
PART 1 - GENERAL**1.1 WORK OF THIS SECTION**

- A. This section of the specification details the requirements for the following:
1. Start-up, testing and commissioning of the Electrical System for LEED compliance.
 2. Coordination and participation of the commissioning of the Mechanical and BMCS systems.
 3. Coordinating of start-up and testing of the interface to any Mechanical System or interface to the BMCS.
 4. Providing assistance to the Commissioning Authority to develop, edit, and document system operation descriptions.
 5. Providing qualified personnel to execute commissioning tests approved or written by Commissioning Authority (CA), including seasonal testing required after the initial commissioning as specified in this specification.
 6. The Division 26 subcontractor shall take the lead responsibility for inspecting, completing and documenting the Pre-Functional Testing for the Electrical Systems to ensure the systems are fully operational and ready for Functional Testing.
 7. Assist in the completion and endorsing Mechanical checklist items of Pre-Functional Test forms for Division 23 equipment and systems to ensure the systems are fully operational and ready for functional testing.
 8. The Division 26 subcontractor shall take the lead responsibility for demonstrating the operations of the Electrical Systems for the Functional Tests.
 9. Assist in the demonstration of the operations of the Mechanical Systems for the Functional Tests.
 10. Provide equipment, materials, and labor necessary to correct deficiencies found during the commissioning process, which fulfill contract and warranty requirements.
 11. Coordinating and scheduling with the Mechanical and BMCS Subcontractors per specification requirements.
 12. Providing operation and maintenance information and record drawings to the Commissioning Authority for review, verification and organization, prior to the start of training.
 13. Providing training for the systems specified in this Division with coordination by the Commissioning Authority.
 14. Delivery of copies of all required engineering calculations and test documentation as noted in the specifications for review by Commissioning Authority. This includes, but is not limited to, manufacturer's factory and field tests, subcontractor installation and start-up reports and independent testing agency reports.
- B. Electrical commissioning is primarily the responsibility of the Division 26 subcontractor, but is led under the guidance and approval of the CA. The commissioning process does not diminish the role and obligations of this subcontractor to complete all portions of work in a satisfactory and fully operational manner.

1.2 SCHEDULING

- A. Commissioning shall comply with the Construction Contract schedule. Cooperate with the Commissioning Authority in the following manner:
1. Allow sufficient time before final completion dates so that test and balance and commissioning testing can be accomplished.
 2. Provide labor and material to make corrections when required without undue delay.

PART 2 – PRODUCTS**2.1 TEST EQUIPMENT**

- A. Provide all necessary test equipment to confirm proper operation of the Electrical Systems.
- B. All testing equipment shall be properly calibrated and documentation of such calibration shall be submitted prior to any verification testing.

PART 3 - EXECUTION**3.1 WORK PRIOR TO COMMISSIONING**

- A. The CA shall provide the Pre-Functional checklists and Functional Testing forms.
- B. Upon request of the Commissioning Authority and General Contractor, the Subcontractor shall provide assistance and consultation with finalization of the Commissioning Plan. All subject Subcontractors shall utilize the Commissioning Plan during project execution. The Subcontractor is obligated to assist the Commissioning Authority in executing the Plan by providing all necessary information pertaining to the actual equipment, installation and related schedules.
- C. Review Pre-Functional and Functional Test forms provided by the CA prior to finalization of the test forms.
- D. Coordinate with the Division 23 and Division 25 BMCS subcontractors for performing and documenting Pre-Functional checks for each of the equipment items listed in Division 23.
- E. If system modifications / clarifications are incorporated to this and related sections of work, commissioning of this work will be made at no additional cost to the Owner.
- F. If Subcontractor initiated system changes have been made that alter the commissioning process, the Commissioning Authority will notify the Architect, and the Subcontractor may be obligated to compensate the Commissioner to test the revised product, or confirm the suitability / unsuitability of the substitution or revision.

3.2 PARTICIPATION IN COMMISSIONING

- A. The Division 26 subcontractor shall take the lead in commissioning of the following Electrical Systems:
 - 1. Lighting Control System.
 - 2. Power Distribution (Pre-functional Only).
- B. Provide skilled technicians to start-up and debug all systems within this Division of work. These same technicians shall be made available to assist the Commissioning Authority in completing the commissioning program as it relates to each system and their technical specialty. Work schedules, time required for testing, etc., will be requested by the Commissioning Authority and coordinated by the Subcontractor. The Subcontractor shall ensure the qualified technician(s) are available and present during the agreed upon schedules and of sufficient duration to complete the necessary tests, adjustments, and/or problem resolutions.
- C. System problems and discrepancies may require additional technician time, Commissioning Authority time, redesign and/or reconstruction of systems, and system components. The additional technician time shall be made available for the subsequent commissioning periods until the required system performance is obtained.
- D. The Commissioning Authority reserves the right to judge the appropriateness and qualifications of the technicians relative to each item of equipment, system, and/or sub-system. Qualifications of technicians include expert knowledge relative to the specific equipment involved, adequate documentation and tools to service/commission the equipment, and an attitude/willingness to work with the Commissioning Authority to get the job done. A liaison or intermediary between the Commissioning Authority and qualified factory representatives does not constitute the availability of a qualified technician for purposes of this work.
- E. Complete start-up and Pre-Functional Test documentation for the Electrical Systems. Submit completed Pre-Functional Test forms to the CA.
- F. Lead the team in the demonstration of the operations of the Electrical Systems to complete the Functional Test documentation.

- G. Participate in Commissioning Mechanical, Electrical and BMCS meetings organized by the Commissioning Authority and General Contractor.
- H. Division 23 Subcontractor and the BMCS Subcontractor are responsible for completing Point-to-Point Testing, Pre-Functional Testing and Functional Testing of the HVAC and Plumbing Systems.
- I. Division 26 Subcontractor and the BMCS Subcontractor are responsible for completing Point-To-Point Testing, Pre-Functional Testing and Functional Testing of the BMCS interface to the specified Electrical Systems.
- J. Provide any manufacturer's testing reports for components of the Electrical System and attached these reports to the appropriate completed Pre-Functional Test forms.
- K. Support Commissioning Authority efforts to satisfy commissioning documentation requirements of the LEED accreditation process for Fundamental and Additional Commissioning.
- L. Provide reporting, scheduling, and notification of testing and work in progress. If a review or testing session has been scheduled with the CA and it is found that the systems are not ready to test, then the subcontractor shall be liable for any additional testing sessions.

3.3 SEASONAL COMMISSIONING AND OCCUPANCY VARIATIONS

- A. Participate in seasonal testing as outlined in Division 23. This testing shall occur within the first year of the initial warranty period.

3.4 WORK TO RESOLVE DEFICIENCIES

- A. In some systems, maladjustments, misapplied equipment, and/or deficient performance under varying loads will result in additional work being required to commission the systems. This work will be completed under the direction of the Owner, with input from the General Contractor, equipment supplier, and Commissioning Authority. Whereas all members will have input and the opportunity to discuss, debate, and work out problems, the Engineer of Record will have final jurisdiction on the necessary work to be done to achieve performance.
- B. Corrective work shall be completed in a timely fashion to permit the timely completion of the commissioning process. Experimentation to render system performance will be permitted. If the Commissioning Authority deems the experimentation work to be ineffective or untimely as it relates to the commissioning process, the Commissioning Authority will notify the Owner indicating the nature of the problem, expected steps to be taken, and the deadline for completion of activities. If the deadline(s) passes without resolution of the problem, the Owner reserves the right to obtain supplementary services and/or equipment to resolve the problem. Costs incurred to solve the problems in an expeditious manner will be the Subcontractor's responsibility.
- C. Provide written response, within two weeks of receipt of any corrective action items noted by the CA.

3.5 PRE-FUNCTIONAL CHECKLISTS

- A. After the initial equipment submittal phase, the CA shall prepare Pre-Functional Test forms for each item of equipment as part of the commissioning. Review respective Pre-Functional Test forms for accuracy and completeness and provide comments to the General Contractor and CA.
- B. The following is a sample Pre-Functional Test form:

<p>SAMPLE</p> <p>MAIN SWITCHBOARDS - PRE-FUNCTIONAL TEST</p> <p>Prerequisites: Utility permanent power.</p>

Equipment Included: MSX, MSX, MSX

1. Approvals

The above equipment and systems integral to them are complete and ready for functional testing. The checklist items are complete and have been checked off *only by parties having direct knowledge of the event*, as marked below, respective to each responsible contractor. This Pre-Functional checklist is submitted for approval and is subject to an attached list of outstanding items yet to be completed. A Statement of Correction (SOC) will be submitted upon completion of any outstanding areas. None of the outstanding items preclude safe and reliable functional tests being performed.

Electrical Subcontractor	Date	Manufacturer's Start-up Technician	Date
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Pre-Functional checklist items are to be completed prior to startup & initial checkout, preparatory to Functional Testing.

This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Items that do not apply shall be noted with the reasons on this form (N/A = not applicable, BO = by others).

Subcontractors assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off.

This checklist has been reviewed. Its completion is approved with the exceptions noted below or on attached Statement of Correction (SOC).

Commissioning Authority	Date	Owner's Representative	Date
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2. Documentation

The following documentation have been submitted to the CA and Owner's representative:

1. Short Circuit Coordination Study (SCCS) per Specification 26XXX, Part X.X, Paragraph X.
 YES NO
2. Grounding test results per Specification 26XXX, Part X.X, Paragraph X.
 YES NO.
3. Megger test results per Specification 26XXX, Part X.X, Paragraph X.
 YES NO

Check if provided. Enter comment or note number on SOC

	MS1	MS2	MS3
Manufacturer's cut sheets			
Manufacturer's Installation and Startup Procedures			
Manufacturer's Start-Up Test Results*			
Breaker Test Results			
Ground Fault test results			
Operations and Maintenance Manuals			

*Include TVSS factory test results per Specification 26XXX, Part X.X, Paragraph X.

Documentation complete as per contract documents. YES NO

3. Model Verification

The equipment installed matches exactly the design specifications for given trade.
 YES NO

*If "NO", the following deviations from the specifications were approved by the design engineers:
(Include all correspondences indicating the design engineer's approval)*

1.	
2.	
3.	

4. Statement Of Correction

Item Number	Deficiency	Anticipated Action to be Taken	Anticipated Completion Date
X.1			
X.2			
X.3			

--END OF CHECKLIST--

3.6 FUNCTIONAL TEST FORMS

- A. After the finalization of the Pre-Functional Test forms, the CA shall prepare Functional Test forms for each system to be documented as part of the commissioning. Review respective Functional Test forms for accuracy and completeness and provide comments to the General Contractor and CA.
- B. The following is a sample Functional Test form.

SAMPLE

LIGHTING CONTROL SYSTEM – FUNCTIONAL TEST

Equipment Included in Test:

Lighting relay panels and BMCS interface

1. Participants

<u>Name</u>	<u>Company</u>	<u>Name</u>	<u>Company</u>
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Party filling out this form and witnessing testing _____

Date _____

2. Prerequisite Checklist

- a. The following have been energized and startup reports* and pre-functional checklists submitted and approved as ready for functional testing: _____ BMCS
- b. All control system functions for this and all interlocking systems are programmed and operable per contract documents, including final set points and schedules and with debugging, loop tuning and sensor and device calibrations completed.
- c. These functional test procedures reviewed by installing contractor. _____
- d. Sufficient clearance around equipment for servicing. _____

3. Testing Procedures and Record

Test 1	
Test Description	Time scheduling package
Expected Operation	Demonstrate lighting operation on a time schedule basis.
Actual Operation	

Test 2	
Test Description	Power fail restart
Expected Operation	Demonstrate restart of lighting control system upon power failure. Verify the system has returned to normal operation, and note time to return to normal operation.
Actual Operation	

Test 3	
Test Description	Graphical display package
Expected Operation	Demonstrate graphical display package.
Actual Operation	

Test 4	
Test Description	Report package
Expected Operation	Demonstrate report generation using on line data and historical data. Verify all points logs, point reports on a system by system basis.
Actual Operation	

Test 5	
Test Description	Operator changes
Expected Operation	Demonstrate the operator's ability to override the functions of the lighting control panel. Verify override capability of time schedules. Verify Password access. Verify operator command changes are executed within the specified time period.
Actual Operation	

Test 6 –					
Test Description	Verify individual zone operation.				
Expected Operation	Select 10 individual lighting circuits at random and verify time clock operation (both on and off). Verify manual override.				
Actual Operation	Circuit or Zone #	"On" by time clock	"Off" by time clock	Manual Override	

-END OF TEST-

End of Section