WEST VIRGINIA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
MATERIALS CONTROL, SOILS AND TESTING DIVISION

MATERIALS PROCEDURE

# PROCEDURAL GUIDELINES FOR MAINTAINING CONTROL CHARTS FOR AGGREGATE GRADATION

1.0 PURPOSE

1.1 To set forth a standard method for developing and maintaining control charts to evaluate the grading characteristics of mineral aggregates.

2.0 SCOPE

2.1 Control charts shall be maintained for aggregates, for bases or sub-bases, portland cement concrete pavement, structural concrete, bituminous concrete, etc. These procedures will be applicable to both job control and record samples.

3.0 GENERAL PROCEDURES

3.1 Control charts shall be prepared on a 10 x 10 cross section paper of approximately 560 mm width. A chart length of approximately 760 mm shall be displayed at all times. When standard cross section sheets are used, the most recent sheet shall be displayed and the previous sheets shall be placed chronologically in a holder.

3.2 The item number and/or description of the material shall be noted on the top of the chart and visible at all times.

3.3 Control charts shall be maintained at locations where gradation samples are taken. It is the intent to have the procedures, outlined hereinafter, used in all instances in which it can be reasonably and logically applied. The applicability of the procedure will normally depend on the quantity of material used, the

continuity of delivery, etc. The moving average may not necessarily be continuous for the entire project. A new moving average series may be started when there are periods of inactivity, changes in materials or processes, change in job mix formula, resuming operations after correcting deficiencies, etc.

4.0 PREPARATION OF CONTROL CHARTS

4.1 Scale

4.1.1 The control chart shall have a vertical scale of one division equal to one percentage point (or 25.4 mm = 10%), except in the following cases: (a) A vertical scale of two divisions equal to one percentage point (or 25.4 mm = 5% shall be used for any sieve which has a specification tolerance range ≤10; (b) in the case of coarse aggregates used in portland cement concrete, a vertical scale of one division equal to 1/10 percentage point (or 25.4 mm = 1%) shall be used for the 75 μm.

4.1.2 On the horizontal scale, test values will be plotted on the heavy, vertical lines (25 mm apart), progressing from the left to the right.

4.2 General Arrangement

4.2.1 Control charts shall be arranged on the cross section paper in the manner described hereinafter; an example of the arrangement is shown in Figure 1.

4.2.2 The largest sieve size shall be located toward the top of the chart and the smallest sieve toward the bottom of the chart. The spacing between the lower limit of one sieve and the upper limit of the adjacent sieve shall be a minimum of 25 mm.

4.2.3 The vertical scale for each sieve shall be arranged so that the heavy lines shall have a value of zero or a value which is a multiple of five.

4.2.4 Lines corresponding to the upper and lower limits on the specification shall be drawn in red (pen or pencil) across the graph. At the beginning and end of each sheet (or the length of the displayed portion), (a) vertical red line shall be drawn between the specification limits

of each sieve, (b) an arrow shall be placed at the end of each vertical line, (c) the specification limits shall be indicated above and below the arrows, and (d) the sieve size and scale shall be indicated between the limits, on the outside of the displayed portion of the chart.

4.2.5 Inside the solid red lines which define the specification limits, two green, dashed lines shall be drawn. (Note exception in 4.2.6). These lines shall be located parallel to the specification lines and at a distance from each specification line equal to approximately 20 percent of the specification range. The band between the green, dashed lines and the specification lines shall be known as the caution band. This band shall be shaded a light yellow or amber to symbolize the caution which the Contractor should exercise to prevent the quality of his work from going outside the specification limits.

4.2.6 For screens specifying 100% passing, plotting of caution bands is not necessary; and for the bottom screen when the lower specification limit is zero percent, plotting of the lower band is not necessary.

5.0 PLOTTING OF TEST DATA

5.1 Symbols and Color Code

5.1.1 Individual test values shall be plotted with a blue color pen, or pencil, using the symbol ⊙ (The circle shall be approximately 2.5 mm in diameter.)

5.1.2 Averages of consecutive five test values shall be plotted with a red color pen, or pencil, using the symbol ⊡ . (The square shall be approximately 2.54 mm on either side.)

5.1.3 Record sample tests shall be plotted with a green colored pen, or pencil, using the symbol Δ . (The sides of the triangle shall be approximately 2.5 mm.)

5.2 Individual Test Values and Moving Average

5.2.1 Test values shall be rounded to the nearest whole percentage point and plotted, except the 75 sieve shall be rounded to the nearest one tenth (0.1) of the percentage point then plotted.

5.2.2 The moving average is the average of five consecutive test values and is determined by starting with the fifth test value and averaging it with the four preceding test values, and plotting the average, thereafter, will be calculated in a similar manner and plotted on the appropriate line. The moving average at the start of the job is not determined until the second test result is obtained. The moving average for the second through fourth test results is the average of all the previous test results. Rounding procedures for the average will be the same as described above for the individual test values.

5.2.3 As successive symbols are plotted across the control chart, from the left to the right, the blue symbol ○. shall be connected with a dashed blue line as depicted in Figure 1, and the red symbols Δ shall be connected with a solid red line.

5.2.4 Additional samples, if taken, shall be plotted on successive heavy lines and treated in the same manner as above.

5.2.5 At the bottom of the cross section paper and immediately to the left of the heavy vertical line on which test data is plotted, the following information shall be written:

(I) The laboratory number assigned to the test.

(II) The initials of the person plotting the test data.

(III) The date sampled.

6.0 INDIVIDUAL OR MOVING AVERAGE TEST VALUES OUTSIDE SPECIFICATIONS

6.1 Individual Test Values

6.1.1 When an individual test value on a sieve is outside the specification limits, or differs markedly from those preceding it, the Project Engineer/Supervisor and the Contractor shall be promptly advised. The Contractor shall immediately take any steps that may be necessary to bring the production under control.

6.2 Moving Average

6.2.1 When the average of consecutive five test values falls in the caution zone, the Contractor shall be advised that the material is, or is becoming, borderline, and the following notation shall be made in the plant diary:

"Contractor advised that _____ material is borderline."

(Write item number for base coarses, or aggregate size and item number for other materials in the blank space.)

6.3 Material Outside Specification Limits

6.3.1 When three consecutive tests are outside specification limits, or when the moving average of the consecutive five tests falls outside the specification limits, the Contractor shall be promptly advised that the material is non-conforming, and he shall immediately take necessary steps to correct the deficiencies. When the moving average falls outside the specification limits and the two immediately following individual test values are also outside specification limits, operations shall be discontinued until the Contractor gives reasonable assurance that the deficiency has been corrected. After the Contractor has taken significant steps to correct deficiencies, the next individual sample that meets the specifications after production is resumed shall be used to start a new moving average.

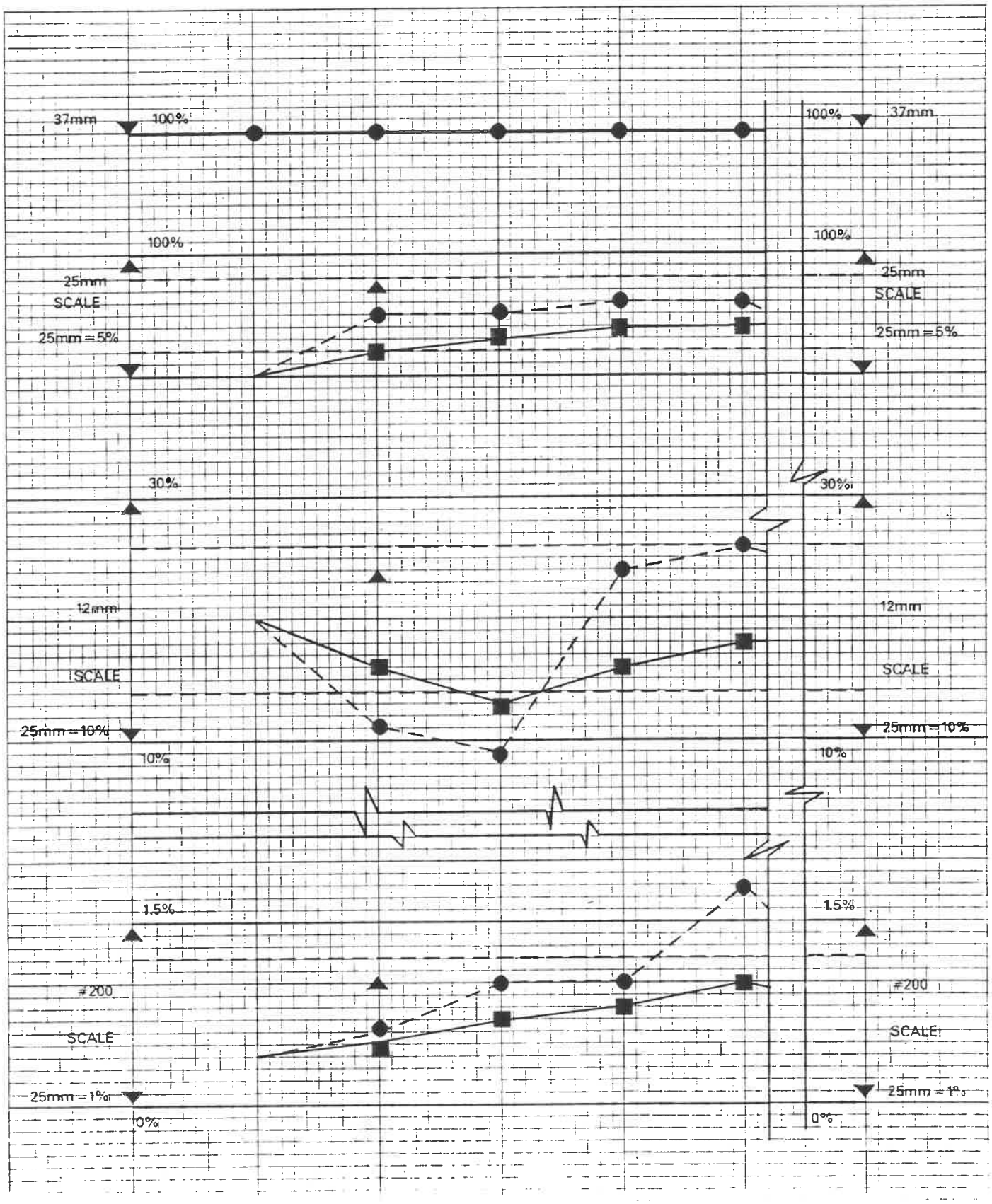
7.0 RECORD SAMPLE TESTS

7.1 Upon receipt of the record sample test results, the test values shall be plotted on the heavy line corresponding to the date the record sample was taken, in accordance with the applicable procedures in Section 5.1.3 and 5.2.

Gary L. Robson, Director
Materials Control, Soils
and Testing Division

GLR:b

Attachments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