Guide Specification:
Diamond Grinding for City Streets

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SCOPE

City streets are defined as roadways with a closed drainage system along with numerous structures such as manholes, water shutoffs and catch basins. The general profile varies to accommodate these structures and intersecting streets. Generally, the posted speed limit is 45 mph or less.

This standard specifies the procedures for operations of continuous diamond grinding Portland cement concrete or asphalt concrete pavement city streets and low speed roadway surfaces to provide desired surface characteristics such as ride, friction and drainage. The standard also provides guidelines for levels of acceptance for the desired surface characteristics. The user of this standard shall be responsible to ensure that all local safety, health and environmental standards are made a part of the project specification.

Conventional diamond grinding also can be utilized to reduce the noise created by the interaction of the tire with the pavement surface in areas of low to moderate noise concern. When grinding solely for noise reduction, it is important to completely remove the existing surface texture such as transverse tining. The profile requirements stated elsewhere in this specification may not apply to grinding solely for noise abatement. In areas of high tire/pavement noise concern and speed limits above 45 mph, the pavement should be ground in accordance with the specification for Next Generation Concrete Surface (NGCS) grinding.

EQUIPMENT

Grinding shall be performed using diamond blades mounted on a self-propelled machine designed for grinding and texturing pavement. The equipment shall be at a minimum 35,000 pounds (15,876 kilograms), including the grinding head, and of a size that will grind a strip at least 3 feet (0.914 meters) wide. The effective wheel base of the machine shall be no less than 12 feet (3.66 meters).

The equipment shall have a positive means of vacuuming the grinding residue from the pavement surface, leaving the surface in a clean, near-dry condition.

Grinding equipment that causes raveling, aggregate fractures or disturbance to the joints shall not be permitted.

The equipment shall be maintained to ensure it is in proper working order, especially the “roundness” of the match and depth control wheels. Any wheels found to be out of round shall be immediately replaced.

CONSTRUCTION

The construction operation shall be scheduled and proceed in a manner that produces a neat, uniform finished surface. Mainline grinding adjacent to any unground turn lane, gutter section, shoulder, auxiliary lane or ramp lane shall feather smoothly from the edge of the ground mainline into the unground surface leaving no more than a 1/8-inch to 1/4 -inch (3.18 mm to 6.35 mm) ridge at this transition as measured by a 3-foot straightedge. Unique project conditions may require the ground area to extend into the gutter section feathering up to 12 inches (30.5 cm) within the curb face to provide proper drainage. Full- and partial-depth concrete repairs, slab stabilization and dowel bar retrofit shall be completed prior to any grinding. Joint sealing shall be completed subsequent to the diamond grinding operations.

Grinding shall be accomplished in a manner that eliminates joint or crack faults so there is no more than a 1/16-inch (1.59 mm) differential between the adjacent sides of the joints and cracks. Grinding shall also substantially remove pavement conditions such as warp and curl to provide an acceptable ride.

The grinding shall feather into existing structures such as manholes and water shutoffs in a manner that eliminates abrupt ridges or drops and provides a uniform texture and acceptable ride. If project conditions exist that prohibit acceptable feathering operations, the engineer may require that the structure be raised or lowered. The added work of raising and lowering these structures that is not included as a predetermined bid item shall be paid for at an agreed upon price or as defined in the Force Account section of the Standard Specifications. Structure adjustments that occur within the limits of a full-depth repair shall be reset to an elevation1/4 - inches (6.35 mm) below the new pavement surface to facilitate the diamond grinding operation.

Lateral drainage shall be achieved by maintaining a constant cross slope between grinding extremities in each lane. The finished cross slope shall mirror the pregrind cross slope and shall have no depressions or misalignment of slope greater than ¼-inch (6.35 mm) in 10 feet (3.05 meters) when measured with a 10-foot (3.05 meter) straightedge placed perpendicular to the centerline. Steps will be taken to ensure that wheel path rutting is substantially removed and that the grinding operation is simply not texturing the wheel path depressions. Areas of deviation shall be reground. Straightedge requirements will not apply across longitudinal joints, areas where existing structures limit grinding operations or outside the specified ground area.

The maximum removal required in any area shall not exceed 5/8 – inch to 3/4-inch. (15.88 mm to 19.05 mm). Areas where required removal exceeds this limit shall be excluded from smoothness requirements found elsewhere in this specification.

Grinding shall begin and end at lines normal to the pavement centerline at the project limits. Passes of the grinding head shall not overlap more than 1-inch (25.4 mm). This requirement shall be waived in irregularly shaped roadway sections that do not allow for full passes of the grinding equipment. No unground surface area between passes will be permitted.

FINAL SURFACE FINISH

The grinding process shall produce a pavement surface that is true in grade and uniform in appearance with a longitudinal line-type texture. The line-type texture shall contain corrugations parallel to the centerline and present a narrow ridge corduroy type appearance. The peaks of the ridges shall be 1/8-inch (3.18 mm) +/- 1/16-inch (1.59 mm) higher than the bottom of the grooves with evenly spaced ridges having a width that measures within the ranges listed below:

	Limestone	**Gravel**
Land area between grooves	0.090 to 0.120 inch (2.29 to 3.05 mm)	0.080 to 0.110 inch (2.03 to 2.79 mm)

It shall be the contractor's responsibility to select the number of blades per foot to be used to provide the proper surface finish for the aggregate type present on the project. The engineer may require removal of unbroken fins at the contractor's expense. The project conditions may dictate that the contractor has to make multiple passes with the equipment to meet the specifications. It is the contractor's responsibility to determine the proper sequence of operations to meet the specification. If multiple passes of the grinding equipment are required, the area will only be considered for payment once. A minimum of 90 percent of the area of any 100-foot (30.48 meter) section of pavement surface shall be textured. Depressed pavement areas due to subsidence or other localized causes will be exempted from texture and smoothness requirements.

SLURRY HANDLING AND REMOVAL

The contractor shall remove and dispose of all residues from the pavement surface in a manner and at a location that satisfies environmental regulations. The diamond grinding machine shall be equipped with a well maintained vacuum system that is capable of removing all standing slurry, leaving the roadway in a damp condition after the grinder passes. Residue shall not be permitted to encroach into open lanes or enter into closed drainage systems. All catch basins shall be covered with filter fabric as shown in the plans. Slurry handling requirements should be defined in the contract documents. (The International Grooving and Grinding Association Best Management Practices for slurry handling should be used in defining the proper operation for each project). The basic handling procedures for urban sections are outlined below:

SLURRY COLLECTION FOR DISPOSAL OR POND DECANTING

In urban and other areas with closed drainage systems, the slurry shall be collected in water-tight haul units and transported to disposal facilities or settlement ponds constructed by the contractor. These ponds may be constructed within or outside of the right-of-way. All means of disposal shall be approved by the engineer. When used, settlement ponds shall be constructed to allow for the settlement of the solids and decanting of the water for reuse in the grinding operation. At the completion of the grinding operation, the remaining water will be

allowed to evaporate or may be used in a commercially useful manner (i.e. dust control). After drying, the remaining solids may be used as fill material or for other commercially useful applications. The pond area shall be reclaimed to its original condition and vegetated to protect against erosion.

SLURRY COLLECTION AND PLANT PROCESSING

The slurry shall be collected and hauled as with the pond processing. There are various plant designs such as centrifuge and belt press. The plant site shall be prepared to control any stormwater runoff in accordance with local regulations. The site should be restored and vegetated at the completion of operations. The processed water and solids are to be handled in the same fashion as the settlement ponds. The site may be within or outside the right-of-way. Site location is to be approved by the engineer.

SMOOTHNESS REQUIREMENTS

An initial profile index of representative portions of the project may be available through the project contact person upon written request. When available, this information represents a summary of conditions found to exist at the time the survey was made. The contractor is cautioned to note the date the survey was taken since the conditions may have changed over time. This profile is for informational purposes and only gives the contractor an idea of the conditions that existed at the time the profile was taken. The contractor assumes the risk of error if the information is used for any purpose other than that intended. Any assumption the contractor makes based on this data will be at the contractor's risk. Also, contractors are responsible for visiting the project site and making their own condition determination prior to bidding.

Prior to performing any grinding work, the contractor shall provide a profile using lightweight profiler equipment with a laser that simulates the tire footprint. Single point lasers shall not be used. Line laser equipment such as RoLine™ or an approved equal shall be used. All equipment shall have current certification and be approved by the contracting authority. This control profile will be used to identify the required smoothness for the project if a percent improvement is the controlling factor. Each 0.1 lane mile (kilometer) segment (528 feet - 160.93 meters) of the finished surface shall have a final IRI of:

- 115 in/mile (181 cm/kilometer).
- For extremely rough conditions: the greater of 35 percent of the pregrind profile or the aforementioned requirement shall be the required smoothness.
- Depressed pavement areas due to subsidence or other localized causes and areas that have reached the maximum removal will be excluded from the smoothness requirements. These areas shall be reviewed and approved by the engineer.

The contractor shall run the profile in both wheel paths and average the resulting IRI results to determine acceptance. The profiles shall be run 3 feet (0.914 meters) from each lane line. A guide shall be used to ensure proper alignment of the profile. The engineer shall have a

representative monitoring the lightweight profiler during all testing periods. This representative shall sign the resulting profile form.

The engineer shall run comparison profiles on no less than 10 percent of the segments using the same type of certified equipment as the contractor. It is of great importance that a proper guide is used to ensure that all testing is completed over the same track. The contractor testing and agency testing should be completed during the same time of day and under similar climatic conditions. The results of these verification profiles shall not vary more than 10 percent from the contractor profiles.

The engineer may choose to accept isolated sections if the variance between the two profiles is less than 15 percent. When the difference exceeds 15 percent on an isolated basis or 10 percent on a consistent basis, referee testing will be required to determine which device is providing an accurate evaluation of the pavement surface. The party found to have the inaccurate equipment will pay for the referee testing. The engineer may choose to withhold payment for segments that do not meet these criteria until the problem is resolved. The engineer may choose to run verification profiles on the entire project if the comparison profiles are constantly outside the allowable tolerance. The engineer will charge $700 ($435)/ lane-mile (kilometer) for the additional testing if the contractor's operation is found to be in error. Segments found not meeting the smoothness requirements will require regrinding at no additional cost to the department.

The finished ground surface shall not include any bumps exceeding 0.4-inch (10.16 mm) in 25 feet (7.62 meters).

The conditions of smaller municipal projects may not be suited for the aforementioned smoothness requirements. In these instances, the use of a 10-foot (3.05 meter) straightedge requiring a maximum1/8-inch (3.18 mm) variance will suffice.

METHOD OF MEASUREMENT

Grinding of pavement will be measured by the square yard (square meter). The square yard measure will be the final textured surface area regardless of the number of passes required to achieve the specified results. Minor areas of unground pavement within the designated areas to be ground will be included in the measurement up to 10 percent of the surface area. When conditions require a feather pass into the shoulder, auxiliary or ramp lanes, payment will be by the square yard (square meters) based on a width of 2 feet (.61 meters) times the length of the required feather pass. The minimum length of a feather pass will be 100 feet (30.5 meters). Gutter sections requiring a feather pass will be paid by the square yard (square meter) based on a width of 1 foot (0.305 meters) times the length of the required feather pass. The minimum length of a feather pass will be paid as 100 feet (30.5 meters).

BASIS OF PAYMENT
Grinding will be paid for at the contract price per square yard (square meter). Payment shall be full compensation for all labor, equipment, material and incidentals to complete this work, including hauling and disposal of grinding residue. Covering of catch basins will be paid per each unit. Structure adjustments will be by agreed price or by Force Account.

RECOMMENDED SMOOTHNESS INCENTIVE FOR CITY STREET APPLICATIONS:

IRI in/mile	**Incentive $ per 0.1 lane mile section**
0.00 – 80.00	$450.00
80.01 – 100.00	$ -12.857(IRI) + 1478.6
100.01 – 115.00	$0.00
>115.01	Corrective Action
IRI cm/km	**Incentive $ per 0.1 lane kilometer section**
0.00 – 122.0	$280.00
122.01 – 158.00	$ -4.666(IRI) + 849.3
158.01 – 182.00	$0.00
>182.01	Corrective Action