

SECTION 220533 - HEAT TRACING SYSTEMS

PART 1 - GENERAL

1.01 DESCRIPTION:

- A. Provide plumbing piping heat tracing as shown on Drawings for freeze prevention, domestic hot-water-temperature maintenance, and snow and ice melting on roofs and in gutters and downspouts with the following electric heating cables as indicated and in compliance with Contract Documents.
 - 1. Plastic insulated, series resistance
 - 2. Self-regulating, parallel resistance
 - 3. Constant wattage

1.02 REFERENCES:

- A. Institute of Electrical and Electronics Engineers (IEEE):
 - 1. 515.1: Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications
- B. National Fire Protection Association (NFPA):
 - 1. 70: National Electrical Code.

1.03 SUBMITTALS:

- A. Submit the following shop drawings.
- B. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
 - 2. Schedule heating capacity, length of cable, spacing, and electrical power requirement for each electric heating cable required.
- C. Shop Drawings: For electric heating cable.
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include diagrams for power, signal, and control wiring.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.
- F. Operation and Maintenance Data: For electric heating cables to include in operation and maintenance manuals.

1.04 WARRANTY:

- A. Special Warranty: Manufacturer agrees to repair or replace electric heating cable that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 SELF-REGULATING, PARALLEL-RESISTANCE HEATING CABLES:

- A. Manufacturers:
 1. Chromalox
 2. Delta-Therm
 3. Raychem
- B. Comply with IEEE 515.1.
- C. The self-regulating heating cable shall consist of two (2) 16 AWG nickel-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature all along its length, allowing the heating cable to be cut to length in the field. The heating cable shall be covered by a radiation-crosslinking modified polyolefin dielectric jacket. To provide a ground path and to enhance the heating cable's ruggedness, the heating cable shall have a braid of tinned copper and an outer jacket of modified polyolefin.
 1. For installation on plastic piping, the heating cable shall be applied using aluminum tape.
- D. In order to conserve energy and to prevent overheating, the heating cable shall have a self-regulating factor of at least 90 percent. The self-regulating factor is defined as the percentage reduction, without thermostatic control, of the heating cable output going from 40 degrees F pipe temperature operation to 150 degrees F pipe temperature operation.
 1. The heating cable shall operate on line voltage of 277 volts without the use of transformers.
 2. Electrical Insulating Jacket: Flame-retardant polyolefin.
 3. Cable Cover: Tinned-copper braid, and polyolefin outer jacket with UV inhibitor.
 4. Maximum Operating Temperature (Power On): 150 degrees F.
 5. Maximum Exposure Temperature (Power Off): 185 degrees F.
 6. Maximum Operating Temperature: 300 degrees F.
- E. Power connection, end seal, splice and tee kit components shall be applied in the field.
- F. All heating-cable components shall be UL Listed, CSA Certified, or FM Approved for use as part of the system to provide freeze protection. Component enclosures shall be rated NEMA 4X to prevent water ingress and corrosion. Installation shall not require the installing contractor to cut into the heating-cable core to expose the bus wires. Connection systems that require the installing contractor to strip the bus wires or that use crimps or terminal blocks, shall not be acceptable. All components that make an electrical connection shall be re-enterable for servicing. An exception will be made in areas where a conduit transition is required.
- G. Capacities and Characteristics: The heating cable for metal-pipe freeze protection shall be sized according to the table below. The required cable output rating is in watts per foot at 50 degrees F assuming 1 inch thick fiberglass insulation.

Heat Output based on Min. Ambient Temp. of 0 degrees F:

Pipe Size (Inches)	Cable Output Rating
3 or less	5 watts
4	5 watts
6	8 watts
8	8 watts
10 +	8 watts x 2 runs

- H. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- I. Capacities and Characteristics:
 - 1. Maximum Heat Output: 8 W/ft
 - 2. Piping Diameter: 4 inch maximum
 - 3. Number of Parallel Cables: 2
 - 4. Spiral Wrap Pitch: 12 inches
 - 5. Electrical Characteristics for Single-Circuit Connection:
 - a. Volts: 208
 - b. Phase: Single
 - c. Hertz: 60

2.02 CONTROLS:

- A. Pipe-Mounted Thermostats for Freeze Protection:
 - 1. Building with Mechanical System Building Automation System Available:
 - a. Provide controls as required to connect and control heat trace via the building automation system (BAS). All components necessary to enable/disable and monitor the heat trace system shall be provided including any gateways or translators to speak to the BacNET MSTP BAS.
 - b. Remote, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 - c. Corrosion-resistant, waterproof control enclosure.
 - d. Heat trace shall be enabled/disabled via BAS system. TC contractor shall coordinate with the ME/EC for install and control of the heat trace and all other snow melt systems.
 - e. Basis of Design: Raychem ACS-30 with ProtoNode gateway.
 - 2. Building Without Mechanical System Building Automation System Available:
 - a. Remote bulb unit with adjustable temperature range from 30 to 50 degrees F.
 - b. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected cable.
 - c. Remote bulb on capillary, resistance temperature device, or thermistor for directly sensing pipe-wall temperature.
 - d. Corrosion-resistant, waterproof control enclosure.

2.03 ACCESSORIES:

- A. Cable Installation Accessories: Fiberglass tape, heat-conductive putty, cable ties, silicone end seals and splice kits, and installation clips all furnished by manufacturer, or as recommended in writing by manufacturer.

- B. Warning Tape: Continuously printed "Electrical Tracing"; vinyl, at least 3 mils thick, and with pressure-sensitive, permanent, waterproof, self-adhesive back.
 - 1. Width for Markers on Pipes with OD, Including Insulation, Less than 6 Inches: 3/4 inch minimum.
 - 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.01 EXAMINATION:

- A. Examine surfaces and substrates to receive electric heating cables for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Ensure surfaces and pipes in contact with electric heating cables are free of burrs and sharp protrusions.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS:

- A. Install the following types of electric heating cable for the applications described:
 - 1. Temperature Maintenance for Domestic Hot Water/Piping Systems: Self-regulating, parallel-resistance heating cable.

3.03 INSTALLATION:

- A. Install electric heating cable across expansion, construction, and control joints according to manufacturer's written instructions; use cable-protection conduit and slack cable to allow movement without damage to cable.
- B. Electric Heating-Cable Installation for Snow and Ice Melting on Roofs and in Gutters and Downspouts: Install on roof and in gutters and downspouts with clips furnished by manufacturer that are compatible with roof, gutters, and downspouts.
- C. Electric Heating-Cable Installation for Freeze Protection for Piping:
 - 1. Install electric heating cables after piping has been tested and before insulation is installed.
 - 2. Install electric heating cables according to IEEE 515.1.
 - 3. Install insulation over piping with electric cables.
 - 4. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- D. Electric Heating-Cable Installation for Temperature Maintenance for Domestic Hot Water:
 - 1. Install electric heating cables after piping has been tested and before insulation is installed.
 - 2. Install insulation over piping with electric heating cables.
 - 3. Install warning tape on piping insulation where piping is equipped with electric heating cables.
- E. Set field-adjustable switches and circuit-breaker trip ranges.

3.04 CONNECTIONS:

- A. Ground equipment according to Section 26 05 26.
- B. Connect wiring according to Section 26 05 19.

3.05 FIELD QUALITY CONTROL:

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections:
 - 1. Perform tests after cable installation but before application of coverings such as insulation, wall or ceiling construction, or concrete.
 - 2. Test cables for electrical continuity and insulation integrity before energizing.
 - 3. Test cables to verify rating and power input. Energize and measure voltage and current simultaneously.
- D. Repeat tests for continuity, insulation resistance, and input power after applying thermal insulation on pipe-mounted cables.
- E. Cables will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

3.06 PROTECTION:

- A. Protect installed heating cables, including non-heating leads, from damage during construction.
- B. Remove and replace damaged heat-tracing cables.



END OF SECTION 220533


STATION LOCATION: EAST WASHINGTON AVENUE AT INDEPENDENCE LANE WB

SCC CODE	ITEM NUMBER	DESCRIPTION	UNITS	QUANTITY
40.01	201.0120	Clearing	ID	13
40.01	201.0220	Grubbing	ID	13
40.01	204.0100	Removing Concrete Pavement	SY	780
40.01	204.0115	Removing Asphaltic Surface Butt Joints	SY	9
40.01	204.0120	Removing Asphaltic Surface Milling	SY	220
40.01	204.0150	Removing Curb & Gutter	LF	140
40.01	204.0155	Removing Concrete Sidewalk	SY	190
40.01	204.0195	Removing Concrete Bases	EACH	2
40.01	204.9090.S.01	Removing Retaining Wall and Railing	LF	160
40.01	205.0100	Excavation Common	CY	170
40.01	208.0100	Borrow	CY	79
20.01	305.0120	Base Aggregate Dense 1 1/4-Inch	TON	22
40.06	305.0120	Base Aggregate Dense 1 1/4-Inch	TON	130
40.07	305.0120	Base Aggregate Dense 1 1/4-Inch	TON	13
40.07	305.0130	Base Aggregate Dense 3-Inch	TON	37
10.02	405.0100	Coloring Concrete WisDOT Red	CY	35
40.07	405.1000	Stamping Colored Concrete	CY	2
10.02	415.0100	Concrete Pavement 10-Inch	SY	120
40.07	415.0100	Concrete Pavement 10-Inch	SY	250
10.02	415.4100	Concrete Pavement Joint Filling	SY	350
40.07	415.4100	Concrete Pavement Joint Filling	SY	320
10.02	416.0610	Drilled Tie Bars	EACH	226
10.02	416.0620	Drilled Dowel Bars	EACH	141
40.07	455.0605	Tack Coat	GAL	16
40.07	460.2000	Incentive Density HMA Pavement	DOL	20
40.07	460.5224	HMA Pavement 4 LT 58-28 S	TON	25
40.02	520.8000	Concrete Collars for Pipe	EACH	3
40.07	601.0205	Concrete Gutter 24-Inch	LF	75
40.07	601.0409	Concrete Curb & Gutter 30-Inch Type A	LF	43
40.07	601.0452	Concrete Curb & Gutter Integral 30-Inch Type D	LF	190
40.07	601.0600	Concrete Curb Pedestrian	LF	40
40.06	602.0410	Concrete Sidewalk 5-Inch	SF	1250
40.06	602.0420	Concrete Sidewalk 7-Inch	SF	2500
40.06	602.0515	Curb Ramp Detectable Warning Field Natural Patina	SF	100
40.02	608.0312	Storm Sewer Pipe Reinforced Concrete Class III 12-Inch	LF	5
40.02	611.0535	Manhole Covers Type J-Special	EACH	1
40.02	611.3230	Inlets 2x3-FT	EACH	1
40.02	611.8110	Adjusting Manhole Covers	EACH	2
40.02	611.8115	Adjusting Inlet Covers	EACH	1
40.02	611.9710	Salvaged Inlet Covers	EACH	1
40.07	620.0300	Concrete Median Sloped Nose	SF	43
10.02	624.0100	Water	MGAL	1
20.01	624.0100	Water	MGAL	0.4
40.06	624.0100	Water	MGAL	3
40.06	625.0105	Topsoil	CY	22
40.08	628.1905	Mobilizations Erosion Control	EACH	1
40.08	628.1910	Mobilizations Emergency Erosion Control	EACH	1
40.06	628.2006	Erosion Mat Urban Class I Type A	SY	400
40.06	628.6505	Soil Stabilizer Type A	ACRE	0.1
40.02	628.7015	Inlet Protection Type C	EACH	11
40.06	629.0210	Fertilizer Type B	CWT	0.3
40.06	630.0500	Seed Water	MGAL	10
40.07	650.7000	Construction Staking Concrete Pavement	LF	370
40.06	650.9000	Construction Staking Curb Ramps	EACH	5
20.01	652.0235	Conduit Rigid Nonmetallic Schedule 40 3-Inch	LF	19

STATION LOCATION: EAST WASHINGTON AVENUE AT INDEPENDENCE LANE WB CONTINUED

SCC CODE	ITEM NUMBER	DESCRIPTION	UNITS	QUANTITY
20.01	652.0615	Conduit Special 3-Inch	LF	176
40.01	690.0150	Sawing Asphalt	LF	15
40.01	690.0250	Sawing Concrete	LF	770
40.06	SPV.0060.001	Construction Staking Sidewalk	EACH	1
40.06	SPV.0060.002	Concrete Curb & Gutter Bike Ramp Special	EACH	1
20.01	SPV.0060.201	Install Electrical Pull Box Type I	EACH	1
40.01	SPV.0060.243	Removing Street Lighting Assembly	EACH	2
20.01	SPV.0060.301	Platform Electrical Cabinet	EACH	1
20.01	SPV.0060.302	Platform Communication Cabinet	EACH	1
20.01	SPV.0060.303	Snow Melt System Shelter Type A1	EACH	1
20.01	SPV.0060.316	Shelter Photovoltaic System	EACH	1
20.01	SPV.0060.401	Reinforced Concrete Platform Type A1	EACH	1
20.01	SPV.0060.417	Platform Shelter Type A1	EACH	1
40.06	SPV.0060.504.02	Trees (Autumn Blaze Freeman Maple, B&B, 2-IN)	EACH	1
40.06	SPV.0060.504.05	Trees (Kentucky Coffee Tree, B&B, 2-IN)	EACH	2
40.06	SPV.0060.504.06	Trees (Skyline Thornless Honey Locust, B&B, 2-IN)	EACH	1
40.06	SPV.0060.504.08	Trees (Swamp White Oak, B&B, 2-IN)	EACH	2
40.06	SPV.0060.504.09	Trees (Chinquapin Oak, B&B, 2-IN)	EACH	2
40.06	SPV.0060.504.11	Trees (American Sentry Linden, B&B, 2-IN)	EACH	3
40.06	SPV.0060.504.13	Trees (Princeton Elm, B&B, 2-IN)	EACH	2
40.06	SPV.0060.504.15	Trees ('Autumn Brilliance' Apple Serviceberry, B&B, 2-IN)	EACH	1
40.06	SPV.0060.507.01	Perennials & Native Grasses (Butterfly Milkweed, Potted, 1 GAL)	EACH	3
40.06	SPV.0060.507.02	Perennials & Native Grasses (Sand Coreopsis, Potted, 1 GAL)	EACH	3
40.06	SPV.0060.507.03	Perennials & Native Grasses (Purple Prairie Clover, Potted, 1 GAL)	EACH	4
40.06	SPV.0060.507.04	Perennials & Native Grasses (Purple Coneflower, Potted, 1 GAL)	EACH	3
40.06	SPV.0060.507.05	Perennials & Native Grasses (Blazing Star, Potted, 1 GAL)	EACH	7
40.06	SPV.0060.507.08	Perennials & Native Grasses (Black-eyed Susan, Potted, 1 GAL)	EACH	6
40.06	SPV.0060.507.11	Perennials & Native Grasses (Prairie Dropseed, Potted, 1 GAL)	EACH	2
40.06	SPV.0060.507.12	Perennials & Native Grasses (Canada Anemone, Potted, 1 GAL)	EACH	3
40.06	SPV.0060.507.13	Perennials & Native Grasses (Sky Blue Aster, Potted, 1 GAL)	EACH	3
40.06	SPV.0060.507.14	Perennials & Native Grasses (Prairie Smoke, Potted, 1 GAL)	EACH	6
40.06	SPV.0060.507.15	Perennials & Native Grasses (June Grass, Potted, 1 GAL)	EACH	4
40.06	SPV.0060.507.16	Perennials & Native Grasses (Jacob's Ladder, Potted, 1 GAL)	EACH	6
40.02	SPV.0060.606	Storm Sewer Tap	EACH	3
40.02	SPV.0060.611	Inlet Cover R-1878-B7G	EACH	1
40.02	SPV.0060.613	Adjust Water Valve	EACH	4
40.02	SPV.0060.621	Sewer Cleanout	EACH	1
40.07	SPV.0060.633	Adjust MMSD Special	EACH	1
40.06	SPV.0085.501	Seeding	LB	7
40.07	SPV.0090.004	Concrete Curb & Gutter Integral 24-Inch Special	LF	240
40.07	SPV.0090.006	Concrete Curb Extension 6-Inch	LF	15
40.07	SPV.0090.011	Docking Guide Strip	LF	80
20.01	SPV.0090.302	Electrical Wire Lighting 4/0 AWG	LF	856
40.07	SPV.0090.402	Railing Steel Special	LF	185
40.02	SPV.0090.602	PVC Pipe 8-inch	LF	120
40.02	SPV.0090.612	PVC Pipe 12-inch	LF	23
40.05	SPV.0165.403	Wall Modular Block Gravity Landscape (Independence)	SF	430

 REVISED 11/02/22 DJC
 REVISED 12/05/22 CTL

60631225P	60631225P	60631225P
MISCELLANEOUS QUANTITIES	CITY OF MADISON, DANE COUNTY, WI	CONTRACT NO: 60631225C
BUS RAPID TRANSIT		
CITY OF MADISON		
 60631225P MQ22-E		

C:\OneDrive\AECOM\City of Madison BRT Quantities - Cost Quantities\Madison BRT MQ Plan Sheets.pptx
 LAST PLOT DATE: 12/05/2022
 FILE NAME:

Undistributed

SCC Code	ITEM NUMBER	DESCRIPTION	UNITS	QUANTITY
40.01	204.0120	Removing Asphaltic Surface Milling	SY	270.00
40.01	205.0100	Excavation Common	CY	270.00
40.01	209.1500	Backfill Granular Grade 1	TON	538.00
40.01	211.0200	Prepare Foundation for Concrete Pavement (project)	LS	1.00
40.07	416.0270	Concrete Driveway HES 7-Inch	SY	35.00
40.07	450.4000	HMA Cold Weather Paving	TON	2451.00
40.06	455.0605	Tack Coat	GAL	37.00
40.06	460.2000	Incentive Density HMA Pavement	DOL	19.00
40.07	460.7424	HMA Pavement 4 HT 58-28 H	TON	30.00
40.08	619.1000	Mobilization	EACH	1.00
40.06	625.0100	Topsoil	SY	1180.00
40.06	628.2006	Erosion Mat Urban Class I Type A	SY	710.00
40.06	628.2008	Erosion Mat Urban Class I Type B	SY	470.00
40.06	629.0205	Fertilizer Type A	CWT	1.00
40.06	632.9101	Landscape Planting Surveillance and Care Cycles	EACH	22.00
40.08	650.9910	Construction Staking Supplemental Control (project)	LS	1.00
40.01	690.0150	Sawing Asphalt	LF	500.00
40.01	801.0117	Railroad Flagging Reimbursement	DOL	21200.00
40.03	SPV.0035.002	Excavation, Hauling, Segregation, and Disposal of Contaminated Soil	TON	70.00
40.06	SPV.0060.614	Connect Pipe Underdrain to Existing Structure	EACH	2.00
40.06	SPV.0085.501	Seeding	LB	13.00
40.06	SPV.0085.502	Stormwater Management Seeding	LB	2.10
40.07	SPV.0090.008	Cold Weather Protection of Concrete Curb & Gutter (Polyethylene)	LF	4564.00
40.08	SPV.0105.002	Field Office Special	LS	1.00
40.06	SPV.0165.003	Cold Weather Protection of Concrete Sidewalk & Drive (Polyethylene)	SF	20300.00
20.01	SPV.0180.001	Cold Weather Protection of Concrete Pavement (Polyethylene)	SY	240.00
40.07	SPV.0180.001	Cold Weather Protection of Concrete Pavement (Polyethylene)	SY	3676.00

Mark	ADDENDUM 6	12/06/22	ALM
Designed By: AECOM	ADDENDUM 3	11/17/22	ALM
60631225P	REVISION	DATE	BY
	Date:	12/02/22	Scale: NTS

60631225P
 MISCELLANEOUS QUANTITIES
 CITY OF MADISON, DANE COUNTY, WI
 BUS RAPID TRANSIT
 CITY OF MADISON
 CONTRACT NO: 60631225C



60631225P

MQ-43

TRAFFIC CONTROL

SCC Code	ITEM NUMBER	DESCRIPTION	UNITS	QUANTITY
40.08	603.8000	Concrete Barrier Temporary Precast Delivered	LF	6,600
40.08	603.8125	Concrete Barrier Temporary Precast Installed	LF	6,600
40.08	614.0905	Crash Cushions Temporary	EACH	32
40.08	643.0300	Traffic Control Drums	DAY	296,072
40.08	643.0410	Traffic Control Barricades Type II	DAY	19,593
40.08	643.0420	Traffic Control Barricades Type III	DAY	41,363
40.08	643.0705	Traffic Control Warning Lights Type A	DAY	102,319
40.08	643.0715	Traffic Control Warning Lights Type C	DAY	156,744
40.08	643.0800	Traffic Control Arrow Boards	DAY	8,708
40.08	643.0900	Traffic Control Signs	DAY	97,965
40.08	643.1050	Traffic Control Signs PCMS	DAY	4,354
40.08	643.5000	Traffic Control	EACH	1
40.08	644.1410	Temporary Pedestrian Surface Asphalt	SF	4,464
40.08	644.1420	Temporary Pedestrian Surface Plywood	SF	4,464
40.08	644.1430	Temporary Pedestrian Surface Plate	SF	4,464
40.08	644.1601	Temporary Pedestrian Curb Ramp	DAY	1,470
40.08	644.1810	Temporary Pedestrian Barricade	LF	9,300
40.08	649.0105	Temporary Marking Line Paint 4-Inch	LF	338,245
40.08	649.0505	Temporary Marking Arrow Paint	EACH	372
40.08	649.0605	Temporary Marking Word Paint	EACH	636
40.08	649.0805	Temporary Marking Stop Line Paint 18-Inch	LF	2,899

REVISED 12/05/22 KJC

REVISED 12/05/22 KJC

1	ADDENDUM 6	KJC	12/05/22	KJC
Mark	REVISION	DATE	BY	Scale: NTS
Designed By: TSI	Date: 12/01/2022			
60631225P				

60631225P
 MISCELLANEOUS QUANTITIES
 BUS RAPID TRANSIT
 CITY OF MADISON
 CITY OF MADISON, DANE COUNTY, WI
 CONTRACT NO: 60631225C



60631225P
 MQ-TC