CITY OF FARGO SPECIFICATIONS
PAVEMENT MARKINGS

PART 1
DESCRIPTION OF WORK

This work to be done under this section of the Specifications and the accompanying plans consists of furnishing and installing the specified pavement markings at the designated locations in the City of Fargo.

PM Certification Requirement

Permanent pavement markings shall be applied in accordance with the manufacturer's recommendations. All Contractors installing the material for the City shall provide a crew of which 50% are trained and "certified" by the manufacturer. "Certified" Contractors must be able to provide proof of the certification through a manufacturer provided ID Card or Certification Paper.

Permanent pavement marks shall include but are not limited to plastic pavement marking film, preformed thermoplastic pavement markings, durable methacrylate markings and epoxy pavement marking paint.

PART 2
MATERIAL

2.1. *PAVEMENT MARKING PAINT*

A. Color

The marking paint shall be white, yellow or blue conforming to standard highway colors.

B. Physical Requirements

The paint shall meet NDDOT specifications for high solids water-based traffic paint. The Contractor shall submit certification of the paint prior to placement.

C. Glass Beads

Glass beads for pavement markings shall conform to the specifications required by the respective paint manufacturer with which the paint material complies.

2.1.1. *PAINT APPLICATION EQUIPMENT*

The equipment required to apply pavement marking paint and glass beads shall be a self-propelled, pneumatic spraying machine with atomizing nozzles capable of applying three 4-inch to 8-inch wide lines at one time. The spray mechanism shall be operated by quick opening and closing valves. The applicator shall apply the materials at a rate specified in an even and uniform thickness with clearly defined edges. The applicator shall have reservoirs or tanks equipped with agitators capable of keeping the material in a smooth, even mixture. Tanks shall have sufficient capacity to apply the materials as specified. The applicator shall be equipped with an automatic skip control device capable of applying a stripe of specified length with a linear tolerance of 3 inches. The applicator shall be capable of retracing and applying materials to traffic markings in place.

Adequate hand-operated equipment will be required to accomplish the pavement markings for areas not readily accessible to the pavement marking applicator.

The machine shall be equipped with a glass bead dispenser adjusted and synchronized with the paint applicator to distribute the reflectorizing spheres uniformly on the painted line(s) using air pressure. The bead dispenser shall be equipped with an automatic cutoff control, synchronized with the cutoff of the striping material.

The applicator truck (striper) shall have a permanently mounted, direction variable early warning arrow board visible to approaching traffic. Truck equipment shall be capable of accumulating the footage applied by each gun individually each day. Only material application shall activate the footage accumulators. The read out shall be digital and not adjustable.

2.2. *PLASTIC PAVEMENT MARKING FILM*

The prefabricated plastic pavement markings shall consist of white or yellow pigmented plastic films, conforming to standard highway colors, with reflective glass spheres incorporated throughout the entire cross-sectional area and a layer of reflective glass spheres bonded to the top surface. The pavement markings shall adhere to bituminous or Portland cement concrete pavements by either a pressure-sensitive precoated adhesive or a liquid contact cement. The markings shall be provided in a form that will facilitate rapid application and protect the markings in shipment and storage. The manufacturer shall identify proper solvents and/or adhesives to be applied at the time of application, all equipment necessary for proper application and recommendations for application that will assure an effective performance life. The marking material shall mold itself to pavement contours by the action of traffic. The pavement marking films shall also be capable of application on new bituminous concrete wearing courses during the paving operation according to the manufacturer's instructions. After application, the markings shall be immediately ready for traffic.

Prefabricated legend and symbols shall conform to the applicable shapes and sizes shown in the "Manual on Uniform Traffic Control Devices."

All plastic marking film required shall be 3M Stamark 380AW & 381AW Durable Pavement Marking Tape. The Contractor may provide equivalent materials from other manufacturers only if the material has been approved in writing by the Engineer.

2.3. *PRE-FORMED THERMOPLASTIC PAVEMENT MARKINGS*

A. The markings must be a resilient white or yellow thermoplastic product with uniformly distributed glass beads throughout the entire cross sectional area. Lines, legends and symbols are capable of being affixed to bituminous and/or Portland concrete pavements by the use of the normal heat of a propane type of torch. Other colors shall be available as required.

B. The markings must be capable of conforming to pavement contours, breaks and faults through the action of traffic at normal pavement temperatures. The markings shall have resealing characteristics, such that it is capable of fusing with itself and previously applied thermoplastic when heated with the torch.

C. The markings must be able to be applied in temperatures down to 32 degrees F. without any special storage, preheating or treatment of the material before application.

D. Must be composed of ester modified resin resistant to degradation by motor fuels, aggregates, pigments, binders and glass beads which have been factory produced as a finished product and meets the requirements of the current edition of the Manual on Uniform Traffic Control Devices for Streets and Highways. The thermoplastic material conforms to AASHTO designation M249-79(86), with the exception of the relevant differences due to the material is supplied in a preformed state.

E. Graded Glass Beads:
The material must contain a minimum of thirty percent (30%) intermixed graded glass beads by weight. The intermixed beads shall be clear and transparent. Not more than twenty percent (20%) consist of irregular fused spheroids, or silica. The index of refraction shall not be less than 1.50.

The material must have factory applied coated surface beads in addition to the intermixed beads at a rate of 1 lb. (±10%) per 11 sq. ft.

F. Pigments:
White: Sufficient titanium dioxide pigment is used to ensure a color similar to Federal Highway White, Color No. 17886, as per Federal Standard 595.

Yellow: Sufficient yellow pigment is used to ensure a color similar to Federal Highway Yellow, Color No. 13655, as per Federal Standard 595. The yellow pigment must be of an organic nature only and contain no lead chromate.

G. Skid Resistance:
The surface, with proper applied and embedded surface beads, must provide a minimum resistance value of 50 BPN when tested according to ASTM E 303.

H. Thickness:
The material must be supplied at a minimum thickness of 125 mils (3.15mm).

I. Versatility:
No glass beads must be applied on the surface of the material before application, as the material shall be able to be placed on the pavement either side up. For instance: Should an arrow, either left or right, be desired, only one arrow needs to be purchased. It is also true of combination arrows and other legends where applicable.

J. Environmental Resistance:
The material must be resistant to deterioration due to exposure to sunlight, water, oil, gasoline, salt or adverse weather conditions.

2.4. EPOXY PAVEMENT MARKING PAINT

A. Composition Requirements
The epoxy resin composition shall be specifically formulated for use as a durable pavement marking material and for hot spray application at elevated temperatures not exceeding 150˚ F. The type and amounts of epoxy resins and curing agents shall be at the option of the manufacturer, providing the other composition and physical requirements of this specification are met.

The marking material shall be a two-component (Part A and Part B), 100% solids type system formulated and designed to provide a simple volumetric mixing ratio (e.g. two volumes of Part A to one volume of Part B).

The component A of both white and yellow shall be within the following limits:

	WHITE	YELLOW
Pigments		
--Titanium Dioxide (ASTM D-476-73 Type II & III)	18-25%	--
--Chrome Yellow (ASTM D-211-67(73) Type III)	--	23-30%
Binder		
--Epoxy Resin*	75-82%	70-77%

*NOTE: Epoxy resin binder must be completely free of TMPTA (Tri-Methylol Propane Tri-Acrylate) and other multi-functional monomers.

Epoxide Number: The epoxy number of the epoxy resin shall be 0.40±0.1 as determined by ASTM D-1652 for both white and yellow Component A on a pigment free basis.

Amine Number: The amine number of the curing agent (Component B) shall not be less than 400 as per ASTM D-2074-66(76).

Toxicity: The material shall not exude fumes, which are toxic or injurious to persons or property.

B. Physical Properties of End Product

Unless otherwise noted, all samples are to be prepared and tested at an ambient temperature of 73±5°F.

1. Color and Weather Resistance:
The mixed epoxy compound, both white and yellow, when applied to 3" x 6" aluminum panels at 15±1 mil in thickness with no glass beads and exposed in a Q.U.V. Environmental Testing Chamber, as described in ASTM G-53-77, shall conform to the following minimum requirements. (*The test shall be conducted for 75 hours at 50°C., 4 hours humidity and 4 hours U.V., in alternating cycles.*

The prepared panels shall be cured at 77°F. for 72 hours prior to exposure.) The color of the white epoxy system shall not be darker that Federal Standard No. 595A-17778. The color of the yellow epoxy system shall be reasonably close to Federal Standard No. 595A-13538.

2. Directional Reflectance

The white epoxy composition (without glass spheres) shall have a daylight directional reflectance of not less than 84% relative to a magnesium oxide standard when tested in accordance with ASTM E-97.

The yellow composition (without glass spheres) shall have a daylight directional reflectance of not less than 55% relative to a magnesium oxide standard when tested in accordance with ASTM E-97.

3. Drying Time (Field)

The material used shall be Type II – slow dry material Mark 55 as manufactured by Polycarb, Inc. or LS 60 as manufactured by Epoplex. The Contractor may provide equivalent materials from other manufacturers only if the material has been approved in writing by the Engineer. It shall be in a "no tracking" condition in 45 minutes or less. "No tracking" condition shall be determined by actual application on the pavement of the pigmented binder at 20 mils wet, covered with glass beads at the rate of 30 pounds per gallon. No visual deposition of the epoxy marking to the pavement surface shall be visible from a distance of 50 feet after a vehicle's tires have passed over the line.

4. Abrasion Resistance

The wear index of the epoxy composition shall not exceed 82 mg when tested in accordance with ASTM C501 using a CS-17 wheel and under a load of 1000 grams for 1000 cycles.

5. Hardness

The epoxy composition when tested in accordance with ASTM D2240 shall have a Shore D hardness of between 75 and 100. Samples shall be allowed to cure for not less than 72 hours nor more than 96 hours prior to testing.

6. Adhesion to Concrete

The catalyzed epoxy pavement marking materials, when tested according to ACI Method 503, shall have such a high degree of adhesion to the specified (4,000 psi minimum) concrete surface that there shall be a 100% concrete failure in the performance of this test. The prepared specimens shall be conditioned at room temperature (75±2°F.) for a minimum of 24 hours and a maximum of 72 hours prior to the performance of the tests indicated.

7. Adhesion to Asphalt

100 % failure in asphalt	ACI-503

C. Reflective Media

All Epoxy markings shall use a Glass bead that meets the following requirements: All beads shall be coated. The Drop-On glass beads shall be a double drop system comprised of:

1. Particle-1, a conglomerate bead visible in wet night conditions, pigmented to match the binder and initial color shall fall within the color box coordinates below:

WHITE

X	.355	.305	.285	.335
Y	.355	.305	.325	.375

YELLOW

X	.475	.490	.495	.520
Y	.450	.433	.475	.450

Crush Strength – The crush strength of the glass or ceramic bead system is important for the long life of the marking, the beads and elements shall resist crushing to 30,000 psi minimum when tested according to ASTM Method D 1213-54.

2. Particle-2, AASHTO M247 Type 1 bead or as approved by the Engineer and binder manufacturer.

3. Drop-On Reflective Bead System:
The high reflective bead system and AASHTO M-247 TYPE 1 glass spheres, as described under part A & B shall be applied in a double drop operation. Particle-1 shall be applied first from the bead dispenser directly behind the marking application gun followed immediately by the application of Particle-2 AASHTO M-247 TYPE 1 beads from a second bead dispenser. The application rates of each of the reflective media shall conform to the manufacturer of the marking and the manufacturer of the bead system suppliers and be approved by the Engineer in the field. The application rate shall be 3 lbs. per gallon for Particle-1 and 25 lbs. per gallon for Particle-2.

2.4.1. *APPLICATION EQUIPMENT*

In general, the applicating equipment shall be mobile, truck mounted and self contained pavement marking machine, specifically designed to apply epoxy materials and reflective glass spheres in continuous and skip-line patterns. The applicating equipment shall be maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. In addition, the truck-mounted unit shall be provided with accessories to allow for the marking of legends, symbols, crosswalks, and other special patterns.

The Engineer and the material manufacturer together may approve the use of a portable applicator in lieu of truck mounted accessories, for use in applying special markings only, provided such equipment can demonstrate satisfactory application of reflectorized markings in accordance with these Specifications.

The mobile applicator shall include the following features:

A. The mobile applicator shall provide individual material reservoirs, or space, for the storage of Part A and Part B of the resin composition.

B. The applicator shall be equipped with heating equipment of sufficient capacity to maintain the individual resin components at the manufacturer's recommended temperature for spray application.

C. The applicator shall be equipped with glass bead dispensing equipment and capable of applying the spheres at the rate of 3 lbs. per gallon for particle-1, and 25 lbs. per gallon for particle-2 of epoxy resin composition.

D. The applicator shall be equipped with metering devices or pressure gauges on the proportioning pumps, as well as stroke counters to monitor gallon usage. Metering devices or pressure gauge and stroke counters shall be visible to the Engineer.

E. The applicator shall be equipped with all the necessary spray equipment, mixers, compressors, and other appurtenances to allow for the placement of reflectorized pavement markings in a simultaneous sequence of operations.

F. The application equipment must have a minimum of a 24" long static mixer unit as manufacture by Kenics Company or equal for proper mixing of the two components, or other mixing apparatus equivalent in performance and certified by the epoxy manufacturer.

G. The mobile applicator must be equipped with a completely enclosed flush and purge system to clean the lines and the guns without exuding any solvents into the environment.

2.4.2 EPOXY PAINT MARKING MONITORING SYSTEM

This specification adds a computerized Data Logging System (DLS) for monitoring the application of striping to the roadway. DLS is an addition to striping equipment to record data relating to pavement marking installation.

A. **CONSTRUCTION REQUIREMENTS**

All striping operations shall be completed in accordance to the latest version of the City of Fargo Specifications. The system shall document for a minimum length of 300 linear foot intervals for the entire striping project. The following data shall be included in the documentation from the DLS:

1. Application vehicle speed to nearest 0.1 MPH,

2. Weight (LBS) and/or volume (GAL as measured through a piston displacement pump mechanism) amount of paint material used by color,

3. Weight (LBS) of reflective material used, excluding wet reflective elements.

4. Pavement surface temperature (°F),

5. Air temperature (°F),

6. Dew point (°F),

7. Humidity (%),

8. The system shall record the average material application rates and film thickness calculated over the section painted.

9. For every roadway striped, the street or avenue with beginning and ending reference of the intersecting street or avenue and all information listed above.

An electronic or printed record of the data shall be provided to the Engineer, daily or at the end of each project area. The Engineer may determine that more frequent submission is necessary, particularly if equipment malfunctions occur. Either the printed or electronic records shall be produced in their final form prior to the records being removed from the striping equipment (i.e. the Contractor presents this it to the Engineer, in the field). If only one record is produced at the striping equipment, the other may be produced in an office. However, the first record shall be presented to the Engineer prior to any of the data entering an office environment. The electronic record shall be a comma or spaces delimited text file, adequate for insertion into a computerized spreadsheet software package or a spreadsheet format acceptable to the Engineer.

The Contractor shall provide the Engineer the above records for all longitudinal non-handwork lines painted.

The Contractor shall have equipment with functional DLS equipment. It shall be operational, calibrated and in use during striping operations.

The Contractor shall provide the Engineer the DLS manufacturer's recommendations for equipment calibration frequency and provide certification that the equipment meets manufacturer's recommended calibration.

A 100 foot distance shall be traveled prior to the start of striping operations to verify the physical and electronic measurement of distance traveled is consistent.

B. **METHOD OF MEASUREMENT**

DLS will not be measured. Pavement Markings will be measured by the linear foot of the various widths of the installed line, complete, in place, and accepted. Only marked portions of broken lines will be measured.

C. **BASIS OF PAYMENT**

All manufacturer representation, labor, equipment, reports, documentation, DLS, and materials necessary to furnish and install the pavement marking shall be included in the price bid for "Paint ____inch Epoxy" LF

At any time throughout the duration of the project, the Contractor shall provide free access to his applicating equipment for inspection by the Engineer, his authorized representative, or the materials representative.

2.5. DURABLE METHACRYLATE ROAD MARKINGS

A. GENERAL

All Durable Methacrylate Markings shall be grooved in the pavement. Groove depth shall be 120 mils in depth with a light sand blast applied after grooving to rough up the surface. Material thickness shall be 120 mils thick and fill the entire groove. Glass beads shall be applied at a minimum of 35 PSI to the marking as per "Glass Beads" specification using a sand blasting machine.

1. Work included

   a. Work described in this section includes surface preparation and permanent installation of methacrylate road markings ("Markings") on asphalt or concrete pavements.

   b. Markings shall be installed within the limits of the project as shown on the plan drawings or as directed by the Engineer in the field.

2. System Description

   a. Marking shall be plural-component, liquid-applied methacrylate material capable of full cure without external heat sources. Binder resins shall be 100% reactive, solvent-free and highly elastic to accommodate various pavement conditions. Configurations may include extruded high-build markings or if approved by the Engineer in the field spray-applied thin-mil markings.

   b. Markings shall be applied on properly prepared pavements or over properly prepared existing methacrylate materials.

   c. Methacrylate spray markings may be used as (a) an underlayment to produce a contrast for concrete pavements-e.g. white markings on black underlayment – or (b) a renewal coat for worn or damaged Markings.

3. Quality Assurance

   a. Supplier Qualifications

      1. Binder- Acceptable binder resins shall be supplied by companies with a minimum of 10 years of commercial experience in the production, sales and technical support of methacrylate reactive resins serving the road marking industry. Companies shall be certified to ISO9001 and ISO14001.

      2. Marking – Acceptable markings shall be supplied by companies ("Manufacturer") with a minimum of 10 years of commercial experience in the production, sales and technical support of road marking materials. Manufacturers shall be certified by the supplier of binder resins.

         a. Under no circumstances shall the manufacturer be allowed to alter the formulation of previously submitted and approved materials. Any changes shall result in forfeiture of eligibility and require re-submittal for approval.

         b. Requests for substitution shall be considered only for products that appear on the qualified products list and only if submitted within 10 days after the execution of the contract. No request for substitution shall be considered that would change the generic type of Marking specified.

   b. Contractor/Sub Contractor Qualifications

      1. Each Contractor or Sub-Contractor responsible for the work on this project shall be pre-qualified and certified by the Manufacturer at the time of installation. Acceptability shall include judgment on equipment capabilities, application history and financial stability. Only those Contractors certified by the Manufacturer shall be allowed to apply Markings. In no case shall the Manufacturer permit the installation of Markings by untrained, non-certified Contractors.

      2. Each certified Contractor shall have been trained by the Manufacturer in phases of surface preparation and installation of specified Markings.

      3. Contractors shall provide only plural-component equipment certified by the manufacturer and designed specifically for the purpose of applying Markings to a uniform nominal width and thickness on the pavement. Hand units shall be allowed with the approval of the project Engineer. Automatic equipment shall be capable of installing a double center line or single edge line in one pass. Automatic bead applicators shall be required for all applications.

4. Reference Standards

   a. ASTM D2240 - Test Method for Rubber Property - Durometer Hardness

   b. ASTM D4541 - Method for Pull-Off Strength of Coatings using Portable Adhesion Testers

   c. ASTM E303 – Test Method for Measuring Surface Frictional Properties Using the British Pendulum Tester

   d. ASTM E1710 – Test Method for Measurement of Retro reflective Marking Materials with CEN-Prescribed Geometry Using Portable Retro Reflectometer.

   e. 40 CFR 59 Subpart D Appendix A – Determination of Volatile Matter Content of Methacrylate Multicomponent Coatings Used as Traffic Marking Coatings.

   f. FHWA "Manual on Uniform Traffic Control Devices"(MUTCD)

5. Submittals

   a. An acceptance sample of the Marking applied to aluminum or similar backing for rigidity and ease of handling.

   b. Manufacturer's literature and MSDS for each product to be used.

   c. Contractor certification by the Manufacturer.

   d. Manufacturer certification by the binder resin supplier.

   e. ISO certification for the binder resin supplier.

6. Delivery, Storage and Handling

   a. All materials shall be in the Manufacturer's sealed containers with all pertinent labels intact and legible.

   b. Materials shall be kept in dry protected areas between 40 degrees to 80 degrees Fahrenheit, out of direct sunlight, protected from open flame and with all containers grounded. Hardener component shall be stored separately from other materials.

   c. Manufacturer's specific label instructions and prudent safety practices for storage and handling shall be followed at all times.

d. The Markings shall be suitable for use for six months after the date of receipt when stored in accordance with the Manufacturer's instructions.

7. Project and Site Conditions

a. Air temperatures shall be in the range of 35 degrees to 75 degrees Fahrenheit during installation and cure. Application temperatures outside this range require the agreement of the project Engineer, and must be in accordance with the Manufacturers recommendations and may only be made with Markings on the qualified products list.

b. Relative humidity in the specific location of the installation shall be less than 85% and the surface temperature shall be at least 5 degrees Fahrenheit above the dew point.

c. The pavement shall be dry and rain-free 24 hours prior to installation.

d. Asphalt pavements shall be dry, clean and free of contaminants such as surface oils. Newly placed asphalt pavements shall be allowed to age a minimum of 14 days prior to application of Markings.

e. Concrete must be fully cured for a minimum of 28 days prior to installation of Markings. Surface contaminants such as curing agents, membranes, bond breakers or laitance shall not be allowed. Moisture content shall not exceed 0.5%.

f. Any presence of existing markings are also deemed contaminants and shall not be allowed. Placement of Markings over existing methacrylates shall be allowed with the approval of the project Engineer. Existing Methacrylate marking must be sand blasted or surface prepped and blown clean before the placement of methacrylate will be allowed.

B. PRODUCTS

1. Binders-100% methacrylate reactive resin. Blends with other resins or liquid vehicles shall not be permitted.

2. Markings

a. Extruded Methacrylate Marking – Plural-component methacrylate compound applied using walk-behind stripers, masking off area and pouring the material in the groove and spreading the material out with a metal concrete rake or automatic extrusion equipment. Markings shall contain intermix beads. Where raised profiles are required, profile shape, height and interval shall be in accordance with the plan drawings.

b. Spray Methacrylate Marking – Plural-component methacrylate compound applied using automatic spray equipment. Markings do not require intermix beads. When required, spray Markings shall also serve as an underlayment. Spray markings must get approval by the Engineer in the field prior to being used.

3. Markings – Plural-component, liquid applied methacrylate material installed using equipment capable of producing an agglomerate pattern. Markings shall contain intermix beads.

4. Auxiliaries – The following products shall be provided by the Manufacturer and used in accordance with the Manufacturer's recommendations.

a. Primer – Plural-component, 100% reactive methacrylate resin.

b. Hardener – 50% dibenzoyl peroxide powder or 40% liquid dispersion.

c. Glass Beads

1. Appearance – Beads shall transparent, clean, dry, free-flowing, free from air inclusions and foreign matter including carbon residues.

2. Size – Bead size shall be in accordance with the Manufacturer's recommendation.

3. Manufacture – Beads shall be produced as a result of directly spherodizing glass from a molten glass tank. Any component of the batch process utilizing recycled glass shall be sourced from North American waste streams.

4. Coating – Methacrylate compatible silane coupling agent. Other silanes, moisture-proof or flotation coatings shall not be permitted.

5. Refractive index – Beads shall have a refractive index of 1.5 or higher as required to meet the minimum retro reflectivity levels for the prescribed period.

Particle-1, a conglomerate bead visible in wet night conditions, pigmented to match the binder and initial color shall fall within the color box coordinates below:

WHITE

X	.355	.305	.285	.335
Y	.355	.305	.325	.375

YELLOW

X	.475	.490	.495	.520
Y	.450	.433	.475	.450

6. Crush Strength – The crush strength of the glass or ceramic bead system is important for the long life of the marking, the beads and elements shall resist crushing to 30,000 psi minimum when tested according to ASTM Method D 1213-54.

7. Particle-2, AASHTO M247 Type 1 bead or as approved by the Engineer and binder manufacturer.

8. The application rate shall be .066 lbs. per 100 square feet for Particle-1 and 6 lbs. per 100 square feet for Particle-2.

5. Marking Performance Criteria

Property	Value
Extrude marking Thickness	Minimum 60 to a maximum of 120 mils as specified
Profile Height	Maximum 120 mils as specified
Spray Marking Thickness	Minimum 60 to maximum of 120 mils as specified
Tolerance	-0/+10 mils extrude, -0/+10 mils spray
Cure Time	Tack-free within 10-45 minutes depending on temperature
VOC Emissions	Less than 150 g/l
Adhesion	Minimum 250 psi or pavement failure
Shore Hardness	Minimum 50D after 24 hours
Bead Application Rate	As per specification
Dry Retro reflectivity	Initial* minimum 300 mcd/lx/m2 white Initial* minimum 200 mcd/lx/m2 yellow
Skid Resistance	Initial* minimum 45
Chemical Resistance	Cured markings shall be resistant to calcium, chloride, sodium chloride, fuels, oils and UV effects

* Defined as 3-14 days after placement

PART 3
CONSTRUCTION

3.1. *INSTALLATION OF EACH MATERIAL TYPE*

A. PAINT

At the time of applying the marking material, the application area shall be free of all contamination, including oil, dirt, grease, curing compound and other matter that might adversely affect adhesion or durability of the marking material.

The Contractor's equipment shall be capable of cleaning the pavement surface of loose dirt, sand, gravel, etc. by the application of compressed air immediately ahead of the marking application. Areas with heavy accumulation of contaminants, which cannot be removed with compressed air, shall not be painted until the pavement surface has been cleaned and shall be painted within 1 hour of the cleaning operation. The Engineer will determine which pavement surfaces are too contaminated for painting.

The paint marking application shall immediately follow the pavement cleaning. Glass beads shall be applied within 3 seconds after application of the painted line.

B. PLASTIC PAVEMENT MARKING FILM.

1. The work shall generally consist of planing the concrete or asphalt surface and subsequent application of pavement marking tape into the planed area.

2. The groove shall be made in a single pass dry cut using stacked diamond cutting heads mounted on a floating head with controls capable of providing uniform depth and alignment. The equipment shall be self-vacuuming, be capable of vacuuming and containing all dust contaminates from entering the air, and leave the cut groove ready for pavement marking installation. If the Engineer in the field deems that the Contractor's dust collection is not adequate then the Engineer may shut down the Contractor's operation until the Contractor has fixed the problem according the satisfaction of the Engineer. The equipment and method used shall be approved by the pavement marking manufacturer. The bottom of the groove shall have a fine corduroy finish. If a course tooth pattern is present, increase the number of blades and decrease the thickness of the spacers on the cutting head. The pavement marking shall be placed in the grooves the same day as the cut. Grooves shall be clean and dry prior to pavement marking application.

Cutting head: Gang stacked 1/8 to ½ inch wide diamond tipped cutting blades.

The spacers between each blade must be such that there is less than a 10-mil raise in the finished groove between the blades.

Groove width: Tape width + ½ inch (+/- 1/8 inch).
Groove depth: 120 mils
Groove length: Full length of marking + 3 inch grooving transition on either end.
Groove position: Minimum of 2 inches from the edge of the longitudinal seam.
Finished surface: The bottom of the groove should have a fine corduroy surface. If a course tooth pattern is present, increase the number of blades and decrease the thickness of the spacers used on the cutting head.
Groove cleaning: Grooves must be cleaned by using high-pressure compressed air with a 185 cfm air compressor or greater at a pressure of at least 80 psi. A leaf blower will NOT be an acceptable substitute for compressed air.

3. If the tape installation does not immediately follow dry pavement grooving, the following shall apply; within 24 hours prior to placing the primer and tape, the groove shall be sandblasted and free of any residue and laitance. If the primer and tape are not placed within 24 hours of sandblasting, the groove shall be re-sandblasted.

   The primer and tape shall be installed in accordance with the manufacturer's recommendations.

4. Existing Tape And Epoxy

   Any existing tape or epoxy that is to be replaced by new tape shall be removed, by the Contractor, before grooving or laying new tape in the groove. No additional compensation shall be given for doing this and it shall be incidental to the price bid for "Grooved Plastic Marking Film".

C. PREFORMED THERMOPLASTIC

1. The work shall generally consist of planing the concrete or asphalt surface and subsequent application of preformed thermoplastic into the planed area.

2. The groove shall be made in a single pass dry cut using stacked diamond cutting heads mounted on a floating head with controls capable of providing uniform depth and alignment. The equipment shall be self-vacuuming, be capable of vacuuming and containing all dust contaminates from entering the air, and leave the cut groove ready for pavement marking installation. If the Engineer in the field deems that the Contractor's dust collection is not adequate then the Engineer may shut down the Contractor's operation until the Contractor has fixed the problem according the satisfaction of the Engineer. The equipment and method used shall be approved by the pavement marking manufacturer. The bottom of the groove shall have a fine corduroy finish. If a course tooth pattern is present, increase the number of blades and decrease the thickness of the spacers on the cutting head. The pavement marking

shall be placed in the grooves the same day as the cut. Grooves shall be clean and dry prior to pavement marking application.

Cutting head:	Gang stacked 1/8 to ½ inch wide diamond tipped cutting blades. The spacers between each blade must be such that there is less than a 10-mil raise in the finished groove between the blades.
Groove width:	Thermoplastic width + ½ inch (+/- 1/8 inch).
Groove depth:	75% of tape thickness (+/- 15%). Example: (Thermoplastic that is 125 mils thick): 95 mils (+/- 15% of 95 mils).
Groove length:	Full length of marking + 3 inch grooving transition on either end.
Groove position:	Minimum of 2 inches from the edge of the longitudinal seam.
Finished surface:	The bottom of the groove should have a fine corduroy surface. If a course tooth pattern is present, increase the number of blades and decrease the thickness of the spacers used on the cutting head.
Groove cleaning:	Grooves must be cleaned by using high pressure compressed air with a 185 cfm air compressor or greater at a pressure of at least 80 psi. A leaf blower will NOT be an acceptable substitute for compressed air.

3. If the thermoplastic installation does not immediately follow dry pavement grooving, the following shall apply. Within 24 hours prior to placing the thermoplastic, the groove shall be sandblasted and free of any residue and laitance. If the thermoplastic is not placed within 24 hours of sandblasting, the groove shall be re-sandblasted.

4. The primer and thermoplastic shall be installed in accordance with the manufacturer's recommendations.

D. EPOXY

1. The pavement surface shall be surface planed. All long line preparation shall be accomplished with self propelled equipment capable of following a straight longitudinal line.

2. Planed width shall be Epoxy width +2" on all sides. Preparation method must be approved by the Engineer before the surface can be planed, ensuring no damage is done to pavement. No carbide or diamond tip blades or wheels are allowed.

3. At the time of applying the marking material, the application area shall be free of all contamination, including oil, dirt, grease, curing compound and other matter that might adversely affect adhesion or durability of the marking material.

4. The Contractor's equipment shall be capable of cleaning the pavement surface of loose dirt, sand, gravel, etc. by the application of compressed air immediately ahead of the marking application.

5. The paint marking application shall immediately follow the pavement cleaning.

6. Epoxy Pavement Surface Preparation

   The pavement shall be planed or sandblasted and shall be the width of the epoxy marking +2" on all sides. All asphalt pavements with an existing seal coat/chip seal must be surfaced prepped by means of sandblasting. Preparation method must be approved by the Engineer before the surface can be planed, ensuring that no damage shall be done to the pavement. No carbide or diamond tip blades or wheels are allowed on surface preparation equipment. No surface preparation will be required on new asphalt that is less than 21 days old, unless the asphalt pavement is contaminated with dirt, oil, or any other surface contaminate. Asphalt pavements that are clean of contaminates and less than 21 days old will only be required to be cleaned with compressed air of at least 100psi.

7. Installation Of Epoxy Markings On Newly Placed Asphalt Pavements

   Asphalt pavements shall be dry, clean and free of contaminants. Newly placed asphalt pavements shall be allowed to age a minimum of 10 days prior to application of epoxy marking. Contractor shall be responsible for installing reflective temporary raised pavement markers before the roadway is opened to traffic. Raised markers shall be maintained by the Contractor until the epoxy marking is installed and then shall be removed by the Contractor after the epoxy marking is installed. This shall be incidental to the price bid for Epoxy. Reflective temporary raised pavement marker shall have 1 marker per skip, 1 marker per 20' on all solid longitudinal lane lines, and 1 marker per 100' on all solid white edge lines.

8. Chip Seal Epoxy Striping Installation

   A. Before the chip seal is installed remove all existing markings that will not be masked by grooving out the existing marking with a groove that is 100 mils in depth.
   B. Before the chip seal is installed, install a groove 100 mils in depth where new markings are to be placed.
   C. Where an existing marking is to be removed but will not be replaced by another marking, the Contractor shall follow the "Obliterate Pavement Marking" specification.
   D. Contractor is responsible for cleanup of all old marking materials that are left on the roadway.
   E. Install reflective temporary raised pavement markers immediately after the existing marking is removed and before the roadway is opened up to traffic.

1. Raised pavement markers shall be maintained by the Contractor until the epoxy marking is installed.
2. Temporary raised pavement markers shall be incidental to the price bid for epoxy.
3. Install 1 marker at the beginning of each skip.
4. Install 1 marker at the beginning and at the end on all solid longitudinal lane lines and every 20' in between.
5. Install 1 marker at the beginning and at the end on all solid white edge lines and every 100' in between.
6. Install 1 marker at the beginning of all striping tapers
7. Install 1 marker at the beginning and end of all gore and cross hatched areas.

F. Epoxy material application shall be 50 mils thick and shall be installed in the entire groove as per marking width.

G. Epoxy markings shall not be installed within 7 days of the chip seal application or before the roadway has been sweep from excess loose chip seal aggregate.

H. All costs associated with the above work shall be incidental to the price bid for "Paint ____inch Epoxy" LF.

E. DURABLE METHACRYLATE MARKING

1. EXECUTION

a. Pre-Work Inspection

1. The Contractor shall examine the pavement to receive the Markings and report to the project Engineer any conditions that will adversely affect performance.

2. The installation shall proceed only with authorization from the project Engineer.

b. Preparation

1. Asphalt and concrete pavements shall be cleaned by surface grinding/scarifiers, and then blowing off the surface prepped area with high-pressure compressed air with 185 cfm air compressor at a pressure of at least 80 psi.

2. Pavements with existing non-methacrylate markings shall remove the entire marking and shall prepare the pavement according to 3.2.1.

3. Pavements with existing methacrylate markings shall be cleaned by sandblasting or scarifying the entire surface of the marking and then blowing off the surface prepped area with high-pressure compressed air with 185 cfm air compressor at a pressure of at least 80 psi.

4. Application of Markings must be completed before water or other contamination of the pavement occurs. Upon the onset of rain, installation shall cease until the pavement is dry for 24 hours or to the satisfaction of the project Engineer.

5. Grooved-methacrylate shall have a groove depth prepared according to the plans as directed by the project Engineer in accordance with the Manufacturer's recommendation. The groove shall be prepared to the depth specified by the plans and according the City of Fargo Standard Specification for Construction of Public Utilities along with any special instructions in the plans. After grooving, the surface must be ruffed up producing a rigid surface with a sand blaster. The surface shall be blown clean with high-pressure compressed air with 185 cfm air compressor at a pressure of at least 80 psi. The groove shall be made in a single pass dry cut using stacked diamond cutting heads mounted on a floating head with controls capable of providing uniform depth and alignment. The equipment shall be self-vacuuming, be capable of vacuuming and containing all dust contaminates from entering the air, and leave the cut groove ready for pavement marking installation. If the Engineer in the field deems that the Contractor's dust collection is not adequate then the Engineer may shut down the Contractor's operation until the Contractor has fixed the problem according the satisfaction of the Engineer. The equipment and method used shall be approved by the pavement marking manufacturer. The bottom of the groove shall have a fine corduroy finish. If a course tooth pattern is present, increase the number of blades and decrease the thickness of the spacers on the cutting head. The pavement marking shall be placed in the grooves the same day as the cut. Grooves shall be clean and dry prior to pavement marking application.

c. Field Quality Control and Inspection

1. Contractor shall request acceptance of surface preparation and groove from the project Engineer prior to application of Markings.

2. If required by the Engineer in the field or manufacturer due to failure of bond without any visual evidence, Bond tests shall be conducted by an independent testing company and paid for by the City of Fargo to judge the suitability of new concrete pavements. Markings shall be applied, allowed to cure, and tested for adhesion in accordance with ASTM D4541. Bond strengths of less than 250 psi without pavements failure shall result in the use of a primer prior to application of the Marking. Primers shall not be required on asphalt pavements.

3. When a primer or underlayment is specified, the Contractor shall request acceptance from the project Engineer before application of Markings.

4. Glass beads shall be applied at the rate specified in section 2.4 to allow for proper embedment and retro reflectivity.

5. Markings shall be unacceptable if:

   a. Groove is not grooved to the specified depth.

   b. Groove is not filled to the specified depth.

   c. Profiles are missing or incorrectly shaped.

   d. Not straight or wide enough.

   e. Thickness is not uniform or less than specified.

   f. Edges are not clear-cut and free from overspray.

   g. Uncured or poorly adhered.

   h. Material darkens or is inconsistent in color.

   i. Glass bead dressings are not properly embedded.

   j. Retro reflectivity is less than specified.

   k. Color is not as specified.

   l. Any of the Specifications for Durable Methacrylate Road Markings are not followed.

6. All work not acceptable to the project Engineer shall be corrected before consideration of final acceptance.

7. A Manufacturer's representative may be requested by the project Engineer for assistance during the commencement phase of the project. The representative shall confer with the Contractor and project Engineer to ensure that Markings are being installed in accordance with recommended procedures. The project Engineer shall have full authority to shut down the project if instructions by the Manufacturer's representative or the City of Fargo Specifications are not followed by the Contractor.

d. Installation Schedule

1. Markings shall be installed following the Manufacturer's recommendations in accordance with the project plan. Marking thickness, height, width, pattern, skip length and interval shall meet the requirements of the project Engineer.

2. For unmarked pavements, a guideline shall be marked for each line prior to installation of the Marking and with the full approval of the project Engineer.

3. A test Marking shall be applied by the Contractor prior to the start of installation. This process shall be performed on roofing felt or other approved material to demonstrate the process to the acceptance of the project Engineer. Test shall be repeated until the project Engineer is satisfied to allow the project to begin. Test sample shall be allowed to cure and harden.

e. Public Safety

1. The Contractor shall provide for the safety of the public, and shall have traffic control measures in place according to the City of Fargo Standard Specification for Construction of Public Utilities, along with the MUTCD and any other specifications in the plans.

2. Fire extinguishers and related equipment as recommended by the Manufacturer and deemed necessary by the project Engineer shall be on-site at all times during the application of the Markings.

3. All Markings shall be fully cured prior to opening the area to traffic. Until cured, markings shall be protected by traffic control devices.

4. Work areas shall not be opened to traffic until fully marked and safe for driving.

f. Cleaning, Waste Disposal

1. All waste materials including surface preparation debris and Markings shall be removed from the site by the Contractor and disposed of in accordance with Federal, State and local requirements.

3.2. REMOVAL METHODS FOR EXISTING MARKINGS

A. OBLITERATE PAVEMENT MARKINGS

This bid item shall be used for the removal of existing markings in areas where the marking that is being removed will not be replaced with a new marking. Method of removal must be approved by the Engineer before any removal can be done. No carbide or diamond tip blades or wheels are allowed on removal equipment. All removal methods shall be demonstrated by the Contractor and approved by the Engineer in the field before removal is allowed.

B. ASPHALT OVERLAY STRIPING REMOVAL

All existing durable methacrylate markings on any asphalt overlay projects that will not have the surface milled prior to installation of the overlay shall remove all existing methacrylate markings on the roadway. This shall be incidental to the price bid for installing the epoxy and durable methacrylate markings.

C. EXISTING TAPE AND EPOXY

Any existing tape or epoxy that is to be replaced by new tape shall be removed, by the Contractor, before grooving or laying new tape in the groove. No additional compensation shall be given for doing this and it shall be incidental to the price bid for "Grooved Plastic Marking Film".

D. TAPE REPLACED BY EPOXY

Any existing tape that is to be replaced by epoxy shall be removed, by the Contractor, before installing the epoxy. No additional compensation shall be given for doing this and it shall be incidental to the price bid for installing the epoxy pavement marking.

3.3. GENERAL INSTALLATION NOTES

A. ARROWS

All arrows shall be installed 15' from the beginning of the turn lane furthest from the intersection. Turn lanes that are 75' or longer, will have 2 turn arrows in the lane. One turn arrow will be 15' from the beginning of the turn lane and the other will be at the midpoint of the turn lane. Turn lanes that are less than 75' in length shall have 1 turn arrow installed 15' from the beginning of the turn lane. If the placement of the arrow as described above would result in the arrow being installed in an unacceptable location (manhole, bad surface, etc.) then the placement of the arrow may move a few feet to an acceptable and good surface location.

B. PAVEMENT MARKING APPLICATION

All material shall be placed in a workmanlike manner, which shall result in a clearly defined line that has been adequately reflectorized with glass beads.

No work will be permitted on Saturday, Sunday or holidays unless the Contractor has given two working days notice, and it has been approved by the Engineer. At all locations the work may be suspended by direction of the Engineer in the field during peak traffic hours 7-8:30am, 11am-1pm, and from 4-6pm, or at any time traffic is being unduly hampered or delayed by the work in progress.

No striping operations will be permitted between sundown and sunrise without permission from the Engineer.

C. STRIPING MARKOUT

Contractor is responsible for marking out all striping that is to be installed, under the direction of the Engineer in the field.

D. PAINT

Pavement markings shall only be applied in seasonable weather when the air temperature is 50 degrees F. or higher, and a relative humidity of 85% or lower. Pavement markings shall not be applied when the wind or other conditions cause a film of dust to be deposited on the pavement surface after cleaning and before the marking material can be applied, or if in the opinion of the Engineer the pavement surface is too wet to apply markings.

The Contractor is responsible for laying out all markings in accordance with the standard drawings. All painted crosswalk lines shall be 6-inches wide. The markings shall extend the full width of the street and end at a point approximately 2-feet from the curb. All longitudinal crosswalk markings shall be 24-inches wide and spaced as shown in the standard drawing or spaced to match existing markings. All painted stop bars shall be 16-inches wide and extend from the edge of the marked centerline of the road to a point approximately 2-feet from the curb, and located as shown on the standard drawing. All painted diagonal parking lines shall be 4-inches wide white, yellow or blue, and placed in accordance with the standard drawing.

Application for the marking paint shall be such as to provide uniform film thickness throughout the coverage area. Stripe ends shall be clean cut and square, with a minimum of material beyond the cutoff.

One gallon of paint shall cover a 4-inch wide stripe for a length of 280 to 320 feet depending upon pavement surface texture. The minimum wet thickness shall be 15 mils. The paint shall not be diluted. Glass beads shall be evenly distributed over the wet paint stripe at a rate of at least 6 pounds per gallon of paint within 3 seconds of applying the paint. Beads applied to markings may be applied by hand if the application equipment is not equipped for automatic pressure dispensing. If the application rates are not within the requirements, the marking application shall be stopped until corrections are made.

E. PLASTIC PAVEMENT MARKING FILM

Pavement marking tape applied as a permanent pavement marking shall be applied according to the manufacturer's application specifications. The tape shall be butt-spliced when required to join two lengths of tape, and the tape shall be cut at both sides of the open joints or cracks in the pavement. The cut ends shall be firmly tamped in place.

Application of plastic pavement marking film, whether by contact cement or mechanical application, shall be according to the manufacturer's recommendation.

F. PREFORMED THERMOPLASTIC

Asphalt: The materials shall be applied using the propane torch method recommended by the manufacturer. The material must be able to be applied at ambient and road temperatures down to 32 degrees F. without any preheating of the pavement to a specific temperature. The pavement shall be clean, dry and free of debris. Supplier must enclose application instructions with each box/package.

Portland Concrete: The same application procedure shall be used as described above. However, a compatible primer sealer must be applied before application to assure proper adhesion.

G. EPOXY

The pavement markings shall only be applied during conditions of dry weather and on subsequently dry pavement surfaces. At the time of installation, the pavement surface temperature and the ambient temperature shall be above 50° F. The Engineer shall determine the atmospheric conditions and pavement surface conditions that produce satisfactory results.

The reflectorized pavement markings shall be placed only on property prepared surfaces and at the widths and patterns designated.

Marking operations shall not begin until applicable surface preparation work is completed and approved by the Engineer.

The pavement markings shall be applied at a minimum uniform wet thickness of 20mils.

The application rates of each of the reflective media shall conform to the manufacturer of the marking and the manufacturer of the bead system suppliers and be approved by the Engineer in the field. The application rate shall be 3 lbs. per gallon for Particle-1 and 25 lbs. per gallon for Particle-2.

Using the applicating equipment, the pavement markings shall be applied in the following manner, as a simultaneous operation:

1. The surface is air-blasted to remove dirt, residues, and if applicable, free-water.

2. The resin, mixed and heated in accordance with the manufacturer’s recommendations, is hot-sprayed onto the pavement surface.

3. The application rates of each of the reflective media shall conform to the manufacturer of the marking and the manufacturer of the bead system

suppliers and be approved by the Engineer in the field. The application rate shall be 3 lbs. per gallon for Particle-1 and 25 lbs. per gallon for Particle-2.

3.4. *TRAFFIC CONTROL*

A. GENERAL TRAFFIC CONTROL

The Contractor shall furnish and place, without extra compensation, all necessary warning and direction signs to maintain traffic and shall provide such protection to the uncured markings as may be needed until traffic can cross them without damage.

The Contractor shall provide advance warning signs in advance of the work zone when placing stop bars and crosswalk markings. The work area shall be coned to protect workers and newly painted markings. Only a portion of each intersection approach shall be painted in one operation. Adequate space shall be provided so that one lane of traffic in each direction can be maintained. All signs and cones shall remain in place until traffic can cross newly painted markings without tracking or discoloration.

The placement of diagonal parking lines will require that the Contractor place appropriate traffic control signing and barricades far enough in advance of the work to insure that cars are not parked in the work area. The Contractor will be allowed to only prohibit parking two blocks at a time for placement of diagonal parking lines.

At all locations the work may be suspended by direction of the Engineer during peak traffic hours or at any time traffic is being unduly hampered or delayed by the work in progress.

B. LONG LINE STRIPING TRAFFIC CONTROL

The Contractor shall furnish and place without extra compensation all necessary warning and direction signs to maintain traffic and shall provide such protection to the uncured markings as may be needed until traffic can cross them without damage or tracking. When necessary, a pilot car and flagmen shall be used to provide adequate control and direction of traffic. Traffic shall be allowed to keep moving at all times and the striping equipment shall be operated in a manner that will not make it necessary for traffic to cross uncured markings. Protective devices such as "cones" shall be of an approved type that will not cause damage to the vehicle when accidentally struck.

C. ALL TRAFFIC CONTROL

The Contractor shall provide the appropriate traffic control as per the MUTCD whenever any work is being performed within any City right-of-way. All necessary traffic control will be incidental to installing the pavement markings.

3.5. *ACCEPTANCE*

A. PAINT

Painted markings that are discolored, damaged by wind-blown dirt, or are ineffective at night will be rejected. Unsightly markings with uneven edge lines, over spray, poor longitudinal alignment, uneven adherence, missing portions or other objectionable faults will be rejected. The Contractor shall repair or replace all rejected markings at his expense.

Removal of unacceptable work shall be accomplished with suitable blasting or grinding equipment unless other means are authorized by the Engineer.

B. PLASTIC PAVEMENT MARKING FILM

Plastic markings that are damaged due to improper placement, placed in the wrong locations, exhibit poor adhesion when tested in accordance to the manufacturers recommendations, have visibly moved or slid due to improper use of adhesives, display poor reflectance or color shall be properly removed and replaced by the Contractor at his expense.

C. PREFORMED THERMOPLASTIC

Thermoplastic markings that are damaged due to improper placement, placed in the wrong locations, exhibit poor adhesion when tested in accordance to the manufacturers recommendations, have visibly moved or slid due to improper use of adhesives, display poor reflectance or color shall be properly removed and replaced by the Contractor at his expense.

D. EPOXY

Painted markings that are discolored, damaged by wind-blown dirt, or are ineffective at night will be rejected. Unsightly markings with uneven edge lines, over spray, poor longitudinal alignment, uneven adherence, missing portions, or other objectionable faults will be rejected. The Contractor shall repair or replace all rejected markings at his expense.

Removal of unacceptable work shall be accomplished with suitable blasting or grinding equipment unless other means are authorized by the Engineer.

E. DURABLE METHACRYLATE MARKINGS

Painted markings that are discolored, damaged by wind-blown dirt, or are ineffective at night will be rejected. Unsightly markings with uneven edge lines, over spray, poor longitudinal alignment, uneven adherence, missing portions, or other objectionable faults will be rejected. The Contractor shall repair or replace all rejected markings at his expense.

Removal of unacceptable work shall be accomplished with suitable blasting or grinding equipment unless other means are authorized by the Engineer.

PART 4
WARRANTY, MEASUREMENT & PAYMENT

4.1. *WARRANTY*

The Contractor shall be responsible for enforcing the manufacturer's warranty on markings.

4.2. *MEASUREMENT AND PAYMENT*

Only the installed portion of broken lines will be measured for payment by the linear foot.

Messages, arrows, and island tip painting will be paid by the square foot.

Obliterate Pavement will be paid for by the square foot.

Pavement Marking Masking will be paid for by the square foot.

All 4", 6", 8", 16", & 24" markings will be paid for by the linear foot.

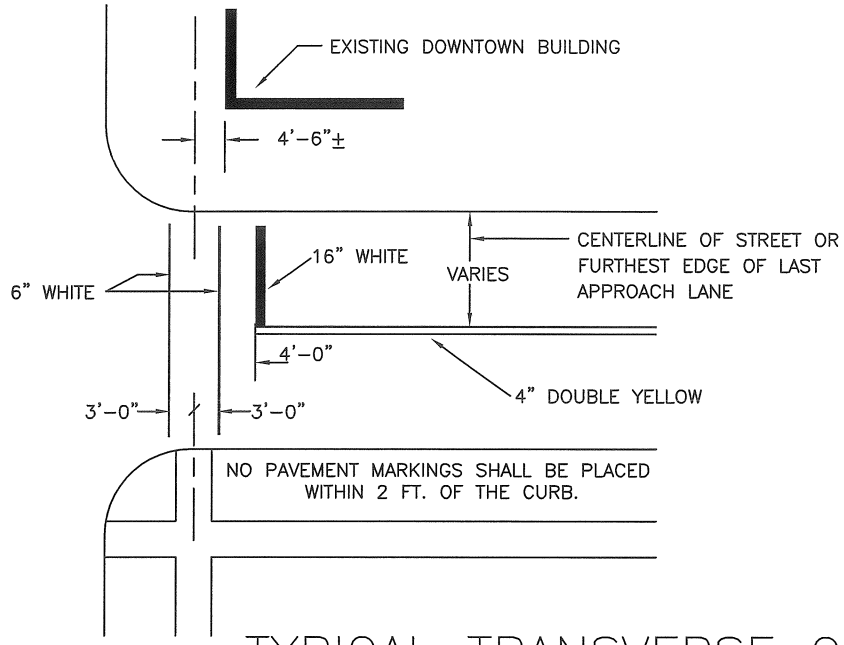
Pavement markings will be measured and paid according to the units as noted on the bid sheet.

A reduction in pay for long line striping shall be made for reduced thickness and/or width. Width shall be computed by random measuring. Thickness shall be computed by the following formula:

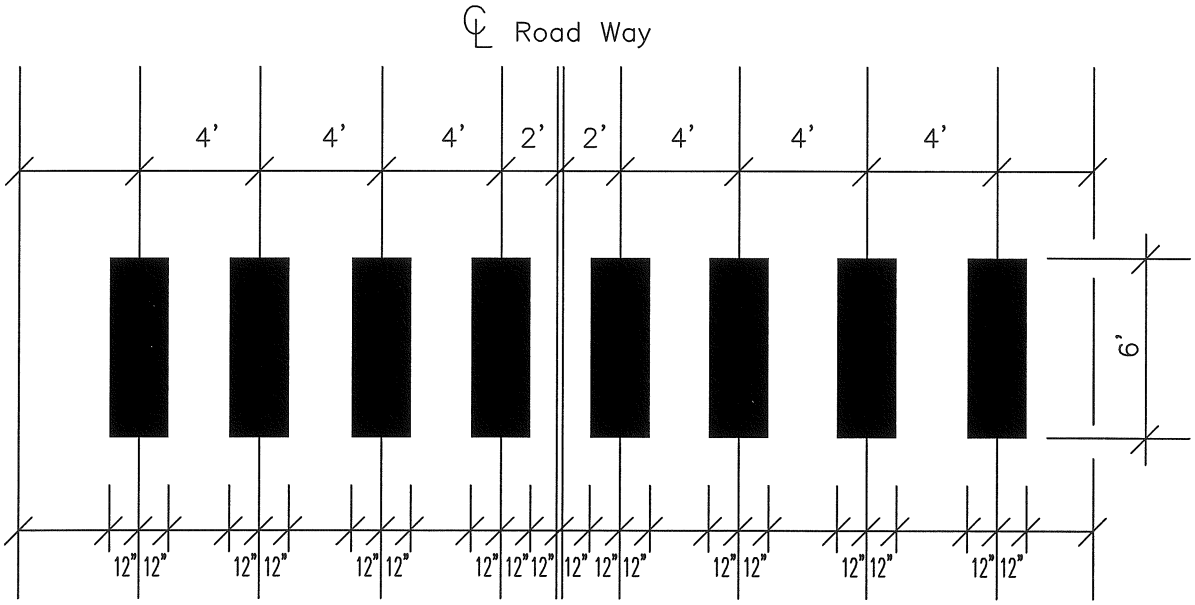
$$\text{Mils Thickness} = \frac{\text{Gallons} \times 231}{\text{Linear Length} \times \text{Striping Width}}$$

The Contractor shall provide the Engineer with the linear feet of 4-inch stripe and gallons of paint used at the end of each days striping.

Where yield computations show a deficiency in material usage of not more than 10 percent, the City may require satisfactory repair or may accept the work at a reduced unit price, which is in direct proportion of the percent of the deficiency. Where the deficiency in material usage exceeds 10 percent the City may require restriping to the satisfaction of the Engineer.



TYPICAL TRANSVERSE CROSSWALK



NOTE: Max. of 24" spacing between blocks.

TYPICAL LONGITUDINAL CROSSWALK

SECTION NO. 4000	DRAWING NO. 5.1
REV,D. 2012	
TYPICAL CROSSWALK	
CITY OF FARGO ENGINEERING DEPARTMENT	
APPROVED: BED	DATE: 2-21-2012

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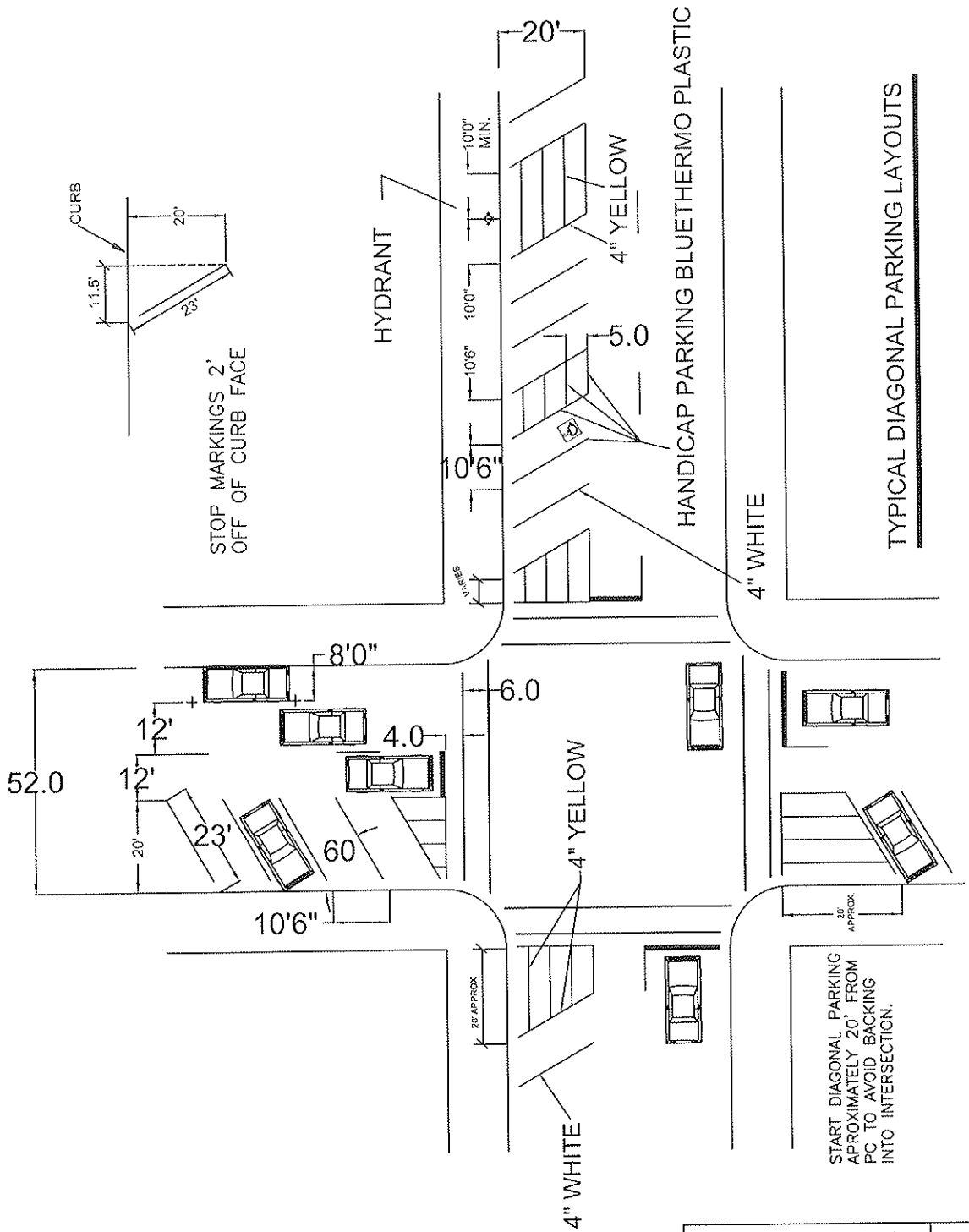

SECTION NO. 4000	DRAWING NO. 5.2
REV,D. 2013	

TYPICAL DIAGONAL PARKING

CITY OF FARGO
ENGINEERING DEPARTMENT

APPROVED JAP	DATE 1/2/2013

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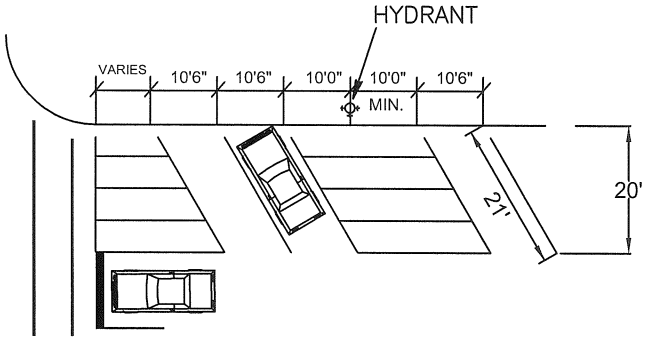
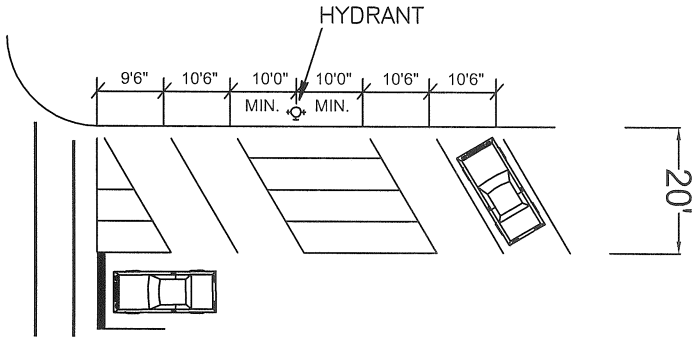


UNDER 9'6" - CROSS HATCH THE REMAINING AREA

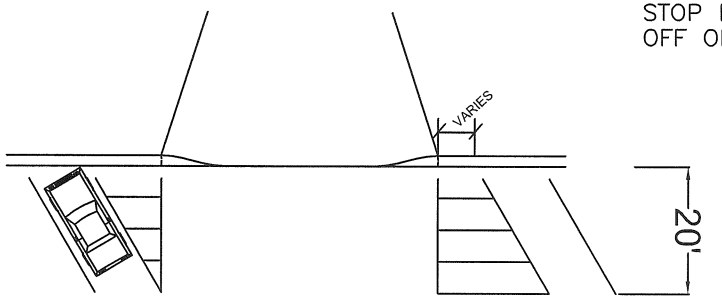
NOTES:

1) WHEN AREA FOR PARKING IS LESS THAN 10'6" MINIMUM PARKING SPACE WIDTH IS 9'6".
2) SKIPS & DBL. YELLOW SHALL START EVEN WITH THE FRONT EDGE OF THE STOP BAR.



MINIMUM 9'6" PARKING SPACE

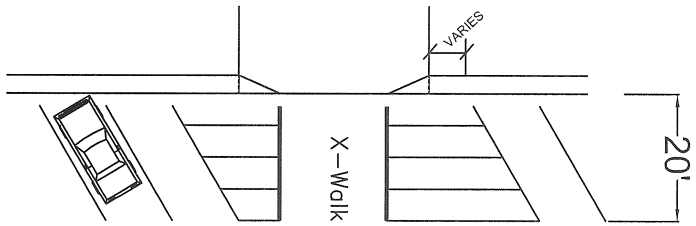
3) STOP BARS SHALL BE PLACED UP TO THE SIDE EDGE OF THE SKIP OR DBL. YELLOW.
4) ALL LAYOUTS WILL START AT THE PC OR 4 FT. FROM THE CROSS-WALK, WHICH EVER IS GREATER. WORK SHALL PROCEDE IN THE DIRECTION OF VEHICLE TRAVEL.



DRIVEWAYS OR ALLEYS

START MEASUREMENTS AT THE BEGINNING OF THE PC - NOT EVEN WITH THE DRIVEWAY

STOP MARKINGS 2' OFF OF CURB FACE



MIDBLOCK PED CROSSING

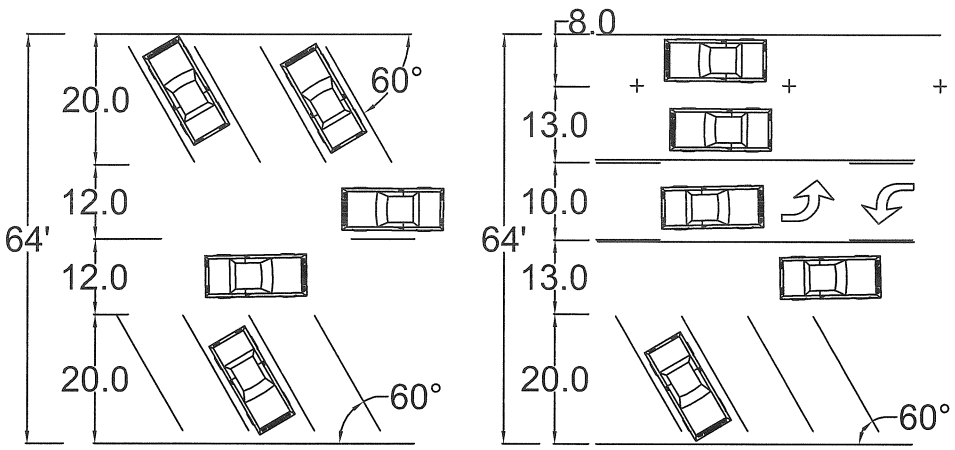
SECTION NO.	4000
DRAWING NO.	5.3
REV.D.	2012

TYPICAL DIAGONAL PARKING

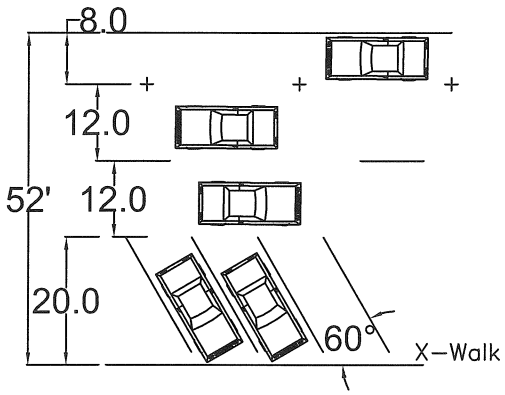
CITY OF FARGO
ENGINEERING DEPARTMENT

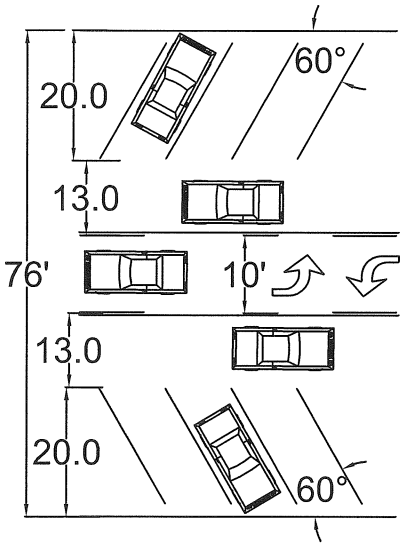
APPROVED BED
DATE 2-21-2012

MINIMUM STREET WIDTHS WITH DIAGONAL PARKING



STOP MARKINGS 2'
OFF OF CURB FACE





SECTION NO. 4000	DRAWING NO. 5.4
REV,D. 2012	

TYPICAL
DIAGONAL PARKING

CITY OF FARGO
ENGINEERING DEPARTMENT

APPROVED BEO	DATE 2-21-2012

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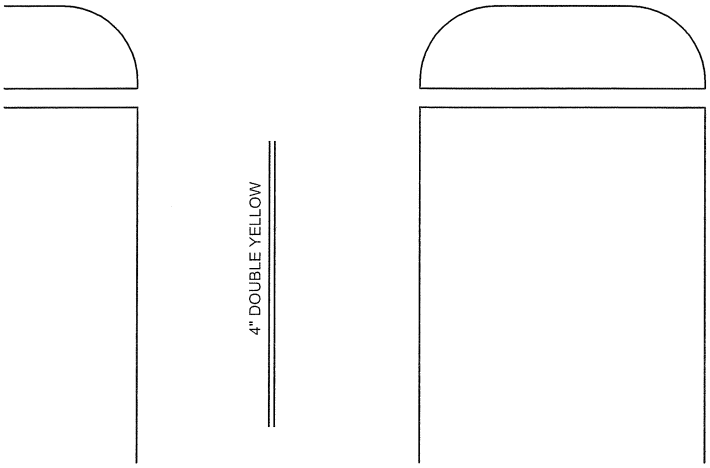
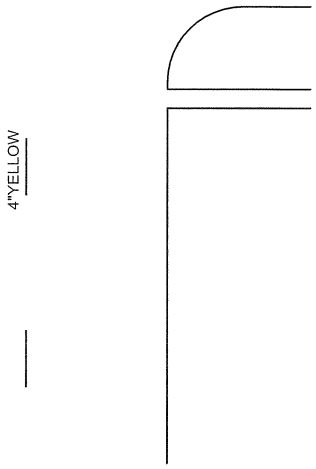
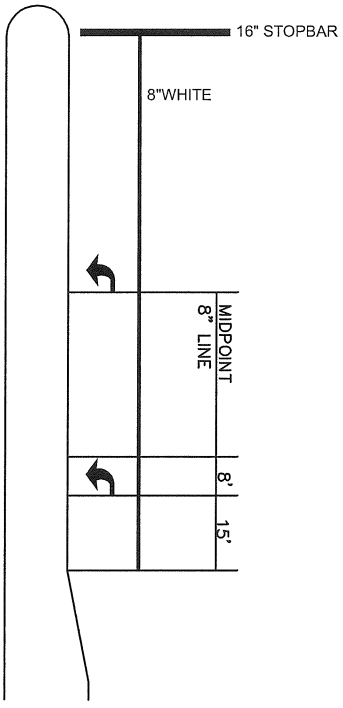


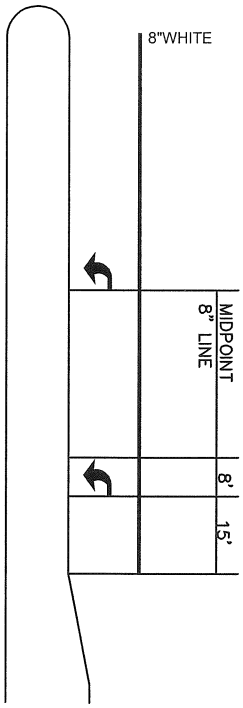
TYPICAL DOUBLE YELLOW-NO STOP BAR
STOP BEFORE CROSSWALK



TYPICAL SKIPS-NO STOP BAR
STOP BEFORE CROSSWALK



TYPICAL TURNBAY-NO CROSSWALK
WITH STOP BAR



TYPICAL TURNBAY-NO STOP BAR
STOP AT END OF ISLAND

SECTION NO. 4000	DRAWING NO. 5.5
REV,D. 2012	

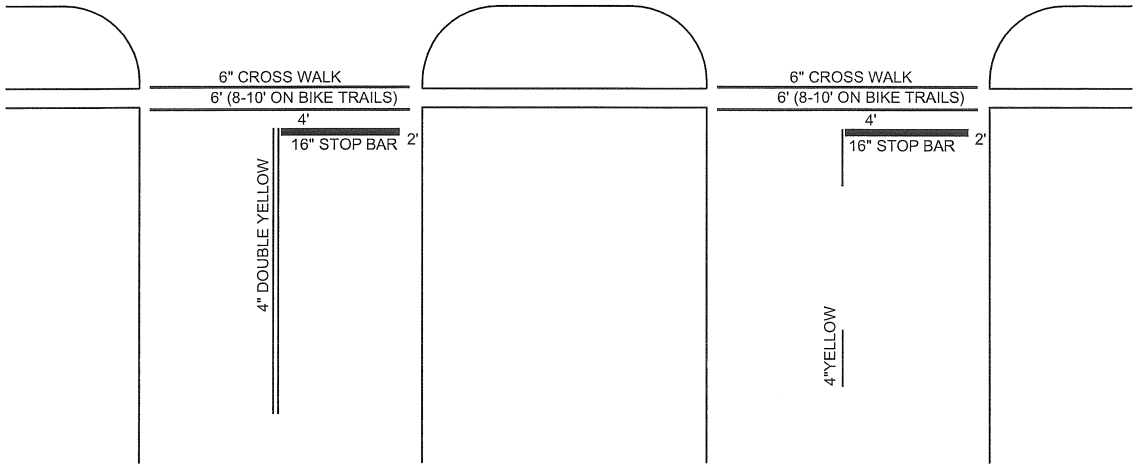
STRIPING DETAIL

CITY OF FARGO
ENGINEERING DEPARTMENT

APPROVED BED	DATE 2-21-2012

T:\Engineering\Traffic\Striping\Striping Files & Details\Standard Drawings\Stripe5_5_6.dwg

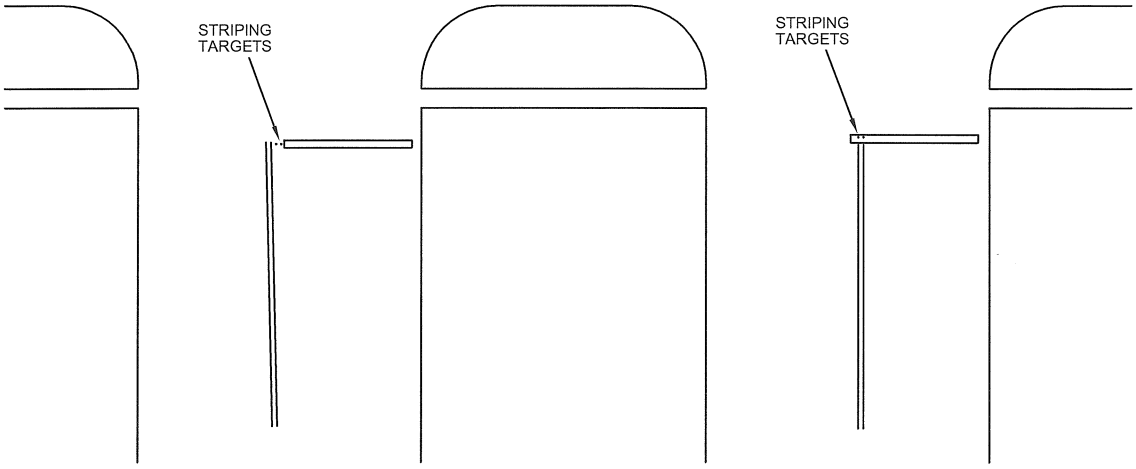
CORRECT MARKING PLACEMENT



TYPICAL DOUBLE YELLOW WITH STOP BAR

TYPICAL SKIPS WITH STOP BAR

INCORRECT MARKING PLACEMENT



TYPICAL DOUBLE YELLOW-W/STOP BAR
STOP BAR RIGHT-DOUBLE YELLOW WRONG*

*NOTE: IF LONGLINE OR STOP BAR ARE INSTALLED INCORRECTLY, THE REMAINING MARKS SHALL BE INSTALLED CORRECTLY REGARDLESS OF THE MISPLACED MARKING.

TYPICAL DOUBLE YELLOW-W/STOP BAR
DOUBLE YELLOW RIGHT-STOPBAR WRONG*

*NOTE: NEW MARKINGS SHALL NOT BE PLACED OVER EXISTING MARKINGS WHICH ARE INCORRECT, BUT SHALL BE PUT DOWN CORRECTLY.

SECTION NO. 4000	DRAWING NO. 5.6
REV,D. 2012	

STRIPING DETAIL

CITY OF FARGO
ENGINEERING DEPARTMENT

APPROVED BED	DATE 2-21-2012

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SECTION NO. 4000	DRAWING NO. 5.7
REV,D. 2012	

TYPICAL HANDICAP PARKING

CITY OF FARGO
ENGINEERING DEPARTMENT

APPROVED BED	DATE 2-21-2012

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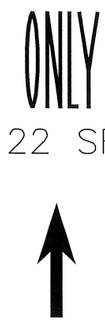
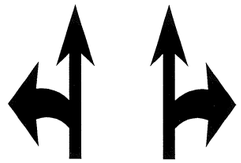
12 SF



ONLY

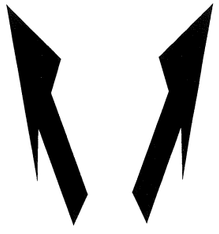
22 SF

12 SF



27 SF

16 SF



42 SF

MUST 27.06 SF

AHEAD 29 SF

MERGE 35.94 SF

ENDS 27.10 SF

STOP 23.5 SF

SHIFT 22.58 SF

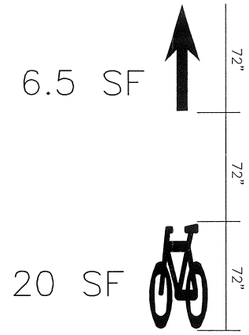
MPH 22.44 SF

25 11 SF

LANE 23 SF

LEFT 20.5 SF

24 SF



6.5 SF

20 SF

RR

70 SF

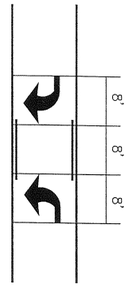
20 SF

XING

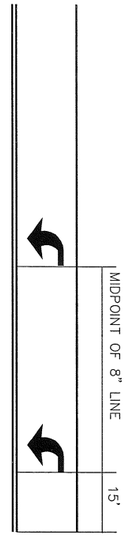
SCHOOL

33 SF

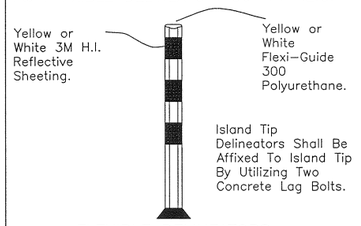
16 SF



ARROW SPACING



INSTALL FLEXIBLE DELINEATORS, LOCATIONS WILL BE MARKED BY THE ENGINEER IN THE FIELD. SHALL BE PAID AS FLEXIBLE DELINEATOR. 36" IN HEIGHT



FLEXIBLE DELINEATORS

ISLAND TIP PAINTING:

ALL ISLAND TIPS TO BE PAINTED SHALL BE CLEANED OF ALL CONTAMINATION, INCLUDING OIL, DIRT, GREASE, AND CURING COMPOUND. THIS PREPARATION PROCESS CAN BE ACCOMPLISHED BY SANDBLASTING, WATERBLASTING, OR ANY OTHER NON-DESTRUCTIVE PROCESS THAT IS APPROVED BY THE ENGINEER.

CURB/ISLAND TIPS SHALL BE PAINTED WITH A MINIMUM UNIFORM 15 MIL THICK YELLOW EPOXY. REFLECTIVE GLASS SPHERES SHALL BE APPLIED TO THE ENTIRE SURFACE OF THE PAINTED AREA. ISLAND TIP PAINTING SHALL BE PAID FOR BY THE SQUARE FOOT AS EPOXY PVMT MK MESSAGE. SUFFICIENT PREPARATION SHALL BE DONE TO ASSURE EPOXY ADHERES TO THE SURFACE. IF THE EPOXY SHOWS SIGNS OF PEELING WITHIN 1 YEAR FROM THE APPLICATION DATE, THE CONTRACTOR SHALL BE REQUIRED TO REPREP AND REPAINT WITH EPOXY AT HIS OWN EXPENSE.

SECTION NO. 4000	DRAWING NO. 5.8
REV,D. 2012	

MISCELLANEOUS MARKINGS & DELINEATION

CITY OF FARGO
ENGINEERING DEPARTMENT

APPROVED BED	DATE 2-21-2012

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