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

MATERIALS PROCEDURE

DOCUMENTATION PROCEDURE FOR AGGREGATE GRADATION BY MEANS OF MARK SENSOR CARDS

1.0 PURPOSE

1.1 This procedure will detail the development, use, and distribution of mark sensor Cards which will serve both as a computer input medium and as a record at the District level.

2.0 SCOPE

2.1 The procedure described shall apply to the recording of all aggregate gradation data associated with Form T-731 and Form T-732. Specific application is as defined in Section 4.0.

3.0 APPLICABLE DOCUMENTS

MP 300.00.51
MP 401.02.23
MP 601.03.51
MP 601.03.52

4.0 GENERAL PROCEDURE

4.1 Application and Distribution of Aggregate Gradation Data - Three different mark sensor Cards are used to record all aggregate gradation data applicable to this procedure. These Cards are designated T-731A (Card #1), T-731B (Card #2), and T-732 (Card #3). The selection depends upon what type of aggregate gradation is being recorded. In this procedure there are three types of aggregate gradations defined: (1) general aggregate gradation such as base coarse, subgrade, etc;

(2) bituminous concrete aggregate gradations such as aggregate for use in wearing I, base I, etc; (3) Portland Cement concrete aggregate gradations such as aggregate for use in concrete pavement, structures, etc.

4.1.1 General Aggregate Gradation Data - The general aggregate gradation data is recorded on Cards T-731A and T-731B, each of which contains a hard (top) copy and two soft copies. After recording the data, the hard copy of both Cards will be forwarded through District Materials to Materials Control, Soils and Testing (MCS&T) Division on a daily basis. One soft copy of each will be maintained at the project and the other soft copy of each will be forwarded to and maintained at District Materials. Detailed instructions concerning data recording procedures are contained in Section 5.0.

4.1.2 Bituminous Concrete Aggregate Data - The recording of bituminous concrete gradation data utilizes all three Cards, that is T-731A, T-731B, and T-732. Each Card contains a hard (top) copy and two soft copies. After recording the data, distribution of the Cards will be similar to that described in 4.1.1 with the following exception: one soft copy of each will be maintained at the plant site instead of at the project. Detailed instructions concerning data recording procedures are contained in Section 6.0.

4.1.3 Portland Cement Concrete Aggregate Data - Portland Cement concrete gradation data is recorded on Cards T-731A and T-731B. After recording the data, distribution will be as described in 4.1.2. Detailed instructions concerning data recording procedures are contained in Section 7.0.

4.1.4 Upon receipt by (MCS&T), the data contained on the applicable mark sensor Cards will be entered into the master data bank. The data will be evaluated in accordance with the governing contract documents and transmitted back to the District in the form of a computer printout.

4.1.5 Control charts will be maintained and moving averages calculated in accordance with MP 300.00.51, MP 401.02.23, or MP 601.03.51 (whichever is applicable).

5.0 RECORDING PROCEDURE FOR GENERAL AGGREGATE GRADATION DATA

5.1 All developed information for this type will be recorded on Cards T-731A and T-731B (see 4.1.1 for distribution information). These two Cards will be linked together by a common District Materials Laboratory Number and will become the T-731 record. All gradation tests will be conducted in accordance with current Division procedures. The gradation and other pertinent data will be recorded on the Cards in accordance with the following instructions:

5.2 Card T-731A - (Card #1)

5.2.1 Laboratory Number - Columns 2 through 14 (each Column is identified at the bottom of the Card).

(a) Column 2 - Contains one of the following letter designations dependent upon the application of the sample (see Attachment #1 for alphabetic character coding instructions):

C - all Quality (process) Control samples taken and tested by the contractor

O - all Quality (process) Control samples taken and tested by the Contractor, witnessed by the Division, and used for acceptance

M - all samples taken and tested by the Division and used for acceptance in conjunction with the Contractor's Quality Control Program

D - all samples taken and tested by the Division for items and work not required to be tested by the Contractor

(b) Column 4 - Contains the number of the applicable District.

(c) Columns through 14 - Contains the actual laboratory number assigned by the District to identify the sample

Example: M567402

Where: "M" identifies an acceptance sample taken and tested by the District in conjunction with the Contractor's Quality Control Program

"5" identifies the District that took the sample (District 5)

"67402" - the laboratory number assigned to the sample by the District

5.2.2 Material Type - Columns 16 through 22 - If the material type contains less than four digits, the entry will be right hand justified, that is, the number will be positioned so that the last digit falls in Column 22. The following material types (codes) shall be used dependent upon the type or use of the aggregate:

Material	Code (Material Type)
All AASHTO sizes (Table 703.4 of Standard Specifications)	Enter the standard stone size number, right hand justified. Example: No. 57 gravel; enter 57.

In addition to the size number to identify aggregates (example: 57), the following identification shall be placed in Column 16 to specify the type of aggregate:

Type of Aggregate	Identification Number
Limestone	1
River Gravel	2
Slag	3
Gravel & Slag (combination)	4
Sandstone	5
Limestone & Gravel (combination)	6

Example of the above - A Number 57 limestone would have the following code:

Column:	16	18	20	22
Entry:	1		5	7

Example - A number 467 gravel and slag mixture would have the following code:

Column:	16	18	20	22
Entry:	4	4	6	7

When material is used other than that described above (AASHTO sizes) the following codes will be utilized dependent upon the type and/or use of the aggregate (these codes all contain four digits, and therefore need no identification number):

Material (other than AASHTO sizes)	Code
Granular Material	2072
Material for Embankment	2073
Select Backfill	2122
Cement Treated Base	3011
Bituminous Treated Base	3023
Open Graded Bituminous Treated Free Draining Base	3041
Class 8 Aggregate	3088
Class 9 Aggregate	3089
Aggregate Subbase	3142
Penetration Macadam #3	4033
Penetration Macadam #7	4037
Penetration Macadam #8	4038
Asphaltic Patch Ls/G	4121
Asphaltic Patch Slag	4122
Sand for PCC	7021
Manufactured Sand	7023
Manufactured Sand	7027
Silica Sand	7028
Pea Gravel	7032
Base or Subbase CL 1	7041
Base or Subbase CL 2	7042
Base or Subbase CL 4	7044
Base or Subbase CL 5	7045
Base or Subbase CL 6	7046
Filter Material	7047
Calcium Chloride Grade A Class I	7151

Material (other than AASHTO sizes)	Code
Sodium Chloride T1 G1	7152
Sodium Chloride T1 G2	7153
Agricultural Limestone	7155
SRIC Abrasive	8006
Unit Weight - Cols. 36-40	8148
Face Fracture (inclusive)	8149

If only one face fracture is to be reported, enter the percent one-face in Columns 64 and 66 on Card 2. Enter zeros in Columns 68 and 70. If entering the value for two or more face fractures, enter percent fracture in Columns 68 and 70. Report all face fracture percentages to nearest whole number.

Plastic Index	8150
Liquid Limit - Cols. 60 & 62 (Card No. 2)	
Plastic Limit - Cols. 64 & 66 " " "	
Plastic Index - Cols. 68 & 70 " " "	

There are some instances where a material is used on a very infrequent basis and consequently is not even included in the Standard Specifications. The codes given to these materials depend upon the number of sieves needed and whether or not the 75 μm is required. The following table lists both the general aggregate types as well as the bituminous concrete extraction types:

Aggregates

No. of Sieves	Code WO/75 μm	Code W,7/75 μm
75 μm only		8110
1	8111	8121
2	8112	8122
3	8113	8123
4	8114	8124
5	8115	8125
6	8116	8126
7	8117	8127

Bituminous Concrete Extractions

No. of Sieves	Code WO/75 µm	Code W/75 µm
1	8131	8141
2	8132	8142
3	8133	8143
4	8134	8144
5	8135	8145
6	8136	8146
7	8137	8147

5.2.3 Quantity - Columns 24 through 30 - Enter the quantity represented by the sample in units normally used to measure the material being tested. These quantities will be rounded to the nearest whole number. Right hand justify this entry.

Example: 134 Mg

Column	24	26	28	30
Entry		1	4	8

5.2.4 Date - Columns 32 through 40 - This entry is set up for the month, day, and year in that order and as follows:

Month - Columns 32 and 34
Day - Columns 36 and 38
Year - Column 40 (only include the last digit in the year)

Example: May 2, 1985

Column:	32	34	363840
Entry:	0	5	0 2 5

Example: October 15, 1985

Column:	32	34	363840
Entry:	1	0	1 5 5

5.2.5 Project Number - Columns 42 through 74 - Enter the project number when applicable beginning with Column 42 (left hand justify). Do not leave spaces or attempt to use special characters. As an example, a project number such as I-77-3(28)43 would be I7732843. If a project number is too long for the spaces provided, drop those characters on the right which would overfill the space provided. In the case of multiple project numbers enter each separated by a space. Should the string of project numbers be too long for the space provided drop those characters which overfill the space.

5.2.6 Contract Number - Column 76 - Enter the contract number of the project where applicable. If there is no contract number, leave Column 76 blank.

5.2.7 Test Sequence - Column 78 - This column indicates the sequence in which the tests are conducted each day. The first tests on a particular day (it could be the only test) will be number one, the second test would be coded number two, and so forth. The sequence will begin at number one for each 24 hour period. One exception to this however, is when a new moving average is started. In this case the first test in any new moving average is always coded number 5. If another test is taken that same day, this test is coded number 6, and so forth. The following day the codes would be as described above as 1, 2, etc., until a new moving average is started.

5.2.8 Card Sequence - Column 80 - Card T-731A will always be coded Card Number One (1).

5.3 Card T-731B - (Card #2)

5.3.1 Laboratory Number - Columns 2 through 14 - This entry will be the same as that entered on Card T-731A (Card #1), and in the same manner.

5.3.2 Item or Plant Code - Columns 16 through 24 - Enter the item number covering the intended use of the material. Right hand justify this entry.

5.3.3 Source Code - Columns 26 through 34 - Enter the source code of the original producer of the aggregate.

5.3.4 Gradation Data - Columns 36 through 76 - Begin entry of test data with the smallest sieve at right and proceed towards the left. Columns 72, 74 and 76 are reserved for the 75μm, which is reported to the nearest 0.1 percent, with the implied decimal between Columns 74 and 76. All other sieves are reported to the nearest whole number. Enter the results of the next size above the 75 μm in Columns 68 and 70; right hand justifying the entry. Sieve sizes to be reported must be identical to those listed in the specification requirements. Do not report any sieves used as interceptors which are not a part of the specification requirements. Continue recording results of the sieve sizes in ascending order up to and including the size where 100 percent must pass. Leave the remaining Columns blank. There is one exception to these instructions:

A few materials have three sieves or less in their governing specifications. In this case, by following the above instructions, one finds that a two Column space is reached (in proceeding from right to left) in which to record 100%. In this case record the two zeros. As an example consider a Class 5 base aggregate with requirements on the 5 mm, 4.75 mm, and the 75 μm. For such a material we find the following results 5 mm-100%, 4.4.75 mm - 70%, and 75μm - 17.5%. It would be recorded in the following manner.

Column:	64	66	68	70	72	74	76
Entry:	0	0	7	0	1	7	5

5.3.5 Evaluation - Column 78 - The evaluation of the test result will be entered in accordance with the following code:

Situation	Code
Material meets specification requirements	1
Material does not meet specification requirements	0

5.3.6 Card Sequence - Column 80 - Card T-731B will always be Card number two.

6.0 RECORDING PROCEDURE FOR BITUMINOUS CONCRETE AGGREGATE DATA

6.1 All developed information for this type will be recorded on Cards T-731A, T-731B, and T-732. These Cards will be linked together by a common District materials laboratory number and will become the T-732 record. All tests will be conducted in accordance with current Division procedures. Refer to 4.1.2 for Card distribution. The appropriate data will be recorded on the Cards in accordance with the following instructions:

6.2 Card T-731A - (Card #1)

6.2.1 All entries are made on this Card in accordance with the instructions detailed in Subsection 5.2 with the following exceptions:

6.2.1 (a) Article 5.2.2 - Material type will be as indicated in article 6.2.2.

(b) Article 5.2.5 - No project number will be entered on this Card for bituminous concrete aggregate data.

6.2.2 Material Type - Columns 16 through 22 - All the following material type codes contain only two digits. These two digits will always be right hand justified.

Material	Code (Material Type)
Base 1	B1
Base 2 or Patch and Level 1	B2
Patch and Level 2	P2
Wearing 1	W1
Wearing 2	W2
Wearing 3	W3
Hot Asphalt Emulsion 3/8" Top Sieve	E1

6.3 Card T-731B - (Card #2)

6.3.1 All entries are made on this Card in accordance with the instructions detailed in subsection 5.3 with the following exception:

(a) Article 5.3.3 - Source Code - see 6.3.2

6.3.2 Source Code - Columns 26 through 34 - Enter the plant code of the plant actually producing the bituminous concrete.

6.4 Card T-732 - (Card #3)

6.4.1 Laboratory Number - Columns 2 through 14 - This entry will be identical to the laboratory number entered on Cards T-731A and T-731B (section 6.0).

6.4.2 MC-14 Number - Columns 16 through 26 - Enter the (MCS&T) Laboratory Number assigned to the job mix formula which governs the proportioning of the mix. Material for maintenance will have no MC-14 number, in which case a "1" will be entered in Column 26.

6.4.3 Target Bitumen Content - Columns 28 and 30 - Enter the optimum percentage of bituminous material required in the mix to the nearest 0.1 percent. Material for maintenance will have no target bitumen content, in which case the actual bitumen content will be entered.

6.4.4 Actual Bitumen Content - Columns 32 and 34 - Enter the actual percentage of bituminous material in the mix as determined from this test to the nearest 0.1 percent.

6.4.5 Columns 36 through 78 - Nothing is entered in these Columns.

6.4.6 Card Sequence - Column 80 - Card T-732 will always be Card number three (3).

7.0 RECORDING PROCEDURE FOR PORTLAND CEMENT CONCRETE AGGREGATE DATA (A)

7.1 All developed information for this type will be recorded on Cards T-731A and T-731B (see article 4.1.3 for distribution information). These two Cards will be linked together by a common District materials laboratory number and will become the T-731 record. All tests will be conducted in accordance with current Division procedures. The gradation and other pertinent data will be recorded on the Cards in accordance with the following instructions:

7.2 Card T-731A (Card #1)

7.2.1 Entries are to be made on this Card in accordance with instructions detailed in Subsection 4.2 with the following exception:

(a) Article 5.2.2 - Material type will be as indicated in article 7.2.2

7.2.2 Material Type - Columns 16 through 22 - (These codes all contain four digits and therefore need no identification number).

Material Type Concrete Aggregate A	Code
Gravel Size #3 and Silica Sand	9003
Gravel Size #4 and Silica Sand	9004
Gravel Size #57 and Silica Sand	9057
Gravel Size #67 and Silica Sand	9067
Gravel Size #7 and Silica Sand	9007
Gravel Size #78 and Silica Sand	9078
Gravel Size #8 and Silica Sand	9008
Crushed Aggregate Size #3 and Silica Sand	9103
Crushed Aggregate Size #4 and Silica Sand	9104
Crushed Aggregate Size #57 and Silica Sand	9157
Crushed Aggregate Size #67 and Silica Sand	9167
Crushed Aggregate Size #7 and Silica Sand	9107
Crushed Aggregate Size #78 and Silica Sand	9178
Crushed Aggregate Size #8 and Silica Sand	9108

Gravel Size #3 and Manufactured Sand	9203
Gravel Size #4 and Manufactured Sand	9204
Gravel Size #57 and Manufactured Sand	9257
Gravel Size #67 and Manufactured Sand	9267
Gravel Size #7 and Manufactured Sand	9207
Gravel Size #78 and Manufactured Sand	9278
Gravel Size #8 and Manufactured Sand	9208

Crushed Aggregate Size #3 and Mfg. Sand	9303
Crushed Aggregate Size #4 and Mfg. Sand	9304
Crushed Aggregate Size #57 and Mfg. Sand	9357
Crushed Aggregate Size #67 and Mfg. Sand	9367
Crushed Aggregate Size #7 and Mfg. Sand	9307
Crushed Aggregate Size #78 and Mfg. Sand	9378
Crushed Aggregate Size #8 and Mfg. Sand	9308

7.3 Card T-731B (Card #2)

7.3.1 Laboratory Number - Columns 2 through 14 - Same instructions as that contained under 5.3.1.

7.3.2 Item or Plant Code - Columns 16 through 24 - Same instructions as that contained under 5.3.2.

7.3.3 Source Code - Columns 26 through 34 - Same instructions as that contained under 5.3.3.

7.3.4 Data - Columns 36 through 76

7.3.4.1 Columns 36, 38, and 40 - Enter the size of coarse aggregate used in the concrete mix (i.e., 57, 67, and 7). Right hand justify the entry.

7.3.4.2 Columns 42, 44, and 46 - The smallest sieve size through which one hundred (100) percent of the coarse aggregate passes will be in accordance with the following code:

Sieve Size Through Which 100% Passes	Code
63.5 mm	001
51 mm	002
38 mm	003
25 mm	004
19 mm	005
12.7 mm	006
9.5 mm	007

7.3.4.3 Columns 48, 50 and 52 - Enter the total solids target A. This value normally will be taken from the approved mix design. Report this A to the nearest 0.01 and right hand justify the entry.

7.3.4.4 Columns 54, 56, and 58 - Enter the total solids A determined in accordance with MP 601.03.51 and report this number to the nearest 0.01. Right hand justify the entry.

7.3.4.5 Columns 60 and 62 - Enter the fine aggregate A determined in accordance with MP 601.03.51 and report this number to the nearest 0.1.

7.3.4.6 Columns 64 and 66 - Enter the percent passing the 75 μm for the coarse aggregate. Report this figure to the nearest 0.1.

7.3.4.7 Columns 68 and 70 - Enter the percent passing the 75μm for the fine aggregate. Report this figure to the nearest 0.1.

7.3.2 Evaluation - Column 78 - See article 5.3.5 for instructions.

7.3.3 Card Sequence - Column 80 See article 5.3.6 for instructions.

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