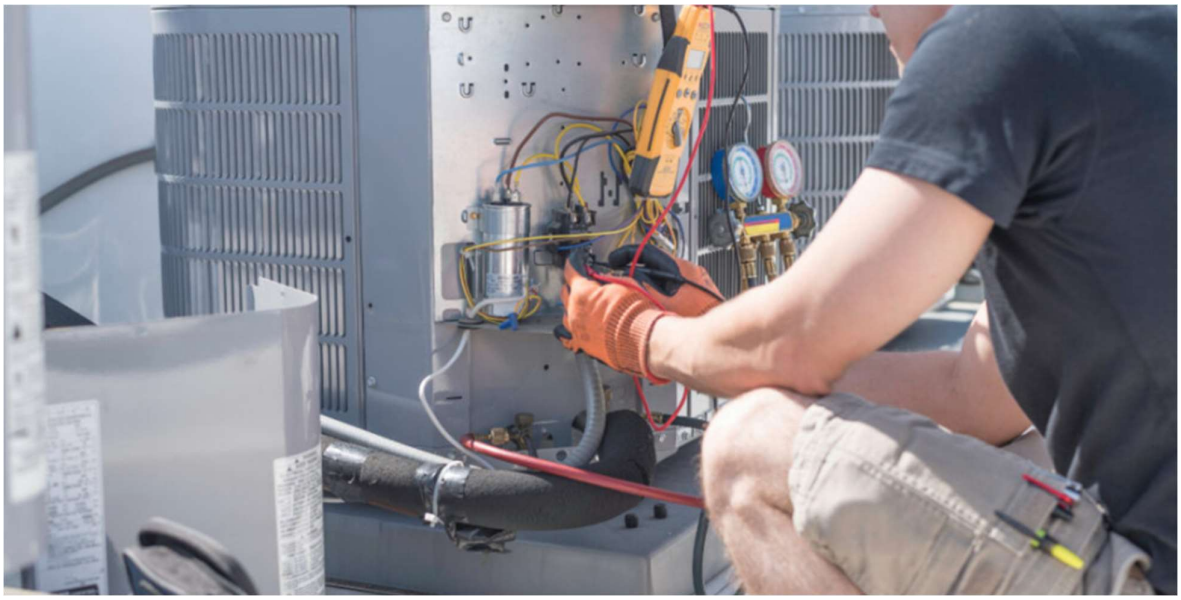
METHOD STATEMENT

FOR

ADJUSTING & BALANCING



OF

HVAC SYSTEM

HVAC SIMPLIFIED™

For HVAC and Engineering content Visit: www.hvacsimplified.in

	Client :-	**Contractor**	
Method Statement Title **Adjusting & Balancing of HVAC System**		***Document No.***	
		Rev. No. & Date:	

Rev.	Description	Date	Prepared By	Reviewed By	Approved By	Approved By

1.0 General Requirements :

Balancing and Adjusting of the HVAC System in compliance with the specified tolerance and limitations outlined with CIBSE & BSRIA standards, guidelines and with reference to project specification.

Before commencement of any test, We shall determine and schedule a list of the commissioning information requirements which shall include the following :

1. Full pre-commissioning check-list for the specified systems & equipments
2. The scope of works, system functions and interrelation with other sevices if any.
3. Technical specifications , tolerance and limits of the system.
4. Set of as built drawings, design drawings and approved submittal of Materials & Equipment
5. Design Criteria
6. Schedules of all HVAC Equipments
7. Manufacturer’s setting to work and operating instructions.
8. Sound levels in selected areas
9. Power demands, starting currents, running currents and control logic
10. All room temperature, humidity and air pressure requirements.
11. All other details necessary to identify the performance of the installed HVAC plant and equipments
12. Program time period of completion as required by the client
13. Witnessing procedures by the consultant/client.

Prior to commissioning works , the following checks shall be carried out

1. Proper installation of Fire Dampers and Volume Control Dampers.
2. Correct sizing of grilles, registers and diffusers.
3. Equipments installation are in accordance with the approved drawing
4. Pipe installation and correct pipe size.
5. Terminal boxes electrical wiring for both power and control as per the recommendation of the supplier.
6. Starter, overload relay ranges, motor sizes and speed controllers verified.

   Type, size and quality of filters is verified.

2.0 Safety Precaution :

Safety awareness should be followed during execution of Testing & Commissioning works :

1. Secure Work Permit in conjunction with the approved safety plan before starting the work.
2. Usage of proper tools, instrument to be handled by the authorized person only.
3. Usage of proper safety shoes, safety belts, safety helmets, gloves, goggles, mask, ear plugs & any other safety accessories as required during commissioning works.
4. Guards of approved design shall be provided for all V-belts drives, coupling shafts and exposed rotating machinery.
5. Electrical power supply shall be isolated and panel switch gear shall be locked whenever carrying out work on any rotating equipment or electrical panels.
6. No commissioning works shall be carried out without adequate lighting available.
7. Approved Project Safety Plan & Procedures shall be followed during execution of commissioning works .

8. Provide Warning Boards / Tapes as required during Testing & Commissioning works

3.0 Preliminary Checks :

The following checks shall be carried out in order to ensure that the system is in a satisfactory and safe condition before starting up fans.

3.1 Air System

A. State of the Building and System

1. All doors and windows are fitted.
2. Suspended ceilings fitted.
3. Access available to all areas to be tested.
4. Leakage test to builders shafts and plenums complete.

B. System Cleanliness

System shall be free from construction debris and dust. The following checks for cleanliness shall be carried out :

1. Air intake screens
2. Fan & other equipment chambers
3. Fan Internals
4. Heater and Cooler batteries
5. Cooling & Condensate Trays
6. Condensate drainage traps
7. Humidifiers
8. Volume Control Dampers and linkages

9. Ducting & other airways

10. Sensing elements

11. Terminal units

C. Check that the system is installed as per the design or approved drawings.

D. Air Regulating Devices and Other components within Airways

1. Volume Control dampers are properly operating and accessible

2. Free movement throughout the range on motorised damper control linkages.

3. Dampers are secured throughout the system.

4. Turning Vanes, thermal insulation, acoustic linings, and sensing elements have been fitted and are undamaged.

5. Measurement points are identified and Test Holes prepared

6. Terminal units are fitted and cleaned

7. Louvers and Diffusers are set properly.

8. Flexible Ducts are installed properly.

9. VAV Units are installed as per the approved drawings & as per manufacturer recommendation.

10. Control sensor and transmitter are installed in correct location.

E. Visual Checks for Air Tightness

1. Builders work ducts and shafts are sealed.

2. Ductwork joints, including flexible joints couplings are air tight

3. Inspection covers are fitted

4. Plugs or covers for Test Holes are fitted.

F. Fan Checks

The following should be checked :

1. Direction of rotation is correct
2. Fan and motor are lubricated
3. Fan rotates freely
4. Drive guard is fitted
5. Motor and pulleys are level and aligned and belt tension is correct.
6. Anti-vibration mountings and the removal of transit bolts and packing materials
7. Internal and external of the fans are cleaned.

G. General Electrical Checks

Prior to the initial start-up of any electrically driven fan, electric air heater or automatically advancing filter, the following shall be checked:

1. Local isolation of motor and control circuits
2. No unshrouded live components within panels
3 Panels and switchgear are clean
4. All electrical panels are site checked.
3. Motor insulation test is completed.
4. Motor surroundings are clean.
5. Transit packing of contactors and other equipments are removed.
6. All power and control wiring is completed in detail to the circuit diagram

7. Fuse ratings are correct

8. Starter overload is set correctly

9. Adjustable thermal cut outs are set correctly

10. All cover plates are fitted.

H. Initial Running of Fan Set

Wherever possible the first start of any motor should be on light load and shall check the following:

1. Direction of rotation is correct
2. Motor, drive and fan are free from vibration or undue noise.
3. Motor starting current for sequence timing adjustment is correct. (star-delta changeover point)
4. Motor running current and voltages on all phases are within the specified motor rating and the readings are recorded.
5. No overheating of motors
6. No seepage of lubricant from housing
7. No overheating of bearings
8. Oil rings are running freely
9. Check motor rpm

3.2 Chilled Water System

A. The following Preliminary checks shall be carried out to find out that the system is in a satisfactory and safe conditions.

1. All plant items are installed in accordance with the design drawings, specifications and the manufacturer's instruction

2. Correct installation procedures were followed

3. Acceptable system cleanliness

4. Pumps are installed in accordance with specs, manufacturers recommendation and approved drawing
5. Water connections are provided as required
6. Manual and automatic air vents are provided as required.
7. Drain valves and air vents of appropriate sizes are connected and free from blockage
8. Connection to FCU, AHU, etc., are correct in relation to design water flow and direction
9. Control, regulating valves and nonreturn valve are installed as per design and direction
10. Strainers are fixed (where applicable)
11. Pipe & fittings are adequately supported.
12. Adequate space is provided to access equipment and system componenet as required.
13. Local isolation of motor and control circuit is provided.
14. Panels and switchgear are clean
15. All connections are tight on bus bar and wiring.
16. Starters overload are correctly set/range is ok
17. Motor terminal wiring is correct.
18. All power and control wiring is complete as per approved drawing
19. Insulation test on pump motor has been performed satisfactorily.
20. Inward cut outs are correctly set.
21. All fuse ratings are correct.

22. All mechanical checks are completed on pump/valves

23. Declared voltage is available on all supply phases.

24. Alignment of the pump & motor is checked

25. Pressure gauges and thermometers are fixed as per approved drawings.

B. Before initial start up of the Chilled water pumps for Flushing purposes, the following checks shall be carried out

1. System is pressure tested, water tight and thoroughly flushed
2. Strainers have been cleaned.
3. Valves are open
4. Bearings and external parts are clean
5. Components are secure, impeller is free to rotate and flow direction is correct
6. Couplings are securely aligned.
7. Drive guard are fitted securely .
8. Motor and pump bearings are lubricated.
9. Power supplies are operational.
10. Direction of rotation checked.
11. Non return valve is installed correctly and operating properly.

Note: Chilled water system flushing and cleaning shall be carried out as per the specialist contractor's procedures and recommendations.

C. Electrical checks:

Before the first operation of any electrical component or appliance the following procedure should be adopted

1. Appliance and control circuits are locally isolated
2. There are no unshrouded live components within the panels
3. Panels and switchgear are clean
4. Transit packing has been removed from contactors and other equipments
5. No mechanical damage to switchgear
6. All connections on busbars and wiring are tight
7. All power and control wiring has been completed in accordance with the circuit diagram
8. All fuse ratings are correct
9. Internal links on the starter are correct
10. Starter overloads are set to the motor full load current.
11. The adjustable thermal cut-outs are set correctly.
12. All the cover plates are fixed.

D. Pumps Initial run

1. The direction and speed of rotation of the motor shaft are correct.
2. The motor, pump and drive are free from vibration and undue noise.
3. For star-delta starters, the starter sequence timing has been adjusted as necessary in the light of motor starting current.
4. The motor running current is balanced between phases and does not exceed the motor nameplate stated rating.

5. No overheating of pump & motors.
6. No seepage of lubricant from the housing
7. Free movement of valve spindle.
8. No overheating of bearings & are lubricated.
9. Ventilation systems of air-cooled motors are operating correctly

4.0 Method Statement :

4.1 Air System

A. Fan Coil Units

1. Check that all automatic controls are fully commissioned and operating properly
2. All pre-commissioning checks have been carried out
3. Select the specified speed of the Fan Coil units
4. Set all the dampers in the duct outlet at full open position
5. Take initial total flow of the unit by adding up all the measured volume from each outlets (initial scan)
6. Compare the reading against the designed flow. Find out the percentage of the design flow.
7. Find out the index outlet (i.e. which has the very low percentage of reading) from the initial scan.
8. Keep the index outlet damper fully open

9. Then throttle the air volume at each outlet to get the design percentage of flow proportionally by using the Flow hood. The velocity measured at the outlet of the hood is to be multiplied by the effective area of hood to get the air volume.
10. Each time when you throttle the outlet by closing the diffuser damper, the index outlet air flow raises gradually. Measure the index point each time.
11. By the time the last outlet is completed, air volume at all outlets including the index are proportionally balanced.
12. Note all the readings at all outlets and keep records.

B. Ventilation Fan (Extract Fan)

1. Check that all pre-commissioning checks has been carried out.
2. Measure the motor ampere & fan rpm of all fans and shall be set to provide total air volume within acceptable tolerances
3. Fan speed & motor current shall not exceed the maximum allowable range set by the manufacturer
4. Set all the main duct & branch duct dampers at full open position
5. Check the total flow of the fan by traverse method, flow will be set to 105 % of design.
6. Check the flow in all branches and find out the index branch

7. Balance the branches in proportion with the same percentage of total flow by adjusting the volume control dampers and keeping the index branch damper at fully open position.
8. Measure the index branch and proportionally balance it to the same percentage.
9. TERMINAL BALANCING (Using Anemometer & Flow Hood)
    - Measure the flow at each outlet of the terminal branches
    - Find out the index terminal and keep the damper fully open
    - Balance the other outlets proportionally to the same percentage of flow set in the branch duct.
    - Check the flow in each outlet and record including the index terminal
10. Take the total flow in the main duct again and record by using traverse duct method.
11. After Total System balance , the following values shall be measured and recorded:
    - Fan RPM
    - Motor voltage and amperes
    - Static pressure entering the Fan
    - Static pressure leaving the fan
12. Static pressure entering and leaving the fan shall be measured as follows:

- Static pressure readings leaving the fan shall be taken as far as from the fan as is practical, but shall be before any restrictions in the duct (such as duct turns)
- No readings shall be taken directly at the fan outlet or through the flexible connection
- Static pressure entering the fan shall be measured in the inlet duct upstream of any flexible connection and downstream of any duct restriction.
- Static pressure entering a double inlet fan shall be measured through the wall of the plenum, which houses the fan
- In all cases, the reading shall be taken to represent as true a value as possible. True value is actual measured static pressure .

C. AHU with Constant Volume System :

1. Set the fan rpm to provide design total air quantity within acceptable limits.
2. Fan speed shall not exceed the maximum allowable rpm as established by the fan manufacturer.
3. Set all the main duct & branch duct dampers and outlet dampers at full open position.
4. Check the total flow of the fan by duct traverse method, flow will be set to 105 % of design flow

5. Check the flow in all branches and find out the index branch.
6. Balance the branches in proportion with the same percentage of total flow by adjusting the volume control dampers and keeping the index branch dampers at fully open condition.
7. Measure the index branch and proportionally balance the air terminals.
8. The final setting of fan rpm shall not result in overloading the fan motor in any mode of operation. Dampers shall be modulated, and the ampere of the supply fan motor shall be measured to ensure that no motor overload can occur.
9. After Total System Balancing, the following values shall be recorded:

    a. Fan rpm
    b. Motor voltage and current
    c. Entering static pressure
    d. Leaving static pressure.

D. Balancing air terminals procedure :

Depending upon location and access to air terminals, various types of airflow measuring instruments will be utilized to record the actual airflow at terminals.

Assuming adequate access provided, a direct reading balometer would be used which gives a direct reading of volume rather than velocity, which cancels out the need for effective grille areas, terminal configuration consideration and velocity corrections.

If access is restricted, then a rotating vane anemometer shall be used and the velocity reading obtained would be converted to volume (velocity x free area = volume) and a comparison between the pitot traverse reading will be made to obtain a correction factor which would be incorporated to give a true velocity reading . Alternatively, the effective area provided by the register / grille manufacturer will be incorporated in the design velocity calculations.

1. Air quantities shall be measured according to CIBSE Application Guide 3/89 Standards.

2. Any main branch may be chosen to start with but as normal practice and having carried out a rough balance of main and sub-branches, start with the most remote branch and then sub-branch.

3. Locate the terminal which is discharging the lowest percentage of its design flow rate. This is generally the last terminal in the run. if not, adjust the damper in the last terminal unit until it is working with the same percentage as the lowest one previously measured.

4. Measure the flow from the terminal next to the index and work out the percentage flow as close as possible to that of the index. Fix the damper in position.

5. Repeat the procedure for the next terminal, again comparing it with the index.

6. As the dampers are closed along the run, more air will be driven towards the downstream terminals and the volume of air discharged at the terminal index will rise. This does not affect the balancing procedure since each terminal being adjusted is related in turn with the index.

7. When all the terminals have been balanced on a sub-branch, each terminal will be running with an equal percentage of the design flow rate, within the allowable tolerances.

8. The flow rates at each terminal must be measured and recorded. Once again a summation should be made to check that the total is in reasonable agreement with the measured sub-branch flow.

9. Test results shall be recorded in the approved test sheets and documents.

E. Witnessing

After satisfactory completion of Testing, Adjusting and Balancing of the Air-Conditioning & Ventilation system, Prime Technologies will demonstrate random sample test results to the Consultants/Clients, provided the witnessing takes place within a reasonable period of time after completion of testing, adjusting and balancing.

4.2 Chilled Water System

The aim of balancing is to apply a disciplined procedure of adjustment to water flow rates throughout a system to meet the particular requirements of the design. The balancing of water flow rates should be carried out to specified tolerances (which may vary for different sections of the same system).

A. Secondary Pumps

Pump shut-off head test

To verify the performance of the pump, the following tests shall be carried out in order to measure and compare against the manufacturer pump data's.

1 Connect a suitable differential pressure gauge across the suction and discharge pressure test points of the pumps.

2 Set all the supply, return valves and control valves in the system at full open position (Cooling coil valve fully open to cooling coil, chilled water flow through the AHU etc.).

3 With the pump on running condition, slowly close the discharge valve for a period of less than 1 minute. Effort should be made to obtain the readings as rapidly as possible in order to minimize the time that the pump is shut off.

4. Determine the shut-off pressure differential, check against the manufacturer data to zero flow then slowly re-open the discharge valve.

5. Where the test results coincides with the manufacturers test data proceed to next paragraph. Where this is not the case, draw a curve parallel to that shown on the published data, starting at the shut-off head pressure.

6. Record the total pressure with the differential pressure gauge at full flow rate and read the actual flow from the manufacturers data, or from the corrected graph curve as appropriate.

B. Preliminary Flow Rate Check

With all valves are fully open, measure and record the total actual flow rate and compare this with the total system design flow rate. Where necessary, close the main regulating valve to provide a flow of approximately 110 % design flow rate.

C. Balancing Chilled Water Terminals, Branches, Risers and Headers by Proportional Flow

1. Keep all the DRV's & isolating valves at fully open position.
2. Take the initial flow across the heat exchangers.
3. Record the flow and compare with the design flow.
4. Measure the initial flow at all the risers.
5. Find out the index branch riser (lower percentage of volume)
6. Keep the DRV of the index riser at fully open position.
7. Throttle the other risers proportionally to the same percentage of total flow measured.
8. Monitor the index percentage after throttling each riser as it increases gradually.
9. By the time the last riser is complete, the flow is balanced at all risers including the index riser.
10. Record the reading of all the risers.

The same method (proportional balancing) can be followed for branches & sub-branches of the Fan Coil Units and Air Handling Units located at the various floors.