**SECTION 000001 – ADDENDUM NUMBER 1**

**DATE:** **December 19, 2014**

**TO:** **ALL BIDDERS**

**FROM:** **CLARK C. BURRITT, PRINCIPAL ARCHITECT**
**CITY OF WORCESTER**
**DEPARTMENT OF PUBLIC WORKS AND PARKS**
**50 SKYLINE DRIVE**
**WORCESTER, MA 01605**

**RE:** **REGIONAL EMERGENCY COMMUNICATIONS CENTER**
**2 COPPAGE DRIVE, WORCESTER, MA 01603**

**THIS ADDENDUM FORMS A PART OF THE CONTRACT AND MODIFIES THE ORIGINAL DOCUMENTS DATED DECEMBER 11, 2014.**

## PART 1 - GENERAL

**1.1** This addendum must be returned with plans and specifications (if not already returned) to have your deposit returned.

**1.2** This addendum modifies, amends, and supplements the Contract Documents for the above referenced project. This addendum is hereby made a part of the Contract Documents by reference and shall be as binding as though inserted in locations designated hereunder.

**1.3** Each general bidder shall be responsible for notifying all his non-filed sub-bidders and suppliers of the content of this addendum. No claim for additional compensation will be considered because of lack of knowledge of changes or modifications contained in this addenda.

**1.4** Questions or requests for clarification shall be in writing, addressed to Jeremy C. Flansburg at **DEPARTMENT OF PUBLIC WORKS AND PARKS**, **ARCHITECTURAL DIVISION,** and may be sent to fax number: (508) 799–8188. Please include your name, phone number, and fax number with your fax.

**1.5** Requests for additional walk-thru inspections or time to investigate the existing conditions of the building can be arranged on an individual basis. Please call the Department of Public Works and Parks at (508) 799 – 8588 to confirm.

**1.6** Part 2 of this addendum indicates revisions to the Project Manual.

**1.7** Part 3 of this addendum indicates revisions to the Drawings.

**1.8** Part 4 of this addendum indicates clarification to Contractors Questions.

## PART 2 - SPECIFICATION

**2.1** **SPECIFICATION SECTION 001000 - INVITATION TO BID/NOTICE TO CONTRACTORS,** DELETE Specification Section 001000 and insert new Specification Section 001000

**2.2** **SPECIFICATION SECTION 006000 -** DELETE BOTH 006000 Specification Sections and INSERT new Specification Section 006000.

**2.3** **SPECIFICATION SECTION 010100 – SUMMARY OF WORK,** DELETE Specification Section 010100 Summary of Work and INSERT new Specification Section 010100 Summary of Work

**2.4** **SPECIFICATION SECTION 033000– CAST-IN-PLACE CONCRETE,** ADD new Section 033000 – CAST-IN-PLACE, attached.

**2.5** **SPECIFICATION SECTION 033543 – POLISHED CONCRETE FINISHING,** ADD new Section 033543 – POLISHED CONCRETE FINISHING, attached.

**2.6** **SPECIFICATION SECTION 055000– METAL FABRICATIONS,** ADD new Section 055000 – METAL FABRICATIONS, attached.

**2.7** **SPECIFICATION SECTION 061053– MISCELLANEOUS CARPENTRY,** ADD new Section 061053– MISCELLANEOUS CARPENTRY, attached.

**2.8** **SPECIFICATION SECTION 088300 – MIRRORS**, ADD new Section 088300 – MIRRORS, attached. This section shall be included with section 088000 filed sub bid.

**2.9** **SPECIFICATION SECTION 096900 – ACCESS FLOORING,** ADD new Section 096900 – ACCESS FLOORING, attached.

**2.10** **SPECIFICATION SECTION 122413 –ROLLER WINDOW SHADES,** ADD new Section 122413 –ROLLER WINDOW SHADES, attached.

**2.11** **SPECIFICATION SECTION 124813 –ENTRANCE FLOOR MATS AND FRAMES,** ADD new Section 124813 –ENTRANCE FLOOR MATS AND FRAMES, attached.

**2.12** **SPECIFICATION SECTION 210000 – FIRE PROTECTION, DELETE** Paragraph 2.7.A.3; NOVEC 1230 & **DELETE** Paragraph 2.7.B; in its entirety.

**2.13** **SPECIFICATION SECTION 260000 – ELECTRICAL**, **ADD** Specification sections 2.37 and 3.28.

### 2.37 UPS SYSTEM CHARACTERISTICS

A. System Capacity: The system shall be rated in the following sizes:

1. 20kVA /16kW

B. Input:

1. AC Input Nominal Voltage: 208V, 3 Phase, 4 wire plus ground, 60 Hz.

2. AC Input Voltage Window: +/-15% of nominal (while providing nominal charging to the battery system).

3. Short Circuit Withstand Rating: 30,000 Symmetrical Amperes

4. Maximum Frequency Range: 40-70Hz

5. Input Power Factor:

   a. .98 for loads greater than 50%

6. Input Current Distortion with no additional filters:

   a. < 5% at 100% load

7. Soft-Start: Shall be linear from 0-100% input current and shall not exhibit inrush. This shall take place over a 15 second time period when transferring from battery operation to mains operation

C. UPS Output:

1. AC Output Nominal Output: 208V, 3 Phase, 4 wire plus ground, 60 Hz.

2. AC Output Voltage Regulation: +/- 1% For 100 % Linear or Nonlinear Load, +/- 5% maximum for 100% linear load step

3. Voltage Transient Recovery within <50 milliseconds

4. Output Voltage Harmonic Distortion:

   a. <2% THD maximum for a 100% linear load

   b. <5% THD maximum for a 100% non-linear load

5. Phase Angle Displacement:

   a. 120 degrees +/- 1 degree for balanced load

   b. 120 degrees +/- 1 degrees for 50% imbalanced load

   c. 120 degrees +/- 3 degrees for 100% imbalanced load

6. Overload Rating:

   a. Normal Operation:

      1) 150% for 30 seconds

2) 100% continuous

b. Bypass Operation:

1) 110% continuous

7. System AC-AC Efficiency: >98% for loads higher than 50% of rated system capacity

8. Output Power Factor Rating: .5 leading to .5 lagging.

D. UPS Modes of Operation

1. Normal: The input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

2. Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.

3. Static Bypass: The static bypass shall be used to provide transfer of critical load from the Inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function. The UPS will be capable of charging the batteries while in static bypass.

4. Internal Mechanical Bypass: As a standard feature, the UPS shall be equipped with an internal, make before break, bypass switch. This switch shall mechanically bypass the UPS for times where maintenance is required.

E. Environmental

1. Storage Ambient Temperature: -58°F to 122°F (-50°C to 50°C).

2. Operating Ambient Temperature: +32°F to 104°F (0°C to 40°C). (77°F is ideal for most battery types).

3. Relative Humidity: 0 to 95% Non-condensing

4. Altitude: Maximum installation with no derating of the UPS output shall be 3280 feet (1000m) above sea level. At higher altitudes the following derating shall apply:

a. 1500 m derating factor of .95

b. 2000 m derating factor of .91

c. 2500 m derating factor of .86

F. Audible Noise: The UPS shall not produce audible noise at a distance of 1m (39”) in excess of the following:

1. 20-30kVA 67dBA

G. Input Power Converter

1. The input power converters of the system shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and Main Inverter regulated output power..

2. Input Current Total Harmonic Distortion: The input current THDI shall be held to 5% or less at full system, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.

3. Soft-Start Operation: As a standard feature, the UPS shall contain soft-start functionality, capable of limiting the input current from 0-100% of the nominal input over a default 15 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation. (di/dt= constant)

4. Magnetization Inrush Current: The UPS shall exhibit 0 inrush current as a standard product. If provided with an optional isolation transformer, inrush shall be limited to 6 times the nominal input current of the transformer.

5. Input Current Limit:

6. The system input current limit, shall be designed to provide 100% load will fully charging the batteries at 10% of the system rating. The system shall be capable of this with up to a +/-15% variation of the nominal input voltage.

H. Charging:

1. The battery charging shall keep the DC bus float voltage of +/- 220v, +/-1%

2. The battery charging circuit shall contain a temperature compensation circuit, which will regulate the battery charging to optimize battery life.

3. The battery charging circuit shall remain active when in Static Bypass and in Normal Operation.

4. Battery Charge Current Limit: The UPS shall be capable of limiting the energy sourced from the mains for purposes of battery charging. As a default setting, the battery charge energy will be set to 100% of its nominal value. When signaled by a dry contact, (such as from an emergency generator) the UPS shall be capable of

limiting the battery charge energy taken from the mains. This shall take place in user selectable increments of 75%, 50%, 25%, 10% and 0% of the nominal charge power. The selection shall be made from the UPS front panel display/control unit.

5. Back-feed Protection: The logic controlled input contactor shall provide the back-feed protection required by UL1778.

I. Output Inverter

1. The UPS output inverter shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT driven power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output inverters.

2. Overload Capability: Steady-state overload conditions of up to 150% of system capacity shall be sustained by the inverter for 30 seconds in normal and battery operation. Overloads of 125% shall be sustainable by the inverter for up to 60 seconds. Should overloads persist past the time limitation, the critical load will be switched to the automatic static bypass output of the UPS.

3. Output Contactor: The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall be removed from the critical bus.

4. Battery Protection: The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.

J. Static Bypass

1. As part of the UPS, a system static bypass switch shall be provided. The system static bypass shall provide no break transfer of the critical load from the Inverter output to the static bypass input source during times where maintenance is required or the inverter can not support the critical bus. Such times may be due to prolonged or severe overloads or UPS failure.

2. The design of the static switch power path shall consist of Silicon Controlled Rectifiers (SCR) with a continuous duty rating of 110% of the UPS output rating.

3. Automatic Transfers: An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation shall take place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.

4. Manual Transfers: Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.

5. Overloads: The static bypass shall be rated and capable of handling overloads equal to or less than 110% of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices or short circuit conditions, the static bypass shall be capable of sustaining overloads of 800% of system capacity for periods of up to 500 milliseconds.

6. System Protection:

   a. As a requirement of UL1778, back-feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back-feed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where back-feeding of the static switch by any source connected to the critical output bus of the system is occurring. One such condition could be a result of a shorted SCR.

7. Dual Feed

   a. For purposes of increased reliability, the static bypass shall be capable of being fed from a separate feed from the input power converter.

K. Display and Controls

1. Display Unit: A microprocessor controlled display unit shall be located on the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.

2. Metered Data: The following metered data, shall be available on the alphanumeric display:

   a. Year, Month, Day, Hour, Minute, Second of occurring events

   b. Source Input Voltage

   c. Output AC voltage

   d. Output AC current

   e. Input Frequency

   f. Battery voltage

   g. Highest Internal Battery temperature

3. Event log: The display unit shall allow the user to display a time and date stamped log of the 64 most recent status and alarm events.

4. Alarms: The display unit shall allow the user to display a log of all active alarms. The following minimum set of alarm conditions shall be available:

   a. Static bypass switch on

   b. EPO Active

   c. Mechanical bypass activated

   d. External bypass switch (Q3) activated

   e. Battery discharged

   f. Return from low battery

   g. Low battery

   h. Load not powered from UPS

   i. UPS in bypass

   j. Runtime calibration aborted

   k. Runtime calibration started

   l. Runtime calibration complete

   m. Battery self test aborted

   n. Battery self test started

   o. Battery self test completed

   p. Number of battery modules decreased

   q. Number of battery modules increased

   r. Fan fault

   s. SBS fault

   t. System not in sync.

   u. Bypass not available, frequency/voltage out of range

   v. Mains voltage/frequency out of range

   w. Site wiring fault

   x. Low battery voltage shut down

   y. XR battery breaker or fuse open

z. Defective battery detected

aa. Runtime is below alarm threshold

bb. Load is above alarm threshold

cc. Battery over-voltage warning

dd. Battery over-temperature warning

ee. Emergency power supply fault

ff. Output overloaded

5. Controls: The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton membrane switches shall facilitate these operations.

a. Silence audible Alarm

b. Set the alphanumeric display language

c. Display or set the date and time

d. Enable or disable the automatic restart feature

e. Transfer critical load to and from static bypass

f. Test battery condition on demand

g. Set intervals for automatic battery tests

h. Adjust set points for different alarms

i. Program the parameters for remote shutdown.

6. Front Panel Interface: The following shall make up the UPS front panel user interface.

a. Indicating LED's

| | | |
|---|---|---|
| 1) | Load On | When Green, this LED indicates the load is being supported by the UPS output |
| 2) | On Battery | When Yellow, this LED indicates the UPS is running from Battery power |
| 3) | Bypass | When Yellow, this LED indicates the load is being supported by static bypass/mechanical bypass |

4) Fault — When Red, this LED indicates there is a fault condition present in the UPS.

b. Push Button User Controls

1) Up Arrow

2) Down Arrow

3) Help Key

4) Escape Key

5) Enter Key

7. Potential Free (Dry) Contacts

a. The following potential free contacts shall be available on an optional relay interface board (AP9610 or equivalent). (Note: This may require the use of an external chassis if used in conjunction with web based management or other "smart slot" type devices):

1) Normal Operation

2) Battery Operation

3) Bypass Operation

4) Common Fault

5) Low Battery

6) UPS Off

8. Communication Interface: For purposes of remote communications with the UPS the following shall be available and contained within the UPS on a removable, "hot swappable" "smart slot" interface card:

a. RJ-45 Interface port for remote communications with a network via web browser or SNMP, or APC InfraStruXure Manager.

b. Environmental monitoring feature, capable of locally monitoring temperature and humidity as well as one additional generic set of user determined dry contacts capable of taking an input signal from any APC or third party on/off signal, such as water detection, smoke detection, motion, or fire detection.

L. Battery

1. The UPS battery shall be of modular construction made up of user replaceable, hot swappable, fused, battery modules. Each battery module shall be monitored

for voltage and temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

2. The battery jars housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type.

**3.28 UPS SYSTEM**

M. FACTORY ASSISTED START-UP

1. If a factory assisted UPS start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

   a. Visual Inspection:

   b. Inspect equipment for signs of damage.

   c. Verify installation per manufacturer s instructions.

   d. Inspect cabinets for foreign objects.

   e. Inspect Battery Units.

   f. Inspect Power Modules.

2. Mechanical Inspection:

   a. Check all UPS and external maintenance bypass cabinet internal control wiring connections.

   b. Check all UPS and external maintenance bypass cabinet internal power wiring connections.

   c. Check all UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.

3. Electrical Inspection:

   a. Verify correct input and bypass voltage.

   b. Verify correct phase rotation of all mains connections.

   c. Verify correct UPS control wiring and terminations.

   d. Verify voltage of all battery modules.

   e. Verify neutral and ground conductors are properly landed.

   f. Inspect external maintenance bypass switch for proper terminations and phasing.

4. Site Testing:

   a. Ensure proper system start-up.

   b. Verify proper firmware control functions.

   c. Verify proper firmware bypass operation.

   d. Verify proper maintenance bypass switch operation.

   e. Verify system set points.

   f. Verify proper inverter operation and regulation circuits.

   g. Simulate utility power failure.

   h. Verify proper charger operation.

   i. Document, sign, and date all test results.

5. On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

N. MANUFACTURER FIELD SERVICE

1. Worldwide service: The UPS manufacturer shall have a worldwide service organization available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.

2. Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, and 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

O. MAINTENANCE CONTRACTS

1. A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available. All contract work shall be performed by APC factory trained service personnel.

P. TRAINING

1. UPS service training workshop: A UPS service training workshop shall be available from the UPS manufacturer. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about

safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.

**2.14 SPECIFICATION SECTION 310000 – EARTHWORK,** ADD new Section 310000 – EARTHWORK, attached.

**2.15 SPECIFICATION SECTION 316217 – STEEL HELICAL PILES,** ADD new Section 316217 – STEEL HELICAL PILES, attached.

## PART 3 - DRAWINGS

### 3.1 SKETCHES

A. The following sketches (attached) revise or supplement currently issued drawings:

1. SKA-01 Interior Window Details
2. SKA-02 Window Spacing & Soffit at Briefing Room
3. SKA-03 Full Height Mirror @ Mens and Womens
4. SKP-01 Plumbing Schedules
5. SKE-01 Electrical Power Revisions-Ejector Pumps
6. SKE-02 Electrical Power Revisions-Ejector Pumps
7. SKE-03 Electrical Power Revisions-Ejector Pumps

### 3.2 DRAWING A1.2 – FIRST FLOOR PLAN-ENLARGED

A. DELETE window type "II" located on strike side of door 16A into Communications Room 16.

### 3.3 DRAWING A8.1 – SCHEDULES & DETAILS

A. All interior window head heights are to be at 8'-0" A.F.F

B. Interior hollow metal window frames are to be replaced with the details found on the attached SKA-01 Interior Window Details.

## PART 4 - CONTRACTOR QUESTIONS

**4.1** QUESTION: Is Section 071416 is responsible for installing the rigid insulation over the newly installed waterproofing at the exterior foundation walls?
ANSWER: ***YES***

**4.2** QUESTION: Is Section 071416 is responsible for installing the Parging Finish System at the exposed grade foundation walls per detail 16 on drawing A5.1.
ANSWER: ***YES***

**4.3** QUESTION: Who furnishes the pad mounted transformer. On E0.2, the riser says it is a utility (National Grid) company pad mounted transformer but note 1 says that the EC furnishes it. If we do furnish it, we will need specs on the unit.
ANSWER: ***Pad Mounted transformer is provided and installed by National Grid.***

**4.4** QUESTION: On E0.2, there are six UPS units shown. Who furnishes the UPS units? They aren't mentioned at all in the specs and we will need them if we do provide them.

ANSWER: ***UPS's are furnished and installed by electrical contractor. Specification sections 2.37 and 3.28 have been added:***

**4.5** QUESTION: On E0.2, they call for the emergency generator enclosed circuit breaker to be NEMA3R. As the circuit breaker is going to be located within the building, can it be NEMA1 instead?

ANSWER: ***Yes, the breaker enclosure will be NEMA 1.***

**4.6** QUESTION: On E0.2, they show the building ground loop as being #2 bare copper wire, but in the specs, it calls for this to be a # 4/0 bare copper wire. Which should be used?

ANSWER: ***Ground Loop shall be #2. Specification shall be revised to reflect this.***

**4.7** QUESTION: On E3.5, they show the security system. In the front of the specs, it calls for us to provide the system. Could you please issue specs for it?
ANSWER: ***Security System devices/panels are furnished and installed by Siemens and purchased by the owner. Contractor is responsible for furnishing and installing the cable as indicated on the riser diagram and any necessary conduit for a complete installation. No specification necessary.***

**4.8** QUESTION: In the specs on 260000-7 item 1.5.A, it calls for the EC to furnish water flow switches and the excess pressure pump kit to be installed by division 210000. As these are inline piped fittings, the fire protection contractor always furnishes and installs them and we then will wire them into the fire alarm system. The fire protection specs call for them to also furnish and install them. Which should it be?
ANSWER: ***Flow Switches are furnished and installed by FP Contractor and wired by Electrical Contractor.***

**4.9** QUESTION: On 260000-5 line 30, they call for short circuit protection and coordination study to be provided. Could you please issue specs for it?

ANSWER: ***Short Circuit protection and Coordination Study is not required for this project outside of typical coordination by manufacturer.***

**4.10** QUESTION: Drawing A8.1 lists a variety of terms for ceiling substrates that are NOT GWB, i.e., "metal liner panel", "exposed roof lining" "exposed to structure," and "exposed to structural roof decking above." It is unclear whether one type or all types of this lining/decking is to be painted. Please clarify what open/non-GWB ceilings are scheduled for field painting.
ANSWER: See 133419 METAL BUILDING SYSTEMS these items are prefinished or are not to be painted

**4.11** Drawing A1.2 Room # 06 calls out for Window type ID, however elevation 5 on Drawing A6.2 calls for these windows to be IC, which one is correct?
ANSWER: ***ID is correct***

**4.12** QUESTION: Specification Section 133419-7 2.1.A lists acceptable manufactures, Could a "or Equal" clause be inserted?

ANSWER: ***Yes, or Equal is acceptable***

**4.13** QUESTION: In the contents it list the following sections, however they are not included in the actual specifications, 024119 Selective Demolition
ANSWER: 0***24119 Selective Demolition will be issued in addendum 2***

**4.14** QUESTION: Specification section 001000 asks to provide "evidence" of compliance with the REO. What type of evidence is the owner looking for? Aside from the Initial Statement and Certification of Compliance form, is there further material expected to be submitted?
ANSWER: ***Form REO 101 page 2 (Specification section 009500 page 4) and form EOO 101(specification section 009500 page 10).***

**4.15** QUESTION: Will you be issuing any Structural drawings for the above?
ANSWER: ***No, structural drawings shalled be submitted by the metal building subcontractor.***

**END OF ADDENDUM NUMBER 1**

CITY OF WORCESTER
INVITATION TO BID / NOTICE TO CONTRACTORS
**REGIONAL EMERGENCY COMMUNICATIONS CENTER**
**2 COPPAGE DRIVE**
Worcester, Massachusetts 01603

The City of Worcester, the Awarding Authority, invites sealed bids for: **REGIONAL EMERGENCY COMMUNICATIONS CENTER, 2 Coppage Drive, Worcester, Massachusetts 01603** in accordance with documents prepared by Clark C. Burritt, Principal Architect, Department of Public Works & Parks, Architectural Services Division, 50 Skyline Drive, Worcester, MA 01605.

The project scope generally includes construction of steel building and interior buildout consisting of plumbing, HVAC, fire protection and electrical and any other related work necessary to complete all of the Work of the respective Sections and indicated on the drawings.

**SEALED GENERAL BIDS** for **REGIONAL EMERGENCY COMMUNICATIONS CENTER** will be received at the Department of Public Works and Parks, Architectural Services Division, 50 Skyline Drive, Worcester, MA 01605 no later than 11:00 a.m., Tuesday, January 13, 2015 and will be publicly opened thereafter and read aloud.

**General Bids must be** accompanied by:

(1) A fully executed FORM FOR THE GENERAL BID;
**Specification Section 004000**.

(2) Certification of Payment of Massachusetts State Taxes Form;
**Specification Section 008500.**

(3) **Affidavit of Acknowledgment and Certificate of Compliance** for the City of Worcester Minority/Women Business Enterprise & Worker Utilization. **M/WBEP-Form EOO-101;**
**Specification Section 009500.**

(4) **Initial Statement and Certification of Compliance** with the Responsible Employer Ordinance**, Form REO-101 page 2.**
**Specification Section 009500**.

(5) **Provide Evidence** of Compliance with the Responsible Employer Ordinance **(REO)**. As per Specification Section 009500.

(6) **A Certificate of Eligibility** certifying the bidder's qualification in the category of ***GENERAL BUILDING CONSTRUCTION*** issued by the Division of Capital Asset Management, DCAM (formerly the Division of Capital Planning and Operations, DCPO), showing that the Bidder has been approved to bid on projects the size and nature of this project. In order to be eligible to be awarded this contract, a general bidder must be certified in the appropriate category and for the total Project Cost including all alternates elected (if applicable) to be taken by the Owner.

(7) **A Contractor Update Statement**, DCPO FORM CQ3. It is the Bidder's responsibility to obtain the necessary forms and make application to DCAM (DCPO) in sufficient time for DCAM (DCPO) to evaluate the application and issue a Certificate of Eligibility. A sample of the

**Contractor Update Statement**, DCAM FORM CQ3 (revised December, 1999) is located at the end of Section 001500.

(8) Bid deposit for the general bid in the amount of **five (5) percent** of the value of the bid, or a bid bond.

(9) **Foreign Corporation Certificate of Registration** from the Commonwealth of Massachusetts State Secretary (if applicable).

**SEALED FILED SUB-BIDS** for **REGIONAL EMERGENCY COMMUNICATIONS CENTER** will be received at the Department of Public Works and Parks, Architectural Services Division, 50 Skyline Drive, Worcester, MA 01605 no later than 11:00 a.m., Tuesday, December 30, 2014 and will be publicly opened thereafter and read aloud.

Filed Sub-Bids required are as follows:

(1) Section 055000 METAL FABRICATIONS
(2) Section 071113 WATERPROOFING, DAMPROOFING & CAULKING
(3) Section 088000 GLASS AND GLAZING
(4) Section 095113 ACOUSTICAL CEILING TILES
(5) Section 099123 INTERIOR PAINTING
(6) Section 210000 FIRE PROTECTION
(7) Section 220000 PLUMBING
(8) Section 230000 HVAC
(9) Section 260000 ELECTRICAL

**SUB-BIDS must be** accompanied by:

(1) A fully executed FORM FOR SUB-BID;
**Specification Section 005000**.

(2) Certification of Payment of Massachusetts State Taxes Form;
**Specification Section 00850**.

(3) **Affidavit of Acknowledgment and Certificate of Compliance** for the City of Worcester Minority/Women Business Enterprise & Worker Utilization. **M/WBEP-Form EOO-101;**
**Specification Section 009500.**

(4) **Initial Statement and Certification of Compliance** with the Responsible Employer Ordinance**, Form REO-101 page 2**, **Specification Section 009500**.

(5) **Provide Evidence** of Compliance with the Responsible Employer Ordinance **(REO)**. **As per Specification Section 009500.**

(6) **A Certificate of Eligibility** certifying the bidders qualification, in the respective filed sub trade category being bid, issued by the Division of Capital Asset Management, DCAM (formerly the Division of Capital Planning and Operations, DCPO), showing that the Bidder has been approved to bid on projects the size and nature of this project. In order to be eligible to be awarded this contract, a bidder must be certified in the appropriate category and for the total Cost of the respective work including all alternates elected (if applicable) to be taken by the Owner.

(7) **A Contractor Update Statement**, DCPO FORM CQ3. It is the Bidder's responsibility to obtain the necessary forms and make application to DCAM (DCPO) in sufficient time for DCAM (DCPO) to evaluate the application and issue a Certificate of Eligibility. A sample of the **Contractor Update Statement**, DCAM FORM CQ3 (revised December, 1999) is located at the end of Section 00150.

(8) Bid deposit for the sub-bid in the amount of **five (5) percent** of the value of the bid, or a bid bond.

(9) **Foreign Corporation Certificate of Registration** from the Commonwealth of Massachusetts State Secretary (if applicable).

**Plans and Specifications** will be available Thursday, December 11, 2014at the Department of Public Works and Parks, Architectural Services, 50 Skyline Drive, Worcester, MA 01605, Phone: (508) 799-8588, Fax: (508) 799-8188. Plans and specifications are also available at http://bids.worcesterma.gov/.

(1) A **refundable** plan **deposit** in the form of a company check (cash not accepted), without date restrictions, payable to "City of Worcester" in the amount of $50.00 per set for up to three (3) sets is required. If additional sets are required, a separate non-refundable check in the amount of $50.00 per set is required. Deposits for up to three (3) sets shall be returned to the bidders who return the complete sets, including any addenda issued, in good condition to the Department of Public Works and Parks, Architectural Services, 50 Skyline Drive, Worcester, MA 01605 within thirty (30) days after the bid opening.

(2) If **plans** and **specifications** are requested to be mailed, a separate non-refundable shipping and handling/mailing fee in the form of a company check payable to "City of Worcester" in the amount of $50.00 is required per set.

(3) A "Contractor's Plans and Specifications Request Form" is required to be filled out to obtain **plans** and **specifications** via the Architectural Services Division. Forms are available at the Department of Public Works and Parks, Architectural Services, 50 Skyline Drive, Worcester, MA 01605, Phone: (508) 799-8588, Fax: (508) 799-8188.

(a) After receipt of Contractor's Plans and Specifications Request Form, deposit and mailing fee, plans and specifications will be shipped via UPS.

(4) PARTIAL SETS **WILL NOT** BE ISSUED OR MAILED.

Contract Documents may be viewed, but not removed, at the following locations:

Architectural Services
Department of Public Works and Parks
50 Skyline Drive
Worcester, MA 01605

**WAGE RATES** - Bids are subject to the provisions of M.G.L., Chapter 149, Section 44A to J inclusive, as amended to date, and such other Federal, State and Municipal laws or regulations.

Attention of bidders is particularly called to the requirements as to conditions of employment to be observed and to the fact that not less than the minimum wage rates set forth in the Contract Documents shall be paid on this project. Minimum wage rates are per M.G.L., Chapter 149, Sections 26 & 27 inclusive.

**MINORITY/WOMEN BUSINESS ENTERPRISE PROGRAM** - The City of Worcester has established goals for the participation of minorities and women workers, contractors, subcontractors, and suppliers on all City projects. Bids must demonstrate the contractor's ability to utilize minorities and

women in all phases of this project. The City of Worcester has established a program to enhance contract opportunities to minority and women-owned businesses through its Minority/Women Business Enterprise Program. This program contains minimum participation goals of ten (10) percent by MBE's and five (5) percent by WBE's calculated as a percentage of the total bid price. Accordingly, all general bidders and filed sub-bidders must execute and submit with their respective bids M/WBEP **Form EOO-101**, Contractor's and Filed Subcontractor's Certification.

**RESPONSIBLE EMPLOYER ORDINANCE** - The performance of the work derived from this bid is subject to the City's Responsible Employer Ordinance, Chapter 2, Section 35 of WRO (2008). Accordingly, all general bidders and filed sub-bidders must execute and submit with their respective bids **Form REO-101 page 2**, Contractor's and Filed Subcontractor's Initial Certification.

NOISE ORDINANCE **– All Contractors must adhere to the provision of § 1A(e)(9) of chapter nine of the Revised Ordinances of the city by limiting their on-site, noise producing construction and related work to the hours specified by said ordinance.**

**PRE-BID CONFERENCE** - The pre-bid conference will be held on Monday, December 22, 2014 at the project site, 2 Coppage Drive, Worcester, 01603 beginning at 10:00 a.m. with a brief overview and tour of the construction areas. It is recommended that all Bidders attend this meeting.

**WORK UNDER SEPARATE CONTRACTS AND BY OWNER** – The Owner may do other work during construction with its own forces or by separate contract.

**COMMENCEMENT OF WORK AND TIME OF COMPLETION** – The selected General Bidder must agree to commence work within five (5) days of the execution of a General Contract and to substantially complete on October 13, 2015 in accordance with the project schedule set forth in the contract documents.

The Awarding Authority reserves the right to waive any informality in, or to reject any or all general bids, if it were in the public interest to do so. In inviting sub-bids in connection with such a contract, the Awarding Authority shall reserve the right to reject any sub-bid on any sub-trade, if it determines that such sub-bid does not represent the sub-bid of a person competent to perform the work as specified, or that less than three (3) such sub-bids were received and that the prices are not reasonable for acceptance without further competition.

The City of Worcester is an equal opportunity/affirmative action employer.

City of Worcester, Massachusetts
Executive Office of the City Manager

**END OF DOCUMENT**

c. 149 Projects

# OWNER-CONTRACTOR AGREEMENT

THIS AGREEMENT made on _____ 20___, at Worcester, in the County of Worcester, Commonwealth of Massachusetts by and between_____, (hereinafter called the Contractor) and the City of Worcester, a municipal corporation within said County of Worcester (hereinafter called the City).

W I T N E S S E T H:

That the Contractor, in consideration of the payments hereinafter mentioned and of the fulfillment of the agreements herein mutually entered into, agrees with the City as follows:

SCOPE OF WORK:

(1) The Contractor shall, pursuant to the terms of this Agreement, provide all the supplies, materials and equipment, and perform all the labor, services and supervision necessary and proper to undertake and complete the _____, including Alternate(s)#_____ at _____ (hereinafter called the "Project") in the City of Worcester, Massachusetts, and to accomplish any and all work incidental thereto.

BONDS:

(2) The Contractor shall obtain and deposit with the City the following bond(s) in the amount of:

PERFORMANCE BOND: _____ Dollars and no cents

($_____.00)

PAYMENT BOND: _____ Dollars and no cents

($_____.00)

with sureties satisfactory to the Contracting Officer to (a) guarantee the faithful performance by the Contractor of all its obligations under this Agreement and (b) constitute the security required by Massachusetts General Laws Chapter l49, Section 29, and Chapter 30, Section 39A, as amended, for the payment by the Contractor and its subcontractors for all labor performed or furnished and for all materials used or employed in connection with this Agreement.

CONTRACTING OFFICER:

(3) (a) Wherever used in this Agreement the term "Contracting Officer" shall mean the City official so designated below, or the individual duly appointed by him/her for the performance of any of his/her functions or responsibilities under this Agreement. The work under this Agreement shall be carried out under the direction and subject to the approval and acceptance of Paul J. Moosey, P.E., Commissioner, City of Worcester, Department of Public Works & Parks (hereinafter called the Contracting Officer).

(b) Anything to the contrary in the preceding paragraph notwithstanding, the City's contract compliance officer is and shall be a designee of the Contracting Officer for all notices, demands, sanctions and other communications relative to such officer's administration, monitoring and enforcement of the City's Minority/Women Enterprise Program and the Responsible Employer Ordinance. Each and every communication from the contract compliance officer directly to the Contractor shall be validly delivered notwithstanding any other contrary provision of this Agreement or other Contract Documents.

INCORPORATED DOCUMENTS:

(4) The performance of this Agreement is subject to the provisions of the following documents, all of which are attached hereto and intended to be an integral part of this Agreement (hereinafter periodically and collectively referred to as "the Contract Documents").

(a) Information to Bidders
(b) Bid Proposal, dated _____, 20___.
(c) Specifications and Related Drawings

The Contract Documents are to be read collectively and complementary to one another; any requirement under one shall be as binding as if required by all. In the event of any conflict or inconsistency between the provisions of this Agreement and any of the other Contract Documents, the provisions of this Agreement shall prevail. In the event of any conflict or inconsistency between this Agreement, the other Contract Documents and any applicable state law, the applicable statutory provisions shall prevail. The Contract Documents set forth the entire legal relationship and requirements of the parties, as well as the technical requirements of the Project, and as such constitute the Contract, as hereinafter referred to.

TIME FOR PERFORMANCE:

(5) Time is of the essence for this Agreement. The Work of this Agreement shall be substantially completed no later than October 13, 2015. Final completion of the Work of this Agreement shall be no later than 30 days after the date of substantial completion. If any Alternates are selected an additional 60 days will be added to the date of substantial completion.

PRICE:

(6) The City will pay the Contractor for all materials delivered or furnished and for all the work performed pursuant to Article (1) hereof a sum of money as follows:

_____Dollars and no cents ($_____.00)

PAYMENT:

(7) Payment to the Contractor shall be made by the City in accordance with General Laws Chapter 30, Section 39K, as amended, which is included in the Supplementary General Conditions to the Contract.

(a) The payment shall be in full for furnishing all materials, supplies, labor, services, supervision, tools and equipment and the use thereof as embraced under the Agreement, and except as may be provided under Article (10)(d), shall also constitute the payment for all loss or damage to the Contractor arising out of the nature of the work or from the action of the elements or from any unforeseen difficulties or obstructions which may arise or be encountered during the execution of the work until its final approval by the Contracting Officer, and for all risks to the Contractor of every description connected with the execution of the work or infringement of patents, trade marks, or copyrights and for completing the work in an acceptable manner.

(b) The payment of any periodic estimate or of any retained percentage shall in no way constitute an acceptance of the work or in no way prejudice or affect the obligation of the Contractor at his own cost or expense to repair, correct, renew, or replace any defects or imperfections in the construction as well as all damages due or attributable to such defects, nor shall any such payment for any current estimate or of any retained percentages prejudice or affect the rights of the City to hold the Contractor liable for breach of contract or to avail itself of the remedies under Article (15), hereof.

(c) If at any time there shall be evidence of any lien or other claim for which, if established, the City may become liable, directly or indirectly, and which is chargeable to the Contractor, the City may retain out of any payment then due or thereafter to become due, an amount sufficient to completely indemnify it against any such claim. If there prove to be any such claims after all the payments are made, the Contractor shall refund to the City all moneys that the City pays in discharging such claim in consequence of the Contractor's default.

(d) The Contractor, and each subcontractor, at every tier, to the Contractor, represents, warrants and certifies that it has complied with all laws of the Commonwealth of Massachusetts relating to taxes and all Ordinances and Orders of the City of Worcester relating to taxes, fees and charges, or is lawfully contesting the validity of the same. The Contractor, and each subcontractor, at every tier, further represents, warrants and certifies that it will remain in such compliance during the term of this Agreement, including any amendments or extensions hereto. Breach of any of these provisions shall be deemed a

material breach which shall entitle the City to immediately terminate this Agreement and take any other action authorized by law to collect any amounts due the City.

PAYMENT OF SUBCONTRACTORS:

(8) Payment to subcontractors shall be made in accordance with General Laws Chapter 30, Section 39F, as amended, which is included in the Supplementary General Conditions.

NOTICE:

(9) Wherever in this Agreement the City is to give or receive a notice, the Contracting Officer as defined in Article (3) shall be the City's Agent for such purpose.

PERFORMANCE:

(10) (a) The Contractor shall give his personal attention constantly to the faithful execution of the work and shall keep the same under his personal control. He shall not assign by power of attorney, or otherwise, the work or any part thereof without the previous written consent of the Contracting Officer. He shall not either legally or equitably assign any of the moneys payable under this Agreement or any claim thereto unless by and with like consent on the part of the Contracting Officer and the City Treasurer. He shall be responsible for all the acts and omissions of his employees and of all persons directly or indirectly employed by him in connection with the execution of this work.

(b) The Contractor shall provide sufficient and proper facilities at all times for the inspection of the work by the City. He shall, after receiving written notice that certain work or construction is improper, unsafe or defective or that such construction in any way fails to conform to the Contract Documents, forthwith remove such unsafe or defective construction and reconstruct the same in a manner satisfactory to the Contracting Officer. Upon failure of the Contractor to remedy the construction after being so notified, the Contracting Officer in accordance with Article 3.4.1 of the General Conditions may cause such defective work to be remedied or replaced and the City may deduct the cost thereof from any moneys due or to become due the Contractor.

(c) The City, acting through the Contracting Officer, or the project Architect, shall have the authority to suspend the work wholly or any part thereof for such period as deemed necessary due to failure of the Contractor to carry out orders given or to perform any provision of the Agreement. Upon receipt of written order from the Contracting Officer or Architect, the Contractor shall immediately suspend the work or such part thereof in accordance with the order. No work shall be suspended without the written permission of the Contracting Officer or Architect. The work shall be resumed when conditions so warrant or deficiencies have been corrected and the condition of the Contract satisfied as ordered or approved in writing by the Contracting Officer or Architect. No allowance of any kind will be made for suspension of work by order of the Contracting Officer or Architect pursuant to this paragraph.

(d) Any request for an adjustment in the contract price by the Contractor or the City, due to differing subsurface or latent physical conditions, shall be governed by the provisions of General Laws Chapter 30, section 39N, as amended, which is included in the Supplementary General Conditions.

(e) The Contractor agrees that it shall have no claim for damages of any kind on account of any delay in commencement of the work. Post commencement, the Contractor shall have no claim for damages of any kind on account of any delay or suspension of any portion of the work except as hereinafter provided. Adjustments, if any, in the contract price due to a suspension, delay, interruption or failure to act by the City shall be governed by the provisions of General Laws Chapter 30, section 39(O), as amended, which is included in the Supplementary General Conditions. Provided, however, the provisions of this paragraph shall not apply to any suspension pursuant to Section (10)(c), or for any suspension, delay, interruption or failure to act to the extent that such is due to any cause for which this Agreement provides for an equitable adjustment of the contract price, or time, under any other provision. Provided, further, that no adjustment shall be made if the performance of the Contractor would have been prevented by other causes, even if the work had not been so suspended, delayed or interrupted by the City. Provided, further, that a subcontractor shall have the same rights against the Contractor for payment for an increase in the cost of his performance as the provisions of this paragraph gives the Contractor against the City, but nothing herein shall in any way change, modify or alter any other rights which the Contractor and subcontractor may have against each other.

(f) The City may award other contracts for additional work. The Contractor shall cooperate fully with other contractors and carefully fit his own work to that of other contracts as may be directed by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor.

(g) The Contractor shall comply with all the laws, state and federal, applicable to the work and construction provided for herein. This Agreement is made subject to all laws, state and federal; and if any clause hereof does not conform to such law, then such clause shall be void and the law operative shall be inserted in lieu thereof. Any violation by the Contractor of state or federal laws relating to the employment of labor upon the work or the construction contemplated by this Agreement shall be a sufficient cause for the City to cancel the Agreement without in any way being liable in damages therefor. Should the City cancel the Agreement because of the failure on the part of the Contractor to observe the state or federal laws, or the rules and regulations relating to employment of labor upon the work herein contemplated, then upon cancellation the City reserves all rights and benefits herein or by law provided against the Contractor for the breach of the conditions of this Agreement.

(h) It shall be a material breach of this Agreement if the Contractor and each subcontractor shall not at all times adhere to the provision of § 1A(e)(9) of chapter nine of the Revised Ordinances of the city by limiting their on-site, noise producing construction and related work to the hours specified by said ordinance.

(i) When the use of explosives is necessary for the execution of the work, the Contractor shall take the utmost care not to endanger life and property. Whenever directed, the number and size of the charges shall be reduced. All explosives shall be stored in a secure manner. All such storage places shall be marked clearly "DANGEROUS-EXPLOSIVES", and shall be in the care of competent watchmen at all times. The method of storage and handling explosives and highly inflammable materials shall conform to all the state laws and regulations, as well as any local requirements.

(j) Upon the completion of the work the Contractor shall, at his own expense, remove all equipment, temporary Contractor's buildings and sheds, fencing, rubbish and waste material in and about the area that has been worked and he shall leave the premises and the work performed all in a neat and proper condition.

(k) Before commencing the work the Contractor shall, if required, submit a schedule of operations for approval of the Contracting Officer or Architect. The schedule shall show the methods and order of operations that the Contractor proposes to use. The approval of the schedule by the Contracting Officer or Architect shall not be construed as relieving the Contractor from any responsibility.

(l) Should the Contractor be obstructed or delayed in the execution of the work as a result of damage which may be caused by lightning, earthquake, rain, storm, or cyclone, then the time fixed for completion may be extended for a period equivalent to the time lost by reason of any of the foregoing causes. No such extension shall be made unless a claim therefor is presented in writing to the Contracting Officer within forty-eight (48) hours of the occurrence of such delay. The Contractor shall have no claim against the City for damages on account of such delay. The duration of the extension itself must be certified to by the Contracting Officer or Architect.

ADDITIONAL WORK:

(11) (a) The Contractor agrees to perform any work related to the subject matter of the Contract, but not within its original scope, upon written order of the Contracting Officer or Architect, the payment for such extra work to be made in accordance with whichever of the following methods the Contracting Officer elects: (i) a price agreed upon between the parties and stipulated in the order for the extra work; or (ii) a price based on the unit prices of the contract; or (iii) a price determined to be the reasonable cost of the extra work as computed by the Contracting Officer in accordance with paragraph (b) below.

(b) In computing reasonable cost for the purposes of (iii) above, the Contracting Officer shall include the reasonable cost to the Contractor,

(i) of the cost of prevailing rates for direct labor, material, and use of equipment;

(ii) plus the cost of worker's compensation insurance, liability insurance, federal Social Security insurance, and Massachusetts unemployment compensation

insurance or, as an alternative, the Contractor may elect to use a flat twenty-five percent (25%) of the total labor rate in (a);

(iii) plus ten percent (10%) of the total labor rate in (a) for overhead, superintendence and profit, which will be paid to the Contractor for Item 1 work, which is the work of the Contractor and all its non-filed subcontractors. On Item 2 work, which is the work of filed subcontractors, this ten percent (10%) will be allowed only to the filed subcontractor and is not applicable to any Paragraph E sub-subcontractors. The Contractor or the filed subcontractor, as the case may be, shall agree upon the distribution of the ten percent (10%) to their respective subcontractors as a matter of contract therewith;

(iv) for work performed by a filed subcontractor, the Contractor shall accept an additional five percent (5%) of the filed subcontractor's price (less the 10% mark-up), as full compensation for processing forms and assuming full responsibility for the faithful performance of such work by the filed subcontractor(s);

(v) plus actual direct premium costs of payment and performance bonds required of the Contractor and filed subcontractors, provided there will be an appropriate credit for premiums for a credit change order; and

(vi) if the extra work requires the use of heavy equipment, cranes and hoisting equipment, machinery, and special tools not on site and not originally required to be used upon the work, then the cost of transportation to and from the work site, not exceeding 100 miles, shall be included. The cost of extra work shall not include any cost or rental of small tools, buildings, or any portion of the time of Contractor's management or office personnel, or any allowance for use of capital.

(c) The Contracting Officer or Architect may make alterations in the line, grade, plan, form, dimensions, or materials of the subject matter of the Contract, or any part thereof, either before or after commencement of construction. Where such alterations increase the quantity or standard of the work to be done, payment for such increase shall be made in the same way that payment is made for extra work under (a) and (b) above. Where such alterations diminish the quantity or standard of the work to be done, an adjustment shall be made to the benefit of the City based upon the unit prices where used or, where unit prices are not used, as the Contracting Officer shall determine.

EMPLOYMENT:

(12) (a) The Contractor shall employ competent workers and if notified by the Contracting Officer, in writing, that any person engaged upon the work is incompetent, unfaithful, disorderly or otherwise unsatisfactory, then such worker shall be discharged from the work.

(b) In the performance of this Agreement, the Contractor shall comply with the provisions of Worcester Revised Ordinances Chapter 2, Section 35 as amended, which are included in the Supplemental General Conditions to the Contract.

(c) The parties shall comply with the provisions of section 179A of Chapter 149 of the Gen. Laws (Ter. Ed.). Notwithstanding any provisions to the contrary contained in the General or Supplemental Conditions to the Contract, in the employment of persons including mechanics, teamsters, chauffeurs and laborers, under this Contract, preference shall be given:

First: To citizens of the Commonwealth who are residents of the City of Worcester and who have served in the Armed Forces of the United States in time of war and have been honorably discharged therefrom or released from active duty therein, and who are qualified to perform the work to which the employment relates.

Second: To citizens of the Commonwealth who are residents of the City of Worcester and are qualified to perform the work to which the employment relates.

Third: To citizens of the Commonwealth who have served in the Armed Forces of the United States in time of war and have been honorably discharged therefrom or released from active duty therein and who are qualified to perform the work to which the employment relates.

Fourth: To citizens of the Commonwealth generally.

Fifth: To citizens of the United States.

The foregoing provisions shall not apply to those persons employed in a supervisory capacity. In so far as practicable preference is to be given Worcester Truckers in hauling materials.

(d) No laborer, worker, mechanic, foreman, or inspector working within the Commonwealth of Massachusetts in the employ of the Contractor, sub-contractors, or other persons doing or contracting to do the whole or part of the work contemplated by this Agreement, shall be required or permitted to work more than eight (8) hours in any one (1) calendar day; or more than forty-eight (48) hours in one (1) week, or more than six (6) days in any one (1) week in full compliance with provisions of G.L. c. 149, s. 34, except in cases of emergency.

(e) Every employee in the work covered by the Contract shall lodge, board and trade where and with whom he elects and neither the Contractor nor his agents or employees shall directly or indirectly require as a condition of employment therein that an employee shall lodge, board or trade at a particular place or with a particular person.

(f) The Contractor shall provide and maintain in a neat and sanitary condition such accommodations for the use of his employees as may be necessary to comply with the requirements of the Department of Public Health, local health officials or of other appropriate authorities. The maintenance of all sanitary facilities shall be subject to the laws of the Commonwealth and to the rules and regulations of the State Board of Health and of the Commissioner of Public Health for the City of Worcester.

(g) The Contractor shall, before commencing the work, provide by insurance for the payment of compensation and the furnishing of other benefits under Chapter 152 of the General Laws to all persons employed under the Agreement, and he shall continue such insurance in force and effect during the term hereof. The City may require the Contractor to deliver certificates of insurance as sufficient proof of compliance with the foregoing. Failure to provide and continue in force such insurance as aforesaid shall be deemed a material breach of the Agreement and shall entitle the City to terminate the Agreement without in any way being liable in damages therefor.

(h) The Contractor shall keep a true and accurate register of all mechanics, teamsters, chauffeurs and laborers employed upon the work contemplated by this Contract, showing the name, address and occupational classification of each such employee, the hours worked by and the wages paid to each such employee, and shall furnish the Massachusetts Department of Labor and Industries, upon its request, a true statement thereof.

(i) Minimum wage rates under the provisions of General Laws chapter 149, section 27, as amended, have been determined by the Commissioner of Labor and Industries for the Commonwealth, and the Contractor shall in the payment of wages be bound by them during the life of the Agreement. The applicable schedule of minimum wage rates, as so determined, are incorporated elsewhere within the Contract Documents.

TERMINATION:

(13) (a) If the Contractor shall be adjudged as bankrupt, or if he shall make a general assignment for the benefit of his creditors, or if a receiver of his property shall be appointed, or if the work to be done under the Agreement shall be abandoned, or if the Agreement or any part of shall be sublet without the previous written consent of the Contracting Officer, or if the Contract or any claim hereunder shall be assigned by the Contractor otherwise than as herein specified, or if at any time the Contracting Officer shall be of the opinion that the work, or any part thereof, is unnecessarily or unreasonably delayed, or that the Contractor has violated any of the provisions of the Agreement, the Contracting Officer, for and in behalf of the City, may notify the Contractor to discontinue all work, or any part thereof; and thereupon the Contractor shall discontinue such work or such part thereof as the Contracting Officer may designate, remove his equipment, tools, supplies and materials as the Contracting Officer directs, and the City may thereupon, by contract or otherwise, as it may determine, complete the work, or such part thereof, and charge the entire expense of so completing the work or any part thereof to the Contractor.

(b) If the Contracting Officer or Architect shall certify by written notice to the Contractor that the rate of progress is not satisfactory, the City may, instead of notifying the Contractor to discontinue all of the work or any part thereof, notify him from time to time to increase the force, equipment and plant, or any of them, employed on the whole or any part of the work, stating the amount of increase required. Unless the Contractor shall, within seven (7) work days after such notice, increase his force, equipment and plant to the extent required therein, and maintain and employ the same from day to day until the

completion of the work or such part thereof or until the conditions as to the rate of progress shall, in the opinion of the Contracting Officer or Architect, be fulfilled, the City may employ and direct the labors of such additional force, equipment and plant as may, in the opinion of the Contracting Officer or Architect, be necessary to ensure the completion of the work or such part thereof within the time specified or at the earliest possible date thereafter, and charge the expense thereof to the Contractor. Neither the notice from the Contracting Officer or Architect to the Contractor to increase his force, equipment or plant nor the employment of additional force, equipment or plant by the City shall be held to prevent a subsequent notice to the Contractor from the City to discontinue the work under the provisions of the preceding portion of this Article.

(c) All expenses charged under this Article shall be deducted by the City out of moneys then due or to become due the Contractor under this Agreement, or any part hereof. In such accounting the City shall not be obligated to obtain the lowest figures for the work of completing the contract or any part thereof, or for insuring its proper completion, and all sums actually paid by the City shall be charged to the Contractor. If the expense so charged is greater than the sum which would have been payable under the Agreement, if the same had been completed by the Contractor, then the Contractor shall pay the amount of the excess to the City upon completion of the work and without further demand being made therefor.

(d) The Contractor shall not be relieved of liability to the City by virtue of any termination of this Agreement and any claim for damages against the Contractor relating to the Contractor's performance hereunder shall survive any termination hereunder.

GUARANTEES:

(14) (a) The Contractor guarantees the work under this Contract and the materials furnished by him for use in connection therewith to be free from defects or flaws for one (1) year after the completion of the work, unless a greater period of time is prescribe by law, or by terms of any special guarantee required under any other provisions of the Contract Documents. It is expressly understood, however, that this guarantee provision shall not absolve the Contractor from any liability to the City arising out of a failure to substantially comply with the terms of the Agreement.

(b) If at any time within said guaranty period, any part of the work constructed under the terms of this Agreement shall, in the opinion of the Contracting Officer or Architect, require repairing due to defective work or materials furnished by the Contractor, he may notify the Contractor in writing to make the required repairs. If the Contractor shall neglect to start such repairs within ten (10) work days of the date of giving him notice thereof and to complete the same to the satisfaction of the Contracting Officer or Architect with reasonable dispatch, then the latter may employ other persons to make such repairs. The City shall charge the expense thereof to the Contractor and may use any moneys still retained to pay for the same, and if such sum is insufficient, the Contractor shall be obligated to pay the balance thereof.

INDEMNIFICATION:

(15) (a) The Contractor shall indemnify and save harmless the City of Worcester and all of its officers, agents and employees against all suits, claims or liability of every name, nature, and description arising out of or in consequence of the acts or omissions of the Contractor in the performance of the work covered by the Agreement and/or his failure to comply with the terms and conditions hereof, and will at his own cost and expense defend any and all such suits and actions.

(b) The Contractor shall bear all losses resulting from the use or storage of explosives and highly inflammable materials, and shall save the City harmless from all claims for bodily injuries or death to any person and from all claims for property damage or destruction arising out of the use or storage of explosives and highly inflammable materials.

(c) The Contractor further covenants to hold and save the City, its officers, servants and employees harmless from and against all and every demand or demands, of any nature or kind for or on account of the use of any patented invention, article or appliance included in the materials and equipment agreed to be furnished, supplied or used under this Agreement.

INSURANCE:

(16) (a) The Contractor shall carry public liability insurance with an insurance company satisfactory to the City so as to save the City harmless from any and all claims for damages arising out of bodily injury to, or death of, any person or persons and for all claims for damages arising out of injury to, or destruction of, property caused by accidents resulting from the use of implements, equipment or labor used in the performance of the Agreement or from any neglect, default omission or want of proper care or misconduct on the part of the Contractor or of any one in his employ during the execution of the work. Such insurance shall include coverage for blasting and explosion, if explosives are to be used.

(b) The Contractor shall carry any other types of insurance as may be required elsewhere in the Contract Documents. All insurance policies required in the Contract Documents shall be provided by companies satisfactory to the City.

(c) Prior to starting work under this Agreement, the Contractor shall deposit, with the City's Law Department, certificates from the insurers to the effect that the insurance policies required in the above paragraphs have been issued to the Contractor. The certificates must be on a form satisfactory to the Law Department.

(d) Unless greater amounts of insurance coverage are required elsewhere in the Contract Documents, the amounts of such public liability insurance shall not be less than the minimum amounts set forth below:

(i) Liability for bodily injury, including accidental death, $250,000.00 for any one person and, subject to the same limit for each person, $500,000.00 on account of one accident.

(ii) Liability for property damage, $100,000.00 on account of any one accident and $300,000.00 on account of all accidents.

(iii) Workers' compensation/employers' liability – MA statutory requirements.

(e) Unless greater amounts of insurance coverage are required elsewhere in the Contract Documents, the Contractor shall also carry bodily injury and property damage insurance in amounts not less than those set forth above, covering the operation of all motor vehicles owned by the Contractor and engaged in this work.

(f) No cancellation of any insurance whether by the insurer or by the insured shall be effective unless written notice thereof is given to the City at least fifteen (15) days prior to the intended effective date thereof, which date has been expressed in the notice. Prior to the effective date of any such cancellation the Contractor shall take out new insurance to cover the policies so cancelled. The Insurance Companies shall remain liable, however, until new and satisfactory insurance policies have been delivered to, and accepted by, the City.

CONFLICT OF INTEREST:

(17) (a) The Contractor warrants that he has complied with all provisions of law regarding the award of this Contract and that he, or his employees, agents, officers, directors or trustees have not offered or attempted to offer anything of any value to any employee of the City in connection herewith.

(b) The Contractor further warrants that no elected official or employee of the City of Worcester, including unpaid members of City boards and commissions, serves as an officer, director, trustee or employee of Contractor, and that no elected officials or employees of the City of Worcester have or will have a direct or indirect financial interest in this Agreement. The foregoing shall not apply, however, if the Contractor qualifies for an exemption and complies with the applicable disclosure provision(s) under G. L. c. 268A.

(c) Violation of this Article shall be a material breach of this Agreement and shall be grounds for immediate termination hereof by the City without regard to any enforcement activities undertaken or completed by any enforcement agency. Termination of this Agreement pursuant to this Article shall not waive any claims for damages the City may have against the Contractor resulting from the Contractor's violation of the terms of this Article.

SEVERABILITY:

(18) If any provision of this Agreement is held invalid by any court or body of competent jurisdiction, the remainder of this Contract shall remain in full force and effect.

HEADINGS:

(19) The section headings in this Agreement are for convenience and reference only and in no way define or limit the scope or content of this Agreement or in any way affect its provisions.

AMENDMENTS:

(20) This Agreement may be amended or modified only by written instrument duly executed by the parties.

ENTIRE AGREEMENT:

(21) This Agreement contains the entire understanding of the parties and supercedes all prior agreements, representations, proposals and undertakings of the parties.

IN WITNESS WHEREOF the Contractor has hereunto set his hand and seal and the City has caused its corporate seal to be hereto affixed and this Agreement to be executed in its name and behalf by a duly authorized officer thereof the day and year first above written.

CITY OF WORCESTER

RECOMMENDED:

_____
Paul J. Moosey P.E.
Commissioner
Department of Public Work & Parks

APPROVED AS TO LEGAL FORM:

_____

CERTIFICATION OF FUNDING

I certify that an appropriation of funds in the amount of this Agreement is contained in account number _____.

_____
Robert V. Stearns
City Auditor

APPROVED:

_____
Edward M Augustus Jr.
City Manager

CONTRACTOR

BY: _____(SEAL)

# PAYMENT BOND

KNOW ALL BY THESE PRESENTS, that _____, a _____ corporation duly established by law and having a usual place of business at _____, as PRINCIPAL, and_____, a corporation organized under the laws of the State or Commonwealth of _____, and duly authorized and admitted, under the provisions of Chapter 175 of the Massachusetts General Laws, as amended, to transact the business of a fidelity and surety company in Massachusetts, as SURETY, are held and firmly bound unto the City of Worcester, a municipal corporation within the Commonwealth of Massachusetts, in the sum of _____ Dollars and no cents ($_____.00) lawful money of the United States of America, to be paid to the City of Worcester, its successors and assigns, to the payment of which, well and truly to be made, the PRINCIPAL and the SURETY bind themselves, their respective heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said PRINCIPAL has entered into an Agreement of even date herewith with the City of Worcester, said Agreement being for the _____ at _____ in the City of Worcester, Massachusetts;

NOW THEREFORE, the condition of this obligation is such that if the PRINCIPAL shall pay for all labor performed or furnished and for all materials used or employed or any appliance and equipment used or employed or rented or hired out in the execution of said Agreement and in any and all duly authorized modifications, alterations, extensions of time, changes or additions to said Agreement that may hereafter be made, notice to the SURETY of such modifications, alterations, extensions of time, changes or additions being hereby waived, the foregoing to include any other purposes or items set out in, and to be subject to, the provisions of Massachusetts General Laws, Chapter 149, Section 29 and Chapter 30, Section 39A, as amended, then this obligation shall become null and void; otherwise it shall remain in full force and virtue.

IN TESTIMONY WHEREOF, the PRINCIPAL has hereunto caused its name and seal to be affixed, and the SURETY has caused its corporate seal to be hereunto affixed by a duly authorized officer thereof and this instrument to be executed and delivered in its name and behalf by its attorney-in-fact, duly authorized by its by-laws and votes, powers of attorney, and letters of appointment and authorization, certificated copies of which documents are annexed to this bond and may be introduced in evidence as if a part hereof.

(PRINCIPAL) _____ (SEAL)

By:_____

(SURETY) _____ (SEAL)

_____
Attorney-in-Fact

# PERFORMANCE BOND

KNOW ALL BY THESE PRESENTS, that _____, a_____ corporation duly established by law and having a usual place of business at_____ as PRINCIPAL, and_____, a corporation organized under the laws of the State or Commonwealth of_____, and duly authorized and admitted, under the provisions of Chapter 175 of the Massachusetts General Laws, as amended, to transact the business of a fidelity and surety company in Massachusetts, as SURETY, are held and firmly bound unto the City of Worcester, a municipal corporation within said Commonwealth of Massachusetts, in the sum of $_____Dollars and no cents ($_____.00) lawful money of the United States of America, to be paid to said City of Worcester, its successors and assigns, to the payment of which, well and truly to be made, the PRINCIPAL and the SURETY bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the said PRINCIPAL has entered into an Agreement of even date herewith with the City of Worcester, said Agreement being for the _____, inclusive, at _____in the City of Worcester, Massachusetts;

NOW THEREFORE, the condition of this obligation is such that if the said PRINCIPAL shall well and faithfully perform all the terms and conditions of said Agreement on its part to be kept and performed as therein stipulated, including guarantee and maintenance provisions therein, and shall pay for all materials furnished and for all labor performed in the execution of said Agreement, and shall indemnify and save harmless the said City of Worcester as therein stipulated, then this obligation shall be of no effect; otherwise it shall remain in full force and virtue.

And the said SURETY, for value received, hereby stipulates and agrees that no change, extension of time, alteration or addition to the terms of said Agreement, or to the work to be performed thereunder, or to the specifications accompanying the same, shall in any way effect its obligation on this bond; and it does hereby waive notice of any change, extension of time, alterations or additions to the terms of said Agreement, or to the work, or to the specifications.

In the event that the Agreement is abandoned by the Contractor, or is terminated by the City of Worcester, under the provisions thereof, said SURETY hereby further agrees that it shall, if requested in writing by the City of Worcester, take such action as is necessary to complete said Agreement.

IN TESTIMONY WHEREOF, the PRINCIPAL has hereunto caused its name and seal to be affixed, and the SURETY has caused its corporate seal to be hereunto affixed by a duly authorized officer thereof and this instrument to be executed and delivered in its name and behalf by its attorney-in-fact, duly authorized by its by-laws and votes, powers of attorney, and letters of appointment and authorization, certificated copies of which documents are annexed to this bond and may be introduced in evidence as if a part hereof.

(PRINCIPAL) _____ (SEAL)

By: _____

(SURETY)_____ (SEAL)

_____
Attorney-in-Fact

STATE LAW NOW MANDATES THAT TO DO BUSINESS WITH THE CITY OF WORCESTER the Massachusetts Revenue Enforcement and Protection Program of 1983 requires that the following be supplied:

DATE: _____

Pursuant to Mass. G.L. c. 62C, Section 49A, I Certify under the Penalties of Perjury That I, To My Best Knowledge and Belief, Have Filed All Massachusetts State Tax Returns and Paid ALL Massachusetts State and City Taxes Required under Law.

Company Name _____

Street & No. _____ _____

Signature of Individual
or
Corporate Officer
(if applicable)

City or Town _____ Tel No. _____

STATE _____ Zip Code _____

_____

SOCIAL SECURITY NUMBER
OR
FEDERAL IDENTIFICATION NUMBER

CERTIFICATE OF VOTE OF AUTHORIZATION

Date _____

I hereby certify that at a meeting of the Board of Directors of: _____ duly called and held on the _____ day of _____, 20___, at which time it was voted that _____ (name), _____ (title) be and hereby is authorized to execute and deliver for and in behalf of the corporation, a contract with the City of Worcester for _____ (the "Project") in the City of Worcester and, as Principal to execute a Performance Bond and Labor and Materials Bond in connection therewith, which Contract and Bonds were presented to and made a part of the records of said meeting.

I further certify that _____ is the duly qualified and acting _____ of the Corporation and that said vote has not been repealed, rescinded or amended.

A true copy of the record,

ATTEST

_____
Clerk of the Corporation

(Corporate Seal)

Sworn to and subscribed to me this ___ day of _____, 20___.

_____
Notary Public
My Commission Expires:

Certificate of Acknowledgement of Contractor if a Corporation

for AGREEMENT

State of _____)
ss
County of _____)

On this ____ day of _____, 20___, before me personally came _____ to me known, who being by me duly sworn, did depose and say as follows:

That he/she resides at _____

and is the _____ (title) of _____, the corporation described in and which executed the foregoing instrument; that he/she knows the corporate seal of said corporation; that the seal affixed to the foregoing instrument is such corporate seal and it was so affixed by order of the Board of Directors of said corporation; and that by the like order he/she signed thereto his/her name and official designation.

_____
Notary Public (Seal)

My Commission Expires: _____

Certificate of Acknowledgment of Contractor if a Corporation

FOR CONTRACT BONDS

State of _____)
ss
County of _____)

On this ___ day of _____, 20___, before me personally came _____ to me known, who being by me duly sworn, did depose and say as follows:

That he/she resides at _____

and is the _____ (title) of _____, the corporation described in and which executed the foregoing instrument; that he/she knows the corporate seal of said corporation; that the seal affixed to the foregoing instrument is such corporate seal and it was so affixed by order of the Board of Directors of said corporation; and that by the like order he/she signed thereto his/her name and official designation.

_____
Notary Public (Seal)

My Commission Expires: _____

**END OF SECTION 00600**

## SECTION 01010 - SUMMARY OF WORK

## PART 1 – GENERAL

### 1.1 CONTRACT DOCUMENTS

A. The Contract Documents include the Drawings as enumerated on the Title Drawing, the general provisions of Contract, including General and Supplemental Conditions, and the provisions of this Project Manual and Addenda as a whole represent and describe the work and requirements of the Project.

### 1.2 GENERAL REQUIREMENTS

Attention is directed to the general and supplementary conditions and Division 1 including all sub-divisions therein attached in this document and drawings, which are made a part of this section.

### 1.3 SUBSTANTIAL COMPLETION

A. The Date of Substantial Completion shall be eight months (240 days) for Contract work.

1. The Date of Substantial Completion shall Increase sixty (60) day if any alternate(s) are chosen to be included in the Contract by the Owner.

B. The Contractor shall obtain a Certificate of Occupancy on or before the Date of Substantial Completion.

### 1.4 PROJECT DESCRIPTION

A. The project scope generally consists of the replacement of an existing 12,000 square foot metal building with a new 12,000 square foot metal building on the same foundation and slab-on-grade. The metal building system includes an elevated partial second floor area containing storage, mechanical and electrical rooms. The metal building system includes the entire building envelope except for the glazed enclosure of the building entrance lobby.

Demolition work includes existing concrete and asphalt paving and existing building construction above the existing slab-on-grade.

Construction includes improvements to the building foundations, foundation waterproofing and drainage, new insulated concrete floor slabs constructed over the existing slab, the glazed enclosure of the building entrance lobby, partitions, ceilings, finishes, specialties, furnishings, and fire protection, plumbing, HVAC, electrical and communication systems.

Site work includes clearing vegetation, storm drainage and utility trenching and backfilling, storm drainage systems, grading, concrete and asphalt paving, fencing, lighting, flagpole and landscape planting. Some of the site work is to be the work of Alternate Number 1.

Construction of a covered trailer storage canopy including its foundations is to be work of Alternate Number 2.

B. The Work of this project shall be performed by the general contractor and filed subcontractors.

C. The Work of this project also includes the requirements in the Contract, the Sub-Contract(s), Sections 0 and Division 1 Sections, in their entirety.

**RELATED WORK UNDER OTHER CONTRACTS**

A. Work by other contractors, which will be under separate contract, may take place during the work of this contract adjacent to and within work areas of this site

B. Cooperate fully with other contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this contract.

## 1.5 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies; perform demolition work in accordance with applicable rules, regulations, codes, and ordinances of local, state and federal authorities.
B. Obtain and pay for necessary building permits, licenses and certificates and give notices as required during the performance of the Work.
C. Provide 4 copies of shop drawings and literature for Architects review and approval for the items referenced in the specifications.
D. Provide schedule and work plan within one week of the contract signing.
E. Attend weekly meetings (or as scheduled) with the Architect and Owner's Representative as scheduled.
F. Provide all Closeout documents including, final acceptance, warranties, guaranties and bonds.

## 1.6 RELATED WORK UNDER OTHER CONTRACTS

A. Work by other contractors, which will be under separate contract, may take place during the work of this contract adjacent to and within work areas of this site. This work, under other contract, shall be coordinated between the different General Contractors. The security system will be installed by the Owner under separate Contract and the general Contractor shall work with the Owners vendor to coordinate their work with the General contractors work.

B. Cooperate fully with separate contractors so that work under those contracts may be carried out smoothly, without interfering with or delaying work under this contract.

## 1.7 WORK SEQUENCE SCHEDULING AND COORDINATION

A. The Work shall be sequenced, scheduled, and coordinated to achieve the Date of Substantial Completion.

1. All deliveries must be scheduled at a minimum of 48-hours in advance with the Architect and Owner.
2. All existing utility tie-in's must be scheduled and coordinated at a minimum of 72-hours in advance with the Architect and Owner.

B. The General Contractor and each Sub-Contractor shall establish and increase or decrease as appropriate the workforce, days of work, number of shifts, work hours, materials, tools and equipment needed to maintain and achieve the Date of Substantial Completion.

C. The General Contractor and each Sub-Contractor shall increase the workforce, days of work, number of shifts, work hours, materials, tools, and equipment needed to maintain the Date of Substantial Completion as necessary to accommodate any additional work authorized by Construction Change Directives and Change Orders modifications.

D. General Contractor will be responsible for the proper conduct of the work to ensure that all trades work together, and in harmony, to achieve substantial and final completion as specified.

## 1.8 WORK HOURS

A. Normal working hours are to be Monday thru Friday from 7:00 AM to 3:30 PM, except Legal Holidays. Any working hours outside of these times shall be considered "Extended Hours" and treated as described below.

B. Extended work hours shall require prior scheduling and coordination with the Architect and Owner at a minimum of 48-hours in advance. Extended work hours on Sundays and Legal Holidays may also require a permit from the Police Department.

1. Upon permission from the Architect and Owner, and prior to the start of any extended work, pay for all fees and obtain through the City of Worcester Police Department a work permit for all Sundays and Legal Holidays.

C. The Contractor shall pay any overtime required for the City's Clerk of Works/Owner's Representative to be on site for any work performed outside of normal working hours as defined above. No work shall take place outside of normal working hours without prior approval and the City's Clerk of Works/Owner's Representative on site.

D. Any project related activities may not interfere with the enjoyment and use of abutting areas within the building or adjacent properties during any extended work hours.

## 1.9 CONTRACTOR USE OF THE PREMISES

A. General Contractor shall have use of the site from date of contract to the Date of Substantial Completion as described above in the Work Hours paragraph.

B. Construction vehicle access and deliveries to the project shall be made during working hours.

C. All contractor personnel shall enter and exit the construction area through Access Driveway.

D. Do not close or obstruct the parking lot, driveways or sidewalks without the proper permit. Conduct operations with minimum traffic interference.

E. The General Contractor shall also be responsible for returning the public areas adjacent to each work area to their original state prior to the start of work in that area.

F. The use of internal combustion engine driven power equipment is prohibited within the building. Alternate power sources, i.e. generators and compressors, may be placed outside the building to provide power to equipment. Placement of any alternate power sources shall be subject to prior Architect and Owner approval.

G. There will be no washing or washing out of any vehicles at the project site. The contractor shall make necessary provisions to accommodate this work off site.

H. All cleaning and wash-down of tools and/or equipment shall be performed in areas designated only by the Architect. This will be strictly enforced.

## 1.10 CONTRACTOR USE OF CITY STREETS

A. The General Contractor's personnel, and all other personnel employed on the project, shall limit their parking on the site to within the areas designated for construction parking and as permitted by the General Contractor. Additionally, Contractor personnel may park as legally allowed within City Limits. Parking on street sidewalks is prohibited.

B. Driveway entrances, walks, and yards to abutting properties shall be kept unobstructed at all times.

## 1.11 WORK CONDITIONS

A. Neither the General Contractor, nor Sub-Contractors at any level, nor their employees shall bring illegal substances or alcoholic beverages on the premises.

B. Vulgar, abusive, obscene language or behavior will not be tolerated.

C. Contractor's personnel engaging in the above shall be removed from the job-site.

D. Radios or any type of “music” broadcasting systems are not allowed.

E. This site is smoke-free; therefore smoking is prohibited within the site limits.

## 1.12 PROJECT MANAGER, SUPERINTENDENTS, FIELD ENGINEER AND FOREMAN

A. The General Contractor shall provide a qualified General Superintendent, who shall be present, full time, on site daily during all work in progress until the Date of Substantial Completion, and for such additional time thereafter as the Architect may determine. Only under extenuating circumstances, with the approval of the Architect and Owner, will the Contractor be allowed to substitute for the General Superintendent prior to the date of Final Completion.

B. The General Superintendent shall supervise and direct the activities of other superintendents and foremen on site. He shall not perform the work of foremen, tradesmen, or home office staff.

C. Each filed sub-bidder and each subcontractor shall provide a Lead Foreman, responsible to be on site full time during the workday.

D. Each foreman, in addition to his regular duties shall be responsible for establishing, maintaining, and providing record drawings, which are required to be updated prior to submitting the current period’s draft Application for Payment.

E. The General Superintendent and Lead Foreman shall not be discharged or changed without prior written consent of the Architect, which will not be unreasonably withheld. The Architect will require that all as-built information be updated and current prior to granting consent.

## 1.13 DAILY REPORTS AND WEEKLY OUTLINE SCHEDULE

A. The General Superintendent shall provide a "Daily Report" to the Clerk of Works containing the following:

1. Name and manpower of each Contractor, filed Sub-Contractor and Sub Contractor.
2. Equipment used.
3. Delivery of products received on site.
4. Weather conditions at start and end of each day and any significant changes or events during the day.
5. Significant problems, hazards or accidental injury occurring during each shift.
6. Summary of progress made each day.

B. A photocopy may be made of the same "Daily Report," containing the information above, that is used by the General Superintendent. The General Superintendent may obscure confidential portions of his "Daily Report" if desired. Reports are due the following day.

C. The Superintendent shall provide the Clerk of Works a written “Weekly (look ahead) Outline Schedule” of work activities planned at the beginning of each week, for that week. The “Weekly Outline Schedule” may be a simple listing of each trade’s activities delineating areas where work is to be scheduled. Note any significant milestones.

## 1.14 CERTIFICATE OF SUBSTANTIAL COMPLETION

A. The Architect shall issue a Certificate of Substantial Completion for the work when and if all of the following conditions have been met:

1. The work is sufficiently complete to allow the Owner beneficial use of the premises. The work remaining to be done is not a danger to the proposed occupants and is of a minor nature.

2. The work is sufficiently complete that the Architect may make affidavits to the Building Official as required by Controlled Construction provisions of the Building Code.

3. The mechanical and electrical systems are fully operational. Required inspections and tests have been successfully completed, and the Owner has been provided instructions regarding operation and maintenance of mechanical and electrical systems in the building.

4. The Contractor has made notifications required to pay cost of final billing for utilities and termination of property insurance.

5. The Owner has made notifications required to assume the future cost of utilities, and provide property insurance.

6. The Building Official has issued a Certificate of Occupancy without restrictions or conditions relating to the contractor’s work.

## 1.15 CITY OF WORCESTER ORDINANCES, LICENSES, PERMITS, AND FEES

A. All Contractors shall comply with City Ordinances which may affect the work of this contract and which have not been previously covered in the Contract Documents. Requirements and fees listed are those in effect as of this writing and each Contractor shall be responsible for verifying the requirements and fee cost as currently in effect and throughout the duration of this project. This includes, but is not limited to, the following:

Worcester Police Department:

Police Details
Hourly rate for one-half day or full day.
Permits for Sunday and Holiday work
Fee Required.

Department of Public Works, Permits Division

Street Opening Permit Bond
$ 5,000.00
Barricade Placement by DPW
1st $85 per day
Each additional $ 40 per day
Drainlayers License
New $ 200.00
Annual Renewal $ 100.00
Drain Permit
$ 180.00
Main Inspection
$ 2.90 per Foot
Assessment
To be Determined
Plan Review
$ 100.00
Street Obstruction
$ 150.00 each
Street Obstruction (Blanket Permit)
$ 1,000.00 per year
Street Opening
Pavement older than 5 years $ 156.00
Pavement 5 years old or less $ 300.00
Driveway Opening
Permit $ 156.00
Wastewater Discharge
Permit $ 250.00
Inspection $ 400.00
Sewer use $ 6.29/CCF
Water meter, etc. Contact Water Department at 508-799-1492.
Traffic and Parking. Contact Department at 508-799-1468.

Worcester Fire Department

Fire and Smoke Alarm
Automatic Sprinkler and Standpipes
Contact Worcester Fire Department at 508-799-1826.

Department of Inspectional Services

Building Permit

Based on total contract price
$11/$1,000 up to first million dollars.
$8.00 per each $1,000.00 over $1,000,000.
Orders of Building Official under Chapter 1, 780 CMR.
Ticket violation under Chapter 33, 780 CMR.

Trash Control
Ticket for Violations

Environmental Control
Air, Water, Noise Pollution - Ticket for Violations
Conservation Commission Enforcement Officer

## 1.17 UTILITY COMPANY BACKCHARGES

A. The Electric backcharge from N-GRID or Verizon Communications are not known at the this time, the Electrical Contractor shall file for all N-Grid and Verizon permits and submit all data and documents as required, and shall pay the required permit and inspection fees. The actual cost of the N-Grid backcharge shall paid by the City directly. All related inspection costs or other fees shall be paid as part of the Contract.

**PART 2 – PRODUCTS** **(Not Used)**

**PART 3 – EXECUTION** **(Not Used)**

**END OF SECTION**

# SECTION 033000 - CAST-IN-PLACE CONCRETE

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes cast-in-place concrete, including gravel base, vapor barriers, board insulation, formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:

1. Footings.
2. Column piers.
3. Pile caps.
4. Foundation walls.
5. Floor slabs covering existing slab-on-grade.
6. Elevated floor slabs.
7. Equipment pads.
8. Concrete fill for steel pipe bollards.

B. Related Sections:

1. Section 033543 “Polished Concrete Finishing” for exposed floor slab finish.
2. Section 133419 "Metal Building Systems" for items to be embedded in concrete.
3. Section 316217 "Helical Steel Piles" for supporting piles.

### 1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and

joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, methods for achieving specified floor and slab flatness and levelness, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

## 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

1. Location of construction joints is subject to approval of the Architect.

E. Samples: For vapor retarder, joint fillers, insulation board.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, manufacturer and testing agency.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Fiber reinforcement.
6. Curing compounds.
7. Floor and slab treatments.
8. Bonding agents.
9. Vapor retarders.
10. Semirigid joint filler.
11. Joint-filler strips.

C. Material Test Reports: For the following, from a qualified testing agency:

1. Aggregates.

D. Minutes of preinstallation conference.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

E. The Owner shall engage an independent testing agency to prepare field quality control reports.

F. Mockups: Cast concrete slab-on-grade panels to demonstrate typical joints, surface finish, texture, color pigments, tolerances, floor treatments, and standard of workmanship.

1. Build panel approximately 200 sq. ft. for slab-on-grade in the location indicated or, if not indicated, as directed by Architect.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.8 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

## 1.9 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.

2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## PART 2 - PRODUCTS

### 2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

### 2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Metal or other approved panel materials.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.3 STEEL REINFORCEMENT

A. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

B. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel, fabricated in flat sheets.

## 2.4 REINFORCEMENT ACCESSORIES

A. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

B. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

## 2.5 UNDERSLAB MATERIALS

A. Drainage Course: Narrowly graded mixture of washed crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and zero to 5 percent passing a No. 8 sieve.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, Type VI, 1.80-lb/cu. ft. density, 40-psi compressive strength.

C. Sheet Vapor Retarder: ASTM E 1745, Class A, except with maximum water-vapor permeance of 0.01. Include manufacturer's recommended adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Fortifiber Building Systems Group, Moistop Ultra 15.
    b. Raven Industries, Inc., VaporBlock VBLP15.
    c. W.R. Meadows, Inc., Perminator 15.

## 2.6 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray.

B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

D. Synthetic Fiber: Monofilament or fibrillated polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 1/2 to 1-1/2 inches long.

## 2.7 ADMIXTURES

A. General: Admixtures are not permitted unless specifically approved by the Architect or as indicted herein.

B. Air-Entraining Admixture: ASTM C 260.

C. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
    b. Grace Construction Products, W. R. Grace & Co.; DCI-S.
    c. Sika Corporation; FerroGard 901.

D. Color Pigment: ASTM C 979/C 979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. BASF Corporation-Construction Systems.
    b. Lambert Corporation.
    c. Solomon Colors, Inc.

2. Color: As selected by Architect from manufacturer's full range.

E. Water: ASTM C 94/C 94M and potable.

## 2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Water: Potable.

C. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

## 2.9 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

## 2.10 BOLLARDS

A. Furnished under Section 055000 “Metal Fabrications.”

## 2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

C. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use corrosion-inhibiting admixture in concrete mixtures in the following locations:

    a. Column piers.
    b. Foundation walls.

c. Floor slabs.
d. Pile caps.

D. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

1. Exposed floor slabs designated “Polished Conc.” in the ROOM FINISH SCHEDULE shall be pigmented.

## 2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings, Foundation Walls, Column Piers, Equipment Pads, Fill for Bollards: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

B. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.50.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd.
4. Slump Limit: 4 inches, plus or minus 1 inch.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.
6. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

## 2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

## 2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

# PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch for smooth-formed finished surfaces.
2. Class B, 1/4 inch for smooth-formed finished surfaces.
3. Class C, 1/2 inch for rough-formed finished surfaces.
4. Class D, 1 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

## 3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

## 3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

## 3.4 UNDERSLAB ITEMS

A. Granular Fill: Place dry washed gravel or stone above existing slab-on-grade to support new floor slab as indicated.

B. Extruded-Polystyrene Board Insulation: Place insulation above existing slab-on-grade to insulate new floor slab as indicated. Protect and repair insulation.

C. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions as indicated.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

## 3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

## 3.6 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Locate horizontal joints in walls and piers at the top of footings.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint.

a. Terminate flush with finished concrete surface unless otherwise indicated.

b. Terminate not less than 2 inches below finished concrete surface where semi-rigid joint filler is indicated, specified in article "Joint Filling" in this section.

2. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

## 3.7 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month or longer as recommended by manufacturer. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler as follows:

1. Full depth in exposed saw-cut joints.
2. At least 2 inches deep at edges of slab at exterior personnel doorways and overhead doorways.
3. Overfill joint and trim joint filler flush with top of joint after hardening.

## 3.8 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of

vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains.
5. Pitch floors as indicated to achieve interior level changes at doorways.
6. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

## 3.9 FINISHING FORMED SURFACES

A. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply Class A formed finish to exposed concrete surfaces, exterior and interior.

B. Rough-Formed Finish:

1. Apply Class C or better formed finish to concealed concrete surfaces.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

## 3.10 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish.

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces exposed to view or to be polished or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
2. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch for level floors.
3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 3/16 inch for floors pitched to drain. Water shall not pond on floors pitched to drain.

## 3.11 MISCELLANEOUS CONCRETE ITEMS

A. Bollards: Set and fill steel pipe bollards as indicated.

B. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

## 3.12 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Water.
    b. Continuous water-fog spray.
    c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.

4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

a. Do not utilize this method for floor slabs to receive floor finishes.

## 3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
8. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

## 3.14 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

# SECTION 033543 - POLISHED CONCRETE FINISHING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes polished concrete finishing.

1. Concrete for polished concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."

### 1.3 DEFINITIONS

A. Design Reference Sample: Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Include Work of this Section in preinstallation conference for Section 033000 "Cast-in-Place Concrete."

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Polishing Schedule: Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

### 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Repair materials.
2. Stain materials.
3. Liquid floor treatments.

1.7 QUALITY ASSURANCE

A. Mockups: Include Work of this Section in mockups for Section 033000 "Cast-in-Place Concrete."

1.8 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatments for Polished Concrete Finish: Clear, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and is suitable for polished concrete surfaces.

PART 3 - EXECUTION

3.1 POLISHING

A. Polish: Level 3: High sheen, 800 grit.

B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth.
2. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
3. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
4. Control and dispose of waste products produced by grinding and polishing operations.
5. Neutralize and clean polished floor surfaces.

END OF SECTION 033543

# SECTION 055000 – METAL FABRICATIONS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 TIME, MANNER AND REQUIREMENTS FOR SUBMITTING SUB-BIDS:

A. Sub-bids for work under this Section shall be for the complete work and shall be filed in a sealed envelope with the City of Worcester, Department of Public Works and Parks, Architectural Division, 50 Skyline Drive, Worcester, MA 01605 at time and place stipulated in the “Invitation to Bid/Notice to Contractors”. The following shall appear on the upper left hand of the envelope:

Name of Sub-Bidder: *Print Name of Sub-bidder*

Project: REGIONAL EMERGENCY COMMUNICATIONS CENTER

Sub-Bid for Section: 088000 - GLAZING

B. Each sub-bid submitted for work under this Section shall be on forms furnished by the City of Worcester as required by Section 44F of Chapter 149 of the General Laws, as amended. Sub-Bid forms may be obtained at the Department of Public Works and Parks, Architectural Division, 50 Skyline Drive, Worcester, MA 01605 in person, or by written request.

C. Sub-bids filed with the City of Worcester shall be accompanied by a BID BOND or CASH or CERTIFIED CHECK or a TREASURER’S or CASHIER’S CHECK issued by a responsible bank or trust company payable to the City of Worcester in the amount of five (5) percent of the bid. A sub-bid accompanied by any other form of bid deposit than those specified will be rejected.

D. Additional Requirements:

1. Sub-bidder's attention is directed to Massachusetts G.L. Chapter 149 §44H, as amended, which provides in part as follows:
2. Each sub-bidder shall list in Paragraph E of the "Form for Sub-bids" the name and bid price of each person, firm or corporation performing each class of work or part thereof for which the Section of the Specifications for that sub-subtrade requires such listing, provided that, in the absence of a contrary provision in the Specifications, any sub-bidder may, without listing any bid price, list his own name or part thereof and perform that work with persons on his own payroll, if such sub-bidders, after sub-bid openings, shows to the satisfaction of the Awarding Authority that he does customarily perform such class of work with persons on his own payroll and is

qualified to do so. This Section of the Specifications requires that the following classes of work shall be listed in Paragraph E under the conditions indicated herein.

| Class of Work | Reference Specification | Paragraphs |
|---|---|---|
| | | |
| | | |
| | | |

E. The work done by this sub-bidder is shown on the following drawings:

| | |
|---|---|
| T1.0 | TITLE SHEET |
| | |
| CIVIL | |
| C1 | EXISTING CONDITIONS |
| C2 | DEMOLITION PLAN |
| C3 | EROSION AND SEDIMENT CONTROL |
| C4.1 | SITE PLAN – BASE BID |
| C4.2 | SITE PLAN – ALTERNATES |
| C5 | DRAINAGE AND UTILITIES |
| C6 | DETAILS |
| | |
| ARCHITECTURAL | |
| D1.0 | DEMOLITION PLAN-EXISTING PLAN & ELEVATIONS |
| A1.0 | EXISTING FOUNDATION WORK PLAN & DETAILS |
| A1.1 | FLOOR PLAN & DETAILS |
| A1.2 | FIRST FLOOR PLAN - ENLARGED |
| A1.3 | ROOF PLAN & DETAILS |
| A1.4 | COVERED TRAILER STORAGE |
| A2.1 | ELEVATIONS |
| A3.1 | BUILDING SECTIONS |
| A4.1 | WALL SECTIONS |
| A4.2 | WALL SECTIONS |
| A5.1 | SECTION DETAILS |
| A6.1 | INTERIOR ELEVATIONS |
| A6.2 | INTERIOR ELEVATIONS |
| A6.3 | INTERIOR ELEVATIONS |
| A7.1 | REFLECTED CEILING PLANS |
| A8.1 | SCHEDULES & DETAILS |
| | |
| FIRE PROTECTION | |
| FP0.1 | FIRE PROTECTION LEGEND, NOTES & DETAILS |
| FP0.2 | FIRE PROTECTION DETAILS |
| FP2.0 | FIRE PROTECTION DEMOLITION PLAN |
| FP3.1 | FIRE PROTECTION FLOOR PLANS |
| | |

| | |
|---|---|
| PLUMBING | |
| P0.1 | PLUMBING LEGEND, NOTES & SCHEDULES |
| P0.2 | PLUMBING DETAILS |
| P2.0 | PLUMBING DEMOLITION PLAN |
| P3.1 | PLUMBING FLOOR PLANS |
| P3.2 | PLUMBING FLOOR PLANS |
| | |
| HVAC | |
| H0.1 | HVAC LEGEND & GENERAL NOTES |
| H0.2 | HVAC LEGEND & GENERAL NOTES |
| H0.3 | HVAC SCHEDULES |
| H0.4 | HVAC DETAILS |
| H0.5 | HVAC DETAILS |
| H0.6 | HVAC CONTROLS |
| H1.1 | HVAC DEMOLITION PLAN |
| H2.1 | HVAC LEVEL 1 FLOOR PLAN |
| H2.2 | HVAC ROOF PLAN |
| | |
| ELECTRICAL | |
| E0.1 | ELECTRICAL LEGEND AND NOTES |
| E0.2 | ELECTRICAL SYSTEMS RISER DIAGRAMS |
| E0.3 | ELECTRICAL SYSTEMS RISER DIAGRAMS |
| E0.4 | ELECTRICAL SCHEDULES |
| E0.5 | ELECTRICAL DETAILS |
| E0.6 | ELECTRICAL DETAILS |
| E1.0 | ELECTRICAL SITE PLAN |
| E2.0 | FIRST FLOOR PLAN ELECTRICAL DEMOLITION |
| E3.0 | FIRST FLOOR PLAN LIGHTING PLAN |
| E3.1 | FIRST FLOOR PLAN ELECTRICAL POWER PLAN |
| E3.2 | FIRST FLOOR PLAN ELECTRICAL RAISED FLOOR PART PLAN |
| E3.3 | FIRST FLOOR PLAN ELECTRICAL RAISED FLOOR PART PLAN |
| E3.4 | FIRST FLOOR PLAN ELECTRICAL FIRE ALARM PLAN |
| E3.5 | FIRST FLOOR PLAN ELECTRICAL SECURITY PLAN |
| E3.6 | ROOF ELECTRICAL PLAN |
| E3.7 | ROOF ELECTRICAL LIGHTING PROTECTION PLAN |

## 1.3 SUMMARY

A. Section Includes:

1. Metal ships' ladders.
2. Metal bollards.
3. Metal canopy.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.

5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts and other items indicated to be cast into concrete.

C. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete fill for bollards, installing anchor bolts and other items cast into concrete.
2. Section 133419 "Metal Building Systems" for columns to support metal canopy and for anchor bolt requirements.

## 1.4 DEFINITIONS

A. Railings: Guards, handrails, and similar devices used for protection of occupants at open-sided floor areas, pedestrian guidance and support, visual separation, or wall protection.

## 1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For ships' ladders, entrance canopy and other installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

C. Welding certificates.

## 1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's aesthetic effects and performance characteristics. Aesthetic effects are

indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including structural analysis, preconstruction testing, field testing, and in-service performance.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

C. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

## 1.8 PROJECT CONDITIONS

A. Guard railing design, finish and installation at north and south stair locations is intended to match existing guard railing construction.

B. Project area is considered a corrosive environment due to heavy use of deicing treatments.

C. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication and indicate measurements on Shop Drawings.

## 1.9 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not suit structural performance requirements.

# PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ships’ ladders and entrance canopy including connections to in-place construction.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

## 2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

E. Cor-Ten Steel Plates, Shapes, and Bars: ASTM A 588 (Cor-Ten B).

F. Cor-Ten Steel Sheet: ASTM A 606-4.

G. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.

H. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

I. Abrasive-Surface Floor Plate: Steel plate with abrasive granules rolled into surface or with abrasive material metallically bonded to steel.

J. Aluminum Plate and Sheet: ASTM B 209, Alloy 6061-T6.

K. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

## 2.3 FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless exposed fasteners are unavoidable or exposed fasteners are the standard fastening method for railings indicated.

1. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

## 2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

E. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

## 2.5 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate. Locate weep holes in inconspicuous locations.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Unless otherwise indicated or approved by the Architect, make shop connections as follows:

1. Fabricate galvanized guard railings with welded connections to match existing.
2. Fabricate running portion of stainless steel handrails with shop-welded or nonwelded connections.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

I. Mechanical Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form changes in direction as follows:

1. By bending or by inserting prefabricated elbow fittings.

K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of hollow railing members with prefabricated end fittings.

## 2.6 METAL SHIPS' LADDERS

A. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.

1. Treads shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height shall be not more than 9-1/2 inches.
2. Fabricate ships' ladders, including railings from steel.
3. Fabricate treads and platforms from galvanized abrasive-surface floor plate.

B. Prime steel ships' ladders, including, railings, brackets, and fasteners, with zinc-rich primer. Treads shall be galvanized and unpainted.

C. Ships' ladders shall be painted in work of other Sections.

## 2.7 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

1. Cap bollards with domed galvanized iron pipe caps after filling with concrete.
2. Where bollards are indicated to receive controls for door operators, provide cutouts for controls and holes for wire.

B. Galvanize bollards.

C. Bollards shall be filled with concrete and painted in work of other Sections.

## 2.8 METAL ENTRANCE CANOPY

A. Fabricate components of metal canopy from structural steel plates, shapes and bars, and Cor-Ten steel roof panels as indicated in Drawings.

B. Provide fasteners for field installation to in-place metal building construction.

C. Fabricate metal roof panels, trim, gutters and downspouts, fasteners and sheet metal accessories from in accordance with SMACNA. Fasten Cor-Ten materials with stainless steel fasteners.

## 2.9 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Fabricate braces for interior hollow metal glazed frames. Coordinate bracing with hollow metal frame assembly and metal drywall framing. Brace the drywall framing above the splice points of the hollow metal framing, but not fewer than one brace for each ten feet of frame.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

## 2.10 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on concrete construction.

1. Provide one plate for each metal building column.
2. Coordinate with Section 133419 "Metal Building Systems" for anchor bolt requirements and Section 316217 "Helical Steel Piles" for pile cap requirements.

B. Drill plates to receive anchor bolts and for grouting.

C. Galvanize plates.

D. Prime plates with zinc-rich primer.

## 2.11 ANCHOR BOLTS

A. Furnish anchor bolts as specified in Section 133419 "Metal Building Systems" for installation in Section 033000 "Cast-in-Place Concrete."

## 2.12 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipment.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Where exposed fasteners are allowed, provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean items of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Other Items: SSPC-SP 3, "Power Tool Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

## 2.14 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended in writing by manufacturer, for exterior applications.

# PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

## 3.2 INSTALLING METAL ENTRANCE CANOPY

A. General: Install framing and roof panels to comply with requirements of the delegated design and requirements indicated on Shop Drawings.

B. Modify in-place metal building construction with the addition of stiffening plates, drillings for connections, and other modifications required in the delegated design.

C. Anchor outriggers, bracing, and perimeter and intermediate support for roof panels securely to in-place building structure.

D. Attach metal roof panels, gutters, downspouts and accessories.

## 3.3 INSTALLING METAL BOLLARDS

A. Excavation, concrete footings, concrete fill and backfilling are work of the General Contractor. Placement and support of bollards is work of this Section.

B. Center and align bollards in holes 3 inches above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Install domed metal caps on bollards.

## 3.4 INSTALLING BEARING AND LEVELING PLATES

A. Coordinate installation with pile caps, anchor bolts and erection of metal building frame.

B. Clean concrete bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

C. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink

grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

## 3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 055000

# SECTION 061053 - MISCELLANEOUS CARPENTRY

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Wood blocking to support wall mounted items.
2. Wood furring to support and level finish carpentry and specialty items.
3. Plywood backing panels.
4. Drywall backing panels.
5. Carpentry required to complete the work and as indicated by other Sections.

### 1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

### 1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements.

Include physical properties of treated materials based on testing by a qualified independent testing agency.

3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

## 1.5 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Fire-retardant-treated wood.
2. Power-driven fasteners.
3. Powder-actuated fasteners.
4. Expansion anchors.

## 1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

## 1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

# PART 2 - PRODUCTS

## 2.1 WOOD PRODUCTS, GENERAL

A. Certified Wood: Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

B. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

C. Maximum Moisture Content of Lumber: 15 percent, unless otherwise indicated.

## 2.2 PRESERVATIVE-TREATED OR NATURALLY DURABLE MATERIALS

A. General: Where the Massachusetts Building Code requires preservative-treated materials or naturally durable materials, use heartwood of decay-resistant wood species that can be fire-retardant treated.

1. Wood grounds embedded in concrete supported by slabs-on-grade shall be decay-resistant.
2. Wood plates or sleepers attached directly to slabs-on-grade shall be decay-resistant.
3. Wood plates or sleepers attached to concrete or masonry supported by foundation walls or slabs-on-grade shall be decay-resistant.

B. Decay-resistant species permitted by the Massachusetts Building Code:

1. Redwood.
2. Cedar.
3. Black locust.
4. Black walnut.

C. In general, preservative treatment is not compatible with fire-retardant treatment. Certain manufacturers of fire-retardant treatment materials offer products that also provide decay resistance for above-ground, weather-protected applications due to boron content. Wood products with this treatment are acceptable for such use in lieu of naturally durable materials.

1. Protect boron-bearing materials from exposure to water.

## 2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Use treatment that does not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

E. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: **Treat all miscellaneous carpentry unless otherwise indicated.**

## 2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Furring.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species unless otherwise indicated.

1. Provide decay-resistant species where indicated herein.

C. For furring provide lumber with 19 percent maximum moisture content of any species unless otherwise indicated.

1. Provide decay-resistant species where indicated herein.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD

A. Equipment Backing Panels: DOC PS 1, Exterior, C-C Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

B. Drywall Backing Panels: DOC PS 1, Exterior, C-C Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

C. Plywood shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Load-bearing Metal Framing: ASTM C 954, length as recommended by screw manufacturer for material being fastened.

F. Screws for Fastening to Non-load-bearing Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

G. Lag Bolts: ASME B18.2.1.

H. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

I. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

1. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

D. Install plywood backing panels by fastening to wall construction; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities.

G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. "Fastening Schedule," in the Massachusetts Building Code.

3.2 WOOD BLOCKING AND NAILER INSTALLATION

A. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal-size furring perpendicular to underlying framing at 24 inches o.c. or horizontally and vertically on masonry or concrete substrates at 24 inches o.c.

3.4 DRYWALL BACKING INSTALLATION

A. Install drywall backing panels by fastening to metal framing at locations indicated. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view for inspection prior to covering.

3.5 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from water. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

# SECTION 088300 - MIRRORS

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:

1. Annealed monolithic glass mirrors.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

C. Samples: For each type of the following products:

1. Mirrors: 12 inches (300 mm) square, including edge treatment on two adjoining edges.
2. Mirror Trim: 12 inches (300 mm) long.

### 1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

### 1.5 QUALITY ASSURANCE

A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

B. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

C. Glazing Publications: Comply with the following published recommendations:

1. GANA's "Glazing Manual" unless more stringent requirements are indicated. Refer to this publication for definitions of glass and glazing terms not otherwise defined in this Section or in referenced standards.
2. GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."

## 1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

## 1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

## 1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which mirror manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

1. Warranty Period: 5 years from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.1 SILVERED FLAT GLASS MIRRORS

A. Glass Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Arch Aluminum & Glass Co., Inc.
b. Binswanger Mirror; a division of Vitro America, Inc.
c. Independent Mirror Industries, Inc.
d. Lenoir Mirror Company.

e. National Glass Industries.
f. Walker Glass Co., Ltd.

B. Clear Glass: Mirror Select Quality.

1. Nominal Thickness: ¼" minimum.

2.2 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

2.3 MIRROR HARDWARE

A. Top and Bottom Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover bottom and top edges of each mirror in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch (9.5 and 22 mm) in height, respectively, and a thickness of not less than [0.05 inch (1.3 mm)].

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Laurence, C. R. Co., Inc.; CRL Standard "J" Channel.
2) Sommer & Maca Industries, Inc.; Aluminum Shallow Nose "J" Moulding Lower Bar.
3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Shallow Nose "J" Moulding Lower Bar.

2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch (16 and 25 mm) in height, respectively, and a thickness of not less than 0.04 inch (1.0 mm).

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Laurence, C. R. Co., Inc.; CRL Deep "J" Channel.
2) Sommer & Maca Industries, Inc.; Aluminum Deep Nose "J" Moulding Upper Bar.
3) Sommer & Maca Industries, Inc.; Heavy Gauge Aluminum Deep Nose "J" Moulding Lower Bar.

3. Finish: Clear bright anodized.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

## 2.4 FABRICATION

A. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of mirror mastic with existing finishes or primers.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

## 3.2 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.

B. Provide a minimum air space of 1/8 inch (3 mm) between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Wall-Mounted Mirrors: Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Top and Bottom Aluminum J-Channels: Provide setting blocks 1/8 inch (3 mm) thick by 4 inches (100 mm) long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch (6.4 mm) wide by 3/8 inch (9.5 mm) long at bottom channel.

## 3.3 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Wash exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 088300

# SECTION 096900 - ACCESS FLOORING

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Access-flooring panels.
2. Understructure.
3. Floor panel coverings.

B. Related Requirements:

1. Section 260000 "Grounding and Bonding for Electrical Systems" for connection to ground of access-flooring understructure.

### 1.3 COORDINATION

A. Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access-flooring pedestals.

B. Mark pedestal locations on subfloor using a grid to enable mechanical and electrical work to proceed without interfering with access-flooring pedestals.

### 1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review connection with mechanical and electrical systems.
2. Review procedures for keeping underfloor space clean.

### 1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.

2. Product Data: For particleboard, indicating that product contains no urea formaldehyde.

C. Shop Drawings: Include layout of access-flooring system and relationship to adjoining Work based on field-verified dimensions.

1. Details and sections with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, and understructures.

D. Delegated-Design Submittal: For access flooring system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Samples for Initial Selection: For each type of product and exposed finish.

F. Samples for Verification: For the following products:

1. Floor Covering: Full-size units.
2. Exposed Metal Accessories: Approximately 10 inches in length.
3. One complete full-size floor panel, pedestal, and understructure unit for each type of access-flooring system required.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For each type of access-flooring system.

C. Product Test Reports: For each type of flooring material and exposed finish, for tests performed by a qualified testing agency.

D. Seismic Design Calculations: For seismic design of access-flooring systems including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Preconstruction Test Reports: For preconstruction adhesive field test.

## 1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Mockups: Build mockups to verify selections made under Sample submittals to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Build mockup of typical access-flooring assembly as shown on Drawings. Size to be an area no fewer than five floor panels in length by five floor panels in width.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install access flooring until spaces are enclosed, subfloor has been sealed, ambient temperature is between 50 and 90 deg F, and relative humidity is not less than 20 and not more than 70 percent.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design access flooring systems.

B. Engineer shall confirm the design requirements of the building code and referenced standards cited here but shall not lessen minimum quantities or raise maximum quantities indicated herein without approval by the Architect.

C. Occupancy Category: This building is assigned to Occupancy Category IV as defined in ASCE 7, Table 1.1 and Massachusetts State Building Code – 8th Edition, Table 1604.5 as an essential facility “for designated emergency preparedness, communications and operations centers and other facilities required for emergency response.”

D. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

E. Design Loads:

1. Uniform Live Load: 100 lbs. per square foot.

F. Structural Performance: Provide access-flooring systems capable of complying with the following performance requirements according to testing procedures in CISCA's "Recommended Test Procedures for Access Floors":

1. Concentrated Loads: To be determined by the delegated designer with the following deflection and permanent set:

a. Top-Surface Deflection: To be determined by the delegated designer.
b. Bottom-Surface Deflection: To be determined by the delegated designer.
c. Permanent Set: To be determined by the delegated designer.

2. Ultimate Loads: To be determined by the delegated designer.
3. Rolling Loads: With local or overall deformation not to exceed 0.040 inch.

a. CISCA Wheel 1: 10 passes at load to be determined by the delegated designer.
b. CISCA Wheel 2: 10,000 passes at load to be determined by the delegated designer.

4. Stringer Load Test: To be determined by the delegated designer, at center of span with a permanent set not to exceed 0.010 inch.
5. Pedestal Axial Load Test: To be determined by the delegated designer.
6. Pedestal Overturning Moment Test: To be determined by the delegated designer.
7. Uniform Load Test: To be determined by the delegated designer, with a maximum top-surface deflection not to exceed 0.040 inch and a permanent set not to exceed 0.010 inch.
8. Drop Impact Load Test: To be determined by the delegated designer.

G. Fire Performance:

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

a. Flame-Spread Index: 25 or less.
b. Smoke-Developed Index: 50 or less.

2. Combustion Characteristics: ASTM E 136.

## 2.2 MANUFACTURERS

A. Source Limitations: Obtain access-flooring system from single source from single manufacturer.

## 2.3 FLOOR PANELS

A. Floor Panels, General: Provide modular panels interchangeable with other field panels without disturbing adjacent panels or understructure.

1. Size: Nominal 24 by 24 inches.
2. Attachment to Understructure: To be determined by the delegated designer.
3. One-to-One Carpet Tile: Fabricate panels to accept one-to-one carpet tile.

B. Unfilled Steel Panels: Fabricated from cold-rolled steel sheet, with the die-cut flat top sheet and die-formed and stiffened bottom pan welded together, and with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tate Access Floors, Inc., All Steel 1000, 1250 or 1500 System to comply with delegated design or a comparable product by one of the following:

a. ASM Modular Systems, Inc.
b. Camino Modular Systems, Inc.
c. Computer Environments, Inc.

d. Haworth, Inc.
e. Johnsonite Access Flooring Systems.
f. Maxcess Technologies, Inc.

2. Solid Panels: Flat, solid top surface.

3. Perforated Panels: Perforated top surface with holes or slots of number, spacing, and size standard with manufacturer to produce a nominal open area to be determined by the delegated designer.

a. Quantity: To be determined by the delegated designer.
b. Finish: Manufacturer's standard.

## 2.4 UNDERSTRUCTURE

A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel.

1. Provide pedestals designed for use in seismic applications.
2. Base: Square or circular base with not less than 16 sq. in. of bearing area.
3. Column: Of height required to bring finished floor to elevations indicated. Weld to base plate.
4. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches and for locking at a selected height, so deliberate action is required to change height setting and prevent vibratory displacement.
5. Head: Designed to support the panel system indicated.

a. Provide sound-deadening pads or gaskets at contact points between heads and panels.
b. Bolted Assemblies: Provide head with four holes aligned with holes in floor panels for bolting of panels to pedestals.

6. Basis-of-Design: Tate Access Floors, Inc., PosiLock Pedestal.

B. Stringer Systems: Modular steel stringer systems designed to bolt to pedestal heads and form a grid pattern. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.

1. Provide stringer system as determined by the delegated design to accommodate height of assembly.
2. Continuous Gaskets: At contact surfaces between panel and stringers, if required, to deaden sound, seal off the underfloor cavity from above, and maintain panel alignment and position.

## 2.5 FLOOR PANEL COVERINGS

A. Carpet: Provide removable modular carpet finish designed to facilitate access to floor panels.

1. Basis-of-Design: Tate Access Floors, Inc., PosiTile System.
2. 24-inch static-control carpet tiles with four permanently affixed positioning buttons that align on access floor panels for one-to-one fit.
3. Color and pattern as selected by the Architect from manufacturer’s full line of products.

## 2.6 FABRICATION

A. Fabrication Tolerances:

1. Size: Plus or minus 0.020 inch of required size.
2. Squareness: Plus or minus 0.015 inch between diagonal measurements across top of panel.
3. Flatness: Plus or minus 0.035 inch, measured on a diagonal on top of panel.

B. Panel Markings: Clearly and permanently mark floor panels on their underside with panel type and concentrated-load rating.

C. Bolted Panels: Provide panels with holes drilled in corners to align precisely with threaded holes in pedestal heads and to accept countersunk screws with heads flush with top of panel.

1. Captive Fasteners: Provide fasteners held captive to panels.

D. Cutouts: Fabricate cutouts in floor panels for cable penetrations and service outlets. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with structural performance requirements.

1. Number, Size, Shape, and Location: As indicated.
2. Grommets: Where indicated, fit cutouts with manufacturer's standard grommets; or, if size of cutouts exceeds maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding with tapered top flange. Furnish removable covers for grommets.

## 2.7 ACCESSORIES

A. Adhesives: Manufacturer's standard adhesive for bonding pedestal bases to subfloor.

1. Adhesives shall have a VOC content of 70 g/L or less.

B. Closures: Where underfloor cavity is not enclosed by abutting walls or other construction, provide metal-closure plates with manufacturer's standard finish.

C. Ramps: Manufacturer's standard ramp construction of width and slope indicated, but not steeper than 1:12, with raised-disc or textured rubber or vinyl-tile floor coverings, and of same materials, performance, and construction requirements as access flooring.

D. Steps: Provide steps of size and arrangement indicated with floor coverings to match access flooring. Apply nonslip aluminum nosings to treads unless otherwise indicated.

E. Railings: Standard extruded-aluminum railings at ramps and open-sided perimeter of access flooring where indicated. Include handrail, intermediate rails, posts, brackets, end caps, wall returns, wall and floor flanges, plates, and anchorages where required.

1. Provide railings that comply with structural performance requirements as determined by the delegated design.

F. Panel Lifting Device: Panel manufacturer's standard portable lifting device for each type of panel required for each computer room.

G. Perimeter Support: Provide manufacturer's standard method for supporting panel edge and forming transition between access flooring and adjoining floor coverings at same level as access flooring.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, with Installer and manufacturer's representative present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, foreign deposits, and debris that might interfere with attachment of pedestals.
2. Verify that concrete floor sealer and finish have been applied and cured.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

A. Lay out floor panel installation to keep the number of cut panels at floor perimeter to a minimum. Avoid using panels cut to less than 6 inches.

B. Locate each pedestal, complete any necessary subfloor preparation, and vacuum subfloor to remove dust, dirt, and construction debris before beginning installation.

### 3.3 INSTALLATION

A. Install access-flooring system and accessories under supervision of access-flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Adhesive Attachment of Pedestals: Set pedestals in adhesive, according to access-flooring manufacturer's written instructions, to provide full bearing of pedestal base on subfloor.

C. Adjust pedestals to permit top of installed panels to be set flat, level, and to proper height.

D. Stringer Systems: Secure stringers to pedestal heads according to access-flooring manufacturer's written instructions.

E. Install flooring panels securely in place, properly seated with panel edges flush. Do not force panels into place.

F. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch where panels abut vertical surfaces.

1. To prevent dusting, seal cut edges of steel-encapsulated, wood-core panels with sealer recommended in writing by panel manufacturer.

G. Cut and trim access flooring and perform other dirt-or-debris-producing activities at a remote location or as required to prevent contamination of subfloor under already-installed access flooring.

H. Grounded Flooring Access Panel Systems: Ground flooring system as recommended by manufacturer and as needed to comply with performance requirements for electrical resistance of floor coverings.

1. Panel-to-Understructure Resistance: Not more than 10 ohms as measured without floor coverings.

I. Underfloor Dividers: Scribe and install underfloor-cavity dividers to closely fit against subfloor surfaces, and seal with mastic.

J. Closures: Scribe closures to closely fit against subfloor and adjacent finished-floor surfaces. Set in mastic and seal to maintain plenum effect within underfloor cavity.

K. Clean dust, dirt, and construction debris caused by floor installation, and vacuum subfloor area as installation of floor panels proceeds.

L. Install access flooring without change in elevation between adjacent panels and within the following tolerances:

1. Plus or minus 1/16 inch in any 10-foot distance.
2. Plus or minus 1/8 inch from a level plane over entire access-flooring area.

## 3.4 PROTECTION

A. Prohibit traffic on access flooring for 24 hours and removal of floor panels for 72 hours after installation to allow pedestal adhesive to set.

B. After completing installation, vacuum access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until time of Substantial Completion.

C. Replace access-flooring panels that are stained, scratched, or otherwise damaged or that do not comply with specified requirements.

END OF SECTION 096900

# SECTION 122413 - ROLLER WINDOW SHADES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades.
2. Motor-operated roller shades.

B. Related Requirements:

1. Section 061053 "Miscellaneous Carpentry" for wood blocking and grounds for mounting roller shades and accessories.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, drive-end and chain location, shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

D. Samples for Initial Selection: For each type and color of shadeband material.

1. Include Samples of accessories involving color selection.

E. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 3 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of shadeband material, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals. Include:

1. Methods for maintaining roller shades and finishes.
2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
3. Maintaining and adjusting operating hardware.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.9 WARRANTY

A. Roller Shade Hardware, Chain and Shadecloth: Manufacturer's standard 25 year non-depreciating warranty.

B. Roller Shade Motors and Motor Control Systems: Manufacturer's standard non-depreciating five-year warranty.

C. Roller Shade Installation: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide manual and motorized chain drive roller shades manufactured by MechoShade Systems, Inc. (represented locally by Shannon Corporation, Sudbury, MA, 978-443-4911) or comparable products by one of the following:

1. Draper Inc.
2. Window Tex.
3. Approved equal.

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Stainless steel, 90 lb. test.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Chain tensioner, jamb mounted wherever possible.

B. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade, unless otherwise noted on submittal.
2. Direction of Shadeband Roll: Regular, from back of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method utilizing hook and loop strip.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material. Heat seal hembar on top and sides so that hembar cannot be removed. Open ended hembar will not be accepted

E. Installation Accessories:

1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

a. Height: Manufacturer's standard in height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

## 2.3 MOTOR-OPERATED, SINGLE-ROLLER SHADES

A. Motorized Operating System: Provide factory-assembled, shade-operator system of size and capacity and with features, characteristics, and accessories suitable for conditions indicated, complete with electric motor and factory-prewired motor controls, power disconnect switch, enclosures protecting controls and operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with building electrical system.

1. Electrical Components: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Electric Motor: Manufacturer's standard tubular, enclosed in roller.

a. Electrical Characteristics: As indicated in Electrical drawings.
b. Maximum Total Shade Width: As required to operate roller shades indicated.
c. Maximum Shade Drop: As required to operate roller shades indicated.
d. Maximum Weight Capacity: As required to operate roller shades indicated.

3. Remote Control: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following for remote-control activation of shades:

a. Individual Switch Control Station: Momentary-contact, wall-switch-operated control station with open, close, and center off functions.
b. Color: As selected by Architect from manufacturer's full range.

4. Crank-Operator Override: Crank and gearbox operate shades in event of power outage or motor failure.
5. Limit Switches: Adjustable switches interlocked with motor controls and set to stop shades automatically at fully raised and fully lowered positions.
6. Operating Features:

    a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.

B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: To be determined at submittal.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Manufacturer's standard method.

C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

D. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers that are operated by one roller drive-end assembly.

E. Shadebands:

1. Shadeband Material: Light-filtering fabric.
2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

    a. Type: Enclosed in sealed pocket of shadeband material. Heat seal hembar on top and sides so that hembar cannot be removed. Open ended hembar will not be accepted

F. Installation Accessories:

1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

    a. Height: Manufacturer's standard in height required to enclose roller and shadeband assembly when shade is fully open, but not less than 4 inches.

2. Endcap Covers: To cover exposed endcaps.
3. Installation Accessories Color and Finish: As selected from manufacturer's full range.

## 2.4 SHADEBAND MATERIALS

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

1. Source: Roller-shade manufacturer.
2. Type: PVC-coated fiberglass, PVC-coated polyester, or PVC-coated fiberglass and polyester blend.
3. Weave: Basketweave.
4. Weight: 15 oz./sq. yd., minimum.
5. Openness Factor: 3 percent.
6. Color: As selected by Architect from manufacturer's full range.

C. Basis-of-Design Product: Subject to compliance with requirements, provide:

1. MechoShade Systems, Inc.; 3% Open Dense Basket Weave 1500 Series; or a comparable product by the selected shade manufacturer.

## 2.5 ROLLER-SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

C. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.

D. Shadeband Fabrication: Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with heat-sealed trimmed edges to hang straight without curling or raveling. Fabricate shadecloth to roll true and straight without shifting sideways more than 1/8 inch in either direction per 8 feet of shade height due to warp distortion or weave design.

Fabricate shadebands without battens or seams to fullest extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances,and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

B. Electrical Connections: Connect motor-operated roller shades to building electrical system.

C. Roller Shade Locations: As indicated on Drawings.

### 3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

### 3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 122413

# SECTION 124813 - ENTRANCE FLOOR MATS AND FRAMES

## PART 1 - GENERAL

### 1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

### 1.2 SUMMARY

A. Section Includes:

1. Resilient-tile entrance mats.
2. Surface-mounted frames.

### 1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Shop Drawings:

1. Perimeter floor moldings.

C. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.
2. Tread Rail: Sample of each type and color.
3. Frame Members: Sample of each type and color.

### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Resilient-Tile Entrance Mats: Full-size tile units equal to 2 percent of amount installed, but no fewer than 1 case.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and the Regulations of the Massachusetts Architectural Access Board.

2.2 RESILIENT-TILE ENTRANCE MATS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Mats, Inc. Dover Tile, or comparable products by one of the following or approved equal:

1. American Floor Products Company, Inc.
2. Matco International.

B. Carpet-Type Tiles: 100 percent solution-dyed ultra-violet stabilized polypropylene carpet bonded to 1/8- to 1/4-inch-thick, flexible vinyl backing to form mats 3/8 or 7/16 inch thick with nonraveling edges.

1. Colors, Textures, and Patterns: As selected by Architect from manufacturer’s full range.
2. Tile Size: 50 cm x 50 cm.

2.3 FRAMES

A. Surface-Mounted Frames:

1. Tapered Frames: Tapered aluminum frame members, not less than 2 inches wide, securing mat at doorways and where edges are exposed to foot traffic.

a. Aluminum Color: Black.

2.4 FABRICATION

A. Surface-Mounted Frames: As indicated for permanent surface-mounted installation, complete with corner connectors, splice plates or connecting pins, and postinstalled expansion anchors.

B. Coat concealed surfaces of aluminum frames that contact cementitious material with manufacturer's standard protective coating.

2.5 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install resilient tile units to comply with manufacturer's written instructions at locations indicated; coordinate with entrance locations and traffic patterns.

1. Anchor fixed surface-type frame members to floor with devices spaced as recommended by manufacturer.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 124813

31000 - EARTHWORK

TABLE OF CONTENTS

SECTION 000 - SPECIFICATIONS

SCOPE OF WORK

All work, under contract, shall be performed in accordance with Division II and III of the latest edition of the Massachusetts Standard Specifications for Highways and Bridges as amended, except as otherwise required in these specifications.

Unless otherwise specified, the work to be completed under contract, consists of the furnishing of all equipment, labor and materials and performing all work in strict compliance with these specifications for the construction of SUPERPAVE bituminous concrete pavement, drainage pipe, removal of designated trees, adjusting frames and covers and all else specified herein, together with all appurtenances. The work is located in the City of Worcester, Massachusetts, in the street noted in the proposal. All work shall conform to the standards and specifications on file with the City of Worcester, Department of Public Works and Parks – Engineering Division, and any changes, drawings, plans and written directions that may, from time to time, be issued by the Contracting Officer.

MEASUREMENT AND PAYMENT

Unless specified otherwise herein, measurements and payment for all items of work shall be in accordance with the applicable provisions of the Massachusetts Standard Specifications for Highways and Bridges latest amendment (MSSHB).

SECTION 100 - EARTHWORK

The work to be done under Items 100 through 110 shall conform to the applicable provisions of Section 101, (MSSHB). Trees under 9 inches and stumps under 9 inches in diameter that are required to be removed are considered as a subsidiary obligation of the Contractor and are to be removed at the Contractor's expense.

ITEM 100 CLEARING & GRUBBING

ITEM 104 TREE REMOVAL (LESS THAN 24 INCHES) INCLUDING STUMP

ITEM 106 TREE REMOVAL (24 INCHES & OVER) INCLUDING STUMP

ITEM 108 STUMP REMOVED (LESS THAN 24 INCHES)

A. GENERAL

The Contractor shall provide all balled and burlapped trees, all necessary hardware, materials, labor, tools, equipment required to properly complete the work.

B. METHOD OF PLANTING

All trees required shall be transported, moved and installed with the fibrous root system as a solid mass of earth as possible.

The diameter and depth of the earth mass must be sufficient to encompass the fibrous and feeding root systems necessary for the healthy development of the new trees, but not larger than the tree planting pit.

The Contractor shall provide at least one (1) person who shall be present at all times during the execution of the work and who shall be thoroughly familiar and knowledgeable with the type of trees being handles in reference to the best methods for their proper delivery, handling and installation.

C. PLANT MATERIALS

All trees shall be nursery grown and shall have a caliper of 2 - 2-1/2 inches.

Tree type shall be London Plane Tree, Ginkgo Biloba (male only), Redmond Linden, Washington American Elm, approximately 18 feet in height.

The root shall be approximately 18 inches in diameter so that it may properly be located in the sidewalk minimizing pedestrian interference.

D. FERTILIZER: 16-8-16 (3) Year Release

Tree fertilizer packets shall be installed in the tree planting pit during tree planting installations. A minimum of two (2) fertilizer packets per tree, or as recommended by the manufacturer.

E. GUARANTEE PERIOD

At the end of the establishment period of 120 days, formal written acceptance from the City Supervisor of Forestry/Parks Department stating that tree plantings and their care and maintenance has been completed by the Contractor in all respects in accordance with the tree specifications.

After the establishment period, the Contractor shall guarantee that all trees shall be in good healthy and flourishing condition two (2) years from date of acceptance.

The Contractor shall note that the guarantee period of two (2) years begins at the end of the establishment period after acceptance from the City Supervisor of Forestry/Parks Department.

F. SPECIAL CONDITIONS

The Contractor shall install a root control system to create an in-soil barrier that can block roots without harming plants. The root control system shall be Typar biobarrier or equal that combines a fabric with time-release herbicide. The specified fabric width is 19.5 inches installed as shown on the figure below.

All newly planted trees shall be watered in by the Contractor within twenty-four (24) hours after planting.

During the establishment period of 120 days, the Contractor shall be required to water trees adequately. An adequate supply of water is estimated to be the equivalent of one (1) inch of water per week, delivered at weekly intervals in the form of natural rain or augmented as required by the Contractor.

Guying all trees shall be completed immediately after planting. Drive ground anchors into the ground by manual or machine method at approximately 45-degree angle to the ground plane and at 120-degree intervals around the tree. Pre-load anchors after driving until anchor turns in ground at 90 degree angle to the line of driving force. Anchor assembly will rise 2 to 6 inches during pre-loading. Attach guying cables, turnbuckles and hoses. Tighten until tree is rigidly guyed. On all guys, 1/3 distance up from ground to trunk, secure white flagging, 1"x18" tied securely.

G. MEASUREMENT AND PAYMENT

The work under Item 107 Street Tree Replacement will be paid per each installed, complete in place.

ITEM 116 EXCAVATION

A. GENERAL

The work to be done under this item shall conform to the applicable provisions of Section 120, (MSSHB).

The bituminous concrete pavement where it exists is to be removed and disposed of satisfactorily with due caution being taken by the Contractor not to disturb any of the castings that are now on the streets in question.

B. MEASUREMENT AND PAYMENT

For the sum bid under this item the Contractor shall also excavate and salvage any inlet stone or capstones encountered in the working area. The inlet or capstone curb shall be stacked at the Department of Public Works and Parks – Millbury Street Yard (formerly Ballard Street Yard) unless otherwise directed by the Contracting Officer. This item will be paid by the cubic yard.

ITEM 118 CLASS "A" ROCK EXCAVATION AND DISPOSAL

A. C. GENERAL

The work to be done under this item shall conform to the applicable provisions of Section 120, (MSSHB) with the exception that method of payment will be made only for excavation to line and grades as indicated on the plans or as directed by the Contracting Officer.

B. D. MEASUREMENT AND PAYMENT

Measurement shall be in cubic yards.

ITEM 120 CLASS "B" ROCK EXCAVATION AND DISPOSAL

A. GENERAL

The work to be done under this item shall conform to the applicable provisions of Section 140, (MSSHB). No allowance in addition to the price paid for the item will be made for pumps, pumping or bailing, equipment or labor necessary on account of water. All excavated and unsuitable material, except as directed by the Contracting Officer, shall be removed from the site.

B. MEASUREMENT AND PAYMENT

Measurement shall be in cubic yards.

ITEM 123 STRUCTURES ABANDONED OR REMOVED

A. GENERAL

The work to be done under this item shall conform to the applicable provisions of Section 140, (MSSHB).

B. MEASUREMENT AND PAYMENT

The unit bid price per each shall be full compensation for all work required including salvage and delivery to the City's Department of Public Works and Parks – Millbury Street Yard (formerly Ballard Street Yard) of any castings as directed by the Engineer.

ITEM 130 CRUSHED STONE 3/4 INCH

ITEM 134 RIP RAP

ITEM 154 TOPSOIL EXCAVATED AND STACKED

A. GENERAL

The work to be done under this item shall conform to the applicable provision of Section 120.65, (MSSHB). Also see Item 751.62, (MSSHB), Topsoil Rehandle and Spread.

B. MEASUREMENT AND PAYMENT

Measurement shall be in cubic yards.

ITEM 155 TOPSOIL REHANDLED AND SPREAD

A. GENERAL

The work under this item shall conform to the applicable provisions of Section 751.61, (MSSHB).

B. MEASUREMENT AND PAYMENT

Measurement shall be in cubic yards.

ITEM 156 SEEDING

A. GENERAL

The work to be done under this item shall conform to the provisions of Section 765, (MSSHB).

No payment for seeding will be made by the Contracting Officer for seeding required when disruption is caused by the removal and replacement of existing sidewalks or driveways. This work shall be considered included.

B. MEASUREMENT AND PAYMENT

Measurement shall be in square yards.

SECTION 200 - TRENCH PIPE WORK

Under Items 220 - 223 the work specified shall consist of excavation, backfilling and compaction of all materials encountered in the trenching for sewer mains and sewer services and the disposal of any and all surplus material from these excavations, as shown on the plans and specified herein. Unless shown on design plans or specified by the Contracting Officer, excavation and backfill for sanitary and surface sewers will be paid for as a common trench. The pay limits of the trench are those shown on a plan titled Typical Trench.

ITEM 220.04 TRENCH EXCAVATION AND BACKFILL, FURNISH AND INSTALL 4" PVC

ITEM 220.06 TRENCH EXCAVATION AND BACKFILL, FURNISH AND INSTALL 6" PVC

DESCRIPTION

The Contractor shall make excavations in such manner and of such widths as will give suitable room for building the structures or laying and jointing pipe; shall furnish and place all sheeting, bracing and supports; shall do all cofferdamming, pumping and draining; and shall render the bottom of the excavation firm and dry and in all respects acceptable. In no case shall the earth be plowed, scraped, or dug by machinery so near to the finished subgrade as to result in disturbance of material below said subgrade.

All excavations, except as otherwise specified or permitted shall be made in the open. No tunneling will be permitted except by order or permit previously obtained from the Contracting Officer in writing.

A. SEPARATION OF SURFACE MATERIALS

From areas where excavations are to be made, loam and topsoil shall be carefully removed and separately stored to be used again as directed, or if the Contractor prefers not to separate surface materials he shall furnish, as directed, and at no additional cost to the City, loam and topsoil at least equal in quantity and quality to that excavated.

B. PREPARATION OF SUBGRADE

From areas upon which embankments are to be built or material is to be placed for grading, the Contractor shall remove loam and topsoil, loose vegetable matter, stumps, large roots, etc. The subgrade shall be shaped as indicated on the drawings and shall be so prepared that the first layer or new material to be placed, on the subgrade, shall be firmly bonded thereto.

C. CUTTING THROUGH PAVEMENT – IN STREETS

Where existing bituminous concrete pavement is to be removed to allow for excavation, the pavement shall be pre-cut in a neat, clean straight line with a pavement breaker or saw. The minimum width of any excavation shall be 24 inches. Pavement edges shall be trimmed to a vertical face and neatly aligned parallel and perpendicular to the centerline of the trench. Pulverization of a trench will be considered an acceptable procedure provided that the trench is cut in a neat, straight line with a pavement breaker or saw prior to permanent restoration. The City may prohibit heavy-duty pavement breakers when their use endangers existing substructures or other property. Unstable pavement shall be removed over cave-ins and breaks and the subgrade shall be treated as the main trench. The Contractor shall not be required to pay for the repair of any pavement damage existing prior to the excavation unless the Contractor's cut results in small floating sections that may be unstable. If this occurs, the Contractor shall remove the unstable portion and the area shall be treated as part of the excavation. The maximum length of open trench permissible at any time shall be two hundred (200) feet. No greater length shall be opened for pavement removal, excavation, construction, backfilling, patching or any other operation without written permission of the City.

D. CUTTING THROUGH PAVEMENT - IN SIDEWALKS

All provisions of CUTTING THROUGH PAVEMENT – IN STREETS above shall also apply to sidewalks. On cement concrete sidewalks, individual concrete panels will be replaced to the nearest joint or score line the full width of the sidewalk.

E. SHEETING AND BRACING

The Contractor shall furnish, put in place, and maintain such sheeting and bracing, etc., as may be required to support the sides of the excavation and to prevent any pavement of earth which would in any way diminish the width of the excavation below that is necessary for proper construction, or otherwise injure or delay the work or endanger adjacent structures.

Whenever possible, sheeting shall be driven ahead of the excavation to avoid loss of material from behind the sheeting. If necessary to excavate below the sheeting, care shall be taken to avoid trimming behind the face along which the sheeting will be driven. Care shall be taken to prevent voids

outside of the sheeting, but if voidsare formed, they shall be immediately filled with sand and compacted.

The Contractor shall leave in place to be embedded in the backfill or concrete all sheeting, bracing, etc., which is shown on the drawings to be left in place, and shall also leave in place any and all other sheeting, bracing, etc., not shown on the drawings which the Contracting Officer may direct him in writing to leave in place at any time during the progress of the work, for the purpose of preventing injury to structures or property. Sheeting to be left in place shall be cut off at an elevation as specified or as directed by the Contracting Officer.

All sheeting and bracing not to be left in place shall be carefully removed in such a manner as not to endanger the construction or other structures. All voids left or caused by withdrawal of sheeting shall be immediately backfilled with approved material and compacted by ramming with tools especially adapted to that purpose, by watering, or otherwise as may be directed. As specified under Sheeting Left in Place, the Contractor shall be paid only for sheeting left in place.

F. DRAINAGE

The Contractor shall at all times during construction provide and maintain ample means and devices with which to remove promptly and dispose properly of all water entering trenches and other excavations and keep said excavations dry until the structures, pipes and appurtenances to be built therein are completed. All water pumped or drained from the work shall be disposed of in a suitable manner without undue interference with other work or damage to pavements or other surfaces. Suitable temporary channels shall be provided for water that may flow along or across the site of the work.

G. DRAINAGE WELLPOINT SYSTEM

The Contractor shall, if required, dewater the excavation by means of an efficient dewatering system to drain the soil and prevent saturated soil from flowing into the excavation. The dewatering system shall be designed for this type of service and the pumping unit used shall be adequately designed and capable of dewatering the excavation.

If required, the installation of the dewatering system shall be done under the supervision of a competent representative of the manufacturer. Any special work shall be done, such as surrounding the system with sand or gravel, to ensure that the system shall operate as herein intended for the unwatering excavation.

H. TRENCH HAND EXCAVATION

When approaching underground pipes, conduits, or other structures, digging by machinery shall be discontinued and the excavation shall be done by hand. Such hand excavation when incidental to normal excavation shall bedone at no expense to the City.

I. DEPTH OF TRENCH

Trenches shall be excavated to such depths as will permit the pipe to be laid to the elevations or slopes indicated on the drawings, and to uniform slope between indicated elevations.

J. PROTECTION OF EXISTING STRUCTURES

All existing pipes, conduits, poles, wires, fences, curbing, property line markers, and other structures which in the opinion of the Contracting Officer, are not required to be changed in location shall be carefully supported and protected from damage by the Contractor, and in case of damage, they shall be restored by him, without compensation therefore, to as good condition as that in which they were found.

Attention is called to the fact that there are water pipes, gas pipes, drain, and other utilities located throughout the project limits. The Contractor shall make himself fully aware of the location of these utilities prior to beginning the new work.

K. RELOCATING EXISTING STRUCTURES

Whenever it becomes necessary, in the opinion of the Contracting Officer, to change the location of any existing pipe, or other structures not otherwise provided for in these specifications, the Contractor, if ordered, shall do the whole or such portions of the work of making such changes as the Contracting Officer may require, and the work shall be paid for as extra work.

L. DISPOSAL OF MATERIALS

The most suitable material from excavations shall be used for backfilling around structures and for backfilling in open trenches as specified below.

All surplus excavated material and all unsuitable material shall be removed from the site of the work and be disposed of by the Contractor without additional compensation.

M. AMOUNT OF OPEN EXCAVATION

The amount of excavation open at any one time will be controlled by project conditions, but shall always be confined to the limits as approved by the Contracting Officer.

N. UNAUTHORIZED EXCAVATIONS

If the bottom of any excavation is being taken out beyond the limits shown on the drawings, or approved by the Contracting Officer, it shall be backfilled at the Contractor's expense with crushed stone as required by the Contracting Officer.

O. ELIMINATION OF UNSUITABLE MATERIAL

If, in the opinion of the Contracting Officer, the material at or below the point to which excavation would normally be carried is unsuitable for foundation, it shall be removed to such widths and depths as he may direct and be replaced with crushed stone of approved size under Items 130 - 132.

P. BACKFILLING AROUND STRUCTURES AND UTILITIES

As soon as practical after the pipes and masonry have been installed and the concrete has acquired a suitable degree of hardness, special leakage tests, if required, shall be made after which backfilling procedures shall begin and shall thereafter be prosecuted expeditiously. Approved Select Common Fill, in compliance with Item #124, shall be used to backfill around structures. Backfilling procedures shall conform to all applicable provisions of this section. JETTING MAY BE CONSIDERED AS A FORM OF COMPACTION AS DIRECTED BY THE CONTRACTING OFFICER.

In the event that 95% compaction cannot be achieved due to the location of existing utilities, the Contractor may be required to use excavatable Controlled Density Fill (CDF) to backfill around utilities. CDF shall conform to Item #385.1 and be paid for by the cubic yard complete in place.

Q. BACKFILLING IN OPEN TRENCH

Pipelines shall be installed as shown on the Typical Trench Details on the plan. Single sanitary pipelines shall be installed in an envelope of stone from 6 inches below the pipeline to 6 inches above the pipeline. Single surface pipelines shall be installed in an envelope of stone from 6 inches below the pipeline to the spring-line of the pipe. In typical trenches containing two (2) pipe lines, the limits of the stone shall be from 6 inches below the lowest pipe line to the center elevation of the higher pipeline. Select common fill shall be placed and thoroughly compacted by means of mechanical or pneumatic tamping up to a level of one (1) foot above the top of the pipe.

The backfilling of the trench shall follow immediately after construction of the pipeline and appurtenances.

The backfilling of the trench shall be made with selected common fill from the excavation and conform to Item #124, Ordinary Borrow/Selected Common Fill.

Prior to beginning backfill operations, the contractor shall be responsible for contacting the Contracting Officer to obtain a soil sample. The soil sample will then be forwarded to an approved material-testing agency to insure its compliance with the project's specifications. A maximum laboratory dry density of the soil will be determined in accordance with ASTM D698. It will benefit the contractor to provide a soil sample prior to the beginning of the project. This will allow field density test values to be calculated, as the excavation is being backfilled and allow for additional passes with compaction equipment, if necessary. It will also be the responsibility of the contractor to notify the Contracting Officer if any change in soil characteristics occurs.

Approved backfill material shall be placed in lifts not to exceed ten (10) to twelve (12) inches and thoroughly compacted by mechanical or pneumatic compactors to at least ninety-five per cent (95%) of the soil's maximum laboratory dry density.

Adequate moisture content in a backfill material is essential to achieve effective compaction. It will be the Contractor's responsibility to adjust the moisture content of the soil as necessary to achieve the specified compaction.

An approved material testing agency or certified City Engineer will then perform field density testing. Density testing will be performed at intervals of one (1) test per one hundred (100) linear feet of the compacted lift. In the event that the project is of a short duration or begins prior to obtaining the soil's maximum laboratory dry density (which is necessary in determining field density test results), the contractor shall assume full responsibility for re-excavating and re-compacting areas of failed field density tests.

Due to the hazardous nature of performing field density testing in deep excavations (6 feet or deeper), the contractor shall be responsible for establishing a method of compaction using mechanical or pneumatic compactors that assures each lift is compacted to at least 95% of the soil's maximum laboratory dry density.

As the excavation is brought to grade and field density tests are taken, the Contracting Officer, along with the contractor, shall establish a sufficient compaction method necessary to achieve at least ninety-five per cent (95%) of the material's maximum laboratory dry density based on the type of compaction equipment, number of passes and existing soil type and moisture content.

BUCKET WHACKING WILL NOT BE PERMITTED AS A MEANS OF COMPACTION.

In public or private streets excavated for sewer mains or sewer services, the top of the selected common fill shall be left one (1) foot below the bottom of the existing pavement surface. The remainder of the trench shall be backfilled with gravel borrow, conforming to MHD Standard, Section M1.03.0, Type b. this layer of gravel borrow shall form the sub-base of the road. This shall be a subsidiary obligation of the Contractor at no additional cost to the City of Worcester.

On Private Streets, the Field Engineer may require that additional gravel borrow be placed on the surface of the backfilled trench to a reasonable depth and width. This will be done to cover part of, or even the entire, traveled way to eliminate impassable traffic conditions. This shall be in effect for one (1) year after completion of the work.

Unless recommended by the ASTM standards and by the manufacturers of the various kinds and types of pipe, the Contractor shall not joint pairs of pipe before laying them.

The factory instructions for unloading, handling, and laying and jointing the various kinds and types of pipes and fittings shall be followed explicitly and shall also follow the standards below, providing that the listed standards do not conflict with the manufacturer's recommendations:

1. ASTM Standard Recommended Practice for Installing Vitrified Clay Pipe Sewers, Designation C 12.

2. ASTM Standard Specifications for Rubber Rings for Asbestos Cement Pipe, Designation D 1869.

3. AWWA Standard for Installation of Cast Iron Water Mains C 600.

4. ASTM Standard Specifications for the Underground Installation of Flexible Thermoplastic Sewer Pipe, Designation D 2321.

5. ASTM Standard Specifications for Butt Fusion of Polyethylene (PE) Plastic Pipe Fittings, Schedule 40, Designation D 2610.

6. ASTM Standard Specifications for Butt Fusion of Polyethylene (PE) Plastic Pipe Fittings, Schedule 80, Designation D 2611.

7. ASTM Recommended Practice for the Underground Installation of Thermoplastic Pressure Piping, Designation D 2774.

8. ASTM Standard Specifications for Plastic Pressure Pipe using Flexible Elastomeric Seals, Designation D 3139.

9. Tentative Specifications for Joints for Drain and Sewer Plastic Pipe using Flexible Elastomeric Seal, Designation D 3212-73T.

10. Standard Specifications for Butt Heat Fusion of Polyethylene (PE) Plastic Pipe and Tubing, Designation D 3261.

Where a concrete cradle is used, the pipe shall be laid on concrete saddles so constructed as to provide lateral support for the pipe while the cradle is being placed. The location, dimensions, and class concrete required for cradles are given on the drawings.

Branches and fittings shall be laid by the Contractor as and where directed. Open ends of pipe and branches shall be closed with the appropriate stoppers and/or plugs secured in place in an acceptable manner using an approved gasket for the stopper and/or plug. No walking on or working over the pipes after they are laid, except when necessary in tamping the earth and backfilling, will be permitted until they are covered with earth to a depth of one (1) foot. All openings to the pipe line shall be satisfactorily protected from the entrance of earth, water, or other material, and all necessary precautions shall be taken to prevent flotation of the pipe.

SURFACE SEWERS

A. GENERAL

Under this item, the Contractor shall furnish all labor, tools, equipment, pipe, fittings, stoppers and/or plugs, jointing materials and screened gravel required to handle, lay and joint pipe for sur-

face sewers (storm drains), including tee connections, Y-branches, and pipe for chimneys. Where applicable the connector shall be Kor-N-Tee as manufactured by NPC Systems, Inc., N.H. or equal.

ITEM 235 CATCH BASIN FRAME & GRATE

A. INSTALLATION OF CASTING FRAMES

Casting frames shall be set on a full bed of mortar, set to finish grade and concentric with the masonry. All voids beneath the bottom flange shall be completely filled to make a watertight fit. A ring of mortar at least 1 inch thick shall be placed around the outside of the bottom flange extending to the outer edge of the masonry all around the frame. A minimum 12 inches of red sewer brick, grade MS only, shall be used under casting.

B. TECHNICAL SPECIFICATIONS

All construction castings shall meet the requirements of AASHTO M306 and shall be supplied by EJ, Inc. – LeBaron Foundry or approved Equal. All manufacturers will need their drawings and weights reviewed by Worcester Engineering to determine if item is equal.

Catch Basin grate shall be EJIW 7288M or LeBaron L28SG1. Catch basin inlet frame shall be EJIW 7288Z (4-Flange), EJIW 7288Z1 (3-Flange) or LeBaron LF288, Type E.

Cascade grate shall be EJIW 5520M8 (Left or Right Flow) or LeBaron L24SG18 grate. Cascade frame shall be EJIW 5520Z (3-Flange), EJIW 5521Z (4-Flange), or LeBaron LK120D.

Cascade Grate adapter shall be EJIW 7288H or LeBaron LE2828X1.

Cascade grate EJIW 5520M8 (Left or Right Flow) or LeBaron L24SG18 fits into the cascade grate adapter EJIW 7288H adapter or LeBaron LE2828X1.

Manhole frame and cover shall be EJIW 1056Z frame and EJIW 1056A cover or LeBaron LC239/L23C-1. Non bolted casting manhole covers shall be supplied with a closed pickhole and shall show the wording ‘Worcester, A Town June 14, 1722: A City February 29, 1848” cast into said cover. Castings that are supplied bolted and watertight may have alternate lettering.

C. MEASUREMENT AND PAYMENT

Catch basin frame and grate, cascade grate with 24" square frame, cascade grate adapter, cascade grate, or manhole frame and cover shall be paid per each complete in place, and set to finish grade as per instructed by the Contracting Officer.

The work to be done under Item 237 shall include the construction of outside drops for sanitary manholes) Outside drops are to be constructed where shown on the design drawing or as specified by the Contracting Officer. This item shall include all labor, materials, and equipment required to furnish and install all piping, fittings, and masonry.

ITEM 249 CATCH BASIN CLEANING

A. GENERAL

The work specified in this item shall include furnishing equipment and labor necessary to clean Worcester standard catch basins and the jetting of the catch basin connection. Catch basins are to be cleaned as thoroughly as possible and to the bottom of each catch basin by means of a truck mounted vacuum catch basin cleaner which uses a high-velocity pressure jet for removing sludge and debris from drainage lines, and simultaneously vacuum the sludge and debris from the catch basin or manhole. Said machine must be approved by the Contracting Officer. Care shall be taken not to damage any portions of the basin particularly that of the headstone, pre-cast structure, brick work or green trap. Any damage to the catch basin or immediate area of roadway or sidewalk shall be restored to its original condition by the Contractor at no expense to the City of Worcester. Waste contents from the catch basin will become the property of the Contractor.

B. MEASUREMENT AND PAYMENT

The unit payment for catch basin cleaning will be per each complete in place.

SECTION 300 - WATER

ITEM 301.02 2” COPPER TUBING L.F.

ITEM 301.06 6” CLDI PIPE L.F.

A. SCOPE OF WORK

The work under this section shall consist of furnishing and installing new water pipe of various sizes, complete with gaskets and accessories, and appurtenances, and making alterations in existing water main systems. The work shall also include excavating, backfilling, chlorinating, testing for leakage and other steps as may be necessary for the construction of new sections of existing water main systems as specified herein, as shown on the plans, or as directed by the Field Engineer.

B. MATERIALS

1. Ductile iron pipe shall be cement lined, coal tar enamel double coated, push-on or mechanical joint type pipe and shall conform to the latest revisions of the following AWWA Standards:

a. PIPE: AWWA C151 Class 52 for sizes 4 inch through 14 inch, Class 51 for 16 inch and up, and Class 53 for all sizes of flanged pipe with threaded flanges.

b. CEMENT LINING: AWWA C104 with a thickness not less than 1/8 inch on pipes 12 inches and smaller, and not less than 3/16 inches on pipe larger than 12 inches.

c. PUSH-ON AND MECHANICAL JOINTS: AWWA C111

d. FLANGES: AWWA C115

2. Polyethylene tubing shall conform to the latest revision of AWWA Standard C901, have a working pressure of 200 psi and shall meet the nominal size as shown on the plan. All tubing shall be copper tube size, meeting ASTM specifications D-1248, D-2239, and D-2737 and shall meet PE 3608 requirements.

3. Copper tubing shall conform to the requirements of ASTM-B88, Type K, “Annealed” (soft).

4. All pipe and tubing shall be thoroughly inspected before being installed. All cracked or otherwise defective pipe shall not be laid but shall be removed immediately from the work, and new materials of acceptable quality shall be furnished at the contractor's expense.

5. Bolts for all Flexible Couplings, Flanged and Mechanical Joints shall be high strength; low alloy steel bolts only, conforming to the latest revision of AWWA C111. Bolt manufacturers certification of compliance shall accompany each shipment.

6. All work shall conform to Typical Trench Detail W-5 which is part of these specifications.

C. DESIGN AND CONSTRUCTION

1. The minimum allowable size of any public water main shall be eight (8) inches in diameter unless otherwise approved by the Department of Public Works - Water Operations.

2. All water mains shall have a five (5) foot minimum and an eight (8) foot maximum depth of cover as measured from the top of the pipe to finish grade.

3. All pipes shall be thoroughly cleaned before being installed, and shall be kept clean until accepted in the finished work. The ends of all uncompleted lines shall be tightly closed with temporary plugs at all times when the pipe laying is not in progress, and no trench water or debris shall be permitted to enter the pipe.

4. The contractor shall furnish the necessary pumps and tools to handle any water encountered in the pipe trench, and shall maintain the trench in a satisfactory condition, free from water, during the laying of the pipe. The pipe, after being laid in place, shall not, under any circumstances, be used as a drainpipe for the trench. Pipe shall be set in accordance with manufacturer's recommendations. Pipe or fittings requiring cutting shall be beveled so that the cut end does not damage the gasket. Joint ends of pipe shall especially be kept clean.

5. When new mains are installed, the corporation stops shall be installed (dry tap) prior to the hydrostatic pressure test or as the Field Engineer directs.

6. Disinfection shall be in accordance with the latest revision of AWWA Standard 651 Disinfecting Water Mains. Precautions shall be taken to protect pipe interiors, fittings, and valves against contamination during construction. The water main shall be flushed prior to disinfection except when the tablet method is used.

The disinfection shall be accomplished by pumping a chlorine solution into the pipes by using the continuous feed method of disinfection. The initial chlorine dose concentration shall be 25 mg/l with a free chlorine residual of not less than 10 mg/l after a 24-hour holding period. After the retention period, the chlorinated water shall be flushed from the main until chlorine concentrations in the water leaving the main are no higher than that generally prevailing in the distribution system.

The tablet method of disinfection shall not be used without the expressed approval of the field engineer.

After final flushing and before the new water main is placed in service, two (2) consecutive sets of acceptable samples, taken at least 24 hours apart, shall be and shall show the absence of coliform bacteria. At least one (1) set of samples shall be collected from the new main. All samples shall be tested for bacteriological quality and be collected from every 1,200 feet of new water main plus one (1) set from the end of the line and at least one (1) set from each branch. All samples shall be collected by the City's Health Department at no charge to the contractor. No hose shall be used in the collection of samples.

If initial disinfection fails to produce satisfactory bacteriological results, the new main shall be re-flushed and shall be re-sampled. If these check samples also fail to produce acceptable results, the main shall be re-chlorinated until satisfactory results are obtained. When check samples are taken, it is advisable to sample water entering the new main also.

The environment to which the chlorinated water is to be discharged shall be inspected. If there is any question that the chlorinated discharge will cause damage to the environment, then a neutralizing chemical shall be applied to the water to be wasted to neutralize thoroughly the chlorine residual remaining in the water. Where necessary, Federal, State and local regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water. The contractor shall be responsible for the proper disposal of all heavily chlorinated water at no cost to the City. Any temporary connection to the main or other facilities required to accomplish the chlorination as just described shall be at the contractor's expense. Any temporary connections shall be properly abandoned as determined by the Field Engineer at no cost to the City.

7. Hydrostatic Testing shall be in accordance with the latest revision of AWWA Standard C600, Installation of Ductile-Iron Water Mains and their Appurtenances.

Hydrostatic pressure test shall be made at 1.5 times the working pressure but not less than 150 psi for a period of not less than 2 hours. The working pressure shall be based on the static pressure at the lowest point of the line or section under test. The test pressure shall not vary by more than 5 psi plus or minus for the duration of the test.

If permanent air release valves are not located at all high points, the contractor shall install temporary connections as necessary to expel any air in the line. All temporary connections shall be removed and plugged as directed by the Field Engineer at no cost to the City. When hydrants are in the test section, the test shall be made against the closed hydrant.

A leakage test shall be conducted concurrently with the pressure test. No pipe installation will be acceptable if the leakage is greater than the allowable leakage as determined by the formula listed in the above-referenced AWWA Standard. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

If any test of laid pipe discloses leakage greater than that specified, the contractor shall, at no cost to the City, locate and repair defective material until leakage is within the specified allowance.

8. All tees shall be three (3) way gated and all crosses shall be four (4) way gated, unless otherwise directed by the Field Engineer.

9. The contractor shall return all existing valves and valve boxes removed under normal excavation to the Millbury Street Yard (formerly Ballard Street Yard) at no additional cost to the City.

10. Small depressions shall be excavated in the trench bottom to accommodate the pipe bells and to assure continuous support of the pipe.

11. Existing valve boxes, where required, shall be removed and stacked at the Millbury Street Yard (formerly Ballard Street Yard) at the direction of the field engineer with no additional cost to the City.

12. Where specified, the existing pipe shall be removed and the new pipe installed within the same trench. The existing water pipe to be removed shall become the property of the contractor and shall be properly disposed of at no additional cost to the City.

13. Where a main is going to be abandoned in place, as specified on the plans, the service and valve boxes shall be removed and stacked at the Millbury Street Yard (formerly Ballard Street Yard) at no cost to the City.

D. SPECIAL CONDITIONS

1. During the cutting of tees, crosses, valves; the installation of tapping sleeves and the repair of leaks and breaks, sanitary construction practices shall be followed so there is no contamination of the new or existing water main with foreign material or groundwater. Any and all pipe, valves, couplings, and fittings used as listed above shall be disinfected as outlined in the latest revision of ANSI/AWWA Standard C651 for Disinfecting Water Mains.

2. All dedicated fire protection/fire sprinkler pipes shall be hydrostatically pressure tested in accordance with the latest revision of National Fire Protection Association standard, NFPA 24. Hydrostatic test shall be made at not less than 200 psi or 50 psi above static pressures in excess of 150 psi for two (2) hours. A typical “Contractor’s Material and Test Certificate for Private Fire Service Mains” shall be submitted to the Worcester Fire Department upon successful completion of all work, inspections and tests.

E. COMPENSATION

1. MEASUREMENT

Water Mains, Copper and Polyethylene Tubing shall be measured complete in place along the axis of the pipe excluding the length occupied by valves and fittings.

2. PAYMENT

Water Mains, Copper and Polyethylene Tubing including fittings, shall be paid for at the Contract Unit Price under the respective items for the kind of work involved, as set forth in the Proposal, which price shall include all pipe, excavation less than 6 feet in depth, backfill, compaction, disposal of all waste material from the excavation, tools, materials, disinfection, sheeting, shoring, successful hydrostatic and leakage tests, labor and equipment necessary to complete the work as specified herein.

3. Special Conditions

Any excavation beyond the standard trench (see detail W-5) shall be compensated under excavation pay item 116. Likewise any excavation, as directed by the City, which results in a “dry” hole, also referred to as “outside excavation” shall also be compensated under item 116.

ITEMS 302 and 303 CAST OR DUCTILE IRON FITTINGS

ITEM 302.1 CAST OR DUCTILE FITTINGS LBS.

A. SCOPE OF WORK

The work under this section shall consist of furnishing and installing cast iron or ductile iron fittings including bends, elbows, tees, plugs, reducers, flexible couplings where required, sleeves and other accessories in new or existing water mains, as shown on the plans, or as directed by the Field Engineer.

B. MATERIALS

1. All fittings for use with cast iron or ductile iron pipe shall conform to the latest revisions of AWWA C110 (gray and ductile iron standard fittings) or AWWA C153 (ductile iron compact fittings). All fittings shall be cement lined in accordance with the latest revision of AWWA C104 and shall have mechanical joints in accordance with the latest revision of AWWA C111. The ductile iron compact fittings shall be marked in accordance with Sec. 53-10 which states that the fittings shall have distinctly cast on them the identity of this standard, C153; the pressure rating, 350 psi; nominal diameter of openings; manufacturer’s identification; the country where cast; the letters “DI” or word “Ductile;” and the number of degrees or fraction of the circle on all bends.

2. All fittings shall be thoroughly inspected before being installed; all cracked or otherwise defective fittings shall not be laid but shall be removed immediately from the work and new materials of acceptable quality shall be furnished at no cost to the City.

3. Mechanical joint restraint shall be incorporated in the design of the follower gland and shall include a restraining mechanism which, when actuated, imparts multiple wedging action against the pipe, increasing its resistance as the pressure increases. This fitting shall be “Mega lug” or equal.

4. Flexible couplings shall be Dresser style or an approved equal. An approved tar coating shall be applied on the entire outer surface of such couplings including bolts when installed. Bolts shall have a factory-applied epoxy coating.

5. Bolts for all Flexible Couplings, Flanged and Mechanical Joints shall be high strength; low alloy steel bolts only, conforming to the latest revision of AWWA C111. Bolt manufacturer’s certification of compliance shall accompany each shipment.

C. DESIGN AND CONSTRUCTION

1. Fittings, which are furnished and installed in the normal course of constructing new water mains, shall conform to all applicable provisions of these specifications.

2. Tees, which are to be furnished and installed in existing water mains, will be known as Cut-in Tees, and construction shall also conform to all the applicable provisions of these specifications. In addition, the work of Cut-in Tees shall include the cutting of the existing pipe to be connected to the run and the branch, and furnishing and installing all necessary items to successfully accomplish the work including the tee, nipples, couplings, sleeves, and accessories as required. When cutting in a tee to a water main, measurements must be taken to insure close tolerances between existing pipe and pipe nipple. If the tolerance is, in the opinion of the Field Engineer, too large, a ring section shall be cut and installed on one side to make up the difference in length.

3. The contractor shall install permanent blocking under any cut-in tee or cross and under any valve or fitting installed to prevent any movement or settlement of the valve or fitting during backfilling and compaction.

D. COMPENSATION

1. MEASUREMENT

Fittings will be measured by the pound and the quantity to be paid for shall be the cast iron weight stated in latest revision of AWWA Specification C110, or the manufacturer’s rated weight, as listed in the catalog, whichever is the lesser. The Contractor shall furnish a copy of the manufacturer’s catalog at the start of the work.

The weight of glands, bolts, gaskets, restraints and other iron fitting accessories will not be included for measurement and payment.

Cut-in Tees and Crosses will be measured per Each completely installed and in place.

2. PAYMENT

Fittings will be paid for at the Contract Unit Price as set forth in the Proposal which price shall include full compensation for furnishing all labor, materials, restraint fittings or rodding, tools, equipment, and incidentals for doing all the work involved in furnishing and installing iron fittings complete in place as specified herein.

The work necessary to install a Cut-in Tee or Cross on an existing water main shall include all pipes, nipples, couplings, sleeves, accessories, the tee or cross, excavation less than 6 feet in depth, backfilling, compaction, sheeting, shoring, tools, equipment and labor. This work shall be paid for only under the item of Cut-in Tee or Cross. Under no circumstances will any of the work under this item be compensated by other pay items.

ITEMS 304 through 308 VALVES AND VALVE BOXES

SCOPE OF WORK

The work under this section shall consist of furnishing and installing new valves in new water lines, new valves in existing water lines, furnishing and installing new or removing and stacking valve boxes in water lines, adjusting gate boxes in street, adjusting service boxes (curb stops) in sidewalk area as specified herein, as shown on the plans, or as directed by the Project Engineer.

ITEM 304.01 VALVE BOX EA.

ITEM 304.03 ADJUST CURB STOP TO GRADE EA.

A. METHOD OF PAYMENT

Adjusting curb stops will only be considered for payment when an extension rod is furnished and installed by the Contractor or if a repair is requested by the Contracting Officer.

ITEM 305.06 6” GATE VALVE EA.

A. MATERIALS

1. All valves 12 inches and less and all tapping valves shall be gate type, New York Style (Metropolitan Pattern) or resilient-seated style. Both types shall meet or exceed the minimum materials and performance requirements of the latest revisions of the applicable AWWA Standards, C-500 for Metropolitan Pattern and C-509 and C515 for resilient-seated. The letters "MET" shall appear on the bonnet of all iron-bodied bronze-mounted Metropolitan style valves. Both ends shall be mechanical joint in accordance with the latest revisions of AWWA C-111 except tapping valves where the outlet end will be mechanical joint.

Design Pressure: The design of the water gate valves as described below shall be based on an internal hydrostatic pressure (working water pressure) of 200 psi.

Stem: Metropolitan and resilient-seated gate valve stems shall be non-rising design, grade E bronze with a yield strength of not less than 32,000 psi. and an elongation of not less than 10 percent in 2 inches, or stainless steel AISI Type 420, 304, or 316. The 300 series stainless steel shall be strain-hardened to meet the physical requirements referenced above.

Resilient-Seated Disc Wedge: The resilient-seated disc wedge shall be fully (100%) encapsulated in rubber. The rubber shall be securely bonded to the wedge, including the part which houses the stem nut. The stem hole through the wedge shall be full opening top to bottom and shall also be covered with rubber. Disc wedges that are not 100% fully encapsulated shall not be acceptable.

Bolting: All resilient-seated gate bonnet bolts, seal or gland plate bolts, stuffing box bolts or any other bolts with threads exposed to the environment shall be type either 304 stainless steel, ever-dur bronze, cadmium-plated (ASTM B766), or zinc-coated (ASTM A153 or ASTM B633).

Tapping Valves: All tapping valves shall be furnished with the tapping flange having a raised face or lip designed to engage the corresponding recess in the tapping sleeve flange in accordance with MSS-SP60. Tapping valves without the raised face shall not be allowed because they do not assure the proper alignment required to prevent damage by a misaligned shell cutter. The interior of the waterway in the valve body shall be a full opening capable of passing a full-sized shell cutter equal to the nominal diameter of the valve.

Country of Origin: To insure compliance with AWWA and other applicable standards, and access to manufacturing facilities for inspection purposes, and assure timely shipment and delivery, all gate type valves shall be manufactured, assembled, and tested in plants located within the continental United States.

2. All valves 14 inches and over shall be butterfly type and shall meet or exceed AWWA Standard C504 as latest revised, and shall comply with the specific requirements and design standards that follow.

Design Pressure: The design of the water butterfly valves as described below shall be based on an internal hydrostatic pressure (working water pressure) of 200 psi.

Body Type: All butterfly valves shall be of the rubber seated tight-closing type. Both ends shall be mechanical joint per AWWA Standard C111 as latest revised. All accessories (bolts, glands, and gaskets) required to make up two (2) mechanical joints shall be supplied in boxes by the vendor. The rubber seat shall be a full circle 360 degrees seat not penetrated by the valve shaft.

Valve: Bodies of all valves shall be either of cast iron conforming to ASTM A126, Class B, or ASTM A48, Class 40; of ductile iron conforming to ASTM A536, Grade 65-45-12; or of alloy cast iron conforming to ASTM A436, Type 1 and 2, or ASTM A439, Type D2, with a maximum lead content of 0.003%.

Valve Seat: The valve seat rubber shall be Buna-N rubber. If the valve seat rubber is on the disk it shall be held mechanically in place with a stainless steel clamp ring and mate with a stainless steel body ring mechanically held in place. If the valve seat rubber is on the valve body, it shall not be glued in place but it shall be held in place without hardware.

Actuator: The actuator is essentially an integral part of a butterfly valve. Actuator shall be totally enclosed and fully greased-packed for buried, submerged service up to 25 feet of head. It shall be capable of withstanding an overload input torque of 450 ft. lbs. at full-open or full-closed position, without damage to the valve or valve operator. Number of turns to operate valve shall closely resemble conventional distribution valve practices and to minimize water hammer. Actuators shall be built in full conformance with AWWA Standard C504, Class 150b as latest revised.

Testing: Shall be in compliance with AWWA C504 Section 5 as latest revised.

Performance Testing: Each valve with the actuator mounted directly on the valve shall be shop-operated three (3) times from the fully closed to the fully opened position and the reverse under a no-flow condition to demonstrate that the complete assembly is workable.

Leakage Tests: Each valve shall be shop-tested for leaks with the disc in the closed position at 200 psi.

Hydrostatic Test: All valve bodies shall be subjected to an internal hydrostatic pressure equivalent to two (2) times the rated pressure.

3. All MET gates (including tapping valves) and butterfly type valves shall be spray coated with a two-component epoxy to cover all interior ferrous surfaces that come in contact with water. The constituents of the cured film shall be non-hygroscopic, non-water soluble, and FDA approved for exposure to fluids for human consumption. Surface preparation shall be blast cleaned or other approved method to near white metal. All metal surfaces shall be cleaned to remove all dirt, dust, mill grade, rust, corrosion products, oxides, paint or any other foreign matter. Blast cleaned surface shall be protected from conditions of high humidity, rainfall or surface moisture. No surface shall be allowed to flash rust before coating. The coating shall be applied to a minimum thickness of 8 mils. All holidays in the coating shall be repaired by the application of another coat of epoxy over the area. The body and ferrous vane shall then be 100% checked on the water-wetted surfaces to be electronically void-free.

All resilient gate valves (including tapping valves) shall have a fusion-bonded epoxy coating applied to and fully cured on all interior and exterior ferrous surfaces that are in constant contact with water. Coating shall meet or exceed the minimum materials and performance requirements in AWWA C550 latest revisions. The coating shall be a minimum of 10 mils thickness, and shall be shown to be holiday-free when tested with a low-voltage holiday detector, using a sponge saturated with a 1/2 percent by weight sodium chloride solution.

4. Certificates of Compliance: A certificate of compliance from the manufacturer stating that the valve, stem, operator and coating meets all criteria set forth in this specification shall be submitted and approved before installation of any valve. The certificate must be signed by an authorized company official and notarized by a notary public.

5. All valves, except 2 inch, shall be fitted with a standard 2 inch square operating nut and shall open right (clockwise).

6. Valve boxes shall be cast iron two- (2) piece slip type having an extension range of 40 inches to 61 inches, with the flange located at the bottom of the top section. Gate box extension sections shall have an extension range as listed below.

Top Section: This section shall be 26 inches in length with a minimum internal diameter of 6-1/8 inches. A flange shall be located at the bottom of the section and the flange shall have a minimum diameter of 9 inches.

Bottom Section: This section shall be 36-inches in length with a minimum internal diameter of 5-1/4 inches. The lower portion of this section shall be bell-shaped to accommodate the operating nut and packing assembly of the valve it will be set on. The minimum internal diameter of the bell-shaped portion shall be 8 inches and the minimum height of the bell-shaped portion shall be 6-1/2 inches.

Intermediate Extension Section: This section shall be 18 inches in length with an extension range up to 14 inches. The section shall have a minimum internal diameter of 5-1/4 inches.

Gate Box Cover: The cover shall be cast iron with the word “WATER” cast into the cover. The cover shall have a minimum overall length of 3-1/2 inches.

Fixed or adjustable cast iron riser sections that are less than 5-1/4 inches in diameter and can be placed on or inserted inside the existing top section shall not be allowed.

7. Roadway Boxes to accommodate 2-inch valves shall be cast iron, two- (2) piece slip type with an arched base having an extension range of 49 inches to 62 inches.

Top Section: This section shall be a minimum of 18 inches in length with a minimum internal diameter of 5-7/16 inches. A flange shall be located at the bottom of the section and the flange shall have a minimum diameter of 8 inches.

Bottom Section: This section shall be a minimum of 27 inches in length with a minimum internal diameter of 4-1/4 inches. The lower portion of this section shall be an arched bell-shape to accommodate the 2-inch valve and 2-inch pipe it will be set over. The minimum width and the minimum height of the arch shall be 3-5/8 inches and 3-1/4 inches respectively. The minimum internal diameter of the bell-shaped portion shall be 7 inches and the minimum height of the bell-shaped portion shall be 6 inches.

Extension Section: This section shall be a minimum of 22 inches in length with an extension range up to 18 inches. This section shall have a minimum internal diameter of 4-1/4 inches.

Cover: The cover shall be cast iron with the word “WATER” cast into the cover. The cover shall have a minimum width and length of 5-7/8 inches and 1-9/16 inches respectively.

8. All 2-inch corporation valves shall be ball-type equal to or exceeding the quality of series FB1000 with tee head adapter (cc. thread x compression) as manufactured by Ford.

9. Bolts for all flexible couplings, flanged and mechanical joints shall be high strength, low alloy steel bolts only, conforming to AWWA C111 as latest revised. Bolt manufactures certification of compliance shall accompany each shipment.

10. CUT-IN VALVES: Valves of a given size to be cut-in to an existing line shall have the same pay item number followed by the words “CUT-IN”. A valve to cut-in shall meet the same specifications as valves of a similar size but shall include cutting of existing pipe, removing existing valve, stacking existing pipe and valve at the Ballard Street Yard, dewatering the trench, the required tie-ins, pipe, couplings, accessories, other fittings, labor, equipment, materials, excavation, and backfilling as specified herein. Under NO circumstances shall any of the work under this item be compensated by other pay items.

11. VALVES REMOVED & RESET: An existing valve to be removed and reset for the purpose of cleaning & cement lining shall have the same pay-item number as other similar valves followed buy “R&R”. A valve to be removed & reset shall utilize the existing valve but shall include cutting of existing pipe, removing existing valve, stacking existing pipe and valve at the Ballard Street Yard, dewatering the trench, the required tie-ins, pipe, couplings, accessories, other fittings, labor, equipment, materials, excavation, and backfilling as specified herein. Under NO circumstances shall any of the work under this item be compensated by other pay items.

B. DESIGN AND CONSTRUCTION

1. All valves shall be installed at a maximum of 500 feet, unless otherwise directed by the Field Engineer. All valves shall be set level. Each gate shall be tightly closed before being placed in line, and shall remain so until the joint on each side is completely made.

2. All valves shall be carefully handled to avoid shock or damage.

3. Proper installation of valve boxes helps ensure against operating difficulties in the future. The soil shall be firmly compacted around the bonnet of the valve to prevent settling. The bottom of the lower section shall enclose the stuffing box and operating nut of the valve. The valve box shall rest above the valve so the weight of traffic passing over the street will not be transferred to the pipe or valve.

4. Valve boxes shall be carefully fitted together and to each valve with a minimum overlap of six (6) inches between the box sections when in the most extended position. The valve box shall be se-

curely held vertical and plumbed straight during backfilling. Covers shall be set to the finished grade as directed by the Field Engineer. After the box is set, the contractor shall operate the valve or corporation stop to the satisfaction of the Field Engineer.

5. During the course of water main construction and/or resurfacing of street, the contractor may have to adjust or remove and replace existing valve and service boxes. When adjusting a water box the contractor shall excavate the complete top section of the box, separate the top section from the lower or bottom section and raise or lower the top section to the specified line or grade. Some gate and service boxes that are called out to be adjusted may not be able to be adjusted as described above. There may be grade changes that exceed the range of adjustment within the existing box; the top and bottom sections of the existing box may be fused together due to age and corrosion and the sections cannot be separated or there may be damage to the box sections that is not visible from the surface. If one or more of these conditions exist, the Field Engineer may deem it necessary to remove and stack the existing box and have a new valve or service box installed. The contractor shall make every effort to separate the sections of the existing box to be adjusted prior to the Field Engineer allowing the removal and stocking of the existing box. The City shall supply new valve or service boxes to replace existing boxes that are not suitable for reuse only when the damaged box is on an existing public water main or service. The City will not supply valve boxes for new construction or to replace damaged boxes that are on private water mains or services.

6. Valve and service boxes that are removed and stacked shall remain the property of the City of Worcester D.P.W. Water Operations. The contractor shall deliver, unload and store said valve and service boxes at the City's Ballard Street Pipe Yard at no additional cost to the City.

7. Valve and service boxes shall be trimmed and/or cut with an abrasive pipe saw only. The use of hammers and wrenches to hand trim the boxes shall not be allowed.

8. Valves that are furnished and installed in existing water mains will be known as Cut-In Valves. The work of cut-in valves shall include the cutting of the existing pipe and furnishing and installing all necessary items to successfully accomplish the work.

9. All tees shall be three (3) way gated and all crosses shall be four (4) way gated unless otherwise directed by the Field Engineer.

10. Water Operations shall check and clean all main gates needed for a shutdown before the contractor starts the work.

C. SPECIAL CONDITIONS

Omitted, not applicable.

D. COMPENSATION

1. MEASUREMENT

Gate valves, butterfly valves, cut-in valves, valves removed & reset, tapping sleeves and valves, roadway boxes and valve boxes will be measured per Each as determined by actual count complete and in place.

2. PAYMENT

Valves, cut-in valves, valves removed &reset, tapping sleeves and valves, ball valves, and boxes will be paid for at the Contract Unit Price as set forth in the Proposal which price shall include full compensation for furnishing all labor, materials, tools, equipment, and incidentals necessary to complete the work specified herein.

Payment for a cut-in valve, valves removed & reset, butterfly or gate type, on an existing line, shall include cutting of existing pipe, removing existing valve, stacking existing pipe and valve at the Ballard Street Yard, dewatering the trench, the required tie-ins, pipe, couplings, accessories, other fittings, labor, equipment, materials, excavation, and backfilling shall be paid only under the item of cut-in valve. Under NO circumstances will any of the work under this item be compensated by other pay items.

Payment for Adjusting Gate Box or Service Box to Grade shall include all excavation, concrete or asphalt collars to anchor the top box, labor, equipment, materials, delivering and unloading of any boxes deemed unsuitable for reuse at the City's Ballard Street Pipe yard and any incidentals necessary to complete the work. Please note: Adjusting the valve box includes lowering or adjusting to any grade other than finished grade. Gravel, temporary and permanent patch, gate boxes, service boxes, and any other items needed for this work shall be paid for at the respective Contract Unit Price for that item.

ITEM 309 SERVICES AND SERVICE CONNECTIONS

ITEM 309.4 SERVICE BOX AND CUT-IN CURB STOP (1 1/4" - 2") EA.

A. SCOPE OF WORK

The work specified in this section includes the installation of new water service lines and the replacement of and the repair of existing water service lines as shown on the plans and specified herein.

B. MATERIALS

1. All brass fittings shall conform to AWWA C800 as latest revised with a maximum lead content of 0.25 % by weight and shall be manufactured by Ford Meter Box Company or equal unless otherwise approved by the Director. The design of all brass fittings shall be based on a minimum internal hydrostatic pressure (working water pressure) of 200 psi

Corporations:

For new taps 1-1/4 inch to 2 inch FB1000 with Tee Head Adapter cc (AWWA) thread x pack joint (compression)

For replacement of existing corporations 1- 1/4 inch to 2 inch FB1100 with Tee Head Adapter IP thread x pack joint (compression)

Curb Stops:

B44 Series full port pack joint x pack joint

Couplings:

C44 Series - pack joint x pack joint

C22 Series - flared joint x flared joint

2. All compression fittings shall be installed with solid tubular stainless steel internal insert stiffeners.

3. Service boxes shall be arch pattern rod type, with a one (1) inch diameter upper section, as manufactured by Quality Water Products, or approved equal. The service box shall adjust one (1) foot for proper height. The arch will accommodate up to one (1) inch ball curbs. The 36-inch rod shall be offset for centering in pipe and must be minimum 5/8" diameter. A brass cotter pin must be supplied with each rod. Rod shall be permanently attached to end yoke. The plug cover shall have a deep slot for the release of water and removal of debris. The brass pentagon plug shall have a coarse thread.

4. Polyethylene tubing shall meet the latest revision of AWWA Standard C901, have a working pressure of 200 psi, and shall meet the nominal size as shown on the plan. All polyethylene tubing shall be copper tube size (CTS), meeting ASTM specifications D-1248, D-2239, and D-2737 and shall meet PE 3608 requirements.

5. Copper tubing shall conform to the requirements of ASTM-B88, Type K, “Annealed” (soft).

6. All materials and construction shall conform to figures W-8A, W-8B, W-8C and W-8D which are part of these specifications.

C. DESIGN AND CONSTRUCTION

1. The minimum allowable size of any water service shall be one (1) inch.

2. All pipe and other appurtenance, on both fire and domestic service lines, from the public or private water main to the outlet side of the meter or to the main control valve immediately inside the foundation in case where meter pits are required shall conform to all City of Worcester DPW&P Standard Specifications and Details.

3. All service lines shall be tapped on or connected to a public water main on City property. No service line shall be connected to another service line without prior written approval from the Director of Water Operations. If one service line is allowed to be connected to another service line, the connection point and controlling valve shall be on City property.

4. All service lines, whether tapped on or connected to a public water main or another service line, shall be individually gated. This is to allow control of any one service line without affecting any other service line.

5. All individually owned units shall have separate water services installed a minimum of six (6) feet apart throughout their entire length.

6. Condominium and apartment-type developments shall be allowed one (1) adequately sized service.

7. All service lines shall be sized by the owner's architect or engineer.

8. All water services shall have a five (5) foot minimum and an eight (8) foot maximum depth of cover as measured from the top of the pipe to finish grade.

9. Contemplated services shall be allowed in order to minimize trenching in base paved streets, particularly in developments. If a contemplated service is not used by the developers or owner, that service shall be properly plugged at the main and curb stop box removed by the developer or owner.

10. Water service lines shall be installed straight and perpendicular from the water main to the foundation unless otherwise directed by the Field Engineer. This will facilitate the easy locating of the service pipe in the future. Service lines shall be installed a minimum of ten (10) feet away from any sewer service.

11. All service lines greater than two (2) inches in size shall be even sized pipe.

12. All service lines between 1-1/4 inches and 2 inches in size shall be copper tubing.

13. All service lines greater than two (2) inches in size shall be ductile iron pipe as specified in Item 301 of these specifications.

14. All service lines shall be pressure tested, disinfected and bacteria tested as specified in Item 301, Section C. of these specifications.

15. When any water service runs under a concrete floor the pipe shall be installed inside an approved conduit. The size of the conduit shall be at least twice the diameter of the service pipe being installed. See figure W-8D.

16. All taps shall be made on the horizontal and a minimum of three (3) feet away from any joint or bell in the water main unless otherwise directed by the Field Engineer.

17. All one (1) inch taps on cast or ductile iron mains 6-inch or greater in size shall be made by direct means only using cc (AWWA) thread corporations. A minimum of three full threads shall be required for one (1) inch corporation stop taps. If the minimum number of threads cannot be achieved, a service saddle shall be used

All one (1) inch taps on cast or ductile iron mains between 2-inch and 4-inch in size shall be made with cc (AWWA) thread corporations using a service saddle.

18. All taps on PVC water mains shall be made using a service saddle.

19. All 1-1/2 inch and 2 inch taps made on mains less than 16 inches in diameter shall be made with cc (AWWA) thread corporations using a service saddle. All 1-1/2 inch and 2 inch taps made on mains 16 inches or larger shall be made by direct means using cc (AWWA) thread corporations.

20. All taps four (4) inches or greater in size shall be made as detailed in Item 311 of these specifications.

21. All lengths of polyethylene and copper tubing shall be joined by means of compression or flared fittings only. Joints below ground shall be kept to a minimum; ideally the service pipe shall be installed in one continuous length from the corporation stop to the curb stop and from the curb stop to the meter valve.

22. As a general rule, a curb stop and box shall be installed within the City right-of-way at or near the property line behind the sidewalk usually in the grass area. Curb stops and boxes shall not be located within the sidewalk unless directed by the Field Engineer because of special or unique conditions. Curb stops boxes shall be supported by a flat brick or concrete block so that the weight of the traffic passing over the box will not be transferred to the valve or service pipe.

23. The Contractor shall be required to install new curb stops and service boxes on existing polyethylene and copper tube service lines with sufficient cover in sizes ranging from 3/4 inch through 2 inch. The pay items covering this operation shall be Item No. 308.3 “Service Box and Cut-In Curb Stop (3/4" - 1")” or Item No. 309.4 “Service Box and Cut-In Curb Stop (1-1/4" - 2").” Any 3/4" or 1" pipe used during the cutting in of any 3/4" or 1" curb stop shall be considered incidental to pay item 309.3 and shall be compensated for under pay item 309.3. Any 1-1/4", 1-1/2" or 2" pipe needed to cut-in any 1-1/4", 1-1/2" or 2" curb stop shall be supplied by the Contractor at no additional compensation to the Contractor. The Contractor is encouraged to reuse the existing service pipe whenever possible.

24. Polyethylene tubing shall be installed with enough slack to compensate for settlement and compaction.

25. When any service pipe is replaced, the contractor shall thoroughly rod out the existing corporation so that there are no obstructions and a full port of water is able to flow. The contractor shall then connect the changed service pipe to the existing corporation.

26. The Contractor shall be required to lower the existing street service boxes whether during the changing of the existing service pipe; on existing service lines that have receive a Service Box and Cut-In Curb Stop or already have a curb stop and box in place. The pay item covering this operation shall be Item no. 304.5 "Lowering Service Box." (see previous section for detailed description) This will be done by removing the existing top box and resetting it to the proper grade approximately 15” to 18” below finished grade unless a rigid road base exists in which case the box shall be set to finish grade of the rigid base. It shall be set in a plumb position over the corporation stop so that the corporation may be operated by a wrench. Gravel Borrow, where required, will be paid to the Contractor under its respective pay item. The Contractor shall be responsible for cleaning existing service boxes over corporation stops where needed. Compensation for this work shall be included as part of Item no. 304.5.

When the Field Engineer deems it necessary, the contractor shall pick up a new street service box for installation over an existing corporation to replace a broken box not suitable for reuse. The contractor shall pick up a street service box at the City's Millbury Street Pipe Yard using his copy of his water permit as a receipt to obtain the boxes. Street service boxes not suitable for reuse shall remain property of the City and shall be returned to the City's pipe yard.

27. The contractor shall operate the completely installed and backfilled curb stop in the presence of and to the satisfaction of the Field Engineer. At this time the contractor shall flush the service to eliminate any foreign material that could clog the plumbing of the building being served. If the service line, meter or internal plumbing becomes plugged due to construction, the contractor under the supervision of the Field Engineer shall remove the meter and flush the service line and the buildings internal plumbing.

D. SPECIAL CONDITIONS

1. New service connections made on existing two (2) inch copper or plastic mains shall consist of a 2 inch brass tee, with a one (1) inch cc threaded side outlet, cut in on the existing main unless otherwise directed by the Field Engineer.

2. When permanent repairs are made to any damaged or broken water service, all repairs shall be made as follows:

a. Plastic (PE) pipe up to one (1) inch in size shall be repaired with the same sized plastic (PE) pipe only.

b. Copper tubing up to two (2) inch in size shall be repaired with the same sized copper tubing only.

c. Iron or galvanized pipe up to one (1) inch in size shall be repaired with the same sized plastic (PE) pipe or copper tubing.

d. Iron or galvanized pipe between one (1) inch and two (2) inch in size shall be repaired with the same sized copper tubing only.

e. Cast iron or ductile iron pipe greater than two (2) inch in size shall be repaired with the same sized ductile iron pipe only.

E. COMPENSATION

1. MEASUREMENT

Service Connections, Service Box and Curb Stop, Service Box and Cut-in Curb Stop, Lower Street Service Box, and 2-Inch Taps will be measured per Each complete in place including excavation as specified herein.

2. PAYMENT

All services connected to the new main shall receive a service connection to be paid for at the Contract Unit Price. This price shall include all excavation less than 6 feet in depth, backfilling, compaction, the corporation stop, brass fittings, the tapping of the water main, tools, labor, and equipment necessary to do the job.

Services that are to be relayed to the street line shall also include a service box and curb stop to be paid under the Contract Unit Price.

Cut-in Curb Stops shall be used where the existing service line is of acceptable material. This shall include all excavation less than 6 feet in depth, the curb stop, service box, service box extensions and base adapters, brass fittings, tools, labor, backfill, compaction, and equipment necessary to do the job.

Services to be abandoned, or boxes to be lowered at the main shall each be paid under the appropriate pay items. This shall include all excavation less than 6 feet in depth, brass fittings, a new service box if needed, tools, labor, backfill, compaction, and equipment necessary to do the job.

ITEMS 311 and 312 TAPS AND TIE-INS

ITEM 311.02 2” TAP EA.

ITEM 312.06 6” TIE-IN EA.

A. SCOPE OF WORK

Work under this section shall consist of making all connections (tie-ins) from the new main to existing mains, existing hydrant laterals and existing services 1-1/2" and greater in size and the making of any and all taps on new or existing mains 1-1/2" greater in size as shown on the plans and as directed by the Field Engineer. (The tapping for and the tying-in of individual services 1" or less in size is not included in this item, see Item 309.)

B. MATERIALS

1. All bolted sleeve-type couplings, reducing couplings, transition couplings, and flanged coupling adapters used to join plain-end steel, cast iron and ductile iron pipe shall conform to the latest revision of AWWA C219 and shall in addition meet the specific requirements and exceptions which follow:

a. The design of bolted couplings shall be based on a rated working pressure of 200 psi, a transient or surge pressure allowance of 100 psi, and a hydrostatic test pressure of 300 psi.

b. Couplings shall be manufactured from carbon steel, stainless steel, ductile iron or malleable iron. All materials used shall conform to AWWA C219, section 4.2.

c. Bolts for all bolted, sleeve-type couplings shall be high strength, low alloy steel bolts only, conforming to AWWA C111 as latest revised. Bolt manufacturers certification shall accompany each shipment.

d. All couplings shall be clearly marked as specified in AWWA C219. These markings shall include the manufacturer's model number or type, pipe size (outside diameter of pipe), center sleeve section identification, or, for steel center sleeves, thickness and length, and the rated working water pressure

2. Tapping sleeves shall be cast or ductile iron full sleeve type capable of containing pressure within the full volume of the sleeve. Sleeves shall be mechanical joint type for use with Class AB or CD cast iron pipe or ductile iron pipe. All tapping sleeves shall conform to the provisions set forth in Items 302 and 303 of these specifications. All tapping sleeves shall have a threaded plug tapped into the body of the tapping sleeve for pressure testing purposes. Wrap around stainless steel sleeves shall not be allowed. As an alternate to cast or ductile iron, rigid stainless steel tapping sleeves with removable bolts may be used. Sleeves shall be all stainless steel 304 (18-8 ) construction with a full gasket giving 360 degree pipe coverage. Sleeves may have stainless steel flange outlet to be used with standard tapping gate or mechanical joint (MJ) outlet suitable for use with standard (MJ) X (MJ) resilient wedge gate valves per AWWA C509.

3. All service saddles shall conform to the following:

a. All service saddles shall have cc (AWWA) threaded outlet.

b. All service saddles for use on cast or ductile iron water mains shall be a double strap (bale) equal to or better than the Ford F202, Mueller DR2A, PowerSeal 3413 or Smith-Blair 313.

c. All service saddles for PVC mains or cast or ductile iron mains in know or suspected corrosive soils shall be a stainless steel double strap (band) equal to or better than Ford FSD202, Mueller DR2S, PowerSeal 3417 or Smith-Blair 317.

4. All 2 inch valves and tapping valves shall conform to all the provisions set forth in Items 303 through 309 of these specifications.

5. Bolts for all Flexible Couplings, Flanged and Mechanical Joints shall be high-strength, low alloy steel bolts only, conforming to the latest revision of AWWA C111. Bolt manufacturers certification of compliance shall accompany each shipment.

C. DESIGN AND CONSTRUCTION

1. Where existing fittings are available, a tie-in shall be made to connect the existing main, hydrant lateral or service lateral to the new main.

2. Where the difference in O.D.'s between the two pipes being joined is greater than one-half (1/2) inch, a transition coupling shall be used. No couplings with transition style gaskets shall be used.

3. Where there are no existing fittings available in the existing main to which the new main is to be connected, a tap may be required.

4. When 1-1/2 inch and 2 inch taps are made on mains less than 16 inches in diameter, service saddles shall be used.

5. When 1-1/2 inch and 2 inch taps are made on mains 16 inches in diameter and larger, the tap shall be made by direct means only.

6. All tapping sleeves and tapping valve assemblies shall be hydrostatically pressure tested prior to tapping. The test shall be at 1-1/2 times the working pressure of the existing main or a minimum of 150 psi and shall be maintained for one (1) hour, or as directed by the Field Engineer.

7. The water service shall be maintained as continuously as possible when taps and tie-ins are made. The contractor shall notify all persons affected by the disruption of water service 48 hours prior to the shut down.

8. An approved tar coating shall be applied on the entire outer surface of all flexible couplings including bolts, when installed.

9. The contractor shall install permanent blocking under the tapping valve to prevent any movement of the tapping sleeve and valve on the pipe.

10. The contractor shall construct a thrust block behind each tapping sleeve after the sleeve has been successfully pressure tested. All thrust blocks shall conform to all provisions in Item 313 of these specifications.

11. The contractor shall be responsible for the proper sizing of the tapping sleeve.

12. No full sized taps shall be allowed (example: 8" tap on an 8" main) without prior written approval from the Director of Water Operations.

13. All taps shall be made on the horizontal and a minimum of three (3) feet away from any joint or bell in the water main unless otherwise directed by the Field Engineer.

D. COMPENSATION

1. MEASUREMENT

Taps and Tie-ins will be measured per Each complete in place as specified herein.

2. PAYMENT

Taps and Tie-ins shall be paid for at the Contract Unit Price as set forth in the Proposal. Price shall include full compensation for furnishing all labor; materials, tools, equipment and incidentals for doing all the work as specified herein.

Included in the tap item shall be all necessary excavation, backfilling, compaction, dewatering, tapping sleeves, service saddles, tapping valves, 1-1/2 inch and 2 inch corporations.

Included in the tie-in item shall be the removal of any existing restraints, plugs, caps, reducers; the installation of all couplings, pipe nipples, rodding, pouring of lead joints if necessary; and all the necessary excavation, dewatering, cutting of pipe, backfilling and compaction.

SECTION 400 - PAVEMENT

ITEM 402 FINE GRADING, ROLLING AND FINISHING

A. GENERAL

The work to be done under this item shall conform to the applicable provisions of Section 170, (MSSHB).

ITEM 405 STRAIGHT CURB (VA-4)

ITEM 409 CIRCULAR CURB (10" RADIUS & UNDER) (VA-4)

A. GENERAL

The work to be done under these items shall conform to the applicable provisions of Section 580, (MSSHB). Any disruption of the roadway caused by the Contractor shall be repaired by the Contractor without extra cost to the City. Driveway curb corners that are reset shall be paid for under this item.

ITEM 422.1 SUPERPAVE 9.5 MM LEVEL 2 (TOP COURSE)

ITEM 422.2 SUPERPAVE 12.5 MM LEVEL 2 (BINDER COURSE)

The bituminous concrete shall be laid and thoroughly rolled in two courses consisting of a bituminous concrete binder course mix and a top course mix or dense mix to the thickness as indicated below:

When a substantial grade change is encountered by the Contracting Officer, he will direct the Contractor to establish new grades and pay for additional gravel and fine grading as needed.

Any sub-base disturbed by the Contractor without the Contracting Officer's approval shall become the Contractor's responsibility to replace with approved gravel (graded and compacted).

All abutting surfaces of bituminous pavements shall be trimmed to a neat straight line and painted with an asphaltic cement, cutback with naptha or approved emulsion. This work of treating the pavement edges shall be the responsibility of the Contractor and payment for the work shall be covered under the contract price for Item 422.

HOT MIX ASPHALT ROADWAY PAVEMENT TON

1.0 DESCRIPTION

1.1. Scope - Work under this item shall consist of furnishing hot mix asphalt composed of mineral aggregate and asphalt binder, mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and conformance to the lines, grades, thickness and typical cross sections shown on the plans or as directed by the Engineer. Where reference is made to MHD Standard Specifications, Form 1995 shall apply for section references; latest edition shall apply for specifications.

Each course shall be constructed to the depth, typical section, or elevation required by the contract and/or plans and shall be rolled, finished, and approved before the placement of the next course. Each course shall be placed to a smooth, dense and uniform appearance.

Many state agencies are implementing Quality Assurance specifications. It is the intent of these municipal quality-based HMA specifications to move toward the goal of quality assurance implementation but tailored toward the real world of municipal construction. To that end, the Contractor is required to establish, provide, and maintain a Quality Control System (QCS) that will detail the methods and procedures that will be taken to assure that all materials and completed construction conform to project specifications, plans, technical specifications and other requirements, whether manufactured or processed by the Contractor or procured from subcontractors or vendors.

2.0 QUALITY ASSURANCE

2.1. The Contractor assumes the responsibility of the quality for all materials and construction incorporated into the work and will control all the processes leading to the final result through this function. Quality Control activities should include:

Maintain a Contractor Quality Control System.

Proficiency testing prior to/during production with Engineer.

Inspection and Testing of Hot Mix Asphalt Production.

Inspection and Testing of Hot Mix Asphalt Placement.

2.2. See Section 7.16 “Contractor Quality Control of HMA Pavement” of these specifications for additional information.

2.3. The City of Worcester or their authorized agent will perform the Quality Acceptance function for this work. All material will be considered for acceptance through a sampling, testing and inspection program performed by the Engineer or their agent. Quality Acceptance activities include:

Proficiency testing prior to/during production with Contractor,

Inspection of HMA Production Plant and Testing Laborator,

Production Trials of HMA Products Intended for Use in the City of Worceste,

Inspection/Testing for Acceptance of Hot Mix Asphalt Productio,

Inspection/Testing for Acceptance of Hot Mix Asphalt Placemen,

HMA Quality Acceptance Report of Activities

3.0 MATERIALS

3.1. Aggregate - Aggregate shall meet the requirements of MHD M3.11.04 latest edition of the Standard Specifications and as further stipulated herein.

Coarse Aggregate

The sodium sulfate soundness loss shall not exceed nine (9) percent, nor the magnesium soundness loss exceed twelve (12) percent, after five cycles, when tested in accordance with AASHTO T104.

The coarse aggregate shall not contain more than one (1) percent of material such as crusher dust, sand or soft, disintegrated pieces. The coarse aggregate shall not contain more than ten (10) percent, by weight, of flat or elongated pieces, when tested in accordance with ASTM D4791 at a ratio of 5:1.

For the Marshall mixes contained in Table 6, the coarse aggregate shall contain a minimum of 75% by weight having at least two or more fractured faces and 85% by weight having at least one fractured face for the base and intermediate courses, when tested in accordance with ASTM D5821. The surface courses in Table 6 shall contain a minimum of 85% by weight having at least two or more fractured faces and 95% by weight having at least on fractured face, when tested in accord-

ance with ASTM D5821. When two fractured faces are continuous, the angle between the planes of fracture shall be as least 30 degrees to count as two fractured faces. For the Superpave mixes contained in Table 5, the coarse aggregate shall conform to the coarse aggregate angularity requirements listed in Table 3 for the traffic level and depth within the pavement structure.

The use of steel slag or blast furnace slag shall not be permitted as a coarse aggregate.

Fine Aggregate

Fine aggregate shall consist of clean, sound, durable, angular particles produced by crushing natural stone, or gravel that meets the requirements for wear and soundness specified for the coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter and shall contain no clay balls. The combined materials that passed the No. 100 mesh sieve shall not have sufficient plasticity to permit the performing of the plastic limit test using AASHTO T90.

Fine aggregates shall have sand equivalent values of 40 or greater when tested in accordance with AASHTO T176. The sand equivalent value shall be determined for the combined mix aggregates, including coarse and fine aggregates and mineral filler portions.

Natural (non-manufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. The aggregate shall have a fine aggregate angularity value of 40% or greater when tested in accordance with AASHTO T304, Method A. The uncompacted void content shall be evaluated for the combined mix aggregates including both coarse and fine aggregate portions.

Mineral Filler: If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of AASHTO M17.

HMA mixtures shall contain a dust to effective asphalt ratio by mass between 0.6 and 1.2. For Superpave designed mixtures, mixtures that pass beneath the Primary Control Sieve (PCS) control point established by AASHTO M323 may contain a dust to effective asphalt ratio by mass between 0.8 and 1.6.

Reclaimed Asphalt Pavement (RAP) The use of a maximum of 15% recycled asphalt pavement (RAP) will be allowed in the HMA courses.

The RAP, incorporated into the HMA mixtures, shall be maintained as a separate captive stockpile and shall not be added to without prior approval. RAP shall consist of asphalt pavement recovered by cold milling or other removal techniques. The RAP shall be crushed so that 100 percent passes the maximum aggregate size of the HMA mix in which it will be used. The Contractor's Quality Control system shall assure that the RAP is free from detrimental amounts of contaminating substances such as joint seal compound and, is reasonably uniformly graded from fine to coarse.

The coarse aggregate in the RAP shall be crushed stone and the top-size shall not exceed the maximum aggregate size established by the JMF. The final HMA mixture containing RAP shall conform to all the specification requirements contained herein.

For mixtures containing 15% or less RAP, the asphalt binder shall be a PG 64-28 or PG 64-22. RAP content shall not exceed 15%

The laboratory RAP-virgin binder blend viscosity value established from the RTFO residue at 140°F (60°C) shall establish the maximum viscosity allowed for the binder after discharge from the HMA plant and/or silo storage, if applicable, when recovered by AASHTO T170 and tested in accordance with AASHTO T202 and AASHTO T316.

For design purposes, the specific gravity of the combined aggregate blend with RAP used in a HMA mixture shall be determined in accordance with the attached test method for BULK SPECIFIC GRAVITY OF AGGREGATE BLENDS WITH RAP.

3.1.1. Sampling and Testing All aggregate samples required for testing shall be furnished by the Contractor when requested. AASHTO-T2 shall be used in sampling coarse aggregate and fine aggregate, and AASHTO T127 shall be used in sampling mineral filler. All tests for initial aggregate submittals necessary to determine compliance with requirements specified herein will be conducted by the Contractor under their Quality Control System. No aggregate shall be used in the production of mixtures without prior approval.

3.1.2. Sources of Supply Sources of aggregate shall be selected well in advance of the time the materials are required in the work. Preliminary approval may be given when the materials are obtained from a previously approved source or an existing quarry source producing aggregates that has a satisfactory service record in hot mix asphalt construction for at least five years. Samples shall be submitted upon contract award. When time permits, samples shall be submitted fourteen days prior to the start of production. An inspection of the producers operation will be made by the Engineer. When new sources are to be developed, the Contractor shall indicate the sources and submit a plan of operation thirty days in advance of starting production. Samples from test pits, borings and other excavations shall be submitted at the same time. Approval of the source of aggregate does not relieve the Contractor in any way of the responsibility for delivery at the job site of aggregates that meet the requirements specified herein.

3.1.3. Samples of aggregates shall be furnished by the Contractor at the start of production and at intervals during production of HMA mixtures. The intervals and points of sampling will be designated by the Engineer.

3.2. Asphalt Binder Material The types, grades, and controlling specifications, the maximum mixing temperatures and compaction temperatures for the asphalt binder materials shall conform to the following:

3.2.1. Performance Graded Asphalt Binder: - The Asphalt Binder shall be a Performance Graded Asphalt Binder (PGAB) which meets the specification requirements of AASHTO M320 and AASHTO R29. Acceptance of the PGAB will be in accordance with AASHTO R26 “Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders”. PGAB shall be provided by an Approved Supplier (AS) under the Approved Supplier Certification (ASC) system.

THE PGAB GRADE SELECTED FOR THIS WORK IS PG 64-28 or 64 -22 - If traffic speed and/or level warrant, the PGAB may be adjusted by the Engineer for the design traffic conditions in accordance with the table below. No chemically modified PGAB shall be used on this project.

Table 1. SUPERPAVE PGAB Adjustment for Design Traffic Conditions

A copy of the Certified Test Reports shall be provided in accordance with the frequency requirements established in the latest version of AASHTO M320, and shall include the following:

Flash point

Rotational viscosity at 275oF and 329oF

Specific gravity at 77oF

Original G*/sinδ and phase angle at test temperature

RTFO percent mass loss

RTFO - G*/sinδ and phase angle at test temperature

PAV Residue - G*(sinδ) and phase angle at test temperature

Creep stiffness and m-value at test temperature

Direct tension results (when equipment available)

Strain sweep in accordance with AASHTO T315 (optional)

Physical hardening after 24 hours in accordance with AASHTO T313 (optional)

3.2.2. Asphalt Binder Anti Stripping Additive This specification provides for an additive to asphalt to assist in the coating of wet aggregate and to increase the resistance of the binder coating to stripping in the presence of water. The additive shall be chemically inert to asphalt (heat stable) and when blended with asphalt shall withstand storage at a temperature of 400oF (204oC) for extended periods without loss of effectiveness.

Composition: Anti stripping compound shall be an organic chemical compound, free from inorganic mineral salts or inorganic mineral soaps. It shall contain no ingredient harmful to the binder material or to the operator, and shall not appreciably alter the specified characteristics of the binder material.

Anti stripping additive shall be incorporated and thoroughly dispersed in the asphalt binder material in an amount equal to the percent by weight established by the job mix formula. This percent is based on the efficiency of the additive as determined by laboratory tests. The treated composite mixture shall have a minimum tensile strength ratio (TSR) of not less than 80, when tested in accordance with AASHTO T283 with the freeze/thaw cycle. The specimens for the AASHTO procedure shall be 4" (100mm) in diameter, compacted with the Marshall hammer or the Superpave gyratory compactor to the desired air void level of 7.0 + 1.0%. If the TSR ratio is less than 80, the aggregates shall be treated with an approved antistrip in sufficient quantity to produce acceptable results. The hot mix asphalt materials and asphalt binder material that require antistrip additives (either liquid or mineral) shall continue to meet all requirements specified herein for binder and HMA. The anti-strip agent shall be included in the bid price.

3.2.3. Tack Coat: Emulsified asphalt; AASHTO M140/ASTM D 997 or AASHTO M 208/ASTM D 2397, RS-1 or CRS-1

3.3. PRELIMINARY MATERIAL ACCEPTANCE: Prior to delivery of HMA materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials certified under the Contractor's quality control system:

3.3.1. Coarse Aggregate

A. Percent of wear

B. Soundness

C. Flat and Elongated

D. Coarse aggregate angularity

3.3.2. Fine Aggregate

A. Liquid limit

B. Plastic index

C. Sand equivalent

D. Fine aggregate anularity

3.3.3. Mineral Filler

3.3.4. Performance Graded Asphalt Binder: The certification(s) shall show the appropriate AASHTO and/or ASTM test(s) for each material, the test results, and a signed statement that the material meets the specification requirement.

3.3.5. The Engineer may request samples for testing, including but not limited to, modifiers, truck coatings, and emulsion, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

4.0 COMPOSITION OF HMA MIXTURES

4.1. Hot Mix Asphalt – HMA plant mix may be composed of a homogeneous mixture of aggregate, filler if required, bitumen, and/or additives, combined to meet the composition limits by weight and other characteristics as specified. The several aggregate fractions shall be sized, uniformly graded and combined in such proportions that the resulting mixture meets the grading requirements of these specifications.

4.2. Hot Mix Asphalt Mix Design: The Contractor shall be responsible for the development of all job mix formulas. All job mix formulas other than for Surface Treatment and Base mix shall be based on and supported by volumetric mix designs, either Marshall Method or Superpave method. Marshall Mix design method, procedures and criteria shall be based on Asphalt Institute MS-2 and AASHTO T245 and the requirements contained herein. At the option of the Contractor, or as specified by the Engineer, Superpave mix designs may be utilized. Superpave mix designs shall be based on Asphalt Institute SP-2 and AASHTO M323, R35, R30, T312, and the requirements contained herein. For the Superpave volumetric mix design, the mixture of asphalt and aggregate shall be oven aged at the mixture's specified compaction temperature in accordance with AASHTO R30.

4.3. JOB MIX FORMULA (JMF). Work shall not begin nor shall any mixture be accepted until the Contractor has submitted a job mix formula, samples of the existing and new materials intended for use, and has established a separate, job mix formula (JMF) for each mixture. A separate job mix formula shall be submitted for each mixture and each approved RAP stockpile (the stockpile shall be of a uniform quality throughout).

4.3.1. JMF Submittal The job mix formula shall establish the percentage of each additional aggregate required, a single percentage of aggregate passing each required sieve size, a single percentage and the grade of asphalt binder to be added, the percentage of recycling additive, and a single temperature at which the mixture is to be discharged from the plant, and the number of seconds for dry mixing time and the number of seconds for wet mixing time. AASHO T195 (Ross Count) with a coating factor of ninety eight (98) percent will be used when necessary to evaluate proper mixing time. The moisture content of all hot mix asphalt upon discharge from the mixer shall not exceed 0.5 percent when tested in accordance with AASHTO T110. The job mix formula shall also specify a single source or uniform blend of particular sources for fine aggregate, a single source for each nominal size of coarse aggregate, and a single source of supply for mineral filler and for asphalt. The JMF shall be submitted in writing by the Contractor to the Engineer at least 30 days prior to the start of paving operations and shall include as a minimum:

Percentage of each individual aggregate and percent passing each sieve. Combined percent passing each sieve size and target gradation desired.

Percent of asphalt binder.

Performance grading test results and Material Certificate certifying the PG grade.

Number of gyrations for the estimated design ESAL loading.

Mixing temperature.

Compaction temperature.

Temperature of mix when discharged from the mixer.

Plot of the combined gradation on the Federal Highway Administration (FHWA) 0.45 power gradation curve.

Percent natural sand.

Percent fractured faces.

Percent flat or elongated particles.

Tensile Strength Ratio (TSR).

Antistrip agent – type and quantity.

Sand equivalent value.

Fine aggregate angularity value.

Percentage of wear.

Sulfate soundness loss.

Individual and combined aggregate specific gravity.

Dust to effective asphalt ratio.

Graphical plot of air voids, voids in mineral aggregate (VMA), and voids filled with asphalt (VFA) versus asphalt content. The Superpave mixes shall also show density at Ninitial, density at Ndesign, and density at Nmaximum versus asphalt content

The Contractor shall submit samples to the Engineer, upon request, for JMF verification testing.

The JMF for each mixture shall be in effect until modified in writing by the Engineer. Should a change in sources of materials be made, a new JMF must be approved by the Engineer before the new material is used.

4.3.2. JMF Tolerances The job mix formula, operating within the allowable action limits for individual measurements as specified in Table 7 herein, shall be set within the design master limits speci-

fied for each mixture class, either Table 5 for Superpave design or Table 6 for Marshall design except that the Engineer may modify the design limits if they determine this to be necessary and in the best interest of the City of Worcester.

4.3.3. Plant Trial Mixtures After receiving the job mix formula prepared by the Contractor, the Engineer will notify the Contractor regarding a verification of the optimum asphalt content and/or preproduction trials and Control Section for those mixtures so designated by the Engineer. A minimum of one trial mix shall be produced at the Contractor's proposed asphalt binder content and aggregate gradation.

4.3.4. JMF Approval – The Contractor will be notified by the Engineer if the JMF submittals are approved for production. The approved job mix formula for the mixture shall be in effect until modified in writing. As indicated in Section 4.3.3, Plant Trial Mixtures, of this specification, the Engineer will notify the Contractor regarding the placement of a Control Section (See Section 5.0). Following placement and testing of the Control Section, the JMF may have to be modified to meet both production and placement requirements of this specification. If warranted, the JMF resubmittal shall follow the applicable requirements of Section 4.3 of this specification. A JMF, once approved, will not be required for further mix approval for the construction season unless a change has occurred that warrants a new JMF approval or as directed by the Engineer. The approval of all JMFs will terminate on December 31st each year, regardless if the work is carried over to the following year. Control strips are required by the contractor for in-place mat thickness, uniformity, longitudinal joint characteristics, and density requirements before approval.

4.4. HMA Mixture Design Criteria

TABLE 2. PERCENT VOIDS IN MINERAL AGGREGATE (VMA)

| Nominal Maximum Aggregate Size | Percent Minimum |
|---|---|
| #4 (4.75mm) | 16.0 |
| 3/8" (9.5 mm) | 15.0 |
| 1/2" (12.5 mm) | 14.0 |
| 3/4" (19.0 mm) | 13.0 |
| 1.0" (25.0 mm) | 12.0 |
| 1.5" (37.5 mm) | 11.0 |

Note 5: If less than 25 % of a given layer is within 100 mm of the anticipated top surface, the layer may be considered to be below 100 mm for mixture design purposes.

Note 6: For Superpave mixtures with design ESALs between 3.0 and 10.0 million, the coarse aggregate angularity criteria shall be 85/80 for layers < 100 mm depth from final surface and a criteria of 60/- - for layers >100 mm from final surface.

TABLE 3: Hot Mix Asphalt and Volumetric Properties for Superpave Mixtures.

| Traffic Levels Design ESALs (million) | Number of Gyrations by Superpave Gyratory Compactor | | | Percent Density of Gmm from HMA specimen | | | Voids Filled with Asphalt (VFA) Based on Nominal mix size | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Nini | Ndes | Nmax | Nini | Ndes | Nmax | 4.75 mm | 9.5 mm | 12.5 mm | 19.0 mm | 25.0 mm | 37.5 mm |
| < 0.3 | 6 | 50 | 75 | ≤ 91.5 | 95 – 97 | ≤ 98.0 | 70 – 80 | 70 – 80 | 70 – 80 | 70 – 80 | 67 – 80 | 64 – 80 |
| 0.3 to < 3.0 | 7 | 75 | 115 | ≤ 90.5 | 95 – 97 | ≤ 98.0 | 65 – 78 | 65 – 78 | 65 – 78 | 65 – 78 | 65 – 78 | 64 - 78 |
| 3.0 to < 30 | 8 | 100 | 160 | ≤ 89.0 | 95 – 97 | ≤ 98.0 | 75 – 78 | 73 – 76 | 65 – 75 | 65 – 75 | 65 – 75 | 64 - 75 |
| ≥ 30.0 | 9 | 125 | 205 | ≤ 89.0 | 95 – 97 | ≤ 98.0 | 75 – 78 | 73 – 76 | 65 – 75 | 65 – 75 | 65 – 75 | 64 - 75 |

Note: The Engineer may increase the Dust to binder ratio from 0.6-1.2 to 0.8-1.6 if the proposed aggregate gradation passes beneath the Primary Control Sieve (PCS) control point established in AASHTO M323.

(a) Dense mix including approved anti stripping compound shall be furnished and used for protective (bottom) courses of pavement on bridges, and elsewhere shown on the plans.

The asphalt content of all mixtures shall be calculated on the percentage basis by weight of the total mix.

4.5. Additional HMA Criteria – In addition to the above HMA design requirements, the HMA mixtures shall also conform to the following:

Stripping:

Each mixture shall be evaluated for stripping by performing indirect tensile tests on compacted mixtures. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by AASHTO T283 with freeze/thaw, is less than 80, the aggregates shall be rejected or the asphalt treated with an approved anti-stripping agent. The amount of anti-stripping agent added to the asphalt shall be sufficient to produce a TSR of not less than 80. If an antistrip agent is required, it will be provided by the Contractor at no additional cost.

Aggregate Composition:

The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory sieves, will conform to the gradation or gradations specified in either Table 5 or Table 6, whichever is applicable, when tested in accordance with AASHTO Standards T27 and T11. The gradations in either Table 5 or 6, whichever is applicable, represent the limits which shall determine the suitability of aggregate for use from the sources of supply. The aggregate, as selected (and used in the JMF) and blended, shall have a gradation within the limits designated in either Table 5 or 6, whichever is applicable, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be well graded from coarse to fine.

JMF Deviations:

Deviations from the final approved mix design for asphalt binder content and gradation of aggregates shall be within the action limits for individual measurements as specified in Table 7. The limits still will apply if they fall outside the master grading band in Table 5 or 6, whichever is applicable.

Minimum Lift Thickness Consideration:

The maximum size aggregate used shall not be more than one-half of the compacted thickness of the course being constructed on a prepared surface or that which can be placed to achieve specification requirements. The maximum size is defined as one sieve size larger than the nominal maximum size. The nominal maximum size is defined as one sieve size larger that the first sieve to cumulatively retain more than 10 percent.

HMA may be stored in surge or storage bins provided that the mixture used from the bins is of a uniform quality and meets the following requirements:

Temporary Storage of Bituminous Mixture Use of surge bins or storage bias for temporary storage of hot mix asphalt will be permitted as follows:

The hot mix asphalt mixture may be stored in surge bins for a period of time not to exceed three hours.

The hot mix asphalt mixture may be stored in insulated and heated storage bins for a period of time not to exceed twelve hours, provided an inert gas atmosphere is maintained in the bin during the storage period.

If the Engineer determines that there is an excessive amount of heat loss, segregation and/or oxidation of the mixture due to temporary storage, use of surge bins or storage bins will be discontinued.

In addition, the recovered asphalt from the mix samples obtained 30 days after production shall meet the following requirements:

RECOVERED ASPHALT

ASTM D1856

ABSON METHOD

| Test Property | Min. | Max. |
|---|---|---|
| Viscosity, poises @ 140F. | - | 6000 |
| Penetration, dmm @ 77F. | 45 | 100 |
| Ductility, cm @ 77F | 75 | - |
| Tmax for G*/Sin (d) DSR (RTFO Aged) | - | One Grade Higher |

5.0 HMA CONTROL SECTION

If required by the Engineer and prior to full production for the City, the Contractor shall place a quantity of hot mix asphalt according to the JMF and the project specifications. The amount of mixture should be sufficient, at a minimum, to construct a test section 300 feet long and 20 to 30 feet wide placed in two lanes, with a longitudinal joint, and shall be of the same depth specified for the construction of the course which it represents. The underlying grade or pavement structure upon which the Control Section is to be constructed shall be the same as the remainder of that project course represented by the Control Section. The equipment used in construction of the Control section shall be the same type and weight to be used on the remainder of the course represented by the Control Section. The control strip may be as large as one production day on a City street as long as a longitudinal joint has been constructed.

Two Random sample(s) shall be taken at the plant by the Engineer and tested for air voids in accordance with the Section 8.10, Plant-Produced Material. One random sample of mixture shall be taken

at the plant and tested for aggregate gradation and asphalt binder content in accordance with the Section 8.10 Plant-Produced Material.

Three randomly selected cores shall be taken from the finished pavement mat in the Control Section, and three randomly selected cores from the longitudinal joint in the Control Section, and tested in accordance with Section 8.2, Field Placed HMA Material. Random sampling shall be in accordance with procedures contained in ASTM D3665.

Mat density and air voids shall be evaluated in accordance with Section 8.2, Field Placed HMA Material. Joint density will be evaluated in accordance with Section 8.2, Field Placed HMA Material.

The Control Section shall be considered acceptable if the uniformity, thickness, and 1) mat density, plant air voids, and joint density are within the requirements of this specification and 2) gradation and asphalt binder content are within the action limits specified herein for individual Measurements. If mat and joint density are below the 100% minimum payment, but above 90% payment for mat and longitudinal joint density, the Control Strip will remain in place and paid for at the reduced price in accordance with these specifications; however, a new Control Strip must be constructed that meets the minimum 100% payment criteria. A maximum of three Control Strips will be allowed.

If the initial Control section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second Control section shall then be placed. Additional Control sections up to three, as required, shall be constructed and evaluated for conformance to the specifications. Any sections that are rejected according to these specifications shall be removed at the Contractor's expense. Full production shall not begin until an acceptable section has been constructed, meeting the minimum 100% payment criteria, and accepted by the Engineer. Any Control section that meets specification requirements shall be paid for in accordance with the Section 10.0 PAYMENT.

Job mix formula quality control testing is to be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the JMF. It should be recognized that the aggregates produced by the plant might not satisfy the gradation requirements or produce a mix that exactly meets the JMF. In those instances, it will be necessary to re-evaluate and redesign the mix using plant-produced aggregates. Specimens should be prepared and the optimum asphalt binder content determined in the same manner as for the original design tests. A revised JMF will need to be submitted and a test section constructed prior to approval and full production. The test section and JMF submittal shall conform to all the specification requirements contained herein.

6.0 EQUIPMENT

6.1. Hot Mix Asphalt Mixing Plant - Shall meet MHD M3.11.07. Sufficient storage space shall be provided for each size of aggregate. The different aggregate sizes shall be kept separated until they have been delivered to the cold elevator feeding the drier. The storage yard shall be neat and orderly, and separated stockpiles shall be readily accessible for sampling.

Sampling Platform: A safe and adequate platform or catwalk with stairway and railing shall be provided to accommodate the inspector while checking temperatures and obtaining samples of the mixture from haul vehicles. The height of the platforms and raised platforms shall be adequate to accommodate safe acquisition of mix samples from the type of hauling unit(s) being utilized on the project.

Testing Laboratory The Contractor or producer shall provide a testing laboratory at the production plant for quality control and quality acceptance functions during periods of mix production, sampling, and testing, and whenever materials subject to the provisions of these specifications are being supplied or tested. The laboratory shall contain adequate equipment, space, and utilities as required for the performance of the specified tests.

It shall be available for joint use by the Contractor for quality control testing, if applicable, and by the Engineer for acceptance testing. The testing laboratory must have adequate equipment for the performance of the tests required by these specifications and the requirements of NETTCP. The Engineer shall have priority in use of the equipment necessary for acceptance testing. All the necessary testing equipment shall be located at the HMA plant supplying material to the project. In addition, all ancillary and miscellaneous equipment needed to perform the testing in accordance with these specifications shall be provided by the Contractor at no additional cost.

The effective working area of the laboratory shall be a minimum of 150 square feet with a ceiling height of not less than 7.5 feet. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 70°F + 5°F.

The plant laboratory shall further contain and be kept supplied with the following laboratory equipment:

Scale (digital): 20,000gm capacity minimum, sensitivity 0.1gm.

Marshall Equipment: Automatic hot mix asphalt compactor mounted in accordance with ASTM D1559 and conforming to specifications for AASHTO T-245 which consists of totally enclosed, rigidly mounted operated frame, a standard circular foot compaction hammer assembly designed to ensure an eighteen (18) inch drop regardless of specimen height, a one third (1/3) horsepower motor with belt guard and controls, an automatic counter that shuts off the power after the set number of hammer drops, and a standard compaction pedestal with guide pins for centering one standard (4 inch diameter) bituminous mold at a time. The Contractor shall also provide two (2) stability compaction molds conforming to ASTM D1559 and suitable for use with the automatic bituminous compactor.

NOTE: The Soil test Model AP 800 automatic bituminous compactor and AP 166 stability compaction molds have been found suitable.

Superpave Gyratory Compactor (For plants supplying materials contained in Table 5) conforming to the requirements of AASHTO R30, R35, M323, T312 and the Asphalt Institute Manual SP-2.

Bulk specific gravity determination equipment (AASHTO T166), and theoretical maximum specific gravity equipment (AASHTO T209).

Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect the Contractor's laboratory facility and witness quality control activities, if applicable. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

6.2. Hauling Equipment Trucks used for hauling hot mix asphalt mixtures shall have tight, clean smooth metal beds which have previously been cleaned of all foreign material. To prevent the mixture from adhering to them, the beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, soluble oils or other approved material. When coating is applied, truck bodies shall be raised immediately prior to loading to remove any excess coating material in the truck bed. Containment of the excess anti-adhesive material may be required for environmental concerns depending on the type of anti-adhesive agent used. Each truck shall have a securely fastened, both front and rear, waterproof cover to protect the mixture at all times. The use of mesh type tarps will not be permitted. When necessary, so that the mixture will be delivered to the site at the specified temperature within 25oF of the approved JMF, truck beds shall be insulated.

6.3. Pavers – Pavers shall be self-contained, heated, power-propelled units with an automated controlled screed, and shall be capable of spreading and finishing courses of hot mix asphalt material which will meet the specified thickness, smoothness, and grade. Pavers used for shoulders and similar construction shall be capable of spreading and finishing courses of hot mix asphalt material in widths shown on the plans.

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed. The hopper shall be maintained in excess of 25% volume of hot mix during normal paving operations thereby eliminating exposure of the drag slat conveyor. The screed assembly shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, segregating or gouging the mixture. e paver shall be capable of operating at forward speeds consistent with satisfactory laying of the mixture. The paver shall be maintained with non-worn reverse augers or kickback paddles at the center of the screed at the auger bearing box.

The paver shall be equipped with hoppers and distributing screws of the reversing type to place the mixture evenly in front of adjustable screeds. They shall be equipped with a quick and efficient steering device and shall have reverse as well as forward traveling speeds.

The paver shall employ mechanical devices such as equalizing runners, straight edge runners, evener arms or other compensating devices to adjust the grade and confine the edges of the mixture to

true lines. To construct tight longitudinal paving joints, the end gate, or an edge plate must be down just off the surface to ensure a light compaction and setup of the material on the joint. The paver shall be capable of spreading the mixture without segregation in layers to the depths and widths required. They shall be equipped with a single joint automated tracker device for proper matching of the elevation of longitudinal joints between adjacent strips or courses of the same thickness. Extensions shall contain auger and tunnel extensions if the end gate exceeds 18” from the end of the auger shaft.

An approved device will be required for heating the screed to the temperature required for the laying of the mixtures without pulling or marring.

The term "screed" includes any device operated by cutting, crowding, or other practicable action, which is effective on the mixtures at permissible workable temperatures without

tearing, shoving, or gouging and which produces a finished surface of the evenness and texture required.

The pavers employed on Worcester projects shall operate by the use of a sensing grid for operation to a stringline and an automated joint matcher for joints, and an automatic grade control device for profile. The paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

The controls shall be capable of working in conjunction with any of the following attachments:

Ski-type device of not less than 30 feet (9.14 m) in length.

Taut stringline (wire) set to grade.

Short ski or shoe.

Laser control.

Sonic control.

The paver screed may be equipped with a Longitudinal Notched - Wedge Joint paver attachment or Straight Wedge Joint paver attachment and screed mounted roller attachment. When placing HMA pavement courses at a thickness of 1.5" or greater, the notched wedge is recommended; when placing HMA pavement courses less than 1.5", the straight wedge is recommended. The notched wedge joint includes a variable notched vertical edge (the notch vertical height to be equal to the mixture’s maximum aggregate size). The sloped surface of the diagonal wedge joint shall not exceed a 6:1 slope.

6.4. Rollers Rollers of the vibratory, steel wheel, oscillatory, and pneumatic-tired type may be used. They shall be in good condition, capable of reversing direction without backlash, and operating at slow speeds to avoid displacement of the hot mix asphalt. Static rollers shall be operated at speeds not to exceed 3 mph and vibratory rollers shall be operated at a minimum of 10 to 12 impacts/ft in vibratory mode. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

The use of equipment which causes excessive crushing of the aggregate or that which does not produce a smooth, dense and uniform HMA mat will not be permitted.

The Contractor shall exercise great caution when using vibratory rollers so as not to cause damage to buried infrastructure or adjacent infrastructure. Damage to buried or adjacent infrastructure will be the responsibility of the Contractor. The new Oscillation type rollers are acceptable for use for intermediate compaction and back rolling of HMA in the City of Worcester.

The Contractor is encouraged, when applicable, to use a pneumatic square edge-tired compaction roller (either one or both axles) as another acceptable alternate for the Intermediate and Final rolling of hot mix in the City of Worcester.

7.0 HMA CONSTRUCTION

7.1. Weather Limitations The hot mix asphalt shall not be placed when weather conditions of fog or rain prevail or when the pavement surface or base shows signs of free moisture (film of water). When the surface temperature of the underlying course is less than 50°F, the estimated time available for compaction shall be provided by the Contractor to the Engineer. The Engineer and the Contractor shall determine if there is an adequate amount of time available to compact the mixture. The Contractor assumes responsibility for constructing the pavement to meet compaction and specification requirements. The estimated time available for compaction can be calculated with computer programs, e.g., Pave Cool Tool 2.4.

This program is available at the following web location:

http://www.dot.state.ia.us/construction/hot_mix_asphalt.htm

The Engineer will not permit work to continue when overtaken by sudden storms until the pavement surface shows no signs of free moisture. The material in transit at the time of shutdown will not be placed until the pavement surface shows no signs of free moisture, provided the mixture is within temperature limits as specified.

The construction of hot mix asphalt concrete pavements shall terminate on November 15 and shall not be resumed prior to April 1 except as determined and directed in writing by the Engineer.

7.2. Thermometer: The City will utilize an approved dial type thermometer with a temperature range of 50oF to 500oF and an infrared pistol thermometer for use during HMA placement. The in-

frared pistol thermometer shall be Fahrenheit or Celsius selectable and conform to the following requirements:

Portable and battery operated Accuracy of +/- 2%

Repeatability of +/- 3oC Emissivity preset at 0.95

LCD Display to nearest 1o Temp. Operating range of

-4oF to 752oF

7.3. Pre-Paving Conference: Prior to the placing of any HMA, a pre-paving conference (approximately 5 hours in length) shall be held to discuss and approve the paving schedule, source of HMA, job mix formula approvals, type and amount of equipment to be used, sequence of paving pattern, rate of HMA supply, all sampling, testing and reporting procedures to be used, traffic control, safety, and general continuity of the operation. Engineer's representatives, Contractor's plant, quality control and field representatives and Engineer's testing and inspection agents shall attend this meeting. All equipment used shall be approved on the project site prior to starting up each day. It will be mandatory for the Contractor and the paving subcontractor, if utilized, to attend this conference. The Contractor will be responsible for all costs associated with additional training.

The Engineer, upon 48 hours notice, may be able to hold this conference preferably on the forecast of an inclement day.

7.4. Preparation of the Underlying Surface. Immediately before placing the hot mix asphalt, the underlying course shall be thoroughly cleaned of all dust and debris by a self-propelled sweeper. Areas inaccessible by power sweepers shall be broom swept until the pavement surface is clean. Extra care shall be required during fall leaf fall.

Proof roll prepared base material surface, if applicable, to identify areas requiring removal and recompaction, and to provide a uniform degree of compaction over the entire pavement area.

Do not begin paving work until deficient base material areas and utility trenches have been corrected and are ready to receive paving. Paving shall not be applied until the Engineer inspects and approves the finished base.

When an existing surface or new base upon which the lower course is to be placed contains unsatisfactory irregularities, in the Engineer's judgment, such irregularities may be eliminated by an adequate placing and compaction of HMA mixture so as to furnish a surface with true contour and grade before placing any specified course of mixture.

Check all frames, covers, grates, water valve boxes and other miscellaneous castings that are located in the proposed pavement areas to ensure that all have been correctly positioned and set to the proper slope and elevation. All covers and grates shall be set flush with the required finished sur-

face. No depressions or mounds will be permitted in the pavement to accommodate inaccuracies in the setting of castings.

For Reclaimed base, reconstruction or where new base is graded, the Contractor shall furnish, set, and maintain all line and grade stakes necessary to guide the automated grade control equipment. Where required these control stakes shall be maintained by the Contractor and used throughout the operations, from the grading of the subbase material up to and including the final layers of the pavement.

Adequate artificial lighting shall be provided during night placements. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to an internal temperature of 140°F minimum.

Proper precautions shall be taken to prevent damage by construction operations to edges adjacent to the hot mix asphalt. These edges may be, but are not limited to, gutters, catch basins, curbs, concrete structures, and hot mix asphalt concrete. If damage occurs, repairs shall be made to the satisfaction of the Engineer with no additional payment.

7.5. Tack Coat: Contact surfaces of manholes, structures, vertical pavement edges, etc. shall be painted with a thin, uniform tack coat just before the material is placed against them.

Tack coat is required on all surfaces to be paved; this includes leveling, base or intermediate layers of HMA, unless the underlying HMA layer was placed during the same day. Particular attention should be made during the application that the longitudinal joint areas be treated with no bare spots. Missing areas adjacent to the longitudinal joint area will require either re-application or localized hand work application as directed by the Engineer.

Tack coat shall be applied at a residual binder amount on the pavement between 0.03 to 0.05 gallons per square yard. Use the lower application amount between new lifts and the higher application rate on milled or Portland cement surfaces. This amounts to a very thin application that needs to be carefully applied. Massachusetts uses RS-1 and CRS-1 type asphalt emulsions for tack coating. These can be applied, as an emulsion, between 0.05 to 0.08 gallons per square yard. Tack coat shall be supplied as part of the HMA operation.

Allow tack coat to dry from a brown color to a black color prior to paving.

7.6. HMA Production

The aggregates and the asphalt binder material shall be weighed or metered and introduced into the mixer in the amount specified by the JMF and within the allowable action limits as stated in Table 7 HMA PRODUCTION LIMITS. These limits shall be applied to the target values established in the JMF. Corrective action shall be taken by the Contractor when the calculated individual result for gradation or asphalt content falls outside the target JMF value beyond the action limit listed in Table 7. The Contractor shall take the appropriate action when results indicate the material is out of tolerance. The Contractor shall be required to suspend production when the calculated individual re-

sult for gradation or asphalt content falls outside the target JMF value beyond the suspension limit listed in Table 7, or when the asphalt binder content is below the minimum values stated in Table 6 for Marshall mixes. The Contractor shall be required to suspend production if two points in a row fall outside the Action Limits for individual measurements or if three nonconsecutive samples fall outside the Action limits. The Contractor shall be required to suspend production if one point falls outside the Suspension Limits for individual measurements. The Contractor shall also be required to suspend production if one point falls outside the Suspension Limits for range, Table 8.

7.6.1. Plant Trials - If production is suspended, the production facility shall be required to produce material on a trial basis for testing purposes without shipment to the project. No payment will be made for material and labor employed for nonconforming plant trials. The Engineer or his representative shall pay for acceptance sampling and testing for the first set of trials necessary to determine conformance with the specification requirements. If the first set of trials does not conform to specification requirements, the Contractor shall pay for any additional trial sampling and testing for acceptance. When trials have been approved, the plant will return to its normal operation.

Failure to stop production and make adjustments when required due to an individual test(s) not meeting the specified requirements may subject all of the mix from the stop point to be considered unacceptable.

The temperature of the mixture shall be in accordance with the Performance Graded Asphalt Binder (PGAB) allowable mixing and compaction temperature range. The temperature of the mixture when discharged from the mixer or silo shall be + 20°F (-6°C) from the value stated in the job mix formula. Mixtures exceeding these limits shall be subject to rejection.

RAP VERIFICATION - The City will randomly test HMA mixtures from the production plant or storage silos to determine the quality of the PG binder. For non-modified binder mixtures, the absolute viscosity of the recovered asphalt shall be no greater than 6,000 poises at 140oF. If the absolute viscosity is greater than 6,000 poises, then a full PG binder test verification will be run for conformance to the PG grade specified. For modified asphalt binder mixtures, a full PG binder test verification will be run for conformance to the PG grade specified. Failure of the PGAB to conform to specification requirements may be cause for rejection of the Lot. Further PGAB tests may be conducted on previous Lots; all costs for the PGAB tests will be the responsibility of the Producer if the results do not meet specifications [TMAX for G*/Sin (d) DSR (RTFO Aged] for PG 64-28 or 64-22 (whichever is applicable) recently placed.

7.7. Transporting, Placing and Finishing: HMA deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver.

Upon arrival, the mixture shall be placed to the full width by a hot mix asphalt paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the hot mix asphalt mat. Unless otherwise permitted,

placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 10 feet except where edge lanes require less width to complete the area. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least one (1) foot, however, the joint in the top layer shall be at the centerline of the pavement. Transverse joints in one layer shall be offset by at least two feet from transverse joints in the previous layer. The placement of the material along the longitudinal joint may be performed by setting the screed to overlap the first mat. The elevation of the screed above the surface of the first mat should be equal to the amount of roll-down expected during compaction of the new mat. The overlapped material shall be bumped by the lutes, if necessary, to optimize the density along the longitudinal joint. Under no circumstances should the overlapped material be broadcast across the mat. Excess material should be removed by hand. Transverse joints in adjacent lanes shall be offset a minimum of 10 feet.

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools. When hand spreading is permitted, the mixture shall be distributed into place by means of hot shovels and spread with lutes in a loose layer of uniform density and correct depth. The use of rakes to spread the hot mix asphalt shall not be permitted. Loads shall not be dumped any faster than they can be properly handled by the shovelers and the shovelers shall not distribute the dumped load any faster than it can properly be handled by the luters. The luting shall be carefully and skillfully done to avoid segregation and so that, after the first passage of the roller over the luted mixture, no back patching will be necessary. Compaction must immediately follow hand spreading such that specification density is achieved while the mixture temperature is above the manufacturers recommended compaction temperature for the performance graded binder.

The mixtures shall be placed and compacted only at such times as to permit the proper inspection and checking by the Engineer.

The mixtures shall only be placed in the work when they can be efficiently and satisfactorily placed, compacted, smoothed, and made uniform in accordance with these specifications. Unless otherwise permitted by the Engineer for special particular conditions, only machine methods of placing shall be used.

No mixture shall be placed unless the breakdown and intermediate rolling can be completed by the time the material has cooled to 150oF, or that minimum compaction temperature specified by the binder manufacturer and provided that the density and uniformity of the completed pavement attains specification compliance.

No traffic of any kind shall be permitted on the HMA intermediate or HMA base when dirt or any other foreign substance may be tracked thereon.

Immediately after any course is screeded and before roller compaction is started, the surface shall be checked, any irregularities adjusted, any accumulation from the screed removed by rake or lute, and all fat spots in any course removed and replaced with satisfactory materials. Irregularities in alignment and grade along outside edges shall be corrected by the addition or removal of mixture before the edges are rolled. Indiscriminate casting of mix on the new screeded surface, where irregularities are not evident, shall not be permitted.

All hot mix shall be placed and compacted in such a manner as to ensure a continuous bond between the tacked hot mix pavement surfaces and obtain the required density.

7.7.1. Second Control Strip Requirement If it is determined, during the performance of the contract, that the pavement does not conform to the surface tolerance, density and uniformity requirements, the Engineer may order the Contractor to cease all operations and construct an HMA CONTROL SECTION consisting of a sufficient quantity of surface course mixture. The Contractor shall construct a control section as directed by the Engineer either: a minimum of 100 feet long by 12 feet wide, or a minimum of 50 feet long by a minimum of 24 feet wide depending upon the problem. A control section may be required each time a change is made in the Job Mix Formula, sources of supply or paving and rolling equipment.

The mixture shall be prepared, placed, and compacted in accordance with this specification. When the control section pavement has cooled sufficiently, a total of six (6) samples of the finished pavement shall be taken and tested in accordance with the requirements of Section 5.0.

If the tests by the Engineer indicate that pavement does not conform to specification requirements, necessary adjustment to plant operation and placement/rolling procedures shall be made.

Where the average density of the core samples for either the mat or longitudinal joint does not conform to specification requirements, the pavement shall be removed at no cost to the Engineer. No payment will be made for material and labor employed, either in placement or removal of the nonconforming control section.

The second control strip may be removed at the direction and at no cost to the Engineer if the test result of any one mat core density falls below 90% of theoretical maximum laboratory density and/or any one longitudinal joint density falls below 88% of theoretical maximum laboratory density.

The Contractor shall not be permitted to place surface course pavement until a control section is approved by the Engineer.

7.8. Joints: The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade. When abutting a previously placed lane, the longitudinal joint should be rolled first followed by the regular rolling procedure.

7.8.1. Transverse Joints The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by temporarily tapering the course, in which case the edge shall be cut back to its full depth and width on a straight line to expose a vertical face. In both methods, all contact surfaces shall be given a coat of hot-pour rubberized asphalt sealer before placing any fresh mixture against the joint.

7.8.2. Longitudinal Joints - All longitudinal joints shall be constructed with the first paver pass in a neat straight line. Deviation from trueness will negate the ability to form a properly compacted longitudinal joint.

The paver screed may be equipped with a Longitudinal Notched - Wedge Joint or Straight Wedge Joint paver attachment and screed mounted roller attachment when placing HMA pavement courses. Use the Notched Wedge Joint for thicknesses of 1.5" or greater and use the Straight Wedge Joint for thicknesses less than 1.5". The notched wedge joint shall include a variable notched vertical edge (the notch vertical height to be equal to the mixture's maximum aggregate size). The sloped surface of the diagonal wedge joint shall not exceed a 6:1 slope. The notched wedge joint shall also include a variable vertical edge at the lower end of the diagonal plate (the vertical height to be equal to the mixture's maximum aggregate size). Prior to placing the adjacent paver pass for sloped joints, all joint contact surfaces shall be given a tack coat prior to placing any fresh mixture against the joint.

Vertical, conventional, confined-edge butt joints which are not constructed straight, or are not constructed with an edge restraining device (either a commercial paver screed attachment or by dropping the end gate down to the surface), or are damaged or otherwise defective shall be cut back 3 inches to expose a clean, sound surface for the full depth of the course. All contact surfaces shall be given a coat of hot-pour rubberized asphalt sealer prior to placing any fresh mixture against the joint. The sealer shall be applied as a bead approximately 1/8" thick at the middle of the overlay thickness on the vertical edge. Hot-pour sealant shall be paid for as a separate pay item.

7.9. Compaction of HMA Mixture After Placing - The mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. Rolling shall be initiated with the drive roll or wheel towards the paving machine. When rolling on steep grades, the previous procedure may need to be altered.

The speed of the roller shall, at all times, be sufficiently slow and of uniform speed to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. The number of rollers and passes required shall be governed by the compaction results;

however, at least two rollers shall be provided for each paver employed on the paving operation. The City of Worcester is encouraging the use of pneumatic or oscillation rollers. If one of the selected rollers is pneumatic, it shall be equipped with the European square edge tires. This will allow the pneumatic roller to handle both the intermediate compaction as well as the back rolling responsibilities on two-roller trains. An alternate to a full pneumatic European tired roller would be a combination 10-ton steel vibratory with large pneumatic square edge rear wheels. An acceptable alternative to the vibratory or pneumatic tired rollers would be the “Hamm” Oscillatory roller. Each roller shall be operated by a competent, experienced roller operator and shall be kept in as nearly continuous operation as practicable while work is underway. A plate shall be attached to each roller showing the ballasted and unballasted weight per length-width of tread.

To prevent adhesion of the mixture to the steel roller, the drums or shall be kept properly moistened, cocoa mats kept clean and scrapers used, but excessive water will not be permitted. Pneumatic rollers shall be operated on adjacent pavement surfaces to get the tires warm to hot from friction, then moved to the fresh mat.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers and vibratory plate compactors.

Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor’s expense. Skin patching shall not be allowed.

Along any adjoining edge such as curb, gutter or an adjoining pavement, and after the HMA is placed by the paver, just enough of the hot HMA shall be placed by hand method to fill any space left open. These joints shall be properly ‘set up’ with the back of a lute at the proper height and level to receive the maximum compaction. Any areas where the rollers cannot access shall be hand tamped or plate compacted.

7.9.1. Shaping Edges While the surface is being compacted and finished, the Contractor shall carefully trim the outside edges of the pavement to the proper alignment. Edges so formed shall be beveled while still hot with the back of a lute or smoothing iron and thoroughly compacted by tampers or by other satisfactory methods.

7.10. Surface Smoothness - The finished surfaces of the pavement shall be uniform in appearance, free from irregularities in contour and texture and shall present a smooth-riding surface. Smoothness evaluation applies to all hot mix asphalt concrete roadways receiving 1.5" or more in plan (compacted) thickness of HMA pavement.

Tests for conformity with the specified crown and grade shall be made by the Contractor immediately after initial compaction. Any variation shall be corrected by the removal or addition of materials and by continuous rolling.

The finished surface of the pavement, when measured with a 10-foot straightedge, shall not vary more than 1/4 inch for the surface course and 3/8 inch for the intermediate course measured perpendicular and parallel to the centerline. If, in the opinion of the Engineer, the surface visually appears wavy, but meets the surface tolerance test with the 10-foot straightedge, the Engineer reserves the right to additionally test with the use of Inertial Profile Equipment which records cumulative vertical deviations per unit length using a statistic called International Roughness Index (IRI). City of Worcester street upset limit for IRI is set at 135 in/mile using similar equipment that MHD specifies in their Quality Assurance HMA projects.

After the completion of final rolling, the smoothness of the course shall again be tested; humps or depressions exceeding the specified tolerances shall be immediately corrected by removing the defective work and replacing with new material, as directed by the Engineer. This shall be done at the Contractor's expense.

Skin patching will not be permitted.

When profile corrections are required, the Contractor shall use one or more of the following corrective methods:

Removing and replacing the entire pavement thickness;

Diamond grinding or micro milling;

Overlaying (not patching) with the specified surface course;

Removing the surface by milling and applying a lift(s) of the specified course(s);

Use of other methods that will provide the desired results;

The corrective method(s) chosen by the Contractor shall be performed at the Contractor’s expense, including all necessary equipment and traffic control. Areas of removal and replacement shall be removed the full width of the lane. The removal areas shall begin and end with a transverse butt joint which shall be constructed with a transverse saw cut perpendicular to the centerline. Replacement materials shall be placed in sufficient quantity so the finished surface will conform to grade and smoothness requirements. The corrective area shall conform to all material and density specification requirements. When the corrective work consists of an overlay, the overlay shall cover the full width of the pavement including shoulders. The area overlaid shall begin and end with a transverse butt joint which shall be constructed with a transverse saw cut and asphalt removal. All materials shall meet contract requirements. The overlay shall be placed so the finished surface will conform to grade and smoothness requirements. The overlayed area shall be compacted to the specified density.

The Engineer shall retest any sections where corrections were made to verify that the corrections produced a surface that conforms to the grade and smoothness requirements

7.11. Uniformity- The HMA mat shall be smooth, dense, and uniform. Uniformity is generally affected by Thermal and/or Aggregate segregation.

If segregation is evident and discernable by either the Contractor or the Engineer, the Contractor shall immediately cease production and take steps to correct and eliminate the cause(s) of the segregation to the satisfaction of the Engineer.

The Contractor shall review all potential causes of segregation as it relates to its operation, including but not limited to HMA Plant issues, loading and transportation issues, placement issues, thermal segregation, and hand work. The Contractor shall employ additional investigation methods and make the necessary changes in their operation such that segregation is eliminated and mat uniformity is acceptable.

The Engineer shall obtain two (2) six inch diameter cores from the identified (segregated) area and two (2) six inch diameter cores from the non-segregated area. The cores may be evaluated for resilient modulus, dry tensile strength, change in air voids, maximum in place air voids, aggregate gradation and binder content. The results of the data obtained on the cores from the segregated area will be compared to the results of tests performed on the cores from the non-segregated area.

If any mix property is beyond the tolerance limits stated in the table below, that area shall be considered segregated and shall be repaired by the contractor.

SEGREGATION LIMITS

Change in Mix Properties Expressed as a Percentage of the Properties in the Non-Segregated Areas

| Property | Limits |
|---|---|
| Resilient Modulus, psi @ 77oF | <80% |
| Dry Tensile Strength, psi @ 77oF | <90% |
| Aggregate Gradation and Binder Content | Refer to Table 7 (Action Limits) |
| Change in Air Voids | >2.5% |

The samples for the segregation analysis will be considered separately from the mat and joint cores tested for acceptance.

Segregated areas not meeting the requirements stated above or areas having more than 13% air voids shall be removed and replaced for the entire pavement thickness and lane width, or as directed by the Engineer. All corrective methods shall be performed at the Contractor's expense. The removal areas shall begin and end with a transverse butt joint which shall be constructed with a

transverse saw cut perpendicular to the centerline. The corrective area shall conform to all grades, smoothness, material, and density specification requirements. The Engineer may retest any areas where corrections were made to verify that the material meets specification requirements.

7.12. Thickness - The thickness requirements contained herein shall apply only when each pavement layer is specified to be a uniform compacted thickness of 1 inch or greater. Thickness shall be evaluated for acceptance by the Engineer to the requirements shown on the plans. Measurements of thickness may be checked periodically by the Contractor in following their QC system for field operations. Measurements of thickness for acceptance shall be made by the Engineer using four-inch minimum diameter pavement cores removed also for subsequent density measurement.

The finished surfaces of each HMA pavement course shall not vary from that specified or cross sections shown on the contract drawings by more than one quarter (1/4) of an inch. The Contractor shall correct pavement areas varying in excess of this amount by removing and replacing the defective work or as ordered by the Engineer. Skin patching will not be permitted.

7.13. Grade - The finished surface of the pavement shall not vary from the gradeline elevations as shown on the plans by more than 1/2 inch. The Contractor shall remove deficient areas and replace with new material. Sufficient material shall be removed to allow at least 1.5 inches of hot mix asphalt to be placed. Skin patching for correcting low areas shall not be permitted. High points may be ground off.

7.14. Leveling Course - Any HMA used for truing and leveling shall meet the requirements of the mix design methods and the requirements of the TABLE 6 or TABLE 3, 4, and 5 specifications for the applicable mixtures. Leveling courses shall not be subject to density requirements. The thickness of the Leveling Course shall be measured off the interface with the existing milled or un-milled pavement surface. The leveling course shall be compacted with the same effort used to achieve placement and density of the test section. The truing and leveling course shall not exceed a nominal thickness of 1.5 inches.

7.15. Opening to Traffic

No vehicular traffic or loads shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled sufficiently to an internal temperature of 140oF or less. If the climatic or other conditions warrant, or if the PGAB manufacturer recommends, the period of time before opening to traffic may be extended at the discretion of the Engineer.

7.16. Contractor Quality Control of HMA Pavement

7.16.1. General. Although guidelines are established and certain requirements are shown, they are suggested at this time. The QC system addresses all elements which affect the quality of the pavement including, but not limited to:

Mix Design

Aggregate Grading

Quality of Materials

Stockpile Management

Proportioning

Mixing and Transportation

Placing and Finishing

Joints

Compaction

Surface smoothness and uniformity

Thickness and grade

The Contractor shall be prepared to discuss and present, at the pre-paving conference, their understanding of quality control for this contract.

7.16.2. Control Charts

Contractor should develop production control charts and post for visual reference in the testing laboratory. The control charts should identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the production test results. If the project data during production indicates a problem and the Contractor is not taking satisfactory corrective action, then the Engineer may suspend production or acceptance of the material, in accordance with these specifications.

Individual Measurements: Control charts for individual measurements may be established to indicate production quality control within given tolerances for aggregate gradation and asphalt binder content. The control charts will use the JMF target values as the indicator of central tendency for the following test parameters with associated Action and Suspension Limits:

TABLE 4 HMA PRODUCTION LIMITS FOR INDIVIDUAL MEASUREMENTS

Sieve Size Action Suspension

1-1/2” (37.5mm) 0% 0%

| | | |
|---|---|---|
| 1" (25.0 mm) | ±6% | ±9% |
| 3/4" (19.0 mm) | ±6% | ±9% |
| 1/2" (12.5 mm) | ±6% | ±9% |
| 3/8" (9.5 mm) | ±6% | ±9% |
| #4 (4.75 mm) | ±6% | ±9% |
| #8 (2.36 mm) | ±5% | ±7.5% |
| #16 (1.18 mm) | ±5% | ±7.5% |
| #30 (0.600 mm) | ±4% | ±5.5% |
| #50 (0.300 mm) | ±3% | ±4.5% |
| #100 (0.150 mm) | ±3% | ±4.5% |
| #200 (0.075 mm) | ±2% | ±3% |
| Asphalt Binder Content | ±0.4% | ±0.70% |
| Design Air Voids (4.0%) | ±1% | ±1.7% |

When evaluating the production limits, the sieve sizes above the maximum size aggregate should be deleted from the Individual Measurements Chart and the maximum aggregate sieve size Action and Suspension Limits should be changed to 0%.

Range: Control charts for range may be established to indicate production variability for the test parameters and Suspension Limits listed below. The range may be computed as the difference between the high and low test results per lot for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. If more than two tests per lot were used, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

Table 5 CONTROL CHART LIMITS BASED ON RANGE

(Based on n = 2)

| Sieve | Suspension | Limit |
|---|---|---|

| | | |
|---|---|---|
| 1-1/2” | (37.5 mm) | 11 percent |
| 1” | (25.0 mm) | 11 percent |
| 3/4” | (19.0 mm) | 11 percent |
| 1/2” | (12.5 mm) | 11 percent |
| 3/8” | (9.5 mm) | 11 percent |
| #4 | (4.75 mm) | 11 percent |
| #8 | (2.36 mm) | 10 percent |
| #16 | (1.18 mm) | 9 percent |
| #50 | (0.30 mm) | 6 percent |
| #200 | (0.075 mm) | 3.5 percent |
| Asphalt Binder Content | | 0.8 percent |
| Design Air Void Content | | 2.0 percent |

Corrective Action: The Contractor should review the control charts on a continuous basis making adjustments to the process when necessary to keep the product consistent. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

1. One point falls outside the Suspension Limit line for individual measurements or range; or

2. Two points in a row fall outside the Action Limit line for individual measurements.

3. Three nonconsecutive samples fall outside the Action Limit line for individual measurements.

4. Two consecutive streets or two consecutive 1,000 ton lots of material tested for mat density or longitudinal joint density falls below the threshold density for 100% adjustment, as noted in Table 9 and Table 10.

The Contractor’s Quality Control system shall include an appropriate action to be taken when the process is believed to be out of tolerance. The Contractor should review the control charts on a continuous basis making adjustments to the process when necessary to keep the product consistent.

Acceptance testing requirements are the responsibility of the Engineer.

8.0 Quality Acceptance of HMA

All acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer at no cost to the Contractor, unless otherwise stated herein. Testing organizations performing these tests shall meet the requirements of ASTM D 3666. All equipment in Contractor furnished laboratories shall be calibrated and verified by a testing organization prior to the start of operations. Such verification/certification shall be furnished to the Engineer prior to production. Engineer's testing personnel shall be certified by the New England Transportation Technician Certification Program (NETTCP). This function does not relieve the Contractor from performing their daily quality control tasks as part of their normal operating business.

The Engineer or their agent shall have access at any time to all parts of the producing plant for:

Inspection of the condition and operations of the yard, plant and laboratory.

1. Confirmation of the adequacy of equipment in use.

2. Verification of the character and proportions of the mixture.

3. Determination of temperatures being maintained in the preparation of the mixtures.

4. Inspection of incidental related procedures.

Samples of all material including compacted specimens and certified copies of all reports and printouts shall be made available to the Engineer or its agent as often as requested including: asphalt binder; virgin aggregates; modifiers, loose and compacted mixture specimens; and combined aggregate samples.

8.1. Plant-Produced Material. Plant-produced material shall be sampled and tested for VMA, gradation, asphalt binder content, and air voids (Marshall or Superpave at Ndesign ), on a lot basis. The Engineer's testing personnel shall be certified by the New England Transportation Technician Certification Program (NETTCP), as HMA Plant Technicians. Sampling shall be from material deposited into trucks at the plant or from trucks at the job site. A lot will consist of:

- one day's production and shall be divided into 300 ton sublots. A minimum of one sample shall be obtained for each lot.

Where more than one plant is simultaneously producing material for, the job, the lot sizes shall apply separately for each plant.

8.1.1. Sampling - Sufficient material for analysis and preparation of test specimens will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D 3665. A minimum of one set of laboratory compacted specimens will be prepared for each lot in accordance with AASHTO T312, at the number of gyrations required by Table 4 herein (for Superpave only), or in accordance with Marshall design criteria, Table 6. Each set of laboratory compacted specimens will consist of two test portions prepared from the same field sample.

The sample of hot mix asphalt may be put in a covered metal tin and placed in an oven for not more than 30 minutes to maintain the heat. The compaction temperature of the specimens should be as specified in the JMF.

In addition to the hot mix asphalt samples, the Contractor shall take one, one-quart sample of the PG binder used to produce the hot mix asphalt at the start of the work. The PG sample shall be turned over to the Engineer on the first day of project production.

8.1.2. Testing

Bulk Specific Gravity - Two (2) laboratory fabricated sample specimens shall be tested for bulk specific gravity per sublot in accordance with AASHTO T166 or T275, whichever is applicable, for use in computing air voids and density. Air voids shall be computed in accordance with AASHTO T269.

Gradation and Asphalt Binder Content - The gradation and asphalt binder content of the mixture shall be measured for each sublot in accordance with the following:

Asphalt Binder Content – An extraction test be performed in accordance with AASHTO T164 or AASHTO T308 for determination of asphalt content. The weight of ash portion of the extraction test, as described in AASHTO T164, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture. If utilizing AASHTO T308 for asphalt content determination, the calibration process and calibration factor, as described in AASHTO T308, shall be determined as stated, prior to acceptance testing. A verification shall be performed as part of every twentieth test performed thereafter or when changes in the mix are apparent.

Gradation - Aggregate gradations shall be determined from mechanical analysis of extracted aggregate in accordance with AASHTO T 30 and AASHTO T27 (Dry Sieve).

The Dust-to-Effective Asphalt ratio shall be determined once for each sublot from the mechanical analysis of extracted aggregate and the asphalt binder content. The Dust-to-Effective Asphalt ratio shall be determined by the Engineer in accordance with AASHTO R35.

The Theoretical Maximum Specific Gravity of the mixture shall be measured for each sublot in accordance with AASHTO T209, Type C, D, or E container. Samples shall be taken on a random basis in accordance with ASTM D 3665. The value used in the field placed void computations shall be the average of the maximum specific gravity measurements for the lot.

Temperatures: Temperatures of the HMA shall be checked in the first three (3) haul units departing the production facility for each production day, and additionally once for each sublot. Additionally, temperatures may be checked to determine the temperatures of the dryer, the asphalt binder in the storage tank, the mixture at the plant, and the mixture at the job site for specification conformance.

VMA and air voids, for each plant sample, will be determined by the Engineer in accordance with the applicable AASHTO test method. The VMA, and air voids for each sublot shall be computed by averaging the results of the two test specimens representing that sublot.

8.1.3. Acceptance of Plant Produced HMA - Acceptance of plant produced HMA material will be based upon plant air voids, Marshall stability and flow (if applicable), VMA, gradation, asphalt binder content, and temperature, and shall be determined by the Engineer in accordance with these specifications.

8.2. Field Placed HMA Material - HMA material placed in the field shall be tested for mat and longitudinal joint density on a completed street or public facility basis. The Engineer's testing personnel shall be certified by the New England Transportation Technician Certification Program (NETTCP), as HMA Paving Technicians or HMA Plant Technicians. The Engineer may conduct any necessary testing to monitor the specified density, uniformity and smoothness. A properly correlated density gauge may be used to monitor the pavement density in accordance with ASTM D2950 or ASTM 7113. Monitoring density with density gauges by the Engineer does not imply acceptance or rejection; the Contractor is ultimately responsible to meet the requirements of the specification.

8.2.1. Sampling - Density gauges may be used by the Engineer to determine density of the paving course mat and/or longitudinal joints. Cores of the material shall be minimized and only taken at the direction of the Engineer and approval of the City. Mat and longitudinal joint density tests will be located by the Engineer or their representative on a stratified random sampling basis for each street or facility paved within three days of construction. The length of the longitudinal paving joint will be divided into sub-lots for sampling and testing purposes. If more than one longitudinal joint is formed on a street, then the random sample length will be the total lineal feet of longitudinal joint placed. A mat and longitudinal joint test will be taken by the Engineer randomly from each of these sub-lot intervals. Sub-lots will be determined on the basis of five (5) sub-lots per one thousand (1,000) tons of material placed or a minimum of five (5) sub-lots from each street or facility paved. Sampling and testing for density will be conducted in the following manner:

Paving courses will tested with the density gauge (for correlation), then sampled by coring the mat and the centerline of the longitudinal joint for confined edge joint construction, or on the hot side of the longitudinal joint when using notched wedge joint construction. A 6 inch diameter wet-core bit specifically designed for cutting pavement shall be used. The cores will be tested for density and thickness.

When sampling of the longitudinal joint for density determinations by coring, the core will be taken directly over the joint for confined edge construction, on the hot side of the longitudinal paving joint, or adjacent to the vertical edge of an existing longitudinal joint, or as directed by the Engineer.

A density sample will be tested from each sub-lot segment. The total width of the paved surface (curb to curb) will be determined at the longitudinal sub-lot location to sample and test for mat density. A transverse off-set distance from the centerline of the roadway will be established for mat

density sampling and testing. The location, either right or left of centerline, will be based on whether a random number is “odd or even” (odd=left; even=right). When the offset location is within 2 foot of the pavement edge, curb, catch basin or structure, or 1 foot off a longitudinal joint, or 10 foot off a transverse joint, the sample shall be relocated.

For nuclear gauge test locations, four 60 second readings will be taken with the gauge turned 90 degrees for each increment. The average of the four readings will be reported as the density value for each location. For non-nuclear density tests, five readings will be taken, after the first reading is taken the gauge will be moved up and to the right approximately 2” (the 2 o’clock position), three more readings will then be taken at the 4 o’clock, 8 o’clock, and 10 o’clock positions using the manufacturers operating procedures. The average of the five density values will be reported for each location.

If the results of the average density gauge readings for a street or pavement facility are below the threshold for 100% adjustment as indicated in Table 9 or Table 10, pavement cores may be removed as per this specification, and used for determining the actual pavement density.

In the event that a new density gauge needs be correlated for this project, cores should be taken from the mat and longitudinal joint representing the test locations. If previous core locations are available, the new density gauge should be correlated in accordance with the “re-correlation” procedure. If “re-correlation” is necessary, take four tests at quarter points around each of five previously cored and tested locations; making sure that the side of the nuclear or non-nuclear gauge is at the edge of the patched core location and firmly seated. Each test must be the average of four test increments turning the gauge 90 degrees.

All core samples shall be neatly cut with a core drill and water cooled bit where the cutting edge of the core drill bit shall be of hardened steel or other suitable material with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be 6 inches. Samples that are clearly defective, as a result of sampling, shall be documented and retained, then another sample taken for testing. The Contractor, Engineer or the Owner’s agent shall furnish all tools, labor, and materials for cutting samples and filling the cored pavement. Cored holes shall be filled in a manner acceptable to the Engineer and within one day after sampling.

The average density will be used to determine the percent payment.

Resampling of the pavement shall be in accordance with applicable provisions of the NETTCP Quality Assurance Technologist Manual, latest edition and these specifications.

With the exception of any Control Strips, if the Contractor is concerned about the test results obtained by the Engineer, the Contractor may request up to one time per street, that an equal number of random core samples be obtained and tested to supplement (not replace) the original core samples (or density gauge samples when bonus applies). The coring, patching and testing of the additional samples will be the responsibility of the Contractor. Cores for the mat and/or longitudinal joint density tests will be located by the Engineer and witnessed by the Contractor. Cores locations

will be based on a new stratified random sampling plan for each street or facility paved in accordance with the procedures stated above. Upon approval of the coring operation, the Contractor will notify the Engineer 48 hours in advance of the cores being taken such that the Engineer can witness the sampling. The additional cores must be tested by a NETTCP certified HMA plant technician in the presence of the Engineer or his designated representative.

Only one (1) set of additional mat and/or longitudinal joint cores will be allowed on a street or lot.

8.2.2. Testing - The bulk specific gravity of each cored sample will be measured by the Engineer's NETTCP certified technician in accordance with AASHTO T166 or T275, whichever is applicable. The theoretical maximum specific gravity shall be the average maximum specific gravity for the lot in accordance with the plant-produced material section. The percent density of each sample will be determined in accordance with AASHTO T269, using the bulk specific gravity of each sample and the average theoretical maximum specific gravity. Retesting of pavement shall be in accordance with applicable provisions of the NETTCP Quality Assurance Technologist Manual, latest edition.

8.2.3. Adjustment Pay Schedule for Mat Density The pay factor based on the density adjustment schedule will be applied to the bid price per ton for compacted mixtures greater than or equal to 1-1/2 inches thickness as shown in the contract award.

Table 6.

HOT MIX ASPHALT MAT DENSITY

Adjustment Schedule

Average Percent of Maximum Density

(minimum 5 samples) Percent Payment

100.0 98.1 98

98.0 - 95.0 102

94.9 - 92.0 100

91.9 – 89.0 90

88.9 – 87.0 75

86.9 or less rejection

8.2.4. Adjustment Pay Schedule for Longitudinal Joint Density The pay factor based on the joint density adjustment schedule will be applied to the bid price per ton for compacted mixtures greater than or equal to 1 1/2 inches thickness as shown in the contract award.

Table 7.

HOT MIX ASPHALT LONGITUDINAL-JOINT DENSITY

Adjustment Schedule

Average Percent of Maximum Density

(minimum 5 samples) Percent Payment

100.0 98.1 98

98.0 - 95.0 102

94.9 - 90.0 100

89.9 89.0 90

88.9 88.0 80

87.9 - 87.0 70

86.9 or less 50% or rejection

The total hot mix asphalt adjustment will be based on the weighted sum as follows:

.60 Mat Adjustment + .40 LJ Adjustment = Total HMA Adjustment

When the construction of the pavement does not include the construction of a longitudinal joint, the payment adjustment will be based on Table 7 only, no weighted sum will be calculated. If the Agency does not test, for whatever reason, payment for that quality characteristic will be 100%. Sidewalk and patching work shall be paid for in accordance with the bid price with no density adjustments; however, production plant action limits for mixture quality will still apply. Any bonus will first be credited against any payment adjustment in the contract for HMA.

8.2.5. Rejection of Inferior HMA The Engineer may at any time, not withstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of hot mix asphalt which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. Similarly, the Engineer may at any time, not withstanding field acceptance for mat density, reject and require the Contractor to correct any HMA pavement that was placed with unacceptable mat uniformity or paving joints due to low density, segregation, improper elevation, or tearing. In the event of such rejection, the Contractor and Engineer may take random split samples of the area(s) in question in the presence of the Engineer, and if it can demonstrate in the laboratory, in the presence of the Engineer, that such material/pavement was erroneously rejected, payment will be made for the material at the contract unit price.

8.3. Rounding - Numbers used in all calculations shall be carried to the correct significant figures and rounded as follows:

When the first digit after those you want to drop is 4 or less, that digit and all others to the right are dropped. Ex. 62.9437 to 3 significant digits = 62.9

When the first digit after those you want to retain is 5 or greater, that and all others to the right are dropped and the last digit retained is increased by one. Ex. 1.955234 to 3 significant digits = 1.96.

All Intermediate calculations should not be rounded and shall be reported to two more significant figures than the least number of significant figures in the data values.

Test Standards and technical look-up tables serve as first priority over these rounding rules.

8.4. Outliers - Due to the extremely low probability of an outlier occurring in a small number of samples representing the Lot, no outliers will be considered. If a result is suspect, it would be prudent to take the time to investigate the sampling, testing, equipment calibration, production, and construction operation to identify the cause of the suspect reading.

9.0 MEASUREMENT

9.1. Method of Measurement the quantity of hot mix asphalt to be paid for shall be the measured by the ton complete in place. The quantity of each truck load shall be obtained from printed tickets indicating the recorded batch weights or certified truck scale weights that have been properly countersigned by an authorized representative of the Engineer at the time of delivery. HMA quantities shall be verified by the Engineer using HMA yield calculations which will include the in-place bulk specific gravity and actual area and nominal depth for the mixture placed.

10.0 PAYMENT

10.1. Basis of Payment Payment shall be made at the contract unit prices per ton complete in place with any applicable adjustments. Note: no density adjustment shall be applied to HMA used for sidewalks or patching. This payment shall be full compensation for furnishing and placing all quality hot mix asphalt materials, including tack coat where specified, cutting of keyways or mill-ing/stripping of pavement to produce neat joints, mechanical sweeping of streets and for all labor, tools, equipment, materials, and all incidentals necessary to complete the work.

10.2. Adjustment for Density Adjustment for mat and joint density shall be made when the HMA material varies from the specification target limits, but is within the tolerances stated in Sections 8.2.3 and 8.2.4 "Adjustment Pay Schedule for Density", respectively; the material will be allowed to remain in place with the specified adjustment in payment with the exception of mixtures placed with mat density below 86.9 percent of maximum. Any bonus (102% payment for 95.0% to 98.0% density) will be first credited against any payment adjustments in the contract for HMA.

| PAY ITEM | DESCRIPTION | PAY UNIT |
|---|---|---|
| Bid Item 422.1 | Superpave 9.5mm, Level 2 Top Course | TON |
| Bid Item 422.2 | Superpave 12.5mm, Level 2, Binder Course | TON |

11.0 TESTING REQUIREMENTS

AASHTO T104 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

AASHTO T11 Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

AASHTO T96 Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

AASHTO T27 Sieve Analysis of Fine and Coarse Aggregates

AASHTO T127 Sampling and the Amount of Testing of Hydraulic Cement

AASHTO T255 Total Moisture Content of Aggregate by Drying

AASHTO T2 Sampling of Aggregates

AASHTO M17 Mineral Filler for Bituminous Paving Mixtures

AASHTO T170 Recovery of Asphalt from Solution by Abson Method

AASHTO T275 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens

AASHTO T110 Moisture or Volatile Distillates in Bituminous Paving Mixtures

AASHTO T245 Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus

AASHTO T209 Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

AASHTO T164 Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

AASHTO T176 Plastic Fines in Graded Aggregates and Soils by Use of the Sand Equivalent Test

AASHTO T195 Determining Degree of Particle Coating of Bituminous-Aggregate Mixtures

AASHTO T166 Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

AASHTO T269 Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures

ASTM D 2950 Density of Bituminous Concrete in Place by Nuclear Method

ASTM D 3665 Random Sampling of Paving Materials

ASTM D 3666 Inspection and Testing Agencies for Bituminous Paving Materials

AASHTO T287 Asphalt Cement Content of Asphalt Concrete Mixtures by the Nuclear Method

AASHTO T89 Determining the Liquid Limit of Soils

AASHTO T90 Determining the Plastic Limit and Plasticity Index of Soils

ASTM D 4791 Flat or Elongated Particles in Coarse Aggregate

ASTM E 178 Practice for Dealing With Outlying Observations

ASTM D5821 Determining the Percentage of Fractured Particles in Coarse Aggregate

AASTHO T304 Uncompacted Void Content of Fine Aggregate

AASHTO T30 Mechanical Analysis of Extracted Aggregate

AASHTO T202 Viscosity of Asphalts by Vacuum Capillary Viscometer

AASHTO T240 Effect of Heat and Air on a Moving Film of Asphalt (Rolling Thin Film Oven Test)

AASHTO T283 Resistance of Compacted Bituminous Mixture to Moisture Induced Damage

AASHTO T308 Determining the Asphalt Binder Content of Hot Mix Asphalt (HMA) by the Ignition Method

The Asphalt Institute's Mix Design Methods for Asphalt Concrete Manual No. 2 (MS-2)

ADDITIONAL REQUIREMENTS

AASHTO M320 Standard Specification for Performance Graded Asphalt Binder

AASHTO MP2 Standard Specification for Superpave Volumetric Mix Design

AASHTO R30 Standard Practice for Mixture Conditioning of Hot Mix Asphalt (HMA)

AASHTO R29 Grading or Verifying the Performance Grade of an Asphalt Binder

AASHTO R26 Standard Practice for Certifying Suppliers of Performance Graded Asphalt Binders

AASHTO R35 Standard Practice for Superpave Volumetric Design of Hot Mix Asphalt (HMA)

AASHTO T312 Determining the Density of Hot Mix Asphalt (HMA) Specimens by Means of the SHRP Gyratory Compactor

AASTHO T315 Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)

AASHTO T316 Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus

11.1. METHOD OF TEST FOR BULK SPECIFIC GRAVITY OF AGGREGATE BLENDS WITH RAP

Scope

This test method covers the procedure to determine the bulk specific gravity (Gsb) of a combined aggregate blend with RAP used in a HMA mixture.

This test method may involve hazardous materials, operations, and equipment. This test method does not purport to address all of the safety problems associated with the test method’s use. The test method user's responsibility is to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

Referenced Documents

AASHTO Standards

T-2 Sampling Aggregates

T-84 Specific Gravity and Absorption of Fine Aggregates

T-85 Specific Gravity and Absorption of Coarse Aggregate

T-100 Specific Gravity of Soils

T-164 Quantitative Extraction of Bitumen from Bituminous Paving Mixtures

T170 Recovery of Asphalt From Solution by Abson Method

T-209 Maximum Specific Gravity of Bituminous Paving Mixtures

T-228 Specific Gravity of Semi-Solid Bituminous Materials (Pycnometer Method)

Other References

MS-2 Mix Design Methods for Asphalt Concrete by the Asphalt Institute

Terminology

Terms and Abbreviations. Definitions for terms and abbreviations shall be in accordance with the Standard Specifications.

Significance And Use

This test method is used to determine the bulk specific gravity of a combined aggregate blend with RAP used in HMA mixture.

The bulk specific gravity (Gsb) of a combined aggregate blend is calculated using an estimate of the bulk specific gravity of the aggregate in the RAP and the actual bulk specific gravity of the other aggregates.

The bulk specific gravity of an aggregate blend is used to perform a volumetric analysis on compacted HMA in accordance with the Mix Design Methods for Asphalt Concrete by the Asphalt Institute.

Apparatus

Apparatus shall be as stated in the referenced test methods.

Sampling

Sampling shall be as stated in the referenced test methods.

Procedure

Identify the coarse aggregate(s), fine aggregate(s) and RAP selected for use in the mix designs.

Identify and record the actual percentages for each of the aggregate components used in the combined aggregate blend of the mix design.

Obtain a representative sample of the coarse aggregate, fine aggregate mineral filler and RAP in accordance with the AASHTO procedures.

Determine and record the bulk specific gravity of each of the coarse aggregate(s) in accordance with AASHTO T-85.

Determine and record the bulk specific gravity of each of the fine aggregate(s) in accordance with AASHTO T-84.

Determine and record the maximum specific gravity of the RAP in accordance with AASHTO T-209, Type C, D, or E container.

Determine and record the asphalt content of the RAP using AASHTO T164.

Calculate and record the effective specific gravity of the RAP aggregate in accordance with the following:

Gse = (100 - Pbrap)/((100/Gmmrap) - (Pbrap/Gbrap))

Where:

Gse = Effective specific gravity of the RAP aggregate

Pbrap = Percent binder of the RAP

Gmmrap = Maximum specific gravity of the RAP

Gbrap = Specific gravity of asphalt in the RAP (AASHTO T228)

Calculate and record the effective specific gravity of the combined aggregate blend as follows.

Where:

GsbBlend = Bulk specific gravity of the combined aggregate blend.

Gsb = Bulk specific gravity of each respective aggregate.

Gse = Effective specific gravity of the RAP.

%CA1 = Percent of aggregate blend that is coarse aggregate #1.

%CA2 = Percent of aggregate blend that is coarse aggregate #2.

%FA1 = Percent of aggregate blend that is fine aggregate #1.

%FA2 = Percent of aggregate blend that is fine aggregate #2.

%BHF = Percent of aggregate blend that is bag house fines.

%RAP = Percent of aggregate blend that is RAP.

Report

Report the Gsb of the combined aggregate blend to the nearest 0.001.

A. MEASUREMENT AND PAYMENT

Item 422 will be paid for by the ton.

ITEM 438 BITUMINOUS CONCRETE BERM MACHINE PLACED

A. GENERAL

Work to be done under this item shall conform to the applicable provisions of Section 470, (MSSHB), Berm Worcester Standard as shown on detail titled Typical Half Section thru Bituminous Concrete and Berm and is to be made of bituminous concrete, as specified for payment, SUPERPAVE, dense mix carefully placed by machine.

All surfaces and angles of the template used with the berm to be smooth and straight, carefully formed, all as shown in Typical Section with Berm Detail.

The bituminous concrete berm shall be well consolidated.

B. MEASUREMENT AND PAYMENT

Bituminous concrete berm machine placed shall be measured in place and shall be paid at the unit price per linear foot bid therefore in the proposal.

The work to be done under Items 440 through 436 shall conform to the applicable provisions of Section 701, (MSSHB), Cement Concrete (Air Entrained, 4,000 p.s.i., 3/4", 610).

ITEM 440 NEW CONCRETE SIDEWALK 4 INCH

A. GENERAL

The work under this item shall conform to the relevant provisions of Sections 701 of the Standard Specifications and the following:

B. INSTALLATION

Install concrete according to requirements of Division 3 Section "Cast-In-Place Concrete."

Do not add water to the mix in the field.

Surfaces shall be uniformly stamped/imprinted, applying the pattern according to the tool manufacturer's instructions. Touch-up pattern and finish edges with hand tools as necessary.

Apply curing and sealing compound for integrally colored concrete according to manufacturer's instructions using manufacturer's recommended application techniques. Apply curing and sealing compound at consistent time for each pour to maintain close color consistency. Curing compound shall be same color as the colored concrete and supplied by same manufacturer of the colored admixture.

Precautions shall be taken in hot weather to prevent plastic cracking resulting from excessively rapid drying at surface as described in CIP 5 Plastic Shrinkage Cracking published by the National Ready Mixed Concrete Association. Do not cover concrete with plastic sheeting.

Minor variations in appearance of colored concrete, which are similar to natural variations in color and appearance of uncolored concrete, are acceptable.

C. MEASUREMENT AND PAYMENT

Cement concrete will be paid for at the Contract unit price per square yard, which price shall include all labor, materials, equipment and incidental costs required to complete the work. No separate payment will be made for the joint sealer or backer rods, but all costs in connection therewith shall be included in the unit price bid.

ITEM 454 WHEELCHAIR RAMP CEMENT CONCRETE - 6" THICK WITH DETECTABLE WARNING PANELS

The design will be dependent upon the width and type of existing sidewalk, conforming to 521 CMR, Architectural Access Board as shown in the City of Worcester Construction Details Book.

On sidewalks having curb, the curb will be reset for the whole length of the ramp. Any increase in thickness designated by the Contracting Officer shall be paid for at a pro-rated basis.

Expansion joints 1/2 inch thick shall be placed at all points where the concrete wheelchair ramp abuts sidewalks, buildings, curb or other permanent structures.

A. SLOPE

The maximum slope shall be one-in-12 (1:12) (8.3%). Where sidewalks are too narrow to install a straight-line curb cut at a slope of one-in-12 (1:12) (8.3%), the primary slope may be steeper than 1:12 (8.3%) but the sides of the curb cut shall not exceed one-in-12 (1:12) (8.3%). The maximum cross-slope for any curb cut shall be 1:50 (2%). (There is no tolerance allowed on slope require-ments).

B. TRANSITIONS

Transitions from curb cuts to walks, gutters, or streets shall be flush with existing surfaces. Maxi-mum slopes of adjoining gutters, road surface immediately adjacent to the curb cuts, or accessible route shall not exceed one-in-20 (1:20) (5%).

C. DRAINAGE

Grading and drainage shall be designed to minimize pooling of water, accumulation of ice, or flow of water across the base of the curb cut.

D. WIDTH

The minimum width of a curb cut shall be 36 inches (36"=914mm), exclusive of flared side.

Landing width: Where a perpendicular curb cut is provided, a landing width of the curb cut shall be provided at the top of the curb cut. The landing shall be 48 inches (48"=1219mm) in length. The slope of said landing shall not exceed one-in-50 (1:50) (2%) in any direction.

E. FLARED SIDES

Sides of curb cuts shall extend at least 5 feet at the curb. The maximum slope of the flare is one-in-ten (1:10) (10%). Curbing at the flared sides must blend with the slope of the flared sides.

F. RETURNED SIDES

Curb cuts with returned sides are only permitted where they are protected by handrails pursuant to 521 CMR 24.5, Handrails or where pedestrian travel across the ramp is obstructed by permanently installed street hardware or landscaping.

G. METHOD OF PAYMENT

Wheelchair ramps shall be measured in place, including excavation, gravel foundation, grading, removing and resetting curb or berm, installing detectable warning panels and removal and replacing of disturbed roadway. Payment shall be at the price per square yard bid in the proposal.

Existing wheelchair ramps that need detectable warning panels shall be measured in place, including all necessary equipment needed for the installation. Payment shall be at the bid price per square foot in the proposal.

Where granite curb is missing the Contractor will be required to set granite curb. Payment for supply of such granite curb shall be through the appropriate Items 405 thru 420.

The work to be done under Item 476 shall conform to the applicable provisions of Section 644, (MSSHB) and shall be paid for at the contract unit price per linear foot (complete in place) including concrete base, line posts and gates.

ITEM 476 CHAIN LINK FENCE, 72 INCHES

SECTION 500 - TRAFFIC

Items 505 through 508 shall conform to specifications on file for “Retroreflective White and Yellow and Black Lead Free Waterborne Pavement Marking Materials” at the Department of Public Works and Parks Traffic Engineering Division, 20 East Worcester Street and the contractor shall provide all labor, material and equipment for the complete application of the item as shown on the drawings and described in these specifications at the unit price and as shown in the proposal.

ITEM 505 4 INCH REFLECTORIZED WHITE LINE (WATERBORNE) LF

ITEM 506 4 INCH REFLECTORIZED YELLOW LINE (WATERBORNE) LF

ITEM 508 PAVEMENT ARROW/LEGEND REFLECTORIZED WHITE (WATERBORNE) EACH

A. MATERIALS

The materials used for this section shall conform to the applicable portions of Section M7.01 Pavement Markings, of the Massachusetts Department of Public Works Standard Specifications for Highways and Bridges most recent edition.

B. EXECUTION

Surface Preparation – The pavement shall be dry and free of sand, grease, oil or other foreign substances. Bituminous concrete shall have been in place for at least 48 hours prior to paint application.

Application – In accordance with the Manufacturer's Specification and with good painting practices, markings shall be applied at locations and at specified dimensions as designated on the drawings.

All applicable requirements of Section 860 of the Massachusetts Department of Public Works Standard Specifications for Highways and Bridges shall be met for work in this section.

Protection – The Contractor shall protect pavement markings until sufficiently dry to bear traffic. Cones or like barriers shall be used to protect markings.

C. MEASUREMENT AND PAYMENT

Payment for all pavement markings shall be as designated at the applicable unit price as bid in the proposal. The price shall include all work necessary to successfully perform all tasks associated with these specifications and to the satisfaction of the Engineer and the Department of Public Works and Parks Traffic Engineering Division.

ITEM 525 COMPLY WITH THE CONSERVATION COMMISSION ORDER OF CONDITIONS

A. GENERAL

Under this item, the Contractor shall provide all labor, tools, equipment and materials required to comply with the "Order of Conditions" issued by the Worcester Conservation Commission or Massachusetts Department of Environmental Protection enclosed with the Bid Documents of the Contract for Siltation Control.

The Contractor is required to comply with all conditions of this document.

B. MEASUREMENT AND PAYMENT

Payment under this item will be as a Lump Sum.

ITEM 525.1 INSTALLATION AND MAINTENANCE OF EROSION CONTROLS

A. GENERAL

The Contractor shall provide all labor, tools, equipment and material required to install, maintain, and remove all siltation control measures shown on the plans.

B. METHOD OF PAYMENT

Payment under this item will be as Linear Feet.

SECTION 900 - LUMP SUM RESERVE

ITEM 900 LUMP SUM RESERVE FOR CITY USE

A. GENERAL

1. Lump Sum Reserve for Contingency Work - The Contractor is advised that the lump sum reserve for contingency work shall be utilized, as required by the City of Worcester, for additional work that may be required by the City and agreed to by the Contractor. Any reserve balance remaining at the end of the contract will return to the City of Worcester.

2. Lump Sum Reserve for Testing - The Contractor is advised that, where indicated by the City of Worcester, independent laboratory tests may be required of materials incorporated into the project. The tests will be performed by an independent laboratory selected by the City and compensated for directly by the City under the Lump Sum Reserve for Testing items. The Contractor is to cooperate fully with the City to make available any material and samples necessary to perform the independent tests. Upon completion of the contract all amount not utilized will return to the City of Worcester.

3. Lump Sum Reserve for Traffic Police - The Contractor is advised that the City of Worcester will designate the number and need for Traffic Police throughout the duration of the contract. The City will compensate directly for Traffic Police, as ordered, under the Lump Sum Reserve for Traffic Police. Upon completion of the contract all amount not utilized will return to the City of Worcester.

SECTION 316217 – STEEL HELICAL PILES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Foundation stabilization.

B. Related Sections:

1. Division 03 Section "Cast-in-Place Concrete".

C. Basis for Payment: See Division 1 Section “Unit Prices” for quantities included in the Contract.

1. From the data obtained as a result of installation, calculate actual total net length of piers used. Contract price per linear foot includes labor, materials, tools, equipment and incidentals, and for performing work for furnishing, installing, cutting off and capping piers. This includes splicing and disposal of cut-offs.
2. Measurements will be based on effective length of piers in place, with fractional lengths measured to nearest foot. Payment for linear footage in excess of that given in the Contract, and credit for linear footage less than that given in the Contract, shall be made at unit prices stated in the Contract, based on net addition or deduction.
3. No payment will be made for rejected piers, including piers installed out of place, imperfect piers, or piers damaged in installing or handling.

1.3 REFERENCES

A. General:

1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

B. ICBO Evaluation Report ER-5110, A. B. Chance Helical Pier Foundation System.

C. ICBO Evaluation Report PFC-5551, Dixie Anchoring System.

1.4 DEFINITIONS

A. Helical Pier: Steel fabrication consisting of one or more helically shaped steel plates attached to a central steel shaft. Piers are extended by adding shaft extensions.

1.5 SUBMITTALS

A. Delegated-Design Submittal: For steel helical pile system indicated to comply with indicated structural requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

B. Submit certification that manufactured components comply with ICBO report ER-5110 or PFC-5551.

C. Submit installer's certification from the manufacturer to install the system.

D. Project Closeout Submittals: Record drawings, record documents.

1.6 QUALITY ASSURANCE

A. Installer Qualification: Installers specializing in performing the work of this section with documented certification from the manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design steel helical pile systems.

B. Engineer shall confirm the design requirements of the building code and referenced standards cited here but shall not lessen minimum quantities or raise maximum quantities indicated herein without approval by the Architect.

C. Occupancy Category: This building is assigned to Occupancy Category IV as defined in ASCE 7, Table 1.1 and Massachusetts State Building Code – 8th Edition, Table 1604.5 as an essential facility "for designated emergency preparedness, communications and operations centers and other facilities required for emergency response."

D. Seismic Performance: Access flooring shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

2.2 MANUFACTURED COMPONENTS

A. Helical plate, pier lead section and extensions, bolts and foundation attachment brackets conforming to the applicable ICBO evaluation report.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products and systems of GoliathTech New England, 389 Concord Rd, Billerica, MA 01821 to comply with delegated design or a comparable product by one of the following:

a. AB Chance Company, a subsidiary of Hubbel Corp., 210 North Allen Street, Centralia, MO 65240-1395
b. Aluma-Form/Dixie,3625 Old Getwell Road, Memphis, TN 38118.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions under provisions of Division 01 Section "Special Procedures."

3.2 PREPARATION

A. Use placement method which will not cause damage to nearby structures.

B. Prepare to place piles from excavated working elevation.

3.3 INSTALLATION

A. Install by certified contractor or dealer.

B. Connect helical piers to the structure and install helical piers as detailed on structural drawings.

C. Provide electric or hydraulic powered, rotary type installation torque units with forward and reverse capability which are capable of positioning the pier at the designed angle.

D. Connect the installation units with manufacturer’s approved adapters. Provide safe connection to piers and extensions.

E. The minimum installation equipment rating shall equal or exceed the maximum torque rating of the specified helical pier.

F. Securely connect the installation equipment to the pier during installation.

G. Monitor torque applied by the installing units during the entire installation and record values achieved on each pier.

H. Provide a torque monitoring device as part of the installing unit or as a separate in-line device.

I. Make calibration torque monitoring data available for the Engineer, Inspector, and Owner.

J. Position helical pier as indicated. Establish proper angular alignment at the start of installation.

K. Install piers in a smooth and continuous manner; the rate of pier rotation shall be five to twenty revolutions per minute.

L. Apply sufficient downward pressure to advance the pier.

M. Provide extension material to obtain indicated depth. Couple the helical pier and extension sections with bolts in accordance with ICBO report ER-5110.

N. Remove encountered obstructions, or relocate the helical pier and adjacent helical piers as required.

O. Install to the minimum depth indicated. Provide a minimum of five 5 feet (1.5 m) of ground cover above the top helix. Obtain written permission from the Owner before proceeding if indicated depth or minimum torque can not be obtained.

## 3.4 FIELD QUALITY CONTROL

A. Field inspection and testing when required will be performed under provisions of Division 01 Section "General Requirements." Special inspection as specified in the applicable ICBO evaluation report is required in accordance with Section 1701 of the CBC.

B. Monitor torque applied by the installing units during the entire installation.

C. Provide torque monitoring device as part of the installation unit or as a separate in-line device.

## 3.5 PROJECT RECORD DOCUMENTS

A. Accurately record the following:

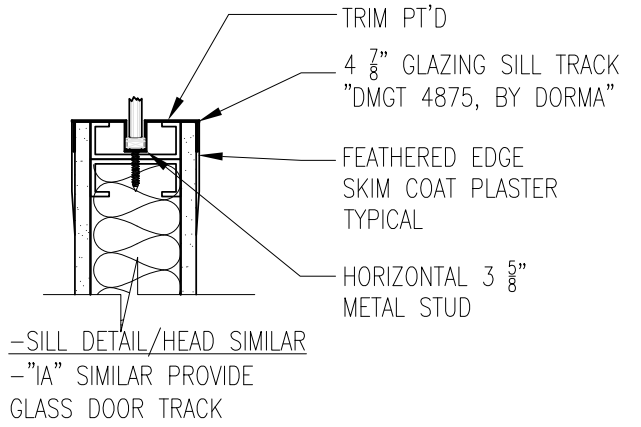
1. Type number and size of helices, and size.
2. Deviation from indicated locations.
3. Actual locations of helical piers, pier diameter, and pier length.
4. Installation angle below horizontal.
5. Extension length along shaft and datum.
6. Anchor testing if required.
7. Torque-installation records on piers.
8. Torque monitoring calibration data.

## 3.6 DEPTH AND TORQUE TOLERANCES

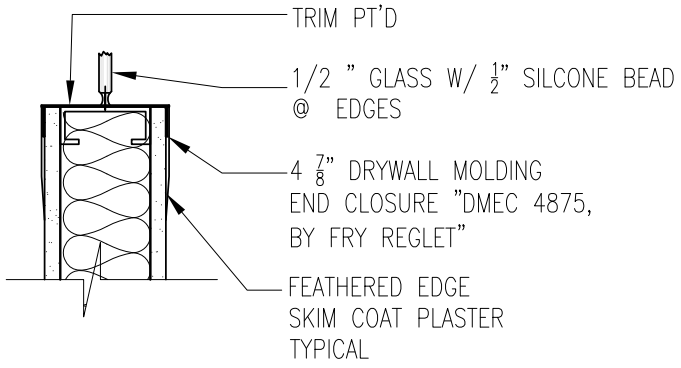
A. Helical piers that reach maximum torque rating before reaching minimum indicated depth shall be subject to the following:

1. Terminate at depth obtained with written approval to Engineer.
2. Replace helical pier with smaller and/or less helices, installed 3 feet minimum beyond termination of original helical pier.

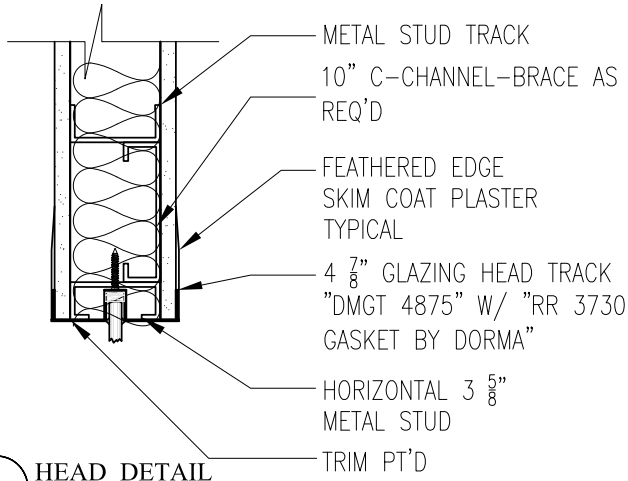
END OF SECTION 316217



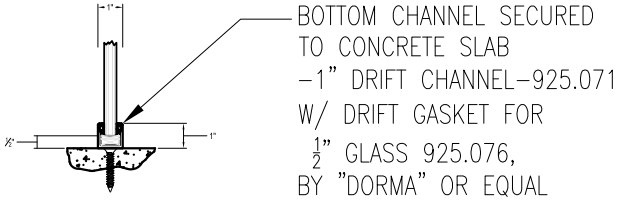

1 SILL DETAIL @ WALL
1 1/2" = 1'-0"




2 JAMB DETAIL
1 1/2" = 1'-0"

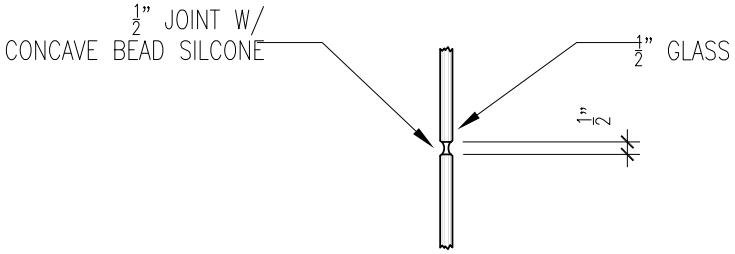



3 HEAD DETAIL
1 1/2" = 1'-0"




4 SILL DETAIL @ FLOOR
1 1/2" = 1'-0"

SILL/FLR DETAIL
@ INTERIOR WINDOWS




5 BUTTED GLASS DETAIL
1 1/2" = 1'-0"

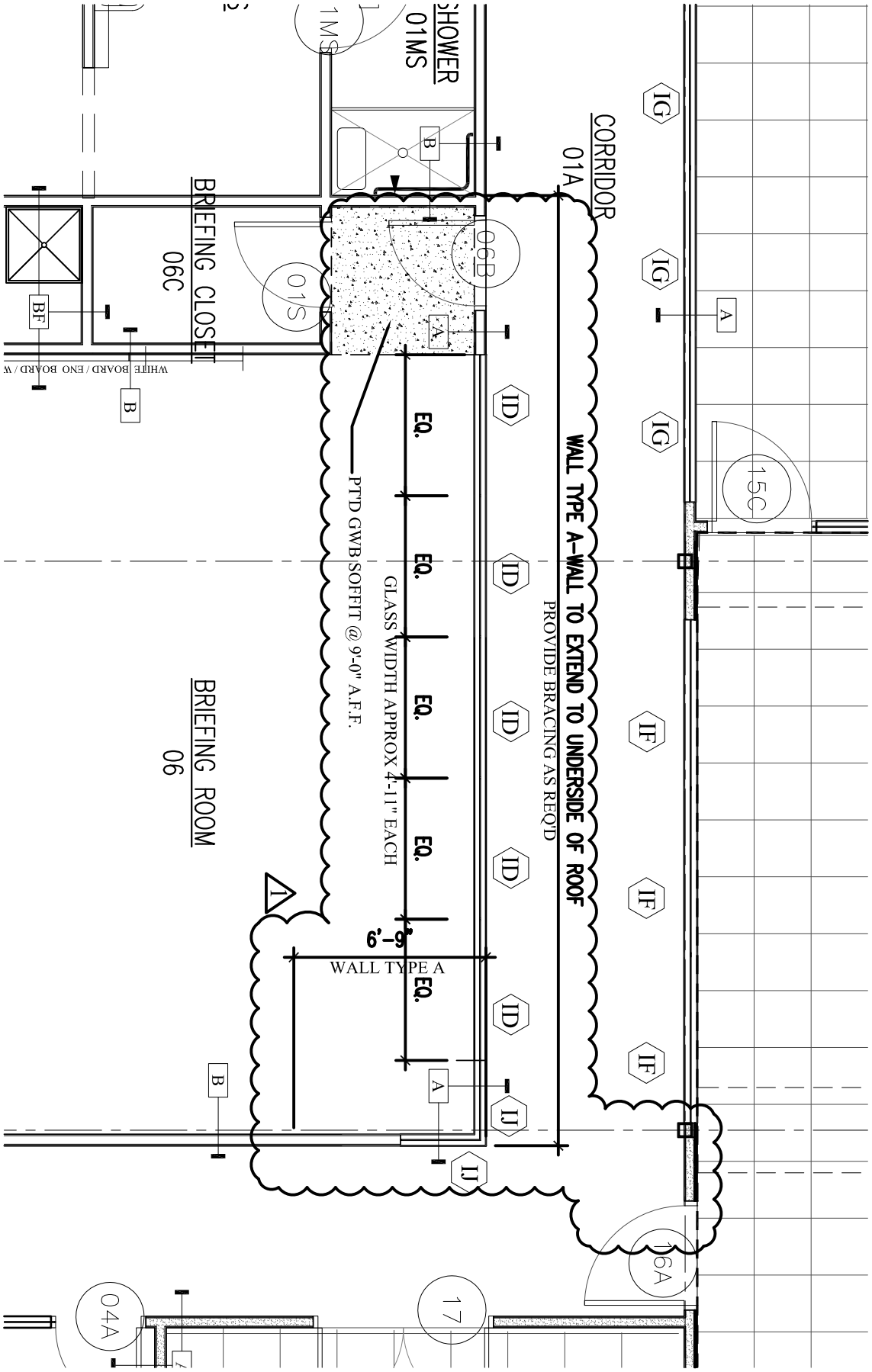
CITY OF WORCESTER

**DEPARTMENT OF PUBLIC WORKS AND PARKS**
ARCHITECTURAL SERVICES DIVISION
50 SKYLINE DRIVE, WORCESTER, MA 01605

**SCALE:** 1/4" =1'-0"
**DATE:** 12/19/14
**REMARKS:**
ISSUED VIA ADDENDUM #1

**PROJECT TITLE:**
**REGIONAL EMERGENCY COMMUNICATIONS CENTER**
2 Coppage Drive, Worcester, MA 01603
**DRAWING TITLE:**
INTERIOR WINDOW DETAILS

**SHEET NUMBER:**
SKA-01




CITY OF WORCESTER

**DEPARTMENT OF PUBLIC WORKS AND PARKS**

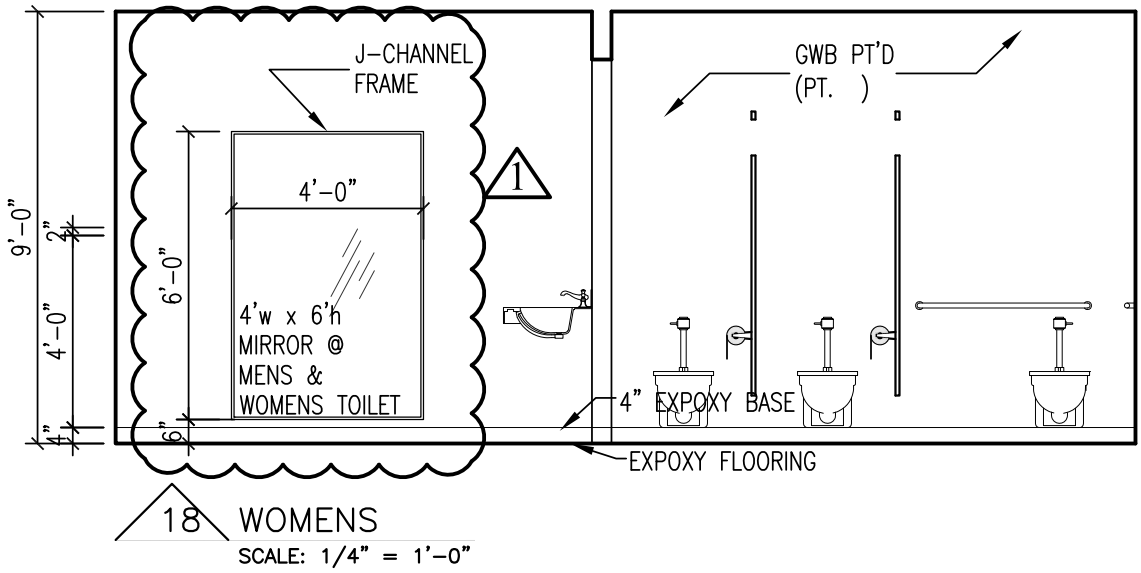
ARCHITECTURAL SERVICES DIVISION
50 SKYLINE DRIVE, WORCESTER, MA 01605

**SCALE:** 3/16" =1'-0"
**DATE:** 12/19/14
**REMARKS:**
ISSUED VIA ADDENDUM #1

**PROJECT TITLE:**
REGIONAL EMERGENCY COMMUNICATIONS CENTER
2 Coppage Drive, Worcester, MA 01603

**DRAWING TITLE:**
WINDOW SPACING & SOFFIT AT BRIEFING ROOM

**SHEET NUMBER:**
SKA-02




18 WOMENS

SCALE: 1/4" = 1'–0"

CITY OF WORCESTER

# DEPARTMENT OF PUBLIC WORKS AND PARKS

ARCHITECTURAL SERVICES DIVISION
50 SKYLINE DRIVE, WORCESTER, MA 01605

**SCALE:** 1/4" =1'-0"
**DATE:** 12/19/14
**REMARKS:**
ISSUED VIA ADDENDUM #1

**PROJECT TITLE:**
REGIONAL EMERGENCY COMMUNICATIONS CENTER
2 Coppage Drive, Worcester, MA 01603

**DRAWING TITLE:**
FULL HEIGHT MIRROR @ MENS & WOMENS

**SHEET NUMBER:**
SKA-03

# SUMP PUMP SCHEDULE

| TAG NO | TYPE | MANUFACTURER | MODEL | ELECTRICAL INPUT | REMARKS |
|---|---|---|---|---|---|
| SP-1 | EFFLUENT | ZOELLER OR APPROVED EQUAL | 72 AQUA-MATE | 115V/1PH ⅓ HP | PROVIDE BALL AND CHECK VALVES ON THE PUMP DISCHARGE PIPING |

NOTES : COORDINATE POWER REQUIREMENTS WITH E.C.

BLW Engineers, Inc.
311 Great Road, Post Office Box 1551
Littleton, Massachusetts 01460
T: 978.486.4301 F: 978.428.0067
www.blwengineers.com
*HVAC * ELECTRICAL * PLUMBING * FIRE PROTECTION*

| | | | |
|---|---|---|---|
| Project: RECC - WORCESTER, MA | | | Sketch No.: SKP-01 |
| Title: PLUMBING SCHEDULES | | | |
| Date: 12/19/14 | Scale: NTS | Project No.: 12136.15 | |
| Drawn By: GGB | Rev. No.: 001 | Dwg. Ref.: P0.1 | |

## PANEL 'PP4', 125 AMP, 120/208 VOLT, 3 PHASE, 4 WIRE AND GROUND

INTERUPTING CAPACITY: 10,000 AMPS RMS SYM | MAIN: MLO | MOUNTING: SURFACE

| LOAD DESCRIPTION | KVA LOAD A | KVA LOAD B | KVA LOAD C | CB/ PHASE | CIRC NO. | PH | CIRC NO. | CB/ PHASE | KVA LOAD A | KVA LOAD B | KVA LOAD C | LOAD DESCRIPTION |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| GATE ENTRY/EXIT POWER | 1.00 | | | 20/1 | 1 | A | 2 | 20/1 | 0.50 | | | FACP |
| STORAGE UNIT POWER | | 1.00 | | 20/1 | 3 | B | 4 | 20/1 | | 0.40 | | ROOF RECEPTACLES |
| STORAGE UNIT POWER | | | 1.00 | 20/1 | 5 | C | 6 | 20/1 | | | 0.50 | CLEAN AGENT SYSTEM C.P. |
| AC-1 | 0.10 | | | 20/2 | 7 | A | 8 | 20/1 | 0.20 | | | SPRINKLER BELL |
| | | 0.10 | | | 9 | B | 10 | 20/1 | | 0.20 | | AUTO DIALER |
| AC-2 | | | 0.10 | 20/2 | 11 | C | 12 | 20/1 | | | 0.20 | CONDENSATE PUMP |
| | 0.10 | | | | 13 | A | 14 | 20/1 | 0.20 | | | CONDENSATE PUMP |
| CU-1 | | 1.40 | | 20/2 | 15 | B | 16 | 20/1 | | | | SPARE |
| | | | 1.40 | | 17 | C | 18 | 20/1 | | | | SPARE |
| CU-2 | 1.40 | | | 20/2 | 19 | A | 20 | 20/3 | 0.30 | | | TEF-1 |
| | | 1.40 | | | 21 | B | 22 | | | 0.30 | | |
| WAP | | | 0.80 | 20/1 | 23 | C | 24 | | | | 0.30 | |
| MOTORIZED SHADES | 1.00 | | | 20/1 | 25 | A | 26 | 20/1 | 0.20 | | | EF-2 |
| MOTORIZED SHADES | | 1.00 | | 20/1 | 27 | B | 28 | 20/1 | | 1.00 | | GEN. BATTERY CHARGER |
| EJECTOR PUMP | | | 0.87 | 20/1 | 29 | C | 30 | 20/1 | | | 1.00 | GEN. BATTERY CHARGER |
| EJECTOR PUMP | 0.87 | | | 20/1 | 31 | A | 32 | 20/1 | 1.00 | | | GEN. BATTERY CHARGER |
| EJECTOR PUMP | | 0.87 | | 20/1 | 33 | B | 34 | 20/1 | | | | SPARE |
| EJECTOR PUMP | | | 0.87 | 20/1 | 35 | C | 36 | 20/1 | | | | SPARE |
| SPARE | | | | 20/1 | 37 | A | 38 | 20/1 | | | | SPARE |
| SPARE | | | | 20/1 | 39 | B | 40 | 20/1 | | | | SPARE |
| SPARE | | | | 20/1 | 41 | C | 42 | 20/1 | | | | SPARE |
| | 4.47 | 5.77 | 5.04 | SUBTOTALS | | | | | 2.40 | 1.90 | 2.00 | |

PHASE A 6.87 KVA

PHASE B 7.67 KVA

PHASE C 7.04 KVA

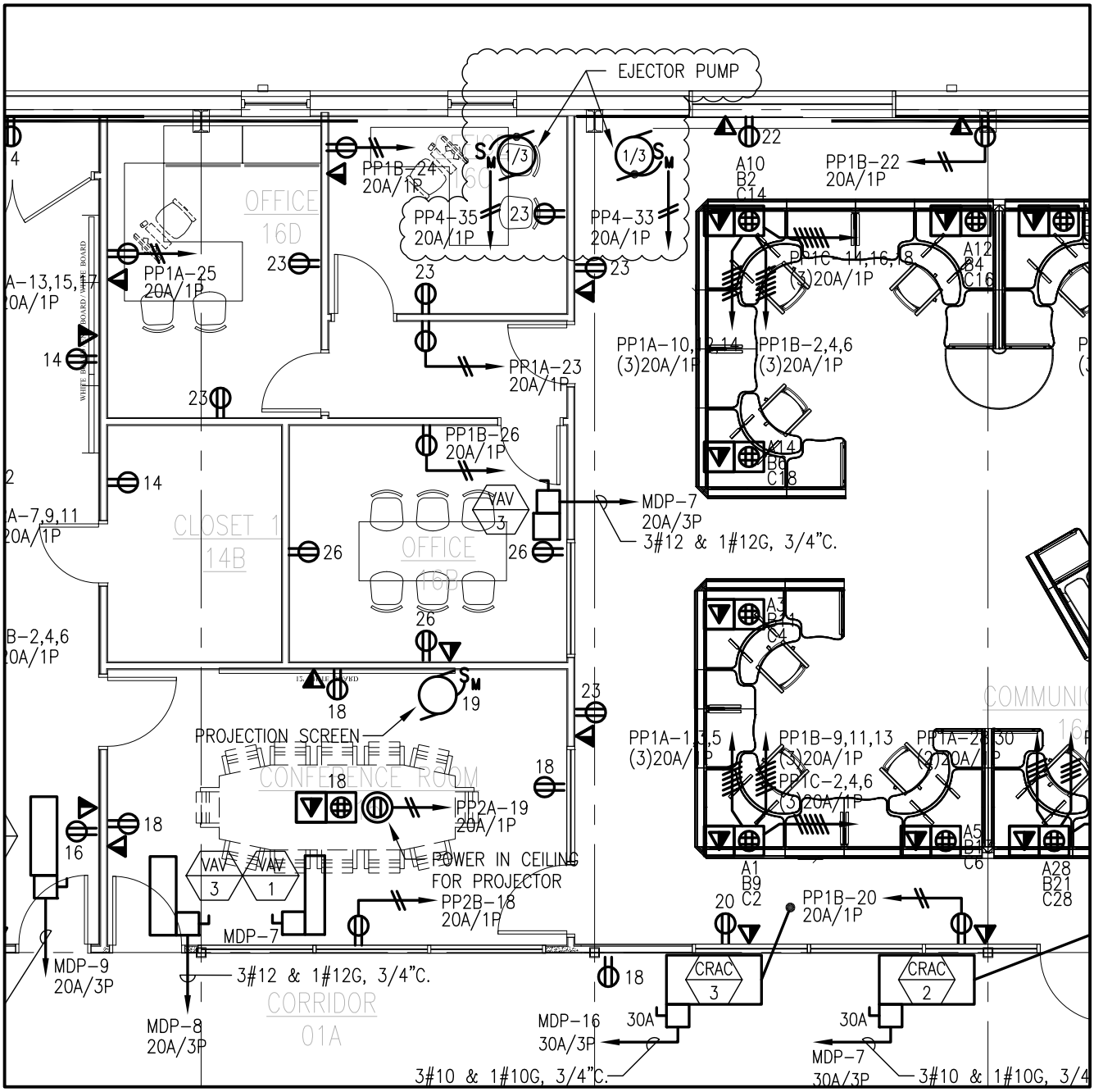
TOTAL LOAD 21.58 KVA

**SECTION 1**

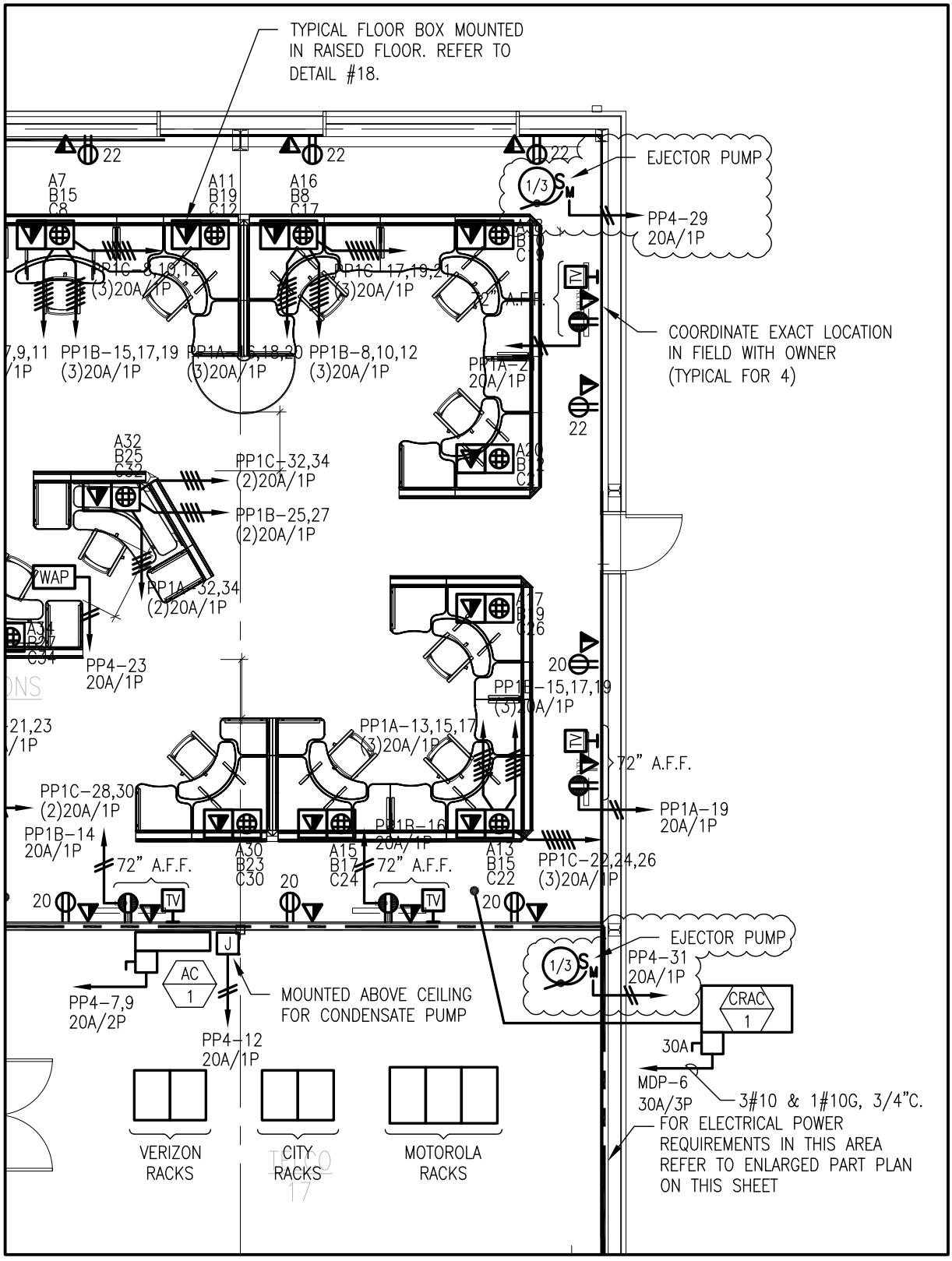
OPTIONS:

BLW Engineers, Inc.
311 Great Road, Post Office Box 1551
Littleton, Massachusetts 01460
T: 978.486.4301 F: 978.428.0067
www.blwengineers.com
HVAC * ELECTRICAL * PLUMBING * FIRE PROTECTION

| | | | |
|---|---|---|---|
| Project: RECC - WORCESTER, MA | | | Sketch No.: SKE-01 |
| Title: ELECTRICAL POWER REVISIONS - EJECTOR PUMPS | | | |
| Date: 12/18/14 | Scale: NTS | Project No.: 12136.15 | |
| Drawn By: CDN | Rev. No.: 001 | Dwg. Ref.: E0.4 | |




| | | | | |
|---|---|---|---|---|
| BLW Engineers, Inc.<br>311 Great Road, Post Office Box 1551<br>Littleton, Massachusetts 01460<br>T: 978.486.4301 F: 978.428.0067<br>www.blwengineers.com<br>*HVAC * ELECTRICAL * PLUMBING * FIRE PROTECTION* | Project: RECC - WORCESTER, MA | | | Sketch No.: SKE-02 |
| | Title: ELECTRICAL POWER REVISIONS - EJECTOR PUMPS | | | |
| | Date: 12/18/14 | Scale: 1/8"=1'-0" | Project No.: 12136.15 | |
| | Drawn By: CDN | Rev. No.: 001 | Dwg. Ref.: E3.1 | |

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| | | | |
|---|---|---|---|
| Project: RECC - WORCESTER, MA | | | Sketch No.: SKE-03 |
| Title: ELECTRICAL POWER REVISIONS - EJECTOR PUMPS | | | |
| Date: 12/18/14 | Scale: 1/8"=1'-0" | Project No.: 12136.15 | |
| Drawn By: CDN | Rev. No.: 001 | Dwg. Ref.: E3.1 | |