SURFACE VEHICLE RECOMMENDED PRACTICE

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Superseding J661 NOV2012

Brake Lining Quality Test Procedure

RATIONALE

The SAE J661 Recommended Practice was developed in the 1950s as a quality control test for friction material manufacturers. Since that time, significant variation has been found in test results, making it difficult to assign a friction coefficient identification per SAE J866. This revision specifies the permissible variation for recertification testing as compared to the original certification results.

1. SCOPE

The purpose of this SAE Recommended Practice is to establish a uniform laboratory procedure for securing and reporting the friction and wear characteristics of brake linings. The performance data obtained can be used for in-plant quality control by brake lining manufacturers and for the quality assessment of incoming shipments by the purchasers of brake linings.

2. REFERENCES

There are no referenced publications specified herein.

3. EQUIPMENT

A typical, commercially available machine as used in the preparation of this test procedure and known as a friction materials test machine is shown in Figures 1 and 2. The friction materials test machine shall be equipped with suitable means for:

a. Measuring the drum temperature.

b. Heating the drum.

c. Controlling the drum heating rate.

d. Cooling the drum from the back side only.

e. Controlling the drum cooling rate.

f. Measuring friction force.

g. Measuring drum rotational speed.

Means shall be provided for measuring specimen thickness and mass.

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The temperature measuring means shall incorporate a welded thermocouple, coin silver slip rings, silver-graphite brushes, and an indicator and/or recorder having a high input impedance.

The drum heating means shall be adjusted as follows and remain so during the test, with the drum rotating at 417 rpm, cool from 149 to 93 °C (300 to 200 °F) with cooling air on. Then cool to 82 °C (180 °F) with cooling air off. Turn on heaters at 82 °C (180 °F) and start timing. Heat for 10 minutes. Drum temperature shall be 221 °C ± 14 °C (430 °F ± 25 °F) at 10 minutes.

The drum cooling means shall be adjusted as follows with the drum rotating at 417 rpm, and after having heated the drum with the heater elements to 371 °C (700 °F), turn off the heaters and turn on cooling air. Cool to 343 °C (650 °F) and start timing. Cool for 10 minutes. Drum temperature shall be 93 °C ± 14 °C (200 °F ± 25 °F) at 10 minutes.

The temperature measuring system shall have ±2% full-scale accuracy.

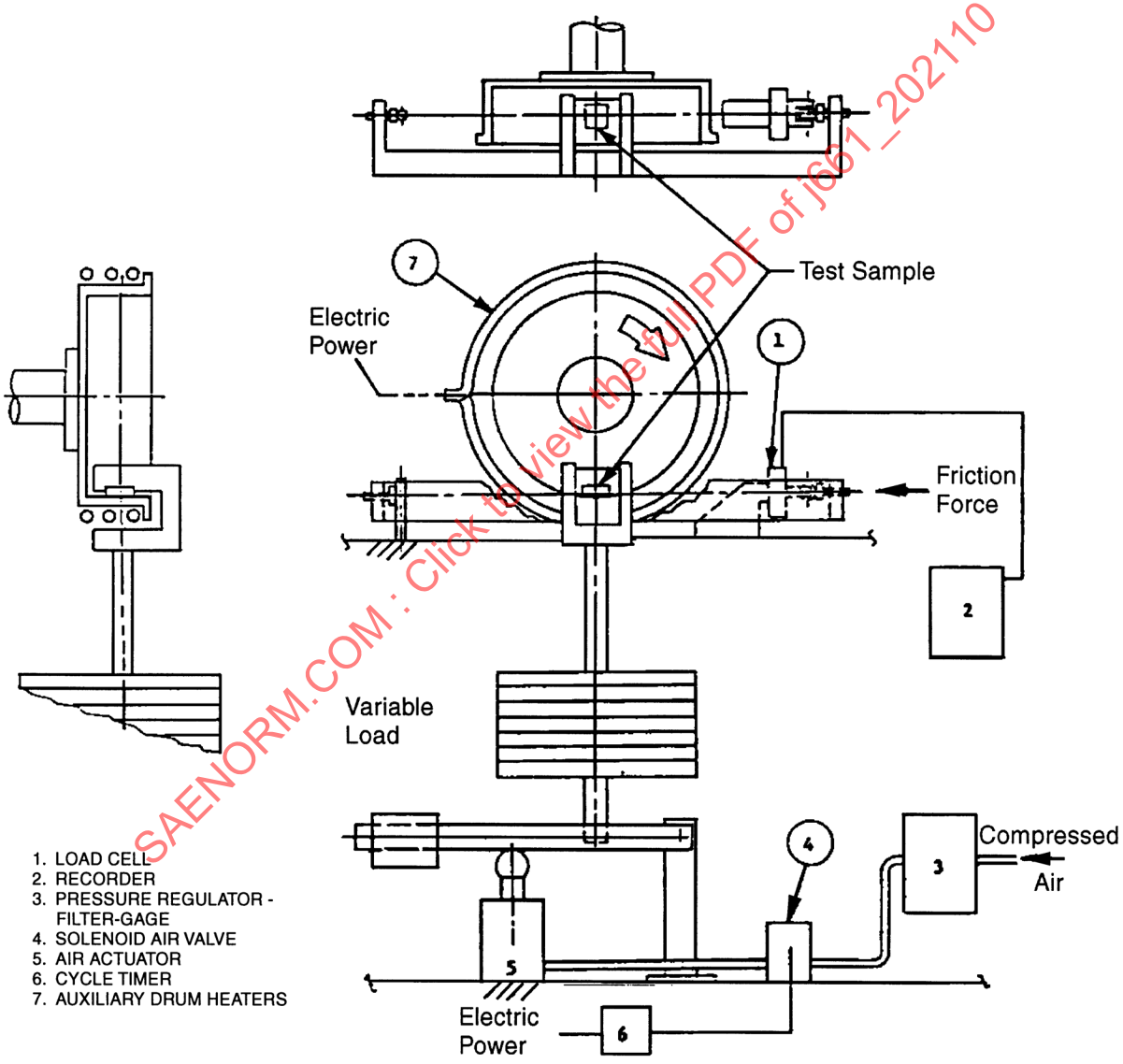

Figure 1 - Schematic diagram of friction materials for test machine

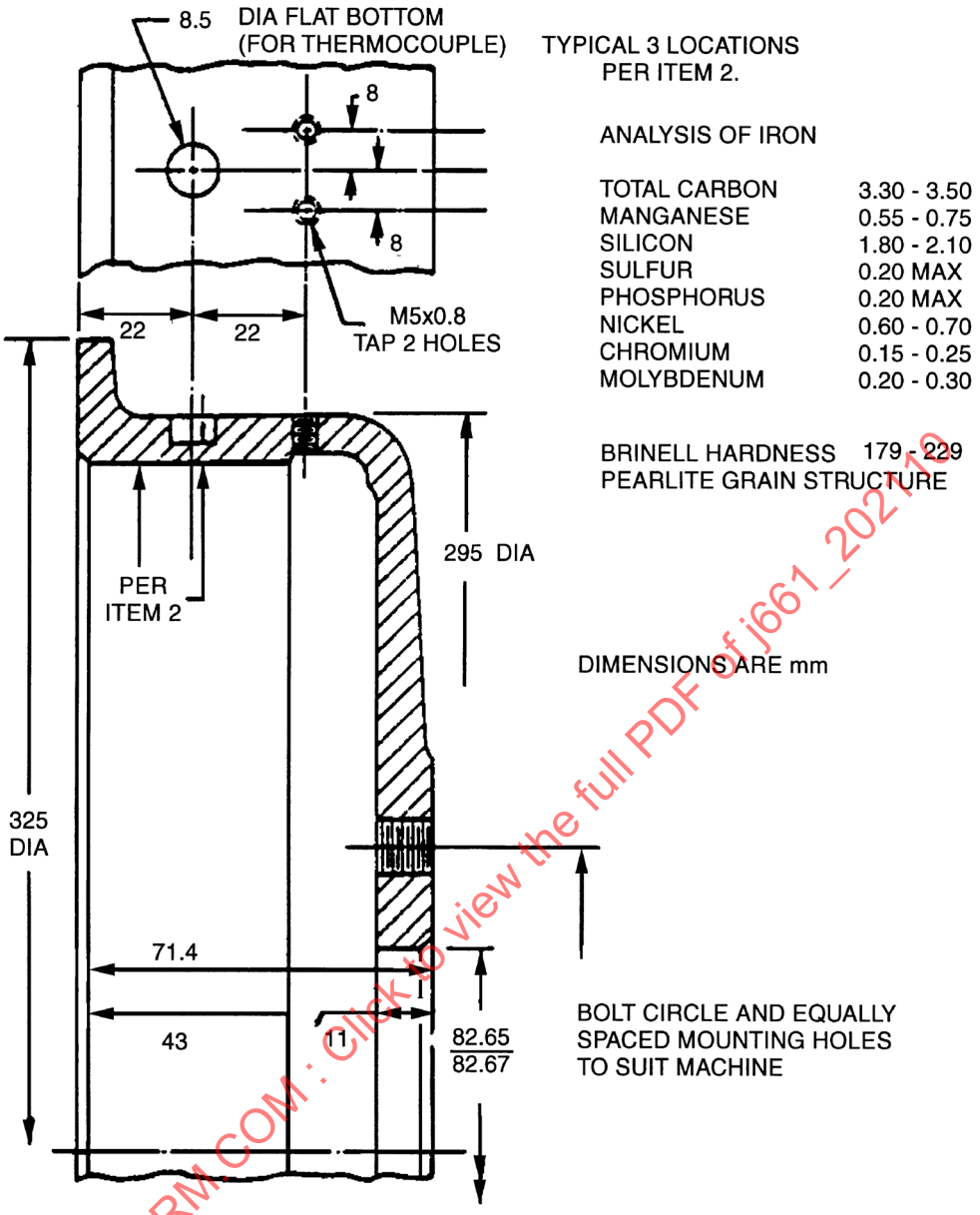

Figure 2 - Friction materials test machine drum

The friction force measuring system shall have ±2% full-scale accuracy.

The drum speed measuring system shall have ±2% full-scale accuracy.

The drum shall be used only between the inside diameter limits of 277.4 to 279.9 mm (10.920 to 11.020 inches) and have three thermocouple locations, one each at depths of 2.55 mm (stamped number 1), 3.05 mm (stamped number 2), and 3.55 mm (stamped number 3) from the new drum surface diameter of 277.4 mm (10.920 inches).

The thermocouple should be mounted in the position indicated in Table 1:

Table 1 - Thermocouple positions

Drum Inside Diameter	Location in Drum
277-278 mm	1
278-279 mm	2
279-280 mm	3

4. TEST CONDITIONS

Actual tests for performance shall be started when preparations have been completed in accordance with Section 5.

4.1 Conduct of Test

All testing shall proceed without interruption.

4.2 Drum Speeds

All drum speeds (rpm) are based on a nominal 279.4 mm (11.0 inch) diameter drum with load applied to the specimen.

5. PROCEDURE

5.1 Preparation of Test Specimen

The test specimen shall be taken from the center of the friction material approximately equidistant from each end.

The test specimen shall have dimensions of 25.4 x 25.4 mm (1.0 x 1.0 inch), flat on the bottom, and the radius of the working surface shall conform to the radius of the test drum. On pre-ground linings, remove at least 0.3 mm (0.01 inch), but not more than 0.5 mm (0.02 inch) from the working surface of the specimen. For unground linings (directly from molds), remove 1.0/1.2 mm (0.04/0.05 inch) to be certain that the resin impregnated surface is totally removed. Specimen thickness (or specimen plus shim) should be approximately 6 mm (0.24 inch) measured at the center of specimen. Excess of material must be removed from the side opposite the working surface of the specimen. In cases where nominal lining thickness is less than 5 mm (0.20 inch), remove a minimum amount of material from the side opposite the working surface to produce flatness.

The working surface of the specimen shall not be handled and shall be kept free from foreign material.

5.2 Preparation of Test Drum Surface

5.2.1 New or Resurfaced Drum

After grinding the drum surface on the test machine, remove all grinder marks by polishing with abrasive paper or cloth. Final polishing shall be with 320 grit. Remove dust from drum with clean dry cheesecloth, white paper toweling, or equivalent. Complete the surface preparation by running a ference specimen continuously at 440 N (100 pounds), 417 rpm, and not over 93 °C (200 °F) until the friction coefficient has stabilized.

5.2.2 Prior to Each Test

Polish the drum surface with abrasive paper or cloth. Final polishing shall be with 320 grit. Remove dust from the drum with clean cheesecloth, white paper toweling, or equivalent.

5.3 Conditioning of Test Specimen

The specimen is burnished at 312 rpm, 440 N (100 pounds), and a maximum temperature of 93 °C (200 °F), for a minimum of 20 minutes, to obtain at least 95% contact.

5.4 Initial Thickness and Mass Measurement

Specimen thickness measurement is taken in three places along the axis parallel to the drum axis (open, center, and closed edges) and recorded. Weigh, to nearest milligram, and record. Reseat specimen by running continuously for 5 minutes at 222 N (50 pounds) and 208 rpm. Initial clearance between specimen and drum should be 0.3 to 0.4 mm in the “OFF” position.

5.5 Initial Wear Measurement

With drum stationary and its temperature between 88 °C (190 °F) and 99 °C (210 °F) with 667 N (150 pounds) on specimen, obtain indicator reading of height of specimen holder and record.

6. TEST RUNS

6.1 Baseline Run

Run 10 seconds “ON” (load applied) and 20 seconds “OFF” (load removed) at 667 N (150 pounds) and 417 rpm for 20 applications.

Start run at a drum temperature of 82 to 93 °C (180 to 200 °F) and maintain the maximum and minimum temperature during each successive application between 82 to 104 °C (180 to 220 °F) with the use of cooling air. Turn cooling air off on 20th load application.

6.2 First Fade Run

Allow drum to cool with drum rotating and heating and cooling means off. At 82 °C (180 °F), apply specimen and energize heating elements. Run continuous drag at 667 N (150 pounds) and 417 rpm. Run for either 10 minutes or until 288 °C (550 °F) is attained, whichever occurs first. Take readings of friction force at intervals of 28 °C (50 °F), starting at 93 °C (200 °F). Record time required to reach 288 °C (550 °F).

6.3 First Recovery Run

Immediately following completion of first fade run (6.2), turn off heater and turn on cooling means and make a 10 second application at 667 N (150 pounds) and 417 rpm at 260 °C (500 °F), 204 °C (400 °F), 149 °C (300 °F), and 93 °C (200 °F) during cooling.

6.4 Second Wear Measurement

Repeat initial wear measurement (5.5).

6.5 Wear Run

Run 20 seconds “ON,” 10 seconds “OFF,” at 667 N (150 pounds) and 417 rpm for 100 applications. Start run at a drum temperature of 193 to 204 °C (380 to 400 °F) and maintain maximum and minimum temperature during each application between 193 to 216 °C (380 to 420 °F) with use of cooling air.

6.6 Third Wear Measurement

Immediately upon completion of wear run (6.5), cool to 88 to 99 °C (190 to 210 °F) and repeat initial wear measurement (5.5).

6.7 Second Fade Run

Upon completion of third wear measurement, allow drum to cool with drum rotating and heating and cooling means off. At 82 °C (180 °F), apply specimen and energize heating elements. Run continuous drag at 667 N (150 pounds) and 417 rpm. Run for either 10 minutes or until 343 °C (650 °F) is attained, whichever occurs first. Take readings of friction force at intervals of 28 °C (50 °F), starting at 93 °C (200 °F). Record time required to reach 343 °C (650 °F).

6.8 Second Recovery Run

Immediately upon completion of second fade run (6.7), turn off heater and turn on cooling means and make a 10 second application at 667 N (150 pounds) and 417 rpm at 316 °C (600 °F), 260 °C (500 °F), 204 °C (400 °F), 149 °C (300 °F), and 93 °C (200 °F) during cooling.

6.9 Baseline Rerun

Repeat baseline run (6.1).

6.10 Final Wear Measurement

Repeat initial wear measurement (5.5).

6.11 Final Thickness and Mass Measurements

Measure and weigh as described in initial thickness and mass measurements (5.4).

7. SELECTION OF PLOT POINT FOR FRICTION COEFFICIENT VALUE

During intermittent application runs, the friction coefficient values are taken at the end of the application.

8. PRESENTATION OF TEST DATA

8.1 Data should be presented on master form log sheet (Figure 3).

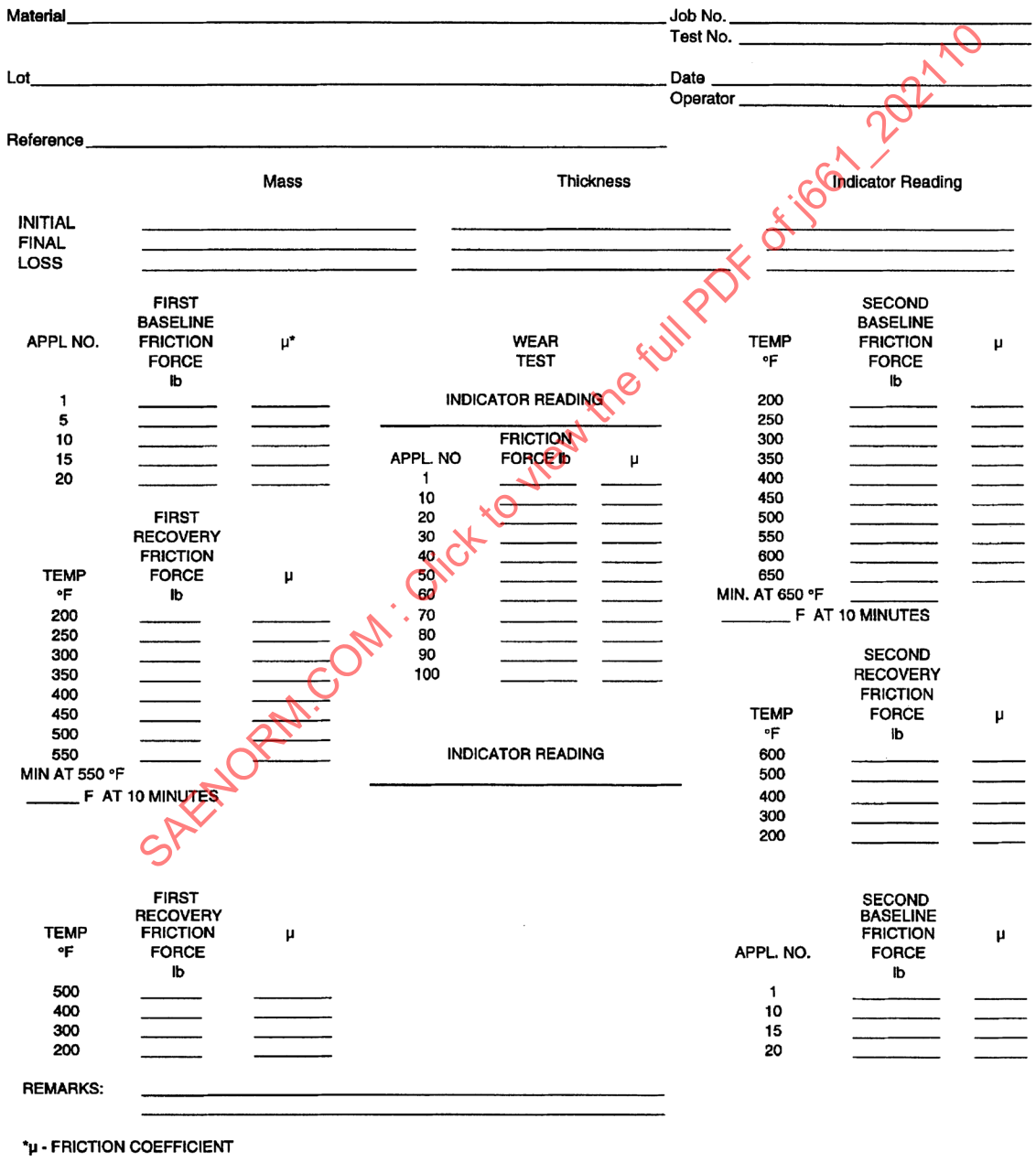

Figure 3 - Master form log sheet

8.2 Data should be plotted on master form plot sheet (Figure 4).

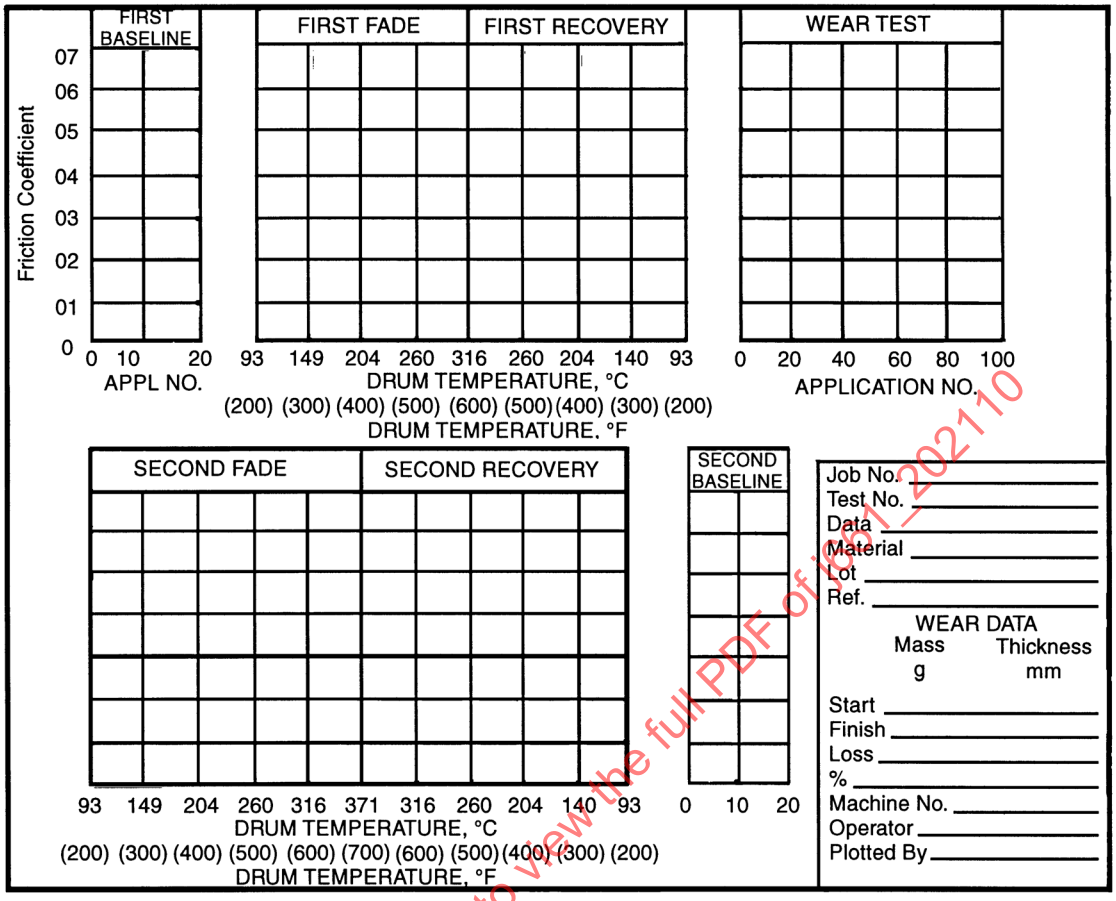

Figure 4 - Master form plot sheet

8.3 It is not uncommon for friction materials to produce normal or hot friction coefficients near the boundaries between code letter being either slightly above or slightly below the boundary values (0.15, 0.25, 0.35, 0.45, or 0.55). This usually causes issues for re-testing of materials for quality control or recertification due to natural variations in the friction test as well as natural variations in the material being tested. As a result, a tolerance is allowed to maintain the original certification code letters.

8.3.1 When crossing the boundary values between code letters, recertification testing must fall within ±0.05 of the original friction coefficient level to maintain the same letter code. All recertification testing shall use the friction coefficients from the original certification to determine the permissible variation.

The examples below illustrate the range for which the original letter code still applies using the ±0.05 recertification allowance if necessary. See Figure 5 for graphical representations:

a. 0.325 original allows up to 0.375 for recertification.

b. 0.345 original allows up to 0.395 for recertification.

c. 0.375 original allows down to 0.325 for recertification.

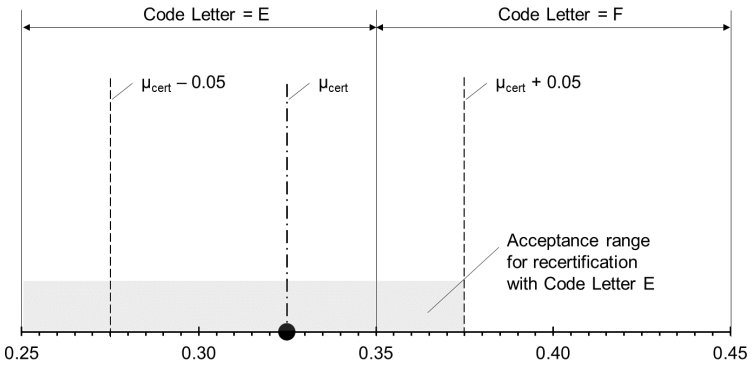

Figure 5A - Original certification friction level of 0.325 (code letter = E)

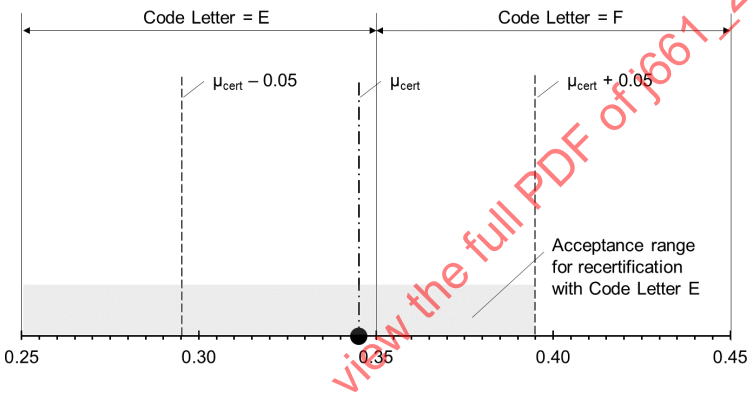

Figure 5B - Original certification friction level of 0.345 (code letter = E)

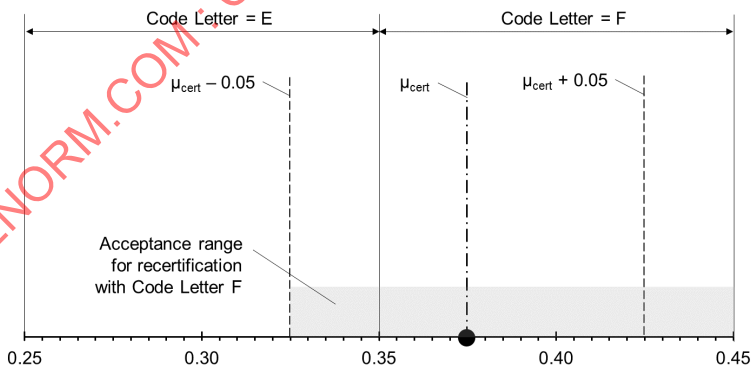

Figure 5C - Original certification friction level of 0.375 (code letter = F)

Figure 5 - Examples of acceptable ranges considering the recertification

8.3.2 Recertification information needs to appear on the SAE J661 brake lining summary test report cover page (see Figures 6 and 7).