Illinois Department of Transportation

Office of Highways Project Implementation / Region 3 / District 5
13473 IL Highway 133 / P.O. Box 610 / Paris, Illinois 61944

ODP-1- B-6
Permit No. 5-35379
Vermilion County

June 22, 2022

Mr. Christopher Yates, Chief
City of Danville Police Department
2 East South Street
Danville, IL 61832

Dear Mr. Yates:

Attached are approved copies of Highway Permit Number 5-35379 for your files. We again wish to call your attention to the necessity for using safety precautions and proper traffic control during the course of construction.

Provisions of this permit require inspection and approval of the work by this office when completed, and you are held liable in accordance with the terms of the permit until so approved.

A form letter is attached for your use in notifying this office that your permit work has been completed and is ready for inspection. Please return this notification to the indicated address.

Please note this permit is valid until the expiration date shown below. An extension of time will be granted on request to this office when supported by legitimate reasons causing delay.

Should any questions arise as to details of how the work should be done, we suggest you call our Permits Supervisor, Kimberly W. Neihart, at telephone number 217-466-7230 in Paris, Illinois.

Sincerely,

Kensil A. Garnett, P. E.
Region Three Engineer

PERMIT EXPIRE: 9/1/2022

FIELD COPY
THIS PERMIT SHALL BE AVAILABLE FOR INSPECTION AT THE JOB SITE

KWN

cc: D. A. Speicher, Attn: S. E. Smith

ODP-1- B-6
Permit No. 5-35379
Vermilion County

Date_____

Mr. Kensil A. Garnett, P. E.
Deputy Director of Highways,
Region Three Engineer
Bureau of Operations
Route 133 West; P.O. Box 610
Paris, Illinois 61944-0610

Dear Mr. Garnett:

This is to inform you that I have completed the work authorized by Highway Permit Number 5-35379, and that I request your inspection and approval of the work.

Do not request an inspection until grass turf has been re-established.

The site of the work is located US 150/ G St; US 150/4th St. SW;US 136/Hazel St; US 136.Lake St EB; US 136/Lynch Rd WB;US 136@Newell Rd; on FAP 729; US 136 & Various in Vermilion County.

Sincerely,

_____
Grantee

_____
Address

_____
City

PERMIT EXPIRES: 9/1/2022

Illinois Department of Transportation

License Plate Reader Permit

Whereas, I (We) City if Danville Police Department (Name of Applicant) S-35379 (Application Serial Number)

2 South St (Mailing Address) Danville (City) IL (State) 61832 (Zip Code)

hereinafter termed the Applicant, request permission and authority to install license plate readers ("Readers") herein described on the right-of-way of the State Highway known as FAP 332; FAP 729 Route IL 1; US 136; US 150

Section _____, Structure Info New FREY pedestal base pole

_____ County. The work is described in detail on the attached plan or sketch and/or as follows:

The work authorized by this permit consists of, but not limited to the placement and maintenance of License Plate Recognition Cameras within the City of Danville at the following locations:

- IL 1/US 136 and Newell Road
- US 150 at "G" Street
- Il 1/US 150 at 4th Street
- US 136 at Hazel Street
- US 136 at Lake Street
- US 136 at Lynch Road

See attached plans and specs in this permit for specifics.

FIELD COPY
PERMIT SHALL BE AVAILABLE FOR INSPECTION AT THE JOB SITE

Emergency Contact Info:

Name	E-mail	Phone
Flock Safety	permit@flocksafety.com	678-562-8766

Address	City	State	Zip Code
1170 Howell Mill Road NW, Ste 210	Atlanta	GA	30318

All work authorized by this permit shall be completed 60 days after the date this permit is approved, otherwise the permit becomes null and void.

This permit is subject to the conditions and restrictions printed on the following pages of this form.

This permit is hereby accepted and its provisions agreed to this ____ day of _____, _____.

Witness Signature	Date	Applicant Signature	Date
[signature]	12/17/2021	[signature] - Chief	1-12-22

Address	Address
1170 Howell Mill Road NW, Ste 210	2 South St

City	State	Zip Code	City	State	Zip Code
Atlanta	GA	30318	Danville	IL	61832

Sign and Return to: Regional Engineer _____

Approved by Department of Transportation:	Regional Engineer Signature	Date
	[signature]	012222

First: The Applicant represents and warrants that it is the party in interest respecting this permit and that it is the agent in fact with authority to bind all parties in interest to the obligations and undertakings agreed to in this permit. The Applicant represents and warrants that the property lines shown on the attached plan sheet(s) or sketch are true and correct, and that all proposed work is accurately depicted thereon.

Second: The proposed work shall be located and constructed to the satisfaction of the Regional Engineer or his/her duly authorized representative. No revision or additions shall be made to the proposed work on the right-of-way without the written permission of the Regional Engineer. The Applicant agrees to complete all work to the standards and specifications identified by the Regional Engineer or his/her authorized representative as a condition of granting this Permit. The Applicant agrees to furnish all labor, equipment and material to restore portions of the highway right-of-way to the condition satisfactory to the Regional Engineer or his/her authorized representative including, but not limited to, all landscape restoration. The Applicant shall not trim, cut or in any way disturb any trees or shrubbery along the highway without the approval of the Regional Engineer or his/her duly authorized representative. Any and all documents, writings and notes reflecting or identifying the standards, specifications, understandings and conditions applicable to the performance of the permitted work required by the Regional Engineer or his/her authorized representative are hereby incorporated into this Permit by reference as though fully set forth herein.

Third: Traffic control is to be utilized when installing License Plate Readers. The attached Highway Standards shall be utilized. The attached OPER 2410 Form shall be submitted at least 21 days in advance of any required lane closure. The Applicant shall also fill out and submit the BSPE 725 form for the proposed traffic control. Both items shall be submitted via e-mail to _____ for approval and processing by the District.

Fourth: An additional Traffic Control permit shall be required each time a lane closure is required for maintenance or repair of any one of the License Plate Readers along with a new OPER 2410 form and a new BSPE 725 form. These future permits shall be obtained from the appropriate District office.

Fifth: The Applicant shall engage only in the proposed work approved herein, and subject to the hazards incident to such activities, assumes all risks associated therewith. The Applicant assumes full and strict liability for the actions of itself, all parties in interest, its agents and employees, contractors, subcontractors and consultants. The Applicant and all parties in interest shall save, defend, hold harmless and indemnify the State of Illinois and each of its officers, agents, employees, invitees and others associated with it from and against any and all suits, claims, actions, losses, injuries, damages, judgments, and expenses that are based on, or that arise or are alleged to have arisen out of the performance of the work approved herein, including, but not limited to, any act, willful or intended, or negligence of the Applicant and any party in interest, its agents and employees, contractors, subcontractors and consultants whether at law, in equity or common law. In the event the Applicant or any party in interest fails, neglects, or refuses to comply with any provision of this indemnity, the State of Illinois may take any action necessary to protect itself from liability, including any action to pay, settle, compromise and procure the discharge thereof, in which case the Applicant or party in interest, jointly and severally, shall be liable and bound unto the State of Illinois for any and all expenses related thereto, including attorney's fees.

Sixth: The Department is not responsible for any damage costs to the License Plate Readers or times when the License Plate Readers cannot be operated due to the Department's normal maintenance or repair activities. Components of the Reader system shall be clear of any walkways or other areas required for structural maintenance operations. Should the License Plate Readers or conduits need to be adjusted, removed or relocated due to the Department's construction, maintenance or repair activities, the costs of said adjustment, removal or relocation will be the Applicant's responsibility. The Department does not warrant nor guarantee the validity of this permit on any new or replacement structure.

Seventh: This permit is effective only insofar as the Department has jurisdiction and does not presume to release the Applicant from compliance with the provisions of any existing statutes, including the Biometric Information Privacy Act, local regulations, or future statutes or regulations.

Eighth: A contractor currently prequalified by the Department in electrical work shall be approved. Prior to the commencement of the said work on the State highway, the applicant shall furnish the Regional Engineer a copy of the contractor's current Certificate of Eligibility, or, if the permittee proposes to use a contractor not currently prequalified by the Department, information satisfactory to the Department evidencing the contractor's qualification and ability to perform the said work. The Department may require the use of one of its electrical maintenance contractors to perform said work in order to avoid conflicts with maintenance of existing Department structures.

Ninth: The Applicant or their contractor at their expense will be responsible for determining the location of and protecting any State owned facilities, including buried facilities, and will be responsible for the cost of repair or replacement of any such facilities damaged as a result of the work covered herein. The Applicant may contact _____ for location information of State-owned facilities. The Applicant shall assume all responsibility for interference with all other existing utilities in, along or upon said right of way. Any damage to IDOT property or appurtenances shall be repaired by the Applicant or their contractor in a manner meeting the Department's approval.

Tenth: License Plate Readers must utilize a separate electrical meter for their energy charges unless specifically authorized by the Department in which case the Department makes no guarantees on the continuity and maintenance of the electric service. The License Plate Readers must use separate electrical cabling and either dedicated communication lines or cellular modems to collect data from the License Plate Readers so as to not use or involve any Department communications infrastructure whatsoever.

Eleventh: Separate conduits for any wiring must be installed outside of the IDOT conduits. The Applicant or their contractor shall provide specific mounting details to the Department for review, comment, and approval prior to any installation of conduit or mounting brackets on the Department structure. All mounting hardware or brackets shall be either stainless steel or other material which will not harm or impede aesthetics. The additional surface area of installed Readers and mounting hardware shall not create a total surface area attached to the structure that exceeds the allowed maximum. The Department reserves the right to perform or require a structural analysis of the proposed attachment of the License Plate Reader system prior to execution of this permit. ABSOLUTELY NO DRILLING, TAPPING, OR PUNCTURING SHALL BE PERMITTED ON ANY STRUCTURE.

Twelfth: The Applicant shall be responsible for repair, removal or replacement of any and all License Plate Reader equipment damaged by any cause whatsoever, and any associated costs. The Department will not provide any compensation for repair, removal or replacement.

Thirteenth: The Applicant shall be responsible to make recovery for damage to any part of the installation from the third party causing the damage.

Fourteenth: The Applicant agrees to respond to emergency calls to repair License Plate Reader equipment and/or associated hardware from authorized parties twenty-four (24) hours per day including Saturdays, Sundays, and holidays.

Fifteenth: The Applicant shall provide the Department the name, address, and telephone number of at least one person who will be available for emergency repair to the License Plate Reader system and shall keep the Department informed on any changes of same.

Sixteenth: The Applicant or their designee bears sole responsibility for all aspects of installation, operations, maintenance, data, and compliance with existing and future laws, including the Biometric Information Privacy Act, associated with the License Plate Readers.

Seventeenth: All documents, data, and records associated with the Applicant's use of the License Plate Readers, without limitation and whether preliminary or final, are the property and responsibility of the Applicant. The Department shall have no responsibility with respect to production or communication of data produced by the License Plate Readers. License Plate Reader installations shall utilize separate microwave or other wireless communication methods. Data collection and/or transfer shall not use IDOT communications infrastructure, including fiber optic cable. IDOT shall not host or move data for other entities, nor record data for storage or later transmission.

Eighteenth: The Applicant acknowledges and agrees that the Applicant will be individually responsible for the obligations of a public body required under the Illinois Freedom of Information Act, 5 ILCS 140 et seq. ("FOIA") for FOIA requests seeking the electronically stored, or otherwise recorded, video, film or other visual memorialization(s) and data created under this permit that constitute a public record, as defined in section 2 of the FOIA statute. Accordingly, the Applicant agrees that IDOT will refer any individuals who submit to IDOT such FOIA requests to the Applicant's Freedom of Information Officer, and that the Applicant will receive and respond to all such requests, and search for, obtain, review for FOIA exempt information, and otherwise entirely handle any of the above-described responsive public records.

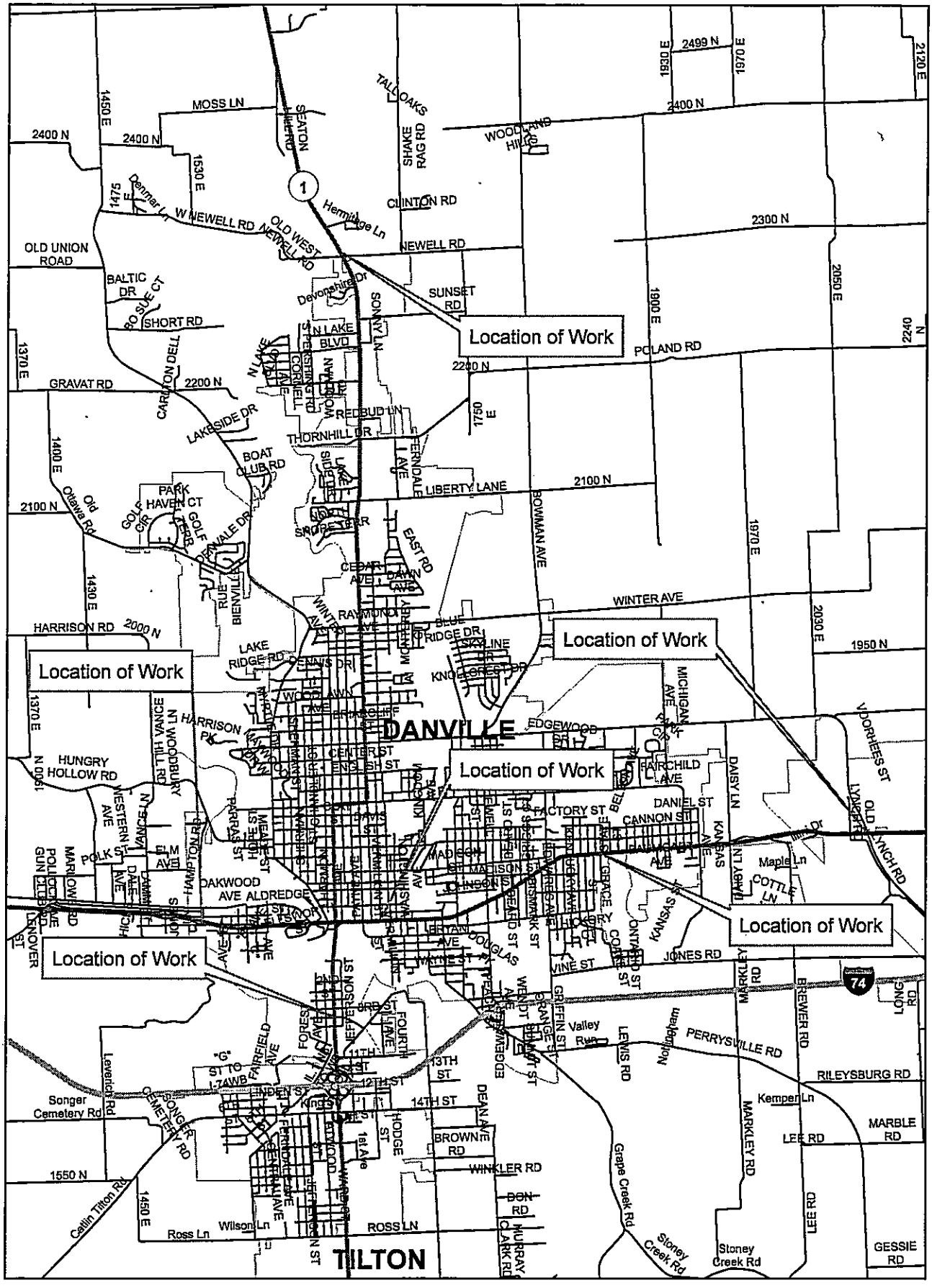
Nineteenth: The Department shall give notice to Applicant of any planned actions or activities which impact the License Plate Readers. The Applicant shall be required to remove any and all License Plate Reader equipment impacted by the Department's planned actions or activities, and as required or requested by the Department. However, the Department will neither compensate nor guarantee alternatives under any circumstances. Applicant's failure to remove equipment within thirty (30) days shall constitute permission to the Department to remove the License Plate Reader equipment, at the Applicant's cost.

Twentieth: Following completion of any work, all waste materials shall be removed from the highway right of way. Any damage to State property shall be the responsibility of the Applicant. Any areas disturbed by equipment or workers shall be repaired and returned to its original condition.

Twenty-first: The Department reserves all rights and authority to revoke this permit at any time for any cause.

Other Applicable Requirements

Permit Number 5-35379



Date: 1/24/2022

STRUCTURAL CALCULATIONS

ALUMINUM POLE DESIGN – 105 MPH WIND ZONE
For 100W Assembly
(4.5" Outside diameter, 0.237" Wall Thickness, 6061-T6 Material)

These calculations have been performed based on AASHTO LRFD for Structural Support for Highway Signs, Luminaries, and Traffic Signals, 2015 edition with 2017, 2018 & 2019 interim revisions; for wind speed of 105 mph based on 300-year MRI. Calculation have performed by Florida Bridge & Transportation, INC; under exclusive direction of and the Engineer of Record, Robert B Zaitooni, PE.

ENGINEER OF RECORD:
Robert B Zaitooni, PE
IL PE # 062061102
REDS, PLLC
(407) 687-8754
bob@REDS-LLC.com

SIGNED DATE : 9/9/21
EXPIRATION DATE : 11/30/21

FLORIDA BRIDGE AND TRANSPORTATION INC.

JOB# 21-64.01 SHEET# 1
PROJECT NAME: Aluminum Pole Design - 105 mph
SUBJECT: Single Post Design 100 % Wind
POLE ID/STATION: 12.15' Exposed Height
CALCULATED BY: SD DATE: 8/26/2021
CHECKED BY: JAV DATE: 8/26/2021

ALUMINUM POLE SINGLE POST DESIGN - 100% Wind

WIND SPEED:
County: Varies

Design Wind Speed: 105 mph
Basic Wind Speed: 105 mph

Wind Pressure Design Criteria as per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2015 (LRFDLTS-1):

(AASHTO 3.8.1) Wind Pressure = $0.00256K_zK_dGV^2C_d$

Pole Exposed Height= 12.15 ft
Pole Diameter at Top= 4.500 in
Taper = 0.000 in/ft

Case 1 100% Wind Load

Height Coefficient = K_z (AASHTO, Table C3.8.4-1)
Gust Factor= G (AASHTO 3.8.6)
Directionality Factor= K_d (AASHTO, Table 3.8.5-1)
Wind Drag Coefficient = C_d (AASHTO, Table 3.8.6-1)

Center of Exposed Height = 6.07 ft

Wind Load Analysis (Pole)

Segment ID		Z Height above Ground (ft)	Kz Height Coefficient	G Gust Factor	V Wind Velocity (mph)	K_d Directionality Factor	p Wind Press. (incl height coeff.) (psf)	Pole Taper (in/ft)	Width (in)	Avg Width (in)	Corner Radius	Cd Drag Coeff.	Exposed Area of Segment (sf)	Avg Pressure on Segment (Includes Drag Coefficient) (psf)	Wind Force on Segment (kip)	Moment Arm to Base (ft)	Wind Moment Acting at Base of Pole (ft*kip)
1	Bottom	0.00	0.84	1.14	105	0.95	25.68	0.000	4.500	4.500	N/A	1.100	4.56	28.24	0.13	6.08	0.78
	Top	12.15							4.500								
Subtotal (Pole only)															0.13	6.08	0.78

Wind Load Analysis (Attachments)

Description	Mounting Height (ft)	Kz Height Coefficient	G Gust Factor	V Wind Velocity (mph)	K_d Directionality Factor	Cd Drag Coeff.	p Wind Press. (psf)	Member Width (in)	Member Height (in)	Exposed Area (sf)	No. of Equipment	Applied Wind Force (kip)	Moment Arm to Base (ft)	Wind Moment Acting at Base of Pole (ft*kip)
Double Panel (Solar)	12.15	0.84	1.14	105	0.85	1.70	39.05	26.40	33.46	6.13	1	0.24	12.15	2.91
Battery Pack	2.75	0.84	1.14	105	0.85	1.70	39.05	18.00	18.00	2.25	1	0.09	2.75	0.24
Flock Safety Camera	11.00	0.84	1.14	105	0.85	1.70	39.05	3.30	10.50	0.24	1	0.01	11.00	0.10
Subtotal (Att. Only)												0.34	9.66	3.26

POLE DESIGN LOADS		
Pole Moment at Base (Ultimate) =	4.097	kip-ft
Pole Torsion at Base (Ultimate) =	0.124	kip-ft
Pole Shear at Base (Ultimate) =	0.466	kips
Pole Axial Load at Base (Ultimate) =	0.120	kips

Pole and Equipment Wieghts:

			DL Ecc. (ft.)	DL Moment (lb.ft)
Flock Safety Camera:	3.60	lb	0.500	1.80
Pole and Panels:	15.70	lb	0.500	7.85
Battery Pack:	90.00	lb	0.500	45.00
Total Dead Load on Foundation =	0.109	kip		0.055 kip-ft

FLORIDA BRIDGE AND TRANSPORTATION INC.

JOB# 21-64.01 SHEET# 1
PROJECT NAME: Aluminum Pole Design - 105 mph
SUBJECT: Single Post Design 75 % Wind
POLE ID/STATION: 12.15' Exposed Height
CALCULATED BY: SD DATE: 8/26/2021
CHECKED BY: JAV DATE: 8/26/2021

ALUMINUM POLE SINGLE POST DESIGN - 75% Wind along x

WIND SPEED:

County: Varies

Design Wind Speed: 105 mph
Basic Wind Speed: 105 mph

Wind Pressure Design Criteria as per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2015 (LRFDLTS-1):

(AASHTO 3.8.1) Wind Pressure = $0.00256K_zK_dGV^2C_d$

Pole Exposed Height= 12.15 ft
Pole Diameter at Top= 4.500 in
Taper = 0.000 in/ft

Case 2 75% Wind Load Along x

Height Coefficient = K_z (AASHTO, Table C3.8.4-1)
Gust Factor= G (AASHTO 3.8.6)
Directionality Factor= K_d (AASHTO, Table 3.8.5-1)
Wind Drag Coefficient = C_d (AASHTO, Table 3.8.6-1)

Center of Exposed Height = 6.07 ft

Wind Load Analysis (Pole)

Segment ID		Z Height above Ground (ft)	Kz Height Coefficient	G Gust Factor	V Wind Velocity (mph)	K_d Directionality Factor	p Wind Press. (incl height coeff.) (psf)	Pole Taper (in/ft)	Width (in)	Avg Width (in)	Corner Radius	Cd Drag Coeff.	Exposed Area of Segment (sf)	Avg Pressure on Segment (Includes Drag Coefficient) (psf)	Wind Force on Segment (kip)	Moment Arm to Base (ft)	Wind Moment Acting at Base of Pole (ft*kip)
1	Bottom	0.00	0.84	1.14	105	0.95	19.28	0.000	4.500	4.500	N/A	1.100	4.56	21.18	0.10	6.08	0.59
	Top	12.15							4.500								
Subtotal (Pole only)															0.10	6.08	0.59

Wind Load Analysis (Attachments)

Description	Mounting Height (ft)	Kz Height Coefficient	G Gust Factor	V Wind Velocity (mph)	K_d Directionality Factor	Cd Drag Coeff.	p Wind Press. (psf)	Member Width (in)	Member Height (in)	Exposed Area (sf)	No. of Equipment	Applied Wind Force (kip)	Moment Arm to Base (ft)	Wind Moment Acting at Base of Pole (ft*kip)
Double Panel (Solar)	12.15	0.84	1.14	105	0.85	1.70	29.29	26.40	33.46	6.13	1	0.18	12.15	2.18
Battery Pack	2.75	0.84	1.14	105	0.85	1.70	29.29	18.00	18.00	2.25	1	0.07	2.75	0.18
Flock Safety Camera	11.00	0.84	1.14	105	0.85	1.70	29.29	3.30	10.50	0.24	1	0.01	11.00	0.08
Subtotal (Att. Only)												0.25	9.66	2.44

POLE DESIGN LOADS		
Pole Moment at Base (Ultimate) =	3.088	kip-ft
Pole Torsion at Base (Ultimate) =	0.093	kip-ft
Pole Shear at Base (Ultimate) =	0.349	kips
Pole Axial Load at Base (Ultimate) =	0.120	kips

Pole and Equipment Wieghts:

			DL Ecc. (ft.)	DL Moment (lb.ft)
Flock Safety Camera:	3.60	lb	0.500	1.80
Pole and Panels:	15.70	lb	0.500	7.85
Battery Pack:	90.00	lb	0.500	45.00
Total Dead Load on Foundation =	0.109	kip		0.055 kip-ft

FLORIDA BRIDGE AND TRANSPORTATION INC.

JOB# 21-64.01 SHEET# 1
PROJECT NAME: Aluminum Pole Design - 105 mph
SUBJECT: Single Post Design 75 % Wind
POLE ID/STATION: 12.15' Exposed Height
CALCULATED BY: SD DATE: 8/26/2021
CHECKED BY: JAV DATE: 8/26/2021

ALUMINUM POLE SINGLE POST DESIGN - 75% Wind along z

WIND SPEED:
County: Varies

Design Wind Speed: 105 mph
Basic Wind Speed: 105 mph

Wind Pressure Design Criteria as per AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, 2015 (LRFDLTS-1):
(AASHTO 3.8.1) Wind Pressure = $0.00256K_zK_dGV^2C_d$

Pole Exposed Height= 12.15 ft
Pole Diameter at Top= 4.500 in
Taper = 0.000 in/ft

Case 2 75% Wind Load Along z

Height Coefficient = K_z (AASHTO, Table C3.8.4-1)
Gust Factor= G (AASHTO 3.8.6)
Directionality Factor= K_d (AASHTO, Table 3.8.5-1)
Wind Drag Coefficient = C_d (AASHTO, Table 3.8.6-1)

Center of Exposed Height = 6.07 ft

Wind Load Analysis (Pole)

Segment ID		Z Height above Ground (ft)	Kz Height Coefficient	G Gust Factor	V Wind Velocity (mph)	K_d Directionality Factor	p Wind Press. (incl height coeff.) (psf)	Pole Taper (in/ft)	Width (in)	Avg Width (in)	Corner Radius	Cd Drag Coeff.	Exposed Area of Segment (sf)	Avg Pressure on Segment (includes Drag Coefficient) (psf)	Wind Force on Segment (kip)	Moment Arm to Base (ft)	Wind Moment Acting at Base of Pole (ft*kip)
1	Bottom	0.00	0.84	1.14	105	0.95	19.26	-0.000	4.500	4.500	N/A	1.100	4.56	21.18	0.10	6.08	0.59
	Top	12.15							4.500								
Subtotal (Pole only)															0.10	6.08	0.59

Wind Load Analysis (Attachments)

Description	Mounting Height (ft)	Kz Height Coefficient	G Gust Factor	V Wind Velocity (mph)	K_d Directionality Factor	Cd Drag Coeff.	p Wind Press. (psf)	Member Width (in)	Member Height (in)	Exposed Area (sf)	No. of Equipment	Applied Wind Force (kip)	Moment Arm to Base (ft)	Wind Moment Acting at Base of Pole (ft*kip)
Double Panel (Solar)	12.15	0.84	1.14	105	0.85	1.70	29.29	1.18	33.46	0.27	1	0.01	12.15	0.10
Battery Pack	2.75	0.84	1.14	105	0.85	1.70	29.29	11.00	18.00	1.38	1	0.04	2.75	0.11
Flock Safety Camera	11.00	0.84	1.14	105	0.85	1.70	29.29	4.50	10.50	0.33	1	0.01	11.00	0.11
Subtotal (Att. Only)												0.06	5.42	0.31

POLE DESIGN LOADS		
Pole Moment at Base (Ultimate) =	0.960	kip-ft
Pole Torsion at Base (Ultimate) =	0.009	kip-ft
Pole Shear at Base (Ultimate) =	0.154	kips
Pole Axial Load at Base (Ultimate) =	0.120	kips

Pole and Equipment Wieghts:

			DL Ecc. (ft.)	DL Moment (lb.ft)
Flock Safety Camera:	3.60	lb	0.500	1.80
Pole and Panels:	15.70	lb	0.500	7.85
Battery Pack:	90.00	lb	0.500	45.00
Total Dead Load on Foundation =	0.109	kip		0.055 kip-ft

Design of the 12.15 ft Aluminum Pole-105 mph Design Wind Speed

Spec & Standards:

AASHTO Standard Spec. for Struct. Supp. for Highway Signs, Luminaires and Traffic Signals (LRFDLTS-1).

Aluminum Design Manual 2010 (ADM-2010)

AISC Steel Construction Manual - 14th edition

FDOT Design Standards

FDOT Standard Specifications

FDOT Structures Design Manual **UNITS:** U.S. Customary

GIVEN:

Aluminum Column: **Aluminum Pipe (6061-T6) Properties:**

$F_{tu} := 38ksi$ $F_{ty} := 35ksi$ $E := 10100ksi$ (ADM Table 1)

$F_{su} := 0.6 \cdot F_{tu}$ $F_{cy} := 35ksi$ $F_{sy} := 0.6 \cdot F_{ty}$

TRY: Aluminum Nominal Pipe Size 4.0" Schedule 40 Pipe (4.5" O.D x 0.237" THK) Properties:

column outside diameter (O.D. column): $Dia_{col} := 4.5 \cdot in$

$Density_{aluminum} := 0.16849 \cdot \frac{kip}{ft^3}$

Wall thickness: $t_w := 0.237in$ Design Wall Thickness: $t_{col} := t_w$

$InsideDia_{col} := Dia_{col} - (2 \cdot t_w) = 4.026 \cdot in$

$A_{col} := \frac{\pi}{4} \cdot \left(Dia_{col}^2 - InsideDia_{col}^2\right) = 3.174 \cdot in^2$

clear column height (for wind direction normal to sign): $Ht_{col} := 12.15 \cdot ft$

$S_{col} := \pi \cdot \frac{\left(Dia_{col}^4 - InsideDia_{col}^4\right)}{32 \cdot Dia_{col}} = 3.214 \cdot in^3$

$r_{Gy} := \frac{\sqrt{Dia_{col}^2 + InsideDia_{col}^2}}{4} = 1.51 \cdot in$

Moment of Inertia: $I := \pi \cdot \frac{\left(Dia_{col}^4 - InsideDia_{col}^4\right)}{64} = 7.233 \cdot in^4$

$I_T := I = 7.233 \cdot in^4$

$I_B := I = 7.233 \cdot in^4$

RESISTANCE FACTORS:

Aluminum Members (AASHTO LRFDLTS-1 Section 6.5)

Resistance Factor for Compression: $\Phi_c := 0.9$

Resistance Factor for Flexure: $\Phi_b := 0.9$

Resistance Factor for Tension (yielding): $\Phi_{ty} := 0.9$

Resistance Factor for Tension (rupture): $\Phi_{tr} := 0.75$

Resistance Factor for Shear: $\Phi_v := 0.9$

COLUMN DESIGN:

Forces from Wind Load and Dead Load at column bottom fixed connection :

Column Axial Dead Load:

Pole Self weight $DL := Density_{aluminum} \cdot A_{col} \cdot Ht_{col} = 0.045 \cdot kip$

Factored Self weight $D_{uP} := 1.1 \cdot DL = 0.05 \cdot kip$

Factored load at top of pole $P_{uT} := 1.1 \cdot 0.0068 \cdot kip = 0.0075 \cdot kip$

$P_{uDL} := P_{uT} + D_{uP} = 0.057 \cdot kip$

Column Flexural Load:

Load Case 1 (100% wind Normal) (AASHTO LRFDLTS-1 Table 3.9.3-1)

Total Mx from wind pressure on sign structure: $M1x_A := 4.097 \cdot kip \cdot ft$ $M1x_A = 4.097 \cdot kip \cdot ft$

Total My (column bottom): $M1y_A := 0.0 \cdot M1x_A$ $M1y_A = 0 \cdot kip \cdot ft$

Design Moment: $M1ucol_T := \sqrt{M1x_A^2 + M1y_A^2}$ $M1ucol_T = 4.097 \cdot kip \cdot ft$

Load Case 2 (75% wind Normal, 75% wind Transverse) (AASHTO LRFDLTS-1 Table 3.9.3-1)

Total Mx $M2x_A := 3.088 \cdot kip \cdot ft$ $M2x_A = 3.088 \cdot kip \cdot ft$

Total My $M2y_A := 0.960 \cdot kip \cdot ft$ $M2y_A = 0.96 \cdot kip \cdot ft$

Design Moment: $M2ucol_T := \sqrt{M2x_A^2 + M2y_A^2}$ $M2ucol_T = 3.234 \cdot kip \cdot ft$

Controlling Moment: $Mucol_T := \max(M1ucol_T, M2ucol_T)$ $Mucol_T = 4.097 \cdot kip \cdot ft$

Column Torsional Load:

Load Case 1 (100% wind Normal)

Torsion: $T_{ut1} := 0.124 \cdot kip \cdot ft$ (AASHTO LRFDLTS-1 Table 3.9.3-1)

Load Case 2 (75% wind Normal, 75% wind Transverse) (AASHTO LRFDLTS-1 Table 3.9.3-1)

Torsion: $T_{ut2a} := 0.093 \cdot kip \cdot ft$

$T_{ut2b} := 0.009 \cdot kip \cdot ft$

$T_{ut2} := T_{ut2a} + T_{ut2b}$

Design Torsion: $T_{ut} := \max(T_{ut1}, T_{ut2})$ $T_{ut} = 0.124 \cdot kip \cdot ft$

Column Shear Load:

Load Case 1 (100% wind Normal)

(AASHTO LRFDLTS-1 Table 3.9.3-1)

Total Vx $V1ux_A := 0.466 \cdot kip$ $V1ux_A = 0.466 \cdot kip$

Total Vy $V1uy_A := 0.0 \cdot V1ux_A$ $V1uy_A = 0 \cdot kip$

Design Shear: $V1ucol_S := \sqrt{V1ux_A^2 + V1uy_A^2}$ $V1ucol_S = 0.466\,kip$

Load Case 2 (75% wind Normal, 75% wind Transverse) (AASHTO LRFDLTS-1 Table 3.9.3-1)

Total Vx $V2ux_A := 0.349 \cdot kip$ $V2ux_A = 0.349\,kip$

Total Vy $V2uy_A := 0.154 \cdot kip$ $V2uy_A = 0.154\,kip$

Design Shear: $V2ucol_S := \sqrt{V2ux_A^2 + V2uy_A^2}$ $V2ucol_S = 0.381\,kip$

Controlling Shear: $Vucol_S := \max(V1ucol_S, V2ucol_S)$ $Vucol_S = 0.466\,kip$

Member Compression

Effective Length Factor: $k = 2.1$ Unbraced length: $L_u := Ht_{col}$ (AASHTO LRFDLTS-1 Table B.6-1)

$\frac{k \cdot L_u}{r_{Gy}} = 202.832$

$\lambda_c := \frac{k \cdot L_u}{r_{Gy}}$ $\lambda_c = 202.832$

Calculate Buckling Constant C_c: (AASHTO LRFDLTS-1 Table 6.5.2-2)

$K := 1.0 \cdot ksi$

Intercept: $B_c := F_{cy} \cdot \left[1 + \left(\frac{F_{cy}}{2250 \cdot K}\right)^2\right]^{\frac{1}{2}}$ $B_c = 39.365\,ksi$

Slope: $D_c := \frac{B_c}{10} \cdot \left(\frac{B_c}{E}\right)^{\frac{1}{2}}$ $D_c = 0.246\,ksi$

Intersection:

$$C_c := 0.41 \cdot \frac{B_c}{D_c}$$

$C_c = 65.673$

$$\lambda_{2c} := C_c$$

$\lambda_{2c} = 65.673$

Design Stresses:

Available Compression Stress:

$$F_c := \begin{cases} \dfrac{0.85 \cdot \pi^2 \cdot E}{\lambda_c^2} & \text{if } \lambda_c \geq \lambda_{2c} \\ 0.85 \cdot \left(\left(B_c - D_c \cdot \lambda_c \right) \right) & \text{if } \lambda_c < \lambda_{2c} \wedge 0.85 \cdot \left(B_c - D_c \cdot \lambda_c \right) \leq F_{cy} \\ F_{cy} & \text{if } \lambda_c < \lambda_{2c} \wedge 0.85 \cdot \left(B_c - D_c \cdot \lambda_c \right) > F_{cy} \end{cases}$$

(AASHTO LRFDLTS-1 Table 6.5.1-3, Eq. 6.5.1-11)

$F_c = 2.06\ \text{ksi}$

$\Phi_c \cdot F_c = 1.854\ \text{ksi}$

Developed Compression Stress:

$$f_c := \frac{P_{uDL}}{A_{col}}$$

$f_c = 0.018\ \text{ksi}$

Ratio of Developed Axial Stress to Available Axial Stress:

$$\frac{f_c}{\Phi_c \cdot F_c} = 9.708 \times 10^{-3}$$

Member Flexure

Calculate coefficient for Moment Magnification B_2:

Check validity for use of Simplified method

(AASHTO LRFDLTS-1, Eq. 4.8.1-1)

$$\text{Method} := \text{if}\left(2 \cdot \pi \cdot \sqrt{\frac{E}{F_{ty}}} \leq \frac{k \cdot L_u}{r_{Gy}}, \text{"Simplified"}, \text{"Detailed"} \right)$$

Method = "Simplified"

$$P_{Euler\_bottom} := \frac{\pi^2 \cdot E \cdot I_B}{(k \cdot L_u)^2}$$ $P_{Euler\_bottom} = 7.691 \cdot kip$

$$P_{equivalent} := \sqrt[3]{\frac{I_B}{I_T}} \cdot P_{uT} + 0.38 \cdot D_{uP}$$ $P_{equivalent} = 0.026 \cdot kip$

$$B_2 := \max\left(\frac{1}{1 - \frac{P_{equivalent}}{P_{Euler\_bottom}}}, 1\right)$$ $B_2 = 1.003$

Available Flexural Stress:

Tension alloy coefficient: $k_t = 1.0$ (AASHTO LRFDLTS-1, Table 6.6.2-1)

Available Flexural Tension yielding strength: $\phi_{ty} \cdot 1.17 \cdot F_{ty} = 36.855 \cdot ksi$ (AASHTO LRFDLTS-1, Table 6.5.1-2)

Available Flexural Tension rupture strength: $\phi_{tr} \cdot \frac{1.24 \cdot F_{tu}}{k_t} = 35.34 \cdot ksi$

Available Flexural Compression yielding strength: $\phi_b \cdot 1.17 \cdot F_{cy} = 36.855 \cdot ksi$ (AASHTO LRFDLTS-1, Table 6.5.1-5)

Developed Flexural Stress:

$$f_b := \frac{Mucol_T}{S_{col}}$$ $f_b = 15.294 \cdot ksi$ $Mucol_T = 4.097 \cdot kip \cdot ft$

Ratio of Developed Flexural Stress to Available Flexural Stress:

$$\frac{f_b}{\min\left(\phi_{ty} \cdot 1.17 \cdot F_{ty}, \phi_{tr} \cdot \frac{1.24 \cdot F_{tu}}{k_t}, \phi_b \cdot 1.17 \cdot F_{cy}\right)} = 0.433$$

Member Shear

Mid-thickness radius of pipe $R_b := \frac{Dia_{col}}{2} - \frac{t_w}{2}$ $R_b = 2.131\ in$

$$\lambda_s := 2.9 \cdot \left(\frac{R_b}{t_w}\right)^{\frac{5}{8}} \cdot \left(\frac{Ht_{col}}{R_b}\right)^{\frac{1}{4}}$$ $\lambda_s = 32.914$ (AASHTO LRFDLTS-1 Table 6.5.1-9)

Calculate Buckling Constant: (AASHTO LRFDLTS-1 Table 6.5.2-2)

Intercept:

$$B_s := F_{sy} \cdot \left[1 + \left(\frac{F_{sy}}{800 \cdot K}\right)^{\frac{1}{3}}\right]$$ $B_s = 27.241\ ksi$

Slope:

$$D_s := \frac{B_s}{10} \cdot \left(\frac{B_s}{E}\right)^{\frac{1}{2}}$$ $D_s = 0.141\ ksi$

Intersection:

$$C_s := 0.41 \cdot \frac{B_s}{D_s}$$ $C_s = 78.946$

$$\lambda_{1s} := \frac{1.3 \cdot B_s - F_{sy}}{1.63 \cdot D_s}$$ $\lambda_{1s} = 62.503$ (AASHTO LRFDLTS-1 Table 6.5.1-9, Eq. 6.5.1-37)

$$\lambda_{2s} := \frac{C_s}{1.25}$$ $\lambda_{2s} = 63.157$

Available Shear Stress:

$$F_s := \begin{cases} F_{sy} & \text{if } \lambda_s \le \lambda_{1s} \\ 1.3 \cdot B_s - 1.63 \cdot D_s \cdot \lambda_s & \text{if } \lambda_{1s} < \lambda_s < \lambda_{2s} \\ \frac{1.3 \cdot \pi^2 \cdot E}{(1.25 \cdot \lambda_s)^2} & \text{if } \lambda_s \ge \lambda_{2s} \end{cases}$$ (AASHTO LRFDLTS-1 Table 6.5.1-9, Eq. 6.5.1-37)

$F_s = 21\ ksi$ $\phi_v \cdot F_s = 18.9\ ksi$

Developed Shear Stress due to shear:

$$f_{sv} := \frac{2.0 \cdot Vucol_S}{A_{col}}$$

$f_{sv} = 0.294\ ksi$ (AASHTO LRFDLTS-1 Table B.3-1)

Developed Shear Stress due to torsion:

$$f_{st} := \frac{T_{ut}}{6.28 \cdot R_b^{\ 2} \cdot t_w}$$

$f_{st} = 0.22\ ksi$

Total Shear Stress due to shear and torsion:

$$f_s := f_{sv} + f_{st}$$

$f_s = 0.514\ ksi$

Ratio of Developed Shear Stress to Available Shear Stress:

$$\frac{f_s}{(\phi_v \cdot F_s)} = 0.027$$

Combined Stress Ratio (CSR):

$$CSR := \frac{f_c}{\phi_c \cdot F_c} + \frac{B_2 \cdot f_b}{\min\left(\phi_{ty} \cdot 1.17 \cdot F_{ty}, \phi_{tr} \cdot \frac{1.24 \cdot F_{tu}}{k_t}, \phi_b \cdot 1.17 \cdot F_{cy}\right)} + \left[\frac{f_s}{(\phi_v \cdot F_s)}\right]^2$$

(AASHTO LRFDLTS-1 Table 6.5.1-12, Eq. 6.5.1-48)

$CSR = 0.445$

$CheckCSR := if(CSR < 1.00, "OK", "NG")$ $CheckCSR = "OK"$

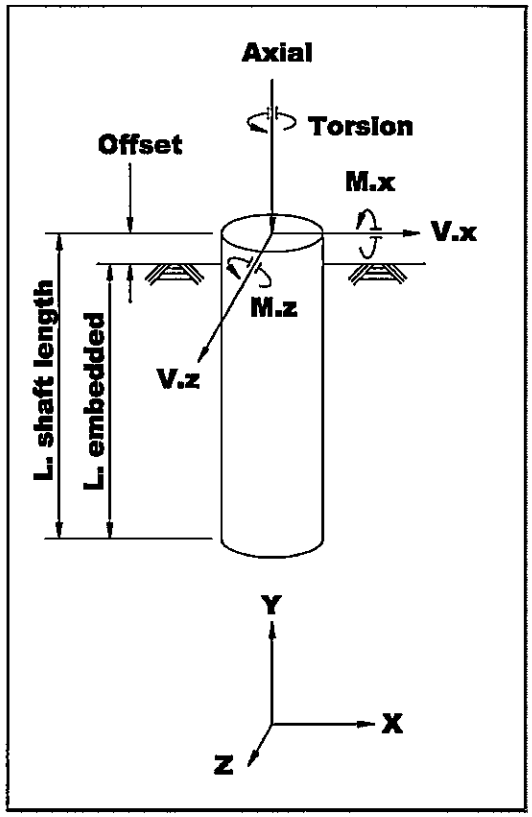
Drilled Shaft Foundation for Sign and Signal Structures
AASHTO LRFD LTS Design Specification, 1st Ed.

FDOT
State Structures Design Office

SUBJECT 105 mph for 100 W Assembly

DESIGNED BY SD DATE 8-26-21
CHECKED BY JAV DATE 8-30-21

Input



Program Changes

Soil Properties

SoilType := Sand / Clay

$\phi_{soil} := 32 \cdot deg$ — *soil friction angle (sand)*

$c_{soil} := 0.0 \cdot \frac{kip}{ft^2}$ — *soil shear strength (clay)*

$N_{blows} := 5$ — *number of blows per foot. If N< 5, contact the district geotech Engineer*

$\gamma_{soil} := 62.5 \cdot pcf$ — *effective soil weight (typical design value = 45 ~ 50 pcf)*

Geometry

$b := 2.0 \cdot ft$ — *shaft diameter*

$Offset := 2.0 \cdot ft$ — *groundline to top of foundation*

Applied Loads (Extreme I)

$M_x := 4.097 \cdot kip \cdot ft$ $V_x := 0.0 \cdot kip$ $Torsion := 0.124 \cdot kip \cdot ft$

$M_z := 0.0 \cdot kip \cdot ft$ $V_z := 0.466 \cdot kip$ $Axial := 0.120 \cdot kip$

StructureType := Cantilever Overhead Sign Structure / Mast Arm Signal Structure / Concrete/Steel Strain Poles / Ground Sign

StructureType = 3

$\phi_{ot} := if(StructureType = 3, 0.8, 0.6)$ $\phi_{ot} = 0.8$ — *ϕ factor against overturning [SM Vol-3 13.6.1.1]*

$\phi_{tor} := if(StructureType = 0, 0.9, 1.0)$ $\phi_{tor} = 1$ — *ϕ factor against torsion [SM Vol-3 13.6.1.1]*

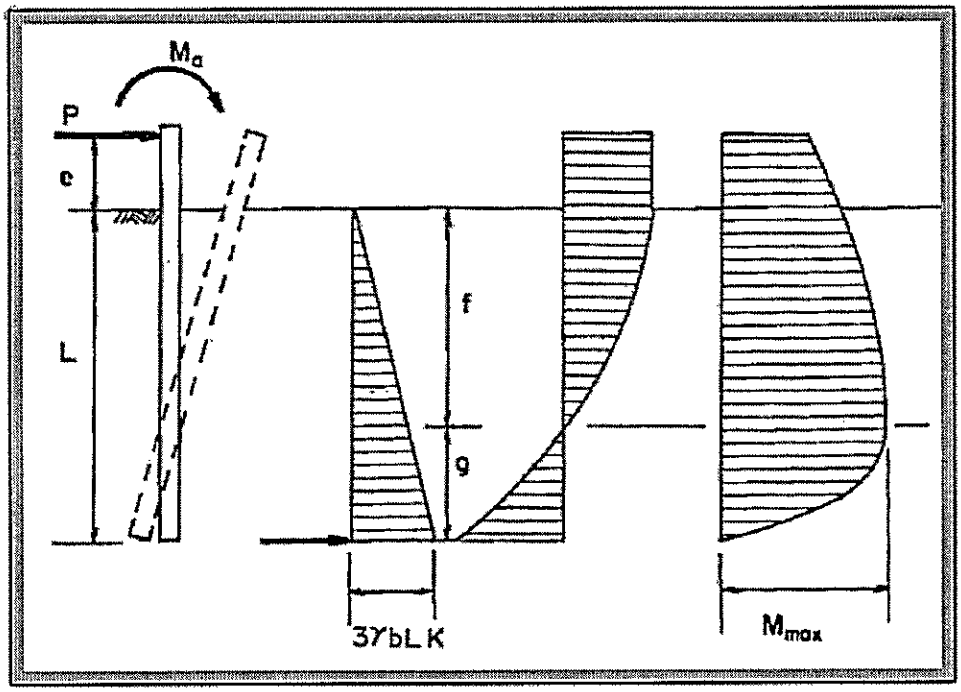
Shaft Depth Required to Resist Overturning

$M_u := \sqrt{M_x^2 + M_z^2} = 4.1 \cdot kip \cdot ft$

$P_u := \sqrt{V_x^2 + V_z^2} = 0.5 \cdot kip$

$T_u :=$ Torsion $= 0.1 \cdot kip \cdot ft$

short free-head pile in cohesionless soil using Broms method



Deflection, load, shear and moment diagram for a short pile in cohesionless soil that is unrestrained against rotation.

$K_p := \tan\left(45 \cdot deg + \frac{\phi_{soil}}{2}\right)^2 = 3.3$ $\quad e_{sand} :=$ Offset $= 2$ ft

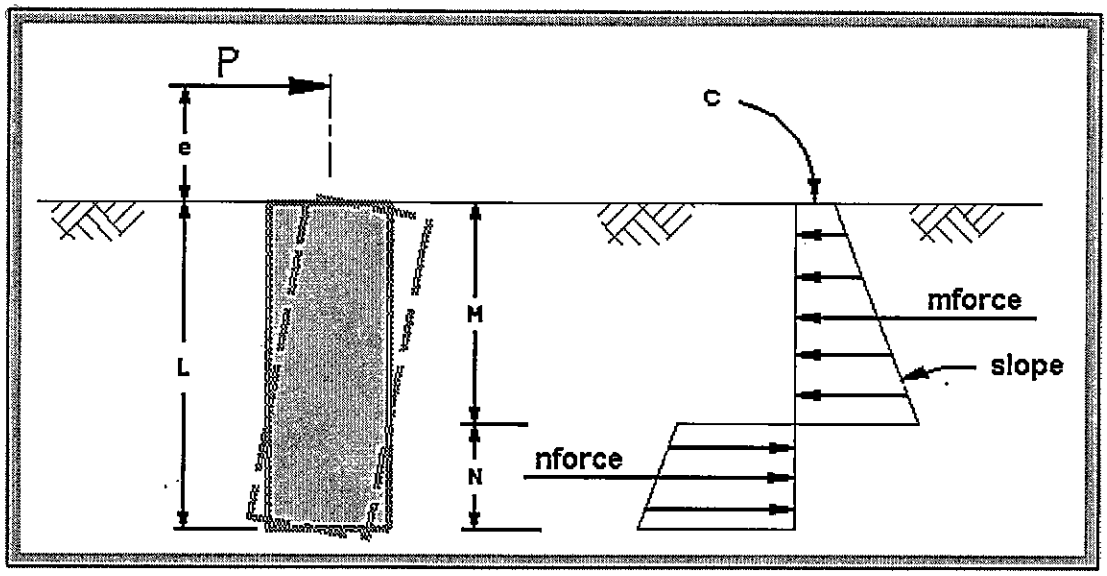
Guess value $\quad L_{otSand} := 8 \cdot ft$

Given $\quad P_u \cdot (e_{sand} + L_{otSand}) + M_u = \phi_{ot} \cdot \left[\left(3 \cdot \gamma_{soil} \cdot b \cdot L_{otSand} \cdot K_p\right) \cdot \left(\frac{1}{2} \cdot L_{otSand}\right) \cdot \left(\frac{1}{3} \cdot L_{otSand}\right)\right]$

$L_{otSand} := \text{Find}(L_{otSand}) = 3.4$ ft

$L_{otSand} := \text{ceil}\left(\frac{L_{otSand}}{ft}\right) \cdot ft = 4$ ft $\quad$ *(round up to next foot)*

short free-head pile in <u>cohesive soil</u> using Modified Broms method for L < 3b (see reference file for derivation)



Deflection, load, shear and moment diagram for a short pile in cohesive soil that is unrestrained against rotation.

$c_{soil} := \text{if}(c_{soil} = 0 \cdot ksf, 0.1 \cdot ksf, c_{soil}) = 0.1 \cdot ksf$

$\text{Slope} := 8 \cdot \frac{c_{soil}}{3 \cdot b} = 0.1 \cdot \frac{kip}{ft^3}$ $\qquad e_{clay} := \frac{M_u}{P_u} + \text{Offset} = 10.8\ ft$

$\text{nforce}(M,N) := \left[\text{Slope} \cdot (2 \cdot M + N) + 2 \cdot c_{soil}\right] \cdot N \cdot \frac{b}{2}$ $\qquad \text{mforce}(M) := \left(2 \cdot c_{soil} + M \cdot \text{Slope}\right) \cdot M \cdot \frac{b}{2}$

$\text{m\_arm}(M) := e_{clay} + \frac{M}{3} \cdot \frac{2 \cdot \left(M \cdot \text{Slope} + c_{soil}\right) + c_{soil}}{M \cdot \text{Slope} + 2 \cdot c_{soil}}$

$\text{n\_arm}(M,N) := e_{clay} + M + \frac{N}{3} \cdot \frac{2 \cdot \left(N \cdot \text{Slope} + M \cdot \text{Slope} + c_{soil}\right) + \left(M \cdot \text{Slope} + c_{soil}\right)}{\text{Slope} \cdot (2 \cdot M + N) + 2 \cdot c_{soil}}$

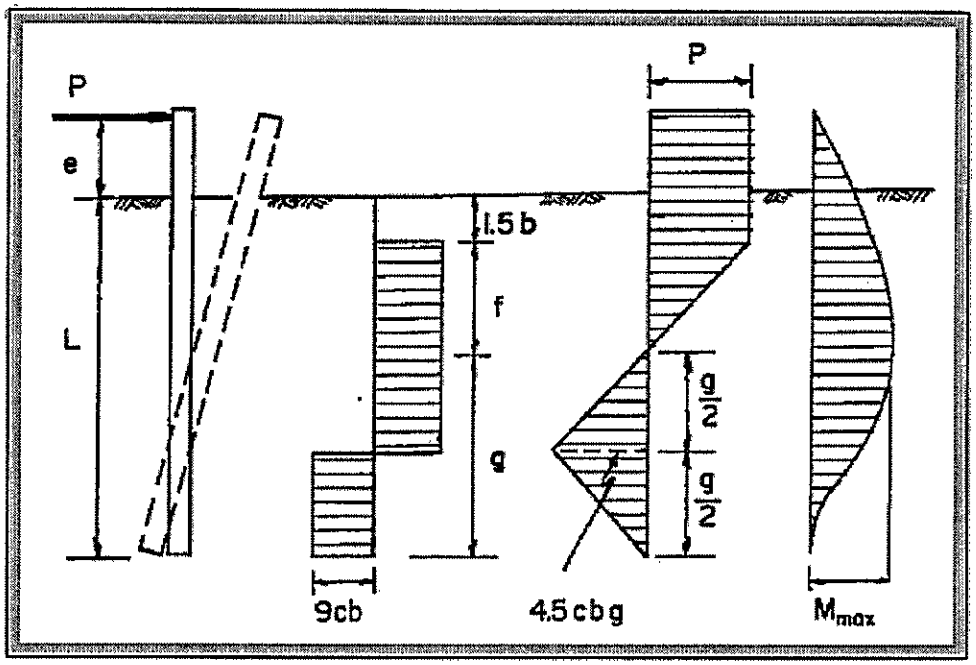
Guess value $\qquad M := 4.0 \cdot ft \qquad N := 4.0 \cdot ft$

Given $\qquad P_u + \phi_{ot} \cdot \text{nforce}(M,N) = \phi_{ot} \cdot \text{mforce}(M) \qquad \text{mforce}(M) \cdot \text{m\_arm}(M) = \text{nforce}(M,N) \cdot \text{n\_arm}(M,N)$

$\begin{pmatrix} M \\ N \end{pmatrix} := \text{Find}(M,N) \qquad L_{otlClay} := M + N = 6.3\ ft$

$L_{otlClay} := \text{ceil}\left(\frac{L_{otlClay}}{ft}\right) \cdot ft = 7\ ft$ $\qquad$ *(round up to next foot)*

short free-head pile in cohesive soil using Regular Broms method for L > 3b



Deflection, load, shear and moment diagram for a short pile in cohesive soil that is unrestrained against rotation.

$M_{max.clay}$ *equation is derived from the integration of the upper part of the shear diagram to the point of zero shear.*

$$f := \frac{P_u}{\phi_{ot} \cdot 9 \cdot c_{soil} \cdot b} = 0.3\,ft$$

$$M_{max.clay} := P_u \cdot \left(e_{clay} + 1.5 \cdot b + 0.5 \cdot f\right) = 6.5 \cdot kip \cdot ft$$

$$g := \sqrt{\frac{M_{max.clay}}{2.25 \cdot \phi_{ot} \cdot c_{soil} \cdot b}} = 4.2\,ft$$

$$L_{ot2Clay} := (1.5 \cdot b + f + g) = 7.6\,ft$$

$$L_{ot2Clay} := ceil\left(\frac{L_{ot2Clay}}{ft}\right) \cdot ft = 8\,ft \qquad \textit{(round up to next foot)}$$

$$L_{otClay} := if\left(L_{ot1Clay} < 3 \cdot b, L_{ot1Clay}, L_{ot2Clay}\right) = 2.4 \qquad \textit{(If } L_{ot} < 3b\textit{, use Modified Broms method)}$$

$$L_{reqdOT} := if\left(SoilType = \text{"Sand"}, L_{otSand}, L_{otClay}\right)$$

$L_{reqdOT} = 4\,ft$ *required shaft embedment depth to resist overturning*

Shaft Depth Required to Resist Torsion

short free-head pile in cohesionless soil

NOTE: ω_{fdot} is based upon concrete soil interaction. This torsion methodology is not to be used with permanent casing.

$N_{blows} = 5$

$$\omega_{fdot} := \text{if}\left(N_{blows} < 5, 0, \text{if}\left(N_{blows} \geq 15, 1.5, 1.5 \cdot \frac{N_{blows}}{15}\right)\right) = 0.5$$

load transfer ratio, If 5<N<15, ω_{fdot} is reduced by a factor of $\frac{N_{blows}}{15}$ SM Vol-3 13.6

Guess value $L_{torSand} := L_{reqdOT} = 4\,ft$

Given $T_u = \phi_{tor} \cdot \left[\pi \cdot b \cdot (L_{torSand}) \cdot \gamma_{soil} \cdot \left(\frac{L_{torSand}}{2}\right) \cdot (\omega_{fdot}) \cdot \frac{b}{2}\right]$

$L_{torSand} := \text{Find}(L_{torSand}) = 1.1\,ft$

$L_{torSand} := \text{ceil}\left(\frac{L_{torSand}}{ft}\right) \cdot ft = 2\,ft$ *(round up to next foot)*

short free-head pile in cohesive soil

$\text{CohesionFactor} := 0.55$

$f_{se} := \text{CohesionFactor} \cdot c_{soil} = 0.1 \cdot ksf$

Guess value $L_{torClay} := L_{reqdOT}$

Given $T_u = \phi_{tor} \cdot \left[f_{se} \cdot (\pi \cdot b) \cdot (L_{torClay} - 1.5 \cdot ft) \cdot \frac{b}{2}\right]$

$L_{torClay} := \text{Find}(L_{torClay}) = 1.9\,ft$

$L_{torClay} := \text{ceil}\left(\frac{L_{torClay}}{ft}\right) \cdot ft = 2\,ft$ *(round up to next foot)*

$L_{reqdTor} := \text{if}(\text{SoilType} = \text{"Sand"}, L_{torSand}, L_{torClay})$

$L_{reqdTor} = 2\,ft$ *required shaft embedment depth to resist torsion*

$L_{embedded} := \text{if}(L_{reqdTor} > L_{reqdOT}, L_{reqdTor}, L_{reqdOT}) = 1.2$

$L_{shaft.length} := L_{embedded} + \text{Offset}$

$L_{shaft.length} = 6\,ft$ *shaft length*

FREY Manufacturing Corp.

Information Package For:

CP6 Series Pole

13150 Stewart Ave., Norwood, MN 55368 | Office: 952-467-4402 | Fax: 1-866-941-3739

Email: FreyMfg@FreyMfgCorp.com | Web: www.FreyMfgCorp.com

FREY Manufacturing Corp.

TABLE OF CONTENTS

FREY Manufacturing Corp.

Product Literature

FREY Manufacturing Corp.
13150 Stewart Ave., Norwood, MN 55368
www.freymfgcorp.com
952-467-4402 freymfg@freymfgcorp.com

Dear Viewer,

Thank you for taking the time to review our product for consideration to be used on your projects. We have been approved in Departments of Transportation across the country and can produce references upon request.

This Information Package has documents for you to get a better understanding of our CP6 Pole Series.

Benefits of our Product:

- **Stocked Product**
- **Small Footprint**
- **Frangible Base**
- **Heights up to 16' tall**
- **AASHTO MASH Breakaway Tested**
- **FHWA Letter of Eligibility for Federal Aid Reimbursement Program. This allows up to 90% reimbursement for this product for approved projects.**
- **ADA Accessible**
- **Can be retrofitted over existing pipes and conduit.**

AAHSTO MASH test link: https://www.youtube.com/watch?v=ap2xXilwRc4&t=1s

See a general information video: https://www.youtube.com/watch?v=ZhAaGT4liVs&t=1s

Federal-aid Program info: www.fhwa.dot.gov/federal-aidessentials/stateresources.cfm

Please let me know how we can help you get the info you need to make a decision for use of this product on your upcoming construction and maintenance season.

With Gratitude,

Michael Frey

Mike Frey, Business Development Director

13150 STEWART AVE. * NORWOOD, MN 55368-9675
PHONE (952) 467-4402; Toll Free Fax: 1-866-941-FREY (3739)
Mobile: (612) 790-2797
E-MAIL: Freymfg@FreyMfgCorp.com; Website: FreyMfgCorp.com

March 27, 2019

Signal Pole, CP6 Series Generic Specification

Edit as required, reference with other state specifications as required.

Requirements:

1. Shall be constructed of aluminum.

    a. Shall be clear anodized. (insert color)

    or

    a. Shall have black powder coat finish. (insert color)

2. Shall not have any sharp edges.

    a. Edges shall be rounded.

3. Shall have a foot print of 7 inches by 7 inches.

4. Shall have a base height of 10 inches tall.

5. Shall fully enclose and cover the anchor rods on the interior of the pedestal base.

    a. Base shall be a single casting with an access door bolted directly to grade with four (4) anchor bolts.

    b. External anchor rod covers are not acceptable.

    c. Bolting base to an anchor flange is not acceptable.

    d. Pedestal base shall be shimmed if necessary for vertical adjustment.

6. Shall be mounted directly to a sidewalk or pier, or foundation with a 6 inch bolt circle.

    a. Shall have 4 mounting anchor bolt slots for securing the pedestal base to grade.

    b. Shall be supported by 5/ 8 X 7 ½ inch stainless steel anchor rods imbedded in adhesive. Adhesive shall be determined by ambient outdoor temperature at the time of installation.

    or

    b. 5/8" x 8" Galvanized Steel L-Anchor Bolt with Nut and USS Flat Washer.

7. Shall have an access door on one vertical side with minimum opening of 21 inches squared.

    a. Shall be clear anodized. (insert color)

    or

a. Shall have black powder coat finish. (insert color)

b. Shall be attached with stainless steel hardware.

8. Shall support a 4 inch National Pipe Thread (N.P.T.) pedestal shaft that is screwed in at the top of the pedestal base. Pipe heights shall accommodate load specifications.

a. Pedestal support pipe under 10' tall and base shall be secured with a cable tether, including 5/16" X 7" stainless steel bolt passing through the base, pedestal support shaft and stainless steel cable rope tether, secured with a washer, lock washer and nut. Stainless steel 1/8" rope tether shall be looped at both ends with swagger fasteners tethering the 5/16" bolt to one of the base anchors with a 5/8" washer and nut.

b. Pedestal support pipe equal to or greater than 10' tall and base shall not be required to include a cable tether.

9. Shall be a breakaway or frangible base.

a. Base shall yield (breakaway, or be frangible) before the schedule 40 aluminum shaft that is secured into the top of the pedestal base fails. Base shall be tested to exceed 12,000 flb. bending moment.

10. Shall have a copper grounding lug installed which supports 14 AWG thru 4 AWG conductors.

11. Shall be 4" Schedule 40 aluminum support pedestal shaft pipe with N.P.T threads on one end to thread into base.

a. Shall be brushed aluminum with clear anodized. (insert color)

or

a. Shall have black powder coat finish. (insert color)

b. Shall be attached with stainless steel hardware.

12. Shall have a top cap secured to support pedestal shaft with three stainless steel Allen head type set screws. Top cap shall have a tapered inside.

a. Shall be clear anodized. (insert color)

or

a. Shall have black powder coat finish. (insert color)

b. Allen bolts shall be flush with the outside of cap

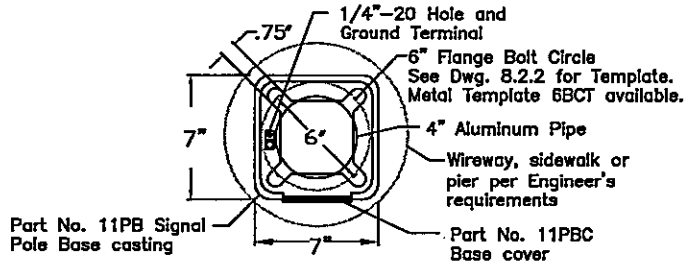
13. Switch shall be mounted with 1/4" insert nut for schedule 40 support shaft.

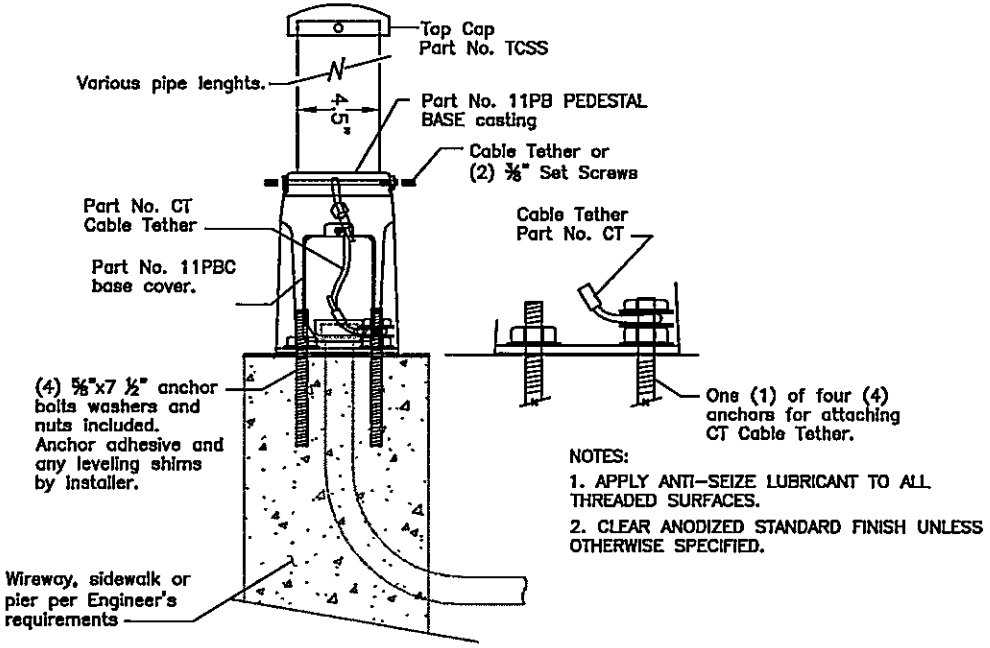
a. Insert nut shall be installed with setting tool designed for insert nut installation.

b. Switch cable shall pass through support pipe protected with an insulating sleeve.

c. Other signal and sign equipment or accessories shall be installed as per those specification sections.

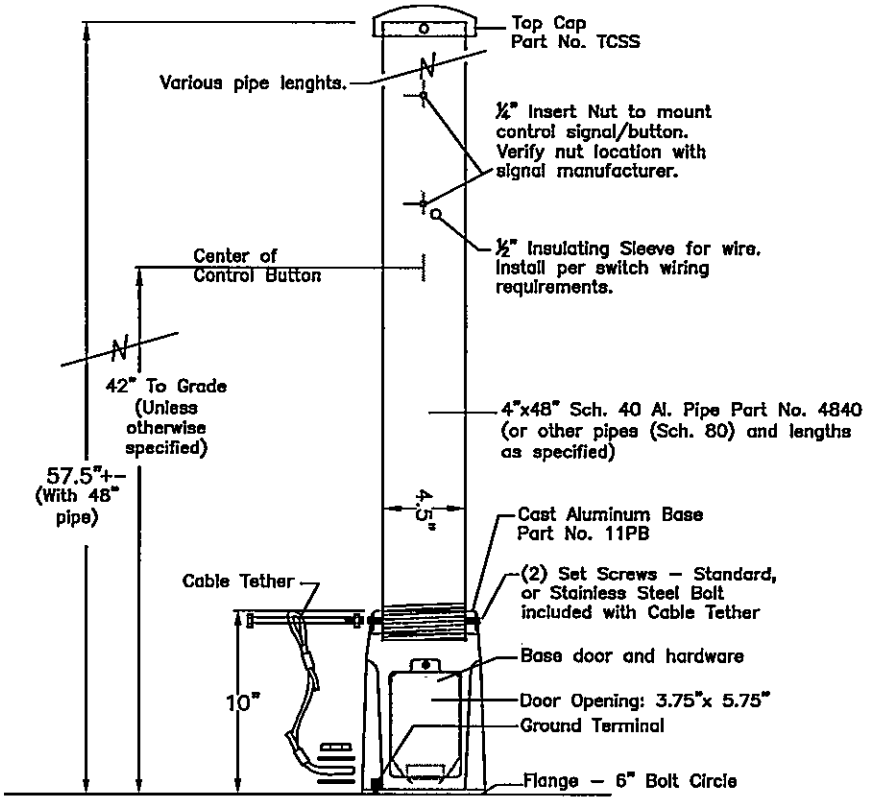
14. Shall be AASHTO MASH Breakaway Tested at an accredited laboratory. Shall be FHWA eligible for Federal-Aid Reimbursement Program.





NOTES:

1. APPLY ANTI–SEIZE LUBRICANT TO ALL THREADED SURFACES.
2. CLEAR ANODIZED STANDARD FINISH UNLESS OTHERWISE SPECIFIED.



CP6A (See "Finish") SIGNAL POLE BASE ASSEMBLY & ANCHORS INCLUDED PARTS:
(1) 11PB ALUMINUM BASE
(1) 11PBC BASE COVER, & HARDWARE
(2) ⅜" SS SET SCREWS
(1) 25ABPK ANCHOR BOLT KIT: (4) ⅝"X7½" SS FT BOLTS, ⅝" FLAT WASHERS & NUTS (Others available)
(ANCHOR ADHESIVE AND ANY REQUIRED LEVELING SHIMS BY INSTALLER)
(1) 14–4 CU GROUND LUG
(1) ¼" SS GROUND LUG BOLT

4840 – (See "Finish") ALUMINUM PIPE ASSEMBLY INCLUDED PARTS:
(1) 48" SCHEDULE 40 ALUMINUM PIPE ONE END THREADED (Other pipes & lengths available)
(2) IN¼20 ¼" INSERT NUTS FOR 4" SCHEDULE 40 PIPE (Install with a setting tool)
(1) 12IS ½" INSULATING SLEEVE

TCSS (See "Finish") DOMED TOP CAP ASSEMBLY INCLUDED PARTS:
(1) 11TCSS TOP CAP
(3) ¼" SS SET SCREW

CT CABLE TETHER INCLUDED PARTS:
(1) ⅝"BOLT
(1) 18" WIRE CABLE ASSEMBLY
(1) ⅝" JAM NUT.
(1) ⅝" LOCK WASHER & NUT
(2) ⅝" FLAT WASHER

BUILD CATALOG NUMBER FROM BELOW CP6 SERIES ASSEMBLIES

Signal pole base w/ 6" Bolt Circle, Cover – Anchors	–	Cable Tether	– 48" Schedule 40 Aluminum Pipe	– Top Cap w/Set Screws	– Vandal Resistant	– Finish
CP6	A Other styles of anchors available	CT	4840 "48" Represents inches of pipe, i.e. a 10' schedule 40 pipe would be 12040. Schedule 80 available.	TCSS	V Vandal resistant hardware option	(Blank) Clear Anodized standard NF (No Finish) (Other finishes & colors available, insert powder coat RAL number or Anodize number) See Note 2.

NOT TO SCALE HARDWARE MEETS OR EXCEEDS STATE SPECIFICATIONS

FREY Manufacturing Corp.
www.FreyMfgCorp.com
Made in USA
Phone: 952-467-4402

CP6 SERIES SIGNAL POLE

AASHTO MASH BREAKAWAY TESTED & FHWA ELIGIBLE FOR FEDERAL-AID REIMBURSEMENT PROGRAM

DATE	DWG. NO.	REV.
5-17-19	8.1.1	R2

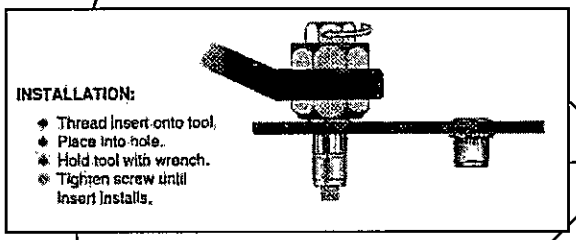
TYP. DRILL & TAP SCH. 80 PIPE. USE INSERT NUTS FOR SCH. 40 PIPE.

CAMPBELL TEMPLATE

OLD POLARA TEMPLATE

NEW POLARA TEMPLATE

6" BOLT CIRCLE



FOLLOW SETTING TOOL INSTRUCTIONS FOR INSERT NUT INSTALLATION. USE SHARP $25/64$" BIT.

DRILL (4) HOLES TO EMBED ANCHORS. 4" MIN. IN CONCRETE.

EPOXY TO SET ANCHORS SUPPLIED BY INSTALLER.

6"

6"

$8\ 1/4$"

POLARA

For new style Polara switch, drill additional 3rd hole 6" down.

FIELD PLACE SWITCH TEMPLATE SO PUSHBUTTON IS 42" ABOVE GRADE, OR AS OTHERWISE SPECIFIED.

NOTE: INSTALL ¼" INSERT NUTS WITH SETTING TOOL.

APPLY ANTI-SEIZE LUBRICANT TO ALL THREADED SURFACES.

FIELD DRILL $5/8$" HOLE FOR INSULATION SLEEVE FOR SWITCH WIRING.

CAMPBELL

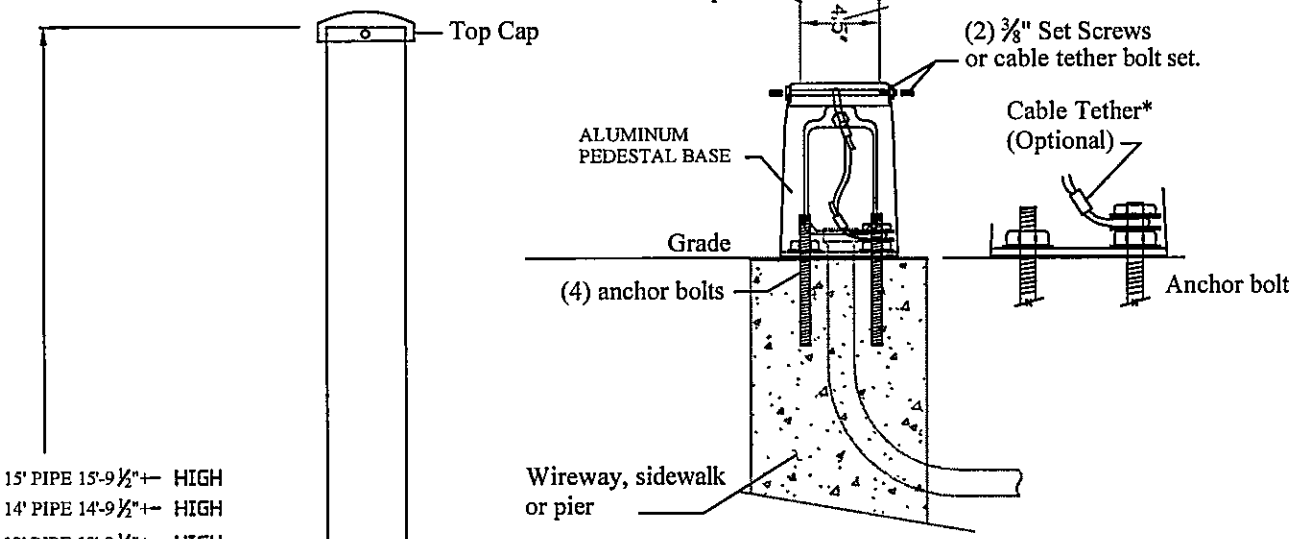
Scale: 1"=1"

IF THIS LINE IS NOT 1 INCH LONG, ADJUST MEASUREMENTS ACCORDINGLY. DO NOT PHOTOCOPY ORIGINAL.

FREY Manufacturing Corp.
www.FreyMfgCorp.com
Patent
Made in USA

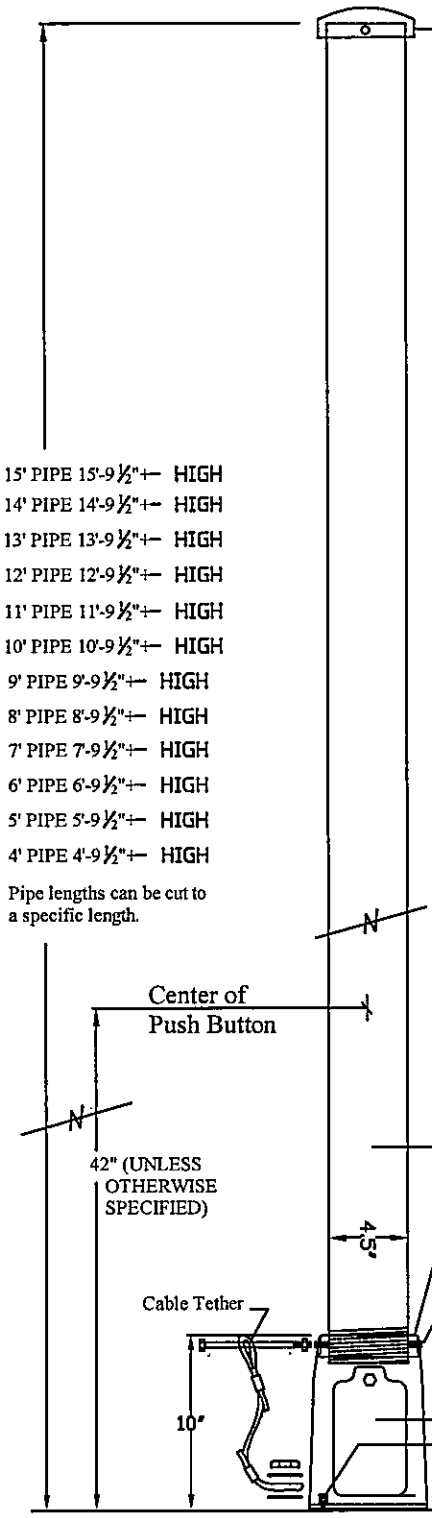
CROSSWALK PEDESTAL
TEMPLATES
BASE & INSERT NUTS

DATE	DWG. NO.	REV.
11-3-14	8.2.1	1

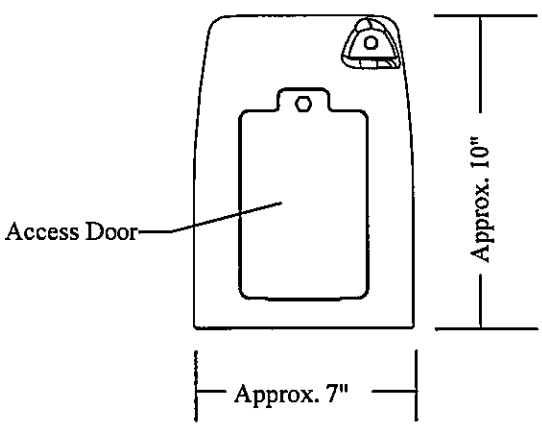


* Cable Tether (CT) recommended for assemblies 10' or less.

BASE MOUNTING



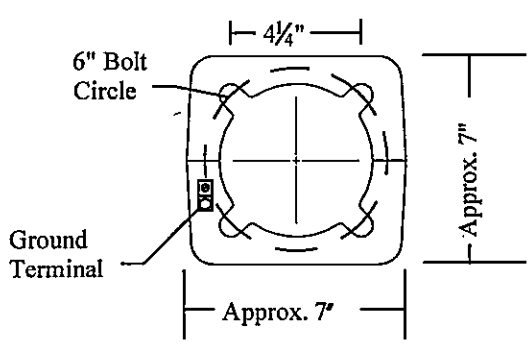
AASHTO MASH test video.



BASE SIDE VIEW

* Cable Tether (CT) recommended for assemblies 10' or less.

CROSSWALK - SIGNAL PEDESTAL ASSEMBLY



BASE BOTTOM VIEW

NOT TO SCALE

MATERIALS MEET OR EXCEED STATE SPECIFICATIONS

FREY Manufacturing Corp.
www.FreyMfgCorp.com
Made in USA - ISO 9001-2015 Certified
Phone: 952-467-4402
Patent 9493918

CROSSWALK - SIGNAL PEDESTAL HEIGHTS
FOR
VARIOUS LENGTHS OF 4" PIPES
CATALOG #: CP6 SERIES

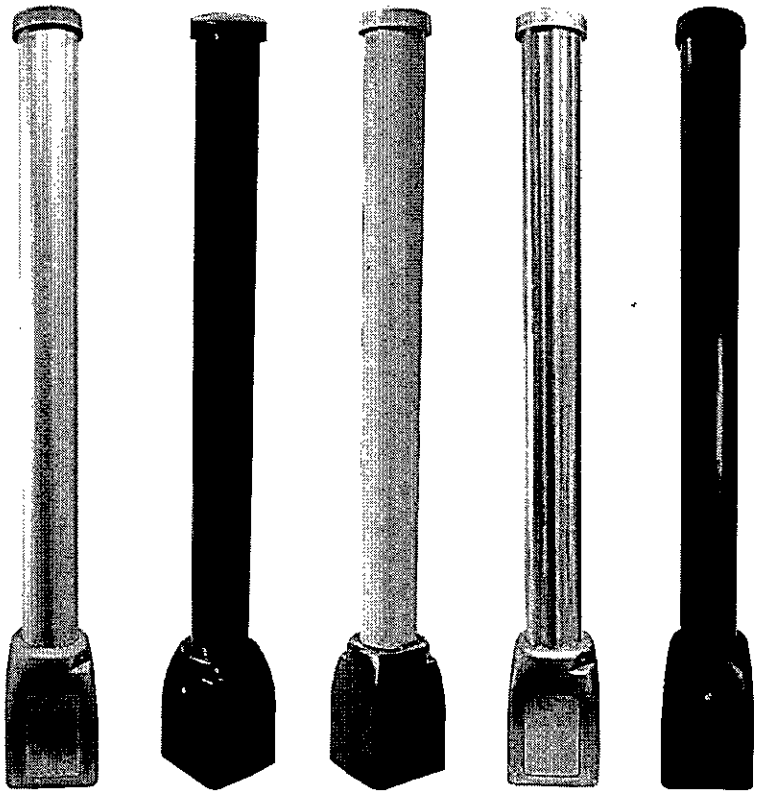
DATE	DWG. NO.	REV.
10-1-18	8.5.0	2

FREY Manufacturing Corp.

Installation Instructions

Crosswalk Pedestal Station

(CP6ACT4840TCSS)**



**Pipes may be ordered in lengths up to 15 feet. Custom anodized or powder coat colors available.

ACCESSIBLE PEDESTRIAN SIGNAL (APS) PUSH BUTTON STATIONS

Accessible Pedestrian push buttons inform the traffic control signal controller, located in the traffic control signal cabinet that pedestrians wish to cross at the intersection. Pedestrian instruction signs, which include braille messages, pedestrian indications and APS pushbuttons, provide information to pedestrians wishing to cross the roadway at an intersection.

APS Pushbuttons must be approved and listed on the Approved/Qualified Products List (APL) for Signals.

For new traffic control signal systems with pedestrian signal indications, an Accessible Pedestrian Signal (APS) must be installed.

This system allows retrofitting in place of traffic control signal systems with APS systems.

ACCESSIBLE PEDESTRIAN SIGNAL (APS)

Dual APS Push Button Stations

The Contractor must ensure that the completed order form, provided in the Contract Documents, is presented to the Accessible Pedestrian Signal System manufacturer to ensure that the appropriate Braille message will be added to the information sign and that the correct voice messages will be programmed in the pedestrian push button unit.

Each button and sign should arrive on the job site with identifying markings allowing the installer to place the buttons in their proper location. Additionally each R10-3e retro reflective information sign should have a maintenance label on the back side printed in English defining the braille message presented on the front of the sign.

The Contractor must refer to the Contract Documents for button locations, and all additional requirements for the Accessible Pedestrian System.

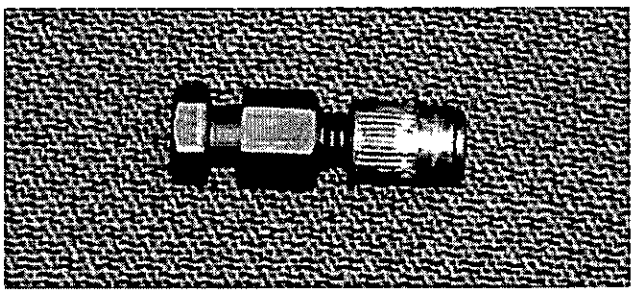
The Contractor must apply "brush-on" anti-seize compound to the screws and all threaded mounting hardware before installing the APS sign to the pole.

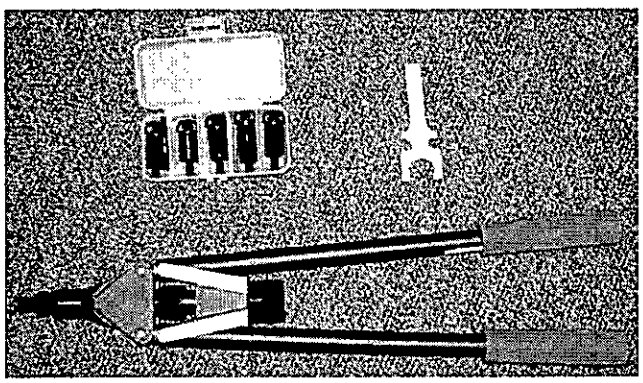
Do not drill weep holes in the bottom of the APS pushbutton unit.

Insert Nuts

When APS push buttons are installed the Special Provisions call for the use of a specific threaded insert (rivet nut). Threaded insert nuts will be provided in the manufacturer's hardware kit.

When Installing threaded insert nuts the Contractor must use a manufacturer approved installation tool.





The Contractor must install APS pedestrian push buttons in accordance with Contract Documents.

The mounting height must be 42 inches above the concrete sidewalk area. Refer to the Contract Documents for details. APS push buttons must be easily accessible to pedestrians and be installed in accordance Contract Documents.

Failure to install pedestrian ramps and APS buttons in accordance with the Contract Documents may require the Contractor to remove and reinstall the ramps and APS buttons as required in the contract at the Contractor's expense.

When installing an APS push button station shaft, securely tighten the pedestal shaft into the base before tightening the set screws. Check the APS button directionality before drilling the required mounting holes. These are good rules to follow to ensure that the button directionality is correct and the station will be sturdy.

Anchor Rod Installation

Care must be taken when installing the pedestrian station stainless steel anchor rods.

Installation of the anchor rods with epoxy in the pre drilled holes must be in accordance with the epoxy manufacturer's installation requirements.

The pre drilled hole must be properly cleaned prior to installation of the anchor rods.

Ensure that only the epoxy listed on the Approved/Qualified Products List is used.

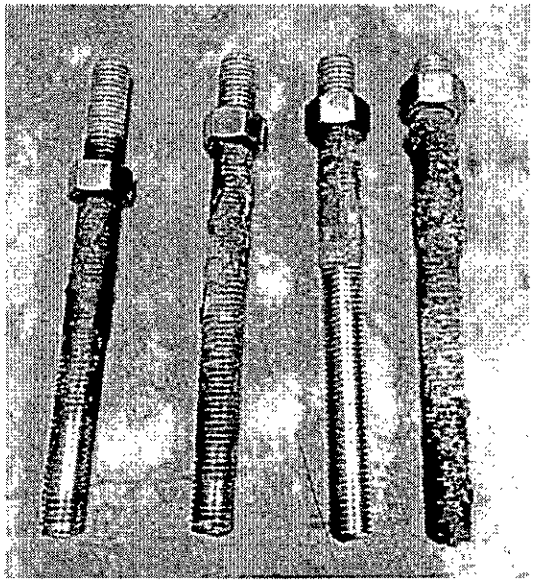
Check the epoxy itself prior to use to ensure that the shelf life of the product has not been exceeded. If the expiration date has passed properly discard the old epoxy and use material that has not exceeded its expiration date.

Ensure the epoxy is properly mixed according to the manufacturer's installation instructions prior to application.

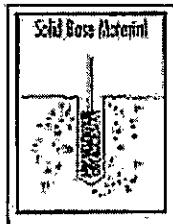
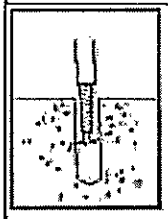
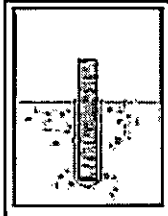
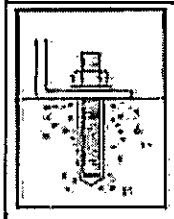
The approved epoxies used to hold the anchor rods have a minimum installation temperature. Check the epoxy manufacturer's recommendations for temperatures when installing the anchor rods. Some epoxies must be installed at temperatures of 41° F or above and some epoxies can be installed down to a temperature of 0° F. When the ambient temperature and concrete temperatures are below 41°F use the approved epoxy rated for installation at temperatures down to 0°F.

Additionally proper curing time for the epoxy must be adhered to before installing the pedestrian push button station. Allow extra curing time in colder temperatures.

The photograph below shows the consequences of not following epoxy installation requirements.



Ped Station epoxy installation instructions are shown below. Note the manufacturers warning that the instructions must be followed.

	1. Drill 1/16" oversize diameter holes for 1/4"–1/2" diameter threaded rods and #3 rebar. Drill 1/8" oversize diameter holes for 5/8"–1-1/4" diameter threaded rods, #4 rebar, grout filled blocks and brick pinning. Clean out hole from bottom with forced air. Complete hole preparation with brush and repeat cleaning with forced air (leave no dust or slurry).
	2. When starting new cartridge or new nozzle, dispense and discard enough adhesive until uniform grey color is achieved. Insert the nozzle into the bottom of the hole and fill to 1/2 the hole depth.
	3. Insert rod slowly by hand into the bottom of the hole with a slow twisting motion. This insures adhesive fills voids and crevices and uniformly coats the anchor rod.
	4. See table for working times and curring times. After the suggested cure time is met, install and tighten fixture into place.
WARNING: Instruction Insert enclosed in carton to be distributed with each cartridge	
WARNING: Manufacturer instructions must be followed	

Installation Checklist

- Remove all components from package.
- Use manufacturer provided template to mark holes on the mounting surface.
- Drill holes in the mounting surface, clean out debris, and set anchor rods in contractor supplied epoxy.
- Install Copper Grounding Lug to the inside of the base.
- Install the base on the anchor rods.
- Screw threaded pipe into the base and secure with set screws.*
- Install pedestal cap and secure with provided hardware.
- Use manufacturer provided template to drill holes in pipe for APS Button installation. (Do not ream holes)
- Install insert nuts and insulating sleeve in drilled holes.
- Install APS Button to the pipe.
- Connect required electrical components.
- Install base door with manufacturer provided hardware.

Notes:

- Anti-seize lube must be applied to all threaded surfaces when installing hardware.

- * If optional cable tether is included:
  - Install threaded pipe to base.
  - Drill through the pipe in line with the holes at the top of base.
  - Insert and install manufacturer supplied bolt with cable tether looped inside.
  - Attach other cable tether loop to an anchor rod with manufacturer hardware.

FREY Manufacturing Corp.

Test Data

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

April 5, 2017

Project B1700847

Mr. Bob Frey
Frey Manufacturing Corp.
13150 Stewart Ave.
Norwood, MN 55368

Re: Report of Mechanical Tests

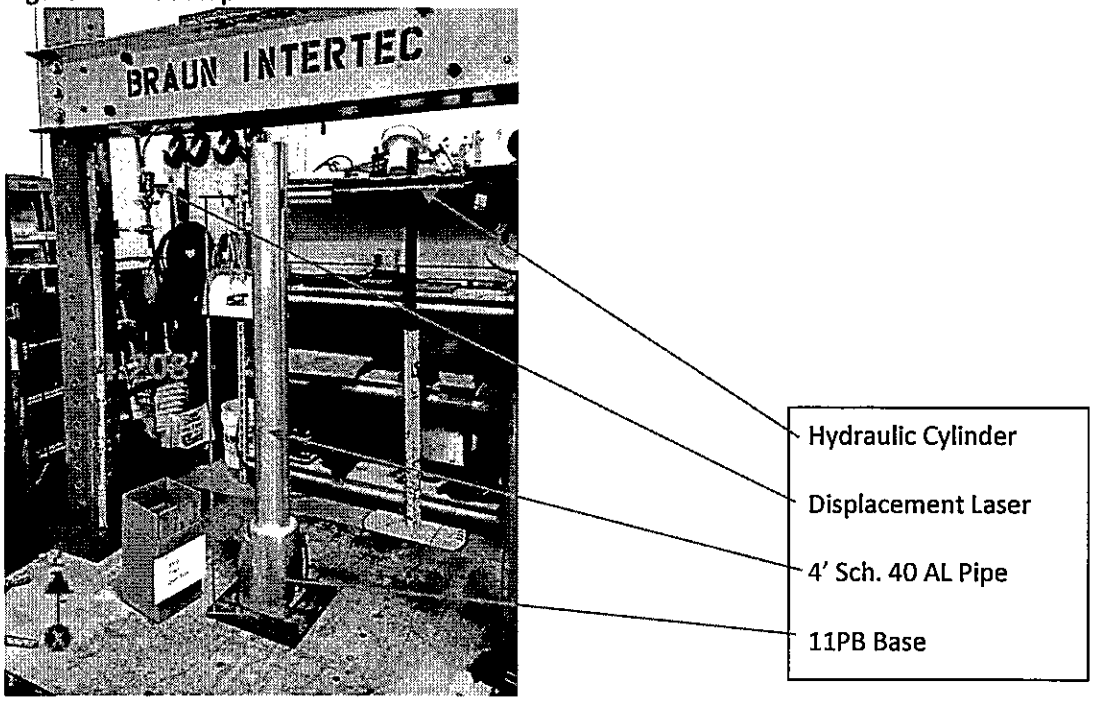
Sample Type:
Cast Aluminum Crosswalk Pedestal

Sample Information:
11PB Pedestal Base
4' Schedule 40 Aluminum Pipe

Services Performed

Two complete test assemblies were constructed and tested to failure. The assembly was anchored to the test frame using four 0.625" grade 8 bolts. The typical test setup used is shown in figure 1 below.

Figure 1: Test Setup



Load was measured using a calibrated pressure transducer and deflection was measured using a Micro-Epsilon ILD1402 displacement measurement sensor. The load and deflection measurements were recorded at a rate of 100 Hz during the test using a DEWESoft 43 data acquisition system. The load was applied at an elevation of 4.208' from the bottom of the base.

Test Results

The test results are summarized in Table 1 below. The base style name indicates it is was either a standard 11PB base or had a Rib/Fillet added to the interior corners of the casting walls.

Table 1: Test Results

Tested on 4-5-2017				
Base style - Alloy & Temper	**Load Direction**	**Load at Failure (lbf)**	**Deflection at Failure (in)**	**Maximum Bending Moment (ft-lbs)**
Fillet – 356 T6	Y	2,903	4.223	12,216
Fillet – 356 T6	X	2,987	3.544	12,569

All of the assemblies tested failed near the bottom of the 11PB Pedestal Base. There was no visible damage to the aluminum tube or any other components in the system. The failure location of each assembly is shown in Figures 2-3 below.

Figure 2: Fillet Base 356 T6 "Y" Direction Failure location

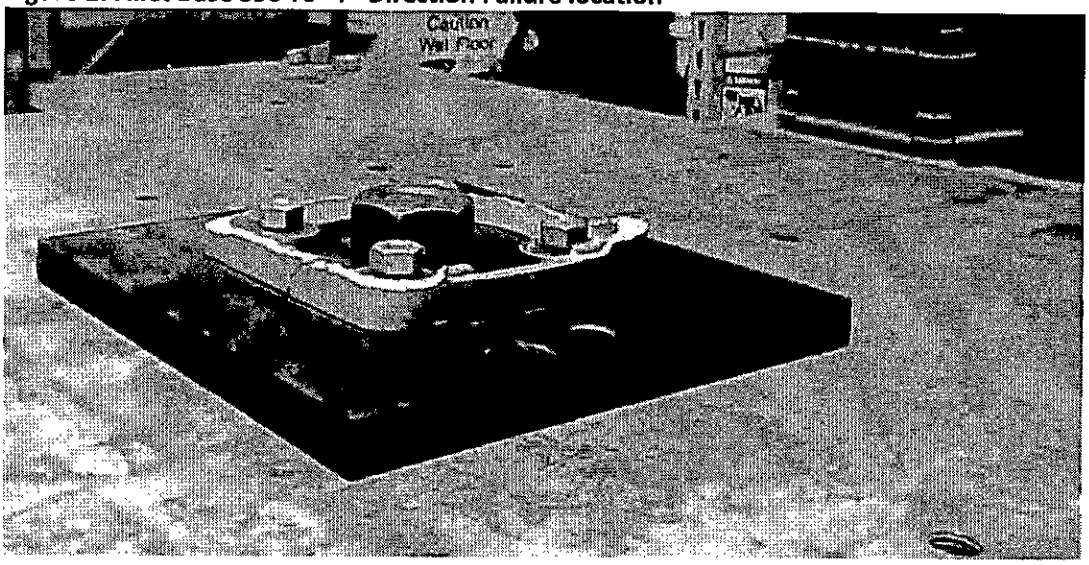
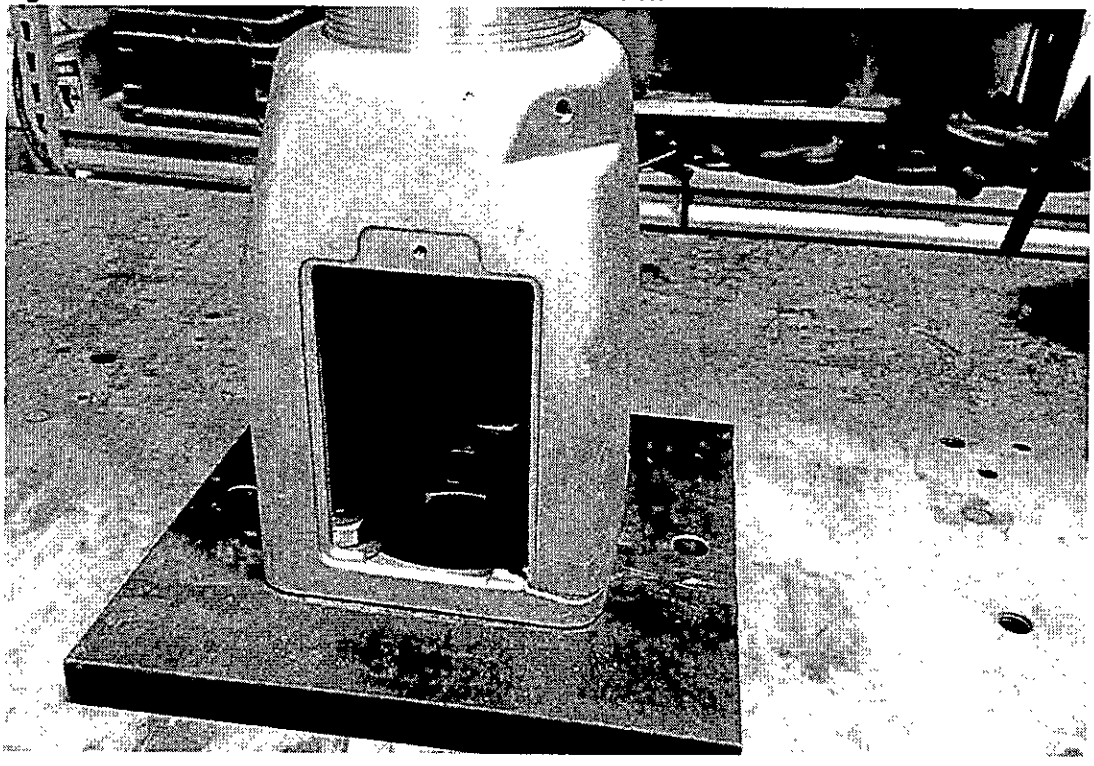
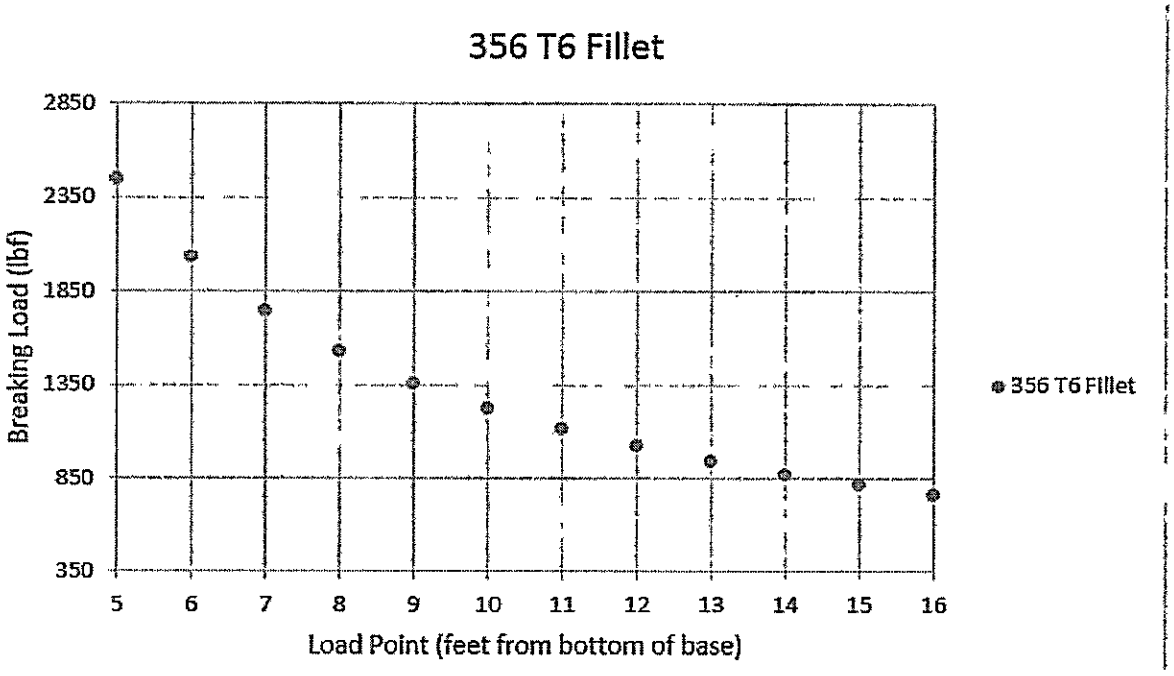


Figure 3: Fillet Base 356 T6 "X" Direction Failure location



The calculated breaking load of the base when the force is applied horizontally at multiple elevations from the bottom of the base is shown in Figure 4 below. The breaking load was calculated using the bending moment from the lowest result of the weakest test direction.

Figure 4:



General

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

If you have any questions regarding this report, please call Erik Knudson at 952.995.2384.

Sincerely

BRAUN INTERTEC CORPORATION

Erik Knudson
Materials Testing Technician

MANUFACTURED IN THE U. S. A.

FREY Manufacturing Corp.

13150 STEWART AVE. * NORWOOD, MN 55368-9675
PHONE (952) 467-4402; Toll Free Fax: 1-866-941-FREY (3739)
Mobile: (612) 790-2797
E-MAIL: FreyMfg@FreyMfgCorp.com; Website: FreyMfgCorp.com

ISO 9001:2015

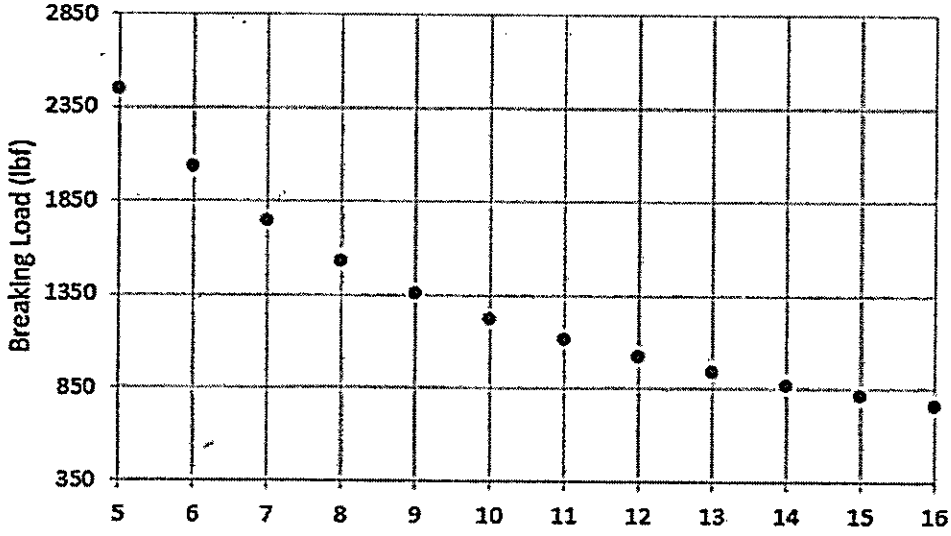
RE: Crosswalk Pedestal Base Load Test for Pedestrian and Traffic Signal equipment.

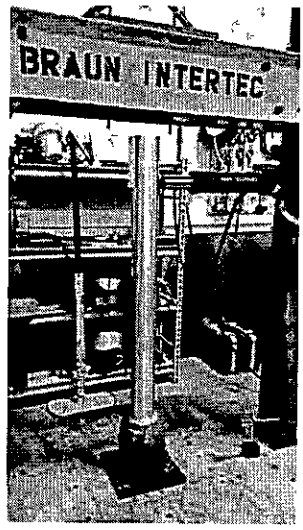
The following tests are for determining the loading for the base and the center of gravity of the load on a pipe. The base is frangible (breakable) with a Schedule 40 pipe. Schedule 40 and Schedule 80 pipes will fit on to the base.

Figure 1

Tested on 4-5-2017				
Base style – Direction of Test	**Load Direction**	**Load at Failure (lbf)**	**Deflection at Failure (in)**	**Maximum Bending Moment (ft-lbs)**
CP6 Door Push	Y @ 4'	2,903	4.223	12,216
CP6 Wall Push	X @ 4'	2,987	3.544	12,569

Figure 2





● Break Point

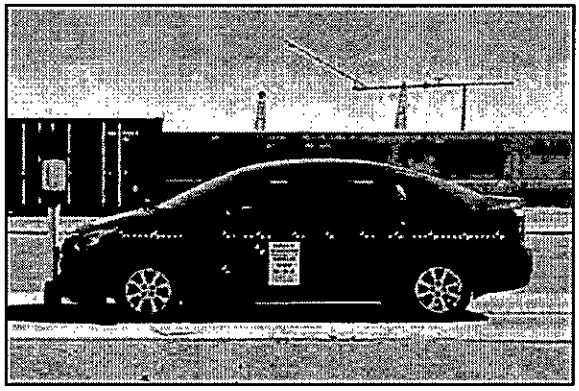
As an approximate guideline, a 3-section plastic signal with sunshield weighs approximately 30 lbs. or 200 lbs. at 100 MPH. A pedestrian signal weighs approximately 10 lbs. or 65 lbs. at 100 MPH. The dots on the chart above show the breaking point of the base, starting with Figure 1 at 2,900 lbs. at 4' above grade. Determine your equipment load, look at Figure 2 chart for where the center of gravity of the load would be, multiply the Breaking Load value by 60% (4 SWL) to determine how much load can be mounted using the CP6 base. Actual Equipment weight, Wind Loading, and Safe Working Load (SWL) to be determined by the engineer. Testing results above are for reference only of a certified test of the CP6 base.

Visit our website for signal mounting equipment.

Test Report For:

Frey Manufacturing

Crosswalk Pedestal Station



TESTED TO:

Manual for Assessing Safety Hardware (MASH 2016)

Test 3-60

PREPARED FOR:

Frey Manufacturing

13150 Stewart Ave.

Norwood, MN 55368

TEST REPORT NUMBER:

TR-P38154-01-NC

REPORT DATE:

October 5, 2018

TEST DATE:

June 27, 2018

ACCREDITED
Testing Laboratory

KARCO Engineering, LLC. TL-371
Automotive Safety and Testing Facility
9270 Holly Road, Adelanto, CA 92301
Tel: (760) 246-1672 Fax: (760) 246-8112
www.KARCO.com

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Tested By: _____

Mr. Balbino A. Beltran
Program Manager

Report By: _____

Mr. Robert L. Ramirez
Project Engineer

Reviewed By: _____

Mr. Andrew J. Espindola
Quality Assurance Manager

Approved By: _____

Mr. Michael L. Dunlap
Director of Operations

Approval Date: October 5, 2018

REVISION CONTROL LOG

TR-P38154-01

Revision	Date	Description
-NC	10/05/18	Original Test Report

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2. Government Accession No.	3. Recipients Catalog No.
TR-P38154-01-NC		

4. Title and Subtitle	5. Report Date
Final Test Report Frey Manufacturing Crosswalk Pedestal Station MASH Test 3-60	October 5, 2018
	6. Performing Organization Code KAR
7. Author(s) Mr. Robert L. Ramirez, Project Engineer, KARCO	**8. Performing Organization Report No.** TR-P38154-01-NC
9. Performing Organization Name and Address KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301	**10. Work Unit No.**
	11. Contract or Grant No.
12. Sponsoring Agency Name and Address	**13. Type of Report and Period Covered** Final Test Report, June 27 - Oct. 5, 2018
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

One (1) Test Level 3, Test 60 (3-60) was performed on the subject Frey Manufacturing Crosswalk Pedestal Station support structure. The support structure was offset a 1/4 width of the vehicle towards the passenger side. Testing was conducted by KARCO Engineering, LLC. in Adelanto, CA on June 27, 2018.

The support structure was impacted at a velocity of 19.09 mph (30.73 km/h). The support structure was subject to damage as a direct result of the impact. The pedestal was broken and released from its anchors. The front bumper had minor damage. The occupant compartment was not penetrated and the deformation limits were not exceeded.

The Frey Manufacturing Crosswalk Pedestal Station met the requirements when tested to MASH test 3-60.

17. Key Words	18. Distribution Statement
Frey Manufacturing Crosswalk Pedestal Station Support Structure MASH 3-60	

19. Security Classification of this report	20. Security Classification of this page	21. No. of Pages	22. Price
		53	

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Conversions

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.574
Pressure	Tire Pressures	lbf/in^2	kPa	6.895
Temperature	General Use	°F	°C	=(Tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

1. Introduction

1.1 Problem Statement

The purpose of this report is to detail the safety performance of the Frey Manufacturing Crosswalk Pedestal Station support structure when evaluated to the criteria set forth by the *Manual for Assessing Safety Hardware* (MASH 2016).

1.2 Objective

The primary objective of this project was to evaluate the safety performance of the Crosswalk Pedestal Station support structure when subjected to full-scale crash testing according to MASH 2016 Test Level 3, Test 60 (3-60) for support structures.

1.3 Scope

This project consists of full-scale dynamic crash testing of the Crosswalk Pedestal Station support structure. The system was subject to MASH 2016 Test 3-60. Test 3-60 was conducted with an 1100C test vehicle impacting the system at the critical impact angle (CIA).

2. System Details

2.1 Test Article

The Frey Manufacturing Crosswalk Pedestal Station is a support structure composed of circular support pipe support and a pedestal base assembly. The as-tested configuration of the Crosswalk Pedestal Station was tested with an accessible pedestrian signal (APS) push button station.

The support pipe was constructed of a 4.5 in. (114 mm) diameter aluminum pipe with a thickness of 0.3 in. (8 mm). The pipe had a length of 4.0 ft. (1.2 m). The bottom of the support pipe was threaded into the pedestal assembly and there was a bolt that went through the pipe and pedestal base. A tether was attached to the through bolt and the opposite end was attached to one of the mounting anchors.

The pedestal assembly was composed of a pedestal and access door. The pedestal was 10.0 in. (254 mm) tall and had the access door incorporated into one of its sides. The pedestal was anchored to the ground with four (4) 0.625 in. (16 mm) diameter by 7.5 in. (191 mm) long threaded studs, four (4) washers, and four (nuts). The anchors had an embedment depth of 4.0 in. (102 mm) to 5.0 in. (127 mm). The threaded rods were epoxied into a 6.0 in. (152 mm) thick concrete pad for this test.

Photographs of the as-tested unit are available in Appendix A of this report. The manufacturer's drawings are available in Appendix C. A complete set of manufacturer drawings are available in KARCO CD-R 2018-4964.

3. Test Requirements and Evaluation Criteria

3.1 Test Requirements

The Crosswalk Pedestal Station described in the report is classified as a support structure. MASH recommends a series of three (3) full scale crash tests to evaluate support structures.

Table 1 MASH TL-3 Test Matrix for Support Structures

	Test Designation	Impact Conditions			Evaluation Criteria
	MASH Test No.	Vehicle	Nominal Speed (mph)	Nominal Angle (deg)	
Test Level 3	3-60	1100C	19	CIA	B,D,F,H,I,N
	3-61	1100C	62	CIA	B,D,F,H,I,N
	3-62	2270P	62	CIA	B,D,F,H,I,N

3.2 Evaluation Criteria

Evaluation criteria for full-scale vehicle crash testing are based on three criteria: (1) Structural Adequacy, (2) Occupant Risk, and (3) Post-Impact Vehicular Response. Criteria for structural adequacy evaluate the article's ability to readily activate in a predictable manner by breaking away, fracturing, or yielding. Occupant risk evaluates the degree of hazard to occupants in the impacting vehicle. Post-impact vehicular response is a measure of the potential of the vehicle to result in a secondary collision with other vehicles or fixed objects.

Table 2 MASH Evaluation Criteria for Support Structures

<table>
<tr><td>Evaluation Factors</td><td colspan="4">Evaluation Criteria</td></tr>
<tr><td>Structural Adequacy</td><td>B.</td><td colspan="3">The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding.</td></tr>
<tr><td rowspan="8">Occupant Risk</td><td>D.</td><td colspan="3">Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment or present undue hazard to other traffic, pedestrian, or personnel in a work zone.</td></tr>
<tr><td>F.</td><td colspan="3">The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</td></tr>
<tr><td rowspan="4">H.</td><td colspan="3">Occupant impact velocities (OIV) should satisfy the following limits:</td></tr>
<tr><td colspan="3">Occupant Impact Velocity Limits, ft/s (m/s)</td></tr>
<tr><td>Component</td><td>Preferred</td><td>Maximum</td></tr>
<tr><td>Longitudinal</td><td>10 ft/s
(3.0 m/s)</td><td>16 ft/s
(4.9 m/s)</td></tr>
<tr><td rowspan="4">I.</td><td colspan="3">The occupant ridedown acceleration should satisfy the following limits:</td></tr>
<tr><td colspan="3">Occupant Ridedown Acceleration Limits (g)</td></tr>
<tr><td>Component</td><td>Preferred</td><td>Maximum</td></tr>
<tr><td>Longitudinal and Lateral</td><td>15.0 G</td><td>20.49 G</td></tr>
<tr><td>Post-Impact Vehicular Response</td><td>N.</td><td colspan="3">Vehicle trajectory behind the test article is acceptable.</td></tr>
</table>

4. Test Conditions

4.1 Test Facility

This test was conducted at KARCO Engineering's test facility in Adelanto, California.

4.2 Vehicle Tow and Guidance System

The tow road is a continuous level surface constructed of reinforced concrete and measures 800.0 ft. (213.4 m) long, 14.0 ft. (4.3 m) wide, and 6.0 in. (152 mm) thick. A steel rail is embedded in the road to provide vehicle guidance. Vehicle tow propulsion is provided by a 1 ton truck using a 1-to-2 pulley system. The test vehicle is towed into the test article by a nylon rope clamped to a 0.375 in. (10 mm) steel cable. The clamp is released from the cable on contact with a cable release mechanism positioned to allow the test vehicle to proceed under its own momentum for a maximum of 25.0 ft. (7.6 m) before impacting the test article.

4.3 Test Vehicle

For test 3-60, an 1100C test vehicle was used. The vehicle was a 2013 Kia Rio with a front mounted engine, automatic transmission, and front wheel drive. The 1100C test vehicle had a curb, test inertial, and gross static weight of 2,414.0 lbs (1,095.0 kg), 2,442.7 lbs (1,108.0 kg), and 2,610.2 lbs (1,184.0 kg), respectively. An Anthropomorphic Test Device (ATD) was placed in the passenger seat for this test. The tested vehicle had a hood height of 29.1 in. (740 mm) and an average track width of 59.6 in. (1,515 mm). Both dimensions fall out of the tolerance recommended in MASH.

The vehicle was used despite the hood height being out of tolerance 1.1 in. (28 mm) because it was determined that the dimension would have an insignificant effect on the test. In the impact of the support structure the main concern has to do with roof or windshield damage, as well as floor pan penetration or deformation.

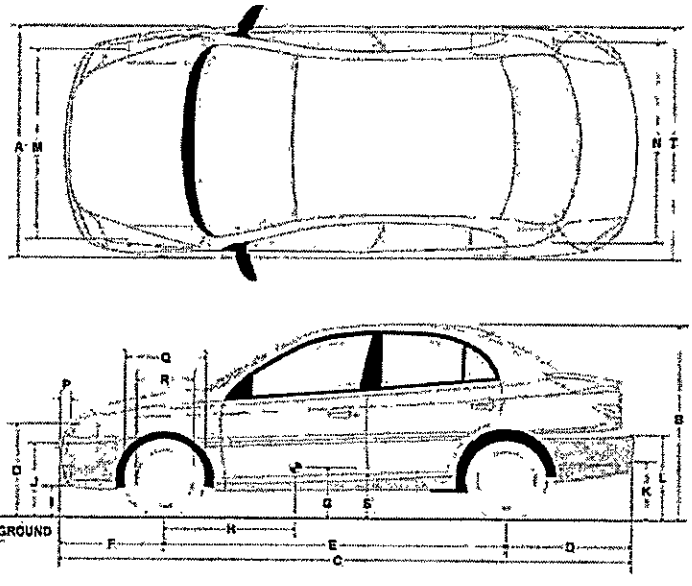
The bumper beam is the first structural member of the vehicle to engage the system. The hood is recessed approximately 7 in. (178 mm) from the bumper beam at the first point of contact. It is unlikely that the bumper beam would deform that distance and the system would contact the hood during the separation from its anchors. The hood is also constructed of sheet metal and contact with the hood would not affect the trajectory of the system. Further video analysis confirmed that the bumper beam activated the frangible base and the trajectory was controlled by the front profile of the vehicle. Based off these observations the out of tolerance hood height had an insignificant effect on the outcome of the test.

Regarding the vehicle's wheel track, a vehicle's track width has the potential to affect the vehicle's trajectory and stability. Being that the total average track width was exceeded by 1.6 in. (41

mm), which approximately translates to only 0.8 in. (20 mm) per wheel, the out of tolerance wheel track was deemed as insignificant. The vehicle's CG was not changed by the out of tolerance wheel track, as it remained the same if the track width was within tolerance.

In summary the out of tolerance hood height and average wheel track were deemed to have an insignificant effect on the outcome of the test. The test vehicle information can be found in Figure 1.

Test Date.....	06/27/18	Project No.....	P38154-01	Year.....	2013
Make.....	Kia	Model.....	Rio	Color.....	Red
Tire Size.....	P185/65R15	Vehicle Vin #...	KNADM4A37D6112753		
Tire Inflation.....	32 psi	Odometer....	76,463 mi		



GVWR Rating

Total.....	3,660 lbs
Front.....	2,028 lbs
Rear.....	1,852 lbs
Engine Type.....	Inline 4
Engine Size.....	1.6 L
Transmission Type.....	Automatic
Dummy Type.....	50th Male
Dummy Mass.....	165 lbs
Seat Position.....	Driver

Previous Vehicle Damage.....None

No.	Inches	mm	No.	Inches	mm	No.	Inches	mm	No.	Inches	mm
A	67.7	1720	F	32.0	813	K	14.0	355	P	1.6	40
B	57.7	1465	G	29.2	658	L	26.4	670	Q	23.6	600
C	171.2	4348	H	62.8	983	M	59.6	1515	R	28.1	715
D	37.8	960	I	8.9	225	N	59.6	1515	S	11.3	288
E	101.4	2575	J	24.4	620	O*	29.1	740	T	67.3	1710

*measured to top of radiator support

TEST VEHICLE MASS

	As Received (lbs)			Test Inertial (lbs)			Gross Static (lbs)		
	Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	758.4	458.6	1217.0	758.4	471.8	1230.2	846.6	557.8	1404.4
Right	749.6	447.5	1197.1	751.8	460.8	1212.6	758.4	447.5	1205.9
Ratio (%)	62.5	37.5	100.0	61.8	38.2	100.0	61.5	38.5	100.0
Total	1508.0	906.1	2414.0	1510.2	932.6	2442.7	1605.0	1005.3	2610.2

	As Received (kg)			Test Inertial (kg)			Gross Static (kg)		
	Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	344.0	208.0	552.0	344.0	214.0	558.0	384.0	253.0	637.0
Right	340.0	203.0	543.0	341.0	209.0	550.0	344.0	203.0	547.0
Ratio (%)	62.5	37.5	100.0	61.8	38.2	100.0	61.5	38.5	100.0
Total	684.0	411.0	1095.0	685.0	423.0	1108.0	728.0	456.0	1184.0

Figure 1 Test 3-60 Vehicle Information

4.4 Data Acquisition Systems

All data acquisition for the tests of the support structure were performed in accordance with the MASH 2016 requirements.

4.4.1 Test Vehicle Instrumentation

The test vehicle was instrumented with one (1) tri-axial accelerometer and one (1) tri-axial angular rate sensor. The set of accelerometers and angular rate sensors were mounted within 2.0 in. (50 mm) of the test vehicle's center of gravity in the x-y plane. The accelerometers measured longitudinal (x), lateral (y), and vertical (z) acceleration. The angular rate sensors measured roll (moment x), pitch (moment y) and yaw (moment z).

Table 3 Vehicle Instrumentation List

Ch.	Location	Axis	Ident. No.	Description	MFR	Model	Units
1	Vehicle CG	X	P51708	Accel, Half Bridge	Endevco	7264-2K	g
2	Vehicle CG	Y	P51700	Accel, Half Bridge	Endevco	7264-2K	g
3	Vehicle CG	Z	P51696	Accel, Half Bridge	Endevco	7264-2K	g
4	Vehicle CG	Yaw	ARS8537	Rate Gyro	DTS	ARS-18K	Deg/s
5	Vehicle CG	Pitch	ARS8532	Rate Gyro	DTS	ARS-18K	Deg/s
6	Vehicle CG	Roll	ARS8486	Rate Gyro	DTS	ARS-18K	Deg/s

4.4.2 Calibration

All equipment used in the tests has been calibrated through standards traceable to NIST and is maintained in a calibrated condition.

4.4.3 Photographic Documentation

Photographic documentation of this test series included a minimum of two (2) real-time video cameras at 30 frames per second (fps), and three (3) high-speed color digital video cameras per test at 1,000 fps. All high-speed cameras were activated by a pressure-sensitive tape switch which was positioned on the test article to indicate the instant of contact (time zero). A digital still camera was used for documenting the pre- and post-test condition of the test article and the test vehicle.

Table 4 High Speed Camera Information

View No.	Location	Identification No.	Manufacturer	Type
1	Overall View	7959	Phantom	V9
2	Close-Up View	6690	Phantom	V5.1
3	Oblique View	8520	Phantom	V9

4.4.4 Measurement Uncertainty

Measurement uncertainties have been determined for pertinent values affecting the results of this test. KARCO maintains these uncertainty budgets, which are available upon request, but are not included in this report. In certain cases the nature of the test method may preclude rigorous and statistically valid calculation of uncertainty of measurement. In these cases, KARCO attempts to identify the components of uncertainty and make a reasonable estimation. Reasonable estimation is based on knowledge of the performance of the method and on the measurement scope and makes use of, for example, previous experience and validation data.

5.Crash Test Results

5.1 Weather Conditions

Test No. P38154-01 was conducted June 27, 2018.

Table 5 Weather Conditions

Parameter	P38154-01
Temperature	91 °F
Humidity	14%
Wind Speed	5 mph
Wind Direction	South West

Information for reference only

5.2 MASH 2016 Test 3-60

As recommended in MASH 2016, a full-scale impact test was conducted to evaluate the impact performance of the Frey Manufacturing Crosswalk Pedestal Station support structure. The support structure was tested at a critical impact angle (CIA) of 90°. It was determined that it was not necessary to test the device at multiple angles due to the symmetry of the pedestal and circular pipe. The 90° impact angle was determined to be the critical impact angle because it had an increased propensity for roof and windshield deformation.

The system was offset 16.7 in. (425 mm) towards the passenger side. The test was conducted using a commercially available 2013 Kia Rio 4-door sedan.

5.3 Test Description

The test vehicle impacted the support structure at a speed of 19.09 mph (30.73 km/h). The vehicle's front bumper made first contact with the system and began to deform. The frangible base fractures at approximately 0.010 s and the base was completely separated by 0.015 s. the vehicle pushed the post forward and lost contact with the vehicle at 0.023 s. The top of the post rotated towards the vehicle and the top of the post impacted the ground at 0.313 s. The post continued forward and came to rest on the right side of the vehicle. The brakes were applied once the vehicle cleared the article. The vehicle's final resting position was 150.9 ft. (46.0 m) downstream and 0.9 ft. (0.6 m) left from its initial point of contact with the article.

5.4 Test Article Damage

The frangible base was broken and one of the anchors was bent. The post remained attached to a large section of the base. The tether was torn at the post side. The display panel on push button assembly was cracked.

5.5 Test Vehicle Damage

The vehicle was subject to minor damage at the front end. The front bumper fascia was dented on the passenger side. The passenger headlight was also unclipped. The occupant compartment was not penetrated and the deformation limits were not exceeded.

Table 6 Maximum Occupant Deformation by Location

Location	Maximum Deformation	MASH Allowable Deformation
Roof	0.0 in.	4.0 in. (102 mm)
Windshield	0.0 in.	3.0 in. (76 mm)
Window	0.0 in.	0.0 in
Wheel / foot well and toe pan	0.0 in.	9.0 in. (229 mm)
Side front panel (forward of A-pillar	0.0 in.	12.0 in. (305 mm)
Front side door area (above seat)	0.0 in.	9.0 in. (229 mm)
Front side door area (below seat	0.0 in.	12.0 in. (305 mm)
Floor pan and transmission tunnel	0.0 in.	12.0 in. (305 mm)

5.6 Structural Adequacy

The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding. Upon impact the pedestal broke away in a controlled manner by fracturing at its base.

5.7 Occupant Risk

Under occupant risk, the test articles are evaluated by four (4) criteria. The first criterion evaluates the potential hazard of detached elements, fragments, or other debris from the test article to penetrate the test vehicle's occupant compartment or present undue hazard to other traffic, pedestrians, or personnel in a work zone. The second criterion is that the vehicle remains upright. The third criterion is that the roll angle of the vehicle does not exceed 75° throughout the test. The final criteria are based on the calculated Occupant Impact Velocities (OIV) and occupant ridedown accelerations. The maximum allowable limit for Occupant Impact Velocity Limit in both the longitudinal and lateral directions is 16.0 ft/s (4.9 m/s). The maximum allowable ridedown acceleration in both the longitudinal and lateral directions is 20.49 g. Both criteria are calculated from the acceleration data collected during the test.

The maximum extent of the debris field was 82.0 ft. (25.0 m) downstream and 6.4 ft. (2.0 m) to the passenger side measured from the first point of contact with the system. The debris consisted of pieces of the base and the support post.

Table 7 Summary of Occupant Risk Factors

Test Parameter	Axis	Units	Max	Time (ms)	Min	Time (ms)
Vehicle Impact Velocity	X	ft/s	27.9			
Occupant Impact Velocity	X	ft/s	2.0	862.1		
Occupant Impact Velocity	Y	ft/s	2.3	862.1		
Ridedown Acceleration	X	g	0.2	871.9	0.0	902.3
Ridedown Acceleration	Y	g	0.1	871.6	0.0	902.0
THIV		ft/s	2.3	750.0		
PHD		g	0.3	871.9		
ASI			0.11	30.4		
Roll	X	deg.	4.0	999.4	-0.1	106.8
Pitch	Y	deg.	3.6	999.9	0.0	0.3
Yaw	Z	deg.	0.4	600.8	0.0	0.0

5.8 Vehicle Trajectory

The vehicle trajectory criterion requires that the vehicle's trajectory behind the test article is acceptable. The vehicle traveled behind the test article and was stable through out the test.

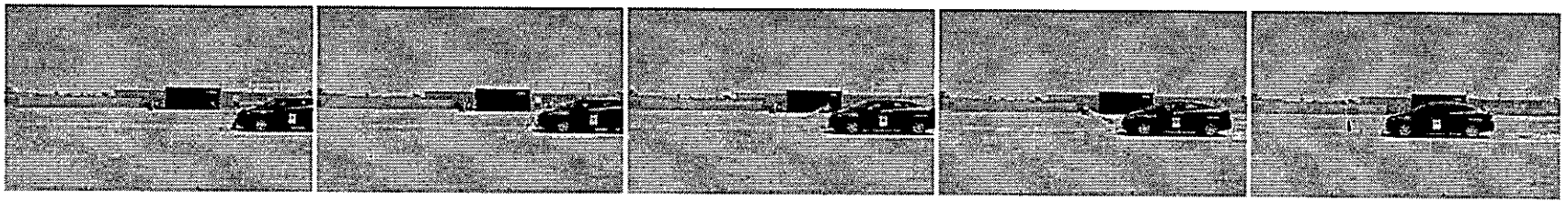
5.9 Discussion and Summary of Results

The Frey Manufacturing Crosswalk Pedestal Station support structure's performance to MASH 2016 test 3-60 was deemed as acceptable. The support structure yielded, the occupant values were not exceeded, there was no potential for article penetration into the occupant compartment, and the vehicle's trajectory was acceptable.

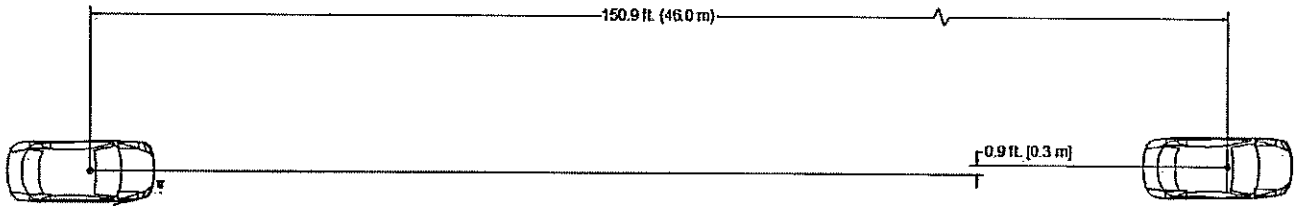
Table 8 Evaluation Criteria Summary

<table>
<tr><th>Evaluation Factor</th><th>Evaluation Criteria</th><th>Result</th></tr>
<tr><td>Structural Adequacy</td><td>B The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding.</td><td>PASS</td></tr>
<tr><td rowspan="4">Occupant Risk</td><td>D Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present undue hazard to other traffic, pedestrians, or personnel in a work zone.</td><td>PASS</td></tr>
<tr><td>F The vehicle should remain upright during and after the collision. The maximum roll and pitch angles are not to exceed 75°.</td><td>PASS</td></tr>
<tr><td>H Occupant impact velocities (OIV) should satisfy the following limits:
<table>
<tr><th>Component</th><th>Preferred</th><th>Maximum</th></tr>
<tr><td>Longitudinal</td><td>10 ft/s (3.0 m/s)</td><td>16 ft/s (4.9 m/s)</td></tr>
</table></td><td>PASS</td></tr>
<tr><td>I The occupant ridedown acceleration should satisfy the following limits:
<table>
<tr><th>Component</th><th>Preferred</th><th>Maximum</th></tr>
<tr><td>Longitudinal and Lateral</td><td>15.0 g</td><td>20.49 g</td></tr>
</table></td><td>PASS</td></tr>
<tr><td>Post-Impact Vehicular Response</td><td>N Vehicle trajectory behind the test article is acceptable.</td><td>PASS</td></tr>
<tr><td colspan="2">OVERALL TEST ASSESSMENT</td><td>PASS</td></tr>
</table>

MASH Test 3-60 SUMMARY



0.000 s | 0.050 s | 0.150 s | 0.150 s | 0.500 s



GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P38154-01
Test Designation	3-60
Test Date	06/27/18

TEST ARTICLE

Name / Model	Crosswalk Pedestal Station
Type	Support Structure
Device Height	4.8 ft. (1.5 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,414.0 lbs (1,095.0 kg)
Test Inertial Mass	2,442.7 lbs (1,108.0 kg)
Gross Static Mass	2,610.2 lbs (1,184.0 kg)

Impact Conditions

Impact Velocity	19.09 mph (30.73 km/h)
Impact Angle	90.0°
Location / Orientation	Offset 17.0 in. (431 mm)
Kinetic Energy	29.8 kip-ft (40.4 kJ)

Exit Conditions

Exit Velocity	17.94 mph (28.87 km/h)
Exit Angle	0.0°
Final Vehicle Position	150.9 ft. (46.0 m) Downstream 0.9 ft. (0.3 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	4.0 °
Maximum Pitch Angle	3.6 °
Maximum Yaw Angle	0.4 °

Occupant Risk

Longitudinal OIV	2.0 ft/s (0.6 m/s)
Lateral OIV	2.3 ft. (0.7 m/s)
Longitudinal RA	0.2 g
Lateral RA	0.1 g
THIV	2.3 ft/s (0.7 m/s)
PHD	0.3 g
ASI	0.11

Test Article Deflections

Debris Field (longitudinal)	82.0 ft. (25.0 m)
Debris Field (lateral)	6.4 ft. (2.0 m)

Vehicle Damage

Vehicle Damage Scale	N/A
CDC	N/A
Maximum Intrusion	N/A

Figure 2 Test 3-60 Summary

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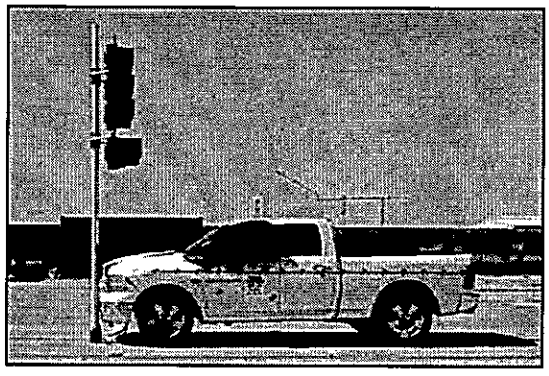
Test Report For:

Frey Manufacturing

Pedestrian Signal Pole



TESTED TO:

Manual for Assessing Safety Hardware (MASH 2016)

Test 3-62

PREPARED FOR:

Frey Manufacturing

13150 Stewart Ave.

Norwood, MN 55368

TEST REPORT NUMBER:

TR-P38168-03-NC

REPORT DATE:

September 14, 2018

TEST DATE:

June 28, 2018

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Mr. Michael L. Dunlap
Director of Operations

Approval Date: September 14, 2018

REVISION CONTROL LOG

TR-P38168-03

Revision	Date	Description
-NC	09/14/18	Original Test Report

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2. Government Accession No.	3. Recipients Catalog No.	
TR-P38168-03-NC			
4. Title and Subtitle Final Test Report Frey Manufacturing Pedestrian Signal Pole MASH Test 3-62		**5. Report Date** September 14, 2018 **6. Performing Organization Code** KAR	
7. Author(s) Mr. Balbino A. Beltran, Program Manager, KARCO		**8. Performing Organization Report No.** TR-P38168-03-NC	
9. Performing Organization Name and Address KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301		**10. Work Unit No.** **11. Contract or Grant No.**	
12. Sponsoring Agency Name and Address		**13. Type of Report and Period Covered** Final Test Report, June 28 - Sep. 14, 2018 **14. Sponsoring Agency Code**	

15. Supplementary Notes

16. Abstract

One (1) Test Level 3, Test 62 (3-62) was performed on the subject Frey Manufacturing Pedestrian Signal Pole support structure. The support structure was offset towards the driver side. Testing was conducted by KARCO Engineering, LLC. in Adelanto, CA on June 28, 2018.

The support structure was impacted at a velocity of 60.34 mph (97.10 km/h). The pedestal was broken as a result of the impact. Once broken the support post released and was rotated over the vehicle. As support post was airborne the traffic control signal brackets detached and scattered as they hit the ground. The support structure did not hit impact the windshield or roof of the vehicle. There was no penetration or intrusion into the occupant compartment.

The Frey Manufacturing Pedestrian Signal Pole met the requirements when tested to MASH test 3-62.

17. Key Words	18. Distribution Statement		
Frey Manufacturing Pedestrian Signal Pole Support Structure MASH 3-62			
19. Security Classification of this report	**20. Security Classification of this page**	**21. No. of Pages** 53	**22. Price**

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List of Figures

Conversions

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.574
Pressure	Tire Pressures	lbf/in^2	kPa	6.895
Temperature	General Use	°F	°C	=(Tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

1. Introduction

1.1 Problem Statement

The purpose of this report is to detail the safety performance of the Frey Manufacturing Pedestrian Signal Pole support structure when evaluated to the criteria set forth by the *Manual for Assessing Safety Hardware* (MASH 2016).

1.2 Objective

The primary objective of this project was to evaluate the safety performance of the Pedestrian Signal Pole support structure when subjected to full-scale crash testing according to MASH 2016 Test Level 3, Test 62 (3-62) for support structures.

1.3 Scope

This project consists of full-scale dynamic crash testing of the Pedestrian Signal Pole support structure. The system was subject to MASH 2016 Test 3-62. Test 3-62 was conducted with a 2270P test vehicle impacting the system at the critical impact angle (CIA).

2. System Details

2.1 Test Article

The Frey Manufacturing Pedestrian Signal Pole is a support structure composed of circular pipe support and a signal pedestal assembly. The as-tested configuration of the Pedestrian Signal Pole was tested with an accessible pedestrian signal (APS) push button station and traffic control signal controllers.

The support was constructed of a 4.5 in. (114 mm) diameter aluminum pipe with a thickness of 0.3 in. (8 mm). The pipe had a length of 15.0 ft. (4.6 m). The bottom of the support pipe was threaded into the pedestal assembly and secured in place with two (2) set screws.

The pedestal assembly was composed of a pedestal and access door. The pedestal was 10.0 in. (254 mm) tall and had the access door incorporated into one of its sides. The pedestal was anchored to the ground with four (4) 0.625 in. (16 mm) diameter by 7.5 in. (191 mm) long threaded studs, four (4) washers, and four (nuts). The anchors had an embedment depth of 4.0 in. (102 mm) to 5.0 in. (127 mm). The threaded rods were epoxied into a 6.0 in. (152 mm) thick concrete pad for this test.

Photographs of the as-tested unit are available in Appendix A of this report. The manufacturer's drawings are available in Appendix C. A complete set of manufacturer drawings are available in KARCO CD-R 2018-4924.

3. Test Requirements and Evaluation Criteria

3.1 Test Requirements

The Pedestrian Signal Pole described in the report is classified as a support structure. MASH recommends a series of three (3) full scale crash tests to evaluate support structures.

Table 1 MASH TL-3 Test Matrix for Support Structures

	Test Designation	Impact Conditions			Evaluation Criteria
	MASH Test No.	Vehicle	Nominal Speed (mph)	Nominal Angle (deg)	
Test Level 3	3-60	1100C	19	CIA	B,D,F,H,I,N
	3-61	1100C	62	CIA	B,D,F,H,I,N
	3-62	2270P	62	CIA	B,D,F,H,I,N

3.2 Evaluation Criteria

Evaluation criteria for full-scale vehicle crash testing are based on three criteria: (1) Structural Adequacy, (2) Occupant Risk, and (3) Post-Impact Vehicular Response. Criteria for structural adequacy evaluate the article's ability to readily activate in a predictable manner by breaking away, fracturing, or yielding. Occupant risk evaluates the degree of hazard to occupants in the impacting vehicle. Post-impact vehicular response is a measure of the potential of the vehicle to result in a secondary collision with other vehicles or fixed objects.

Table 2 MASH Evaluation Criteria for Support Structures

<table>
<tr><td>Evaluation Factors</td><td colspan="4">Evaluation Criteria</td></tr>
<tr><td>Structural Adequacy</td><td>B.</td><td colspan="3">The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding.</td></tr>
<tr><td rowspan="8">Occupant Risk</td><td>D.</td><td colspan="3">Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment or present undue hazard to other traffic, pedestrian, or personnel in a work zone.</td></tr>
<tr><td>F.</td><td colspan="3">The vehicle should remain upright during and after collision. The maximum roll and pitch angles are not to exceed 75 degrees.</td></tr>
<tr><td rowspan="4">H.</td><td colspan="3">Occupant impact velocities (OIV) should satisfy the following limits:</td></tr>
<tr><td colspan="3">Occupant Impact Velocity Limits, ft/s (m/s)</td></tr>
<tr><td>Component</td><td>Preferred</td><td>Maximum</td></tr>
<tr><td>Longitudinal</td><td>10 ft/s
(3.0 m/s)</td><td>16 ft/s
(4.9 m/s)</td></tr>
<tr><td rowspan="4">I.</td><td colspan="3">The occupant ridedown acceleration should satisfy the following limits:</td></tr>
<tr><td colspan="3">Occupant Ridedown Acceleration Limits (g)</td></tr>
<tr><td>Component</td><td>Preferred</td><td>Maximum</td></tr>
<tr><td>Longitudinal and Lateral</td><td>15.0 G</td><td>20.49 G</td></tr>
<tr><td>Post-Impact Vehicular Response</td><td>N.</td><td colspan="3">Vehicle trajectory behind the test article is acceptable.</td></tr>
</table>

4. Test Conditions

4.1 Test Facility

This test was conducted at KARCO Engineering's test facility in Adelanto, California.

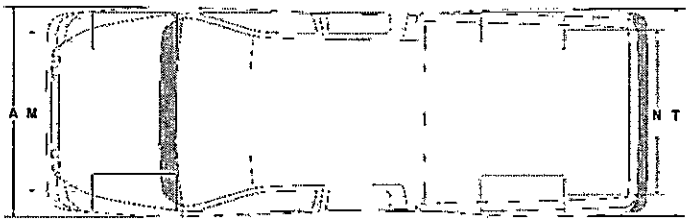
4.2 Vehicle Tow and Guidance System

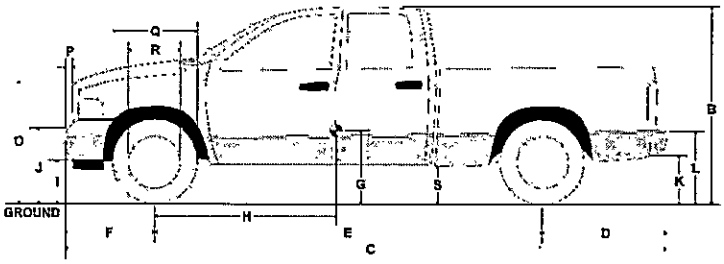
The tow road is a continuous level surface constructed of reinforced concrete and measures 800.0 ft. (213.4 m) long, 14.0 ft. (4.3 m) wide, and 6.0 in. (152 mm) thick. A steel rail is embedded in the road to provide vehicle guidance. Vehicle tow propulsion is provided by a 1 ton truck using a 1-to-2 pulley system. The test vehicle is towed into the test article by a nylon rope clamped to a 0.375 in. (10 mm) steel cable. The clamp is released from the cable on contact with a cable release mechanism positioned to allow the test vehicle to proceed under its own momentum for a maximum of 25.0 ft. (7.6 m) before impacting the test article.

4.3 Test Vehicle

For test 3-62, a 2270P test vehicle was used. The vehicle was a 2012 Ram 1500 with a front mounted engine, automatic transmission, and rear wheel drive. The 2270P test vehicle had a curb, test inertial, and gross static weight of 5,025.4 lbs (2,279.5 kg), 5,060.6 lbs (2,295.5 kg), and 5,060.6 lbs (2,295.5 kg), respectively. An Anthropomorphic Test Device (ATD) was not used for this test. The test vehicle information can be found in Figure 1.

Test Date.....	06/28/18	Project No.....	P38168-03	Year.....	2012
Make.....	RAM	Model.....	1500	Color.....	White
Tire Size.....	P275/60R20	Vehicle Vin #...	1C6RD6GT0CS141696		
Tire Inflation.....	35 psi	Odometer....	195,104 mi		





GVWR Rating

Total.....	6,700 lbs
Front.....	3,700 lbs
Rear.....	3,900 lbs

Engine Type.....	V8
Engine Size.....	5.7 L
Transmission Type.....	Automatic

Dummy Type.....	None
Dummy Mass.....	n/a
Seat Position.....	n/a

Previous Vehicle Damage.....None

No.	Inches	mm	No.	Inches	mm	No.	Inches	mm	No.	Inches	mm
A	78.9	2005	F	38.0	965	K	20.1	510	P	4.5	115
B	75.0	1905	G	29.2	714	L	30.5	775	Q	31.9	810
C	227.4	5775	H	62.8	1570	M	68.6	1742	R	21.5	545
D	48.6	1235	I	13.2	335	N	68.1	1730	S	14.4	367
E	140.7	3575	J	24.4	620	O*	46.1	1170	T	79.5	2020

*measured from radiator support

TEST VEHICLE MASS

	As Received (lbs)			Test Inertial (lbs)			Gross Static (lbs)		
	Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	1418.7	1121.0	2539.7	1419.8	1139.8	2559.6	1419.8	1139.8	2559.6
Right	1420.9	1064.8	2485.7	1418.7	1082.5	2501.2	1418.7	1082.5	2501.2
Ratio (%)	56.5	43.5	100.0	56.1	43.9	100.0	56.1	43.9	100.0
Total	2839.6	2185.8	5025.4	2838.5	2222.3	5060.6	2838.5	2222.3	5060.6

	As Received (kg)			Test Inertial (kg)			Gross Static (kg)		
	Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	643.5	508.5	1152.0	644.0	517.0	1161.0	644.0	517.0	1161.0
Right	644.5	483.0	1127.5	643.5	491.0	1134.5	643.5	491.0	1134.5
Ratio (%)	56.5	43.5	100.0	56.1	43.9	100.0	56.1	43.9	100.0
Total	1288.0	991.5	2279.5	1287.5	1008.0	2295.5	1287.5	1008.0	2295.5

Figure 1 Test 3-62 Vehicle Information

4.4 Data Acquisition Systems

All data acquisition for the tests of the support structure were performed in accordance with the MASH 2016 requirements.

4.4.1 Test Vehicle Instrumentation

The test vehicle was instrumented with one (1) tri-axial accelerometer and one (1) tri-axial angular rate sensor. The set of accelerometers and angular rate sensors were mounted within 2.0 in. (50 mm) of the test vehicle's center of gravity in the x-y plane. The accelerometers measured longitudinal (x), lateral (y), and vertical (z) acceleration. The angular rate sensors measured roll (moment x), pitch (moment y) and yaw (moment z).

Table 3 Vehicle Instrumentation List

Ch.	Location	Axis	Ident. No.	Description	MFR	Model	Units
1	Vehicle CG	X	P51708	Accel, Half Bridge	Endevco	7264-2K	g
2	Vehicle CG	Y	P51700	Accel, Half Bridge	Endevco	7264-2K	g
3	Vehicle CG	Z	P51696	Accel, Half Bridge	Endevco	7264-2K	g
4	Vehicle CG	Yaw	ARS8537	Rate Gyro	DTS	ARS-18K	Deg/s
5	Vehicle CG	Pitch	ARS8532	Rate Gyro	DTS	ARS-18K	Deg/s
6	Vehicle CG	Roll	ARS8486	Rate Gyro	DTS	ARS-18K	Deg/s

4.4.2 Calibration

All equipment used in the tests has been calibrated through standards traceable to NIST and is maintained in a calibrated condition.

4.4.3 Photographic Documentation

Photographic documentation of this test series included a minimum of two (2) real-time video cameras at 30 frames per second (fps), and three (3) high-speed color digital video cameras per test at 1,000 fps. All high-speed cameras were activated by a pressure-sensitive tape switch which was positioned on the test article to indicate the instant of contact (time zero). A digital still camera was used for documenting the pre- and post-test condition of the test article and the test vehicle.

Table 4 High Speed Camera Information

View No.	Location	Identification No.	Manufacturer	Type
1	Overall View	7959	Phantom	V9
2	Close-Up View	6690	Phantom	V5.1
3	Oblique View	8520	Phantom	V9

4.4.4 Measurement Uncertainty

Measurement uncertainties have been determined for pertinent values affecting the results of this test. KARCO maintains these uncertainty budgets, which are available upon request, but are not included in this report. In certain cases the nature of the test method may preclude rigorous and statistically valid calculation of uncertainty of measurement. In these cases, KARCO attempts to identify the components of uncertainty and make a reasonable estimation. Reasonable estimation is based on knowledge of the performance of the method and on the measurement scope and makes use of, for example, previous experience and validation data.

5.Crash Test Results

5.1 Weather Conditions

Test No. P38168-03 was conducted June 28, 2018.

Table 5 Weather Conditions

Parameter	P38168-03
Temperature	86 °F
Humidity	16%
Wind Speed	15 mph
Wind Direction	SW

Information for reference only

5.2 MASH 2016 Test 3-62

As recommended in MASH 2016, a full-scale impact test was conducted to evaluate the impact performance of the Frey Manufacturing Pedestrian Signal Pole support structure. The support structure was tested at a critical impact angle (CIA) of 0°. It was determined that it was not necessary to test the device at multiple angles due to the symmetry of the pedestal and circular pipe. The 0° impact angle was determined to be the critical impact angle because it had an increased propensity for roof and windshield deformation.

The vehicle was offset towards the driver side. The test was conducted using a commercially available 2012 RAM 1500 pickup truck.

5.3 Test Description

The test vehicle impacted the support structure at a speed of 60.34 mph (97.10 km/h). Upon impact the pedestal broke at 0.005 s at the front anchors and subsequently also broke at the top were the support post threads to the pedestal at 0.007 s. The vehicle continued forward and passed over the broken pedestal. Once the support post was separated from the pedestal, the post rotated into the air and cleared the vehicle's windshield and roof. While the support post was airborne the traffic control signal brackets separated from the post and scattered after hitting the concrete.

The vehicle exited with a velocity of 59.13 mph (95.16 km/h). Once the vehicle cleared the impact zone the brake abort system was applied and the vehicle came to a stop 301.1 ft. (91.8 m) from the pre-test location of the support structure.

5.4 Test Article Damage

Upon impact the support post's pedestal was broken at the anchors. The anchors were not damaged and a piece of the pedestal remained attached to the anchors. The top of the pedestal was also broken at the threaded portion where the post is secured.

The support post was deformed at its base. All the traffic control signal assemblies attached to the support post released from the post as they fell to the ground.

5.5 Test Vehicle Damage

The vehicle was subject to minor damage due to the impact. The hood was deformed at the front and the grill was broken. The bumper was also dented by the impact with the post. The front bumper had a slight indentation due to the impact.

Table 6 Maximum Occupant Deformation by Location

Location	Maximum Deformation	MASH Allowable Deformation
Roof	0.0 in.	4.0 in. (102 mm)
Windshield	0.0 in.	3.0 in. (76 mm)
Window	0.0 in.	0.0 in
Wheel / foot well and toe pan	0.0 in.	9.0 in. (229 mm)
Side front panel (forward of A-pillar	0.0 in.	12.0 in. (305 mm)
Front side door area (above seat)	0.0 in.	9.0 in. (229 mm)
Front side door area (below seat	0.0 in.	12.0 in. (305 mm)
Floor pan and transmission tunnel	0.0 in.	12.0 in. (305 mm)

*Note: Deformation limit applicable if side window is laminated

5.6 Structural Adequacy

The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding. Upon impact the pedestal of the support structure broke off its anchors and as a result the support structure fell to the ground.

5.7 Occupant Risk

Under occupant risk, the test articles are evaluated by four (4) criteria. The first criterion evaluates the potential hazard of detached elements, fragments, or other debris from the test article to penetrate the test vehicle's occupant compartment or present undue hazard to other traffic, pedestrians, or personnel in a work zone. The second criterion is that the vehicle remains upright. The third criterion is that the roll angle of the vehicle does not exceed 75° throughout the test. The final criteria are based on the calculated Occupant Impact Velocities (OIV) and occupant ridedown accelerations. The maximum allowable limit for Occupant Impact Velocity Limit in both the longitudinal and lateral directions is 16.0 ft/s (4.9 m/s). The maximum allowable ridedown acceleration in both the longitudinal and lateral directions is 20.49 g. Both criteria are calculated from the acceleration data collected during the test.

The maximum extent of the debris field was 161.1 ft. (49.1 m) downstream and 18.9 ft. (5.8 m) to the passenger side measured from the first point of contact with the system. The debris consisted of traffic controller pieces, the support structure, and traffic controller brackets.

Table 7 Summary of Occupant Risk Factors

Test Parameter	Axis	Units	Max	Time (ms)	Min	Time (ms)
Vehicle Impact Velocity	X	ft/s	88.6			
Occupant Impact Velocity	X	ft/s	N/A	N/A		
Occupant Impact Velocity	Y	ft/s	N/A	N/A		
Ridedown Acceleration	X	g	N/A	N/A	N/A	N/A
Ridedown Acceleration	Y	g	N/A	N/A	N/A	N/A
THIV		ft/s	N/A	N/A		
PHD		g	N/A	N/A		
ASI			N/A	N/A		
Roll	X	deg.	2.8	999.5	0.0	1.7
Pitch	Y	deg.	0.9	999.9	-0.1	21.7
Yaw	Z	deg.	0.0	0.0	-4.0	999.9

*Note: Theoretical occupant does not contact vehicle interior.

5.8 Vehicle Trajectory

The vehicle trajectory criterion requires that the vehicle's trajectory behind the test article is acceptable. The test vehicle stayed in its lane throughout the duration of the test and therefore its trajectory was deemed as acceptable.

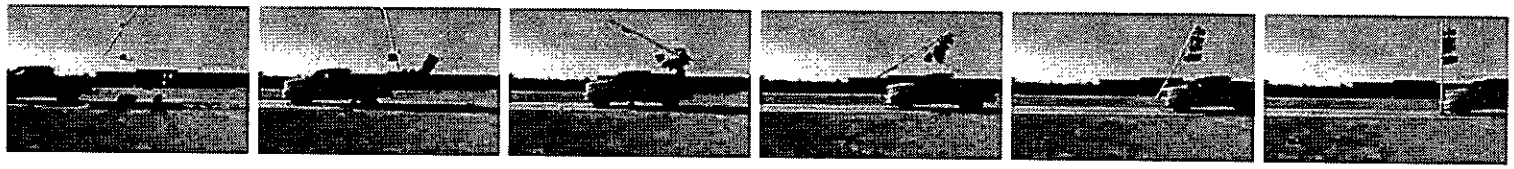
5.9 Discussion and Summary of Results

The Frey Manufacturing Pedestrian Signal Pole support structure's performance to MASH 2016 test 3-62 was deemed as acceptable. The support structure yielded, the occupant values were not exceeded, there was no potential for article penetration into the occupant compartment, and the vehicle's trajectory was acceptable.

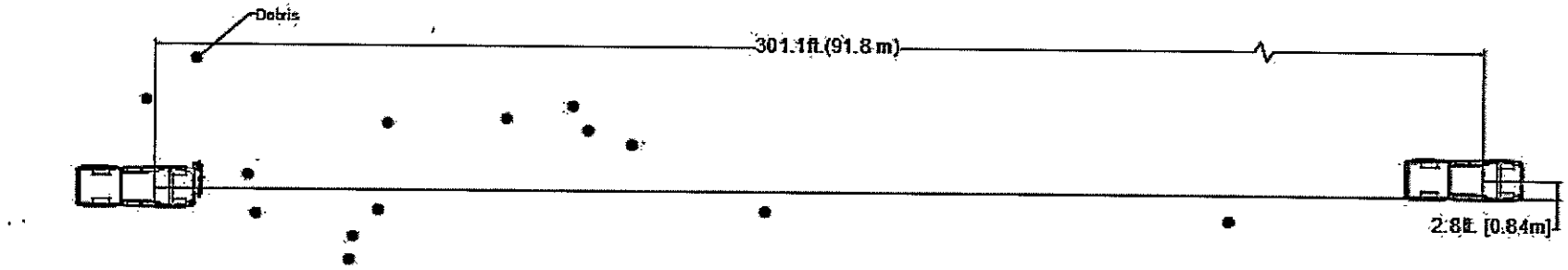
Table 8 Evaluation Criteria Summary

<table>
<tr><th>Evaluation Factor</th><th>Evaluation Criteria</th><th>Result</th></tr>
<tr><td>Structural Adequacy</td><td>B The test article should readily activate in a predictable manner by breaking away, fracturing, or yielding.</td><td>PASS</td></tr>
<tr><td rowspan="4">Occupant Risk</td><td>D Detached elements, fragments, or other debris from the test article should not penetrate or show potential for penetrating the occupant compartment, or present undue hazard to other traffic, pedestrians, or personnel in a work zone.</td><td>PASS</td></tr>
<tr><td>F The vehicle should remain upright during and after the collision. The maximum roll and pitch angles are not to exceed 75°.</td><td>PASS</td></tr>
<tr><td>H Occupant impact velocities (OIV) should satisfy the following limits:
<table><tr><th>Component</th><th>Preferred</th><th>Maximum</th></tr><tr><td>Longitudinal</td><td>10 ft/s (3.0 m/s)</td><td>16 ft/s (4.9 m/s)</td></tr></table></td><td>PASS</td></tr>
<tr><td>I The occupant ridedown acceleration should satisfy the following limits:
<table><tr><th>Component</th><th>Preferred</th><th>Maximum</th></tr><tr><td>Longitudinal and Lateral</td><td>15.0 g</td><td>20.49 g</td></tr></table></td><td>PASS</td></tr>
<tr><td>Post-Impact Vehicular Response</td><td>N Vehicle trajectory behind the test article is acceptable.</td><td>PASS</td></tr>
<tr><td colspan="2">OVERALL TEST ASSESSMENT</td><td>PASS</td></tr>
</table>

MASH Test 3-62 SUMMARY



0.400 s 0.300 s 0.200 s 0.100 s 0.050 s 0.000 s



GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P38168-03
Test Designation	3-62
Test Date	06/28/18

TEST ARTICLE

Name / Model	Pedestrian Signal Pole
Type	Support Structure
Device Height	14.8 ft. (4.5 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2012 RAM 1500
Curb Mass	5,025.4 lbs (2,279.5 kg)
Test Inertial Mass	5,060.6 lbs (2,295.5 kg)
Gross Static Mass	5,060.6 lbs (2,295.5 kg)

Impact Conditions

Impact Velocity	60.34 mph (97.10 km/h)
Impact Angle	0.0°
Location / Orientation	Offset towards driver side
Kinetic	615.8 kip-ft (835.0 kJ)

Exit Conditions

Exit Velocity	59.13 mph (95.17 km/h)
Exit Angle	0.0°
Final Vehicle	301.1 ft. (91.8 m) dw 2.8 ft. (0.9 m) left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	2.8 °
Maximum Pitch Angle	0.9 °
Maximum Yaw Angle	-4.0 °

Occupant Risk

Longitudinal OIV	N/A
Lateral OIV	N/A
Longitudinal RA	N/A
Lateral RA	N/A
THIV	N/A
PHD	N/A
ASI	N/A

Test Article Deflections

Debris Field (longitudinal)	161.1 ft. (49.1 m)
Debris Field (lateral)	18.9 ft. (5.8 m)

Vehicle Damage

Vehicle Damage Scale	12-FL-2
CDC	12FLDW1
Maximum Intrusion	No measureable

Figure 2 Test 3-62 Summary

62

American Aluminum Extrusion
1 St. Lawrence Ave
Beloit, WI 53511

CERTIFIED INSPECTION REPORT FOR EXTRUDED PRODUCTS

OUR ORDER NUMBER	ITEM
95105	5

CERTIFICATION: Rod/Bar chem/mech

BILL TO	MANIFEST NUMBER	DIE NUMBER		DATE OF SHIPMENT
2259-Midwest Steel Supply Co	129857	WS2713		11/28/2018
SHIP TO	**CUSTOMER PO**	**ALLOY**	**TEMPER**	**SALESMAN**
2259-Midwest Steel Supply Co	47913	6061	T6	Mike Zintak
TICKETS ON MANIFEST	**CUSTOMER PART NUMBER**	**DESCRIPTION**		
471222 471243 471244	61AP4SCH40	4" SCH PIPE 40		

QA Signature _____

We hereby certify that the material covered by this report has been inspected in accordance with, AMS-QQ-A-200/8, ASTM B221, ASTM B308,and ASME SB221('13) and has been found to meet the applicable requirements described herein, including any specifications forming a part ofthe description, and that samples representative of the material met the composition limits and had the mechanical properties shown.Extrude country of origin of material included herein is the United States of America using raw materials sourced both foreign and domestic.T6511 also conforms to T6-not applicable to other tempers.

Mechanical Properties

Lot	Cast/Heat Number	Alloy	Alloy Type	Test No.	Test Date	Ultimate Tensile Strength (KSI)	Yield Strength (KSI)	Percent Elongation	Hardness	Conductivity
1	1811035	6061	S	23847	11/15/18	40.9	35.9	11%		

Chemical Limits

	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ga	V	B	Zr	Bi	Pb	Sn	Sr	Co	Each	Total
ALLOY 6061	TYPE S																			
Minimum	0.62	0.14	0.22	0.00	0.85	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.15
Maximum	0.72	0.24	0.29	0.05	0.95	0.11	0.00	0.05	0.05	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.00	0.00		

Density: Electrical Conductivity: Thermal Conductivity: Alloy Constant:

Chemical Composition

Cast/Heat Number	Alloy	Alloy Type	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ga	V	B	Zr	Bi	Pb	Sn	Sr	Co	Al	Other
1811035	6061	S	0.68	0.22	0.25	0.03	0.95	0.07	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	REM	0.00

KRONICK INDUSTRIES, INC.
3101 East Hennepin Avenue
Minneapolis, Minnesota 55413
612-331-8080 (Fax) 612-331-8083

Certified

CHEMICAL ANALYSIS

ALLOY	356.1
HEAT #	1C5
Si	7.260
Fe	0.370
Cu	0.100
Mn	0.19
Mg	0.42
Cr	0.040
Ni	0.010
Zn	0.03
Ti	0.17
Na	
Pb	0.002
Sn	0.005
Sr	
Be	
Ca	
P	

FREY Manufacturing Corp.

Quality Control Plan

QAS International

REGISTRATION CERTIFICATE

This document certifies that the administration systems of

Frey Manufacturing Corporation

13150 Stewart Avenue, Norwood, MN 55368, USA

have been assessed and approved by QAS International to the following management systems, standards and guidelines:

ISO 9001:2015

The approved administration systems apply to the following:

Frey Manufacturing Corporation, located in Norwood, Minnesota designs, develops, manufactures and distributes traffic mounting systems.

Original Approval	*18th April 2017*
Current Certificate	*18th April 2020*
Certificate Expiry	*18th April 2021*
Certificate Number	*US4134*

Signed: Certification Officer

On behalf of QAS International

This certificate remains valid while the holder maintains their administration systems in accordance with the standards and guidelines stated above, which will be audited annually by QAS International. The holder is entitled to display the above registration mark for the duration of this certificate, which should be returned to QAS International upon reasonable request.
Issuing Office: QAS International, 5 Technology Park, Colindeep Lane, London, NW9 6BX, UK

QAS INTERNATIONAL Registered Company

QUALITY MANAGEMENT SYSTEM MANUAL

13150 Stewart Avenue
Norwood, MN 55368

Certificate No: US4134

Contents

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Q02 Document Amendments

All copies of this Quality Management Systems Manual (QMSM) must be kept under strict control to prevent the system from becoming unreliable. The following controls will ensure that the system remains current and valid.

1. All copies of the manual will be clearly numbered and the Holder recorded.

2. Each page in the manual will carry its own number.

3. The Quality Representative will be responsible for all revisions and additions being recorded.

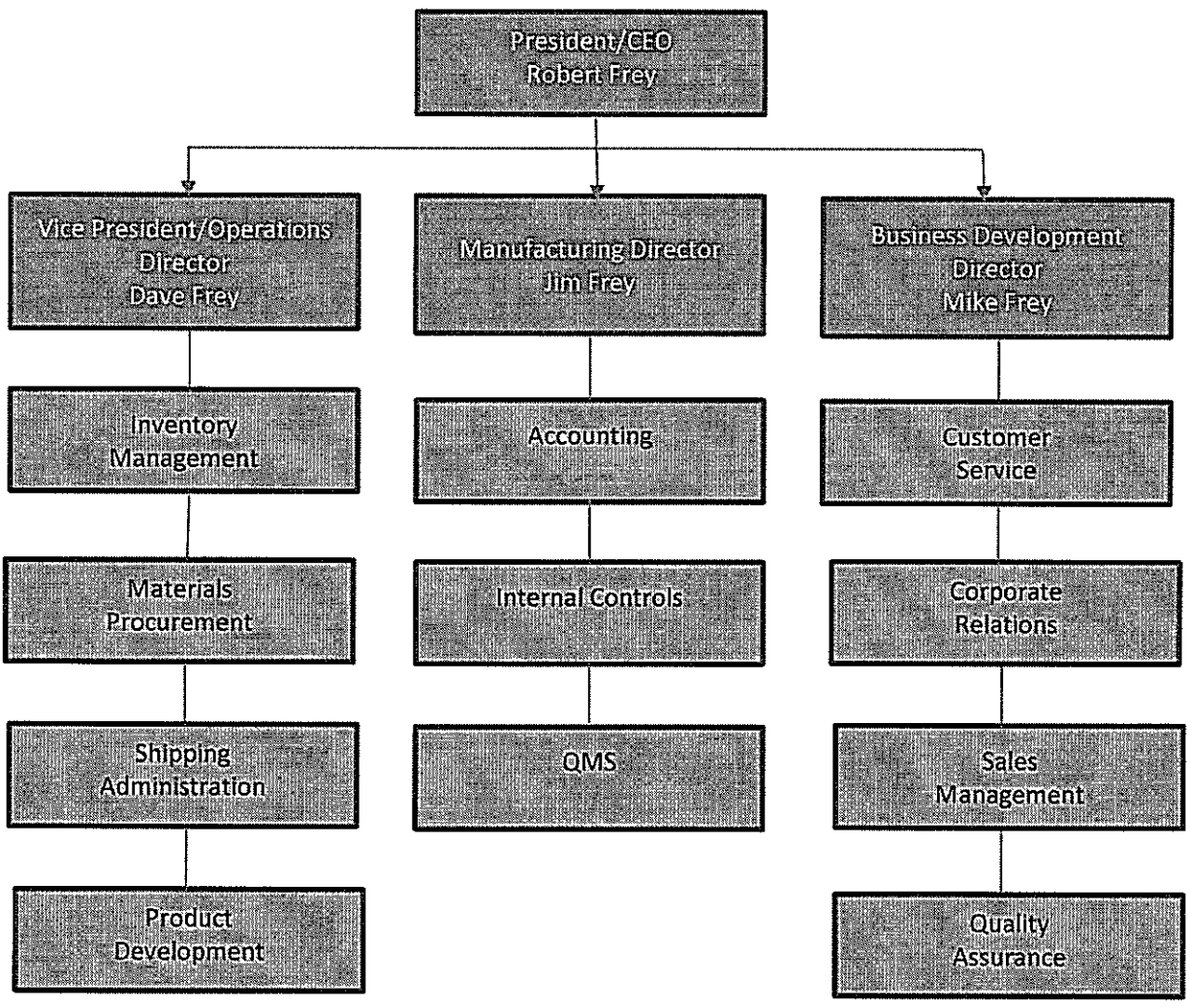
4. Changes can be suggested by any Employee but must receive signed approval before being entered into the QMSM.

5. All changes must be recorded on the Amendments Table below and appropriate pages in each QMSM changed. Significant changes will be shaded to make them easy to identify. (Where existing text is reworded or reorganized in the document, these changes will not be shaded.)

Amendments Table

Doc. No.	Page No.	Issue	Date	Description of change	Authorization
All	All	1	4/11/17	QMS Initial Release	

Q03 Company Organization Chart



Q04 Quality Management System

4. Context of the organization

4.1 Understanding the Organization and its Context

Frey Manufacturing Corp. is committed to providing the best traffic signal mounting equipment in the industry. Our products are proudly manufactured in the USA and have a long history of reliability for each designated use. The innovation that drives our company continues to adapt to satisfy the ever-growing demands of municipal traffic departments in our increasingly technological economy. The ability to provide products that are designed to work with unique traffic situations and the flexibility to improve upon existing structures makes Frey Manufacturing Corp your go-to place for your traffic needs. With attention to detail including properly NEC grounded equipment and no set screw installation on signal mounts our products prove to be the best functioning and lowest maintenance in our industry. The changing traffic industry has demanded the best signal mounting equipment, and we have been manufacturing them since 1981.

We have determined the relevant external and internal issues that affect our ability to achieve the intended outcomes of our management system. We have considered the full business environment, the key drivers and trends having impact on the objectives of the organization and the relationship and values of external stakeholders. Details of the context of our organization are given below:

See document R21 Internal and External Issues

4.2 Understanding the Needs and Expectations of Interested Parties

We have identified the interested parties and their requirements with the emphasis being on quality. We have included a process to determine any legal requirements relating to activities, products and services that are relevant to the scope of our management system.

See document R22 Understanding the Needs and Expectations of Interested Parties

4.3 Determining the Scope of the Quality Management System

We have determined the boundaries and applicability of our management system and have taken into account the issues identified in Clause 4.1 and 4.2 (above) as well as those that relate to our product and service when establishing the scope.

See document – M01 Scope of QMS

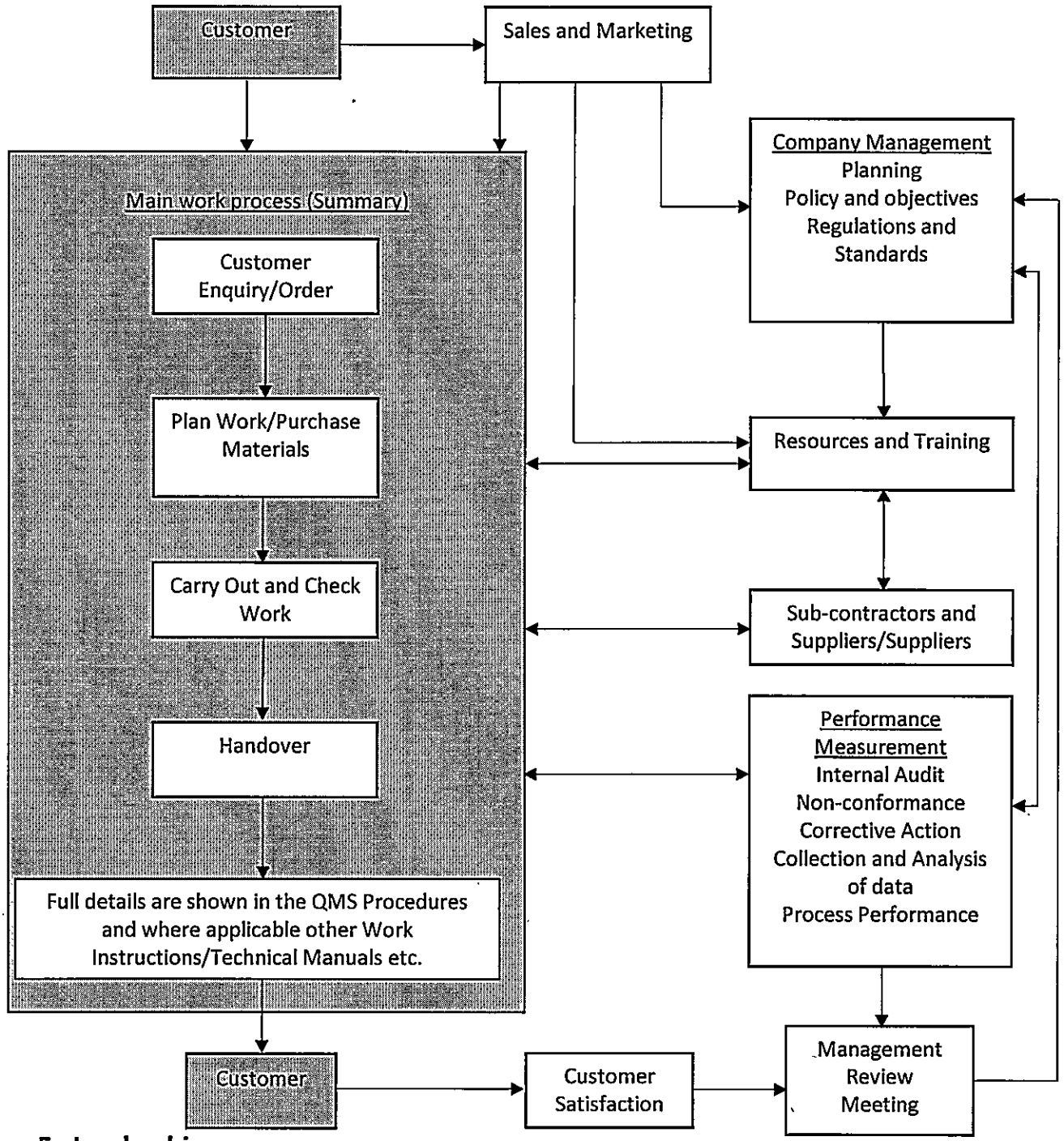
4.4 Quality Management System and its processes (QMS)

We have established and implemented, and will look to maintain and continually improve our quality management system, including the processes and their interactions needed to meet the requirements of the international standard.

In order to deliver the requirements, we have identified:

- the processes needed for the implementation, operation and maintenance of the management system along with opportunities for its improvement and their application throughout the organization;
- the inputs required and outputs expected from these processes;
- the sequence and interaction of these processes;
- criteria and methods needed to ensure that both the operation and control of these processes are effective;
- the availability of resources and information necessary to support the operation and monitoring of these processes;
- the risks and opportunities within the management system and how to plan to address them;
- the monitoring, measuring and analysing of these processes, and implement actions necessary to achieve planned results and continual improvement.
- Appropriate documented information is maintained to support these processes and is retained as records to demonstrate that all processes are working as planned.

QMS Process Diagram



5. Leadership

5.1 Leadership and Commitment

5.1.1 General

Our Top management have demonstrated leadership and commitment with respect to our QMS by taking accountability of the effectiveness of the QMS; by establishing a quality policy and quality objectives that are compatible with the direction of the organization; that both policy and objectives are communicated, understood and applied within the organization; ensuring integration of QMS requirements into the organization's business processes and by promoting awareness of a process approach and risk based thinking.

In addition, our Top Management have provided the necessary resources for the QMS; communicated the importance of effective quality management and of conforming to QMS requirements; ensuring that the QMS achieves intended results; engaging with, directing and supporting persons to contribute to the effectiveness of the QMS; promote improvement and support other members of the management team to demonstrate their leadership as it applies to their area of responsibility.

5.1.2 Customer Focus

As an organization, we strive to meet our clients' expectations; top management at Frey Manufacturing Corporation have demonstrated their leadership and commitment by ensuring that clients' requirements and applicable regulatory and statutory requirements are met; that risks and opportunities that could affect our products and services have been addressed; that our focus is on consistently providing client satisfaction.

5.2 Policy

Our Top Management have developed a quality policy that is in line with the requirements of the standard. The Policy is available as documented information, is communicated throughout the organization and is also available to interested parties, as appropriate.

See Document – M02 Quality Policy

5.3 Organizational Roles, Responsibilities and Authorities

Our Top management will ensure that the responsibilities and authorities for relevant roles are assigned and communicated throughout the organization. The organization has identified, documented and communicated the roles, responsibilities and authorities of those involved in the management system and their interrelationships within the organization.

See Document – R01 Job description

6. Planning

6.1 Actions to Address Risks and Opportunities

We have considered the issues detailed in clause 4.1 and 4.2 of this document and have determined the risks and opportunities that need to be addressed to assure the QMS can achieve its intended outcomes; that we prevent or reduce undesired effects and achieve continual improvement.

We have put a plan in place to address these risks and opportunities and also a plan to integrate and implement these actions in the QMS and evaluate their effectiveness. We have produced a risk assessment register to show what has been achieved.

See document – M03 Risk Assessment Procedure
R02 Risk Assessment Register

6.2 Quality Objectives and Planning to achieve them

We have established quality objectives at various levels throughout the organization in line with the requirements of ISO9001:2015 Clauses 6.2.1 and 6.2.2; a document has been produced detailing these objectives and the procedure around establishing them.

See document – M04 Quality Objectives Procedure Document
R03 Quality Objectives

6.3 Planning of Changes

If we make changes to our QMS they would be carried out in a planned and systematic manner. We will consider the purpose of any change, their potential consequences, the integrity of the QMS, the availability of resources and the allocation or reallocation of responsibilities and authorities.

See document – R14 Document Change Request

7. Support

7.1 Resources

7.1.1 General

We have determined and provided the resources needed for the establishment, implementation, maintenance and continual improvement of our QMS. We have considered the capabilities of our existing resources and what we need to obtain from external providers.

7.1.2 People

Those resources include people who have the necessary skills and competencies to effectively operate our QMS and to meet and exceed our clients' expectations. Also, see Clause 7.2.

7.1.3 Infrastructure

We have provided the infrastructure determined necessary for the provision of our processes and conformity of our products and services.

7.1.4 Environment for the Operation of Processes

We have provided the environment determined necessary for the provision of our processes and conformity of our products and services.

7.1.5 Monitoring and Measuring Resources

We have looked at the requirements of this clause in the standard and have determined that they are not applicable to the scope of our management system.

7.1.6 Organizational Knowledge

We have determined the knowledge necessary to operate our processes when achieving conformity of our products and services. We have systems in place to address any changes to our needs and possible trends that come up from time to time. The knowledge is in the form of documented information and is available to those who require it.

7.2 Competence

We have determined the competence of people doing work under our control that affects performance to ensure that these people are competent on the basis of appropriate education, training or experience and where applicable, take actions to acquire the necessary competence and evaluate the effectiveness of the actions taken.

See document – R05 Competency Record
R06 Training Record

7.3 Awareness

We have ensured that people doing work under our control are aware of our policies; our quality objectives relevant to them; their contribution to the effectiveness of the system and the implications of not conforming to the QMS requirements.

See document – R06 Training Record

7.4 Communication

We have determined the need for internal and external communications relevant to the system including on what, when, with whom, how and who would communicate.

See documents: WI 01 Process for Company Meetings
R23 Meeting Minutes

7.5 Documented Information

We have written policies and procedures as appropriate to meet the requirements of our QMS and the ISO9001:2015 standard. Details of how we produce and control our documented information are detailed in M06.

See document – M06 Document Control & Records

8. Operation

8.1 Operational Planning and Control

We have planned, implemented and controlled processes needed to meet requirements for the provision of our products and services, and to implement the actions determined in clause **6.1** of this document by determining the requirements of our products and services; establishing criteria for those processes and for the acceptance of our products and services. We have also determined the resources needed to achieve conformity of our products and services and by implementing control of the processes in accordance with the detailed criteria.

We keep documented information to the extent necessary to have confidence that the processes have been carried out as planned and that demonstrate the conformity of our products and services.

We shall control planned changes and review the consequences of unintended changes, taking action to mitigate any adverse effects as necessary. We shall ensure that outsourced processes are also controlled.

See document – R07 Typical Packing Slip Template

8.2 Requirements for Products and Services

8.2.1 Customer Communication

We communicate with clients where necessary in relation to information related to our products and services, enquiries, contracts or order handling including changes, customer property, obtaining their feedback, including complaints and specific contingency actions where appropriate.

8.2.2 Determination of Requirements Related to Products and Services

When determining the requirements for our products and services offered to potential clients; we have ensured that applicable regulatory and statutory requirements have been defined and that we have the ability to meet those requirements and that we can substantiate any claim made for our products and services.

8.2.3 Review of Requirements Related to Products and Services

We review our Clients' requirements including those for delivery and post-delivery activities; any statutory and regulatory requirement applicable to the product and service being provided. We also review those requirements not stated by the client, when known, plus any contract or order requirements that are different from the original request.

We conduct this review prior to our commitment to supply our products and services; we always provide a documented confirmation of the order, even if the client has not; details of all orders are recorded on document R07.

Where requirements change, we ensure that all relevant documentation is amended and that personnel are made aware prior to delivery. See procedure WI 07 Purchase Order Processing and Flow Chart for details of the customer Purchase Order and Change Order process.

See documents - WI 07 Purchase Order Processing and Flow Chart
R07 Typical Packing Slip Template

8.2.4 Changes to requirements for products and services

We will ensure that when changes are made to our products and services relevant persons are made aware and relevant documentation is amended to reflect those changes made.

8.3 Design and Development of Products and Services

We have determined that we need to use design and development resources for evidence of conformity for our products and services and have created specific documented information detailing how we have approached this requirement.

See document – M07 Design and Development Procedure
R10 Process for Research, Design and Development
R26 Orders to be filled 2017 and Inventory

8.4 Control of Externally Provided Processes, Products and Services

We have produced a procedure (M08) which details how our organization would deal with the control of externally provided products and services.

See documents - M08 Control of Externally provided products and services
R12 External Providers Performance
WI 03 Process of Ordering Inventory
R15 Typical Purchase Order Template

8.5 Production and Service Provision

8.5.1 Control of Production and Service Provision

We have implemented controlled conditions for the production and service provision, including delivery and post-delivery activities in line with the requirements of Clause 8.5.1 of the ISO9001: 2015 quality management system standard.

8.5.2 Identification and Traceability

Where necessary we have introduced a system to uniquely identify our products and services for the purposes of traceability. We retain documented information appropriate to maintaining identification and traceability.

See documents - WI 05 Process of Traceability
R07 Typical Packing Slip Template

8.5.3 Property belonging to Customers or External Providers

We exercise due care and attention when dealing with property belonging to external providers (including clients). We report any defect, damage or loss to the external provider as soon as it has been identified by our personnel.

8.5.4 Preservation

We ensure the preservation of our products and services to the extent necessary to maintain their conformity throughout the production process.

8.5.5 Post-delivery Activities

We ensure that where applicable we meet the requirements for post-delivery activities associated with our products and services to the extent that we have considered the risks associated with the products and services, the nature of use and lifetime of the products and services, customer feedback and statutory and regulatory requirements.

8.5.6 Control of Changes

We review and control changes necessary for the production and service provision to ensure continued conformity of our products and services. We keep documented records of any such changes using form R14.

See document - M09 Production and Service Provision
R14 Document Change Request
WI 07 Purchase Order Processing and Flow Chart
R07 Typical Packing Slip Template

8.6 Release of Products and Services

We have implemented arrangements at appropriate stages of production or service provision to verify that product and service requirements have been met; evidence of such acceptance criteria are recorded on the product and service record (see form R15).

Products and services will not be released to our clients until the verification arrangements have been met; the exception is when authorized by management or by the client themselves. Appropriate records of who authorized the release are recorded on the product and service record (see form R15).

See document - R07 Typical Packing Slip Template

8.7 Control of Nonconforming Outputs

We have produced a procedure (M10) which details how our organization would deal with the control of nonconforming process outputs, products and services.

See document – M10 Non-conformance & Corrective Action

9. Evaluation

9.1 Monitoring, measurement, analysis and evaluation

9.1.1 General

We have determined what needs to be monitored and measured; the methods for monitoring, measurement, analysis and evaluation, as applicable, to ensure valid results; when the monitoring and measuring shall be performed and when the results from monitoring and measurement shall be analyzed and evaluated.

We retain documented information on the results of such monitoring and measurement to enable us to evaluate the effectiveness of our QMS.

See document – M11 Monitoring and Measurement Results

9.1.2 Customer Satisfaction

We have determined the methods for obtaining information regarding our clients' perception of our organization in terms of meeting or exceeding their requirements in the provision of our products and services. The information gathered is reviewed as part of the Management Review process.

See document – M11 Monitoring and Measurement Results

9.1.3 Analysis and Evaluation

We analyze and evaluate data gathered as part of our monitoring and measuring activities and the results are used as part of our Management Review process.

See document – M11 Monitoring and Measurement Results

9.2 Internal Audit

We conduct internal audits at planned intervals to provide information on whether our QMS conforms to our requirements, to the requirements of ISO9001:2015 Quality Management System standard and is effectively implemented and maintained; it also takes into

consideration the importance of the processes concerned. We have implemented a procedure (M12) that covers in detail the process surrounding the internal audit process.

See document – M12 Internal Audit
R16 Internal Audit Program
R17 Internal Audit Report

9.3 Management Review

Our Top management reviews the organization's QMS at planned intervals, at least once every 12 months, to ensure its continuing suitability, adequacy and effectiveness. Each review will take into consideration the status of actions from any previous meetings and any changes in internal or external issues relevant to our QMS and performance information, including trends and indicators as detailed in ISO9001: 2015 Clause 9.3.1 and 9.3.2.

Information relating to each of these meetings is recorded using document R18 Management Review Agenda and Minutes

See document – M13 Management Review
R18 Management Review Agenda and Minutes

10 Improvements

10.1 General

We have determined and shall select such opportunities as necessary for improving our clients' requirements and satisfaction. This will include improving our products and services; correcting, preventing or reducing undesired effects improving the performance and effectiveness of our QMS.

10.2 Nonconformity and Corrective Action

When non-conformity occurs, we shall react to the nonconformity and take action to control and correct it and then deal with the consequences. We will evaluate the need for action to eliminate the causes of the nonconformity, in order that it does not recur or occur elsewhere in the organization. We will implement the actions required and review the effectiveness of any corrective action taken, update risks and opportunities determined during planning (if necessary) and make changes to the QMS, where necessary.

We record all nonconformities, actions taken and the results of any corrective action using the appropriate documentation.

See documents - M10 Non-conformance and Corrective Action
R19 Non-conformance Report Form
R20 Corrective Action Report Form
R24 FMC RMA -1701RMA Template

10.3 Continual Improvement

We shall continually improve the suitability, adequacy and effectiveness of our QMS. We consider the results of analysis and evaluation and the outputs from management review to determine if there are needs or opportunities that could be addressed as part of our continual improvement.

Q05 Document Register

Reference	Title	Issue No.	Date	Authority
M01	Scope of QMS	1	4/11/17	
M02	Quality Policy	1	4/11/17	
M03	Risk Assessment Procedure	1	4/11/17	
M04	Planning to Achieve Quality Objectives	1	4/11/17	
M06	Document Control & Records	1	4/11/17	
M07	Design & Development	1	4/11/17	
M08	Control of Externally Provided P & S	1	4/11/17	
M09	Production & Service Provision	1	4/11/17	
M10	Non-conformance & Corrective Action	1	4/11/17	
M11	Monitoring & Measurement Results	1	4/11/17	
M12	Internal Audit	1	4/11/17	
M13	Management Review	1	4/11/17	
WI 01	Process for Company Meetings	1	4/11/17	
WI 02	Process for Order Revision	1	4/11/17	
WI 03	Process of Ordering Inventory	1	4/11/17	
WI 04	Process of Receiving Product In	1	4/11/17	
WI 05	Process of Traceability	1	4/11/17	
WI 06	Processing in Inventory	1	4/11/17	
WI 07	Purchase Order Processing and Flow Chart	1	4/11/17	
R01	Job Description	1	4/11/17	

Reference	Title	Issue No.	Date	Authority
R02	Risk Assessment Register	1	4/11/17	
R03	Quality Objectives	1	4/11/17	
R05	Competency Statement	1	4/11/17	
R06	Training Record	1	4/11/17	
R07	Typical Packing Slip Template	1	4/11/17	
R10	Research, Design & Development Acceptance	1	4/11/17	
R12	External Provider Performance	1	4/11/17	
R14	Document Change Request	1	4/11/17	
R15	Typical Purchase Order Template	1	4/11/17	
R16	Internal Audit Program	1	4/11/17	
R17	Internal Audit Report	1	4/11/17	
R18	Management Review Agenda & Minutes	1	4/11/17	
R19	Non-conformance Report Form	1	4/11/17	
R20	Corrective Action Report Form	1	4/11/17	
R21	Internal & External Issues	1	4/11/17	
R22	Understanding Needs & Expectations of Interested Parties	1	4/11/17	
R23	Meeting Minutes	1	4/11/17	
R24	FMC RMA -1701RMA Template	1	4/11/17	
R25	Agreement Terms and Conditions	1	01/29/16	
R26	Orders to be filled 2017 and Inventory	1	4/11/17	

Reference	Title	Issue No.	Date	Authority

FREY Manufacturing Corp.

Contact or Reference List

Departments and Entities Currently using the Signal Pole CP6 Series

Minnesota Department of Transportation
Peter Skweres, P.E.
651-234-7053
Peter.skweres@state.mn.us

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847-705-4504
Lukasz.pociecha@illinois.gov

Colorado Department of Transportation
Sam Sanders, P.E.
970-385-1616
Sam.sanders@state.co.us

Utah Department of Transportation
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801-965-4924
jsweeten@utah.gov

St. Louis County, MO
Marty Koeller
314-615-0210
Mkoeller2@stlouisco.com

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dposten@siouxfalls.org

City of Overland Park, KS
Bruce Wacker, P.E.
913-895-6027
Bruce.wacker@opkansas.org

City of Minneapolis, MN
Dave Prehall, P.E.
612-221-5322
Dave.prehall@minneapolismn.gov

City of Duluth, MN
Earl Stewart, P.E.
218-730-4421
estewart@duluthmn.gov

Virginia Department of Transportation
Bret Galloway, P.E.
804-786-2536
Bret.galloway@vdot.virginia.gov

More references available upon request.
Contact:
Mike Frey
Frey Manufacturing Corp.
952-467-4402
Mike@freymfgcorp.com

FREY Manufacturing Corp.

Other Pertinent Information

U.S.Department
of Transportation
Federal Highway
Administration

January 30, 2019

1200 New Jersey Ave., SE
Washington, D.C. 20590

In Reply Refer To:
HSST-1/SS-183

Mr. Micheal Frey
Frey Manufacturing
13150 Stewart Avenue
Norwood, MN. 55368

Dear Mr. Frey:

This letter is in response to your November 8, 2018 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number SS-183 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

- Crosswalk Pedestal Station

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the AASHTO's MASH. Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: Crosswalk Pedestal Station
Type of system: Sign Support
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: KARCO
Date of request: November 14, 2018

FHWA concurs with the recommendation of the accredited crash testing laboratory on the attached Form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of AASHTO's MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number SS-183 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.

- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.

- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	November 08, 2018	◉ New ○ Resubmission
	Name:	Robert Ramirez	
	Company:	Applus IDIADA KARCO Engineering	
	Address:	9270 Holly Rd. Adelanto, CA 92301	
	Country:	USA	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program:

Device & Testing Criterion - Enter from right to left starting with Test Level

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'SS': Breakaway Sign Supports, Mailboxes, & other small sign supports	◉ Physical Crash Testing ○ Engineering Analysis	Crosswalk Pedestal Station	AASHTO MASH	TL3

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	Mike Frey	Same as Submitter ☐
Company Name:	Frey Manufacturing	Same as Submitter ☐
Address:	13150 Stewart Ave. Norwood, MN 55368	Same as Submitter ☐
Country:	USA	Same as Submitter ☐

Enter below all disclosures of financial interests as required by the FHWA 'Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.

Frey Manufacturing and Applus IDIADA KARCO Engineering LLC share no financial interests between the two organizations. This includes no shared financial interest but not limited to:
i. Compensation including wages, salaries, commissions, professional fees, or fees for business referrals
iii. Research funding or other forms of research support;
iv. Patents, copyrights, licenses, and other intellectual property interests;
vi. Business ownership and investment interests;

PRODUCT DESCRIPTION

(•) New Hardware or Significant Modification ( ) Modification to Existing Hardware

The Frey Manufacturing Crosswalk Pedestal Station is a support structure composed of circular support pipe support and a pedestal base assembly. The as-tested configuration of the Crosswalk Pedestal Station was tested with an accessible pedestrian signal (APS) push button station.

The support pipe was constructed of a 4.5 in. (114 mm) diameter aluminum pipe with a thickness of 0.3 in. (8 mm). The pipe had a length of 4.0 ft. (1.2 m). The bottom of the support pipe was threaded into the pedestal assembly and there was a bolt that went through the pipe and pedestal base. A tether was attached to the through bolt and the opposite end was attached to one of the mounting anchors.

The pedestal assembly was composed of a pedestal and access door. The pedestal was 10.0 in. (254 mm) tall and had the access door incorporated into one of its sides. The pedestal was anchored to the ground with four (4) 0.625 in. (16 mm) diameter by 7.5 in. (191 mm) long threaded studs, four (4) washers, and four (nuts). The anchors had an embedment depth of 4.0 in. (102 mm) to 5.0 in. (127 mm). The threaded rods were epoxied into a 6.0 in. (152 mm) thick concrete pad for this test.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Robert Ramirez	
Engineer Signature:	Robert Ramirez Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2018.11.14 09:49:32 -08'00'	
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter ☒
Country:	USA	Same as Submitter ☒

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-60 (1100C)	Applus IDIADA KARCO test number P38154-01. An 1100C test vehicle impacting the support at a nominal speed of 19 mph (30 km/h). This test is designed to evaluate the kinetic energy required to activate the release mechanism of the support. The test vehicle, a 2013 Kia Rio 4-door sedan with a test inertial weight of 2,442.7 lbs (1,108.0 kg) impacted the device at a speed of 19.09 mph (30.73 km/h). The support was activated in a controlled manner and did not cause excessive velocity change . There were no intrusion or deformation of the occupant compartment. The occupant impact velocity in the lateral and longitudinal direction were 2.0 ft/s (0.6 m/s) and 2.3 ft/s (0.7 m/s), respectively. The ridedown accelerations in the longitudinal and lateral directions were 0.2 g and 0.1 g, respectively. The occupant risk values were below the preferred values in MASH and there was no intrusion into the occupant compartment. The Frey Manufacturing Crosswalk Pedestal Station met all the requirements for MASH Test 3-60.	PASS
3-61 (1100C)	Applus IDIADA KARCO test number P38154-02. An 1100C test vehicle impacting the support at a nominal speed of 62 mph (100 km/h). This test is designed to evaluate the behavior of the feature during high-speed impacts. The test vehicle, a 2013 Kia Rio 4-door sedan with a test inertial weight of 2,442.7 lbs (1,108.0 kg) impacted the device at a speed of 61.55 mph (99.06 km/h). The support was activated in a controlled manner and did not cause excessive velocity change . The device contacted and cracked the windshield but the deformation limits were not exceeded and there was no penetration into the occupant compartment. The occupant impact velocity in the lateral and longitudinal direction were 0.7 ft/s (0.2 m/s) and 3.6 ft/s (1.1 m/s), respectively. The ridedown accelerations in the longitudinal and lateral directions were 0.1 g and 0.2 g, respectively. The occupant risk values were below the preferred values in MASH and there was no penetration into the occupant compartment. The Frey Manufacturing Crosswalk Pedestal Station met all the requirements for MASH Test 3-61.	PASS

Required Test Number	Narrative Description	Evaluation Results
3-62 (2270P)	Applus IDIADA KARCO test number P38154-03. An 2270P test vehicle impacting the support at a nominal speed of 62 mph (100 km/h). This test is designed to evaluate the behavior of the feature during high-speed impacts. The test vehicle, a 2012 RAM 1500 4-door pickup truck with a test inertial weight of 4,974.6 lbs (2,256.5 kg) impacted the device at a speed of 63.58 mph (101.75 km/h). The support was activated in a controlled manner and did not cause excessive velocity change . There was no occupant compartment deformation or penetration. The occupant impact velocity in the lateral and longitudinal direction were 2.3 ft/s (0.7 m/s) and 3.6 ft/s (1.1 m/s), respectively. The ridedown accelerations in the longitudinal and lateral directions were 0.2 g and 0.4 g, respectively. The occupant risk values were below the preferred values in MASH and there was no penetration into the occupant compartment. The Frey Manufacturing Crosswalk Pedestal Station met all the requirements for MASH Test 3-62.	PASS

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Applus IDIADA KARCO Engineering	
Laboratory Signature:	Robert Ramirez	Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2018.11.14 09:50:42 -08'00'
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter ☒
Country:	USA	Same as Submitter ☒
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371 Valid up to July 1, 2019	

Submitter Signature*: Robert Ramirez Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2018.11.14 09:50:34 -08'00'

Submit Form

ATTACHMENTS

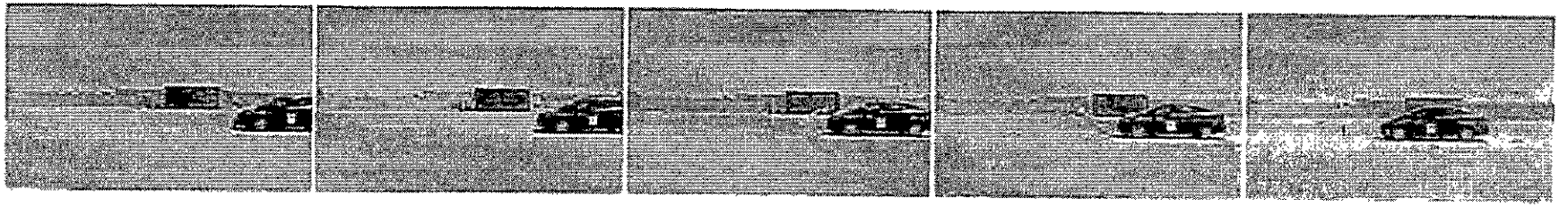
Attach to this form:

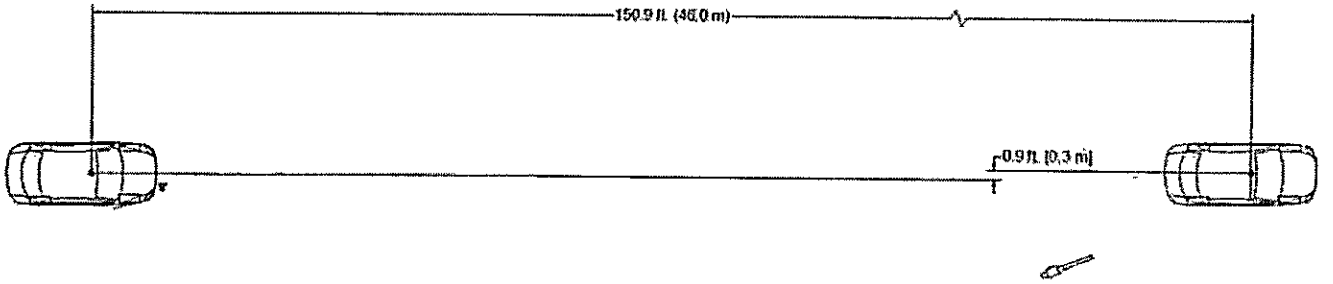
1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words

MASH Test 3-60 SUMMARY





GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P38154-01
Test Designation	3-60
Test Date	06/27/18

TEST ARTICLE

Name / Model	Crosswalk Pedestal Station
Type	Support Structure
Device Height	4.8 ft. (1.5 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,414.0 lbs (1,095.0 kg)
Test Inertial Mass	2,442.7 lbs (1,108.0 kg)
Gross Static Mass	2,610.2 lbs (1,184.0 kg)

Impact Conditions

Impact Velocity	19.09 mph (30.73 km/h)
Impact Angle	90.0°
Location / Orientation	Offset 17.0 in. (431 mm)
Kinetic Energy	29.8 kip-ft (40.4 kJ)

Exit Conditions

Exit Velocity	17.94 mph (28.87 km/h)
Exit Angle	0.0°
Final Vehicle Position	150.9 ft. (46.0 m) Downstream 0.9 ft. (0.3 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	4.0 °
Maximum Pitch Angle	3.6 °
Maximum Yaw Angle	0.4 °

Occupant Risk

Longitudinal OIV	2.0 ft/s (0.6 m/s)
Lateral OIV	2.3 ft/s (0.7 m/s)
Longitudinal RA	0.2 g
Lateral RA	0.1 g
THIV	2.3 ft/s (0.7 m/s)
PHD	0.3 g
ASI	0.11

Test Article Deflections

Debris Field (longitudinal)	82.0 ft. (25.0 m)
Debris Field (lateral)	6.4 ft. (2.0 m)

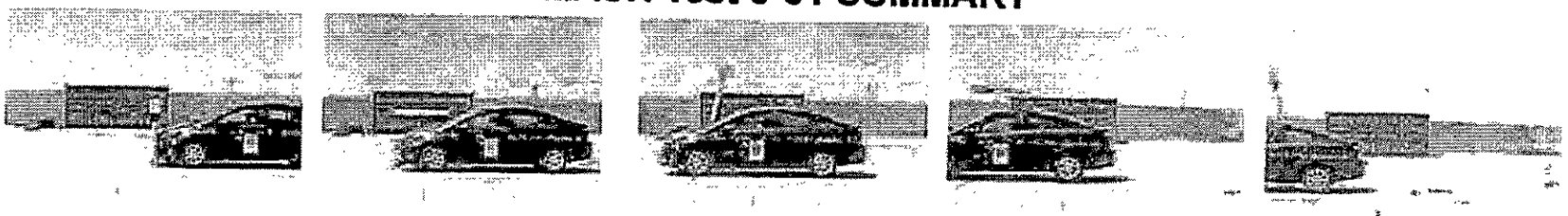
Vehicle Damage

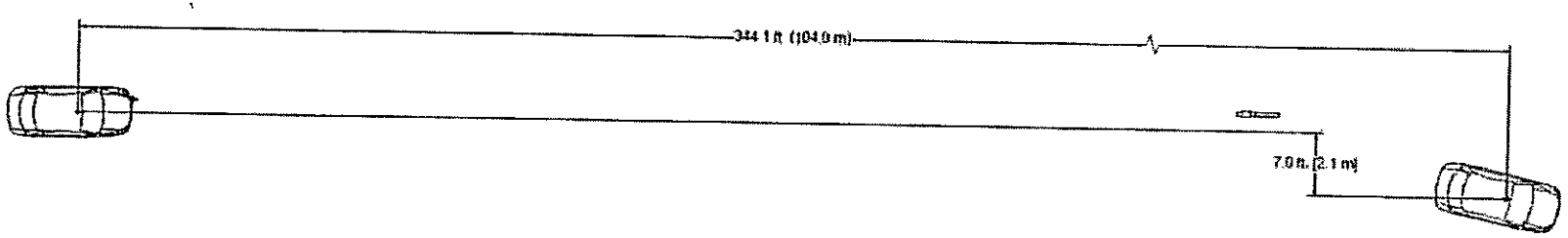
Vehicle Damage Scale	N/A
CDC	N/A
Maximum Intrusion	N/A

Figure 2 Test 3-60 Summary

66

MASH Test 3-61 SUMMARY





GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P38154-02
Test Designation	3-61
Test Date	06/27/18

TEST ARTICLE

Name / Model	Crosswalk Pedestal Station
Type	Support Structure
Device Height	4.8 ft. (1.4 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,414.0 lbs (1,095.0 kg)
Test Inertial Mass	2,442.7 lbs (1,108.0 kg)
Gross Static Mass	2,610.2 lbs (1,184.0 kg)

Impact Conditions

Impact Velocity	61.55 mph (99.06 km/h)
Impact Angle	90.0°
Location / Orientation	Offset 17.0 in. (431 mm)
Kinetic Energy	309.4 kip-ft (419.5 kJ)

Exit Conditions

Exit Velocity	59.31 mph (95.45 km/h)
Exit Angle	0.0°
Final Vehicle Position	344.1 ft. (104.9 m) Downstream 7.0 ft. (2.1 m) Right
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	3.1 °
Maximum Pitch Angle	5.1 °
Maximum Yaw Angle	-1.0 °

Occupant Risk

Longitudinal OIV	0.7 ft/s (0.2 m/s)
Lateral OIV	3.6 ft/s (1.1 m/s)
Longitudinal RA	0.1 g
Lateral RA	0.2 g
THIV	3.3 ft/s (1.0 m/s)
PHD	0.3 g
ASI	0.10

Test Article Deflections

Debris Field (longitudinal)	288.0 ft. (87.8 m)
Debris Field (lateral)	9.7 ft. (3.0 m)

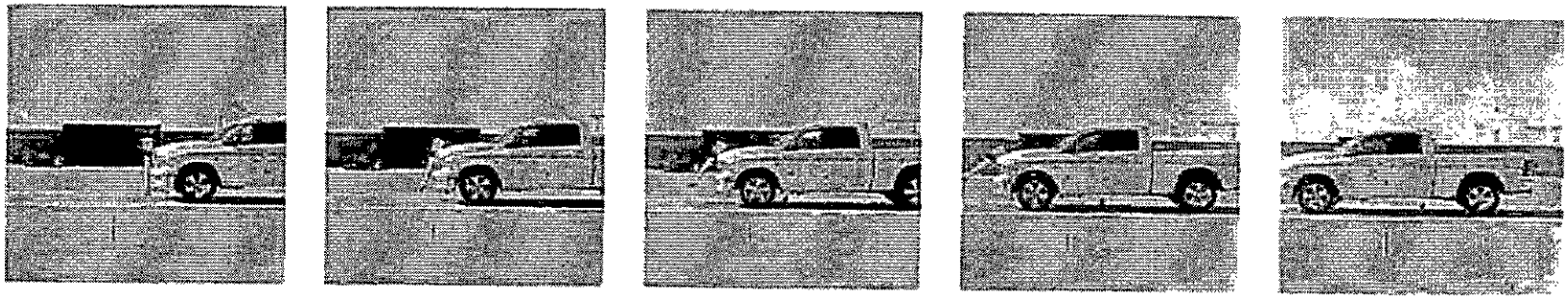
Vehicle Damage

Vehicle Damage Scale	N/A
CDC	12FLGN1
Maximum Intrusion	1.2 in. (31 mm)

Figure 3 Test 3-61 Summary

100

MASH Test 3-62 SUMMARY



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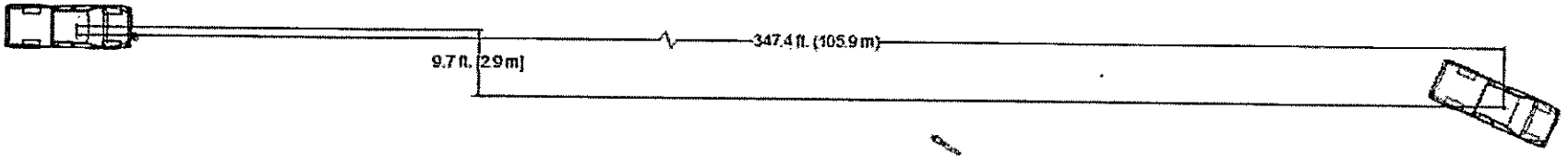


GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P38154-03
Test Designation	3-62
Test Date	06/27/18

TEST ARTICLE

Name / Model	Crosswalk Pedestal Station
Type	Support Structure
Device Height	4.8 ft. (1.5 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2012 RAM 1500
Curb Mass	5,119.0 lbs (2,322.0 kg)
Test Inertial Mass	4,974.6 lbs (2,256.5 kg)
Gross Static Mass	4,974.6 lbs (2,256.5 kg)

Impact Conditions

Impact Velocity	63.22 mph (101.75 km/h)
Impact Angle	90.0°
Location / Orientation	Offset 17.0 in. (431 mm)
Kinetic Energy	664.8 kip-ft (901.3 kJ)

Exit Conditions

Exit Velocity	62.58 mph (100.71 km/h)
Exit Angle	0.0°
Final Vehicle Position	347.4 ft. (105.9 m) Downstream 9.7 ft. (3.0 m) Right
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	-0.5 °
Maximum Pitch Angle	3.0 °
Maximum Yaw Angle	-1.7 °

Occupant Risk

Longitudinal OIV	2.3 ft/s (0.7 m/s)
Lateral OIV	3.6 ft/s (1.1 m/s)
Longitudinal RA	0.2 g
Lateral RA	0.4 g
THIV	5.6 ft/s (1.7 m/s)
PHD	0.4 g
ASI	0.10

Test Article Deflections

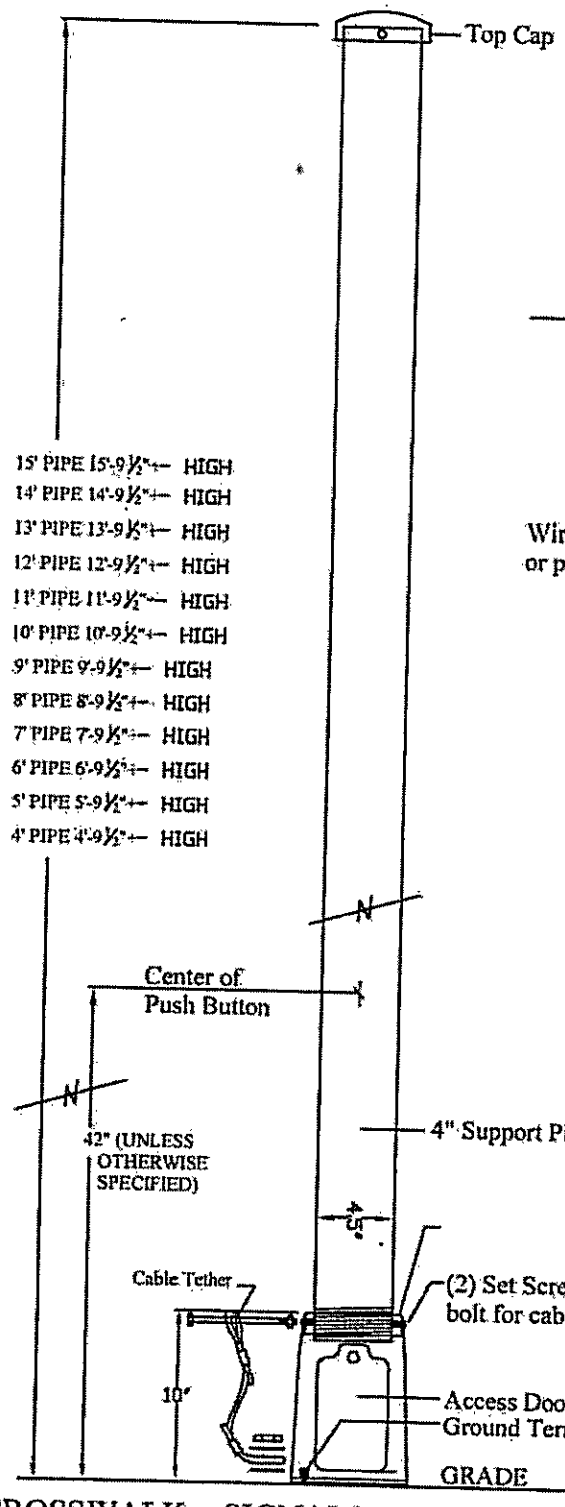
Debris Field (longitudinal)	257.0 ft. (78.3 m)
Debris Field (lateral)	14.6 ft. (4.5 m)

Vehicle Damage

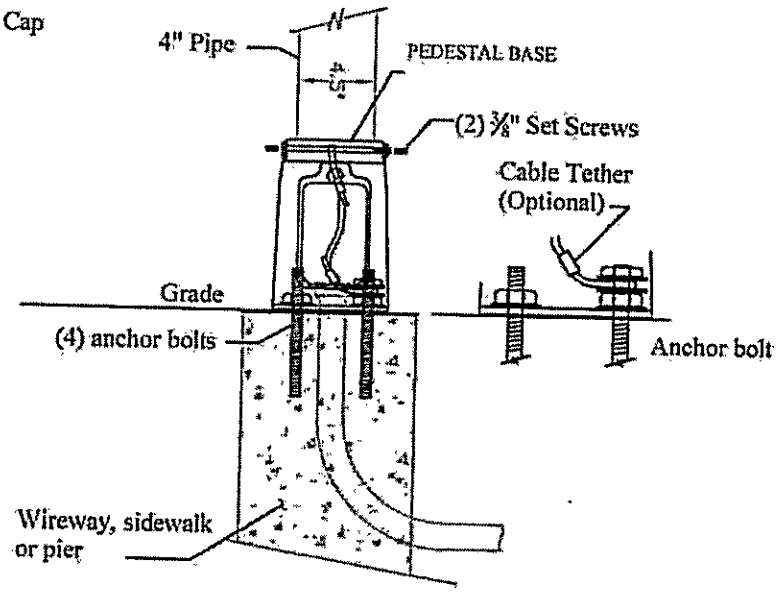
Vehicle Damage Scale	12-FR-1
CDC	12FZEN1
Maximum Intrusion	0.0 in. (0 mm)

Figure 3 Test 3-62 Summary

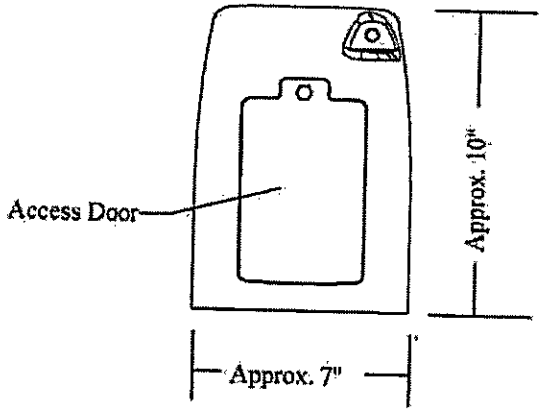
101



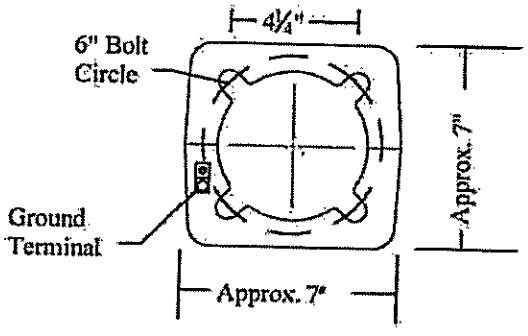
CROSSWALK - SIGNAL PEDESTAL ASSEMBLY



BASE MOUNTING



BASE SIDE VIEW



BASE BOTTOM VIEW

NOT TO SCALE

HARDWARE MEETS OR EXCEEDS STATE SPECIFICATIONS

FREY Manufacturing Corp.
www.FreyMfgCorp.com
Made in USA
Phone: 952-467-4402

CROSSWALK - SIGNAL PEDESTAL HEIGHTS FOR VARIOUS LENGTHS OF 4" PIPES
CATALOG #: CP6 SERIES

DATE	DWG. NO.	REV.
04-19-18	8.5.0	1

U.S. Department
of Transportation
Federal Highway
Administration

January 30, 2019

1200 New Jersey Ave., SE
Washington, D.C. 20590

In Reply Refer To:
HSST-1/SS-184

Mr. Micheal Frey
Frey Manufacturing
13150 Stewart Avenue
Norwood, MN. 55368

Dear Mr. Frey:

This letter is in response to your November 8, 2018 request for the Federal Highway Administration (FHWA) to review a roadside safety device, hardware, or system for eligibility for reimbursement under the Federal-aid highway program. This FHWA letter of eligibility is assigned FHWA control number SS-184 and is valid until a subsequent letter is issued by FHWA that expressly references this device.

Decision

The following device is eligible within the length-of-need, with details provided in the form which is attached as an integral part of this letter:

- Pedestrian Signal Pole

Scope of this Letter

To be found eligible for Federal-aid funding, new roadside safety devices should meet the crash test and evaluation criteria contained in the American Association of State Highway and Transportation Officials' (AASHTO) Manual for Assessing Safety Hardware (MASH). However, the FHWA, the Department of Transportation, and the United States Government do not regulate the manufacture of roadside safety devices. Eligibility for reimbursement under the Federal-aid highway program does not establish approval, certification or endorsement of the device for any particular purpose or use.

This letter is not a determination by the FHWA, the Department of Transportation, or the United States Government that a vehicle crash involving the device will result in any particular outcome, nor is it a guarantee of the in-service performance of this device. Proper manufacturing, installation, and maintenance are required in order for this device to function as tested.

This finding of eligibility is limited to the crashworthiness of the system and does not cover other structural features, nor conformity with the Manual on Uniform Traffic Control Devices.

Eligibility for Reimbursement

Based solely on a review of crash test results and certifications submitted by the manufacturer, and the crash test laboratory, FHWA agrees that the device described herein meets the crash test and evaluation criteria of the AASHTO's MASH. Therefore, the device is eligible for reimbursement under the Federal-aid highway program if installed under the range of tested conditions.

Name of system: Pedestrian Signal Pole
Type of system: Sign Support
Test Level: MASH Test Level 3 (TL3)
Testing conducted by: KARCO
Date of request: November 14, 2018

FHWA concurs with the recommendation of the accredited crash testing laboratory on the attached Form.

Full Description of the Eligible Device

The device and supporting documentation, including reports of the crash tests or other testing done, videos of any crash testing, and/or drawings of the device, are described in the attached form.

Notice

This eligibility letter is issued for the subject device as tested. Modifications made to the device are not covered by this letter. Any modifications to this device should be submitted to the user (i.e., state DOT) as per their requirements.

You are expected to supply potential users with sufficient information on design, installation and maintenance requirements to ensure proper performance.

You are expected to certify to potential users that the hardware furnished has the same chemistry, mechanical properties, and geometry as that submitted for review, and that it will meet the test and evaluation criteria of AASHTO's MASH.

Issuance of this letter does not convey property rights of any sort or any exclusive privilege. This letter is based on the premise that information and reports submitted by you are accurate and correct. We reserve the right to modify or revoke this letter if: (1) there are any inaccuracies in the information submitted in support of your request for this letter, (2) the qualification testing was flawed, (3) in-service performance or other information reveals safety problems, (4) the system is significantly different from the version that was crash tested, or (5) any other information indicates that the letter was issued in error or otherwise does not reflect full and complete information about the crashworthiness of the system.

Standard Provisions

- To prevent misunderstanding by others, this letter of eligibility designated as FHWA control number SS-184 shall not be reproduced except in full. This letter and the test documentation upon which it is based are public information. All such letters and documentation may be reviewed upon request.

- This letter shall not be construed as authorization or consent by the FHWA to use, manufacture, or sell any patented system for which the applicant is not the patent holder.

- This FHWA eligibility letter is not an expression of any Agency view, position, or determination of validity, scope, or ownership of any intellectual property rights to a specific device or design. Further, this letter does not impute any distribution or licensing rights to the requester. This FHWA eligibility letter determination is made based solely on the crash-testing information submitted by the requester. The FHWA reserves the right to review and revoke an earlier eligibility determination after receipt of subsequent information related to crash testing.

- If the subject device is a patented product it may be considered to be proprietary. If proprietary systems are specified by a highway agency for use on Federal-aid projects: (a) they must be supplied through competitive bidding with equally suitable unpatented items; (b) the highway agency must certify that they are essential for synchronization with the existing highway facilities or that no equally suitable alternative exists; or (c) they must be used for research or for a distinctive type of construction on relatively short sections of road for experimental purposes. Our regulations concerning proprietary products are contained in Title 23, Code of Federal Regulations, Section 635.411.

Sincerely,

Michael S. Griffith
Director, Office of Safety Technologies
Office of Safety

Enclosures

Request for Federal Aid Reimbursement Eligibility of Highway Safety Hardware

Submitter	Date of Request:	November 08, 2018	◉ New ○ Resubmission
	Name:	Robert Ramirez	
	Company:	Applus IDIADA KARCO Engineering	
	Address:	9270 Holly Rd. Adelanto, CA 92301	
	Country:	USA	
	To:	Michael S. Griffith, Director FHWA, Office of Safety Technologies	

I request the following devices be considered eligible for reimbursement under the Federal-aid highway program.

Device & Testing Criterion - Enter from right to left starting with Test Level

System Type	Submission Type	Device Name / Variant	Testing Criterion	Test Level
'SS': Breakaway Sign Supports, Mailboxes, & other small sign supports	◉ Physical Crash Testing ○ Engineering Analysis	Pedestrian Signal Pole	AASHTO MASH	TL3

By submitting this request for review and evaluation by the Federal Highway Administration, I certify that the product(s) was (were) tested in conformity with the AASHTO Manual for Assessing Safety Hardware and that the evaluation results meet the appropriate evaluation criteria in the MASH.

Individual or Organization responsible for the product:

Contact Name:	Mike Frey	Same as Submitter ☐
Company Name:	Frey Manufacturing	Same as Submitter ☐
Address:	13150 Stewart Ave. Norwood, MN 55368	Same as Submitter ☐
Country:	USA	Same as Submitter ☐
Enter below all disclosures of financial interests as required by the FHWA 'Federal-Aid Reimbursement Eligibility Process for Safety Hardware Devices' document.		
Frey Manufacturing and Applus IDIADA KARCO Engineering LLC share no financial interests between the two organizations. This includes no shared financial interest but not limited to: i. Compensation including wages, salaries, commissions, professional fees, or fees for business referrals iii. Research funding or other forms of research support; iv. Patents, copyrights, licenses, and other intellectual property interests; vi. Business ownership and investment interests;		

PRODUCT DESCRIPTION

◉ New Hardware or Significant Modification ○ Modification to Existing Hardware

The Frey Manufacturing Pedestrian Signal Pole is a support structure composed of circular pipe support and a signal pedestal assembly. The as-tested configuration of the Pedestrian Signal Pole was tested with an accessible pedestrian signal (APS) push button station and traffic control signal controllers.
The support was constructed of a 4.5 in. (114 mm) diameter aluminum pipe with a thickness of 0.3 in. (8 mm). The pipe had a length of 15.0 ft. (4.6 m). The bottom of the support pipe was threaded into the pedestal assembly and secured in place with two (2) set screws.
The pedestal assembly was composed of a pedestal and access door. The pedestal was 10.0 in. (254 mm) tall and had the access door incorporated into one of its sides. The pedestal was anchored to the ground with four (4) 0.625 in. (16 mm) diameter by 7.5 in. (191 mm) long threaded studs, four (4) washers, and four (nuts). The anchors had an embedment depth of 4.0 in. (102 mm) to 5.0 in. (127 mm). The threaded rods were epoxied into a 6.0 in. (152 mm) thick concrete pad for this test.

CRASH TESTING

By signature below, the Engineer affiliated with the testing laboratory, agrees in support of this submission that all of the critical and relevant crash tests for this device listed above were conducted to meet the MASH test criteria. The Engineer has determined that no other crash tests are necessary to determine the device meets the MASH criteria.

Engineer Name:	Robert Ramirez	
Engineer Signature:	Robert Ramirez — Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2018.11.12 14:41:07 -08'00'	
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter ☒
Country:	USA	Same as Submitter ☒

A brief description of each crash test and its result:

Required Test Number	Narrative Description	Evaluation Results
3-60 (1100C)	Applus IDIADA KARCO test number P38168-01. An 1100C test vehicle impacting the support at a nominal speed of 19 mph (30 km/h). This test is designed to evaluate the kinetic energy required to activate the release mechanism of the support. The test vehicle, a 2013 Kia Rio 4-door sedan with a test inertial weight of 2,426.1 lbs (1,100.5 kg) impacted the device at a speed of 18.68 mph (30.06 km/h). The support was activated in a controlled manner and did not cause excessive velocity change . The device impacted the roof but the deformation limits were not exceeded and there was no penetration into the occupant compartment. The occupant impact velocity in the lateral and longitudinal direction were 0.3 ft/s (0.1 m/s) and 4.9 ft/s (1.5 m/s), respectively. The ridedown accelerations in the longitudinal and lateral directions were 0.5 g and 1.0 g, respectively. The Frey Manufacturing Pedestrian Signal Pole met all the requirements for MASH Test 3-60.	PASS
3-61 (1100C)	Applus IDIADA KARCO test number P38168-02. An 1100C test vehicle impacting the support at a nominal speed of 62 mph (100 km/h). This test is designed to evaluate the behavior of the feature during high-speed impacts. The test vehicle, a 2012 Kia Rio 4-door sedan with a test inertial weight of 2,410.7 lbs (1,093.5 kg) impacted the device at a speed of 60.99 mph (98.15 km/h). The support was activated in a controlled manner and did not cause excessive velocity change . The device rotated over the top of the vehicle and did not contact the windshield or roof. The occupant impact velocity in the lateral and longitudinal direction were 0.3 ft/s (1.0 m/s) and 1.0 ft/s (3.3 m/s), respectively. The ridedown accelerations in the longitudinal and lateral directions were 0.2 g and 0.3 g, respectively. The occupant risk values were below the preferred values in MASH and there was no penetration into the occupant compartment. The Frey Manufacturing Pedestrian Signal Pole met all the requirements for MASH Test 3-61.	PASS

Required Test Number	Narrative Description	Evaluation Results
3-62 (2270P)	Applus IDIADA KARCO test number P38168-03. An 2270P test vehicle impacting the support at a nominal speed of 62 mph (100 km/h). This test is designed to evaluate the behavior of the feature during high-speed impacts. The test vehicle, a 2012 RAM 1500 4-door pickup truck with a test inertial weight of 5,060.6 lbs (2,295.5 kg) impacted the device at a speed of 63.58 mph (101.75 km/h). The support was activated in a controlled manner and did not cause excessive velocity change . There was no occupant compartment deformation or penetration. There was not sufficient velocity change to create occupant impact velocities and as a result the ridedown accelerations were also zero. The occupant risk values were below the preferred values in MASH and there was no penetration into the occupant compartment. The Frey Manufacturing Pedestrian Signal Pole met all the requirements for MASH Test 3-62.	PASS

Full Scale Crash Testing was done in compliance with MASH by the following accredited crash test laboratory (cite the laboratory's accreditation status as noted in the crash test reports.):

Laboratory Name:	Applus IDIADA KARCO Engineering	
Laboratory Signature:	Robert Ramirez Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2016.11.14 09:46:32 -05'00'	
Address:	9270 Holly Rd. Adelanto, CA 92301	Same as Submitter ☒
Country:	USA	Same as Submitter ☒
Accreditation Certificate Number and Dates of current Accreditation period :	TL-371 Valid up to July 1, 2019	

Submitter Signature*: Robert Ramirez Digitally signed by Robert Ramirez DN: cn=Robert Ramirez, o=KARCO Engineering, ou=Project Engineer, email=rramirez@karco.com, c=US Date: 2016.11.14 09:46:32 -05'00'

Submit Form

ATTACHMENTS

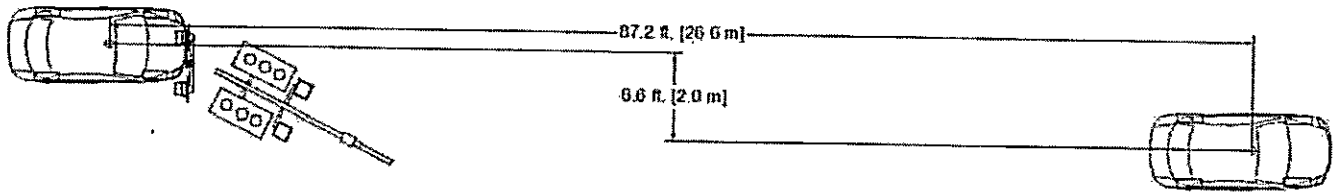
Attach to this form:

1) Additional disclosures of related financial interest as indicated above.
2) A copy of the full test report, video, and a Test Data Summary Sheet for each test conducted in support of this request.
3) A drawing or drawings of the device(s) that conform to the Task Force-13 Drawing Specifications [Hardware Guide Drawing Standards]. For proprietary products, a single isometric line drawing is usually acceptable to illustrate the product, with detailed specifications, intended use, and contact information provided on the reverse. Additional drawings (not in TF-13 format) showing details that are relevant to understanding the dimensions and performance of the device should also be submitted to facilitate our review.

FHWA Official Business Only:

Eligibility Letter		
Number	Date	Key Words

MASH Test 3-60 SUMMARY



GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No.	P38168-01
Test Designation	3-60
Test Date	06/28/18

TEST ARTICLE

Name / Model	Pedestrian Signal Pole
Type	Support Structure
Device Height	14.8 ft. (4.5 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2013 Kia Rio
Curb Mass	2,538.6 lbs (1,151.5 kg)
Test Inertial Mass	2,426.1 lbs (1,100.5 kg)
Gross Static Mass	2,590.4 lbs (1,175.0 kg)

Impact Conditions

Impact Velocity	18.68 mph (30.06 km/h)
Impact Angle	0.0°
Location / Orientation	Offset 17.0 in. (431 mm)
Kinetic Energy	28.3 kip-ft (38.4 kJ)

Exit Conditions

Exit Velocity	16.47 mph (26.51 km/h)
Exit Angle	0.0°
Final Vehicle	87.2 ft. (26.6 m) Downstream 6.6 ft. (2 m) Right
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	-12.3 °
Maximum Pitch Angle	0.8 °
Maximum Yaw Angle	-2.4 °

Occupant Risk

Longitudinal OIV	0.3 ft/s (0.1 m/s)
Lateral OIV	4.9 ft/ (1.5 m/s)
Longitudinal RA	0.5 g
Lateral RA	1.0 g
THIV	4.9 ft/s (1.5 m/s)
PHD	1.1 g
ASI	0.16

Test Article Deflections

Debris Field (longitudinal)	65.3 ft. (19.9 m)
Debris Field (lateral)	7.9 ft. (2.4 m)

Vehicle Damage

Vehicle Damage Scale	N/A
CDC	12TCDW1
Maximum Intrusion	2.3 in. (58 mm)

Figure 3 Test 3-60 Summary

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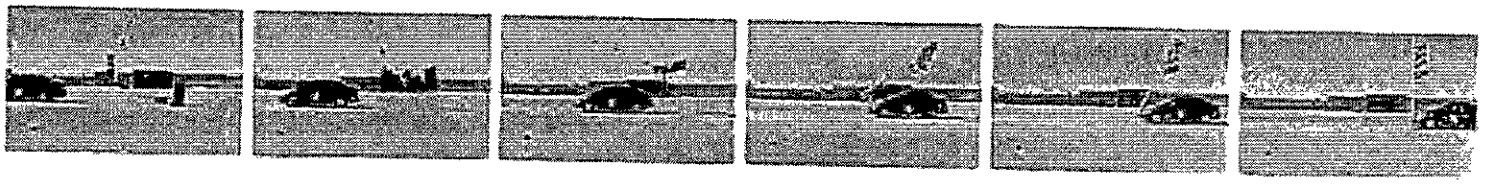
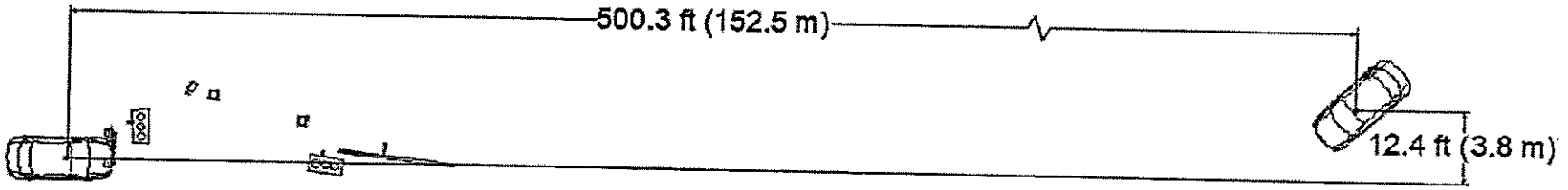
MASH Test 3-61 SUMMARY





GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P38168-02
Test Designation	3-61
Test Date	06/28/18

TEST ARTICLE

Name / Model	Pedestrian Signal Pole
Type	Support Structure
Device Height	14.8 ft. (4.5 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	1100C
Year, Make, and Model	2012 Kia Rio
Curb Mass	2,497.8 lbs (1,133.0 kg)
Test Inertial Mass	2,410.7 lbs (1,093.5 kg)
Gross Static Mass	2,579.4 lbs (1,170.0 kg)

Impact Conditions

Impact Velocity	60.99 mph (98.15 km/h)
Impact Angle	0.0°
Location / Orientation	Offset 17.0 in. (431 mm)
Kinetic	299.7 kip-ft (406.4 kJ)

Exit Conditions

Exit Velocity	58.06 mph (93.44 km/h)
Exit Angle	0.0°
Final Vehicle	500.3 ft (152.5 m) dw 12.4 ft. (3.8 m) Left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	4.4 °
Maximum Pitch Angle	5.6 °
Maximum Yaw Angle	-3.1 °

Occupant Risk

Longitudinal OIV	0.3 m/s (1.0 ft/s)
Lateral OIV	1.0 m/s (3.3 ft/s)
Longitudinal RA	0.2 g
Lateral RA	0.3 g
THIV	1.0 m/s (3.3 ft/s)
PHD	0.3 g
ASI	0.20

Test Article Deflections

Debris Field (longitudinal)	146.8 ft. (44.7 m)
Debris Field (lateral)	17.9 ft. (5.5 m)

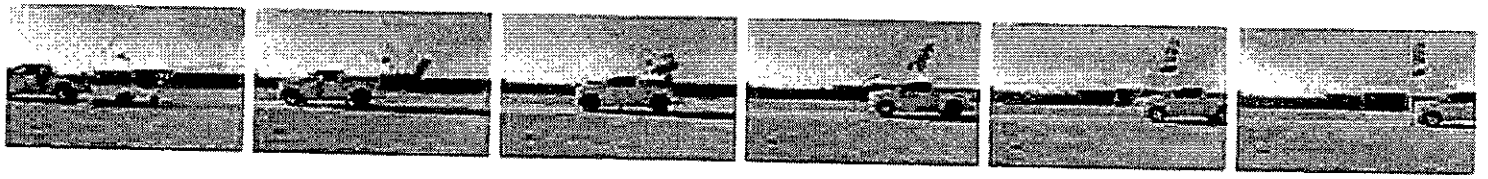
Vehicle Damage

Vehicle Damage Scale	N/A
CDC	N/A
Maximum Intrusion	N/A

Figure 2 Test 3-61 Summary

112

MASH Test 3-62 SUMMARY



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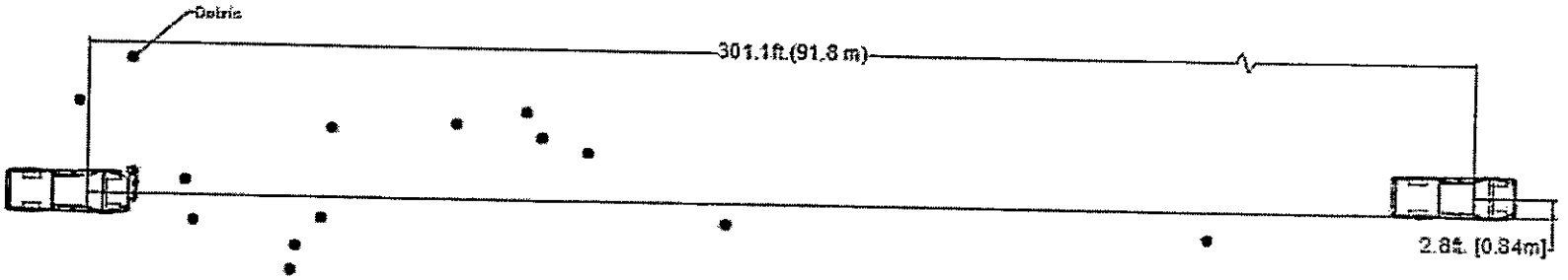


GENERAL INFORMATION

Test Agency	KARCO Engineering, LLC.
KARCO Test No	P38168-03
Test Designation	3-62
Test Date	06/28/18

TEST ARTICLE

Name / Model	Pedestrian Signal Pole
Type	Support Structure
Device Height	14.8 ft. (4.5 m)
Key Elements	Support and Pedestal
Road Surface	Concrete

TEST VEHICLE

Type / Designation	2270P
Year, Make, and Model	2012 RAM 1500
Curb Mass	5,025.4 lbs (2,279.5 kg)
Test Inertial Mass	5,060.6 lbs (2,295.5 kg)
Gross Static Mass	5,060.6 lbs (2,295.5 kg)

Impact Conditions

Impact Velocity	60.34 mph (97.10 km/h)
Impact Angle	0.0°
Location / Orientation	Offset towards driver side
Kinetic	615.8 kip-ft (835.0 kJ)

Exit Conditions

Exit Velocity	59.13 mph (95.17 km/h)
Exit Angle	0.0°
Final Vehicle	301.1 ft. (91.8 m) dw 2.8 ft. (0.9 m) left
Exit Box Criteria Met	N/A
Vehicle Snagging	None
Vehicle Pocketing	None
Maximum Roll Angle	2.8 °
Maximum Pitch Angle	0.9 °
Maximum Yaw Angle	-4.0 °

Occupant Risk

Longitudinal OIV	N/A
Lateral OIV	N/A
Longitudinal RA	N/A
Lateral RA	N/A
THIV	N/A
PHD	N/A
ASI	N/A

Test Article Deflections

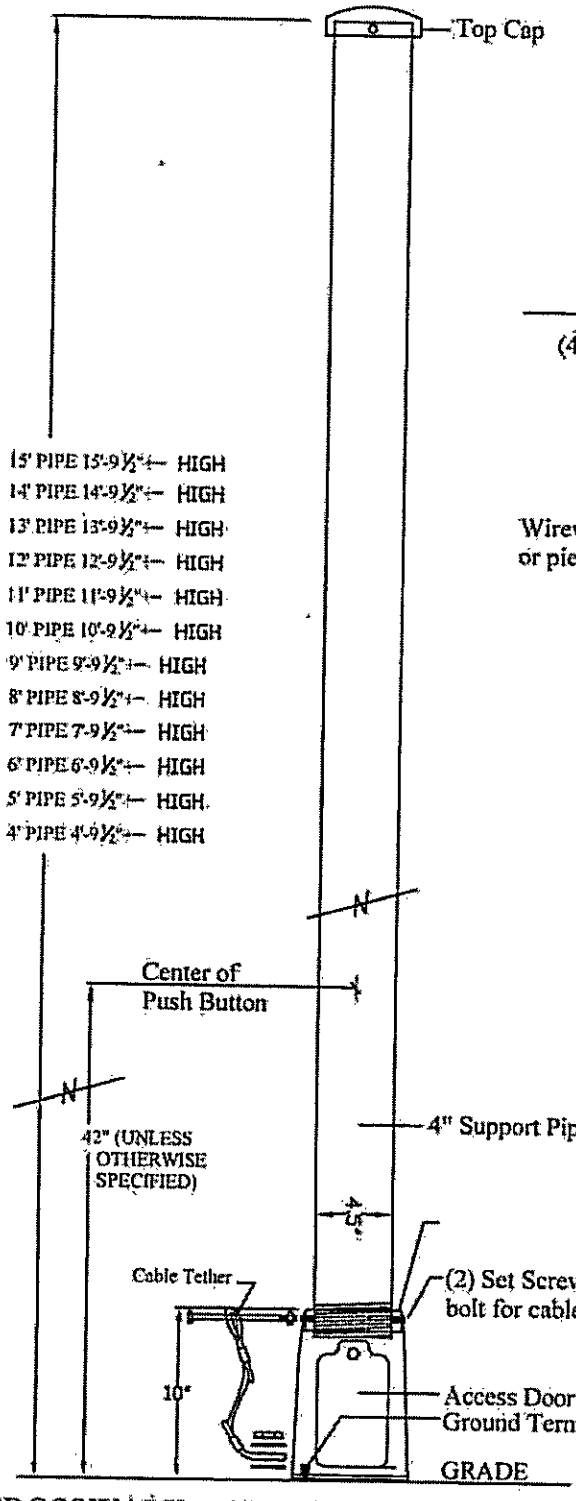
Debris Field (longitudinal)	161.1 ft. (49.1 m)
Debris Field (lateral)	18.9 ft. (5.8 m)

Vehicle Damage

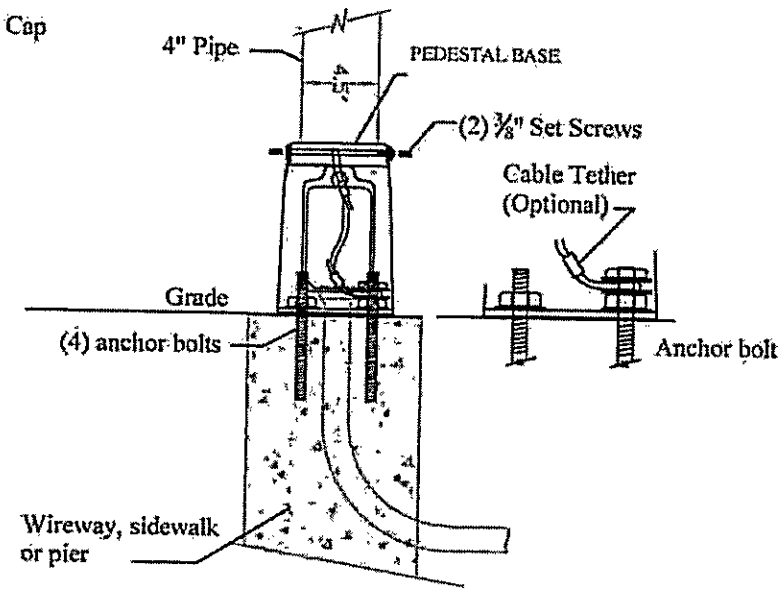
Vehicle Damage Scale	12-FL-2
CDC	12FLDW1
Maximum Intrusion	No measureable

Figure 2 Test 3-62 Summary

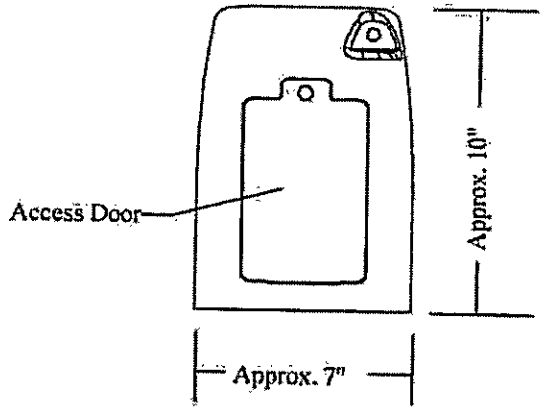
113



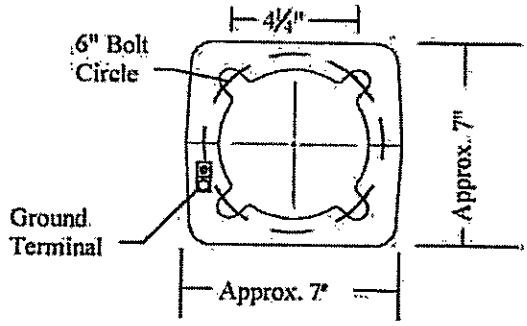
CROSSWALK - SIGNAL PEDESTAL ASSEMBLY



BASE MOUNTING



BASE SIDE VIEW



BASE BOTTOM VIEW

NOT TO SCALE

HARDWARE MEETS OR EXCEEDS STATE SPECIFICATIONS

FREY Manufacturing Corp.
www.FreyMfgCorp.com
Made in USA
Phone: 952-467-4402

CROSSWALK - SIGNAL PEDESTAL HEIGHTS FOR
VARIOUS LENGTHS OF 4" PIPES
CATALOG #: CP6 SERIES

DATE	DWG. NO.	REV.
04-19-18	8.5.0	1

FREY Manufacturing Corp.

Suggested Specification Language

13150 STEWART AVE. * NORWOOD, MN 55368-9675
PHONE (952) 467-4402; Toll Free Fax: 1-866-941-FREY (3739)
Mobile: (612) 790-2797
E-MAIL: Freymfg@FreyMfgCorp.com; Website: FreyMfgCorp.com

March 27, 2019

Signal Pole, CP6 Series Generic Specification

Edit as required, reference with other state specifications as required.

Requirements:

1. Shall be constructed of aluminum.

    a. Shall be clear anodized. (insert color)

    or

    a. Shall have black powder coat finish. (insert color)

2. Shall not have any sharp edges.

    a. Edges shall be rounded.

3. Shall have a foot print of 7 inches by 7 inches.

4. Shall have a base height of 10 inches tall.

5. Shall fully enclose and cover the anchor rods on the interior of the pedestal base.

    a. Base shall be a single casting with an access door bolted directly to grade with four (4) anchor bolts.

    b. External anchor rod covers are not acceptable.

    c. Bolting base to an anchor flange is not acceptable.

    d. Pedestal base shall be shimmed if necessary for vertical adjustment.

6. Shall be mounted directly to a sidewalk or pier foundation with a 6 inch bolt circle.

    a. Shall have 4 mounting anchor bolt slots for securing the pedestal base to grade.

    b. Shall be supported by 5/ 8 X 7 ½ inch stainless steel anchor rods imbedded in adhesive. Adhesive shall be determined by ambient outdoor temperature at the time of installation.

    or

    b. 5/8" x 8" Galvanized Steel L-Anchor Bolt with Nut and USS Flat Washer.

7. Shall have an access door on one vertical side with minimum opening of 21 inches squared.

    a. Shall be clear anodized. (insert color)

    or

a. Shall have black powder coat finish. (insert color)

b. Shall be attached with stainless steel hardware.

8. Shall support a 4 inch National Pipe Thread (N.P.T.) pedestal shaft that is screwed in at the top of the pedestal base. Pipe heights shall accommodate load specifications.

   a. Pedestal support pipe under 10' tall and base shall be secured with a cable tether, including 5/16" X 7" stainless steel bolt passing through the base, pedestal support shaft and stainless steel cable rope tether, secured with a washer, lock washer and nut. Stainless steel 1/8" rope tether shall be looped at both ends with swagger fasteners tethering the 5/16" bolt to one of the base anchors with a 5/8" washer and nut.

   b. Pedestal support pipe equal to or greater than 10' tall and base shall not be required to include a cable tether.

9. Shall be a breakaway or frangible base.

   a. Base shall yield (breakaway, or be frangible) before the schedule 40 aluminum shaft that is secured into the top of the pedestal base fails. Base shall be tested to exceed 12,000 flb. bending moment.

10. Shall have a copper grounding lug installed which supports 14 AWG thru 4 AWG conductors.

11. Shall be 4" Schedule 40 aluminum support pedestal shaft pipe with N.P.T threads on one end to thread into base.

    a. Shall be brushed aluminum with clear anodized. (insert color)

    or

    a. Shall have black powder coat finish. (insert color)

    b. Shall be attached with stainless steel hardware.

12. Shall have a top cap secured to support pedestal shaft with three stainless steel Allen head type set screws. Top cap shall have a tapered inside.

    a. Shall be clear anodized. (insert color)

    or

    a. Shall have black powder coat finish. (insert color)

    b. Allen bolts shall be flush with the outside of cap

13. Switch shall be mounted with 1/4" insert nut for schedule 40 support shaft.

    a. Insert nut shall be installed with setting tool designed for insert nut installation.

    b. Switch cable shall pass through support pipe protected with an insulating sleeve.

    c. Other signal and sign equipment or accessories shall be installed as per those specification sections.

14. Frangible base shall be AASHTO MASH Breakaway Tested at an accredited laboratory.

FREY Manufacturing Corp.

Product Warranty

AGREEMENT TERMS AND CONDITIONS

Apply to All Sales

1. General Terms and Conditions

All sales of material or equipment by Frey Manufacturing Corporation (herein after known as FMC) are expressly conditioned upon the terms and conditions set forth below. Any additional terms or conditions set forth on the purchase order of the Purchaser or in any similar such communications shall not be binding or effective unless asserted to in writing by an officer of FMC. All pricing is shown and made in United States Dollars (USD).

2. Terms

Purchase Orders and shipping shall be pre-paid unless an FMC credit application has been submitted and approved.

The terms of the sale of merchandise listed on the front of the invoice shall be subject to the terms as listed on the front of the invoice. A FINANCE CHARGE is added if not paid within 35 days.

3. Cancellation

Purchaser may cancel order only by mutual agreement based upon payment to FMC of reasonable and proper cancellation charges. No cancellation of any kind may be made after an order has been shipped and/or invoiced.

4. Returned Goods

Materials and equipment must not be returned without advance written consent of FMC and a Return Materials Authorization (RMA) number. Except for provisions made in *No. 5 Warranty and Limit of Liability*, no returns of equipment shall be allowed after 60 days of the original billing date of equipment. All returns will be subject to a restocking charge of 20%. Returned materials must be new, unused and complete as originally shipped. Any equipment not returned in such condition may be rejected or incur additional restocking charges, or returned at Purchaser's prepaid expense plus 10% handling charge.

No return shall be allowed for custom ordered assemblies of parts, colored or coated finished parts except for provisions made in No. 5 *Warranty and Limit of Liability*.

5. Warranty And Limit Of Liability

FMC warrants for a period of ninety (90) days from the date of original billing date that the items manufactured by FMC and sold hereunder will be free from defects in material and workmanship. FMC's sole obligation in the event of breach of such warranty, shall be repair or replacement and shipping of the items which were manufactured by FMC at no cost to Purchaser. THIS WARRANTY IS IN LIEU OF ALL AND ANY OTHER WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED. No items shall be returned to FMC without its prior written permission.

Failure of items as a result of unauthorized service, improper handling, or installation are not covered by this warranty.

6. Damages

FMC shall not be liable for any damages caused by delay in delivery or in any other performance under this Agreement. The sole and exclusive remedy for any breach of warranties or merchantability or fitness, and the sole remedy for FMC's liability of any kind, including liability for negligence, with respect to the items purchased hereunder and with respect to all performance by *FMC* under or pursuant to this Agreement, shall be limited to the repair or replacement specified under Paragraph (5) hereof, and shall in no event include any incidental or consequential damages.

7 Delays

If FMC suffers delay in performance due to any cause beyond its control, such as act of God, war, act of government, act or omission of Purchaser, fire, flood, strike or labor trouble, sabotage, delay in obtaining from others suitable services, materials, components, equipment or transportation, the time of performance shall be extended a period of time equal to the period of the delay and its consequences. FMC will give to the Purchaser notice in writing within a reasonable time after FMC becomes aware of any such delay.

FMC does not inventory custom finished parts or assemblies and may require a set up charge and additional time for custom finished parts or assemblies.

8. Purchase Orders

Purchase Orders may be filled within 21 calendar days of acknowledgement of receipt at FMC, or within two weeks of the requested shipment date noted on the purchase order. If a longer time is required to fill a purchase order, FMC will notify Purchaser in writing with an estimate date of shipment. Custom colors/finishes may require additional time. Orders requiring shipment within 21 days will be considered ASAP and may incur reasonable and/or unavoidable additional handling charges. As in the past, FMC will make every effort to get your materials delivered as requested without additional ASAP charges. If Purchaser requires same day, next day, 2nd day shipment, call FMC to confirm availability. Large quantity (approximately 300+ of an assembly) orders may require additional time, and may have additional discount and shipping cost advantages. Request FMC for quotation and/or confirmation of estimated delivery time.

Purchase Order must include a Ship To: Company Name, Contact Name, Physical Address and Phone Number for point of delivery. Other information will be added to the P.O. as instructed (Job#, etc.). Verify with FMC prior to requesting a job site delivery.

When material certifications are required, the request must appear on the Purchase Order.

Purchase Orders may be invoiced against an open or blanket customer Purchase Order agreement (State, County, City etc.), however the originator of the Purchase Order for delivery of products ordered shall also be responsible for payment.

Where a Certificate Of Liability (COL) insurance policy is required for an order, the insurance requirements must be in writing and disclosed at the time of quotation request. Unless other arrangements are made in writing, the COL amount will be added to the quotation as a line item and must appear in the Purchase Order. Sufficient time for FMC to obtain a COL quotation must be permitted and can vary with requirements.

For a credit card payment, the credit card surcharge will be added to the Total Amount Due on the Invoice at time of charge, see Credit Card Payments below.

Any Taxes that may be applicable to the Purchase Order must be included as a line item on your Purchase Order. Taxes may not be included on a Quote from FMC.

All pricing and payment for Purchase Order must be in United States Dollars (USD).

9. Shipments

All shipments are Freight On Board (F.O.B.) factory in Norwood, Minnesota. The carrier must be selected by FMC unless other prior arrangements have been made in writing. Any shipping, insurance, and handling fees will be pre-paid and added to the invoice. Unless stated in writing from FMC, errors in the shipment shall be brought to the attention of FMC within 10 business days of invoice or the Purchase Order will be considered complete and closed. Any errors in shipment made by FMC shall be remedied and shipped at the expense of FMC. Shipping claims from damage resulting in transit shall be made with the carrier.

10. Payments And Finance Charge

All payments are made directly to FMC. Any payment not paid within 35 days of the original Invoice Date of the invoice, is subject to the highest FINANCE CHARGE allowable by law. Non-payment will also be subject to the Purchaser paying all collection, attorney's fees and court costs incurred by FMC for such collection. Originator of Purchase Order shall be responsible for payment of invoice.

Any discrepancies, errors or omissions shall be brought to the attention of FMC within 7 business days of Invoice date.

11. Credit Card Payments

Products and services shall have a credit card convenience fee to the FMC Invoice Total Amount Due not to exceed 5% per transaction. Credit cards accepted are: Visa, MasterCard, American Express, Discover, JCB, or UnionPay. Convenience fee is subject to change with credit card service fees. Required information to make a credit card charge: Card Company, Account Number, Expiration Date, Card Security Number, Name on Card, Card Billing Zip Code.

Orders made with a credit card will be charged prior to shipment unless other prior arrangements have been made.

FREY Manufacturing Corp.
13150 Stewart Ave., Norwood, MN 55368
www.freymfgcorp.com
952-467-4402 freymfg@freymfgcorp.com

CERTIFICATE OF COMPLIANCE

For: Review of Product

I certify that the information listed in this submittal package is true and accurate with verifiable, documented, and current certifications, reports, and claims.

I also certify that I am an official binding agent of the manufacturer and authorized to submit all information and other requests for the purpose of providing an accurate and complete understanding for the persons reviewing this package.

Signed: Michael Frey

Printed Name: Michael Frey

Title: Business Development Director

Company: Frey Manufacturing Corp.

Date: 02/13/2019

FREY Manufacturing Corp.

Thank you for the opportunity to provide information about our product.

We hope to provide products for use on your infrastructure soon.

END OF INFORMATION PACKAGE

TRAFFIC SIGNAL GENERAL REQUIREMENTS
Effective: May 22, 2002
Revised: March 25, 2016
800.01TS

These Traffic Signal Special Provisions and the "District One Standard Traffic Signal Design Details" supplement the requirements of the State of Illinois "Standard Specifications for Road and Bridge Construction." The intent of these Special Provisions is to prescribe the materials and construction methods commonly used for traffic signal installations.

- All material furnished shall be new unless otherwise noted herein.
- Traffic signal construction and maintenance work shall be performed by personnel holding current IMSA Traffic Signal Technician Level II certification. A copy of the certification shall be immediately available upon request of the Engineer.
- The work to be done under this contract consists of furnishing, installing and maintaining all traffic signal work and items as specified in the Plans and as specified herein in a manner acceptable and approved by the Engineer.

Definitions of Terms.
Add the following to Section 101 of the Standard Specifications:

101.56 Vendor. Company that sells a particular type of product directly to the contractor or the Equipment Supplier.

101.57 Equipment supplier. Company that supplies, represents and provides technical support for IDOT District One approved traffic signal controllers and other related equipment. The Equipment Supplier shall be located within IDOT District One and shall:

- Be full service with on-site facilities to assemble, test and trouble-shoot traffic signal controllers and cabinet assemblies.
- Maintain an inventory of IDOT District One approved controllers and cabinets.
- Be staffed with permanent sales and technical personnel able to provide traffic signal controller and cabinet expertise and support.
- Technical staff shall hold current IMSA Traffic Signal Technician Level III certification and shall attend traffic signal turn-ons and inspections with a minimum 14 calendar day notice.

Submittals.
Revise Article 801.05 of the Standard Specifications to read:

All material approval requests shall be submitted electronically through the District's SharePoint System unless directed otherwise by the Engineer. Electronic material submittals shall follow the District's Traffic Operations Construction Submittals guidelines. General requirements include:

1. All material approval requests shall be made prior to or no later than the date of the preconstruction meeting. A list of major traffic signal items can be found in Article

801.05. Material or equipment which is similar or identical shall be the product of the same manufacturer, unless necessary for system continuity. Traffic signal materials and equipment shall bear the U.L. label whenever such labeling is available.

2. Product data and shop drawings shall be assembled by pay item. Only the top sheet of each pay item submittal will be stamped by the Department with the review status, except shop drawings for mast arm pole assemblies and the like will be stamped with the review status on each sheet.
3. Original manufacturer published product data and shop drawing sheets with legible dimensions and details shall be submitted for review.
4. When hard copy submittals are necessary, four complete copies of the manufacturer's descriptive literatures and technical data for the traffic signal materials shall be submitted. For hard copy or electronic submittals, the descriptive literature and technical data shall be adequate for determining whether the materials meet the requirements of the plans and specifications. If the literature contains more than one item, the Contractor shall indicate which item or items will be furnished.
5. When hard copy submittals are necessary for structural elements, four complete copies of the shop drawings for the mast arm assemblies and poles, and the combination mast arm assemblies and poles showing, in detail, the fabrication thereof and the certified mill analyses of the materials used in the fabrication, anchor rods, and reinforcing materials shall be submitted.
6. Partial or incomplete submittals will be returned without review.
7. Certain non-standard mast arm poles and special structural elements will require additional review from IDOT's Central Office. Examples include ornamental/decorative, non-standard length mast arm pole assemblies and monotube structures. The Contractor shall account for the additional review time in his schedule.
8. The contract number or permit number, project location/limits and corresponding pay code number must be on each sheet of correspondence, catalog cuts and mast arm poles and assemblies drawings.
9. Where certifications and/or warranties are specified, the information submitted for approval shall include certifications and warranties. Certifications involving inspections, and/or tests of material shall be complete with all test data, dates, and times.
10. After the Engineer reviews the submittals for conformance with the design concept of the project, the Engineer will stamp the drawings indicating their status as 'Approved', 'Approved-As-Noted', 'Disapproved', or 'Incomplete'. Since the Engineer's review is for conformance with the design concept only, it is the Contractor's responsibility to coordinate the various items into a working system as specified. The Contractor shall not be relieved from responsibility for errors or omissions in the shop, working, layout drawings, or other documents by the Department's approval thereof. The Contractor must still be in full compliance with contract and specification requirements.
11. The Contractor shall secure approved materials in a timely manner to assure construction schedules are not delayed.
12. All submitted items reviewed and marked 'APPROVED AS NOTED', 'DISAPPROVED', or 'INCOMPLETE' are to be resubmitted in their entirety, unless otherwise indicated within the submittal comments, with a disposition of previous comments to verify contract compliance at no additional cost to the contract.

13. Exceptions to and deviations from the requirements of the Contract Documents will not be allowed. It is the Contractor's responsibility to note any deviations from Contract requirements at the time of submittal and to make any requests for deviations in writing to the Engineer. In general, substitutions will not be acceptable. Requests for substitutions must demonstrate that the proposed substitution is superior to the material or equipment required by the Contract Documents. No exceptions, deviations or substitutions will be permitted without the approval of the Engineer.
14. Contractor shall not order major equipment such as mast arm assemblies prior to Engineer approval of the Contractor marked proposed traffic signal equipment locations to assure proper placement of contract required traffic signal displays, push buttons and other facilities. Field adjustments may require changes in proposed mast arm length and other coordination.

Marking Proposed Locations.
Revise "Marking Proposed Locations for Highway Lighting System" of Article 801.09 to read "Marking Proposed Locations for Highway Lighting System and Traffic Signals."

Add the following to Article 801.09 of the Standard Specifications:

It shall be the contractor's responsibility to verify all dimensions and conditions existing in the field prior to ordering materials and beginning construction. This shall include locating the mast arm foundations and verifying the mast arms lengths.

Inspection of Electrical Systems.
Add the following to Article 801.10 of the Standard Specifications:

(c) All cabinets including temporary traffic signal cabinets shall be assembled by an approved equipment supplier in District One. The Department reserves the right to request any controller and cabinet to be tested at the equipment supplier's facility prior to field installation, at no extra cost to this contract.

Maintenance and Responsibility.
Revise Article 801.11 of the Standard Specifications to read:

a. Existing traffic signal installations and/or any electrical facilities at all or various locations may be altered or reconstructed totally or partially as part of the work on this Contract. The Contractor is hereby advised that all traffic control equipment, presently installed at these locations, may be the property of the State of Illinois, Department of Transportation, Division of Highways, County, Private Developer, Municipality or Transit Agency in which they are located. Once the Contractor has begun any work on any portion of the project, all traffic signals within the limits of this contract or those which have the item "Maintenance of Existing Traffic Signal Installation," "Temporary Traffic Signal Installation(s)" and/or "Maintenance of Existing Flashing Beacon Installation," shall become the full responsibility of the Contractor. The Contractor shall supply the Engineer, Area Traffic Signal Maintenance and Operations Engineer, IDOT

ComCenter and the Department's Electrical Maintenance Contractor with two 24-hour emergency contact names and telephone numbers.

b. Automatic Traffic Enforcement equipment such as red lighting running and railroad crossing camera systems are owned and operated by others and the Contractor shall not be responsible for maintaining this equipment.

c. Regional transit, County and other agencies may also have equipment connected to existing traffic signal or peripheral equipment such as PTZ cameras, switches, transit signal priority (TSP and BRT) servers and other devices that shall be included with traffic signal maintenance at no additional cost to the contract.

d. When the project has a pay item for "Maintenance of Existing Traffic Signal Installation," "Temporary Traffic Signal Installation(s)" and/or "Maintenance of Existing Flashing Beacon Installation," the Contractor must notify both the Area Traffic Signal Maintenance and Operations Engineer at (847) 705-4424 and the Department's Electrical Maintenance Contractor, of their intent to begin any physical construction work on the Contract or any portion thereof. This notification must be made a minimum of seven (7) working days prior to the start of construction to allow sufficient time for inspection of the existing traffic signal installation(s) and transfer of maintenance to the Contractor. The Department will attempt to full-fill the Contractor's inspection date request(s), however workload and other conditions may prevent the Department from accommodating specific dates or times. The Contractor shall not be entitled to any other compensation if the requested inspection date(s) cannot be scheduled by the Department. If work is started prior to an inspection, maintenance of the traffic signal installation(s) will be transferred to the Contractor without an inspection. The Contractor will become responsible for repairing or replacing all equipment that is not operating properly or is damaged at no cost to the owner of the traffic signal. Final repairs or replacement of damaged equipment must meet the approval of the Engineer prior to or at the time of final inspection otherwise the traffic signal installation will not be accepted.

e. The Contractor is advised that the existing and/or temporary traffic signal installation must remain in operation during all construction stages, except for the most essential down time. Any shutdown of the traffic signal installation, which exceeds fifteen (15) minutes, must have prior approval of the Engineer. Approval to shut down the traffic signal installation will only be granted during the period extending from 10:00 a.m. to 3:00 p.m. on weekdays. Shutdowns shall not be allowed during inclement weather or holiday periods.

f. The Contractor shall be fully responsible for the safe and efficient operation of the traffic signals and other equipment noted herein. Any inquiry, complaint or request by the Department, the Department's Electrical Maintenance Contractor or the public, shall be investigated and repairs begun within one hour. Failure to

provide this service will result in liquidated damages of $1000 per day per occurrence. In addition, the Department reserves the right to assign any work not completed within this timeframe to the Electrical Maintenance Contractor. All costs associated to repair this uncompleted work shall be the responsibility of the Contractor. Failure to pay these costs to the Electrical Maintenance Contractor within one month after the incident will result in additional liquidated damages of $1000 per month per occurrence. Unpaid bills will be deducted from the cost of the Contract. The Department may inspect any signalizing device on the Department's highway system at any time without notification.

g. Any proposed activity in the vicinity of a highway-rail grade crossing must adhere to the guidelines set forth in the current edition of the Manual on Uniform Traffic Control Devices (MUTCD) regarding work in temporary traffic control zones in the vicinity of highway-rail grade crossings which states that lane restrictions, flagging, or other operations shall not create conditions where vehicles can be queued across the railroad tracks. If the queuing of vehicles across the tracks cannot be avoided, a uniformed law enforcement officer or flagger shall be provided at the crossing to prevent vehicles from stopping on the tracks, even if automatic warning devices are in place.

h. The Contractor shall be responsible to clear snow, ice, dirt, debris or other condition that obstructs visibility of any traffic signal display or access to traffic signal equipment.

i. The Contractor shall maintain the traffic signal in normal operation during short or long term loss of utility or battery back-up power at critical locations designated by the Engineer. Critical locations may include traffic signals interconnected to railroad warning devices, expressway ramps, intersection with an SRA route, critical corridors or other locations identified by the Engineer. Temporary power to the traffic signal must meet applicable NEC and OSHA guidelines and may include portable generators and/or replacement batteries. Temporary power to critical locations shall not be for separately but shall be included in the contract.

Damage to Traffic Signal System.
Add the following to Article 801.12(b) of the Standard Specifications to read:

Any traffic signal control equipment damaged or not operating properly from any cause shall be replaced with new equipment meeting current District One traffic signal specifications and provided by the Contractor at no additional cost to the Contract and/or owner of the traffic signal system, all as approved by the Engineer. Final replacement of damaged equipment must meet the approval of the Engineer prior to or at the time of final inspection otherwise the traffic signal installation will not be accepted. Cable splices are only allowed at the bases pf post and mast arms.

Temporary replacement of damaged or knockdown of a mast arm pole assembly shall require construction of a full or partial span wire signal installation or other method approved by the

Engineer to assure signal heads are located overhead and over traveled pavement. Temporary replacement of mast arm mount signals with post mount signals will not be permitted.

Automatic Traffic Enforcement equipment, such as Red Light Enforcement cameras, detectors, and peripheral equipment, damaged or not operating properly from any cause, shall be the responsibility of the municipality or the Automatic Traffic Enforcement company per Permit agreement.

Traffic Signal Inspection (TURN-ON).
Revise Article 801.15(b) of the Standard Specifications to read:

It is the intent to have all electric work completed and equipment field tested by the Equipment Supplier prior to the Department's "turn-on" field inspection. If in the event the Engineer determines work is not complete and the inspection will require more than two (2) hours to complete, the inspection shall be canceled and the Contractor will be required to reschedule at another date. The maintenance of the traffic signals will not be accepted until all punch list work is corrected and re-inspected.

When the road is open to traffic, except as otherwise provided in Section 850 of the Standard Specifications, the Contractor may request a turn-on and inspection of the completed traffic signal installation at each separate location. This request must be made to the Area Traffic Signal Maintenance and Operations Engineer at (847) 705-4424 a minimum of seven (7) working days prior to the time of the requested inspection. The Department will attempt to full-fill the Contractor's turn-on and inspection date request(s), however workload and other conditions may prevent the Department from accommodating specific dates or times. The Contractor shall not be entitled to any other compensation if the requested turn-on and inspection date(s) cannot be scheduled by the Department. The Department will not grant a field inspection until written or electronic notification is provided from the Contractor that the equipment has been field tested and the intersection is operating according to Contract requirements. The Contractor must invite local fire department personnel to the turn-on when Emergency Vehicle Preemption (EVP) is included in the project. When the contract includes the item RE-OPTIMIZE TRAFFIC SIGNAL SYSTEM, OPTIMIZE TRAFFIC SIGNAL SYSTEM, or TEMPORARY TRAFFIC SIGNAL TIMINGS, the Contractor must notify the SCAT Consultant of the turn-on/detour implementation schedule, as well as stage changes and phase changes during construction.

The Contractor must have all traffic signal work completed and the electrical service installation connected by the utility company prior to requesting an inspection and turn-on of the traffic signal installation. The Contractor shall be responsible to provide a police officer to assist with traffic control at the time of testing.

The Contractor shall provide a representative from the control equipment vendor's office who is knowledgeable of the cabinet design and controller functions to attend the traffic signal inspection for both permanent and temporary traffic signal turn-ons.

Upon demonstration that the signals are operating and all work is completed in accordance with the Contract and to the satisfaction of the Engineer, the Engineer will then allow the signals to be placed in continuous operation. The Agency that is responsible for the maintenance of each traffic signal installation will assume the maintenance upon successful completion of this inspection.

The District requires the following Final Project Documentation from the Contractor at traffic signal turn-ons in electronic format in addition to hard copies where noted. A CD/DVD shall be submitted with separate folders corresponding to each numbered title below. The CD/DVD shall be labelled with date, project location, company and contract or permit number. Record Drawings, Inventory and Material Approvals shall be submitted prior to traffic signal turn-on for review by the Department as described here-in.

Final Project Documentation:

1. Record Drawings. Signal plans of record with field revisions marked in red ink. One hard copy set of 11"x17" record drawings shall also be provided.
2. Inventory. Inventory of new and existing traffic signal equipment including cabinet types and devices within cabinets in an Excel spread sheet format. One hard copy shall also be provided.
3. Pictures. Digital pictures of a minimum 12M pixels of each intersection approach showing all traffic signal displays and equipment. Pictures shall include controller cabinet equipment in enough detail to clearly identify manufacture and model of major equipment.
4. Field Testing. Written notification from the Contractor and the equipment vendor of satisfactory field testing with corresponding material performance measurements, such as for detector loops and fiber optic systems (see Article 801.13). One hard copy of all contract required performance measurement testing shall also be provided.
5. Materials Approval. The material approval letter. A hard copy shall also be provided.
6. Manuals. Operation and service manuals of the signal controller and associated control equipment. One hard copy shall also be provided.
7. Cabinet Wiring Diagram and Cable Logs. Five (5) hard copies 11" x 17" of the cabinet wiring diagrams shall be provided along with electronic pdf and dgn files of the cabinet wiring diagram. Five hard copies of the cable logs and electronic excel files shall be provided with cable #, number of conductors and spares, connected device/signal head and intersection location.
8. Controller Programming Settings. The traffic signal controller's timings; backup timings; coordination splits, offsets, and cycles; TBC Time of Day, Week and Year Programs; Traffic Responsive Program, Detector Phase Assignment, Type and Detector Switching; and any other functions programmable from the keyboard. The controller manufacturer shall also supply a printed form, not to exceed 11" x 17" for recording that data noted above. The form shall include a location, date, manufacturer's name, controller model and software version. The form shall be approved by the Engineer and a minimum of three (3) copies must

be furnished at each turn-on. The manufacturer must provide all programming information used within the controller at the time of turn-on.

9. Warrantees and Guarantees. All manufacturer and contractor warrantees and guarantees required by Article 801.14.
10. GPS coordinate of traffic signal equipment as describe in the Record Drawings section herein.

Acceptance of the traffic signal equipment by the Department shall be based upon inspection results at the traffic signal "turn on", completeness of the required documentation and successful operation during a minimum 72 hour "burn-in" period following activation of the traffic signal. If approved, traffic signal acceptance shall be verbal at the "turn on" inspection followed by written correspondence from the Engineer. The Contractor shall be responsible for all traffic signal equipment and associated maintenance thereof until Departmental acceptance is granted.

All equipment and/or parts to keep the traffic signal installation operating shall be furnished by the Contractor. No spare traffic signal equipment is available from the Department.

All punch list work shall be completed within two (2) weeks after the final inspection. The Contractor shall notify the Electrical Maintenance Contractor to inspect all punch list work. Failure to meet these time constraints shall result in liquidated damage charges of $500 per month per incident.

All cost of work and materials required to comply with the above requirements shall be included in the pay item bid prices, under which the subject materials and signal equipment are paid, and no additional compensation will be allowed. Materials and signal equipment not complying with the above requirements shall be subject to removal and disposal at the Contractor's expense.

Record Drawings.

The requirements listed for Electrical Installation shall apply for Traffic Signal Installations in Article 801.16. Revise the 2nd paragraph of Article 801.16 of the Standard Specifications to read:

"When the work is complete, and seven days before the request for a final inspection, the reduced-size set of contract drawings, stamped "RECORD DRAWINGS", shall be submitted to the Engineer for review and approval and shall be stamped with the date and the signature of the Contractor's supervising Engineer or electrician. The record drawings shall be submitted in PDF format on CDROM as well as hardcopy for review and approval. If the contract consists of multiple intersections, each intersection shall be saved as an individual PDF file with TS# and location name in its file name.

In addition to the record drawings, copies of the final catalog cuts which have been Approved or Approved as Noted shall be submitted in PDF format along with the record drawings. The PDF files shall clearly indicate the pay item either by filename or PDF Table of Contents referencing the respective pay item number for multi-item PDF

files. Specific part or model numbers of items which have been selected shall be clearly visible."

As part of the record drawings, the Contractor shall inventory all traffic signal equipment, new or existing, on the project and record information in an Excel spreadsheet. The inventory shall include equipment type, model numbers, software manufacturer and version and quantities.

Add the following to Article 801.16 of the Standard Specifications:

"In addition to the specified record drawings, the Contactor shall record GPS coordinates of the following traffic signal components being installed, modified or being affected in other ways by this contract:

- All Mast Arm Poles and Posts
- Traffic Signal Wood Poles
- Rail Road Bungalow
- UPS
- Handholes
- Conduit roadway crossings
- Controller Cabinets
- Communication Cabinets
- Electric Service Disconnect locations
- CCTV Camera installations
- Fiber Optic Splice Locations
- Conduit Crossings

Datum to be used shall be North American 1983.

Data shall be provided electronically and in print form. The electronic format shall be compatible with MS Excel. Latitude and Longitude shall be in decimal degrees with a minimum of 6 decimal places. Each coordinate shall have the following information:

- File shall be named: TSXXX-YY-MM-DD (i.e. TS22157_15-01-01)
- Each intersection shall have its own file
- Row 1 should have the location name (i.e. IL 31 @ Klausen)
- Row 2 is blank
- Row 3 is the headers for the columns
- Row 4 starts the data
- Column A (Date) – should be in the following format: MM/DD/YYYY
- Column B (Item) – as shown in the table below
- Column C (Description) – as shown in the table below
- Column D and E (GPS Data) – should be in decimal form, per the IDOT special provisions

Examples:

Date	Item	Description	Latitude	Longitude
01/01/2015	MP (Mast Arm Pole)	NEQ, NB, Dual, Combination Pole	41.580493	-87.793378
01/01/2015	HH (Handhole)	Heavy Duty, Fiber, Intersection, Double	41.558532	-87.792571
01/01/2015	ES (Electrical Service)	Ground mount, Pole mount	41.765532	-87.543571
01/01/2015	CC (Controller Cabinet)		41.602248	-87.794053
01/01/2015	RSC (Rigid Steel Crossing)	IL 31 east side crossing south leg to center HH at Klausen	41.611111	-87.790222
01/01/2015	PTZ (PTZ)	NEQ extension pole	41.593434	-87.769876
01/01/2015	POST (Post)		41.651848	-87.762053
01/01/2015	MCC (Master Controller Cabinet)		41.584593	-87.793378
01/01/2015	COMC (Communication Cabinet)		41.584600	-87.793432
01/01/2015	BBS (Battery Backup System)		41.558532	-87.792571
01/01/2015	CNCR (Conduit Crossing)	4-inch IL 31 n/o of Klausen	41.588888	-87.794440

Prior to the collection of data, the contractor shall provide a sample data collection of at least six data points of known locations to be reviewed and verified by the Engineer to be accurate within 1 foot. Upon verification, data collection can begin. Data collection can be made as construction progresses, or can be collected after all items are installed. If the data is unacceptable the contractor shall make corrections to the data collection equipment and or process and submit the data for review and approval as specified.

Accuracy. Data collected is to be mapping grade. A handheld mapping grade GPS device shall be used for the data collection. The receiver shall support differential correction and data shall have a minimum 1 foot accuracy after post processing.

GPS receivers integrated into cellular communication devices, recreational and automotive GPS devices are not acceptable.

The GPS shall be the product of an established major GPS manufacturer having been in the business for a minimum of 6 years."

Delete the last sentence of the 3rd paragraph of Article 801.16.

Locating Underground Facilities.
Revise Section 803 to the Standard Specifications to read:

IDOT traffic signal facilities are not part of any of the one-call locating service such as J.U.L.I.E or Digger. If this Contract requires the services of an Electrical Contractor, the Contractor shall

be responsible at his/her own expense for locating existing IDOT electrical facilities prior to performing any work. If this Contract does not require the services of an Electrical Contractor, the Contractor may request one free locate for existing IDOT electrical facilities from the District One Electrical Maintenance Contractor prior to the start of any work. Additional requests may be at the expense of the Contractor. The location of underground traffic facilities does not relieve the Contractor of their responsibility to repair any facilities damaged during construction at their expense.

The exact location of all utilities shall be field verified by the Contractor before the installation of any components of the traffic signal system. For locations of utilities, locally owned equipment, and leased enforcement camera system facilities, the local Counties or Municipalities may need to be contacted: in the City of Chicago contact Digger at (312) 744-7000 and for all other locations contact J.U.L.I.E. at 1-800-892-0123 or 811.

Restoration of Work Area.
Add the following article to Section 801 of the Standard Specifications:

801.17 Restoration of work area. Restoration of the traffic signal work area shall be included in the related pay items such as foundation, conduit, handhole, underground raceways, etc. All roadway surfaces such as shoulders, medians, sidewalks, pavement, etc. shall be replaced in kind. All damage to mowed lawns shall be replaced with an approved sod, and all damage to unmowed fields shall be seeded. All brick pavers disturbed in the work area shall be restored to their original configuration as directed by the Engineer. All damaged brick pavers shall be replaced with a comparable material approved by the Engineer. Restoration of the work area shall be included in the contract without any extra compensation allowed to the Contractor.

Bagging Signal Heads.

Light tan colored traffic and pedestrian signal reusable covers shall be used to cover dark/un-energized signal sections and visors. Covers shall be made of outdoor fabric with urethane coating for repelling water, have elastic fully sewn around the cover ends for a tight fit over the visor, and have a minimum of two straps with buckles to secure the cover to the backplate. A center mesh strip allows viewing without removal for signal status testing purposes. Covers shall include a message indicating the signal is not in service.

Any change in land, land usage, storm water drainage, or driveway usage will require the Applicant, his/their successors or assigns, to contact the Illinois Department of Transportation for a review of required modifications to the storm water drainage or detention system and the driveway and highway facility.

See attached permit provisions, traffic control standards, and plan sheets.

All construction shall be in accordance with IDOT Highway Standards and "Standard Specifications for Road and Bridge Construction" adopted April 1, 2016 and the "Supplemental Specifications" in effect on the date of construction.

This permit covers the operation and presence of specified equipment, material, or facility on the right-of-way which may be related to the authorized work.

GENERAL

PERMIT PROVISIONS

The term "Applicant" as herein used shall mean the Applicant, their successors or assigns.

The attached layout sketch or plan sheets shall be construed as a part of this permit.

The Applicant shall complete all backfilling, reshaping and reseeding, and restore the right-of-way to its original condition within the time limit specified for this permit. Any extension of time necessary to complete this work shall be obtained in writing prior to specified completion date and authorized by letter from the Deputy Director of Highways, Region Three Engineer or his duly authorized representative.

There shall be no additions or changes of location in the work authorized by this permit without prior approval of the Deputy Director of Highways, Region Three Engineer or his duly authorized representative. If deviations are made in the work authorized by this permit without approval, the Applicant may be required to remove the encroachments from right-of-way or to relocate the encroachments off the right-of-way at the Applicant's expense.

The Applicant shall locate, furnish, construct, and maintain the entire improvement at their expense and shall assume all risk or liability of every nature accruing during construction or thereafter as a result of the improvement.

All underground facilities shall be located prior to construction. Call J.U.L.I.E. at telephone number 1-800-892-0123 at least 48 hours in advance. **The Illinois Department of Transportation is not a member of J.U.L.I.E.** Contact the Districts Lighting and Signal Technician, Bureau of Operation, at phone number 217-465-4181 for locations of all underground electric cable and electric conductors in conduit owned and maintained by the Department.

Any underground utility or drainage facility, whether farm tile, sanitary sewer, or storm sewer cut or damaged by this construction shall be restored to functional condition and to the satisfaction of the owner of the facility. Existing highway ditch drainage shall be maintained at all times.

The proposed construction shall be performed at such a time as not to interfere with the State's mowing operations.

Any damage to the pavement due to construction or maintenance of the work authorized by this permit shall be repaired to the satisfaction of the Deputy Director of Highways, Region Three Engineer or duly authorized representative, by the Applicant at their expense.

The Applicant or their Contractor shall keep the highway pavement clear of mud, gravel, sand, or any other construction debris at all times.

Construction or maintenance of the work authorized by this permit shall be limited to such time as the unsurfaced portion the right-of-way is in a dry and sufficiently firm condition to support required vehicles or other equipment without rutting or otherwise damaging the right-of-way.

Work cannot be started on the highway right-of-way until the permit has been signed by the Applicant and approved by the Deputy Director of Highways, Region Three Engineer. This permit is required to be available at the job site at all times for inspection by a duly authorized representative of the Department of Transportation or the Illinois State Police.

It must be understood that everyone working on this project shall indemnify and save harmless the State of Illinois, its officers, and employees from all suits, actions, or damages received or sustained by any person or property on account of or in consequence of any act of omission, neglect, or misconduct, by your organization or anyone working with your organization.

The Applicant shall furnish their contractor with one (1) copy of this permit. This copy shall be available for inspection at the job site by authorized personnel upon request.

The Deputy Director of Highways, Region Three Engineer or his duly authorized representative shall be notified twenty-four (24) hours before the installation begins so the work may be inspected for conformity.

The Applicant, his successors and assigns, agrees to hold harmless the State of Illinois and its duly appointed agents and employees against any action for personal injury, property damage, or claims arising out of environmental laws or regulations sustained by reason of the exercise of this permit.

The Applicant must ascertain the presence of Highway Authority Agreements established in accordance with 35 Ill. Admin. Code Section 742.1020 in the path of its proposed installation and take precautions to protect its workers, human health and the environment in those areas. (See Section 530.2340). Where contamination is encountered through excavation in the right-of-way, it should be managed off site and IDOT's generator number for the appropriate county may be used.

As a condition of this permit, the Applicant shall request the District Permit Office to identify sites in the right-of-way where access to contaminated soil or ground water is governed by Tiered Approach to Corrective-Action Objectives (TACO) Agreements. The Applicant shall take measures before, during and after any access to these sites to protect worker safety, human health, and the environment. Excavated contaminated soil should be managed off site in accordance with all environmental laws.

The Applicant or their Contractor shall control and protect all vehicular and pedestrian traffic by use of signs, barricades, flagmen, lights and watchmen and by any other means as required in the "Manual on Uniform Traffic Control Devices for Streets and Highways" during the progress of the work as described within this permit. Minimum desirable standards are attached for normal situations. However, additional protection must be provided when special complexities and hazards arise. Type I barricades, Type II barricades, or vertical panels on 50-foot centers will be required along the edge of pavement if the difference in elevation between the edge of pavement and the area adjacent to the edge of pavement exceeds 3 inches.

Whenever the work under this permit involves any obstruction to the free flow of traffic in the normal traffic lanes at any time on multilane highways (more than 2 lanes) or work of sufficient time duration that the obstruction will exist during hours of darkness on any other highway, plans of the proposed method of traffic control must be submitted to and approved by the Deputy Director of Highways, Region Three Engineer at least 72 hours, and preferably longer, before the start of the work. These traffic control plans shall consist of a completed standard Form 725.

Work performed on or adjacent to one and two lane pavements during hours of daylight does not necessitate a special approved traffic control plan; however, it is understood that the said work will be protected by the applicable standards set forth in the Illinois Manual on Uniform Traffic Control Devices for Streets and Highways.

In emergency, limited parking on the paved roadway will be permitted provided proper safety regulations, including the use of the required cones, signs, and flaggers are complied with. At no time shall the Applicant and/or the Contractor park vehicles, equipment, or buildings nor will they store materials within the limits of State right-of-way.

The roadway shall remain open to traffic at all times while completing the work authorized by this permit. The traffic control standards and/or special details included in this permit shall be used to control the flow of traffic.

All work authorized herein shall be performed in accordance with applicable portions of State of Illinois Department of Transportation Manuals entitled "Policy on the Accommodation of Utilities on Right-of-Way of the Illinois State Highway System," and "Standard Specifications for Road and Bridge Construction."

Applicants for permits to perform work on the highway right-of-way must also obtain approval or permission from the adjacent property owner, since the State has only acquired property rights that are a mere right to use the land for highway purposes and is known as an "Easement for Highway Purposes" to the right-of-way.

All turf areas on State right-of-way disturbed by this construction shall be seeded or reseeded until a grass turf is reestablished. The disturbed areas shall be seeded with the specified mixture at the following ratio: Three pounds of Kentucky Bluegrass or Kentucky 31 or Alta Fescue, and two pounds of Perennial Ryegrass. The application rate shall be five pounds per 1,000 square feet. All areas shall be mulched with straw and areas with slopes greater that 3:1 shall be covered with an erosion control fabric.

This permit is void on specified holidays, beginning at noon the day preceding the holiday or the holiday weekend. The specified holidays are: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day.

This permit is void when visibility is impaired due to rain, snow, fog, or when the pavement is wet, ice or snow covered, wholly or partially, or when travel conditions are considered to be unsafe by the Department of the Illinois State Police.

All personnel on foot within the highway right-of-way shall wear a fluorescent orange, fluorescent yellow/green, or a combination of fluorescent orange and fluorescent yellow/green vest meeting the requirements of ANSI/ISEA 107-2004 for Conspicuity Class 2 garments. Other types of garments may be substituted for the vest as long as the garments have a manufacturer's tag identifying them as meeting the ANSI Class 2 requirement.

The permittee agrees to fully comply with the following legal obligations in advance of entering and while upon any Right-of-way within the Illinois State Highway System.

a) Only a permit issued by the Department under this Part will satisfy the "written consent" requirement of Section 9-113 of the Illinois Highway Code (the Code).

b) A permit from the Department grants a license only to undertake certain activities in accordance with this Part on a State right-of-way and does not create a property right or grant authority to the permittee to impinge on the rights of others who may have an interest in the right-of-way. Such others might include an owner of an underlying fee simple interest if the right-of-way is owned as an easement or dedication of right of way, an owner of an easement, or another permittee.

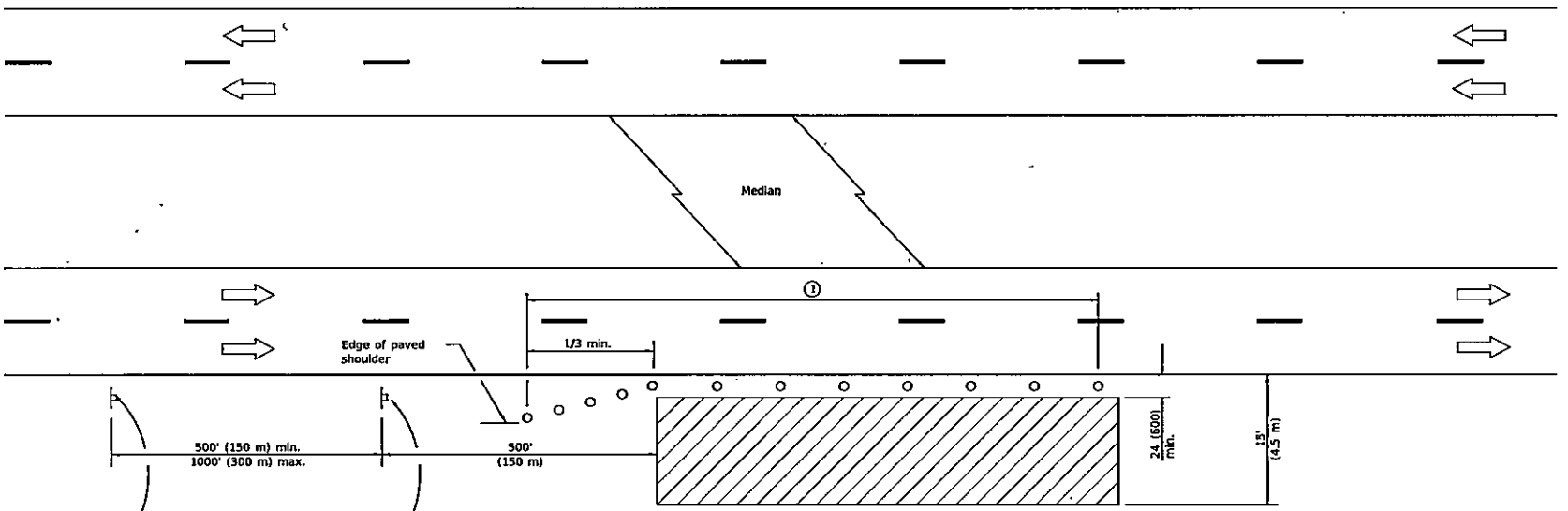
c) The permittee shall avoid conflicts with any existing underground or above-ground facilities on or near the highway right-of-way. Both the Department and J.U.L.I.E. are to be contacted for assistance during the application process.

d) The issuance of a highway permit by the Department does not excuse the permittee from complying with any existing statutes, local regulations or requirements of other Department (e.g., oversize and overweight vehicles) or the requirements of other State agencies including, but not limited to, the following:

   Illinois Commerce Commission, Illinois Department of Agriculture
   Illinois Department of Natural Resources, Illinois Department of Mines and Minerals
   Illinois Environmental Protection Agency, Illinois Historic Preservation Agency

e) Rights of abutting and underlying property owners are protected by common law and Sections 9-113 and 9-127 of the Code. The permittee will address these rights prior to initiating activities on State right-of-way. The Department will not be a party in any negotiations between the utility and abutting property owners.

f) In no case shall the permit give or be construed to give an entity any easement, leasehold or other property interest of any kind in, upon, under, above or along the State highway right-of-way.



For contract construction projects

W20-1103(0)-48

W21-1(0)-48

For maintenance and utility projects

W20-1(0)-48

TYPICAL APPLICATIONS

Utility operations
Culvert extensions
Side slope changes
Guardrail installation and maintenance
Delineator installation
Landscaping operations
Shoulder repair
Sign installation and maintenance

① When the work operation exceeds one hour, cones, drums or barricades shall be placed at 25' (8 m) centers for L/3 distance, and at 50' (15 m) centers through the remainder of the work area.

SYMBOLS

Work area

Sign

Cone, drum or barricade

GENERAL NOTES

This Standard is used where any vehicles, equipment, workers or their activities will encroach in the area 15' (4.5 m) to 24 (600) from the edge of pavement.

Calculate L as follows:

SPEED LIMIT	FORMULAS English	(Metric)
40 mph (70 km/h) or less:	$L=\frac{WS^2}{60}$	$L=\frac{WS^2}{150}$
45 mph (80 km/h) or greater:	L=(W)(S)	L=0.65(W)(S)

W = Width of offset in feet (meters).

S = Normal posted speed mph (km/h).

All dimensions are in inches (millimeters) unless otherwise shown.

Illinois Department of Transportation

PASSED April 1, 2016
ENGINEER OF SAFETY ENGINEERING

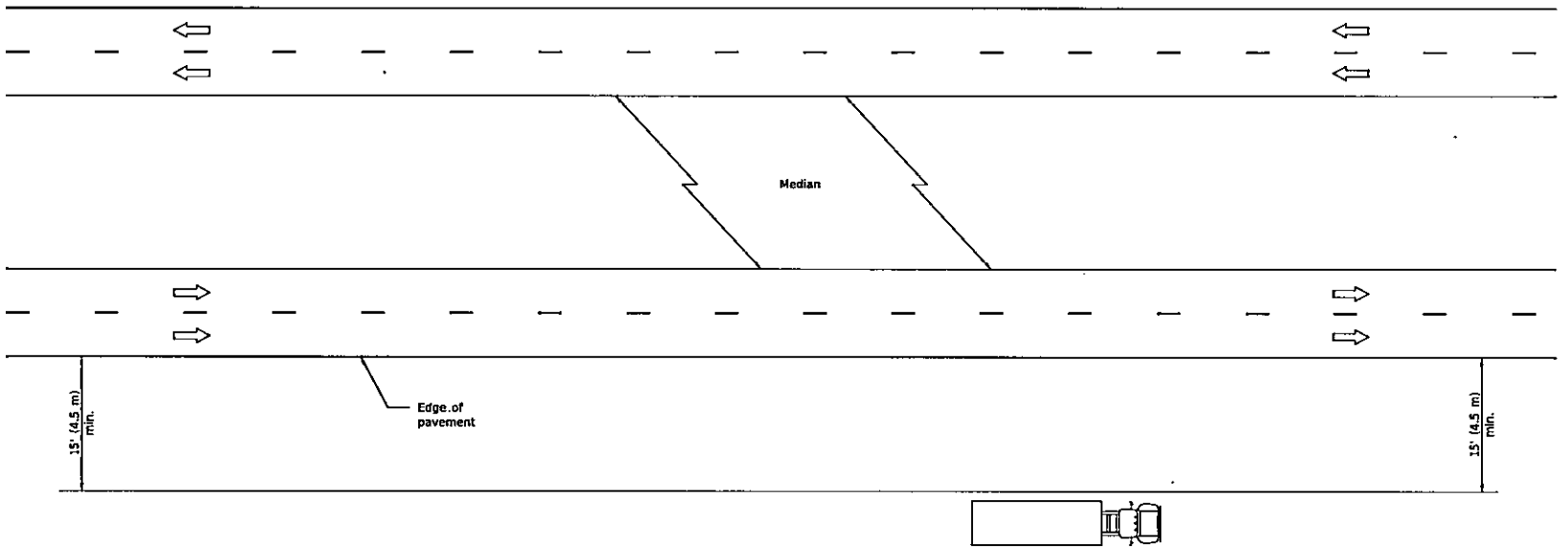
APPROVED April 1, 2016
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 4-1-16

DATE	REVISIONS
4-1-16	Corrected typo in title.
1-1-14	Revised workers sign
	number to agree with
	current MUTCD.

OFF-RD OPERATIONS, MULTILANE, 15' (4.5 m) TO 24" (600 mm) FROM PAVEMENT EDGE

STANDARD 701101-05



TYPICAL APPLICATIONS

Landscaping work
Utility work
Fencing contracts

GENERAL NOTES

This Standard is used where at all times all vehicles, equipment, workers or their activities are more than 15' (4.5 m) from the edge of pavement.

When the work operation requires that two or more work vehicles cross the 15' (4.5 m) clear zone in any one hour, traffic control shall be according to Standard 701101.

This Standard also applies to work performed in the median more than 15' (4.5 m) from either pavement.

All dimensions are in inches (millimeters) unless otherwise shown.

Illinois Department of Transportation

PASSED January 1, 2009
ENGINEER OF OPERATIONS

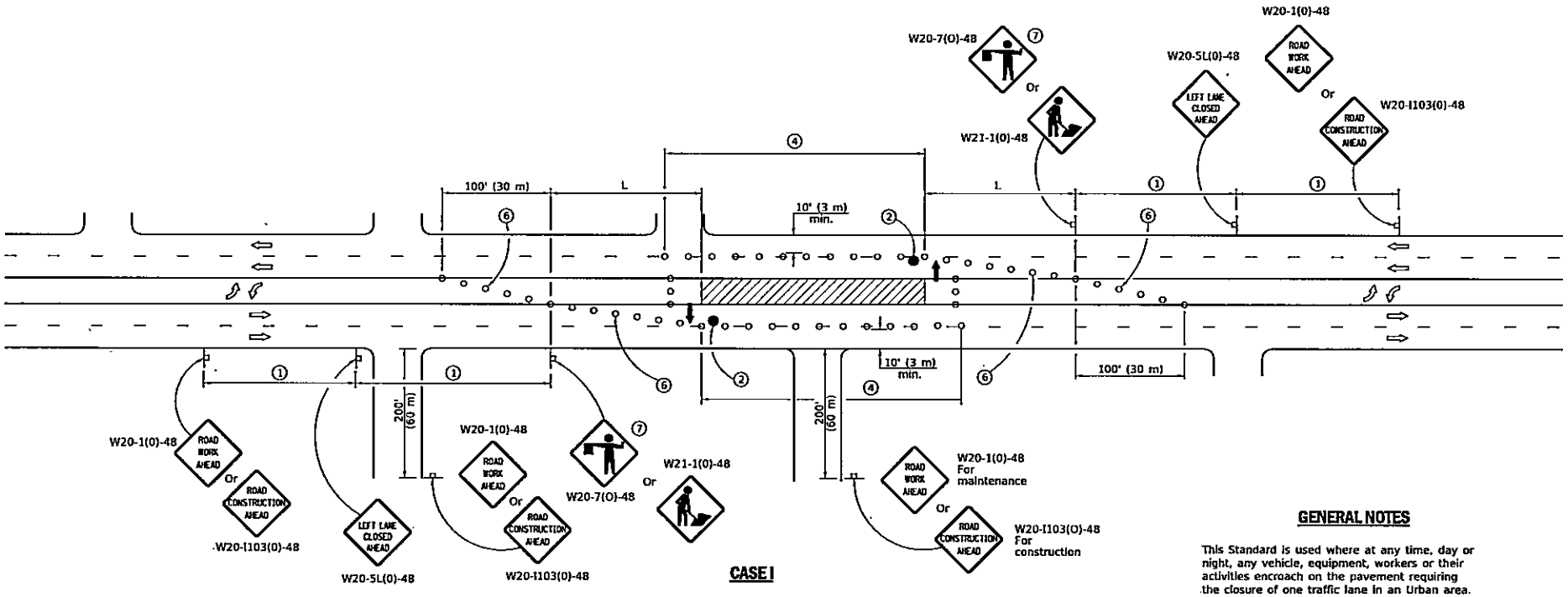
APPROVED January 1, 2009
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 1-1-87

DATE	REVISIONS
1-1-05	Switched units to English (metric).
1-1-05	Revised title.

OFF-RD OPERATIONS, MULTILANE, MORE THAN 15' (4.5 m) AWAY

STANDARD 701106-02



SIGN SPACING	
Posted Speed	Sign Spacing
55	500' (150 m)
50-45	350' (100 m)
<45	200' (60 m)

SYMBOLS

- Arrow board
- Work area
- Barricade or drum with steady burning mondirectional light
- Flagger with traffic control sign
- Cone, drum or barricade
- Sign on portable or permanent support
- Type III barricade with flashing lights

CASE I

1. Refer to SIGN SPACING TABLE for distances.
2. Required for speeds > 40 mph (70 km/h).
3. Required if work exceeds 500' (164 m) or 1 block, repeat every 1 mile (1.6 km).
4. Cones at 25' (8 m) centers for 250' (75 m) on approach. Additional cones may be placed at 50' (15 m) centers. When drums or type I or II barricades are used, the interval between devices may be doubled.
5. For approved sideroad closures.
6. Cones, drums or barricades at 20' (6 m) centers in taper.
7. Use flagger sign only when flagger is present.

GENERAL NOTES

This Standard is used where at any time, day or night, any vehicle, equipment, workers or their activities encroach on the pavement requiring the closure of one traffic lane in an Urban area.

If the work operation is performed between 9:00 a.m. and 3:00 p.m. and does not exceed 15 min. Traffic protection shall be as shown for Standard 701426.

Calculate L as follows:

SPEED LIMIT	FORMULAS English	(Metric)
40 mph (70 km/h) or less:	$L=\frac{WS^2}{60}$	$L=\frac{WS^2}{150}$
45 mph (80 km/h) or greater:	L=(W)(S)	L=0.65(W)(S)

W = Width of offset in feet (meters).

S = Normal posted speed mph (km/h).

All dimensions are in inches (millimeters) unless otherwise shown.

Illinois Department of Transportation

APPROVED January 1, 2019
ENGINEER OF SAFETY PROG. AND ENGINEERING

APPROVED January 1, 2019
ENGINEER OF DESIGN AND ENVIRONMENT

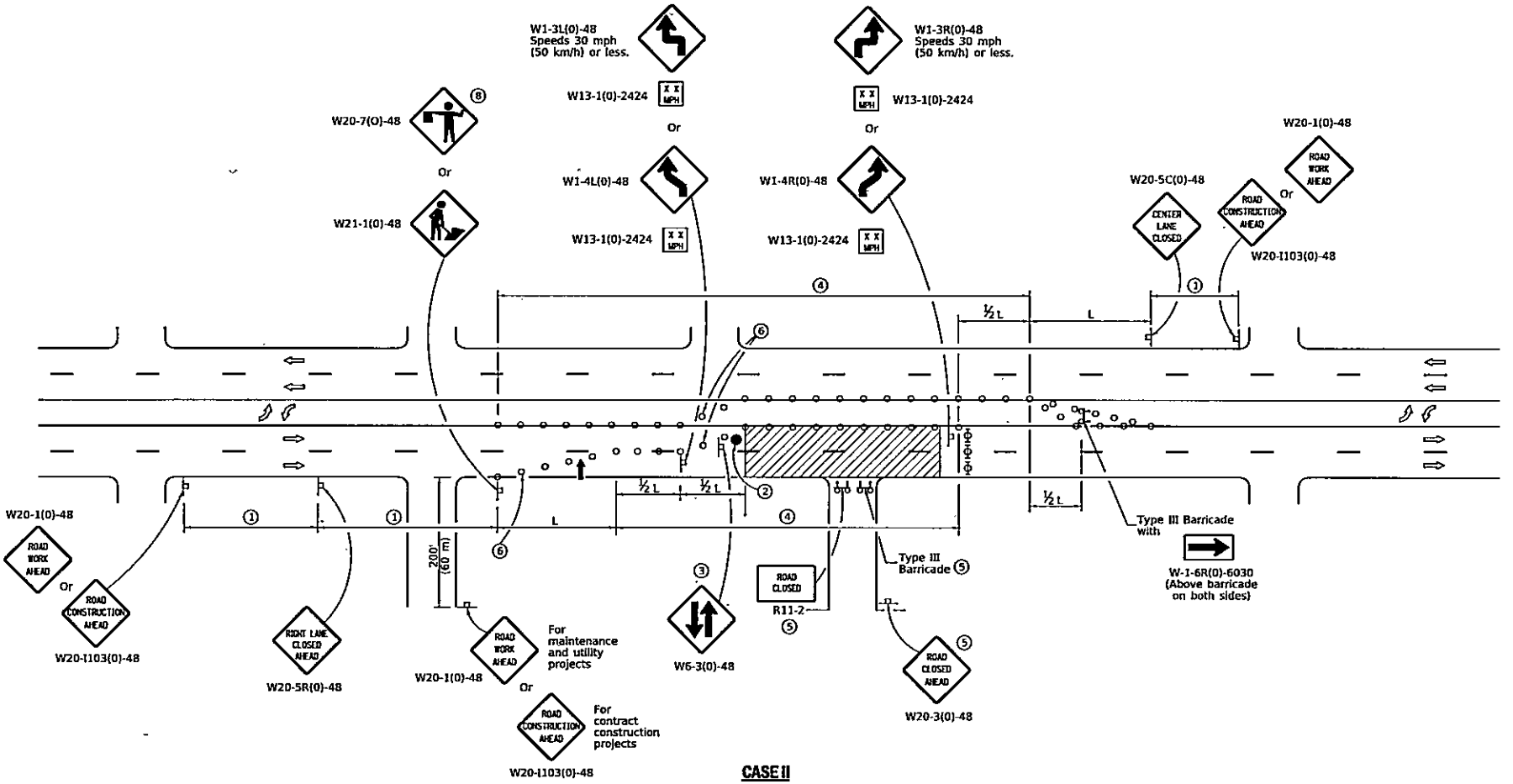
ISSUED 1-1-19

DATE	REVISIONS
1-1-19	Revised to allow cones at night.
1-1-18	Moved arrow boards into
	closed lanes for CASE I.

URBAN LANE CLOSURE, MULTILANE, 2W WITH BIDIRECTIONAL LEFT TURN LANE

(Sheet 1 of 4)

STANDARD 701602-10



CASE II

Illinois Department of Transportation

APPROVED January 1, 2019
ENGINEER OF SAFETY PROG. AND ENGINEERING

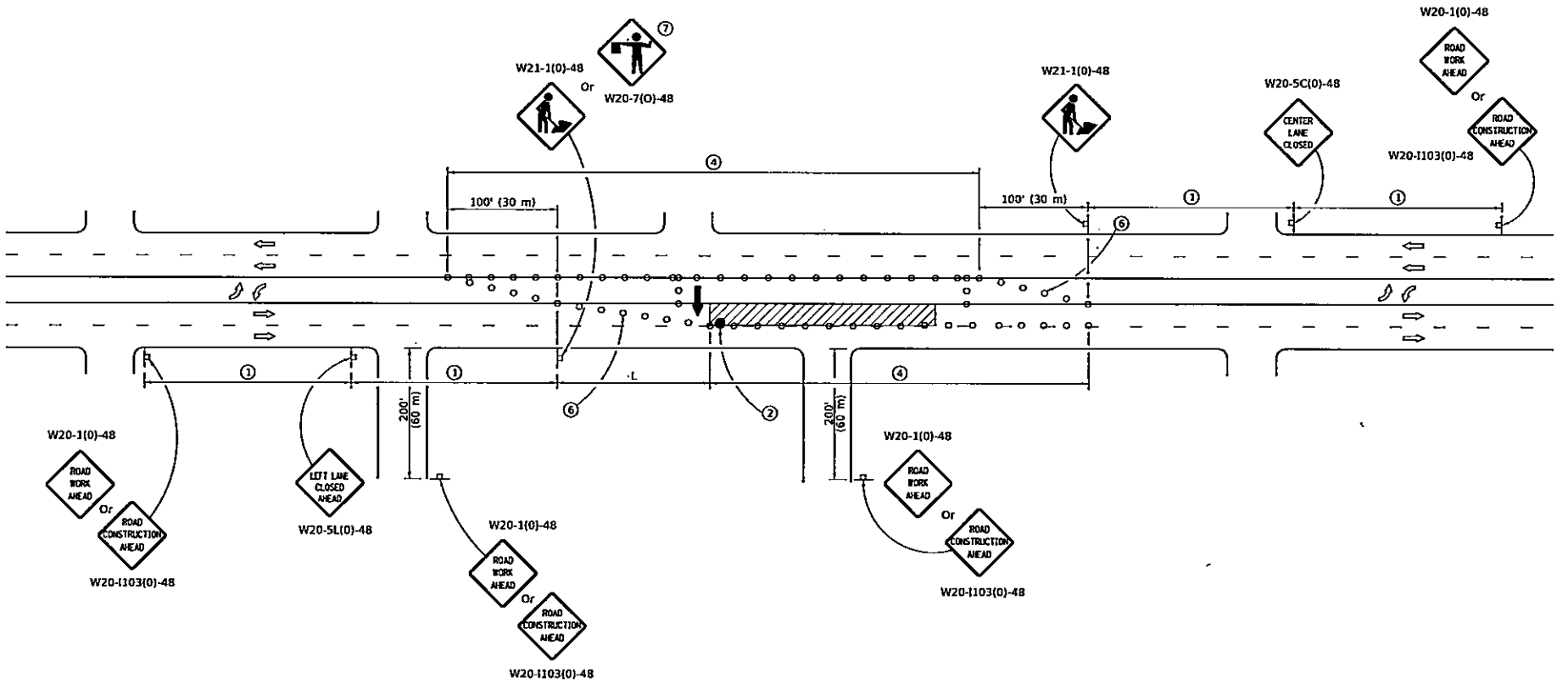
APPROVED January 1, 2019
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 14-13

URBAN LANE CLOSURE, MULTILANE, 2W WITH BIDIRECTIONAL LEFT TURN LANE

(Sheet 2 of 4)

STANDARD 701602-10



CASE III

Illinois Department of Transportation

APPROVED January 1, 2019
ENGINEER OF SAFETY PROG. AND ENGINEERING

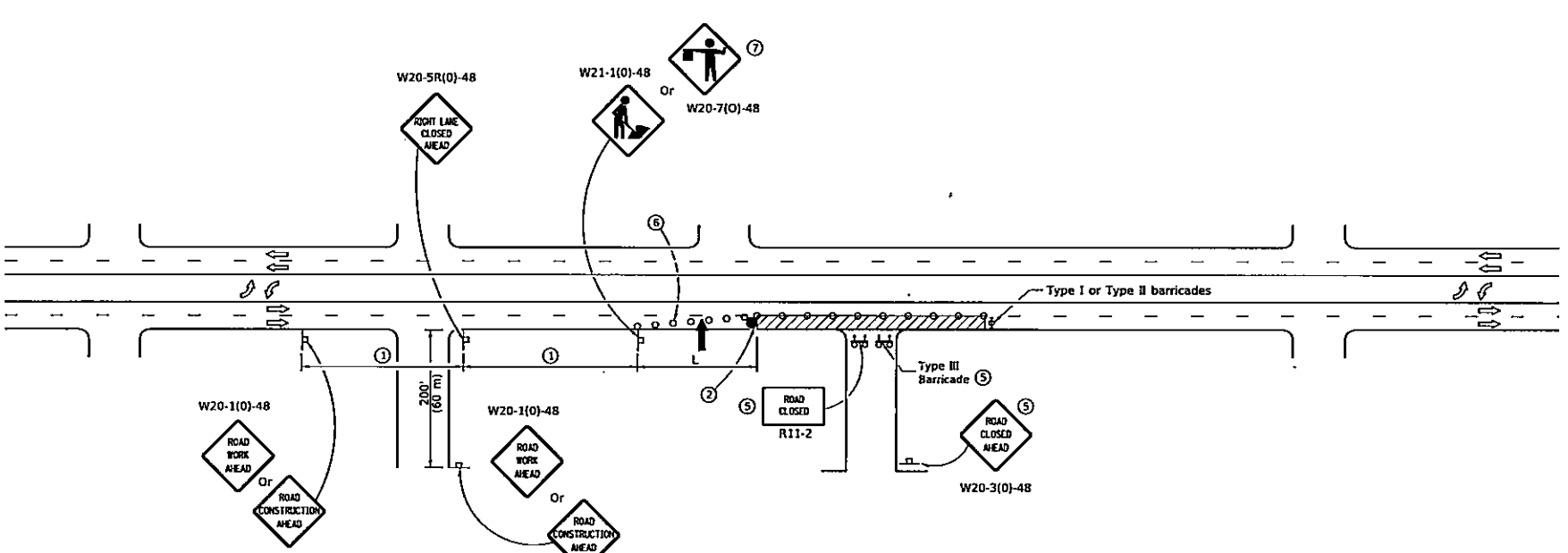
APPROVED January 1, 2019
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 1-1-13

URBAN LANE CLOSURE, MULTILANE, 2W WITH BIDIRECTIONAL LEFT TURN LANE

(Sheet 3 of 4)

STANDARD 701602-10



CASE IV

Illinois Department of Transportation

APPROVED January 1, 2019
ENGINEER OF SAFETY PROG. AND ENGINEERING

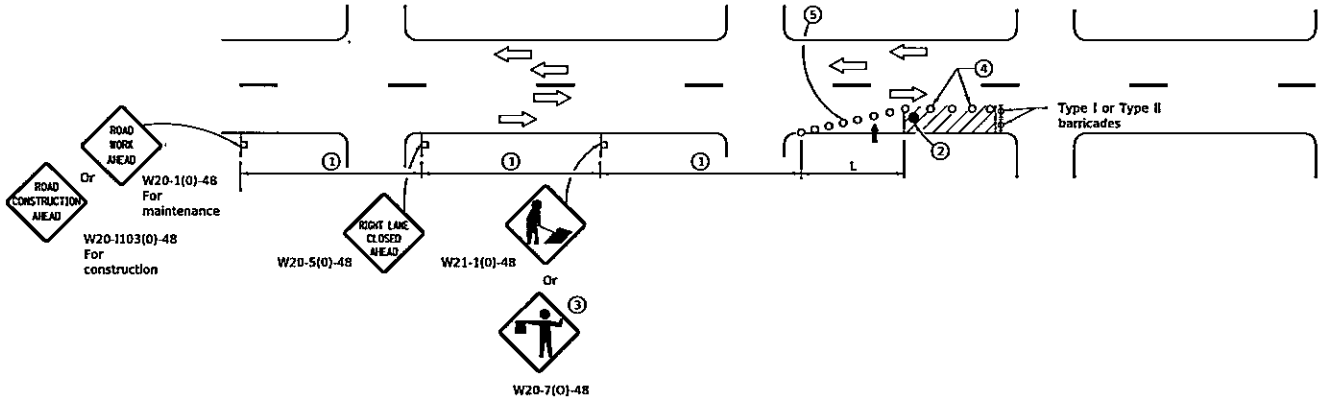
APPROVED January 1, 2019
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 1-1-13

URBAN LANE CLOSURE, MULTILANE, 2W WITH BIDIRECTIONAL LEFT TURN LANE

(Sheet 4 of 4)

STANDARD 701602-10



SIGN SPACING	
Posted Speed	Sign Spacing
55	500' (150 m)
50-45	350' (100 m)
<45	200' (60 m)

SYMBOLS

- Arrow board
- Cone, drum or barricade
- Sign on portable or permanent support
- Work area
- Barricade or drum with flashing light
- Flagger with traffic control sign.

1. Refer to SIGN SPACING TABLE for distances.
2. Required for speeds > 40 mph.
3. Use flagger sign only when flagger is present.
4. Cones at 25' (8 m) centers for 250' (75 m). Additional cones may be placed at 50' (15 m) centers. When drums or Type I or Type II barricades are used, the interval between devices may be doubled.
5. Cones, drums or barricades at 20' (6 m) centers in taper.

GENERAL NOTES

This Standard is used where at any time, day or night, any vehicle, equipment, workers or their activities encroach on the pavement requiring the closure of one traffic lane in an Urban area.

Calculate L as follows:

SPEED LIMIT	FORMULAS English	(Metric)
40 mph (70 km/h) or less:	$L=\frac{WS^2}{60}$	$L=\frac{WS^2}{150}$
45 mph (80 km/h) or greater:	L=(W)(S)	L=0.65(W)(S)

W = Width of offset in feet (meters).

S = Normal posted speed mph (km/h).

All dimensions are in inches (millimeters) unless otherwise shown.

Illinois Department of Transportation

PASSED January 1, 2015
ENGINEER OF SAFETY ENGINEERING

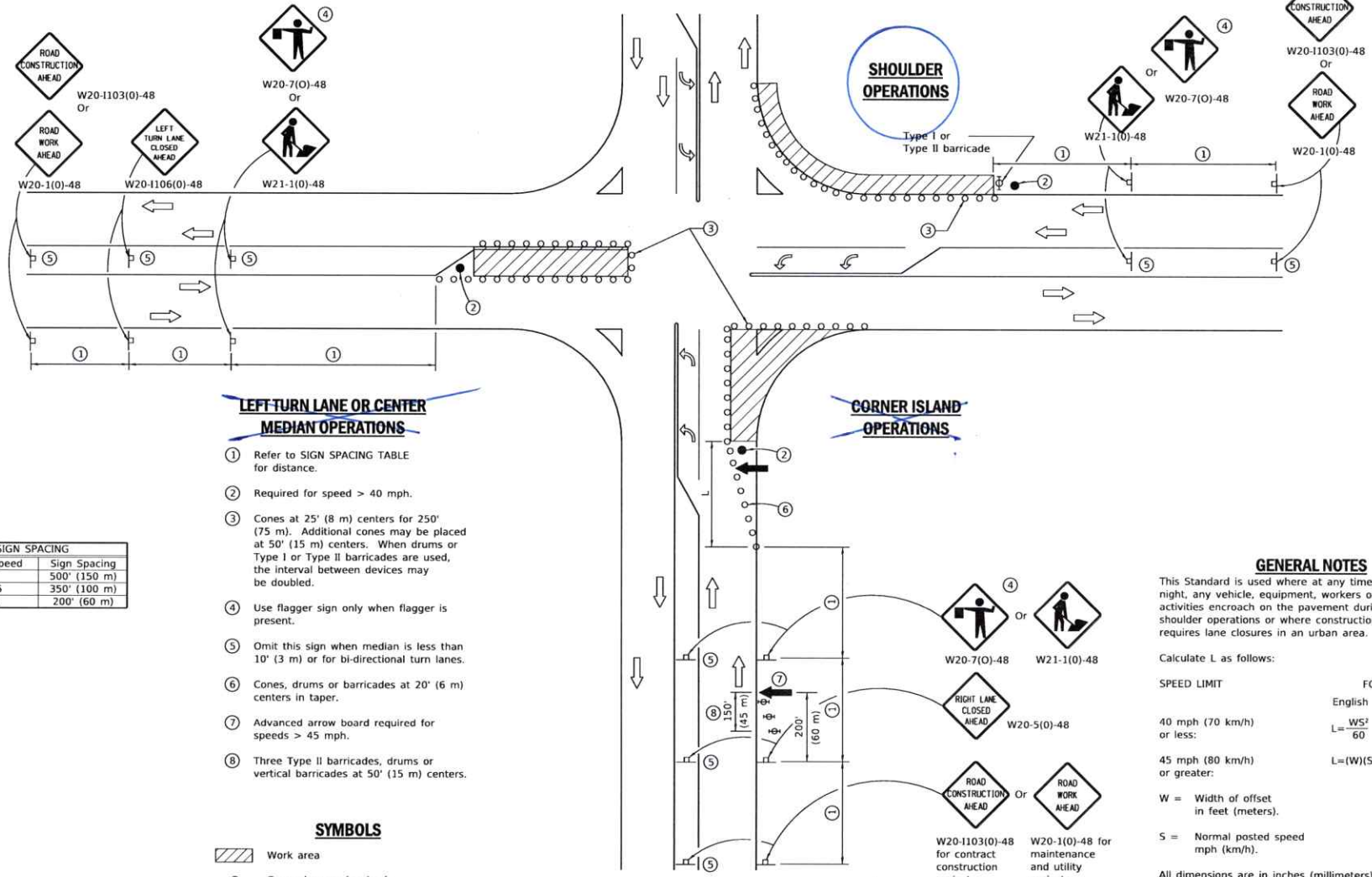
APPROVED January 1, 2015
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 1-1-15

DATE	REVISIONS
1-1-15	Renamed standard. Moved
	case on Sheet 2 to new
	Highway Standard.
1-1-14	Revised workers sign
	number to agree with
	current MUTCD.

URBAN SINGLE LANE CLOSURE, MULTILANE, 2W WITH MOUNTABLE MEDIAN

STANDARD 701606-10



SIGN SPACING	
Posted Speed	Sign Spacing
55	500' (150 m)
50-45	350' (100 m)
<45	200' (60 m)

1. Refer to SIGN SPACING TABLE for distance.
2. Required for speed > 40 mph.
3. Cones at 25' (8 m) centers for 250' (75 m). Additional cones may be placed at 50' (15 m) centers. When drums or Type I or Type II barricades are used, the interval between devices may be doubled.
4. Use flagger sign only when flagger is present.
5. Omit this sign when median is less than 10' (3 m) or for bi-directional turn lanes.
6. Cones, drums or barricades at 20' (6 m) centers in taper.
7. Advanced arrow board required for speeds > 45 mph.
8. Three Type II barricades, drums or vertical barricades at 50' (15 m) centers.

SYMBOLS

- Work area
- Cone, drum or barricade
- Sign on portable or permanent support
- Arrow board
- Barricade or drum with flashing light
- Flagger with traffic control sign

GENERAL NOTES

This Standard is used where at any time, day or night, any vehicle, equipment, workers or their activities encroach on the pavement during shoulder operations or where construction requires lane closures in an urban area.

Calculate L as follows:

SPEED LIMIT	FORMULAS English	(Metric)
40 mph (70 km/h) or less:	$L=\frac{WS^2}{60}$	$L=\frac{WS^2}{150}$
45 mph (80 km/h) or greater:	L=(W)(S)	L=0.65(W)(S)

W = Width of offset in feet (meters).

S = Normal posted speed mph (km/h).

All dimensions are in inches (millimeters) unless otherwise shown.

Illinois Department of Transportation

PASSED April 1, 2016
ENGINEER OF SAFETY ENGINEERING

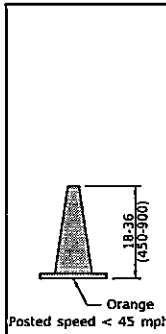
APPROVED April 1, 2016
ENGINEER OF DESIGN AND ENVIRONMENT

ISSUED 1-1-14

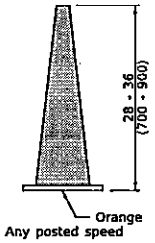
DATE	REVISIONS
4-1-16	Corrected sign number for
	LEFT TURN LANE CLOSED
	AHEAD.
1-1-14	Added devices at arrow
	board upstream from taper.
	Rev. workers sign number.

URBAN LANE CLOSURE, MULTILANE INTERSECTION

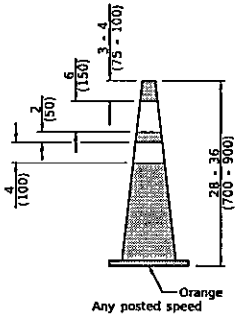
STANDARD 701701-10

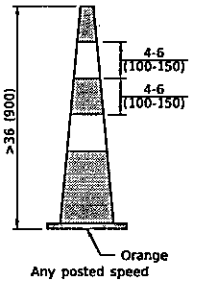


DAYTIME USE

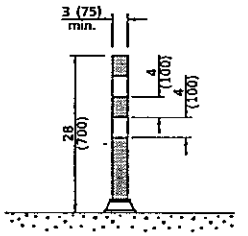


CONES

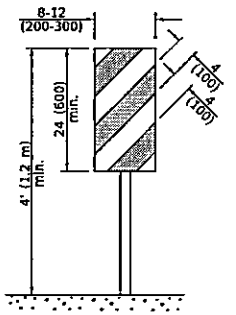




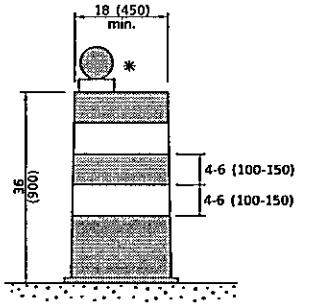
DAY OR NIGHTTIME USE



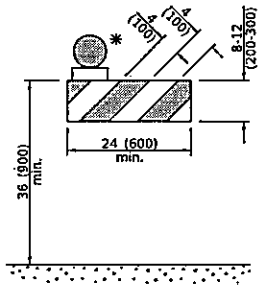
TUBULAR MARKER



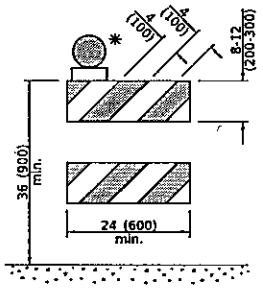
VERTICAL PANEL
POST MOUNTED



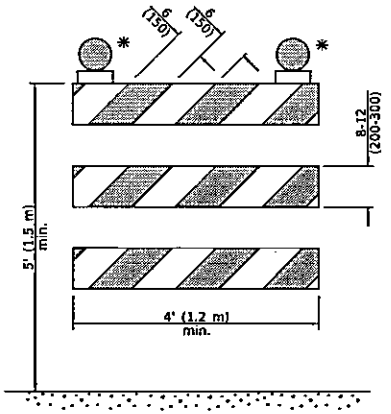
DRUM



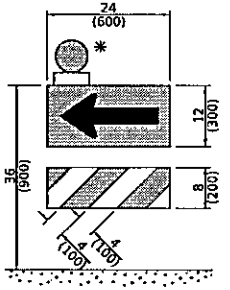
TYPE I BARRICADE



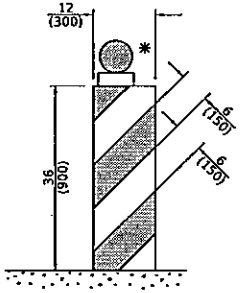
TYPE II BARRICADE



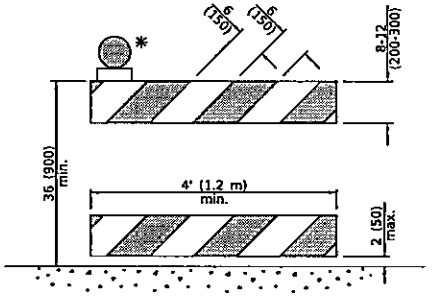
TYPE III BARRICADE



DIRECTION INDICATOR BARRICADE



VERTICAL BARRICADE



DETECTABLE PEDESTRIAN CHANNELIZING BARRICADE

* Warning lights (if required)

GENERAL NOTES

All heights shown shall be measured above the pavement surface.

All dimensions are in inches (millimeters) unless otherwise shown.

Illinois Department of Transportation

APPROVED January 1, 2019
ENGINEER OF SAFETY PROG. AND ENGINEERING

APPROVED January 1, 2019
ENGINEER OF DESIGN AND ENVIRONMENT

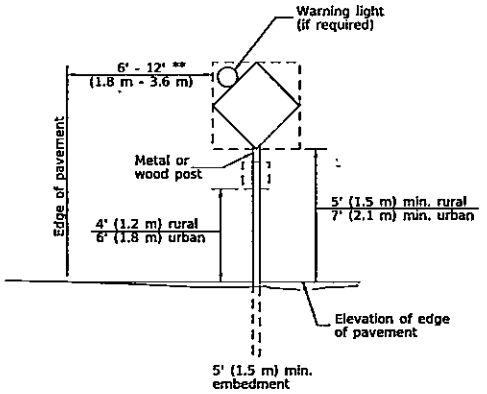
BSM3 1-1-19

DATE	REVISIONS
1-1-19	Revised cone usage and
	added cones >36" (900 m) height.
1-1-18	Revised END WORK ZONE
	SPEED LIMIT sign from
	orange to white background.

TRAFFIC CONTROL DEVICES

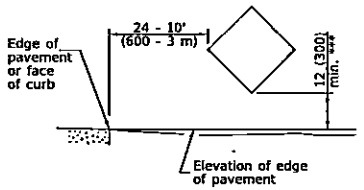
(Sheet 1 of 3)

STANDARD 701901-08



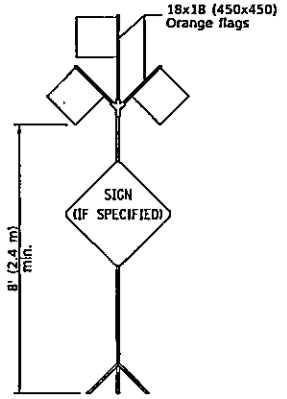
POST MOUNTED SIGNS

** When curb or paved shoulder are present this dimension shall be 24 (600) to the face of curb or 6' (1.8 m) to the outside edge of the paved shoulder.



SIGNS ON TEMPORARY SUPPORTS

*** When work operations exceed four days, this dimension shall be 5' (1.5 m) min. If located behind other devices, the height shall be sufficient to be seen completely above the devices.

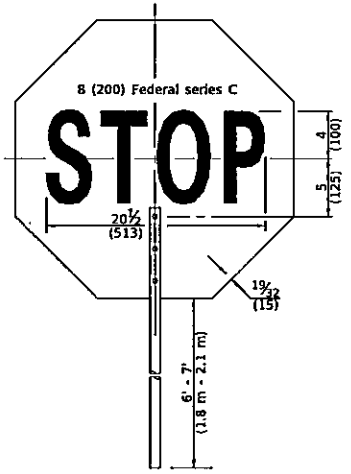


HIGH LEVEL WARNING DEVICE

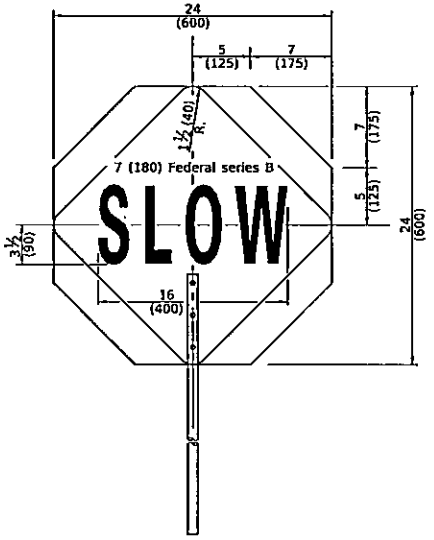
W12-1103-4848

WIDTH RESTRICTION SIGN

XX'-XX" width and X miles are variable.



FRONT SIDE



REVERSE SIDE

FLAGGER TRAFFIC CONTROL SIGN

ROAD CONSTRUCTION NEXT X MILES — G20-1104(0)-6036

END CONSTRUCTION — G20-1105(0)-6024

This signing is required for all projects 2 miles (3200 m) or more in length.

ROAD CONSTRUCTION NEXT X MILES sign shall be placed 500' (150 m) in advance of project limits.

END CONSTRUCTION sign shall be erected at the end of the job unless another job is within 2 miles (3200 m).

Dual sign displays shall be utilized on multi-lane highways.

WORK LIMIT SIGNING

WORK ZONE — W21-1115(0)-3618

SPEED LIMIT XX — R2-1-3648

PHOTO ENFORCED — R10-1108p-3618 ****

$XXX FINE MINIMUM — R2-1106p-3618

Sign assembly as shown on Standards or as allowed by District Operations.

END WORK ZONE SPEED LIMIT — G20-1103-6036

This sign shall be used when the above sign assembly is used.

HIGHWAY CONSTRUCTION SPEED ZONE SIGNS

**** R10-1108p shall only be used along roadways under the jurisdiction of the State.

Illinois Department of Transportation

APPROVED January 1, 2019
ENGINEER OF SAFETY PROG. AND ENGINEERING

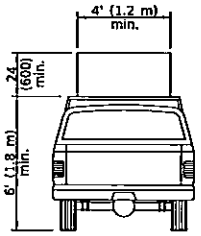
APPROVED January 1, 2018
ENGINEER OF DESIGN AND ENVIRONMENT

REVISED 1-1-18

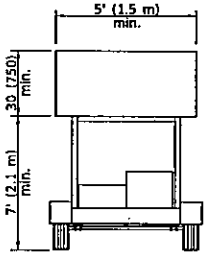
TRAFFIC CONTROL DEVICES

(Sheet 2 of 3)

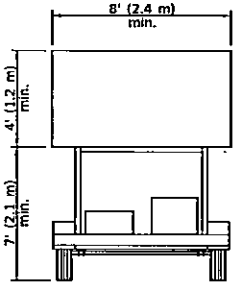
STANDARD 701901-08



TYPE A
ROOF MOUNTED

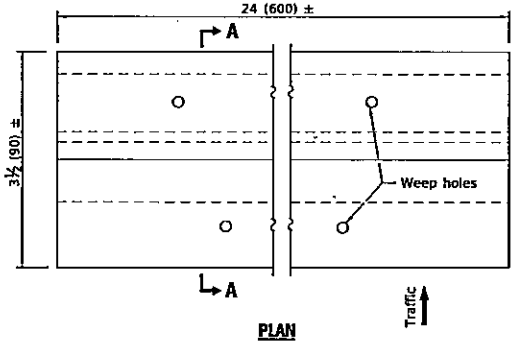


TYPE B
ROOF OR TRAILER MOUNTED

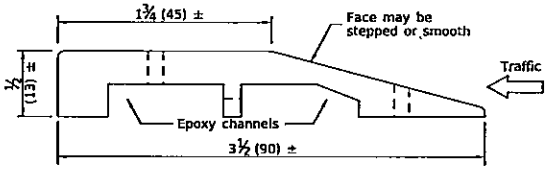


TYPE C
TRAILER MOUNTED

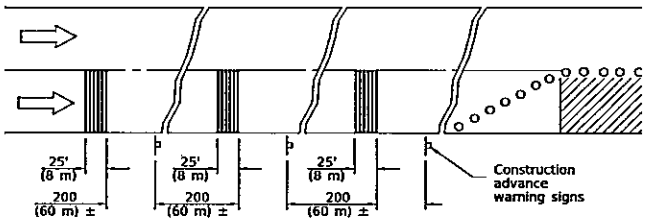
ARROW BOARDS

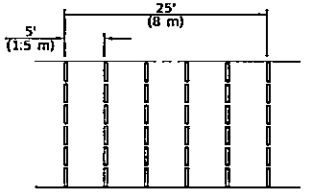


PLAN



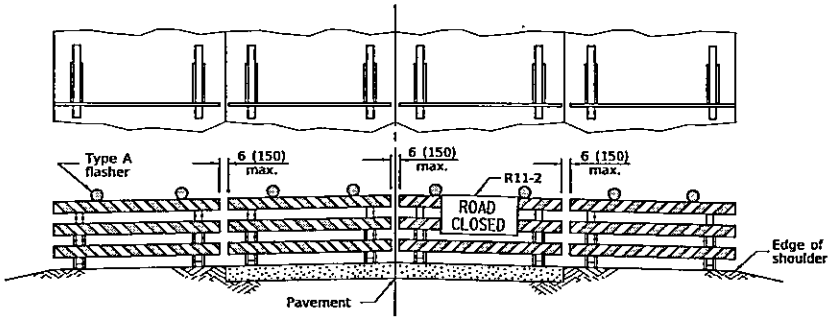
SECTION A-A





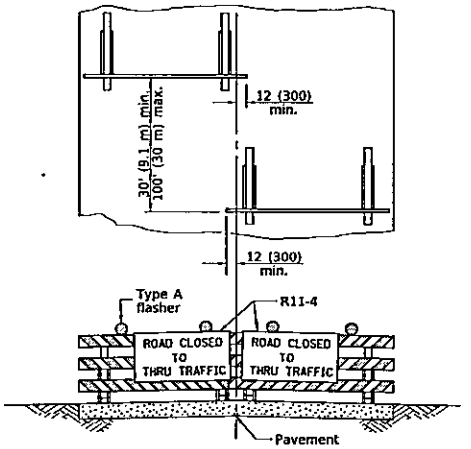
TYPICAL INSTALLATION

TEMPORARY RUMBLE STRIPS



ROAD CLOSED TO ALL TRAFFIC

Reflectorized striping may be omitted on the back side of the barricades. If a Type III barricade with an attached sign panel which meets NCHRP 350 is not available, the sign may be mounted on an NCHRP 350 temporary sign support directly in front of the barricade.



ROAD CLOSED TO THRU TRAFFIC

Reflectorized striping shall appear on both sides of the barricades. If a Type III barricade with an attached sign panel which meets NCHRP 350 is not available, the signs may be mounted on NCHRP 350 temporary sign supports directly in front of the barricade.

Illinois Department of Transportation

APPROVED January 1, 2019
ENGINEER OF SAFETY PROG. AND ENGINEERING

APPROVED January 1, 2019
ENGINEER OF DESIGN AND ENVIRONMENT

BSSRD 1-1-13

TYPICAL APPLICATIONS OF TYPE III BARRICADES CLOSING A ROAD

TRAFFIC CONTROL DEVICES

(Sheet 3 of 3)

STANDARD 701901-08