

## Attachment J-C18.1

### HVAC Work Instructions

<b><u>SOW Item No.</u></b>	<b><u>Title</u></b>	<b><u>Page</u></b>
C18-02	Control Air Systems Annual PM	2
C18-03	Split System AC Indoor Section Annual PM	3
C18-04	Condensing Unit Semi-Annual PM	4
C18-05	Packaged Air Conditioner Annual PM	5
C18-06	Air Handling Unit Semi-Annual PM	6-7
C18-07	Air Handling Unit Annual PM	8
C18-08	Humidification Annual PM	9
C18-09	Air Handling Unit Glycol Protection Annual PM	10
C18-10	Fan Coil Unit Annual PM	11
C18-11	Exhaust Fan Annual PM	12
C18-12	Infrared Gas Heaters Annual PM	13
C18-13	Institutional Cooling Tower Annual PM	14
C18-14	Steam Trap Annual PT&I	15
C18-15	Heating Hot Water Boilers Annual PM	16
C18-16	Ground Source Heat Pump Annual PM	17
C18-17	Energy Recovery Unit Annual PM	18
C18-18	Kitchen Exhaust Hood Cleaning Semi-Annual PM	19
C18-19	Refrigerators/Food Displays/Freezers Annual PM	20
C18-20	Ice Machine Semi-Annual PM	21
C18-21	Building Chillers Annual PM	22

**SOW Item No. C18-02**  
**Control Air System Annual PM**

- \_\_1. Check compressed-air system (e.g., air compressor, air dryer, receiver, pressure regulating valve, blowdown valve, etc...) for proper operation.
- \_\_2. Check oil level. Check for evidence of oil carryover. Replace oil filter.
- \_\_3. Check air pressure in receiver tank and pressure regulator adjustment in supply line.
- \_\_4. Drain moisture from air receiver.
- \_\_5. Visually inspect air compressor, make sure safety guards are in place.
- \_\_6. Inspect belt alignment, tension and condition. Adjust or replace belts as required.
- \_\_7. Inspect the compressor during loading and unloading sequencing. Check for unusual noises and vibrations.
- \_\_8. Check air dryer operating cycle and clean heat exchanger. Check outlet dewpoint. Replace filter cartridges, both pre-filter and after filter.
- \_\_9. Check pneumatic lines to control panels for leaks.
- \_\_10. In pneumatic control panels check for leaks or deteriorated tubing and repair.
- \_\_11. Check safety relief valve for proper operation at full operating pressure. Test safety relief valve. Replace valve if faulty. Complete FORM C-4030.
- \_\_12. Fill out maintenance report/record.

**SOW Item No. C18-03**  
**Split System AC Indoor Section Annual PM**

**Note: Coordinate this task with associated Condensing Unit Semi-Annual PM**

- \_\_1. Replace air filters to ensure proper operation.
- \_\_2. Check control system and devices for evidence of improper operation. Clean, lubricate, repair, adjust, or replace components as needed to ensure proper operation.
- \_\_3. Check fan. Clean and repair as needed to ensure proper operation.
- \_\_4. Inspect all areas for moisture accumulation and biological growth. Clean drain pan, P-trap and drain line. Disinfect as needed. Prime traps as needed. Add bio tablets as needed.
- \_\_5. Check for proper operation of cooling or heating coil. Check for damage or evidence of leaks. Clean and restore as required.
- \_\_6. Fill out maintenance report/record.

**SOW Item No. C18-04**  
**Condensing Unit Semi-Annual PM**

**Note: Coordinate this task with associated Split System AC Indoor Section Annual PM or Air Handling Unit Annual PM**

- \_\_1. Check control system and devices for evidence of improper operation. Clean, lubricate, repair, adjust, or replace components as needed to ensure proper operation.
- \_\_2. Check motor for excessive heat and pitting or other signs of damage.
- \_\_3. Check fan. Clean and repair, as needed to ensure proper operation.
- \_\_4. Check refrigerant system pressures or temperatures. If outside of recommended levels, find cause, repair, and adjust refrigerant to achieve optimal operating levels.
- \_\_5. Check low ambient head pressure control sequence for evidence of improper operation. Repair or replace components or modify software/algorithm to ensure proper operation.
- \_\_6. Check refrigerant oil levels for refrigerant systems with oil pressure/level controls. Repair or adjust as needed to ensure proper operation. Replace filters as needed.
- \_\_7. Check refrigerant piping insulation. Repair as needed.
- \_\_8. Check condenser coils for damage, leaks and cleanliness. Clean and repair as needed.
- \_\_9. Check and clean debris screens. Check guards and covers to ensure they are secure.
- \_\_10. Fill out maintenance report/record.

**SOW Item No. C18-05**  
**Package Air Conditioner Annual PM**

- \_\_1. Replace air filters to ensure proper operation.
- \_\_2. Check control system and devices (valves, dampers, etc....) for evidence of improper operation. Clean, lubricate, repair, adjust, or replace components as needed to ensure proper operation.
- \_\_3. Check and clean strainers on water lines and steam lines to unit.
- \_\_4. Check motor and compressors for excessive heat and vibration.
- \_\_5. Check fan. Clean as needed to ensure proper operation.
- \_\_6. Check refrigerant system temperatures. If outside of recommended levels, find cause, repair, and adjust refrigerant charge to achieve optimal operating levels.
- \_\_7. Check condenser and evaporator coils for damage, leaks and cleanliness. Clean as needed.
- \_\_8. Inspect all areas for moisture accumulation and biological growth. Clean drain pan, P-trap and drain line. Disinfect as needed. Prime traps as needed. Add bio tablets as needed.
- \_\_9. Lubricate unit if necessary.
- \_\_10. If unit has a condensate water alarm, ensure proper operation.
- \_\_11. If unit has a microprocessor, run microprocessor check for proper operation.
- \_\_12. If unit has belts, check for wear, proper tension and alignment. Adjust or replace as needed.
- \_\_13. If unit has humidifier, check operation and repair or replace as needed. If humidifier unit is the bottle type, check for leaks and proper operation. Replace bottle if needed. Check water supply for leakage and proper supply to bottle.
- \_\_14. If unit has gas heat, check heat exchanger, combustion chamber, burner, and flue for deterioration, moisture problems, condensation, and combustion products. Clean, test and adjust combustion process for proper operation.
- \_\_15. If unit has steam coil, check steam trap operation with infra-red temperature differential or ultra-sonic.
- \_\_16. Check integrity of all panels on equipment. Replace fasteners as needed.
- \_\_17. Fill out maintenance report/record.

**SOW Item No. C18-06**  
**Air Handling Unit Semi-Annual PM**

- \_\_1. Replace pre-filters. Replace final filter if needed. Note: Where EMCS monitors pressure differential on final filters, replacement of filter will be when alarm is triggered.
- \_\_2. Check control system and devices (valves, damper actuators, etc...). Clean, lubricate, repair, adjust, or replace as needed to ensure proper operation.
- \_\_3. Check fan. Clean as needed to ensure proper operation.
- \_\_4. Lubricate bearings if necessary. Use good grade lithium base grease.
- \_\_5. Check fan belt tension. Check for belt wear and replace if necessary to ensure proper operation. Check sheaves for evidence of improper alignment or evidence of wear and correct as needed.
- \_\_6. Inspect all areas for moisture accumulation and biological growth. Clean drain pan, P-trap and drain line. Disinfect as needed. Prime traps as needed to ensure proper operation. Add bio tablets as needed.
- \_\_7. Check cooling or heating coil for damage or evidence of leaks. Blow down strainers and clean screens if required.
- \_\_8. Check for proper operation of enthalpy device, if needed.
- \_\_9. EMCS controls
  - a. Verify operation and calibration of sensors. Impose simulated conditions to activate controls and check operation (Example: freeze stat).
  - b. Check trend log of system.
  - c. Cycle control valves and dampers to check operation.
  - d. Check operation of VFDs.

If Unit has DX coil:

- \_\_10. Check refrigerant system. Check controls and refrigerant charge to achieve optimal operating levels. Locate and repair leaks.
- \_\_11. If unit has air cooled condensers, coordinate task with Condensing Units Semi-annual PM.

If unit has steam coil:

- \_\_12. Check steam trap operation with infra-red temperature differential or ultra-sonic.

If unit has humidifier:

- \_\_13. If unit has humidifier, check operation and repair or replace as needed. If humidifier unit is the bottle type, check for leaks and proper operation. Replace bottle if needed.

- \_\_14. Check makeup water system for pressure and operation.
- \_\_15. Operate humidistat or controller through its throttling range to verify activation and deactivation.
- \_\_16. Clean and/or replace water/steam nozzles as needed.

If unit has gas heater:

- \_\_17. Check heat exchanger, combustion chamber, burner, and flue for deterioration, moisture problems, condensation, and combustion products. Clean, test and adjust combustion process for proper operation.

For motors with 25 HP and larger also:

- \_\_18. Check motor with thermography
- \_\_19. Check fan vibration
- \_\_20. Fill out maintenance report/record.

**SOW Item No. C18-07**  
**Air Handling Unit Annual PM**

- \_\_1. Replace pre-filters. Replace final filter if needed. Note: Where EMCS monitors pressure differential on final filters, replacement of filter will be when alarm is triggered.
- \_\_2. Check control system and devices (valves, damper actuators, etc...). Clean, lubricate, repair, adjust, or replace as needed to ensure proper operation.
- \_\_3. Lubricate bearings if necessary. Use good grade lithium base grease.
- \_\_4. Check fan. Clean as needed to ensure proper operation.
- \_\_5. Check fan belt tension. Check for belt wear and replace if necessary to ensure proper operation. Check sheaves for evidence of improper alignment or evidence of wear and correct as needed.
- \_\_6. Inspect all areas for moisture accumulation and biological growth. Clean drain pan, P-trap and drain line. Disinfect as needed. Prime traps as needed to ensure proper operation. Add bio tablets as needed.
- \_\_7. Check coils for damage or evidence of leaks. Clean and restore as required. Blow down strainers and clean screens if required.

If unit has DX coil also:

- \_\_8. Check refrigerant system. Check controls and refrigerant charge to achieve optimal operating levels. Locate and repair leaks.
- \_\_9. If unit has air cooled condensers, coordinate task with Condensing Units Semi-annual PM.

If unit has steam coil also:

- \_\_10. Check steam trap operation with infra-red temperature differential or ultra-sonic.
- \_\_11. Fill out maintenance report/record.

**SOW Item No. C18-08**  
**Humidification Annual PM**

This work shall be done in the fall, just prior to the winter months. This is for the humidification system for the B333 High Bay Clean Room.

- \_\_1. Check ultraviolet lamp. Clean as needed to ensure proper operation.
- \_\_2. Check for proper fluid flow and for fluid leaks. Clean, adjust, and repair as needed to restore proper flow to humidifiers in AHUs.
- \_\_3. Measure relative humidity and adjust system controls as necessary.
- \_\_4. Visually inspect distributors, drain pans, and other areas of moisture accumulation for biological growth. Clean or disinfect as needed.
- \_\_5. Check the Reverse Osmosis (RO) System operating data. Check controls and wiring.
- \_\_6. Check the pre-filter cartridge for RO System, replace cartridge.
- \_\_7. Clean/Sanitize RO membranes using Peracetic Acid.
- \_\_8. Sanitize RO storage reservoir.
- \_\_9. Clean ultrasonic humidifier storage tank interior using Peracetic Acid.
- \_\_10. Check operation of ultrasonic humidifier transducer and nebulizers.
- \_\_11. Check ultrasonic humidifier nebulizers print plate.
- \_\_12. Check operation of ultrasonic humidifier solenoid valve. Replace if necessary.
- \_\_13. Check operation of ultrasonic humidifier float switches. Replace if necessary.
- \_\_14. Check ultrasonic humidifier relay plate for damage or causing problems. Replace if necessary.
- \_\_15. Fill out maintenance report/record.

**SOW Item No. C18-09**  
**Air Handling Unit Glycol Protection Annual PM**

- \_\_1. In the fall, isolate air handling chilled water coils with isolation valves. Place caution tags on valves (Do not open).
- \_\_2. Drain existing chilled water to the sanitary sewer.
- \_\_3. Pump glycol mixture (-5 deg.) into coil.
- \_\_4. In the spring, drain glycol from coils and capture glycol for reuse.
- \_\_5. Flush coil thoroughly with city water to make sure no glycol mixture gets into the central chilled water system.
- \_\_6. Remove valve tags and open isolation valves to central chilled water system.

**SOW Item No. C18-10**  
**Fan Coil Unit Annual PM**

- \_\_1. Replace filters and make sure they are secured in place. NOTE: Some filters are located in the associated return air grille.
- \_\_2. Check unit for noise and vibration.
- \_\_3. Check control system and devices (valves, dampers, etc....) for evidence of improper operation. Clean, lubricate, repair, adjust, components as needed to ensure proper operation.
- \_\_4. Check for proper operation of cooling or heating coil and for damage or evidence of leaks.
- \_\_5. Vacuum (HEPA vacuum) entire unit, fan, coils and cabinet.
- \_\_6. Check for deterioration of interior insulation of unit.
- \_\_7. Lubricate bearings (if not sealed) if necessary.
- \_\_8. Clean coil strainers if applicable.
- \_\_9. Inspect areas of moisture accumulation for biological growth. If present, clean or disinfect as needed. Clean drain pan, P-trap, and drain line. Ensure flow of drain line. Add bio-tablets to pan if needed.
- \_\_10. If unit has steam coil, check steam trap operation with infra-red temperature differential or ultra-sonic.
- \_\_11. Check integrity of all panels on equipment. Replace fasteners as needed.
- \_\_12. Damp wipe exterior surfaces and grilles.
- \_\_13. If unit has a water alarm, ensure proper operation.
- \_\_14. Fill out maintenance report/record.

**SOW Item No. C18-11**  
**Exhaust Fan Annual PM**

- \_\_1. Check fan for unusual noise and vibration or evidence of malfunction.
  - \_\_2. Check fan belt tension. Check for belt wear and replace if necessary to ensure proper operation. Check sheaves for evidence of improper alignment or evidence of wear and correct as needed. Multiple belt drives should be replaced with matched sets.
  - \_\_3. Check fan drive for problems due to poor alignment or poor bearing seating. Repair or replace as needed.
  - \_\_4. Check fan. Clean to ensure proper operation.
  - \_\_5. Lubricate fan and motor if necessary.
  - \_\_6. Check variable-frequency drive for proper operation.
  - \_\_7. Check motor for excessive heat and pitting or other signs of damage.
  - \_\_8. Check integrity of all panels on equipment. Replace fasteners as needed.
  - \_\_9. Visually inspect ductwork connections.
  - \_\_10. Check for proper damper operation. Clean, lubricate and repair or adjust as needed to ensure proper operation.
  - \_\_11. Check control system and devices for evidence of improper operation.
  - \_\_12. Check integrity of flexible connections. Correct as needed.
  - \_\_13. Replace filters where applicable.
- For motors with 10 HP and larger also:
- \_\_14. Check motor with thermography.
  - \_\_15. Check fan vibration.
  - \_\_16. Fill out maintenance report/record.

**SOW Item No. C18-12**  
**Infrared Gas Heater Annual PM**

- \_\_1. Check heater for dirt or dust. Replace filter if applicable.
- \_\_2. Check for any dirt, sagging, cracking or distortion of reflector. Clean outside surface with a damp cloth.
- \_\_3. Check venting for obstructions, cracks on the pipe or gaps in the sealed areas or corrosion. Remove any carbon deposits or scale using a wire brush.
- \_\_4. Check outside air inlet for obstructions, cracks on the pipe or gaps in the sealed areas or corrosion. Clean as required.
- \_\_5. Check tubes for cracks, dirt, sagging, bending or distortion. Vacuum (HEPA) tubes.
- \_\_6. Clean combustion chamber window and check for cracks or holes.
- \_\_7. Inspect and vacuum (HEPA) blower scroll, wheel and motor.
- \_\_8. Carefully remove any dust and debris from the burner head and orifice.
- \_\_9. Replace electrode if there are cracked ceramics, excessive carbon residue, or erosion of the electrode.
- \_\_10. Make sure the heater is hanging securely.
- \_\_11. With pump operating, check for excessive vibration or noise. Check the inlet and outlet of the pump for blockage or excessive soot and clean as necessary. Check boots for cracking or deterioration.
- \_\_12. Check the condition and operation of the pressure switch.
- \_\_13. Check operation of the solenoid gas valve, if applicable. Make sure it opens and closes properly.
- \_\_14. Check function of the thermostat to ensure proper operation.
- \_\_15. Fill out maintenance report/record.

**SOW Item No. C18-13**  
**Institutional Cooling Towers Annual PM**

- \_\_1. Check cooling tower for noise, vibration and excessive heat of motors.
- \_\_2. Drain tower completely. Clean tower including basin, eliminators, structural components and tower exterior, removing scale, corrosion and debris. Replace damaged components and fasteners.
- \_\_3. Inspect blowdown or drain valve. Clear all debris to ensure proper operation. Repair or replace if needed.
- \_\_4. Check cooling tower fan open drive system couplings, bearings and seals for wear and proper alignment. Inspect and adjust fan motor drive pulleys and belts. Replace belts if needed. If unit is equipped with a shaft drive and gearbox, check for signs of oil leakage, oil level, etc. Change oil in gearbox. Check all couplings. Adjust, lubricate and repair as needed.
- \_\_5. Check variable-frequency drive for proper operation, if applicable.
- \_\_6. Check and clean fan blades and fan housing. Repair as needed to ensure proper operation.
- \_\_7. Clean strainers, if applicable.
- \_\_8. Check control system and devices for evidence of improper operation. Clean, lubricate, repair, adjust, or replace components as needed to ensure proper operation.
- \_\_9. Check make-up water valve for proper operation.
- \_\_10. Clean distributions spray nozzles (to ensure full flow) and screens.
- \_\_14. Check air inlet screens for damage.
- \_\_15. Check associated electrical pipe heat trace, if applicable.
- \_\_16. Check basin heaters and controls for proper operation.
- \_\_17. Check tower for leaks and other signs of tower deterioration, and include notes in CMMS.
- \_\_18. Fill out maintenance report/record.

**SOW Item No. C18-14**  
**Steam Traps Annual PT&I**

- \_\_1. Check steam trap operation with infra-red temperature differential or ultra-sonic.
- \_\_2. Fill out maintenance report/record.

**SOW Item No. C18-15**  
**Heating Hot Water Boilers Annual PM**

**This Task shall be performed before each heating season.**

- \_\_1. Check air intake and exhaust vent outlet for any blockage, restrictions or leaks.
- \_\_2. Check for any leaks in the boiler piping.
- \_\_3. Check spark plug, if applicable. Replace if needed.
- \_\_4. Check combustion chamber, burner, and flue for deterioration, moisture problems, condensation, and combustion products. Clean, test, and adjust combustion process for proper operation.
- \_\_5. Remove the low water cut off probe and clean. Replace the probe if needed.
- \_\_6. On units utilizing a flame rod, the flame rod should be changed.
- \_\_7. Visually inspect fuel filter. Replace to ensure proper operation.
- \_\_8. Inspect blow down or drain valve. Clear all debris to ensure proper operation. Repair or replace if needed.
- \_\_9. Check control system and devices for evidence of improper operation. Clean, lubricate, repair, replace, or adjust components as needed to ensure proper operation.
- \_\_10. Verify proper operation of safety devices per manufacturer's recommendations.
- \_\_11. Test safety relief valve by lifting lever and complete FORM C-4030.
- \_\_12. Fill out maintenance report/record.

**SOW Item No. C18-16**  
**Ground Source Heat Pump Annual PM**

- \_\_1. Replace filters.
- \_\_2. Check unit for noise and vibration.
- \_\_3. Check control system and devices (valves, dampers, etc....) for evidence of improper operation. Clean, lubricate, repair, adjust, components as needed to ensure proper operation.
- \_\_4. Check refrigerant system temperatures. If outside of recommended levels, find cause, repair, and adjust refrigerant charge to achieve optimal operating levels.
- \_\_5. Inspect areas of moisture accumulation for biological growth. If present, clean or disinfect as needed. Clean drain pan, P-trap, and drain line. Ensure flow of drain line. Add bio-tablets to pan if needed.
- \_\_6. Check for proper operation of cooling/heating coil and for damage or evidence of leaks.
- \_\_7. Vacuum (HEPA vacuum) entire unit, fan, coils and cabinet.
- \_\_8. Check for deterioration of interior insulation of unit.
- \_\_9. Check fan blades and fan housing.
- \_\_10. Clean strainers, if applicable.
- \_\_11. Check integrity of all panels on equipment. Replace fasteners as needed.
- \_\_12. Check associated pumps (differential pressures, leaks, noise and vibration)
- \_\_13. Check glycol in system to maintain freeze protection. Check tank levels if applicable.

**SOW Item No. C18-17**  
**Energy Recovery Unit Annual PM**

- \_\_1. Replace supply and exhaust filters.
- \_\_2. Check unit for noise and vibration.
- \_\_3. Check control system and devices for evidence of improper operation. Clean, lubricate, repair, adjust or replace components as needed to ensure proper operation.
- \_\_4. Check dampers for unobstructed operation. Clean as necessary to ensure proper operation.
- \_\_5. Check for proper operation of energy recovery wheel and for damage. Check for cleanliness, belt wear tension and alignment, check pulley, lubricate bearings and motor, if needed. Clean and restore as needed. Replace belts if needed.
- \_\_6. Check fan wheel, fasteners and fan housing. Check for cleanliness; check all fasteners for tightness and check for fatigue, corrosion and wear. Clean and repair as needed to ensure proper operation.
- \_\_7. Check integrity of all panels on equipment. Replace fasteners as needed.
- \_\_8. Visually inspect areas of moisture accumulation for biological growth. If present, clean or disinfect as needed.
- \_\_9. Fill out maintenance report/record.

**SOW Item No. C18-18**  
**Kitchen Exhaust Hood Cleaning Semi-Annual PM**

- \_\_1. Clean hood in accordance with NFPA 96.
- \_\_2. Provide report in accordance with NFPA 96, Section 11.6.15.
- \_\_3. Fill out maintenance report/record.

**SOW Item No. C18-19**  
**Refrigerator/Food Displays/Freezer Annual PM**

- \_\_1. Vacuum (HEPA) condenser and evaporator coils, fans, intake screens; lubricate motor.
- \_\_2. Inspect door gaskets for damage and proper fit. Repair if needed.
- \_\_3. Check refrigerant pressures and compressors and add refrigerant if necessary.
- \_\_4. Clean drain pan.
- \_\_5. Fill out maintenance report/record.

**SOW Item No. C18-20**  
**Ice Machine Semi-Annual PM**

- \_\_1. Visually check for liquid or refrigerant leaks. Repair as needed.
- \_\_2. Replace in-line water filter.
- \_\_3. Lubricate fan motors and other parts in accordance with manufacturer, if applicable.
- \_\_4. Check and clear ice machine draining system (drain vent and trap).
- \_\_5. Use ice machine cleaner on deposits.
- \_\_6. Vacuum (HEPA) motor, compressor and condenser coil.
- \_\_7. Inspect door hinges, gaskets, handles, etc.
- \_\_8. Ensure proper operation.
- \_\_9. Fill out maintenance report/record.

**SOW Item No. C18-21**  
**Building Glycol Chiller Annual PM**

- \_\_1. Perform chemical testing of glycol system water. Treat as needed and add glycol to ensure proper water chemistry and freeze protection.
- \_\_2. Check chiller for noise and vibration.
- \_\_3. Check and clean debris screens.
- \_\_4. Check control system and devices for evidence of improper operation. Clean, lubricate, repair, adjust, or replace components as needed to ensure proper operation.
- \_\_5. Check motor for excessive heat and lubricate if necessary.
- \_\_6. Check fan. Clean and repair, as needed to ensure proper operation.
- \_\_7. Check refrigerant system pressures and/or temperatures. If outside of recommended levels, find cause, repair, and adjust refrigerant charge to achieve optimal operating levels.
- \_\_8. Inspect air-cooled condenser surfaces for damage or evidence of leaks. Repair or clean as needed.
- \_\_9. Check low ambient head pressure control sequence for evidence of improper operation. Repair or replace components or modify software/algorithm to ensure proper operation.
- \_\_10. Check compressor oil level and/or pressure on refrigerant systems having oil level and/or pressure measurement means. Repair, replace, or adjust as needed to ensure proper control.
- \_\_11. Check operation of associated glycol pump(s).
- \_\_12. Fill out maintenance report/record.