

SECTION 4 - SPECIFICATION FOR TESTING AND COMMISSIONING (T&C)

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SECTION 2 - SPECIFICATION FOR TESTING AND COMMISSIONING (T&C)**2.1 WATER CIRCULATION SYSTEM**

The Contractor shall have all necessary testing equipment in order to calibrate and test the system. Among the test that the contractor should carried as follow but not limited as below and S.O as the right to request the contractor to do certain test to conformant to certain standard and requirement for example water quality of swimming pool and another pool meeting FINA Standard or WHO standard for the safety of the user. If necessary the report to produce by certain accredited laboratory then the contractor must do so.

The inspection, testing and approval of the water supply by state water authorities shall be the responsibility of the Contractor. Any fee in respect of testing and approval shall be borne by the Contractor. The Contractor shall allow for the cost of all tests to the plumbing system to the satisfaction of the S.O. The completed system shall be tested for water and the plumbing system shall be tested for hydraulic performance.

The cost for providing all testing and measuring equipment, all materials and consumables such as fuel, electricity, water etc. shall be borne by the Contractor.

All pipework which is to be encased or concealed shall be tested and approved before it is finally enclosed.

The Contractor shall give the S.O a full seven days' notice of his readiness to carry out acceptance tests and shall submit for his approval a complete and detailed schedule of the tests to be carried out.

Before the commencement of acceptance tests the Contractor shall have brought the installation to a state of practical completion and shall have completed all of his preliminary testing and adjusted the equipment to its proper running order.

During the testing period no modification, adjustment or other work on the installation shall be carried out without the permission of the S.O. Should there be any contravention of this requirement the results of all tests completed may be rejected and a retest carried out.

No acceptance test shall be carried out except in the presence of the S.O the Local Authority's representative and the Contractor or their respective representative appointed for the purpose.

Should the installation fail to perform in accordance with the requirements of the Specification, the S.O may reject the whole or any part of it. The Contractor shall bear all costs and expenses for all retests and remedial works.

2.1.1 Testing of Pipework**2.1.1.1 Pressure Test**

Internal reticulation and main distribution pipes shall be slowly and carefully charged with water in order that all air is expelled from the system. The system shall be allowed to stand full for 24 hours. An air relief valve should be provided at the highest point in the system to bleed off any air that is present.

The bursting test for pipe shall be carried out according to nominal pressure (PN) pipe at the factory prior to installation.

A test pressure of 1.5 times the maximum working pressure measured at the lowest point or 100 psi measured at the lowest point, whichever imposes the higher pressure on the system, shall be applied for 24 hours. After correction for ambient temperature the pressure drop shall not exceed 5% of the test pressure.

Should any signs of leakage occur in the tanks or pipe-work, their positions shall be marked and the Contractor shall carry out remedial measures. The pressure tests procedure shall be repeated until the whole water system passes.

No pipe-work shall be covered or concealed until it has been tested to the satisfaction of the S.O. Where arrangement of work makes necessary, the piping system shall be tested by sections but final overall test shall be carried out to prove joints between sections.

All equipment not designed to withstand test pressure shall be disconnected during test, but shall be reconnected and tested under actual working pressure.

2.1.1.2 Flow Test

Upon completion of pressure tests on all risers, all pumps shall be run with all valves fully open. During test running, the following data shall be recorded:-

- a) Flow at outlet into tank to which water is pumped
- b) Head at pump discharge outlet
- c) Current consumed, and
- d) Voltage

The permanently installed pumps shall not be used for pressure testing of the water system.

2.1.1.3 Flushing/Sterilization of Water Circulation System

After completion of the pressure tests to the satisfaction of the S.O and the State Water Authority, the whole system shall be thoroughly flushed with clean mains water to remove any debris within the system.

The Contractor, at his own expense, shall use public water supply for cleaning and flushing out of all the plumbing system that he had installed in this Contract.

Control valves and all equipment liable to damage, shall be disconnected before cleaning out. All strainers shall be thoroughly cleaned out during and at the completion of the cleaning out operation.

2.1.1.4 Balancing

Prior to balancing, all isolation/gate valves shall be checked to be in the fully open position.

The balancing shall be carried out on a floor by floor basis. All water appliances on the floor to be balanced shall be turn on.

2.1.1.5 Records

All pressure, flow and balancing tests shall be recorded and certified by Contractor and S.O.

The S.O reserves the rights to order a re-test should the Contractor fail to produce authentic test record.

2.1.2 **Testing of Storage Water Tank**

After complete installation of the tank, it shall be thoroughly sterilized and flushed with mix water and chloride of lime with concentration of 1.0 ppm. After flushing, the tank shall be filled with water to maximum operating capacity level and the level of water surface shall be carefully recorded. The tank shall be accepted as satisfactory if after a period of 48 hours there is:-

- a) No measured reduction in water level, due allowance being made for evaporation from the surface of water
- b) No visible sign of leakage from any part of tank: and
- c) No deformation of any part of the surface

If the test results do not satisfy the above conditions of test, the Contractor shall locate and rectify all defects and leakages and the test shall be repeated. The Contractor shall bear all costs and expenses for all tests and remedial works.

2.1.3 Testing of Pump

All pumps and motors shall be checked for flow rates, pressures and RPM. The input signal device sensors and controllers shall be checked to ensure the pumps cut-in and cut-out. Refer to JKR Malaysia required flow rate as per tender.

2.1.4 Post Occupancy Testing and Commissioning

Further adjustments to the system controls such as re-balancing, re-tuning, re-checking and re-adjustment etc. shall be made whilst the building is occupied and the installation is in use during the defects liability period. The cost of the adjustment shall be included in the tender.

2.1.5 Testing of Filtration System

Normally for conventional type pool filtration system, filtering of the water is by sand bed filters. For other systems reference should be made to the particular equipment manufacturer's published instructions. State of System Check that :-

filter beds are set on concrete kerb or slab and are level;

the correct grade and depth of sand has been installed against the manufacturer's filter data label;

pump strainer basket is in proper position and lid is properly secured; and

all inspection doors are properly closed after inspection and that all valves are set in their proper position for initial starting up.

After the water has been filled to the correct pool level and that all mechanical and electrical checks on the circulating pumps are completed to satisfaction, initial start-up of the filter beds could then commence.

Set the corresponding valves in "filter" positions.

Switch on the circulation pump and run for approximately 5 minutes.

During this filtering cycle some remnant construction debris and pipe dirt will be carried and directed into the top of the filter and then trapped in the filter. The pressure across the filter bed as reflected in the differential pressure gauge provided will increase.

After the prescribed time lapsed, turn off the pump and set all the necessary valves to "backwash" position.

Run the backwash pump and air compressor and backwash for 6 to 8 minutes or until the water appears to be clean through the sight glass. The air supply must be kept at the manufacturer's recommended value and should not be exceeded.

After "backwash" process is completed, turn off the pump and reset all necessary valves to their "filter" position for normal operation.

2.1.6 Testing of Disinfection System

2.1.6.1 Sodium hypochlorite (mixed oxidant) generation system

Check that all pipework and their associated connections are tight, all the strainers are free of dirt, all the valves are in the correct positions and flow alignment, their connections are tight and that all other relevant fire services as well as occupational safety and health requirements of the electrolytic cell (mixed oxidant generator) room are complied with.

Check the power and control cables to all equipment and controllers in the system for correct material, sizing, and installation, and the provision of all necessary earth terminals and their interconnections are tight and tally with the details on the approved shop drawings, then carry out Meggar test on the metal casing of all equipment and for every motor starter to ensure that they are properly earthed in particular for the door earth strap and earth terminals of the casing, and finally test the proper function of the power supply of the whole system for electrical safety protection.

Check any air (hydrogen) blowers and injection pumps in the system and the associated equipment by hand for smooth running, and then examine all equipment mounting for safety and integrity.

Check the electrolytic cell for any damage or cracks, the nameplate data such as the rated hypochlorite (mixed oxidant) output, the full load current and wattage, the required input voltage and wattage, water level, serial numbers of electrolytic cell and its associated power supply unit (transformer/rectifier) and incoming power isolating switch and record them on a test record.

Check the brine storage tank, the hypochlorite (mixed oxidant) tank, and the water softener tank for sufficient storage capacities (minimum 2-week continuous consumption), any impact damage and whether their liquid level assemblies are in place and undamaged. Ensure that the feed water source of the softener tank is derived from the city mains fresh water.

Check that the sodium hypochlorite (mixed oxidant) line is connected to the hypochlorite (mixed oxidant) tank.

Check that the check valves are provided to prevent the softener from flowing back into the brine tank.

Check that all manual valves in the water line operate freely, ensure that all pipe joints are water-tight, all connections are made, and all water leakage test shave been satisfactorily completed. Then close all drain valves and open all manual valves and the regulating valves in the water flow and return lines to admit water returned from the filtration system (and bypassed the heating system where provided). Check the fitness of the solenoid valve diaphragm and the cleanliness of the filter media in the cooling water system in case of a water-cooled power supply unit.

Calibrate the liquid level sensors, the brine concentration sensor, the pH sensor, the free chlorine (mixed oxidant) analyzer, the ORP sensor, and the gaseous hydrogen leakage sensor, and check their cleanliness from the monitor of the control panel.

Check the control panel for the correct layout as approved shop drawings, the availability of mains AC power supply and equipment terminal AC/DC power supplies at required operating voltages, the section control circuits, the tightness of its wiring terminals, the indication lamps (flash lights) and alarm buzzers (sirens), the cooling fans, the general cleanliness, the control fuse or MCB, and test the emergency stop, the sensing devices and measuring instruments, and the control functions. Ensure that the control unit has been set to proper levels of ppm for breakpoint chlorination condition and for minimum combined residual level and pH value.

Pre-commission the water lines by filling, flushing and refilling with main's fresh water as well as cleaning the strainers and replacing the filter media. Commission the water flow rates for the electrolytic cell by adjusting the regulating valves to ensure adequate water supply is available to system water inlets at the normal operating flow rate and the desirable ranges of water flow temperatures and water pressures for full load output of the electrolytic cell, and perform functional test for the water flow switches and pressure regulators.

Turn on the power supply. Test and commission the proper function of the whole system for accomplishing system working pressure, safety and operation interlock, running status, running current, and proper range of operation parameters of the system, and record measurement results.

Perform disinfectant production performance test at full load current, and record the output pH level and free chlorine (mixed oxidant) concentrations by the pH sensor and free chlorine (mixed oxidant) analyzer as well as take down the water flow rate readings from flow transmitter for calculation of the production rate of disinfectant.

2.1.7 Testing of Control System

All controllers and actuators shall be tested and adjusted for the modulating range to ensure correct operation of all control systems. Control sequences shall also be verified. Adjustment should be carried out until requirement of the water quality set by FINA or WHO being met.

All safety controls shall be tested and if necessary under simulated conditions.

2.1.8 Electrical

All thermal overloads on starters shall be checked and adjusted for the actual load and the settings recorded. All circuit breaker overload settings shall be checked and recorded. All test report should be endorsed by competent personal approved by Suruhanjaya Tenaga to ensure the system is safe to use and operate.

Each motor shall have its voltage and current drawn recorded.

2.1.9 Reliability Test & Test Records

When the preparatory tests have been completed successfully and the Contractor has notified the Superintending Officer that the system is ready to work, each section of the installation will be required to operate either continuously or intermittently as may be required without failure of any kind before the 'Handing Over Certificate' will be issued.

Should any failure occurred due to, or arising from faulty fittings, materials, or workmanship but otherwise sufficient to prevent the commercial use of the installation, a reliability test period of one calendar month shall be recommended after the Contractor has remedied the cause of failure to the satisfaction of the Superintending Officer.

On completion of the testing and commissioning of the installation, the Contractor shall submit 2 copies of all test record to the Superintending Officer for verification.

2.1.10 Portable Pool Cleaning Equipment

These are loose items usually to be ordered and specified in the General or Specification. Visual check on the correctness of the equipment offered and simple performance check against the equipment manufacturer.

----- **END OF SECTION 4** -----