through fan on based on the fan limit, not high limit trip and fan off based on the fan limit after the heat has shut off.

2. The Working Group struggled with the term "Performance Objective". There is a definition in the Standard for the term "Performance" related to indoor air quality, thermal comfort, and energy efficiency. The term "Performance Objective" in section 4 seems to relate to more granular concepts like CFM of air flow or superheat as a refrigeration cycle performance metric. The Working Group recommends resolving this issue.
    a. The Working Group determined that indoor air quality, thermal comfort and energy efficiency are the proper level of detail to communicate to customers. Some reporting is required to communicate progress towards meeting these objectives.
    b. However, the more granular concepts like CFM of airflow or superheat as a refrigeration cycle performance metric is the proper level of detail to communicate with the technician. The consensus of the Working Group is that without specific guidance to the technician, there cannot be consistency, even within a single service provider, that current practices will not change, and there will be no "Market transformation".

3. Task sequencing - The Working Group recommends the task sequencing outlined in the report section called "Order of Tasking".

Detailed analysis of the tasks

5-22 Inspection/Maintenance Tasks	**Frequency**
a- Check for particulate accumulation on filters. Clean or replace as necessary to ensure proper operation.	Quarterly

Understanding of the meaning of the task:

1. The Working Group understands this task relates to the air filters in the return air stream.
2. The Working Group expects that filters will be replaced as defined in the maintenance contract.
3. The Working Group agrees that quarterly filter assessments are a reasonable minimum frequency.
4. The Working Group recognizes that the maintenance plan and subsequent maintenance contract may properly call for filter changes that are more frequent than the minimum without any need for the process detailed in section 4.2.2.2d of Standard 180.
5. The Working Group recognizes that some maintenance contracts allow the technician to judge the need for filter replacement.
6. The Working Group finds that the technician has a responsibility to document abnormal filter condition when found; this includes filters that are unexpectedly clean as well as excessively dirty.
7. The Working Group recognizes that there are different kinds of filter systems and a single analysis method may be inappropriate in some cases.

8. The Working Group recognizes that measuring the pressure drop across the filters in "Standard" commercial applications may require tools and effort beyond that considered reasonable and therefore out of scope for maintenance in that application.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. When working on units with "Standard" air filters, assessment means removing the filter from the unit and looking at the amount of light that passes through it.
2. When working on units with "Non-Standard" filter systems:
    a. Pre filters, when they exist are replaced at similar frequency as Standard filters.
    b. These types of filter systems sometimes have a means for measuring the pressure drop across the filter system. While the permanently installed means for measuring pressure drop may drift in calibration, adjustment or calibration of the measuring means is outside of Standard maintenance and very likely to occur only in response to an obvious problem with the measurement.
    c. The maximum pressure drop across the filter system is expected to be specified in the maintenance plan (condition indicator) and the maintenance contract. The group expects that the maximum pressure drop will be marked on the permanently installed measurement means.
    d. The Working Group recognized that it is a responsibility of the technician to record the pressure drop measurement in the maintenance records where these kinds of systems exist.

Guidance to the technician when performing the task:

1. The Working Group recognized that it is a responsibility of the technician to properly dispose of replaced filters.
2. The Working Group recognized that it is a responsibility of the technician to look for gaps, missing spacers and other opportunities for the air to bypass the filters, and has a responsibility to correct the problem if allowed by the business relationship or document the problem with the expectation that the solution will be proposed to the responsible party if the repair is not allowed.
3. Air filters are directional, the technician has the responsibility to look for the arrow and install filters such that the air flows in the direction of the arrow.

Impact of unacceptable condition or performance:

1. When filters are clean after being in the unit for a time defined by the filter change frequency, this indicates that the unit hasn't operated much, if at all. This raises the suspicion that the unit is inoperable or the temperature controls are inoperable. Other maintenance tasks will verify the operability of the unit. A unit that is operable and not used may occur for various reasons. Unused units require less frequent maintenance.

<u>Cooling</u>

2. Filters that are too dirty restrict airflow through the unit. Unacceptably restricted airflow may produce consequences to the performance of the unit including:
    a. Excessive refrigeration cycle energy use.
    b. Reduced sensible and total refrigeration capacity.
    c. Indoor air quality degradation.
    d. Fouling of the blower wheel and the evaporator coil.

e. Evaporator coil freezing. (cause loss of cooling capacity to the space, water leaks from the unit)
f. Liquid refrigerant entering the compressor (leads directly to premature compressor failure)

Heating

3. Filters that are too dirty restrict airflow through the unit. Unacceptably restricted airflow may produce consequences to the performance of the unit including:
    a. Tripping the high limit safety switch
    b. Cracking gas heat, heat-exchangers

Definitions:

1. Standard filters are washable or replaceable air filters that fit in a filter rack or filter grill. Standard filters are filters that are commonly replaced during maintenance visits and where the air passes through one step of filtration.
2. Non-Standard filters include very high efficiency filters, high capacity (bag) filters, HEPA filters, electro-static filters, or other filters that are not commonly replaced frequently.

Best practices and minimum Standards:

1. The Working Group finds that dating replaceable filters with the installation date is a recommended best practice.
2. The Working Group agrees that quarterly filter assessments are a reasonable minimum frequency.
3. When working on units with "Standard" air filters, assessment means removing the filter from the unit and looking at the amount of light that passes through it.
4. The Working Group recommends MERV 8 filters as the minimum filter efficiency for commercial applications.

Timing for this task:

This task is appropriate for the following maintenance visits:

1. As defined by the maintenance contract
2. The cooling start-up inspection
3. The heating start-up inspection
4. Mid-season inspections

b- Check UV Lamp. Clean or replace as needed to ensure proper operation.	Quarterly

Understanding of the meaning of the task:

1. UV lamps may still emit light even though the germicidal effects have degraded with age. The Working Group determined that check UV lamp means to verify it is under a year old, or the manufacturer's recommended life, if there is no indicator LED or to check to see if the indicator lamp is on if one exists. The Working Group determined that clean the UV lamp means to wipe with a cotton cloth, and avoid getting oil from your skin on the lamp touching by touching it.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Look for a change indicator; if none exist, the expected life is one year or the manufacturer's recommendation.

Guidance to the technician when performing the task:

1. Do not look directly at a lit UV lamp.
2. Do not touch it with your skin.

Impact of unacceptable condition or performance:

"The danger UV lamps attempt to address include many infectious diseases transmitted through inhalation of airborne infectious particles termed droplet nuclei. Airborne infectious particles can be disseminated through ventilation systems. A microbial population subject to certain UV exposure will tend to decay exponentially over time. There is also a potential for energy savings based upon consistent use of UVGI systems. The use of UVGI on cooling coils tends to restore them to original design conditions and will maintain them in a clean state for as long as the UVGI system is operated." (AA&W)

Definitions:

1. UV- Ultra Violet light

Best practices and minimum Standards:

1. Mark the lamp with date installed.
2. Some bulbs that have change indicator- replace when indicated.
3. Bulbs without change indicator- replace bulbs annually or the manufacturer's recommended life.
4. Clean bulbs with a cloth rag.
5. Do not touch with hand.

Timing for this task:

1. Quarterly inspections

c- Check steam system traps, pumps and controls. Clean or replace as needed to ensure proper operation.	Semi-annually

Understanding of the meaning of the task:

The Working Group determines that hydronic systems, including steam traps are out of scope for this Working Group.

d- Check control system and devices for evidence of improper operation. Clean, lubricate, repair, adjust or replace components as needed to ensure proper operation.	Semi-annually

Understanding of the meaning of the task:

1. This task is distinct from task k; cleaning tasks concerning control sections dirt and debris or other similar issues are properly found in task k.
2. The Working Group has found the pneumatic controls are not applicable to rooftop units.

3. Control system is not one thing in rooftop units and commercial split systems. The Working Group finds that there are temperature controls, operating controls and safety controls.
    a. Visual inspection- The visual inspection looks for disconnected wires, jumped out controls, degraded connections etc.
    b. Functional test- The functional test consists of giving the unit a call for operation the subsystem being tested and verifying that the subsystem is operating through visual inspection. The functional test is intended to test the control sequence; system performance is assessed in other tasks.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Look for disconnected wires.
2. Look for burnt or discolored wiring, connectors, or terminals.
3. Look for jumpers.
4. Safety controls tripping during a functional test of the unit or in a tripped state upon arrival is an unacceptable condition.
5. Look for alarm codes on units with that feature.

Guidance to the technician when performing the task:

1. Disconnected or jumped controls may be that way for a reason. Investigate for a reason and re-connect wires or remove jumpers after careful consideration.
2. Discolored or burnt wires, connectors, or terminals indicate a high heat condition often caused by loose connections.
3. Discolored or burnt wires, connectors or terminals usually need to be replaced. Burnt wires should be cut back to shiny metal and a new connector applied. Burnt spade terminals are often unrepairable, meaning they will continue to overheat even if cleaned.
4. Safety controls, that which would impact occupant health and safety, cannot be left jumped out or otherwise bypassed when the technician leaves the job. If the unit cannot run without a safety control bypassed, the unsafe condition causing the safety control to trip must be repaired, the control replaced, if that is the required repair, or the unit must be taken out of service and locked/tagged out until repair is made.
5. Document and reset alarm codes if the unit has that feature and are present. Some alarm codes indicate operating conditions that are unsafe. The technician should seek guidance from the appropriate person if unsure of the meaning or impact of specific alarm codes prior to leaving the job with the unit continuing to run.

Impact of unacceptable condition or performance:

1. A higher likelihood of an emergency service call
2. Loss of comfort or process
3. Customer inconvenience and cost

Definitions:

1. Operating controls – Those controls that begin with the unit's thermostat interface and safely operate the sub-systems in a package unit. Typically in package units all operating controls were shipped with the unit.
2. Safety controls – Those controls that protect the machine, building or occupants from unsafe operating conditions.

3. Temperature controls – Those controls that cause a call for fan, cooling, heat, or other unit function to change the conditions in the controlled zone. Typically temperatures controls, including thermostats and building management systems (BMS/EMS) are separate products or accessories to a unit.

Best practices and minimum Standards:

1. Have an agreed amount of money that can be spent for detected service work at the time of the maintenance inspection for low-cost/high-impact repairs like this.
2. High voltage connections on compressor contactors should be tightened at semi-annual maintenance inspections.

Instrumentation requirements:

1. The Working Group determined that visual inspection and functional testing is required for this task. Use of instrumentation could mean that the job has moved into a follow-up service stage and is no longer maintenance. Refer to the maintenance contract.

Timing for this task:

This task is appropriate for the following maintenance visits:

1. As defined by the maintenance contract
2. The cooling start-up inspection - testing controls related to mechanical cooling
3. The heating start-up inspection - testing controls related to heat

e- Check P-trap. Prime as needed to ensure proper operation.	Semi-annually

Understanding of the meaning of the task:

1. The Working Group determined that this task relates to the entire condensate draining system including the condensate pan.
2. The Working Group determined that the task of checking means to clean the trap and drain line to assure proper drainage.
3. Prime means to verify the trap is full of water and to fill it if necessary.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group suggests that if there is extensive rust in a metal drain pan that the technician believes suggests an impending leak problem, this situation should be documented and a quote to replace may be given to the customer per company policies.
2. The tech should notice air being pulled through the trap as unacceptable performance.

Guidance to the technician when performing the task:

1. The Working Group determined that judgment is not required. The trap and drain line should be cleaned at each maintenance visit.

Impact of unacceptable condition or performance:

1. Condensate leaks may produce conditions for biological growth, a health/safety issue

2. The Working Group determined that any condensate leak from a unit under a competent maintenance contract is a call-back. The customer normally cannot be charged for a water leak call unless it can be established that improper maintenance is ruled out.
3. Condensate leaks are very undesirable. They cause additional expense to the service provider. They cause damage to the building and contents. They cause inconvenience to the customer and they could cause slip and fall liability for the customer and service provider.

Best practices and minimum Standards:

1. P-traps must be installed on all HVAC units.
2. The depth of the trap, in inches, must exceed the static pressure by 1" to 2" (positive or negative) of the system to avoid airflow through the trap.
3. A vent may be installed after the trap.
4. A clean out fitting may be installed at the lowest point of the trap.
5. The drain line must slope downhill at least ⅛ inch per running foot of drain line.
6. The drain line must be supported to avoid sagging.
7. Traps and drain lines may be copper or PVC depending on local code. Leaving some joints unglued or unsoldered to allow disassembly may make cleaning easer.

Timing for this task:

1. The Standard calls for semi-annual inspections of the trap and drain line.
2. The Working Group determined that condensate trap and drain lines should be cleared each maintenance visit because the effort is small compared to the cost of a condensate leak.

f- 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.	Semi-annually

Understanding of the meaning of the task:

1. The Working Group determined that check belt tension means to be sure that the belt is neither too tight nor too loose.
2. Belt wear includes cracked, frayed, or glazed belts.
3. Checking sheaves for alignment during maintenance is a visual inspection. Setting alignment requires the use of a straight edge.
4. Sheave wear is on the inside surfaces of the sheave. Wear is when metal is removed by friction with the belt. The signs of wear include a ridge below the area wear the belt rides in the sheave that can be felt with your finger of a change of shape of the inside of the sheave where that "V" shape becomes more of a "U" shape.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Belts should be replaced per contract terms, very often annually.
2. Correct belt tightness is hard to generalize, but there should be some deflection in the belt at the center between sheaves. Many technicians suggest something like one-inch deflection.
3. Belts should not squeal on start-up.

4. Check alignment visually by sighting down the belt. Look so you can see the edge of the sheave closest to you and the far edge of the same sheave. The look past that to the far sheave, it should also align.
5. Alignment may also be determined by looking how the belt sits in the sheave, it should run straight down the middle.

Guidance to the technician when performing the task:

1. Always shut off the service disconnect prior to touching belts and sheaves.
2. Technician should allow blower to stop before touching belts and sheaves.
3. Adjustable sheaves adjust the fan speed not the belt tension. Move the motor or tensioning wheel to adjust belt tension.
4. Be especially careful not to over tighten belts when sleeve bearings or bushings are used.

Impact of unacceptable condition or performance:

1. Worn belts and sheaves reduce air flow through the unit. Low airflow may reduce system efficiency and capacity. It may damage compressors and gas heat exchangers. It may cause a freeze stat, low pressure switch, or gas heat high limit switch to open.
2. Worn or cracked belts may break causing the system to stop delivering cool or warm air to the building or zone.
3. Poorly aligned belts may wear faster, may cause wear to the motor sheave. Poorly aligned belts may be thrown off completely.
4. Over tightened belts may cause bearings to prematurely fail.
5. Loose belts cause excessive wear to the motor sheave. Loose belts can be thrown off.

Best practices and minimum Standards:

1. When working with multiple belt systems, be sure that the belts used are matched. There is a matching code stamped into the belts. All belts used in a multiple belt system should have the same matching code.
2. Link belts are for temporary use only.
3. Belts should not be rolled off the sheave for installation or removal.

Timing for this task:

1. The Standard call for belts and sheaves to be checked semi-annually at cooling and heating start-up.

g- Check variable frequency drive for proper operation. Correct as needed.	Semi-annually

Understanding of the meaning of the task:

1. The Working Group determined that the VFD, for the purposes of this task, includes any sensors or controls required to operate the VFD.
2. The Working Group determined that checking a VFD for proper operation includes:
3. A visual inspection of the device where the following is determined:
    a. If it is in by-pass mode.
    b. If it is in the “Auto” mode.
    c. Existence and meaning of any error codes

4. Performance testing means observing the fan speed change in response to a changed condition.
5. Additional maintenance related to cooling the VFD:
    a. Clean dirt from cooling fins and ensure there is adequate space for air passage around the VFD.
    b. Maintain clean filters and operable cooling fans if those features exist.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Unacceptable conditions include:
    a. Non-functional or disconnected VFD
    b. Not responsive to control signals
    c. Hunting or unstable operation
    d. Discolored (overheated) VFD
    e. VFD in bypass mode
    f. VFD set to manual (not Auto) operation
    g. VFD that is dirty or its ability to cool itself is otherwise compromised

Guidance to the technician when performing the task:

1. This task includes cleaning the VFD and looking for indications the VFD is improperly configured.
2. The Working Group determined that extensive testing; including voltage measurements, is beyond the scope of maintenance.
3. The Working Group has determined the technician is responsible to document all error codes.
4. The technician is responsible to notify his supervisor of any concerns he has with the VFD.

Impact of unacceptable condition or performance:

1. Excessive speed and high static pressure might cause dampers and sheet metal to be damaged or blown apart.
2. Insufficient air flow because of a VFD controlling at lower speed during cooling operation leads to lower evaporator temperatures; this may result in coils freezing up. Running with frozen coils risks premature compressor failure.
3. Insufficient air flow because of a VFD controlling at lower speed during heating operation leads to higher heat exchanger temperatures; this may result in high limit safety trips and premature heat exchanger cracking. A leaking heat exchanger is a life/safety hazard.
4. The technician should be aware that the VFD (variable fan speed) impacts outside air intake.

Definitions:

1. NEMA Insulation class “H” motors are Inverter-duty rated motors.
2. NEMA Insulation class “H” is safe to 356F.

Best practices and minimum Standards:

1. Note VFD controlled motor may not be “Inverter-duty rated” if so, inform the responsible party of a potential decrease in expected motor life.
2. VFD’s are complex devices that require detailed information, skill and experience to configure it to its application. This is outside the scope of maintenance.

Timing for this task:

1. The Standard calls for VFD's to be checked semi-annually at the cooling and heating start-up.

h- (Deleted) - Check for evidence of build-up on or fouling on heat exchange surfaces. Restore as needed to ensure proper operation.	Semi-annually

Removed and replaced

h1- (Alternate) - Check for evidence of fouling on the indoor refrigeration cycle heat exchanger surfaces. Restore as needed to ensure acceptable condition.	Semi-annually

Understanding of the meaning of the task:

1. This task calls for a visual inspection of the indoor coil surfaces for fouling.
2. Refer to task n for performance analysis of the indoor coil.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Any visual indication of fouling should be removed by brushing.

Guidance to the technician when performing the task:

1. The method selected to clean a coil should be appropriate to the situation.
    a. Brush - Brushing removes surface dirt and may be appropriate for light cleaning or when the fouling is on the surface. Best efforts should be made to remove dirt from the system.
    b. High pressure gas – The Working Group suggests that using high pressure gas to clean evaporator coils may blow the dirt into the return duct. The Working Group recognizes that there are times when using water may be inconvenient enough to make using high pressure gas the appropriate cleaning method. The Working Group recognizes that there are some fouling materials that should not be wetted and blowing out the coils is preferred; examples of materials that should not be wetted include cement powder or plaster dust.
    c. Pump bottle and hose – The Working Group recognizes that this method is the most common method for applying cleaning agents and are generally satisfied with this method when combined with rinsing with a hose and nozzle at city water pressure. There are spray devices with chemical feeds bottles that make foam. These devices have similar intensities and produce similar results. When coils are very dirty this method may be time consuming and may not produce a satisfactory outcome with reasonable effort.
    d. Pressure washer – The Working Group recognizes that the use of pressure washers to clean coils may be very effective but caution that there is the potential to damage the fins. Technicians should be careful to not bend over fins with a pressure washer by using careless pressure washing techniques. The Working Group recognizes that pressure washing may be the appropriate method for thick coils or in other circumstances.
    e. Steam – The Working Group's opinion is that steam is usually not a desirable cleaning method because heating refrigerant filled heat exchangers is undesirable.
2. When to use a cleaning agent or plain water:

   a. Indoor coils are usually cleaned with detergent cleaners.
   b. Care should be taken when using foaming cleaners on evaporators because the foam can easily fill the condensate pan and flow down the return air duct.
3. When using an aggressive cleaning agent:
   a. The Working Group recommends a single application of the cleaning agent.
   b. The Working Group recognizes that aggressive cleaning agents, especially those that leave the coil looking shiny are actually removing material from the coil fins and are reducing the life of the coil. The Working Group cautions that the use of coil brighteners should be minimized.
   c. The Working Group recommends giving the cleaning agent time to react with the fouling, typically at least 5 minutes, or per manufacturers guideline, but not so long as to allow it to dry, prior to rinsing.
   d. The Working Group recommends thorough rinsing of aggressive cleaning agents.
   e. The Working Group recognizes that strongly acidic coil cleaners "off-gas" hazardous or irritating gases and recommends the acidic coil cleaners be used only on condenser coils when good ventilation exists.
4. When to use plain water:
   a. Plain water is sometimes all that is required to remove some fouling from coils. Example: paper dust may be removed with water as effectively as with a cleaning agent.
5. The technician is advised to always follow the coil cleaning agent's manufacturer's instructions.
6. The Working Group recognizes that airflow and charge adjustment might be required after coil cleaning, see task n for details.
7. The Working Group cautions technicians that clean coils have lower resistance to air flow and that fan current must be checked and fan speed adjusted when indoor coil have been cleaned to prevent overloading the blower motor.

Impact of unacceptable condition or performance:

1. Insufficient heat transfer because of a fouled evaporator may lead to lower evaporator temperatures; this may result in coils freezing up. Running with frozen coils risks premature compressor failure.
2. Lower evaporator temperatures reduce total capacity and therefore system efficiency.
3. Reducing the area open for air to pass through the coil increased the pressure drop across the coil. This increases the velocity of the air through the evaporator. When the coil is wet with condensate, the increased velocity may carry water off the coil, beyond the drain pan. This may cause condensate leaks and may enable biological growth in the unit.
4. Because reduced evaporator heat transfer capacity causes low evaporator temperatures and low superheat, some technicians may interpret this as a charge problem and apply counterproductive maintenance strategies that may further reduce the efficiency and capacity of the unit and may lead to reduced reliability of the unit.

Definitions:

1. Fouling (of an air-to-air HVAC heat exchanger) – Deposits of unwanted materials that reduce heat transfer by insulating the surfaces or impeding air flow through the device.

2. Aggressive cleaner – A cleaning agent that is acidic or caustic. Aggressive cleaners are considered strongly acidic when their pH is around 3 or less and strongly caustic when the pH is around 12 or higher.

Best practices and minimum Standards:

1. The Working Group recommends thorough rinsing of the coil whenever a cleaning agent is used without regard to its pH.
2. When cleaning indoor coils, using high pressure gas may place the fouling matter into a place where it can re-enter the coil or enter the building. This is considered undesirable.
3. When cleaning the indoor coil with water, care should be taken to not allow the water to flow down the return are duct. This often causes damage to ceilings or products and may get on people or cause a slip and fall hazard in the space.
4. When cleaning the indoor coil with a cleaning agent, be aware that the cleaning agent has an odor that may be unacceptable to the occupants. Consult with an occupant with authority over the space to inform them of the likely noticeable smell and adjust the process to address the occupants concerns.
5. The Working Group recognizes that while periodic coil cleaning is part of many commercial maintenance contracts, the Standard calls for an analysis of the heat exchangers condition and performance and remediation based on that analysis. The Working Group recognizes that the reality of HVAC operation under the various conditions HVAC units may be exposed to produces a need for coil cleaning based on condition and performance analysis that may be more or less often than any periodic schedule would require.

h2- (Alternate) - Check for evidence of fouling on the outdoor refrigeration cycle heat exchanger surfaces. Restore as needed to ensure acceptable condition.	Semi-annually

Understanding of the meaning of the task:

1. This task calls for a visual inspection of the outdoor coil surfaces for fouling.
2. Refer to task n for performance analysis of the outdoor coil.

Guidance to technician when judging acceptable or unacceptable condition or performance:

2. Any visual indication of fouling should be removed by brushing.

Guidance to the technician when performing the task:

1. The method selected to clean a coil should be appropriate to the situation.
    a. Brush – Brushing removes surface dirt and may be appropriate for light cleaning or when the fouling is on the surface. Best efforts should be made to remove dirt from the system.
    b. High pressure gas – The Working Group suggests that using high pressure gas to clean evaporator coils may blow the dirt into the return duct. The Working Group recognizes that there are times when using water may be inconvenient enough to make using high pressure gas the appropriate cleaning method. The Working Group recognizes that there are some fouling materials that should not be wetted and blowing out the coils is preferred; examples of materials that should not be wetted include cement powder or plaster dust.

   c. Pump bottle and hose – The Working Group recognizes that this method is the most common method for applying cleaning agents and are generally satisfied with this method when combined with rinsing with a hose and nozzle at city water pressure. There are spray devices with chemical feeds bottles that make foam. These devices have similar intensities and produce similar results. When coils are very dirty this method may be time consuming and may not produce a satisfactory outcome with reasonable effort.
   d. Pressure washer – The Working Group recognizes that the use of pressure washers to clean coils may be very effective but caution that there is the potential to damage the fins. Technicians should be careful to not bend over fins with a pressure washer by using careless pressure washing techniques. The Working Group recognizes that pressure washing may be the appropriate method for thick coils or in other circumstances.
   e. Steam – The Working Group's opinion is that steam is usually not a desirable cleaning method because heating refrigerant filled heat exchangers is undesirable.
2. When to use a cleaning agent or plain water:
   a. Cleaning agents, when used, should be targeted to the type of fouling present. Example: restaurant units often have grease from the kitchen exhaust fouling condensers. A cleaner effective on grease would be needed in that context.
   b. Foam – The Working Group recognizes many technicians use foaming cleaners because it stays in contact with the fouling material long enough to act upon it.
3. When using an aggressive cleaning agent:
   a. The Working Group recommends a single application of the cleaning agent.
   b. The Working Group recognizes that aggressive cleaning agents, especially those that leave the coil looking shiny are actually removing material from the coil fins and are reducing the life of the coil. The Working Group cautions that the use of coil brighteners should be minimized.
   c. The Working Group recommends giving the cleaning agent time to react with the fouling, typically at least 5 minutes, or per manufacturers guideline, but not so long as to allow it to dry, prior to rinsing.
   d. The Working Group recommends thorough rinsing of aggressive cleaning agents.
   e. The Working Group recognizes that strongly acidic coil cleaners "off-gas" hazardous or irritating gases and recommends the acidic coil cleaners be used only on condenser coils when good ventilation exists.
4. Discussion about cleaning coated coils:
   a. Technicians should be aware that units might have coated coils, especially in salt-air environments.
   b. Coated coils coating cannot stand up to harsh chemicals.
   c. Generally coil coating manufacturers recommend mild, neutral pH detergents.
5. Discussion about cleaning micro-channel condensers:
   a. Generally micro-channel coil manufacturers recommend mild, neutral pH detergents and pressure washing.
6. The Working Group discussed the proposal that condenser coils should be cleaned from the inside out and came to some conclusions:
   a. The Working Group understands the theory that the dirt enters from the outside and that it is undesirable to push dirt further into the coil. The Working Group suggests

that, in practice, the potential benefits derived from cleaning from the inside as opposed to cleaning from the outside seems slight.

b. The Working Group recognizes that the effort required to clear a condenser coil from the inside changes from unit to unit. The Working Group suggests that the effort required for residential type equipment is probably reasonable, the additional effort required on medium size equipment, 10-30 ton, is more, and the additional effort required on large equipment is substantial.
c. The Working Group recognizes that accessing the inside of the coil for cleaning often requires disassembly of the equipment and determined that disassembly increases the risk of damaging the equipment.
d. The Working Group determined that in some units, especially as the size increases, cleaning from the inside requires a worker to enter an enclosed space and poses a significant safety hazard to the worker.
e. The Working Group recognizes that there are different condenser coil designs that have different cleaning challenges. The Working Group determined that coil type has no influence on the benefit of cleaning from the inside as opposed to the outside of the coil.
f. The Working Group determined that condensers that are dirty can be cleaned acceptably from the outside and does not recognize that a problem exists that cleaning from the inside would solve.
g. The Working Group considered the case where incentive dollars might be available to pay the cost difference of cleaning from the inside and determined that because of the risk to the worker, the risk of damaging the equipment accessing the inside of the coil, the reduction in productivity, the slight, if any benefit gained, the inconvenience to the customer by having the equipment off line longer and the substantial additional cost, the requirement to clean the coils from the inside would be a very poor use of incentive dollars.
h. The question was posed to the group, "Do you believe that cleaning condenser coils from the inside is the only acceptable method to clean condenser coils?" Each member was polled individually and no member agreed that cleaning condenser coils from the inside is the only acceptable method to clean condenser coils.

Impact of unacceptable condition or performance:

1. Reduced heat transfer through the condenser causes the condensing temperature (Head pressure) to rise. A compressor, the major energy user in an air conditioner, will use more energy to pump against higher head pressure. This reduced the efficiency of the unit.
2. Condenser coils can become so fouled that heat transfer is diminished beyond the operational requirements of the unit and cause the unit to shut off, either because of a high pressure safety control opening, or because the internal by-pass in the compressor opening.

Definitions:

1. Fouling (of an air-to-air HVAC heat exchanger) - Deposits of unwanted materials that reduce heat transfer by insulating the surfaces or impeding air flow through the device.
2. Aggressive cleaner - a cleaning agent that is acidic or caustic. Aggressive cleaners are considered strongly acidic when their pH is around 3 or less and strongly caustic when the pH is around 12 or higher.

Best practices and minimum Standards:

1. The technician is advised to always follow the coil cleaning agent's manufacturer's instructions.
2. Near oceans coastline rinsing condenser coils with clean water to remove salt residue is known to extend the life of the coil.
3. The Working Group recognizes that airflow and charge adjustment might be required after coil cleaning, see task n for details.
4. The Working Group recognizes that while periodic coil cleaning is part of many commercial maintenance contracts, the Standard calls for an analysis of the heat exchangers condition and performance and remediation based on that analysis. The Working Group recognizes that the reality of HVAC operation under the various conditions HVAC units may be exposed to produces a needed for coil cleaning based on condition and performance analysis that may be more or less often than any periodic schedule would require.

i- (Deleted) - Check for proper operation of cooling coil, heating coil or heat exchangers and for damage or evidence of leaks. Clean, restore or replace as required.	Semi-annually

Removed and replaced

s- (Deleted) - Check evaporator coil fins. Restore if possible. Replace coil if necessary to return to proper functioning.	Annually

Removed and replaced

v- (Deleted) - Inspect air-cooled condenser surfaces for damage or evidence of leaks. Repair or clean as needed.	Annually

Removed and replaced

i1- (Alternate) - Check for damage or evidence of leaks on the indoor refrigeration cycle heat exchanger surfaces. Restore or replace as required to ensure acceptable function.	Annually

Understanding of the meaning of the task:

1. This task calls for a visual inspection for damage or leaks.
    a. Damage means fin damage, corrosion or fin loss due to repairs made to the evaporator.
        i. This observation is separate from performance analysis. See task n for more information about heat exchanger performance analysis.
        ii. The Working Group recognizes that some level of fin restoration is within the scope of maintenance. However extensive fin restoration, that which takes more than several minutes to perform exceeds the scope for maintenance.
    b. Leaks mean a visual indication of refrigerant leakage. Typically leaking refrigerant carries oil with it. The oil will be visible as discoloration on the coil. It is common for dirt to be embedded in oil residue.
    c. The Working Group determined that the visual inspection of the refrigeration cycle heat exchangers is intended to be done as a part of a comprehensive refrigeration cycle

analysis annually. This means that evaporator and condenser condition assessments should be performed at the same time as the task n performance analysis.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. This task calls for a visual inspection.
2. This task calls for a visual inspection for damage or leaks.
    a. Unacceptable damage means damage to the fins or other parts of the coil that are not repairable as a maintenance task. Not repairable as a maintenance task means damage that requires more than a few minutes of effort to resolve.
    b. Any refrigerant leak is unacceptable.

Guidance to the technician when performing the task:

1. The Working Group recognizes that some level of fin restoration is within the scope of maintenance. However extensive fin restoration, that which takes more than several minutes to perform exceeds the scope for maintenance.
2. The technician has the responsibility to document and condenser fin damage that exceeds the scope for maintenance.
3. When a technician detects evidence of a leak in the evaporator, they have a responsibility to perform a performance analysis to detect a loss of refrigerant charge.
4. The technician has the responsibility to document any evidence of refrigerant leaks and to notify the responsible party when there is an indication of reduced system charge from the performance analysis. See task n for more information about refrigeration cycle performance analysis.

Impact of unacceptable condition or performance:

1. Any fin damage that breaks the bond between the round copper tubes and the aluminum fins will substantially reduce the heat transfer capacity of the evaporator.
2. Reduced heat transfer through the evaporator causes the evaporating temperature (Suction pressure) and the superheat to drop.
3. Evaporator coil fins can become so damaged that heat transfer is diminished beyond the operational requirements of the unit and cause the unit to shut off, either because of a low pressure safety control opening or a evaporator freeze protection switch.
4. Loss of refrigerant charge reduces the system capacity. The loss of capacity causes an increase in superheat. This reduces compressor cooling and may lead to premature compressor failure.
5. Loss of charge may result in the units ability to maintain comfort in the space and may result is the system being shut off by a low pressure, a charge loss, or a low evaporator temperature control.
6. Charge loss is a common reason for low energy efficiency in a refrigeration cycle.

i2- (Alternate) - Check for damage or evidence of leaks on the outdoor refrigeration cycle heat exchanger surfaces. Restore or replace as required to ensure acceptable function.	Annually

Understanding of the meaning of the task:

1. This task calls for a visual inspection for damage or leaks.
    a. Damage means fin damage, corrosion or fin loss due to repairs made to the condenser.

i. This observation is separate from performance analysis. See task n for more information about heat exchanger performance analysis.
ii. The Working Group recognizes that some level of fin restoration is within the scope of maintenance. However extensive fin restoration, that which takes more than several minutes to perform exceeds the scope for maintenance.
iii. The Working Group recognizes that some utility incentive programs have a requirement that fin damage exceeding 15% of the surface area of the coil be repaired or the coil replaced as a condition of acceptance into the program without regard to thermodynamic performance. The Working Group does not support this requirement because it is judged as not being cost effective to the end user.

b. Leaks mean a visual indication of refrigerant leakage. Typically leaking refrigerant carries oil with it. The oil will be visible as discoloration on the coil. It is common for dirt to be embedded in oil residue.
c. The Working Group determined that the visual inspection of the refrigeration cycle heat exchangers is intended to be done as a part of a comprehensive refrigeration cycle analysis annually. This means that evaporator and condenser condition assessments should be performed at the same time as the task n performance analysis.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. This task calls for a visual inspection.
2. This task calls for a visual inspection for damage or leaks.
    c. Unacceptable damage means damage to the fins or other parts of the coil that are not repairable as a maintenance task. Not repairable as a maintenance task means damage that requires more than a few minutes of effort to resolve.
    d. Any refrigerant leak is unacceptable.

Guidance to the technician when performing the task:

1. The Working Group recognizes that some level of fin restoration is within the scope of maintenance. However extensive fin restoration, that which takes more than several minutes to perform exceeds the scope for maintenance.
2. The technician has the responsibility to document any condenser fin damage that exceeds the scope for maintenance.
3. When a technician detects evidence of a leak in the condenser, they have a responsibility to perform a performance analysis to detect a loss of refrigerant charge.
4. The technician has the responsibility to document any evidence of refrigerant leaks and to notify the responsible party when there is an indication of reduced system charge from the performance analysis. See task n for more information about refrigeration cycle performance analysis.

Impact of unacceptable condition or performance:

1. Any fin damage that breaks the bond between the round copper tubes and the aluminum fins will substantially reduce the heat transfer capacity of the condenser.
2. Reduced heat transfer through the condenser causes the condensing temperature (Head pressure) to rise.

3. Condenser coil fins can become so damaged that heat transfer is diminished beyond the operational requirements of the unit and cause the unit to shut off, either because of a high pressure safety control opening, or because the internal by-pass in the compressor opening.
4. Loss of refrigerant charge reduces the system capacity. The loss of capacity causes an increase in superheat. This reduces compressor cooling and may lead to premature compressor failure.
5. Loss of charge may result in a reduction in the units ability to maintain comfort in the space and may result is the system being shut off by a low pressure, a charge loss, or a low evaporator temperature control.
6. Charge loss is a common reason for low energy efficiency in a refrigeration cycle.

j- Check air filter fit and housing seal integrity. Correct as needed.	Annually

Understanding of the meaning of the task:

1. Refer to task "a" for a discussion of filters.
2. Filter fit refers minimizing air bypassing the filters because of gaps.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. It is the technician's responsibility to notice and document when the wrong size filters were installed.
2. When the wrong size filters were installed, effort should be expended to correct the error going forward by correcting the records used when acquiring filters.

Guidance to the technician when performing the task:

1. Any gap in the filters should be minimized. If the gap is noticeable it should be filled. One common way to fill an excessive gap is with a metal filler piece that may have to be fabricated.

Impact of unacceptable condition or performance:

1. The impact of air bypassing the filters because of gaps is that the evaporator coil gets dirty faster. This may include an increase need for coil cleaning.
2. The impact of a dirty indoor coil includes:
   a. <u>Cooling</u>
      Coils that are too dirty restrict airflow through the unit. Unacceptably restricted airflow may produce consequences to the performance of the unit including:
      i. Excessive refrigeration cycle energy use
      ii. Reduced sensible and total refrigeration capacity
      iii. Indoor air quality degradation
      iv. Fouling of the blower wheel
      v. Evaporator coil freezing (cause loss of cooling capacity to the space, water leaks from the unit)
      vi. Liquid refrigerant entering the compressor (leads directly to premature compressor failure)
   b. <u>Heating</u>

Coils that are too dirty restrict airflow through the unit. Unacceptably restricted airflow may produce consequences to the performance of the unit including:

i. Tripping the high limit safety switch
ii. Cracking gas heat, heat-exchangers

Best practices and minimum Standards:

1. Experience shows that filler pieces are more likely to remain in place if they are put in before the filters are installed so has to not to have to be removed when the filters are replaced. Filler pieces that get removed are too often not put back.

k- Check control box for dirt, debris and/or loose terminations. Clean and tighten as needed.	Annually

Understanding of the meaning of the task:

1. The tasks of inspecting loose terminations means to test tighten each high voltage termination.
2. Be aware that life forms may be present in unit.
3. Looking for dirt and debris is primarily about removing items that are not required to be there. This might include old parts that have been replaced, leftover wiring or waste from jobs including packaging and other extraneous materials.
4. Dirt and dust means particulate matter beyond that reasonably expected in equipment.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Control sections should appear reasonably similar to the way they looked when the unit was delivered. Additional equipment should be mounted and wired in a professional manner.
2. Materials that do not belong in the control section should be removed. Some materials are acceptable as long as they do not interfere with the operation of the control system. Examples might include spare parts like fuses, relays, etc.

Impact of unacceptable condition or performance:

1. Sand in a panel or control box would cause contacts to burnout prematurely.

Best practices and minimum Standards:

1. The Working Group supports having documentation available to the technician on the job and understands that having it inside the unit, out of the weather is where it would be most accessible to technician when needed. The Working Group cautions that storing paper documentation in a place where it interferes with the operation of the unit of where it could start on fire is a possibility. The Working Group recommends that documentation stored in the unit be secured in a convenient place and out of the way of hazards. One example might be a zip-lock bag taped to an inside panel or hanging by a wire tie.
2. Loose wiring connections may lead to excessive temperatures at the connections or terminals. It is a best practice to use infrared thermometers or imaging to detect excessive connections or terminals temperatures.

l- Check motor contactor for pitting or other signs of damage. Repair or replace as needed.	Annually

Understanding of the meaning of the task:

1. This task refers to a visual inspection of contactor contacts.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Discolored or pitted contacts are an unacceptable condition.
2. Chattering contacts are unacceptable. Determine root cause of chattering.
3. Add pictures if available.

Guidance to the technician when performing the task:

1. Technicians could look for wires that had oxidation as a sign they weren't connected properly or were dissimilar metal wires. Aluminum or copper wire oxidation would look like white crystals or powder and was common in humid areas.
2. Technicians should not attempt to "repair" a contactor if the points showed signs of wear. A contactor with unacceptable condition should be replaced.
3. For contactor replacement it is important to confirm the contactor coil voltage rating, not just assume one from looking at the nameplate or cover.
4. The technician should confirm that a contractor is the correct size, meaning the size delivered originally with the unit, rather than to replace it with the current size.
5. In some maintenance contracts, replacing contactors are generally outside the maintenance scope.

Impact of unacceptable condition or performance:

1. Contactors with terminals that have an unacceptable condition may lead to premature failure of a compressor or fan motor. This may cause higher operating expenses because it may cause unnecessary service calls.

Best practices and minimum Standards:

1. Contactor contact deterioration may lead to excessive temperatures at the contacts. It is a best practice to use infrared thermometers or imaging to detect excessive contact temperatures.
2. Detecting a voltage drop across a contactor is an indication of an unacceptable condition.

m- Check fan blades and fan housing. Clean, repair or replace as needed to ensure proper operation.	Annually

Understanding of the meaning of the task:

1. This task may include the indoor blower or the condenser fan.
2. This task refers to a visual inspection of fans and housings.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Check blowers for:
    a. Cracks or other defects in blades, mounting hardware, and missing fasteners.
    b. Excessive dirt or accumulation on fan blades, especially on forward curved blades
    c. Missing counter weights indicated by discoloration on the blades
    d. Excess vibration
    e. Rotation direction

   f. Rust or water damage, need to be reported under maintenance and recommendation made for replacement of effected parts, if warranted
   g. Set screw tightness and potential damage to shaft
   h. Housing missing screws or loose panels
   i. Motor mount brackets and connection bolts and securing parts like rubber grommets
   j. Noticing any hanging or suspended wires
2. Check condenser fans for:
   a. Cracks or other defects in blades, mounting hardware and missing fasteners
   b. Proper positioning in the shroud
   c. Loose hub
   d. Rotation direction

Guidance to the technician when performing the task:

1. The technician should always disconnect power from the unit before working on any fans.
2. The Working Group suggests using OEM parts for any fan motor and blade replacements.
3. The Working Group suggests that the prop, capacitor, and rain shield be replaced when replacing condenser fan motors.
4. The Working Group does not mean to suggest replacing the fan motor is required if only the prop needs to be replaced.
5. When wiring a fan or blower motor the technician should verify the motor is properly grounded.
6. The Working Group strongly suggests that fan scrolls and props are replaceable and not repairable parts.
7. The Working Group cautions the technician to verify the correct rotation of replaced fan scrolls and props.
8. The Working Group suggests always replace belt guard, covers, and grills.

Impact of unacceptable condition or performance:

The impact of unacceptable indoor blower operation is low airflow.

1. The impact of indoor airflow includes:
   a. <u>Cooling</u>
      Unacceptable airflow may produce consequences to the performance of the unit including:
      i. Excessive refrigeration cycle energy use.
      ii. Reduced sensible and total refrigeration capacity
      iii. Indoor air quality degradation
      iv. Fouling of the blower wheel and the evaporator coil
      v. Evaporator coil freezing (cause loss of cooling capacity to the space, water leaks from the unit)
      vi. Liquid refrigerant entering the compressor (leads directly to premature compressor failure)
   b. <u>Heating</u>
      Unacceptable airflow airflow may produce consequences to the performance of the unit including:
      i. Tripping the high limit safety switch.
      ii. Cracking gas heat, heat-exchangers
2. The impact of unacceptable condenser airflow includes:

a. Reduced heat transfer through the condenser causes the condensing temperature (Head pressure) to rise. A compressor, the major energy user in an air conditioner, will use more energy to pump against higher head pressure. This reduced the efficiency of the unit.
b. Air flow can become so reduced that heat transfer is diminished beyond the operational requirements of the unit and cause the unit to shut off, either because of a high pressure safety control opening, or because the internal by-pass in the compressor opening.

n- Check refrigerant system temperatures. If outside of recommended levels, find cause, repair, and adjust refrigerant charge to achieve optimal operating levels.	Annually

Understanding of the meaning of the task:

1. The Working Group has determined that refrigeration system temperatures refer to evaporating temperature, superheat, condensing temperature over ambient and subcooling.
2. The Working Group has determined this task includes performance analysis of the indoor and outdoor refrigeration cycle heat exchangers and the airflow through each.
3. The Working Group has determined restoration of the performance of the indoor and outdoor refrigeration cycle heat exchangers or the airflow through each may be required prior to final charge adjustment.

Guidance to technician when judging acceptable or unacceptable condition or performance:
The Working Group worked during several weekly meetings reviewing several different methods to determine the goal values for the performance indicators evaporating temperature, superheat, condensing temperature over ambient and subcooling. The sense of the Working Group is that simple rules-of-thumb are inadequate to deliver goal values specific enough to produce an acceptable outcome enough of the time to be an acceptable minimum Standard. The Working Group feels that the correct solution requires information technology. The Working Group is not ready to recommend a particular product and is not sure how commercial products fit within a national maintenance Standard.

The Working Group has scheduled a significant block of time, currently estimated at 20 weekly meetings to come to a resolution of this issue. That effort is scheduled to commence during the May 1, 2014 meeting and to carry on until the issue is resolved.

Guidance to the technician when performing the task:

There are six important measurements that are needed to diagnose a refrigeration cycle. A complete diagnosis is not available with less information. The six important measurements are:

SP – suction pressure

LP – liquid pressure

ST – suction temperature

LT – liquid temperature

AMB – outdoor ambient temperature

RAWB – return air wet bulb temperature

From these measurements we can calculate these performance indices:

COA (condensing temperature over ambient)

ET (evaporating temperature)

PD (pressure drop across the metering device)

SH (suction superheat)

SC (liquid subcooling)

The problems a working technician sees most commonly.

1. There can be too little heat absorbed into the low side.
2. There can be too much heat absorbed into the low side.
3. It can be too hard to reject heat from the high side.
4. There can be too much heat rejected from the high side.
5. There can be too little refrigerant in the system.
6. There can be too much refrigerant in the system.
7. There can be too little refrigerant flow through the system.
8. There can be too much refrigerant flow through the system.
9. There can be contaminants in the refrigerant.
10. The compressor can be pumping less than it was designed to pump.

Best practices and minimum Standards:

1. When coils are cleaned, there is an impact on airflow and heat absorption into the evaporator. The Working Group determined that charge and airflow should be evaluated, and if necessary adjusted, after indoor or outdoor coil cleaning.

o- Check fan drive for wear or problems due to poor alignment or poor bearing seating. Repair-or replace as needed.	Annually

Understanding of the meaning of the task:

1. The Working Group recognizes that this task is related to Task f.
2. This task refers to checking the fan drive to inspect the sheave for wear.
3. This task refers to checking for bearing wear.
4. The technician has the responsibility to document any wear or suspicion of wear and suggest the appropriate actions.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Checking sheaves for alignment during maintenance is a visual inspection. Setting alignment requires the use of a straight edge.
2. Sheave wear is on the inside surfaces of the sheave. Wear is when metal is removed by friction with the belt. The signs of wear include a ridge below the area where the belt rides in the sheave that can be felt with your finger of a change of shape of the inside of the sheave where the “V” shape becomes more of a “U” shape.
3. Detect bearing wear in several ways:

   a. By testing for up/down motion on the shaft, any up/down motion beyond that which is barely perceptible is unacceptable.
   b. By rotating the shaft and listen for unexpected sounds including grinding and "clunking" sounds.
   c. Look for metal shavings around the bearings.
   d. Look for shaft damage at the bearing.
4. The belt must be removed to detect bearing wear by looking for unacceptable up/down motion; therefore it is recommended that bearing wear inspection be done when the belt is being replaced.
5. If the technician is unsure if any noticed evidence of bearing wear is significant, the Working Group recommends documenting the suspicion and retesting at the time of the following inspection.
6. The Working Group suggests that the technician be sensitive to the as-found belt tension. Over tightened belts destroy bearings. If the belt is very tight, adjust it. If the bearing is worn and the belt was very tight, understand that it might have been the cause of the failure. The technician should refer to company policies or ask their supervisor about how to document that issue.

Guidance to the technician when performing the task:

1. The Working Group wishes to caution technicians that sheave adjustment changes the speed of the fan. It is not an appropriate way to adjust belt tension. Refer to task f for more information about belts.
2. *(Here because a task related to motor operation isn't included in the Standard yet.*) When adjusting sheaves, the technician is cautioned to be aware of the fan motor current draw and to be careful to not exceed the motor's nameplate current rating.
3. The Working Group determined that airflow adjustment is often outside the maintenance scope. However, detecting and documenting an airflow problems or a motor over current problem is properly within scope for maintenance.

Impact of unacceptable condition or performance:

1. Worn bearings risk damaging the shaft and blower scroll. Replacing shafts and scrolls greatly increases the cost of the repair over replacing the bearings prior to further damage.
2. Increased resistance to rotation requires more motor energy.
3. Additional damage to evaporator coils may result from damaged shafts and blower scrolls.

Best practices and minimum Standards:

1. The Working Group suggests that maintenance logs, kept at the job site are useful to record bearing wear suspicion among other things.
2. Many people believe that fixed sheaves wear and perform better than adjustable sheaves long-term after the appropriate sheave size has been determined.

p- Check integrity of all panels and curbs on equipment. Replace fasteners as needed to ensure proper integrity and fit/finish of equipment.	Annually

Understanding of the meaning of the task:

1. This task refers to inspecting panel fasteners.
2. This task refers to inspecting unit curbs and other supporting structures.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. Panel fasteners – Panels should be secured with fasteners.
    a. Missing fasteners should be replaced.
    b. stripped fasteners should be replaced with oversized versions or installed in an alternate locations.
2. Panels – All panels should be in place when leaving the job. Damaged or missing panels should be documented and recommended for replacement.

Guidance to the technician when performing the task:

1. Be careful not to strip out the fasteners when reinstalling them.
2. Be careful not to drop panels on their corners, it may puncture the roof and cause a leak.
3. Document any holes or cracks in the curb, flashing, or surrounding roof and recommend repair.
4. It is the technician's responsibility to secure all panels properly before leaving the unit.

Impact of unacceptable condition or performance:

1. Unplanned air leakage into or out of the unit is an energy problem and the source of a potential comfort problem.
2. Missing panels may cause a system reliability problem.
3. Unsecured panels that blow off may be a liability problem and a potential safety hazard.

Definitions:

1. This task refers to inspecting all unit panels including those that are structural, those that impact air leakage either in or out of the unit, and those that are purely decorative.
2. Fasteners are the means used to secure the panels to the unit. They include screws, hinges, latches or other devices.

q- Assess field serviceable bearings. Lubricate if necessary.	Annually

Understanding of the meaning of the task:

1. This task refers to lubricating bearings that require lubrication.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group recognizes the most modern equipment use sealed bearings that are not field serviceable for the purposes of this task.
2. The Working Group suggests that serviceable bearings should be greased once each year. This task should be assigned to either the spring or fall maintenance to avoid over greasing.

Guidance to the technician when performing the task:

1. Bearings with grease fittings often have drain fittings. The drain fittings should be removed and grease should be pumped in until new grease comes out of the drain fitting hole. The drain fitting should be replaced when the lubrication task is finished.
2. Bearings with grease fittings but no drain fittings should be lubricated sparingly (one or two pumps of the grease gun. Over filling a bearing will damage the grease seal.
3. The Working Group recognizes that there is the possibility of chemical interaction between different types of grease, but from a practical perspective the Working Group discounts the probability of a problem occurring and recommends using commercially available grease.
4. The Working Group urges the technician to be aware that motors that are speed controlled with a VFD require electrically conductive grease.
5. The Working Group suggests that care should be used to avoid introducing dirt or moisture into the bearing when lubricating.

Impact of unacceptable condition or performance:

1. Improper lubrication of worn field serviceable may lead premature bearing failure.
2. Bearing failure may lead to other consequential damage to shafts and fan props and scrolls.

Definitions:

1. Serviceable refers to the existence of a means to lubricate a bearing. The Working Group recommends that grease fittings should not be installed in the field.

r- Check drain pan, drain line and coil for biological growth. Clean as needed.	Annually

Understanding of the meaning of the task:

1. This Working Group determined that this task calls for a visual inspection and documentation of unusual material without a determination of the identity of the material.
2. This Working Group determined that cleaning provides no assurance of any specific outcome outside the removal of an obstruction to drainage.
3. The HVAC technician is very likely the only person that is going to look into the HVAC unit on a regular basis and therefore must be relied on to note unusual material.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group recognizes that HVAC technicians are generally not trained to identify biological growth.
2. The technician is encouraged to document, with a photograph if possible any unusual substance found in the unit.

Guidance to the technician when performing the task:

1. The Working Group determined that the technician has the responsibility to document the existence of anything unusual in the unit.

Impact of unacceptable condition or performance:

1. Unusual substances may be a concern to the building occupants.

Definitions:

1. Unusual means that which the technician determines is not ordinary.

Best practices and minimum Standards:

1. It is a best practice to document unusual substances with a photograph.

t- Inspect for evidence of moisture carryover beyond the drain pan from cooling coils. Make corrections or repairs as necessary.	Annually

Understanding of the meaning of the task:

1. The Working Group determined that this is a visual inspection for moisture outside the condensate pan. This is caused by moisture being blown off the evaporator coil.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The technician might choose to investigate moisture carryover when there is moisture outside the drain pan and the drain pan is not full. (alternate would be a leaking drain pan)
2. Moisture outside the draining system is unacceptable.

Guidance to the technician when performing the task:

1. The Working Group suggests that the primary cause of moisture carryover is high air velocity through the coil caused by the coil being obstructed in some way.
2. The Working Group suggests that the appropriate response to discovering moisture carryover on a maintenance visit is to document the issue and start the process that leads to evaporator coil cleaning.
3. There is a possibility that high air velocity can be caused by excessive fan speed.

Impact of unacceptable condition or performance:

1. Moisture carryover causes condensate leaks.
2. Moisture carryover creates conditions that allow biological growth.
3. Wet insulation has greatly reduced insulation R-value.
4. Moisture outside the drain pan may be the root cause for rust in the unit and ductwork.

Definitions:

1. Moisture carryover means moisture drawn off the coil by excessive air velocity.

u- Check for proper damper operation. Clean, lubricate, repair, adjust or replace as needed to ensure proper operation.	Annually

Understanding of the meaning of the task:

1. Economizer maintenance is covered under table 5-12, consult that table for more information related to economizer maintenance.
2. The Working Group recognizes that there may be dampers in a rooftop package unit that are used for a variety of purposes. The task refers to any non-economizer related damper.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group suggests that the technician should visually inspect fixed dampers and determine that they are positioned correctly and if not adjust it or document the issue as per the requirements of the maintenance contract.

Guidance to the technician when performing the task:

1. The Working Group recognizes that dampers may require lubrication and have determined the lubricating dampers and linkages are a required maintenance function.

Impact of unacceptable condition or performance:

1. Improperly positioned fixed outside air dampers may bring in excessive or insufficient outside air.

w- Check low ambient head pressure control sequence for proper operation. Repair or replace components or modify software/algorithm to ensure proper operation.	Annually

Understanding of the meaning of the task:

1. The Working Group determined that in the context of commercial rooftop unit and split systems, the concept of software algorithms is not something that is field accessible where they exist.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group concluded that in the context of maintenance, checking low ambient equipment includes only a visual inspection to look to see if any low ambient controls exist and if so if there is any evidence that they have been uninstalled or disabled.

Guidance to the technician when performing the task:

1. Systems with functioning low ambient controls controlled by head pressure or condenser return bend temperature will have the condenser fan off or running slowly on compressor start-up. The fans come on when the head pressure reaches the cut-in set point. If this is what happens, the low ambient controls are functional.
2. Some low ambient controls are based on ambient temperature. If the ambient temperature is below the set point, a condenser fan will be off. If the ambient temperature is above the set point, service provider may simulate a low ambient condition to do functional testing within scope of maintenance.

Impact of unacceptable condition or performance:

1. Running commercial rooftop units or split systems in low ambient conditions without operational low ambient controls may result in frozen evaporator coils, of running with low evaporating temperatures and high superheat. These conditions may lead to premature compressor failures.

x- Check combustion chamber, burner and flue for deterioration, leaks, moisture problems, condensation, and combustion products. Clean, test and adjust combustion process for proper operation.	Annually

Understanding of the meaning of the task:

1. The Working Group determined that this task refers to the gas heat section.
2. The Working Group determined that this task does not require combustion analysis.
3. The Working Group determined that this task requires a visual inspection of exposed metal components for rust and corrosion.
4. The Working Group determined that this task requires a visual inspection for soot.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group determined that a visual analysis of the character of the flames is usually the proper level of analysis of the combustion process in a maintenance context.
2. The Working Group suggests that measuring manifold pressure is the critical measurement for RTU gas heat section performance analysis, but that would be in response to an observed problem and usually outside the scope of maintenance.

Guidance to the technician when performing the task:

1. The Working Group determined that this task does not require cleaning of the heat section unless stated differently in the maintenance contract, if the inspection determines that cleaning is required, it is generally a service task and outside the scope of maintenance.

i3- (Alternate) - Check for damage or evidence of leaks on the gas heat section heat exchanger surfaces. Restore or replace as required to ensure acceptable function.	Annually

Understanding of the meaning of the task:

1. This task calls for an inspection for damage or leaks.
2. The Working Group determined that a detailed inspection of the gas heat exchanger is outside the scope of maintenance because of the effort required to access the heat exchanger in most cases.
3. The Working Group determined that a detailed inspection of the gas heat exchanger would be a service task that would be undertaken in the event that there is a reason to suspect a leak.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group suggests that a visual inspection of flames for lifting or movement, especially when the indoor fan starts.

Guidance to the technician when performing the task:

1. Any detected leaks from the gas heat, heat exchange are unacceptable.
2. The recommended response to a leaking heat exchanger is to disable the gas heat section, shut off and lockout the gas supply and document the condition for heat exchanger or unit replacement.

Impact of unacceptable condition or performance:

1. This is a life/safety issue.

Best practices and minimum Standards:

1. The Working Group suggests that testing for CO in the supply air when the gas heat section is in operation is a good practice.

y- Visually inspect insulation and areas of moisture accumulation for biological growth. If present, clean or disinfect as needed.	Annually

Understanding of the meaning of the task:

1. This Working Group determined that this task calls for a visual inspection and documentation of unusual material without a determination of the identity of the material.
2. This Working Group determined that cleaning provides no assurance of any specific outcome.
3. The HVAC technician is very likely the only person that is going to look into the HVAC unit on a regular basis and therefore must be relied on to note unusual material.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group recognizes that HVAC technicians are generally not trained to identify biological growth.
2. The technician is encouraged to document, with a photograph if possible any unusual substance found in the unit.

Guidance to the technician when performing the task:

1. The Working Group determined that the technician has the responsibility to document the existence of anything unusual in the unit.

Impact of unacceptable condition or performance:

1. Unusual substances may be a concern to the building occupants.

Definitions:

1. Unusual means that which the technician determines is not ordinary.

Best practices and minimum Standards:

1. It is a best practice to document unusual substances with a photograph.

z- Check compressor oil levels and or pressure on refrigerant systems having oil level and/or pressure measurement means. Repair, replace, or adjust as needed to ensure proper operation.	Annually

Understanding of the meaning of the task:

1. The Working Group determined that this task is a visual inspection of the oil level using the sight glass when available.
2. The Working Group does not feel that measuring oil pressure is within the scope of maintenance.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. The Working Group suggests that the Standard to be used for judging oil level in the absence of manufacturer's specifications is that an oil level of 3/8 to 3/4 is acceptable.

Guidance to the technician when performing the task:

1. Maintenance is a test, document and notify activity. If oil level problems are found, the Working Group recommends that the situation is documented as an unacceptable condition and rechecked the following inspection at a minimum.
2. If oil level problems are found, service tasks are required to resolve the issue:
    a. If the oil level is high:
        i. And there is a means to pump the system down, run the compressor into a vacuum to boil refrigerant out of the oil. If that drops the oil level to an acceptable level, investigate liquid refrigerant entering the compressor.
        ii. If the oil level remains high and there is a convenient way to remove oil, bring the oil level to an acceptable level based on the assumption that additional oil had been added to the system at some time.
    b. If the oil level is low:
        i. Look for signs of oil leakage and suggest a repair.
        ii. If the system has unloading, run the system loaded for a time and check for oil return. If oil returns investigate unloader set points and if additional unloading was added beyond the system design, correct found issues.
        iii. If the oil doesn't return and there is a convenient way to add oil, bring the oil level to an acceptable level based on the assumption that oil had been leaked from the system at some time.

Impact of unacceptable condition or performance:

1. Oil level problems may lead to premature compressor failures.

aa- Visually inspect exposed ductwork and external piping for insulation and vapor barrier for integrity. Correct as needed.	Annually

Understanding of the meaning of the task:

1. The Working Group determined that the duct work referenced in the task refers to ductwork that is outside the occupied building envelope.
2. The Working Group determined that the pipe insulation reference refers to all insulated piping.
3. The Working Group determined that the ductwork referred to is limited to the HVAC ductwork.

Guidance to technician when judging acceptable or unacceptable condition or performance:

1. An unacceptable condition for duct work is a problem that would allow water into the duct.
2. An unacceptable condition for ductwork is a problem that would allow outside air to enter the return duct or conditioned air to leave the supply duct outside the conditioned space.
    a. The Working Group believes the intent is to find large leaks, crushed ductwork, blown apart or disconnected ductwork and missing panels or caps as examples.
    b. Duct sealing for small leaks is not a maintenance task.

3. All exposed ductwork outside the conditioned space should be insulated, either internally or externally. The Working Group suggests that uninsulated ductwork outside the conditioned space is an unacceptable condition.
4. An unacceptable condition for piping is a problem that would allow condensate formation.
5. Piping on the roof should be constructed and supported per the local code.
6. Condensate piping requires a minimum downhill slope.

Order of Tasking

The Working Group determined that the order of maintenance tasking has to meet two interests:

1. The order of tasking must take dependencies into account. Example: restoration of the performance of the indoor and outdoor refrigeration cycle heat exchangers or the air flow through each may be required prior to final charge adjustment.[i]
2. The order of tasking must be practical and efficient for the technician. Therefore, the Working Group recommends that when dependencies are not an issue, the technician needs to have flexibility in the task order to meet the needs of the particular job.

The Working Group suggests the following task order as logical recommendation:

Walk around

*- Check service disconnect for proper operation
p- Check integrity of all panels and curbs on equipment. Replace fasteners as needed to ensure proper integrity and fit/finish of equipment.
aa- Visually inspect exposed ductwork and external piping for insulation and vapor barrier for integrity. Correct as needed.
v- Inspect air-cooled condenser surfaces for damage or evidence of leaks. Repair or clean as needed.
h- Check for evidence of build-up on or fouling on heat exchange surfaces (condenser). Restore as needed to ensure proper operation.

If an economizer is installed:

a- Check air filter and housing integrity. Correct as needed.
b- Check for particulate accumulation on filters. Clean or replace as necessary to ensure proper operation.
h- Check sealing integrity of all panels on equipment. Replace fasteners and gasketing as needed.

Fan/filter/evaporator/condensate section

Filter

a- Check for particulate accumulation on filters. Clean or replace as necessary to ensure proper operation.
j- Check air filter fit and housing seal integrity. Correct as needed.
b- If installed, Check UV Lamp. Clean or replace as needed to ensure proper operation.

Condensate

e- Check P-trap. Prime as needed to ensure proper operation.

r- Check drain pan, drain line, and coil for biological growth. Clean as needed.

t- Inspect for evidence of moisture carryover beyond the drain pan from cooling coils. Make corrections or repairs as necessary.

y- Visually inspect insulation and areas of moisture accumulation for biological growth. If present, clean or disinfect as needed.

Blower

f- 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.

o- Check fan drive for wear or problems due to poor alignment or poor bearing seating. Repair or replace as needed.

m- Check fan blades and fan housing. Clean, repair or replace as needed to ensure proper operation.

q- Assess field serviceable bearings. Lubricate if necessary.

g- Check variable frequency drive for proper operation. Correct as needed.

Evaporator

i- Check for proper operation of cooling coil, heating coil or heat exchangers (evaporator) for damage or evidence of leaks. Clean, restore or replace as required.

s- Check evaporator coil fins. Restore if possible. Replace coil if necessary to return to proper functioning.

Damper

u- Check for proper damper operation. Clean, lubricate, repair, adjust or replace as needed to ensure proper operation.

If an economizer is installed:

c- Check condition, setting, and operation of outdoor sensor, return air sensor, or change-over controller. Repair, adjust, or replace components to ensure proper operation.

d- Check condition, setting, and operation of the economizer controller. Repair, adjust, or replace components to ensure proper operation.

e- Check condition, setting, and operation of the mixed air/discharge sensor or changeover controller. Repair, adjust, or replace components to ensure proper operation.

f- Check dampers for proper operation, condition, setting and operation. Repair, adjust, lubricate, or replace components to ensure proper operation

g- Check condition, setting, and operation of the economizer damper motors. Repair, adjust, lubricate, or replace components to ensure proper operation.

j- Assess field serviceable bearings, lubricate if necessary.

k- Check condition, setting, and operation of the low limit stat. Repair, adjust, or replace components to ensure proper operation.

Controls section

d- Check control system and devices for evidence of improper operation. Clean, lubricate, repair, adjust or replace components as needed to ensure proper operation.
k- Check control box for dirt, debris and/or loose terminations. Clean and tighten as needed.
l- Check motor contactor for pitting or other signs of damage. Repair or replace as needed.

Refrigeration cycle

*- Verify acceptable low and high side teat transfer units' refrigerant system temperatures, evaporator temperature, superheat and condensing temperature over ambient.
n- Check refrigerant system temperatures. If outside of recommended levels, find cause, repair, and adjust refrigerant charge to achieve optimal operating levels.
*- If charge is adjusted, re-verify acceptable low and high side teat transfer units' refrigerant system temperatures, evaporator temperature, superheat and condensing temperature over ambient.
w- If installed – Check low ambient head pressure control sequence for proper operation. Repair or replace components or modify software/algorithm to ensure proper operation.
z- Check compressor oil levels and or pressure on refrigerant systems having oil level and/or pressure measurement means. Repair, replace, or adjust as needed to ensure proper operation.

Heating

x- Check combustion chamber, burner, and flue for deterioration, leaks, moisture problems, condensation, and combustion products. Clean, test, and adjust combustion process for proper operation.
c- If installed – Check steam system traps, pumps and controls. Clean or replace as needed to ensure proper operation.

EXHIBIT A

Working Group Participants (3-19-2013 thru 4-24-2014)

		Last	First	Company
Chair	1	Rossi	Dale	Field Diagnostic Services, Inc.
	2	Baker	Bob	ASHRAE
	3	Basarkar	Mangesh	Pacific Gas and Electric Company
	4	Billheimer	John	MAS Service/JB Mechanical Corp.
	5	Blazey	Michael	PECI
	6	Cherniack	Mark	Mark Cherniack, Consultant and previously with New Buildings Institute
	7	Compton	Chris	HVACRedu.net
	8	Danks	Richard	Richard Danks Consulting
	9	Dell'Osso	Dan	previously with Honeywell Utility Solutions
	10	Heinemeier	Kristin	Western Cooling & Efficiency Center UC Davis
	11	Hunziker	Pepper	Tre'Laine Associates
	12	Hussey	Ted	Marina Mechanical
	13	Langston	Don	Aire Rite AC & Refrigeration
	14	Lawing	Mike	Honeywell ECC
	15	Lipscomb	Ben	PECI
	16	Mann	Denny	Marina Mechanical
	17	Mason	Roger	Sheet Metal Workers Local #104/JATC
	18	Paavola	Mark	previously with Northern California Valley Sheet Metal Workers Training Center
	19	Prather	Donald	Air Conditioning Contractors of America
	20	Sanders	Greg	PECI
	21	Siegert	Susan	Integrity Mechanical Systems Corporation
	22	Sundberg	Bob	BNB Consulting
	23	Taylor	Jeff	HVACRedu.net and It's About Q
	24	Thilges	Monica	PECI
	25	Thomle	Adrienne	Honeywell ECC
	26	Tisencheck	Lou	DNV GL-Energy (was KEMA)
	27	Whitehurst	Duane	PECI
	28	Withers	Michael	Conservation Services Group
	29	Young	Randy	Sheet Metal Workers Local #104/JATC

[i] This description is consistent with ASHRAE interpretation IC 180-2008-1 rendered August 8, 2012

WHPA Work Product Summary

DATE: May 7, 2014

INITIATING BODY: WHPA CQM Standard 180 Maintenance Task Working Group

WORK PRODUCT NAME: CQM Committee ANSI/ASHRAE/ACCA Standard 180 Maintenance Task Working Group Report – Table 5-22 Rooftop Units

TYPE OF ACTION REQUESTED: ☒ **VOTE** ☐ **GUIDANCE** ☐**OTHER**: The Initiating Body requests that the WHPA Commercial Quality Maintenance Committee (CQM) review the referenced Work Product and vote to (1) approve it and (2) escalate it to the WHPA Executive Committee (EC) for review, validation as a WHPA work product, and distribution to the ANSI/ASHRAE/ACCA Standard 180 Committee.

APPROVAL HISTORY

WORKING GROUP: WHPA CQM Standard 180 Maintenance Task Working Group

☒ **BY CONSENSUS** ☐ **BY VOTE**

TALLY: There was a unanimous aye vote with no opposed or abstained. The voting members present were ACCA, FDSI, Honeywell ECC, HVACRedu.net, Marina Mechanical, and PECI.

DATE: May 1, 2014

COMMITTEE: WHPA Commercial Quality Maintenance Committee

☐ **BY CONSENSUS** ☒ **BY VOTE**

TALLY: Eleven of fourteen member firms voted "aye." Those included ACCA, Aire Rite AC & Refrigeration, CSG, FDSI, Honeywell ECC, Marina Mechanical, PECI, PG&E, SCE, Tre' Laine Associates and Western Allied Corporation. No members voted "nay." Honeywell Smart Grid Solutions abstained from voting.

DATE: May 13, 2014

Preface

The Commercial Quality Maintenance Committee Maintenance Task Working Group Report prepared this report on ANSI/ASHRAE/ACCA Standard 180 Table 5-22 Rooftop Units as the first in a series of reports that will be issued by the Working Group in the 2014-2015 timeframe. This first report looks specifically at many of the maintenance tasks listed in Table 5-22 that are related to DX packaged/rooftop equipment. The report provides an expert explanation of the tasks as well as additional guidance for technicians performing maintenance related to these tasks.

The review of Standard 180 is not yet complete and this report is only intended to be one of several such documents. The Working Group has identified several areas within Standard 180 that will need a much more comprehensive review and these areas will be addressed by this and at least one other Working Group well into 2015. The areas identified for additional review include:

- Table 5-22, Task n (Check Refrigerant System);
- Consideration for adding an addition task related to airflow evaluation;
- Table 5-12, Tasks a-k (Economizers);
- Table 5-9, Task e (Control Systems/Schedules);
- Other tables with packaged equipment/rooftop unit related maintenance tasks; and
- Standard 180, Section 4 (Maintenance Plan).

While this report is intended to help operationalize Standard 180 and be used by ASHRAE to inform the development of a Standard 180 User Guide, the guidance provided should only be considered as suggested revisions prepared by a group of WHPA subject matter experts. The ASHRAE/ACCA Standard 180 Committee will ultimately determine how or if suggestions are incorporated into a revised standard. Output of this working group will also be considered by California utilities as they work to refine and improve their quality maintenance programs. Consider this work to be part of a broader and collaborative effort to address thermal comfort, indoor air quality and energy efficiency through HVAC maintenance.

The long-term plan is for the Western HVAC Performance Alliance to submit this initial report and future revisions to ASHRAE/ACCA so it can be provided to the Standard 180 Committee when it is re-activated. It is intended to be fully considered in the context of the ANSI review process for future updates of Standard 180 and/or the preparation of other materials that support Standard 180.

WORK PRODUCT OBJECTIVES: The CQM Committee appointed the Maintenance Task Working Group to complete a detailed review of ANSI/ASHRAE/ACCA Standard 180-2012 tasking tables and report. The Working Group established the following five objectives for this report:

1. To achieve consensus around the meanings and implementation of the various tasks in the tables considered, beginning with this report on Table 5-22 for Rooftop Units.
2. To define the tables that apply to air cooled DX package units and split systems and their associated heat packages, and those that do not apply.
   a. The Working Group determined that the target units are of the common 2-150 ton units.
   b. The Working Group determined that hydronic systems do not apply to the target set of units.
3. To look for conflicts and redundancies between tables and between tasks and attempt to resolve them.
4. To provide detailed understandings of the tasks, provide best practices, minimum standards and advice to the technicians to promote more effective implementation of Quality Maintenance.
5. When working on the detailed analysis of a task to consider it with the following prioritization:
   a. Maintain reliable comfort
   b. Reduce service interruptions
   c. Increase the serviceable life of the unit
   d. Maintain or improve system energy efficiency
   e. Maintain or improve indoor air quality

CA ENERGY EFFICIENCY PLAN STRATEGIC GOAL ALIGNMENT:

☐ GOAL 1 ☒ GOAL 2 ☐ GOAL 3 ☐ GOAL 4

CEESP HVAC GOAL STRATEGIES: Strategic Plan Goal 2: Quality HVAC installation and maintenance becomes the norm. The marketplace understands and values the performance benefits of quality installation and maintenance.

• Strategy 2.1: Create a statewide quality installation and maintenance (QI/QM) brand that will be attached to systems/installation/contactors that meet quality standards.

BENEFITS: The detailed task analyses for each task in the Working Group's report should improve overall effectiveness in performing Standard 180 Table 5-22 tasks as part of a fixed priced maintenance agreement by

clarifying the understanding of the meaning of the task, providing guidance to the technician when judging acceptable or unacceptable condition or performance, providing guidance to the technician when performing the task, clarifying the impact of unacceptable condition or performance, defining terminology as needed, and specifying the timing for the task. Cumulatively this will ultimately result in improved energy efficiency savings. The findings' recommendations also propose updates that may influence subsequent versions of Standard 180 Table 5-22 for enhanced accuracy and improved understanding by:

1. Reorganizing/improving tasks dealing with heat exchangers (Tasks "h", "l", "s" and "v") into a more usable context of the range of equipment focused on by the Working Group.
2. Updating the frequency of "p-trap" changes to quarterly for low cost best practices and reduced water leak liability and damage.
3. Eliminating the suggestion to repair fan props and blower scrolls in Task "m" as it is a replacement only item, not a maintenance issue.
4. Eliminating the direction in Task "l" for technicians to "repair" a contactor if the points show signs of wear since a contactor with unacceptable condition should be replaced.
5. Adding language to the Standard to cover topics focused on lockout and tag out; motor maintenance, including grounding, motor current and service factor; fuses and circuit breakers and service disconnects.
6. Bringing attention to items that are NOT included in the Standards, such as:
   a. the terms "CO2 and "DCV".
   b. customer facing reporting that should be addressed either as an expansion of Section 4 or as a new section.
   c. the concept of checking air flow.
   d. a new task requiring an observation of the entire heat cycle from ignition through fan on based on the fan limit, not high limit trip and fan off based on the fan limit after the heat has shut off.
7. Clarifying the definition of "Performance Objective".
8. Recommending the task sequencing outlined in the "Order of Tasking" section of the report.

OUTSTANDING ISSUES / DEBATES / MINORITY VIEWS: Comments were received during the voting meeting from Robert Mowris Associates, Inc. that they reviewed the report as part of the EM&V team and felt that portions of the report related to the economizer and air flow refrigerant charge, particularly on the heating side should be expanded to improve the overall good report. The Chair clarified that those areas are outside the scope of this report but would be covered as the Working Group's next focuses. The Working Group's planned future work products developed from May thru October, 2014 will be on clarification of Table 5-22 Task "n" refrigeration cycle and air flow.

POTENTIAL AUDIENCE: WHPA CQM Committee, WHPA Executive Committee, WHPA Council of Advisors, ANSI/ASHRAE/ACCA Standard 180 Committee, Contractors, Technicians, IOUs, CEC, and CPUC.

MOTION to the Executive Committee: The "Maintenance Task Working Group Report (Draft) Table 5-22 Rooftop Units" dated May 13, 2014, be adopted as an official WHPA Report.

Following adoption by the WHPA Executive Committee of WHPA Work Product presented for action, the following steps will be taken:

1. The word "DRAFT" will be removed from the work product and be replaced by the words "A WHPA Report."
2. The WHPA Work Product Summary will
   a) document the final vote of the Executive Committee and
   b) be joined to and become the preface to the adopted report.
3. The adopted report will be posted at the WHPA website on
   a) the homepage in the "WHPA Work Products" section and

b) the relevant committee/working group page listed under "Meeting Notes and Supporting Documents."

4. Any recommendations presented in the referenced report will be prioritized and acted upon as specific tactics that support the WHPA's strategic goals.
5. WHPA Staff will draft a letter of appreciation from the Executive Committee to members of the relevant committee/working group and email it to them.

VOTE TALLY: On June 11, 2014, the following 13 EC member organizations (or their designated proxies) unanimously voted "aye" to adopt the presented report and the above detailed motion: ACCA, AHRI, ASHRAE, CEC, CPUC, HARDI by proxy to AHRI, IHACI by proxy to ACCA, JCEEP by proxy to UA, PG&E by proxy to SDG&E, SDG&E, SCE, SoCalGas, UA.

FURTHER ACTIONS REQUIRED: WHPA Staff will ensure the required motion steps are completed for finalization and posting of the report, plus the drafted letter of appreciation. The CQM Standard 180 Maintenance Task Working Group will continue its work as detailed in the preface on Pages 1-2 of this Work Product Summary.

NEXT STEPS: It is strongly encouraged that the detailed report be reviewed to ensure understanding of the full impact of the detailed analysis of the Table 5-22 Rooftop Units Tasks as well as the definitions the Working Group used for maintenance provider responsibility, quarterly maintenance, visual inspection, and functional tests.