

A large, 3D-style graphic of a hexagonal prism. The prism is composed of several concentric layers. The outermost layer is a light gray outline. The next layer inward is a solid yellow color. The innermost layer is a solid light blue color. The text 'Electric Wedge' is centered within the prism in a bold, dark blue, sans-serif font.

Electric Wedge

SECTION 34 71 13.19

ACTIVE VEHICLE BARRIERS
03/2014

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO HB-17 (2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M (2010; Errata 2011) Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A106/A106M (2011) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service

ASTM D3034 (2008) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

ASTM F2656 (2007) Standard Test Method for Vehicle Crash Testing of Perimeter Barriers

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J517 (2013) Hydraulic Hose

U.S. DEPARTMENT OF STATE (SD)

SD-STD-02.01 (2003; Rev A) Specification For Vehicle Crash Test of Perimeter Barriers and Gates

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD (2009) Manual on Uniform Traffic Control

Devices

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910

Occupational Safety and Health Standards

UNDERWRITERS LABORATORIES (UL)

UL 486A-486B

(2013) Wire Connectors

1.2 SYSTEM DESCRIPTION

Barrier systems used shall be listed in either the Department of State (DoS) certified or Department of Defense (DoD) approved anti-ram vehicle barrier lists. Barrier widths shall be 'as certified/approved' on these lists. Alternatively, if a barrier system's width is between the widths of two listed barrier systems that are identical except for their widths, then that barrier system is also acceptable. Exceptions and acceptable widths will only be taken from the DoD anti-ram vehicle barrier list. The design and structural materials of the vehicle barrier furnished shall be the same as those used in the crash tested barrier. Crash test must have been performed and data compiled by an approved independent testing agency in accordance with either ASTM F2656 or SD-STD-02.01. Barriers tested and certified on the previous Department of State standard, SD-STD-02.01 and listed on the DoD approved anti-ram vehicle barrier list are also acceptable.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation[; G]
Equipment[; G]
Electrical Work[; G]

Detail drawings containing complete wiring and schematic diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the Drawings proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including foundation and clearances for maintenance and operation. Include with the Detail drawings a copy of the Department of State certificate of barrier performance.

SD-03 Product Data

Barrier Systems

A complete list of equipment, materials, including industrial standards used and how they apply to the applicable component and manufacturer's descriptive data and technical literature, catalog cuts, and installation instructions. Information necessary to document a minimum 1-year successful field operation performance

history for each type of vehicle barrier installed.

SD-06 Test Reports

Field Testing

Test reports in booklet form showing all field tests, including component adjustments and demonstration of compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate with each test report the final position of controls.

SD-10 Operation and Maintenance Data

Barrier Systems[; G] Operating and Maintenance Instructions

Five (5) copies of operation and maintenance manuals, a minimum of 2 weeks prior to field training. One complete set prior to performance testing and the remainder upon acceptance. Manuals shall be approved prior to acceptance. Operation manuals shall outline the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall include routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include equipment layout and simplified wiring and control diagrams of the system as installed.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect components placed in storage from the weather, humidity, and temperature variation, dirt and dust, or other contaminants. Store structural materials on sleepers or pallets and protect them from rust and objectionable materials such as dirt, grease, or oil.

1.5 EXTRA MATERIALS

Provide a manufacturer's standard recommended spare parts package, with current unit prices and source of supply complete with detailed manuals on parts replacement, with each barrier to facilitate 1 year of normal operation. Give particular consideration to system components which are not readily available from local or commercial sources and which are critical to the operation of the system.

PART 2 PRODUCTS

2.1 RETRACTABLE BARRIERS

When in the raised position, the total retractable barrier heights shall be no less than 28 inches above the roadway surface and shall be 132 inches wide. When in the lowered position, the retractable barrier shall extend no more than 5/8 inch above the roadway surface. Retractable barriers in the lowered position shall be capable of supporting a 32,000 pound axle load or a 16,000 pound wheel load. Design for this load shall be in

accordance with AASHTO HB-17.

2.1.1 Powered Retractable Barrier

The retractable barrier shall be capable of 240 complete up/down cycles per hour. The retractable barrier motion shall be instantly reversible and shall be capable of raising the barrier from the lowered position to the raised position within 2 seconds during normal use, and within 2 seconds during an emergency. Also, the barrier shall be capable of being lowered from the raised position to the lowered position in not more than 3 seconds.

[Retractable barrier shall withstand a 15000 pound vehicle at impact speed of 50 mph with maximum barrier deflection or vehicle penetration of 3.3 feet.

2.1.1.1 Failure Modes of Operation

The system shall be designed to remain in the last commanded position in the event of hydraulic, electrical, or mechanical failure. A manual pump, or other system, shall be included for operation of hydraulic barriers without power.

2.1.1.2 Electric Motors

Unless otherwise indicated, electric motors shall have [drip-proof] [totally enclosed] [totally enclosed fan cooled] enclosures. All couplings, motor shafts, gears, and other moving parts shall be fully guarded in accordance with 29 CFR 1910 Subpart O. Guards shall be removable without disassembling the guarded unit. For multiple barriers operated from a single hydraulic unit it is highly recommended that the electric motor be 3-phase.

2.1.1.3 System

The system shall be designed to maintain the barriers in the raised position, without inspection, for periods of time of up to 1 week. If a hydraulic system is used, it shall be equipped with pressure relief valves to prevent overpressure. The system shall not require continuous running of the motor to stay in the raised position, excluding the use of manual pinning to do so.

2.1.1.4 Electric Power Unit

The barrier is operated by a linear servo actuator using a spring assist assembly. The system operates on 208-240 three phase, 60 hertz power supply. In the event of a power failure, the barrier system can be operated by an optional battery back-up system. The standard battery backup system will allow the barrier to operate 3 complete cycles. The electrical components used to power and control the barrier are housed in with a weather resistant NEMA 3R enclosure. The up and down controls are provided on the front of the enclosure for ease of operation during system maintenance. All enclosure field connections are made through a terminal strip.

2.1.1.5 Hydraulic Power Unit Enclosure

A NEMA Type 3R enclosure as specified in NEMA 250 shall be provided to enclose the hydraulic power unit. The enclosure shall be designed for easy removal of the hydraulic power unit and other accessories without complete

removal of the enclosure. An access door with hinges and an inside and outside operable/lockable (exterior) door latch shall be provided. Equipment within the enclosure shall be placed and configured so that all periodic maintenance can be performed through the access door without removal of the equipment. The enclosure shall be equipped with weatherproof louver vents appropriately sized and located to dissipate internal heat generation.

2.2 NAMEPLATES

Nameplate data shall be permanently attached to each vehicle barrier. The data shall be legibly marked on corrosion-resistant metal plates and shall consist of at least the following:

- a. Manufacturer's name.
- b. Model number.
- c. Serial number.
- d. Date of manufacture.

2.3 CONTROL PANEL

A control panel and control circuit shall be provided to interface between all barrier control stations and the power unit. A control panel shall be provided for the inbound lanes and a separate one for the outbound lanes where the barriers are located. The control station is defined as the main control panel [and the remote control panel] as shown. The control circuit shall contain all relays, timers, and other devices or an industrial programmable controller programmed as necessary for the barrier operation. The control panel shall allow direct interface with auxiliary equipment such as card readers, remote switches, loop detectors, infrared sensors, and [sliding] [swinging] gate limit switches. Loop controllers shall not cause an automatic barrier raise following power loss or restoration. The enclosure shall be as indicated on the drawings. All device interconnect lines shall be run to terminal strips.

2.3.1 Voltage

The control circuit shall operate from a 120 volt 60 Hz supply. The control circuit voltage shall be 24 dc for all external control panels.

2.3.2 Main (OR MASTER) Control Panel

A main control panel shall be supplied to control barrier function. This panel shall have a key-lockable main switch with main power "ON" and panel "ON" lights. Buttons to raise and lower each [barrier] [set of barriers] shall be provided. Barrier "UP" and "DOWN" indicator lights shall be included for each [barrier] [set of barriers]. An emergency fast operate circuit (EFO) shall be operated from a push button larger than the normal controls and have a flip safety cover installed over the push button or toggle switch. The EFO shall also be furnished with an EFO-active light and reset button. [The main control panel shall have a key lockable switch to arm or disable the remote control panel. An indicator light shall show if the remote control panel is enabled.

2.3.3 Remote (OR MAINTENANCE) Control Panel

A remote control panel, one panel for the inbound lane(s) and a separate panel for the outbound lane(s), shall have a panel "ON" light that is lit when enabled by a key lockable switch on the main control panel. Buttons to raise and lower each barrier shall be provided. Barrier "UP" and "DOWN" indicator lights shall be included for each barrier. The EFO shall be operated from a push button larger than the normal controls and have a flip safety cover installed over the push button or toggle switch. Activation of either EFO will operate all barriers. The EFO shall be interconnected with an EFO-active light. When the remote control panel EFO is pushed, operation of the barrier will not be possible from this panel until reset at the main control panel.

2.4 MISCELLANEOUS EQUIPMENT

2.4.1 Safety Equipment

2.4.1.1 Barrier Systems Sensors

The barrier system sensors shall consist of the following:

- a. Suppression Loops - Two inductive loops whose outputs shall be used to prevent barriers raising when a vehicle is within a prescribed distance of the barrier. The output of the loops shall override all barrier rise signals until one second after a vehicle clears the suppression loop.

The sensors shall be compatible with the barrier controller and shall function as part of a complete barrier control system.

2.4.1.2 Barrier Signals

Pole Top Mounted - Red / yellow (flashing) 8 inch traffic lights shall be supplied for each entrance and exit to alert motorists of the barrier position. Traffic lights are not required for manual barriers. The yellow flashing light shall indicate that the barrier is fully open. All other positions shall cause the light to show red. Brackets shall be supplied to allow the light to be mounted a minimum 4.5 feet above the roadway pavement

Mast Arm Mounted - Red 12 inch / yellow 12 inch / yellow (flashing) 8 inch traffic lights shall be supplied for each entrance and exit to alert motorists of the barrier position. Traffic lights are not required for manual barriers. The yellow flashing light shall indicate that the barrier is fully open.

2.4.2 Heater

A waterproof barrier heater with a thermostat control and NEMA 4 junction box connection point shall be provided for de-icing and snow melting. The heater shall provide barrier operation to an ambient temperature of minus 40 degrees F.

2.4.3 Signage

Signage shall conform to MUTCD .

2.5 FINISH

Surfaces shall be painted in accordance with requirements of Section 09 90 00 PAINTS AND COATINGS. The roadway plate shall have a nonskid surface painted white with reflective red 4 inch wide red reflective stripes 4 inches apart. The barrier front shall be painted white and have 4 inch wide reflective red stripes 4 inches apart. The diagonal striping should point down and outward from the center of the device.

2.6 CONCRETE

The concrete shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.7 WELDING

Welding shall be in accordance with AWS D1.1/D1.1M.

2.8 PAVEMENT

After placement of the vehicle barrier, the pavement sections shall be replaced to match the section and depth of the surrounding pavement. Pavement shall be warped to match the elevations of existing pavement. Positive surface drainage, away from the vehicle barrier, shall be provided by pavement slope.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation in accordance with manufacturers instructions and in the presence of a representative of the manufacturer. Manufacturer's representative shall be experienced in the installation, adjustment, and operation of the equipment provided. The representative shall also be present during adjustment and testing of the equipment.

3.2 Power & Encoder Cables

Place buried cables in separate polyvinyl chloride (PVC) sleeves. Provide positive drainage from the electric power unit to the barrier for drainage of condensation within the PVC sleeve.

3.3 PIT DRAINAGE

Provide a drain connection in each barrier that requires pit/vault type construction. Provide hookups between the storm drains.

3.4 ELECTRICAL

All control power wiring requiring compression terminals shall use ring-style terminals. Terminals and compression tools shall conform to UL 486A-486B. Roundhead screws and lockwashers shall be used to provide vibration-resistant connections. Connections between any printed circuit cards and the chassis shall be made with screw connections or other locking means to prevent shock or vibration separation of the card from its chassis. The electrical power supply breaker for the hydraulic power unit shall be capable of being locked in the power on and power off positions.

3.5 MANUFACTURER'S SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment supplied. The representative shall supervise the installation, adjustment, and testing of the equipment.

3.6 FIELD TRAINING

Provide a field training course for designated operating staff members. Training shall be provided for a total period of not less than [8 hours] [1 hour] of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the [operating and maintenance instructions](#).

3.7 FIELD TESTING

Submit test reports in booklet form showing all field tests, including component adjustments and demonstration of compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate with each test report the final position of controls. Upon completion of construction, perform a field test for each vehicle barrier. The test shall include raising and lowering the barrier, both electrically and manually, through its complete range of operation. Each vehicle barrier shall then be continuously cycled for not less than 30 minutes to test for heat build-up in the hydraulic system. Notify the Contracting Officer at least 7 days prior to the beginning of the field test. Furnish all equipment and make all necessary corrections and adjustments prior to tests witnessed by the Contracting Officer. Any conditions that interfere with the proper operation of the barrier disclosed by the test shall be corrected at no additional cost to the Government. Adjustments and repairs shall be done by the Contractor under the direction of the Contracting Officer. After adjustments are made to assure correct functioning of components, applicable tests shall be completed.

-- End of Section --



SECTION 34 71 13.19

ACTIVE VEHICLE BARRIERS
03/2014

PART 1 GENERAL

1.1 REFERENCES

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Occupational Safety and Health Standards

UNDERWRITERS LABORATORIES (UL)

UL 486A-486B

(2013) Wire Connectors

1.2 SYSTEM DESCRIPTION

Barrier systems used shall be listed in either the Department of State (DoS) certified or Department of Defense (DoD) approved anti-ram vehicle barrier lists. Barrier widths shall be 'as certified/approved' on these lists. Alternatively, if a barrier system's width is between the widths of two listed barrier systems that are identical except for their widths, then that barrier system is also acceptable. Exceptions and acceptable widths will only be taken from the DoD anti-ram vehicle barrier list. The design and structural materials of the vehicle barrier furnished shall be the same as those used in the crash tested barrier. Crash test must have been performed and data compiled by an approved independent testing agency in accordance with either ASTM F2656 or SD-STD-02.01. Barriers tested and certified on the previous Department of State standard, SD-STD-02.01 and listed on the DoD approved anti-ram vehicle barrier list are also acceptable.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation[; G]
Equipment[; G]
Electrical Work[; G]

Detail drawings containing complete wiring and schematic diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show on the Drawings proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including foundation and clearances for maintenance and operation. Include with the Detail drawings a copy of the Department of State certificate of barrier performance.

SD-03 Product Data

Barrier Systems

A complete list of equipment, materials, including industrial standards used and how they apply to the applicable component and manufacturer's descriptive data and technical literature, catalog cuts, and installation instructions. Information necessary to document a minimum 1-year successful field operation performance

history for each type of vehicle barrier installed.

SD-06 Test Reports

Field Testing

Test reports in booklet form showing all field tests, including component adjustments and demonstration of compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate with each test report the final position of controls.

SD-10 Operation and Maintenance Data

Barrier Systems[; G] Operating and Maintenance Instructions

Five (5) copies of operation and maintenance manuals, a minimum of 2 weeks prior to field training. One complete set prior to performance testing and the remainder upon acceptance. Manuals shall be approved prior to acceptance. Operation manuals shall outline the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall include routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include equipment layout and simplified wiring and control diagrams of the system as installed.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect components placed in storage from the weather, humidity, and temperature variation, dirt and dust, or other contaminants. Store structural materials on sleepers or pallets and protect them from rust and objectionable materials such as dirt, grease, or oil.

1.5 EXTRA MATERIALS

Provide a manufacturer's standard recommended spare parts package, with current unit prices and source of supply complete with detailed manuals on parts replacement, with each barrier to facilitate 1 year of normal operation. Give particular consideration to system components which are not readily available from local or commercial sources and which are critical to the operation of the system.

PART 2 PRODUCTS

2.1 RETRACTABLE BARRIERS

When in the raised position, the total retractable barrier heights shall be no less than 28 inches above the roadway surface and shall be 132 inches wide. When in the lowered position, the retractable barrier shall extend no more than 5/8 inch above the roadway surface. Retractable barriers in the lowered position shall be capable of supporting a 32,000 pound axle load or a 16,000 pound wheel load. Design for this load shall be in

accordance with AASHTO HB-17.

2.1.1 Powered Retractable Barrier

The retractable barrier shall be capable of 240 complete up/down cycles per hour. The retractable barrier motion shall be instantly reversible and shall be capable of raising the barrier from the lowered position to the raised position within 2 seconds during normal use, and within 2 seconds during an emergency. Also, the barrier shall be capable of being lowered from the raised position to the lowered position in not more than 3 seconds.

[Retractable barrier shall withstand a 15000 pound vehicle at impact speed of 50 mph with maximum barrier deflection or vehicle penetration of 3.3 feet.

2.1.1.1 Failure Modes of Operation

The system shall be designed to remain in the last commanded position in the event of hydraulic, electrical, or mechanical failure. A manual pump, or other system, shall be included for operation of hydraulic barriers without power.

2.1.1.2 Electric Motors

Unless otherwise indicated, electric motors shall have [drip-proof] [totally enclosed] [totally enclosed fan cooled] enclosures. All couplings, motor shafts, gears, and other moving parts shall be fully guarded in accordance with 29 CFR 1910 Subpart O. Guards shall be removable without disassembling the guarded unit. For multiple barriers operated from a single hydraulic unit it is highly recommended that the electric motor be 3-phase.

2.1.1.3 System

The system shall be designed to maintain the barriers in the raised position, without inspection, for periods of time of up to 1 week. If a hydraulic system is used, it shall be equipped with pressure relief valves to prevent overpressure. The system shall not require continuous running of the motor to stay in the raised position, excluding the use of manual pinning to do so.

2.1.1.4 Hydraulic Power Unit

The hydraulic power unit shall contain synthetic biodegradable hydraulic fluid which maintains its viscosity operating range, even at constant heaviest use rate, for an ambient temperature range of 20 to 150 degrees F. A hydraulic fluid heater shall be provided so that the viscosity remains within its operating range if ambient temperatures below 20 degrees F are expected. Buried hydraulic lines for the connection of the hydraulic power unit to the barrier shall be flexible or carbon steel pipe, or a combination of flexible and carbon steel pipe. Flexible and rigid hydraulic line working pressures shall exceed the maximum system relief pressure.

- a. Flexible hydraulic lines shall be in accordance with SAE J517.
- b. Rigid hydraulic lines shall be seamless carbon steel pipe in accordance with ASTM A106/A106M.

2.1.1.5 Hydraulic Power Unit Enclosure

A NEMA Type 3R enclosure as specified in NEMA 250 shall be provided to enclose the hydraulic power unit. The enclosure shall be designed for easy removal of the hydraulic power unit and other accessories without complete removal of the enclosure. An access door with hinges and an inside and outside operable/lockable (exterior) door latch shall be provided. Equipment within the enclosure shall be placed and configured so that all periodic maintenance can be performed through the access door without removal of the equipment. The enclosure shall be equipped with weatherproof louver vents appropriately sized and located to dissipate internal heat generation.

2.2 NAMEPLATES

Nameplate data shall be permanently attached to each vehicle barrier. The data shall be legibly marked on corrosion-resistant metal plates and shall consist of at least the following:

- a. Manufacturer's name.
- b. Model number.
- c. Serial number.
- d. Date of manufacture.

2.3 CONTROL PANEL

A control panel and control circuit shall be provided to interface between all barrier control stations and the power unit. A control panel shall be provided for the inbound lanes and a separate one for the outbound lanes where the barriers are located. The control station is defined as the main control panel [and the remote control panel] as shown. The control circuit shall contain all relays, timers, and other devices or an industrial programmable controller programmed as necessary for the barrier operation. The control panel shall allow direct interface with auxiliary equipment such as card readers, remote switches, loop detectors, infrared sensors, and [sliding] [swinging] gate limit switches. Loop controllers shall not cause an automatic barrier raise following power loss or restoration. The enclosure shall be as indicated on the drawings. All device interconnect lines shall be run to terminal strips.

2.3.1 Voltage

The control circuit shall operate from a 120 volt 60 Hz supply. The control circuit voltage shall be 24 dc for all external control panels.

2.3.2 Main (OR MASTER) Control Panel

A main control panel shall be supplied to control barrier function. This panel shall have a key-lockable main switch with main power "ON" and panel "ON" lights. Buttons to raise and lower each [barrier] [set of barriers] shall be provided. Barrier "UP" and "DOWN" indicator lights shall be included for each [barrier] [set of barriers]. An emergency fast operate circuit (EFO) shall be operated from a push button larger than the normal controls and have a flip safety cover installed over the push button or

toggle switch. The EFO shall also be furnished with an EFO-active light and reset button. [The main control panel shall have a key lockable switch to arm or disable the remote control panel. An indicator light shall show if the remote control panel is enabled.

2.3.3 Remote (OR MAINTENANCE) Control Panel

A remote control panel, one panel for the inbound lane(s) and a separate panel for the outbound lane(s), shall have a panel "ON" light that is lit when enabled by a key lockable switch on the main control panel. Buttons to raise and lower each barrier shall be provided. Barrier "UP" and "DOWN" indicator lights shall be included for each barrier. The EFO shall be operated from a push button larger than the normal controls and have a flip safety cover installed over the push button or toggle switch. Activation of either EFO will operate all barriers. The EFO shall be interconnected with an EFO-active light. When the remote control panel EFO is pushed, operation of the barrier will not be possible from this panel until reset at the main control panel.

2.4 MISCELLANEOUS EQUIPMENT

2.4.1 Safety Equipment

2.4.1.1 Barrier Systems Sensors

The barrier system sensors shall consist of the following:

- a. Suppression Loops - Two inductive loops whose outputs shall be used to prevent barriers raising when a vehicle is within a prescribed distance of the barrier. The output of the loops shall override all barrier rise signals until one second after a vehicle clears the suppression loop.

The sensors shall be compatible with the barrier controller and shall function as part of a complete barrier control system.

2.4.1.2 Barrier Signals

Pole Top Mounted - Red / yellow (flashing) 8 inch traffic lights shall be supplied for each entrance and exit to alert motorists of the barrier position. Traffic lights are not required for manual barriers. The yellow flashing light shall indicate that the barrier is fully open. All other positions shall cause the light to show red. Brackets shall be supplied to allow the light to be mounted a minimum 4.5 feet above the roadway pavement

Mast Arm Mounted - Red 12 inch / yellow 12 inch / yellow (flashing) 8 inch traffic lights shall be supplied for each entrance and exit to alert motorists of the barrier position. Traffic lights are not required for manual barriers. The yellow flashing light shall indicate that the barrier is fully open.

2.4.2 Heater

A waterproof barrier heater with a thermostat control and NEMA 4 junction box connection point shall be provided for de-icing and snow melting. The heater shall provide barrier operation to an ambient temperature of minus 40 degrees F.

2.4.3 Signage

Signage shall conform to MUTCD .

2.5 FINISH

Surfaces shall be painted in accordance with requirements of Section 09 90 00 PAINTS AND COATINGS. The roadway plate shall have a nonskid surface painted white with reflective red 4 inch wide red reflective stripes 4 inches apart. The barrier front shall be painted white and have 4 inch wide reflective red stripes 4 inches apart. The diagonal striping should point down and outward from the center of the device.

2.6 CONCRETE

The concrete shall conform to Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.7 WELDING

Welding shall be in accordance with AWS D1.1/D1.1M.

2.8 PAVEMENT

After placement of the vehicle barrier, the pavement sections shall be replaced to match the section and depth of the surrounding pavement. Pavement shall be warped to match the elevations of existing pavement. Positive surface drainage, away from the vehicle barrier, shall be provided by pavement slope.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation in accordance with manufacturers instructions and in the presence of a representative of the manufacturer. Manufacturer's representative shall be experienced in the installation, adjustment, and operation of the equipment provided. The representative shall also be present during adjustment and testing of the equipment.

3.2 HYDRAULIC LINES

Place buried hydraulic lines in polyvinyl chloride (PVC) sleeves. Provide positive drainage from the hydraulic power unit to the barrier for drainage of condensation within the PVC sleeve.

3.3 PIT DRAINAGE

Provide a drain connection in each barrier that requires pit/vault type construction. Provide hookups between the storm drains.

3.4 ELECTRICAL

All control power wiring requiring compression terminals shall use ring-style terminals. Terminals and compression tools shall conform to UL 486A-486B. Roundhead screws and lockwashers shall be used to provide vibration-resistant connections. Connections between any printed circuit cards and the chassis shall be made with screw connections or other locking

means to prevent shock or vibration separation of the card from its chassis. The electrical power supply breaker for the hydraulic power unit shall be capable of being locked in the power on and power off positions.

3.5 MANUFACTURER'S SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment supplied. The representative shall supervise the installation, adjustment, and testing of the equipment.

3.6 FIELD TRAINING

Provide a field training course for designated operating staff members. Training shall be provided for a total period of not less than [8 hours] [1 hour] of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the [operating and maintenance instructions](#).

3.7 FIELD TESTING

Submit test reports in booklet form showing all field tests, including component adjustments and demonstration of compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate with each test report the final position of controls. Upon completion of construction, perform a field test for each vehicle barrier. The test shall include raising and lowering the barrier, both electrically and manually, through its complete range of operation. Each vehicle barrier shall then be continuously cycled for not less than 30 minutes to test for heat build-up in the hydraulic system. Notify the Contracting Officer at least 7 days prior to the beginning of the field test. Furnish all equipment and make all necessary corrections and adjustments prior to tests witnessed by the Contracting Officer. Any conditions that interfere with the proper operation of the barrier disclosed by the test shall be corrected at no additional cost to the Government. Adjustments and repairs shall be done by the Contractor under the direction of the Contracting Officer. After adjustments are made to assure correct functioning of components, applicable tests shall be completed.

-- End of Section --