

**TESTING AND COMMISSIONING PROCEDURE**

**FOR**

**STEAM BOILER AND CALORIFIER INSTALLATION**

**IN**

**GOVERNMENT BUILDINGS**

**OF**

**THE HONG KONG SPECIAL ADMINISTRATIVE REGION**

2007 EDITION



ARCHITECTURAL SERVICES DEPARTMENT  
THE GOVERNMENT OF THE HONG KONG SPECIAL ADMINISTRATIVE REGION

## **PREFACE**

This Testing and Commissioning (T & C) Procedure aims to lay down the minimum testing and commissioning requirements to be carried out on steam boiler and calorifier installation in Government Buildings of the Hong Kong Special Administrative Region (HKSAR). Such requirements are applicable to both new installations upon completion and existing ones after major alteration.

The present edition was developed based on its 2000 edition by the Mechanical Installation Specialist Support Group that was established under the Building Services Branch Technical Information and Research & Development Committee. With the benefit of information technology, electronic version of this new edition is to be viewed on and free for download from the Architectural Services Department (ArchSD) Internet homepage. As part of the Government's efforts to limit paper consumption, hard copies of this T & C Procedure will not be put up for sale.

The Architectural Services Department welcomes comments on its contents at anytime since the updating of this T & C Procedure is a continuous process to tie in with technological advances.

## **DISCLAIMER**

This T & C Procedure is solely compiled for use on steam boiler and calorifier installation carried out for or on behalf of the ArchSD in Government buildings of the HKSAR.

There are no representations, either expressed or implied, as to the suitability of this T & C Procedure for purposes other than that stated above. The material contained in this T & C Procedure may not be pertinent or fully cover the extent of the installation in non-government buildings. Users who choose to adopt this T & C Procedure for their works are responsible for making their own assessments and judgement of all information contained here. The Architectural Services Department does not accept any liability and responsibility for any special, indirect or consequential loss or damage whatsoever arising out of or in connection with the use of this T & C Procedure or reliance placed on it.

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# Testing and Commissioning Procedure for Steam Boiler and Calorifier Installation

## 1. Introduction

The procedures stated in this document cover the activities in preliminary tests and inspections, functional performance tests and the commissioning of newly completed installations and existing ones after major alteration. They are so compiled to facilitate the work of Project Electrical and Mechanical Engineer (PEME), Project Building Services Engineer (PBSE) and Project Electrical and Mechanical Inspector (PEMI) in the following aspects with respect to testing and commissioning (T & C):

- (i) To vet and approve the T & C procedures proposed and submitted by the Contractor;
- (ii) To witness those T & C procedures as specified; and
- (iii) To accept the T & C certificates and other supporting data.

The Contractor shall carry out the T & C works as detailed in this document. Supplementary T & C plans may be proposed by the Contractor as appropriate and agreed by PEME/PBSE, e.g. for special equipment supplied and/or installed by the Contractor.

The administrative requirements for T & C works are in general as specified in the latest General Specification for Mechanical Installations (the General Specification) 2007 Edition issued by the Architectural Services Department. If there is any discrepancy between this procedure and the General Specification, the General Specification shall take precedence.

## 2. Objectives of the T & C works

The objectives of the T & C works are:

- (i) to verify proper functioning of the equipment/system after installation; and
- (ii) to verify that the performance of the installed equipment/systems meet with the specified design intent through a series of tests and adjustments.
- (iii) to capture and record performance data of the whole installation as the baseline for future operation and maintenance.

For the avoidance of doubt, depending on the specific demands of individual installation, the PBSE may require additional or substitute T & C works in regard to any elements in the installation other than those indicated in this Procedure.

### **3. Scope of the T & C Works**

#### **3.1 Tests and Inspections during Construction**

The purpose of these tests is to ensure that all components and systems are in a satisfactory and safe condition before start up. Preliminary adjustment and setting of equipment at this stage shall also be carried out at the same time to pave way for the coming functional performance tests.

Before carrying out any test, the Contractor shall ensure that the installation complies with all relevant statutory requirements and regulations. The T & C works shall also comply with all site safety regulatory requirements currently in force namely:

- (i) Boilers and Pressure Vessels Ordinance, Cap. 56, and its subsidiary legislations*
- (ii) Fire Services Ordinance, Cap.95, and its subsidiary legislations*
- (iii) Danger Goods Ordinance, Cap 295, and its subsidiary legislations*
- (iv) Gas Safety Ordinance, Cap. 51, and its subsidiary legislations*
- (v) Air Pollution Control Ordinance, Cap. 311, and its subsidiary legislations*
- (vi) Electricity Ordinance, Chapter 406, and its subsidiary legislations*
- (vii) The latest Code of Practice for the Electricity (Wiring) Regulations*

#### **3.2 Functional Performance Tests**

The purpose of functional performance tests is to demonstrate that the equipment/installation can meet the functional and performance requirements as specified in the General/Particular Specifications. Functional performance test should proceed from the testing of individual components to the testing of different systems in the installation.

The Contractor may have to make temporary modifications as the test proceeds. The specific tests required and the order of tests will vary depending on the type and size of systems, number of systems, sequence of construction, interface with other installations, relationship with the building elements and other specific requirements as indicated in the General/Particular Specifications. The testing of systems may have to be carried out in stages depending on the progress of work or as proposed by the Contractor.

Part of the tests may be required to be carried out in suppliers' premises in accordance with the provisions in the General/Particular Specification.

Any performance deficiencies revealed during the functional performance tests must be evaluated to determine the cause and whether they are part of the contractual obligations. After completion of the necessary corrective measures, the Contractor shall repeat the tests.

If any test cannot be completed because of circumstances that are beyond the control of the Contractor, it shall be properly documented and reported to the PEME/PBSE, who shall then liaise with the relevant parties to resolve the situation. The Contractor shall resume his testing work immediately upon the attainment of a suitable testing environment.

### 3.3 Commissioning and Statutory Inspections

Commissioning is the advancement of an installation from the stage of static completion to full working conditions and to meet the performance requirements as specified in the General/Particular Specification. This will include setting into operation and regulation of the installation. It is expected that fine-tuning of the commissioned system shall be done by the Contractor to match system performance to the actual needs of the building occupier more closely.

Where necessary, after the proper testing and commissioning of the Steam Boiler and Calorifier Installation, the Contractor shall notify the appropriate authority, through the PEME/PBSE of the completion of the installation and its readiness for final inspection.

### 3.4 Documentation and Deliverables

The Contractor shall submit his proposed T & C procedures together with the Testing and Commissioning Progress Chart shown in Annex I to PEME/PBSE for approval.

All inspection and T & C results shall be recorded in the data record forms shown in Part 3 and 4 of Annex II. Data recorded in other formats may also be acceptable subject to agreement between the PEME/PBSE and the Contractor. Upon completion of all the required T & C works, the Contractor's project engineer shall complete and sign a testing and commissioning certificate as shown in Part 1 and 2 of Annex II to the effect that the agreed T & C works have been duly carried out.

A functional performance test report covering all measured data, data sheets, and a comprehensive summary describing the operation of the system at the time of the functional performance tests shall be prepared and submitted to the PEME/PBSE. Deviations in performance from the General/Particular Specifications or the design intent should be recorded, with a description and analysis included.

Where required in the General Specification, the Contractor shall conduct a final evaluation of the performance of the Steam Boiler and Calorifier Installation, the results of which shall be included in the commissioning report.

One month before the actual commissioning of the steam boilers and pressure receiver, the equipment should be registered with the Pressure Equipment Division, Labour Department through FORM 3 of the Boiler & Pressure Vessels Ordinance, Cap. 56. In addition 2 copies of the following documents

after endorsement by an Approved Examiner certifying that they relate to the equipment under application should also be attached for submission:

- (a) The maker's certificate;
- (b) Where the boiler or pressure vessel was constructed in Hong Kong a certificate as to the inspection thereof during construction issued by an Approved Examiner; and
- (c) Where the boiler or pressure vessel was not constructed in Hong Kong, a certificate issued in respect of the boiler or pressure receiver by a recognised inspecting authority in the country in which it was constructed.

Before it being put in use the equipment under the above Ordinance must be examined by a Boiler Inspector appointed under the Boilers and Pressure Vessels Ordinance, Cap. 56.

## 4. T & C Procedures

### 4.1 Tests and Inspections during Construction

Certain tests will be carried out on different systems of the installation during construction to ensure their suitability for operating at the design conditions. Certificates of such tests have to be issued together with certificates of any work tests.

#### 4.1.1 Factory Manufactured Equipment

Relevant Clauses  
in Annex II

Factory test shall be carried out for the boiler plant, tanks, cylinders and pumps as required as follows

- (a) The complete and fully assembled equipment shall be tested at the manufacturer's works before dispatch, including full operational tests as well as tests on control devices, safety devices and protection devices in accordance with the specification. NA
- (b) Before the tests are carried out, the test procedure shall be submitted to the Architect for approval. NA
- (c) The original official Birth Certificate for the equipment shall be submitted to the Architect at least 4 calendar weeks before the equipment departs from the manufacturer's factory and prior to shipment.

#### 4.1.2 Concealed Structures and Installations

Installations or sections which will be embedded in the structure or concealed in permanently sealed ducts, trenches, roof spaces, etc., shall in addition to the above specified tests be individually tested as they are laid and before being embedded or concealed. NA

### 4.1.3 Pipework & Accessories

- (a) All pressure tests shall be carried out before the application of thermal insulation, where this would prejudice the completion of the installation the section concerned shall be individually tested before the application of the insulation. NA
- (b) All pipework, vessels and boilers shall be clean up thoroughly before subject to inspection, both internally and externally. NA
- (c) All associated pipework, fitting and valves shall be completely drained after hydraulic test and shall be blown with compressed air to remove any trace of water and dirt. NA
- (d) After being dried, the pipework, fitting and valves shall be flushed with oil to prevent rusting. NA
- (e) Certain tests will be carried out on different systems of the installation during construction to ensure their suitability for operating at the design conditions. Certificates of such tests have to be issued together with certificates of any work tests. NA

## 4.2 Functional Performance Tests

Before the system is put under test the following pre-testing inspection procedures are carried out.

### 4.2.1 Boiler System

Clause 3.1.1

- (a) Before securing the access doors and manholes ensure all components of the system are clean and free from foreign matter.
- (b) Mechanical Check shall be carried out on the system to ensure all the components are correctly installed and ready for use.
- (c) Burner
  - (i) General connection inspection on supply piping
  - (ii) Ignition system test
  - (iii) Safety shut down device functional test, etc.
- (d) Fuel Oil System
  - (i) Fuel supply line condition check
  - (ii) Pump control function test, etc.
- (e) Gas System
  - (i) Pressure test on piping
  - (ii) Control test for safety devices, etc.
- (f) Underground Tank
  - (i) Welding standard inspection

- (ii) Tank coating inspection
- (iii) Hydraulic test

4.2.2 Water Tanks, Calorifiers and De-aerators

Pre-testing Inspection

Clause 3.1.2

4.2.3 Steam and Condensate Pipework System

Pre-testing Inspection

Clause 3.1.3

4.2.4 Hot Water Steam

- (a) Pre-testing Inspection
- (b) Water Chemical Test
- (c) Water level control test

Clause 3.2.1

4.2.5 Steam Boilers

- (a) Pre-testing Inspection
- (b) Water Chemical Test
- (c) Water level control test
- (d) Feed system control test

Clause 3.2.2

4.2.6 Complete Steam Boiler System

- (a) Full-load test
- (b) Thermal Test

Clause 3.3

The above performance tests shall then be out carried on the system with the witness of the PEME/PBSE or PEMI. All testing results shall be properly recorded in accordance with Annex II during testing at the witness of the PEME/PBSE or PEMI. Immediately after the testing, the Contractor shall endorse the data recorded on site, irrespective of whether the tests are successful or not, and submit a copy of the data record sheet to the Architect. A full commissioning and testing report shall be forwarded to the Architect within 14 calendar days after completion of commissioning and testing of the installation. The report shall be in accordance with the requirements in the specification.

Clause 3 & 4

4.3 Commissioning and Statutory Inspections

4.3.1 Steam Boiler System

The steam boiler equipment including safety valves and accessories after completion shall be subject to the inspection and approval by the Commissioner for Labour and Director of Water Supplies. The examination of the plant by approved independent Surveyor(s) or Laboratories is required if deemed necessary by the above relevant authorities. The Contractor is required to obtain the respective Certificates of Approval or Fitness and registration on behalf of the

Clause 4

Employer for those equipment or systems which fall within the Boilers & Pressure Vessels Ordinance, Cap.56, and other relevant statues. Original certificates should be framed and posted conspicuously near the respective equipment or systems on site. 4 copies of these certificates shall be submitted to the Architect.

4.3.2 Fuel Oil System and Underground Tank

Clause 4.3

The Contractor shall arrange necessary inspection and approval from the statutory authorities if fuel oil is used for burner in accordance with the Dangerous Goods Ordinance, Cap. 295 and the Fire Services Ordinance, Cap. 95.

4.3.3 Exhaust & Ventilation System

The Contractor shall carry out test and request inspection if necessary and obtain approval from the statutory authority regarding the boiler exhaust in accordance with the Air Pollution Control Ordinance, Cap.311.

## Testing and Commissioning Progress Chart for “Steam Boiler and Calorifier Installation”

Contract No.: \_\_\_\_\_

Contract Title: \_\_\_\_\_

Name of Contractor/sub-contractor: \_\_\_\_\_

Contract Period: / /20 to / /20 \* Revised/Actual Completion Date : / /20

Testing and Commissioning Progress Chart for Steam Boiler and Calorifier Installation (Rev. ) <sup>(1)</sup>																			
	Activities	Referen ce to Annex II	Dates <sup>(2)</sup>																Remark
			S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
1.	<b>General Inspection/Tests</b>	3.1.1																	
	Boiler																		
	Water storage and expansion tank																		
	De-aerators																		
	Steam and condensate pipework system																		
	Chimney & flue gas ducting																		
	Blowdown vessel																		
	Water treatment plant																		
	Gas booster & burner																		
	Air inlet																		
	Burner																		
	Gas supply system																		
	Fuel oil system																		
	Underground oil tank																		
	Submission of Record of Test																		

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

## Testing and Commissioning Progress Chart for “Steam Boiler and Calorifier Installation”

Testing and Commissioning Progress Chart for Steam Boiler and Calorifier Installation (Rev. ) <sup>(1)</sup>																				
Dates <sup>(2)</sup>																				Remark
Activities	Reference to Annex II	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
2.	<b>Mechanical Check</b>	3.1.1																		
	Access doors and manholes																			
	Boiler mountings, fittings and valves																			
	Flue gas ducting																			
	Chimney																			
	Water piping connections																			
	Fire fighting system																			
	Safety valve relief piping																			
3.	<b>Chemical Test for Boiler Water</b>	3.1.2																		
	Submission of Record of Test																			
4.	<b>Water Level Control Test</b>	3.1.2																		
	Submission of Record of Test																			

Tested / Checked by : (Name of Contractor's Representative)	Signature -  (                      )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  (                      )	Post :	
		Tel. No. :	
		Date :	

## Testing and Commissioning Progress Chart for “Steam Boiler and Calorifier Installation”

Testing and Commissioning Progress Chart for Steam Boiler and Calorifier Installation (Rev. ) <sup>(1)</sup>																				
Dates <sup>(2)</sup>																				Remark
Activities	Reference to Annex II	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	
5.	Performance Test for Boiler	3.3																		
	Full load Test																			
	Thermal Test																			
	Submission of Record of Test	4.1-4.2																		
6.	Compliance of Statutory Requirements	4.3																		
	Form 3 from Labour Dept.																			
	Surveyor certificates																			
	Submission of Record of Test																			
7.	Submission of T & C Certificate	1.0																		
8.	Others (Please specify)																			

### Notes

\* Delete if not applicable

(1) Insert revision no.

(2) Insert additional columns as necessary

S - schedule % completion

A - actual % completion

Tested / Checked by : (Name of Contractor's Representative)	Signature -  (                      )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  (                      )	Post :	
		Tel. No. :	
		Date :	

## Testing and Commissioning Certificate for Steam Boiler and Calorifier Installation

### Part 1: Detail of Project

- 1.1 Project title (with location) :
- 1.2 \* P.W.P. / Project No. :
- 1.3 \*Contract/sub-contract/Quotation No. :
- 1.4 \*Contractor/Sub-contractor :
- 1.5 PEME/PBSE :
- 1.6 PEMI :

### Part 2: Declaration

- 2.1 I certify that the Steam Boiler and Calorifier Installation as specified in the Contract/Sub-contract/Quotation at the above location has been inspected, tested and commissioned in accordance with this procedure and/or any other procedures agreed between the PEME/PBSE and the Contractor. The results are satisfactory in the aspects as mentioned in Part 3 and/or as recorded in Part 4 of this Certificate, except as indicated in the COMMENTS items.
- 2.2 I also certify that site tests have been performed in accordance with the requirements set out in Section 4 and Annex II of this procedure and that the results are satisfactory. A record of the tests has been prepared and submitted to the PEME/PBSE.

(Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
(Designation of Contractor's Representative )	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
(Name and Stamp of Contractor)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

Note : This certificate must be signed by a person authorized by the Firm/Contractor.

\* Delete if not applicable

**Part 3 :Items Inspected and Tested**

	Item tested checked by <u>Contractor</u>	Items witnessed by <u>PEME/PBSE/PEMI</u>
3.1 <u>Pre-commissioning Inspection</u>		
3.1.1 <u>Boiler</u>		
(a) Before securing the access doors and manholes ensure the following items are clean and free from foreign matter.	*Yes/No	*Yes/No
(i) Boiler interiors, both fireside and waterside	*Yes/No	*Yes/No
(ii) Water storage and/or expansion tank	*Yes/No	*Yes/No
(iii) De-aerators (if installed)	*Yes/No	*Yes/No
(iv) Chimney & flue gas ducting from boiler	*Yes/No	*Yes/No
(v) Blowdown vessel or pits	*Yes/No	*Yes/No
(vi) Water treatment plant	*Yes/No	*Yes/No
(vii) Gas booster	*Yes/No	*Yes/No
(viii) Air inlet to the boiler room	*Yes/No	*Yes/No
(b) <u>Mechanical Check</u>		
(i) Access doors and manholes are secure and that joints are tight.	*Yes/No	*Yes/No
(ii) Boiler mountings, fittings and valves are correctly installed, with provision for drainage or blowdown and that provision for boiler expansion movement has been made at support or cradles.	*Yes/No	*Yes/No
(iii) The flue gas ducting is correctly installed, adequately supported with due provision for expansion and that access covers are secure and fitted with joints.	*Yes/No	*Yes/No
(iv) The chimneys are complete, with access doors secured.	*Yes/No	*Yes/No
(v) The piping connections are correctly installed & blowdown piping, where fitted, is terminated in suitable chambers with drain vents and internal baffles or weirs, and that blowdown chamber covers are secure.	*Yes/No	*Yes/No

Tested / Checked by : (Name of Contractor's Representative)	Signature -  (                    )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  (                    )	Post :	
		Tel. No. :	
		Date :	

## Annex II

	Item tested checked by Contractor	Items witnessed by <u>PEME/PBSE/PEMI</u>
(vi) The fire fighting systems are installed and ready for use.	*Yes/No	*Yes/No
(vii) Safety valve relief piping is secure, unobstructed and led safe position and that the safety valves are free to operate and provided with unrestricted drain connections. Where specified, a works test certificate should be available for the valves. Check other safety devices as appropriate.	*Yes/No	*Yes/No
<b>(c) Burner</b>		
(i) All oil and gas connections are properly made and that the piping system is complete and that there are no open ends which can discharge fuel into the space or boilers.	*Yes/No	*Yes/No
(ii) All flame failure, ignition and fuel control devices are correctly installed.	*Yes/No	*Yes/No
(iii) Control devices, such as safety shut-off valves, governors, thermostats, pressure-stats, draught regulators, air pressure switches etc. are installed and in good condition.	*Yes/No	*Yes/No
(iv) Correct filters are installed on oil and gas piping.	*Yes/No	*Yes/No
(v) Vents terminating at roof level are installed from safety shut-off systems, meters, over-pressure valves and governors, as specified.	*Yes/No	*Yes/No
(vi) Emergency isolating valves have been installed outside the building in safe and accessible positions, on both gas and oil supply lines.	*Yes/No	*Yes/No
(vii) In the case of rotary cup oil burners, the cups and forced draught fan impellers spin freely, the cup edges are undamaged and the drive belts, where fitted, are correctly tensioned and aligned.	*Yes/No	*Yes/No
(viii) In the case of pressure jet burners, the correct nozzles are fitted, the orifices are undamaged, the primary air fans spin freely, the draught tubes are unobstructed and clean filters are fitted.	*Yes/No	*Yes/No

Tested / Checked by : (Name of Contractor's Representative)	Signature -  <div style="text-align: center;">(            )</div>	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  <div style="text-align: center;">(            )</div>	Post :	
		Tel. No. :	
		Date :	

## Annex II

	Item tested checked by Contractor	Items witnessed by <u>PEME/PBSE/PEMI</u>
(ix) In the case of air atomizing burners, the primary and secondary air supply ducting and silencers are unobstructed and securely connected, the fuel tube slides or flame shape adjustments operate freely and the fan impellers spin freely on their bearings.	*Yes/No	*Yes/No
(x) In the case of gas burners, nozzles and governor parts are clean and unobstructed, the nozzle types and adjustments are consistent with the gas supply, the forced draught fans, where fitted, spin freely and the draught tubes are unobstructed. Check that gas pressure proving devices, if provided, are correctly installed.	*Yes/No	*Yes/No
<b>(d) <u>Fuel Oil System</u></b>		
(i) The oil storage tanks have been adequately charged with the correct oil at the correct storage temperature and the content gauges are operative.	*Yes/No	*Yes/No
(ii) Electrical supplies are available to pump motors, heaters and controls.	*Yes/No	*Yes/No
(iii) Valves are open or closed according to the priming plan.	*Yes/No	*Yes/No
(iv) Drains and piping vents are closed.	*Yes/No	*Yes/No
(v) The system is primed by releasing the vents and drains until a steady flow is achieved at the correct temperature.	*Yes/No	*Yes/No
(vi) Ventilation of the tank room is available.	*Yes/No	*Yes/No

Tested / Checked by : (Name of Contractor's Representative)	Signature -  (                      )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  (                      )	Post :	
		Tel. No. :	
		Date :	

## Annex II

	Item tested checked by Contractor	Items witnessed by <u>PEME/PBSE/PEMI</u>
<b>(e) <u>Gas System</u></b>		
(i) Pressure testing of the gas piping has been carried out by the gas supply authority.	*Yes/No	*Yes/No
(ii) The gas supply is available at the correct pressure and is of the correct type.	*Yes/No	*Yes/No
(iii) The electrical supply is available to the safety shut-off controls and the booster, if installed.	*Yes/No	*Yes/No
(iv) The main supply and safety shut-off valves are closed.	*Yes/No	*Yes/No
<b>(f) <u>Underground Tank</u></b>		
(i) The welding has been examined and the effectiveness of the welding and standard of workmanship is satisfactory.	*Yes/No	*Yes/No
(ii) The metal surface has been properly prepared in accordance with the specification.	*Yes/No	*Yes/No
(iii) The manufacturer's application procedure for the primer has been followed and the type of primer, the numbers of coatings are in accordance with the specification.	*Yes/No	*Yes/No
(iv) The underground tank has been subjected to hydraulic test to a pressure as specified and the results are satisfactory.	*Yes/No	*Yes/No
 <b>3.1.2 <u>Water Tanks, Calorifiers and De-aerators</u></b>		
(a) These are clean and, where lined or galvanized, are undamaged.	*Yes/No	*Yes/No
(b) The vessels are adequately and securely supported, particularly sectional tanks.	*Yes/No	*Yes/No
(c) Piping connections and valves are installed as specified.	*Yes/No	*Yes/No
(d) Covers, where specified, are supplied and properly fitted	*Yes/No	*Yes/No
	*Yes/No	*Yes/No

Tested / Checked by : (Name of Contractor's Representative)	Signature -  (                    )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  (                    )	Post :	
		Tel. No. :	
		Date :	

## Annex II

	Item tested checked by <u>Contractor</u>	Items witnessed by <u>PEME/PBSE/PEMI</u>
(e) All fittings are supplied and secured.	*Yes/No	*Yes/No
(f) Where tanks contain a chemical solution, adequate overflow arrangements are provided and that these, together with the drains, are piped to a suitable discharge.	*Yes/No	*Yes/No
(g) Where motorized or hand stirring facilities are specified, these are installed and in working order.	*Yes/No	*Yes/No
<b>3.1.3 <u>Steam and Condensate Pipework System</u></b>		
(a) This has been correctly installed.	*Yes/No	*Yes/No
(b) All flanged joints and connections are securely made.	*Yes/No	*Yes/No
(c) The correct valves have been installed and each is free to operate.	*Yes/No	*Yes/No
(d) All probes, pockets, pressure gauges, thermostats, syphons, strainers, orifice plates and taps and air vents etc. are correctly installed.	*Yes/No	*Yes/No
(e) The steam pipework is installed with the correct gradient so that pockets of condensate cannot collect, the steam traps sets are correctly installed and the piping connections are correctly made.	*Yes/No	*Yes/No
(f) The condensate pipework is installed with the correct gradient.	*Yes/No	*Yes/No
(g) All pipework is adequately supported and secured, with adequate provision for expansion.	*Yes/No	*Yes/No
(h) The thermal insulation is complete.	*Yes/No	*Yes/No
(i) The condensate receivers and pump sets have been correctly installed, with piping connections securely made, the valves are free to operate and the level controls and gauge glasses are installed as specified.	*Yes/No	*Yes/No
(j) The pipeworks are correctly painted with the proper colour band and direction of flow.	*Yes/No	*Yes/No
(k) The valves, fittings & controls are properly labelled.	*Yes/No	*Yes/No

Tested / Checked by : (Name of Contractor's Representative)	Signature -  (                    )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  (                    )	Post :	
		Tel. No. :	
		Date :	

## Annex II

3.2 <u>Preparation for Firing</u>	Item tested checked by Contractor	Items witnessed by <u>PEME/PBSE/PEMI</u>
3.2.1 <u>Hot Water Steam</u>		
Check :		
(a)      that the system is filled with water to the appropriate level, vented and that the condition of the water is chemically correct.	*Yes/No	*Yes/No
(b)      that the main isolating valves on the distribution headers and pumps are open and the system has been checked.	*Yes/No	*Yes/No
3.2.2 <u>Steam Boilers</u>		
(a)      Open the air vent on the boiler shell.	*Yes/No	*Yes/No
(b)      Close the main boiler stop valve and the drain valves on the level and alarm controls.	*Yes/No	*Yes/No
(c)      Open the feed check valve and the isolating valves to the water level controls and the alarm and the feed pump.	*Yes/No	*Yes/No
(d)      Check that the blow-down valve is fully closed.	*Yes/No	*Yes/No
(e)      Check that electrical supplies are available at the boiler control panel and that the feed system is available for immediate use.	*Yes/No	*Yes/No
(f)      Check that the condition of the water in the hot-well is chemically correct and then start the feed pump and fill the boilers to correct gauge glass level. Check also that the direction of rotation of the feed pumps is correct, that the casings are purged of air and that the feed pump motors are not overloaded. Alternatively, fill the boiler from a hose pipe.	*Yes/No	*Yes/No
(g)      Check the operation of the water level control by allowing the feed pump to run until switched by operation of the level controller. Open the blow-down valve and check that the pump restarts at correct level. Close the blow-down valve.	*Yes/No	*Yes/No
(h)      Check the operation of the high level alarm by isolating the water level controller and opening its drain valve. The high level alarm should sound when the feed pump has raised the water level to the pre-set condition. Open the isolating valves on the level controller and close its drain valve.	*Yes/No	*Yes/No

Tested / Checked by : (Name of Contractor's Representative)	Signature -  <div style="text-align: center;">(                      )</div>	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  <div style="text-align: center;">(                      )</div>	Post :	
		Tel. No. :	
		Date :	

## Annex II

	Item tested checked by Contractor	Items witnessed by <u>PEME/PBSE/PEMI</u>
(i) Check the operation of the low level alarm by opening the blow-down valve. The low level alarm should sound at the correct low water level. Close the blow-down valve and allow the feed pump to restore the water level. Check that the supply of water to the feed tank is adequate. Repeat the sequence and check the operation of the burner lock out at the second low water level.	*Yes/No	*Yes/No
(j) Check that the water level in the blow-down vessel is satisfactory and that the vent is adequate.	*Yes/No	*Yes/No
<b>3.3 <u>Performance Tests</u></b>		
3.3.1 A full-load performance test has been carried out. The results are satisfactory.	*Yes/No	*Yes/No
3.3.2 A full-load performance test have <u>NOT</u> been carried out but it will be carried out during the maintenance period.	*Yes/No	*Yes/No
<b>3.4 <u>Record of Tests</u></b>		
A record of test as indicated in Annex II of this procedure has been completed and submitted to the project engineer.	*Yes/No	*Yes/No
<b>3.5 <u>Comment</u></b>		

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

Part 4 : Test Record attached to the Test Certificate4.1. Equipment Details4.1.1 Steam Boiler(a) General

- (i) Manufacturer
- (ii) Model
- (iii) Rated steam output (kg/hr)
- (iv) Rated output pressure (kPa)
- (v) Maximum output pressure (kPa)
- (vi) Overall dimension L x W x H (mm)
- (vii) Diameter of the flue (mm)
- (viii) No. of pass

(b) Burner

- (i) Manufacturer
- (ii) Type
- (iii) Rating (kW)
- (iv) Minimum gas supply pressure (kPa)
- (v) Gas consumption at rated output (m<sup>3</sup>/s)
- (vi) Minimum oil supply pressure (kPa)
- (vii) Oil consumption at rated output (l/s)

(c) Feed Pump

- (i) Type
- (ii) Manufacturer
- (iii) Flow rate (l/s)
- (iv) Pump head (kPa)

(d) Accessories

- (i) Size of safety valves
- (ii) Size of steam outlet valves
- (iii) Size of blowdown valves
- (iv) Size of manholes
- (v) Induced draft fan rating (kW)
- (vi) Induced draft fan flow rate (m<sup>3</sup>/s)
- (vii) No. of thermometer
- (viii) No. of steam pressure gauge

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

(e) Instrumentation Panel

Manufacturer/Model No.

- (i) Smoke density meter
- (ii) Draught gauge
- (iii) Carbon dioxide meter
- (iv) Flue gas temperature indicator
- (v) Steam pressure indicator
- (vi) Steam mass flow integrating meter
- (vii) Ambient temperature indicator
- (viii) Quartz clock

(f) Chemical Dosing Equipment

- (i) Type of chemical used
- (ii) Size of the mixing tank
- (iii) Material of Construction of the tank
- (iv) Make/model of dosing pump
- (v) Dosing rate of the pump (l/s)

4.1.2 Calorifier

- (i) Manufacturer/Model
- (ii) Type
- (iii) Dimension L x W x H (mm)
- (iv) Storage capacity (L)
- (v) Cycle time (min.)
- (vi) Steam shell working pressure (kPa)
- (vii) Steam/hotwater consumption (kg/h or l/h)
- (viii) Steam pressure (kPa)
- (ix) Secondary water flow rate (l/h)

Hotwater/Steam

4.1.3 Fuel Pump

- (i) Manufacturer/Model
- (ii) Speed
- (iii) Flowrate (l/h)
- (iv) Pump head (kPa)
- (v) Flame proof motor & wiring

4.1.4 Level Switch

- (i) Manufacturer/Model
- (ii) Type

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

4.2. Assessing the Thermal Performance of the System

4.2.1 General

Name of Premises : \_\_\_\_\_  
 Date of Assessment : \_\_\_\_\_  
 Name of the Contractor : \_\_\_\_\_  
 Contractor Representatives : \_\_\_\_\_  
 Operation & Maintenance Representatives: \_\_\_\_\_  
 Site Inspector : \_\_\_\_\_

4.2.2 Boiler Data

Manufacturer/Make : \_\_\_\_\_  
 No. of Boilers : \_\_\_\_\_  
 Type & Description : \_\_\_\_\_  
 Maximum Rated Steam Output (kg/hr) : \_\_\_\_\_  
 Working Gauge Pressure (kPa) : \_\_\_\_\_  
 Final Steam Temperature (°C) : \_\_\_\_\_

4.2.3 Burner Data

Burner Manufacturer : \_\_\_\_\_  
 Type of Burner : \_\_\_\_\_  
 Thermal Capacity (MJ/Min) : \_\_\_\_\_

4.2.4 Fuel Data

Type : \_\_\_\_\_  
 Calorific Value (gross) : \_\_\_\_\_  
 Liquid fuel  $Q_{IF}$  (kJ/kg) : \_\_\_\_\_  
 Gaseous fuel  $Q_{gF}$  (MJ/m<sup>3</sup>) : \_\_\_\_\_

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

## 4.2.5 Test Data

Three readings (1st / 2nd / 3rd) should be taken for each firing Rate & average out these data (Av.).

Measurement	Symbols	Unit	Fire Rate		
			High 1st / 2nd / 3rd / Av.	Medium 1st / 2nd / 3rd / Av.	Low 1st / 2nd / 3rd / Av.
Duration of test	T	Sec.			
Temperature of combustion air	t <sub>a</sub>	°C			
Temperature of liquid fuel	t <sub>c</sub>	°C			
Temperature of gas fuel	t <sub>g</sub>	°C			
Liquid fuel fired	M <sub>f</sub>	kg			
Gas fuel fired	V <sub>g</sub>	m <sup>3</sup> /kg			
Flow rate of steam leaving boiler or feed water entering boiler	F <sub>s</sub>	m <sup>3</sup> /s kg/s			
Temperature of water entering boiler	t <sub>w</sub>	°C			
Mean gauge pressure of steam in boiler	P <sub>s</sub>	mbar			
Mean temperature of steam	t <sub>s</sub>	°C			
Mean temperature of feed water	t <sub>f</sub>	°C			

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

## 4.2.6 Calculation

(a) Constant from Steam Table

Measurement	Symbols	Unit	Firing Rate		
			High	Medium	Low
Specific volume of saturated steam at the tested temperature & pressure	$V_g$	$m^3/kg$			
Specific volume of saturated liquid at the tested temperature & pressure	$V_f$	$m^3/kg$			
Sensible heat of steam at the pressure of steam discharged from boiler	$h_f$	$KJ/kg$			
Latent heat of steam at pressure of steam discharged from boiler	S	$kJ/kg$			

(b) Rate of Heat Supply by Fuel(i) Liquid Fuel

$$Q_{lf} = \frac{M_f}{T} [ Q_{lf} + 1.92 ( t_c - t_a ) ]$$

(ii) Gaseous Fuel

$$Q_{gf} = 1000V Q_F Q_{gF}$$

$$\text{Where } V = \frac{V_g ( P_a + P_g ) 288}{1013 ( t_g + 273 )}$$

$P_g$  = Pressure of gaseous fuel at meter in m bar

$Q_{lf}$  = Rate of heat supply by liquid fuel

$Q_{gf}$  = Rate of supply by gaseous fuel

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

(c) Heat output from the Steam Boiler

$$Q_B = F_s ( h_f + xS ) - t_a C )$$

Where C = 4.1868 kJ/kg.K for water  
 x = dryness fraction

(d) Boiler Efficiency

$$E_B = \frac{Q_B}{Q_{if} \text{ or } Q_{gf}} \times 100\%$$

4.2.7 Result

Measurement	Symbols	Unit	Firing Rate		
			High	Medium	Low
Output from boiler	Q <sub>B</sub>	kW			
Boiler Efficiency	E <sub>B</sub>	%			

Tested / Checked by : (Name of Contractor's Representative)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	
Witnessed by : (Name(s) of *PBSE/PBSI)	Signature -  ( )	Post :	
		Tel. No. :	
		Date :	

### List of Calibrated Instrument Necessary for the T & C Works

The contractor shall supply calibrated equipment as stipulated in the Specification of the Contract for the inspection, measuring and testing of the installation. The equipment shall be calibrated by laboratories accredited by the Hong Kong Laboratory Accreditation Scheme (HOKLAS) or other laboratory accreditation schemes as approved by the PBSE.

Performance Specification	Accuracy	Maximum period between calibrations
Tachometer 30-5000 rpm	+1%	1 year
Multi-tester (AVO) 0-1000V 0-10A 0-W	+1%	1 year
Clamp on ammeter 0-1000A	+1%	1 year
Insulation tester 500V-1000V	+1%	1 year
Pressure Gauge 0-100kPa 0-1000kPa	+ 2%	1 year
Sound meter 0-120 dbA	+2%	1 year
Hydraulic Tester (suitable range)	+ 2%	1 year
Temperature Gauge (suitable range)	+ 2%	1 year
Flow Meter (suitable range)	+ 2%	1 year
Other necessary testing equipment	+2%	1 year