

4	ENERGY USE	4.4 PROVISIONS FOR ENERGY MANAGEMENT	
		EU 10 TESTING AND COMMISSIONING	
	EXCLUSIONS	None.	
	OBJECTIVE	Commissioning the electrical and mechanical systems to ensure the impact on energy use of the systems is adequate, the systems performance is as specified and the systems operation is as intended.	
	CREDITS ATTAINABLE	4 + 1 BONUS	
	PREREQUISITES	None.	
	CREDIT REQUIREMENT	<p>a) Commissioning specifications 1 credit for provision of appropriate specifications and/or cost provisions in contract documents detailing the commissioning requirements for all systems and equipment that impact on energy use and indoor environmental quality.</p> <p>b) Commissioning plan 1 credit for the appointment of a commissioning authority and provision of a detailed commissioning plan that embraces all specified commissioning work.</p> <p>c) Commissioning 1 credit for ensuring full and complete commissioning of all systems, equipment and components that impact on energy use and indoor environmental quality.</p> <p>d) Commissioning report 1 credit for providing fully detailed commissioning reports for all systems, equipment and components that impact on energy use and indoor environmental quality.</p> <p>e) Independent Commissioning Authority 1 BONUS credit for engagement of an independent commissioning authority in the Testing and Commissioning process.</p>	
	ASSESSMENT	<p>a) Commissioning specifications The Client shall submit copies of detail specifications on the commissioning requirements for each system and equipment, and/or the details of the cost provisions for the commissioning work.</p> <p>The credit shall be awarded where it can be shown that the specifications meet the requirements given in Section 8.5.1 as a minimum or cost provisions are sufficient to carry out the intended work.</p> <p>b) Commissioning plan There shall be appropriate cost provisions for the appointment of a commissioning authority and for the commissioning processes. The commissioning authority shall be a Registered Professional Engineer with adequate expertise in the commissioning of electrical and mechanical systems, equipment and components. A suitably qualified member of the organization that performed the design may act as the commissioning authority. Reporting of all conditions and findings must be immediate and direct from the commissioning authority to the Client. The commissioning authority shall be responsible for:</p> <ul style="list-style-type: none"> review and approval of commissioning specifications; the development of a commissioning plan; and 	<p>A1</p> <p>A2</p> <p>A3</p> <p>B1</p> <p>B2</p> <p>B3</p> <p>B4</p>

- determining and documenting whether systems, equipment and components are functioning in accordance with the design intent and in accordance with the construction documents.

Where the Client can provide evidence that the commissioning plan meets the requirements detailed in Section 8.5.2 as a minimum the credit shall be awarded.

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c) Commissioning

Where the Client appoints a commissioning agent to be responsible for performing the functional testing of systems and equipment, as documented by the commissioning authority, using forms approved by the commissioning authority, and all of which meet the requirements of Section 8.5.3 as a minimum, the credit shall be awarded.

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d) Commissioning report

Where the Client demonstrates that after all commissioning tasks except seasonally deferred testing have been completed, and a commissioning report is provided covering as a minimum the items given in Section 8.5.4, the credit shall be awarded.

D1

D2

e) Independent Commissioning Authority

Where the Client demonstrates that the commissioning authority shall fulfill the following requirements:

- the commissioning authority must have relevant experience in at least 2 building projects;
- the individual must not be responsible for any aspect of the project design or construction management or supervision for the subject building;
- the individual must not be an employee of the design firm;
- the individual must not be an employee of, or contracted through, a contractor or construction manager dealing with construction contracts; and
- the individual may be a qualified employee or consultant of the owner.

BACKGROUND

Commissioning is a quality assurance process for buildings from pre-design through design, construction, and operations. It involves achieving, verifying, and documenting the performance of each system to meet the building's operational needs within the capabilities of the documented design and equipment capacities, according to the owner's functional criteria. Commissioning includes preparing project operational and maintenance documentation and training operation and maintenance personnel. The result should be fully functional systems that can be properly operated and maintained throughout the life of the building.

CIBSE [1,2,3], BSRIA [4] and ASHRAE [5] publications provide guidance on commissioning requirements and procedures, such as management, design for commissioning, access, testing, measurements and tolerances, installed transducers, specification for portable measuring equipment, etc. The Architectural Services Department publishes

- 1 The Chartered Institution of Building Services Engineers. Air distribution systems. CIBSE. Commissioning Code A. <http://www.cibse.org/index.cfm>
- 2 The Chartered Institution of Building Services Engineers. Water distribution systems. CIBSE Commissioning Code W.
- 3 The Chartered Institution of Building Services Engineers. Automatic controls. CIBSE Commissioning Code C.
- 4 Building Services Research and Information Association. Commissioning air systems. Application procedures for buildings. <http://www.bsria.co.uk/>
- 5 ASHRAE. New Building Commissioning. <http://www.ashrae.org/>

8.5 PROVISIONS FOR ENERGY MANAGEMENT

8.5.1 COMMISSIONING SPECIFICATIONS

8.5.2 COMMISSIONING PLAN

8.5.3 COMMISSIONING

8.5.4 COMMISSIONING REPORT

8.5.5 INDEPENDENT COMMISSIONING AUTHORITY

8.5.6 OPERATIONS AND MAINTENANCE MANUAL

8.5.7 ENERGY MANAGEMENT MANUAL

8.5.8 OPERATOR TRAINING AND FACILITIES

8.5.1 COMMISSIONING SPECIFICATIONS

Functional performance testing procedures shall be defined and must be used to functionally test systems, equipment, components, and modes of operation. Test procedures must be documented to describe the individual test procedure, the expected system response, and acceptance criteria for each procedure. Testing documentation must identify the actual system response and must provide any pertinent observations.

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Commissioning specifications shall be included in the construction documents and embrace:

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- scope and details of the commissioning process;
- qualifications and skills required by the commissioning agent;
- detailed description of the responsibilities of all parties included in the commissioning process;
- systems, equipment and components to be commissioned;
- requirements for functional checklists and start-up;
- the functional performance testing process;
- specific functional performance test requirements, including testing conditions and acceptance criteria for each piece of equipment being commissioned;
- provisions for resolving deficiencies;
- requirements for reporting and documentation for commissioning;
- requirements for training; and
- requirements for an operations and maintenance manual, and for systems and an energy management manual.

8.5.2 COMMISSIONING PLAN

To execute commissioning in a comprehensive and orderly manner a commissioning plan, covering a given system, equipment or component shall be prepared. The plan shall include:

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- start-up and inspection checklists and procedures;
- functional performance testing procedures and checklists;
- testing, adjusting, and balancing;
- development of a comprehensive operations and maintenance manual and energy management manual; and
- completion of the commissioning report.

For each system commissioned the plan shall provide:

B7

- an overview of the tasks to be executed during commissioning;
- a list of all features to be commissioned;

- a list of reference documents related to commissioning, including specification references, drawing list, and submittal drawings;
- a list of primary participants in the commissioning process and their responsibilities;
- a plan for management, communication and documentation;
- description of checklists and tests to be performed, with reference to specification;
- pre-start and start-up checklists;
- list of the functional performance tests to be performed; and
- description of the training to be provided to the operations and maintenance personnel.

8.5.3 COMMISSIONING

Start-up and inspection checklist shall comprise the checks and tests to determine that all components, equipment, subsystems, systems, and interfaces between systems operate in accordance with specifications and construction documents, including all modes and sequences of control operation, interlocks and conditional control responses, and specified responses to abnormal or emergency conditions.

The results of the start-up and check-out shall be documented and must be performed according to the manufacturer's written instructions for the systems and equipment being commissioned, and the as-fitted construction documents.

C3

Certificates of readiness shall be prepared by the commissioning agent verifying that start-up and inspections have been successfully completed and that all equipment, systems, and controls are complete and ready for functional performance testing.

C4

After initial inspection and checking has been verified each sequence in the sequence of operations shall be tested, including the following:

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- start-up;
- shutdown;
- unoccupied and manual modes;
- modulation up and down the unit's range of capacity, if applicable;
- staging, if applicable;
- power failure/power down;
- alarms;
- backup upon failure; and
- interlocks with other equipment.

The commissioning authority shall verify that:

C6

- initial inspections, start-up and checking were successfully completed;
- every point of the control system has been checked and that a minimum sample of each type of control point is commanding, reporting and controlling as specified in the as-fitted construction documents;
- if any control point in the sample is not functioning as specified, then an additional sample shall be checked, until all control points in the sample are found to be performing as specified;
- a minimum sample of each type of sensor has been calibrated so that the value reported in the control system represents the actual

local value;

- if any sensor in the sample is out of calibration, then an additional sample shall be re-calibrated, until all sensors in a the sample are found to be in calibration;
- a minimum sample of each type actuators have been adjusted and observed to fully close and open dampers and valves, and that the reported values in the control system are correct;
- if any actuator, valve, or damper in the sample does not operate as required, then an additional sample of each type of actuator, valve, or damper shall be checked until all actuators, valves, or dampers in the sample are found to be to be operating as required;
- testing, adjusting and balancing by re-measuring a minimum sample of values reported for each type of component, equipment, subsystem, or system in the testing, adjusting and balancing reports;
- if any re-measured value in the sample deviates from requirements by more than 10 percent, then an additional samples shall be re-measured for each type part for which there is a deviation;
- any chimneys, chimney connectors and stacks are free of cracks, blockages and leaks;
- ensure that proper combustion air is provided to equipment; and
- ensure that all appliances are installed in accordance with applicable fire safety and local building codes.

The functional performance of each type of system, equipment, and component shall be tested based on a minimum sample for each type. If any part is found not to operate as required then additional samples shall be tested to ensure satisfactory performance has been achieved.

C7

As far as practicable equipment shall be tested to demonstrate performance at near-design conditions (details of seasonally deferred testing can be submitted as an alternative).

The efficiency of central plant shall be recorded for reference by operations staff.

Functional performance testing can carried out using manual methods, control system trend logs, stand-alone data loggers, etc, as considered appropriate.

8.5.4 COMMISSIONING REPORT

The report shall contain:

D3

- an executive summary;
- list of participants and their respective roles;
- a brief building description;
- an overview of the scope of commissioning and testing;
- a general description of testing and verification methods;
- a list of each feature or system commissioned; and
- for each piece of commissioned equipment, the determination of the commissioning authority regarding the adequacy of the equipment, documentation and training.

The commissioning report shall address the following areas:

D4

- adequacy of equipment with respect to construction documents

and design intent;

- equipment installation;
- functional performance and efficiency;
- equipment documentation;
- operations and maintenance review and recommendations; and
- operator training.

The functional performance and efficiency section for each piece of equipment shall identify the verification method used observations and conclusions from the testing.

D5

The report must also include a list of outstanding commissioning issues and any testing that is scheduled for a later date.

D6

All outstanding deficiencies identified during or as a result of commissioning activities shall have been corrected or must be separately listed and highlighted in the commissioning report.

D7

Each non-compliance issue must be referenced to where the deficiency is documented.

D8

Verification and documentation of installation of systems, equipment and components shall ensure:

D9

- that they are installed according to construction documents and manufacturer's instructions;
- or any differences between the final installation and the original construction documents are documented;
- that other building systems or components are not compromising the efficiency of the systems or features being commissioned;
- the start-up and inspection checklists were completed and performed as required;
- that functional performance tests are completed as required.
- that HVAC piping testing and duct testing is completed and documentation is included in operations and maintenance manuals;
- sufficient functional testing of any control systems;
- that testing record include any deficiencies and corrections;
- final testing outcomes are included in the commissioning report and in operations and maintenance manuals;
- documentation of any seasonally deferred testing and corrections of any deficiencies;
- the operations and maintenance manual and energy management manual are complete for all components, equipment, subsystems, and systems that have been commissioned; and
- adequacy of training provided for the Owner's management, operations and maintenance personnel.

If components, equipment, subsystems, or controls, or sequences of operations as-built are differing from the original construction documents, the report shall detail these differences.

D10

If seasonally deferred testing is completed to be under the original contract, the commissioning authority shall issue an addendum to the report, arranged in the same manner as in the initial report.

D11

**8.5.5 INDEPENDENT
COMMISSIONING
AUTHORITY**

The Commissioning Authority shall be an entity that is independent of the design term appointed by the Client to carry out the role of commissioning authority.

**8.5.6 OPERATIONS AND
MAINTENANCE
MANUAL**

The parties responsible for the design each system to be commissioned shall provide in writing:

- the design intent;
- the basis of design; and
- full sequences of operation for all equipment and systems, all of which must meet the legal requirements and industry wide standards.

The description of the design intent shall include as a minimum:

- space temperature and humidity criteria (refer also to the section on IEQ);
- levels operator and/or occupant control over HVAC systems;
- ventilation requirements and related indoor air quality criteria (refer also to the section on IAQ);
- performance criteria related to energy efficiency;
- environmental responsiveness of the facility; and
- commissioning criteria.

The basis of design shall include at a minimum:

- details of occupancy;
- space activity and any process requirements;
- applicable regulations, codes, and standards;
- design assumptions;
- performance standards and benchmarks; and
- control system appropriate for the skill of the operations and maintenance staff.

The operations and maintenance manual must include for each piece of equipment and each system:

- the name and contact information of the manufacturer or vendor and installing contractor;
- submittal data; and
- operations and maintenance instructions with the models and features for the subject site clearly marked.

The manual shall include only data for equipment that is actually installed, and include the following:

- instructions for installation, maintenance, replacement, start-up;
- special maintenance requirements and sources for replacement parts/equipment;
- parts list and details of and special tooling requirements;
- performance data; and
- warranty information.

The manual shall include an as-built documentation package for controls covering the following:



Circular Letter No.: 2019.154 (Revision 1)

Issue Date: 21 January 2019

Revision Date: 12 February 2019

Application: BEAM Plus NB Version 1.1 & 1.2

Effective Date: 12 February 2019

EU 10 Testing and Commissioning

1. The Circular Letter provides a further interpretation on the requirement of Commissioning Authority (CxA) and Independent Commissioning Authority (iCxA) under the captioned credit.

B8 E2

2. The **qualification** and **responsibilities** of the CxA and iCxA are outlined in the table below:

B9 E3

	Qualifications	Responsibilities¹
Commissioning Authority (CxA)	<ul style="list-style-type: none">• Have the experience in testing & commissioning for at least 2 building projects;• Have adequate expertise in the commissioning of electrical and mechanical systems, equipment and components;• Cannot be involved in the construction or installation of any building services installations of the project²;• May be the project owner³ or his/her employee; and• Possesses the qualification of a Registered Professional Engineer or MHKIE under the discipline of building services, mechanical, electrical, energy or environmental at the time of the assessment submission⁴.	<ul style="list-style-type: none">• Involve in pre-design and design process;• Review project design to meet owner's requirement;• Incorporate all testing and commissioning requirements into the tender documents (i.e. commissioning specifications);• Develop and endorse the Commissioning Plan;• Supervise the Contractors to implement the Commissioning Plan;• Develop the procedures and checklists of the functional test;• Witness the functional test;• Document and endorse the result of functional test;• Confirm that the systems, equipment and components are functioning in accordance with the design intent and in accordance with the construction documents;• Verify that all findings are documented into the Commissioning Report; and

¹ The responsibilities listed under this table is a general summary of Appendices 8.5.1 to 8.5.4 of the BEAM Plus Manual. Should the Applicant decide to attempt credit EU 10, the Applicant should observe the testing and commissioning requirements specified under Appendices 8.5.1 to 8.5.4 of the BEAM Plus Manual.

² The wording of this paragraph has been updated on 12 February 2019.

³ Project owner refers to the party that oversees the overall management of the project. For a design-bid-build project, this could be the project manager acting on behalf of the building owner or the building owner him/herself. For a design and build project, this could be the project manager acting on behalf of the building owner.

⁴ Assessment submission refers to the date when the assessment package is formally accepted by BSL.

	Qualifications	Responsibilities ¹
		<ul style="list-style-type: none"> Report all findings directly to project owner, if the commissioning works are not conducted by the project owner⁵.
Independent Commissioning Authority (iCxA)	<ul style="list-style-type: none"> Have the experience in testing & commissioning for at least 2 building projects; Have adequate expertise in the commissioning of electrical and mechanical systems, equipment and components; Cannot be responsible for the pre-design and design process; Cannot be involved in the construction or installation of any building services installations of the project⁶; Cannot be appointed as a design consultant or contractor for the project; May be the project owner or his/her employee; Maybe an independent consultant appointed by the project owner; and Possesses the qualification of a Registered Professional Engineer or MHKIE under the discipline of building services, mechanical, electrical, energy or environmental at the time of the assessment submission. 	<ul style="list-style-type: none"> Involve in pre-design and design process; Verify that all testing and commissioning requirements are fully incorporated into the tender documents (i.e. commissioning specifications) Verify that the Commissioning Plan has included the owner's requirement; Endorse the Commissioning Plan; Review the functional test procedures and verify the result of the functional test; Verify and endorse all findings in the Commissioning Report; and Report all findings directly to project owner, if the commissioning works are not conducted by the project owner⁷.

3. To ensure the due diligence within the testing and commissioning process, the Applicant should take note of the following requirement when appointing the CxA and iCxA:

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- i. The same personnel or entity could not be qualified for the dual role of CxA and iCxA. For example, if a project owner has assigned the design consultant as the CxA, then the project owner should assign someone else other than the design consultant as the iCxA.
 - ii. A single design consultancy firm could not be appointed for the dual role of CxA and iCxA. For example, if a project owner has appointed design consultancy firm A as the CxA, then the project owner should assign the role of iCxA to a different firm.
 - iii. There can only be one CxA and one iCxA responsible for the testing and commissioning works for each project. If there are changes in CxA and/or iCxA during the design and construction timeline, the Applicant should make reasonable effort in ensuring that there is a seamless transfer of testing and commissioning tasks between the old and the new CxA and/or iCxA and to ensure that the new CxA and/or iCxA confirms that the project complies with all testing and commissioning requirements.
4. The Applicant is encouraged to file a Credit Interpretation Request for clarifications if he/she is in doubt whether a candidate can qualify for the role of CxA or iCxA.

⁵ The Applicant should provide an organization chart to show that the CxA is a subordinate to the project owner.

⁶ The wording of this paragraph has been updated on 12 February 2019.

⁷ The Applicant should provide an organization chart to show that the iCxA is a direct subordinate to the project owner.

5. For the avoidance of doubt, the Applicant is requested to submit the following document on top of the standard enclosures (e.g. commissioning specification, commissioning plan, commissioning records, commissioning report, etc.) for the credit assessment:
- i. For Provisional Assessment and all re-assessment(s) commenced before Final Assessment: Undertaking letter from the project's CxA and/or iCxA committing his/her involvement in the testing and commissioning process together with his/her CV. B11
E5
 - ii. For Final Assessment and all re-assessment(s) afterward: Confirmation letter from the project's CxA and/or iCxA confirming that the electrical and mechanical systems, equipment and components have been fully tested and commissioned together with his/her CV. B12
E6
6. Sample undertaking and confirmation letter demonstrating the CxA/iCxA's involvement in the project are provided in Appendix A of this Technical Circular for reference. The Applicant is encouraged to refer to these samples when preparing the undertaking or confirmation letter for submission.
7. Approved PA projects: For projects that have already completed PA where certain personnel has been approved as a CxA or iCxA, the Applicant may continue to have the same personnel as the CxA or iCxA for the subsequent assessments (FA or Re-assessment in the PA stage). For the avoidance of doubt, the Applicant shall provide PA evidences (e.g. extract of the PA report, documents submitted for assessment in PA, etc). in subsequent assessments to support the intention having the same personnel as CxA or iCxA as in PA.



Mr KM So
Chairperson of Standards Sub-committee



Appendix A:

**Sample Undertaking/Confirmation Letter on Commissioning Authority (CxA)/
Independent Commissioning Authority (iCxA)**

1. The Applicant may refer to the sample undertaking/confirmation letter in the subsequent pages to undertake their intention/confirm their compliance to the Commissioning Authority (CxA)/Independent Commissioning Authority (iCxA) requirement under BEAM Plus New Buildings v1.1/v1.2.
2. To make use of the letter template, the Applicant shall complete all fields highlighted in yellow. Once all fields have been filled in, the letter should then be printed with the letterhead and be submitted as part of the assessment package.
3. Please note that all data specified in the letter templates will be used for the following purposes:
 - (a) Facilitate BEAM Plus applicants to undertake their intention or confirm their compliance on the CxA/iCxA requirement;
 - (b) Enable Technical Review Committee to assess the Applicant's compliance with the CxA/iCxA requirement; and
 - (c) For any other purposes related to BEAM Plus assessments ONLY.
4. All enquiries relating to the personal data of the CxA/iCxA, including making access and correction, should be submitted by post to BEAM Society Limited, 1/F Jockey Club Environmental Building, 77 Tat Chee Avenue, Kowloon Tong, Hong Kong, or via email to enquiry@beamsociety.org.hk



Appendix A1:

Undertaking to Act as Commissioning Authority (CxA)/Independent Commissioning Authority (iCxA)

Our reference:

Your reference:

<Insert Date Here>

BEAM Society Limited
1/F, Jockey Club Environmental Building,
77 Tat Chee Avenue,
Kowloon Tong, Hong Kong
(Attn: Chairperson of Assessment Sub-committee)

Dear Sir/Madam,

Undertaking to Act as <Commissioning Authority (CxA)/Independent Commissioning Authority (iCxA)>
for <Insert The Project Name>

I, <Insert The Name of The CxA/iCxA>, hereby undertake to act as the <CxA/iCxA> for the captioned project and is committed to observing all testing and commissioning requirements specified under BEAM Plus New Buildings <v1.1/v1.2>. My CV demonstrating that I possess the necessary qualification to act as <CxA/iCxA> is enclosed for your review.

Should there be any other queries, please do not hesitate to contact the undersigned (tel.: <Telephone of The CxA/iCxA> or e-mail: <E-mail of The CxA/iCxA>).

Your faithfully,

<Signature>

<RPE/MHKIE> Membership Number: <Insert Membership Number>

Encl. CV of the <CxA/iCxA>



Appendix A2:

Confirmation to Act as Commissioning Authority (CxA)/Independent Commissioning Authority (iCxA)

Our reference:

Your reference:

<Insert Date Here>

BEAM Society Limited
1/F, Jockey Club Environmental Building,
77 Tat Chee Avenue,
Kowloon Tong, Hong Kong
(Attn: Chairperson of Assessment Sub-committee)

Dear Sir/Madam,

Confirmation to Act as <Commissioning Authority (CxA)/Independent Commissioning Authority (iCxA)>
for <Insert The Project Name>

I, <Insert The Name of The CxA/iCxA>, hereby confirms that I have acted as the <CxA/iCxA> for the captioned project. I have confirmed that the captioned project complies all testing and commissioning requirements specified under BEAM Plus New Buildings <v1.1/v1.2>. My CV demonstrating that I possess the necessary qualifications to act as <CxA/iCxA> is enclosed for your review.

Should there be have any other queries, please do not hesitate to contact the undersigned (tel.: <Telephone of The CxA/iCxA> or e-mail: <E-mail of The CxA/iCxA>).

Your faithfully,

<Signature>
<RPE/MHKIE> Membership Number: <Insert Membership Number>

Encl. CV of the <CxA/iCxA>