METHOD OF TEST FOR QUANTITATIVE EXTRACTION OF ASPHALT CEMENT AND MECHANICAL ANALYSIS OF EXTRACTED AGGREGATE FROM BITUMINOUS PAVING MIXTURES - ONTARIO PROCEDURE

1. SCOPE

1.1 This method covers the quantitative determination of asphalt cement in a bituminous paving mixture using a solvent and ultrasonic bath equipment.

1.2 The mineral fines content (smaller than 75 µm) is determined by the use of a high speed centrifuge on the extract and by the washing of the extracted aggregate. The remaining aggregate is used for sieve analysis.

2. APPARATUS

2.1 DRYING OVENS: Capable of maintaining the required temperature ± 5°C.

2.2 BALANCE: Minimum 3 kg capacity, accurate to 0.1 g.

2.3 BALANCE PAN.

2.4 SIEVES: Sieves with a minimum diameter of 200 mm. The sieves shall conform to ASTM Specification E 11.

2.5 THERMOMETER: Capable of reading from 20°C to 250°C, accurate to 2°C.

2.6 DRYING PANS: Flat seamless enamel, stainless steel, or aluminum pans with a minimum of 10 square mm horizontal surface area per gram of sample, shall be used for drying of the washed aggregate. Rectangular metal pans of nominal size 250 x 400 x 50 mm have been suitable for the determination of moisture content.

2.7 ULTRASONIC BATH: Ultrasonic cleaner unit certified for ordinary (non-hazardous) locations to the requirements of CAN/CSA C22.2 No. 68-92, Motor-Operated Appliances (Household and Commercial). The specification requires the unit to be marked "USE A CLEANING FLUID HAVING A FLASH POINT HIGHER THAN 60°C".

Approximate ultrasonic unit tank capacity - 12 L, approximate internal dimensions - L 300 mm x W 240 mm x H 200 mm.

Note 1: Engineering methods to control hazardous conditions are required. For engineering controls (mechanical ventilation, process enclosure) data, refer to the solvent MSDS and contact your local Occupational Health and Safety Office for assistance.

2.8 EXTRACTION SAMPLE CONTAINER: Stainless steel beaker, 4000 ml capacity.

2.9 POSITIONING TRAY: Metal tray, with the edges formed to fit over the ultrasonic bath tank and the opening to support sample container. The container shall be suspended on the positioning tray with approximately half its height submerged in the water. The clearance between the sample container bottom and the bath tank bottom shall be not less than 25 mm.

2.10 SIEVES: 1.18 mm and 75 µm sieves with a minimum diameter of 200 mm. The sieves shall conform to ASTM Specification E 11.

2.11 EXTRACT AND RINSEWATER CONTAINERS: Containers of sufficient diameter and capacity to capture all solvent and water rinses passing through the 1.18 mm and 75 µm sieves and which will permit the quantitative transfer of the liquids to the high-speed centrifuge.

2.12 CENTRIFUGE: High- speed as described in ASTM D-2172.

2.13 EFFLUENT RECEIVERS: Separate containers for solvent and water effluent, each of approximately 2 L capacity.

2.14 GRADUATED CYLINDER: 1000 mL capacity, with graduated intervals of 10 mL.

2.15 MISCELLANEOUS ITEMS: Metal stirring spoon or spatula 250 mm minimum length, 1 L plastic wash bottles, stopwatch.

2.16 RIFFLE SPLITTER: For splitting hot mix samples. Recommended width of the individual chutes is approximately 38 mm for all types of paving mix.

3. REAGENTS

3.1 Non-chlorinated solvents with a flash point (by Tag Closed Cup) above 60°C (140°F). For health and safety precautions see Section 11, HEALTH AND SAFETY AND ENVIRONMENTAL REQUIREMENTS, and/or consult with your local Occupational Health and Safety Office.

4. SAMPLE SIZE

4.1 The size of the test sample shall be governed by the 'Designated Large Sieve' size of the mix (see Note 2) and shall conform to the requirements as shown in Table 1.

Table 1 - Size Of Test Sample

Designated Large Sieve Size, MTO Sieve Designation, mm	Minimum Mass Of Sample, kg
2.36	0.5
9.5	1.5
13.2	1.5
16.0	2.0

Note 2: The Designated Large Sieve is a sieve size specifically designated for gradation testing with the following mixes:

2.36 mm for HL 2;
9.5 mm for HL 1, HL 3, HL 3A, Dense Friction Course or Open Friction Course;
13.2 mm for HL 4 Binder or Surface Course;
16.0 mm for HL 8, Medium Duty Binder Course, or Heavy Duty Binder Course.

4.2 For moisture content, a minimum sample size of 1000 g is required for all types of paving mix.

5. SAMPLE PREPARATION

5.1 PLATE OR LOOSE PAVING MIXTURES: Obtain the samples in accordance with specified procedures and reduce to proper size. Two methods of reducing the field sample to testing size are acceptable: quartering or splitting using a mechanical splitter. Both procedures are specified in ASTM C 702 Standard Practice for Reducing Field Samples of Aggregate to Testing Size.

5.1.1 Quartering: Warm the field sample to achieve sufficient workability for quartering. A conventional oven maintained at 110°C or a microwave oven (see Note 3) may be used for this purpose. The surface upon which the sample is to be reduced should be flat, non-abrasive, non-absorptive and of sufficient area to provide for uniform quartering. Heat lamps may be used to keep the surface warm (see Note 4). The sample shall be mixed until uniform, then quartered, and opposite quarters removed. This process is to be repeated until the test portion is obtained.

Note 3: ***Caution:*** *Frequent mixing may be necessary to prevent localized overheating when using a microwave oven to heat paving mixtures. Also, the presence of metallic particles in some mixtures may render the microwave oven unsafe for the heating of those mixtures.*

Note 4: If required, ‘Pam’ or equivalent used in minimal quantities has been found suitable in preventing the sample from adhering to the surface. Motor oils must not be used for this purpose.

5.1.2 Riffle Splitter: Warm the field sample to achieve sufficient workability for splitting. A conventional oven maintained at 110°C or a microwave oven (see Note 3 above) may be used for this purpose. The mix may agglomerate if it is too cold or stick to the splitter if too hot. A temperature range of 90 to 110°C is satisfactory. Heat lamps may be used to keep the walls of the splitter box warm (see Note 4 above). Chutes shall be cleaned after each split. The use of a putty knife or a 25 mm diameter wire brush used to clean glassware has been found suitable.

5.2 COMPACTED PAVING MIXTURES: When testing core samples for asphalt cement content and sieve analysis, the core shall be warmed just sufficiently to enable the trimming of the curved face to remove particles which were cut during the coring process. The depth trimmed shall be equivalent to the 'Designated Large Sieve' size for the particular mix type, except for HL 2 mix for which the depth trimmed shall be 4.75 mm. Dry the trimmed core to a constant mass to remove moisture (see Section 6.1).

6. TEST PROCEDURES

6.1 MOISTURE CONTENT DETERMINATION

6.1.1 In extraction test calculations, asphalt cement content is obtained by subtracting the extracted aggregate mass from the original mass of the test sample. If moisture is present in the original sample, it will appear as asphalt cement in the final calculation unless a correction is made. This is done by determining the amount of moisture in a 1000 g portion and adjusting the adjusting the mass of the extraction test portion or, if time permits, heating the extraction test portion to a constant dry mass. The first method has the advantage that the two procedures can be run concurrently. Either method is acceptable.

6.1.2 Weigh the test portion obtained for moisture content determination and record the mass to 0.1 g. Place in an oven maintained at 110 ± 5°C and dry to a constant mass.

Note 5: Constant mass is defined as no change in mass in excess of 0.1 % or 1 g, whichever is less, for each 30 minute drying period.

6.1.3 Reweigh the test portion and calculate its moisture content rounding off to the nearest 0.01 % as follows:

$$\%\ \text{Moisture Content},\ (Z) = \frac{(Ma - Md)}{Md} \times 100$$

where: Ma = Original mass of mix, g
Md = Oven dry mass of mix, g

Adjust the original mass of the test sample used for extraction. If the method of drying the test sample is followed, then use the dried mass as the original mass in the subsequent calculations.

6.2 ASPHALT CEMENT EXTRACTION

6.2.1 Fill the ultrasonic bath with water. Add a few drops of liquid detergent to improve cavitation. Turn on the bath heater to preheat water to 50°C.

Note 6: Under ultrasonic power the solvent will heat up gradually. The solvent's flash point determines the range of the process' working temperature. The maximum bath temperature must be a minimum of 16.7°C (30°F) below the solvent's flash point. The temperature given in this test method is based on a minimum solvent flash point of 67°C.

6.2.2 Measure and record the mass of the original test portion to the nearest 0.1 g (W1). Use the work sheet report form (WS1) found at the end of this test method and dedicated for the Ontario LS-291 procedure.

6.2.3 Carefully transfer the mix from the balance pan into the steel beaker. Monitor the mix temperature and allow to cool below the solvent's flash point. Pour approximately 1 L of solvent over the warm mix [see Section 11, HEALTH AND SAFETY AND ENVIRONMENTAL and/or contact your local Occupational Health and Safety Office for specific requirements for the approved solvent(s)] to completely cover the sample (see Note 7). Wash any of the mix remaining in the balance pan or on the thermometer into the steel beaker using the solvent. Stir the sample with the metal spoon to uniformly distribute and break up the mix; leave the spoon in the beaker.

Note 7: The quantities of solvent or water used in this procedure are based on a mix mass of 1 kg and a 4 L beaker (approximately 160 mm diameter) as a sample container. If a larger mix mass is required and/or alternative container is used, adjust the quantities of solvent or water to completely cover the sample.

6.2.4 Suspend the beaker on the positioning tray placed over the ultrasonic bath. Adjust the bath water level such that it is above the level of solvent covering the mix in the beaker. Allow the mix to soak in solvent a minimum of 1 hour at 50°C.

Note 8: For a virgin mix, 1 hour is sufficient. For a RAP or RHM mix, a minimum soaking period of 4 hours is required to break up agglomerations. In no case shall a mix be allowed to soak for more than 24 hours.

Note 9: A water bath at 50°C may be used in lieu of the ultrasonic bath for the soaking period as required by Section 6.2.4.

6.2.5 After the soaking period, turn on the ultrasonic bath for a 20 minute cycle.

6.2.6 Turn off the ultrasonic bath after the 20 minute cycle and stir the sample with the spoon/spatula for 15 seconds to reorient the aggregate particles.

Note 10: While the bath is on, avoid any contact with the liquid and containers through which ultrasonic vibrations are being transmitted. For more information on preventive measures for operating ultrasonic equipment see Section 11, HEALTH AND SAFETY AND ENVIRONMENTAL.

6.2.7 Turn the bath on for another 20 minute ultrasonic cycle.

6.2.8 Turn off the ultrasonic bath. Carefully decant the sample solvent through the 1.18 mm and 75 µm sieves into an extract container.

6.2.9 Add a small portion of new solvent to the sample, stir the sample and again decant through the sieves into the extract container. Repeat the procedure approximately six to eight times until the solvent extract is essentially colourless, using a total of approximately 1.5 L of solvent (see Note 7 above). The last decant should leave the aggregate drip dry.

6.2.10 Use new solvent to wash through the sieves any asphalt residue remaining on the metal spoon/spatula and the sieves. Replace the extract container under the sieves with a rinse water container. Save the solvent in the extract container for SMM centrifuging.

6.2.11 In order to wash the solvent off the aggregate, add approximately 0.3 L of water and 10 mL of wetting agent solution at 50°C (see Notes 6, 7, and 11) to the aggregate sample. Stir the sample, then carefully decant the sample rinse water through the sieves into the rinse water container.

Note 11: Wetting agent solutions may be pre-mixed at the rate of 50 g of Calgon or Alconox per L of water.

6.2.12 Repeat Section 6.2.11 three more times. The last decant should leave the aggregate drip dry.

6.3 WASHING OF EXTRACTED AGGREGATE

6.3.1 Transfer the aggregate from the sample beaker into a clean metal pan. Cover the aggregate with water and 100 mL of wetting agent solution (see Notes 11 and 12). The contents of the pan shall be agitated vigorously taking care not to splash out any material (see Note 13), and then the water shall be immediately decanted through the 1.18 mm and 75 µm sieves into the rinse water container.

Note 12: It has been found advantageous to allow the first wash to soak for five minutes after the addition of the wetting agent solution and preliminary agitation.

Note 13: The agitation shall be sufficiently vigorous to completely separate particles finer than the 75 µm from the coarse particles and bring them into suspension, in order that they may be removed by decanting the wash water. The use of a hand or the metal spoon/spatula to stir and agitate the aggregate in the wash water has been found to be satisfactory. Care shall be taken to prevent decanting the aggregate coarse particles.

6.3.2 Repeat Section 6.3.1 until the wash water is clear. The last decant should leave the bulk aggregate drip dry.

6.4 MINERAL FINES IN EXTRACT

6.4.1 Determine at 90 to 100°C the mass of two clean empty high-speed centrifuge cups to the nearest 0.1 g. Place one of the cups in the high-speed centrifuge.

6.4.2 Start the centrifuge and allow it to reach a constant operational speed (9000 r.p.m. minimum). Close the feed funnel control valve and place an effluent receiver at the effluent drain to collect solvent. Fill the feed funnel with solvent from the extract container. Open the control valve at the bottom of the funnel to allow a flow rate of 100 to 150 ml/min, using the graduated cylinder to measure the centrifuge effluent flow rate. Continue to top up the feed funnel until all the solvent has been centrifuged. Wash any fines remaining in the extract container into the feed funnel using a solvent filled wash bottle.

6.4.3 Replace the receiver filled with solvent at the effluent drain with another effluent receiver to collect rinse water. Fill the feed funnel with water from the rinse water container. Continue to top up the feed funnel until all the rinse water has been transferred. Wash any fines remaining in the rinse water container into the feed funnel using a water filled wash bottle.

6.4.4 Stop the centrifuge, remove the cup containing the mineral fines, and place the second cup in the centrifuge. Recentrifuge all of the solvent collected in the effluent receivers followed by recentrifuging of all rinse water collected in the effluent receivers. Wash any fines remaining in the solvent and rinse water effluent receivers through the feed funnel, using a water filled wash bottle.

Note 14: Solvent waste and rinse water waste may be kept in separate containers for storage and/or disposal.

6.5 DRYING OF EXTRACTED AGGREGATE

6.5.1 Mineral fines: Stop the centrifuge and remove the second cup. Dry both cups containing mineral fines to constant mass in a drying oven at 110 ± 5°C. Record the mass of mineral fines to the nearest 0.1 ± 0.05 g (W4).

Note 15: To avoid damage to the balance and because dry aggregate absorbs moisture when exposed to air, determine the mass of the extracted aggregate immediately after cooling to 90 to 100°C.

6.5.2 Calculate mineral fines in extract as follows:

Dry mass of mineral fines in high speed centrifuge cups, (W4) = Mcf - Mc

where: Mcf = mass of cups plus fines, g
Mc = mass of cups, g

6.5.3 Remaining aggregates: Invert the 1.18 mm sieve onto a clean metal pan. Strike the rim of the inverted sieve gently with the wooden handle of a sieve brush to dislodge particles from the sieve cloth and evenly distribute the pan aggregate over the entire horizontal area. Reverse flush the 1.18 mm and 75 µm sieves with water onto a second clean metal pan to capture any retained particles. Dry the pans in an oven (see Note 16) to constant mass (see Note 15 above) to the nearest 0.1 g (W3).

Note 16: The pan drying of the aggregate should be done in temperature stages to avoid fracturing aggregate particles (first at 110°C for a minimum of one half hour, then at 10°C above the boiling point of the solvent until constant mass has been achieved).

6.5.4 Calculate the mass of dried aggregate as follows:

Dry mass of extracted aggregate after washing, (W3) = Mba - Mb

where: Mba = mass of balance pan plus dried aggregate, g
Mb = mass of balance pan, g

6.6 ASPHALT CEMENT CONTENT CALCULATION: Calculate the asphalt cement content in the test portion to two decimal places making use of work sheet (WS1) as follows:

6.6.1 If moisture is present in the mix and the sample has not been dried to constant mass to eliminate the moisture, adjust the original mass of the mixture for the test portion as follows:

Dry mass of test portion, $(W2) = \frac{W1}{100 + Z} \times 100$

where: W1 = mass of original test portion, g
Z = moisture content, %

6.6.2 For the test portion calculate the total mass of dry aggregate as follows:

Total mass of extracted aggregates, (W5) = W3 + W4

where: W3 = dry mass of extracted aggregates after washing, g
W4 = dry mass of fines in high speed centrifuge cup(s), g

6.6.3 The mass of the asphalt cement can be determined for the test portion as follows:

Mass of asphalt cement, $(W6) = W2 - W5$

where: W2 = dry mass of test portion, g
W5 = total mass of extracted aggregates, g

6.6.4 The asphalt cement content expressed as a percentage of the moisture free mix is calculated as follows:

% Asphalt cement content, $(W7) = \frac{W6}{W2} \times 100$

where: W6 = mass of asphalt cement, g
W2 = dry mass of test portion, g

6.7 GRADATION OF THE AGGREGATE

6.7.1 Sieve analysis: Transfer cooled aggregate into the nest of coarse and fine sieves (see Note 17). Agitate on a mechanical shaker. A satisfactory end of sieving is considered to have been reached when an additional 1 minute of sieving by hand fails to change the mass on any sieve by more than 1 %. This is usually about twelve minutes. On completion of the sieving operation, separate the sieves. Each sieve shall be placed within a round stainless steel bowl and shaken manually, checking to see if additional material passes through. Any additional material should be transferred to the next smaller sieve size. When emptying the sieves, gently strike the rim of the inverted sieve with the wooden handle of the sieve brush. This helps to dislodge aggregate particles from the cloth. Individual particles stuck in coarser sieves may also require help. Following this, brush the bottom surface of the sieve cloth with a circular motion. In no case should the particles be turned or manipulated through the sieves by hand. Weigh and record cumulatively (e.g. each successive size is to be added to the previous total) on the appropriate work sheet, the mass of the fraction retained on each sieve.

Note 17: The transfer may require splitting the cooled aggregate into two approximately equal portions for sieving to prevent sieve overloading, and then recombining results on each of the sieve sizes to obtain the correct gradation.

6.7.2 Calculation of aggregate fractions: Calculate the percent passing on each sieve in the test portion as follows:

% passing on "x" sieve $= 100 - \frac{Wx \times 100}{W5}$

where: Wx = cumulative mass retained on that sieve, g
W5 = total mass of extracted aggregates, g

7. EXAMPLE CALCULATION

7.1 MOISTURE CONTENT

7.1.1 Percent moisture in the sample:

Mass of sample plus moisture (Ma) 1000.3 g

Mass of dried sample (Md) 998.1 g

% Moisture (Z) $= \dfrac{(1000.3 - 998.1)}{998.1} \times 100 = 0.22$

7.1.2 Adjust original mass of test portion

Original mass of test portion (W1) 1020.4 g

Dry mass of test portion (W2) $(W2) = \dfrac{1020.4}{(100 + 0.22)} \times 100 = 1018.2$ g

7.2 ASPHALT CEMENT CONTENT

i) Dry mass of test portion (W2),	1018.2 g
ii) Dry mass of aggregate:	
Dry mass of aggregate plus pan (Mba)	1160.8 g
Mass of pan (Mb)	- 200.0 g
Dry mass of aggregate (W3)	960.8 g
iii) Dry mass of mineral fines in extract:	
Dry mass of cup and fines after centrifuge (Mcf)	143.1 g
Mass of cup (Mc)	- 141.1 g
Dry mass of mineral fines (W4)	2.0 g
iv) Total dry mass of aggregate:	
Dry mass of aggregate (W3)	960.8 g
Dry mass of mineral fines (W4)	+ 2.0 g
Total dry mass of aggregate including fines (W5)	962.8 g
v) Mass of asphalt cement	
Dry mass of test portion (W2)	1018.2 g
Dry mass of aggregate including fines (W5)	- 962.8 g
Mass of asphalt cement (W6)	55.4 g

% asphalt cement, $(W7) = \dfrac{55.4}{1018.2} \times 100 = 5.44$

7.3 AGGREGATE FRACTIONS

Total mass of aggregate (W5)	962.8 g
Cumulative mass retained on 9.5 mm sieve	213.3 g
% passing 9.5 mm sieve = $(100 - \dfrac{213.3}{962.8}) \times 100$	77.8
Cumulative mass retained on 600 µm sieve	689.8 g
% passing 600 µm sieve = $(100 - \dfrac{689.8}{962.8}) \times 100$	28.4

7.4 SWING BACK GRADING (Optional): This is the grading of the coarse or fine aggregate when either fraction is considered to be the total sample.

For fine aggregate the calculation is as follows:

The percent passing the 4.75 mm sieve in the total grading, divided into the percent passing each subsequent sieve and the result multiplied by 100 will give the fine aggregate gradation expressed as a percent passing each sieve.

Example:

Given for the full gradation:

% passing the 4.75 mm sieve is 52.1
% passing the 2.36 mm sieve is 40.9
% passing the 1.18 mm sieve is 33.0

then for the fine gradation:

% passing the 2.36 mm sieve = $\frac{40.9}{52.1} \times 100 = 78.5$

% passing the 1.18 mm sieve = $\frac{33.0}{52.1} \times 100 = 63.3$

To "swing back" the grading of the coarse aggregate fraction of the extracted aggregate, the following procedure is used:

The percent retained on the 4.75 mm sieve in the total grading, is divided into the percent retained on each of the coarse aggregate sieves in the total gradation and the result is multiplied by 100, to give the coarse aggregate grading expressed as the percent retained on each sieve.

Example:

Given for the full gradation:

% passing the 13.2 mm sieve is 92.5
% passing the 9.5 mm sieve is 75.4
% passing the 4.75 mm sieve is 52.4

then for the coarse gradation:

% ret'd on the 13.2 mm sieve $= \frac{(100 - 92.5)}{(100 - 52.4)} \times 100 = 15.8$

% ret'd on the 9.5 mm sieve $= \frac{(100 - 75.4)}{(100 - 52.4)} \times 100 = 51.7$

8. REPORTING OF RESULTS

8.1 The asphalt cement content shall be reported as a percentage of the total mass of the mix to two decimal places.

8.2 For the aggregates, the cumulative mass and the cumulative percentages passing each sieve shall be reported to one decimal place.

8.3 The swing back grading, when required, shall be recorded as a percentage retained or passing for each sieve, accurate to one decimal place, and shall be reported as described in Section 7.4.

9. GENERAL NOTES

9.1 When testing Cold Mix such as SC 800, the sample must be dried at 110 ± 5°C to a constant mass to remove all solvents before testing.

9.2 Samples are weighed while still warm to avoid absorption of moisture. In order to avoid undue variation in this process it is recommended that on removal from the drying oven all samples be weighed at 90 to 100° C.

9.3 Extreme care must be exercised when transferring the aggregates from one container to another to avoid any loss of the particles.

9.4 Prior to using, check each sieve for the condition of the mesh, the soldered edges and the nest for correct order of descending sizes.

9.5 All balances should be calibrated at least once a year, at the start of the construction season. When the operator questions the accuracy/condition of the balance, it should be re-calibrated and/or inspected immediately.

9.6 Several important factors affect the operation of ultrasonic bath. In order to achieve the best results while extracting asphalt using ultrasonic cavitation the following should be considered:

a) any weight on the tank bottom dampens sound energy and may cause damage to the transducer. Do not place any objects on the tank bottom. Always use a positioning tray to support the sample container.

b) closely monitor the time and temperature of the solvent during the extraction cycle by using ultrasonic bath controls backed by external thermometer and a stopwatch.

c) follow general rules of operating the ultrasonic bath as described in the operator's manual.

9.7 All equipment and testing for LS-291 including MINERAL FINES IN EXTRACT (Section 6.4) shall be located in one laboratory building only.

10. PRECISION AND BIAS

10.1 The statements of precision for asphalt cement content and aggregate sieve analysis have not been established yet. To determine precision and bias statements for single-operator and multilaboratory precision for the test method, a correlation program will be carried out.

11. GENERAL HEALTH AND SAFETY AND ENVIRONMENTAL REQUIREMENTS

The following are a number of general health, safety, and environmental requirements to be followed when conducting this method. Specific requirements for the approved reagent(s) can be obtained from your local Occupational Health and Safety Office.

11.1 TRAINING: Prior to conducting work, all employees must receive training on the hazards associated with the method and the solvent being used. This training should include: instruction on safe handling, storage, use, disposal and transport of the solvent; the required control measures (i.e. local exhaust ventilation, personal protective equipment and devices etc.); and safe operating, handling and spill response procedures.

In addition, all employees must have WHMIS (Workplace Hazardous Materials Information System) training.

It is also recommended that all employees working in the laboratory receive first aid training.

11.2 WHMIS: A current MSDS (Material Safety Data Sheet) for the solvent being used must be maintained in the workplace in a location accessible to all employees. Employees should refer to the MSDS for specific information on the solvent.

All containers must be labelled with a supplier label or a workplace label if decanted from the original supplier container.

11.3 CONTROL MEASURES: In most cases the solvent should be used under local exhaust ventilation to control for potential exposure to the vapours and fire hazards. Information regarding the minimum recommended level of local exhaust ventilation specific to the solvent being used can be obtained from your local Occupational Health and Safety Office.

In most cases the personal protective equipment and devices required are specific to the solvent being used. Information regarding them can be obtained from your local Occupational Health and Safety Office. In all cases approved eye safety goggles should be worn when there is a danger of solvent splashing.

Eating or drinking is not allowed in the working area of the laboratory.

11.4 FIRE SAFETY: If the solvent is flammable or combustible the local Occupational Health and Safety Office and Fire Chief should be consulted where necessary to ensure the correct fire protection controls and facilities are in place.

11.5 ULTRASOUND SAFETY: The ultrasonic bath is a high power device that produces vibrations at a frequency above the audible range (i.e. the frequency of the vibration is too high to hear). The ultrasonic bath should not be touched while it is operating. There are risks associated with immersing fingers or hands in the bath, or handling objects that transmit ultrasound with wet or greasy hands. The known adverse health effects include dermatitis (i.e. skin irritation), and localized skin damage that resembles bruises. These effects are reversible.

11.6 TDGA: The transportation of some solvents and the waste generated from their use in asphalt extraction testing procedures, may be regulated under the Transportation of Dangerous Goods Act and Regulations due to their flammability or poisonous nature. Information can be obtained from your Regional Environmental Planner--Waste Management.

11.7 WASTE MANAGEMENT AND DISPOSAL: Waste solvents generated from asphalt extraction testing procedures will be classified as either hazardous or liquid industrial waste. They will require special management for disposal subject to Regulation 347 of the Environmental Protection Act which may include a Certificate of Approval for waste management from MOEE, generator registration with MOEE, manifesting during transport and driver training for transport.

11.8 SPILLS: Spills of solvents and waste indoors must be contained and cleaned up in a healthy and safe manner. Spills to the natural environment during transfer may require certain notifications to be made as well as containment and clean up.

ONTARIO EXTRACTION TEST - WORK SHEET (WS1)

Hot Mix - Acceptance Test Result for Gradation and Asphalt Cement

Contract No.:	Highway No.:	Lot No.:	Sublot No.:	Date Sampled: YR | MM | DD
Item No.:	Mix Type:	Job Mix Formula No.:		Date Tested: YR | MM | DD

Note: All mass measurements below are to the accuracy requirements of MTO method LS - 291

MOISTURE CONTENT BY LS - 291 FOR EXTRACTION (WS1)	
Option #1 Determine amount of moisture in original test portion (W1) by drying to constant mass. W2 = M3	$Z = \frac{(M1-M2)-M3}{M3} \times 100$
Option #2 Determine amount of moisture in a 1000 g portion by drying to constant mass and adjusting original test portion (W1).	$W2 = \frac{W1}{100+Z} \times 100$

MOISTURE CONTENT

Drying to Constant Mass	Option 1	Option 2	
Sample Mass with Moisture + Pan			M1
Mass at 30 min.			
Mass at 60 min.			
Mass at 90 min.			
Mass at 120 min.			
Mass at min.*			
Mass of Pan			M2
Constant Mass - Mass of Pan			M3

*Continue process until constant mass is obtained.

EXTRACTION (to nearest 0.1 g)

Mass of original test portion (with moisture)		W1
Dry mass of test portion		W2
Dry mass of extracted aggregates after washing		W3
Dry mass of fines in high speed centrifuge cup(s)		W4
Total mass of extracted aggregates, [W3 + W4]		W5
Mass of asphalt cement, [W2 - W5]		W6
Asphalt cement, (to 0.01%) % = [(W6 / W2) x 100]		W7

WASHED SIEVE ANALYSIS

Designated Sieve	26.5	19.0	16.0	13.2	9.5	4.75	2.36	1.18	600	300	150	75	Pan
Cumulative Mass Retained, Wx													
% Passing 100 - (Wx / W5 x 100)													▨
% Swingback See LS-291						▨							▨

Remarks: ______________________________

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