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Question: 1514

A building uses 1,000 gallons of #2 Fuel Oil. How many MMBtu does this represent?

- A. 138 MMBtu
- B. 141 MMBtu
- C. 091 MMBtu
- D. 100 MMBtu

Answer: A

Explanation: The standard energy content of #2 fuel oil is approximately 138,500 Btu per gallon. Therefore, $1,000 \text{ gallons} \times 138,500 \text{ Btu/gal} = 138,500,000 \text{ Btu}$, or 138.5 MMBtu.

Question: 1515

An auditor is performing an airflow and static pressure diagnostic on a central variable air volume (VAV) HVAC system in an office/residential mixed-use building. Using a digital micro-manometer and static pressure probe, the auditor measures static pressure in the main supply trunk duct near the air handler discharge, finding it significantly higher than design specifications while terminal diffusers report low flow. What is the most likely mechanical root cause?

- A. The outdoor air intake louver is fully open, allowing excessive wind gusts to pressurize the mechanical equipment room.
- B. The return air filter is completely missing, allowing unrestricted airflow directly into the cooling coil assembly.
- C. A downstream motorized fire/smoke damper has failed in a partially closed position, choking airflow.
- D. The central supply fan motor has lost all electrical phases, causing complete shutdown of the entire HVAC distribution network.

Answer: C

Explanation: High static pressure measured near the fan discharge coupled with low airflow at

terminal units typically indicates a severe flow restriction downstream in the main trunk duct. A partially closed fire/smoke damper, a collapsed flexible duct, or a stuck VAV box damper creates a major bottleneck, raising static pressure upstream while starving downstream delivery points.

Question: 1516

To mitigate thermal bridging in a masonry cavity wall retrofit, which insulation approach is most effective for continuous thermal performance?

- A. Filling cavity spaces with loose-fill fiberglass insulation batts.
- B. Installing reflective foil wrap directly behind interior plaster.
- C. Placing continuous rigid insulation outboard of the backup wall.
- D. Applying spray foam strictly to interior stud cavities.

Answer: C

Explanation: Placing continuous insulation outboard of the structural backup wall wraps the building in a thermal blanket, eliminating thermal bridging through framing or masonry ties and maximizing effective R-value.

Question: 1517

An analyst reviewing a master-metered electric graph for an apartment building detects a steady, unseasonable baseline creep upward over three consecutive years despite stable occupancy. What physical factor best explains this electrical baseload increase?

- A. Aging common area equipment degradation, increasing plug loads, or failing motor bearings in pumps.
- B. Gradual reductions in outdoor ambient temperatures occurring during successive summer seasons.
- C. Decreased domestic hot water usage resulting from aggressive tenant water conservation

campaigns.

D. Improvements in building envelope thermal insulation reducing overall HVAC fan energy requirements.

Answer: A

Explanation: Unseasonable baseload creep in master-metered electric accounts usually stems from deteriorating equipment efficiency, such as failing pump bearings, increasing friction, or tenant additions of unmetered plug loads. Unlike weather-dependent loads, baseload creep reflects degradation in base operations. Tracking this trend helps identify preventive maintenance needs.

Question: 1518

A building's outdoor air intake is located near the cooling tower discharge. What is the primary concern for the building analyst?

- A.** The increase in the static pressure within the supply air ductwork.
- B.** The decrease in the overall lifespan of the cooling tower fan motor.
- C.** The potential for Legionella or moisture to enter the ventilation air.
- D.** The reduction in the sensible cooling capacity of the chiller system.

Answer: C

Explanation: This is a critical health and safety issue. Building analysts must ensure that the outdoor air (OA) intakes are located away from potential sources of contamination. Cooling towers can harbor Legionella bacteria in their mist; if the intake is too close, these pathogens can be distributed throughout the building.

Question: 1519

An auditor is inspecting a multifamily building with a pneumatic control system for the HVAC. The air compressor is running continuously. Which of the following is the most likely impact on system performance?

- A. The terminal units will default to the fully closed position.
- B. The actuators will fail to position valves/dampers correctly.
- C. The indoor air quality will decrease due to oil in the ducts.
- D. The boiler will stay in high-fire mode due to pressure loss.

Answer: B

Explanation: Pneumatic systems rely on stable air pressure to move actuators. If the compressor runs constantly, it indicates a significant leak in the main lines or branch lines. Without adequate pressure, the controllers cannot generate the signal required to move valves or dampers to their commanded positions, leading to poor temperature control and energy waste.

Question: 1520

An energy audit of a multifamily building's oil-fired heating plant reveals a smoke spot number of 4

on the Bacharach scale, a net stack temperature of 610°F, and a carbon dioxide concentration of 8.0%. The oil burner nozzle is rated at 2.0 GPH

with a 60°

hollow cone pattern. What is the root cause of these operating conditions?

- A. Fuel oil preheater temperature is maintained below optimal viscosity limits.
- B. Stack damper is pinned in a restricted position, causing backpressure buildup.
- C. Nozzle operating pressure is set excessively high above pump ratings.
- D. Inadequate combustion air mixing and incorrect retention head positioning occur.

Answer: D

Explanation: A smoke number of 4

combined with a low CO₂

level of 8.0%

indicates severe fuel-air mixing deficiencies and insufficient oxygen turbulence around the flame front. Adjusting the burner retention head and ensuring proper atomization and air swirl will eliminate soot formation and raise combustion efficiency.

Question: 1521

An energy analyst assesses the economic impact of upgrading incandescent hallway lighting to LED fixtures in a multifamily building. The fixtures are controlled by occupancy sensors. Which interaction factor must be considered when calculating heating and cooling energy impacts?

- A. Motion sensors eliminate all electrical baseline loads, rendering insulation upgrades redundant.
- B. LED spectral output changes alter exterior window U-factor thermal transmittance values.
- C. Reduced internal heat gains from lighting decrease cooling loads but increase heating loads.
- D. Reduced fixture wattage permanently increases domestic hot water distribution temperatures.

Answer: C

Explanation: Lighting fixtures generate internal heat gains. Upgrading to high-efficiency LEDs reduces internal heat gains, which decreases air conditioning energy consumption in summer (cooling credit) but increases space heating energy consumption in winter (heating penalty). Comprehensive building analysis accounts for these thermal interactive effects.

Question: 1522

An auditor is evaluating point-of-use water saving measures for a low-income multifamily property. The current showerheads flow at 2.5 gpm. The auditor recommends 1.5 gpm high-efficiency heads. Which secondary impact must be evaluated to ensure resident satisfaction and safety?

- A. The likelihood of sediment buildup in the new aerator holes.
- B. The increase in time required to reach desired temperature.
- C. The reduction in the total available volume of the DHW tank.
- D. The potential for thermal shock due to pressure imbalances.

Answer: D

Explanation: Low-flow showerheads increase the sensitivity of the mixing valve to pressure fluctuations in the hot and cold water lines. If a toilet is flushed elsewhere, the pressure drop in the cold line can cause the shower temperature to spike (thermal shock) more drastically with a low-flow head than with a high-flow head, unless pressure-balancing valves are installed.

Question: 1523

What is the "Dew Point" of air at $70^{\circ}F$ and 100% Relative Humidity?

- A. $50^{\circ}F$
- B. $80^{\circ}F$
- C. $70^{\circ}F$
- D. $32^{\circ}F$

Answer: C

Explanation: By definition, when the Relative Humidity is 100%, the air is saturated. This means the dry bulb temperature, the wet bulb temperature, and the dew point temperature are all identical. Any cooling of this air will result in immediate condensation.

Question: 1524

A multifamily building analyst is using a spreadsheet to calculate the savings for a lighting retrofit. The current lighting uses 100 fixtures at 60 watts each, operating 8,760 hours per year. The proposed LED fixtures use 12 watts. Which formula correctly calculates the annual energy savings in kWh?

- A. $((100 \times 60) + (100 \times 12)) \times 8760/1000$
- B. $(100 \times (60 - 12))/8760 \times 1000$
- C. $(100 \times 60 \times 8760) - (100 \times 12)$
- D. $((100 \times 60) - (100 \times 12)) \times 8760/1000$

Answer: D

Explanation: To calculate energy savings in kWh, one must find the difference in total wattage between the baseline and the proposed case, multiply by the annual hours of operation, and divide by 1,000 to convert watts to kilowatts. This ensures the spreadsheet accurately reflects the reduction in consumption based on the power draw of the fixtures and their duty cycle.

Question: 1525

You are calculating the potential energy savings for a DHW circulation pump control upgrade. The current pump is 1/2 HP (0.37 kW) and runs 24/7. The proposed control will shut the pump off for 6 hours at night. What is the annual energy savings in kWh?

- A. 2,190 kWh

- B. 3,240 kWh
- C. 810 kWh
- D. 1,240 kWh

Answer: C

Explanation: The savings are calculated by multiplying the power by the hours reduced:

$$0.37 \text{ kW} \times 6 \text{ hours/day} \times 365 \text{ days/year} = 810.3 \text{ kWh.}$$

Question: 1526

A multifamily building replaces all incandescent bulbs in apartments with LEDs. The heating system is electric baseboard, and the cooling is provided by window AC units. In a climate with a long cooling season and a short heating season, what is the net effect on the annual utility costs?

- A. Costs remain neutral because the heating penalty equals the cooling savings.
- B. Costs increase because the electric baseboards are less efficient than the bulbs.
- C. Costs decrease for lighting but increase for cooling due to higher humidity.
- D. Costs decrease significantly due to lower lighting kWh and lower cooling kWh.

Answer: D

Explanation: In a cooling-dominated climate, reducing internal gains from lighting is doubly beneficial. First, the lighting energy consumption (kWh) drops. Second, the air conditioning system does not have to remove the waste heat previously generated by the incandescent bulbs, leading to lower cooling kWh. While there is a small heating penalty in the winter, the cooling savings and lighting savings far outweigh it in this specific climate scenario.

Question: 1527

An energy auditor evaluates an advanced energy management system (EMS) for a multifamily property's central heating and cooling plant. Which advanced control strategy delivers the greatest energy savings?

- A. Implementing automated outdoor reset schedules that dynamically adjust hot water supply temperatures.
- B. Maintaining constant maximum boiler water supply temperatures year-round regardless of weather conditions.
- C. Shutting off all central plant circulation pumps whenever outside temperatures exceed 70°F.
- D. Relying entirely on manual tenant thermostat adjustments to control central boiler firing rates.

Answer: A

Explanation: Outdoor reset schedules optimize heating water supply temperatures by lowering them during milder weather, reducing standby distribution heat losses and improving overall thermal efficiency.

Question: 1528

An analyst evaluates ventilation fan energy usage from electrical utility data and finds it matches a constant 24/7 run-time, contradicting observed building management schedules stating fans run only during day hours. What is the cause of this mismatch?

- A. Tenants manually shutting down the central ventilation system from their individual apartment thermostats.
- B. Building management successfully enforcing scheduled shutdown protocols every evening at midnight.
- C. Hardwired manual override switches or failed timeclocks forcing continuous uninterrupted fan operation.
- D. Variable frequency drives automatically modulating fan speed down to zero during nighttime hours.

Answer: C

Explanation: Operational schedules reported by management often differ from reality due to broken timeclocks, overridden manual switches, or failed building management system (BMS) programming. When electrical data shows continuous operation against a scheduled profile, physical inspection of control panels is required. Control verification bridges data and observation.

Question: 1529

An auditor is evaluating a heat pump water heater (HPWH) installation. The unit costs \$4,500 installed, compared to \$1,500 for a standard electric tank. The HPWH saves \$400 annually. The auditor applies a federal tax credit of 30% of the total installed cost. What is the simple payback period for the incremental cost of the HPWH after the tax credit is applied?

- A. The simple payback period is 4.13 years for the incremental investment.
- B. The simple payback period is 7.50 years for the incremental investment.
- C. The simple payback period is 8.25 years for the incremental investment.
- D. The simple payback period is 5.25 years for the incremental investment.

Answer: A

Explanation: The incremental cost before the credit is $\$4,500 - \$1,500 = \$3,000$. The tax credit is 30% of the total cost ($0.30 \times \$4,500 = \$1,350$). The net incremental cost is $\$3,000 - \$1,350 = \$1,650$. The simple payback period is the net incremental cost divided by the annual savings: $\$1,650 / \$400 = 4.125$ years. This calculation demonstrates how financing incentives and tax credits directly improve the cost-effectiveness of high-efficiency equipment.

Question: 1530

An analyst is tasked with measuring the flow rate of a wall-mounted supply register in a small studio apartment. The register is located in a tight corner, making it impossible to fit a standard capture hood. Which alternative tool and method would provide the most accurate measurement of the airflow?

- A. A rotating vane anemometer using a multi-point grid average
- B. A thermal anemometer held at the center of the register face
- C. An ultrasonic flow meter placed on the exterior of the duct
- D. A pitot tube traverse performed within the main supply trunk

Answer: A

Explanation: When a capture hood cannot be used, a rotating vane anemometer is the preferred tool for measuring terminal velocity at a grille. To get an accurate CFM reading, the analyst must take multiple readings across the face of the register to calculate an average velocity (V) and then multiply by the free area of the grille (A), using the formula $Q = A \times V$. A single-point measurement with a thermal anemometer is inaccurate due to the non-uniform flow patterns typical of supply registers.

Question: 1531

An auditor is reviewing the utility data for a cooperative housing complex and notices a significant spike in water consumption following the installation of low-flow fixtures two years ago. The maintenance log shows frequent repairs to the booster pump system but no reported leaks in individual units. When interviewing the head of maintenance, the auditor learns that the staff has been manually bypassing the pressure reducing valves (PRVs) to satisfy resident complaints about shower pressure. What is the most appropriate next step in the auditing process?

- A. Calculate the potential energy savings from restoring the PRV settings and installing even lower-flow aerators in all bathrooms.
- B. Analyze the relationship between the booster pump operating hours and the bypassed PRVs to determine the impact on water energy.

- C. Review the original capital replacement schedule to see if the booster pumps were scheduled for an upgrade during the last cycle.
- D. Schedule a meeting with the cooperative board to explain how resident behavior and maintenance bypasses are negating the retrofits.

Answer: B

Explanation: Determining the purpose of the audit and analyzing observed data requires connecting mechanical system performance with human intervention. By analyzing the pump data in relation to the PRV bypass, the auditor can quantify the energy-water nexus impact, which is a critical auditing skill for identifying why previous retrofits failed to yield the expected savings.

Question: 1532

A multifamily building analyst evaluates the total heat load of an apartment unit using enthalpy calculations. The total heat formula combines both sensible and latent components using air mass flow rate and enthalpy difference. What is the standard psychrometric formula for total heat load?

- A. Total Load (BTU/hr) = $1.08 \times \text{CFM} \times \Delta T$
- B. Total Load (BTU/hr) = $0.68 \times \text{CFM} \times \Delta T$
- C. Total Load (BTU/hr) = $4.5 \times \text{CFM} \times \Delta h$
- D. Total Load (BTU/hr) = $4.84 \times \text{CFM} \times \Delta W$

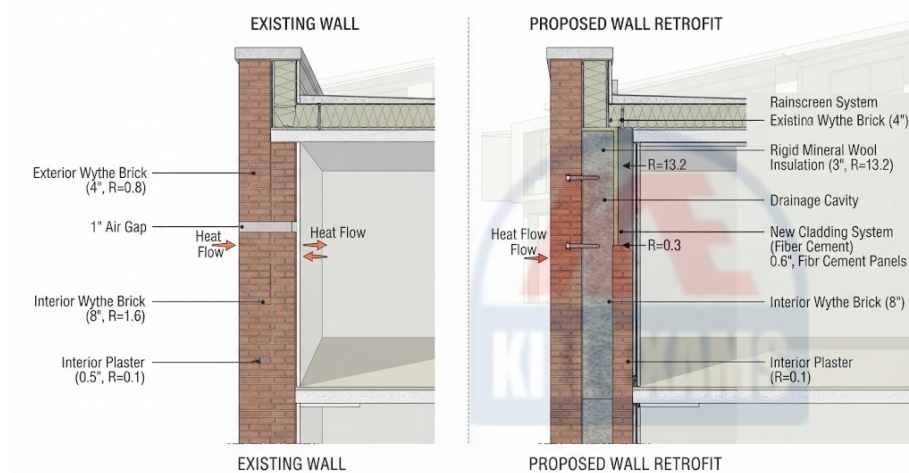
Answer: C

Explanation: Total heat load combining sensible and latent energy is calculated using the formula Total Load = $4.5 \times \text{CFM} \times \Delta h$, where Δh is the enthalpy difference in BTUs per pound of dry air between outdoor and indoor air streams.

Question: 1579

An auditor is performing a building envelope assessment on a 1970s masonry multifamily building. The goal is to prioritize retrofit measures based on the ratio of annual energy savings to the total installed cost. The auditor calculates the heat loss through a specific wall section using the formula $Q = U \times A \times \Delta T$. Given a wall area of 12,000 sq. ft., an existing U-value of 0.25, and a proposed U-value of 0.08 after adding exterior insulation, which factor will most heavily influence the "Measure Prioritization" in a cold climate (Zone 6)?

CROSS-SECTION: MULTI-WYTHE BRICK WALL RETROFIT



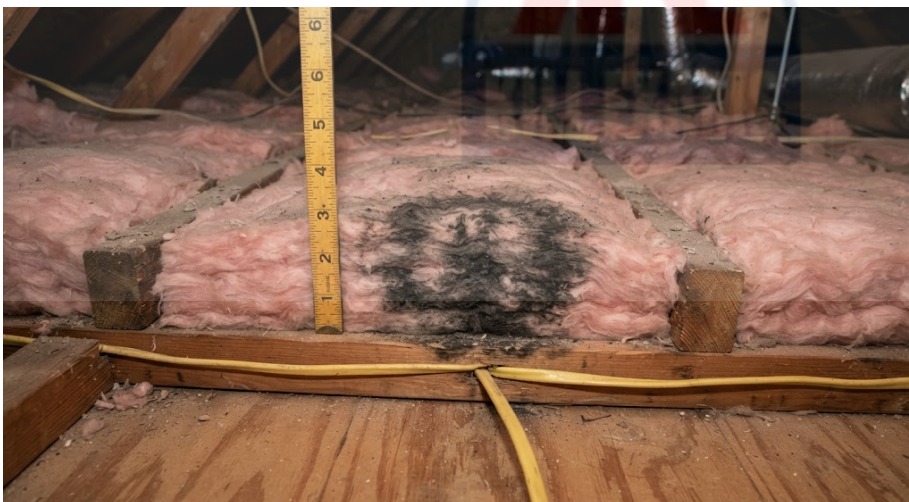
- A. The cost of interior finish repairs required after the exterior insulation is installed
- B. The inherent thermal bridging caused by the existing floor slab edges and balconies
- C. The reduction in the building's peak cooling load during the summer design days
- D. The durability of the new cladding system relative to the building's remaining life

Answer: B

Explanation: In multifamily masonry buildings, thermal bridging at floor slabs (where the concrete slab penetrates the vertical wall plane) can account for a massive percentage of total envelope heat loss. Even if the wall U-value is improved, failing to account for these bridges will lead to an overestimation of savings. BPI-MFBA standards emphasize that "Measure Prioritization" must account for the actual realized performance, which is limited by structural thermal bridges.

Question: 1580

An analyst is evaluating the attic insulation of a 1970s garden-style apartment complex. The attic contains 6 inches of loose-fill fiberglass insulation. The auditor notes that the insulation is dark and discolored near the top plates of the interior partition walls. What does this visual condition indicate regarding the building's thermal and pressure boundary?



- A. The R-value has increased due to the accumulation of fine particulate matter
- B. The fiberglass insulation has reached its maximum moisture saturation capacity

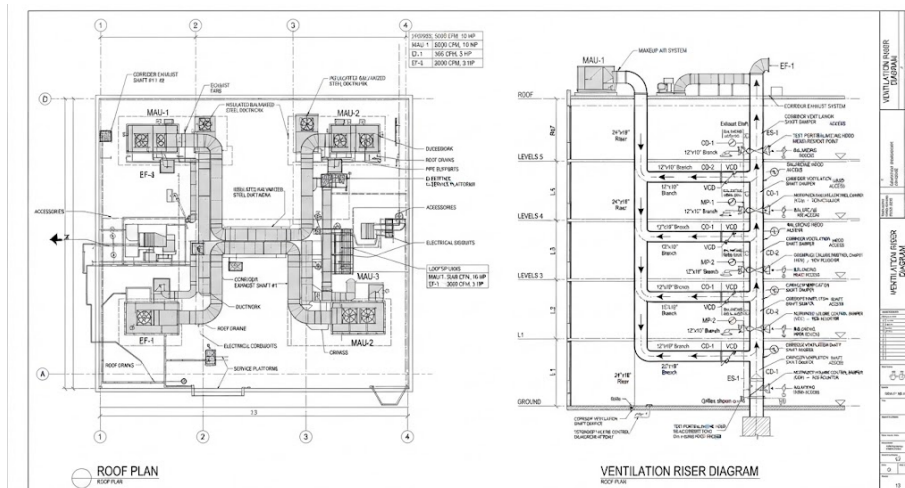
- C. The insulation was installed at a density that exceeds the manufacturer's limit
D. Air bypasses are allowing conditioned air to filter through the fiberglass media

Answer: D

Explanation: The correct approach is to recognize that the discoloration, often called "ghosting" or "filtering," indicates significant air leakage from the conditioned space into the attic. Fiberglass acts as a filter; as warm, buoyant air escapes through top-plate bypasses, the insulation traps dust and particulates, turning the material dark. This confirms the presence of a pressure boundary failure. The discoloration is not an indicator of R-value improvement or material density, nor is it typically a sign of bulk moisture saturation.

Question: 1581

An auditor is evaluating mechanical corridor ventilation rates in a high-rise multifamily building to verify whether the system meets current ventilation standards and design specifications.



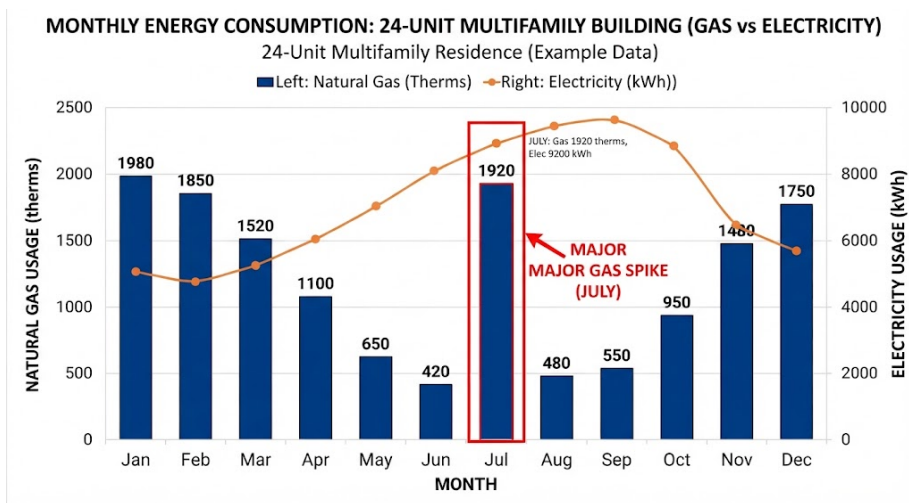
- A. Measure exhaust airflow rates at all corridor relief grilles using a balometer and compare results against design specs.
- B. Seal all corridor ventilation shafts permanently to eliminate infiltration heat losses during the winter heating season.
- C. Install carbon dioxide sensors in every apartment unit to automatically control the central exhaust fan speeds.
- D. Increase the operational speed of the supply fan to create a positive pressure throughout the entire stairwell enclosure.

Answer: A

Explanation: Assessing mechanical ventilation performance in multifamily corridors requires field-measuring airflow rates at relief grilles using calibrated instruments like balometers and comparing measured values against ventilation standards.

Question: 1582

A multifamily analyst is reviewing the trailing 12-month utility consumption graph for a 24-unit apartment building with individual electric meters and a central hot water boiler fueled by natural gas. The graph indicates a sudden, inexplicable upward surge in gas consumption during July, a month when space heating is inactive. What primary operational anomaly does this visualization most directly highlight?



- A. A continuous domestic hot water recirculation loop aquastat failure or massive leak
- B. An unseasonal cooling load driven by excessive occupant window infiltration
- C. Severe envelope thermal degradation manifesting as accelerated basement heat loss
- D. A persistent steam trap failure within the primary heating distribution loop

Answer: A

Explanation: In a multifamily building with a central gas-fired boiler where space heating is turned off during the summer, natural gas consumption is driven entirely by domestic hot water production. A sharp, unexpected surge in gas use during warm months indicates that water heating energy is being wasted continuously, which points directly to a failing domestic hot water recirculation aquastat, a stuck mixing valve, or a severe thermal leak in the hot water distribution loop.

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