

SUTTON MECHANICAL & ENVIRONMENTAL

FarmWild Orangery, Hamilton MT

Project Manual -- Table of Contents

Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE -- verify all values, editions, and manufacturers per project and jurisdiction.

Section	Title
22 05 00	Common Work Results for Plumbing
22 11 16	Domestic Water Piping
22 13 16	Sanitary Waste and Vent Piping
22 40 00	Plumbing Fixtures
23 05 00	Common Work Results for HVAC
23 05 29	Hangers and Supports for HVAC Piping and Equipment
23 05 48	Vibration and Seismic Controls for HVAC
23 05 53	Identification for HVAC Piping and Equipment
23 05 93	Testing, Adjusting, and Balancing
23 07 13	Duct Insulation
23 11 26	Facility Liquefied-Petroleum Gas Piping
23 31 13	Metal Ducts
23 34 23	HVAC Power Ventilators
23 55 23	Gas-Fired Radiant Heaters
23 76 13	Direct Evaporative Air Coolers
23 82 39	Unit Heaters
26 05 00	Common Work Results for Electrical
26 05 19	Low-Voltage Electrical Power Conductors and Cables
26 05 26	Grounding and Bonding for Electrical Systems
26 09 23	Lighting Control Devices
26 24 16	Panelboards
26 27 26	Wiring Devices
26 28 16	Enclosed Switches and Circuit Breakers
26 51 19	LED Interior Lighting
26 52 13	Emergency and Exit Lighting
26 56 00	Exterior Lighting

Division 22 (Plumbing), Division 23 (HVAC), and Division 26 (Electrical) sections above make up the MEP portion of the project manual for this demonstration issue. Refer to the combined issue PDF 2026-12-SPECS.pdf for full section text in the order listed.

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements and common products and execution that apply to all Division 22 Sections for the FarmWild Orangery, a 30 ft x 60 ft glass event hall with an attached 16 ft x 30 ft single-story service wing on the east gable, Hamilton, Montana.
- B. Related Sections: 22 11 16 Domestic Water Piping; 22 13 16 Sanitary Waste and Vent Piping; 22 40 00 Plumbing Fixtures.
- C. The building is served by a farm well (water) and a new private septic system (waste), both outside the physical limits of this contract except for the connections noted in the individual Sections.

1.2 REFERENCES

- A. International Plumbing Code (IPC), edition as adopted by the Montana Department of Labor and Industry, Building Codes Bureau.
- B. Uniform Plumbing Code (UPC) Tables 422.1 (fixture count) and 702.1/703.2 (drain sizing) as cited on the basis-of-design pipe sizing calculations for this project.
- C. ARM 24.301.351 - Montana plumbing fixture count rule.
- D. ASME A13.1 - Scheme for the Identification of Piping Systems.
- E. NSF/ANSI 61 - Drinking Water System Components (all potable water materials).

1.3 DEFINITIONS

- A. "Furnish" means supply and deliver; "Install" means set in place and connect; "Provide" means furnish and install complete and ready for use.
- B. WSFU and DFU refer to water supply fixture units and drainage fixture units as tabulated on the Pipe Sizing calculation sheet referenced in Part 2 of the piping Sections.

1.4 SUBMITTALS

- A. Action Submittals:
 - 1. Product data for pipe, fittings, valves, fixtures, and equipment scheduled in the individual Sections.
 - 2. Shop drawings showing the domestic water and sanitary routing through the service wing plumbing wall (plan x = 66 ft) and the restroom group (Toilet Rooms 101-103).
- B. Informational Submittals: welder/solderer qualifications (copper and PEX), septic system permit from Ravalli County Environmental Health, and the well/pressure-tank data furnished by others.

- C. Closeout Submittals: record drawings, O&M manuals, and fixture/equipment warranties.

1.5 QUALITY ASSURANCE

- A. Installer qualifications: licensed Montana master or journeyman plumber, minimum 5 years documented commercial experience.
- B. Regulatory requirements: Montana-adopted IPC, Ravalli County on-site wastewater rules for the new septic system, and the AHJ (Montana Building Codes Bureau) for the posted assembly occupant load of 99.

► The occupant load of 99 is a posted limit per IBC 1004.5, carried by the Bureau for this project; confirm the fixture count basis (UPC Table 422.1, single-user all-gender rooms) at permit submittal.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store pipe and fittings off grade, capped, and protected from weather and freezing; store PEX-A out of direct sunlight per manufacturer limits.

1.7 PROJECT CONDITIONS

- A. Site utilities: domestic water from an existing farm well (well and pressure tank furnished by Owner); sanitary waste to a new private septic system permitted separately by others; propane from a supplier-owned 500-gal above-ground tank (LP-1).
- B. Winter design condition -4 deg F outdoor, elevation 3,570 ft (Hamilton, MT); protect exposed and below-slab piping from freezing per Section 22 11 16.

PART 2 - PRODUCTS

2.1 COMMON MATERIALS

- A. Pipe sleeves: Schedule 40 galvanized steel at exterior wall and slab penetrations, sized for pipe plus insulation.
- B. Escutcheons: chrome-plated, at exposed pipe penetrations in finished restroom and staging surfaces.
- C. Dielectric fittings: at each junction of copper and steel or dissimilar metals.
- D. Firestopping: through-penetration systems tested to ASTM E814/UL 1479, matching the fire rating of the assembly penetrated (mech/jan partition).

2.2 BASIS-OF-DESIGN REFERENCE TABLE

Item	Basis	Notes
Pipe sizing method	IPC/UPC WSFU + Hunter curve; DFU + horizontal branch/building drain tables	Per project Pipe Sizing calculation sheet, 2026-09-30
Gas sizing method	IFGC/NFPA 54 Spitzglass Eq. 402.4, low-pressure	LP at 11 in wc, 0.5 in wg drop
Fitting allowance	1.50x on developed length (domestic water/sanitary routes)	Design Criteria tab
Sanitary slope	0.25 in/ft	Governs building drain capacity table column used

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify well capacity/pressure and septic permit status with Owner before rough-in; report discrepancies with the routing shown on Drawings P-101/P-501/P-601 to the Engineer.

3.2 CUTTING, PATCHING, AND SLEEVES

- A. Cut, core, and patch to match adjacent construction; do not cut post-frame structural members without Engineer approval. Install sleeves and firestop at all penetrations.

3.3 IDENTIFICATION

- A. Label domestic water and gas piping per ASME A13.1 at 20 ft maximum spacing, at each penetration, and at each valve.

3.4 CLEANING AND CLOSEOUT

- A. Flush and disinfect the domestic water system per AWWA C651 before use; clean fixtures and equipment; deliver closeout documentation and Owner training on the well/water heater/septic interfaces.

END OF SECTION 22 05 00

SECTION 22 11 16

DOMESTIC WATER PIPING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes domestic cold and hot water piping, valves, and the electric water heater (WH-1) from the farm well service entry (W-1) to the plumbing fixtures in Toilet Rooms 101-103, the Mech/Jan room, and the caterer staging area (Room 105).
- B. Related Sections: 22 05 00 Common Work Results; 22 13 16 Sanitary Waste and Vent Piping; 22 40 00 Plumbing Fixtures.

1.2 REFERENCES

- A. IPC Chapter 6 - Water Supply and Distribution; IPC 604.7 water velocity limits.
- B. ASSE 1017 - Temperature-actuated mixing valves; ASSE 1070 - fixture mixing valves.
- C. ASTM F876/F877 - PEX-A tubing; ASTM B88 - Type L copper.

1.3 DESIGN BASIS

- A. Source: existing farm well; well pump and pressure tank furnished and maintained by Owner, not in this contract.
- B. Water service entry W-1: 1 in shutoff with dual check backflow assembly and pressure gauge, sediment filter downstream of the shutoff.
- C. Water heater WH-1: 50-gal electric tank type, two 4.5 kW elements, non-simultaneous operation, 240V/1-phase. Store at 140 deg F; ASSE 1017 mixing valve tempers building hot water to 120 deg F. Provide thermal expansion tank and a T&P relief valve piped full size to within 6 in of the floor.

► *Expansion tank size is not in the source calculation. Confirm against the 50-gal tank and the closed system (check valve/PRV) configuration at shop drawing stage.*

B.

Segment	Serves	Demand (WSFU)	Flow (gpm)	Pipe Size	Velocity
DW-MAIN	Building water service (all groups)	31.95	20.15	1 in	7.8 fps
DW-HW	Hot branch, WH-1 to fixtures	14.10 (hot)	10.56	1 in	4.1 fps
DW-TR1	Toilet Room 101 (WC, LAV)	5.70	5.02	1/2 in	6.9 fps
DW-TR2	Toilet Room 102 (WC, LAV)	5.70	5.02	1/2 in	6.9 fps
DW-TR3	Toilet Room 103	5.95	5.20	1/2 in	7.2 fps

	(WC, LAV, bottle filler)				
DW-STAGING	Staging (3 hand sinks, 3-comp sink, ice machine)	6.60	5.67	3/4 in	3.8 fps
DW-MECH	Mech/Jan (mop sink, 2 hose bibbs)	8.00	6.65	3/4 in	4.4 fps

► DW-STAGING is drawn at 3/4 in; the WSFU/Hunter-curve pipeline calculation would allow 1/2 in, but 1/2 in runs the 3-compartment sink fill over 7 fps. Engineer override per the Pipe Sizing sheet.

1.4 SUBMITTALS

- A. Product data for water heater WH-1, mixing valve, expansion tank, backflow assembly, and pipe/fitting materials.
- B. Pressure test report, disinfection/flush report, and record drawing of the routing through the plumbing wall at plan x = 66 ft.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Above slab (CW/HW): PEX-A per ASTM F876, or Type L copper; expansion-type or solder joints.
- B. Below slab (CW/HW): PEX-A, continuous length with no joints below slab, sleeved through the slab.
- C. Valves: full-port ball valves at each fixture group and at WH-1 isolation; ASSE 1017 mixing valve at WH-1 outlet.

2.2 EQUIPMENT SCHEDULE

Tag	Item	Size/Rating	V/Ph	Notes
WH-1	Electric tank water heater	50 gal, 2 x 4.5 kW non-simultaneous	240/1	140 F store, ASSE 1017 mixing to 120 F, expansion tank, T&P to floor
W-1	Water service entry	1 in shutoff, dual check + gauge	-	Sediment filter; well and pressure tank by Owner

2.3 BASIS-OF-DESIGN MANUFACTURERS

- A. Water heater: Rheem; A.O. Smith; Bradford White. Mixing valve: Powers; Leonard; Symmons. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Route the main in the plumbing wall at plan x = 66 ft, overhead at 8.5 ft to the staging area, per Drawing P-101; drop to WH-1 and to each fixture group as shown.
- B. Protect all piping in unheated or marginally-heated spaces (mech/jan, wing) from freezing; coordinate with the electric wall heaters of Section 23 82 39 for freeze protection of the mech/jan room.

- C. Slope and drain piping subject to freezing; provide hose bibb drains at HB-1 (exterior patio) and HB-2 (north wall), both ASSE 1019 frost-free. EC-1 has its own 1/2 in cold water branch off the overhead main inside the heated wing, routed up through the wing roof to the unit, with a drain-down valve at the branch inside the heated space per Section 23 76 13, separate from HB-1/HB-2.

3.2 FIELD QUALITY CONTROL

- A. Hydrostatically test domestic water piping at 1.5 times working pressure (minimum 100 psi) for 2 hours minimum with no drop, per IPC 312.5, before concealment.
- B. Disinfect per AWWA C651; flush until free of disinfectant before turnover.

END OF SECTION 22 11 16

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes sanitary drain, waste, and vent piping from the plumbing fixtures of Toilet Rooms 101-103, Mech/Jan 104, and Staging 105 to the building sewer connection, gravity to a new private septic system south of the service wing (design by septic engineer of record, Ravalli County permit by others).
- B. Related Sections: 22 40 00 Plumbing Fixtures; 22 05 00 Common Work Results.

1.2 REFERENCES

- A. IPC Chapter 7 / UPC Table 702.1, 703.2 - Sanitary drainage sizing; UPC Table 710 and IPC 710 horizontal branch and building drain capacity.
- B. UPC 909 - Island fixture venting (bar hand sink HS-3).
- C. ASTM D2665/D3311 - PVC DWV pipe and fittings.

1.3 DESIGN BASIS

- A. Each water closet drain is a minimum 3 in per UPC Table 702.1, regardless of the fixture unit table result.

Segment	Serves	Load (DFU)	Size	Basis / Notes
SS-TR1	Toilet Room 101 (1 WC, 1 LAV)	5.0	3 in	WC minimum 3 in governs over the 2 in table size
SS-TR2	Toilet Room 102 (1 WC, 1 LAV)	5.0	3 in	Same as SS-TR1
SS-TR3	Toilet Room 103 (1 WC, 1 LAV, 1 bottle filler)	5.5	3 in	Same as SS-TR1
SS-STAGING	Staging collector (3 hand sinks, 3-comp sink, 2 floor sinks)	10.0	3 in	Pipeline calc gives 2-1/2 in; not a stock DWV size, drawn 3 in. Drains separately through GI-1.
SS-MAIN	Building drain (all groups)	27.5	4 in	Pipeline calc gives 3 in (at the UPC 703.2 limit for 3 WCs at 25 DFU); drawn 4 in for margin and to match the septic tank inlet.
SS-VENT	Building vent stack (V-1 to V-4)	27.5	2 in + 3 in VTR	Increased to 3 in below roof for frost closure in

				the Hamilton climate.
--	--	--	--	-----------------------

► All drawn sizes differ from the raw fixture-unit table lookup; each override above is an engineering judgment call recorded on the Pipe Sizing calculation sheet, not a software default.

1.4 SUBMITTALS

- A. Product data for PVC DWV pipe/fittings, cleanouts, and the grease interceptor (GI-1).
- B. Septic system permit and design documents from the septic engineer of record (by others); coordinate invert elevations at the building sewer connection.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

- A. Sanitary and vent piping: PVC Schedule 40 DWV, solid wall, solvent-welded joints per ASTM D2665/D3311 and D2564.
- B. Cleanouts: at the staging collector (rm1), at the main bend, and at the building sewer exit, per the cleanout schedule; extend to grade or finished wall.

2.2 EQUIPMENT SCHEDULE

Tag	Item	Size/Rating	Notes
GI-1	Gravity grease interceptor	Size by septic designer	Outdoor, in-ground; traffic lid not required
Septic system	New private on-site system (by others)	Design flow approx. 1,200 gpd; 3,000-gal tank; 1,500-4,000 sf pressure-dosed field	

1. *Septic tank and drainfield size is preliminary, pending soils/percolation testing and the Ravalli County Environmental Health pre-application review. Final sizing by the septic engineer of record.*

2.3 BASIS-OF-DESIGN MANUFACTURERS

- A. Grease interceptor: Schier; Zurn; Thermaco. Cleanouts: Zurn; Josam; Jay R. Smith. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Route the sanitary main down the plumbing wall at plan x = 66 ft and out the south side of the wing at a minimum slope of 1/4 in per ft, per Drawing P-101/P-601.
- B. Route the staging collector (rm1) through GI-1 before joining the building drain; do not combine grease-bearing waste with the toilet room drains upstream of the interceptor.
- C. Terminate the vent stack 2 in below roof, increased to 3 in through the roof for frost closure; flash and counterflash per roofing manufacturer requirements.

3.2 FIELD QUALITY CONTROL

- A. Test DWV piping by water or air test per IPC 312 before concealment; witness by the AHJ as required.
- B. Verify invert elevation and slope continuity to the septic tank inlet before backfill.

END OF SECTION 22 13 16

SECTION 22 40 00

PLUMBING FIXTURES

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes plumbing fixtures and trim for the three single-user, all-gender toilet rooms (101-103), the exterior bottle filler, the Mech/Jan room, and the caterer staging area of the FarmWild Orangery.

1.2 REFERENCES

- A. ICC A117.1 - Accessible and Usable Buildings and Facilities (Toilet Rooms 101 and 102).
 B. UPC Table 422.1 / ARM 24.301.351 - Minimum fixture count for the posted occupant load of 99.
 C. ASSE 1019 - Freeze-resistant wall hydrants; UPC 704.3 - Direct-connected indirect waste; UPC 909 - Island venting.

► *Schedule note on Drawing P-601: three single-user all-gender rooms are shown against the 99-guest fixture count check. The Staging area is a caterer staging space, not a full commercial kitchen; the county environmental health plan review may add fixtures not carried here.*

1.3 SUBMITTALS

- A. Product data for each fixture and trim item listed in Part 2; fixtures are basis-of-design level, with product selection by the Contractor, submitted for the Engineer's review.
 B. Maintenance data and warranties for the ice machine connection filter and the bottle filler.

PART 2 - PRODUCTS

2.1 FIXTURE SCHEDULE

Tag	Fixture	Room	CW	HW	Waste	Vent
WC-1, WC-2	Water closet, floor, tank, 1.28 gpf, ADA rim 17-19 in	101, 102	1/2 in	-	3 in	2 in
WC-3	Water closet, floor, tank, 1.28 gpf, standard	103	1/2 in	-	3 in	2 in
L-1, L-2	Lavatory, wall hung, ADA, 0.5 gpm	101, 102	1/2 in	1/2 in	1-1/2 in	1-1/4 in
L-3	Lavatory, wall hung, 0.5 gpm	103	1/2 in	1/2 in	1-1/2 in	1-1/4 in

BF-1	Bottle filler + hi-lo fountain, exterior, freeze-resistant	South face	1/2 in	-	1-1/4 in	1-1/4 in
MSB-1	Mop service basin, floor, 24 x 24 in	104	1/2 in	1/2 in	3 in	1-1/2 in
HS-1, HS-2	Hand sink, wall hung, food service	105	1/2 in	1/2 in	1-1/2 in	1-1/4 in
HS-3	Hand sink, bar	100 (island)	1/2 in	1/2 in	1-1/2 in	Island (UPC 909)
S-1	3-compartment sink, 18 x 18 x 12 in, 2 drainboards	105	3/4 in	3/4 in	2 in	1-1/2 in
PR-1	Pre-rinse spray unit, 1.15 gpm	105	1/2 in	1/2 in	To table	-
IM-1	Ice machine connection, filter	105	1/2 in	-	Ind. to FS-2	-
FS-1, FS-2	Floor sink, 12 x 12 in, 1/2 grate	105	-	-	3 in	2 in
HB-1	Wall hydrant, frost-free, ASSE 1019	Patio	3/4 in	-	-	-
HB-2	Wall hydrant, frost-free, ASSE 1019	North wall	3/4 in	-	-	-

- A. Grab bars at WC-1 and WC-2 by Architect/general construction, ICC A117.1 compliant.
- B. HS-1 and HS-2 are vented to vent stack V-4; HS-3 is an island fixture vented per UPC 909, no air admittance valve without AHJ approval.

2.2 BASIS-OF-DESIGN MANUFACTURERS

- A. Water closets/lavatories: American Standard; Kohler; Zurn. Bottle filler: Elkay; Halsey Taylor. 3-compartment sink: Advance Tabco; John Boos. Wall hydrants: Woodford; Prier. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set fixtures level and secure; provide stops, supplies, and trim complete at each fixture.
- B. Mount WC-1/WC-2 and L-1/L-2 at ADA rim/rim heights and clearances per ICC A117.1; coordinate grab bar blocking with the Architect.
- C. Provide trap primers at FS-1 and FS-2 per the fixture schedule.

3.2 FIELD QUALITY CONTROL

- A. Test each fixture for proper operation, adequate flow, and no leaks; verify ADA clearances before Substantial Completion.

END OF SECTION 22 40 00

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section specifies administrative and procedural requirements and common products and execution that apply to all Division 23 Sections for the FarmWild Orangery: a 30 ft x 60 ft glass event hall (posted occupant load 99) plus an attached 16 ft x 30 ft service wing on the east gable, Hamilton, Montana, elevation 3,570 ft.
- B. Related Sections: 23 05 93 TAB; 23 11 26 LP Gas Piping; 23 31 13 Metal Ducts; 23 34 23 HVAC Power Ventilators; 23 55 23 Gas-Fired Radiant Heaters; 23 76 13 Direct Evaporative Air Coolers; 23 82 39 Unit Heaters.

1.2 REFERENCES

- A. ASHRAE 62.1 - Ventilation for Acceptable Indoor Air Quality (basis of the Hall outdoor air and the toilet/janitor exhaust rates).
- B. International Mechanical Code (IMC), as adopted by the AHJ; IMC 403.3.1.1 toilet room exhaust; IMC 501-502 general exhaust.
- C. NFPA 70 - National Electrical Code (equipment interface, 120/1 and 240/1 connections).

1.3 DESIGN BASIS SUMMARY

- A. Design days: winter -4 deg F; summer 92 deg F db / 62 deg F wb; heating safety factor 1.25; cooling safety factor 1.15 (informational only -- this project has no mechanical cooling).
- B. The Hall is heated to 60 deg F air (event heat only, radiant tube heaters); the wing is kept above freezing by electric heat. There is no mechanical cooling; comfort in warm weather is by ceiling fans, lantern stack vents, and one roof-mounted direct evaporative cooler (EC-1) ducted into the Hall, furnished and installed under this contract per Sections 23 76 13 and 23 31 13.

► Two future 4-ton mini-split condensing units (MS-1, MS-2) have a grade pad and power rough-in only under this contract; the units themselves are a future purchase, not part of this Division 23 scope.

1.4 SUBMITTALS

- A. Product data for each piece of equipment scheduled in the individual Sections; manufacturer clearance-to-combustibles data for all gas and electric heaters.
- B. Shop drawings showing heater mounting heights and clearances relative to the 5:12 roof pitch and the roll-up bay doors along the Hall long walls.
- C. Closeout: O&M manuals, record drawings, and the TAB report of Section 23 05 93.

1.5 QUALITY ASSURANCE

- A. Installer qualifications: licensed Montana mechanical contractor, minimum 5 years documented commercial HVAC experience; LP gas appliance installers certified by the appliance manufacturer.
- B. Regulatory: Montana-adopted IMC/IFGC and the AHJ review of the posted assembly occupant load.

1.6 COORDINATION

- A. Coordinate heater and fan mounting with the post-frame structure, the lantern stack vents, and the roof-pitch roll-up door tracks; maintain the manufacturer's clearance to the raised door position.

PART 2 - PRODUCTS

2.1 COMMON MATERIALS

- A. Equipment supports: welded structural steel or manufacturer's chain-hanger kits, hot-dip galvanized where exposed to weather.
- B. Disconnect switches: NEMA 3R at exterior/wing locations, NEMA 1 elsewhere, sized per equipment nameplate.
- C. Thermostats: integral or wall-mounted line-voltage type as scheduled with each heater in Sections 23 55 23 and 23 82 39.

2.2 DESIGN CRITERIA REFERENCE

Field	Value
Indoor design temp, winter (Hall, event heat)	60 deg F
Indoor design temp, winter (wing, above freezing)	40 deg F min
Outdoor design temp, winter	-4 deg F
Outdoor design temp, summer	92 deg F db / 62 deg F wb
Ventilation standard	ASHRAE 62.1
Heating safety factor	1.25
Elevation	3,570 ft

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Set equipment level and secure; provide vibration isolation where recommended by the manufacturer; maintain code clearances to combustibles at every gas and electric heater.

3.2 CUTTING, PATCHING, AND FIRESTOPPING

- A. Cut and patch to match adjacent construction for duct/vent/flue penetrations; firestop rated assemblies per ASTM E814/UL 1479.

3.3 CLEANING AND CLOSEOUT

- A. Clean equipment and exposed surfaces; verify filters, if any, are new at turnover; conduct Owner training on the event-heat thermostats and the lantern-interlock control described in Section 23 55 23.

END OF SECTION 23 05 00

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes hangers and supports for the above-ground LP gas piping of Section 23 11 26, the exhaust and EC-1 supply ductwork of Section 23 31 13, and the suspended and wall-mounted HVAC equipment of the FarmWild Orangery: gas IR tube heaters IR-1 and IR-2, exhaust fans EF-1 through EF-5, ceiling fans CF-1 through CF-4, and electric heaters EUH-1 and EWH-1 through EWH-4. EC-1 itself bears directly on the wing roof framing on its own stand, specified in Section 23 76 13, and is not a hung load under this Section.
- B. Related Sections: 23 05 00 Common Work Results for HVAC; 23 05 48 Vibration and Seismic Controls for HVAC; 23 11 26 Facility Liquefied-Petroleum Gas Piping. Domestic water and sanitary piping supports are specified in Division 22.

1.2 REFERENCES

- A. MSS SP-58 - Pipe Hangers and Supports: Materials, Design, Manufacture, Selection, Application, and Installation.
- B. International Fuel Gas Code (IFGC) Section 415 - Piping support intervals.
- C. SMACNA HVAC Duct Construction Standards - Metal and Flexible (duct hangers).

1.3 SUBMITTALS

- A. Product data for each hanger, rod, attachment, and chain-hanger kit.
- B. Attachment details for IR-1 and IR-2 to the post-frame structure, showing the load at each hanger point and the attachment hardware, coordinated with the framing supplier.

1.4 QUALITY ASSURANCE

- A. Hangers, rods, and attachments rated by the manufacturer for the supported load with a minimum 5 to 1 safety factor on ultimate strength.

PART 2 - PRODUCTS

2.1 PIPE HANGERS

- A. Horizontal steel gas piping: adjustable steel clevis hangers, MSS SP-58 Type 1, or galvanized pipe straps on wood framing where the run is concealed in the wing walls.
- B. Vertical gas piping at the wing north wall riser: riser clamp or wall bracket at the wall penetration and at the top of the riser.

- C. Hanger rod: continuous-thread steel, electro-galvanized, 3/8 in minimum.

2.2 STRUCTURAL ATTACHMENTS

- A. Wood post-frame and truss members: side-mount rod hangers or lag-attached angle brackets rated for wood; do not notch or bore truss chords. Beam clamps where steel framing occurs.
- B. Exterior or damp locations, including the tank-side riser: hot-dip galvanized hardware.

2.3 EQUIPMENT SUPPORTS

- A. IR-1, IR-2: manufacturer's chain-hanger kit with turnbuckles, attached at the manufacturer's hanger spacing along each 50 ft tube.
- B. EF-1 through EF-4: manufacturer's mounting brackets to ceiling joists. EF-5: wall sleeve framed into the Staging wall.
- C. CF-1 through CF-4: manufacturer's downrod mount with the factory secondary safety cable attached to structure.
- D. EUH-1: manufacturer's ceiling or wall bracket rated for the unit weight.

2.4 SUPPORT SPACING SCHEDULE

Service	Material	Nominal Size	Max. Horizontal Spacing	Min. Rod
LP gas	Sch 40 steel	1/2 in	6 ft	3/8 in
LP gas	Sch 40 steel	3/4 in and 1 in	8 ft	3/8 in
LP gas	Sch 40 steel	1-1/4 in and larger	10 ft	3/8 in
Exhaust duct	Galvanized round	4 in	10 ft and within 2 ft of each fan and cap	Strap
EC-1 supply duct	Galvanized spiral round	24 in to 36 in	10 ft max, from roof framing	Strap or rod and cable

► Gas spacing follows IFGC Table 415.1 for steel pipe. Vertical gas piping is supported at every floor level, which on this single-story wing means the wall penetration and the riser top.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support gas piping at the scheduled spacing and within 12 in of each heater connection, valve, and sediment trap; do not let the flexible connectors at IR-1 and IR-2 carry piping weight.
- B. Do not support piping or duct from other piping, ductwork, conduit, or the heater tubes.
- C. Hang IR-1 and IR-2 so the tube can expand freely along its length; keep the chains plumb at the scheduled 11 ft mounting height and at the manufacturer's clearance to the raised roll-up doors.
- D. Seismic restraint of IR-1, IR-2, CF-1 through CF-4, EUH-1, and EF-5 is specified in Section 23 05 48. Leave room at each hanger for the restraint attachments.

3.2 FIELD QUALITY CONTROL

- A. Inspect hangers, attachments, and chain kits for level, load sharing, and free thermal movement before the heaters are fired and before ceilings in the wing are closed.

END OF SECTION 23 05 29

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes vibration isolation and seismic restraint for the HVAC equipment, LP gas piping, and exhaust ductwork of the FarmWild Orangery. Equipment is light: the heaviest items are the two chain-hung gas IR tube heaters (IR-1, IR-2) and the four 84 in ceiling fans (CF-1 through CF-4). There is no base-mounted rotating equipment, no ducted air handler, and no hydronic system.
- B. Related Sections: 23 05 00 Common Work Results for HVAC; 23 05 29 Hangers and Supports.

1.2 REFERENCES

- A. ASCE/SEI 7-22 Chapter 13 - Seismic Design Requirements for Nonstructural Components, as adopted through the International Building Code by the State of Montana.
- B. SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems.

1.3 DESIGN BASIS

- A. Seismic Design Category D. Component importance factor $I_p = 1.0$ for all HVAC components on this project. SDS and the design force F_p per ASCE/SEI 7-22 Section 13.3, using the SDS on the structural drawings and the a_p and R_p values of ASCE/SEI 7-22 Table 13.6-1.
- B. Components requiring seismic restraint: IR-1 and IR-2 (suspended at 11 ft, so the floor-mounted light-equipment exemption of Section 13.1.4 does not apply), CF-1 through CF-4 (pendant-hung, over 20 lb), EUH-1 (ceiling-hung), and EF-5 (wall-mounted, over 20 lb).
- C. Components exempt under ASCE/SEI 7-22 Section 13.1.4 and 13.6, which still need the positive attachment of Section 23 05 29: EF-1 through EF-4 and EWH-1 through EWH-4 (20 lb or less, flexible connections); the LP gas piping (3/4 in and 1/2 in, under the 3 in size limit for $I_p = 1.0$); and the 4 in exhaust ducts (under 6 sq ft cross section).
- D. LP-1 tank anchorage is outside the building and is by the LP supplier under Section 23 11 26 and NFPA 58.

► A heater on chains swings in an earthquake and can pull its gas connection or strike the raised roll-up doors. The restraint kits stop that sway while leaving the tubes free to grow lengthwise as they heat.

1.4 DELEGATED DESIGN

- A. The restraint manufacturer, or a professional engineer licensed in Montana working for the Contractor, designs each restraint and its attachment to the post-frame structure for F_p . Submittals carry that engineer's seal.

1.5 SUBMITTALS

- A. Product data for isolators and restraint kits.
- B. Sealed restraint calculations and details for IR-1, IR-2, CF-1 through CF-4, EUH-1, and EF-5: design force, cable or brace layout, and the fastener and load at each attachment to the trusses, posts, or girts. Coordinate attachment loads with the post-frame supplier.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION

- A. EF-1 through EF-4: integral rubber-in-shear isolation as furnished by the fan manufacturer; flexible duct connector or isolated collar at the fan outlet.
- B. CF-1 through CF-4: manufacturer's factory isolation at the motor mount and downrod; no field isolators.
- C. IR-1, IR-2: none required. The burner and blower are factory-isolated, and the tubes hang on chains.

2.2 SEISMIC RESTRAINT KITS

- A. Manufacturers: Mason Industries; Kinetics Noise Control; Vibro-Acoustics; or the heater or fan manufacturer's own seismic kit; or approved equal. Cable kits are pre-stretched galvanized aircraft cable with factory swaged or listed cable-lock fittings, rated for the design force.
- B. IR-1, IR-2: four-way (two transverse, two longitudinal) cable restraint at the burner box and at each tube hanger point the delegated design calls for, set slack so the tube can expand lengthwise. Where the heater manufacturer offers a listed seismic kit, use it.
- C. CF-1 through CF-4: the fan manufacturer's seismic guy-wire kit (four cables from the motor housing to structure at about 45 degrees), in addition to the factory secondary safety cable.
- D. EUH-1: four-way cable restraint, or a rigid wall or ceiling bracket rated for the design force.
- E. EF-5: wall sleeve fastened to the framing for the design force, with the fan bolted to the sleeve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install isolators and any restraints per the manufacturer and the approved submittal; do not bridge isolation with rigid duct, conduit, or gas connections.
- B. Install restraint cables snug, without pulling the unit off plumb; on IR-1 and IR-2 leave the slack the delegated design sets for tube expansion. Attach to structure only, never to the gas header, conduit, or another restraint.
- C. Connect IR-1 and IR-2 to the gas header with the listed flexible connector of Section 23 11 26 so the heater can move without straining the piping.
- D. Attach the ceiling fan secondary safety cables to structure, not to the downrod bracket.

3.2 FIELD QUALITY CONTROL

- A. Run each fan and heater and confirm no transmitted vibration or noise at the structure; correct any rigid contact found.

- B. Engineer of record observes the installed restraints before ceilings and the roll-up doors are closed out; the restraint designer provides a letter that the installation matches the sealed details.

END OF SECTION 23 05 48

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes identification of the LP gas piping and valves, the exhaust ductwork, and the HVAC equipment of the FarmWild Orangery.
- B. Related Sections: 23 05 00 Common Work Results for HVAC; 23 11 26 Facility Liquefied-Petroleum Gas Piping.

1.2 REFERENCES

- A. ASME A13.1 - Scheme for the Identification of Piping Systems.
- B. NFPA 54 / IFGC and NFPA 58 - Marking of gas piping and shutoff valves.

1.3 SUBMITTALS

- A. Product data for labels and tags, and a valve and equipment tag list.

PART 2 - PRODUCTS

2.1 PIPE LABELS

- A. Preprinted, self-adhesive or snap-on labels per ASME A13.1 with legend and flow arrow, rated for outdoor UV exposure at the exterior riser.

2.2 VALVE AND EQUIPMENT TAGS

- A. Valve tags: 1-1/2 in brass disc, stamped, on a brass chain or S-hook.
- B. Equipment nameplates: engraved laminated plastic, white letters on black, 1/2 in high, with the scheduled tag and the space served (for example EF-1 TOILET RM 101).
- C. Duct labels: stenciled or self-adhesive, EXHAUST with flow arrow.

2.3 COLOR AND LEGEND SCHEDULE

Service	Label Color	Legend Text
LP gas piping	Yellow with black letters	LP GAS
Exhaust ductwork	White with black letters	EXHAUST

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Label exposed LP gas piping at 20 ft maximum on straight runs, at each side of a wall or roof penetration, at the exterior riser, and at each heater connection.
- B. Tag the main LP gas shutoff at the building riser and the appliance shutoffs at IR-1 and IR-2; list them on a valve chart posted in Mech/Jan 104.
- C. Install a nameplate on each of IR-1, IR-2, EF-1 through EF-5, CF-1 through CF-4, EUH-1, and EWH-1 through EWH-4, readable from the floor.
- D. Label exhaust ductwork where exposed or accessible above ceilings, at least once per run.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes testing, adjusting, and balancing (TAB) of the exhaust fans, air balance of the EC-1 evaporative cooler supply duct and registers, and verification of heater output for the FarmWild Orangery. There is no hydronic system on this project; TAB scope is limited to the exhaust fans, the propeller fan, the EC-1 supply air system, and functional verification of the gas and electric heaters.

1.2 REFERENCES

- A. AABC National Standards or NEBB Procedural Standards, as applicable to the limited scope of this Section.
- B. ASHRAE 111 - Measurement, Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

- A. TAB plan identifying each fan, the EC-1 supply system, and each heater to be tested; final TAB report with measured vs. design airflow for each fan and register, measured output for each heater, and the EC-1 damper end switch status.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

- A. Calibrated rotating-vane or hot-wire anemometer for fan and register airflow; calibrated clamp-on ammeter for heater electrical verification; manufacturer-furnished manometer port at each gas tube heater for gas pressure verification.

PART 3 - EXECUTION

3.1 EXHAUST FAN BALANCING

Tag	Serves	Design CFM	ESP	Tolerance
EF-1	Toilet Room 101	70 cfm	0.50 in wg	+/- 10%
EF-2	Toilet Room 102	70 cfm	0.50 in wg	+/- 10%
EF-3	Toilet Room 103	70 cfm	0.50 in wg	+/- 10%
EF-4	Mech/Jan 104	50 cfm	0.50 in wg	+/- 10%

EF-5	Staging 105 (wall propeller)	400 cfm	0.10 in wg	+/- 10%
------	------------------------------	---------	------------	---------

- A. Verify EF-1 through EF-3 operate on the light switch with a minimum 15-minute run-on timer; verify EF-4 runs continuously; verify EF-5 operates on its 85 deg F thermostat and the manual wall switch.

3.2 SUPPLY AIR BALANCING - EC-1

Tag	Serves	Design CFM	Tolerance
EC-1	Total unit airflow	Approx. 12,000 cfm	+/- 10%
SR-1 to SR-12	Each side register (12 total)	Approx. 1,000 cfm each	+/- 10%

- A. Verify the motorized wall damper end switch proves the damper open before the EC-1 fan is allowed to run, and proves the damper closed when the unit is off; report the end switch result with the airflow readings.

3.3 HEATER FUNCTIONAL VERIFICATION

- A. IR-1 and IR-2: verify gas input at each unit (75 MBH input each) by clocking the gas meter or manufacturer test port; verify the wall thermostat holds 60 deg F event-mode setpoint and that IR-2 responds to the lantern-vent interlock (heaters lock out when the lantern stack vents are open).
- B. EWH-1 through EWH-4 and EUH-1: verify integral/line thermostats hold setpoint (40 deg F minimum in Toilet Rooms and Mech/Jan; 60 deg F event / 40 deg F standby in Staging) and that EUH-1 has an interlock note to avoid nuisance cycling against the staging oven exhaust heat.

3.4 REPORTING

- A. Submit a certified report listing measured vs. design airflow for each fan and register, measured electrical draw for each electric heater, gas input verification for IR-1 and IR-2, and the EC-1 damper end switch result.

END OF SECTION 23 05 93

SECTION 23 07 13

DUCT INSULATION

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes insulation for the exhaust ductwork of EF-1 through EF-4 in the FarmWild Orangery service wing. The project also has one supply duct, the EC-1 evaporative cooler supply duct of Section 23 31 13, which is not insulated under this Section for the reasons given below. The insulation here is for condensation control on exhaust duct that runs through cold space to the wall and roof caps.
- B. Related Sections: 23 31 13 Metal Ducts; 23 34 23 HVAC Power Ventilators.

1.2 REFERENCES

- A. ASTM C1136 - Flexible, Low Permeance Vapor Retarder Facings for Thermal Insulation.
- B. ASTM C553 - Mineral Fiber Blanket Thermal Insulation.
- C. ASTM E84 - Surface burning characteristics: flame spread 25 or less and smoke developed 50 or less for the insulation, facing, and adhesive, per the International Mechanical Code.
- D. International Energy Conservation Code (IECC) 2021 Section C403.12.1, as adopted by the State of Montana.

1.3 DESIGN BASIS

- A. IECC C403.12.1 sets insulation for supply and return ducts outside the building thermal envelope or in unconditioned space. The EC-1 supply duct runs entirely inside the conditioned Hall, is used only in warm weather, and does not cross the thermal envelope; it is therefore not required to be insulated and is not insulated.
- B. Exhaust duct in unconditioned attic or roof space, and the last 10 ft before each wall or roof cap, is insulated to R-6 so moist toilet room air does not condense and drip back at the -4 deg F winter design temperature. This is an engineering requirement, not an energy code requirement.

1.4 SUBMITTALS

- A. Product data with installed R-value, facing permeance, and ASTM E84 ratings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Duct wrap: glass-fiber blanket, ASTM C553, with factory FSK vapor retarder facing per ASTM C1136, installed R-6 minimum (about 2.2 in at 25 percent compression).

- B. Tape and mastic: listed for the FSK facing, meeting the ASTM E84 limits.

2.2 INSULATION SCHEDULE

Duct	Location	Minimum Installed R-Value
EF-1 to EF-4 exhaust, 4 in round	Unconditioned attic or roof space	R-6
EF-1 to EF-4 exhaust, 4 in round	Last 10 ft to the wall or roof cap	R-6
EF-1 to EF-4 exhaust, 4 in round	Inside the heated wing envelope	None required
EC-1 supply duct, 36 in to 24 in round	Inside the conditioned Hall (Section 23 31 13)	None required

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Insulate after the duct joints are sealed per Section 23 31 13; keep the vapor retarder continuous and seal every seam, penetration, and tear with listed tape.
- B. Do not compress the wrap below its rated thickness at hangers; carry insulation to the wall or roof cap collar.

3.2 FIELD QUALITY CONTROL

- A. Inspect for full coverage and a sealed facing before the wing ceilings are closed.

END OF SECTION 23 07 13

SECTION 23 11 26

FACILITY LIQUEFIED-PETROLEUM GAS PIPING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes LP gas piping from the supplier-owned above-ground propane tank (LP-1) to the two gas-fired infrared tube heaters (IR-1, IR-2) specified in Section 23 55 23.

1.2 REFERENCES

- A. NFPA 54 / International Fuel Gas Code (IFGC) - Spitzglass Equation 402.4, low-pressure sizing method, used for this project's gas piping.
- B. NFPA 58 - Liquefied Petroleum Gas Code (tank location and setback).

1.3 DESIGN BASIS

- A. Supply: LP-1, 500-gal water-capacity above-ground propane tank, supplier owned, located northeast of the service wing, minimum 10 ft from the building per NFPA 58; two-stage regulation.
- B. Connected load: IR-1 75 MBH input; IR-2 75 MBH input; total 150 MBH (150 CFH at approximately 2,516 Btu/cf LP).
- C. Routing: buried service from LP-1 to a riser outside the wing's north wall, then through Staging, overhead along the east gable header at 10.8 ft, dropping to each heater at the east end of its eave. Longest run: 80 ft.
- D. Design pressure: 11 in wc at the header, 0.5 in wg allowable drop to the appliances.

Segment	Load (MBH / CFH)	Length	Size	Basis / Notes
2nd-stage regulator to header tee	150 MBH / 59.6 CFH	80 ft	3/4 in Sch 40	Required ID 0.74 in by Spitzglass at 11 in wc, 0.5 in wg drop. The design software's default sizes on natural gas at 7 in wc and returns 1-1/4 in; 3/4 in is the correct LP answer and is what is drawn.
Header to IR-1 / IR-2 (each)	75 MBH / 29.8 CFH	-	1/2 in Sch 40	Sediment trap and shutoff valve at each heater connection.

► This is the one place on the project where the automated pipe-sizing tool's answer (1-1/4 in) is wrong for the actual fuel and must be overridden: it assumes natural gas at 7 in wc. Confirm the LP supplier's actual delivery pressure and re-check this sizing before ordering pipe.

1.4 SUBMITTALS

- A. Product data for regulators, shutoff valves, sediment traps, and flexible connectors; LP supplier's tank installation and setback drawing; gas piping test report.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Above ground: Schedule 40 black steel pipe, threaded joints.
- B. Buried: polyethylene pipe per ASTM D2513 with tracer wire, heat-fusion joints, furnished and installed by the LP supplier from the tank to the riser.

2.2 EQUIPMENT SCHEDULE

Tag	Item	Size/Rating	Notes
LP-1	Propane tank, above ground	500-gal water capacity	Supplier owned, 10 ft from building, two-stage regulation
Header regulator	2nd-stage regulator	Outlet 11 in wc	At tank or first wall penetration, per supplier standard

- A. *First-stage regulator setting at the tank and vent-limiter sizing are by the LP supplier's standard practice for this tank size and load.*

2.3 BASIS-OF-DESIGN MANUFACTURERS

- A. Regulators: Fisher; Rego. Tank: local propane supplier standard 500-gal ASME tank. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install the buried service and tank per the LP supplier's design and NFPA 58 setbacks; coordinate the riser location with the wing's north wall framing.
- B. Install a sediment trap and accessible shutoff valve at each heater connection; support above-ground piping per code spacing.

3.2 FIELD QUALITY CONTROL

- A. Pressure test all gas piping per IFGC 406 before connecting appliances; leak-test every joint with an approved leak-detection solution.
- B. Purge and verify manifold pressure at each heater per the manufacturer's startup procedure.

END OF SECTION 23 11 26

SECTION 23 31 13

METAL DUCTS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the exhaust ductwork from ceiling cabinet fans EF-1 through EF-4 to their wall and roof caps, and the spiral round supply duct and side registers for EC-1, in the FarmWild Orangery service wing and Hall. EF-5 discharges through a wall sleeve with no ductwork.
- B. Related Sections: 23 05 29 Hangers and Supports; 23 07 13 Duct Insulation; 23 34 23 HVAC Power Ventilators; 23 76 13 Direct Evaporative Air Coolers (EC-1 unit); 23 05 93 Testing, Adjusting, and Balancing.

1.2 REFERENCES

- A. SMACNA HVAC Duct Construction Standards - Metal and Flexible, including Seal Class A for the EC-1 supply duct.
- B. International Mechanical Code (IMC) Chapter 5 (exhaust systems, Section 501.3.1 termination clearances) and Chapter 6 (duct construction).
- C. IECC 2021 Section C403.7.7 (exhaust outlet dampers) and Section C403.12.2 (duct sealing).

1.3 SUBMITTALS

- A. Product data for duct, fittings, sealant, wall and roof caps, and the EC-1 side registers; a marked plan showing each duct route, register locations, and termination/end cap locations.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Exhaust ductwork (EF-1 through EF-4): round galvanized steel duct and fittings, ASTM A653 G60, 26 gauge minimum for 4 in diameter.
- B. EC-1 supply duct: galvanized spiral lock-seam round duct and fittings per SMACNA HVAC Duct Construction Standards, sized 36 in diameter for the first 20 ft from EC-1, reducing to 30 in diameter to 40 ft, reducing to 24 in diameter to a galvanized end cap at approximately 56 ft; reducers concentric. Pressure class 2 in wg positive; joints sealed to SMACNA Seal Class A.
- C. Sealant: water-based duct mastic or foil tape listed to UL 181B, rated for the duct pressure class.
- D. Wall caps (EF-1 through EF-3) and roof cap (EF-4): galvanized or aluminum, with bird screen and a gravity backdraft damper; roof cap with curb or flashing boot to match the roofing.

2.2 DUCT CONSTRUCTION SCHEDULE

System	Size	Pressure Class	Seal	Termination
EF-1 to EF-3 toilet exhaust	4 in round	-1/2 in wg	All joints and seams	Wall cap
EF-4 Mech/Jan exhaust	4 in round	-1/2 in wg	All joints and seams	Roof cap
EC-1 supply (Hall centerline)	36 in to 30 in to 24 in round	2 in wg positive	SMACNA Seal Class A	End cap, approx. 56 ft

► At 0.5 in wg fan static, IECC C403.12.2 does not require a duct leakage test on the exhaust side. Sealing all joints and seams still matters here, because a leak into the attic carries toilet room moisture into cold space. The EC-1 supply duct is summer-only and inside conditioned space; it is not insulated, per Section 23 07 13.

2.3 SUPPLY REGISTERS

- A. EC-1 supply duct: 12 side registers (6 pairs, one each side of the duct, approximately every 8 ft), tagged SR-1 through SR-12. Each register: 24 in x 10 in double-deflection face with an opposed-blade damper, mounted on the duct side, approximately 1,000 cfm each.

2.4 BASIS-OF-DESIGN MANUFACTURERS

- A. Duct and fittings: SEMCO; McGill AirFlow; Lindab. Registers: Titus; Krueger; Price. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Exhaust ductwork: run each duct as short and straight as practical, sloped down toward the termination; fasten round joints with three sheet metal screws and seal per the schedule.
- B. Locate exhaust terminations per IMC 501.3.1: at least 3 ft from property lines, 3 ft from operable openings into the building, and 10 ft from any mechanical air intake.
- C. EC-1 supply duct: hang from the roof framing on the hall centerline at 13 ft AFF to centerline, with hangers (strap, or rod and cable) at a maximum 10 ft spacing; seal every joint to SMACNA Seal Class A; set reducers concentric; close the run with the galvanized end cap.
- D. Mount SR-1 through SR-12 on the duct sides in pairs at approximately 8 ft spacing along the duct run; orient the opposed-blade damper for field adjustment of each register to its design airflow.
- E. Support exhaust and supply ductwork per Section 23 05 29 and insulate the exhaust ductwork per Section 23 07 13; the EC-1 supply duct is not insulated.

3.2 FIELD QUALITY CONTROL

- A. Verify each exhaust backdraft damper opens when the fan runs and closes when it stops; verify each SR register damper is set and the EC-1 motorized wall damper interlock functions; airflow and the damper end switch are verified under Section 23 05 93.

END OF SECTION 23 31 13

SECTION 23 34 23

HVAC POWER VENTILATORS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the toilet room and janitor exhaust fans (EF-1 through EF-4), the staging wall propeller fan (EF-5), and the reversible ceiling fans (CF-1 through CF-4) for warm-weather destratification and air movement in the Hall.
- B. Related Sections: 23 05 93 TAB; 23 55 23 Gas-Fired Radiant Heaters (lantern interlock); 23 76 13 Direct Evaporative Air Coolers (relief air path through the lantern vents and the open overhead doors); 23 82 39 Unit Heaters.

1.2 REFERENCES

- A. AMCA 210/211 - Fan performance testing and rating; AMCA 300/301 - Sound.
- B. IMC 403.3.1.1 - Public toilet room exhaust rates; ASHRAE 62.1 Table 6.4 - Janitor closet exhaust.

1.3 DESIGN BASIS

- A. EF-1 through EF-3 are sized at 70 cfm per water closet, the IMC 403.3.1.1 rate for intermittent (occupancy-sensed or switch-tied) operation; the lower 50 cfm rate applies only to continuous operation and is not used here.
- B. EF-4 is sized at 1.00 cfm/sf x 45 sf (Mech/Jan) per ASHRAE 62.1 Table 6.4, continuous operation.
- C. EF-5 is not a code-required exhaust; it is an engineering-judgment fan for holding-cabinet heat in Staging, sized for approximately 20 air changes per hour.
- D. CF-1 through CF-4 provide warm-weather air movement and winter destratification in the Hall in lieu of mechanical cooling; reverse direction is used in winter to push warm air at the ridge back down to the occupied zone.

1.4 SUBMITTALS

- A. Product data and AMCA-certified performance for each fan; sound data (sones) for EF-1 through EF-4 in occupied toilet rooms.

PART 2 - PRODUCTS

2.1 EXHAUST FAN SCHEDULE

Tag	Serves	Type	CFM	ESP	Discharge	Control	V/Ph
EF-1	Toilet Rm 101	Ceiling cabinet	70	0.50 in wg	4 in to wall cap	Light switch +	120/1

						15 min run-on	
EF-2	Toilet Rm 102	Ceiling cabinet	70	0.50 in wg	4 in to wall cap	Light switch + 15 min run-on	120/1
EF-3	Toilet Rm 103	Ceiling cabinet	70	0.50 in wg	4 in to wall cap	Light switch + 15 min run-on	120/1
EF-4	Mech/Jan 104	Ceiling cabinet	50	0.50 in wg	4 in to roof cap	Continuous	120/1
EF-5	Staging 105	Wall propeller	400	0.10 in wg	Wall sleeve + shutter	T-stat 85 F + manual	120/1

- A. Provide a backdraft damper, disconnect switch, and speed controller as accessories with each of EF-1 through EF-5.
- B. *Sound rating: 1.5 sones or less at EF-1 through EF-3 (occupied toilet rooms).*

2.2 CEILING FAN AND EVAPORATIVE COOLER SCHEDULE

Tag	Type	Size	Mount	V/Ph	Control	Notes
CF-1 to CF-4	Ceiling fan, reversible	84 in dia	13 ft AFF	120/1	Wall speed control	Reverse in winter (destrat)
EC-1	Roof-mounted direct evap cooler, ducted supply	Approx. 12,000 cfm, 2 hp	Galvanized steel stand on wing roof, hall east gable	208-230/1	Unit controls + motorized damper interlock	Contractor furnished and installed; full requirements in Sections 23 76 13 and 23 31 13
MS-1, MS-2	Future mini-split condensing unit	Approx. 4 ton each	Grade pad	240/1	-	Rough-in only: grade pad and power whip, unit is a future purchase, not in this contract

2.3 BASIS-OF-DESIGN MANUFACTURERS

- A. Exhaust fans: Greenheck; Broan; Panasonic. Propeller fan: Greenheck; Air King. Ceiling fans: Big Ass Fans; MacroAir; Hunter Industrial. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount EF-1 through EF-4 in the ceiling cabinet location shown; duct to the wall or roof cap noted in the schedule with a backdraft damper at the termination.
- B. Mount EF-5 in the Staging wall sleeve with a gravity shutter; wire to the 85 deg F thermostat and a manual override switch.
- C. Mount CF-1 through CF-4 at 13 ft AFF clear of the roll-up bay doors and the roof-pitch door track; coordinate blade tip clearance with the post-frame structure and the lantern.

3.2 FIELD QUALITY CONTROL

- A. Balance each fan per Section 23 05 93; verify rotation direction and reverse-mode operation of CF-1 through CF-4.

END OF SECTION 23 34 23

SECTION 23 55 23

GAS-FIRED RADIANT HEATERS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes two gas-fired low-intensity infrared tube heaters (IR-1, IR-2) that provide the primary heat for the 30 ft x 60 ft Hall of the FarmWild Orangery. Heat is "event heat": the Hall air is held at 60 deg F, relying on radiant comfort rather than a higher air setpoint.
- B. Related Sections: 23 11 26 Facility LP Gas Piping; 23 34 23 HVAC Power Ventilators (lantern stack vent interlock).

1.2 REFERENCES

- A. NFPA 54 / IFGC - Venting and clearance requirements for gas-fired appliances.
- B. ANSI Z83.19 / CSA 2.35 - Gas-fired low-intensity infrared heaters.
- C. IMC/IFGC clearance-to-combustibles requirements as published in the manufacturer's listing.

1.3 DESIGN BASIS

- A. Hall peak heating load: 92.6 MBH; with a 1.25 heating safety factor, 115.8 MBH output is required over the two units.
- B. *Each unit: 75 MBH input, LP gas, approximately 57.9 MBH output required minimum per unit; selected units are rated for approximately 63.75 MBH output each (85% steady-state efficiency), giving about 127.5 MBH output total against the 115.8 MBH requirement.*
- C. IR-1 is mounted at the south eave, IR-2 at the north eave, each with an 50 ft tube length and an 11 ft mounting height, chain-hung from the post-frame structure.
- D. Venting: each unit is vented, power/direct vent through a 4 in flue to the roof, per the manufacturer's venting kit; these are not unvented (blue-flame) heaters, consistent with the occupied assembly use of the Hall.
- E. Gas connection: 1/2 in at each unit, from the header described in Section 23 11 26.

Tag	Location	Fuel	Input (MBH)	Output Req'd (MBH)	Tube Length	Mount Height	Vent
IR-1	South eave	LP	75	57.9	50 ft	11 ft	4 in flue thru roof
IR-2	North eave	LP	75	57.9	50 ft	11 ft	4 in flue thru roof

1.4 CONTROLS

- A. IR-1: wall thermostat, 60 deg F event mode.
- B. IR-2: same thermostat as IR-1, plus a lantern-vent interlock that locks out both heaters when the lantern stack vents are open, to avoid heating against an open vent.
- C. Two-stage or modulating control is preferred for both units for comfort at the lower 60 deg F air setpoint.

1.5 SUBMITTALS

- A. Product data with AHRI/matrix performance, venting kit, and clearance-to-combustibles data for the raised roll-up door position; provide the manufacturer's permanent clearance signage at each heater per Schedule Note 2 on Drawing M-601.

PART 2 - PRODUCTS

2.1 EQUIPMENT SCHEDULE

Tag	Item	Accessories	Notes
IR-1/2	Gas IR tube heater, 2 units	Chain hanger kit, reflector end caps, vent and combustion air kit, flexible gas connector + shutoff valve, event-heat thermostat	2-stage or modulating preferred; manufacturer clearance signage at each heater

2.2 CLEARANCES

- A. *Maintain the manufacturer's listed clearance to combustibles at the reflector, tube, and end caps, including clearance to the roll-up bay door in its raised position under the 5:12 roof (doors travel to approximately 15.8 ft, ending about 4.3 ft off center).*

2.3 BASIS-OF-DESIGN MANUFACTURERS

- A. Re-Verber-Ray; Detroit Radiant Products (Re-Verber-Ray); Superior Radiant Products; Schwank. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Chain-hang each unit from the post-frame structure at the mounting height and eave location scheduled; verify clearance against the raised door track before final positioning; lower or shift inboard as needed per the manufacturer's clearance chart.
- B. Vent each unit through the roof per the manufacturer's venting kit; flash and counterflash the roof penetration.
- C. Wire the lantern-vent interlock to the operator of the lantern stack vents; verify with Section 23 34 23 and the controls contractor for the lantern vent actuators.

3.2 FIELD QUALITY CONTROL

- A. Startup by a factory-authorized or manufacturer-trained technician; verify gas input rate, combustion, and vent draft at each unit; verify the thermostat and lantern interlock function together per Section 23 05 93.

END OF SECTION 23 55 23

SECTION 23 76 13

DIRECT EVAPORATIVE AIR COOLERS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes one roof-mounted, direct (single-stage) evaporative air cooler (EC-1) furnished and installed under this contract, providing warm-weather comfort cooling for the Hall of the FarmWild Orangery. The unit sits on a galvanized steel stand on the flat service wing roof at the hall east gable and discharges through a gable wall opening into a ducted supply system.
- B. Related Sections: 23 05 00 Common Work Results for HVAC; 23 05 93 TAB (air balance of the duct and registers); 23 31 13 Metal Ducts (EC-1 supply duct and registers); 23 34 23 HVAC Power Ventilators (ceiling fans, relief air path); Division 22 for the water service to the unit; Division 26 for the branch circuit and disconnect.

1.2 REFERENCES

- A. AMCA 210/211 - Fan performance testing and rating, basis of the unit's airflow rating.
- B. NFPA 70 - National Electrical Code; NEC Table 430.248 full-load current for single-phase motors, basis of the branch circuit and disconnect sizing.
- C. Manufacturer's standard winterizing and startup instructions for direct evaporative coolers (no single consensus standard governs seasonal lay-up of this equipment type).

1.3 DESIGN BASIS

- A. Sizing is preliminary, by air change rate, not a cooling load calculation: Hall volume approximately 23,400 cf x 30 ACH equals approximately 11,700 cfm required; one unit at approximately 12,000 cfm meets this air change rate.
 - *No cooling load calculation has been performed for this project; confirm against manufacturer selection software and the owner's comfort expectations before final unit selection. A wet-bulb design condition check for this location remains open and should be confirmed before construction.*
- B. EC-1 sits on a galvanized steel stand on the flat service wing roof (roof top approximately 11.2 ft) at the hall east gable. The stand bears directly on the wing roof framing; the structural engineer of record shall verify the framing for the unit's approximately 1,000 lb operating weight before the stand is set. Provide roof membrane protection and flashing at each stand leg.
- C. EC-1 discharges horizontally, west, through a solid insulated gable panel and a motorized insulated damper, into a spiral round galvanized supply duct run on the Hall centerline at 13 ft AFF to centerline, hung from the roof framing per Section 23 31 13. Twelve side registers (SR-1 to SR-12) distribute the air along the duct run.

- D. The motorized, insulated damper at the gable opening is normally closed; it opens only when EC-1 runs, and an end switch proves the damper open before the fan is allowed to run. The Hall is heated for winter events, so the damper stays closed and sealed through the heating season.
- E. Relief air is through the ridge lantern awning vents and the open overhead doors; no mechanical relief fan is provided.
- F. EC-1: horizontal discharge, approximately 12,000 cfm, 2 hp motor, 208-230V single phase, 8 in thick rigid media evaporative pads. Per NEC Table 430.248, full-load current (FLC) is approximately 12A; minimum circuit ampacity (MCA) is approximately 15A, served by a 20A, 2-pole branch circuit with disconnect.
- G. Water service: 1/2 in cold water branch taken off the overhead main inside the heated service wing, routed up through the wing roof to the unit. The drain-down valve for this branch is located inside the heated space, not at grade or on the roof, so it cannot freeze. Float fill is approximately 2 gpm; bleed-off is approximately 0.2 gpm, piped in 1/2 in line across the wing roof to the gutter and downspout.
- H. Seasonal operation: the unit is drained down and covered from October through May, and the gable damper stays closed through that period. Fall lay-up is drain the roof water line at the inside drain-down valve, drain the sump, close and verify the damper, and cover the unit; spring startup is uncover, restore water service, fill and check the pads and float, and open the damper.

1.4 SUBMITTALS

- A. Product data with AMCA-certified airflow and sound rating, motor electrical data, motorized damper and end switch data, and float valve/bleed assembly data.
- B. Shop drawings showing the roof stand, gable wall opening, damper, and duct connection, coordinated with the structural engineer of record's review of the wing roof framing and with Section 23 31 13 duct routing.
- C. Informational Submittals: manufacturer's startup and winterizing instructions.
- D. Closeout Submittals: O&M manuals, record drawings, and the owner training sign-off of Part 3.

1.5 QUALITY ASSURANCE

- A. Installer qualifications: licensed Montana mechanical contractor for the unit, stand, and water piping; licensed Montana electrician for the branch circuit and the damper interlock wiring; structural engineer of record verification of the wing roof framing before the stand is set.

1.6 COORDINATION

- A. Coordinate the stand location, gable opening, and duct connection with the structural engineer of record's roof framing review and with the roofing contractor for membrane protection and flashing at the stand legs.

1.7 WARRANTY

- A. Manufacturer's standard warranty, minimum 1 year on the complete unit including pump and motor.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. EC-1: galvanized steel or polymer cabinet, horizontal discharge, 8 in thick rigid media pads, direct- or belt-drive blower, recirculating pump, float-type fill valve, bleed-off assembly to limit mineral buildup in the sump, and a weatherproof electrical compartment, suitable for roof mounting.

2.2 EQUIPMENT SCHEDULE

Tag	Item	Airflow	Motor	V/Ph	Media	Location / Mount
EC-1	Roof-mounted direct evap cooler, horizontal discharge to duct	Approx. 12,000 cfm	2 hp	208-230/1	8 in rigid media	Galvanized stand on service wing roof, hall east gable

2.3 MOTORIZED DAMPER

- A. Gable wall opening: motorized, insulated, low-leakage damper, normally closed, interlocked to open only when EC-1 is energized. An end switch proves the damper open before the blower is allowed to run, and proves closed when the unit is off; the damper fails closed on loss of power.

2.4 WATER SERVICE AND DRAINAGE

- A. 1/2 in cold water branch from the overhead main inside the heated service wing, routed up through the wing roof to the unit, with a drain-down valve at the branch located inside the heated space, a float-type fill valve at the unit (approximately 2 gpm), and a bleed line (approximately 0.2 gpm) piped across the wing roof to the gutter and downspout.
- B. Stand: welded galvanized steel, sized and anchored to bear on the wing roof framing per the structural engineer of record; roof membrane protection and flashing at each leg.

2.5 ELECTRICAL

- A. EC-1: dedicated 208-230V single-phase branch circuit, 20A, 2-pole, sized per NEC Table 430.248 (FLC approximately 12A, MCA approximately 15A), with a weatherproof (NEMA 3R) unit disconnect switch mounted on the stand.

2.6 BASIS-OF-DESIGN MANUFACTURERS

- A. Phoenix Manufacturing; Champion Cooler; Adobe Air; Essick Air. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set the stand on the service wing roof at the hall east gable location shown, only after the structural engineer of record has verified the wing roof framing for the unit's operating weight; anchor per manufacturer instructions; provide roof membrane protection and flashing at each stand leg.
- B. Frame the gable wall opening at the solid insulated panel; connect the unit discharge through the motorized damper to the spiral round supply duct of Section 23 31 13.
- C. Install the motorized damper in the gable opening with its end switch wired to interlock with the unit controls, so the damper opens and the end switch proves it open before the blower starts, and the damper closes when the unit stops.

- D. Run the 1/2 in cold water branch from the overhead main inside the heated service wing, up through the wing roof to the unit, with the drain-down valve installed inside the heated space; pipe the float fill and bleed line per the manufacturer's connection diagram, with the bleed line routed across the wing roof to the gutter and downspout.
- E. Provide the dedicated 208-230V 20A 2-pole branch circuit and stand-mounted disconnect for the unit per Division 26.
- F. Provide permanent ladder access to the service wing roof for routine service of EC-1.

3.2 STARTUP AND SEASONAL SERVICE

- A. Startup: factory-authorized or manufacturer-trained technician startup; verify pump and float operation, bleed rate, damper interlock, and rotation/vibration-free operation of the blower.
- B. Fall lay-up, each October or before the first hard freeze: drain the roof water line at the inside drain-down valve, drain the sump, close the motorized damper and verify it seals, and install the manufacturer's weather cover over the unit.
- C. Spring startup, each May: remove the weather cover, restore water service, fill and check the pads and float valve, check the belt and motor, and verify the damper opens with the unit.

3.3 FIELD QUALITY CONTROL

- A. Functional test the unit: damper opens and closes with the unit and seals closed when off, with the end switch proving each state; float fill shutoff level is correct; bleed rate matches the manufacturer's setting; the inside drain-down valve fully drains the roof water line; the unit disconnect operates; motor rotation is correct and free of abnormal vibration. Duct and register airflow is measured under Section 23 05 93.

3.4 CLOSEOUT

- A. Owner training on seasonal startup, fall lay-up and winterizing, pad replacement, float/bleed adjustment, and roof access procedure; provide O&M manuals and the manufacturer's winterizing checklist.

END OF SECTION 23 76 13

SECTION 23 82 39

UNIT HEATERS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the electric unit heater (EUH-1) serving the caterer Staging area and the electric wall heaters (EWH-1 through EWH-4) serving Toilet Rooms 101-103 and the Mech/Jan room of the FarmWild Orangery service wing. These spaces are kept above freezing (or at a modest occupied setpoint) year-round, separate from the Hall's event-heat gas tube heaters of Section 23 55 23.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code, electric heater interface and disconnects.
B. UL 1995 - Heating and Cooling Equipment (electric resistance heaters).

1.3 DESIGN BASIS

- A. Wing peak heating load (Toilet Rooms + Mech/Jan): 6.0 MBH; with a 1.25 heating safety factor, 7.6 MBH output is required over the 4 electric wall heaters (EWH-1 through EWH-4), or approximately 1.9 MBH per unit minimum.
B. Selected wall heaters: 750 W each (2.6 MBH each), giving margin over the 1.9 MBH minimum.
C. Staging peak heating load: 9.3 MBH; with the 1.25 safety factor, 11.7 MBH output is required. Selected unit heater EUH-1: 5 kW (17.1 MBH), 240/1, giving substantial margin for door openings and the ventless kitchen equipment's cold-start recovery.

Tag	Serves	Type	Load Req'd	Selected	V/Ph	Control
EWH-1	Toilet Rm 101	Wall, recessed	1.9 MBH	750 W (2.6 MBH)	240/1	Integral t-stat, 40 F min
EWH-2	Toilet Rm 102	Wall, recessed	1.9 MBH	750 W (2.6 MBH)	240/1	Integral t-stat, 40 F min
EWH-3	Toilet Rm 103	Wall, recessed	1.9 MBH	750 W (2.6 MBH)	240/1	Integral t-stat, 40 F min
EWH-4	Mech/Jan 104	Wall, surface	1.9 MBH	750 W (2.6 MBH)	240/1	Integral t-stat, 40 F min; freeze protection for the domestic water piping in this room
EUH-1	Staging 105	Unit heater, ceiling	11.7 MBH	5 kW (17.1 MBH)	240/1	T-stat 60 F event / 40 F standby

► EUH-1's thermostat should be sequenced so the unit heater does not fight the exhaust heat from the ventless double-stack oven; coordinate the setpoint and any oven-interlock/off signal noted on Drawing M-601 ("heat oven off") with the kitchen equipment supplier.

1.4 SUBMITTALS

- A. Product data for each electric heater, including integral thermostat range and mounting bracket/recessed can details.

PART 2 - PRODUCTS

2.1 EQUIPMENT SCHEDULE

Tag	Item	Accessories
EWH-1 to EWH-4	Electric wall heater, 750 W, 240/1	Recessed wall can (EWH-1 to EWH-3), surface can (EWH-4), integral thermostat
EUH-1	Electric unit heater, 5 kW, 240/1	Wall/ceiling mounting bracket, disconnect switch, thermostat

2.2 BASIS-OF-DESIGN MANUFACTURERS

- A. Wall heaters: Markel/QMark; Berko; Dimplex. Unit heater: Markel/QMark; Modine; Berko. Substitutions "or approved equal."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Recess EWH-1 through EWH-3 in the toilet room walls per the manufacturer's rough-in dimensions; surface-mount EWH-4 in the Mech/Jan room near the domestic water piping it protects, per the P-601 note "pipes here."
- B. Ceiling-mount EUH-1 in Staging with clearance from the hood/exhaust path and the holding cabinets; provide a disconnect switch within sight of the unit.

3.2 FIELD QUALITY CONTROL

- A. Verify each heater's thermostat setpoint and operation per Section 23 05 93; verify EWH-4 maintains the Mech/Jan room above freezing under the winter design condition of -4 deg F outdoor.

END OF SECTION 23 82 39

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements common to all Division 26 Sections: electrical service and distribution coordination, raceway and boxes, conductor identification, equipment supports and seismic anchorage, firestopping of electrical penetrations, sleeves, cutting and patching, demolition of existing electrical work, and record documentation.
- B. Related: Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables; Section 26 05 26 - Grounding and Bonding for Electrical Systems; Section 26 24 16 - Panelboards; Section 26 28 16 - Enclosed Switches and Circuit Breakers; Section 26 51 19 - LED Interior Lighting; Division 23 Sections for mechanical equipment furnished with integral controls and factory wiring.
- C. Division 26 provides all line-voltage power to mechanical equipment, including the final connection, unless a Division 23 Section expressly states the equipment is furnished with a factory cord-and-plug connection. Control wiring downstream of a mechanical control device remains Division 23 scope.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code, edition adopted by the Authority Having Jurisdiction.
- B. NFPA 70E - Standard for Electrical Safety in the Workplace (arc-flash labeling and work practices).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction.
- D. UL/ANSI product standards as cited in each individual Division 26 Section.
- E. ASCE/SEI 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures (Chapter 13 nonstructural component anchorage).

► Confirm the NEC edition actually adopted by the AHJ and state it here. The calculated design delivered with this Project Manual (DESIGN.xlsx Electrical tab) states the edition it was computed against in its ASSUMPTIONS & BASIS block -- the two must agree, and a newer adopted edition may change ampacity, GFCI/AFCI, surge-protection, and receptacle-spacing requirements.

1.3 SUBMITTALS

- A. Product Data for each product specified in Division 26.
- B. Shop Drawings: dimensioned equipment layouts for electrical rooms showing NEC 110.26 working clearances, and a coordinated single-line diagram reflecting as-purchased equipment ratings.
- C. Coordination drawings reconciling raceway, ductwork, piping, and structure in congested areas prior to rough-in.
- D. Field quality-control test reports required under Article 3.5 of this Section.

- E. Operation and Maintenance data and record drawings reflecting actual installed circuiting, including corrected panel schedule directories.

1.4 QUALITY ASSURANCE

- A. Products: listed and labeled by a Nationally Recognized Testing Laboratory for the application and environment in which they are installed.
- B. Installer: licensed in the jurisdiction of the Work; workmanship per NECA 1.
- C. Electrical work performed under the supervision of a licensed electrical contractor of record identified in the submittal.

1.5 PROJECT CONDITIONS AND COORDINATION

- A. Coordinate the service entrance location, metering arrangement, available fault current, and point of delivery with the serving utility before rough-in; obtain the utility's written available fault current for use in equipment short-circuit ratings.
- B. Coordinate equipment nameplate data (voltage, phase, minimum circuit ampacity, and maximum overcurrent protective device rating) with the Division 22 and 23 equipment submittals before ordering branch overcurrent devices, disconnects, or conductors. Where a scheduled MCA value is identified on the Drawings as an estimate pending vendor data, do not order material against it -- submit the actual nameplate value for review first.

PART 2 - PRODUCTS

2.1 RACEWAY AND BOXES

- A. Electrical metallic tubing (EMT), ANSI C80.3, with steel compression fittings: interior dry locations, exposed and concealed.
- B. Rigid metal conduit (RMC) or intermediate metal conduit (IMC), ANSI C80.1/C80.6: exterior exposed locations, where subject to physical damage, and for service-entrance raceway above grade.
- C. Rigid PVC conduit, Schedule 40 (Schedule 80 where subject to physical damage), NEMA TC 2: underground and under-slab raceway, with a code-sized equipment grounding conductor pulled in each raceway.
- D. Liquidtight flexible metal conduit: final connections to motors, and vibrating or field-adjusted equipment; 6 ft maximum length.
- E. Boxes: galvanized steel outlet and device boxes interior; cast metal, gasketed, NEMA 3R boxes exterior and in damp/wet locations. Sized per NEC 314.16 for the contained conductors and devices.
- F. Minimum raceway size: 3/4 in. for feeders and homeruns; 1/2 in. permitted only for individual device drops from an accessible box.

2.2 IDENTIFICATION

- A. Engraved laminated phenolic nameplates (white letters on black field) on all service equipment, panelboards, disconnects, and motor controllers, identifying equipment designation, voltage/phase, and source of supply.
- B. Conductor color coding maintained consistently throughout the Project:

System	Phase A	Phase B	Phase C	Neutral	Equipment Ground
120/240 V, 1-phase, 3-wire	Black	Red	--	White	Green

- C. Feeder and branch-circuit conductors identified at each termination, junction, and pull point with the panel designation and circuit number.
- D. Arc-flash warning labels per NFPA 70E and NEC 110.16 on all service equipment, panelboards, and motor control equipment likely to require examination while energized.

2.3 SUPPORTS AND ANCHORAGE

- A. Channel/strut support systems, threaded rod, and anchors sized for the supported load; raceway supported independently of ductwork, piping, ceiling grid, and other trades' supports.
- B. Floor-mounted and wall-mounted electrical equipment anchored for the seismic design category of the Project per ASCE/SEI 7 Chapter 13; submit anchorage calculations where the component importance factor requires certification.

2.4 FIRESTOPPING AND SLEEVES

- A. Penetrations of fire-rated assemblies sealed with a tested and listed through-penetration firestop system (ASTM E814 / UL 1479) matching the rating of the assembly.
- B. Sleeves at wall and floor penetrations, sized to permit raceway movement, sealed against smoke and moisture migration.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

- A. Verify that structural, architectural, and mechanical conditions permit installation before starting rough-in; report conflicts before proceeding.

3.2 RACEWAY INSTALLATION

- A. Install raceway concealed in finished areas; exposed raceway permitted in mechanical, and service areas, run parallel or perpendicular to building lines.
- B. Maintain NEC 300.5 burial depths and provide warning tape above underground raceway; seal raceways entering the building from underground per NEC 225.27/300.5(G).
- C. Provide pull strings in all empty raceway; cap and label spare raceway at both ends.
- D. Do not exceed 360 degrees of bends between pull points.

3.3 EQUIPMENT INSTALLATION AND CLEARANCES

- A. Maintain NEC 110.26 dedicated equipment space and working clearance at all switchboards, panelboards, and motor control equipment; do not install piping, ductwork, or storage within the dedicated space.
- B. Mount panelboards with the top of the enclosure not more than 6 ft-7 in. above the finished floor and the highest operating handle within reach per NEC 240.24(A).

3.4 CONNECTIONS TO MECHANICAL EQUIPMENT

- A. Provide a disconnecting means within sight of each motor and appliance per NEC 430 Part IX and 422 Part III, unless the equipment is furnished with a listed integral disconnect.
- B. Make final connections with liquidtight flexible conduit; leave sufficient slack for equipment servicing and vibration isolation without strain on terminations.

3.5 FIELD QUALITY CONTROL

- A. Perform continuity, insulation-resistance (feeders and branch circuits), polarity, and ground-continuity testing before energizing; record and submit results.
- B. Measure and record phase currents at each panelboard main under representative load; rebalance branch circuits between phases where measured imbalance exceeds 20 percent, and update the panel schedule directory to match.
- C. Verify torque of all feeder and service terminations to the manufacturer's published values with a calibrated torque tool; record values.

3.6 CLOSEOUT

- A. Provide typed panel schedule directories reflecting as-built circuiting in every panelboard.
- B. Provide record drawings showing actual routing of underground and concealed feeders, and the as-installed single-line diagram.

END OF SECTION 26 05 00

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes building-wire conductors, cables, connectors, terminations, and splices rated 600 V and less for service-entrance, feeder, and branch-circuit power distribution.
- B. Related: Section 26 05 00 - Common Work Results for Electrical (raceway, identification, color coding); Section 26 05 26 - Grounding and Bonding (equipment grounding and bonding conductors); Section 26 24 16 - Panelboards (terminations at panel bus and breakers).

1.2 REFERENCES

- A. NFPA 70 (NEC) Article 310 - Conductors for General Wiring, including Table 310.16 ampacity and Table 310.15(C)(1) adjustment factors.
- B. NFPA 70 (NEC) Article 215 - Feeders, and Article 210 - Branch Circuits.
- C. UL 83 - Thermoplastic-Insulated Wires and Cables; UL 44 - Thermoset-Insulated Wires and Cables; UL 1581 - Reference Standard for Electrical Wires, Cables, and Flexible Cords.
- D. NEMA WC 70 / ICEA S-95-658 - Power Cables Rated 2000 V or Less.

1.3 SUBMITTALS

- A. Product Data for conductors, connectors, terminations, and splice kits.
- B. Field test reports per Article 3.4.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Conductor material: copper. Aluminum conductors are not acceptable for feeders or branch circuits under this Contract unless a specific substitution is approved in writing, in which case the Contractor is responsible for the resulting increase in conductor size, raceway size, and termination provisions at no additional cost.
- B. Insulation: THHN/THWN-2, 600 V, rated 90 C dry and wet. Ampacity selected from the 75 C column of NEC Table 310.16 in accordance with the 75 C termination limitation of NEC 110.14(C); the 90 C rating is used only for derating calculations.
- C. Stranding: solid permitted for No. 10 AWG and smaller; stranded required for No. 8 AWG and larger and for all connections to vibrating equipment.

- D. Minimum branch-circuit conductor size: No. 12 AWG. No. 14 AWG is permitted only for control and signal circuits.
- E. Metal-clad (Type MC) cable is permitted only for concealed branch-circuit drops from an accessible junction box to luminaires and devices in finished areas, in lengths not exceeding 6 ft. Type NM cable is not permitted.

2.2 CONNECTORS, TERMINATIONS, AND SPLICES

- A. No. 10 AWG and smaller: listed twist-on or push-in connectors rated for the conductor combination, or insulated crimp connectors.
- B. No. 8 AWG and larger: listed compression connectors or mechanical lugs rated 75 C minimum, installed with the manufacturer's die and torqued to published values.
- C. Splices in feeders are not permitted except at approved pull points with listed compression connectors and rated insulating covers; splices in underground raceway are not permitted.
- D. Antioxidant compound at all connections where required by the connector listing.

2.3 SIZING BASIS

- A. Conductors sized as scheduled on the Drawings. The scheduled sizes are based on: 75 C copper ampacity per NEC Table 310.16; continuous loads taken at 125 percent per NEC 210.19(A) and 215.2(A); ambient and conduit-fill adjustment per NEC Table 310.15(B)(1) and 310.15(C)(1); and the voltage-drop limits in Article 2.4.
- B. Do not reduce a scheduled conductor size. Where field conditions increase a run length beyond that shown, notify the Engineer so the voltage drop can be re-evaluated before installation.

2.4 VOLTAGE DROP

Circuit Type	Maximum Voltage Drop	Basis
Feeder (service to panel, panel to panel)	2%	NEC 215.2(A)(1) Informational Note 2
Branch circuit (panel to outlet)	3%	NEC 210.19(A) Informational Note 4
Combined feeder + branch to farthest outlet	5%	NEC Informational Notes, combined limit

► These limits are NEC Informational Notes -- recommendations, not enforceable code minimums -- but they are contract requirements under this Section. The scheduled feeder sizes on the Drawings were computed against the 2 percent feeder limit at the routed lengths shown; a longer field route can push a feeder over the limit without violating any ampacity rule, which is why Article 2.3.B requires notification rather than a field judgment call.

2.5 CONDUCTOR APPLICATIONS SCHEDULE

Application	Conductor/Cable	Raceway
Service entrance, above grade	THWN-2 copper	RMC or IMC
Service entrance, underground	THWN-2 copper	PVC Sch 40, concrete-encased where required
Feeders, interior dry	THHN/THWN-2 copper	EMT
Feeders, exterior or wet	THWN-2 copper	RMC or PVC Sch 40
Branch circuits, interior dry	THHN/THWN-2 copper	EMT
Luminaire and device drops, finished	Type MC (6 ft max.)	--

areas		
Final connection to motors/equipment	THHN/THWN-2 copper	Liquidtight flexible metal conduit

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pull conductors into completed, cleaned, and dry raceway systems using listed pulling compound; do not exceed the conductor manufacturer's maximum pulling tension or sidewall pressure.
- B. Install a separate insulated equipment grounding conductor in every raceway; do not rely on the raceway alone as the equipment grounding path.
- C. Neutral conductors: provide a separate neutral for each 120 V branch circuit serving electronic loads, dimmed lighting, or receptacle circuits. Shared (multiwire branch-circuit) neutrals are permitted only where the circuit is provided with a listed handle tie or common-trip breaker per NEC 210.4(B) and is not serving nonlinear loads.
- D. Neutral conductors on 4-wire circuits serving nonlinear loads sized not less than the phase conductors and counted as current-carrying conductors for derating per NEC 310.15(E)(3).
- E. Group and train conductors neatly in gutters and wireways; support conductors in vertical raceway per NEC 300.19.

3.2 TERMINATIONS

- A. Terminate to lugs listed for the conductor material and quantity; do not place two conductors under a lug listed for one.
- B. Torque every termination to the manufacturer's published value with a calibrated torque tool; document per Section 26 05 00 Article 3.5.

3.3 IDENTIFICATION

- A. Color code and tag all conductors per Section 26 05 00 Article 2.2 at every accessible point.

3.4 FIELD QUALITY CONTROL

- A. Insulation-resistance test all feeders and all branch circuits at 500 Vdc minimum after installation and before energizing; minimum acceptable value 1 megohm, or the manufacturer's published value if higher.
- B. Verify continuity and phase identification of every feeder at both ends before energizing.
- C. Correct or replace conductors failing the tests; retest after correction.

END OF SECTION 26 05 19

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the grounding electrode system, grounding electrode conductors, equipment grounding conductors, bonding jumpers, and grounding terminations and connections.
- B. Related: Section 26 05 00 - Common Work Results for Electrical; Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables; Section 26 24 16 - Panelboards (main bonding jumper and isolated neutral/ground bars).

1.2 REFERENCES

- A. NFPA 70 (NEC) Article 250 - Grounding and Bonding, including Table 250.66 (grounding electrode conductor) and Table 250.122 (equipment grounding conductor).
- B. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
- C. UL 467 - Grounding and Bonding Equipment.

1.3 SUBMITTALS

- A. Product Data for ground rods, exothermic weld and compression connection systems, and ground bars.
- B. Field test report of measured ground-electrode resistance per Article 3.4, including test method, weather/soil conditions, and date.

PART 2 - PRODUCTS

2.1 GROUNDING ELECTRODES

- A. Ground rods: copper-clad steel, 3/4 in. diameter by 10 ft minimum length, UL 467 listed.
- B. Concrete-encased electrode (Ufer): not less than 20 ft of bare No. 4 AWG copper or 1/2 in. reinforcing bar encased in the building foundation footing per NEC 250.52(A)(3). Where a concrete-encased electrode is present, it must be used as part of the grounding electrode system.
- C. Metal underground water pipe in direct contact with earth for 10 ft or more, bonded per NEC 250.52(A)(1) and supplemented by an additional electrode per NEC 250.53(D)(2).

2.2 CONDUCTORS AND CONNECTIONS

- A. Grounding electrode conductor: bare or green-insulated copper, sized per NEC Table 250.66 for the largest service-entrance conductor.
- B. Equipment grounding conductors: green-insulated copper, sized per NEC Table 250.122 for the rating of the upstream overcurrent device, increased proportionally where phase conductors are upsized for voltage drop per NEC 250.122(B).
- C. Below-grade and concealed connections: exothermic weld. Accessible connections: listed compression connectors or bolted lugs; no soldered connections anywhere in the grounding system.
- D. Ground bars: copper, minimum 1/4 in. by 2 in., insulated standoffs, in each electrical room and telecommunications room.

2.3 GROUNDING AND BONDING SIZING SCHEDULE

Element	Sizing Basis	Typical Result
Grounding electrode conductor	NEC Table 250.66, from largest ungrounded service conductor	No. 6 Cu for 1 AWG service
Main bonding jumper	NEC 250.28(D), from service conductor size	No. 6 Cu for 1 AWG service
Equipment grounding conductor	NEC Table 250.122, from upstream OCPD rating	No. 10 Cu for 60 A; No. 6 Cu for 125 A
Supply-side bonding jumper	NEC 250.102(C)	Per Table 250.102(C)(1)

► The typical results column illustrates the sizing for the service and feeder ampacities in this building class; the governing values are the NEC tables and the sizes scheduled on the Drawings. Where the calculated design upsized a feeder for voltage drop, NEC 250.122(B) requires the equipment grounding conductor to be increased in the same proportion -- verify this on any feeder the Drawings flag as voltage-drop upsized.

PART 3 - EXECUTION

3.1 GROUNDING ELECTRODE SYSTEM

- A. Bond all electrodes present at the building into one grounding electrode system per NEC 250.50: concrete-encased electrode, metal underground water pipe, driven rods, and building steel.
- B. Install driven ground rods full length, spaced not less than 6 ft apart, in accessible test wells or with the connection accessible for inspection.
- C. Install the concrete-encased electrode before the footing pour and coordinate the inspection with the AHJ; a missed Ufer cannot be added after the pour.

3.2 EQUIPMENT GROUNDING AND BONDING

- A. Install an insulated equipment grounding conductor in every feeder and branch-circuit raceway, bonded to each enclosure, box, and device grounding terminal.
- B. Bond metal water piping, metal gas piping (at the point of appliance connection per NEC 250.104(B)), building structural steel, and metal ductwork crossing electrical rooms.
- C. Bond the equipment grounding conductor of the mechanical equipment feeder to the equipment frame at the disconnecting means and at the unit itself.

3.3 PROHIBITED PRACTICES

- A. Do not use the grounded (neutral) conductor as an equipment grounding conductor downstream of the service disconnecting means.
- B. Do not install isolated/insulated ground receptacle circuits unless specifically scheduled; where scheduled, run the isolated grounding conductor unbroken to the derived system ground point.

3.4 FIELD QUALITY CONTROL

- A. Measure grounding electrode system resistance to earth by the fall-of-potential method per IEEE 81 before energizing; target 25 ohms or less for a single electrode. Where a single electrode exceeds 25 ohms, install a supplemental electrode per NEC 250.53(A)(2) and retest.
- B. Verify continuity of the equipment grounding path from the farthest outlet on each panel back to the service ground.
- C. Submit test results identifying the measured resistance, method, instrument, ambient/soil conditions, and the location of each electrode tested.

END OF SECTION 26 05 26

SECTION 26 09 23

LIGHTING CONTROL DEVICES

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes occupant sensors, wall-box dimmers, daylight-responsive dimming controls, the exterior photocell and time switch, and the low-voltage 0-10 V control wiring that connects them to the luminaires scheduled in Section 26 51 19.
- B. Related: Section 26 51 19 - LED Interior Lighting; Section 26 52 13 - Emergency and Exit Lighting; Section 26 56 00 - Exterior Lighting; Section 26 27 26 - Wiring Devices.

1.2 REFERENCES

- A. IECC 2021 (Montana adopted, ARM 24.301.161 -- verify the amendment set with the AHJ), Section C405.2 (lighting controls) and Section C408.3 (functional testing of lighting controls).
- B. NEMA WD 7 - Occupancy Motion Sensors Standard; NEMA 410 - Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers.
- C. IEC 60929 Annex E / NEMA LSD 64 - 0-10 V dimming interface.
- D. UL 508 - Industrial Control Equipment; UL 916 - Energy Management Equipment; UL 20 - General-Use Snap Switches.

1.3 SUBMITTALS

- A. Product data for each sensor, dimmer, power pack, photocell, and time switch, with the coverage pattern of each occupant sensor drawn over the room it serves.
- B. Wiring diagram for each control zone showing line-voltage switching, the 0-10 V dimming pair, and the emergency luminaires that stay unswitched.
- C. Functional test report per Article 3.3, signed by the installer.

PART 2 - PRODUCTS

2.1 CONTROL SCHEDULE

- A. Provide the controls listed for each room. The schedule is the basis of design from the project lighting calculation; it shows the minimum the energy code requires and the dimming the Owner asked for.

Room	Area (ft2)	Luminaires	Controls required
HALL	1800	15 x A	Occupant sensor, auto-off 20

			min, manual-on or auto-on to 50%; Manual dimming (0-10 V); Daylight-responsive dimming in the sidelit zone (C405.2.4)
TR1	29	1 x C	Occupant sensor, auto-off 20 min, manual-on or auto-on to 50%; Manual dimming (0-10 V)
TR2	29	1 x C	Occupant sensor, auto-off 20 min, manual-on or auto-on to 50%; Manual dimming (0-10 V)
TR3	39	1 x C	Occupant sensor, auto-off 20 min, manual-on or auto-on to 50%; Manual dimming (0-10 V)
CORR	56	2 x C	Occupant sensor, auto-off 20 min, manual-on or auto-on to 50%; Manual dimming (0-10 V)
MECH-JAN	49	1 x D	Occupant sensor, auto-off 20 min, manual-on or auto-on to 50%
STAGING	240	6 x B	Occupant sensor, auto-off 20 min, manual-on or auto-on to 50%; Manual dimming (0-10 V)

2.2 OCCUPANT SENSORS

- A. Dual-technology (passive infrared plus ultrasonic or microphonic) ceiling or wall sensors with field-adjustable time delay set to 20 minutes maximum and sensitivity adjustment.
- B. Single-occupant toilet rooms and small support rooms: wall-switch sensor in place of the local switch, set to manual-on or auto-on to 50 percent.
- C. Large rooms: ceiling sensors with a 360 degree pattern, quantity as needed for full coverage of the occupied floor, wired to a power pack rated for the controlled load.

2.3 DIMMING CONTROLS

- A. Wall-box 0-10 V low-voltage dimmers, sink type, matched to the scheduled driver dimming range, with an on/off switch that operates independent of the dim level.
- B. Daylight-responsive dimming in HALL: closed-loop photosensor that dims the general lighting in the daylight zone continuously to 15 percent or less and turns it off when daylight alone meets the target illuminance, per IECC 2021 C405.2.4.

2.4 EXTERIOR CONTROLS

- A. Photocell (or astronomical time switch) to turn the exterior lighting on at dusk and off at dawn, plus a 7-day time switch with battery carryover that reduces the exterior lighting power by not less than 50 percent from midnight or 1 h after close, to 6 am or opening (window wording unverified).

2.5 EMERGENCY LUMINAIRES

- A. Emergency units and exit signs connect to the unswitched leg of the local lighting branch circuit, ahead of every sensor, dimmer, and switch. No control in this Section may turn them off.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount sensors at least 6 ft from supply air outlets and clear of the lighting heat and of glazing that sees moving traffic outside.
- B. Run 0-10 V dimming pairs as Class 1 conductors in the branch-circuit raceway, or as Class 2 cable separated from power conductors per NEC 725.136.

3.2 ADJUSTMENT

- A. Set occupant sensor time delays to 20 minutes or less and adjust sensitivity so the lights stay on with a seated occupant and do not trip on corridor traffic.
- B. Calibrate daylight sensors once at night (electric light only) and once in full daylight.

3.3 FUNCTIONAL TESTING

- A. Test every control zone per IECC 2021 C408.3: occupant sensor coverage and time-out, manual and automatic on behavior, dimming range, daylight response, exterior on/off and after-hours reduction. Record each result and correct every failure before Substantial Completion.

END OF SECTION 26 09 23

SECTION 26 24 16

PANELBOARDS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes main distribution panelboards, power distribution panelboards, and lighting and appliance branch-circuit panelboards, including bolt-on molded-case branch overcurrent devices and surge protective devices.
- B. Related: Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables; Section 26 05 26 - Grounding and Bonding; Section 26 28 16 - Enclosed Switches and Circuit Breakers.

1.2 REFERENCES

- A. NFPA 70 (NEC) Article 408 - Switchboards, Switchgear, and Panelboards; Article 220 - Branch-Circuit, Feeder, and Service Load Calculations.
- B. UL 67 - Panelboards; UL 50/50E - Enclosures for Electrical Equipment.
- C. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
- D. UL 1449 - Surge Protective Devices; NEMA PB 1 / PB 1.1 - Panelboards, and instructions for safe installation, operation, and maintenance.

1.3 SUBMITTALS

- A. Product Data and Shop Drawings for each panelboard: enclosure dimensions, bus rating, main device rating, short-circuit current rating, number of circuit positions, and a complete circuit directory schedule.
- B. Short-circuit and overcurrent-protective-device coordination study, or a manufacturer's series-rating letter, demonstrating that every device's interrupting rating equals or exceeds the available fault current at its point of application.
- C. Field test reports and final as-built circuit directories per Part 3.

1.4 QUALITY ASSURANCE

- A. All panelboards on the Project by a single manufacturer, with breakers of that manufacturer's listing; mixed-manufacturer classified breakers are not acceptable.
- B. Short-circuit current rating of each panelboard not less than the available fault current determined from the serving utility's written value, calculated to the point of application.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Panelboards: UL 67 listed, dead-front, with copper bus and full-capacity copper neutral bus; aluminum bus is not acceptable.
- B. Equipment ground bus in every panelboard, bonded to the enclosure. Isolated neutral bus (not bonded to the enclosure) in all panelboards downstream of the service disconnecting means or of a separately derived system.
- C. Enclosures: NEMA 1 interior dry locations; NEMA 3R exterior and damp locations; NEMA 12 in dusty industrial areas. Hinged, lockable door-in-door trim on branch panelboards.
- D. Bus rating, main overcurrent device rating, voltage/phase configuration, and circuit position count as scheduled on the Drawings. Provide not less than 20 percent spare circuit positions, and not less than two spare positions in any panelboard, wired to the bus and covered with blank fillers.
- E. Branch overcurrent devices: bolt-on, thermal-magnetic, UL 489 molded-case circuit breakers. Plug-in breakers are not acceptable. Common-trip multipole breakers for all multiwire and multipole circuits.
- F. Provide GFCI (Class A, 5 mA) breakers or devices where required by NEC 210.8, and ground-fault equipment protection (30 mA) for heat-tracing and similar circuits where scheduled.

2.2 SURGE PROTECTIVE DEVICES

- A. Provide a UL 1449 Type 1 or Type 2 surge protective device at the service entrance equipment and at each panelboard serving electronic or control loads, integrally mounted or connected with leads as short and straight as practicable.
- B. Minimum ratings: 50 kA per phase surge current capacity at the service; 20 kA per phase at branch panelboards; with status indication and audible or visual failure annunciation.

2.3 PANELBOARD SCHEDULE BASIS

Attribute	Requirement	Source
Bus rating	As scheduled; not less than the panel main device rating	Drawings / panel schedule
Main device	Main circuit breaker unless 'MLO' is scheduled	Drawings / panel schedule
Connected and demand load	As scheduled per panel	NEC Article 220 calculation
Spare positions	20% minimum, 2 positions minimum	This Section, Article 2.1.D
Short-circuit rating	Not less than available fault current at the panel	Utility letter + study
Phase balance	Within 20% between phases at the panel main	Section 26 05 00, Article 3.5.B

► The panel schedules issued with the Drawings carry a calculated connected VA, demand VA, demand amps, and per-phase totals for every panel. Where the Contractor re-circuits during construction, the as-built directory must be updated and the phase balance re-verified -- a re-circuited panel that leaves one phase heavily loaded defeats the calculated feeder sizing even though every breaker is still correctly rated.

2.4 AVAILABLE FAULT CURRENT AND INTERRUPTING RATINGS

- A. Every panelboard, main device, and branch overcurrent device shall carry a fully rated interrupting rating (UL 489) not less than the minimum shown; series-combination ratings are not accepted.

Panel	System	Bus / Main	Calc. AFC	Min. AIC	Specified
MDP	240/120 1-ph	400 A / 400 A	30.7 kA	35 kA	--
LP-1	240/120 1-ph	400 A / 350 A	24.9 kA	25 kA	--

► Available fault current computed by the point-to-point method from the utility transformer data: TX-2 100 kVA, 1.5 percent impedance (ASSUMED: REC has not sized pad TX-2; 100 kVA 1-ph, 1.5%Z, infinite-bus primary). Where that data is ASSUMED, obtain the utility's written transformer kVA, impedance, and primary fault duty and have the Engineer rerun the calculation before releasing panelboards for fabrication.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount panelboards plumb and rigid, with the top of the trim not more than 6 ft-7 in. above the finished floor; maintain NEC 110.26 working clearance and dedicated equipment space.
- B. Install a nameplate on each panelboard per Section 26 05 00, identifying the panel designation, voltage/phase, source of supply, and available fault current with the date the value was determined per NEC 110.24.

3.2 CIRCUITING AND BALANCING

- A. Circuit branch loads to the phases indicated on the panel schedules. Where field conditions require re-circuiting, distribute loads to keep the phase-to-phase imbalance at the panel main below 20 percent.
- B. Provide a typed, as-built circuit directory in each panelboard identifying the load and room served by every circuit; handwritten directories are not acceptable at closeout.

3.3 FIELD QUALITY CONTROL

- A. Torque all bus and breaker terminations to the manufacturer's published values with a calibrated tool; record values.
- B. Measure and record phase currents at each panelboard main under representative operating load; submit with the closeout documents and rebalance where the limit in Article 3.2 is exceeded.

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes receptacles, GFCI devices, wall switches, occupancy and vacancy sensors, device plates, and floor and poke-through service fittings.
- B. Related: Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables; Section 26 51 19 - LED Interior Lighting (luminaire-integral and networked lighting controls).

1.2 REFERENCES

- A. NFPA 70 (NEC) Article 210 - Branch Circuits, including 210.8 (GFCI), 210.12 (AFCI), and 406.4(D) (replacement receptacles).
- B. NEMA WD 1 / WD 6 - General Requirements for Wiring Devices; Wiring Devices - Dimensional Specifications.
- C. UL 498 - Attachment Plugs and Receptacles; UL 943 - Ground-Fault Circuit-Interrupters; UL 20 - General-Use Snap Switches.
- D. ICC A117.1 / ADA Standards for Accessible Design - mounting heights and reach ranges.
- E. ASHRAE 90.1 / IECC - automatic lighting shutoff and receptacle control requirements.

1.3 SUBMITTALS

- A. Product Data for each device type, including color, grade, and finish.
- B. Occupancy/vacancy sensor coverage layout for each controlled space, with sensor type (passive infrared, ultrasonic, or dual-technology) and coverage pattern.

PART 2 - PRODUCTS

2.1 RECEPTACLES

- A. General-purpose receptacles: specification grade, NEMA 5-20R, 20 A, 125 V, back-and-side wired with screw terminals; push-in (stab) terminations are not acceptable.
- B. Tamper-resistant receptacles where required by NEC 406.12; weather-resistant, listed for damp/wet location with an in-use cover, at all exterior and damp locations.
- C. GFCI receptacles: UL 943 Class A, self-testing, with end-of-life indication and lockout, at all locations required by NEC 210.8 including restrooms, rooftops, outdoors, within 6 ft of a sink, and in unfinished service areas at grade.

- D. Special-purpose receptacles: NEMA configuration matched to the served equipment as scheduled; confirm the actual cord cap furnished with the equipment before rough-in.
- E. Controlled receptacles required for automatic receptacle shutoff: permanently marked to identify them as controlled, per the energy code and NEC 406.3(E).

2.2 SWITCHES AND SENSORS

- A. Wall switches: specification grade, 20 A, 120/277 V, quiet AC-rated toggle or decorator style, with screw terminals.
- B. Occupancy sensors: dual-technology (passive infrared plus ultrasonic) in enclosed rooms with obstructions (restrooms, storage, break rooms); passive infrared acceptable in open areas with clear line of sight. Wall-box sensors with a manual-off override in offices; ceiling-mounted sensors with a separate low-voltage power pack in open areas.
- C. Vacancy (manual-on/automatic-off) sensors in private offices, conference rooms, and other spaces where the energy code requires manual-on control.
- D. Provide adjustable time delay (5 to 30 minutes) and sensitivity on all sensors; factory default settings are not acceptable at closeout without field adjustment.

2.3 PLATES AND FINISHES

- A. Device plates: smooth thermoplastic or nylon in finished areas; galvanized steel in unfinished mechanical, and electrical rooms; gasketed weatherproof in-use covers at exterior and damp locations.
- B. Device and plate color: as selected by the Owner from the manufacturer's standard range; controlled receptacles in a contrasting color or with permanent marking per Article 2.1.E.
- C. Machine-engraved or printed label on every device plate identifying the panel and circuit number serving it in unfinished, mechanical, and electrical areas.

2.4 MOUNTING HEIGHT SCHEDULE

Device	Mounting Height (to centerline, AFF)	Note
General receptacle	18 in.	ADA reach range 15 in. minimum
Receptacle above counter/backsplash	6 in. above counter (44 in. max.)	Coordinate with casework
Wall switch / wall-box sensor	44 in.	ADA reach range 48 in. maximum
Receptacle, exterior/wet location	24 in., in-use cover	Weather-resistant, GFCI
Equipment/special-purpose receptacle	As required by the served equipment	Verify before rough-in

► Mounting heights shown satisfy both the ADA reach range and normal construction practice, but casework, wainscot, window sills, and equipment locations routinely force exceptions -- confirm each against the architectural elevations before rough-in rather than defaulting to this table.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install devices plumb and flush with the finished surface; device plates seated tight to the wall with no gaps and no visible box edge.

- B. Ground each device with a bonding jumper from the device grounding terminal to the box grounding screw; self-grounding yokes alone are acceptable only in metal boxes in dry locations.
- C. Do not share neutrals between controlled and uncontrolled receptacle circuits.

3.2 SENSOR COMMISSIONING

- A. Aim, mask, and set the sensitivity and time delay of each occupancy/vacancy sensor to cover the full occupied area with no false-off events during normal use and no triggering from adjacent circulation.
- B. Walk-test every sensor with the Owner present; record final time-delay and sensitivity settings for the closeout documents.

3.3 FIELD QUALITY CONTROL

- A. Test every receptacle for correct polarity, ground continuity, and open neutral with a listed circuit tester; test every GFCI device with its integral test button and with an external GFCI tester.
- B. Verify that each device plate label matches the as-built panel directory.

END OF SECTION 26 27 26

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes enclosed fusible and nonfusible safety switches, enclosed molded-case circuit breakers, fuses, and equipment disconnecting means serving mechanical and process equipment.
- B. Related: Section 26 24 16 - Panelboards; Section 26 05 26 - Grounding and Bonding; Division 22 and 23 Sections for equipment furnished with factory-integral disconnects.

1.2 REFERENCES

- A. NFPA 70 (NEC) Article 404 - Switches; Article 408; Article 430 Part IX - Disconnecting Means for motors; Article 440 - Air-Conditioning and Refrigerating Equipment.
- B. UL 98 - Enclosed and Dead-Front Switches; UL 489 - Molded-Case Circuit Breakers; UL 248 - Low-Voltage Fuses.
- C. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches; NEMA 250 - Enclosures for Electrical Equipment.

1.3 SUBMITTALS

- A. Product Data for each switch, breaker, and fuse type, including interrupting rating, enclosure type, and horsepower rating where applicable.
- B. Schedule cross-referencing each equipment tag to its disconnect type, ampere rating, fuse class and size, enclosure NEMA type, and the equipment nameplate MCA and MOCP it was selected against.

PART 2 - PRODUCTS

2.1 ENCLOSED SWITCHES

- A. Heavy-duty (HD), quick-make/quick-break, UL 98 listed safety switches with visible blades and a defeatable door interlock; general-duty switches are not acceptable.
- B. Horsepower rated for motor loads; lockable in the OFF position with a padlock provision meeting the lockout/tagout requirements of the Owner's electrical safety program.
- C. Fusible switches where the equipment nameplate requires fuse protection or where the equipment maximum overcurrent protective device rating is smaller than the upstream breaker; provide rejection-type Class R fuse clips in all fusible switches.
- D. Enclosures: NEMA 1 interior dry; NEMA 3R exterior and rooftop; NEMA 4X stainless or nonmetallic in washdown, corrosive, or high-humidity areas.

- E. Provide a solid neutral assembly and a ground lug kit in every enclosed switch on a 4-wire circuit.

2.2 FUSES

- A. Class RK5 or RK1 dual-element time-delay fuses for motor circuits; Class J where required by the equipment listing or to achieve the required interrupting rating.
- B. Fuse sizes selected per the equipment nameplate maximum overcurrent protective device rating, never larger.
- C. Furnish the Owner one complete spare set of each fuse type and rating installed, in a labeled wall-mounted spare fuse cabinet in the main electrical room.

2.3 ENCLOSED CIRCUIT BREAKERS

- A. UL 489 molded-case, thermal-magnetic circuit breakers in NEMA-rated enclosures matched to the environment; interrupting rating not less than the available fault current at the point of application.
- B. Adjustable magnetic trip on breakers serving motors 50 hp and larger or where required for coordination.

2.4 EQUIPMENT DISCONNECT SELECTION BASIS

Served Equipment	Disconnect Type	Selection Basis
EF-1 (EF, 120 V/1-ph, MCA 1 A est.)	Nonfusible, NEMA 1/3R	HP-rated; within sight per NEC 430.102(B)
EF-2 (EF, 120 V/1-ph, MCA 1 A est.)	Nonfusible, NEMA 1/3R	HP-rated; within sight per NEC 430.102(B)
EF-3 (EF, 120 V/1-ph, MCA 1 A est.)	Nonfusible, NEMA 1/3R	HP-rated; within sight per NEC 430.102(B)
EF-4 (EF, 120 V/1-ph, MCA 1 A est.)	Nonfusible, NEMA 1/3R	HP-rated; within sight per NEC 430.102(B)
EF-5 (EF, 120 V/1-ph, MCA 2 A est.)	Nonfusible, NEMA 1/3R	HP-rated; within sight per NEC 430.102(B)
IR-1/2 (Gas IR Tube Heater, 120 V/1-ph, MCA 5 A est.)	Nonfusible, NEMA 1/3R	HP-rated; within sight per NEC 430.102(B)
EWB (Electric Wall Heater, 240 V/1-ph, MCA 12 A est.)	Nonfusible, NEMA 1 (or listed integral)	NEC 422.31(B), within sight
EUH-1 (Electric Unit Heater, 240 V/1-ph, MCA 18 A est.)	Nonfusible, NEMA 1 (or listed integral)	NEC 422.31(B), within sight
EC-1 (Evaporative Cooler, 230 V/1-ph, MCA 15 A)	Nonfusible, NEMA 1/3R	HP-rated; within sight per NEC 430.102(B)

► Select every disconnect and fuse from the ACTUAL equipment nameplate MCA and MOCP on the approved submittal, not from the scheduled estimate. Where the Equipment Schedule flags an MCA as an estimate pending vendor data, that value was derived from a load-based estimating table for sizing the distribution -- it is not a substitute for nameplate data when selecting the branch device.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install a disconnecting means within sight of and not more than 50 ft from each motor and appliance per NEC 430.102(B) and 422.31, unless the equipment is furnished with a listed lockable integral disconnect.
- B. Mount switches at 48 to 60 in. to the operating handle centerline, accessible without climbing over ductwork, piping, or equipment; do not mount on removable equipment panels or on the equipment casing where the casing is not rated for it.

- C. Label every disconnect with an engraved nameplate identifying the equipment served and the upstream panel and circuit.

3.2 FIELD QUALITY CONTROL

- A. Verify that the installed fuse or breaker rating does not exceed the equipment nameplate maximum overcurrent protective device rating for every unit; correct any mismatch before startup and record the as-installed values.
- B. Operate each switch through its full travel; verify the door interlock, the padlock provision, and the blade visibility.
- C. Torque all terminations to the manufacturer's published values with a calibrated tool.

END OF SECTION 26 28 16

SECTION 26 51 19

LED INTERIOR LIGHTING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior LED luminaires, drivers, emergency battery packs, exit signs, and luminaire-integral and networked lighting controls.
- B. Related: Section 26 27 26 - Wiring Devices (wall switches, occupancy and vacancy sensors); Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables (luminaire drops).

1.2 REFERENCES

- A. ANSI/IES LM-79 - Electrical and Photometric Measurements of Solid-State Lighting Products.
- B. ANSI/IES LM-80 and TM-21 - Measuring and Projecting Lumen Maintenance of LED Packages.
- C. ANSI/IES RP-1 / IES Lighting Handbook - recommended illuminance for the space types served.
- D. ASHRAE 90.1 / IECC - interior lighting power density limits and mandatory lighting controls.
- E. NFPA 101 - Life Safety Code, and NFPA 70 (NEC) Article 700 - Emergency Systems (egress illumination and exit signs).
- F. UL 1598 - Luminaires; UL 924 - Emergency Lighting and Power Equipment; UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products.

1.3 SUBMITTALS

- A. Product Data for each luminaire type with LM-79 photometric report, delivered lumens, input watts, efficacy (lm/W), CCT, CRI, L70 lumen maintenance per LM-80/TM-21, and driver data.
- B. Lighting power density (LPD) compliance calculation for the interior, by space or by whole-building method, demonstrating compliance with the adopted energy code.
- C. Point-by-point photometric calculation for each space type, showing average maintained illuminance, uniformity, and the light-loss factors used.
- D. Emergency egress illumination plan showing the luminaires on battery backup and the resulting egress-path footcandle levels.
- E. Warranty documentation per Article 1.4.

1.4 WARRANTY

- A. Manufacturer's warranty covering the luminaire, LED array, and driver for a minimum of five years from Substantial Completion.
- B. Emergency battery packs and exit sign batteries warranted for a minimum of five years.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Luminaires: UL 1598 listed, LM-79 tested by an independent laboratory; manufacturer's data based on the complete luminaire, not on bare LED package data.
- B. LED performance: minimum L70 of 50,000 hours at the rated drive current and 25 C ambient per LM-80/TM-21; minimum 80 CRI (90 CRI in spaces where color rendering matters to the Owner's operation); CCT and CRI as scheduled in Article 2.2, with a maximum 3-step MacAdam ellipse color consistency across all luminaires of the same type.
- C. Drivers: 0-10 V dimming to 10 percent or lower on all dimmed luminaires, greater than 0.90 power factor, less than 20 percent total harmonic distortion at full output, with integral surge protection; field-replaceable without removing the luminaire from its mounting.
- D. Luminaires in unheated or refrigerated spaces rated for the low-ambient starting temperature of that space; luminaires in damp or wet locations listed for the location.

2.2 LUMINAIRE SCHEDULE

- A. Provide the luminaire types scheduled below, or approved equals of equal or higher delivered lumens at equal or lower input watts. Types EM and EX are specified in Section 26 52 13; exterior types in Section 26 56 00.

Type	Description	Mounting	Source	Lumens	Watts	Qty	Locations
A	LED round pendant, direct, hall general lighting	Pendant 12 ft AFF	LED 3000K 90 CRI	3,500	28	15	HALL
B	LED 4 ft vapor-tight linear, NSF splash zone, food prep	Surface ceiling 9 ft	LED 4000K 80 CRI	4,000	29	6	STAGING
C	LED 6 in downlight, damp location	Recessed ceiling 9 ft	LED 3000K 90 CRI	1,000	10	5	TR1, TR2, TR3, CORR
D	LED 4 ft strip, wire guard	Surface ceiling 9 ft	LED 4000K 80 CRI	3,000	22	1	MECH-JAN

► Lumens and watts are the basis of design from the project lighting calculation (GENERIC family tables (lighting_rules.yaml cu_tables); replace with the selected fixture IES file). A substitution with a different photometric distribution must be re-checked against the footcandle targets in Article 2.4.

2.3 EMERGENCY LIGHTING AND LIGHTING CONTROLS

- A. Emergency egress luminaires and exit signs: Section 26 52 13.
- B. Occupant sensors, dimmers, daylight-responsive controls, and the exterior photocell/time switch: Section 26 09 23. Drivers shall be compatible with the 0-10 V control devices specified there.

2.4 ILLUMINANCE AND LIGHTING POWER DESIGN BASIS

Room	Area (ft2)	Type x Qty	Target fc	Design fc	W/ft2
------	------------	------------	-----------	-----------	-------

HALL	1800	A x 15	20	21	0.23
TR1	29.2	C x 1	10	15.7	0.34
TR2	29.2	C x 1	10	15.7	0.34
TR3	39	C x 1	10	11.8	0.26
CORR	56	C x 2	10	16.4	0.36
MECH-JAN	49	D x 1	20	21	0.45
STAGING	240	B x 6	50	56.6	0.72

► Interior lighting power 666.0 W against an IECC 2021 (Montana adopted, ARM 24.301.161 -- verify the amendment set with the AHJ) allowance of 1947.1 W (PASS). A submitted package that raises the connected lighting watts must be re-checked against both the energy code allowance and the lighting panel load before approval.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support luminaires independently from the building structure; do not support from ductwork, piping, or ceiling grid alone. Provide seismic support wires at suspended-ceiling luminaires where required by the seismic design category.
- B. Align rows of luminaires straight and level; coordinate final locations with ductwork, sprinkler heads, structural members, and rack layout before installation.
- C. Connect luminaires with the branch circuit indicated; do not combine emergency and normal luminaires on a shared switch leg.

3.2 AIMING, COMMISSIONING, AND ADJUSTMENT

- A. Commission all lighting controls: verify occupancy sensor coverage and time delays, calibrate daylight sensors after dark and during daylight, and verify the automatic shutoff schedule.
- B. Perform a night-time illuminance survey in a representative area of each space type and compare measured average maintained footcandles to the design basis; submit the survey.

3.3 FIELD QUALITY CONTROL

- A. Test every emergency battery unit and exit sign for the full 90-minute duration; record results and replace any unit that fails to hold the required output (Section 26 52 13).
- B. Replace any luminaire showing visible color mismatch against adjacent luminaires of the same type.
- C. Provide the Owner with attic stock: two percent of each luminaire type (minimum one), and two percent of each driver type (minimum two).

END OF SECTION 26 51 19

SECTION 26 52 13

EMERGENCY AND EXIT LIGHTING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes self-contained battery emergency lighting units and self-contained LED exit signs for the means of egress.
- B. Related: Section 26 09 23 - Lighting Control Devices; Section 26 51 19 - LED Interior Lighting.

1.2 REFERENCES

- A. International Building Code, Sections 1008 (means of egress illumination) and 1013 (exit signs), edition adopted by the AHJ.
- B. NFPA 101 - Life Safety Code, Sections 7.9 (emergency lighting) and 7.10 (marking of means of egress).
- C. NFPA 70 (NEC) Article 700 - Emergency Systems; UL 924 - Emergency Lighting and Power Equipment.

1.3 PERFORMANCE REQUIREMENTS

- A. On loss of normal power, provide not less than 1 fc average and 0.1 fc minimum along the egress path at the floor, with a maximum-to-minimum ratio not over 40 to 1, for not less than 90 minutes. Illumination may decline to 0.6 fc average and 0.06 fc minimum at the end of 90 minutes.

1.4 SUBMITTALS

- A. Product data with UL 924 listing, battery type and rated duration, and photometric data for the emergency heads.
- B. Egress point-by-point calculation for the submitted units showing the Article 1.3 levels are met.
- C. 90-minute discharge test report per Article 3.2.

PART 2 - PRODUCTS

2.1 EMERGENCY LIGHTING UNITS

- A. Type EM: Emergency unit, 2 LED heads, 90 min battery, self-test. Mounting: wall 8 ft aff. 3 W input, 500 lm per unit, 120 V.
- B. Sealed maintenance-free nickel-cadmium or lithium iron phosphate battery, automatic charger, test switch, charge indicator, and self-diagnostics that run a 30 second test monthly and a 90 minute test yearly and show a fault by indicator.

2.2 EXIT SIGNS

- A. Type EX: LED exit sign, red letters, battery, self-test. Mounting: wall or ceiling over exit door. Not over 5 W per face. Field-applied directional chevrons. Same battery and self-diagnostic features as the emergency units.

2.3 BASIS OF DESIGN LAYOUT

Room	EM units	Calculated egress fc (avg)	Exit signs
HALL	5	1.04	4
CORR	1	4.11	1
STAGING	1	1.27	1

► Egress fc is the lumen-method average from lighting_design.py using the generic EM head output. It shows enough units to reach 1 fc average. The submitted point-by-point calculation governs the 0.1 fc minimum and the 40 to 1 uniformity.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Connect each unit to the unswitched leg of the branch circuit that serves the normal lighting in the same area, so a branch circuit failure transfers the unit to battery.
- B. Mount exit signs so the bottom is not over 80 in. above the floor where over a door, and so a sign is visible from every point in the egress path.

3.2 FIELD QUALITY CONTROL

- A. After the batteries have charged 24 hours, run a 90 minute discharge test with normal power off. Measure floor illuminance along the egress path at the start and end of the test and replace any unit that does not hold the Article 1.3 levels.
- B. Turn over the monthly 30 second and yearly 90 minute test log form to the Owner.

END OF SECTION 26 52 13

SECTION 26 56 00

EXTERIOR LIGHTING

Project: FarmWild Orangery, Hamilton MT | Rev 0 | Issued for Review | 2026-09-30

SAMPLE / WORKED EXAMPLE. Verify all values, editions, and manufacturers per project and jurisdiction.

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes building-mounted and site LED luminaires and their bases.
- B. Related: Section 26 09 23 - Lighting Control Devices; Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables; Section 26 05 26 - Grounding and Bonding.

1.2 REFERENCES

- A. IECC 2021 (Montana adopted, ARM 24.301.161 -- verify the amendment set with the AHJ), Section C405.4 (exterior lighting power) and C405.2.7 (exterior controls).
- B. IES TM-15 - Luminaire Classification System (BUG ratings); UL 1598 wet location listing.

1.3 PERFORMANCE REQUIREMENTS

- A. Total connected exterior lighting power is 170 W against an allowance of 568 W in lighting zone 1 (base site 350 W, entries 12 ft x 14 = 168 W, walkway 100 lf x 0.5 = 50 W). A submittal that raises the total above the allowance is not accepted.
- B. Every luminaire full cutoff (U0 uplight rating per TM-15) with 3000 K or warmer source, to keep the site dark-sky friendly.

1.4 SUBMITTALS

- A. Product data with LM-79 report, BUG rating, input watts, and wet location listing for each type.
- B. Bollard base and anchor detail.

PART 2 - PRODUCTS

2.1 LUMINAIRE SCHEDULE

Type	Description	Mounting	Source	Lumens	W each	Qty	Total W
X1	Exterior LED wall sconce, full cutoff, dark-sky	Wall 8 ft by each door	LED 3000K 80 CRI	2000	18	5	90
X2	LED path bollard, 3.5 ft, full cutoff	Grade, path to the flower shop	LED 3000K 80 CRI	700	10	8	80

2.2 GENERAL REQUIREMENTS

- A. Die-cast aluminum housing, polyester powder coat finish (color by Architect), tempered glass or UV-stabilized acrylic lens, IP65 or better.
- B. Driver rated for -40 F starting, 0.9 power factor minimum, with 6 kV surge protection.
- C. L70 at 50,000 hours or more per LM-80 and TM-21.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wall luminaires centered over or beside the door they serve at the scheduled height. Seal the wall penetration watertight.
- B. Bollards on a cast-in-place or precast concrete base with anchor bolts per the manufacturer. Bond each base per Section 26 05 26.
- C. Site circuits in Schedule 40 PVC at not less than 18 in. cover per NEC Table 300.5, with an equipment grounding conductor in every run.

3.2 FIELD QUALITY CONTROL

- A. After dark, check that every luminaire is aimed down with no visible uplight, and that the photocell and after-hours reduction work per Section 26 09 23.

END OF SECTION 26 56 00