Action Plan Template • HVAC—Page 1

Action	Roles & Responsibilities	Implementation Dates						Notes
Once		**Fill in implementation Date**						
Establish expected HVAC system efficiency - Write down the expected efficiency of HVAC systems to use as a baseline - Add this information to maintenance plan documentation - Some efficiency measures to collect are: - EER or kW/ton of cooling equipment - Thermal efficiency or HSPF for heating equipment - Bhp for fans and pump motors - Expected air and water flows								
Determine type of economizer and proper operation both during benchmarking and at the installation of new equipment economizer - Collect information on the type of economizer installed in each system and document the intended operation in the maintenance plan - Type of controls: fixed dry bulb temperature setpoint, fixed enthalpy setpoint or differential dry bulb or enthalpy control - Note whether the economizer is intended for integrated (together with compressor) or non-integrated operation								
Commission, re-commission, or retro-commission HVAC system once for each season to identify baseline efficiency of HVAC system								

Daily		Fill in implementation Date						
Conduct overall visual inspection of all systems *								
Turn off or sequence equipment when unnecessary *								
Air Compressor								
Look for and report any system leakages *								
Check compressor lubricant level, color, and pressure. Compare with trended values *								
Drain condensate from tank, legs, and traps *								
Verify operating temperature is per manufacturer's specifications *								
Air Conditioning								
Chiller								
Check all setpoints for proper setting and function *								
Cooling Tower								
Check for clogging by making sure water is flowing in tower *								
Adjust all belts and pulleys *								
Controls								
Verify in control software that schedules and setpoints are accurate for season and occupancy *								
Heating								
Boilers								
Follow manufacturer's recommended procedures in lubricating all components. Compare temperatures with tests performed after annual cleaning *								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Check steam pressure to make sure the variation in steam pressure is as expected under different loads. Wet steam may be produced if the pressure drops too fast *								
Check water level stability for unstable levels, which can be a sign of contaminates in feedwater, overloading of boiler, or equipment malfunction *								
Check burner for proper control and cleanliness *								
Check motor condition temperatures for proper function *								
Check air temperatures in boiler room. Temperatures should not exceed or drop below design limits *								
Verify the bottom, surface, and water column blowdowns are occurring and are effective *								
Keep daily logs on: - Type and amount of fuel used - Flue gas temperature - Make-up water volume - Steam pressure, temperature, and amount generated Look for variations as a method of fault detection *								
Check oil filter assemblies and clean/replace oil filters and strainers *								
Inspect oil heaters to ensure that oil is at the proper temperature prior to burning *								
Check boiler water treatment to confirm water treatment system is functioning properly *								
Steam Trap								
Test high-pressure steam traps (250 psig or more). Daily/weekly testing is recommended *								

Weekly		Fill in implementation Date						
Air Compressor								
Verify all pressure relief valves are functioning properly *								
Check belt tension and alignment for proper settings *								
Clean or replace intake filter pads as necessary *								
All air-consuming devices need to be inspected on a regular basis for leakage. Leakage typically occurs in: - Worn, cracked, or frayed hoses - Sticking air valves - Cylinder packing *								
Clean out debris and check operation *								
Air Conditioning								
Chiller								
Assess evaporator and condenser coil fouling as required *								
Compressor motor temperature per manufacturer's specifications *								
Check water quality for proper chemical balance *								
Conduct leak testing on all compressor fittings, oil pump joints and fittings, and relief valves *								
Check insulation for condition and appropriateness *								
Verify proper control function, including: - Hot gas bypass - Liquid injection *								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Cooling Tower								
Check the condition of the fan motor through temperature or vibration analysis and compare to baseline values *								
Physically clean suction screen of all debris *								
Test for proper water concentrations of dissolved solids and chemistry. Adjust blowdown and chemicals as necessary *								
Operate make-up water float switch manually to ensure proper operation *								
Check for excessive vibration in motors, fans, and pumps *								
Check tower structure for loose fill, connections, leaks, etc. *								
Controls								
Check all gauges to make sure readings are as expected *								
Check control tubing (pneumatic system) for proper control and cleanliness *								
Check outside air volumes for proper function *								
Check temperature setpoints to make sure they do not exceed or drop below design limits *								
Verify the bottom, surface, and water column blowdowns are occurring and are effective *								
Assure that all deadbands are accurate and that the only simultaneous heating and cooling is by design *								
Heating								
Boilers								
Check flue gas temperatures and composition. Measure flue gas composition and temperatures at selected firing positions—recommended O_2% and CO_2% Fuel O_2% CO_2% Natural gas 1.5 10 No. 2 fuel oil 2.0 11.5 No. 6 fuel oil 2.5 12.5 Note: Percentages may vary due to fuel composition variations *								
Check all relief valves for leaks *								
Check water level control and stop feedwater pump and allow control to stop fuel flow to burner. Do not allow water level to drop below recommended level *								
Clean pilot and burner following manufacturer's guidelines and examine for mineral or corrosion buildup *								
Check boiler operating characteristics. Stop fuel flow and observe flame failure. Start boiler and observe characteristics of flame *								
Inspect system for water or steam leaks and leakage opportunities. Look for: leaks, defective valves and traps, corroded piping, and condition of insulation *								
Inspect all linkages on combustion air dampers and fuel valves for proper settings and tightness *								
Inspect boiler for air leaks and check damper seals *								
Steam Trap								
Test medium-pressure traps (30–250 psig). Weekly/monthly testing is recommended *								
Others								
Motors								
Check the condition of the motor through temperature or vibration analysis and compare to baseline values *								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Monthly		Fill in implementation Date						
Compare HVAC energy consumption with similar school buildings seasonally, normalized for heating degree days								
Record sub-metered energy consumption monthly to check for unexplained changes and provide data for an overall energy audit								
Ensure that all doors and windows are closed when the air-conditioning or heating system is operating								
Maintain notes on the equipment service records and fuel consumption. Prepare the notes when the information is fresh								
Air Compressor								
Lubricate motor bearings to manufacturer's specifications *								
Depending on use and compressor size, develop periodic oil sampling to monitor moisture, particulate levels, and other contamination. Replace oil as required *								
Air Conditioning								
Air Conditioner. Check for the following: - Dirty filters and fans - Improper belt alignment and adjustment - Air leaks in equipment cabinets and ducts - Improper air damper operation - Dirty condenser and evaporator coils - Improper refrigerant charge								
Chiller								
Check the settings for the following equipment per manufacturer's specifications: - Vane control settings - Motor load limit control - Load balance operation - Chilled water reset settings and function - Chiller lockout setpoint *								
Cooling Tower								
Assure that all bearings are lubricated per the manufacturer's recommendation *								
Check motor supports and fan blades for excessive wear and secure fastening *								
Align the motor coupling to allow for efficient torque transfer *								
Look for proper positioning and scale buildup in drift eliminators, louvers, and fill *								
Controls								
Conduct thorough check of all sensors for temperature, pressure, humidity, and flow for expected values *								
Check time clocks for accuracy and clean *								
Heating								
Measure and record boiler combustion efficiency at least once a month during the heating season (Have a qualified technician perform boiler maintenance.)								
Track boiler fuel usage and boiler make-up water usage and compare it to similar months with similar schedules								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Perform boiler routine maintenance (Have a qualified technician perform boiler maintenance.) - Check feedwater - Check for leaks, damages, or missing insulation								
For schools that use steam heating, check and maintain the steam trap								
Boilers								
Check blowdown and water treatment procedures to determine whether blowdown is adequate to prevent solids buildup *								
Measure and compare last month's readings for flue gas composition over entire firing range *								
Check combustion air inlet to boiler room and boiler to make sure openings are adequate and clean *								
Check pressure gauge, pumps, filters, and transfer lines. Clean filters as required *								
Check belts for proper tension and check packing glands for compression leakage *								
Check for air leaks around access openings and flame scanner assembly *								
Check all blower belts for tightness and minimum slippage *								
Check gaskets for tight sealing. Replace if they do not provide a tight seal *								
Inspect all boiler insulation and casings for hot spots *								
Calibrate steam control valves as specified by manufacturer *								
Check pressure-reducing or regulating valves for proper operation *								
Perform water quality test to check water quality for proper chemical balance *								
Steam Trap								
Test low-pressure traps. Monthly/annual testing is recommended *								
Repair or replace stream traps when testing shows there are problems. Typically, traps should be replaced every 3–4 years. When replacing, take the time to make sure traps are sized properly *								
Others								
Motors								
Assure that all bearings are lubricated per the manufacturer's specifications *								
Check packing for wear and repack as necessary. Consider replacing packing with mechanical seals *								
Align the motor coupling to allow for efficient torque transfer to the pump *								
Check and secure all motor mountings *								
Tighten connection terminals as necessary *								
Remove dust and dirt from motor to facilitate cooling *								
Pumps								
Assure that all bearings are lubricated per the manufacturer's recommendations *								
Check packing for wear and repack as necessary. Consider replacing packing with mechanical seals *								
Align the pump/motor coupling to allow for efficient torque transfer to the pump *								
Check and secure all pump mountings *								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Quarterly		Fill in implementation Date						
Air Conditioning								
Inspect air-conditioning fan bearings on older units every 3–6 months for excessive noise, vibration, or heat (signs of failure) and to lubricate the bearings								
Inspect tubing connections and fittings in the refrigerant loop for evidence of oil, which may indicate a leak. Tighten or replace fittings and check refrigerant charge								
Controls								
Check proper operation of thermostats considering the following factors: - Setback and setup temperatures - Start and stop times - Fan operation (i.e., always on) - Adequate dead band between cooling and heating operation (or manual changeover between heating and cooling mode) - Heat pumps controlled to use electric strip heaters only when necessary								
Update or recalibrate the Energy Management System (EMS) schedule according to building use								
Air Filters								
Replace air filters. Increase the frequency under severe operating conditions or when the economizer cycle is being used. Premium filters may require less frequent changing - Use the correct filter for the application - Include detailed filter specifications in the maintenance plan (filter dimension, filter media type, filter efficiency) - Shut off the fan before replacing the filter to prevent dirt on the filter from entering the duct system - Clean dirt from around the area around the filter housing - Ensure that the filter is properly fitted in its holder to prevent air bypass - Check fan belts for wear and correct tension and replace at least annually - Ensure filter is installed facing the proper direction relative to air flow (usually marked on filter housing) - Write filter size, quantity, efficiency inside or outside the unit to help ensure correct replacement filters are used - If the filter is damp or moldy, then try to find the source of the moisture and repair any leaks - Consider purchasing and using a complete air pressure testing kit								
Economizer								
Inspect, clean, and lubricate: - Check that dampers are not obstructed and dampers move freely. Observe the damper position under a range of outside air conditions (fool the economizer controls with your hands or an electric hair dryer) - Check the condition of damper seals to ensure that leakage is not excessive - Tighten and adjust linkage if necessary - Check movable economizer setpoints - Calibrate and clean sensors - Look for jumps in heating and cooling energy consumption, supply and exhaust air imbalances - Conduct ongoing diagnostic with an Energy Management System								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Fans								
Check fan, belts, and bearings: - Include information on how to test the belt tightness for each piece of equipment (based on manufacturer's recommendations) - Write the belt size and quantity inside or outside the unit to help ensure that the correct size is installed in the future - Check fan blades for dirt buildup, and clean accordingly - Check alignment of belt and pulleys using a straight edge, and adjust/replace if necessary - Check for noise, vibration, or heat from the bearing - Check fan blades for chips or cracks that may cause noise or vibration - Check fan current for accuracy								
Ducts								
Check cabinet access panels and duct connections for tight fit and air leaks. Seal any leaks and/or replace seals around access panel if necessary								
Heating								
Test boiler combustion efficiency (monthly during heating seasons) by flue gas analysis. Typical combustion efficiencies for standard boiler range from 70–85% depending on the firing rate of the boiler. Efficiency usually drops at lower firing rates. The efficiency for condensing boilers should be as high as 95% (Have a qualified technician perform boiler maintenance.)								
Conduct the following furnace operation checks: - Inspect for smooth ignition and proper flame color. Clean the burners if there are problems with the ignition or flame - Check for operation of limit devices or flame sensors - Check manufacturer's guidelines for proper operation - Test gas connections for leaks - Perform the AGA furnace heat exchanger leakage test annually (www.aga.org) - Inspect the flue for blockage - Repair or replace other components as necessary								
Clean the heat exchanger condenser and evaporator coils								

Bi-Annually		Fill in implementation Date						
Controls								
Conduct school energy consumption comparisons with similar school buildings and season-to-season comparison, normalized for heating degree days								
Other								
Inspect electrical connections and tighten if necessary to prevent overheating and/or improper equipment operation. For safety reasons, shut off all power to the unit before handling								

Annually		Fill in implementation Date						
Air Compressor								
Inspect all couplings for proper function and alignment *								
Check all shaft seals for leakage or wear *								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Inspect airline filters. Replace particulate and lubricant removal elements when pressure drop exceeds 2–3 psid *								
Check and secure all compressor mountings *								
Air Conditioning								
Chiller								
Clean condenser and evaporator tubes as part of shutdown procedures *								
As required, conduct eddy current test to assess tube wall thickness *								
Clean evaporator tubes as part of shutdown procedures *								
Check all compressor motor and assembly alignments to specification. Check all seals and provide lubrication where necessary *								
Compressor oil system - Conduct analysis on oil and filter - Change as required - Check oil pump and seals - Check oil heater and thermostat - Check all strainers, valves, etc. *								
Assess proper water flow in evaporator and condenser *								
Add refrigerant as required. Record amounts and address leakage issues *								
Cooling Tower								
Remove all dust, scale, and algae from tower basin, fill, and spray nozzles *								
Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary *								
Check the condition of the motor through temperature or vibration analysis to assure long life *								
Heating								
Boiler								
Follow manufacturer's recommendation on cleaning and preparing waterside surfaces *								
Follow manufacturer's recommendation on cleaning and preparing fireside surfaces *								
Inspect and repair refractories on fireside and use recommended material and procedures *								
Remove and recondition or replace relief valves *								
Clean and recondition feedwater pumps. Clean condensate receivers and deaeration system *								
Clean and recondition system pumps, filters, pilot, oil preheaters, oil storage tanks, and other system components *								
Check hydraulic and pneumatic valves operation and repair as necessary *								
Make adjustments to ensure optimal flue gas composition. Record composition, firing position, and temperature *								
As required, conduct eddy current test to assess tube wall thickness *								
Controls								
Establish policies and procedures for maintaining temperature settings								
Inspect all access panels and gaskets, particularly on the supply-air side								
Calibrate all sensors for temperature, pressure, humidity, and flow *								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Compressors								
Measure the current draw on compressors and analyze the coil to see if moisture or acid are present (inexpensive temperature indicator tapes may be used to measure case temperature, a frequent precursor of compressor failure). Reference the manufacturer's guidelines for compressors								
Others								
Clean all electrical terminals. Check electronic controls and replace any defective parts *								
Inspect piping insulation annually, as they tend to degrade over time, especially if exposed to sunlight								
Motors								
Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary *								
Check the condition of the motor through temperature or vibration analysis to assure long life *								
Check for balanced three-phase power. Unbalanced power can shorten the motor life through excessive heat buildup *								
Check for over-voltage or under-voltage conditions. Over- or under-voltage situations can shorten the motor life through excessive heat buildup *								
Pumps								
Inspect bearings and drive belts for wear. Adjust, repair, or replace as necessary *								
Check the condition of the motor through temperature or vibration analysis to assure long life *								

Once Every Multiple Years		Fill in implementation Date						
Air-Conditioning								
Check cooling efficiency every 3–5 years, or following a change in the HVAC system. Find the cooling efficiency based on the following parameters: - Airflow - Temperatures - Electrical Demand								
Verify correct refrigerant charge every 3–5 years, or following a change to HVAC system or when evidence of a leak is detected - These measurements must be performed by an EPA-certified technician - See manufacturers' recommendations for more information. It usually makes sense to perform this measurement as part of system checkup that includes supply-air testing								
Fan								
Check that actual supply-air flow matches the design value every 3–5 years or after changes to HVAC system changes - Airflow tests should be performed by trained technicians - If airflow is lower than manufacturer's specifications, check for obstructions in duct or closed balancing dampers before increasing fan speed setting (Eliminating obstructions is preferred over increasing fan speed to reduce noise and save energy.) - If airflow exceeds manufacturer's specifications, reduce the fan speed per manufacturer's instructions to achieve correct airflow and save fan energy. Fan speed can be adjusted using the electrical connections to select different motor speeds, using a pulley (sheave) adjustment, or replacement to change the fan speed								

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Action	Roles & Responsibilities	Implementation Dates						Notes
Duct								
Test duct and air handler leakage every 5 years or following a change to the duct system or replacement of HVAC equipment								

Training		Fill in implementation Date						
Train facilities staff to conduct HVAC energy consumption comparisons with similar school buildings and season-to-season comparison, normalized for heating degree days								
Train facilities staff to maintain detailed notes on the equipment service records and energy use (fuel consumption). Prepare the notes when the information is fresh								
Train teachers or other staff on how to use programmable thermostats								
Train or hire qualified technicians for specialized equipment maintenance (e.g., boiler)								

Communications		Fill in implementation Date						
Communicate to facilities staff the importance of keeping detailed notes on equipment service records and energy use, when the information is fresh								
Communicate to facilities staff the importance of conducting school energy consumption comparisons with similar school buildings and season-to-season comparison, normalized for heating degree days								
Communicate HVAC consumption comparison results to school and district administrators to demonstrate the benefits of energy management								
Maintain adequate communications between central staff and building operators								
Communicate to facilities staff that the boiler is usually the single largest piece of energy-using equipment								

Other Actions		Fill in implementation Date						
Reset time clocks after every power outage *								

* FEMP O&M: *Federal Energy Management Program Operations and Maintenance Best Practices Guide*; http://www1.eere.energy.gov/femp/operations_maintenance/om_bpguide.html