Section 922. TEMPORARY TRAFFIC CONTROL MATERIALS

922.01. Description. Temporary traffic control devices must meet the design requirements of the MMUTCD, Part 6 and the requirements of section 922.

Provide the Engineer with certification and an FHWA acceptance letter stating that the materials and devices meet the requirements of this section. Certification documents and the FHWA acceptance letter do not waive material and device inspection, sampling, or testing requirements, as determined by the Engineer.

922.02. Temporary Signs.

A. Sign Panel and Supports. Temporary signs must meet NCHRP-350 crashworthy requirements or the requirements of the Manual for Assessing Safety Hardware (MASH), as applicable.

1. Portable Sign Systems. Portable sign systems must meet the following requirements:
   a. Signs for which the substrate totals 20 square feet or less, must be constructed with the materials and design features specified in the FHWA acceptance letter.
   b. Signs must have a 5-foot minimum bottom height and have one or two rigid legs.
   c. The leg of bases using only one rigid leg must have an “X” or “H” configuration.
   d. Temporary ground driven sign system must be constructed as described in the Maintaining Traffic Typical WZD-100 or other NCHRP-350/MASH accepted design.

2. Portable Sign Substrate. Portable sign substrates must conform to the materials requirements of section 919 and the following requirements:
   a. Rigid sign panels no greater than 3 feet by 3 feet must be aluminum sheet or plywood.
   b. Rigid sign panels larger than 3 feet by 3 feet and up to 8 feet in width must be plywood.
   c. Rigid sign panels with a width of greater than 8 feet but not greater than 12 feet must be plywood or extruded aluminum.
   d. Rigid sign panels with a width greater than 12 feet must be extruded aluminum.
   e. Temporary sign panels fabricated with plywood must have a minimum thickness of ½ inch.
The Department will not permit vertical joints in sign substrates or horizontal splices through legends or symbols.

B. Reflective Sheeting. Prismatic grade reflective sheeting must meet the requirements of ASTM D 4956, for Type VIII prismatic sheeting or higher. Orange colored sheeting must be fluorescent orange reflective sheeting.

C. Legend. Legend fabrication and application must meet the requirements of the Michigan Standard Highway Signs Manual or as shown on the plans.

D. Sign Covers. Cover material for permanent signs and temporary signs on driven supports must be exterior grade plywood, hardboard, sheet metal, aluminum, or rigid plastic capable of resisting deterioration from weathering and atmospheric conditions for the duration of the project. Do not use flexible materials on permanent signs. Flexible materials may only be used on temporary signs.

Covers must be opaque during all light and weather conditions and must cover the entire front of sign panels. The Engineer will not require the Contractor to cover the entire sign panel on overhead signs and large guide signs greater than 60 square feet, but the Contractor must cover conflicting information.

922.03. Channelizing Devices. Channelizing devices include cones, drums, 42-inch channelizing devices, and Type III barricades. Reflective sheeting for channelizing devices must meet or exceed the requirements of ASTM D 4956 for Type III high intensity sheeting.

A. Cones. Traffic cones must be predominantly orange, at least 28 inches high, and made of material capable of withstanding impact without damaging vehicles. Provide certification from the manufacturer that cones meet NCHRP-350/MASH requirements.

B. Drums. Drums must be composed of a low-density polyethylene plastic. Do not use high-density polyethylene for plastic drums. Provide certification from the manufacturer that drums meet NCHRP-350/MASH requirements. Reflectorized sheeting on drums must consist of 6-inch stripes meeting the requirements of ASTM D 4956, for flexible Type III high intensity reflectorized sheeting. The drum striping design must meet the requirements of WZD-125.

C. Drums with Lights. Drums with warning lights must meet NCHRP-350/MASH requirements.

D. 42-Inch Channelizing Devices. Forty-two-inch channelizing devices must meet the following requirements:
1. Have 42-inch minimum height and may include a “handle” or lifting device that extends above the 42-inch height;
2. Be fabricated of material capable of withstanding impact without damaging vehicles;
3. Meet NCHRP-350/MASH requirements;
4. Have a base at least 8 inches in diameter and taper to at least a 4-inch diameter at the top, regardless of orientation;
5. Provide predominantly orange 42-inch channelizing devices;
6. Include ballast meeting the manufacturer’s specifications as necessary to keep them upright; and
7. Be reflectorized with flexible ASTM D 4956 Type III high-intensity sheeting material as follows:
   a. Sheetings material must have a smooth, sealed outer surface capable of displaying the same color during the day and night.
   b. Sheetings pattern must consist of four 6-inch alternating orange and white bands with no more than 2 inches between the bands, with the top band being orange and spaced no greater than 4 inches from the top of the device.

E. Type III Barricades. Type III barricades consist of three horizontal reflectorized rails, supports, and warning lights. When Type III barricades are shown on the plans as being double sided, both sides of the rails must be reflectorized. Rails must be reflectorized with orange and white diagonal striped ASTM Type III high intensity sheeting. Type III barricades must meet NCHRP-350/MASH requirements and the design criteria of WZD-125.

922.04. Temporary Concrete Barrier and Endings.

A. Temporary Concrete Barrier. Provide temporary barrier sections at least 10 feet long. Provide shorter barrier sections for locations where longer sections cannot achieve the required curvature or deflection in barrier alignment. Furnish and operate section lengths that meet the requirements of NCHRP-350/MASH, and that have been accepted by the FHWA. Provide certification documenting that the concrete used in fabricating the barrier sections meets or exceeds the requirements of the concrete used in crash tested sections.

Temporary concrete barrier must meet the requirements of NCHRP-350 Test Level 3 or higher or MASH requirements and when installed, the tested maximum deflection must not exceed 6½ feet.

The bottom width of barrier sections must not exceed 28 inches. The top of sections must be flat and at least 6 inches wide.
Cast barriers using Grade S3 concrete and cure in accordance with subsection 804.03.F. Cast barriers in accordance with the weather and temperature limitations specified in subsection 602.03.T. Ensure a uniform, smooth finish on temporary concrete barrier surfaces.

The Contractor may use lifting devices or openings to enhance placement. Ensure lifting devices do not protrude from the sides or top of the barrier when the barrier is in place.

Install barrier reflector markers on temporary concrete barrier to delineate the barrier wall. Markers must be trapezoidal or rectangular and include a methyl acrylate reflective area of at least 7.5 square inches. Initial photometric requirements at 0.2-degrees observation angle and 0-degree entrance angle must be at least 9 candela per lux for white markers and 6.5 candela per lux for yellow markers.

B. Temporary Concrete Barrier Ending. The concrete end section shown on Standard Plan R-52 Series must meet the requirements for temporary concrete barrier as specified in section 812. The cross section and connection type for concrete barrier endings must match the cross section of the end of the in-place concrete barrier.

Impact attenuator devices must be constructed from material specified by the manufacturer and in accordance with Standard Plan R-49, R-52, R-54, and R-126 Series.

Construct concrete attenuator base pads, foundations, anchor blocks, or backup units using Grade S1 concrete, unless otherwise directed by the Engineer.

The Contractor may use NCHRP-350, Test Level 3 or MASH approved attenuation.

Ensure attenuator transition assemblies, transition panels, end panels, connections and other miscellaneous accessories required for installation meet the manufacturer’s specifications.

Provide all modules in a sand module attenuator array from the same manufacturer. Do not mix different types of modules.

Provide sand for filling sand module attenuators meeting the gradation and moisture content requirements specified by the manufacturer.

922.05. Temporary Guardrail. Use existing guardrail beam elements and guardrail approach terminals for reconstructing guardrail if the Engineer determines this material is reusable in their present condition. The Contractor may reuse existing guardrail posts in good condition, as determined by the Engineer, for reconstructing guardrail. If existing
material is not reusable, provide new guardrail panels, posts, bolts, reflectorized washers, and other fittings.

Provide new guardrail beam elements and associated hardware meeting the requirements of subsection 908.11.

Provide new guardrail posts of the same type as existing posts, and ensure new guardrail posts meet the requirements of section 912 for wood posts, or section 908 for steel posts.

922.06. Temporary Pavement Markings. Temporary pavement markings consist of painted lines, pavement marking tape, and temporary raised pavement markers (TRPMs).

A. Pavement Marking Materials. Select paint, preformed tape, and temporary raised pavement markers from the Qualified Products List.

1. Pavement Marking, Type R. The contract documents require Type R markings if the markings, applied during the project, require removal during the life of the contract. Provide Type R temporary pavement marking as preformed tape. Apply and remove preformed tape in accordance with the manufacturer's instructions. The tape must remain flexible and conform to the texture of the pavement surface during use.

2. Pavement Marking, Type NR. The contract documents require Type NR markings if the markings applied during the project can remain in place. Provide Type NR temporary pavement markings as preformed tape or paint reflectorized with glass beads, as required. The tape must remain flexible and conform to the texture of the pavement surface during use.

B. Temporary Raised Pavement Markers (TRPM). Provide temporary raised pavement markers, reflectorized on one or both sides, depending on exposure to one-way or two-way traffic. Install TRPMs using the manufacturer's recommended adhesive and in accordance with the manufacturer's instructions.

1. TRPM Type 1. TRPM Type 1 consists of a flexible retroreflective strip with a protective removable plastic shield that the Contractor may use as a temporary pavement marking on a hot-mix asphalt (HMA) pavement surface before applying chip seal.

2. TRPM Type 2. TRPM Type 2 consists of a flexible retroreflective strip that the Contractor may use as a temporary pavement marking on interim HMA layers or concrete surfaces.
3. **TRPM Type 3.** TRPM Type 3 consists of a solid plastic device with a retroreflective face surface that the Contractor may use as a durable temporary pavement marking.

C. **Pavement Marking Cover.** Preformed polymer tape pavement marking covers must have a black or gray non-reflective matte finish. In addition to the requirements of subsection 922.06.A.1, pavement marking cover tape must meet the following requirements and characteristics:

1. Be 6 inches wide, and designed to last from 1 day to 10 days;
2. Be at least 0.04 inches thick, not including adhesive;
3. Be pre-coated with a pressure sensitive adhesive, capable of adhering to existing markings;
4. Contain no metallic foil;
5. Consist of a mixture of high quality polymeric material, pigments, and inorganic fillers distributed throughout the base cross sectional area, with a black or gray non-reflective matte finish top layer with non-skid particles;
6. Provide an initial average surface skid resistance value of 60 BPN when tested in accordance with ASTM E 303;
7. Remain in useable condition for 1 year after the receipt date, when stored in accordance with the manufacturer’s recommendations; and
8. Be manually removable in large pieces, at temperatures greater than 40 °F, without using heat, solvents, grinding, or blasting.

Ensure the tape, when applied in accordance with the manufacturer’s recommendations, provides a neat, durable masking that does not flow or distort on a stable pavement surface due to high temperature. Provide weather resistant film, capable of withstanding normal traffic wear without lifting, shrinking, tearing, rollback, or other signs of poor adhesion. Incorporate a non-metallic medium to facilitate removal.

922.07. Lighting Devices.

A. **Lighted Arrow, Types B and C.** Lighted arrows for traffic control in work zones consist of a lighted arrow panel, controller, and a power supply, mounted on a heavy-duty trailer.

1. **Lighted Arrow Panel.** Lighted arrow panels must have a flat black non-reflective surface and lights on the back to indicate which message mode is in operation.

   Type B panels must be at least 30 inches high by 60 inches wide and be equipped with 13 light emitting diode (LED) amber lights. Type C panels must be at least 48 inches high by 96 inches wide.
and be equipped with 15 LED amber lights. Program lights to present the following flashing message modes:

a. Left arrow,
b. Right arrow,
c. Double arrow, and
d. Caution.

2. **Controller.** Lighted arrows must have a photoelectrically controlled circuit that automatically adjusts the lamp intensity to ambient light conditions and with no manual override. An automatic intensity control that keeps the lamps at constant brightness when the battery is low is required.

3. **Power Supply.** Lighted arrows must have a solar power supply with a battery backup and a built-in 110 VAC battery charger. When fully charged, the arrow panel must be capable of operating for 20 days in single arrow mode with the photocell covered.

4. **Legibility.** The arrow panel must have an average legibility of 1 mile and, must be legible from ½ mile if viewed 10 degrees from center. Ensure arrow panels, installed for field use, meet the legibility requirements of subsection 812.03.D.7.

5. **Trailer.** The trailer and trailer components, with the exception of the sign panel, must be painted in highway orange. Delineate the trailer with a 4-inch by 18-inch strip, or an equivalent area, of reflectorized red and white conspicuity tape, installed on each of the four sides of the trailer. Locate these strips at each corner of the trailer.

B. **Warning Lights.** Provide warning lights with LED technology. Type A, Type B, and Type C warning lights must meet the Institute of Transportation Engineers Purchase Specification for Flashing and Steady Burn Warning Lights. Lights must be battery or solar powered, and must be maintained in accordance with subsection 812.03.G.6. Provide the following types of warning lights as required:

1. Type A, low intensity flashing warning lights with a yellow lens.
2. Type B, high intensity flashing warning lights with a yellow lens and a visor affixed to shield the lens from overhead sunlight.
3. Type C, steady burn warning lights with a yellow lens.
4. Type D, 360-degree steady burn warning lights with a yellow lens. Lenses for Type D lights on plastic drums must be visible for 360 degrees and the LED light source must emit light equally for 360 degrees. The LED light source must sustain constant brightness, evenly distributed throughout the lens until unable to
C. Portable Changeable Message Signs. Portable Changeable Message Signs (PCMS) consist of a message board, controller, and power supply, mounted on a heavy-duty tow-able trailer.

1. **Message Board.** Message boards must meet the following requirements:
   
   a. Measure at least 75 inches high by 114 inches long;
   
   b. Have a character height of 18 inches with 8 characters per line and a pixel matrix that is 5 pixels wide and 7 pixels high;
   
   c. Provide spacing between characters at least twice the element stroke width;
   
   d. Be either disk matrix, or LED, or both disk matrix and LED, capable of displaying three message lines;
   
   e. Include a photocell to regulate the internal lighting system; and
   
   f. Include a sighting device to ensure required alignment.

   Disk matrix PCMS must have fluorescent lighting at the top and bottom of each message line. LED PCMS must have with forced air ventilation and with filtered inlets to maintain the interior temperature within temperature limits for LEDs.

2. **Legibility.** PCMS must have an average legibility of 1,000 feet if viewed head-on and 10 degrees off center.

3. **Controller.** Controllers for PCMS must be equipped with the following:

   a. Micro-processor based unit with a storage capacity of at least 50 preprogrammed messages;
   
   b. Non-volatile memory capable of holding the keyboard created messages in memory during a non-power period;
   
   c. Password security feature to prevent unauthorized use;
   
   d. Message display capable of displaying a variable message at a rate of 0.25 second increments or correlated to 0.25 second increments; and
   
   e. Message display panel showing the message on the sign or created on the keyboard, and capable of giving the operator programming instructions.

4. **Electrical/Electronics.** Control cabinet for PCMS must be equipped with the following:

   a. Lockable door and an interior light for night operations.
b. Ventilated cabinet with screen covering on the vents to prevent damage from insects.

c. NEC 400-10 and NEC 400-14 compliant connections to control cabinets and sign board.


e. Shock-mounted sign electronics, to reduce vibration. Provide shock mountings in the circuit designs, mechanical supports for drive transistors, and in the type of conformal coating.

f. Printed circuit boards mounted with spring-load tension screws for ease of access and removal.

5. **Power Supply.** Power supply to the PCMS must be a maintenance-free battery with one of the following backup systems:

   a. Generator with electric start, capable of continuous operation without refueling for 72 hours; and

   b. Solar, with a built-in 115 VAC battery charger, capable of sequencing a message for 18 days to 21 days consecutively without sun in 16 °F weather conditions.

6. **Trailer.** The PCMS trailer must be painted in highway orange. Delineate the trailer with a 4-inch by 18-inch strip, or an equivalent area, of reflectorized red and white conspicuity tape, installed on each of the four sides of the trailer. Locate these strips at each corner of the trailer. The trailer must conform to the Michigan Vehicle Code with a nonskid upper surface.

   The PCMS must be mounted to the trailer with a sign panel support that moves up, down, and rotates 360 degrees, with a safety bolt to prevent the sign panel from lowering once in the raised position. The support must be equipped with a hydraulic system that includes a manual pump with manual release for use as a back up for the electric hydraulic pump. The bottom of the sign panel must be at least 7 feet above the roadway when in operating mode.

**922.08. Temporary Traffic Signals and Street Lighting.** The Contractor may provide used material and equipment for temporary traffic signals and street lighting. Obtain the Engineer’s approval for used material before installation. The Contractor is responsible for performance and maintenance of used material throughout the life of the project.

**922.09. Temporary Traffic Signals.** Material for temporary traffic signals must meet the requirements of section 918 and section 921, the
Institute of Transportation Engineers (ITE) for *Vehicle Traffic Control Signal Heads* (VTCSH), “LED Circular Signal Supplement,” and the MMUTCD.

**922.10. Portable Temporary Traffic Signal System.** Material for portable temporary traffic signal systems (PTS) must meet the requirements of section 918 and section 921, the Institute of Transportation Engineers (ITE) for *Vehicle Traffic Control Signal Heads* (VTCSH), “LED Circular Signal Supplement,” and the MMUTCD.

A. **Trailer.** PTS trailer must be self-contained and meet the following requirements:

1. Consist of a vertical upright and horizontal mast arm to accommodate two 12-inch overhead traffic signal heads, mounted at the same height, and capable of providing at least 16 feet of clearance.
2. Allow at least one signal head on the horizontal mast to be placed over the traffic lane.
4. Allow for transporting two signal trailers with one vehicle.
5. Have adequate structural integrity to allow for lifting and placing the PTS trailer, as required.
7. Equipped with four stabilizing and leveling jacks, one on each corner of the trailer.
8. Delineated with a 4-inch by 18-inch strip, or an equivalent area, of reflectorized red and white conspicuity tape, installed on each of the four sides of the trailer. Locate these strips at each corner of the trailer.

B. **Traffic Signal Heads/Display Requirements.** The PTS system must meet the following requirements:

1. Conform to the physical display and operational requirements of conventional traffic signals, as specified in Part IV of the MMUTCD, ITE Specifications for LED Circular Signals, and NEMA Standards TS1 and TS2;
2. Be equipped with two overhead, 12-inch, LED traffic signal heads with visors that extend beyond the signal head at least 10 inches;
3. Be equipped with traffic signal heads that can accommodate back plates and that rotate horizontally 180 degrees; and
4. Provide traffic signal head clearance height of at least 16 feet, measured from the bottom of the green signal housing or signal back plate, whichever is lowest, to the road surface.

C. **Power Requirements.** Each PTS trailer must be equipped with batteries capable of operating the traffic signal system for at least 21 days at 72 °F without charging. Provide a charging system that includes at least 450 watts of solar collection capability and an onboard battery charger for use with a 110 Volt power source, and an onboard monitoring system, capable of regulating and providing a visual display of the battery voltage and solar input.

The PTS system must be fully operable if connected to a 110 Volt power source, if required.

D. **PTS Operational Requirements.** PTS must have an operating system that includes a conflict monitoring system that conforms to NEMA standards, capable of operating in a fixed time, traffic actuated, or manual control mode. The fixed time mode operation option must be capable of providing at least five automatic traffic signal timing changes in a 24-hour period. The traffic actuation mode option must allow minimum and maximum green time programming to extend the green times in predetermined programmable segments, as required.

In addition, the PTS operating system must meet the following requirements:

1. Control at least seven traffic phases and include programmable green times from 3 seconds to 250 seconds, and red times from 1 second to 250 seconds, in 1 second increments.
2. Can facilitate standby modes of red, red flash, and yellow flash.
3. Capable of interfacing with a remote monitoring system that will report signal location, battery voltage, and system default. Ensure the monitoring system is not limited to cellular phone coverage areas, and remains operational regardless of location and weather conditions.
4. Can accommodate a pre-emption system with optical activation that provides a priority green phase in the direction of equipped approaching emergency vehicles.
5. Allows for connect and control of the PTS by a standard NEMA-type controller.
6. Equipped with diagnostic capabilities in the event of a system failure and can identify the failure to expedite return to full operational mode.
7. Has an integrated mechanism, capable of recording system malfunctions, and providing a printout of this record that must be kept with the PTS, including the following:
   a. Date and time of system failure,
   b. Service and maintenance performed,
   c. A description of the equipment serviced and why the service was performed,
   d. Repairs made to the unit, and
   e. Past operational history of the unit.

E. **Actuation Requirements.** PTS system must have traffic actuation capabilities that include microwave motion sensors, video detection, and in-pavement loops. PTS system must be capable of operating with a motion and true-presence actuation system.

F. **Communication Requirements.** Equip the PTS system to communicate via hardwire connection or wireless radio link communication. If using the hardwire communication, do not obstruct vehicular and pedestrian traffic or intrude into the work area while deploying the communication cable. If using the radio link communication option, maintain clear line of sight between PTS trailers, and ensure the radio system conforms to Federal Communication Commission (FCC) requirements and applicable state and local requirements.

G. **Default Requirements.** Program the PTS system to revert to a red, red flash, or yellow flash mode upon system failure. Set the default setting to red flash or a preprogrammed operating mode to ensure safety in the work zone, unless otherwise required, or directed by the Engineer. Upon failure, ensure the PTS system can notify Contractor personnel via the remote monitoring system specified in subsection 922.10.D.

The Contractor is responsible for repairing the PTS system. Make repairs to return the PTS system to full operational condition as soon as possible. Identify an authorized service center for timely response to system failures.

922.11. Traffic Regulator Equipment.

A. **Stop/Slow and Stop/Stop Sign Paddle.** Equip traffic regulators with a stop/slow or stop/stop paddle meeting design requirements of the MMUTCD. Do not use red flags, except in case of emergencies.

B. **Traffic Regulator's High-Visibility Safety Apparel.** Provide fluorescent vests, shirts, or jackets, clearly visible at a distance of at least 1,000 feet, day and night. Provide orange, yellow, white, silver, strong
yellow green, or a fluorescent version of these colors, designed to be visible through the full range of body motions.


D. Two-Way Radio System. Provide a two-way radio system with power to send and receive signals over the length of the intended flagging operations. If a two-way radio system is required, place a backup system on standby, readily available to the flaggers.


A. Dust Palliative. Calcium chloride dust palliative in solid or liquid form must conform to the requirements of ASTM D 98, except as modified by this subsection

Solid-form calcium chloride must have a minimum concentration of 77 percent CaCl₂ with 100 percent passing the ¾-inch sieve, and from 0 to 5 percent passing the No. 30 sieve.

Liquid-form calcium chloride must be a solution with a concentration of 33, 35, or 38 percent CaCl₂.

Provide two copies of a report, with each load, that includes the following information:

1. The volume in gallons or weight of solution delivered, or the weight of solids delivered;
2. The concentration of solids or solution delivered, expressed as the percent of CaCl₂;
3. Equivalent tons of CaCl₂ determined for the concentration shown on the delivery report in accordance with Table 922-1; and
4. Copy of manufacturer’s certification that the calcium chloride conforms to this section.

<table>
<thead>
<tr>
<th>Concentration, %</th>
<th>Pounds of Calcium Chloride Per Gallon of Solution</th>
<th>Per Pound of Solution or Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>33</td>
<td>3.7</td>
<td>0.33</td>
</tr>
<tr>
<td>35</td>
<td>3.9</td>
<td>0.35</td>
</tr>
<tr>
<td>38</td>
<td>4.4</td>
<td>0.38</td>
</tr>
<tr>
<td>77</td>
<td>N/A</td>
<td>0.77</td>
</tr>
</tbody>
</table>
If the manufacturer's certification indicates a solution does not conform to the concentration stated on the report, the Engineer will use the value from Table 922-1 for the next lower concentration to which the solution conforms to calculate the equivalent weight of calcium chloride.

If the manufacturer's certification indicates a solution has a concentration less than required for a 33 percent concentration, or a quantity of solids has a concentration less than required for 77 percent concentration, the Engineer will calculate the weight of equivalent calcium chloride using the required concentration.

If manufacturer's certification indicates a concentration of calcium chloride greater than stated on the delivery report, the Engineer will calculate the weight of equivalent calcium chloride using the concentration indicated on the report.