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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) 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 with specification and good engineering practises.
- iii. To verify the performance in terms of functionality, safety, maintainability and operation ability of the installed equipment/systems meet the specified design intent through a series of tests and adjustments.
- iv. To ensure all test result is 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 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, responsibility, 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 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 in 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 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 and Testing Plan

Stage	Inspection / Test Name	Scope and Boundaries	Responsibility	Method Statement	Test Form No	Expected Date
Delivery Stage	Equipment Verification and Physical Inspection	Equipment	Contractor	AFA-ITP-01	AFA-01	01 Jan
Installation Stage	Support and Hanger Load Test	Equipment	Contractor	AFA-ITP-02	AFA-02	05 Jan
	Cable Continuity and Insulation Test	All LV Cable	Contractor	AFA-ITP-03	AFA-03	07 Feb
Functional Performance Stage	Fire Alarm Panel Physical Test	Fire Alarm Panel	Contractor	AFA-ITP-02	AFA-02	15 Mac
	Batteries Test	Batteries	Contractor	AFA-ITP-03	AFA-03	18 Apr
	Devices and signaling Test	Devices and Cable	Contractor	AFA-ITP-02	AFA-02	17 May
	Sound Level Test/Flashing Light Test	Alarm/Sounder/Flashing Light	Contractor	AFA-ITP-03	AFA-03	06 Jun



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.

1.2.2 Installation Stage

List of inspection and testing works during installation as per Table 2;

Table 2 : Test List in Installation Stage

Inspection / Test Name	System / Component	Objectives
Cabling Insulation Test	Cabling	Verify insulation effectiveness
Cable Continuity Test	Electrical Cabling	Verify cable continuity effectiveness

1.2.2.1 Cabling Insulation Test

Insulation resistance test shall be performed via a megohmmeter with an acceptable voltage output that recommended by cable manufacturer. Each conductor shall be individually test with all other conductors and shields grounded. Test duration shall be one minute and the resistance value shall be recorded until a steady reading is obtained.

1.2.2.2 Cable Continuity Test

Cable continuity test shall be performed on each power cable by ohmmeter method. Perform an acceptance test on cables, including terminations and joints, after cable system installation and before the cable system is placed into service. In accordance with ANSI/IEEE 400, by means of direct voltage (dc) and recorded in the relevant testing form.

1.2.3 Functional Performance Test

List of functional performance test are as the following. All Functional Performance Test shall commence after all inspection and testing during installation stage has been completed.

1.2.3.1 Fire Alarm Panel Operational Test

Before the testing, mains power shall be supplied and backup battery shall be properly connected to the fire alarm panel. When the fire alarm panel switched on, all relevant indicators shall be illuminated such as “Supply on”, etc. and fault indicator shall not be illuminated such as “Power failure”, etc. The printer shall be tested to print any status/fault occurred or recorded by the fire alarm panel.



The panel shall be able to integrated and sending signal to Control Monitoring System (CMS) and link to Jabatan Bomba dan Penyelamat Malaysia, sub Fire Alarm Panel and all relay (e.g. AHU, Lift and Pump).

1.2.3.2 Batteries Test

The batteries shall be tested as follows:

- i. Charger test: With the batteries fully charged and connected to the charger, the voltage across the batteries shall be measured with a voltmeter. The voltage reading shall be as per specified in the specification.
- ii. Load voltage test: With battery charger disconnected, the terminal voltage shall be measured while supplying the maximum load required by its application. The voltage level shall not fall below the levels specified in the specification.

Turn Off mains power supply to the fire alarm panel and ensure that the batteries supply shall be able to sustain the load as per specification.

Turn On the mains power supply and ensure that the duration to recharge the batteries to full charge shall be in accordance to the specification.

1.2.3.3 Devices and Signaling Operational Test

Detectors and main fire alarm panel shall be tested at different zone and the result shall be as follow:

- i. The device's address shall be shown on fire alarm panel as per designed/programmed and mimic diagram.

For all tests conducted which involve an alarm signal or fault signal:

- i. Master alarm sounder/bell shall be activated for the initialisation of alarm signal;
or
- ii. Buzzer in the fire alarm panel shall be activated for the fault signal.

Manual call point shall be tested using testing key and alarm/sounder/flashing light shall be response within 3 seconds.

1.2.3.4 Alarm/Sounder/Flashing Light Test

Alarm/sounder/flashing light shall be tested for the function. The result of the test shall be in accordance to the specification.



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 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.*
 - *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
- Emergency response & safety procedures and
- Environmental protection 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

The contractor shall provide all necessary testing, calibrating instruments and labour required for the testing, adjusting, balancing and commissioning of the addressable fire alarm 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. Provisional sum for that purpose is provided in Schedule of Price.

Testing Instruments specification shall be but not limited to as per Table 3.

Table 3 : Testing Instruments

Measurement	Type	Accuracy
Noise Level	Sound Level Meter Class 1	Class 1 as per IEC 61672-1:2002
Ampere	Clampmeter (instantaneous)	2.0% ± 5 digits (45-65Hz)
Voltage	Clampmeter (instantaneous)	1.5% ± 5 digits
Electrical Resistance of insulator	Megohmmeter	-
Cable Continuity	Ohmmeter	-
Functional of Manual Call Point	Testing Key	-
Functional of Optical beam/Aspirating /Smoke Detector	Aerosol spray	-
Functional of Heat Detector	Heat Gun, Hair dryer, Heat Lamp	-
Functional of Flashing Light	Flashlight, Test Lamp	-



