



MATERIAL SPECIFICATION FOR AGGREGATES - WATERBODY

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1005.01	SCOPE

This specification covers the requirements for aggregate materials placed in waterbodies.

1005.02 REFERENCES

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Materials

OPSS 1001 Aggregates - General

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-602	Sieve Analysis of Aggregates
LS-618	Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-625	Guidelines for Sampling of Aggregate Materials
LS-630	Determination of the Amount of Contamination of Coarse Aggregate

MTO Forms:
PH-CC-112 Waterbody Materials Worksheet
PH-D-10 Aggregate Sample Data Sheet

Designated Sources for Materials (DSM)
DSM #3.05.25 Aggregates: Surface Friction Courses

MTO Aggregate Sources Lists (ASL):
Aggregate Sources List for Structural Concrete Fine and Coarse Aggregates
Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates

ASTM International

D 6473-10 Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control

1005.03 DEFINITIONS

For the purpose of this specification, the definitions in OPSS 182 and the following definitions apply:

Deleterious Material means as defined in OPSS 1001.

Unacceptable Material means earth, humus, clay or other coatings, clay lumps, shale or shaley partings, deleterious materials, or deleterious substances, reclaimed asphalt pavement, reclaimed hydraulic cement concrete, glass, ceramics, or any other reclaimed or slag materials.

1005.05 MATERIALS

1005.05.01 General

The requirements of OPSS 1001 shall apply to this specification.

All waterbody materials shall consist of clean, hard, durable, natural particles that are free of unacceptable materials.

Waterbody materials for the WB-100 and smaller gradation bands, shall consist of naturally-formed, rounded or sub-rounded materials obtained from pit sources. Waterbody materials with top sizes larger than the gradation band for WB-100 may come from pit sources, quarry sources or both, unless otherwise specified in the Contract Documents.

When any change in the character of the aggregate occurs or when the performance of an aggregate meeting the requirements of this specification is found to be unsatisfactory, use of that aggregate shall be discontinued until a reappraisal with the approval of the Contract Administrator proves the source to be satisfactory.

1005.05.02 Physical Properties

All waterbody materials shall meet the requirements of Table 1.

In addition, all waterbody materials shall meet the requirements shown in Table 2 unless one of the following applies:

- a) Material is from a source on:
 - i. the ministry's DSM list; or

- ii. Ontario Ministry of Transportation Structural Concrete Aggregate Sources List; or
- iii. Concrete Aggregate Sources List for Concrete Base/Pavement Coarse Aggregates.

Or;

b) Acceptance by the Owner based on a written request for consideration containing all the following:

- i. Prior testing results demonstrating the physical requirements are as specified in Table 2.
- ii. The testing has been done within 12 months of the material being used in the Work.
- iii. Field performance has continually been satisfactory.

1005.05.03 Gradation or Size and Mass

All waterbody materials shall be according to Tables 3, 4, and 5, for gradation or size and mass requirements.

For each waterbody material of WB-400 and larger:

- a) The largest rectilinear dimension of every boulder shall be no more than 1.5 times the average of its 2 smallest rectilinear dimensions (i.e. for an equivalent rectangular prism); and
- b) At least 80% of the boulders, by mass, shall have an average of their two smallest rectilinear dimensions (i.e. for an equivalent rectangular prism), no larger than the designated size and no smaller than 60% of the designated size.

1005.07 PRODUCTION

1005.07.01 Aggregate Processing, Handling, and Stockpiling

Aggregates separated during processing shall be placed in individual stockpiles. Processed aggregates secured from different sources and aggregates from the same source, but of different gradations shall be placed in individual stockpiles.

Aggregates that have become mixed with foreign matter of any description or aggregates from different stockpiles that have become mixed with each other shall not be used and shall be removed from the stockpile immediately.

1005.08 QUALITY ASSURANCE

1005.08.01 General

The total quantity of each different waterbody material type from each source location shall represent an individual lot.

The Contract Administrator shall be permitted access to all sampling locations.

Unless specified in the Contract Documents, testing shall be carried out for the purpose of ensuring that the waterbody materials used in the Work are according to the physical property and gradation requirements.

Test data for each waterbody material type shall be managed independently according to an individual lot.

1005.08.02 Sampling

Sampling shall be according to LS-625 and taken at the time and location determined by the Contract Administrator. Samples shall be of sufficient mass to conduct the necessary gradation and physical property tests of the material. Minimum sample sizes for each waterbody material type, up to the WB-350 gradation, shall be as shown in Table 6.

Unless specified in the Contract Documents, all samples shall be randomly taken from sampling pads constructed from individual stockpiles that is intended for use in the Work. Suitable stockpile locations include the Working Area and the source. Each sample shall be treated as a discrete sample and not combined or blended with any other sample.

All samples, representing an individual lot of waterbody material, shall be duplicate samples. At least one set of duplicate samples shall be obtained for each waterbody material item used in the Work.

The Contractor shall provide new or clean containers for sampling. Sample containers shall be constructed to prevent the loss of any part of the material or contamination or damage to the contents during shipment. Metal or cardboard containers are unacceptable. Samples shall be identified both inside and outside of the sample container. Data to be included with samples shall be according to the requirements of MTO Form PH-D-10, Aggregate Sample Data Sheet.

Medium to large boulders, as specified in Table 5 shall be randomly chosen for sampling, at the discretion of and at the location determined by the Contract Administrator.

Unless specified in the Contract Documents, testing for physical properties shall be completed. For WB-350 and larger waterbody materials, duplicate sawed portions of individual boulders may be required as specified in Table 2.

1005.08.03 Testing and Retention of Samples

1005.08.03.01 General

One of the duplicate samples of waterbody materials shall be randomly selected for testing.

1005.08.03.02 Designated Laboratory

Unless specified in the Contract Documents, the laboratory designated by the Owner shall carry out the following testing:

- a) Testing of physical properties and gradation for WB-53 and smaller, as specified in Tables 1, 2 and 3.
- b) Testing of physical properties for WB-100 and larger as specified in Table 2.

The laboratory shall retain the remaining sealed samples for referee testing if it is invoked.

1005.08.03.03 Contract Administrator

1005.08.03.03.01 General

The Contract Administrator shall carry out the testing within the Working Area or the source.

The remaining sealed samples shall be retained for referee testing if it is invoked.

1005.08.03.03.02 Examination of stockpiles

Examination of stockpiles of waterbody materials for unacceptable materials and contamination as specified in Table 1.

1005.08.03.03.03 Mass Gradation

Mass gradation for WB-100, WB-200 and WB-350 shall be according to Table 4.

The mass gradation shall be determined by individually weighing a minimum of 20 randomly-chosen cobbles and boulders from a sampling pad, constructed according to LS-625, from the stockpiled material that's intended for use and then comparing the mass of the stone particles within each specified fraction of the mass gradation with the total mass of all of the stone particles that were measured for that sample. That information shall be recorded on Form PH-CC-112.

For a boulder with a mass larger than 25 kg, its approximate mass may be determined by multiplying the average of its three rectilinear dimensions (i.e. for an equivalent rectangular prism) by the average specific gravity for the same waterbody material, determined according to Notes 1 and 2 of Table 2.

1005.08.03.03.04 Measurements

Measurements for WB-400 and larger shall be according to Table 5.

For each waterbody material type in Table 5, the dimensions for a minimum of 20 randomly-chosen boulders, that are intended for use, shall be recorded on Form PH-CC-112.

1005.08.04 Acceptance

QA test results shall be used for acceptance purposes, except when referee testing has been carried out.

When QA test results for the sample representing an individual lot shows that the material meets the applicable physical property, gradation, size and mass requirements of this specification, the lot shall be accepted.

When QA test results show that the material does not meet the applicable requirements of this specification, then all the aggregates in that lot shall be considered rejected and shall be removed from the Work at no additional cost to the Owner.

The Contract Administrator shall notify the Contractor that material represented by the test result is not acceptable. This notification shall take place in writing within 3 Business Days of receipt of the non-conforming data.

1005.08.05 Referee Testing

The Contractor may invoke referee testing for one or more attributes by submitting a written request to the Contract Administrator within 5 Business Days following notification that the aggregate does not meet the requirements of this specification.

Referee testing shall be carried out, as specified herein and elsewhere in the Contract Documents.

The retained duplicate QA sample shall be used for referee testing.

All referee test results for a lot shall replace the respective QA tests for acceptance of the applicable lot and shall be binding on both the Owner and the Contractor.

If a lot is not accepted based on the referee test results, then the Contractor shall be responsible for the cost of the referee testing of that lot, including the cost of transporting the samples to the referee laboratory, at the rates specified in the Contract Documents. In all other cases, the Owner shall bear the cost of the referee testing and the cost of transporting the samples of that lot.

1005.08.05.01 Referee Testing Directly After QA Testing

Upon receiving the Contractor's written request, the Contract Administrator may elect to carry out the referee testing for mass gradation or measurements directly after the QA testing.

1005.08.05.01.01 Referee Testing for Mass Gradation

The Contract Administrator shall carry out the referee testing for mass gradation according to the Mass Gradation clause.

1005.08.05.01.02 Referee Testing for Measurements

The Contract Administrator shall carry out the referee testing according to the Measurements clause.

TABLE 1
Mandatory Physical Property Requirements for Waterbody Materials

Description of Test	Test Number	WB-6.7	WB-13.2	WB-19	WB-37.5	WB-53	WB-100	WB-200	WB-350	WB-400	WB-500	WB-750	WB-1000	WB-1250	WB-1500
Loss by Washing, Pass 75 µm Sieve, Guideline A, % Maximum	LS-601	5.0	2.0	2.0	-	2.0	-								
Amount of Contamination, % Maximum	LS-630	0.5	0.5	0.5	0.5	0.5	-								
Notes: A. Stockpiles of any waterbody materials intended for use in the Work shall not contain any visible unacceptable materials and contamination.															

TABLE 2
Physical Property Requirements for Waterbody Materials

Description of Test	Test Number	WB-6.7	WB-13.2	WB-19	WB-37.5	WB-53	WB-100	WB-200	WB-350	WB-400	WB-500	WB-750	WB-1000	WB-1250	WB-1500
Specific Gravity, Minimum	ASTM D6473 or LS-604 (Notes 1 & 2)	-	-	-	-	-	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
Absorption, % Maximum		-	-	-	-	-	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Absorption, % Maximum	LS-604	2.0	2.0	2.0	2.0	2.0	-	-	-	-	-	-	-	-	-
Micro-Deval Abrasion Coarse Aggregate Loss, Grading A % Maximum	LS-618	-	30	30	30 (Note 3)	30	30 (Note 4)	-	-	-	-	-	-	-	-
Micro-Deval Abrasion Fine Aggregate Loss, % Maximum	LS-619	35	-	-	35	-	-	-	-	-	-	-	-	-	-

Notes:

1. These requirements shall be based on the average test results for at least five cobbles, boulders or sawed portions of individual boulder of WB-350 and larger, where the source appears lithologically uniform or at least eight cobbles or boulders or sawed portions of individual boulder of WB-350 and larger, where the source appears lithologically non-uniform. The cobbles or boulders, to be tested, shall be randomly sampled, as specified in Notes 1, 2, and 3 of Table 6. Each sawed portion shall be a minimum of 2kg. In addition, no individual piece of tested rock shall have a specific gravity less than 2.30 or an absorption greater than 3.5%.
2. ASTM D6473 shall be used for acceptance for WB-100 and larger, unless written notification to the Contract Administrator to replace it with LS-604 for acceptance is received prior to sampling of the applicable materials for QA purposes. Provided the Contract Administrator has received such a request, LS-604 shall be performed on another aggregate product or on a WB-53 or smaller, if it is being simultaneously produced from the same formation and location within a pit or a quarry as the WB-100 and larger. Otherwise, conformance to ASTM D6473 shall be required.
3. This requirement shall be waived if the material has more than 80% passing the 4.75 mm sieve.
4. Testing may be carried out on another aggregate product or on a WB-53 or smaller, if it is being simultaneously produced from the same formation and location within a pit or a quarry as the WB-100, as long as the quantity of the other aggregate product being produced is sufficient for sampling and testing using LS-618. For example, if it can be demonstrated that the cobbles used to produce WB-100 are the oversize for the simultaneous production of a coarse granular material or a WB-37.5 which has a LS-618 Micro-Deval Abrasion Loss of no more than 30%, then the WB-100 cobbles being simultaneously produced with that granular material or the WB-37.5 shall also be considered to meet the requirements of LS-618.

TABLE 3
Gradation Requirements for Sand and Gravel Used for Waterbody Materials,
Percent Passing

Sieve Size mm	Gradation (LS-602) of Waterbody Materials % Less Than Sieve Size Specified				
	WB-6.7	WB-13.2	WB-19	WB-37.5	WB-53
63.00	-	-	-	-	100
53.00	-	-	-	100	90-100
37.50	-	-	-	90-100	-
26.50	-	-	100	50-100	-
19.00	-	-	90-100	-	0-15
16.00	-	100	-	-	-
13.20	-	96-100	-	-	-
9.50	100	50-73	0-55	30-100	-
6.70	97-100	-	-	-	-
4.75	90-100	0-10	0-10	20-100	-
2.36	50-95	-	-	-	-
1.18	20-90	-	-	10-100	-
0.60	0-70	-	-	-	-
0.30	0-35	-	-	2 - 65	-
0.15	0-15	-	-	-	-
0.07	0-5	0-2	0-2	0-8	0-2

TABLE 4
Mass Gradation Requirements for Cobbles and Small Boulders
Used as Waterbody Materials

Gradation %, By Mass, Less Than Mass Specified				
Maximum 2 nd Smallest Dimension of an Equivalent Rectangular Prism (mm)	Mass of Gravel/Cobble /Boulder (kg)	WB-100	WB-200	WB-300
350	97	-		100
300	60	-		75-100
200	18	-	100	20-40
150	7.7	-	40-60	0-15
100	2.3	100	0-10	-
63	0.55	40-60	-	-
53	0.35	0-10	-	-

TABLE 5
Medium to Large Boulders Used For Waterbody Materials

Size	WB-400	WB-500	WB-750	WB-1000	WB-1250	WB-1500
Designated Size (i.e. the Average of the Two Smallest Dimensions of an Equivalent Rectangular Prism) (mm)	400	500	750	1000	1250	1500
Average Approximate Mass of Boulders (kg) (Note 1)	145	285	955	2265	4425	7645
<p>Note:</p> <p>1. The mass of any individual boulder, will vary significantly from the stated values, depending on its shape (e.g. cubical, prism, sphere, oblate spheroid etc.) and actual dimensions.</p>						

TABLE 6
Sample Size Requirements

Waterbody Material Designation	Minimum Sample Size for Physical Properties Testing kg (Note 1)
WB-6.7	10
WB-13.2	20
WB-19	20
WB-37.5	40
WB-53	80
WB-100	25 (Note 2)
WB-200	75 (Note 3)
WB-350	150 (Note 3)
WB-400, WB-500, WB-750, WB-1000, WB-1250 and WB-1500	(Note 3)
<p>Notes:</p> <ol style="list-style-type: none"> 1. Individual sample bags shall not exceed 25 kg. For a boulder with a mass larger than 25 kg, the boulder shall be cut using a portable diamond saw by the contractor to produce duplicate sample portions for testing. 2. Each duplicate sample shall consist of at least five cobbles from lithologically uniform sources or at least eight cobbles from lithologically non-uniform sources and no cobble shall have a mass less than 0.4 kg. 3. Each duplicate sample shall consist of at least five cobbles, boulders or sawed portions of individual boulder of WB-350 and larger from lithologically uniform sources or at least eight cobbles, boulders or sawed portions of individual boulder of WB-350 and larger from lithologically non-uniform sources. 	