# TENDER DOCUMENTS

# SUBSECTION 6.82
# HOT-MIX PAVEMENT

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## SUBSECTION 6.82 HOT-MIX PAVEMENT

### 6.82.1 GENERAL

6.82.1.1 This subsection describes the requirements relating to hot-mix pavement for the construction of new structures or the rehabilitation of existing structures covered by this Contract.

6.82.1.2 Any specific requirements pertaining to the hot-mix pavement work covered by this Contract are set out on the drawings and in Section 4 *Special Technical Conditions*.

6.82.1.3 The requirements relating to the removal of asphalt pavement are described in subsection 6.21 *Demolition and Removal.*

6.82.1.4 The requirements relating to roadway marking are described in subsection 6.73 *Road Marking*.

6.82.1.5 The requirements relating to base work are described in subsection 6.81 *Base and Sub-Base*.

### 6.82.2 MEASUREMENT UNITS

6.82.2.1 The measurement units and respective symbols thereof used in this subsection are described as follows:

| Measurement Unit | Designation | Symbol |
|---|---|---|
| area | square centimeter | $cm^2$ |
| area | square meter | $m^2$ |
| length | meter | m |
| length | millimeter | mm |
| length | micrometer | µm |
| length | kilometer | km |
| mass | gram | g |
| mass | kilogram | kg |
| mass | ton | t |
| pressure, stress | pascal | Pa |
| temperature | Celsius degree | °C |
| volume | litre | L |
| volume | cubic centimeter | $cm^3$ |

## 6.82.3 REFERENCE STANDARDS

6.82.3.1 The **Contractor** shall perform all hot-mix pavement work in accordance with the requirements of the following standards and documents to which the provisions of this Contract are added:

6.82.3.1.1 (AFNOR) Association Française de Normalisation [French standards association]:

- NF EN 12697-22+A1 *Mélanges bitumineux – Méthodes d'essai pour mélange hydrocarboné à chaud –Partie 22: essai d'orniérage;*
- NF EN 12697-33+A1 *Mélanges bitumineux – Méthodes d'essai pour mélange hydrocarboné à chaud – Partie 33: confection d'éprouvettes au compacteur de plaque.*

6.82.3.1.2 (ASTM) ASTM International:

- ASTM D36/D36M *Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)*;
- ASTM D113 *Standard Test Method for Ductility of Bituminous Materials*;
- ASTM D242/D242M *Standard Specification for Mineral Filler for Bituminous Paving Mixtures;*
- ASTM D995 *Standard Specification for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures;*
- ASTM D2669 *Standard Test Method for Apparent Viscosity of Petroleum Waxes Compounded with Additives (Hot Melts)*;
- ASTM D5167 *Standard Practice for Melting of Hot-Applied Joint and Crack Sealant and Filler for Evaluation;*
- ASTM D5329 *Standard Test Methods for Sealant and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements;*
- ASTM D6690 *Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements*;
- ASTM E950/E950M *Standard Test Method for Measuring the Longitudinal Profile of Traveled Surfaces with an Accelerometer Established Inertial Profiling Reference*;
- ASTM E1926 *Standard Practice for Computing International Roughness Index of Roads from Longitudinal Profile Measurements*.

6.82.3.1.3 (BNQ) Bureau de normalisation du Québec:

- BNQ 2560-114 *Travaux de génie civil – Granulats*, Partie I *Définitions, classification des granulats et désignation*;
- BNQ 2560-114 *Travaux de génie civil – Granulats*, Partie II *Fondation, sous-fondation, couche de roulement et accotement (granulats utilisés pour les chaussées)*;

- BNQ 2560-114 *Travaux de génie civil – Granulats* – Partie IV *Granulats utilisés dans la préparation du béton de masse volumique normale et du béton à haute performance.*

6.82.3.1.4 (ISO) International Organization for Standardization:

- ISO 9001 *Quality Management System – Requirements.*

6.82.3.1.5 (MTQ) Ministère des Transports du Québec:

- MTQ – *Cahier des charges et devis généraux* (CCDG) – *Construction et réparation*;
- MTQ – *Normes – Ouvrages routiers* – Tome VII *Matériaux*, Chapitre 4 *Liants et enrobés bitumineux :*
    - Norme 4101 *Bitumes;*
    - Norme 4104 *Bitumes fluidifiés*;
    - Norme 4105 *Émulsions de bitume*;
    - Norme 4201 *Enrobés à chaud formulés selon le principe de la méthode Marshall*;
    - Norme 4202 *Enrobés à chaud formulés selon la méthode de formulation du Laboratoire des chaussées;*
    - Norme 4401 *Produits de colmatage de fissures et de joints*.

- (LC) Laboratoire des chaussées du MTQ:
    - LC 21-040 *Analyse granulométrique;*
    - LC 21-065 *Détermination de la densité et de l'absorption du granulat fin;*
    - LC 21-066 *Détermination de la densité et de l'absorption du granulat fin de classe granulaire d/D;*
    - LC 21-067 *Détermination de la densité et de l'absorption du gros granulat;*
    - LC 26-001 *Tenue à l'eau (par trempage);*
    - LC 26-003 *Détermination de l'aptitude au compactage des enrobés à chaud à la presse à cisaillement giratoire ;*
    - LC 26-004 *Formulation des enrobés à l'aide de la presse à cisaillement giratoire selon la méthode du Laboratoire des chaussées;*
    - LC 26-005 *Échantillonnage;*
    - LC 26-040 *Détermination de la densité brute et de la masse volumique des enrobés à chaud compactés;*
    - LC 26-045 *Détermination de la densité maximale;*
    - LC 26-060 *Méthode Marshall de détermination de la résistance à la déformation d'éprouvettes;*

- LC 26-100 *Détermination de la teneur en bitume;*
- LC 26-110 *Détermination de la masse du filler dans le produit de l'extraction;*
- LC 26-150 *Détermination du facteur de correction à utiliser pour le calcul de la teneur en bitume;*
- LC 26-320 *Détermination du pourcentage de vides et de la compacité dans les enrobés à chaud compactés;*
- LC 26-350 *Analyse granulométrique des granulats;*
- LC 26-510 *Détermination de la masse volumique in situ des enrobés à l'aide d'un nucléodensimètre;*
- LC 26-900 *Détermination de caractéristiques par le calcul de divers facteurs.*

6.82.3.1.6 (CGSB) Canadian General Standards Board:

- CAN/CGSB-37.50-M *Hot Applied, Rubberized Asphalt for Roofing and Waterproofing.*

## 6.82.4 MATERIALS

6.82.4.1 BITUMEN

6.82.4.1.1 The bitumen used in the mix shall comply with this subsection and MTQ standard 4101.

6.82.4.1.2 The bitumen used shall be produced by a manufacturer whose plant holds a registration certificate attesting that the quality system complies with standard ISO 9001.

6.82.4.1.3 The performance grade of the bitumen used for the mixes shall be as indicated on the drawings.

6.82.4.2 AGGREGATE

6.82.4.2.1 The aggregate used in the mixes shall comply this subsection, with the drawings and with MTQ standard 4201 or 4202 and shall make it possible to conduct on the asphalt mix all the tests indicated in Appendix 6.82-I *Hot-Mix Asphalt formulated using the Marshall Method* or Appendix 6.82-II *Hot-Mix Asphalt formulated using the MTQ "Laboratoire des chaussées" Method*. The intrinsic and manufacturing properties of the aggregates are indicated on the drawings.

6.82.4.2.2 The **Contractor** shall prepare a stockpile of each given grade of aggregate for a minimum of three (3) production days, except if it obtains its supply from commercial quarries that carry out production monitoring.

6.82.4.2.3 The aggregate of different grades shall be stored in separate stockpiles. The stockpiles shall be located on sites that have been levelled, drained and cleaned of any contaminants.

6.82.4.2.4 Unless otherwise indicated on the drawings, the use of asphalt aggregate is prohibited under this Contract.

6.82.4.2.5 The aggregate used in the manufacture of the asphalt mix shall have the properties specified in Tables 2, 3 and 4 of Part I of BNQ standard 2560-114.

6.82.4.2.6 In addition to having the above-mentioned properties and the complementary properties specified in MTQ standard 4202, the coarse aggregate used in the manufacture of hot-mix asphalt shall consist of 100% crushed stone. For top layers, the fine aggregate shall consist of 100% crushed stones.

6.82.4.2.7 The use of steel slag as aggregate is prohibited.

6.82.4.2.8 Complementary properties of coarse aggregate for top layer hot-mix asphalt

6.82.4.2.8.1 In addition to having the complementary properties specified in MTQ standard 4202, all coarse aggregate used in the manufacture of top layers hot-mix asphalt shall have a polishing-by-projection coefficient (CPP) greater than or equal to 0.50 in accordance with test method LC 21-102.

6.82.4.2.8.2 At least fourteen (14) days prior to the commencement of hot-mix asphalt pavement works, the **Contractor** shall submit to the Engineer a CPP result that is representative of the stockpile specially intended for the manufacture of the top layer asphalt mix. This test shall have been conducted during the current calendar year. Thereafter, the Engineer reserves the right to check at any time the compliance of the CPP by sampling the coarse aggregate at the plant. The **Contractor** may not constitute his stockpile from a mixture with coarse aggregates of a source that does not meet the requirement contained in this paragraph.

6.82.4.2.8.3 The aggregate used in the manufacture of the asphalt mix to be placed as top layer shall have the complementary properties specified in Table 3 of Partie V of standard BNQ 2560-114.

6.82.4.3 FILLER

6.82.4.3.1 The filler shall comply with standard ASTM D242/D242M. However, 80 µm, 315 µm and 630 µm sieves shall be used instead of the 75 µm, 300 µm and 600 µm sieves indicated in that standard.

6.82.4.3.2 Where imported filler is used, the **Contractor** shall identify the origin of the filler. That origin shall remain the same throughout the duration of this Contract.

6.82.4.4 TACK COAT OR PRIME COAT

6.82.4.4.1 Unless otherwise indicated on the drawings, the prime coats shall be slow-setting, low-viscosity asphalt emulsions compliant with MTQ standard 4105. After October 1 and before May 1, the **Contractor** may, upon authorization from the Engineer, use cutback bitumen compliant with MTQ standard 4104.

6.82.4.4.2 Unless otherwise indicated on the drawings, the tack coats shall be bitumen emulsions in accordance with MTQ standard 4105. After October 1 and before May 1, the **Contractor** may, upon authorization from the Engineer, use cutback bitumen in accordance with MTQ standard 4104.

6.82.4.5 HOT-MIX ASPHALT

6.82.4.5.1 The type of hot-mix asphalt to be used shall be as indicated on the drawings.

6.82.4.5.2 The hot-mix asphalt shall comply with this subsection and MTQ standard 4201 or 4202.

6.82.4.5.2.1 The hot-mix asphalt formulated using the Marshall method shall have the properties described in Appendix 6.82-I *Hot-Mix Asphalt formulated using the Marshall Method* of this subsection.

6.82.4.5.2.2 The hot-mix asphalt formulated using the MTQ "Laboratoire des chaussées" method shall have the properties described in Appendix 6.82-II *Hot-Mix Asphalt formulated using the "Laboratoire des chaussées" Method* of this subsection.

6.82.4.5.2.3 For the rutting resistance tests, the **Contractor** shall provide the Engineer with the following samples:

6.82.4.5.2.3.1 EG-10 and ESG-10: two (2) separate 12.5 kg bags of granular mixture;

6.82.4.5.2.3.2 GB-20: two (2) separate 25 kg bags of granular mixture.

6.82.4.5.2.4 Each bag of aggregate must contain and be representative of the combined aggregate grading of the proposed formula. In addition, the **Contractor** shall supply four (4) liters of bitumen of the performance grade specified in this Contract.

6.82.4.5.2.5 When sending samples, the **Contractor** shall ensure to send the asphalt mix formula, a copy of the certificate of conformity of the bitumen and the particle size distribution of the formula. The **Contractor** is responsible for supplying materials that are representative of the asphalt mix that it intends to manufacture.

6.82.4.5.2.6 The Owner's Laboratory will conduct the rutting resistance test on the laboratory-mixed asphalt, using the materials supplied by the **Contractor**. The Owner's Laboratory requires fourteen (14) calendar days, following the reception of the materials, to present the rutting resistance results.

6.82.4.5.2.7 The asphalt placement is authorized only after the Engineer has received the results of the **Contractor**'s validation of the assessment during production and after a compliant rutting resistance result of the test conducted on the laboratory-mixed asphalt by the Owner's Laboratory has been obtained.

6.82.4.5.2.8 If new rutting resistance tests prove necessary following non-compliant results, the cost of retesting shall be borne by the **Contractor.**

6.82.4.5.2.9 The **Owner** reserves the right to sample the asphalt mix, at any time during placement of the asphalt, to check the rutting resistance.

6.82.4.5.2.10 The **Contractor** shall validate the mix during production according to this Contract. This validation shall take place outside the worksite from a continuous production of a minimum of 100 t of asphalt mix. All costs relating to the validation of the mix are the responsibility of the **Contractor**. Any additional validation shall also be at the **Contractor**'s expense.

6.82.4.6 ADHESIVE PRODUCT FOR THE EXECUTION OF A COLD JOINT

6.82.4.6.1 The product used shall be *Crafco Pavement Joint Adhesive* or an equivalent product authorized by the Engineer and shall have the following properties:

| | |
|---|---|
| Brookfield viscosity, at 204°C (ASTM D2669) | 4 to 10 Pa●s |
| Cone penetration, at 25°C (ASTM D5329) | 60 to 100 (1/10 mm) |
| Flow, at 60°C (ASTM D5329) | ≤ 5 mm |
| Resilience, at 25°C (ASTM D5329) | ≥ 30% |
| Ductility, at 25°C (ASTM D113) | ≥ 30 cm |
| Ductility, at 4°C (ASTM D113) | ≥ 30 cm |
| Adhesion (Tensile Adhesion), at 25°C (ASTM D D5329) | ≥ 500% |
| Flexibility, at -18°C (Manufacturer's procedure) | Compliant |
| Softening point (ASTM D36) | ≥ 77°C |
| Bitumen compatibility (ASTM D5329) | Compliant |

6.82.4.6.2 The technical data sheet on the product shall be submitted to the Engineer at least fourteen (14) days prior to the use of the product.

## 6.82.5 EQUIPMENT AND TOOLS

6.82.5.1 ASPHALT MIXING PLANT

6.82.5.1.1 The **Contractor** shall obtain its supply from a manufacturer capable of certifying that the facilities, equipment and materials used in the manufacturing and all operations related to the manufacturing of the hot-mix asphalt comply with standard ASTM D995.

6.82.5.1.2 The asphalt mixing plant shall be equipped with a dust collection system in accordance with the Quebec *Environment Quality Act* (CQLR, c. Q-2).

6.82.5.1.3 The hot-mix asphalt produced by the asphalt mixing plant shall comply with the final formula approved by the Engineer.

6.82.5.1.4 The pipes connecting the tank to the mixing system's bitumen incorporating device shall be fitted with a faucet that allows the collection of bitumen samples at any time.

6.82.5.2 TACK COAT SPREADER

6.82.5.2.1 The tack coat spreader shall be fitted with a flow sensor to control the application rate.

6.82.5.3 FINISHERS

6.82.5.3.1 Unless otherwise indicated on the drawings, the asphalt mix shall be spread mechanically by means of a self-propelled finisher capable of placing the asphalt mix according to the alignment, slope and camber indicated on the drawings.

6.82.5.3.2 The finishers shall be fitted with hoppers and screw distributors so that the asphalt mix is placed evenly in front of the adjustable asphalt pavement graders.

6.82.5.3.2.1 The term " asphalt pavement graders" includes all the leveling devices which, by cutting or compacting, level the asphalt mix at the implementation temperatures without producing tears, deformations or grooves and give a surface having the characteristics indicated on the drawings.

6.82.5.3.3 The finishers shall be capable of spreading the asphalt mix over thicknesses ranging from 15 mm to the thickness indicated on the drawings without risk of segregration or tearing.

6.82.5.3.4 The variable-width finishers are accepted for extra-wide areas and longitudinal joints, provided the screed extension is vibrating and heating and produce a surface that has all the required properties indicated on the drawings.

6.82.5.4 COMPACTION ROLLERS

6.82.5.4.1 The compaction rollers shall make it possible to achieve the compactness and surface properties indicated on the drawings and in this subsection.

6.82.5.4.2 The following three (3) types of compaction rollers may be used, subject to the restrictions mentioned in Article 6.82.6.8.4 *Asphalt Mix Compaction:*

6.82.5.4.2.1 static steel drum roller;

6.82.5.4.2.2 vibratory steel drum roller;

6.82.5.4.2.3 pneumatic-tire roller.

6.82.5.5 TRUCK

6.82.5.5.1 The dump box of the trucks used to transport the asphalt mix shall be watertight and fitted with a metal bottom. It shall be free of dust, screening, petroleum-based hydrocarbons and any other materials that may damage the asphalt.

6.82.5.5.2 The use of petroleum-based hydrocarbons as release agent is prohibited.

6.82.5.5.3 The dump box shall be fitted with a tarpaulin large enough to fully cover the asphalt mix, slow the cooling process thereof and protect it from adverse weather conditions.

6.82.5.6 HAND TOOLS

6.82.5.6.1 The tampers used to pack the asphalt mix in areas that the rollers cannot reach shall weigh at least 10 kg and have a maximum surface area of 300 $cm^2$.

6.82.5.6.2 Mechanical compactors and vibrating plates may be used instead of tampers with prior authorization from the Engineer.

6.82.5.6.3 The hand tools shall be cleaned away from the surface to be covered and from the freshly placed asphalt.

6.82.5.7 GAUGE

6.82.5.7.1 The **Contractor** shall supply and make available to the Engineer, throughout the duration of the hot-mix pavement work, a gauge in the form of a straight edge at least 3 m long and fitted with a level.

6.82.5.8 EQUIPMENT FOR EXECUTION OF A COLD JOINT

6.82.5.8.1 The **Contractor** shall have all equipment necessary to carry out a cold joint and it shall be in good condition, safe and well calibrated.

6.82.5.8.2 At the first worksite meeting, prior to starting the application of the adhesive product, the **Contractor** shall submit to the Engineer the technical data sheets on all the equipment it intends to use. The **Contractor** shall also submit to the Engineer a calibration certificate of the melter thermometers and thermostats, issued during the current year by a laboratory member of the *Association des firmes de génie conseil – Québec* (*AFG*).

6.82.5.8.3 The Engineer may request to stop the realization of a cold joint if he finds that the equipment does not comply to the recommendations of the manufacturer for the application of the product.

6.82.5.8.4 Melter

6.82.5.8.4.1 The characteristics of the melter shall meet the specifications described in the product manufacturer's application instructions. Among other things, the melter shall indirectly heat the product by means of an oil base and mix the product in accordance with standard ASTM D6690. The melter shall be fitted with a calibrated thermometer and shall allow the maintenance of the product temperature within the limits recommended by the manufacturer for application thereof, without exceeding the maximum heating temperature indicated in MTQ standard 4401.

6.82.5.8.5 Applicator

6.82.5.8.5.1 The joint adhesive shall be placed with a disc applicator installed at the end of an articulated heating arm, connected to the melter.

## 6.82.6 EXECUTION OF WORK

6.82.6.1 WORK PLANNING

6.82.6.1.1 The **Contractor** is responsible for proportioning the proposed hot-mix asphalt. At least fourteen (14) days prior to the asphalt mix spreading operations, the **Contractor** shall provide the Engineer with the technical data sheets on the theoretical and final formulas, comprising the following information:

6.82.6.1.1.1 Hot-mix asphalt formulated using the Marshall method:

6.82.6.1.1.1.1 for the cold aggregate, the grades of aggregate, type, origin, granularity, percentage used, bulk density and percentage of water absorption for each grade of aggregate;

6.82.6.1.1.1.2 the intrinsic, manufacturing and complementary characteristics of the fine aggregate mixture, based on the theoretical method, or of each grade of fine aggregate and each grade of coarse aggregate;

6.82.6.1.1.1.3 the performance grade of the bitumen;

6.82.6.1.1.1.4 the density at 25ºC expressed in g/cm$^3$;

6.82.6.1.1.1.5 the granularity, bulk density, percentage of water absorption and total aggregate grading of the mixture, optimum bitumen content proposed to obtain a void content ranging between 3% and 4%, as well as the stability, deformation and bulk and maximum density at the proposed bitumen content;

6.82.6.1.1.1.6 the percentage of voids, the percentage of voids between the aggregate particles (VMA) filled with bitumen, the VMA, the total specific surface and compactability of the hot-mix asphalt, the percentage of actual bitumen and the average thickness of the actual bitumen film at the proposed bitumen content;

6.82.6.1.1.1.7 the stability value maintained at the proposed bitumen content in accordance with test method LC 26-001;

6.82.6.1.1.1.8 the compactness, except for asphalt used for patching or correction prior to paving;

6.82.6.1.1.1.9 the five-point physical property curves of the asphalt mix for the each of the following properties:

6.82.6.1.1.1.9.1 stability;

6.82.6.1.1.1.9.2 flow index;

6.82.6.1.1.1.9.3 density;

6.82.6.1.1.1.9.4 percentage of voids in the asphalt mix;

6.82.6.1.1.1.9.5 percentage of filled VMA;

6.82.6.1.1.1.9.6 actual bitumen film.

6.82.6.1.1.2 Hot-mix asphalt formulated using the MTQ “Laboratoire des chaussées” method:

6.82.6.1.1.2.1 for the cold aggregate, the grades of aggregate, type, origin, granularity, bulk density, apparent density, percentage of water absorption and, based on the formula produced in accordance with test method LC 26-004, the percentage of each grade of aggregate used;

6.82.6.1.1.2.2 the intrinsic and complementary manufacturing properties of the fine aggregate mixture, in accordance with the theoretical formula, or of each grade of fine aggregate and each grade of coarse aggregate;

6.82.6.1.1.2.3 the performance grade of the bitumen;

6.82.6.1.1.2.4 the density at 25ºC expressed in g/cm$^3$;

6.82.6.1.1.2.5 based on the formula produced in accordance with test method LC 26-004, the final granularity, the actual density of the asphalt mix aggregate, the percentage of water absorption of the mixture, the proposed fibre content for EGA-10 and SMA-10 asphalt mixes, the total aggregate grading, the actual bitumen volume, the percentage of initial bitumen corresponding to the Vbe, expressed in cm, the percentage of total bitumen with the correction factor, expressed in cm, the average of void percentages to the required number of gyrations corresponding to the percentage of initial bitumen ($P_{bi}$) and to the percentage of total bitumen ($P_b$), if the $P_b$ differs from the $P_{bi}$ and the maximum density corresponding to the percentage of initial bitumen $P_{bi}$ and to the percentage of total bitumen $P_{b,}$ if the $P_b$ differs from the $P_{bi}$;

6.82.6.1.1.2.6 the stability value maintained at the proposed bitumen content according to test method LC 26-001;

6.82.6.1.1.2.7 the compactness, except for asphalt mix used for patching or correction prior to paving.

6.82.6.1.2 The theoretical and final formulas for the hot-mix asphalt shall be dated and signed by the manufacturer's person in charge of quality control.

6.82.6.1.3 The mix formulas shall be reviewed and approved by the Owner's Laboratory. The Engineer reserves the right to request changes to the formula in order for it to comply with this subsection.

6.82.6.1.4 The **Contractor** shall provide the results of the rutting resistance test. If the rutting resistance test has already been conducted on asphalt by one of MTQ's laboratories but the test results are more than three (3) years old, the conduct of a new rutting resistance test on that asphalt is mandatory, even if the manufacturer has not changed its formula.

6.82.6.2 DELIVERY OF BITUMEN

6.82.6.2.1 Quality system compliant with ISO standard

6.82.6.2.1.1 The **Contractor** shall obtain its supplies of bitumen, cutback bitumen and bitumen emulsion from a manufacturer whose plant holds a registration certificate attesting that the quality system complies with standard ISO 9001.

6.82.6.2.1.2 If the bitumen, cutback bitumen and bitumen emulsion are stored in and shipped to a place other than the manufacturing location, the **Contractor** shall ensure that the company responsible for the storage and shipment holds a registration certificate attesting that the quality system complies with standard ISO 9001.

6.82.6.2.2 Certificate of conformity

6.82.6.2.2.1 At least fourteen (14) days prior to ordering any materials, the **Contractor** shall submit to the Engineer the certificates of conformity for each product that will be used in the performance of the work covered by this subsection.

6.82.6.2.2.2 More specifically, for each shipment of bitumen, the certificates of conformity shall include, without however being limited to, the following information:

6.82.6.2.2.2.1 name of the manufacturer and location of manufacturing;

6.82.6.2.2.2.2 storage site and the place from which the bitumen will be shipped to the **Contractor**;

6.82.6.2.2.2.3 performance grade of the bitumen;

6.82.6.2.2.2.4 batch number;

6.82.6.2.2.2.5 date of manufacture;

6.82.6.2.2.2.6 date of characterization;

6.82.6.2.2.2.7 following test results:

6.82.6.2.2.2.7.1. density at 25°C expressed in g/cm$^3$;

6.82.6.2.2.2.7.2. Brookfield viscosity at 135°C and 165°C;

6.82.6.2.2.2.7.3. storage stability and average softening point;

6.82.6.2.2.2.7.4. elasticity recovery where required in Table 4101-1 of MTQ standard 4101;

6.82.6.2.2.2.7.5. ash content;

6.82.6.2.2.2.7.6. Rolling Thin Film Oven Test (RTFOT) mass change;

6.82.6.2.2.2.7.7. high-temperature characterization;

6.82.6.2.2.2.7.8. low-temperature characterization;

6.82.6.2.2.2.7.9. modulus of rigidity and slope measured on original bitumen;

6.82.6.2.2.2.7.10. monitoring date;

6.82.6.2.2.2.7.11. minimum and maximum storage temperatures;

6.82.6.2.2.2.7.12. minimum and maximum mixing temperatures.

6.82.6.2.3 Delivery control

6.82.6.2.3.1 The prime coat delivery control shall comply with Article 13.2.2.3.1 *Liant d'imprégnation* of the CCDG.

6.82.6.2.3.2 The tack coat delivery control shall comply with Article 13.2.2.3.2 *Liant d'accrochage* of the CCDG.

6.82.6.2.3.3 The asphalt delivery control shall comply with Article 13.3.2.1.3 *Contrôle de réception du bitume* of the CCDG.

6.82.6.3 MANUFACTURE OF HOT-MIX ASPHALT

6.82.6.3.1 The hot-mix asphalt shall be manufactured by a company that operates an asphalt plant that holds a registration certificate attesting that the quality system complies with standard ISO 9001.

6.82.6.3.2 The **Contractor** shall submit to the Engineer, at least fourteen (14) days prior to starting the manufacturing of the hot-mix asphalt, a copy of the plant's registration as well as a quality plan in accordance with MTQ standard 4201 or 4202.

6.82.6.3.3 The Owner's Laboratory will establish the compliance of the asphalt on the basis of the results provided by the **Contractor**. However, in the case where the Owner's Laboratory would perform a validation of the test results conducted by the **Contractor** and calculations of the various factors thereby made, the provisions of Article 13.3.2.2.5 *Contrôle de réception de la compacité du revêtement* of the CCDG will apply.

6.82.6.3.4 At the plant, the asphalt shall be mixed according to the mixing temperature indicated on the certificate of conformity of the bitumen used.

6.82.6.3.5 The hot-mix asphalt shall be stored in a silo protected from adverse weather conditions so as to prevent the segregation, compaction and contamination, and the cooling of the asphalt at a temperature below that recommended for the type of bitumen used.

6.82.6.4 DELIVERY SLIP

6.82.6.4.1 Prior to spreading the hot-mix asphalt, the **Contractor** shall submit to the Engineer a delivery slip containing the following information:

6.82.6.4.1.1 name of the hot-mix asphalt manufacturer and identification of the asphalt plant;

6.82.6.4.1.2 formula number and type of hot-mix asphalt;

6.82.6.4.1.3 loading date and delivery slip identification number;

6.82.6.4.1.4 **Contractor**'s name;

6.82.6.4.1.5 name of each affected structure or the **Contractor**'s Contract number;

6.82.6.4.1.6 quantity being delivered and quantity delivered to date.

6.82.6.5 SURFACE PREPARATION

6.82.6.5.1 Granular surface

6.82.6.5.1.1 The placement of the granular material shall in accordance with subsection 6.81 *Base and Sub-Base* and shall be authorized by the Engineer prior to the start of paving work.

6.82.6.5.1.2 The preparation of the surface to be paved shall be carried out by correcting the longitudinal and transversal profiles and by giving the roadway the required camber and slope. The surface preparation shall be carried out over the full width of the roadway or as indicated on the drawings and in this subsection so as to allow water to run freely to the ditches or drainage systems.

6.82.6.5.1.3 The base aggregate shall be spread and compacted according to the requirements for the placement of the pavement base materials. The thickness of the correction layer may vary depending on the work to be carried out and the extent to which the profile has to be corrected.

6.82.6.5.2 Asphalt or cement concrete surfaces

6.82.6.5.2.1 Correction with hot-mix asphalt

6.82.6.5.2.1.1 The surface to be covered shall be cleaned to remove any mud, litter or deleterious materials.

6.82.6.5.2.1.2 The **Contractor** shall apply a tack coat at the rate indicated on the drawings over the entire asphalt or cement concrete surface area to be covered.

6.82.6.5.2.1.3 If indicated on the drawings or at the request of the Engineer, rough and irregular surfaces shall be corrected by means of hot-mix correction asphalt.

6.82.6.5.2.1.4 If compaction is not carried out by means of a pneumatic-tire roller, the **Contractor** is required to wait at least twelve (12) hours following the correction before the next layer is placed.

6.82.6.5.2.2 Correction by leveling

6.82.6.5.2.2.1 If indicated on the drawings or at the request of the Engineer, the surfaces shall be corrected by restoring the longitudinal and transversal profiles by leveling the existing pavement and removing any visible surface imperfections.

6.82.6.5.2.2.2 Unless otherwise indicated on the drawings, in locations where there is insufficient adhesion between the top layer and the underlying layer, the leveling depth shall be increased until the top layer is completely removed.

6.82.6.5.2.2.3 In straight sections, the leveling planes shall intersect at the line that separates the traffic lanes. The 2% slope shall be restored on each lane with an accuracy of ±0.2%. In curves, the slopes shall be restored by means of a uniform rectilinear leveling plane.

6.82.6.5.2.2.4 The leveling shall be carried out without interruption from the edge of one shoulder to the other. The leveling of a single lane shall be carried out from the middle of the road towards the shoulder.

6.82.6.5.2.2.5 At the end of each shift, the transverse temporary joint shall be executed perpendicular to the road.

6.82.6.5.2.2.6 The **Contractor** shall ensure that the curbs, valve covers, grids and deck joint shoulders are not damaged during the leveling operations. The **Contractor** is liable for damage caused during these operations and shall make any necessary repairs, if required, at its expense.

6.82.6.5.2.2.7 The surface shall be mechanically swept to remove any dust using equipment specifically intended for sweeping, cleaning and waste collection. A manual sweeping shall be carried out in addition to the mechanical sweeping in areas that are more heavily soiled. The **Contractor** is responsible for the disposal of the asphalt aggregate in accordance with subsection 6.13 *Environmental Protection*.

6.82.6.6 APPLICATION OF THE TACK COAT OR PRIME COAT

6.82.6.6.1 Unless otherwise indicated on the drawings, the **Contractor** shall spread a prime coat on the granular surfaces and a tack coat on any asphalt or cement concrete surfaces to be covered as well as between each layer of hot-mix asphalt.

6.82.6.6.2 The **Contractor** shall apply the tack coat or prime coat evenly, using a pressurized distributor, at the following rates with a permissible deviation of ±10%:

6.82.6.6.2.1 at the residual bitumen rate of 1.2 L/m² for the prime coat on a scarified granular surface;

6.82.6.6.2.2 at the residual bitumen rate of 0.15 L/m² for the tack coat on a waterproofing membrane placed on a bridge deck;

6.82.6.6.2.3 at the residual bitumen rate of 0.20 L/m² for the tack coat on new asphalt pavement;

6.82.6.6.2.4 at the residual bitumen rate of 0.25 L/m² for the tack coat on worn asphalt pavement or on a smooth cement concrete surface;

6.82.6.6.2.5 at the residual bitumen rate of 0.30 L/m² for the tack coat on leveled asphalt pavement or on a rough cement concrete surface.

6.82.6.6.3 The application rate and uniformity of the spreading shall be measured and checked by the **Contractor** by means of a method submitted to the Engineer at least fourteen (14) days prior to the start of binder spreading.

6.82.6.6.4 All surfaces that come into contact with the hot-mix asphalt, such as the vertical surfaces of curbs, sidewalks, construction joints and other structures shall be brushed with a thin uniform coat of bituminous binder in order to ensure a permanent watertight joint.

6.82.6.6.5 The vehicular traffic on the binder is prohibited at all times.

6.82.6.6.6 The application of a tack coat when it is raining, on a wet or frozen surface, or when the ambient air temperature is below the temperature recommended by the manufacturer is prohibited.

6.82.6.6.7 After a minimum waiting time of thirty (30) minutes following the application of the binder, the granular surface shall be compacted to a minimum of 98.0% of the maximum dry density prescribed for worksite compactness of roadway base materials.

6.82.6.6.8 The **Contractor** shall wait for the complete curing of the binder prior to placing the asphalt mix.

6.82.6.6.9 In all cases, the **Contractor** shall take the necessary precautions to ensure that the tack coat or prime coat is not spread onto adjacent surfaces that have already been or do not have to be covered.

6.82.6.7 TRANSPORTATION OF THE HOT-MIX ASPHALT

6.82.6.7.1 It is prohibited to overheat the asphalt mix to compensate for the cooling resulting from transportation, regardless of the duration. The decrease in the asphalt mix temperature between the mixing and the time of placement on worksite shall not exceed 15°C.

6.82.6.8 ASPHALT PAVEMENT IMPLEMENTATION

6.82.6.8.1 General

6.82.6.8.1.1 All surveying needed to implement the elevation points of the final profile of the asphalt pavement shall be carried out by the **Contractor**, at its expense, and the **Contractor** shall bear full responsibility for the accuracy of that work.

6.82.6.8.1.2 It is prohibited to carried out hot-mix pavement work when the surface to be covered is frozen, wet or covered with puddles of water or mud.

6.82.6.8.1.3 The ambient temperature shall remain above 10°C at all times during the placement of asphalt pavement whose thickness after compaction is less than 50 mm. For thicknesses of 50 mm or more, the ambient temperature shall be above 2°C and rising.

6.82.6.8.1.4 The ambient temperature shall be measured using a thermometer with an accuracy of 1°C. The readings shall be taken at a height of 1.5 m above the ground and farther than 5 m from the construction equipment or any other sources of heat.

6.82.6.8.2 Mechanical spreading

6.82.6.8.2.1 The travel speed of the finisher shall make it possible to achieve a pavement whose density and properties comply with those indicated on the drawings.

6.82.6.8.2.2 Immediately after one layer has been placed and prior to undertaking the compaction, the **Contractor** shall check the surface and correct any unevenness. Any accumulation of materials shall be removed and the indentations and other depressions shall be levelled and filled with hot-mix asphalt.

6.82.6.8.3 Manual spreading

6.82.6.8.3.1 The asphalt mix shall be spread manually in areas that the finisher cannot reach. The **Contractor** shall distribute the asphalt mix evenly and spread it in an even loose layer of uniform density, taking care to avoid segregation. Prior to compaction, the **Contractor** shall check the surface with a ruler and correct any unevenness. The asphalt mix shall not be thrown on the surface in such a way that the aggregate deploys like a fan.

6.82.6.8.4 Asphalt mix compaction

6.82.6.8.4.1 The following requirements apply to all pavement layers:

6.82.6.8.4.1.1 except in the cases where the work is carried out at night, the compaction shall be completed before sunset. The Engineer may waive this requirement if he considers that the precautions taken by the **Contractor** are satisfactory;

6.82.6.8.4.1.2 the **Contractor** shall pay special attention when using vibratory compaction rollers to avoid damaging the underlying or surrounding structures and pipes. If there is any doubt, vibration is prohibited;

6.82.6.8.4.1.3 the compaction sequence shall make it possible to obtain the driving surface and compactness indicated on the drawings.

6.82.6.8.4.2 Each layer shall have a uniform texture, without segragation or bleeding and be regular and compliant with the transversal and longitudinal profiles indicated on the drawings. The Engineer may, if he deems appropriate, prohibit the use of the vibratory compaction roller.

6.82.6.8.4.3 The use of a vibratory compaction roller is prohibited on bridge and viaduct decks and within 2 m of an abutment or a retaining wall.

6.82.6.8.4.4 Any layer of asphalt pavement applied directly onto the existing cement concrete of slabs on ground shall be compacted by means of a pneumatic-tire compactor.

6.82.6.8.4.5 The on-site density of the compacted mix shall range between 93% and 98% of the theoretical “Rice” density of the mix.

6.82.6.8.4.6 On bridges and viaducts, the worksite density of the compacted mix shall range between 92% and 98% of the theoretical “Rice” density of the mix.

6.82.6.8.4.7 The compactness of the asphalt pavement will be checked as prescribed in Article 6.82.7 *Quality Control*.

6.82.6.8.5 Surface properties of pavement layers

6.82.6.8.5.1 For all work involving the placement of asphalt mix, except for correction asphalt mixes, the thickness of each layer and the total thickness of the asphalt pavement to place shall not vary by more than 6 mm from the average thickness indicated by the placement rate per square meter. This rate shall be converted into thickness using the average bulk density obtained when measuring the compactness. No irregularities or depressions shall exceed 5 mm within 3 m for the top layer or 6 mm within 3 m for the other layers.

6.82.6.8.5.2 In all cases where a profile is indicated on the drawings, the Engineer will check the alignment and the slopes after final compaction of each layer. The profile of each layer shall not vary by more than 6 mm from the profile determined using the final profile and asphalt thicknesses indicated on the drawings.

6.82.6.9 JOINTS IN THE ASPHALT PAVEMENT

6.82.6.9.1 The longitudinal joints shall be parallel to the roadway alignment and shall not overlap.

6.82.6.9.2 The longitudinal joints in the wearing layer or top layer shall not be located under the normal wheel path.

6.82.6.9.3 The work shall be planned so that the placement of asphalt at the end of the day does not leave a longitudinal joint to be completed the next day.

6.82.6.9.4 Any transversal or longitudinal joint whose temperature is below 85°C shall be brushed with a uniform tack coat layer. All joints shall have the surface properties required for pavement layers.

6.82.6.9.5 On structures, it is only at the location of expansion joints that the **Contractor** shall execute transversal joints.

6.82.6.9.6 The new pavement shall be tightly packed against the vertical face of the existing pavement.

6.82.6.9.7 The **Contractor** shall push the asphalt mix overlapping the existing pavement onto the new section over a width of 75 to 100 mm from the joint.

6.82.6.9.8 The **Contractor** shall have the compaction roller run over the existing pavement, overlapping the new pavement section by 75 to 150 mm.

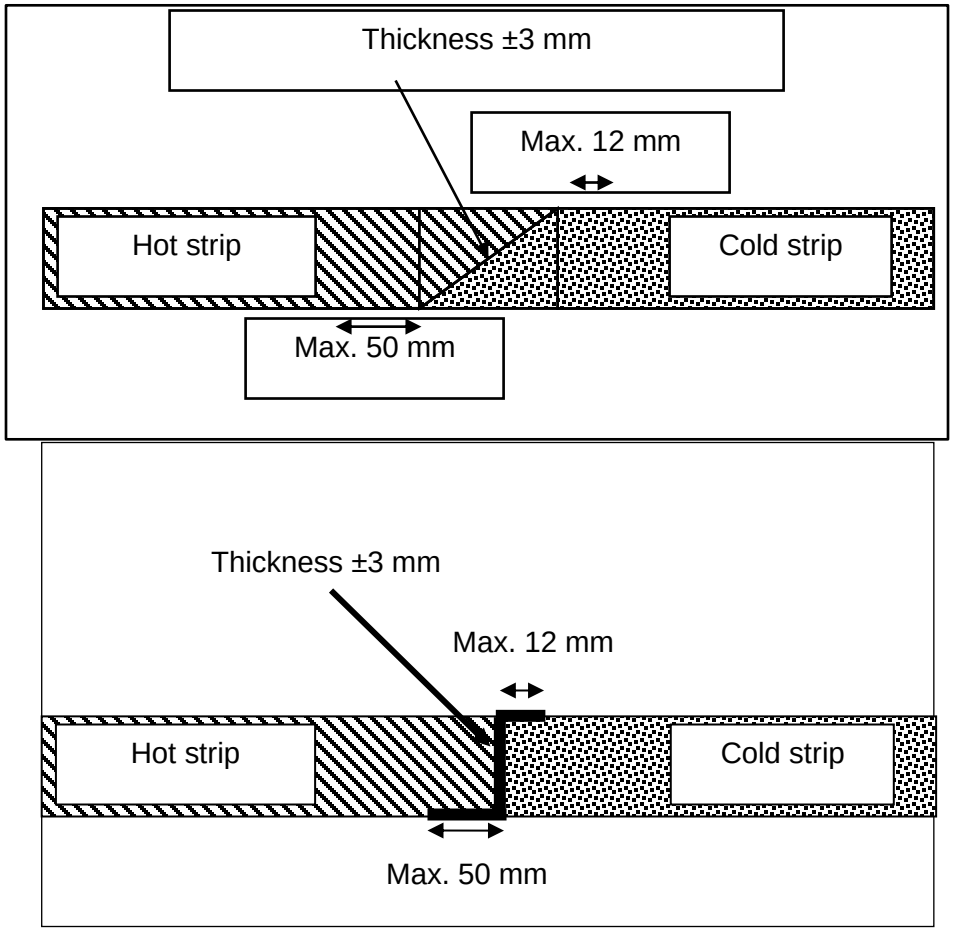
6.82.6.9.9 The compaction roller shall make at least two (2) passes in this manner in order to ensure the perfect compaction of the narrow strip adjacent to the joint and get a smooth joint surface at the existing pavement.

6.82.6.10 APPLICATION OF AN ADHESIVE PRODUCT FOR COLD JOINT

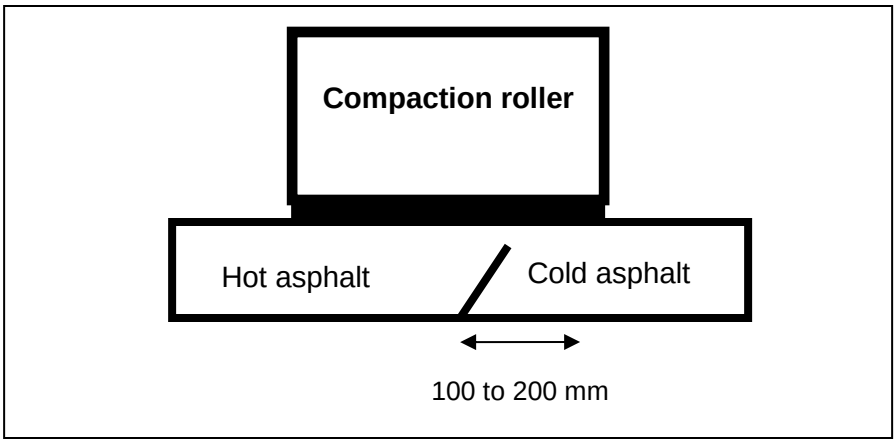
6.82.6.10.1 The placement of the adhesive joint consists in applying the adhesive on the longitudinal face of the asphalt strip in the location where the adjacent strip will be placed.

6.82.6.10.2 The product thickness shall be ±3 mm, which corresponds to approximately 0.45 kg per m. The 75 mm diameter disc applicator shall make it possible to adjust the product thickness at the time of application.

6.82.6.10.3 The adhesive shall not be more than 50 mm wide at the base of the joint and shall not exceed the top of the joint by more than 12 mm. The placement geometry shown below shall be complied with:




6.82.6.10.4 The adjacent asphalt strip may be placed after the adhesive has been placed. In order to obtain a greater density at the joint, the first compaction of the joint shall be carried out from the hot-mix asphalt strip, having the compaction roller overlap on a portion of 100 mm to 200 mm of the cold asphalt strip. The compaction shall be carried out in each direction, which represents two (2) passes. Subsequently, the compaction shall be carried out in accordance with the methods set out in Article 6.82.6.8.4 *Asphalt Mix Compaction*.




6.82.6.10.5 When paving on concrete slab roadways, the **Contractor** shall execute transversal joints only at expansion joints.

6.82.6.10.6 The new pavement shall be packed tight against the vertical face of the existing pavement.

6.82.6.10.7 The **Contractor** shall push the asphalt mix overlapping the existing pavement onto the new section over a width of 75 to 100 mm from the joint.

6.82.6.10.8 The **Contractor** shall have the compaction roller pass over the existing pavement, overlapping the new pavement section by 75 to 150 mm.

6.82.6.10.9 The compaction roller shall make at least two (2) passes in this manner in order to ensure the perfect compaction of the narrow strip adjacent to the joint and get a smooth joint surface at the existing pavement.

## 6.82.7 QUALITY CONTROL

6.82.7.1 VERIFICATION OF COMPACTNESS

6.82.7.1.1 Inspections and testing of the asphalt mix and materials thereof will be conducted by the Owner's Laboratory.

6.82.7.1.2 At least twenty-four (24) hours prior to the start of each paving work, the **Contractor** shall send a written work notice to the Engineer so that the latter may notify the Owner's Laboratory. The **Contractor** shall ensure that a representative of the Owner's Laboratory is present during the asphalt mix placement, failing which the Engineer will not allow paving to proceed.

6.82.7.1.3 After the final compaction of each layer, the Engineer will check the alignment and the slopes. The profile of each layer shall not vary by more than 6 mm from the profile indicated on the drawings. No irregularities or depressions shall exceed 5 mm within 3 m for the top layer or 6 mm within 3 m for the other layers. The thickness of each layer shall not vary by more than 6 mm from the average thickness indicated by the placement rate per square metre. That rate shall be converted to thickness using the average bulk density obtained when compactness was measured.

6.82.7.1.4 Irregularities are checked by the Engineer using a gauge supplied by the **Contractor**.

6.82.7.1.5 The **Contractor** is responsible for ensuring that the work carried out produces the profile indicated on the drawings. In case of non-compliance, the **Contractor** is required to resume, by leveling and resurfacing and at its expense, the work on the portion of lane affected by the non-compliance.

6.82.7.1.6 The percentage of compactness is determined according to test method LC 26-510.

6.82.7.1.7 The batch unit for acceptance of a lot consists of the quantity of asphalt mix placed during the day for each hot-mix asphalt formula.

6.82.7.1.8 A lot is accepted when the average of the six (6) compactness results for the day ranges between 93.0% and 98.0%. If the average compactness value for the day falls under the 93.0% requirement, the Engineer will notify the **Contractor** in writing and inform the latter that a reassessment of the compactness will be carried out by means of test specimens collected by core sampling.

6.82.7.1.9 The compactness reassessment is carried out by means of six (6) test specimens collected by core sampling that cover the surface area of asphalt placed during that day and whose locations are randomly determined by the Engineer. The sampling shall be carried out within twenty (20) days after the notice is sent to the **Contractor**.

6.82.7.1.10 The percentage of compactness of the pavement is the ratio of the bulk density of the core sample collected on the roadway and the average maximum density for the day found during the delivery control, multiplied by 100.

6.82.7.1.11 The bulk density tests will be conducted in the Owner’s Laboratory using test method LC 26-040.

6.82.7.1.12 If the average of these six (6) compactness measurements using test specimens collected by core sampling falls under the required minimum compactness of 93.0%, the asphalt placed during that day is deemed non-compliant.

6.82.7.1.13 The holes made by the core sampling shall be filled by the **Contractor** at its expense immediately after sampling. The cost for signage and maintenance of traffic shall be borne by the **Contractor**.

6.82.7.1.14 The **Contractor** shall designate an observer during the sampling and testing. Any comments about a procedure the observer deems incorrect shall be reported on the spot, and the Engineer shall be notified in writing of any disagreement.

6.82.7.1.15 Pavement work deemed non-compliant with regard to compactness and thickness will not be accepted, and the **Contractor** shall resume the work at its expense while meeting the deadlines and timelines of this Contract.

6.82.7.2 VERIFICATION OF HOT-MIX ASPHALT PROPERTIES

6.82.7.2.1 The **Contractor** shall control the manufacturing of the hot-mix asphalt in accordance with Article 13.3.2.2.2 *Enrobés à chaud formulés selon la méthode du Laboratoire des chaussées* of the CCDG.

6.82.7.2.2 For the purposes of acceptance and sampling, a batch unit shall consist of 500 t of asphalt mix placed and prepared according to the same final dosage formula and by a same plant.

6.82.7.2.3 The Owner's Laboratory will collect five (5) asphalt samples per batch, at a rate of one (1) sample per 100 t of asphalt mix placed. The samples will be collected randomly in accordance with the LC 26005 sampling procedure.

6.82.7.2.4 The Owner's Laboratory will conduct laboratory control tests on each sample in order to check the physical properties of the asphalt in accordance with MTQ standard 4202.

6.82.7.2.5 The properties of a batch are deemed compliant when the deviation between the average of the batch results and the mix formula submitted prior to the work is less than or equal to the following tolerable deviations:

| | **Tolerable deviation - Td** | **Critical deviation - Cd** |
|---|---|---|
| Passing the 5 mm sieve | 3.30% | 7.00% |
| Passing the 80 μm sieve | 0.80% | 1.70% |
| Bitumen content | 0.24% | 0.50% |
| Total aggregate grading | 14% | 30% |

6.82.7.2.6 A batch will be rejected and the section represented by that batch must be resumed at the **Contractor**'s expense in the following cases:

6.82.7.2.6.1 when the deviation between the average of the batch results and the mix formula is greater than the critical deviation for one of the following properties: passing the 5 mm sieve, passing the 80 μm sieve, bitumen content and total aggregate grading;

6.82.7.2.6.2 when the average of the results on the first sieve where a refusal is permitted is less than the minimum percentage indicated in Table 1 of MTQ standard 4202 and the difference between these values is greater than 3%;

6.82.7.2.6.3 when the requirement of 100% passing the sieve superior to that of the maximum permitted aggregate size is not complied with;

6.82.7.2.6.4 if the analysis of a batch results shows that for one of the following properties: passing the 5 mm sieve, passing the 80 μm sieve or bitumen content, the range of results is greater than twice the critical deviation. In this case, the production shall be considered out of control. The work covered by that batch are rejected and shall be resumed at the **Contractor**'s expense;

6.82.7.2.6.5 if the deviation between one or more of the following average values: passing the 5 mm sieve, passing the 80 μm sieve, bitumen content, total aggregate grading and the mix formula submitted is greater than the tolerable deviation and less than or equal to the critical deviation. In such a case, the unit price of the asphalt mix shall be adjusted using the formula presented in paragraph 6.82.7.2.7 below.

6.82.7.2.7 The revised price applicable to the asphalt mix shall be calculated using the following formula:

$$Rpm = Up \times (1 - (F5+F80+Fb+Fag+Ft))$$

6.82.7.2.7.1 If the total (F5+F80+Fb+Fag+Ft) is greater than 1, the paving work will be rejected and shall be resumed at the **Contractor**'s expense.

Where Rpm = revised price for the mix

Up = tendered unit price

F80 = correction factor for the passing 80 μm sieve (F80 = 0 if the absolute deviation between the formula and the batch average is less than the tolerable deviation)

F5 = correction factor for the passing 5 mm sieve (F5 = 0 if the absolute deviation between the formula and the batch average is less than the tolerable deviation)

Fb = correction factor for the bitumen (Fb = 0 if the absolute deviation between the formula and the batch average is less than the tolerable deviation)

Fag = correction factor for the total aggregate grading

Ft = correction factor for the thickness

6.82.7.2.7.2 The correction factors F5, F80, Fb and Fag shall be calculated using the following formula:

$$\text{F5, F80, Fb and Fag} = 0.50 \times \frac{(Td/a - Td)}{(Cd - Td)})$$

Where Td/a = absolute deviation between the formula and the batch average, Cd = critical deviation and Td = tolerable deviation

6.82.7.2.7.3 If for F5, F80, Fag or Fb, the Td/a value < Td, then F5, F80, Fag or Fb = 0 according to the applicable factor.

6.82.7.2.7.4 The correction factor for the thickness Ft shall be calculated using the following formula:

$$Ft = 1 - F't$$

6.82.7.2.7.5 Where At' < (T - 6mm), the factor F't shall be calculated using the following formula:

$$F't = \frac{(At')^2}{(T)^2}$$

Where At' = measured average thickness (in mm) and T = target thickness (in mm)

6.82.7.2.7.6 Where At' > (T + 6mm), the factor F't for the thickness shall be calculated using the following formula:

$$F't = \frac{(T)^2}{(At')^2}$$

Where At' = measured average thickness (in mm) and T = target thickness (in mm)

6.82.7.2.7.7 If (T - 6 mm) ≤ At' ≤ (T + 6 mm), then Ft = 0.

6.82.7.3 SURFACE ROUGHNESS

6.82.7.3.1 The surface roughness assessment applies only to the top layer placed on traffic lanes.

6.82.7.3.2 Measurement device and unit

6.82.7.3.2.1 The surface roughness shall be measured by means of an inertial profiler such as the requirements of a Class 1 device according to standard ASTM E950.

6.82.7.3.2.2 The surface roughness measurement unit shall be the International Roughness Index (IRI). The IRI is expressed in m/km and calculated according to standard ASTM E1926. The IRI is calculated in the two-wheel paths with an accuracy of one hundredth of m/km and per 100 m segment.

6.82.7.3.2.3 The roughness requirements apply to the truncated value, with an accuracy of one tenth of m/km, of the average IRI values of the two-wheel paths per 100 m segment.

6.82.7.3.3 Surface roughness assessment

6.82.7.3.3.1 Upon completion of the hot-mix roadway pavement work, the **Contractor** shall notify the Engineer so that the latter evaluates the surface roughness.

6.82.7.3.3.2 During the conduct of the surface roughness assessment by the Engineer, the **Contractor** shall:

6.82.7.3.3.2.1 maintain the traffic lane surfaces free from residues that might influence the roughness measurement;

6.82.7.3.3.2.2 install and maintain workzone signage according to current standards, in order to allow the passage, without hindrance, of the inertial profiler at a constant speed of 50 to 80 km/h, according to the posted speed limit, on the lanes subject to the roughness requirements as well as over a minimum distance of 100 m on both sides thereof;

6.82.7.3.3.2.3 provide all assistance required by the Engineer for his assessment.

6.82.7.3.4 Identification of the lanes subject to the roughness requirements

6.82.7.3.4.1 The surface roughness assessment is conducted in both wheel paths of every traffic lane subject to the roughness requirements presented in the table indicated on the drawings.

6.82.7.3.4.2 If the above-mentioned table is modified, the Engineer will provide the **Contractor** with a copy of the modified table.

6.82.7.3.4.3 Unless otherwise indicated on the drawings, the stationing segmentation start shall correspond to a 10 m section after the lane pavement work joint on the lane towards the main direction. Any modification of the stationing segmentation start is prohibited after the surface roughness assessment by the Engineer.

6.82.7.3.4.4 From the stationing segmentation start, the IRI values shall be calculated by consecutive 100 m segments. The stationing segmentation end corresponds to 10 m before the lane pavement work joint. If the last segment is shorter than 100 m, it is excluded from the roughness requirements. For adjacent lane roadways, the stationing segments shall coincide.

6.82.7.3.4.5 The 100 m segments that comprise obstacles, and 10 m on both sides of each obstacle, are excluded from the roughness requirements. The obstacles are, among others, manhole or catch basin grids, deck joints and bridge decks. If an obstacle is located outside of the traffic lane, the roughness requirements apply. If an obstacle is located outside of the traffic lane, but touches the edge line, the roughness requirements do not apply.

6.82.7.3.4.6 No modification may be made to the segmentation of the lanes subject to the roughness requirements after the surface roughness assessment by the Engineer.

6.82.7.3.5 Surface roughness requirements

6.82.7.3.5.1 For each 100 m segment subject to the surface roughness requirements, the target value per 100 m segment is an IRI of ≤ 1.2 m/km. The acceptance process by the Engineer of the surface roughness will be done as follows:

6.82.7.3.5.1.1 a segment is accepted when the IRI value obtained for it is ≤ 1.7 m/km.

6.82.7.3.5.1.2 a segment is rejected when the IRI value obtained for it is > 1.7 m/km.

6.82.7.3.5.2 Two (2) passes shall be made in each lane subject to the surface roughness requirements. However, if all IRI values are ≤ 1.2 m/km after the first pass, only one (1) pass is required.

6.82.7.3.5.3 When two (2) passes have been made, the pass with the fewer segments rejected is used. When the number of rejected segments is the same for both passes, the pass with the adjustment amount that is the most favorable to the **Contractor** is used. Only the results of the pass used shall be communicated in writing to the Engineer. No official result shall be provided on site during the roughness assessment.

6.82.7.3.6 Corrective measures and roughness reassessment

6.82.7.3.6.1 For every 100 m segment rejected, the **Contractor** shall take the necessary corrective measures, within twenty-eight (28) days including the period for the **Contractor**'s appeal, after the Engineer has notified it in writing of the results of the surface roughness assessment. The exact nature of the corrective measures, leveling or asphalt thickness and completion date shall be approved by the Engineer prior to the corrective measures work.

6.82.7.3.6.2 The **Contractor** shall notify the Engineer in writing after having taken the corrective measures on all the work. The Engineer will then reassess the surface roughness. For every segment corrected, the result of the reassessment replaces the initial result.

6.82.7.3.6.3 All the provisions and requirements relating to the asphalt pavement surface roughness apply to the corrective measures taken by the **Contractor** as well as to the reassessment of the surface roughness of any corrected segment.

6.82.7.3.7 Contractor's appeal

6.82.7.3.7.1 Within seven (7) days from receiving the written notification, by the Engineer, of the surface roughness assessment results, the **Contractor** may notify the Engineer, in writing, of its intent to proceed, at its expense, to a new assessment of the surface roughness on a portion of or all of the segments, with a device other than that used by the Engineer for the initial check.

6.82.7.3.7.2 For the results of a new assessment to be accepted by the Engineer and replace, in whole or in part, the results of the initial assessment, the following cumulative conditions shall be met:

6.82.7.3.7.2.1 the new assessment be completed within seven (7) days after reception of the notice of the **Contractor**'s appeal by the Engineer and that the results be communicated to the Engineer in writing within that period;

6.82.7.3.7.2.2 the method, technique, calibration and procedure be approved in advance by the Engineer;

6.82.7.3.7.2.3 the measurement device and unit used meet the requirements mentioned in Article 6.82.7.3.2 *Measurement Device and Unit*;

6.82.7.3.7.2.4 the Engineer be present at all stages of the assessment.

6.82.7.3.7.3 All the provisions and requirements relating to the surface roughness apply to this new assessment.

6.82.7.3.8 Calculation of the adjustment amount relating to surface roughness

6.82.7.3.8.1 The adjustment amount relating to the surface roughness applicable to each 100 m segment accepted for each lane subject to the surface roughness requirements are indicated in the following table:

| **IRI Value used of the accepted segment (m/km)** | **Adjustment Amount relating to the surface roughness ($)** |
|---|---|
| ≤ 1.2 | 0 |
| 1.3 | - 10 |
| 1.4 | - 20 |
| 1.5 | - 100 |
| 1.6 | - 500 |
| 1.7 | - 1,000 |
| >1.7 | Segment rejected and to be corrected |

6.82.7.3.8.2 The adjustment amounts of the segments of each lane subject to the surface roughness requirements shall be added for the entire Contract and are subject to a global deduction where applicable.

6.82.7.3.9 Corrective measures and surface roughness reassessment

6.82.7.3.9.1 The corrective measures taken shall be borne by the **Contractor.**

6.82.7.3.9.2 Every reassessment of the surface roughness by the Engineer shall be carried out at the **Contractor'**s expense in the amount of $200 for each 100 m segment corrected. An amount of $1,000 is added for the mobilization and demobilization.

**END OF SUBSECTION**

# APPENDIX 6.82-I

# HOT-MIX ASPHALT FORMULATED USING THE MARSHALL METHOD

# (1 PAGE)

HOT-MIX ASPHALT FORMULATED USING THE MARSHALL METHOD

| Type of Asphalt | EB-20 | EB-14 | EB-10S | EB-10C | EB-5 | CH-10 |
|---|---|---|---|---|---|---|
| Uses | Base layer | Single layer, top layer or base layer | Top layer | Top layer or correction layer | Hand patching or correction layer | Waterproofing |
| Minimum number of separate aggregate grades to be used | 3 | 3 | 2 | 2 | 1 | 2 |
| Sieve | (% passing) | | | | | |
| 28 mm | 100 | | | | | |
| 20 mm | 95-100 | 100 | | | | |
| 14 mm | 65-88 | 95-100 | 100 | 100 | | 100 |
| 10 mm | 48-78 | 75-90 | 92-100 | 94-100 | 100 | 96-100 |
| 5 mm | 34-55 | 50-65 | 50-65 | 66-78 | 85-100 | 75-85 |
| 2.5 mm | 24-45 | 29-47 | 27-50 | 45-65 | 65-90 | 57-75 |
| 1.25 mm | 16-39 | 20-40 | 18-42 | 30-50 | - | - |
| 630 µm | 9-31 | 14-34 | 12-35 | 20-40 | 26-65 | 25-50 |
| 315 µm | 6-23 | 10-26 | 8-26 | 14-29 | 18-48 | 15-40 |
| 160 µm | 4-15 | 5-17 | 5-17 | 7-18 | 8-30 | 7-25 |
| 80 µm | 3.0-8.0 | 3.0-8.0 | 4.0-10.0 | 4.0-10.0 | 4.0-12.0 | 4.0-13.0 |
| Binder (% min) | 4.2 | 4.7 | 4.8 | 5.2 | 6 | 5.5 |
| Flow (mm) | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.0 | 2.0-4.5 | 2.0-4.0 |
| Stability (N)(min) | 9,000 | 9,000 | 9,000 | 9,000 | 7,000 | 9,000 |
| Voids (%) | 2.0-5.0 | 2.0-5.0 | 2.0-5.0 | 2.0-5.0 | 2.0-5.0 | 2.0-5.0 |
| Filled VAN (% max) | 85 | 85 | 85 | 85 | 85 | 85 |
| Compactness (% min) | 93 | 93 | 93 | 93 | 93 | 93 |
| Rutting resistance on 100 mm plates at 60°C at 30,000 cycles (% max deformation) | 10.0 | 10.0 | - | - | - | - |
| Rutting resistance on 50 mm plates at 60°C | | | | | | |
| at 1,000 cycles | - | - | 10.0 | 10.0 | - | - |
| at 3,000 cycles (% max deformation) | - | - | 20.0 | 20.0 | - | - |
| Water content (% min) | 70 | 70 | 70 | 70 | | |

# APPENDIX 6.82-II

# HOT-MIX ASPHALT FORMULATED USING THE MTQ "LABORATOIRE DES CHAUSSÉES" METHOD

# (1 PAGE)

HOT-MIX ASPHALT FORMULATED USING THE MTQ "LABORATOIRE DES CHAUSSÉES" METHOD

| | Type of Asphalt | GB-20 | ESG-14 | ESG-10 | EG-10 | EC-10 | SMA-10 | ESG-5 |
|---|---|---|---|---|---|---|---|---|
| | Uses | Base layer | Single layer, top layer or base layer | Top layer | Top layer | Correction layer | Top layer | Anti-cracking layer |
| | Minimum number of separate aggregate grades to be used | 3 | 3 | 2 | 2 | 2 | 2 | 2 |
| | Sieve | (% passing) | | | | | | |
| Particle size range | 28 mm | 100 | | | | | | |
| | 20 mm | 95-100 | 100 | | | | | |
| | 14 mm | 67-90 | 95-100 | 100 | 100 | 100 | 100 | |
| | 10 mm | 52-75 | 70-90 | 92-100 | 90-100 | 94-100 | 90-100 | 100 |
| | 5 mm | 35-50 | 40-60 | 52-65 | 40-48 | 66-78 | 25-35 | 85-100 |
| | 2.5 mm | - | 39.2 | 46.1 | 46.1 | 45-65 | 18-28 | 50-70 |
| | 1.25 mm | - | 25.7-31.7 | 30.7-36.7 | 30.7-36.7 | - | - | - |
| | 630 µm | - | 19.1-23.1 | 22.8-26.8 | 22.8-26.8 | - | - | - |
| | 315 µm | - | 15.4 | 18.1 | 18.1 | - | - | - |
| | 160 µm | - | - | - | - | - | - | - |
| | 80 µm | 4.0-8.0 | 3.0-8.0 | 4.0-10.0 | 4.0-10.0 | 4.0-10.0 | 8.0-11.0 | 4.0-12.0 |
| Restriction zone [8] | 2.5 mm | - | 39.2 | 46.1 | 46.1 | - | - | - |
| | 1.25 mm | - | 25.7-31.7 | 30.7-36.7 | 30.7-36.7 | - | - | - |
| | 630 µm | - | 19.1-23.1 | 22.8-26.8 | 22.8-26.8 | - | - | - |
| | 315 µm | - | 15.4 | 18.1 | 18.1 | - | - | - |
| | Percentage fibres (%) | | | | | - | 1.0 | |
| | Vibration (%) | 10.2 | 11.4 | 12.2 | 12.4 | 12.6 | 14.8 | 13.5 |
| | Voids at 10 gyrations (%) | ≥ 11.0 | ≥ 11.0 | ≥ 11.0 | ≥ 11.0 | ≥ 11.0 | ≥ 11.0 | (6g) ≥ 11.0 |
| | Voids at 80 gyrations (%) | | - | 4.0-7.0 | 4.0-7.0 | 4.0-7.0 | (60g) 4.0-7.0 | (50g) 4.0-7.0 |
| | Voids at 100 gyrations (%) | | 4.0-7.0 | - | - | - | | |
| | Voids at 120 gyrations (%) | 4,0-7,0 | | | | | | |
| | Voids at 200 gyrations (%) | ≥ 2,0 | ≥ 2,0 | ≥ 2,0 | ≥ 2,0 | ≥ 2,0 | ≥ 2,0 | (75g) ≥ 2,0 |
| | Compactness (% min) | 93,0 | 93,0 | 93,0 | 93,0 | 93,0 | 93,0 | 93,0 |
| | Rutting resistance on 100 mm plates at 60°C at 30,000 cycles (% max deformation) | 10,0 | 10,0 | - | - | - | - | - |
| | Rutting resistance on 50 mm plates at 60°C | | | | | | | |
| | at 1,000 cycles | - | - | 10,0 | 10,0 | 10,0 | - | - |
| | at 3,000 cycles (% max deformation) | - | - | 20,0 | 20,0 | 20,0 | 10,0 | - |
| | Water content (% min) | 70 | 70 | 70 | - | 70 | 70 | 70 |