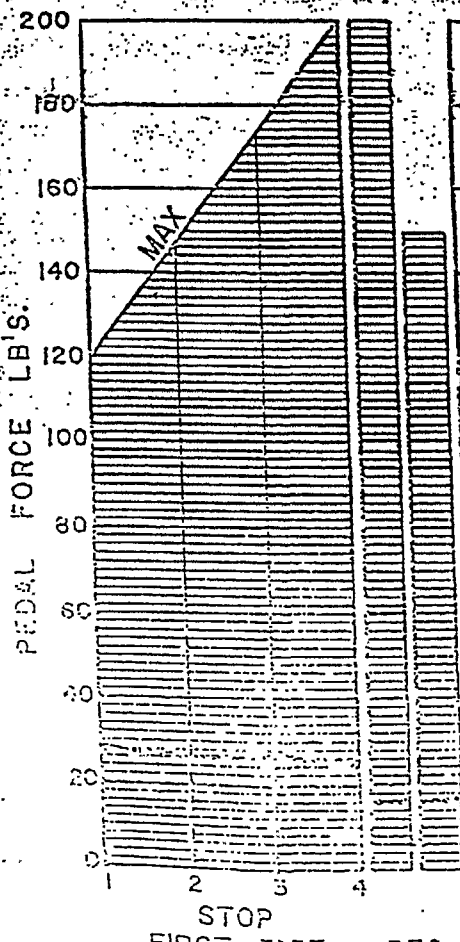
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SAE 937b



EFFECTIVENESS



TEST NO. 955-29

MG-36 & 37

7401-NR

1960 CHEVROLET

ENGINEERING TEST PROCEDURES

P3-57M

Page 1

PRODUCT ENGINEERING FORD MOTOR COMPANY

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

1. INTRODUCTION. This procedure establishes a passenger car route used to obtain durability and reliability data on components as well as on complete vehicles. Driving conditions are more severe than average customer usage. The test route consists of 37.1 miles of operation on the Michigan Proving Ground. Average vehicle speed is approximately 37 mph with a maximum speed of 80 mph.

2. INSTRUMENTATION.

(a) U-Tube Decelerometer, 4 inch, Bendix or equivalent to monitor brake stops.

(b) Tire Pressure Gage, dial type, Marshall Town Gage or equivalent.

2.1 CALIBRATION. Tire pressure gages are calibrated weekly. The decelerometer must have a current calibration card in accordance with Instrument Calibration Procedures Manual Procedure C2-1.

3. FACILITIES. The test is conducted at the Michigan Proving Ground on various road surfaces including: Basic Hill and Car Gravel Durability Roads; High Speed Track, 7, 15, 17 and 29 Percent Test Grades; and the Cobblestone, Chuckhole and Resonance Roads.

4. VEHICLE PREPARATION

(a) Install decelerometer

(b) Ballast vehicle according to Durability Weight as outlined in Procedure P6-1, Test Weight Standards, or as specified in the Test Authorization. Weigh vehicle and record.

(c) Adjust tire pressure according to Procedure P6-2, Tire Pressure Standards, or as specified in the Test Authorization, and record.

(d) Change engine oil and filter as required in the Test Authorization.

5. OPERATION. If specified on the Test Authorization, include the following procedures during durability testing: P6-8, Component Check List, and P6-12, Extended Engine Idle Test.

5.1 PERIODIC OPERATIONS

5.1.1 250 MILE INTERVALS

(a) Make one brake stop from 60 mph at 22 fpsps at the fourth brake stop pad. This stop replaces one 15 fpsps stop normally scheduled on the High Speed Track. Report any unusual brake performance; omit if brake stop area is wet.

(b) Make one pass at 15 mph through the Salt Bath when the brakes are cool, such as at the start of a shift or after a break. Omit when the ambient air temperature is below 24°F.

ENGINEERING TEST PROCEDURES

PS-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 2

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

(c) On speed control equipped vehicles perform the following speed control function checks on the Basic Durability Road to assure proper operation. Report any malfunction to the Traffic Office and note on the vehicle data sheet.

<u>Vehicle Speed (MPH)</u>	<u>Driver Action</u>	<u>Speed Control Functional Check</u>
35	Depress "On" Switch	System shall not engage
35	Depress "Set-Accel" Control	System sets speed
35 (Man. Trans.)	Depress Clutch Pedal	System disengages
35-50 (Man. Trans.)	Depress "Set-Accel" Control	System sets speed
35-50	Depress Brake Pedal	System disengages
35-50	Depress "Set-Accel" Control	System sets speed
35-50	Accelerate with "Set-Accel" control to 50 mph and set	System accelerates vehicle gradually and sets at 50 mph
35-50 (Resume Feature Equipped)	Brake to 35 mph. Depress and release "Resume" Control	System accelerates to 50 mph and sets at 50 mph automatically
35-50	Depress "Off" Switch	System disengages and deactivates

5.1.2 750 MILE INTERVALS. Measure and record tire pressure on Vehicle Data Sheet. Increase pressure in each tire by 4 psi. Proceed to the High Speed Track and operate vehicle for 50 miles at 80 mph or 5 mph under maximum speed, whichever is lower (using speed control). Stop, turn off the ignition and wait five minutes. Check engine oil level during this soak period and report any unusual loss of oil. Start engine, turn speed control on and operate vehicle for another 50 miles at 80 mph or 5 mph under maximum speed, whichever is lower (using speed control).

After leaving the High Speed Track, measure and record tire pressures on Vehicle Data Sheet. Then reduce tire pressures by 4.3 psi as accurately as equipment will allow.

5.1.5 1000 MILE INTERVALS. When the brakes are moderately cool, such as after a shift change, lunch period or break, proceed to the 15 or 17 Percent Test Grade and complete one round trip over the 15 Percent, 29 Percent and 17 Percent Test Grades and perform the following:

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ENGINEERING TEST PROCEDURES

P3-374

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 3

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

(a) Proceed to the 15 percent Test Grade and stop the vehicle on the grade with the service brake. Apply parking brake with enough effort to hold the vehicle on the grade with the transmission in "neutral". Place automatic transmission in Drive, manual transmission in low gear, release parking brake, ascend to top of grade and continue over the 29 and 17 percent grades. Return and repeat parking brake check on the descent of the 15 percent grade. Place automatic transmission in Low, 3-speed manual transmission in low gear, and 4-speed manual transmission in second gear, release parking brake and descend to bottom of grade making brake retards as required to maintain 30 mph.

(b) Automatic transmission vehicles only - during the above round trip over the 17, 29, and 15 Percent Test Grades, make four parking pawl checks spaced at intervals of 75 to 100 feet on the ascent and descent of the 17 and 15 Percent Test Grades and one parking pawl check on the ascent and descent of the 29 Percent Test Grade for a total of 18 pawl checks. Completely stop vehicle before engaging parking pawl.

5.2 ROUTE. Proceed as described below until the requested mileage is accumulated. Use speed control device on vehicles so equipped as indicated. Use "D" position on vehicles equipped with a Ford Integral Overdrive (FIOD) transmission unless otherwise specified.

MILES

Proceed to the Basic Durability Road via the Access Road. Stop. (Turn speed control on.)

- 0.0 Turn west onto the Basic Durability Road and accelerate to 45 mph. Pass over the "Chatter Bumps" and reduce speed on approach to the exit junction with the Hill Durability Road. Stop. Accelerate at full throttle to 50 mph (set speed control). Turn left onto the entrance junction with the Hill Durability Road. Stop. On vehicles equipped with manual transmissions downshift 1 gear from high prior to making the above two stops.
- 1.0 Enter the Hill Durability Road and accelerate to 40 mph (set speed control). Decelerate in gear (with speed control by depressing the coast control) to 35 mph for the right curve at the top of the first grade. Accelerate to 55 mph (with speed control by depressing the acceleration control); make a brake retard to 35 mph for the left curve at the top of the second grade. Maintain 35 mph past the 7 Percent Test Grade upper turnaround pad and around the next left curve. Descend the grades on the eastern portion of the Hill Durability Road to the Traffic Circle at a maximum speed of 45 mph. Stop. (Turn speed control off.)

ENGINEERING TEST PROCEDURES

PS-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 4

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

MILES

- 2.3 Enter the Traffic Circle and proceed at 25 mph to the 17 Percent Test Grade. Climb the 17 Percent Test Grade at full throttle but do not exceed 40 mph. Slow to 10 mph at the crest of the grade. Stop on the level stretch at the top of the grade and shift into "Low" or "1" range. Approach the 29 Percent Test Grade at 5 mph. When the vehicle is fully on the grade, accelerate and climb the grade at full throttle. Slow to 10 mph when entering the upper turnaround pad and stop. Resume normal shift patterns. Descend the 15 Percent Test Grade in high range and at 30 mph downshift to "2" position (Downshift FIOD to "1" position; Downshift manual transmissions 1 gear from high). Maintain 30 mph to the bottom of the grade, making brake retards as necessary. Stop at the bottom of the grade.
- 3.4 Shift transmission into "D" position; (manual transmission to low gear). At 5 mph make a U-turn, and approach the 15 Percent Test Grade. When the vehicle is fully on the grade, accelerate at full throttle to 45 mph. Reduce speed to 40 mph and proceed to the top of the grade. Slow to 10 mph when approaching the upper turnaround pad. Stop at the top of the 29 Percent Test Grade. Shift transmission to "Low" or "1" range (3-speed manual transmissions in first gear and 4 and 5-speed transmissions in second gear). Descend the 29 Percent Test Grade at a maximum speed of 25 mph, making brake retards where necessary. Reduce speed to 15 mph at the top of the 17 Percent Test Grade. Remain in "Low" range (shift 3-speed manual transmissions to second gear and 4 and 5 speed transmissions to third gear) and descend the 17 Percent Test Grade at a maximum speed of 30 mph, making brake retards where necessary. At the bottom of the 17 Percent Test Grade, resume normal shift patterns and proceed to the 7 Percent Test Grade. Do not exceed 40 mph on the 7 Percent Test Grade approach or grade.
- 4.0 Slow to 10 mph when fully on the 7 Percent Test Grade. Kickdown through detent to low gear (manual transmission vehicles stop at the base of the 7 Percent Test Grade) and accelerate at full throttle to 40 mph; close throttle and decelerate to 20 mph. Kickdown through detent (manual transmission downshift one or more gears) and accelerate to and maintain 40 mph to the top of the 7 Percent Test Grade. Slow to 20 mph when approaching the upper turnaround pad. Stop at the entrance to the Hill Durability Road. Enter the Hill Durability Road and accelerate to 35 mph. Descend the grades on the eastern portion of the Hill Road to the Traffic Circle at a maximum of 45 mph. Stop.
- 5.2 Continue on the Hill Durability Road at 35 mph. Decelerate in gear to 20 mph when approaching the base of the 25 Percent Test Grade (manual transmission vehicles stop in the right lane at the base of the 25 Percent Test Grade). Shift to "Low" or "1" range, and climb the 25 Percent Test Grade at 25 mph. Shift to "D" position at the top of the grade near the entrance to the 45 and 60 Percent Test Grades. Descend the 14 Percent Test Grade in gear and at a speed of 30 mph shift into "Low" or "1" range (downshift manual transmissions one gear from high). Continue to the bottom of the grade. Stop.

ENGINEERING TEST PROCEDURES

P3-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 5

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

MILES

- 5.8 Shift transmission into "D" position (turn speed control on). Accelerate to 40 mph (set speed control) and continue on the Hill Durability Road. Decelerate in gear (with speed control by depressing the coast control) to 35 mph for the right curve at the top of the first grade. Accelerate to 55 mph (with speed control by depressing the acceleration control); make a brake retard to 35 mph for a left curve at the top of the second grade. Maintain 35 mph past the 7 Percent Test Grade upper turnaround pad and around the next left curve. Descend the grades on the eastern portion of the Hill Durability Road to the Traffic Circle at a maximum speed of 45 mph. Stop.
- 7.7 Continue on the Hill Durability Road at 35 mph to the junction with the Basic Durability Road. Bear west onto the Basic Durability Road, accelerating (with speed control by depressing the acceleration control) to 50 mph and proceed through the southwest turn to the Back-up Road. Kickdown through detent and accelerate to 75 mph (set speed control). When approaching the northwest turn, release the throttle (turn speed control off) and downshift automatic transmission to "2" position (Downshift F10D to "1" position). Decelerate in gear to 40 mph, then shift to "D" position. Proceed through the turn, then accelerate to and maintain 65 mph (turn speed control on and set speed control). Make a brake retard to 50 mph when approaching the third stretch of rough pavement on this leg (set speed control) and maintain this speed to the entrance junction with the Car Gravel Road. Stop. (Downshift manual transmission one gear from "high" prior to making stop).
- 11.9 Proceed on the Basic Durability Road. Accelerate to 50 mph (use speed control "Resume" from 30 mph to 50 mph if equipped-set speed control). Reduce speed (with speed control by depressing the coast control) for the left and right curves (increase speed where possible to 50 mph by depressing the acceleration control). Enter the Ride and Handling Loop at 30 mph (turn speed control off). Maintain 30 mph until approaching the Resonance and Impact Bumps. Reduce speed to 25 mph and pass over the Resonance and Impact Bumps, (manual transmission stays in high gear). Leave the Ride and Handling Loop via the Car Gravel Access Road at 25 mph.
- 14.6 Enter the Car Gravel Road, accelerating to 55 mph. Maintain a maximum speed of 55 mph to the junction with the Truck Gravel Road, reducing speed to 45 mph for the two right curves. Proceed west on the Truck Gravel Road at a maximum speed of 35 mph. Increase speed to 45 mph after passing the entrance to the Gravel Pit and maintain this speed until approaching the east entrance to the Cobblestone Road. Downshift to "1" position at 45 mph and decelerate in gear to 10 mph. Stop. Shift to "D" position and enter the Cobblestone Turnaround Pad at 10 mph. After passing over the Jounce-Rebound holes, continue at 1-5 mph over the special car body twist. Proceed to the "Stop" area in the east turnaround pad for the reverse operation. Back up for approximately 100 ft. at 10 mph. Stop.

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ENGINEERING TEST PROCEDURES

P5-37M

Page 6

PRODUCT ENGINEERING

FORD MOTOR COMPANY

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

MILES

14.6 (Cont'd)

Automatic transmission vehicles. Shift into "Neutral" and turn off ignition. For catalytic converter equipped vehicles, if auto ignition occurs, turn ignition to "on" position, place transmission in Drive, and turn ignition off to stop engine. Wait five seconds, place transmission in "Low" and turn ignition key to determine if engine will crank. Engine should not crank. Perform this operation in each of the drive ranges and reverse. With brakes applied, place transmission in "neutral" and start engine. Release brake and see if vehicle moves; do the same in "Park". Vehicle should not move. If the "starter-neutral" switch or the transmission does not operate properly, describe the malfunction on the Vehicle Data Sheet and notify the Track Office for corrective action.

17.3

Proceed at 8-10 mph to the Chuckhole Access Road. Enter the Chuckhole Access Road and accelerate to approximately 30 mph. Make a brake retard to 8-10 mph when approaching the Chuckholes and proceed through the Chuckholes at 8-10 mph (3-speed manual transmission in second gear and 4- and 5-speed transmissions in third gear). Continue to the west turnaround pad. Turn the steering wheel from lock-to-lock six times. If the vehicle is equipped with manual steering, perform this check at 1-3 mph. If the vehicle is equipped with power steering, perform this check when stopped; do not impact steering stops or hold against the stops for more than 3 seconds. Proceed to the entrance of the Cobblestone Road at 8-10 mph, and turn onto the Cobblestone Road entrance with the wheels against the wheel stop. Increase speed to 12 mph and proceed over the Cobblestone Road (3-speed manual transmission in second gear and 4 and 5 speed transmissions in third gear). Make a brake retard from 12 mph to 5 mph on the east turnaround pad upon completing the pass over the Cobblestone Road. Proceed to the Chuckhole Access Road at 8-10 mph. Turn right onto the Chuckhole Access Road with the wheels against the wheel stop. Repeat the Chuckhole and Cobblestone Road sequence four additional times excluding the steering wheel lock-to-lock sequence. Make one additional pass over the Chuckhole Road and proceed to the entrance to the Basic Durability Road. Stop. (Turn on speed control.) Turn west on the Basic Durability Road and proceed at 45 mph (set speed control) to the intersection with the Access Road. Stop. (Turn speed control off.) Downshift manual transmissions one gear prior to making stop.

21.2

Turn right on the Access Road and proceed at 35 mph (maximum) to the High Speed Track slowing to 25 mph (maximum) on the U-turn section. Stop. (Turn speed control on.)

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ENGINEERING TEST PROCEDURES

P3-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 7

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

MILES

21.6

Turn right onto the High Speed Track.

+ 1.4
23

NORMAL DURABILITY
TEST CUT OFF
POINT.

Lap 1 - Accelerate at full throttle until the upshift to high gear is completed for manual and non-overdrive automatic transmissions (on FIOD transmission, accelerate at full throttle until 2-3 upshift occurs, then slowly release throttle until 3-4 upshift occurs). Do not exceed 80 mph or 5 mph under maximum speed, whichever is lower. After completing the above acceleration, decelerate in gear, without using brakes, to 60 mph (set speed control). Proceed at 60 mph and make a 15 ft/sec/sec deceleration brake stop on the first brake stop pad. Repeat the above acceleration, deceleration, cruise at 60 mph, and brake stop sequence for the second, third and fourth brake stop pads.

Lap 2 - After stopping on the fourth brake stop pad, accelerate to 80 mph or 5 mph under maximum speed, whichever is lower (on FIOD transmission, slowly release throttle until 3-4 upshift occurs). Set speed control and complete one non-stop lap at that speed.

Lap 3 - Decelerate (with speed control by depressing the coast control) in gear to 60 mph and make a 15 ft/sec/sec deceleration brake stop on the first brake stop pad. Accelerate at full throttle to 80 mph or 5 mph under maximum speed, whichever is lower (on FIOD transmission, slowly release throttle until 3-4 upshift occurs). Set speed control and continue at that speed until approaching third brake stop pad, then decelerate (with speed control by depressing the coast control) in gear to 60 mph. Make a 15 ft/sec/sec deceleration brake stop on the third brake stop pad. Accelerate at full throttle to 80 mph or 5 mph under maximum speed, whichever is lower (on FIOD transmission, slowly release throttle until 3-4 upshift occurs). Set speed control and continue at that speed. Starting at the target sign in the southeast turn, make a brake retard at 5 ft/sec/sec to 60 mph. Decelerate in gear to the exit (turn speed control off).

36.7 Turn right off the High Speed Track and proceed on the Access Road at 35 mph maximum to the intersection with the Basic Durability Road, slowing to 15 mph on the U-turn section.

37.1 Stop at the intersection with the Basic Durability Road. This completes one cycle.

6. GENERAL

6.1 ROUTE DATA

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MAR 004308

ENGINEERING TEST PROCEDURES

P3-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 8

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

6.1.1 MILEAGE

	<u>Miles</u>	<u>Percent</u>
(a) Basic Durability Road	8.3	19.8
(b) Hill Durability Road and Test Grades	6.6	15.7
(c) Gravel Roads	2.7	6.4
(d) Cobblestone Road	1.3	3.1
(e) Resonance and Impact Road	0.8	1.9
(F) High Speed Track		
3-Lap Cycle	15.1	36.0
Pro-rated Increment of 100 Mile - 80 mph Operation Every 20 Cycles (Paragraph 5.1.2)	4.9	11.6
(g) Approaches and Turnarounds	2.0	4.8
(h) Chuckholes	.3	0.7
(i) One Complete Circuit	42.0	100.0

6.1.2 BRAKE AND THROTTLE APPLICATIONS

- (a) Brake Stops
 - Automatic Transmissions - 24
 - Manual Transmissions - 26
- (b) Brake Retards - 19
- (c) Reverse Stops - 1
- (d) Full Throttle Acceleration Starts - 10

6.2 OPERATING CONDITIONS

- (a) Full throttle accelerations referred to in this procedure are defined as maximum accelerations short of wheelspin. All other accelerations are to be part throttle.

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MAR 004309

ENGINEERING TEST PROCEDURES

P3-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 9

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

(b) Where any speed specified is greater than the maximum speed of a particular vehicle, operate at 5 mph less than maximum speed.

(c) On full throttle accelerations, kick down through detent unless otherwise specified.

(d) Unless otherwise specified, make brake stops at 6 to 10 ft/sec/sec.

(e) When making all brake stops, gradually reduce the brake pedal force near the end of the stop to prevent vehicle rock-back.

(f) Unless otherwise specified, when making brake retards, reduce speed by 10 mph.

(g) Unless otherwise specified, operate automatic transmissions in that range which automatically incorporates the maximum number of forward gears.

(h) Vehicles equipped with manual transmissions will be shifted into first gear between 5 and 10 mph before all forward stops, except for the stops on the High Speed Track, where the shift will be made after the vehicle is stopped.

(i) Where transmission downshifts are specified in the procedure, the speed at which the downshift will be made is:

Downshift	<u>Downshift Speed Range</u>		
	3-Speed Manual All Axle Ratios	4 and 5 Speed Manual Axle Ratio 3.50 or Less	4 and 5 Speed Manual Axle Ratio Above 3.50
2-1	20 - 25 mph	20 - 25 mph	15 - 20 mph
3-2	45 - 50 mph	35 - 40 mph	25 - 30 mph
4-3	---	45 - 50 mph	35 - 40 mph
5-4	---	55 - 60 mph	45 - 50 mph

(j) Upshift speeds for manual transmission vehicles will be specified by the requester.

(k) Maximum upshift points are governed by the capabilities of the engine. Under no circumstances should the engine be overspeeded.

(l) All vehicles must be completely stopped before shifting into reverse gear.

(m) Unless otherwise specified, operate overdrive transmissions with overdrive engaged.

(n) Operate vehicle in accordance with Procedure PL-42M, Michigan Proving Ground Traffic Rules.

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ENGINEERING TEST PROCEDURES

P3-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 10

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

- (o) Adjust vehicle speed as necessary to permit safe operation, considering road, weather, and traffic conditions.
- (p) Do not ascend the 17 Percent and 29 Percent Test Grades when pavement is wet or slippery.
- (q) When making brake applications at greater than 10 ft/sec/sec decelerations, exercise caution if braking areas are wet to avoid wheel lock-up or skids.
- (r) If the vehicle grounds out at specified speed on any test surfaces, contact the Track Office.
- (s) Use only the fuel and engine oil specified in the Test Authorization.

6.3 SPEED CONTROL USAGE

- (a) Do not activate the speed control when the road surfaces are ice or snow covered.
- (b) Deactivate the speed control before operating on: (1) test grades of 14, 15, 17 and 29 percent and (2) the gravel portion of the basic durability road.
- (c) Speed Control must be turned off before manually downshifting an automatic transmission.
- (d) Specified full throttle accelerations are done with the accelerator.

6.4 TERMINOLOGY. Certain terms used in this procedure are described below:

- (a) Accelerate with Speed Control. Increase vehicle speed by depressing the acceleration control ("Set-Accel" switch or "Set" switch) with the Speed Control in operation.
- (b) Decelerate with Speed Control. Reduce vehicle speed by depressing the deceleration control ("Coast" switch or "Set" switch on some vehicles) with the Speed Control in operation.
- (c) Set Speed. Engage the Speed Control to control vehicle speed at the desired value. This is usually accomplished by depressing and releasing the "Set-Accel" switch or "Set" switch.
- (d) Turn Speed Control On. Put the speed control system in operation by operating the "On" switch. Does not include setting a control speed.
- (e) Turn Speed Control Off. Completely deactivate speed control system by operating the "Off" switch. Merely disengaging Speed Control by braking or dropping below control speed does not satisfy this operation.

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MAR 004311

ENGINEERING TEST PROCEDURES

P5-37M

PRODUCT ENGINEERING

FORD MOTOR COMPANY

Page 11

COMBINED DURABILITY ROUTE FOR PASSENGER CARS

(F) Resume with Speed Control. Increase vehicle speed by momentarily depressing the "Resume" control. Vehicle will accelerate at a controlled rate and set at the previous set speed. Resume must follow a set and a brake application, and must be actuated above the minimum speed control operating speed (approximately 30 mph).

7. PRESENTATION OF DATA.

(a) Report daily on Vehicle Data Sheet the number of complete test cycles, any departures from the test procedure, route or specified speed and any repairs performed.

8. REFERENCES.

- (a) Procedure P1-42M, Michigan Proving Ground Traffic Rules
- (b) Procedure P6-1, Test Weight Standards
- (c) Procedure P6-2, Tire Pressure Standards
- (d) Procedure P6-3, Component Check List
- (e) Procedure P6-12, Extended Engine Idle Test

GENERAL PRODUCT ACCEPTANCE SPECIFICATION

Passenger Cars

System GEN 6.02

SUBSYSTEM: DISC BRAKE

I. Application

This General Product Acceptance Specification is applicable to all passenger car lines for all model years. In addition to the requirements listed in this specification, the Disc Brake Subsystem must comply with all applicable requirements listed in the Brake System Specification (GEN 6.00).

II. Subsystem Description

This specification defines the limits of acceptability of the Disc Brake Subsystem. The functional objectives of this Subsystem and the definition of parts and subassemblies of which it is comprised can be found in the NAAO "Design and Release Responsibility Manual".

III. Subsystem Functional Responsibility

Powertrain and Chassis Product Engineering (Chassis)

IV. Requirements

A. Performance

1. Brake roughness, shudder, pedal free-travel, and/or pedal feel will be evaluated for acceptability by jury evaluation in accordance with Engineering Test Procedure P6-101.
2. The vehicle must be capable of completing Engineering Test Procedure P4-43 without failure or permanent deformation of any brake component that will impair minimum performance, defined as making a smooth, even, straight line stop within a twelve-foot lane on dry, clean, level concrete from a speed of 20 mph within a distance of 25 feet.
3. On manual brake vehicles, the pedal travel, measured statically, when applying 50 pounds effort to the pedal, shall not exceed 50 percent of the total available travel, with burnished and cold brakes.
4. On power brake vehicles, the pedal travel, measured statically, at engine idle, when applying 50 pounds effort to the pedal, shall not exceed 60 percent of the total available travel.

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IV. A. Performance (Cont'd)

5. Brake effectiveness tests will be conducted in accordance with Engineering Test Procedure P4-66, modified. Pedal efforts for the first and second 30 and 60 mph tests shall not exceed those specified below. Stopping rates specified are sustained deceleration rates. Wheel skid must not occur at or below (22 fpsps) during the 30 and 60 mph effectiveness tests.

Deceleration ft/sec ²	Manual Brakes (pounds)	Power Brakes (pounds)
5	38	20
10	54	30
15	67	40
20	80	50
25	95	60

Exception:

Vehicles offering a temporary spare tire shall be tested for braking stability. The test shall be conducted on a level surface with a friction coefficient of .75, at brake test weight, with the test spare tire and wheel installed and evaluated at each wheel position. Brake stops will be conducted from 30 and 60 mph, but not to exceed the maximum recommended speed for the tire, at the deceleration rates specified in IV.A.5. (max of 22ft/sec²). The vehicle shall not deviate from a 12 ft. lane and shall not exhibit brake lock-up at or below 22 ft/sec². The brake pull rating shall not be less than 5. This criteria applies to testing the spare tire at any wheel position on the vehicle with either manual or power steering (if offered).

6. Mountain Test

The brake system must successfully complete the Mountain Brake Test, Engineering Test Procedure P4-47. Pedal efforts encountered during the fade and drag portions of the test must not exceed 200 pounds. Recovery characteristics must meet the requirements below. During the fade and drag portion of this test, no wheel lock-ups, severe pulls or objectionable noise will be considered acceptable.

The pedal effort for the first recovery stop shall not exceed three times the effort on the recovery check stop. Not more than five recovery stops shall be required to attain check stop effort, plus or minus 20 percent for manual brakes, and plus 15, minus 10 pounds for power brakes.

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SUBSYSTEM: DISC BRAKE

IV. A. Performance (Cont'd)

7. Disc Brake Pad Knock and Shake-Back

Disc brake pedal travel increase due to pad knock-back, or shake-back on the Ride-Handling, Grist Mill and Resonant Bumps and Cobblestones shall not exceed the limits listed below:

- a. Baseline Check - Perform four brake snubs, 1.25 miles apart, from 20 mph to 10 mph at 10 fpsps. Record the pedal travel along the chord of the pedal pad arc for four (4) snubs to obtain an average travel.
- b. Pad Knock-Back Check (Ride and Handling) - Without applying the brakes, operate the vehicle at 40 mph on the ride and handling road, followed by 35 mph for 360 degrees of the 150-foot radius curve. Upon completion of one cycle, perform a brake snub from 20 mph to 10 mph at 10 fpsps. Repeat the check to obtain an average pedal travel for two right and two left-hand trips through the course. The average pedal travel shall not be more than 1.25 inches greater than the baseline check in Paragraph 7a.
- c. Pad Knock-Back Check (Grist Mill) - Without applying the brakes, conduct three (3) Grist Mill Test turns (Engineering Test Procedure P3-52), followed by a brake snub from 20 mph to 10 mph at 10 fpsps. The resulting pedal travel shall not be more than 1.75 inches greater than the baseline stop described in Paragraph 7a.
- d. Pad Shake-Back Check (Resonant Bumps or Cobblestones) - Without using the brakes, operate the vehicle one pass over the resonance and impact bumps at MPG at 25 mph, or three passes over the cobblestones at DPG at 25 mph, after which the pedal travel for a 20 mph to 10 mph snub stop at 10 fpsps shall not be more than .75 inch greater than the baseline check in Paragraph 7a.

B. Durability

1. Brake Lining Life

When tested in accordance with Engineering Test Procedure P3-376, Combined Durability Route for Passenger Cars, the minimum brake lining life shall be 11,000 miles for Semi-metallic linings or 13,000 miles for asbestos linings.

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