
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 BMCS.
 2. Coordination and participation of the commissioning of the Mechanical and Electrical systems.
 3. Coordinating of start-up and testing of the interface to any Mechanical or Electrical System 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 BMCS subcontractor shall take the lead responsibility for inspecting, completing and documenting the Pre-Functional Testing for the BMCS to ensure the systems are fully operational and ready for Functional Testing.
 7. Assist in the completion and endorsing Mechanical and Electrical checklist items of Pre-Functional Test forms for Division 23 and 26 equipment and systems to ensure the systems are fully operational and ready for functional testing.
 8. The BMCS subcontractor shall take the lead responsibility for demonstrating the operations of the BMCS Functional Tests.
 9. Assist in the demonstration of the operations of the Mechanical and Electrical 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 Electrical 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. BMCS commissioning is primarily the responsibility of the Division 25 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 BMCS.
- 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. Coordinate with the Division 23 and 26 subcontractors for performing and documenting pre-functional checks for each of the equipment items listed in 23 08 00 and 26 08 00. Pre-functional checklists shall be provided by the CA and shall be at a minimum a reproduction of the manufacturer's recommended checklist.
- B. Upon request of the Commissioning Authority, 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. 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.
- D. 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. Provide skilled technicians to start-up and debug all systems within the 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.
- B. 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.
- C. 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.
- D. Complete start-up and Pre-Functional Test documentation for the BMCS. Submit completed Pre-Functional Test forms to the CA.
- E. Lead the team in the demonstration of the operations of the BMCS to complete the Functional Test documentation.
- F. Participate in a Commissioning Mechanical, Electrical and BMCS meetings organized by the Commissioning Authority and General Contractor.
- G. Division 23 Subcontractor and the Division 25 BMCS Subcontractor are responsible for completing Point-To-Point Testing, Pre-Functional Testing and Functional Testing of the HVAC and Plumbing Systems. Provide point-to-point verifications of each BMCS point as outlined below. These sheets shall be attached to the associated pre-functional test forms.

- H. Division 26 Subcontractor and the Division 25 BMCS Subcontractor are responsible for completing Point-To-Point Testing, Pre-Functional Testing and Functional Testing of the Lighting Control and BMCS monitoring of the Electrical Systems. Provide point-to-point verifications of each BMCS point as outlined below. These sheets shall be attached to the associated pre-functional test forms.
- I. Commission all aspects of the BMCS including hardware, software, and networks.
- J. Support Commissioning Authority efforts to satisfy commissioning documentation requirements of the LEED accreditation process for Fundamental and Additional Commissioning.
- K. 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 23 08 00. 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 POINT TO POINT VERIFICATION

- A. Prior to the scheduling of the functional testing, the BMCS subcontractor shall perform a complete and detailed operational check of each BMCS component. Test results shall be documented using test sheets. The test sheets shall be prepared in an appropriate format for the various categories of component to be tested. The format of the test forms shall be submitted for approval during the shop drawing phase of the project and shall be based on the following format:

DIGITAL OUTPUT POINT							
PROJECT:				CHECKOUT PERFORMED BY:			
POINT(ENGLISH LANGUAGE):				SYSTEM(ENGLISH LANGUAGE):			
SYSTEM MNEMONIC:				POINT MNEMONIC:			
DCP/UC ADDRESS:							
BMCS SUBCONTRACTOR-S CALIBRATION DATA:							
OPEN CONTACT				CLOSED CONTACT			
DATE	ALARM / NORMAL STATUS	OPERATING STATE (ON OR OFF)	STATUS AT OIW	ALARM / NORMAL STATUS	OPERATING STATE (ON OR OFF)	STATUS AT OIW	COMMENTS/DETAILS OF RECALIBRATION
FINAL ACCEPTANCE CALIBRATION DATA:							
EQUIPMENT SCHEDULING: Y / N / NA				OPTIMIZED			
DUTY CYCLING: Y / N / NA				PEAK DEMAND: Y / N			
RESTART AFTER FIRE ALARM: Y / N / NA				RESTART AFTER			
HARDWIRED INTERLOCKS CHECKED: Y / N / NA							
NOTES:							
ACCEPTED BY:				DATE:			

DIGITAL INPUT POINT							
PROJECT:				CHECKOUT PERFORMED BY:			
POINT(ENGLISH LANGUAGE):				SYSTEM(ENGLISH LANGUAGE):			
SYSTEM MNEMONIC:				POINT MNEMONIC:			
DCP/UC ADDRESS:							
BMCS SUBCONTRACTOR-S CALIBRATION DATA:							
OPEN CONTACT				CLOSED CONTACT			
DATE	ALARM / NORMAL STATUS	OPERATING STATE (ON OR OFF)	STATUS AT OIW	ALARM / NORMAL STATUS	OPERATING STATE (ON OR OFF)	STATUS AT OIW	COMMENTS/DETAILS OF RECALIBRATION
FINAL ACCEPTANCE CALIBRATION DATA:							
REAL TIME PLOTTING: Y / N / NA				HISTORICAL			
EQUIPMENT OPERATING TIME: Y / N / NA				ALARM LOCKOUT: Y			

HARDWIRED INTERLOCKS CHECKED: Y / N / NA	
NOTES:	
ACCEPTED BY:	DATE:

ANALOG INPUT POINT					
PROJECT:			CHECKOUT PERFORMED BY:		
POINT(ENGLISH LANGUAGE):			SYSTEM(ENGLISH LANGUAGE):		
SYSTEM MNEMONIC:			POINT MNEMONIC:		
DCP/IIC ADDRESS:			SENSOR OUTPUT:		
BMCS SUBCONTRACTOR-S CALIBRATION DATA:					
DATE	ACTUAL VALUE CALIBRATION STANDARD	VALUE AT OIW	ERROR (ENG. UNITS)	ERROR (%)	COMMENTS/DETAILS OF RECALIBRATION
FINAL ACCEPTANCE CALIBRATION DATA:					
REAL TIME PLOTTING: Y / N / NA			HISTORICAL		
ALARM LOCKOUT: Y / N / NA					
HIGH ALARM LIMIT: Y / N / NA			LOW ALARM LIMIT: Y		
NOTES:					
ACCEPTED BY:			DATE:		

ANALOG OUTPUT POINT - VALVE							
PROJECT:				CHECKOUT PERFORMED BY:			
POINT(ENGLISH LANGUAGE):				SYSTEM(ENGLISH LANGUAGE):			
SYSTEM MNEMONIC:				POINT MNEMONIC:			
DCP/IIC ADDRESS:				ACTUATOR INPUT:			
BMCS SUBCONTRACTOR-S CALIBRATION DATA:							
DATE	CLOSED COMM AND FROM OIW	VALVE POSITION (%)	50% OPEN COMM AND FROM OIW	VALVE POSITION (%)	100% OPEN COMM AND FROM OIW	VALVE POSITION (%)	COMMENTS/DETAILS OF RECALIBRATION
FINAL ACCEPTANCE CALIBRATION DATA:							
HIGH OUTPUT ALARM LIMIT CHECKED: Y / N / NA				LOW OUTPUT ALARM			
FAILURE POSITION: Y / N / NA				HARDWIRED			
NOTES:							
ACCEPTED BY:				DATE:			

ANALOG OUTPUT POINT - DAMPER							
PROJECT:				CHECKOUT PERFORMED BY:			
POINT(ENGLISH LANGUAGE):				SYSTEM(ENGLISH LANGUAGE):			
SYSTEM MNEMONIC:				POINT MNEMONIC:			
DCP/LIC ADDRESS:				ACTUATOR INPUT:			
BMCS SUBCONTRACTOR-S CALIBRATION DATA:							
DATE	CLOSED COMMAND AND FROM OIW	DAMPER POSITION (%)	50% OPEN COMMAND AND FROM OIW	DAMPER POSITION (%)	100% OPEN COMMAND AND FROM OIW	DAMPER POSITION (%)	COMMENTS/DETAILS OF RECALIBRATION
FINAL ACCEPTANCE CALIBRATION DATA:							
HIGH OUTPUT ALARM LIMIT CHECKED: Y / N / NA				LOW OUTPUT ALARM			
FAILURE POSITION: Y / N / NA				HARDWIRED			
NOTES:							
ACCEPTED BY:					DATE:		

3.6 PRE-FUNCTIONAL CHECKLISTS

- A. After the initial equipment submittal phase, the CA shall prepare Pre-Functional Test forms for each item of equipment to be documented as part of the commissioning. Review respective Pre-Functional Test forms for accuracy and completeness and provide comments to the General Contractor and CA.

3.7 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.

End of Section