

Date:	Appendix No: 15	Page 1 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

Appendix 15

Erection, Pre-Commissioning and Commissioning,

Performance Tests

Date:	Appendix No: 15	Page 2 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

1. GENERAL NOTE

The CONTRACTOR is responsible to provide the details of INSTRUCTION FOR PRECOMMISSIONING, COMMISSIONING AND PERFORMANCE TESTS under the framework set by EMPLOYER, based on the CONTRACT DOCUMENTS. EPC contractor shall prepare commissioning and pre-commissioning organization chart and get EMPLOYER's approval.

CONTRACTOR shall provide skilled personnel with Resume and Job description, 3 months prior to commencement of pre-commissioning phase, and get EMPLOYER's approval.

1.1. PRE-COMMISSIONING

In conjunction with the completion of construction WORKS, the CONTRACTOR shall conduct pre-commissioning checks to all MATERIALS/ EQUIPMENT prior to the issue of a "Certificate of Mechanical Completion".

1.1.1. PRE-COMMISSIONING activities shall include, but shall not be limited to the following:

1.1.1.1. Cleaning, flushing, draining, blowing out, drying and purging of MATERIAL/EQUIPMENT and their linings and piping works, including the installation and removal of temporary blinds, strainers, screens, etc., and the replacement of all permanent items removed while the pre-commissioning is in progress.

1.1.1.2. Chemical cleaning wherever required including feed water. Provision of chemicals and disposal of wastes.

1.1.1.3. Testing, calibration and adjustment of instruments and equipment including control valves and safety devices, and installation and checking of orifice plates and other sensory devices in so far as this can be done before actual operation of the item concerned.

1.1.1.4. Cleaning of screens and filters, replacement and adjustment of packing and

Date:	Appendix No: 15	Page 3 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

seals and tightening of flanges.

1.1.1.5. Checking out electrical Equipment including sub-stations, cables and switch gears; checking of all interlocks and setting of all relays. This shall include drying out operations, filtering of oil, if required.

1.1.1.6. For motor driven equipment, amperage checking of motors and removal of temporary safety screens.

1.1.1.7. Introduction of utilities.

1.1.1.8. Introduction of chemicals into and initial operation of treatment units.

1.1.1.9. Test running of all rotating equipment wherever possible, including mills, pumps, etc., and adjustment of all protection and safety devices.

1.1.1.10. For all piping works, installation and removal of temporary blinds as required, circulation and commissioning of Plant including process, effluent, drainage, fire water network and utilities distribution.

1.1.1.11. Setting-up circulations and running in pumps on water, or other medium as appropriate wherever possible and functional testing of instruments as far as possible.

1.1.1.12. Adjustment of all piping expansion and support devices.

1.1.1.13. Air drying any section of the PLANT which is required to be water free.

1.1.1.14. Testing (including running, tightness) of Project as necessary to ensure that the sections and components of the scope of the WORKS are ready for operation.

1.1.1.15. All such further works which CONTRACTOR judges to be necessary or in the opinion of EMPLOYER is necessary to bring the PLANT to a state of readiness for processing requirements and for safe commencement of operation.

The above items are general and CONTRACTOR shall do all of the works required prior to commissioning of each equipment and system as per normal practice for general items and as

Date:	Appendix No: 15	Page 4 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

per equipment manuals and vendor instruction for equipment

2. COMMISSIONING

Upon completion of pre-commissioning and issuance of the MECHANICAL COMPLETION CERTIFICATE, the Plant shall be ready for COMMISSIONING and at this stage COMMISSIONING shall commence under direction and responsibility of CONTRACTOR deploying personnel of EMPLOYER trained by CONTRACTOR.

3. TESTS AT SITE

3.1 GENERAL

Tests shall be carried out by CONTRACTOR in accordance with the Test Procedure as follows:

During erection and after the erection has been performed, tests shall be executed in accordance with the CONTRACT as follows:

- Tests at site
- Tests during erection
- Tests during final assembling of the equipment
- Alignment Tests
- Crabbing check
- Tests during final assembling of the equipment

Minor defects which do not affect the operation shall not impede the beginning of the respective testing. The necessary pre-requisites for proper execution of testing will be provided by EMPLOYER in good time.

During the Period of Commissioning till the issuance of provisional acceptance certificate the CONTRACTOR shall have custody of the project. The CONTRACTOR shall be responsible for carrying out and supervising the progress of the work and checking its accuracy to any

Date:	Appendix No: 15	Page 5 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

extent that may be required.

EMPLOYER shall have unrestricted access to all site quality control records maintained by the CONTRACTOR'S senior supervisory engineer and EMPLOYER shall make available to the CONTRACTOR its own records as EMPLOYER considers necessary. Site testing of equipment, services equipment, pipe work and electrical apparatus shall be carried out by CONTRACTOR in accordance with appropriate international standards and the agreed quality assurance procedure. The EMPLOYER's supervisory engineers shall supervise the contractually agreed quality control procedures, inspection, checks prior to final assembling and tests of material, systems and equipment to confirm that the work of installation, assembly and erection is being correctly carried out by CONTRACTOR. Details of the quality control to be carried out at site shall be incorporated in the agreed manual of detailed quality assurance procedure in order to ensure the continuity of practice from design to setting to final assembling.

The form of report shall be mutually agreed by the CONTRACTOR and EMPLOYER. It shall include special reports on rejections, defects or damage. All test and supervision reports shall be prepared by the CONTRACTOR's supervisory engineers. Both EMPLOYER's resident engineer and the CONTRACTOR's senior supervisory engineer shall maintain a complete set of records and reports at site.

3.2 TESTS DURING ERECTION

Tests shall be carried out by CONTRACTOR and supervised specified by EMPLOYER during erection of the equipment to ensure that the equipment has constructed to the standards. Generally, these tests shall be limited to

- cold, dry and no load
- tests and related to the constructional standards of the units of equipment, rather than the Performance or function of equipment. The CONTRACTOR shall list the tests with prior approval of EMPLOYER which shall be included, but not limited to the following:

Date:	Appendix No: 15	Page 6 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

- A) Checking installation of gland packing and lubrication valves and minor machinery
- B) Isolating equipment, removing expansion joints, rupture discs and relief valves from pipe work and equipment, flushing, cleaning and testing of lines and pressure vessels.
- C) Hydraulic and/or pneumatic pressure testing of equipment and pipe work and testing of all relief valves.
- D) Installation of orifice plates after line cleaning installation of temporary strainers and removal of gland plates.
- E) Application of special treatment or other preparation of inside surfaces
- F) Removing all loose material and dirt from electrical and mechanical equipment.
- G) Checking all electrical connections for tightness.
- H) Checking all cables are secure and marked to standards.
- I) Checking electrical earth continuity and insulation to standards.
- J) Testing of electrical insulating oil.
- K) Checking the alignment of major machineries and drives: cleaning and flushing lubricating oil installations and similar items.

Date:	Appendix No: 15	Page 7 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

L) Inspecting all parts of the machines for damage and to ensure all packing materials have been removed.

M) Checking all clearances between the machines and conveyors structure and adjacent machines.

N) Checking the long travel rails to ensure they are securely fastened and are straight, true and level one with the other and generally in a satisfactory condition.

O) Checking the long travel flanges to ensure they do not foul the rail clips and that the rail joints have been correctly made.

P) Checking bridge alignment

Q) Checking that all cable reeling drums to be are mounted correctly and operated freely.

During this phase adjustments of the mechanical equipment may be performed, and the parties may sign a protocol named: “Completion of Erection”.

3.3 TESTS DURING FINAL ASSEMBLING OF THE EQUIPMENT

Following the end erection, tests shall be carried out by CONTRACTOR and supervised by EMPLOYER to ensure the safe and correct final assembling of the equipment or equipment section.

Once the “cold, dry, no load “tests are completed, further tests using loaded system shall be conducted. Under-load operation testing shall be performed within 10 days after the end of no-load operation testing. Under-load testing shall give evidence that the machines are properly designed for the specified normal operational conditions. During such under-load operation testing adjustments, if necessary shall be performed. Under-load operation testing shall be performed at least three times on different days. The time for the run shall be three hours. During the equipment being final assembled each individual item and function of the equipment shall be tested to prove correct operation and all functions are correct in relation to each other. The CONTRACTOR shall list the tests with prior approval of EMPLOYER required with shall include but not be limited to the followings:

A) Clean the machines and ensure patches of oil and grease are cleaned up. Ensure all loose items of equipment used for erection, nuts and bolts, cable ends and other debris are removed

Date:	Appendix No: 15	Page 8 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

from the machine.

B) Check the lubrication system and oil levels in all gearboxes.

C) Check that all hoist ropes are in satisfactory condition, lubricated, free of kinks, twisting and the rope ends are properly secured.

D) Check that the long travel rails are clear of obstruction and that end stops are securely fixed.

E) Check that the power supply is isolated and lockable.

Date:	Appendix No: 15	Page 9 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

- F) Check the power supply and measure the voltage drop across the trailing cable.
- G) Carry out the insulation resistance tests on all motors in accordance with standards and check the rotation of each motor with the control push- button so that each motion operates in the correct mode and direction.
- H) Check that the brake shop clearances on all motions are correctly adjusted and that each brake operates satisfactory.
- I) check that the sequence operation of all CONTRACTOR functions correctly.
- J) Test and prove all limit switch devices, emergency stops, warning devices and weighing equipment.
- K) Check that all cabling is in satisfactory condition and does not foul any moving parts.
- L) Check the supply and measure the voltage drop across reeling drum system.
- M) Checking action of instruments and testing individual electrical controls, alarms and interlocks and the like.
- N) Carrying out short running - in tests on items of machinery as required
- O) Calibration of instruments.

3.4 ALIGNMENT TESTS

Machine bridge alignment tests shall be carried out prior to and after load testing at site and a certificate shall be furnished that the limits and tolerances previously specified by CONTRACTOR have been maintained. All limits and tolerances shall be to the approval of EMPLOYER.

3.5 CRABBING CHECK

Any tendency of the machine to crab whilst in motion over the full travel distance shall be carefully checked and measured. The machine shall be run the full operational length and returned to its start position. In all cases the finish and return rail to runner clearances shall be such that be excessive flange to rail binding does not occur. Each run to check crabbing shall

Date:	Appendix No: 15	Page 10 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

be repeated three times.

3.6 TESTS DURING FINAL ASSEMBLING OF THE EQUIPMENTS PERFORMANCE TEST

3.6.1 TEST OPERATION PROCEDURE

CONTRACTOR should take the various necessary preparatory work such as, mechanical test, trial test, Start- Up preparation and trial operation, to carry out the guarantee tests. The following items are those concerning the procedure for the process performance test operation only.

- Check availability of sufficient quantities of additives to conduct the test operation.
- Check availability of feed stock (copper,...) and utilities in accordance with the design basis, and ensure that they are available in sufficient quantity to conduct the test operation
- Check records to verify that construction is complete and Package is operated and maintained in accordance with the associated operation manuals.
- Check that all process conditions are in line with the process design basis.
- Check and analyze the data obtained during the test operation against the design data by using approved, acceptable, well-established factors and methods. The figures so obtained should be the same as those which would have been obtained if test conditions had duplicated the design conditions.
- On completion of test, final confirmation test shall be performed on sampling points and the final test data sheets should be prepared.

3.6.2 REPORTING

Upon the completion of the tests the CONTRACTOR shall inform EMPLOYER's representative on the data on which he desired to start the relevant test operation to be witnessed and verified.

- Should the results of test operation meet the Performance Guarantee figures, the CONTRACTOR shall be deemed to have fulfilled the said Performance Guarantee and the necessary protocols of fulfillment of the test operation shall be signed by representative and the CONTRACTOR.

Date:	Appendix No: 15	Page 11 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

- If one or more of the established performance figures could not be obtained during the test operation, CONTRACTOR shall duly inform EMPLOYER's representative of corrective measures to be taken for rectification.

4. PERFORMANCE TESTS

- 4.1 Upon the successful COMMISSIONING of the PLANT and pursuant to operation of the PLANT for a period of 14 DAYS thereafter the PERFORMANCE TESTS of the PLANT shall be conducted by CONTRACTOR as per under:
- 4.2 The PLANT will meet the Normal operation
- 4.3 All persons employed by the CONTRACTOR or in connection with the performance of the CONTRACT shall be suitably qualified, competent and experienced in the fields of the responsibilities to which they are respectively assigned by the CONTRACTOR.
- 4.4 The PLANT shall be subject to PERFORMANCE TESTS as stipulated below, during which it shall demonstrate the PERFORMANCE GUARANTEE figures set out below.
- 4.5 The CONTRACTOR shall within the Detailed Engineering Work prepare the test procedures for conducting the PERFORMANCE TESTS in co-operation with and subject to APPROVAL of EMPLOYER/CONSULTANTE
- 4.6 The PLANT PERFORMANCE TESTS shall be conducted when the PLANT have reached the steady and reliable conditions and has operated under these conditions for a minimum period of two WEEKS, however no later than one MONTH after COMMISSIONING of the PLANT.
- 4.7 CONTRACTOR shall prepare the detailed procedures for PERFORMANCE

Date:	Appendix No: 15	Page 12 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

TESTS and shall submit them for EMPLOYER's review, comment, and APPROVAL at least six (6) MONTHS prior to the commencement of the above PERFORMANCE TESTS.

4.8 All instruments and tools for measuring the PERFORMANCE GUARANTEES shall be recommended and provided by CONTRACTOR but APPROVED by EMPLOYER.

4.9 The duration for PERFORMANCE TESTS of the PLANT shall be 14 days under the conditions defined in the CONTRACT DOCUMENTS.

4.10 If the periods of performance guarantee tests as specified here, are interrupted due to each reason for which the CONTRACTOR is not responsible, the plant shall be started again as soon as possible. In case the period of interrupted operation is less than 7 days, the test shall be repeated from the beginning. However in case the test period of interrupted operation is longer than 7 days the test shall be continued for the balance of the remaining period immediately after reaching normal operation. The duration of the tests shall be extended by the duration of such interruptions and the tests shall then be deemed to have been performed continuously.

However; if the interruption is due to CONTRACTOR, the period will re-commence without calculation of the period before interruption.

4.11 After the successful completion of the PERFORMANCE TESTS the CONTRACTOR shall prepare a PERFORMANCE TEST report which shall be signed by CONTRACTOR and submitted to EMPLOYER for APPROVAL.

4.12 In special cases where a certain UNIT(S) inside the PLANT cannot demonstrate its/ their designed performance while executing the PLANT PERFORMANCE GUARANTEE TESTS, additional specific tests shall be carried out to demonstrate the individual capacity of such UNIT(S). These special cases shall be clearly indicated in the test procedures of the PLANT for APPROVAL by EMPLOYER.

Date:	Appendix No: 15	Page 13 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

4.13 The following assumptions are made as to the PERFORMANCE GUARANTEES:

- (a) The design considerations and process PERFORMANCE GUARANTEES for the PLANT are based on the results from the test work as per Basic Engineering Package.
- (b) EMPLOYER provides all the necessary raw materials, and utilities as defined in the respective CONTRACT document.
- (c) EMPLOYER will provide suitable personnel trained by CONTRACTOR for PERFORMANCE TESTS and operation of the PLANT, under direction and responsibility of the CONTRACTOR.

5. ACCEPTANCE

The works shall be considered as accepted

- If the Performance Test has been successfully concluded, or
- If the liquidated damages for minor Performance have been paid, or
- If the Performance Test could not be performed within the time limit foreseen for reasons not attributable to the CONTRACTOR.

6. CERTIFICATES

After passing of each step of tests the following certificates will be issued and signed by both parties:

- Mechanical completion:

The WORKS, tasks or any portion of the works is complete and pre-commissioning activities have been successfully completed and ready for PRECOMMISSIONING.

- Certificate of acceptance:

In this stage Construction works and pre-commissioning and commissioning, performance tests would have been done completely, there would not remain any defects in works and PLANT will have worked continuously according to the

Date:	Appendix No: 15	Page 14 of 14
Appendix Title: Erection, Pre-Commissioning and Commissioning, Performance Tests		

warranted digits for 30 days.

Issue of this certificate is essential for provisional acceptance of project.

- Certificate of completion:

The certificate issued by EMPLOYER REPRESENTATIVE stating that the part of the WORKS specified in the certificate has been completed.

7. CERTIFICATE OF COMPLETION

After performance tests and demonstration of guarantee Figures, the Certificate of Completion will be issued by CONTRACTOR based on back up document and accepted by EMPLOYER/Consultant which the same date will be considered for the plant Guarantee period. Completion of the project or ready for startup means:

The Plant have reached a stage when all condition relating to mechanical completion, have been accomplished and all required tests have been carried out, sufficient trained operators and maintenance personnel familiar with equipment and their functions, all utilities and services are available under the required condition, all mechanical equipment has been adequately tested under load and have been properly lubricated, and the plant returned to a state of readiness to accept raw materials. The CONTRACTOR will attend and supervise the first actual operation show a smooth operation and control of the plant.