

- X. DESTRATIFICATION FAN SHALL BE AN AIR PEAR THERMAL EQUALIZER MODEL 60 OR ONYX PER SCHEDULE.
1. SIZE AND WEIGHT:
 1. STANDARD 32 INCH HEIGHT TO BAIL; 24 INCH HEIGHT TO RIM. 20 INCH DIAMETER, 22LB (10KG)
 2. MOTOR (EC):
 1. ELECTRONICALLY COMMUTATED MOTOR, UP TO 92% EFFICIENT, STEEL BLADES WELDED TO STEEL HUB. BALL BEARINGS SHALL BE PERMANENTLY LUBRICATED AND SHIELDED, UP TO 1825 CFM, 1660 RPM, 68 DBA. THERMALLY PROTECTED MOTOR WITH AN OPERATING RANGE OF -13° F (-25° C) TO +140° F (+60° C).
 2. RECOMMENDED CEILING HEIGHT UP TO 60 FEET (18.3 M) AND AREA COVERAGE UP TO 2000 SQ. FT. (186 SQ. M); 25 FEET (7.6 M) FROM THE FAN'S CENTER IN ALL DIRECTIONS.
 3. ELECTRICAL REQUIREMENTS:
 1. 277V AC, SINGLE PHASE, 50/60 HZ.; 0 - 1.3 AMPS; 0 - 170 WATTS FOR A-60.
 2. 208V AC, SINGLE PHASE, 50/60 HZ.; 0 - 0.8 AMPS; 0 - 98 WATTS FOR ONYX.
 4. CONTROLS SHALL BE COORDINATED WITH MOTOR SELECTION (EC).
 1. EC MOTOR SHALL BE CONTROLLED BY 0-10VDC CONTROL SIGNAL VIA BAS.
- R. LOW PRESSURE HOT WATER CONDENSING BOILER B-1-1 & 2):
- I. MANUFACTURERS:
 1. AERCO
 2. CLEAVERBROOKS
 3. LOCHINVAR
 - II. DESCRIPTION:
 1. BOILER SHALL BE EITHER NATURAL GAS FIRED FULLY CONDENSING FIRE TUBE DESIGN. IT SHALL BE DESIGN TO OPERATE IN VARIABLE PRIMARY OR PRIMARY SECONDARY PIPING CONFIGURATION. POWER BURNER SHALL HAVE FULL MODULATION, DISCHARGE INTO A POSITIVE OR NEGATIVE PRESSURE VENT AND THE MINIMUM FIRING RATE SHALL NOT EXCEED THE FOLLOWING PER MODEL:
 1. BOILERS THAT HAVE AN INPUT GREATER THAN WHAT IS SPECIFIED ABOVE AT MINIMUM FIRE WILL NOT BE CONSIDERED. BOILER EFFICIENCY SHALL INCREASE WITH DECREASING LOAD (OUTPUT), WHILE MAINTAINING SETPOINT. BOILER SHALL BE FACTORY-FABRICATED, FACTORY-ASSEMBLED AND FACTORY-TESTED, FIRE-TUBE CONDENSING BOILER WITH HEAT EXCHANGER SEALED PRESSURE-TIGHT, BUILT ON A STEEL BASE, INCLUDING INSULATED JACKET, FLUE-GAS VENT CONNECTIONS, COMBUSTION-AIR INTAKE CONNECTIONS, WATER SUPPLY, DUAL INLET RETURNS CONDENSATE DRAIN CONNECTIONS, AND CONTROLS.
 - IV. HEAT EXCHANGER:
 1. THE HEAT EXCHANGER SHALL BE CONSTRUCTED OF 439 STAINLESS STEEL FIRE TUBES AND TUBESHEETS, WITH A ONE-PASS COMBUSTION GAS FLOW DESIGN. THE FIRE TUBES SHALL BE 1/2" OR 5/8" OD, WITH NO LESS THAN 0.048" WALL THICKNESS. THE UPPER AND LOWER STAINLESS STEEL TUBESHEET SHALL BE NO LESS THAN 0.25" THICK. THE PRESSURE VESSEL/HEAT EXCHANGER SHALL BE WELDED CONSTRUCTION. THE HEAT EXCHANGER SHALL BE ASME STAMPED FOR A WORKING PRESSURE NOT LESS THAN 150 PSIG. ACCESS TO THE TUBESHEETS AND HEAT EXCHANGER SHALL BE AVAILABLE BY BURNER AND EXHAUST MANIFOLD REMOVAL. MINIMUM ACCESS OPENING SHALL BE NO LESS THAN 8 INCH DIAMETER.
 - V. PRESSURE VESSEL: THE PRESSURE VESSEL SHALL HAVE A MAXIMUM WATER VOLUME PER EACH MODEL AS LISTED BELOW:
 1. BMK1500: 44 GALLONS (166.6 LITERS)
 - VI. THE BOILER WATER PRESSURE DROP SHALL NOT EXCEED THE FOLLOWING PER MODEL SIZE:
 1. BMK1500 AND 2000: 3 PSIG @ 170 GPM
 - VII. THE BOILER WATER CONNECTIONS SHALL BE FLANGED 150 POUND, ANSI RATED.
 1. BMK1500 - 3000; 4 INCH FLANGE
 - VIII. THE PRESSURE VESSEL SHALL BE CONSTRUCTED OF ASME SA53 CARBON STEEL, WITH A 0.25 INCH THICK WALL AND 0.50 INCH THICK UPPER HEAD. INSPECTION OPENINGS IN THE PRESSURE VESSEL SHALL BE IN ACCORDANCE WITH ASME SECTION IV PRESSURE VESSEL CODE. THE BOILER SHALL BE DESIGNED SO THAT THE THERMAL EFFICIENCY INCREASES AS THE BOILER FIRING RATE DECREASES.
 - IX. MODULATING AIR/FUEL VALVE AND BURNER: THE BOILER BURNER SHALL BE CAPABLE OF THE FOLLOWING FIRING TURNDOWN RATIOS WITHOUT LOSS OF COMBUSTION EFFICIENCY OR STAGING OF GAS VALVES. THE TURNDOWN RATIOS SHALL BE AS FOLLOWS AND ARE BASED ON BTU SIZE:
 1. BMK1500: 20:1
 - X. THE BURNER SHALL NOT OPERATE ABOVE 7.5% OXYGEN LEVEL OR 55% EXCESS AIR. THE BURNER SHALL PRODUCE LESS THAN 13 PPM OF NOX, UNDER STANDARD CALIBRATION, CORRECTED TO 3% EXCESS OXYGEN WHEN FIRING ON NATURAL GAS. THE BURNER SHALL BE METAL FIBER MESH COVERING A STAINLESS STEEL BODY WITH SPARK OR PROVEN PILOT IGNITION AND FLAME RECTIFICATION. ALL BURNER MATERIAL EXPOSED TO THE COMBUSTION ZONE SHALL BE OF STAINLESS STEEL CONSTRUCTION. THERE SHALL BE NO MOVING PARTS WITHIN THE BURNER ITSELF. A MODULATING AIR/FUEL VALVE SHALL METER THE AIR AND FUEL INPUT. THE MODULATING MOTOR MUST BE LINKED TO BOTH THE GAS VALVE BODY AND AIR VALVE BODY WITH A SINGLE LINKAGE. THE LINKAGE SHALL NOT REQUIRE ANY FIELD ADJUSTMENT. A VARIABLE SPEED CAST ALUMINUM PRE-MIX BLOWER SHALL BE USED TO ENSURE THE OPTIMUM MIXING OF AIR AND FUEL BETWEEN THE AIR/FUEL VALVE AND THE BURNER.
 - XI. FUEL:
 1. THE BOILER SHALL USE ONE OF THE FOLLOWING GAS TRAIN OPTIONS:
 - XII. NATURAL GAS:
 1. THE UNIT GAS TRAIN SHALL BE SPECIFICALLY DESIGNED AND CALIBRATED FOR A SINGLE PREDETERMINED FUEL. THE GAS TRAIN SHALL BE A VENTLESS GAS TRAIN.
 - XIII. EXHAUST MANIFOLD:
 1. THE EXHAUST MANIFOLD SHALL BE OF CORROSION RESISTANT CAST ALUMINUM OR 316 STAINLESS STEEL WITH THE FOLLOWING DIAMETER FLUE CONNECTIONS:
 1. BMK750 - 1500: 6 INCH
 - XIV. THE EXHAUST MANIFOLD SHALL HAVE A COLLECTING RESERVOIR AND A GRAVITY DRAIN FOR THE ELIMINATION OF CONDENSATION.
 - XV. BLOWER:
 1. THE BOILER SHALL INCLUDE A VARIABLE-SPEED, DC CENTRIFUGAL FAN TO OPERATE DURING THE BURNER FIRING SEQUENCE AND PRE-PURGE THE COMBUSTION CHAMBER.
 - XVI. MOTORS:
 1. BLOWER MOTORS SHALL COMPLY WITH REQUIREMENTS SPECIFIED IN DIVISION 23 SECTION "COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT."
 - XVII. MOTOR SIZES:
 1. MINIMUM SIZE AS INDICATED. IF NOT INDICATED, LARGE ENOUGH SO DRIVEN LOAD WILL NOT REQUIRE A MOTOR TO OPERATE IN THE SERVICE FACTOR RANGE ABOVE 1.0.
 - XIX. IGNITION:
 1. IGNITION SHALL BE VIA SPARK OR PROVEN PILOT IGNITION WITH 100 PERCENT MAIN-VALVE SHUTOFF AND ELECTRONIC FLAME SUPERVISION.
 - XX. COMBUSTION AIR:
 1. THE BOILER SHALL BE DESIGNED SUCH THAT THE COMBUSTION AIR IS DRAWN FROM THE INSIDE OF THE BOILER ENCLOSURE, DECOUPLING IT FROM THE COMBUSTION AIR SUPPLY AND PREHEATING THE AIR TO INCREASE EFFICIENCY.
 - XXI. COMBUSTION AIR FILTER:
 1. THE BOILER SHALL BE EQUIPPED WITH AN AUTOMOTIVE HIGH FLOW AIR FILTER TO ENSURE EFFICIENT COMBUSTION AND UNHINDERED BURNER COMPONENTS OPERATION.
 - XXII. ENCLOSURE:
 1. THE PLASTIC AND SHEET METAL ENCLOSURE SHALL BE FULLY REMOVABLE, ALLOWING FOR EASY ACCESS DURING SERVICING.
 - XXIII. O2 SENSOR LOCATED IN THE COMBUSTION CHAMBER:
 1. THE BOILER SHALL BE EQUIPPED WITH AN OXYGEN SENSOR. THE SENSOR SHALL BE LOCATED IN THE BOILER COMBUSTION CHAMBER. BOILERS WITHOUT OXYGEN SENSOR OR BOILERS WITH AN OXYGEN SENSOR IN THE EXHAUST SHALL NOT BE ACCEPTABLE DUE TO MEASUREMENT ESTIMATION AND PERFORMANCE ACCURACY.
 - XXIV. CONTROLS:
 1. THE BOILER SHALL HAVE AN INTEGRATED BOILER CONTROL THAT IS CAPABLE OF OPERATING THE BOILER AND ASSOCIATED ACCESSORIES INCLUDING BUT NOT LIMITED TO: ITS PUMPS, VALVES AND DAMPERS.
 2. THE CONTROL SHALL HAVE A 5 INCH COLOR TOUCH SCREEN DISPLAY AS WELL AS SIX FUNCTION BUTTONS THAT ARE SEPARATE FROM THE DISPLAY. USER SHALL HAVE THE ABILITY TO NAVIGATE THE MENUS VIA TOUCHSCREEN OR NAVIGATION BUTTONS. CONTROLS

- NOT EQUIPPED WITH NAVIGATION BUTTON OPTIONS SHALL NOT BE PERMITTED.
3. THE CONTROL SHALL BE EQUIPPED WITH A MULTI-COLOR LINEAR LED LIGHT TO INDICATE THE LEVEL OF FIRING AND/OR AIR/FUEL VALVE POSITION.
 4. THE CONTROL SHALL DISPLAY TWO TEMPERATURES USING TWO DEDICATED THREE-DIGIT SEVEN-SEGMENT DISPLAYS.
 5. THE CONTROL SHALL OFFER AN ENABLE/DISABLE TOGGLE SWITCH AS WELL AS TWO BUTTONS FOR TESTING AND RESETTING THE LOW WATER CUTOFF.
 6. THE MANAGER DESIGNATED BOILER CONTROL SHALL BE CAPABLE OF THE FOLLOWING FUNCTIONS WITHOUT THE NEED FOR ADDITIONAL EXTERNAL CONTROLS:
 7. SEQUENCE UP TO 16 BOILERS,
 8. CONTROL BOILER VARIABLE SPEED OR SINGLE SPEED PUMPS AND/OR MODULATING MOTORIZED VALVES,
 9. OPERATE OR MODULATE A VARIABLE OR SINGLE SPEED SYSTEM PUMP OR ROTATE TWO SYSTEM PUMPS,
 10. CONTROL AND COMMUNICATE WITH UP TO 6 SMARTPLATE DOMESTIC WATER HEATERS AND THEIR DOMESTIC HOT WATER PUMP,
 11. THE CONTROL SHALL CONNECT TO OTHER PLANT BOILER CONTROLS USING RS485 AND COMMUNICATE USING MODBUS PROTOCOL.
 12. THE CONTROL SYSTEM SHALL BE SEGREGATED INTO THREE COMPONENTS: "EDGE [I]" CONTROL PANEL, POWER PANEL AND INPUT/OUTPUT CONNECTION BOX. THE ENTIRE SYSTEM SHALL BE UNDERWRITERS LABORATORIES RECOGNIZED.
 13. THE CONTROL PANEL SHALL CONSIST OF SEVEN INDIVIDUAL CIRCUIT BOARDS USING SURFACE-MOUNT TECHNOLOGY IN A SINGLE ENCLOSURE. EACH BOARD SHALL BE INDIVIDUALLY FIELD REPLACEABLE. THESE CIRCUIT BOARDS SHALL INCLUDE:
 14. A MICROCONTROLLER BOARD WITH INTEGRATED 5 INCH TOUCHSCREEN COLOR DISPLAY PROVIDING THE USER INTERFACE.
 15. A 7-SEGMENT DISPLAY BOARD. THIS BOARD INCLUDES TWO 3-DIGIT 7-SEGMENT DISPLAYS. THESE DISPLAYS SHALL BE USED TO VIEW A VARIETY OF TEMPERATURE SENSOR VALUES AND OPERATING AND STARTUP FUNCTION STATUS.
 16. AN INTERFACE BOARD CONNECTS THE MICROCONTROLLER BOARD TO INTERNAL COMPONENTS USING RIBBON CABLES.
 17. AN ELECTRIC LOW-WATER CUTOFF BOARD CONNECTS TO THE TEST AND MANUAL RESET FUNCTIONS ON THE MICROCONTROLLER BOARD.
 18. A POWER SUPPLY BOARD IS DESIGNED TO PROVIDE THE DIFFERENT DC VOLTAGES TO THE REST OF THE BOARDS. IT ALSO ACTS AS VOLTAGE REGULATOR AND REDUCE POWER NOISE.
 19. AN IGNITION AND COMBUSTION BOARD. THIS BOARD CONTROLS THE AIR/FUEL VALVE AND SAFETY SHUTOFF VALVE, FLAME STATUS AND IGNITION TRANSFORMER
 20. A CONNECTOR BOARD USED TO CONNECT ALL EXTERNAL ELECTRICAL CONNECTION.
 - XXV. SYSTEM PUMP LEAD/LAG ROTATION:
 1. THE CONTROL SHALL BE CAPABLE OF OPERATING TWO SYSTEM PUMPS. IT SHALL ROTATE THE LEAD PUMP BASED ON USER TIME SETTING. THE USE OF AN EXTERNAL PUMP LEAD-LAG CONTROL SHALL NOT BE PERMITTED UNLESS FUNCTION IS PERFORMED BY BUILDING MANAGEMENT SYSTEM.
 - XXVI. VARIABLE SPEED PUMP:
 1. THE CONTROL SHALL BE CAPABLE OF MODULATING A VARIABLE SPEED PUMP. IT SHALL MODULATE THE PUMP BASED ON THE BOILER FIRING RATE, THE BOILER PLANT FIRING RATE, OR BASED ON THE RETURN HEADER TEMPERATURE DIFFERENTIAL FROM SUPPLY WATER TEMPERATURE ON A PRIMARY SECONDARY PIPING APPLICATION.
 - XXVII. MINIMUM NUMBER OF BOILER PLANT OPEN VALVES:
 1. THE CONTROL SHALL MANAGE THE MINIMUM NUMBER OF BOILER MOTORIZED VALVES TO REDUCE VARIABLE SPEED PUMP FLOW AND ENERGY USED. THE CONTROL SHALL OFFER A SETTING TO CONTROL THE NUMBER OF VALVES OPEN DURING LOW LOAD AND STANDBY OPERATION. MANUFACTURERS WITHOUT THIS FEATURE SHALL OFFER ADDITIONAL PUMP CONTROLLER AND A SMALLER SINGLE SPEED PUMP TO RUN DURING THE LOW LOAD AND STANDBY PERIODS.
 - XXVIII. CONTROL SETTINGS TRANSFER USING USB:
 1. THE CONTROL SHALL SIMPLIFY AND SIGNIFICANTLY LESSEN STARTUP AND BOILER SETTING TIME BY BEING ABLE TO USE A USB FLASH DRIVE TO COPY SETTINGS FROM ONE BOILER TO ANOTHER BOILER. INSTALLERS SHALL USE SUCCESSFULLY PRECONFIGURED BOILER SETTINGS IN THEIR PORTFOLIO TO NEWLY INSTALLED BOILERS.
 - XXIX. COMBUSTION CALIBRATION:
 1. THE CONTROL SHALL OFFER AT LEAST 5 CALIBRATION POINTS. THE USE OF LESS THAN 5 CALIBRATION POINTS IS NOT PERMITTED TO IMPROVE OVERALL SYSTEM EFFICIENCY UNDER ALL FIRING RATES. EACH COMBUSTION CALIBRATION POINT SHALL OPERATE WITH 5 TO 7% O2 LEVELS TO IMPROVE OPERATING EFFICIENCY. DEVIATING AWAY FROM THESE VALUES SHALL NOT BE ACCEPTABLE.
 - XXX. ASSISTED COMBUSTION CALIBRATION:
 1. THE CONTROL SHALL OFFER AN ASSISTED COMBUSTION CALIBRATION FEATURE TO HELP REDUCE SETUP TIME AND IMPROVE SETUP ACCURACY. THE ASSISTED COMBUSTION CALIBRATION SHALL ADJUST THE O2 LEVEL AT EACH CALIBRATION POINT TO HELP KEEP O2 LEVEL WITHIN ALLOWABLE EFFICIENCY. THE CONTROL SHALL LOG, DATE AND TIME STAMP THE CALIBRATED POINT COMBUSTION VALUES OF O2 AND ALLOW THE USER TO LOG NOX, CO AND 15A6. THE CONTROL SHALL CHECK THESE VALUES AGAINST MANUFACTURER ALLOWABLE COMBUSTION VALUES AND COLOR IDENTIFY VALUES OUT OF MANUFACTURER ACCEPTABLE RANGES. AS AN ADDITIONAL CAPABILITY, THE CONTROL SHALL ALSO HAVE THE ABILITY TO PERFORM MANUAL COMBUSTION CALIBRATION. NOT HAVING ASSISTED COMBUSTION CALIBRATION FUNCTION SHALL BE PROHIBITED.
 - XXXI. VALVE BALANCING:
 1. TO HELP SIMPLIFY INSTALLATION AND AS PART OF A BOILER PLANT, THE CONTROL SHALL BE CAPABLE OF CONTROLLING AN ELECTRONIC MODULATING MOTORIZED VALVE FOR EACH OF THE BOILERS USING THE MANAGER BOILER CONTROL. IT SHALL HAVE A BUILT-IN LOGIC TO PROVIDE A MAXIMUM FLOW USING AN ADJUSTABLE VALVE OPENING PERCENTAGE POINT FOR EACH BOILER. THE CONTROL SHALL BE CAPABLE OF CLOSING ANY VALVE THAT HAS AN OFF BOILER. IF ALL BOILERS ARE OFF, THE CONTROL SHALL KEEP AT MINIMUM ONE VALVE OPEN TO PROTECT PUMPS.
 - XXXII. BUILDING AUTOMATION:
 1. THE CONTROL SHALL BE ABLE TO COMMUNICATE TO BUILDING MANAGEMENT SYSTEMS USING BACNET AND MODBUS WITHOUT THE USE OF EXTERNAL GATEWAYS. THE CONTROL SHALL BE ABLE TO COMMUNICATE OVER EACH OF THE TWO PROTOCOLS USING IP AS WELL AS RS485. THE USE OF EXTERNAL GATEWAYS IS NOT ACCEPTABLE. THE CONTROL SHALL BE ABLE TO COMMUNICATE TO THE BUILDING MANAGEMENT SYSTEM USING:
 1. BACNET MS/TP AND BACNET IP/ETHERNET. WHEN COMMUNICATING OVER BACNET IP, THE CONTROL SHALL OFFER AN ADDITIONAL LAYER OF IP SECURITY BY MAPPING ALL CONTROL BACNET IP COMMUNICATION TO THE BACNET SERVER'S IP AND MAC ADDRESSES. NOT HAVING THIS LEVEL OF SECURITY SHALL DEEM THE IP COMMUNICATION INSECURE AND SHALL NOT BE ACCEPTABLE.
 - XXXIII. SOFTWARE UPDATE:
 1. THE CONTROL SHALL BE CAPABLE OF FIELD SOFTWARE UPDATES WITHOUT A NEED FOR HARDWARE COMPONENT(S) REPLACEMENT. THIS SHALL BE PERFORMED EITHER USING SOFTWARE ON A USB FLASH DRIVE OR VIA INTERNET CONNECTION. THE SOFTWARE UPDATE MECHANISM SHALL BE PERFORMED BY A TRAINED TECHNICIAN. THE SOFTWARE UPDATE MENU SHALL BE SECURED USING A PASSWORD LEVEL. AFTER THE SOFTWARE UPDATE, THE CONTROL SHALL RETAIN ALL OF ITS PRIOR FIELD SETTINGS.
 - XXXIV. COPY SETTINGS FROM ONE BOILER TO THE OTHER:
 1. TO SIGNIFICANTLY REDUCE INSTALLATION TIME BY REDUCING LONG REPETITIVE WORK, THE CONTROL SHALL HAVE THE CAPABILITY OF SAVING ITS SETTINGS TO A USB FLASH DRIVE. IN ADDITION, THE CONTROL SHALL HAVE THE ABILITY OF COPYING NEW SETTINGS FROM A FLASH DRIVE.
 - XXXV. BACKUP BOILER:
 1. THE CONTROL SHALL BE ABLE TO OPERATE A LOWER EFFICIENCY BACK UP BOILER DURING PEAK PERIODS WHEN MAIN PLANT BOILERS ARE AT OR CLOSE TO PEAK LOAD.
 - XXXVI. THE CONTROLS SHALL ANNUNCIATE BOILER AND SENSOR STATUS AND INCLUDE EXTENSIVE SELF-DIAGNOSTIC CAPABILITIES.
 - XXXVII. THE CONTROL PANEL SHALL INCORPORATE:
 1. SETPOINT HIGH LIMIT: SETPOINT HIGH LIMIT ALLOWS FOR A SELECTABLE MAXIMUM BOILER OUTLET TEMPERATURE AND ACTS AS TEMPERATURE LIMITING GOVERNING. SETPOINT LIMIT IS BASED ON A PID FUNCTION THAT AUTOMATICALLY LIMITS FIRING RATE TO MAINTAIN OUTLET TEMPERATURE WITHIN A 0 TO 10 DEGREE SELECTABLE BAND FROM THE DESIRED MAXIMUM BOILER OUTLET TEMPERATURE.
 2. SETPOINT LOW LIMIT: ALLOW FOR A SELECTABLE MINIMUM OPERATING TEMPERATURE.
 3. FAILSAFE MODE: FAILSAFE MODE ALLOWS THE BOILER TO SWITCH ITS MODE TO OPERATE

- FROM AN INTERNAL SETPOINT IF ITS EXTERNAL CONTROL SIGNAL IS LOST, RATHER THAN SHUT OFF. THIS IS A SELECTABLE MODE, ENABLING THE CONTROL CAN TO SHUT OFF THE UNIT UPON LOSS OF EXTERNAL SIGNAL, IF SO DESIRED.
- XXXVIII. EACH BOILER SHALL INCLUDE AN ELECTRIC, SINGLE-SEALED COMBINATION SAFETY SHUTOFF VALVE/REGULATOR WITH PROOF OF CLOSURE SWITCH IN ITS GAS TRAIN. EACH BOILER SHALL INCORPORATE DUAL OVER-TEMPERATURE PROTECTION WITH MANUAL RESET, IN ACCORDANCE WITH ASME SECTION IV AND CSO 1.
- XXXIX. O2-TRIM OR AERTRIM: EACH BOILER SHALL BE EQUIPPED WITH THE PATENTED AERTRIM SYSTEM, AN ADVANCED O2-TRIM SYSTEM FOR CONDENSING BOILER APPLICATIONS. THE SYSTEM SHALL UTILIZE A LOW COST RELIABLE AUTOMOTIVE O2 SENSOR THAT MEASURES AND MONITORS THE OXYGEN CONTENT OF THE EXHAUST GASES. THE SYSTEM SHALL ADJUST THE BLOWER SPEED TO MAINTAIN OPTIMAL AIR-FUEL RATIOS IN THE EVENT OF ANY SITE CONDITION CHANGES (AIR DENSITY, GAS PRESSURE, BTU CONTENT, ETC.). THE SYSTEM SHALL HAVE THE FOLLOWING CAPABILITIES:
 1. SELF-DIAGNOSTICS
 2. SYSTEM STATUS AND ERROR MESSAGES
 3. WHEN EXCESSIVE TRIMMING IS OCCURRING
 4. WHEN O2 SENSOR HAS FALLEN OUT OF CALIBRATION
 5. ADJUSTABLE PARAMETER SETTINGS
 6. O2 TARGET AND RANGE TO MEET SITE REQUIREMENTS
 7. SCHEDULE DAILY OR WEEKLY SELF-DIAGNOSTICS
- XL. THE O2 SENSOR SHALL BE INSTALLED THROUGH THE UNIT'S BURNER PLATE AND MEASURE THE OXYGEN CONTENT DIRECTLY WITHIN THE UNIT'S COMBUSTION CHAMBER.
- XLI. BOILERS WITHOUT AN EQUIVALENT O2 TRIM WILL BE DEEMED UNACCEPTABLE. DUE TO THE MOISTURE CONTENT OF FLUE GASES FROM CONDENSING BOILERS, PLACING THE O2 SENSOR IN THE EXHAUST MANIFOLD OR STACK WILL BE DEEMED UNACCEPTABLE.
- XLII. BOILERS WHICH REQUIRE THEIR O2 SENSOR BE CHANGED ANNUALLY WILL BE DEEMED UNACCEPTABLE.
- XLIII. EACH BOILER SHALL HAVE INTEGRATED BOILER SEQUENCING TECHNOLOGY (BST), CAPABLE OF MULTI-UNIT SEQUENCING WITH LEAD-LAG FUNCTIONALITY AND PARALLEL OPERATION. THE SYSTEM WILL INCORPORATE THE FOLLOWING CAPABILITIES:
 1. EFFICIENTLY SEQUENCE 2-TO-16 UNITS ON THE SAME SYSTEM TO MEET LOAD REQUIREMENT.
 2. INTEGRATED CONTROL AND WIRING FOR SEAMLESS INSTALLATION OF OPTIONAL MODULATING MOTORIZED VALVE: WHEN VALVES ARE UTILIZED, THE SYSTEM SHALL OPERATE ONE MOTORIZED VALVE PER UNIT AS AN ELEMENT OF LOAD SEQUENCING. VALVES SHALL CLOSE WITH DECREASED LOAD AS UNITS TURN OFF, WITH ALL VALVES OPEN UNDER NO-LOAD CONDITIONS.
 3. AUTOMATICALLY ROTATE LEAD/LAG AMONGST THE UNITS ON THE CHAIN AND MONITOR RUN HOURS PER UNIT AND BALANCE LOAD IN AN EFFORT TO EQUALIZE RUN HOURS AMONG ACTIVE UNITS.
 4. OPTION TO MANUALLY DESIGNATE LEAD AND LAST BOILER
 5. DESIGNATED MANAGER CONTROL, USED TO DISPLAY AND ADJUST KEY SYSTEM PARAMETERS.
 6. AUTOMATIC BUMP-LESS TRANSFER OF MASTER FUNCTION TO NEXT UNIT ON THE CHAIN IN CASE OF DESIGNATED MASTER UNIT FAILURE; MASTER/SLAVE STATUS SHALL BE SHOWN ON THE INDIVIDUAL UNIT DISPLAYS.
- XLIV. ELECTRICAL POWER:
 1. SINGLE-POINT FIELD POWER CONNECTION: FACTORY-INSTALLED AND FACTORY-WIRED SWITCHES, MOTOR CONTROLLERS, TRANSFORMERS AND OTHER ELECTRICAL DEVICES SHALL PROVIDE A SINGLE-POINT FIELD POWER CONNECTION TO THE BOILER.
- XLV. VENTING:
 1. THE BOILER SHALL BE CAPABLE OF VENTING IN POLYPROPYLENE VENTING MATERIAL. THE EXHAUST VENT MUST BE UL LISTED FOR USE WITH CATEGORY II, III AND IV APPLIANCES AND COMPATIBLE WITH CONDENSING FLUE GAS SERVICE. UL LISTED VENTS OF POLYPROPYLENE OR AL 29-4C STAINLESS STEEL MUST BE USED WITH BOILERS.
 2. PVC/CPVC IS APPROVED FOR USE WITH BMK750 AND 1000 MODELS
 3. THE MINIMUM EXHAUST VENT DUCT SIZE FOR EACH BOILER IS SIX INCH (BMK750 - 1500) DIAMETER.
- XLVI. COMBUSTION-AIR INTAKE:
 1. BOILERS SHALL BE CAPABLE OF DRAWING COMBUSTION AIR FROM THE OUTDOORS VIA A METAL OR PVC DUCT CONNECTED BETWEEN THE BOILER AND THE OUTDOORS.
 2. THE MINIMUM DUCTED COMBUSTION AIR DUCT SIZE FOR EACH BOILER IS SIX INCH (BMK750 - 1500) DIAMETER.
- XLVII. COMMON VENT AND COMMON COMBUSTION AIR MUST BE AN AVAILABLE OPTION FOR BOILER INSTALLATION TO IMPROVE SYSTEM EFFICIENCY. MULTI-BOILER SYSTEM SHALL UTILIZE SEQUENCING LOGIC WITH COMMON VENTING AS WELL AS INDIVIDUAL BOILER VENTING CONFIGURATION. MANUFACTURERS NOT ALLOWING PARALLEL MODULATION FOR COMMON SHALL NOT BE ACCEPTABLE. CONSULT MANUFACTURER FOR COMMON VENT AND COMBUSTION AIR SIZING.
- XLIX. FOLLOW GUIDELINES SPECIFIED IN MANUFACTURER'S VENTING GUIDE.
- L. SOURCE QUALITY CONTROL:
 1. BURNER AND HYDROSTATIC TEST: FACTORY ADJUST BURNER TO ELIMINATE EXCESS OXYGEN, CARBON DIOXIDE, OXIDES OF NITROGEN EMISSIONS AND CARBON MONOXIDE IN FLUE GAS, AND TO ACHIEVE COMBUSTION EFFICIENCY. PERFORM HYDROSTATIC TESTING.
 2. TEST AND INSPECT FACTORY-ASSEMBLED BOILERS, BEFORE SHIPPING, ACCORDING TO ASME BOILER AND PRESSURE VESSEL CODE.
 1. IF BOILERS ARE NOT FACTORY ASSEMBLED AND FIRE-TESTED, THE LOCAL VENDOR IS RESPONSIBLE FOR ALL FIELD ASSEMBLY AND TESTING.
 2. ALLOW OWNER ACCESS TO SOURCE QUALITY-CONTROL TESTING OF BOILERS. NOTIFY ARCHITECT FOURTEEN DAYS IN ADVANCE OF TESTING.
- LI. EXAMINATION:
 1. BEFORE BOILER INSTALLATION EXAMINE ROUGHING-IN FOR CONCRETE EQUIPMENT BASES, ANCHOR-BOLT SIZES AND LOCATIONS AND PIPING AND ELECTRICAL CONNECTIONS TO VERIFY ACTUAL LOCATIONS, SIZES AND OTHER CONDITIONS AFFECTING BOILER PERFORMANCE, MAINTENANCE AND OPERATIONS.
 2. BOILER LOCATIONS INDICATED ON DRAWINGS ARE APPROXIMATE. DETERMINE EXACT LOCATIONS BEFORE ROUGHING-IN FOR PIPING AND ELECTRICAL CONNECTIONS.
 3. EXAMINE MECHANICAL SPACES FOR SUITABLE CONDITIONS WHERE BOILERS WILL BE INSTALLED.
 4. PROCEED WITH INSTALLATION ONLY AFTER UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.
- LII. BOILER INSTALLATION:
 1. INSTALL BOILERS LEVEL ON CONCRETE BASES.
 2. INSTALL GAS-FIRED BOILERS ACCORDING TO NFPA 54.
 3. ASSEMBLE AND INSTALL BOILER TRIM.
 4. INSTALL ELECTRICAL DEVICES FURNISHED WITH BOILER BUT NOT SPECIFIED TO BE FACTORY MOUNTED.
 5. INSTALL CONTROL WIRING TO FIELD-MOUNTED ELECTRICAL DEVICES.
- LIII. CONNECTIONS:
 1. PIPING INSTALLATION REQUIREMENTS ARE SPECIFIED IN OTHER DIVISION 23 SECTIONS. DRAWINGS INDICATE GENERAL ARRANGEMENT OF PIPING, FITTINGS AND SPECIALTIES.
 2. INSTALL PIPING ADJACENT TO BOILER TO PERMIT SERVICE AND MAINTENANCE.
 3. INSTALL PIPING FROM EQUIPMENT DRAIN CONNECTION TO NEAREST FLOOR DRAIN. PIPING SHALL BE AT LEAST FULL SIZE OF CONNECTION, PROVIDE AN ISOLATION VALVE IF REQUIRED.
 4. CONNECT GAS PIPING TO BOILER GAS-TRAIN INLET WITH UNIONS. PIPING SHALL BE AT LEAST FULL SIZE OF GAS TRAIN CONNECTION. PROVIDE A REDUCER IF REQUIRED.
 5. CONNECT HOT-WATER PIPING TO SUPPLY AND RETURN BOILER TAPINGS WITH SHUTOFF VALVE AND UNION OR FLANGE AT EACH CONNECTION.
 6. INSTALL PIPING FROM SAFETY RELIEF VALVES TO NEAREST FLOOR DRAIN.
- LIV. BOILER VENTING:
 1. KIT: COMPLETE SYSTEM, ASTM A959, TYPE 29-4C STAINLESS STEEL OR POLYPROPYLENE (PPS), PIPE, VENT TERMINAL, THIMBLE, INDOOR PLATE, VENT ADAPTER, CONDENSATE TRAP AND DILUTION TANK, AND SEALANT. VENT SYSTEM SHALL MEET CATEGORY IV VENTING REQUIREMENTS.
- LIV. COMBUSTION-AIR INTAKE:

1. COMPLETE SYSTEM, STAINLESS STEEL, PIPE, VENT TERMINAL WITH SCREEN, INLET AIR COUPLING, AND SEALANT.
 2. CONNECT VENTING FULL SIZE TO BOILER CONNECTIONS. [COMPLY WITH REQUIREMENTS IN DIVISION 23 SECTION "BREECHINGS, CHIMNEYS AND STACKS."]
- LVI. FIELD QUALITY CONTROL:
 1. PERFORM TESTS AND INSPECTIONS AND PREPARE TEST REPORTS.
 2. MANUFACTURER'S FIELD SERVICE: ENGAGE A FACTORY-AUTHORIZED SERVICE REPRESENTATIVE TO INSPECT COMPONENTS, ASSEMBLIES AND EQUIPMENT INSTALLATIONS, INCLUDING CONNECTIONS, AND TO ASSIST IN TESTING.
- S. AUTOMATIC SHRINK OUT SMOKE & HEAT VENT (SHV-1 THRU 12):
- I. MANUFACTURERS:
 1. WASC0VELUX
 2. SIMILAR
- II. MATERIALS
 1. CURB FRAME: EXTRUDED ALUMINUM ALLOY 6063-T5 (MIN.) ASTM B 221 (ASTM B 221 M) WITH MINIMUM EFFECTIVE THICKNESS OF 0.060 INCH. PROVIDE INTEGRAL CONDENSATION GUTTER SYSTEM WITH CORNERS FULLY WELDED FOR WATERPROOF QUALITY.
 2. RETAINER FRAME: EXTRUDED ALUMINUM ALLOY 6063-T5 (MIN.) ASTM B 221 (ASTM B 221 M) WITH MINIMUM EFFECTIVE THICKNESS OF 0.060 INCH.
 3. INTEGRAL CURBS: FABRICATE FROM DOUBF SKIN OF 1100-H14 SHEET ALUMINUM, INSULATED WITH 1-1/2 INCH FIBERGLASS INSULATION. PROVIDE THERMAL BREAK AT BOTTOM.
 4. PROVIDE MINIMUM THICKNESS REQUIRED TO MEET SPECIFIED LOADS FOR OUTER AND INNER SKIN.
 5. PLASTIC SHEETS: MONOLITHIC, FORMABLE, TRANSPARENT (COLORLESS) OR TRANSLUCENT (WHITE) SHEETS WITH GOOD WEATHER AND IMPACT RESISTANT.
 6. ACRYLIC: THERMOFORMABLE, ACRYLIC (METHACRYLATE), CATEGORY C-2 OR CC-2 TYPE UVA (FORMULATED WITH ULTRAVIOLET ABSORBER), WITH FINISH 1 (SMOOTH OR POLISHED), UNLESS OTHERWISE INDICATED.
- III. SHAPE AND SIZE:
 1. AS INDICATED BY MODEL NUMBER.
- IV. GLAZING:
 1. THERMOFORMED ACRYLIC: (CLEAR, #2447 WHITE) OUTER DOME WITH 25% RISE. CLEAR, #2247 WHITE TRANSLUCENT (52% TRANSMITTANCE), THERMOFORMED ACRYLIC INNER DOME (CLEAR, #2447 WHITE).
- V. FASTENERS:
 1. SAME METAL AS METALS BEING FASTENED, OR NONMAGNETIC STAINLESS STEEL OR OTHER NON-CORROSIVE METAL AS RECOMMENDED BY MANUFACTURER.
- VI. BITUMINOUS COATING:
 1. SSPC-PAINT 12, SOLVENT-TYPE, BITUMINOUS MASTIC, NOMINALLY FREE OF SULFUR AND CONTAINING NO ASBESTOS FIBERS, COMPOUNDED FOR 15-MIL (0.4 MM) DRY FILM THICKNESS PER COATING.
- VII. PRODUCTS:
 1. PROVIDE MODEL CSO MEETING THE REQUIREMENTS OF THIS SECTION.
- VIII. INTEGRAL CURBS:
 1. FABRICATE FROM DOUBLE SKIN OF 1100-H14 SHEET ALUMINUM, INSULATED WITH 1-1/2" R5.8, EPS INSULATION. PROVIDE THERMAL BREAK AT TOP AND BOTTOM.
 2. HEIGHT 12 INCHES FROM BOTTOM OF ROOF FLANGE TO TOP OF RETAINER
 3. PROVIDE .025-INCH MINIMUM THICKNESS OUTER SKIN, MILL FINISH. OUTER SKIN TO BE .032 INCH WHEN LENGTH EXCEED NOMINAL 48"
 4. PROVIDE .032-INCH MINIMUM THICKNESS INNER SKIN, PREFINISHED WHITE.
 5. CURB ASSEMBLY TO HAVE A MINIMUM U-VALUE OF 0.17.
- IX. CONDENSATION CONTROL:
 1. FABRICATE SKYLIGHT UNITS WITH INTEGRAL INTERNAL GUTTERS AND WEEPS TO COLLECT AND DISPOSE OF CONDENSATION.
- X. SHAPE AND SIZE:
 1. AS INDICATED BY MODEL NUMBER.
- XI. GLAZING:
 1. THERMOFORMED ACRYLIC. (CLEAR, # 2447 WHITE).
- XII. FABRICATION:
 1. UNITS SHALL BE UNDERWRITERS LABORATORIES (UL) LISTED, FACTORY ASSEMBLED, AND CONSISTING OF A 100% ACRYLIC DOUBLE DOME DESIGNED TO DROP OUT IN IN THE EVENT OF A FIRE.
 2. THE VENT SHALL OPERATE AT A MAXIMUM TEMPERATURE OF 286 DEGREES F PER UL STANDARD 793.
 3. UNIT SHALL CONSIST OF AN ALL-ALUMINUM FULLY INSULATED CURB AND BODY ASSEMBLY WITH INTEGRAL CAP FLASHING AND 4" ROOF FLANGE.
 4. UNIT HEIGHT SHALL BE 12" FROM BOTTOM OF ROOF FLANGE TO TOP OF RETAINER.
 5. OUTER ACRYLIC DOME TO BE MINIMUM .177" THICK 100% ACRYLIC.
 6. THE INNER DOME SHALL BE IMPACT MODIFIED ACRYLIC CONFIGURED FOR STIFFNESS TO SUPPORT THE OUTER DOME AND A 40 PSF LIVE LOAD.
 7. DOME TO BE CONFIGURED AS NOT TO REQUIRE THE ADDITION OF SCREENS FOR FIRE BRAND PROTECTION.
- XIII. FINISHES:
 1. MILL FINISH: MANUFACTURER'S STANDARD MILL FINISH.
- 2.08 MOTOR STARTERS, CONTROL DEVICES AND MOTORS
- A. MECHANICAL CONTRACTOR TO FURNISH AND INSTALL STARTERS FOR POWER WIRING BY THE ELECTRICAL CONTRACTOR.
- B. MOTOR STARTERS SHALL BE CUTLER HAMMER, WESTINGHOUSE OR ALLEN-BRADLEY MANUFACTURER, SUITABLE FOR WALL OR ANGLE IRON FRAME MOUNTING.
- C. ALL STARTERS FOR MOTORS LESS THAN 1/2 HP SHALL BE 120 VOLT, SINGLE PHASE, 60 CYCLE, A.C. SERVICE. MANUAL STARTERS WITH OVERLOAD PROTECTION AND LOCKOUT TYPE DISCONNECT SWITCH OR BREAKER MAY BE USED TO CONTROL SUCH MOTORS, EXCEPT WHERE INTERLOCKS OR AUTOMATIC CONTROLS ARE REQUIRED. IN SUCH CASES, MAGNETIC ACROSS-THE-LINE STARTERS SHALL BE FURNISHED.
- D. ALL STARTERS FOR MOTORS 1/2 HP TO 75 HP SHALL BE COMBINATION FUSED DISCONNECT, MAGNETIC ACROSS-THE-LINE TYPE WITH FUSIBLE SWITCH. STARTERS 75 HP AND GREATER SHALL BE SOLID STATE ELECTRONIC SOFT START TYPE STARTERS.
- E. ALL MAGNETIC STARTERS SUBJECT TO MANUAL START AND IN DIRECT VIEW OF THE MOTORS THEY CONTROL SHALL HAVE MOMENTARY CONTACT START AND STOP BUTTONS AND PILOT LIGHT BUILT IN TO COVER. ALL MAGNETIC STARTERS SUBJECT TO ELECTRICAL INTERLOCK OR AUTOMATIC CONTROL SHALL HAVE HAND-OFF-AUTOMATIC SWITCHES AND PILOT LIGHT BUILT INTO COVER.
- F. WHERE STARTERS ARE NOT IN SIGHT OF MOTORS THEY CONTROL, A LOCAL DISCONNECT SWITCH WILL BE PROVIDED BY THE ELECTRICAL CONTRACTOR.
- G. PROVIDE ALL STARTERS WITH TRANSFORMERS BUILT INTO EACH STARTER CASING FOR CONTROL CIRCUIT. TRANSFORMERS SHALL SERVE ALL CONTROL CIRCUITS. EACH STARTER SUBJECT TO ELECTRICAL INTERLOCK AND/OR AUTOMATIC CONTROL SHALL HAVE THE NECESSARY AUXILIARY CONTACTS. ONE SET OF TERMINALS SHALL BE PROVIDED FOR EACH CONTROL CIRCUIT. CONTROL CENTERS SHALL BE PROVIDED WITH CONTROL TERMINAL BLOCKS. PROVIDE THREE SETS OF NORMALLY CLOSED OR NORMALLY OPEN CONTACTS.
- H. ALL MAGNETIC STARTERS SHALL HAVE THERMAL OVERLOAD IN EACH PHASE LEG AND LOW VOLTAGE PROTECTION.
- I. ALL PARTS SUBJECT TO WEAR, ARCING, ETC. SHALL BE REPLACEABLE.
- J. ALL WIRING, STARTERS, SWITCHES, ETC., SHALL BE IN FULL ACCORDANCE WITH ALL LOCAL INSURANCE UNDERWRITERS CODE REQUIREMENTS.
- K. FURNISH DETAILED COMPOSITE WIRING DIAGRAMS FOR THOSE INSTALLING ELECTRICAL WORK, AND FURNISH SUCH OTHER INFORMATION NECESSARY TO ASSURE THE PROPER CONNECTION, OPERATION AND CONTROL OF MOTORIZED EQUIPMENT, INCLUDING INTERLOCKS, AUTOMATIC OR SAFETY CONTROLS AND AUXILIARY CIRCUITS.
- L. FURNISH THE PERTINENT INFORMATION SUCH AS STARTING TORQUE REQUIREMENTS OF HIGH INERTIA EQUIPMENT, SO THAT THE PROPER TYPE STARTER MAY BE PROVIDED BY THE STARTER MANUFACTURER. ALL INFORMATION IS SUBJECT TO THE REVIEW OF THE ENGINEER.
- M. PROVIDE LAMINATED NAME PLATE ATTACHED TO EACH STARTER AND VFD IDENTIFYING THE SYSTEM IT SERVES.

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KEY PLAN

REV	DESCRIPTION	DATE
	ISSUED FOR DOB SUBMISSION	09/10/2021
	ISSUED FOR BID	10/15/2021
	ISSUED FOR PROGRESS	01/18/2022

DRAWN BY :

CHECKED BY :

APPROVED BY :

DATE :

SCALE :

DRAWING TITLE :

**MECHANICAL
SPECIFICATIONS SHEET #4**

DWG NUMBER :
M-804

TO THE BEST KNOWLEDGE, BELIEF AND PROFESSIONAL JUDGEMENT, THESE PLANS AND SPECIFICATIONS ARE IN COMPLIANCE WITH THE 2020 ENERGY CONSERVATION CONSTRUCTION CODE OF NEW YORK STATE.