



ENGINEERING
DETROIT

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FRUEHAUF
ENGINEERING
STANDARDS

F. E. S.
74

SHEET 1 OF 14

CHANGE LTR. D

TITLE

INERTIA DYNAMOMETER TEST

PURPOSE: TO EVALUATE WEAR AND PERFORMANCE OF LININGS, BRAKES AND BRAKE DRUMS

THE PROCEDURE INCLUDES THE FOLLOWING TESTS:

1. TORQUE OUTPUT AND DECELERATION. (VARIOUS SPEEDS AND BRAKE INPUT).
2. EVALUATION OF LINING LIFE (WEAR TESTS).
3. BRAKE CHARACTERISTICS (FADE AND RECOVERY TESTS, NOISE, CHATTER, GRABBINESS).
4. DRUM EVALUATION (WEAR, HEAT CHECKING, SCORING, WARPAGE AND WHEN REQUESTED, DRUM DEFLECTION).

FOREWARD:

1. THIS TEST PROCEDURE IS OUTLINED AS A FULL AND COMPLETE TEST ON ALL BRAKES. WHEN TYPE SAE-667 EVALUATION ONLY IS WANTED, SECTION III THRU XIX, EXCLUDING SECTION VI, WILL BE SPECIFIED. WHEN FMVSS 121 PROCEDURE IS REQUIRED, SECTION XX ONLY IS TO BE SPECIFIED.

SECTION VI IS TO BE INCLUDED AS PART OF TEST ONLY WHEN SO SPECIFIED BY COMPONENT ENGINEERING GROUP OF DIVISION ENGINEERING WHEN DRUM EVALUATION OR COMPLETE BRAKE EVALUATION IS REQUIRED.

1. GENERAL INSTRUCTIONS:

1. LOG SHEETS ARE TO BE FURNISHED TO THE MACHINE OPERATOR AND HE MUST BE INSTRUCTED IN KEEPING A COMPLETE LOG OF ALL RUNS. IN ADDITION TO THE SPECIFIC DATA RELATING TO THE TEST, THESE LOG SHEETS MUST BEAR TEST ORDER NUMBER, DATE AND AMBIENT TEMPERATURE, AND MUST BE SIGNED BY THE TESTER AT THE END OF HIS RUN.
2. LOG SHEETS MUST ALSO NOTE, AT ALL TIMES DURING THE TEST, SUCH FEATURES AS CHATTER, BRAKE NOISES OR OTHER PECULIARITIES OF PERFORMANCE.



RELEASE NO.	DATE	CHG LTR	REMARKS	RELEASE NO.	DATE	CHG LTR	REMARKS
40669	5/2/73	A	REWRITTEN.	42647	11/1/77	D	Sheet 14 added for Abex linings.
41869	11/26/75	B	Rewritten				
42060	4/9/76	C	SHEETS 10, 11, 12 & 13 Revised for use of MMD-39 Lining in lieu of MM-8C5				

SCF-ABEX-1591



S-FTS-31



S-CC-31



ABEX-136 02

OBR 05064

INERTIA DYNAMOMETER TEST

3. The following classification will be used for brake noises other than those due to interference between moving and stationary parts. These noises are classified according to pitch and will be designated as follows:
"Peeps" or "Squeaks" (meaning medium to high pitch noises of very short duration and very loud). "Chatter" (low frequency, but rather high intensity stuttering of the brake). On some chatters, the dynamometer shakes a bit, may be any length. "Howl" (noise of rather long duration and very loud, medium pitch). "Squawks" (medium low pitched noises of very short duration). "Groans" (medium low pitched noises of long duration). "Moans" (very low pitched noises of long duration).
Optional: If a sound meter is available, recordings should be taken every 10th stop during burnish and wear, and on all performance stops.
4. Note should also be made of line pressures at which noise occurs and whether noise prevails throughout stop, at beginning only, or at end of stop. Also, whether noise is present only with cold or hot brakes or both. Effort should likewise be made to determine whether noise is caused by forward or reverse shoe and cause of same.
Information at top of log sheets is important and must be complete and accurate.
5. Autographic recorder traces of torque vs. time, pressure vs. time and time to stop (actuation pressure to zero wheel velocity) as well as all log sheets and summary charts are to be furnished Fruehauf Division Engineering for compliance acceptance.

II. BRAKE SET-UP PREPARATION FOR TEST

1. Examine brake assemblies for defects or errors in manufacture, 2 blueprints are to be furnished with test order. Note any abnormal condition found and have same corrected. Ascertain that shoes are lined with the specified lining.
2. Mark shoes for lining wear measurements at 8 locations on each shoe, along each side at each end of each block adjacent to each rivet by saw cut into edge of block and table or other suitable means.

3. Check and record weight, braking surface smoothness (Profilometer reading) and general condition of drum. Check and record drum diameter in two places one inch from the open end, 90° apart, and six inches from the open end, 90° apart, for a total of four readings. If runout is more than .010, total indicator reading, attempt to adjust the condition by shifting drum around on its mounting bolts in combination with shifting of drum adaptor on its bolts if necessary. If runout condition cannot be corrected in this manner, drum is to be discarded or ground to secure concentricity. If taper is more than .005 across the braking surface, drum is to be discarded or ground.
4. THERMOCOUPLES FOR TEMPERATURE WORK ARE TO BE INSTALLED AS FOLLOWS:
 - Number 1 - In drum ring midway of braking surface and .090" from rubbing surface.
 - Number 2 - In brake lining at maximum pressure point recessed .040".
5. Take feeler gauge readings at cam end, center and anchor end of shoe.
6. Take initial lining measurements and feeler gauge readings.
7. Adjustments - Slack adjuster stroke should be as short as possible without the brakes dragging (approximately 3/4" at 20 psi). In the off position with the brake at rest, a .010 feeler gauge should pass between the rubbing surfaces. Record slack adjuster stroke before adjustment and after adjustment (measure at the clevis pin). Check the adjustment periodically throughout the test and maintain the above specifications.

PROCEDURE

Brake cooling - Air at ambient temperature is directed uniformly and continuously over the brake drum at a velocity of 2,200 feet per minute. Fan on throughout the entire test except during static break-away tests.

1. Measurement - Measure, weight and record drum dimensions. Adjust shoe clearance to .010" at center of shoes.

III. FIRST STATIC BREAK-AWAY TEST

1. Install a large lever arm to dynamometer flywheel.
2. Apply air pressure to brake in 10 PSI increments from 20 to 100 psi.
3. While the proper line pressure is on move the arm by means of a chain hoist or hydraulic ram until peak torque at that pressure is obtained. Repeat until all line pressures have been run.

4. Reverse the torque arm and ram and repeat for reverse rotation.
5. Record torque readings and calculate output.

IV. BURNISH

SPEED - 40 MPH

DECELERATION - 11 ft./sec.²

TEMPERATURE - 250°F maximum (control from drum thermocouple)
at start of each application.

STOPS - 200 minimum - if 80% lining contact has not been reached
continue until this condition is met.

MEASUREMENT - Measure in 8 locations on each shoe and record, weigh
shoes and record.

V. FIRST PERFORMANCE TEST

SPEED - 20 thru 60 MPH (in 10 MPH increments)

STOPS - 10 PSI increments starting at 30 PSI thru 90 PSI, do
not exceed 25 ft./sec.².

TEMPERATURE - Cool to 150°F. between stops (control from
drum thermocouple).

MEASUREMENT - Make torque and deceleration charts on all
stops. Check and record temperatures of
drum and lining at the end of each stop.

VI. DRUM DISTORTION TEST (*SEE FOREWORD, PAGE 1)

1. By means of a dial indicator mounted so as to record the outer surface of the drum deflection, a stroboscope timer connected to the dynamometer tachometer shaft and a stroboscope light take distortion readings every 20 degrees, starting from the cam centerline and proceeding around the brake in the forward operating direction.
2. Run the flywheel shaft at 40 MPH speed without operating the brake and note with the stroboscope the amount of negative reading produced by centrifugal force. Stop the flywheel with means other than test brake and set indicator dial ahead the amount of the negative reading observed. Record room temperature. (Cool brake with inside air - fully opened damper).
3. Now operate the machine at 40 MPH on a two (2) minute cycle 10 second application time with 90 PSI line pressure until the drum temperature as shown by the autographic recorder has reached a balanced condition. Note and record the amount of positive reading just before a brake application. This reading represents the amount of radial drum expansion due to the difference between room temperature and the temperature

denoted by the low end of the temperature chart. Note and record the balancing point temperature. If specified peak torque is exceeded with above line pressure, reduce pressure accordingly.

4. Stop the machine just long enough to again reset the indicator back the amount of the positive reading just observed. The indicator should now read zero just before a stop with the flywheel rotating at 40 MPH and the drum temperature balanced. If it does not, it should be further adjusted until it does.
5. Operate the machine as before, continuing a two-minute cycle. Note and record the amount of positive reading immediately after a stop - just as the shoes are released. This reading represents the amount of radial drum expansion due to temperature rise during one stop and must be deducted from all distortion readings taken later to give actual distortion figures.
6. Now place the stroboscope on the zero point. Zero point is at the centerline of cam. Zero the stroboscope, phasing dial to correspond with pointer on the timer and lock same securely.
7. Proceed to take distortion readings every 20 degrees, proceeding around the brake in the forward operating direction. Carefully record all readings, repeating any that may be doubtful. Usually one stop at any given angular position will be sufficient.

Draw out torque curves at 0, 80, 160, 240, and 320 degrees. Measure and calculate.

8. Take one series of readings as near the open end of the drum as possible and another series as near the back corner as practical and a third series as near the centerline of the brake as possible.
9. Measure brake lining for wear and record measurements.
10. Take feeler gauge readings.

VII. FIRST FADE AND RECOVERY

1. Prefade check

Before starting fade and recovery test, run a maximum of 5 stops each to establish the correct constant torque control setting for 15 ft./sec.² stops at both 50 and 30 MPH. Record trial stops.

Trial Stop Fade Speed - 50 MPH

Temperature - 150°F at the beginning of each trial stop
(control from drum thermocouple).

Trial Stop Recovery Speed - 30 MPH

Temperature - 150°F. at the beginning of each trial stop
(control from drum thermocouple).

2. 1st Fade

Speed - 50 MPH

Deceleration - Use torque established in prefade check for fade speed. (Record minimum and maximum line pressures).

Cycle - One minute (i.e., from the beginning of one stop to the beginning of the next stop).

Temperature - 150°F at the beginning of the first stop.

No. of stops - 10

Record drum and lining temperatures.

Immediately following this step continue on to the recovery step.

3. 1st Recovery

Speed - 30 MPH

Deceleration - Use torque established in prefade check for recovery speed. (Record minimum and maximum line pressures).

Cooling - Cool for 3 minutes from the end of the last fade stop before starting the 1st recovery stop.

Cycle - One minute (i.e., from the beginning of one stop to the beginning of the next stop).

No. of stops - If the lining has not recovered at 10 stops, continue on to 15 stops at one minute cycles.

Record drum and lining temperatures.

Inspect and record lining and drum condition.

VIII. SECOND FADE AND RECOVERY

1. Prefade Check

Before starting fade and recovery test, run a maximum of 5 stops each to establish the correct constant torque control setting for 15 ft./sec.² stops at both 60 and 30 MPH. Record trial stops.

Trial Stop-Fade Speed - 60 MPH

Temperature - 150°F at the beginning of each trial stop (control from drum thermocouple).

Trial Stop Recovery Speed - 30 MPH

Temperature - 150°F. at the beginning of each trial stop (control from drum thermocouple).

2. 2nd Fade

Speed - 60 MPH

Deceleration - Use torque established in prefade check for fade speed. (Record minimum and maximum line pressures).

Cycle - One minute (i.e., from the beginning of one stop to the beginning of the next stop).

Temperature - 150°F at the beginning of the first stop.

No. of Stops - 5

Record drum and lining temperatures.

Immediately following this step continue on to recovery step.

3. 2nd Recovery

Speed - 30 MPH

Deceleration - Use torque established in prefade check for recovery speed.

(Record minimum and maximum line pressures).

Cooling - Cool for 3 minutes from the end of the last fade stop before starting the first recovery stop.

Cycle - One minute, (i.e., from the beginning of one stop to the beginning of the next stop).

No. of stops - If the lining has not recovered at 10 stops continue on to 15 stops at one minute cycles.

Record drum and lining temperatures.

Inspect and record lining and drum condition.

IX. SECOND PERFORMANCE TEST

Speed - 20 thru 60 MPH (in 10 MPH increments)

Stops - 10 PSI increments starting at 30 PSI thru 90 PSI
Do not exceed 25 ft./sec.².

Temperature - Cool to 150°F. between stops (control from drum thermocouple).

Measurement - Make torque and deceleration charts on all stops. Check and record temperatures of drum and linings at the end of each stop. Inspect lining and drum conditions and record.

X. LINING WEAR TEST - 30 MPH

Speed - 30 MPH

Deceleration - 11 ft./sec.² (record minimum and maximum line pressures).

Temperature - 200°F. (control from drum thermocouple at the beginning of each application)

No. of stops - 500

Record - Every 10th application and make torque and deceleration and line pressure graph charts.

Measurement - Record drum temperature every tenth stop throughout run. With shoes in position, measure and record lining thickness at 8 locations per shoe at beginning and end of test, being careful not to disturb the dust on the linings or in the drum.

XI. LINING WEAR TEST - 40 MPH

Speed - 40 MPH

Deceleration - 11 ft./sec.² (record minimum and maximum line pressures).

Temperature - 300°F. (control from drum thermocouple) at beginning of each application.

No. of stops - 300

Record: Every 10th application make torque, deceleration and line pressure graph chart.

Measurement - Record drum temperatures every tenth stop throughout run. With shoes in position, measure and record lining thickness at 8 locations per shoe, being careful not to disturb the dust on the linings or in the drum.

XII. THIRD PERFORMANCE TEST

Repeat procedure in part V including charts and measurements.

XIII. STATIC BREAK-AWAY TEST

1. Cool brakes to 100°F. or less.
2. Install a large lever arm to dynamometer flywheel.
3. Apply air pressure to brake in 10 PSI increments from 20 to 100 PSI.
4. While the proper line pressure is on, move the arm by means of a chain hoist or hydraulic ram until peak torque at that pressure is obtained. Repeat until all line pressures have been run.
5. Reverse the torque arm and ram and repeat for reverse rotation.
6. Record torque readings and calculate output.

XIV. LINING WEAR TEST - 50 MPH

Speed - 50 MPH

Deceleration - 11 ft/sec.² (record minimum and maximum line pressures).

Temperature - 350°F. (control from drum thermocouple) at beginning of each application.

No. of stops - 300

Record - Every 10th application and make torque, deceleration and line pressure graph charts.

Measurement - Record drum temperatures every tenth stop throughout run. With shoes in position, measure and record lining thickness at 8 locations per shoe, being careful not to disturb the dust on the linings or in the drum.

XV. THIRD FADE AND RECOVERY TEST

Repeat procedure in Part VII including charts and measurements.

XVI. FOURTH FADE AND RECOVERY TEST

Repeat procedure in part VIII including charts and measurements.

XVII. LINING WEAR TEST - 60 MPH

Speed - 60 MPH

Deceleration - 11 ft./sec.² (record minimum and maximum line pressures).

Temperature - 350°F (control from drum thermocouple) at beginning of each application.

No. of stops - 300

Record - Every 10th application and make torque deceleration and line pressure graph charts.

Measurement - Record drum temperatures every tenth stop throughout run. With shoes in position, measure and record lining thickness at 8 locations per shoe, being careful not to disturb dust on the linings or in the drum.

XVIII. FOURTH PERFORMANCE TEST

1. Repeat procedure in Part V, including charts and measurements.

XIX. FINAL INSPECTION

1. Test having been concluded, brake is to be inspected thoroughly in all respects and report made of final condition of linings, shoes, anchors, etc. Report should also be made of final condition of brake drum.

Shoes - Remove and measure in 8 locations on each shoe.

Record measurements.

Weigh, record condition use.

Drum - Check and record drum diameter in two places 1" from the open end, 90° apart, and six inches from the open end, 90° apart, for a total of four readings. Take Brinell hardness readings of drum and record (if hard spots are evident (shiny blotches) take typical reading also and record).

NOTES:

Constant checking of brake clearance is very important on CAM type air brakes. Check regularly and record facts on data sheet. Maintain a slack adjuster stroke of 3/4" at 20 PSI. If adjustment is made, due to wear or swell, record this and amount of adjustment (degree of adjuster shaft rotation).

Any tests run for 16 1/2 x 7 brakes or linings must be run using a 115-lb. (nominal) weight cast drum Dayton nbr. 03-120664; for 16 1/2 x 8 5/8 size use Dayton drum nbr. 03-120376 (131 lbs.), for 12 1/4 x 8 size use Dayton Drum nbr. 03-120-918 (78 lbs.)

Dynamometer inertia is to be equivalent to the load on the wheel with the axle loaded on its GAWR.
Axle ratings 20,000 lbs. and 23,000 lbs. with wheel loads of 10,000 and 11,500 respectively.

- 20,000-lb. axle based on 10:00/22 (F) Tires has a static loaded radius of 20.7".
23,500-lb. axle based on 11:00/20 (G) Tires has a static loaded radius of 20.7".

XX. FMVSS NO. 121
DYNAMOMETER TEST PROCEDURE

1. Dynamometer inertia is to be equivalent to the load on the wheel with the axle loaded on its GAWR.
Axle ratings 20,000 lbs. and 23,000 lbs.
2. Ambient temperature is to be between 75°F and 100°F.
3. Air at ambient temperature is directed uniformly and continuously over the brake drum at a velocity of 2,200 feet per minute.
4. The temperature of each brake is measured by a single plug type thermocouple installed in the center of the lining surface of the most heavily loaded shoe, recessed .040".

PROCEDURE

Brake Cooling - Fan ON throughout the entire test.

Step 1. Measurement

Check and record weight, braking surface smoothness (Profilometer Reading) and general condition of drum. Check and record drum diameter in two places one inch from the open end, 90° apart, and six inches from the open end, 90° apart, for a total of four readings.

Adjust shoe clearance to .010" at end of shoes.

Step 2. First Burnish

Speed - 40 MPH

Deceleration - 10 ft./sec.²

Temperature - from 315°F. to 385°F. (control from lining thermocouple) at the start of each application.

No. of stops - 200

Record - Every 1st and every 25th stop. Air pressure, time, deceleration, torque and ambient and drum temperature at start and end of stop.

Step 3. Second Burnish

Speed - 40 MPH

Deceleration - 10 ft/sec.²

Temperature - from 450°F to 550°F. (control from lining thermocouple) at the start of each application.

No. of stops - 200

Adjustment - reset thermocouple depth to .040"

Step 4. Brake Retardation

Speed - 50 MPH

Stops - 10 psi increments starting at 20 psi through 80 psi.
DO NOT EXCEED 25 ft/sec.²

Temperature - 125 to 200 between stops (control from lining thermocouple).

Adjustment - Reset thermocouple depth to .040".

Step 5. Brake Power

Speed - 50 MPH to 15 MPH

Pressure - required to maintain a 9 f.p.s.p.s. not to exceed 100 psi.

Cycle - 72 seconds (i.e., from the beginning of one stop to the beginning of the next stop).

Temperature - 125 to 200°F.

No. of stops - 10

Step 6. Hot Stop

Speed - 20 MPH

Deceleration - 14 ft/sec.²

Cycle - 1 minute after the end of the 10th brake power stop (Step 5).

Stop - One

Immediately following this step, continue on to the recovery step.

Step 7. Recovery - Brake Power

Speed - 30 MPH

Pressure - not to exceed a minimum of 20 psi or a maximum of 85 psi.

Cooling - Cool for 2 minutes from the end of hot stop before starting the recovery stop (Step 6).

Cycle - One minute (i.e., from the beginning of one stop to the beginning of the next stop).

No. of stops - 20

XXI Approved Brake Lining For S-Cam Brakes

Manufacturer	Lining Code	Brake Size	Max. Rolling Radius	Axle Rating
Carlisle Abex	MMD 39 (Chief) FRU 913 GG (693-551-G)	16½ X 7	20.7	20,000
Carlisle Abex	MMD 39 (Chief) FRU 913 GG (693-551-G)	16½ X 8 5/8	20.7	20,000
Carlisle	MMD 39 (Chief)	12½ X 8	17.5	18,000
Carlisle Abex	MM 8C5 (PCL) FRU 912 GG (551-D)	16½ X 7	20.7	23,000
Carlisle Abex	MM 8C5 (PCL) FRU 912 GG (551-D)	16½ X 8 5/8	20.7	23,000
Carlisle	MM 8C5 (PCL)	12 ½ X 8	17.5	21,000

NOTE: All linings must meet the minimum friction standards of The New York Brake Lining Law.

XXII Brake Lining Identification:

A. Carlisle Identification Requirements:

- a) The edge of the lining without the imprint, to be color coded completely coating the edge with green (for MMD 39) and yellow (for MM 8C5) paint. The other edge, with the imprint to have a two inch wide band adjacent to the imprint with the corresponding paint.

Fruehauf Code, CHIEF (for MMD 39) or PCL (for MM 8C5) to be rubber stamped on the fully painted edge of the lining.

- b) The following information is to be imprinted to a minimum of 0.01" deep x 0.125" high on the edges of the lining

(1) Batch Code: _____
(2) NYS Code: MMD 39-EE or MM 8C5 - GH

- c) The following information is to be imprinted to a minimum of 0.01" deep x 0.125" high on the under-face of the lining by Carlisle:

(1) Fruehauf Part No.: A-CE62xx -1, -2, -3, or -4*
(2) FMS No.: _____
(3) ANC. or CAM

* -1 Denotes Original Equipment	MMD 39
-2 Denotes Service Equipment	MMD 39
-3 Denotes Original Equipment	MM 8C5
-4 Denotes Service Equipment	MM 8C5

B. ABEX IDENTIFICATION REQUIREMENTS

- a). The edge of the lining without the imprint, to be color coded completely, coating the edge with blue (for FRU913GG) and white (for FRU912GG) paint. The other edge (with the imprint) to have a two inch wide band adjacent to the imprint with the corresponding paint.
- b). The following information is to be imprinted to a minimum of 0.01 inch deep x .125 inch high on the edges of the lining.
- (1). Batch Code:
- (2). NYS Code: FRU913GG or FRU912GG
- c). The following information is to be imprinted to a minimum of 0.01 inch deep x 0.125 inch high on the underface of the lining by ABEX.
- (1). Fruehauf part No. A-CE62xx
- (2). FMS No:
- (3). ANC. or CAM

-5	Denotes	Original	Equipment	FRU913GG
-6	Denotes	Service	Equipment	FRU913GG
-7	Denotes	Original	Equipment	FRU912GG
-8	Denotes	Service	Equipment	FRU912GG