METHODS OF SAMPLING AND TESTING
MT 201-13
SAMPLING ROADWAY MATERIALS

1 General

1.1 Sampling for evaluation of potential aggregate sources should be performed by a responsible, trained and experienced person. Because of the wide variety of conditions under which sampling may be done, it is not possible to describe detailed procedures applicable to all circumstances.

1.2 The sample bags must be tightly-woven and durable so that the required amount of sample can be shipped without rupture of the bag or loss of fine material through the fabric. Also, when tied, as in 1.3, the bag must be sealed tightly enough to prevent loss or contamination of the material.

1.3 Samples shall be double-tied as close to the gravel as possible with the necessary papers between the double tie. This procedure insures a good sample together with a legible laboratory sheet.

2 Referenced Documents

MT Materials Manual
MT 101 Making and Curing Concrete Compressive and Flexural Strength Field Test Specimens
MT 202 Sieve Analysis of Fine and Coarse Aggregate
MT 207 Centerline Soil Survey
MT 210 Moisture Density Relation of Soils Using a 5.5 lb. Rammer
MT 218 Determining Relative Compaction and Percent Moisture
MT 230 Moisture Density Relation of Soils Using a 10 lb. Rammer
MT 601 Materials Sampling, Testing and Acceptance Guide
MT 607 Procedure for Reducing Filed Samples to Testing Size

3 Number of Samples

3.1 The frequency of sampling as described in this procedure is the minimum required and more should be taken if deemed necessary.

4 Pre-construction Proposed Surfacing Sampling

4.1 Proposed surfacing samples should represent a vertical cross-section of the proposed source.

4.1.1 Describe each site or area investigated with each test hole, boring or test pit clearly located (horizontally and vertically) with reference to some established coordinate system or permanent monument on an area map or sketch.

4.1.2 Log each test hole, boring, test pit or cut-surface exposure with the field description and location of each material encountered clearly shown by Montana Department of Transportation symbols and word descriptions used on Form 30. An example of Form 30 is in MT 207.

4.1.3 Each aggregate layer that is included in the sample should be noted along with the depth of the water table if it is encountered should be shown on the log of test holes.

4.2 Overburden or clay seams may be sampled separately.

4.3 Rocks larger than 6 inches (150mm) in diameter shall not be included in the sample. However, the estimated percentage of rock larger than 12 inches (300mm); between 6 and 12 inches (150 and 300mm); between 4 and 6 inches (100 and 150mm); and less than 4 inches (100mm) in diameter shall be shown on the Prospected Area Report.

4.4 Representative samples shall be taken on the following basis:

4.4.1 Each sample shall be a minimum of 150 pounds (68 Kg).

4.4.2 Not less than 3 samples shall be taken from any proposed source.

4.4.3 Up to 50,000 cubic yards (38,230 cubic meters) - a minimum of 3 samples.

4.4.4 50,000 to 100,000 cubic yards (38,230 to 76,460 cubic meters) - 3 to 5 samples.

4.4.5 100,000 to 150,000 cubic yards (76,460 to 114,690 cubic meters) - 5 to 8 samples.

4.4.6 150,000 to 200,000 cubic yards (114,690 to 152,920 cubic meters) - 8 to 10 samples.

4.4.7 Providing the material is uniform, one sample may represent material from as many as ten test holes in large areas if provisions 4.4.1 through 4.4.6 above are met.

4.4.8 For large sources, a suggested sampling sequence is to take samples around the perimeter of the source with additional samples taken toward the middle to check for uniformity. Each proposed source is unique, however, and the final sampling sequence shall be determined by the District Materials Supervisor or Area Lab Supervisor.

4.5 The District or Area laboratory will determine the gradation, LL, PL, PI, soil class and 24-hour volume swell and submit to the Materials Bureau on a form 123. Also, a visual examination by the Materials Supervisor will be made. An interpretation of these results will determine if the material in the proposed source is worthy of further consideration.

4.5.1 Predominately Unacceptable - If the tests show the material to be predominately unsatisfactory and material of a better quality is available, no further consideration shall be given this source.

4.5.2 Uniformly Acceptable - If the tests indicate the material is uniformly satisfactory, at least one sample for every six tested in the District or Area laboratory (a minimum of three) shall be sent to the Materials Bureau. Each sample shall consist of 1-75 lb. (34 Kg) split for wear, gradation and other correlations (see note 1). Also, one 180 lb. (32 Kg) composite sample per source is required for Sodium Sulfate and Micro-Deval testing.

4.5.3 Spotty sources - If the tests indicate the material is spotty, at least one sample for every six tested in the District or Area laboratory (a minimum of one) for each of the areas (satisfactory, questionable, and unsatisfactory) shall be sent to the Materials Bureau for wear test, gradation check, evidence of disintegration, and other correlations. Also, one 180 lb. (32 Kg) composite sample per source is required for Sodium Sulfate and Micro-Deval testing.

Number of Representative Pounds from Each Hole to Make Composite

Holes	**Sodium Sulfate**	**Sodium Sulfate**	**Micro Deval**	**Micro Deval**
	Lbs.	**Kg**	**Lbs.**	**Kg**
2	120	54	60	27
5	24	11	12	5
10	12	5	6	3
15	8	4	4	2

Note 1 – Each area within a source that exhibits different physical characteristics should be sampled completely as per 4.5.2. In a large volume area one sample may be a composite of a series of holes of uniform material (example: sample number 1 may be a composite of holes 1 through 6; sample number 2 - holes 7 through 12; sample number 3 - holes 13 through 20, etc.) The example cited above is to be used as a guide only.

4.5.4 Material for each portion of the composite sample shall be obtained by quartering, splitting, recombining and splitting again according to MT 607 so that a homogenous mix is obtained. The material will be split so that no more than 77 lbs. (35 Kg) are placed in one bag.

4.5.5 The Core Drill Section, under the direction of the Geotechnical Section, can be utilized in problem areas where conventional equipment is inadequate. Assistance, either geologic or drilling, can be provided usually within a period of a month or six weeks.

5 Laboratory Form No. 99

5.1 The "Field Sample Analysis Report" Form No. 99 is to be used in reporting district or area laboratory tests. This information will be transferred to the "Available Surfacing Material Report" in Helena and will be available to prospective bidders, along with the usual Materials Bureau test results.

5.2 The District Materials Supervisor or Area Lab Supervisor is to use his experience and engineering judgment to give a summation of all information such as the past history of the source and his comments and recommendations regarding the laboratory test data which would include a statement as to which holes were represented by the Sodium Sulfate and Micro-Deval samples. This information will be placed on the bottom portion of Lab Form No. 99. However, the acceptance or rejection of the source will be the responsibility of the Materials Bureau in Helena when all testing is complete.

6 Laboratory Form No. 92

6.1 The field information on Laboratory Form No. 92 shall include a correct legal description of the deposit. In some cases, it may be necessary to have a survey party retrace the boundary lines and make section line ties before right-of-way negotiations can be completed. Where deposits are located adjacent to the highway right-of-way, the boundary lines of the deposit should be tied to the centerline and shown on Laboratory Form No. 92 so that a legal description can be prepared without any further field work. Under some circumstances, the Department of Transportation will obligate by purchase or option surfacing material sources for future construction projects and maintenance use.

6.2 Form No. 92 "Prospected Area Report" must be completely filled out especially with reference to definite location, total yardage represented by the samples, ownership, and depth of overburden. The haul distance shall be reported to the nearest one-tenth mile over the shortest and most practical route from the deposit to a definite station on the project.

6.3 A sketch shall be attached Form No. 92 showing the boundary lines of the deposit with all dimensions and ties neatly plotted to a scale that is indicated on the sketch. All test holes shall be numbered and shown in their correct location.

6.4 In those cases where areas are being explored on which data has been previously submitted, a new "Prospected Area Report" shall accompany the new sampling showing any laboratory numbers previously assigned.

7 Reports on Proposed Surfacing Sources

7.1 The Materials Bureau will issue a final report based on an evaluation of the district or area laboratory test data, the recommendations of the District Materials Supervisor or Area Lab Supervisor, and an interpretation of tests performed by the Materials Bureau.

8 Preconstruction Binder Samples

8.1 Binder samples shall be taken incidental to all proposed gravel source exploration. A 25 lb. (11 Kg) sample from each distinct type proposed for use shall be taken and tested in the district or area laboratory. Binder samples need not be sent to the Materials Bureau unless an unusual problem arises.

9 Size of Samples: Required for District, Area and Materials Bureau Testing

9.1 The sample size depends on 100% of the aggregate passing the specified sieve size. The amounts specified in the table below provide adequate material for routine testing (gradation, LL, PI, volume swell, etc.). Minimum Field Test sample sizes are in MT 202.

SPECIFIED 100% PASSING SIEVE SIZE	MINIMUM WEIGHT OF SAMPLE (See Note 2)
4.75 mm (4 Mesh)	14 Kg (30 lb.)
9.5 mm (3/8 Inch)	14 Kg (30 lb.)
12.5 mm (1/2 Inch)	14 Kg (30 lb.)
16.0 mm (5/8 Inch)	14 Kg (30 lb.)
19.0 mm (3/4 Inch)	14 Kg (30 lb.)
25.0 mm (1 Inch)	35 Kg (77 lb.)
37.5 mm (1½ Inch)	35 Kg (77 lb.)
50 mm (2 Inch)	35 Kg (77 lb.)
63 mm (2½ Inch)	35 Kg (77 lb.)

Note 2 – The sample shall be obtained by quartering or splitting to insure a representative sample. If necessary, the representative sample shall be split again so that no more than 77 lbs. (35 Kg) are placed in two bags.

10 Sampling from Stockpiles

10.1 When such sampling is necessary, every effort should be made to enlist the services of power equipment to develop a separate, small sampling pile composed of materials drawn from various levels and locations in the main pile after which several increments may be combined to compose the field sample.

10.2 Coarse Aggregate Stockpiles – Where power equipment is not available, samples from stockpiles should be made up of at least three increments taken from the top third, at the midpoint, and at the bottom third of the volume of the pile. A board shoved vertically into the pile just above the sampling point aids in preventing further segregation.

10.3 Fine Aggregate Stockpile – A suggested sampling procedure for fine aggregate would be to remove the outer layer, which may have become segregated and take the sample from the material beneath. Sampling tubes approximately 1¼ inches (30-mm) minimum by 6 feet (2-m) minimum in length may be inserted into the pile at random locations to extract a minimum of five increments of material to form the sample.

11 Production Sampling

11.1 Production samples shall be taken in three equal increments from a stopped belt or with an automatic sampling device and combined to make the sample. Such samples shall be reduced to testing size, according to MT 607, Method A or Method B.

12 Windrow Sampling (Cement Treated Base and Cold In-Place Recycle)

12.1 Samples should be composed of a number of samples taken at various points along the windrow, combined and reduced to testing size according to MT 607, Method A or Method B.

13 Pug Mill – Mixed Aggregate Sampling

13.1 Samples for gradation and fracture testing shall be taken from a minimum of three increments from the processed material on the roadway after lay down.

13.2 Samples for crushed cover material gradation and fracture will be taken at the most convenient point before application determined by the engineer.

13.3 Samples for other specified properties will be taken at the point of production.

14 Sampling from Roadway

14.1 Samples from the roadway (minimum of three increments) should be taken for the full depth of the material, taking care to exclude any underlying material. Where necessary, place templates on the existing roadway to separate the underlying material from the sample. The sample shall be taken from the processed material on the roadway after laydown.

14.2 District or Area labs will determine the gradation, LL, PL, PI and soil class for Soil Survey “R” Value samples. The results will be reported on a form 123 which will accompany the sample to the Materials Bureau.

15 “Special Borrow”

15.1 District or Area labs will determine the gradation, LL, PL, PI and soil class for Special Borrow “R” Value samples. The results will be reported on a form 123 which will accompany the sample to the Materials Bureau.

16 Reduction of Sample Size by Quartering or Splitting

16.1 The procedure for reducing the size of field sample of aggregate is described in MT 607.

17 Required Production Samples other than Aggregates for Plant Mix

17.1 Field testing for Acceptance shall conform to the frequency as shown in MT 601, under "Aggregate Surfacing".

18 Independent Assurance Samples

18.1 The District or Area laboratories shall take Independent Assurance samples in accordance with the frequency shown in MT 601. The same sample shall be tested by each lab, with all the material returned to the sample.

18.2 If discrepancies occur between the District or Area laboratory and the Acceptance samples, the District or Area laboratory will investigate and change any procedures or equipment found to be causing the differences.

18.3 If differences are found to exist between the District or Area laboratory and the Materials Bureau, the Materials Bureau will have the authority to investigate all of the testing procedures and make any changes found necessary.

19 Plant Mix Aggregates

19.1 Sampling will be in accordance with the sample size and frequency described in MT 601 and the following:

19.2 WHEN STOCKPILED - In order to establish a stockpile average, the samples shall be secured and tested as the stockpile is being produced.

19.3 BATCH TYPE HOT PLANT- A representative sample of dried aggregate shall be provided by means of an approved sampling device.

19.4 DRYER DRUM HOT PLANT - A representative composite sample shall be provided, by means of an approved sampling device, at a point just prior to the aggregate entering the dryer drum mixer.

19.5 CONTINUOUS FLOW HOT PLANT - A representative sample of dried aggregate shall be provided by means of an approved sampling device.

20 Aggregates for Design

20.1 MAINTENANCE MIX DESIGN - The amount of material submitted to the Materials Bureau for a proposed mix design shall be as follows: Plant Mix Aggregate - 300 lbs. (136 Kg), Seal and Cover Aggregate - 150 lbs. (68 Kg).

20.2 The sample shall be prepared in the district or area laboratory as described in 19.2 and 19.3.

20.3 Non-Quality Assurance Projects

20.3.1 When a satisfactory stockpile average has been established, a sieve analysis shall be performed, in the District or Area laboratory, on a representative sample of the stockpiled material.

20.3.2 Compare the sieve analysis obtained in paragraph 19.2 above, to the established stockpile average.

20.3.3 If the minus 4 mesh portion of the sample is within plus or minus 2% and the minus 200 mesh portion is within plus or minus 1% of the stockpile average, the sample may be submitted to the Materials Bureau for a mix design, without further preparation.

20.3.4 If the sample does not meet the above criteria, it will be necessary to adjust the gradation, in the District or Area laboratory, to allowable variations described in paragraph 20.2.3 above, before it is shipped to the Materials Bureau.

20.3.5 The stockpile average shall be shown on the laboratory work sheet that accompanies the sample.

21 Mineral Filler

21.1 One 2.3 Kg (5 lb.) sample per project of mineral filler will be sampled and submitted to the Materials Bureau for testing and acceptance.

22 Compaction Samples

22.1 The District or Area laboratory shall run at least one sample from each different soil type using the methods described in MT 210 or MT 230. It will not be necessary to submit compaction samples to the Materials Bureau. If the material being sampled consists of fine material, 30 pounds (14 Kg) shall be obtained. If the material consists of coarse and fine material, the sample shall be large enough to yield 30 lbs. (14 Kg) of the fine material (minus 4 mesh).

23 Field Density Tests

23.1 Field density tests shall be taken in accordance with MT 601, under "Density Control, Embankment" and MT 218 (Determining Relative Compaction and Percent Moisture).

24 Concrete Aggregates

24.1 Concrete aggregate samples shall be submitted in accordance with MT 601.

25 Concrete Test Specimens

25.1 Concrete compressive and flexural strength test specimens will be made and cured in accordance with MT 101.

26 Cement Treated Base

26.1 Cement Treated Base shall be sampled in accordance Section 12.1 or Section 14.1, and MT 601.

27 Field Construction Sampling

27.1 Samples for soil classification and “R” value shall be obtained from the top 2 feet (0.6 meters) of the sub-grade. Sample frequency will be one sample every 1000 feet (305 meters) for projects with 3 or more cuts or fills per mile. If the project has fewer than 3 cuts or fills per mile the sample distance is extended to 2000 feet (610 meters).

27.2 District/Area lab personnel will determine the soil classification. If the soil class is not equal to or better than that used by the Surfacing Design Unit to determine the typical section, then samples for “R” value determination are to be submitted to the Materials Bureau in Helena.

27.3 Samples for soil classification and/or “R” value are not required when the top two feet of subgrade is constructed with Special Borrow tested and accepted at the borrow source. However, samples may be obtained from the roadway and tested to ensure the in-place material meets the contract requirements. Take samples whenever the material delivered to the roadway appears to differ from samples used for pit acceptance. Sample frequency is at the discretion of the Project Manager.

Note 3 – These samples are as a design check only. Sampling every 1000 feet (305 meters) is a general guide and some discretion should be used. For example, it may be advisable to take more samples in fill sections than cut sections, or if there is an obvious change in the soil conditions or soil class, etc. No samples will be required for typical sections with a design “R” of 5 or less or for soils classified as A-6 or A-7.

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