

TESTING AND COMMISSIONING PROCEDURE

FOR

STEAM BOILER AND CALORIFIER INSTALLATION

IN

GOVERNMENT BUILDINGS

OF

THE HONG KONG SPECIAL ADMINISTRATIVE REGION

2012 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 2007 edition by the Mechanical Installation Specialist Support Group that was established under the Building Services Branch Technical Information and Research & Development Committee of the Architectural Services Department (ArchSD). This T&C Procedure had incorporated the latest changes in corrigendum no. GSMI01-2012 for the 2012 edition of the General Specification for Mechanical Installations.

With the benefit of information technology, electronic version of this new edition is to be viewed on and free for download from the 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 ArchSD welcomes comments on content of this T&C Procedure at any time 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 herein. The ArchSD 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.

TABLE OF CONTENTS

	Page
1. Introduction	1
2. Objectives of the T&C works	1
3. Scope of the T&C Works	2-4
3.1 Tests and Inspections during Construction	
3.2 Functional Performance Tests	
3.3 Commissioning and Statutory Inspections	
3.4 Documentation and Deliverables	
4. T&C Procedures	4-8
4.1 Tests and Inspections during Construction	
4.1.1 Factory Manufactured Equipment	
4.1.2 Concealed Structures and Installations	
4.1.3 Pipework & Accessories	
4.2 Functional Performance Tests	
4.2.1 Boiler System	
4.2.2 Water Tanks, Calorifiers and De-aerators	
4.2.3 Steam and Condensate Pipework System	
4.2.4 Hot Water Steam	
4.2.5 Steam Boilers	
4.2.6 Complete Steam & Boiler System	
4.3 Commissioning and Statutory Inspections	
4.3.1 Steam Boiler System	
4.3.2 Fuel Oil System and Underground Tank	
4.3.3 Exhaust & Ventilation System	

Annex

Annex I	Testing and Commissioning Progress Chart for Steam Boiler and Calorifier Installation
Annex II	Testing and Commissioning Certificate for Steam Boiler and Calorifier Installation
Annex III	List of Calibrated Instrument Necessary for the T&C Works

Testing and Commissioning Procedure for Steam Boiler and Calorifier Installation

1. Introduction

The procedures stated in this T&C Procedure 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), who are appointed as the Architect's Representatives, 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 for the Steam Boiler and Calorifier Installation (MI Contractor);
- (ii) To witness those T&C procedures as specified; and
- (iii) To accept the T&C certificates and other supporting data.

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

The administrative requirements for T&C works are in general as specified in the General Specification for Mechanical Installations 2012 Edition and all current corrigenda/amendments thereto published before the date of first tender invitation for the Contract issued by the ArchSD (the General Specification).

All words and expressions shall have the meaning as assigned to them under the General Specification unless otherwise specified herein.

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

For the avoidance of doubt, depending on the specific demands of individual installation, the PEME/PBSE may require additional or substitute T&C works in regard to any elements in the installation other than those indicated in this T&C 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 MI Contractor shall ensure that the Steam Boiler and Calorifier Installation (Installations) complies with all relevant statutory requirements and regulations. The T&C works shall also comply with all site safety regulatory requirements currently in force. In particular, the MI Contractor shall note the following:-

- (a) Boilers and Pressure Vessels Ordinance (Cap. 56), and its subsidiary legislation;
- (b) Fire Services Ordinance (Cap.95), and its subsidiary legislation;
- (c) Dangerous Goods Ordinance (Cap 295), and its subsidiary legislation;
- (d) Gas Safety Ordinance (Cap. 51), and its subsidiary legislation;
- (e) Air Pollution Control Ordinance (Cap. 311), and its subsidiary legislation;
- (f) Electricity Ordinance (Cap. 406), and its subsidiary legislation;
- (g) Code of Practice for the Electricity (Wiring) Regulations published by the EMSD;
- (h) Occupational Safety and Health Ordinance (Cap. 509), and other subsidiary legislation made under the Ordinance;
- (i) Factories and Industrial Undertakings Ordinance (Cap. 59), and other subsidiary legislation made under the Ordinance, including but not limited to Construction Site (Safety) Regulations; and
- (j) Electricity supply rules of the relevant power supply companies.

3.2 Functional Performance Tests

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

The MI 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 Specification and/or Particular Specification. The testing of systems may have to be carried out in stages depending on the progress of work or as proposed by the MI Contractor.

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

Any performance deficiencies revealed during the functional performance tests must be evaluated to determine the cause. After completion of the necessary corrective measures, the MI Contractor shall repeat the tests.

If any test cannot be completed because of circumstances that are beyond the control of the MI 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 MI 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 the Installations 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 Installations. Fine-tuning of the commissioned system shall be done by the MI 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 Installations, the MI Contractor shall notify the appropriate authority as specified in the General Specification and/or Particular Specification, through the PEME/PBSE of the completion of the Installations and its readiness for final inspection.

3.4 Documentation and Deliverables

The MI 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 by the MI Contractor in the appropriate test record forms. A complete set of these forms can be found in Annex II.

Data recorded in other formats may also be acceptable subject to prior approval of the PEME/PBSE. Upon completion of all the required T&C works, the MI 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 Specification and/or Particular Specification or the design intent should be recorded, with a description and analysis included.

Where required in the General Specification and/or Particular Specification, the MI Contractor shall conduct a final evaluation of the performance of the Installations, the results of which shall be included in the commissioning report.

One month before the actual commission 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 Installations 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.

Relevant
Clauses in
Annex II

4.1.1 Factory Manufactured Equipment

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 PEME/PBSE for approval. | NA |
| (c) | The original official Birth Certificate for the equipment shall be submitted to the PEME/PBSE 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 Installations 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 Installations 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

Clause
3.1.2

Pre-testing Inspection

4.2.3 Steam and Condensate Pipework System

Clause
3.1.3

Pre-testing Inspection

4.2.4 Hot Water Steam

Clause
3.2.1

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

- 4.2.5 Steam Boilers Clause
3.2.2
- (a) Pre-testing Inspection
 - (b) Water Chemical Test
 - (c) Water level control test
 - (d) Feed system control test
- 4.2.6 Complete Steam Boiler System Clause 3.3
- (a) Full-load test
 - (b) Thermal Test

The above performance tests shall then be carried out 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 MI Contractor shall endorse the data recorded on the Site, irrespective of whether the tests are successful or not, and submit a copy of the data record sheet to the PEME/PBSE. A full commissioning and testing report shall be forwarded to the PEME/PBSE within 14 calendar days after completion of commissioning and testing of the Installations. 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 Clause 4
- 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 MI Contractor is required to obtain the respective Certificates of Approval or Fitness and registration on behalf of the Employer for those equipment or systems which fall within the Boilers & Pressure Vessels Ordinance (Cap.56), and other relevant statutes. Original certificates should be framed and posted conspicuously near the respective equipment or systems on the Site. 4 copies of these certificates shall be submitted to the PEME/PBSE.
- 4.3.2 Fuel Oil System and Underground Tank Clause 4.3

The MI 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 MI 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 “Steam Boiler and Calorifier Installation”

Contract No.: _____

Contract Title: _____

Name of MI 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. _____) (1)																				
		Dates (2)																		Remark
Activities		Reference to Annex II	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A	S	A
1.	General Inspection/Tests	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 MI 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

“Steam Boiler and Calorifier Installation”

[illegible]

Tested / Checked by : (Name of MI 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 “Steam Boiler and Calorifier Installation”

Testing and Commissioning Progress Chart for Steam Boiler and Calorifier Installation (Rev.) ⁽¹⁾																				
Dates ⁽²⁾																				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 MI 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: Details 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 Testing and Commissioning (T&C) Procedure (*Note 1*) and/or any other procedure(s) as agreed between the PEME/PBSE and the Steam Boiler and Calorifier (MI) 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 item(s).
- 2.2 I also certify that site tests have been performed in accordance with the requirements set out in Parts 3 & 4 of this T&C Procedure and that the results are satisfactory. A record of the tests has been prepared and submitted to the PEME/PBSE.

Name of MI Contractor's Representative: _____	Signature: _____
Designation / Post of MI Contractor's Representative: _____	Date signed: _____
Name and Stamp of MI Contractor: _____	Telephone No.: _____

Notes:

1. "T&C Procedure" refers to the Testing & Commissioning Procedure for Steam Boiler and Calorifier Installation.
 2. The MI Contractor's Representative signing this Certificate must be a person or representative authorized by the MI Contractor.
- * Delete as applicable

Part 3 :Items Inspected and TestedItem tested/
checked by
MI ContractorItems witnessed
by PEME/
PBSE/PEMI3.1 Pre-commissioning Inspection3.1.1 Boiler

- | | | |
|--|---------|---------|
| (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 secured and that joint 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 secured 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 secured. | *Yes/No | *Yes/No |

Tested / Checked by : (Name of MI 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>MI Contractor</u>	Items witnessed by PEME/ <u>PBSE/PEMI</u>
(vi)	The fire fighting systems are installed and ready for use.	*Yes/No	*Yes/No
(vii)	Safety valve relief piping is secured, 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
(c) <u>Burner</u>			
(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 MI 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 <u>MI Contractor</u>	Items witnessed by PEME/ <u>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
 (d) <u>Fuel Oil System</u>		
(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 MI 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

	<u>Item tested/ checked by MI Contractor</u>	<u>Items witnessed by PEME/ PBSE/PEMI</u>
(e) <u>Gas System</u>		
(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
(f) <u>Underground Tank</u>		
(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
3.1.2 <u>Water Tanks, Calorifiers and De-aerators</u>		
(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

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

Annex II

	<u>Item tested/ checked by MI Contractor</u>	<u>Items witnessed by 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

3.1.3 Steam and Condensate Pipework System

(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 MI 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

3.2	<u>Preparation for Firing</u>	Item tested/ checked by <u>MI Contractor</u>	Items witnessed by PEME/ <u>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 MI 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 <u>MI Contractor</u>	Items witnessed by PEME/ <u>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

3.3 Performance Tests

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

3.4 Record of Tests

has	A record of test as indicated in Annex II of this T&C Procedure	*Yes/No	*Yes/No
	been completed and submitted to the project engineer.		

3.5 Comment

Tested / Checked by : (Name of MI 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 (m³/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 (m³/s)
- (vii) No. of thermometer
- (viii) No. of steam pressure gauge

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

(e) Instrumentation PanelManufacturer/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 MI 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 System4.2.1 General

Name of Premises : _____

Date of Assessment : _____

Name of the MI Contractor : _____

MI 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/m³) : _____

Tested / Checked by : (Name of MI 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 _a	°C			
Temperature of liquid fuel	t _c	°C			
Temperature of gas fuel	t _g	°C			
Liquid fuel fired	M _f	kg			
Gas fuel fired	V _g	m ³ /kg			
Flow rate of steam leaving boiler or feed water entering boiler	F _s	m ³ /s kg/s			
Temperature of water entering boiler	t _w	°C			
Mean gauge pressure of steam in boiler	P _s	mbar			
Mean temperature of steam	t _s	°C			
Mean temperature of feed water	t _f	°C			

Tested / Checked by : (Name of MI 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 MI 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 $C = 4.1868 \text{ kJ/kg.K}$ for water
 $x = \text{dryness fraction}$

(d) Boiler Efficiency

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

4.2.7 Result

Measurement	Symbols	Unit	Firing Rate		
			High	Medium	Low
Output from boiler	Q_B	kW			
Boiler Efficiency	E_B	%			

Tested / Checked by : (Name of MI 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 MI 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	$\pm 1\%$	1 year
Multi-tester (AVO) 0-1000V 0-10A 0-W	$\pm 1\%$	1 year
Clamp on ammeter 0-1000A	$\pm 1\%$	1 year
Insulation tester 500V-1000V	$\pm 1\%$	1 year
Pressure Gauge 0-100kPa 0-1000kPa	$\pm 2\%$	1 year
Sound meter 0-120 dBA	$\pm 2\%$	1 year
Hydraulic Tester (suitable range)	$\pm 2\%$	1 year
Temperature Gauge (suitable range)	$\pm 2\%$	1 year
Flow Meter (suitable range)	$\pm 2\%$	1 year
Other necessary testing equipment	$\pm 2\%$	1 year