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1.0 TESTING, ADJUSTING, BALANCING AND COMMISSIONING REQUIREMENTS

1.1 GENERAL

This section specifies the requirements for all testing, adjusting, balancing and commissioning (TABC) of the mechanical works to be carried out under the contract. The objectives of TABC are;

i. To verify the delivered materials are as per approved specification and good physical condition.

ii. To verify the installation works are carried out in accordance to specification and good engineering practises.

iii. To verify the performance in terms of functionality, safety, maintainability and operational ability of the installed equipment/systems meet the specified design intention through a series of tests and adjustments.

iv. To ensure all test result are systematically recorded and verified prior to system commissioning.

TABC works are divided into three stages as the following;

i. Delivery stage.

ii. Installation stage.

iii. Functional Performance Test stage.

Contractor shall submit Inspection and Testing Plan (ITP) of TABC works to be carried out in accordance to with this specification to Superintending Officer (S.O) for review and approval.

1.2 INSPECTION AND TESTING PLAN (ITP)

ITP shall consist of;

i. List of All TABC Requirement

All TABC works with specific scope and boundaries shall be clearly stated at every stage of TABC works and comply with the regulation of Jabatan Bomba dan Penyelamat Malaysia and document contract. Sample of Inspection and Testing Plan as per Table1.

ii. TABC Work Schedules

TABC work schedules shall be integrated into main project schedules.

iii. Method Statements

TABC method statements shall consists of TABC procedures, responsibilities, necessary tools, measuring equipment and accuracy, consumables and acceptance criteria. Type of test required is listed in Schedule of Inspection and Testing.

Method statements and acceptance criteria for all equipment installation stage inspection and functional performance testing shall be endorsed by manufacturer or manufacturer's valid representative.

Acceptance criteria shall be stated as per Schedule of Design Requirements, technical specification or any applicable standards.

ITP shall be updated for any changes and resubmitted to the S.O/S.O's representative for approval.

Prior to the commencement of the TABC works as per approved ITP, contractor shall issue Request For Inspection and Testing (RFIT) to the S.O. During the TABC, contractor shall have his supervising foreman and mechanics available to aid the testing and to perform any adjustments as directed. The TABC works shall be carried out under the direction of experienced personnel and witnessed by S.O or S.O's representatives. No subsequent installation works shall proceed without S.O's approval of the test result.

Depending on the specific demands of individual installation, S.O's Representative may require additional or substitute testing works in regard to any elements in the installation other than those indicated in this specification.

Table 1: Sample of Inspection Plan

Stage	Inspection / Test Name	Scope and Boundaries	Responsibility	Method Statement	Test Form No	Expected Date
Delivery Stage	Visual Inspection	All Equipment	Contractor	FS-ITP-001	FS-01	17 Jan
	Measurement (Size and Capacity etc)	Pipe & Cylinders	Contractor	FS-ITP-002	FS-02	19 Jan
	Documentation (DO, QA, etc).	All Equipment	Contractor	FS-ITP-003	FS-03	10 Feb
Installation Stage	Flushing Test	Pipe work	Contractor	FS-ITP-004	FS-04	17 Feb
	Cable Continuity and Insulation Test	Power cable from incoming supply to Switchboard and from Switchboard to cylinder actuator and detectors	Contractor	FS-ITP-006	FS-06	20 Feb
	Cylinder	Capacity, painting, leaking, bracket valves & Fittings	Contractor	FS-ITP-007	FS-07	17 Mac
	Room Integrity Test	Room (Air Tight)	Contractor	FS-ITP-008	FS-08	18 Mac
Functional Performance Stage	Simulated Discharge Test	Switchboard, detectors, actuator and flashing light	Contractor	FS-ITP-009	FS-09	30 Mac

1.2.1 Delivery Stage

All incoming material and equipment to site shall be verify by visual inspection, documentation and measurement that delivered items are comply with technical specification, as per approved materials and good physical conditions. Materials delivered to site shall be free from defects and adequately protected against site conditions.

List of verify and inspection during delivery stage as per Table 2:-

Table 2: Verify and Inspection

Inspection / Test Name	Description
Visual Inspection	• Good physical conditions • Free from defects • Adequately protected
Documentation	• Delivery Order • Quality Assurance • Technical Data
Measurement	• Size and dimension • Orientation of equipment and Plant Layout

1.2.2 Installation Stage

1.2.2.1 Visual Inspection

List of visual inspection and testing during installation as per Table 3: -

Table 3: Visual Inspection of Fire Suppression System

Inspection / Test Name	System/Component	Objectives
Visual Inspection	Cylinder	Verify the capacity, numbers and location cylinders as per drawing
	Pilot Cylinder	Verify the location as per drawing
	Flexible Hose	Verify the condition
	Safety Valve and pressure gauge	Verify the condition
	Support Bracket	Verify support and hanger ability to hold the cylinders during discharged.
	Piping	Verify types of pipe and colour coding
	Pipe support	Verify hanger and supports as per detail drawing and technical specification
	Pipe sleeves	Verify all the pipe sleeves with the right size
	Fire seal	Verify seal thru any floor, wall or partitions using non-combustible or fire resistant sealant material
	Nozzles	Verify of type and size of the orifice
	Detectors	Verify the cleanliness
	Cable and conduit	Verify the condition conduit
	Switchboard	Verify the colour coding and IP 65
	Switchboard Mounting	Verify the physical condition
	Flashing lights	Verify the colour of flashing light
	Signage	Verify the proper signage and labeling

1.2.2.2 **Testing**

List of inspection and testing works during installation as per Table 4:-

Table 4: Test List in Installation Stage

Inspection / Test Name	System/Component	Objectives
Pneumatic Test	Pipework	Verify integrity of all pipe joints and fittings are clean
Cable Continuity Test	Cable	Verify cable continuity effectiveness

1.2.3 Functional Performance Test

All Functional Performance Test shall commence after all inspection and testing during installation stage has been completed. List of functional performance test as per Table 5:-

Table 5: List of Functional Performance Test

Inspection / Test Name	System/Component	Objectives
Interfacing Test	Detectors & Switchboard	Verify interfacing between detectors and Switchboard
Indicator Light Inspection	LED	Verify all the devices is function and good operation
1st zone alarm test	Smoke detectors, flashing light, intermittent alarm sound.	Verify the mode of operation (at first stage the smoke will be detect)
2nd zone alarm test	Heat detectors, flashing light, continuous alarm sound.	Verify the mode of operation (at second stage the heat will be detect)
Discharge test	Solenoid valve/cylinder actuator	Verify the 12 volt current supply to solenoid valve/actuator
Fault Test	Fault switch	Verify the fault switch is function
Cable continuity test	Cable	Verify connection to main fire alarm
Simulated automatic discharge test	Switchboard, detectors, cylinders, flashing light, cable & other component	Verify the system activated
Simulated manual discharge test	Manual key switch	Verify the manual discharge

Detail method statement for testing shall be submitted conforming to the test requirements in this specification. All components shall be installed as per approved working/shop drawings, approved material list and free from defects.

1.2.3.1 Switchboard and Power Supply

List of Switchboard and power supply inspection and test name are listed in Table 6. Detail method statement for testing shall be submitted conforming to the test requirements in this specification. Only competent person as in Electricity regulations 1994 shall conduct the switchboard testing.

Table 6: Switchboard and Power Supply Inspection and Test Requirements

Inspection / Test Name	Description
Switchboard General Inspection	• Verify physical switchboard components are as per specification. • Check for tripping setting and system trip • Check for cable terminal tightness. • Check for equipment, lightning arrestor and grounding connection.
Power Supply Test	• Verify that power supply parameters are within permissible range, safety protections are in place and physical condition of switchboard and cabling works are acceptable as per specification and approved shop drawings. • Verify phase protection relay installation and function. • Switching from normal electrical to essential supply

1.3 COMMISSIONING

Commissioning includes achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.

All completed test forms and test summary shall be submitted to S.O/S.O's representative for final review and approval. Having satisfied that all appropriate tests have been conducted and the performance of the installation meet the design objectives; S.O's representative will issue or recommends to the S.O for the issuance of Certificate of Practical Completion (CPC).

1.3.1 Handing Over Documents

After the issuance of Certificate of Practical Completion, contractor shall submit all related project handing over documents as the following;

a) Test Report complete with fully verified Inspection checklist and Test Forms.
b) Defects List
c) Operation and Maintenance Manual which includes
    - *Manual/Standard Operating Procedures*
    - *Preventive Maintenance Schedule and Manual*
    - *Equipment/Product Engineering Data.*
    - *Method Operation of the system*
    - *Contractor and manufacturer contact details*
    - *Circuit Diagrams*
    - *Inventory List*
d) As-Built drawings
e) Schedule of System Familiarization Program to end users.

1.3.2 System Familiarization Program

In-class and practical System Familiarization Program shall be conducted to the personnel nominated by S.O within one (1) month of issuance of Certificate of Practical Completion. Program shall focus on:

- Overview of design concept and objectives
- Operation instruction & competency requirement
- Maintenance procedures
- Critical operating parameters monitoring and
- Emergency response & safety procedures.
- Jabatan Bomba dan Penyelamat Malaysia requirement and procedures.

Contractor shall submit program modules and materials to S.O for approval prior to commencement of training. Particulars of trainee shall be recorded and send to S.O for records.

2.0 TESTING INSTRUMENTS AND ACCESSORIES

All permanent sensors and gauges use for measurement of temperature, pressure and flow shall be factory calibrated and all calibration certificates shall be submitted to S.O prior to testing works.

The contractor shall provide all necessary testing, calibrating instruments and labour required for the testing, adjusting, balancing and commissioning of the complete firefighting system installed under the contract.

The contractor shall also allow for any necessary replacement of parts in order to achieve the conditions specified in the drawings and specification.

Testing instruments specification shall be but not limited to as per *Table 7*.

Table 7: Testing Instruments

Measurement	Type	Accuracy
Ampere	Clampmeter (instantaneous)	2.0% ± 5 digits (45-65Hz)
Voltage	Clampmeter (instantaneous)	1.5% ± 5 digits
Combined power, ampere, voltage, multi meter.	Power/Energy logger (continuous)	Active Power: ±(1.2% of reading + 0.005% of range) (For PF≥0.99); ±(1.2% of reading + 7 x (1-PF) + 0.005% of range) (from 0.6 PF to 0.98PF)