

Olbrich Maintenance Shed

Contract 8275

Attachment A

Specification Index:

22 00 00 Plumbing

26 00 00 Electrical

33 11 00 Water Utility Distribution Piping

1 **SECTION 22 00 00 - PLUMBING**

2
3
4 **PART 1 - GENERAL**

5
6 **1.01 DESCRIPTION**

7
8 A. Work Included: Provide plumbing where shown on the Drawings, as specified herein, and as
9 needed for a complete and proper installation including, but not necessarily limited to:

10
11 1. Natural gas piping systems.

12
13 B. Related Work:

14
15 1. Documents affecting work of this Section include, but are not necessarily limited to,
16 General Conditions, Supplementary Conditions, and Sections in Division 1 of these
17 Specifications.

18
19 C. Work of Other Sections:

- 20
21 1. Openings for new Plumbing work in new construction walls, floors, roof, ceiling, etc. shall
22 be provided by the General Contractor. Location and size of these openings shall be the
23 responsibility of the Plumbing Contractor.
24 2. Roofing, exterior wall and related exterior openings shall be caulked, sealed and patched
25 by the General Contractor.
26 3. Final gas piping connections for HVAC equipment by Others.
27 4. Exterior site utilities by the Plumbing Contractor - refer to Division 33 requirements.
28

29 **1.02 GENERAL PROVISIONS**

30
31 A. This specification Section is a general description of the work requirements. The particular
32 descriptions are not intended to be all-inclusive. Bidders shall also refer to the Drawings.
33

34 B. Prior to submitting a bid, the Contractor shall call the Engineer's attention (in writing only) to any
35 materials or items of work believed to be inadequate. Bidders are required to visit the premises,
36 take measurements, inspect existing conditions and limitations, and obtain first hand information
37 necessary to submit a bid. The intent of the Contract is to obtain complete system installations,
38 tested, ready for operation. No extras will be allowed because Contractor's misunderstanding of
39 the scope work involved.
40

41 C. Everything essential for the completion of the work implied to be covered by these Specifications
42 to make the system ready for normal and proper operation must be furnished and installed by this
43 Contractor. Accordingly, any omission from either the plans or the Specifications, or both of
44 details necessary for the proper installation and operation of the system shall not relieve this
45 Contractor from furnishing such detail in full and proper manner.
46

47 D. The Drawings show various details indicating the general arrangement of the plumbing work,
48 sizes and locations of piping, equipment, etc. The said Drawings with figures, lettering, etc., shall
49 be considered a part of these Specifications and no charge or alternation shall be made in any
50 case unless ordered by the Engineer.
51

52 E. In addition to the Plumbing work, refer to the Plumbing work shown on the general Construction
53 Drawings of the building as being part of this Contract, unless specified to be done by other
54 contractors.
55

56 **1.03 QUALITY ASSURANCE**

- 1 A. Use adequate number of skilled workmen who are thoroughly trained and experienced in the
2 necessary crafts and who are completely familiar with the specified requirements and the
3 methods needed for proper performance of the work of this Section.
4
5 B. Without additional cost to the Owner, provide such other labor and materials as required to be
6 complete the work of the Section in accordance, with the requirements of governmental agencies
7 having jurisdiction, regardless of whether such materials and associated labor are called for
8 elsewhere in the Contract Documents.
9
10 C. In acceptance or rejection of installed work, the Architect or Engineer shall make no allowance for
11 lack of skill on the part of the Workmen.
12
13 D. For the actual field fabrication, installation and testing of the Plumbing work, use only thoroughly
14 trained and experienced workmen complete familiar with the items required and manufacturer's
15 current recommended methods of installation.
16
17 E. Reference Standards:
18
19 ANSI American National Standards Institute
20 ASME American Society of Mechanical Engineers
21 ASSE American Society of Sanitary Engineering
22 ASTM American Society of Testing and Material
23 AWWA American Waterworks Association
24 CISPI Cast Iron Soil Pipe Institute
25 FM Factory Mutual
26 MCA Mechanical Contractors Association
27 NEC National Electric Code
28 NEMA National Electrical Manufacturers Association
29 NFPA National Fire Protection Association
30 NSF National Sanitation Foundation
31 WQA Water Quality Association
32 IBC International Building Code
33 NFPA National Fuel Gas Code
34 ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
35

36 **1.04 CODES AND PERMITS**

- 37
38 A. This contractor must comply with building codes and other ordinances in force where the building
39 is located as far as same apply to his work.
40
41 B. Plumbing work shall meet all Federal, State, Local Codes, ordinances and utility regulations.
42
43 1. In the event of conflict between or among specified requirements and pertinent
44 regulations, the more stringent requirement will govern when so directed by the Engineer.
45
46 C. Plumbing Contractor must secure permits from proper offices and pay all legal fees as may be
47 necessary for fulfilling the requirements of these specifications.
48
49 D. Submit one (1) copy of all permits to the Owner.
50

51 **1.05 COORDINATION**

- 52
53 A. Cooperate and coordinate with other trades to assure that all systems pertaining to the Plumbing
54 work shall be installed in the best feasible arrangement. Coordinate as required with all other
55 trades to share space in common areas and to provide the maximum of access to each system.
56
57 B. Arrange plumbing work in neat, well organized manner with piping and similar services running
58 with primary lines of building construction, and with minimum of 8 foot overhead clearance, where
59 possible.

- 1
2 C. Locate equipment properly to provide easy access, and arrange entire plumbing work with
3 adequate access for operation and maintenance.
4
5 D. Give right-of-way to piping, which must slope for drainage.
6
7 E. Where Plumbing work is to connect to existing, the Contractor must field verify all connection
8 points before beginning any rough-in work. Verify gravity flow lines and proper invert elevations
9 required prior to starting piping installation.
10

11 **1.06 PLUMBING SYSTEM IDENTIFICATION**

12

- 13 A. General: Provide adequate marking of plumbing system and control equipment to allow
14 identification and coordination of maintenance activities and maintenance manuals.
15
16 1. Furnish and install adequate marking, tagging and labeling of all *accessible and exposed*
17 Plumbing equipment, piping and control devices, per ANSI A13.1-1981. Accessible
18 locations shall include all ceiling spaces above accessible ceilings.
19
20 B. Equipment: Identify all major Plumbing equipment with plastic-laminate signs of 2" high painted
21 stencils and contrasting background. Provide test of sufficient clarity and lettering to convey
22 adequate information at each location and mount permanently. Identify control equipment by 1-
23 1/2" x 4" plastic laminate nameplates with 1/4" high lettering.
24
25 C. Piping: Identify piping once every 30 feet at each branch, at termination of lines, and near valve
26 or equipment connections. Place flow directional arrows at each piping system for identification
27 of flow direction. Provide lettering of the appropriate size to convey information on wrap-around
28 signage, adhesive-backed or paint stenciled labels.
29
30 D. Valves: Identify all valves with 1-1/2" diameter polished brass tags with stamp-engraved labels or
31 plastic laminate tags. Prefix or color-code tags for each generic piping service. Prepare and
32 submit valve tag schedule, listing location, service and tag description, and incorporate in
33 Instruction Operations Manual.
34
35 E. Operational Labels: *Where* needed for proper or adequate information on operation and
36 maintenance of Plumbing systems, provide tags or labels of plastic or laminated card stock,
37 typewritten to convey the message.
38

39 **1.07 FLOOR, WALL, ROOF AND CEILING OPENINGS**

40

- 41 A. The General Contractor will be required to leave openings in ceiling, floors, walls, roof, partitions,
42 etc., as required to install the Plumbing work specified or shown on the Drawings. The Plumbing
43 Contractor is responsible for correct size and location of his openings. Where penetrations
44 through existing construction are required, they shall be the responsibility of the Plumbing
45 Contractor.
46
47 B. The Plumbing Contractor shall set sleeves and anchors for all equipment, etc., and shall provide
48 watertight seals on pipes through exterior walls, floors and roof and where noted on the
49 Drawings.
50
51 C. Provisions for openings, holes and clearances through walls, floors, ceilings and partitions to be
52 made in advance of construction of such parts of the building.
53
54 D. If the Plumbing Contractor should neglect to inform the General Contractor of his opening
55 requirements and that portion of the Building construction has been completed, the Plumbing
56 Contractor shall pay the General Contractor for providing such openings.
57

- 1 F. Make arrangements with various other contractors for all special framing, spacing and chases.
2 Mason will leave chases in mason work, but Plumbing Contractor is responsible for correct size and
3 location.

4 **1.09 CUTTING AND PATCHING**

- 5
6 A. General: Refer to Division 1 General Requirements.
7
8 B. Perform all cutting and patching required for complete installation of the HVAC systems, unless
9 specifically noted otherwise. Provide all materials required for patching unless otherwise noted.
10
11 1. All cutting and patching necessary of structural members to install any Plumbing work
12 shall not be done without permission, and then only carefully done under the direction of
13 the Architect and General Contractor.
14
15 C. The Contractor shall not endanger any work of other trades by demolition, cutting, digging or
16 otherwise. Any cost caused by defective or ill-timed cutting and patching work shall be borne by
17 the contractor responsible. Each contractor requiring cutting and patching shall hire men skilled
18 in such cutting and patching to do the work.
19
20 1. All patching work in existing areas shall match existing work and restore the finish to
21 its original condition in material, quality, texture, finish and color unless specifically noted
22 or scheduled otherwise.
23

24 **1.10 TESTS AND INSPECTIONS:**

- 25
26 A. All plumbing tests shall be conducted in the presence of and to the satisfaction of the Governing
27 Authorities, Architect/ Engineer, and Owner or his authorized representative.
28
29 B. The Plumbing Contractor shall be responsible for applying tests and ordering inspections as
30 required by Federal, State and local Code and Inspection authorities.
31
32 1. All work shall remain exposed until it has been tested, inspected and approved.
33

34 **1.11 TEMPORARY SERVICES**

- 35
36 A. Provide temporary services for all plumbing services to the existing facility to maintain function of
37 sanitary, storm, natural gas and water services during the construction period.
38

39 **1.12 TRENCHING AND BACKFILLING**

- 40
41 A. Trench, excavate and tunnel to place all piping and other related work necessary at the
42 elevations indicated or required, as shown on the Drawings.
43
44 1. Cut bottom of trench to grade, make trench 12" wider than the widest
45 dimension of the pipe.
46 2. All pipes shall be laid on a compacted bed of sand 6" deep. Do not lay
47 piping on large stones, rocks or bricks.
48
49 B. Backfill in layers and compact sufficiently to prevent settlement. Backfill with damp sand and fine
50 gravel mixture.
51
52 1. Exterior locations shall be backfilled to 12" of grade with sand and fine
53 gravel mixture and the remainder with native compacted topsoil.
54 2. Do not start backfill operations until plumbing work has been properly inspected and
55 approved.
56

57 **1.13 EQUIPMENT SUPPORTS**

1 A. General: Provide all supporting steel and related materials not indicated on structural drawings
2 as required for the installation of equipment and materials, including angles, channels, beams
3 and hangers.

4
5 1. Prime coat paint all metal supports.
6

7 **1.14 GUARANTEE**

8
9 A. All material and workmanship must be new and first class in every respect; the plumbing
10 equipment must be turned over to the owner in complete working order and free from mechanical
11 or performance defects.

12
13 B. The Plumbing Contractor must guarantee all labor and materials for one (1) year from the
14 completion of the plumbing system. Maintain and repair plumbing equipment for the above
15 period, unless such defects are clearly the result of bad management after plumbing system is
16 turned over to the Owner.

17
18 C. Before final acceptance of the plumbing work, the Plumbing Contractor shall have the entire
19 apparatus and system in complete and satisfactory operation and shall maintain same in
20 satisfactory and continuous operation for a period of ten days prior to the date of acceptance; fuel
21 to be furnished by Owner.
22

23 **1.15 SUBMITTALS**

24
25 A. Refer to Division 1 for additional submittal requirements.

26
27 B. The Plumbing Contractor will be held responsible for correction of work deemed necessary by the
28 Engineer due to proceeding with the work without shop drawings that have the
29 Architect/Engineers final approval.
30

31 C. Shop drawings shall include data on physical dimensions, gauges, materials of construction and
32 capacities.
33

34 1. Incomplete drawings will be disapproved.
35

36 D. This Contractor will be responsible for all figures and dimensions shown on the shop drawings.
37 Approval of shop drawings describing equipment that cannot fit in the space allotted does not
38 relieve this Contractor from providing equipment that will meet the space requirements.
39

40 E. Submit electronic PDF copies of shop drawings to the Architect/Engineer for approval, with
41 complete detail for all equipment, materials, etc., to be furnished and installed for this project as
42 follows:
43

- 44 1. Valves.
 - 45 2. Pipe and piping specialties.
 - 46 3. Natural gas systems.
 - 47 4. Instructions and O&M manuals(2 copies).
 - 48 5. As-built Drawings(1 copy).
- 49

50 **1.16 HOUSEKEEPING AND CLEANUP**

51
52 A. Periodically as work progress and/or as directed by the Architect/Engineer, the Contractor shall
53 remove waste materials from the building and leave the area of the work room clean. Upon
54 completion of work remove all tools, scaffolding, broken and waste materials, etc., from the site.
55

56 **1.17 LUBRICATION**

1 A. Upon completion of the work and before turning over to the Owner, clean and lubricate all
2 bearings except sealed and permanently lubricated bearings. Use only lubricant recommended
3 by the manufacturer.

4
5 1. The Contractor is responsible for maintaining lubrication of all mechanical equipment
6 under his contract until work is accepted by the Owner.

7
8 B. Furnish a chart with each piece of equipment listed, itemizing location for lubricant required and
9 recommended periods of lubrication. Incorporate chart in Instruction Manual.

10 11 **1.18 INSTRUCTIONS AND MANUALS**

12
13 A. Upon completion of the installation, but before final acceptance of the system, the Plumbing
14 Contractor shall instruct the Owner on the care and operation of all parts of the Plumbing system.

15
16 B. Assemble two (2) complete sets of manufacturer's printed operating and maintenance
17 instructions for all mechanical equipment and installed under this contract. Prepare in bound
18 copies complete with index tabs. Information must include parts lists, equipment warranties, and
19 wiring diagrams. Submit bound copies to Architect for disbursement.

20 21 **1.19 AS-BUILT DRAWINGS**

22
23 A. During construction maintain a set of prints showing installed as-built work for the project.

24
25 B. Upon completion of construction before final acceptance, provide a set of as-built drawings to the
26 Architect/Engineer.

27 28 29 **PART 2 - PRODUCTS**

30 31 **2.01 NATURAL GAS PIPING**

32
33 A. Interior Above Ground: 3" and Smaller:

34
35 1. Black steel pipe, Schedule 40, Type F, Grade A, ASTM A53; with black malleable iron
36 threaded fittings, Class 150, ASTM A197/ANSI B16.3; Seamless carbon steel weld
37 fittings, standard weight ASTM A234 grade WPB/ANSI B16.9.

38
39 B. Exterior Below Ground: 2" and Smaller:

40
41 1. Underground thermoplastic polyethylene(PE) gas pressure pipe ASTM A2513; with butt
42 or socket-type fusion welded fittings.

43
44 C. Gas valves:

45
46 1. 3" and smaller: Ball valve, bronze-body, threaded ends, stainless steel ball, full or
47 conventional port, teflon seat, blowout-proof stem, two-piece construction suitable for 150
48 psig working pressure, U.L. listed for use as a natural gas shut-off valve.

49 2. Gas Pressure Regulators(2lb to 14oz.): Brass construction body with stainless steel
50 spring valve, orifice regulator of ventless-type listed by UL. Maxitrol or
51 equal.

52 53 **2.02 PIPE HANGERS**

54
55 A. Piping:

56
57 1. Split ring hangers with supporting rods.
58 2. Adjustable clevis.

59

1 B. Multiple or Trapeze Hangers:

- 2
3 1. Steel channels with welded spacers and hanger rods.

4
5 C. Floor Support:

- 6
7 1. Painted steel pipe saddle, stand and bolted floor flange.

8
9 D. Copper Pipe Supports:

- 10
11 1. All supports, fasteners, clamps, etc. directly connected to copper piping
12 shall be copper-plated or polyvinylchloride(PVC)-coated.
13 2. Where steel strut supports are used, provide isolation collar between supports/clamp and
14 copper piping.
15

16 **2.03 FIXTURES AND EQUIPMENT**

17
18 A. General: Provide plumbing fixture, trim, and equipment as shown on the "**Fixture and**
19 **Equipment Schedule**" on the Contract Drawings, and as specified herein.

- 20
21 1. Engineer will evaluate and make final decision on whether submitted fixture is equal to
22 specified fixture.
23 2. Other fixture manufacturers who consider their products equal to those specified are
24 required to request pre-approval for bidding as base bid in accord with Instructions to
25 Bidders section.
26

27 **2.04 OTHER MATERIALS**

- 28
29 A. Provide other materials, not specifically described but required for a complete and proper
30 installation, as selected by the Contractor subject to the approval of the Architect.
31
32

33 **PART 3 - EXECUTION**

34
35 **3.01 SURFACE CONDITIONS**

- 36
37 A. Examine the areas and conditions under which work of this Section will be performed. Correct
38 conditions detrimental to timely and proper completion of the Work. Do not proceed until
39 unsatisfactory conditions are corrected.
40

41 **3.02 SITE UTILITIES**

- 42
43 A. Verify all flow lines to the septic system sewer prior to installing any underground sewer piping.
44 Advise the General Contractor of site conditions or inverts inconsistent with the plumbing layout
45 and proposed flow line prior to proceeding.
46

47 **3.03 PLUMBING SYSTEM LAYOUT**

- 48
49 A. Lay out the plumbing system in careful coordination with the Drawings, determining proper
50 elevations for all components of the system and using only the minimum number of bends to
51 produce a satisfactorily functioning system.
52
53 B. Follow the general layout shown on the Drawings in all cases except where other work may
54 interfere.
55
56 C. Lay out pipes to fall within partition, wall, or roof cavities, and to not require furring other than
57 shown on the Drawings.
58

- 1 D. Where work is to connect to existing, Plumbing contractor must field verify all connection points
2 before beginning any rough-in work. Verify all connecting invert elevations and flow lines of new
3 work connected to existing gravity drainage.
4

5 **3.04 TRENCHING AND BACKFILLING**

6

- 7 A. Perform trenching and backfilling associated with the work of this Section in strict accordance
8 with the provisions of Division 2 of these Specifications and consistent with the national, state
9 and local plumbing codes.
10
11 B. Cut bottom of trenches to grade. Make trenches 12" wider than the greatest dimension of the
12 pipe.
13
14 C. Bedding and backfilling:
15
16 1. Install piping promptly after trenching. Keep trenches open as short a time as
17 practicable.
18 2. Under the building, install pipes on a 6" bed of damp sand. Backfill to bottom of slab with
19 damp sand.
20 3. Outside the building, install underground piping on a 6" bed of damp sand. Backfill to
21 within 12" of finish grade with damp sand. Backfill remainder with native topsoil.
22 4. Do not backfill until installation has been approved and until Project Record Documents
23 have been properly annotated.
24

25 **3.05 INSTALLATION OF PIPING AND EQUIPMENT, GENERAL**

26

27 A. General:
28

- 29 1. Proceed as rapidly as the building construction will permit.
30 2. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until
31 fixtures are installed and final connections have been made.
32 3. Cut pipe accurately, and work into place without springing or forcing properly clearing
33 window, doors, and other openings. Excessive cutting or other weakening of the building
34 will not be permitted.
35 4. Show no tool marks or threads on exposed plated, polished, or enameled connections
36 from fixtures. Tape all finished surfaces to prevent damage during construction.
37 5. Make changes in directions with fittings; make changes in main sizes with eccentric
38 reducing fittings. Unless otherwise noted, install water supply and return piping with
39 straight side of eccentric fittings at top of the pipe.
40 6. Run horizontal sanitary piping at a uniform grade of 1/4" per ft., unless otherwise noted.
41 Run horizontal water piping with an adequate pitch upwards in direction of flow to allow
42 complete drainage.
43 7. Provide sufficient swing joint, ball joints, expansion loops, and devices necessary for a
44 flexible piping system, whether or not shown on the Drawings.
45 8. Support piping independently at pumps, coils, tanks, and similar locations, so that weight
46 of pipe will not be supported by the equipment.
47 9. Pipe the drains from pump glands, drip pans, relief valves, air vents, and similar
48 locations, to spill an open sight drain, floor drain, or other acceptable discharge point,
49 and terminate with a plain and unthreaded pipe 6" above the drain.
50 10. Securely bolt all equipment, isolators, hangers, and similar items in place.
51 11. Support each item independently from other pipes. Do not use wire for hanging or
52 strapping pipes.
53 12. Provide complete dielectric isolation between ferrous and non-ferrous metals.
54 13. Provide union and shut off valves suitably located to facilitate maintenance and removal
55 of equipment and apparatus.
56

57 B. Equipment access:
58

1. Install piping, equipment, and accessories to permit access for maintenance. Relocate items as necessary to provide such access, and without additional cost to the Owner.
2. Provide access doors where valves, motors, or equipment requiring access for maintenance are located in wall or chases or above ceilings. Coordinate location of access doors with other trades as required.

3.06 PIPE JOINTS

A. Polyethylene Gas Piping: All joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings.

1. Install shut off valves as shown on drawings.
2. Blow compressed air into gas piping system as a part of commissioning system, before placing into service, to clean piping until target cloth is clean and free of debris.

B. Gas tubing:

1. Cut square, remove burrs, and clean inside of female fitting to a bright finish.
 - a. Apply solder flux with brush to tubing.
 - b. Remove internal parts of solder-end valves prior to soldering.

C. Screwed piping:

1. Deburr cuts.
 - a. Do not ream exceeding internal diameter of the pipe.
 - b. Thread to requirements of ANSI B2.1.
2. Use Teflon tape on male thread prior to joining other services.
3. Use litharge and glycerin on joint prior to cleaning for air and oil piping.

D. Leaky joints:

1. Remake with new material.
2. Remove leaking section and/or fitting as directed.
3. Do not use thread cement or sealant to tighten joint.

3.07 PIPE SUPPORTS

A. Support suspended piping with clevis or trapeze hangers and rods.

B. Space hangers and support for horizontal steel pipes according to the following schedule:

<u>Pipe size:</u>	<u>Maximum spacing on centers:</u>
1-1/4" and smaller:	8'-0"
1-1/2" to 3":	10'-0"
4" to 5":	14'-0"

C. Space hangers and supports for horizontal copper tubing according to the following schedule:

<u>Tube size:</u>	<u>Maximum spacing on centers:</u>
1" and smaller:	6'-0"
1-1/2":	7'-0"
2":	8'-0"
2-1/2":	9'-0"
3" and larger:	10'-0"

D. Provide sway bracing on hangers longer than 18".

- 1 E. Support vertical piping with riser clamps secured to the piping and resting on the building
2 structure. Provide at each floor unless otherwise noted.
- 3
- 4 F. Provide insulation continuous through hangers and rollers. Protect insulation by galvanized steel
5 shields.
- 6
- 7 G. Arrange pipe supports to prevent excessive deflection, and to avoid excessive bending stress.
- 8

9 **3.08 SLEEVES AND OPENINGS**

- 10
- 11 A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, and ceilings.
12
 - 13 1. Set pipe sleeves in place before concrete is placed.
 - 14 2. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing
15 through, or provide a minimum of 1/2" clearance between inside and outside of the pipe.
 - 16 3. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of
17 pipe covering, with clearance for packing and caulking.
- 18
- 19 B. Caulk the space between sleeve and pipe or pipe covering, using a noncombustible, permanently
20 plastic, waterproof, non-staining compound which leaves a smooth finished appearance, or pack
21 with noncombustible asbestos cotton, or fiberglass to within 1/2" of both wall faces, and provide
22 the waterproof compound described above.
- 23

24 **3.09 VALVES**

- 25
- 26 A. Provide valves in gas systems as indicated. Locate and arrange so as to give complete
27 regulation of apparatus, equipment, and fixtures.
- 28
- 29 B. Locate valves for easy accessibility and maintenance.
- 30

31 **3.10 OTHER TESTING AND ADJUSTING**

- 32
- 33 A. Provide personnel and equipment, and arrange for and pay the costs of, all required tests and
34 inspections required by governmental agencies having jurisdiction.
35
 - 36 1. Gas piping shall be compressed air tested at 100 psig for 24 hours.
 - 37
- 38 B. Where test show materials or workmanship to be deficient, replace or repair as necessary, and
39 repeat the tests until the specified standards are achieved.
- 40
- 41 C. Adjust the system to optimum standards of operation.
- 42

43 **END OF SECTION**

1 **SECTION 26 00 00 - ELECTRICAL**

2
3
4 **PART 1 - GENERAL**

5
6 **1.01 DESCRIPTION**

7
8 A. Work Included: Provide complete electrical service and distribution system with equipment and
9 materials where shown on the Drawings, as specified herein, and as needed for a complete and
10 proper installation including, but not necessarily limited to:

- 11
12 1. Underground Electric Service (200-amp, 1-phase, 120/240 volt), service disconnect -
13 meter cabinet with service ground, distribution panel with main circuit breaker, SPD
14 device and branch circuit breakers;
15 2. Branch circuit wiring, for lighting, receptacles, motors and equipment;
16 3. Lighting fixtures;
17 4. Wiring system for equipment and controls provided under other Sections of these
18 Specifications including General Construction, Plumbing and HVAC trades;
19 5. Lighting Control System;
20 6. Power to relocated hoop houses as indicated on Drawings.
21 7. Power to electric overhead door operators by others.
22 8. Hangers, anchor sleeves, chase supports for fixtures, and other electrical materials and
23 equipment;
24 9. Other items and services required to complete the electrical systems.

25
26 B. Related Work:

- 27
28 1. Documents affecting work of this Section include, but are not necessarily limited to,
29 General Conditions, Supplementary Conditions, and Sections in Division 1 of these
30 Specifications;
31 2. Equipment structural supports, etc.;
32 3. All line voltage control wiring and starter interlocks, where specified;
33 4. Final equipment electrical connections.

34
35 C. Work of Other Sections:

- 36
37 1. Low-voltage (less than 100 volts) controls for General Construction, Plumbing, and HVAC
38 trades.

39
40 **1.02 GENERAL PROVISIONS**

41
42 A. Everything essential for the completion of the work implied to be covered by these Specifications
43 to make the system ready for normal and proper operation must be furnished and installed by this
44 Contractor. Accordingly, any omission from either the plans or the Specifications, or both, of
45 details necessary for the proper installation and operation of the system shall not relieve this
46 Contractor from furnishing such detail in full and proper manner.

47
48 B. In addition to the electrical plans, see General Plans of the building, as all electrical work
49 appearing on the latter plans will be part of this contract unless especially specified to be done by
50 other contractors, as well as, the said work detailed on the electrical plans.

51
52 **1.03 QUALITY ASSURANCE**

53
54 A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the
55 necessary crafts and who are completely familiar with the specified requirements and methods
56 needed for proper performance of the work of this Section.

1 B. Without additional cost to the Owner, provide such other labor and materials as required to
2 complete the work of this Section in accordance with the requirements of governmental agencies
3 having jurisdiction, regardless of whether such materials and associated labor are called for
4 elsewhere in these Contract Documents.

5
6 C. Reference Standard: The following standards are imposed, as applicable to the work:

7
8
9
10
11
12
13

ASTM	American Society of Testing and Materials
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
UL	Underwriters Laboratories

14 **1.04 CODES AND PERMITS**

15
16 A. The Contractor must comply with national, state of Wisconsin and city of Kenosha building and
17 electrical codes and other ordinances in force where the building is located as far as same apply
18 to his work.

- 19
20 1. IBC 2015;
21 2. IEEC 2015;
22 3. NEC 2014;
23 4. Wisconsin Electrical Code SPS sections.

24
25 B. He must secure permits from proper offices and pay fees as may be necessary for fulfilling the
26 requirements of these Specifications.

27
28 C. One (1) copy of all permits must be furnished to the Owner.

29
30 D. Electric Service Fee: Electrical Contractor shall secure and pay all fees for new electrical service
31 from electric utility, including temporary power services.

32
33 **1.05 COORDINATION**

34
35 A. Cooperate and coordinate with other trades to assure that all systems in the electrical work may
36 be installed in the best arrangement. Coordinate as required with all other trades to share space
37 in common areas and to provide the maximum of access to each system.

38
39 B. Arrange electrical work in neat, well-organized manner with piping and similar running parallel
40 with primary lines of building construction.

41
42 C. Locate operating and control equipment properly to provide easy access, and install entire
43 electrical systems with adequate access for operation and maintenance.

44
45 D. Give right-of-way to piping which must slope for drainage.

46
47 **1.06 ELECTRICAL PROVISIONS OF THE MECHANICAL WORK**

48
49 A. Line Voltage Wiring: The Electrical Contractor shall make all line voltage (100 volts and greater)
50 electrical wiring, final connections and motor wiring for Mechanical equipment.

51
52 B. Control Wiring: Low-voltage (less than 100 volts) control wiring in conjunction with Mechanical
53 work shall be by the Mechanical Contractor in strict accordance with the applicable sections of
54 the Electrical Specifications.

55
56 C. Motors, Starters, and Disconnects: All motors starter and disconnects shall be provided by the
57 Electrical Contractor, unless provided with the equipment or indicated otherwise.

- 1
2 1. Mechanical Contractors shall furnish list of and location of all Mechanical equipment and
3 requirements for electrical connections, along with wiring diagrams.
4

5 **1.07 FLOOR, WALL, ROOF AND CEILING OPENINGS**
6

- 7 A. The General Contractor will be required to leave openings in new construction ceiling, floors,
8 walls, roof, partitions, etc., as required to install the Electrical work specified or shown on the
9 Drawings. The Electrical Contractor is responsible for correct size and location of openings.
10
11 B. Provisions for openings, holes and clearances through new construction walls, floors, ceilings
12 and partitions are to be made in advance of construction of such parts of the building.
13
14 C. The Electrical Contractor shall set sleeves and anchors for all equipment, etc., and shall provide
15 watertight seals on pipes through exterior walls, floors and roof locations, and where noted on the
16 Drawings.
17

18 **1.08 CUTTING AND PATCHING**
19

- 20 A. General: Refer to Division 1 General Requirements.
21
22 B. Perform all cutting and patching required for complete installation of the Electrical systems,
23 unless specifically noted otherwise. Provide all materials required for patching unless otherwise
24 noted.
25
26 1. All cutting and patching necessary of structural members to install any Electrical work
27 shall not be done without permission, and then only carefully done under the direction of
28 the Architect and General Contractor.
29

30 **1.09 TRENCHING AND BACKFILLING**
31

- 32 A. Comply with pertinent provisions of Division 1.
33
34 B. Perform trenching and backfilling associated with the work of this Section in strict accordance
35 with the provisions of Division 2 of the Specifications.
36

37 **1.10 SUBMITTALS**
38

- 39 A. Comply with pertinent provisions of Division 1.
40
41 B. Shop Drawing Submittals: Submit six (6) copies of shop drawings to the Architect for approval,
42 with complete detail for all equipment, materials, etc., to be furnished and installed for this project
43 as follows:
44
45 1. Electric Service Equipment;
46 2. Distribution Panelboards;
47 3. Starters and Disconnects;
48 4. Light Fixtures;
49 5. Electrical Devices.
50
51 C. Shop Drawings:
52
53 1. The Electrical Contractor will be held responsible for correction of work deemed
54 necessary by the Engineer due to proceeding with the electrical work without approved
55 shop drawings that have the Architect/Engineers final approval.
56 2. Shop drawings shall include data on physical dimensions, gauges, materials of
57 construction and capacities. Incomplete drawings will be disapproved.

- 1 3. This Contractor will be responsible for all figures, quantities and dimensions shown on
2 the shop drawings.
3 4. Approval of shop drawings describing equipment that cannot fit in the space allotted does
4 not relieve this Contractor from responsibility of resubmitting equipment that will meet the
5 space requirements.
6

7 D. O & M Manual: Upon completion of this portion of the Work, and as a condition of its
8 acceptance, deliver to the Architect two (2) copies of an operation and maintenance manual
9 compiled in accordance with the provisions of Division 1 of these Specifications. Include the
10 following within the bound O&M manual:
11

- 12 1. Copy of the approved Record Documents for this portion of the Work;
13 2. Copies of all warranties and guaranties.
14 3. As-built drawings.
15

16 E. As-built Drawings: Record installation as-built on a set of blueline prints during construction.
17 Plan shall represent actual locations, materials and circuiting of equipment installed.
18

19 1.11 PRODUCT HANDLING

20
21 A. Comply with pertinent provisions of Division 1.
22

23 1.12 WARRANTY

24
25 A. In addition to standard one year warranty on all labor and materials, provide an additional
26 warranty on ballasts for all new fluorescent and HID lighting fixtures as specified.
27

28 1.13 HOUSEKEEPING AND CLEAN-UP

29
30 A. Periodically as work progresses and/or as directed by the Architect, the Contractor shall remove
31 waste materials from the building and leave the area of the workroom clean. Upon completion of
32 work remove all tools, scaffolding, broken and waste materials, etc., from the site.
33

34 1.14 TEMPORARY SERVICES

- 35
36 A. This Contractor shall provide temporary lighting and power as required throughout the
37 construction period.
38
39 B. Arrange for temporary electrical utility with local electrical utility. Electrical Contractor shall pay all
40 temporary electrical service and usage fees.
41
42

43 PART 2 - PRODUCTS

44 2.01 GENERAL

45
46
47 A. Provide only materials that are new, of the type and quality specified. Where Underwriters'
48 Laboratories, Inc. has established standards for such materials, provide only materials bearing
49 the UL label.
50

51 2.02 SERVICE ENTRANCES AND METERING

52
53 A. New Service: Provide new underground 200A, 120/240 volt, 1-phase, 3-wire electric service
54 from pad-mounted transformer as required by the local electrical utility(MG&E) and as shown on
55 Drawings.
56

- 1 B. Metering: Provide combination service disconnect with ground and metering socket cabinet for
2 exterior mounting and related metering equipment per local electrical utility requirements(MG&E).
3
4 1. Utility approved metering equipment: Milbank U5784-O-200-5T-CB
5
6 C. Main Switches: Provide a 200-amp main circuit breakers in the service metering cabinet with
7 current limiting capabilities to meet utility AIC requirements.
8
9 D. Service Distribution Panel (Panel 'A'):
10
11 1. Provide 200-amp, 1-phase main distribution panel as indicated on plans complete with
12 200-amp main circuit breaker rated for 22,000 AIC, branch circuit breakers, NEMA 1
13 enclosure, main service ground and solid neutral buss lugs and other components
14 required for a complete installation.
15 2. SPD service device as specified herein and scheduled on Drawings.
16

17 **2.03 SURGE PROTECTIVE DEVICES**

- 18
19 A. The surge protective device (SPD) shall be designated a location Type 2 device intended for
20 installation on the load side of the service equipment overcurrent device, including SPDs located
21 at the branch panel. The SPD shall be Listed in accordance with UL 1449.
22
23 B. The SPD shall be made up of metal oxide varistors (MOV's), or a combination of MOV's with
24 selenium cells or silicon avalanche diodes, ensuring that all of the performance requirements are
25 met. Gas tubes shall not be used.
26
27 C. The SPD shall have a maximum continuous operating voltage (MCOV) rating not less than 115%
28 of nominal voltage of the system it is protecting.
29
30 1. MCOV = 150 volt.
31
32 D. Protection Modes: The SPD shall have line to neutral (L-N), line to ground (L-G), line to line (L-L)
33 and neutral to ground (N-G) protection modes for grounded wye configured systems. For a delta
34 configured system, the device shall have line to line (L-L) and line to ground (L-G) protection
35 modes.
36
37 E. Voltage Protection Rating (VPR):
38 The UL 1449 Voltage Protection Rating (VPR) for the device shall not exceed the following:
39
40 1. Surge current per phase rating: 80kA
41 2.. 240/120 volt applications: 900V L-N, 1200V L-G, 700V N-G, 1500 L-L
42
43 F. Nominal Discharge Current (In): The SPD shall have a UL 1449 Nominal Discharge Current
44 Rating (In) of not less than 20kA.
45
46 G. Short Circuit Current Rating (SCCR):
47 The SPD shall have a UL 1449 Short Circuit Current Rating (SCCR) of not less than 200kA.
48

49 **2.04 GROUNDING SYSTEM**

- 50
51 A. Ground all equipment, including switches, transformers, conduit systems, motors, and other
52 apparatus, by conduit or conductor to cold water main and to independent electrode, using
53 ground clamps manufactured by Burndy or T&B, and approved by the Engineer.
54
55 B. Provide new service grounding electrode system. Add ground rods, foundation rebar ground and
56 water service grounding electrodes as required per NEC 250.50 for a common grounding
57 electrode system.
58

1. Note - water service is non-metallic pipe eliminating the piping as a service ground.

C. Provide grounding conductor from service ground to solid ground buss bar at all distribution panelboards.

D. Provide grounding jumper from electrical devices to the metallic device boxes.

E. GFI receptacles shall be provided with separate insulated ground wire conductor to the main service ground bar.

F. Ground all motor and equipment connections with dedicated ground conductor.

2.05 IDENTIFICATION

A. Junction and pull boxes shall be stenciled utilizing a coded identification system. The following junction and pull boxes shall be identified using a coded system. Coding shall be submitted to Engineer for approval.

1. Light and Power - 120/240V;

B. Label circuit numbers for all accessible line voltage power distribution raceways and junction boxes.

C. Laminated Bakelite Plates: Engraved plastic nameplate shall be securely fastened to the following equipment. Size 1" x 4" with 3/8" high letters unless space available dictates differently.

1. Panelboards.

D. Typewritten Directory: Each panelboard shall be provided with a typewritten directory in a steel frame with plastic cover contained on the inside of panel door. These directories shall indicate load served and rooms served by each protective device in the respective panel.

E. Identify all conductors per NEC:

120/240V - Phase A - Black
 - Phase B - Red
 - Neutral - White
 - Ground - Green

2.06 POWER DISTRIBUTION SYSTEM

A. See plans for panelboard capacity, voltage ratings, and branch circuit breaker units.

B. All panelboards to be of the circuit breaker type with bolt-on circuit breakers. AIC rating as scheduled on drawings.

C. Branch circuit breakers shall be thermal magnetic; quick-make and quick break. Multi-pole breakers to have common trip. Handle ties of any sort not allowed.

D. Panelboards shall be Square "D" type NQOD with bolt-on branch circuit breakers rated for 10,000 AIC.

1. Square 'D' is the only approved manufacturer for this project.

F. Each panel shall be provided with a typewritten directory mounted on inside of panel door and covered with clear plastic. This directory shall indicate the load supplied by each branch circuit breaker in panel. Room numbers shall be actual room numbers.

1
2 G. Each panelboard shall be securely attached to the building structure on 3/4" AC plywood backer
3 board with non-metallic painted surface.
4

5 H. All panelboards shall be equipped with an equipment grounding bar that is separate from the
6 solid neutral bar.
7

8 **2.07 WIRING DEVICES**

9 10 A. General:

- 11
- 12 1. Devices shall be provided at each location shown on the plans or called for in the
13 Specifications.
- 14 2. All devices shall be of one manufacturer. Acceptable manufacturers: Leviton, Pass and
15 Seymour, Hubbell or General Electric.
- 16 3. Device catalog references herein and on the plans are to be considered as standards of
17 comparison. Comparable devices manufactured by the other manufacturer will be
18 considered as an optional choice.
- 19 4. Device finish color to be selected by Architect.
20

21 B. Receptacles:

- 22
- 23 1. Duplex Receptacles: Industrial-specification grade, nylon face and base, NEMA 5-15R,
24 15A, tamperproof, side-wired only, 3-wire grounding type with the third terminal U-shaped
25 and grounded to the conduit system or green wire ground. Use of self-grounding option
26 not permitted.
 - 27 a. 15-amp: Leviton 5262;
 - 28 b. 20-amp: Leviton 5362;
- 29 2. GFCI Receptacle: Industrial-specification grade, NEMA 5-15R or 20R with indicator light
30 and feed through. Provide tamper resistant devices in public areas.
 - 31 a. 15-amp: Leviton 7599; tamper resistant: Leviton T7599
 - 32 b. 20-amp: Leviton 7899; tamper resistant: Leviton T7899
33

34 C. Switches:

- 35
- 36 1. All toggle switches used to control lighting shall be 20 amp rated for 120/277 volts, A.C.,
37 industrial-specification grade.
- 38 2. 15 amp switches shall not to be used unless specifically shown otherwise for special
39 control.
- 40 3. Switches to be back and side wired, silent or quiet type.
- 41 4. The following catalog numbers refer to Leviton, Inc.:
 - 42 a. single pole – 1221-2;
 - 43 b. three way – 1223-2;
 - 44 c. four way – 1224-2;
 - 45 d. Single pole with pilot light – 1221-PLR;
46

47 D. Plates:

- 48
- 49 1. Provide as required for each outlet, single or multiple gang.
- 50 2. Provide blank covers on all empty boxes or outlets.
- 51 3. Plates shall be 204 stainless steel construction in all areas.
- 52 4. Galvanized steel box covers shall be used in unfinished areas. Cover shall be 1/2"
53 raised with no sharp edges.
- 54 5. Provide single gang die-cast weather resistant in-use covers equal to Leviton M5979 on
55 receptacles in damp areas and exterior locations.
56

57 **2.08 RACEWAY SYSTEM**

- 1
2 A. Steel Conduit. Galvanized or sheradized steel intermediate or rigid metal conduit, or electrical
3 metallic tubing (EMT) with steel set screw or compression ring type fittings.
4
5 1. Provide steel conduits as all exposed in the work areas.
6 2. Where conduit is installed underground or in the floor slab, provide rigid galvanized steel
7 conduit, or PVC coated steel conduit is acceptable.
8
9 B. Rigid Non-Metallic Conduit. Schedule 40 PVC with solvent welded fittings.
10
11 1. Below grade installation only.
12 2. Encase in concrete below drives and roadways.
13
14 C. Electrical Non-Metallic Tubing(ENT):
15
16 1. Above grade indoor concealed installation only, for branch circuit wiring after the first
17 metallic junction box from the panelboard.
18 2. Not allowed for service conduit and panelboard feeders.
19 3. Provide and install per NEC Article 331 with grounding conductor.
20
21 D. Outlets, Junction Boxes and Switch Boxes:
22
23 1. Provide standard one-piece units, galvanized or sheradized, of shape and size best
24 suited to that particular location, of sufficient size to contain enclosed wires without
25 crowding.
26 2. Provide deep boxes(2-1/8") with 1" and larger conduit.
27 3. For lighting outlets, provide standard 4" octagon or square units, with 3/8" malleable iron
28 fixture studs and box hangers where required.
29 4. For switches and receptacles, provide boxes 4" square by 1-1/2" deep minimum with
30 rings and covers as required.
31
32 E. Low Voltage Cabling Raceways:
33
34 1. Provide 4" square boxes with single device ring and 3/4" raceway stubbed to accessible
35 area at ceiling with insulating bushing.
36 2. In areas with no ceiling, extend raceway to adjacent accessible ceiling space or to
37 telephone backboard or as directed by Owner.
38 3. Provide pull string for all low-voltage raceways.
39
40 F. Pull Boxes:
41
42 1. Provide galvanized code-gauge sheet units with screw-on covers, of size and shape required
43 to accommodate wires per NEC wire bending requirements, without crowding access and to
44 suit the location.
45
46 G. Provide sleeves and chases where conduits pass through floors and walls.
47

48 **2.09 CONDUCTORS**

- 49
50 A. Wire and Cable (600 Volt): Provide 600 V insulated copper wire and cable, NEC standard, of
51 types specified below for different applications, with UL label, and color coded as required by
52 governmental agencies having jurisdiction. Use only copper wires and cables.
53
54 1. With conductors No. 4 and larger, provide insulating bushings.
55 2. Wire and cable shall be THHN or THWN.
56 3. Branch circuit wiring installed in wiring channels of continuous row-mounted fixtures shall
57 be provided. UL listed type RHH or other approved 90 degree C wires, rated at 600 V.

4. Wire No. 10 and smaller shall be solid or stranded wire; wire larger than No. 10 shall be stranded wire.
5. Wire in conduits subjected to direct sunlight shall be THWN or RHWN.
6. Provide XHHW/CU wiring in underground exterior conduit.
7. Identify feeder neutrals with white tape or white paint.
8. All low-voltage wiring located in accessible areas shall be installed in metallic conduit.
9. Provide separate identified neutral conductor for emergency and exit lighting circuits.
10. All branch circuit conductors shall be connected by means of a screw terminal.

B. Armored Cable (AC) or Metal-Clad Cable (MC):

1. Limit AC and MC usage to concealed only locations, branch-circuit wiring after the first junction box from the panelboards; where approved by NEC, state and local electrical inspecting authorities.
2. Not allowed for Panelboard feeders or service conduit.
3. Provide and install per NEC Articles 333 and 334 with grounding conductor.

2.10 MOTOR WIRING

- A. See plans for approximate location and sizes of all motors. Verify exact locations at job site with the contractor that is furnishing the motor driven equipment.
- B. The Drawing motor schedules indicate that the anticipated horsepower loads and circuit sizes. Verify all these requirements with contractor concerned and install accordingly under this contract.
- C. Install disconnect means where required by code for motors out of sight of controller. These shall be fusible safety switches, fuse-tron box cover unit, or non-fused switch as indicated on plans. All switches shall be horsepower rated.
- D. All motors will be furnished and installed by others, unless noted otherwise.
- E. Motor starters to be provided and installed by the Electrical Contractor unless indicated otherwise herein or on the plans. See Motor Schedule.
- F. All final connections to motors to be made by this Contractor.
- G. All motors to be connected using flexible metallic conduits extending from motor box to outlet box. Use liquid tight flexible metallic conduit with PVC covering in wet or oily locations and for all motors within 12" of floor. See paragraph on GROUNDING. All wires in flexible metallic conduit shall be stranded. Grounding wires shall be in all cases installed in flexible conduit and not wrapped around the outside of the conduit.

2.11 SAFETY SWITCHES

- A. Provide safety switches of general duty type, horsepower rated, quick-make and quick-break design, externally operated with provision for padlocking, fusible or non-fusible as shown on the Drawings.
- B. Provide enclosures clearly marked for maximum voltage, current, and horsepower rating, and:
 1. Indoor: NEMA type 1.
 2. Outdoor: NEMA type 3R, raintight.
- C. Approved Manufacturers: Square D, Cutler Hammer or Siemens.

2.12 LIGHTING FIXTURES

- 1
2 A. Provide fixtures of the types shown on the Drawings, and with the following accessories as
3 applicable.
4
5 B. Light Fixtures:
6
7 1. Provide units having a UL label.
8 2. Provide local label in addition if so required by governmental agencies having jurisdiction.
9 3. Verify all ceiling types as shown on final architectural plans and be responsible for
10 ordering proper fixtures and accessories for the proper ceiling.
11
12 C. LED Lighting:
13
14 1. The manufacturer of the LED lighting fixture shall utilize high-brightness LEDs and high-
15 efficiency electronic LED drivers, dimmed or no dimmed as required.
16 2. The LED fixture shall be thermally designed as to not exceed the maximum junction
17 temperature of the LED for the ambient temperature of the location the fixture is to be
18 installed
19 3. Light output of the LED system shall be the absolute photometry following IESNA LM-
20 79 and IESNA LM-80 requirements and guidelines.
21 4. Minimum power factor of 0.90.
22 5. LED lighting fixture shall be mercury-free, lead-free and RoHS compliant.
23 6. The LED lighting fixture shall maintain 70% lumen output for a minimum of 50,000 hours.
24 7. All components of the LED lighting fixture shall be replaceable.
25 8. The LED lighting fixture shall carry a limited 3-year warranty minimum.
26
27 D. Acceptable Lighting Fixture Manufacturers:
28
29 1. Refer to **Fixture Schedule**. Engineer will evaluate and make final decision on whether
30 submitted fixture is equal to specified light fixture.
31 2. Other fixture manufacturers who consider their products equal to those specified are
32 required to request pre-approval for bidding as base bid in accord with Instructions to
33 Bidders section.
34

35 2.13 OCCUPANCY SENSOR CONTROLS

- 36
37 A. Occupancy Sensors shall be equal to Sensor Switch or approved equal. Refer to Occupancy
38 Sensor schedule on the Drawings for specific types required.
39
40 1. All sensors shall be capable of operating normally with electronic fluorescent ballasts
41 and LED driver systems and rated motor loads.
42 2. Coverage of sensors shall remain constant after sensitivity control has been set. No
43 automatic reduction shall occur in coverage due to the cycling of air conditioner or
44 heating fans.
45 3. All sensors shall have readily accessible, user adjustable settings for time delay and
46 sensitivity. Settings shall be located on the sensor (not the control unit) and shall be
47 recessed to limit tampering.
48 4. All sensors shall provide an LED as a visual means of indication at all times to verify that
49 motion is being detected during both testing and normal operation.
50
51 B. Wall Sensors:
52
53 1. Wall switch sensors shall be capable of detection of occupancy at desktop level up to
54 300 square feet, and gross motion up to 1000 square feet.
55 2. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to
56 1200 watts at 277 volts and shall have 180° coverage capability.
57 3. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off
58 mode for safety purposes and shall have voltage drop protection.

1 4. Wall switch sensors shall provide a field selectable option to convert sensor operation
2 from automatic-ON to manual-ON.
3

4 C. Passive Infrared Sensors:

- 5
6 1. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature
7 Analysis to respond only to those signals caused by human motion.
8 2. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to
9 false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior
10 performance, and greater reliability.
11

12 D. Ultrasonic Sensors:

- 13
14 1. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection
15 threshold dynamically to compensate for constantly changing levels of activity and air flow
16 throughout controlled space.
17 2. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within $\pm 0.005\%$
18 tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure
19 reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies
20 are not acceptable.
21

22 E. Dual Technology Sensors:

- 23
24 1. Dual technology sensors shall be corner mounted to avoid detection outside the
25 controlled area when doors are left open.
26 2. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for
27 occupancy detection. Products that react to noise or ambient sound shall not be
28 considered.
29

30 **2.14 TELEPHONE SERVICE RACEWAY**

- 31
32 A. Provide 2" service conduit stubbed outside the building 24" below grade and capped from the
33 mechanical room for future telephone or data services. Coordinate locations with Owner.
34

35 **2.15 OTHER MATERIALS**

- 36
37 A. Provide other materials, not specifically described but required for a complete and proper
38 installation, as selected by the Contractor subject to the approval of the Architect.
39
40

41 **PART 3 - EXECUTION**

42
43 **3.01 SURFACE CONDITIONS**

- 44
45 A. Examine the areas and conditions under which work of this Section will be performed. Correct
46 conditions detrimental to timely and proper completion of the Work. Do not proceed until
47 unsatisfactory conditions are corrected.
48

49 **3.02 PREPARATION**

50
51 A. Coordination:

- 52
53 1. Coordinate as necessary with other trades to assure proper and adequate provision in
54 the work of those trades for interface with the work of this Section.
55 2. Coordinate the installation of electrical items with the schedule for work of other trades to
56 prevent unnecessary delays in the work schedule.

1 3. Where lighting fixtures and other electrical items are shown in conflict with locations of
2 structural members and mechanical or other equipment, provide required supports and
3 wiring to clear the encroachment.
4

5 B. Data indicated on the Drawings and in these Specifications are as exact as could be secured, but
6 their absolute accuracy is not warranted. The exact locations, distances, levels, and other
7 conditions will be governed by actual construction and the Drawings and Specifications should be
8 used only for guidance in such regard.
9

10 C. Where outlets are not specifically located on the Drawings, locate as determined in the field by
11 the Architect. Where outlets are installed without such specific direction, relocate as directed by
12 the Architect and at no additional cost to the Owner.
13

14 D. Verify all measurements at the building. No extra compensation will be allowed because of
15 differences between work shown on the drawings and actual measurements at the site of
16 construction.
17

18 E. The Electrical Drawings are diagrammatic, but are required to be followed closely as actual
19 construction and work of other trades will permit. Where deviations are required to conform with
20 actual construction and the work of other trades, make such deviations without additional cost to
21 the Owner.
22

23 **3.03 INSTALLATION OF ELECTRIC SERVICE**

24

25 A. Coordinate installation with local utility as required for a complete electric service installation.
26

27 B. Installation shall be approved by the local utilities.
28

29 **3.04 TRENCHING AND BACKFILLING**

30

31 A. Perform trenching and backfilling associated with the work of this Section in strict
32 accordance with the provisions of Division 2 of these Specifications.
33

34 B. Cut bottom of trench to grade, make trench 12" wider than the widest dimension of the pipe.
35

36 C. Bedding and backfilling:
37

38 1. Install piping promptly after trenching. Keep trenches open as short a time as
39 practicable.

40 2. *Under the building slab:* Install all pipes on a compacted bed of damp sand 6" deep. Do
41 not lay piping on large stones, rocks or bricks.

42 3. *Outside the building:* Install all underground piping on a compacted bed of damp sand
43 6" deep. Backfill to within 12" of finish grade with damp sand. Backfill the remainder with
44 native topsoil. Backfill in layers and compact sufficiently to prevent settlement.

45 4. Do not start backfill operations until underground plumbing work has been properly
46 inspected and approved by governing authorities.
47

48 **3.05 INSTALLATION OF RACEWAYS AND FITTINGS**

49

50 A. Where conduit is installed concealed in walls or above ceiling, or exposed in work areas, provide
51 rigid galvanized conduit or electrical metallic tubing with compression type fittings.
52

53 1. Seal joints to prevent entrance of water.

54 2. Provide ground wire of proper size per NEC 250.

55 3. Use nylon (rather than steel) fish tape.
56

57 B. Use flexible conduit only for short motor connections, or where subject to vibration.

- 1
2 C. Provide necessary sleeves and chases where conduits pass through floors and walls and provide
3 other necessary openings and spaces, arranging for proper time to prevent unnecessary cutting
4 in connection with the Work.
5
6 D. Where conduit is exposed, run parallel to or at right angle with lines of the building.
7
8 E. Securely and rigidly support conduits throughout the work.
9

10 **3.06 INSTALLATION OF LIGHTING FIXTURES**

- 11
12 A. Install lighting fixtures complete and ready for service in accordance with the Lighting Fixture
13 Schedule shown on the Drawings.
14
15 B. Wire fixtures with fixture wiring of at least 90 degrees C rating. Where fixtures are mounted in
16 continuous rows, provide conductors in wiring channels of the same size as the circuit wires
17 supplying the row of fixtures.
18
19 C. Use only bonderized, galvanized, or sheradized steel for fixture installation for protection against
20 rust and corrosion, and install fluorescent fixtures straight and true with reference to walls.
21
22 D. Install all lighting fixtures, including those mounted in continuous rows, so that the weight of the
23 fixture is supported, either directly or indirectly, by a safe and sound structural member of the
24 building, using adequate number and type of fastenings to assure safe installation.
25
26 1. Screwed fastenings, and toggle bolts through ceiling material or wall paneling, are not
27 acceptable.
28

29 **3.07 INSTALLATION OF POWER EQUIPMENT**

- 30
31 A. Provide power and control wiring for motor starters and safety switches as shown on the
32 Drawings.
33

34 **3.08 INSTALLATION OF CONDUCTORS**

- 35
36 A. Unless otherwise shown on the Drawings or noted in these Specifications, use No. 12 AWG
37 conductors for all branch circuits, protected by 20 amp circuit breakers. For runs exceeding 100
38 feet, use larger wires to limit voltage drops.
39
40 B. Use identified (white) neutrals and color-coded phase wires for all branch circuit wiring.
41
42 1. Make splices electrically and mechanically secure with pressure-type connectors.
43 2. Provide "Scotchlok", Buchanon "B-cap", or Ideal "Wing-nut" connectors for wires sizes 6
44 AWG and smaller.
45 3. Provide Burndy compression-type connectors, "Hydent" or equal applied with a
46 mechanical tool and die equipment for wire sizes 4 AWG and larger.
47 4. Insulate splices with a minimum of two half-lapped layers of Scotch Branch No. 33 vinyl-
48 plastic electrical tape where insulation is required.
49

50 **3.09 INSTALLATION OF PANELBOARDS**

- 51
52 A. Unless otherwise shown on the Drawings, install panels with the top of the trim 6'-3" above the
53 finished floor.
54
55 B. Mount a typewritten directory behind plastic on the inside of each panel door and on the
56 directory, showing the circuit number and complete description of all outlets on each circuit.
57

- 1 C. Provide two (2) spare 1" conduits, stubbed out of the top of each flush-mounted panel and
2 terminated in accessible ceiling space, with each conduit tagged with panel description.
3

4 **3.10 TESTING AND INSPECTION**
5

- 6 A. Provide personnel and equipment, make required tests, and secure required approvals from the
7 Architect and governmental agencies having jurisdiction.
8

- 9 B. Make written notice to the Architect adequately in advance of each of the following stages of
10 construction:
11

- 12 1. Test all parts of the electrical system and prove that all such items provided under this
13 Section function electrically in the required manner.
14 2. Immediately submit to the Architect a report of maximum and minimum voltages and a
15 copy of the recording volt-meter chart.
16 3. Also measure voltages between phases and between phase wires and neutrals and
17 report these voltages to the Architect.
18

19 **3.11 PROJECT COMPLETION**
20

- 21 A. Upon completion of the work of this Section, thoroughly clean all exposed portions of the
22 electrical installation, removing all traces of soil, labels, grease, oil, and other foreign material,
23 and using only the type cleaner recommended by the manufacturer of the item being cleaned.
24

- 25 B. Thoroughly indoctrinate the Owner's operation and maintenance personnel in the contents of the
26 operations and maintenance manual required to be submitted under Article 1.3 of this Section of
27 these Specifications.
28

29 **END OF SECTION**

1 **SECTION 33 11 00 - WATER UTILITY DISTRIBUTION PIPING**

2
3
4 **PART 1 - GENERAL**

5
6 **1.01 SCOPE**

7
8 A. The work under this section shall consist of providing all work, materials, labor, equipment, and
9 supervision necessary to provide water distribution system components and other work, as
10 required in these specifications, on the drawings and as otherwise deemed necessary to complete
11 the work.

12
13 **1.02 REFERENCE**

14
15 A. Applicable provisions of Division 1 shall govern all work under this Section.

16
17 **1.03 REFERENCE STANDARDS**

- 18 A. American Society for Testing and Materials (ASTM):
- 19 B88 Standard Specifications for Seamless Copper Water Tube
- 20 C504-00 Rubber-Seated Butterfly Valves
- 21 C509-01 Resilient-Seated Gate Valves for Water Supply Service
- 22 C515-01 Reduced Wall, Resilient Seated Gate Valves for Water Supply Service
- 23 C800-01 Underground Service Line Valves and Fittings
- 24 AWWA C 904 Cross-linked Polyethylene(PEX) Pressure Pipe

25
26
27 **1.03 SUBMITTALS**

28
29 A. Provide manufacturers product information (cut sheets) and O&M information for watermain
30 materials including:

- 31
- 32 1. Pipe
- 33 2. Fittings
- 34 3. Valves

35
36 B. Provide reports that document pressure and continuity testing procedures and results.

37
38 C. Provide copies of record drawings.

39
40 **1.04 QUALITY ASSURANCE**

41
42 A. Maintain and submit record drawings.

43
44 B. Conduct pressure testing, continuity testing and safe sampling as required in Part 3 – Execution.

45
46 **1.05 PERMITS/FEEES**

47
48 A. Contractor shall be solely responsible for obtaining all permits necessary to complete the work.
49 Contractor shall pay all fees associated with obtaining permits. These include, but are not
50 limited to permits for work within public right-of-way, street opening permits, utility
51 connection permits, and plumbing permits.

52
53 **1.06 SURVEY AND STAKING**

54
55 A. Contractor shall be responsible for transferring benchmarks, control points, lines and grades
56 necessary to complete his work.

57
58 **1.07 RECORD DOCUMENTS**

1
2 A. Maintain record drawings that show the actual locations, sizes and types of utilities and other
3 features encountered.

- 4
5 1. Note any modifications to proposed watermain size, alignment, or grades.
6 2. Record any other deviations from the original design.
7

8
9 **PART 2 - PRODUCTS**

10
11 **2.01 COPPER WATER SERVICE**

- 12
13 A. Type K, soft copper tubing meeting the requirements of ASTM B88.
14
15 B. Copper watermain 1½" inch diameter and larger shall be provided in straight lengths, not roll
16 stock.
17

18 **2.02 CROSS-LINKED POLYETHYLENE(PEX) SERVICE**

- 19
20 A. Cross-linked polyethylene(PEXa) piping meeting the requirements of ASTM D3350 and D2766.
21
22 1. Certified to standards meeting ASTM F876, ASTM F877, CSA B137.5, NSF 14 and 61, and
23 PPI TR-4.
24 2. Pipe shall be certified to AWWA C 904.
25
26 B. Fittings: AWWA C-800 compression joint valves and fittings, suitable for buried applications.
27

28 **2.03 SADDLES**

- 29
30 A. Saddles are required at:
31
32 1. All 1½-inch and 2-inch service lateral taps.
33 2. All service lateral taps on PVC, HDPE, or CIPP-lined water mains.
34
35 B. Approved saddles:
36
37 1. Ford Series 202B double strap brass saddle.
38 2. A.Y. McDonald - Series 3825 saddles (double strap).
39

40 **2.04 COUPLINGS**

- 41
42 A. Couplings shall be copper-to-copper fittings.
43
44 1. Compression couplings are only permitted when reconnecting existing copper tubing to
45 new copper tubing.
46
47 B. Allowable couplings:
48
49 1. Mueller H15400.
50 2. Mueller HI5405.
51 3. Mueller H5403.
52 4. Mueller P15403.
53 5. Ford C44-33 / 44 / 66 / 77
54

55 **2.04 CORPORATION STOPS & SERVICE FITTINGS**

- 56
57 A. 1½-inch and 2-inch diameter Service Fittings (1/8 bends):
58
59 1. Mueller H – 15470.

- 1
2 B. Supply all Service Fittings (1/8 bends) with a fiber gasket.
3

4 **2.05 CURB STOPS**
5

- 6 A. 1 ½-inch and 2-inch diameter Curb Stops:
7

- 8 1. Mueller H15201.
9

10 **2.06 CURB BOXES**
11

- 12 A. Ensure that all curb boxes are complete, with covers marked "WATER".
13

- 14 1. Mark cover for air blowout connection "AIR CONNECTION".
15

- 16 B. Curb Box Assemblies shall include the following:
17

- 18 1. Brass screws.
19 2. 2½-inch new style flush fit cover.
20 3. 54-inch rods and guide rings.
21 4. 2½-inch screw type shaft.
22 5. 37-inch bottom section.
23 6. 29-inch top section.
24 7. 16-inch center section.
25

- 26 C. 1½-inch and 2-inch diameter Curb Boxes:
27

- 28 1. Tyler or Bingham and Taylor (Standard Valve Box).
29 2. No rods or rings.
30

31 **2.07 DISINFECTION CHEMICALS**
32

- 33 A. Dry chemicals:
34

- 35 1. Chloride of Lime.
36 2. HTH.
37 3. Pittchlor.
38 4. Or equal (65 % available Chlorine), granular form only.
39

- 40 B. Liquid:
41

- 42 1. Only to be used with Engineer's written authorization.
43 2. Sodium hypochloric.
44

45 **2.08 BOARD INSULATION**
46

- 47 A. Rigid, closed-cell, extruded polystyrene insulation. Insulation shall be suitable for buried
48 installation.
49

- 50 B. Individual boards shall have minimum dimensions of 8'x4'x2".
51

- 52 C. Dow Styrofoam, or approved equal.
53

54 **2.09 LOCATOR TAPE**
55

- 56 A. Detectable metallic locator tape, specifically manufactured for marking utilities.
57

- 58 B. Tape shall be a minimum of 6" wide and designed to be detectable at a depth of 18".
59

1 C. Tape shall be marked "WATER" and blue colored.

2
3 **2.10 PIPE JOINT LUBRICANT**

4
5 A. Petroleum free pipe lubricant formulated for use with potable water systems. Product shall meet
6 the requirements of ANSI/NSF Standard #61.

7
8
9 **PART 3 - EXECUTION**

10
11 **3.01 GENERAL**

12
13 A. Complete exploratory excavations at utility crossings as shown on the plans and as necessary to
14 complete the work.

15
16 B. Maintain clearances between watermains and existing or proposed sewer lines as follows:

- 17
18 1. 8' horizontal separation (measured center to center) between watermains and existing or
19 proposed sanitary or storm sewers.
20 2. 6" vertical separation (measured from outsides of pipes) where watermains cross over
21 sanitary or storm sewers.
22 3. 18' vertical separation (measured from outsides of pipes) where watermains cross under
23 sanitary or storm sewers.

24
25 C. Store and handle pipe in accordance with manufacturers recommendations. Keep pipes clean of
26 soil, debris and animals.

27
28 **3.02 EXCAVATION**

29
30 A. Construct water mains and appurtenances in open trenches and in a manner to protect the pipe and
31 appurtenances from unusual stresses at all times.

32
33 B. Trench Excavation:

- 34
35 1. All excavation, sheeting, shoring and bracing shall be done in accordance with the latest
36 edition OSHA regulations and any additional requirements specified in the Plans or
37 Contract Documents.
38 2. Provide all sheeting, bracing and/or shoring necessary to protect the work, existing
39 property, utilities, pavement, etc., and to provide safe working conditions in the trench.
40 All costs of sheeting, bracing and/or shoring is considered incidental to any work which
41 necessitates it.
42 3. When not in use, remove sheeting and bracing, unless permission to leave in-place has
43 been given in writing by the Engineer.
44 4. Excavate trenches in conformity with the required alignment and grades as shown on
45 the drawings and as laid out in the field by the Engineer.
46 5. Remove all vegetation and topsoil along the trench line to the width of the proposed trench
47 before beginning excavation.
48 6. Deposit material excavated from the trench on the sides of the trenches and excavations,
49 beyond the reach of slides. Transport material to spoil banks as an alternative.

50
51 C. Properly dispose of surplus material at no additional cost to the City. Surplus material
52 includes but is not necessarily limited to:

- 53
54 1. Vegetation from the trench line.
55 2. Excavated rock or cobbles in excess of 6-inches in diameter.
56 3. All other material from excavation not needed or suitable for backfilling trenches.

57
58 D. For water main construction, the width of the trench shall be such as to leave a clear space of not
59 less than 6-inches between the earth wall, or the supporting sheeting or bracing where such is

1 used, and the sides of the pipe. The trench width established by this pipe clearance, measured at
2 the spring line, shall be applicable to that portion of the trench from 1-foot above the top of the pipe
3 to the bottom of the trench.
4

5 E. On streets opened to traffic, on restricted easements, and other specified locations, minimize the
6 width of the trench at the ground surface to the extent possible to accommodate the pipe installation
7 and any necessary sheeting or bracing.
8

9 F. The Engineer reserves the right to limit the extent of excavation depending on the nature of the soil
10 and other conditions.

11
12 1. As ordered by the Engineer due to trees, fences, buildings, shrubs, etc., dig trenches by
13 hand.
14

15 **3.03 EXCAVATION IN POOR SOILS**

16

17 A. If, in the opinion of the Engineer, an artificial foundation is necessary because of the nature of the
18 excavated material, excavate the unsuitable material and replace with suitable specified material to
19 produce an acceptable pipe foundation.
20

21 B. The undercut depth shall be as directed by the Engineer but shall be a minimum of 1-foot below the
22 bottom of the pipe. Any work involved in forming a satisfactory foundation at depths of 1- foot or less
23 below the bottom of pipe will be considered to be incidental to the work.
24

25 C. Backfill this portion of the trench with specified approved bedding material and mechanically
26 compact the select fill prior to laying the pipe. Limit the width of the trench excavation to the outside
27 diameter of the pipe plus 2-feet, plus the amount necessary for sheeting and/or bracing.
28

29 **3.04 DEWATERING**

30

31 A. In accordance with these Specifications, remove by pumping, bailing, or otherwise, any water that
32 may accumulate or be found in the trenches and other excavations.
33

34 B. Form all dams, flumes or other works necessary to keep the trenches or excavations entirely clear
35 of water while the water mains and their appurtenances are being installed.
36

37 1. Direct all water from excavations, so as not to flow over or damage private or public
38 property.

39 2. All costs of dewatering are considered to be incidental to the associated work.
40

41 **3.05 BACKFILL REQUIREMENTS**

42

43 A. Backfill trenches and excavations immediately after the water main and appurtenances have been
44 installed.
45

46 B. Close trenches at the end of every day.
47

48 C. Backfill to the original surface elevation or otherwise specified elevation. In the event of a shortage
49 of material to perform this work, including replacement as may be required by rock excavation or
50 removal of boulders, provide the necessary fill material at no cost to the City.
51

52 D. Except as may be necessary in compacting and backfilling, do not walk or work on installed pipe
53 until the trench has been backfilled to an elevation at least 2-feet above the top of the pipe. Do not
54 take backfill material from trench walls below an elevation 2-feet above the top of pipe.
55

56 E. Evenly place backfill material so that no unbalanced pressures are placed upon the water system.
57 Backfill material may be dumped directly into the trench from trucks when the amount of material to
58 be dumped is controlled by proper equipment.
59

- 1 F. Deposit, spread and level backfill material in layers not exceeding 12-inches in thickness before
2 compacting. Compact each layer to the density specified herein before placing the succeeding
3 layer. When the material being compacted is of a granular nature and the compacting equipment
4 is adaptable for the purpose, the thickness of the layer may be increased to a maximum of 24-
5 inches at the Engineer's discretion, provided the required compaction density is obtained.
6
- 7 G. Only use heavy equipment in the trench for compaction or other purposes if the pipe is adequately
8 protected and the Engineer approves. Trucks, vehicles, or other equipment are not allowed within
9 the limits of the trench prior to the completion of the backfilling operations.
- 10
- 11 H. Dump imported backfill material along the top of the trench beyond the reach of slides. Do not store
12 imported material such that it increases the stresses on the trench section.
- 13
- 14 I. Carefully draw and remove any required sheathing and bracing such that it will not disturb the
15 completed work. Carefully fill and compact any voids created by the removal of sheathing and
16 bracing with approved backfill material.
- 17
- 18 J. Whenever possible, backfill trenches and other excavations with materials excavated during the
19 course of the work.
- 20
- 21 K. Do not include vegetation, stones, or fragments of broken rock in excess of 6-inches in any
22 dimension in the backfill.
- 23
- 24 L. Note that the Engineer may reject material due to:
25
 - 26 1. Unacceptable moisture content.
 - 27 2. Unacceptable gradation or composition
 - 28 3. The presence of frozen material.
 - 29 4. Remove all rejected materials from the site.

30

31 **3.06 CAMPACTION REQUIREMENTS**

- 32
- 33 A. Mechanically compact backfill layers in trenches and excavations to thoroughly consolidate the
34 material to the density specified and to not damage or disturb the pipe or other structures.
- 35
- 36 B. Begin mechanical compaction of the backfill material when the depth of the backfill material is 2-feet
37 above the top of the pipe. (In the case of structures, begin compaction of the backfill material with
38 the placing of the first layer of backfill material).
- 39
- 40 C. The Engineer will perform compaction testing as necessary to verify uniformity of compaction.
- 41
- 42 D. Compaction Density Requirements:
- 43
- 44 E. From 2-feet over the pipe to within 3-feet of the bottom of subgrade:
45
 - 46 1. A minimum of 90% of maximum density.
- 47
- 48 F. Within 3-feet of the bottom of subgrade:
49
 - 50 1. A minimum of 95% of maximum density.
- 51
- 52 G. Determine maximum density in accordance with the Standard Method of Test for the Moisture-
53 Density Relations of Soils, ASTM Designation: D 1557, Method D, latest revision. Replace the
54 fraction of material retained on a ¾-inch sieve, with No. 4 to ¾-inch material.
- 55
- 56 H. Determine the density of compacted backfill in accordance with one of the following: Test for
57 Density of Soil-in-Place by the Sand-Cone Method, ASTM Designation: D 1556, latest revision, or
58 Test for Density of Soil and Soil-Aggregate in Place by Nuclear Methods, ASTM Designation: D
59 2922, latest revision.

- 1
2 I. In the event that the material in the density sample differs in percentage of aggregate retained on a
3 No. 4 sieve from that in the sample upon which maximum density was determined, adjust the
4 maximum density in accordance with approved procedures.
5
6 J. In the event of inadequate moisture in the backfill materials, add water as necessary to obtain the
7 required compaction.
8
9 K. Whenever the work of installing water pipes takes place during freezing weather, follow the
10 specifications for trench compaction above, if practicable. If the specified compaction cannot be
11 achieved, and the Engineer determines that the work may not be suspended until more favorable
12 weather conditions exist, proceed as follows:
13
14 1. Remove all frozen material in the trench at the beginning of the day's work.
15 2. Do not compact frozen materials.
16 3. Compact material in 6-inch maximum lifts.
17 4. Compact to densities specified herein.
18
19 L. If the top 3-feet of material does not meet 95% of maximum density, remove the material and place
20 Select Fill using 6-inch maximum lifts and compact to 95% of maximum density.
21
22 M. As a guideline, no construction will be permitted when the temperatures are too cold to achieve the
23 specified compaction of the backfill. Ensure that temperatures are at least 15°F and rising, with
24 winds less than 10 mph, before considering working in freezing conditions.
25

26 **3.07 BEDDING AND INITIAL COVER**

- 27
28 A. Watermain and water service piping shall be provided with 4" of bedding material and 12" of
29 initial cover material (both measured at the bell of the pipe).
30
31 B. Bedding and cover material for various types of pipe shall consist of the following:
32
33 1. Copper Water Services: Bedding sand or crushed stone screenings.
34

35 **3.08 INSTALLING FITTINGS AND VALVES**

- 36
37 A. Install fittings and valves at locations shown on the drawings.
38
39 B. Unless otherwise shown, provide mechanical joint connections. Install materials in accordance
40 with manufacturer's recommendations.
41
42 C. Maintain electrical continuity through all fittings, valves and hydrants. Provide and install suitable
43 jumper cables for epoxy coated valves.
44
45 D. Install valve box so that bonnet rests on compacted initial backfill material at the same elevation as
46 the top of the valve stuffing box. Center the valve box over the valve nut.
47
48 E. Install valve box plumb and level, backfilling evenly. Extend valve box to proposed final grade;
49 provide valve box extensions as necessary. Valve boxes that shift during backfilling or restoration
50 shall be excavated and re-set.
51

52 **3.09 MECHANICAL JOINT PIPE AND FITTINGS.**

- 53
54 A. A mechanical pipe joint is made by compressing a rubber gasket between a bell, cast on the end
55 of one pipe, and a gland that slides along the plain end of the pipe to be joined. The joints are
56 tightened using nuts and bolts.
57
58 B. Assemble mechanical joints in accordance with AWWA C600 – latest revision.
59

- 1 C. Restrained joints using MEGALUG® Series 1100 or approved equal mechanical joint-restraint
2 retainer glands shall have bolts tightened in accordance with the manufacturer's installation
3 specifications.
- 4
- 5 D. Before slipping the gland and the gasket onto the plain end for joint assembly, lubricate both the
6 gasket and the plain end of the pipe with an approved pipe lubricant meeting the requirements of
7 ANSI/AWWA C111/A21.11 - latest revision.
- 8
- 9 E. Place the gland on the plain end with the lip extension toward the joint, followed by the gasket with
10 the narrow edge toward the joint. Insert the pipe into the bell and press the gasket firmly and evenly
11 into the gasket recess in the bell keeping the joint straight during assembly. Push the gland toward
12 the bell and center it around the pipe, with the flange lip against the gasket. Insert bolts and hand
13 tighten nuts. Deflect pipe after assembly, but before tightening bolts.
- 14

15 **3.10 INSTALLATION OF WATER SERVICES AND FITTINGS**

- 16
- 17 A. Connect water service piping to watermain or other supply as shown on the drawings.
- 18
- 19 B. Watermain taps shall be made under pressure using a tapping machine specifically designed to
20 tap and install corporation stops. Dry watermain taps are not allowed.
- 21
- 22 C. Service saddles shall installed on services where the corporation stop is 1½" nominal diameter or
23 greater.
- 24
- 25 D. Provide a horizontal offset adjacent to the main for all copper services. Comply with pipe
26 manufacturer's requirements with respect to minimum radius on bends.
- 27
- 28 E. Install curb stops as shown on the drawings. If specific curb stop location is not shown on the
29 plans, consult with Construction Representative to determine acceptable location prior to installing.
- 30
- 31 F. Place curb stop box on a 4"x8"x8" solid concrete masonry unit set on compacted ground. Orient
32 box so that no portion of the box bears on the water service or curb stop.
- 33
- 34 G. Install curb stop box plumb and level, backfilling evenly. Extend curb stop box to proposed final
35 grade; provide extensions as necessary. Curb stop boxes that shift during backfilling or restoration
36 shall be excavated and re-set.
- 37
- 38 H. Mark all curb stop boxes with a steel "U" fence post to protect them from damage.
- 39
- 40 I. Install copper water service as shown on the drawings. Limit the number of water service joints,
41 using full lengths of pipe whenever possible.
- 42
- 43 J. Prepare copper pipe joints in accordance with pipe and fitting manufacturer recommendations.
44 Cut pipe squarely, remove burs and round ends as necessary.
- 45
- 46 K. Install fittings in accordance with manufacturers recommendations. Torque compression
47 connections to recommended tightness; do not over-tighten compression joints.
- 48
- 49 L. Provide dead-end copper water services with compression connectors fitted with plugs. Do not tap
50 the ends of copper water services shut. Mark the location of dead-end services with an 8' long
51 4x4 timber and steel "U" fence post.
- 52

53 **3.11 SERVICE LATERALS**

- 54
- 55 A. Provide and install saddles on all 1-1/2-inch and 2-inch services and at all service lateral taps on
56 new or existing PEX, HDPE or copper water mains. Use a standard valve box in lieu of a curb
57 box, with no rod or rings required, for all 1-1/2-inch and 2-inch services.
- 58

- 1 B. Use a pipe cutter to cut all copper tubing. Hacksaws or other such devices to cut copper tubing are
2 not permitted.
- 3
- 4 C. Excavate and expose the area on the water main for new service connections, as noted on the
5 drawings or as otherwise instructed by the Engineer. Maintain a separation distance of at least 18-
6 inches between adjacent service taps and between a service tap and a pipe joint or fitting. Locate
7 the tap on the upper half of the main at a 45° angle from the vertical plane, perpendicular to the
8 water main and on the side of the main to which the service extends.
- 9
- 10 D. Tap the water main and install the corporation stop using a tapping machine specifically designed to
11 tap water main under pressure. No other method of tapping the water main will be allowed. Repair
12 and replace any cut or removed polyethylene encasement following the tap to ensure that the water
13 main is fully protected.
- 14
- 15 E. After the tap has been made and the corporation stop and bend have been inserted, loop the
16 copper tubing out and then back toward the main, then back away from the main to form the shape
17 of a vertical "S". Ensure that the "S" loop is of sufficient size so that it uses a minimum of 2-feet of
18 copper tubing. Ensure that the highest portion of the loop is not higher than the top of the water
19 main.
- 20
- 21 F. Lay the service flat to the property line or otherwise indicated point of termination. Provide a
22 minimum of 6-feet of cover below finished grade.
- 23
- 24 G. Place at least 1-foot of approved bedding material around the copper service pipe. The bedding
25 material is considered incidental to the cost of backfilling the service lateral trenches. Protect all
26 laterals and appurtenances from damage when backfilling. Stones 3-inches in diameter or larger
27 are not allowed within 18-inches of the copper service. Backfill containing rocks 3-inches or larger
28 may not be placed around curb boxes.
- 29
- 30 H. Restore any disturbed terrace or turf areas associated with the lateral installation work. Any terrace
31 or turf restoration work is considered incidental to any work associated with service laterals.
- 32
- 33 I. Coordinate with property owners to allow for flushing service laterals both prior to and immediately
34 after any work impacting a service. Resolve any problems with property owners, including but not
35 limited to problems regarding discolored water or low/no water flow.
- 36

37 **3.12 PRESSURE TESTING**

- 38
- 39 A. Pressure test all watermain and copper water services.
- 40
- 41 B. Provide all valves fittings, joint restraints, hoses, compressors, and water and power supply as
42 necessary to complete pressure testing. Utilize testing apparatus that is fabricated specifically for
43 testing watermains. Calibrate pressure gauges as necessary.
- 44
- 45 C. Flush main as necessary to remove air prior to testing. Comply with the requirements of this
46 section with respect to flushing.
- 47
- 48 D. For longer installations or installations consisting of watermain and copper water service, the
49 Contractor may elect to pressure test the system in short segments.
- 50
- 51 E. All pressure testing shall be conducted in the presence of the Owner's representative. Provide
52 minimum of 48 hours advanced notice of testing.
- 53
- 54 F. Conduct a combined pressure/leakage test for 1 hour at a pressure equal to 150% of system
55 normal operating pressure (as measured at the lowest point in the system), or a minimum
56 pressure of 150 psig.
- 57
- 58 G. When conducting test, pressure test equipment shall be set-up as close to the highest point in the
59 line as possible.

1
2 H. Make-up water for the test shall be clean potable water supplemented with ½ oz of dry calcium
3 hypochlorite per 35 gallons of water.

4
5 I. Leakage for test shall not exceed gallons per hour as allowed by the attached formula:

6
7
$$G = (ND\sqrt{P})/7400$$

8
9 Where: G= Allowable leakage (gallons per hour of test)

10 N=Number of joints under test

11 D=Nominal diameter of main (inches)

12 P=Average pressure during test (psig)

13
14 J. Record and document pressure test by recording the following information:

- 15
16 1. Date of test
17 2. Section tested
18 3. Diameter and length of main under test
19 4. Number of fittings, valves hydrants, etc.
20 5. Results of test including test length, pressure, actual water loss
21 6. Calculation of allowable leakage
22 7. If a failed test, describe actions taken to eliminate leaks and results of re-testing
23

24 K. Submit reports documenting pressure testing.

25
26 **3.13 CONTINUITY TESTING**

27
28 A. At the request of the Owner's Representative, conduct continuity test on all ductile iron watermain
29 and copper water services.

30
31 B. The continuity test shall be performed using an multi-meter to verify electrical continuity of the
32 watermain system.

33
34 C. The Contractor shall furnish all labor and equipment necessary to conduct the continuity test.

35
36 D. Document continuity testing by recording the following information:

- 37
38 1. Date of test
39 2. Test methods and equipment
40 3. Section tested
41 4. Diameter and length of main under test
42 5. Number of fittings, valves hydrants, etc.
43 6. Results of test including resistance
44 7. If a failed test, describe actions taken to eliminate leaks and results of re-testing
45

46 E. Submit reports documenting continuity testing.

47
48 **3.14 DISINFECTION/FLUSHING**

49
50 A. After filling the main, allow a minimum of 48 hours time for disinfection to occur before flushing.

51
52 B. Flush all sections of watermain and water service. When possible, utilize hydrants or other
53 large diameter orifices to complete flushing and achieve 2.5 fps water velocity. If needed, utilize
54 services or temporary connections to complete flushing.

55
56 C. All watermain and services shall be flushed for a minimum of 10 minutes, or as necessary to
57 obtain a sediment-free and bacteriologically safe sample.
58

- 1 D. Utilize diffusers, hoses, settling basins and other devices as necessary to limit erosion and other
2 damage to the site and downstream areas.
- 3
- 4 E. Contractor shall be responsible for providing all necessary fitting, valves, joint restraints, hydrants
5 and other materials necessary to conduct flushing.
- 6
- 7 F. Submit reports documenting disinfection and flushing.
- 8

9 **3.15 BACTERIOLOGICAL SAMPLE**

- 10
- 11 A. Following all pressure testing and flushing, the contractor shall collect a sample from the newly
12 installed watermain or water service(s). Samples shall be submitted to the State Laboratory of
13 Hygiene, or other licensed testing laboratory for bacteriological (colliform bacteria) analysis.
- 14
- 15 B. The Contractor shall be responsible for all costs associated with sample collection(s) and
16 analysis.
- 17
- 18 C. Document bacteriological sample collection and analysis by recording the following information:
19
 - 20 1. Date of sample collection
 - 21 2. Sample collection methods and equipment
 - 22 3. Person collecting the sample
 - 23 4. Location(s) sample was collected
 - 24 5. Results of sample analysis
- 25
- 26 D. If sample results indicate water is “Unsafe – Colliform Bacteria Present”, Contractor shall re-
27 disinfect watermain and water services by introducing additional chlorine into the line and re-
28 flushing the main. This process shall be repeated as necessary until a clean sample is obtained.
29 The Contractor shall be responsible for all costs associated with all efforts necessary to obtain a
30 “Safe – Coliform Bacteria Not Present” sample.
- 31
- 32 E. Submit reports documenting bacteriological sample collection and analysis.
- 33
- 34
- 35

END OF SECTION