December 19, 1994
JEGEL 93249

SUMMARY REPORT
RUBBER MODIFIED ASPHALT PAVEMENT PROJECT
MAIN STREET
BIRCH STREET TO POWER PLANT

Prepared For
TOWN OF KIRKLAND LAKE

By

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RUBBER MODIFIED ASPHALT DEMONSTRATION PROJECT

SUMMARY

In September, 1994, the Corporation of the Town of Kirkland Lake in conjunction with the Ontario Ministry of Environment and Energy (MOEE), constructed a demonstration project with rubber modified hot-mix asphalt concrete (MRUAC) as part of the Waste Reduction Office Scrap Tire Project. The primary objectives of the trial are to assess the performance of the MRUAC mix and to evaluate the use of the modified process.

A 300 m section of Main Street from Birch Street to the Power Plant was surfaced with two lifts of a HL 4 MRUAC containing 1.2 percent No. 30 mesh crumb rubber modifier (CRM) by mass of mix (20 percent by mass of asphalt cement). The CRM was incorporated at the hot-mix plant during the mixing cycle. John Emery Geotechnical Engineering Limited, Consulting Engineers (JEGEL), were retained to complete the mix designs, conduct quality assurance inspection and testing and a complete preliminary post construction performance evaluation.

The demonstration project was constructed without any significant problems and is considered to be successful in all aspects of the work. While emissions testing was not involved, there were no perceived environmental problems with the MRUAC process. The cost of the MRUAC mix for the trial is in the order of 20 percent higher than conventional mix in the area. Ultimately, the long term performance of this section of pavement will reveal whether the process is cost effective and a viable alternative for adding crumb rubber modifier to hot-mix asphalt.
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INTRODUCTION

John Emery Geotechnical Engineering Limited, Consulting Engineers (JEGEL), were retained by the Corporation of the Town of Kirkland Lake in conjunction with the Ministry of Environment and Energy (MOEE) to carry out inspection and testing for the HL 4 rubber modified hot-mix asphalt (MRUAC) demonstration project constructed in September/94.

This report summarizes the mix design information, construction details, and the quality control/quality assurance aspects of the project. A preliminary performance discussion is also presented based on deflection testing using the Falling Weight Deflectometer (FWD), profile measurements with the Digital Incremental Profiler (‘Dipstick’) and visual assessments.

BACKGROUND

As part of the Ontario Ministry of Environment and Energy (MOEE) scrap tire program, the Town of Kirkland Lake asked to participate in a demonstration project in 1993. The project consisted of adding up to 3.0 percent No. 10 mesh crumb rubber modifier (CRM) to hot mix asphalt using the ‘dry’ process. A section of Main Street approximately 300 m in length, from Birch Street to the Power Plant was selected for the trial.

Construction of the project was initially scheduled for late fall 1993. However, due to concerns with cool weather paving it was decided to defer the work until 1994. In 1994, based on a review of the rubber modified asphalt projects constructed during 1990 to 1993 by JEGEL\(^1\), the MOEE decided to study the viability of the ‘wet’ technology. However, the Kirkland Lake project was still active and scheduled for construction incorporating crumb rubber modifier (CRM) using the ‘dry’ process technology. As a result, JEGEL

recommended to proceed with the work using a modified dry process incorporating a finer crumb rubber (No. 30 mesh). This has been called a 'moist' process (MRUAC) by some to distinguish between the dry (RUMAC) and the 'wet' asphalt rubber processes (AR). The MOEE agreed with this proposal and construction was planned using 20 percent No. 30 mesh CRM by mass of asphalt cement, which in this case was equivalent to 1.2 percent by mass of the mix.

PROJECT DESCRIPTION

The project consisted of placing two 40 mm lifts of HL 4 MRUAC on a 300 m section of Main Street from Birch Street southerly to the Power Plant. This section of Main Street extends beyond a residential area and has been used as a gravel road (unpaved) primarily to provide access to the Power Plant. Traffic on the roadway consists mainly of large haul vehicles (chip trucks) carrying scrap wood chips which are used as fuel for the power plant, and passenger vehicles of the plant personnel. The special provisions prepared by JEGEL for the project (i.e. 1993 RUMAC and 1994 MRUAC) are given in Appendix A.

MIX DESIGNS

The mix design for the MRUAC HL 4 surface and binder courses was completed by JEGEL and is given in Appendix B. In addition to the design for the mix placed, two additional mix designs were completed to compare the Marshall properties of the MRUAC if a 150/200 asphalt cement penetration grade is used and to study the effects of 'tempering' (oven conditioning) the mixes. Mixes B and C were conditioned in an oven for one hour at 155°C to simulate more closely the actual production process. Mix A was not conditioned. The additional laboratory mix designs are given in Appendix C. A summary of the Marshall mix design properties is presented in Table 1. The HL 4 RUMAC mix designs completed in 1993 for this project (not used) and a conventional HL 4 mix verified in the laboratory using the same aggregate proportions are shown for comparison.

The Marshall properties observed during preparation of the laboratory mixes indicate that the MRUAC mix behaviour is similar to the RUMAC mixes produced to date. The Marshall stability and the Bulk Relative Density (BRD)
of the mix are lower than for conventional mixes, while the Marshall Flow and Voids in the Mineral Aggregate (VMA) are both considerably higher. However, it should be noted that the changes are more dramatic with the RUMAC and both RUMAC mixes accommodated more asphalt cement (AC) than the MRUAC mix. An additional 0.9 percent asphalt cement was required for the HL 4 RUMAC binder course mix.

A comparison of the experimental (i.e. conditioned versus the unconditioned) mixes yields the following observations.

1) the Marshall stability of the MRUAC (Mix C) which incorporated the 150/200 asphalt cement (harder asphalt cement) is significantly higher than the MRUAC (Mix B) which incorporated the 300/400 asphalt cement (softer asphalt cement) grade;
2) the Marshall stability and flow of the unconditioned MRUAC (Mix A) are considerably lower; and

3) the voids in the mineral aggregate (VMA) and the percent air voids are slightly higher for the unconditioned mix.

Based on this somewhat limited testing, it is recommended that MRUAC mix designs incorporate conditioning and one grade softer asphalt cement compared to conventional hot-mix asphalt being used.

CONSTRUCTION

A local contractor, Grant Paving and Materials Limited, was awarded the contract. The MRUAC was produced at the Contractor's plant located in New Liskeard approximately 80 km from the site. A Barber Greene 4000 pound batch plant (Photograph 1), equipped with a wet collection system for dust control, was used to produce the mix. The rubber (CRM) was added manually by conveyor to the batcher (Photograph 2). The addition, mixing and handling of the CRM was performed without any difficulties. Emissions testing was not completed for this project, and was not part of the 1994 program. Nevertheless, there were no perceived environmental problems with the MRUAC process.

The mix was placed using a Cedarapids BSF-5 rubber-tired paver. After some problems with start-up, primarily because the road fine grading and raising of manholes had not been completed (Photograph 3), paving started at about 3:00 pm on September 20/94 and continued until 7:30 pm. The binder course in both lanes, and approximately three quarters of the surface course, were placed on the first day (Photograph 4). The ambient air temperature during paving ranged from 16°C to 22°C. The temperature of the mix upon arrival at the site varied from 125°C to 145°C.

The contractor experienced several problems on the first day of paving. The compaction equipment on site (Huber 8 - 10T static) proved to be inadequate to provide sufficient compactive effort and compaction was delayed to remove dirt and old hot-mix stuck on the roller drum. Meanwhile, the mat temperature of the mix already placed dropped to 110°C. Also, the water pump on the roller was not distributing the soap solution and mix pick-up became a
problem. Nuclear density testing indicated that specified level of compaction was not being attained. JEGEL personnel on-site informed the contractor that the compaction equipment was not satisfactory, and an additional larger vibratory steel-wheeled roller (Raygo 8T static) was sent to the site (arrived at 7:20 pm). Compaction continued until the asphalt concrete mat temperature was approximately 45°C and was stopped around 9:45 pm. A significant increase in compaction was achieved with the modified rolling train using the vibratory roller.

On September 21/94 paving commenced at 8:30 am and was completed by 10:30 am. The problems observed the first day were not encountered and the paving was generally in accordance with specification requirements. Quality assurance testing indicated compaction was satisfactory. Practical experience with this MRUAC project indicates the importance of the contractor understanding and following the special provisions for CRM projects.

QUALITY ASSURANCE TESTING

Asphalt concrete field and laboratory quality assurance testing completed by JEGEL included:

1) Asphalt cement content determination at the asphalt plant using a nuclear asphalt cement gauge:
2) compaction testing on-site using a nuclear density gauge, and by coring, to verify the in situ density of the mix;
3) pavement profile measurements using a Digital Incremental Profiler (Dipstick);
4) pavement structural capacity testing using a Falling Weight Deflectometer (FWD); and
5) laboratory testing of samples taken during paving including complete Marshall compliance checks, crumb rubber modifier (CRM) gradations, and asphalt cement penetration and viscosity tests.

ASPHALT CEMENT CONTENT

A nuclear asphalt cement gauge was used to verify the asphalt cement content at the hot-mix plant. The asphalt cement content of the mix ranged
from 5.7 to 6.1 percent which is generally in accordance with the project job mix formula.

**ASPHALT CONCRETE COMPACTION**

The detailed results of the compaction testing completed using the nuclear density gauge are given in Appendix D. The testing indicates that compaction of the first lift in the northbound lane did not comply with the minimum specified compaction of 96 percent for a 40 mm lift thickness. Compaction of this lift ranged from 88 to 94 percent. This was confirmed by the cores obtained from this area. The percent compaction for the three cores tested ranged from 94.7 to 96.1 percent with an average value of 95.4 percent. The pavement compaction based on the Theoretical Maximum Density (MRD) ranged from 89.2 to 90.5 percent, which indicates that the in situ or pavement air voids are in the order of 10 percent. This somewhat low compaction is undoubtedly related to the Contractor's problems during the first day of paving. Based on the tests carried out with the nuclear density gauge the compaction for the remainder of the pavement section was in accordance with the project specification.

**PAVEMENT STRUCTURAL CAPACITY TESTING**

Pavement load deflection testing was completed using a Dynatest 8081 High Capacity Falling Weight Deflectometer (FWD). The FWD applies an impulse type load to the pavement surface by dropping a series of weights on a dampening system with the resultant pavement surface deflection measured by nine seismic transducers spaced at predetermined intervals from the loading plate.

FWD tests were completed at 50 m intervals in each lane before and after paving. At each test location, three load levels were used to determine the deflection response of the pavement (30, 40 and 50 kN). The 40 kN load level simulates the wheel load of a standard heavy truck or bus (80 kN single axle load). The normalized FWD dynamic deflection is the pavement surface deflection that would be anticipated under a load of 40 kN. In addition to the normalized deflection, the pavement modulus was calculated. The surface
modulus is a weighted average modulus (or stiffness) of the combined pavement layers and subgrade, and provides an indication of the overall support characteristics of the pavement. The detailed results of the deflection testing are given in Appendix E.

The normalized dynamic deflection measured prior to the placement of the HL 4 MRUAC ranged from 0.46 to 0.97 mm with an overall mean of 0.65 mm. The surface modulus values range from 192 to 402 MPa which indicates generally fair support. The normalized dynamic deflection measurements after placement of the hot-mix were generally more consistent, ranging from 0.43 to 0.77 mm with a mean of 0.51 mm. The corresponding surface modulus values ranged from 194 to 343 MPa, indicating generally good support.

PROFILE MEASUREMENTS

Pavement surface profile measurements were taken using a Digital Incremental Profiler (Dipstick). The Dipstick measures the difference in elevation between two fixed points 300 mm apart. The difference in elevation between the two points is recorded by an on-board computer, the unit is then rotated forward and the next reading is taken. This process continues until measurements have been taken over the entire length to be surveyed.

Pavement surface profiles were established for both the northbound and southbound lanes. Upon completion of the profile measurements, the data were uploaded to the Highway Roughness Analysis Program (HRAP). HRAP calculates several standard pavement surface roughness statistics including International Roughness Index (IRI), Root Mean Square Vertical Acceleration (RMSVA) and the Surface Profile/Travelling Straight Edge (SP/TSE). The results of the pavement profile surface roughness analysis are given in Appendix F. The low IRI value of 0.201 mm/m monitored indicates a very smooth pavement surface.

LABORATORY TESTING

A summary of the extraction tests is shown in Table 2. These results indicate fairly good compliance with the job mix formula gradation. However, the asphalt cement content was found to be considerably higher (0.51 to 0.80
percent) than the target value of 6.0 percent. The amount of CRM added to the mix ranged from 0.2 to 0.6 percent higher than specified.

The gradations for the CRM used on the project are presented in Table 3. These results indicate that the gradations of the recovered CRM are much finer than the original material prior to mixing. It would appear that the CRM has 'broken down' significantly through the hot mix production process.

The Marshall compliance testing (Table 4) indicated that the samples tested met the specification requirements. The complete Marshall compliance test results are given in Appendix G.

**ASPHALT CEMENT PROPERTIES**

One sample of the 300/400 penetration grade asphalt cement was tested, and indicated good compliance with OPSS 1101. The penetration and kinematic viscosity were found to be 357 dmm and 225.4 mm²/sec, respectively.

A sample of the HL 4 MRUAC was tested to determine the recovered penetration of the mix produced. The test result of 257 dmm indicated the material did not meet the MTO requirement of 135 to 200 dmm for a 300/400 grade asphalt cement. It is not clear from the testing conducted whether the recovered penetration is much higher because of the additional asphalt cement (i.e. due to increased film thickness) or due to the presence of the CRM which has partially dissolved. Regardless, the high recovered penetration is a positive attribute in terms of potential resistance to cold weather transverse thermal cracking, provided there is not an increased hot weather rutting potential.

**COST**

The cost of the MRUAC mix supplied to this project, which includes the cost associated with adding the crumb rubber (i.e. for additional asphalt cement, handling etc.), is approximately $90/tonne. Based on a conventional cost of $75/tonne for HL 4 in the Kirkland Lake area, this is equivalent to an increase of 20 percent over the cost of conventional mix. The cost of the CRM
### TABLE 2
**ACCEPTANCE TEST RESULTS**

<table>
<thead>
<tr>
<th>Property</th>
<th>Mix Design</th>
<th>Sample Number</th>
<th>Trial Batch</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC Content(%)</td>
<td>6.0</td>
<td>6.61</td>
<td>6.80</td>
</tr>
<tr>
<td>CRM (%)</td>
<td>1.2</td>
<td>1.5</td>
<td>1.8</td>
</tr>
<tr>
<td>Percent Passing -4.75 mm</td>
<td>55.0</td>
<td>58.9</td>
<td>55.6</td>
</tr>
<tr>
<td>-75 μm</td>
<td>3.9</td>
<td>2.9</td>
<td>2.4</td>
</tr>
</tbody>
</table>

### TABLE 3
**CRM GRADATION RESULTS**

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>30 mesh CRM (original)</th>
<th>Sample Number</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.36 mm (No. 8)</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>600 μm (No. 30)</td>
<td>99.1</td>
<td>96.7</td>
<td>96.2</td>
</tr>
<tr>
<td>300 μm (No. 50)</td>
<td>9.0</td>
<td>25.3</td>
<td>29.0</td>
</tr>
<tr>
<td>150 μm (No. 100)</td>
<td>0.9</td>
<td>16.0</td>
<td>19.4</td>
</tr>
<tr>
<td>75 μm (No. 200)</td>
<td>0.6</td>
<td>2.0</td>
<td>2.1</td>
</tr>
</tbody>
</table>

* Primarily dust or mineral filler

### TABLE 4
**MARSHALL PROPERTIES**

<table>
<thead>
<tr>
<th>Property</th>
<th>Sample Number</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Stability (N)</td>
<td>6,873</td>
</tr>
<tr>
<td>Flow (0.25 mm)</td>
<td>15.5</td>
</tr>
<tr>
<td>VMA (%)</td>
<td>19.1</td>
</tr>
<tr>
<td>Air Voids (%)</td>
<td>3.8</td>
</tr>
<tr>
<td>BRD</td>
<td>2.341</td>
</tr>
<tr>
<td>MRD</td>
<td>2.433</td>
</tr>
</tbody>
</table>
was $0.33/kg, about $4.00 per tonne of hot-mix asphalt, plus CRM shipping cost. It should be for this project noted that the incremental cost shown for the MRUAC is higher than expected due to the experimental nature of this project and the small quantity of hot mix involved. A more accurate cost comparison could be made if the MRUAC is included in the contract at the tendering stage for larger projects at the full implementation stage.

DISCUSSION

The HL 4 MRUAC mix was produced and placed without any major difficulties. It can be considered a successful demonstration even though there were some problems with compaction in the early stages of placement. A soap solution is definitely required on the wheels of the compaction equipment to prevent or minimize mix pick-up (this was recommended by JEGEL at all stages of preparation for the project and incorporated in the project special provision), and compaction should be continued for sometime after placement (i.e. to mat temperatures of 50°C). Also, it is important to provide support to the pavement edge as soon as possible, as the mix tends to push outward under traffic. The Town of Kirkland Lake subsequent visual assessment of the placed MRUAC has been good. It is anticipated that the project will be included in the MOEE’s overall asphalt rubber continuing evaluation process.

RECOMMENDATIONS AND CONCLUDING REMARKS

The rubber modified asphalt project completed at Kirkland Lake demonstrated the ability to construct a high quality pavement incorporating crumb rubber modifier. Future performance monitoring will allow a detailed engineering assessment of the cost effectiveness of such rubber modified asphalt mixes using the ‘moist’ (MRUAC) process.

Based on the laboratory test data, it would appear that one area of concern is determining the correct asphalt cement and CRM content of rubber modified mixes. This could have serious implications under current MTO hot mix acceptance criteria where the mix is price adjusted for not meeting the specification for asphalt cement content. It is believed that the current extraction method may not be appropriate for mixes containing finer CRM. It
is anticipated that this problem will likely be more evident with asphalt rubber (AR) mixes in the ‘wet’ technology. Therefore, it is recommended that the study be extended to include a laboratory research program to develop a test procedure to accurately determine the asphalt cement and rubber (CRM) content of rubber modified hot-mix asphalt mixes.

JOHN EMERY GEOTECHNICAL ENGINEERING LIMITED

Vince Aurilio, P.Eng.
Senior Asphalt and Pavement Engineer
Photograph 1  Grant Paving and Materials Limited Batch Plant, New Liskeard, Ontario. [VA, Sep. 20/94]

Photograph 2  CRM Addition System. Bags of CRM are manually fed by conveyor to the batcher. [VA, Sep. 20/94]
Photograph 3  Main Street preparation for paving, September 20, 1994.  [VA, Sep. 20/94]

Photograph 4  Main Street after first day of paving.  [VA, Sep. 21/94]
APPENDIX A

Special Provision for Rubber Modified Hot-Mix Asphalt (RUMAC)
SPECIAL PROVISION FOR HOT-MIX ASPHALT INCORPORATING CRUMB RUBBER (MRUAC) – MODIFIED DRY PROCESS HL 4 (MRUAC) BINDER COURSE AND HL 4 (MRUAC) SURFACE COURSE

1.0 SCOPE

This Special Provision covers the supplemental requirements to OPSS 310 (Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving and Hot Mix Patching) and OPSS 1150 (Material Specification for Hot Mixed, Hot Laid Asphaltic Concrete) for the materials, equipment and methods to be followed for proportioning, mixing, placing and compacting hot-mix asphalt incorporating crumb rubber (MRUAC). This is commonly referred to as the modified generic dry process for incorporating medium fineness recycled scrap tire crumb rubber (CRM) in hot-mix asphalt.

Two hot-mix asphalt types incorporating crumb rubber are specified in the Contract:

- **HL 4 (MRUAC) Binder Course Mix** - incorporating 20 percent CRM (No. 30 Mesh) by asphalt cement content mass, with a 300/400 penetration grade asphalt cement content of 5.9 percent by total mix mass for tendering purposes; and
- **HL 4 (MRUAC) Surface Course Mix** - incorporating 20 percent CRM (No. 30 Mesh) by asphalt cement content mass, with a 300/400 penetration grade asphalt cement content of 5.9 percent by total mix mass for tendering purposes.

Payment will be adjusted for the actual Job Mix Formula asphalt cement content of the MRUAC mixes, from the asphalt cement contents for tendering purposes, as covered in Section 7.2 of this Special Provision.

2.0 MATERIALS

2.1 Supply of Materials

With the exception of the crumb rubber (CRM), the Contractor shall supply all materials necessary for the execution and completion of the Contract.

The Corporation of the Town of Kirkland Lake will supply the CRM, FOB the Contractor's hot-mix batch plant on trucks, in 50 pound bags (plastic, non-heat melt), 40 bags to the pallet (shrink plastic covered). It shall be the Contractor's responsibility for unloading the pallets and storing the CRM such as there is no physical or environmental damage to the CRM.

2.2 Asphalt Cement

Asphalt cement shall comply with OPSS 1101 (Material Specification for Asphalt Cement). The asphalt cement penetration grade shall be 300/400.
2.3 Coarse Aggregate(s)
Coarse Aggregate(s) (aggregate retained on the 4.75 mm) shall meet the requirements of OPSS 1001 (Material Specification for Aggregates - General) and OPSS 1003 (Material Specification for Aggregates - Hot Mixed, Hot Laid, Asphaltic Concrete).

2.4 Fine Aggregate(s)
Fine Aggregate(s) (aggregate passing the 4.75 mm) shall meet the requirements of OPSS 1001 and OPSS 1003.

2.5 Crumb Rubber (CRM)
Crumb rubber (CRM) will be supplied by the Corporation of the Town of Kirkland Lake as described in Section 2.1 of this Special Provision.

2.6 Additives
Antistripping additive, if required, shall be as indicated by type and amount on the Job Mix Formula for the MRUAC mixes. When an antistripping additive is required, it shall be supplied and used at the Contractor's cost.

3.0 JOB MIX FORMULA (JMF)

3.1 Contractor Submittals
The Contractor shall, within two working days of Contract award, advise the Corporation of the Town of Kirkland Lake (Engineer), in writing, of the sources of asphalt cement, coarse aggregate(s), fine aggregate(s) and antistripping additive, if any. The Contractor should also advise the Engineer, at this time, of factors such as previous experience with the materials and HL 4 mix designs that will be of assistance to the Engineer in having mix designs completed.

The Contractor shall, within four working days of Contract award, supply the Engineer with 75 kg of each aggregate, 5 kg of fines (minus 75 μm), if any to be added to mix design, 4 2 of asphalt cement, 0.1 2 of antistripping additive, if any to be used (or equivalent amount of hydrated lime), and the temperature-viscosity chart for the asphalt cement.

3.2 Mix Designs
The Engineer will complete Marshall method mix designs (Ministry of Transportation procedures, AI MS-2) for the MRUAC mixes, using the materials and information submitted by the Contractor. The Job Mix Formula for each MRUAC mix will be based on these mix designs. These mix designs will be completed within 7 working days of materials submittal.

3.3 Job Mix Formula (JMF)
The Engineer will provide the Contractor with the Job Mix Formula (JMF) for the HL 4 (MRUAC) Binder Course mix and HL 4 (MRUAC) Surface Course mix upon completion of the mix designs.

The JMF will specify the source, composition and proportion of the aggregates, CRM, asphalt cement and antistripping additive, if any, for each MRUAC mix. The JMF for each MRUAC mix shall be in effect until modifications, if any, are approved by the Engineer.
4.0 TRIAL BATCHES

The Contractor shall make pre-construction plant trial batches of the MRUAC mixes from which samples will be taken by the Engineer to ensure that each MRUAC mix meets the requirements of its JMF. Each trial batch shall be representative of consistent mix production. Such MRUAC trial batches shall be produced until a complete mix compliance check indicates conformance with the JMF proportions and properties of the mix. The trial batches shall be paid at the Contract price for HL 4 (MRUAC) Binder Course and HL 4 (MRUAC) Surface Course.

5.0 CONSTRUCTION REQUIREMENTS

5.1 Weather Limitations
The MRUAC mixes shall only be placed under the following minimum conditions and when weather conditions will permit proper construction.

For compacted thickness less than 40 mm
- Ambient air temperature: 15°C and rising
- Surface temperature: 15°C minimum
- Surface condition: dry

For compacted thickness 40 mm and greater
- Ambient air temperature: 10°C and rising
- Surface temperature: 10°C minimum
- Surface condition: dry

5.2 Equipment
Equipment used for the production, placement and compaction of MRUAC mixes shall conform to OPSS 310 and OPSS 1150 with the following modifications:

The MRUAC shall be produced in a hot-mix batch plant.

The batch plant shall have automatic controls that coordinate the proportioning, timing and discharge of the hot-mix asphalt. The batch plant shall be capable of uniformly feeding and measuring the amount of crumb rubber (CRM) placed into the pug mill.

Transporting MRUAC mixes on rubber belts is prohibited.

The hauling equipment and compaction rollers shall be thinly coated with a light application of a non-petroleum based wetting agent (soap solution) to reduce sticking of the mixture to the equipment. Oiling the surfaces with kerosene or diesel fuel will not be permitted.

Pneumatic-tired rollers will not be used.

5.3 Surface Preparation
Pavement surface preparation shall conform to OPSS 310.
5.4 Mixing, Placing and Compaction
Mixing, placing and compaction of each MRUAC mix shall conform to the JMF and OPSS 310 and OPSS 1110 with the following modifications:

When the production method uses units (bags) of CRM for proportioning at the batch plant, the batch size and CRM unit size shall be adjusted to use whole units (bags) of CRM. Adding partial units (bags) of CRM into the mix will not be permitted.

The CRM shall be incorporated into the mix prior to the addition of asphalt cement. The dry mixing cycle shall be increased as necessary to ensure that all of the CRM is properly mixed with the aggregates. The wet mixing time shall be increased by 30 seconds over conventional mixes.

The Contractor will take care to ensure that the CRM bags are fully opened and dumped out when incorporating CRM, and no fragments of bags are permitted to get into the mix. (The bags are not heat-melt type.)

The MRUAC mixes discharge temperature from the plant shall be 150 to 155°C. The compaction temperature shall be 140 to 145°C.

The Contractor will take care with the initial compaction of the mix as MRUAC mixes have an initial low stability.

Finish rolling shall continue until the temperature of the mat drops below 60°C.

Traffic shall not be permitted on the MRUAC mixes until they have cooled to less than 40°C.

6.0 MEASUREMENT FOR PAYMENT
Measurement for payment of MRUAC mixes will be in tonnes conforming to OPSS 102 (Weighing of Materials). Trial batch quantities will be measured for payment.

7.0 BASIS OF PAYMENT

7.1 HL 4 (MRUAC) Binder Course and HL 4 (MRUAC) Surface Course
Payment at the Contract price for the above items shall be full compensation for all labour, equipment and materials required to do the work.

7.2 Payment Adjustment for Asphalt Cement Content
In the event that the actual JMF for the MRUAC mix(es) is different for asphalt cement content than that shown for tendering purposes in Section 1.0 of this Special Provision, an asphalt cement content adjustment will be applied. For each 0.1 percent more (less) asphalt cement content the payment per tonne of MRUAC mix(es) will be increased (decreased) by $0.20.
APPENDIX B

HL 4 MRUAC Mix Design
PAVEMIX - MARSHALL MIX DESIGN REPORT
Prepared for: Kirkland Lake
JOB NO: 93249B

HOT MIX TYPE: HL 4 (MRUAC) Surface/Binder Course

DATE SAMPLES RECEIVED: July, 1994  DATE COMPLETED: August 16, 1994
TEST RESULTS SUPPLIED BY: JEGEL

JOB MIX FORMULA - GRADATION PERCENT PASSING *

<table>
<thead>
<tr>
<th>% AC</th>
<th>26.5</th>
<th>19.0</th>
<th>16.0</th>
<th>13.2</th>
<th>9.5</th>
<th>4.75</th>
<th>2.36</th>
<th>1.18</th>
<th>600</th>
<th>300</th>
<th>150</th>
<th>75</th>
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<td>6.0</td>
<td>100.0</td>
<td>99.7</td>
<td>92.0</td>
<td>74.2</td>
<td>55.0</td>
<td>47.3</td>
<td>40.5</td>
<td>25.4</td>
<td>9.9</td>
<td>5.4</td>
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<table>
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<tr>
<th>MARSHALL PROPERT.</th>
<th>REQUIRED</th>
<th>SELECTED</th>
<th>% CA#1</th>
<th>41.7</th>
<th>% FA#1</th>
<th>35.0</th>
<th>% FA#2</th>
<th>23.3</th>
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<tbody>
<tr>
<td>% VOIDS, SSD (min)</td>
<td>3.5</td>
<td>4.2</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>(max)</td>
<td>4.5</td>
<td>19.6</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>FLOW (min)</td>
<td>8.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STABILITY, N(min)</td>
<td>5800</td>
<td>5120</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>% VMA (min)</td>
<td>15.0</td>
<td>17.9</td>
<td></td>
<td></td>
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<table>
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<tr>
<th>ASPHALT CEMENT</th>
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<tbody>
<tr>
<td>SUPPLIER</td>
<td>PENETRATION</td>
</tr>
<tr>
<td>McAsphalt</td>
<td>300/400</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>CRUMB RUBBER ADDITION</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUPPLIER</td>
</tr>
<tr>
<td>Recovery Tech.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AGG. TYPE</th>
<th>DESCRIPTION - SOURCE</th>
<th>INVENTORY NO</th>
<th>BRD</th>
<th>ABS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA#1</td>
<td>HL 4 Stone (Grant Pit #2)</td>
<td>C-23-27-0</td>
<td>2.755</td>
<td>0.460</td>
</tr>
<tr>
<td>FA#1</td>
<td>Screened Sand (Adshead)</td>
<td>C-23-6-0</td>
<td>2.645</td>
<td>0.891</td>
</tr>
<tr>
<td>FA#2</td>
<td>Screenings (Grant Pit #2)</td>
<td>C-23-27-0</td>
<td>2.705</td>
<td>0.682</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AGG. TYPE</th>
<th>DESCRIPTION - SOURCE</th>
<th>INVENTORY NO</th>
<th>BRD</th>
<th>ABS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA#1</td>
<td>HL 4 Stone (Grant Pit #2)</td>
<td>C-23-27-0</td>
<td>2.755</td>
<td>0.460</td>
</tr>
<tr>
<td>FA#1</td>
<td>Screened Sand (Adshead)</td>
<td>C-23-6-0</td>
<td>2.645</td>
<td>0.891</td>
</tr>
<tr>
<td>FA#2</td>
<td>Screenings (Grant Pit #2)</td>
<td>C-23-27-0</td>
<td>2.705</td>
<td>0.682</td>
</tr>
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AGG. TYPE | AGGREGATE GRADATION - PERCENT PASSING |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>26.5</td>
</tr>
<tr>
<td>CA#1</td>
<td>100.0</td>
</tr>
<tr>
<td>FA#1</td>
<td>100.0</td>
</tr>
<tr>
<td>FA#2</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Fines Returned to the Mix (1.0%). JMF Does Not Include CRM.
** No Air Voids 'Correction' Necessary, No Visible Aggregate Absorption for MRD Mix at 5.5 - 6.0% AC.
REMARKS: Gradations from Samples (Checked Against Process Control).
Briquettes Compacted at 145°C, 60 Blows Mechanical (~75 Blows Manual).
Oven Retention and Surcharge Procedure for Rubber Modified Hot Mix
Asphalt Followed. AI MS-2 Procedures Followed.
This Mix Design is Subject to Marshall Compliance Checks that May Require JMF Adjustment.
HL 4 Marshall Parameters

COMMENTS: See Marshall Mix Design Worksheets. Designed at 6.0% Asphalt Cement Content and 4.2% Air Voids to Meet the Mix Design Requirements. AI MS-2 Procedure Followed.
APPENDIX C

Experimental Mixes
PAVEMIX - MARSHALL MIX DESIGN REPORT
Prepared for: Corporation of the Town of Kirkland Lake
JOB NO: 93249A

HOT MIX TYPE: HL 4 MRUAC (Surface/Binder)

DATE SAMPLES RECEIVED: July, 1994
DATE COMPLETED: August 4, 1994
TEST RESULTS SUPPLIED BY: JEGEL

JOB MIX FORMULA - GRADATION PERCENT PASSING *

<table>
<thead>
<tr>
<th>% AC</th>
<th>26.5</th>
<th>19.0</th>
<th>16.0</th>
<th>13.2</th>
<th>9.5</th>
<th>4.75</th>
<th>2.36</th>
<th>1.18</th>
<th>600</th>
<th>300</th>
<th>150</th>
<th>75</th>
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</thead>
<tbody>
<tr>
<td>5.9</td>
<td>100.0</td>
<td>99.7</td>
<td>92.0</td>
<td>74.2</td>
<td>55.0</td>
<td>47.2</td>
<td>40.6</td>
<td>25.4</td>
<td>9.9</td>
<td>5.4</td>
<td>3.9</td>
<td></td>
</tr>
</tbody>
</table>

MARSHALL PROPERT. REQUIRED SELECTED

| % VOIDS, SSD (min) (max) | 3.0 | 5.0 | 4.5 |

FLOW (min) | 8.0 | 15.6 |
STABILITY, N(min) | 5800 | 3261 |
% VMA (min) | 15.0 | 18.2 |

% CA#1 | 41.7 |
% FA#1 | 35.0 |
% FA#2 | 23.3 |

% RAP |
% AC RAP |
RAP PEN |
BRIQ. BRD | 2.352 |
MRD | 2.461 |
MRD (SSD) ** |

Gb | 2.704 |

ASPHALT CEMENT

SUPPLIER PENETRATION

McAsphalt | 300/400 |

CRUMB RUBBER ADDITION

SUPPLIER TYPE % of AC

Recovery Tech. 30 Mesh CRM | 20 |

AGG. TYPE DESCRIPTION - SOURCE

| CA#1 | HL 4 Stone (Grant Pit #2) |
| FA#1 | Screened Sand (Adshead Pit) |
| FA#2 | Screenings (Grant Pit #2) |

INVENTORY NO | BRD | ABS %

C23-27-0 | 2.755 | 0.460 |
C23-6-0 | 2.645 | 0.891 |
C23-27-0 | 2.705 | 0.682 |

AGG. TYPE AGGREGATE GRADATION - PERCENT PASSING

<table>
<thead>
<tr>
<th>26.5</th>
<th>19.0</th>
<th>16.0</th>
<th>13.2</th>
<th>9.5</th>
<th>4.75</th>
<th>2.36</th>
<th>1.18</th>
<th>600</th>
<th>300</th>
<th>150</th>
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<tbody>
<tr>
<td>CA#1</td>
<td>100.0</td>
<td>99.2</td>
<td>80.9</td>
<td>38.0</td>
<td>4.8</td>
<td>2.8</td>
<td>2.3</td>
<td>2.2</td>
<td>2.1</td>
<td>1.8</td>
<td>1.4</td>
</tr>
<tr>
<td>FA#1</td>
<td>100.0</td>
<td>99.2</td>
<td>96.3</td>
<td>87.7</td>
<td>51.0</td>
<td>11.7</td>
<td>3.1</td>
<td>1.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FA#2</td>
<td>100.0</td>
<td>78.4</td>
<td>52.4</td>
<td>36.6</td>
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<td>18.2</td>
<td>11.8</td>
<td>8.1</td>
<td></td>
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</tbody>
</table>

* Fines Returned to the Mix (1.0%). JMF Does Not Include CRM.
** No Air Voids 'Correction' Necessary, No Visible Aggregate Absorption for MRD Mix at 5.5 - 6.0% AC.

REMARKS: Gradations from Samples (Checked Against Process Control)
Briquettes Compacted at 145°C, 60 Blows Mechanical (≈75 Blows Manual).
AI MS-2 Procedures Followed. This Mix Design is Subject to Marshall Compliance Checks that May Require JMF Adjustment.
 COMMENTS: See Marshall Mix Design Worksheets. Designed at 5.9% Asphalt Cement Content and 4.5% Air Voids to Meet Mix Design Requirements. AI MS-2 Procedure Followed.
PAVEMIX - MARSHALL MIX DESIGN REPORT
Prepared for: Corporation of the Town of Kirkland Lake

HOT MIX TYPE: HL 4 MRUAC (Surface/Binder)

DATE SAMPLES RECEIVED: July, 1994  DATE COMPLETED: August 16, 1994

TEST RESULTS SUPPLIED BY: ____________________________
                      JEGEL

JOB MIX FORMULA - GRADATION PERCENT PASSING *

<table>
<thead>
<tr>
<th>% AC</th>
<th>26.5</th>
<th>19.0</th>
<th>16.0</th>
<th>13.2</th>
<th>9.5</th>
<th>4.75</th>
<th>2.36</th>
<th>1.18</th>
<th>600</th>
<th>300</th>
<th>150</th>
<th>75</th>
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<tbody>
<tr>
<td>6.0</td>
<td>100.0</td>
<td>99.7</td>
<td>92.0</td>
<td>74.2</td>
<td>55.0</td>
<td>47.3</td>
<td>40.5</td>
<td>25.4</td>
<td>9.9</td>
<td>5.4</td>
<td>3.9</td>
<td></td>
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</tbody>
</table>

MARSHALL PROPERT. REQUIRED SELECTED

% VOIDS, SSD (min) 3.5 4.0 4.0
(max) 4.5 18.1
FLOW (min) 8.0 8553
STABILITY, N(min) 5800
% VMA (min) 15.0 2.704

% CA#1 41.7
% FA#1 35.0
% FA#2 23.3

% RAP
% AC RAP
RAP PEN

BRIQ. BRD 2.362
MRD 2.460
MRD (SSD) **

# ASPHALT CEMENT

SUPPLIER: McAsphalt
PENETRATION: 150/200

# CRUMB RUBBER ADDITION

SUPPLIER: Recovery Tech.
TYPE: 30 Mesh CRM
% of AC: 20

# AGG. TYPE DESCRIPTION - SOURCE

<table>
<thead>
<tr>
<th>AGG. TYPE</th>
<th>DESCRIPTION - SOURCE</th>
<th>INVENTORY NO</th>
<th>BRD</th>
<th>ABS %</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA#1</td>
<td>HL 4 Stone (Grant Pit #2)</td>
<td>C-23-27-0</td>
<td>2.755</td>
<td>0.460</td>
</tr>
<tr>
<td>FA#1</td>
<td>Screened Sand (Adshead)</td>
<td>C-23-6-0</td>
<td>2.645</td>
<td>0.891</td>
</tr>
<tr>
<td>FA#2</td>
<td>Screenings (Grant Pit #2)</td>
<td>C-23-27-0</td>
<td>2.705</td>
<td>0.682</td>
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# AGGREGATE GRADATION - PERCENT PASSING

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<th>16.0</th>
<th>13.2</th>
<th>9.5</th>
<th>4.75</th>
<th>2.36</th>
<th>1.18</th>
<th>600</th>
<th>300</th>
<th>150</th>
<th>75</th>
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<tbody>
<tr>
<td>CA#1</td>
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<td>99.2</td>
<td>80.9</td>
<td>38.0</td>
<td>4.8</td>
<td>2.8</td>
<td>2.3</td>
<td>2.2</td>
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<td>1.8</td>
<td>1.4</td>
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<tr>
<td>FA#1</td>
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<td>99.2</td>
<td>96.3</td>
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<td>3.1</td>
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<tr>
<td>FA#2</td>
<td>100.0</td>
<td>78.4</td>
<td>52.4</td>
<td>36.6</td>
<td>26.4</td>
<td>18.2</td>
<td>11.8</td>
<td>8.1</td>
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</tbody>
</table>

* Fines Returned to the Mix (1.0%). JMF Does Not Include CRM.
Minus 4.75 mm Aggregate Component of JMF Adjusted.

** No Air Voids 'Correction' Necessary, No Visible Aggregate Absorption for MRD Mix at 5.5 - 6.0% AC.

REMARKS: Gradations from Samples (Checked Against Process Control)
Briquettes Compacted at 145°C, 60 Blows Mechanical (≈75 Blows Manual).
AI MS-2 Procedures Followed. This Mix Design is Subject to Marshall Compliance Checks that May Require JMF Adjustment.
COMMENTS: See Marshall Mix Design Worksheets. Designed at 6.0% Asphalt Cement Content and 4.0% Air Voids to Meet the Mix Design Requirements. AI MS-2 Procedure Followed.
APPENDIX D

Asphalt Concrete Compaction Results
**CORPORATION OF THE TOWN OF KIRKLAND LAKE**

**ASPHALT CONCRETE COMPACTION TEST REPORT**

**ATTENTION:** Mr. Norman Brace, C.E.T.  
Town of Kirkland Lake

**TESTING DATE/TIME:** Tuesday, September 20/94

**HOT MIX TYPE/LIFT:** HL 4 MRUAC/Base

**HOT MIX TEMPERATURE:** 135°C

**WEATHER:** Clear +22°C

**LOCATED BY:** JEGEL

**JEGEL NO.:** 93249

**CONTRACTOR:** Grant Paving & Materials

**HOT MIX NO.:** 93249

**PROJECT:** Main Street

**LOCATION:** Birch Street to Power Plant

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Location</th>
<th>Mix Type</th>
<th>Compacted Density (kg/m^3)</th>
<th>Marshall Density (kg/m^3) (Closest Compliance Check)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0+000 NB Lane o/s 2.5 m W. of EEP, 5 passes</td>
<td>HL 4 MRUAC</td>
<td>2198</td>
<td>2341</td>
<td>93.9</td>
</tr>
<tr>
<td>2</td>
<td>0+010 NB Lane o/s 3.0 m W. of EEP, 2 passes</td>
<td>HL 4 MRUAC</td>
<td>2157</td>
<td>2341</td>
<td>92.1</td>
</tr>
<tr>
<td>3</td>
<td>0+050 NB Lane o/s 3.0 m W. of EEP, 4th pass =55°C</td>
<td>HL 4 MRUAC</td>
<td>2167</td>
<td>2341</td>
<td>92.6</td>
</tr>
<tr>
<td>4</td>
<td>0+098 NB Lane o/s 1.5 m W. of EEP, 4th pass =48°C</td>
<td>HL 4 MRUAC</td>
<td>2151</td>
<td>2341</td>
<td>91.9</td>
</tr>
<tr>
<td>5</td>
<td>0+140 NB Lane o/s 2 m W. of EEP, 4th pass =58°C</td>
<td>HL 4 MRUAC</td>
<td>2192</td>
<td>2341</td>
<td>93.6</td>
</tr>
<tr>
<td>6</td>
<td>0+180 o/s 2 m W. of EEP, 2nd pass =55°C</td>
<td>HL 4 MRUAC</td>
<td>2141</td>
<td>2341</td>
<td>91.5</td>
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<tr>
<td>7</td>
<td>0+220 NB Lane o/s 2 m W. of EEP, 2nd pass =85°C</td>
<td>HL 4 MRUAC</td>
<td>2069</td>
<td>2341</td>
<td>88.4</td>
</tr>
<tr>
<td>8</td>
<td>0+240 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2122</td>
<td>2341</td>
<td>90.6</td>
</tr>
<tr>
<td>9</td>
<td>0+220 NB Lane o/s 1 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2145</td>
<td>2341</td>
<td>91.6</td>
</tr>
</tbody>
</table>

**Note:** W. of EEP = West of East Edge of Pavement

**REMARKS:** Station 0+060 to 0+160 - roller broke down. When it started to roll again, the temperature had dropped to -78°C.

**PRELIMINARY RESULTS LEFT WITH** ____________________________ AT ___________________________ ON ________________

**FINAL RESULTS REPORTED TO** ____________________________ AT ___________________________ ON ________________

ATC ____________________________________________________
# Asphalt Concrete Compaction Test Report

**Attention:**
Mr. Norman Brace, C.E.T.
Town of Kirkland Lake

**Testing Date/Time:**
Tuesday, September 20/94

**Hot Mix Type/Lift:**
HL 4 MRUAC/Base

**Hot Mix Temperature:**
135°C

**Weather:**
Clear +22°C

**Contract No.:**

**Project:**
Main Street

**Location:**
Birch Street to Power Plant

**Paving Contractor:**
Grant Paving & Materials

**Hot Mix Supplier/Plant:**
Grant/New Liskeard

**Mix No.:**
93249

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Location</th>
<th>Mix Type</th>
<th>Compacted Density (kg/m³)</th>
<th>Marshall Density (kg/m³)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0+020 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2172</td>
<td>2341</td>
<td>92.8</td>
</tr>
<tr>
<td>11</td>
<td>0+040 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2239</td>
<td>2341</td>
<td>95.6</td>
</tr>
<tr>
<td>12</td>
<td>0+060 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2236</td>
<td>2341</td>
<td>95.5</td>
</tr>
<tr>
<td>13</td>
<td>0+080 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2243</td>
<td>2341</td>
<td>95.8</td>
</tr>
<tr>
<td>14</td>
<td>0+100 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2290</td>
<td>2341</td>
<td>97.8</td>
</tr>
<tr>
<td>15</td>
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<td>HL 4 MRUAC</td>
<td>2281</td>
<td>2341</td>
<td>97.4</td>
</tr>
<tr>
<td>16</td>
<td>0+140 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2319</td>
<td>2341</td>
<td>99.1</td>
</tr>
<tr>
<td>17</td>
<td>0+160 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2348</td>
<td>2341</td>
<td>100.0+</td>
</tr>
<tr>
<td>18</td>
<td>0+180 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2321</td>
<td>2341</td>
<td>99.1</td>
</tr>
</tbody>
</table>

**Note:** E. of WEP = East of West Edge of Pavement

**Remarks:**

**Preliminary Results Left With:**

**Final Results Reported To:**

---

ATC
**ASPHALT CONCRETE COMPACTION TEST REPORT**

**ATTENTION:** Mr. Norman Brace, C.E.T.  
**TESTING DATE/TIME:** Tuesday, September 20/94  
**HOT MIX TYPE/LIFT:** HL 4 MRUAC/Base  
**HOT MIX TEMPERATURE:** 135°C  
**WEATHER:** Clear +22°C  
**TESTED BY:** JEGEL  
**HOT MIX NO.:** 93249  
**MIX NO.:** 93249

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Location</th>
<th>Mix Type</th>
<th>Compacted Density (kg/m³)(Closest Compliance Check)</th>
<th>Marshall Density (kg/m³)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>0+200 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2353</td>
<td>2341</td>
<td>100.0+</td>
</tr>
<tr>
<td>20</td>
<td>0+220 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2378</td>
<td>2341</td>
<td>100.0+</td>
</tr>
<tr>
<td>21</td>
<td>0+240 SB Lane o/s 1 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2139</td>
<td>2341</td>
<td>91.4</td>
</tr>
<tr>
<td>22</td>
<td>0+260 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2182</td>
<td>2341</td>
<td>93.2</td>
</tr>
<tr>
<td>2nd Lift</td>
<td>0+000 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2247</td>
<td>2341</td>
<td>96.0</td>
</tr>
<tr>
<td>2nd Lift</td>
<td>0+020 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2231</td>
<td>2341</td>
<td>95.3</td>
</tr>
<tr>
<td>2nd Lift</td>
<td>0+040 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2293</td>
<td>2341</td>
<td>97.9</td>
</tr>
<tr>
<td>2nd Lift</td>
<td>0+060 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2286</td>
<td>2341</td>
<td>97.7</td>
</tr>
<tr>
<td>2nd Lift</td>
<td>0+080 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2252</td>
<td>2341</td>
<td>96.2</td>
</tr>
</tbody>
</table>

**Note:** E. of WEP = East of West Edge of Pavement  
W. of EEP = West of East Edge of Pavement

**REMARKS:**

PRELIMINARY RESULTS LEFT WITH ___________________________ AT ___________________________ ON ___________________________

FINAL RESULTS REPORTED TO ___________________________ AT ___________________________ ON ___________________________

ATC ___________________________
# Asphalt Concrete Compaction Test Report

**Attention:** Mr. Norman Brace, C.E.T.

**Contract Number:**

**Project:** Main Street

**Location:** Birch Street to Power Plant

**Paving Contractor:** Grant Paving & Materials

**Hot Mix Supplier/Plant:** Grant/New Liskeard

**Testing Date/Time:** Tuesday, September 20/94

**Hot Mix Type/Lift:** HL 4 MRUAC/Second Lift

**Hot Mix Temperature:** 135°C

**Weather:** Clear +22°C

**Tested By:** JEGEL

**JEGEL No.:** 93249

**Mix No.:** 93249

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Location</th>
<th>Mix Type</th>
<th>Compacted Density (kg/m³)</th>
<th>Marshall Density (kg/m³)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28</td>
<td>0+100 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2188</td>
<td>2341</td>
<td>93.5</td>
</tr>
<tr>
<td>29</td>
<td>0+120 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2282</td>
<td>2341</td>
<td>97.5</td>
</tr>
<tr>
<td>30</td>
<td>0+140 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2335</td>
<td>2341</td>
<td>99.7</td>
</tr>
<tr>
<td>31</td>
<td>0+160 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2281</td>
<td>2341</td>
<td>97.4</td>
</tr>
<tr>
<td>32</td>
<td>0+110 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2341</td>
<td>2341</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Note: W. of EEP = West of East Edge of Pavement

**Remarks:**

---

Preliminary results left with ______________________ at ________________ on _______

Final results reported to ______________________ at ________________ on _______

ATC ______________________
# ASPHALT CONCRETE COMPACtion TEST REPORT

**ATTENTION:** Mr. Norman Brace, C.E.T.  
Town of Kirkland Lake

**CONTRACT NO.:**  
Main Street

**PROJECT:**  
Birch Street to Power Plant

**PAVING CONTRACTOR:**  
Grant Paving & Materials

**HOT MIX SUPPLIER/PLANT:**  
Grant/New Liskeard

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Location</th>
<th>Mix Type</th>
<th>Compacted Density (kg/m³)</th>
<th>Marshall Density (kg/m³)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0+200 NB Lane o/s 2 m W. of EEP, 2nd pass =128°C</td>
<td>HL 4 MRUAC</td>
<td>2188</td>
<td>2375</td>
<td>92.1</td>
</tr>
<tr>
<td>2</td>
<td>0+200 NB Lane o/s 2 m W. of EEP, 4th pass =124°C</td>
<td>HL 4 MRUAC</td>
<td>2212</td>
<td>2375</td>
<td>93.1</td>
</tr>
<tr>
<td>3</td>
<td>0+200 NB Lane o/s 2 m W. of EEP, 6th pass =110°C</td>
<td>HL 4 MRUAC</td>
<td>2261</td>
<td>2375</td>
<td>95.2</td>
</tr>
<tr>
<td>4</td>
<td>0+200 NB Lane o/s 2 m W. of EEP, 8th pass = 96°C</td>
<td>HL 4 MRUAC</td>
<td>2291</td>
<td>2375</td>
<td>96.4</td>
</tr>
<tr>
<td>5</td>
<td>0+200 NB Lane o/s 2 m W. of EEP, 14 passes</td>
<td>HL 4 MRUAC</td>
<td>2322</td>
<td>2375</td>
<td>97.8</td>
</tr>
<tr>
<td>6</td>
<td>0+220 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2290</td>
<td>2375</td>
<td>96.4</td>
</tr>
<tr>
<td>7</td>
<td>0+240 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2330</td>
<td>2375</td>
<td>98.1</td>
</tr>
<tr>
<td>8</td>
<td>0+260 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2293</td>
<td>2375</td>
<td>96.5</td>
</tr>
<tr>
<td>9</td>
<td>0+280 NB Lane o/s 2 m W. of EEP</td>
<td>HL 4 MRUAC</td>
<td>2313</td>
<td>2375</td>
<td>97.4</td>
</tr>
</tbody>
</table>

Note: W. of EEP = West of East Edge of Pavement

**REMARKS:**

Preliminary results left with AT ON  
Final results reported to AT ON

ATC
## ASPHALT CONCRETE COMPACTION TEST REPORT

**ATTENTION:** Mr. Norman Brace, C.E.T.  
Town of Kirkland Lake

**CONTRACT NO.:**

**PROJECT:** Main Street

**LOCATION:** Birch Street to Power Plant

**PAVING CONTRACTOR:** Grant Paving & Materials

**SUPPLIER/PLANT:** Grant/New Liskeard

**TESTING DATE/TIME:** Wednesday, September 21/94

**HOT MIX TYPE/LIFT:** HL 4 MRUAC/Second Lift

**HOT MIX TEMPERATURE:** 138°C

**WEATHER:** Clear +22°C

**TESTED BY:** JEGEL

**JESEL NO.:** 93249

**MIX NO.:** 93249

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Location</th>
<th>Mix Type</th>
<th>Compacted Density (kg/m³)</th>
<th>Marshall Density (kg/m³) (Closest Compliance Check)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0+286 SB Lane o/s 1.5 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2307</td>
<td>2375</td>
<td>97.2</td>
</tr>
<tr>
<td>11</td>
<td>0+260 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2322</td>
<td>2375</td>
<td>97.8</td>
</tr>
<tr>
<td>12</td>
<td>0+240 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2323</td>
<td>2375</td>
<td>97.8</td>
</tr>
<tr>
<td>13</td>
<td>0+200 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2328</td>
<td>2375</td>
<td>98.0</td>
</tr>
<tr>
<td>14</td>
<td>0+200 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2303</td>
<td>2375</td>
<td>97.0</td>
</tr>
<tr>
<td>15</td>
<td>0+180 SB Lane o/s 1.5 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2330</td>
<td>2375</td>
<td>98.1</td>
</tr>
<tr>
<td>16</td>
<td>0+160 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2309</td>
<td>2375</td>
<td>97.2</td>
</tr>
<tr>
<td>17</td>
<td>0+140 SB Lane o/s 1.5 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2302</td>
<td>2375</td>
<td>96.9</td>
</tr>
<tr>
<td>18</td>
<td>0+120 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2317</td>
<td>2375</td>
<td>97.6</td>
</tr>
</tbody>
</table>

**NOTE:** E. of WEP = East of West Edge of Pavement

**REMARKS:**

---

**PRELIMINARY RESULTS LEFT WITH**

**FINAL RESULTS REPORTED TO**
# Asphalt Concrete Compaction Test Report

**Attention:** Mr. Norman Brace, C.E.T.

**Town of Kirkland Lake**

**Contract No.:**

**Project:** Main Street

**Location:** Birch Street to Power Plant

**Contractor:** Grant Paving & Materials

**Supplier/Plant:** Grant/New Liskeard

<table>
<thead>
<tr>
<th>Test No.</th>
<th>Test Location</th>
<th>Mix Type</th>
<th>Compacted Marshall Density (kg/m³)</th>
<th>Marshall Density (kg/m³) (Closest Compliance Check)</th>
<th>Compaction (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
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<td>2307</td>
<td>2375</td>
<td>97.2</td>
</tr>
<tr>
<td>20</td>
<td>0+260 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2322</td>
<td>2375</td>
<td>97.8</td>
</tr>
<tr>
<td>21</td>
<td>0+240 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2323</td>
<td>2375</td>
<td>97.8</td>
</tr>
<tr>
<td>22</td>
<td>0+200 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2328</td>
<td>2375</td>
<td>98.0</td>
</tr>
<tr>
<td>23</td>
<td>0+200 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2303</td>
<td>2375</td>
<td>97.0</td>
</tr>
<tr>
<td>24</td>
<td>0+180 SB Lane o/s 1.5 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2330</td>
<td>2375</td>
<td>98.1</td>
</tr>
<tr>
<td>25</td>
<td>0+160 SB Lane o/s 2 m E. of WEP</td>
<td>HL 4 MRUAC</td>
<td>2309</td>
<td>2375</td>
<td>97.2</td>
</tr>
</tbody>
</table>

Note: E. of WEP = East of West Edge of Pavement

**Remarks:**

**Testing Date/Time:** Wednesday, September 21/94

**Hot Mix Type/Lift:** HL 4 MRUAC/Second Lift

**Hot Mix Temperature:** 138°C

**Weather:** Clear +22°C

**Tested By:** JEGEL

**JEGEL No.:** 93249

**Mix No.:** 93249

---

PRELIMINARY RESULTS LEFT WITH ____________ AT ____________ ON ________

FINAL RESULTS REPORTED TO ____________ AT ____________ ON ________

ATC ________
APPENDIX E

FWD Test Data
### PAVEMENT DEFLECTION ANALYSIS RESULTS

**Main Street**

**Granular Surface**

<table>
<thead>
<tr>
<th>Station (km)</th>
<th>Lane</th>
<th>Normalized FWD Dynamic Deflection (mm)</th>
<th>Pavement Surface Modulus (MPa)</th>
<th>Pavement Support Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.025</td>
<td>NBL</td>
<td>0.90</td>
<td>208</td>
<td>Poor</td>
</tr>
<tr>
<td>0.050</td>
<td>SBL</td>
<td>0.60</td>
<td>311</td>
<td>Fair</td>
</tr>
<tr>
<td>0.075</td>
<td>NBL</td>
<td>0.67</td>
<td>276</td>
<td>Fair</td>
</tr>
<tr>
<td>0.100</td>
<td>SBL</td>
<td>0.97</td>
<td>192</td>
<td>Poor</td>
</tr>
<tr>
<td>0.125</td>
<td>NBL</td>
<td>0.70</td>
<td>265</td>
<td>Fair</td>
</tr>
<tr>
<td>0.150</td>
<td>SBL</td>
<td>0.65</td>
<td>286</td>
<td>Fair</td>
</tr>
<tr>
<td>0.175</td>
<td>NBL</td>
<td>0.60</td>
<td>311</td>
<td>Fair</td>
</tr>
<tr>
<td>0.200</td>
<td>SBL</td>
<td>0.47</td>
<td>399</td>
<td>Fair</td>
</tr>
<tr>
<td>0.225</td>
<td>NBL</td>
<td>0.75</td>
<td>249</td>
<td>Poor</td>
</tr>
<tr>
<td>0.250</td>
<td>SBL</td>
<td>0.46</td>
<td>402</td>
<td>Fair</td>
</tr>
<tr>
<td>0.275</td>
<td>NBL</td>
<td>0.52</td>
<td>361</td>
<td>Fair</td>
</tr>
<tr>
<td>0.300</td>
<td>SBL</td>
<td>0.55</td>
<td>341</td>
<td>Fair</td>
</tr>
</tbody>
</table>

Mean: 0.65
Std. Dev.: 0.15
Coefficient of Variation: 23.4

[*) - Indicates value not used in the statistical calculations
PAVEMENT DEFLECTION TEST RESULTS
Main Street
Granular Surface

Normalized Dynamic Deflection (mm) vs Station (km)
PAVEMENT DEFLECTION ANALYSIS RESULTS  
Main Street  
Asphalt Surface

| Station  
(Km) | Lane | Normalized FWD Dynamic Deflection (mm) | Pavement Surface Modulus (MPa) | Pavement Support Quality |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000</td>
<td>SBL</td>
<td>0.57</td>
<td>259</td>
<td>Good</td>
</tr>
<tr>
<td>0.025</td>
<td>NBL</td>
<td>0.48</td>
<td>308</td>
<td>Good</td>
</tr>
<tr>
<td>0.050</td>
<td>SBL</td>
<td>0.51</td>
<td>294</td>
<td>Good</td>
</tr>
<tr>
<td>0.075</td>
<td>NBL</td>
<td>0.43</td>
<td>343</td>
<td>Good</td>
</tr>
<tr>
<td>0.100</td>
<td>SBL</td>
<td>0.48</td>
<td>311</td>
<td>Good</td>
</tr>
<tr>
<td>0.125</td>
<td>NBL</td>
<td>0.55</td>
<td>272</td>
<td>Good</td>
</tr>
<tr>
<td>0.150</td>
<td>SBL</td>
<td>0.51</td>
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</tr>
<tr>
<td>0.175</td>
<td>NBL</td>
<td>0.44</td>
<td>338</td>
<td>Good</td>
</tr>
<tr>
<td>0.200</td>
<td>SBL</td>
<td>0.77*</td>
<td>194</td>
<td>Fair</td>
</tr>
<tr>
<td>0.225</td>
<td>NBL</td>
<td>0.49</td>
<td>304</td>
<td>Good</td>
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<tr>
<td>0.250</td>
<td>SBL</td>
<td>0.57</td>
<td>262</td>
<td>Good</td>
</tr>
<tr>
<td>0.275</td>
<td>NBL</td>
<td>0.53</td>
<td>281</td>
<td>Good</td>
</tr>
<tr>
<td>0.300</td>
<td>SBL</td>
<td>0.60</td>
<td>248</td>
<td>Fair</td>
</tr>
</tbody>
</table>

Mean: 0.51, 293  
Std. Dev.: 0.05, 29  
Coefficient of Variation: 9.7, 9.8

[*] - Indicates value not used in the statistical calculations
PAVEMENT DEFLECTION TEST RESULTS
Main Street
Asphalt Surface
APPENDIX F

Profile Measurements
# SUMMARY OF PROFILE ANALYSES

Town of Kirkland Lake Rubber Modified Asphalt Pavement

<table>
<thead>
<tr>
<th># Section</th>
<th>Root Mean Square Vertical Acceleration (mm/m²)</th>
<th>International Roughness Index (mm/m)</th>
<th>Profile Deviation Per Unit Length (mm/m)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Base Length</td>
<td>Straight Edge Length</td>
<td>Base Length</td>
</tr>
<tr>
<td># Section</td>
<td>0.3m</td>
<td>1.5m</td>
<td>3.0m</td>
</tr>
<tr>
<td>1.Main Street SB Lane</td>
<td>15.28</td>
<td>1.55</td>
<td>0.73</td>
</tr>
<tr>
<td>DATE: 09/21/94</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.Main Street NB Lane</td>
<td>13.65</td>
<td>1.52</td>
<td>0.79</td>
</tr>
<tr>
<td>DATE: 09/21/94</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Profile Plot
Main Street : NB Lane
OFFSET: 0.0

0.1775
0.1442
0.1120
0.0793
0.0465
0.0138
-0.0140
-0.0517
-0.0844

0 40 80 120 160 200 240 280 320 360 400

Station (m)
Profile Plot
Main Street : SB Lane
OFFSET: 0.0

Station (m)
APPENDIX G

Laboratory Test Results
**SURFACE COURSE**

**HOT MIX TYPE** | **HL 4 (MRUAC)**
---|---
**SAMPLE NUMBER** | **1**

| **TRIAL BATCH** | **EXTRACTION/GRADATION** | **FULL MARSHALL COMPLIANCE** |
---|---|---|

**ATTENTION:** Mr. Norm Brace  
Corporation of the Town of Kirkland Lake

**PROJECT NO.:** C326-53C-3331

**PROJECT:** Rubber Modified Asphalt Pavement Project

**LOCATION:** Main Street - Birch St. to Power Plant

**PAVING CONTRACTOR:** Miller Paving

**HOT MIX SUPPLIER/PLANT:** Grant Paving

**SAMPLING DATE/TIME:** September 20, 1994 @ 4:05 PM

**SAMPLE LOCATION:** Station 0+050, NBL, o/s 1.5 m EP., Load 3

---

**EXTRACTION/GRADATION TEST RESULTS**

**SIEVE SIZE** | **SAMPLE** | **SPECIFICATION** | **% PASSING** |
---|---|---|---|
26.5 mm | **X** | JMF TOLERANCE | A/B/R |
19.0 mm | 100.0 | 100.0 |
16.0 mm | 100.0 | 99.7 | ±5.0 | A |
13.2 mm | 95.6 | 92.0 | ±5.0 | A |
9.5 mm | 78.2 | 74.2 | ±5.0 | A |
4.75 mm | 58.9 | 55.0 | ±5.0 | A |
2.36 mm | 45.8 | 47.3 | ±4.5 | A |
1.18 mm | 35.6 | 40.5 | ±4.0 | R |
600 µm | 22.2 | 25.4 | ±3.5 | A |
300 µm | 10.0 | 9.9 | ±3.0 | A |
150 µm | 4.9 | 5.4 | ±2.5 | A |
75 µm | 2.9 | 3.9 | ±2.0 | A |
ASPHALT CONTENT (%) | 6.61 | 6.0 | ±0.5,-0.3 | R |

**WASHED** | **FINES CORR.** | **X** |

**MIX MOISTURE CONTENT** | **0.07 %**

**REMARKS:**  
**Unwashed Sample**  
14.9 grams of Rubber Recovered = 1.5% of Mix.

**Washed Sample**  
Rubber not included in gradation.

**FINAL RESULTS REPORTED TO**  
**AT**  
**ON**  

---

**MARSHALL TEST RESULTS**

| **TEST** | **SAMPLE** | **SPEC.** | **** |
---|---|---|---|
AIR voids (%) | 3.8 |
AIR voids, SSD (%) | 3.8 | 3.0 - 5.0 |
V.M.A. (%) | 19.1 | 15.0 min |
STABILITY (N) | 6873 | 5800 min. |
FLOW (0.25 mm) | 15.5 | 8.0 min. (AT 3.5% AV) |
BRD | 2.341 |
MRD | 2.433 |
MRD, SSD | 2.433 |

**APPEARANCE**

| **MIX APPEARANCE** | **D** | **N** | **R** | **VR** |
---|---|---|---|---|
BRIQUETTE APPEARANCE | **D** | **N** | **R** | **SF** |
COATING | F. AGG. | P | F | G |
C. AGG. | P | F | G |
STRIPPING | **NI** | **SL** | **M** | **H** |
C. AGG. FRACTURE | **NI** | **SL** | **M** | **H** |

**A - ACCEPTABLE**  
**B - BORDERLINE**  
**R - REJECTABLE**

**OUT OF SPECIFICATION**

---
# SURFACE COURSE

**HOT MIX TYPE**: HL 4 (MRUAC)  
**SAMPLE NUMBER**: 2

- **TRIAL BATCH**:  
- **EXTRACTION/GRADATION**: X  
- **FULL MARSHALL COMPLIANCE**:  

**ATTENTION**: Mr. Norm Brace  
Corporation of the Town of Kirkland Lake

**PROJECT NO.**: C32S-53C-3331

**PROJECT**: Rubber Modified Asphalt Pavement Project

**LOCATION**: Main Street - Birch st. to Power Plant

**PAVING CONTRACTOR**: Miller Paving

**HOT MIX SUPPLIER/PLANT**: Grant Paving

**SAMPLE TYPE**: Plate

**SAMPLE TEMPERATURE**: 135°C

**WEATHER**: -

**SAMPLED BY**: F. Pendleton, JEGEL

**TESTED BY**: H. Windross, JEGEL

**JEGEL NO.**: 93249

**MIX NO.**: 93249b

---

## EXTRACTION/GRADATION TEST RESULTS

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>% PASSING</th>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5 mm</td>
<td>100.0</td>
<td>JMF</td>
</tr>
<tr>
<td>19.0 mm</td>
<td>100.0</td>
<td>JMF ±5.0 A</td>
</tr>
<tr>
<td>16.0 mm</td>
<td>100.0</td>
<td>JMF ±5.0 A</td>
</tr>
<tr>
<td>13.2 mm</td>
<td>96.7</td>
<td>JMF ±5.0 A</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>79.8</td>
<td>JMF ±5.0 A</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>55.6</td>
<td>JMF ±5.0 A</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>41.0</td>
<td>JMF ±4.5 R</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>33.6</td>
<td>JMF ±4.0 R</td>
</tr>
<tr>
<td>600 μm</td>
<td>21.1</td>
<td>JMF ±3.5 R</td>
</tr>
<tr>
<td>300 μm</td>
<td>9.1</td>
<td>JMF ±3.0 A</td>
</tr>
<tr>
<td>150 μm</td>
<td>4.2</td>
<td>JMF ±2.5 A</td>
</tr>
<tr>
<td>75 μm</td>
<td>2.4</td>
<td>JMF ±2.0 A</td>
</tr>
<tr>
<td>ASPHALT CONTENT (%)</td>
<td>6.80</td>
<td>6.0</td>
</tr>
</tbody>
</table>

**WASHED**: X  
**FINES CORR.**: X  
**MIX MOISTURE CONTENT**: 0.07 %

**REMARKS**:  
**Unwashed Sample**: 18.6 grams of Rubber Recovered = 1.8% of Mix.  
**Washed Sample**: Rubber not included in gradation.

---

## MARSHALL TEST RESULTS

<table>
<thead>
<tr>
<th>TEST</th>
<th>SAMPLE</th>
<th>SPEC.</th>
<th>**</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR VOIDS (%)</td>
<td>2.7</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>AIR VOIDS, SSD (%)</td>
<td>2.7</td>
<td>3.0 - 5.0</td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>V.M.A. (%)</td>
<td>18.1</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>STABILITY (%)</td>
<td>7583</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>FLOW (0.25 mm)</td>
<td>15.6</td>
<td>8.0 min. (AT 5.5% AV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRIQUE TTE (50 mm)</td>
<td>2.376</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>MRO</td>
<td>2.443</td>
<td></td>
<td>A</td>
<td></td>
</tr>
<tr>
<td>MRO, SSD</td>
<td>2.443</td>
<td></td>
<td>A</td>
<td></td>
</tr>
</tbody>
</table>

**APPEARANCE**

- **MIX APPEARANCE**: D H F VR  
- **BRIQUE TTE APPEARANCE**: D H F SF F  
- **COATING**: F. AGG. P F S  
- **C. AGG.**: P F S  
- **STRIPPING**: C. AGG. FRACTURE (IL) SL M H  

* OUT OF SPECIFICATION  
A - ACCEPTABLE  
B - BORDERLINE  
R - REJECTABLE

---

**FINAL RESULTS REPORTED TO**  
**AT**  
**ON**
**SURFACE COURSE**

**HOT MIX TYPE**: HL 4 (MRUAC)  
**SAMPLE NUMBER**: 3

- **TRIAL BATCH**:  
- **EXTRACTION/GRADATION**:  
- **FULL MARSHALL COMPLIANCE**:  
- **WITH IMMERSION MARSHALL COMPLIANCE**: 

**ATTENTION**: Mr. Norm Brace  
Corporation of the Town of Kirkland Lake

**PROJECT NO.**: C325-53C-3331  
**PROJECT**: Rubber Modified Asphalt Pavement Project  
**LOCATION**: Main Street - Birch st. to Power Plant

**PAVING CONTRACTOR**: Miller Paving  
**HOT MIX SUPPLIER/PLANT**: Grant Paving  
**SAMPLING DATE/TIME**: September 20, 1994 @ 6:25 PM  
**SAMPLE LOCATION**: Station 0+252, SBL, 0/s 3.0 m E. of EP

---

**EXTRACTION/GRADATION TEST RESULTS**

<table>
<thead>
<tr>
<th>SIEVE SIZE (mm)</th>
<th>% PASSING</th>
<th>SPECIFICATION</th>
<th>JMF</th>
<th>TOLERANCE</th>
<th>A/B/R</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5</td>
<td>100.0</td>
<td>**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19.0</td>
<td></td>
<td>***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.0</td>
<td>100.0</td>
<td>**</td>
<td>99.7</td>
<td>±5.0</td>
<td>A</td>
</tr>
<tr>
<td>13.2</td>
<td>97.5</td>
<td>**</td>
<td>92.0</td>
<td>±5.0</td>
<td>R</td>
</tr>
<tr>
<td>9.5</td>
<td>79.4</td>
<td>**</td>
<td>74.2</td>
<td>±5.0</td>
<td>R</td>
</tr>
<tr>
<td>4.75</td>
<td>55.2</td>
<td>**</td>
<td>55.0</td>
<td>±5.0</td>
<td>A</td>
</tr>
<tr>
<td>2.36</td>
<td>43.1</td>
<td>**</td>
<td>47.3</td>
<td>±4.5</td>
<td>A</td>
</tr>
<tr>
<td>1.18</td>
<td>34.7</td>
<td>**</td>
<td>40.5</td>
<td>±4.0</td>
<td>R</td>
</tr>
<tr>
<td>600 µm</td>
<td>22.2</td>
<td>**</td>
<td>25.4</td>
<td>±3.5</td>
<td>A</td>
</tr>
<tr>
<td>300 µm</td>
<td>9.5</td>
<td>**</td>
<td>9.9</td>
<td>±3.0</td>
<td>A</td>
</tr>
<tr>
<td>150 µm</td>
<td>4.8</td>
<td>**</td>
<td>5.4</td>
<td>±2.5</td>
<td>A</td>
</tr>
<tr>
<td>75 µm</td>
<td>2.5</td>
<td>**</td>
<td>3.9</td>
<td>±2.0</td>
<td>A</td>
</tr>
<tr>
<td>ASPHALT CONTENT (%)</td>
<td>6.51</td>
<td>**</td>
<td>6.0</td>
<td>+0.5,-0.3</td>
<td>R</td>
</tr>
</tbody>
</table>

**WASHED**: X  
**FINES CORR.**: X  
**MIX MOISTURE CONTENT**: 0.00 %

**REMARKS**:  
- **Unwashed Sample**: 14.5 grams of Rubber Recovered = 1.4% of Mix.  
- **Washed Sample**: Rubber not included in gradation.

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**MARSHALL TEST RESULTS**

- **AIR VOIDS (%)**: 3.0 - 5.0  
- **V.M.A. (%)**: 15.0 min  
- **STABILITY (N)**: 5000 min.  
- **FLOW (0.25 mm)**: 8.0 min. (AT 3.5% AV)  
- **BRD**  
- **MRD**  
- **MRD, SSD**  

**APPEARANCE**

- **MIX APPEARANCE**: D M R VR  
- **BRIQUETTE APPEARANCE**: D M R SF F  
- **COATING**: F. AGG. P F G  
- **C. AGG.**: P F G  
- **STRIPPING**: NIL SL M H  
- **C. AGG. FRACTURE**: NIL SL M H

* OUT OF SPECIFICATION  
A - ACCEPTABLE  
B - BORDERLINE  
R - REJECTABLE

**FINAL RESULTS REPORTED TO** ___________________________  
**AT** ___________________________  
**ON** ___________________________
SURFACE COURSE

HOT MIX TYPE: HL 4 (MRUAC)

SAMPLE NUMBER: T1

X TRIAL BATCH  X EXTRACTION/GRADATION

ATTENTION: Mr. Norm Brace

Corporation of the Town of Kirkland Lake

PROJECT NO.: C32S-53C-3331

PROJECT: Rubber Modified Asphalt Pavement Project

LOCATION: Main Street - Birch St. to Power Plant

PAVING CONTRACTOR: Miller Paving

HOT MIX SUPPLIER/PLANT: Grant Paving

SAMPLE LOCATION: Grant Paving Plant

EXTRACTION/GRADATION TEST RESULTS

<table>
<thead>
<tr>
<th>SIEVE SIZE</th>
<th>SAMPLE</th>
<th>% PASSING</th>
<th>SPECIFICATION</th>
<th>TOLERANCE</th>
<th>A/B/R</th>
</tr>
</thead>
<tbody>
<tr>
<td>26.5 mm</td>
<td>**</td>
<td>100.0</td>
<td>JMF</td>
<td>±5.0</td>
<td>A</td>
</tr>
<tr>
<td>19.0 mm</td>
<td>**</td>
<td>100.0</td>
<td>JMF</td>
<td>±5.0</td>
<td>A</td>
</tr>
<tr>
<td>16.0 mm</td>
<td>**</td>
<td>96.0</td>
<td>JMF</td>
<td>±5.0</td>
<td>A</td>
</tr>
<tr>
<td>13.2 mm</td>
<td>**</td>
<td>90.0</td>
<td>JMF</td>
<td>±5.0</td>
<td>A</td>
</tr>
<tr>
<td>9.5 mm</td>
<td>**</td>
<td>83.4</td>
<td>JMF</td>
<td>±5.0</td>
<td>R</td>
</tr>
<tr>
<td>4.75 mm</td>
<td>**</td>
<td>61.7</td>
<td>JMF</td>
<td>±5.0</td>
<td>R</td>
</tr>
<tr>
<td>2.36 mm</td>
<td>**</td>
<td>51.8</td>
<td>JMF</td>
<td>±4.5</td>
<td>A</td>
</tr>
<tr>
<td>1.18 mm</td>
<td>**</td>
<td>42.4</td>
<td>JMF</td>
<td>±4.0</td>
<td>A</td>
</tr>
<tr>
<td>600 μm</td>
<td>**</td>
<td>25.6</td>
<td>JMF</td>
<td>±3.5</td>
<td>A</td>
</tr>
<tr>
<td>300 μm</td>
<td>**</td>
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<td>A</td>
</tr>
<tr>
<td>150 μm</td>
<td>**</td>
<td>4.5</td>
<td>JMF</td>
<td>±2.5</td>
<td>A</td>
</tr>
<tr>
<td>75 μm</td>
<td>**</td>
<td>2.6</td>
<td>JMF</td>
<td>±2.0</td>
<td>A</td>
</tr>
<tr>
<td>ASPHALT CONTENT (%)</td>
<td>**</td>
<td>6.43</td>
<td>6.0</td>
<td>+0.5,-0.3</td>
<td>A</td>
</tr>
</tbody>
</table>

MIX MOISTURE CONTENT: 0.10 %

WASHED X FINES CORR. X

REMARKS: ** Unwashed Sample

12.5 grams of Rubber Recovered = 1.2% of Mix.

*** Washed Sample

Rubber not included in gradation.

FINAL RESULTS REPORTED TO ________________ AT ________________ ON ________________

HOT MIX TYPE/LIFT: HL 4 (MRUAC)

SAMPLE TYPE: -

SAMPLE TEMPERATURE: -

WEATHER: -

SAMPLE MADE BY: Dave Soanes, JEGEL

TESTED BY: M. Windross, JEGEL

JEGEL NO.: 93249

DRAIN

MARSHALL TEST RESULTS

<table>
<thead>
<tr>
<th>TEST</th>
<th>SAMPLE</th>
<th>SPEC.</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIR VOIDS (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AIR VOIDS, SSD (%)</td>
<td>3.0 - 5.0</td>
<td></td>
</tr>
<tr>
<td>V.M.A. (%)</td>
<td>15.0 min</td>
<td></td>
</tr>
<tr>
<td>STABILITY (N)</td>
<td>5800 min</td>
<td></td>
</tr>
<tr>
<td>FLOW (0.25 mm)</td>
<td>8.0 min (AT 3.5% AV)</td>
<td></td>
</tr>
<tr>
<td>BRD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MRD, SSD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPEARANCE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIX APPEARANCE</td>
<td>D M R VR</td>
<td></td>
</tr>
<tr>
<td>BRICUETTE APPEARANCE</td>
<td>D M R SF F</td>
<td></td>
</tr>
<tr>
<td>COATING</td>
<td>F. AGG. P F G</td>
<td></td>
</tr>
<tr>
<td>C. AGG.</td>
<td>P F G</td>
<td></td>
</tr>
<tr>
<td>STRIPPING</td>
<td>NIL SL M H</td>
<td></td>
</tr>
<tr>
<td>C. AGG. FRACTURE</td>
<td>NIL SL M H</td>
<td></td>
</tr>
</tbody>
</table>

* OUT OF SPECIFICATION
A - ACCEPTABLE  B - BORDERLINE  R - REJECTABLE