SHEET NUMBER	SHEET NAME
M001	MECHANICAL ABBREVIATIONS AND SYMBOLS
M101A	MECHANICAL FLOOR PLAN - BELOW MECHANICAL PLATFORM
M101B	MECHANICAL FLOOR PLAN - MECHANICAL PLATFORM AND ABOVE
M102	MECHANICAL PIPING LAYOUT PLAN
M501	MECHANICAL DETAILS
M502	MECHANICAL DETAILS
M590	MECHANICAL SPECIFICATIONS
M591	MECHANICAL SPECIFICATIONS
M592	MECHANICAL SPECIFICATIONS
M601	MECHANICAL SCHEDULES
M701	CAPTIVEAIRE DRAWINGS
M702	CAPTIVEAIRE DRAWINGS
M703	CAPTIVEAIRE DRAWINGS
M704	CAPTIVEAIRE DRAWINGS
M705	CAPTIVEAIRE DRAWINGS
M706	CAPTIVEAIRE DRAWINGS
M707	CAPTIVEAIRE DRAWINGS

RESPONSIBILITY MATRIX

DESCRIPTION	FURNISHED			INSTALLED			REMARKS
	GENERAL CONTRACTOR	OWNER	LANDLORD	GENERAL CONTRACTOR	OWNER	LANDLORD	
DIVISION 23: HEATING, VENTILATING, AND AIR CONDITIONING							
23.1 HVAC DUCTWORK AND PIPING IDENTIFICATION							
23.1.1 HVAC DUCTWORK SYSTEM IDENTIFICATION	X			X			
23.1.2 PIPING SYSTEM IDENTIFICATION	X			X			
23.1.3 UTILITY SHUT OFF IDENTIFICATION IN KITCHEN	X			X			
23.1.4 VALVE TAGS AND CHART	X			X			
23.1.5 HVAC DAMPER IDENTIFICATION	X			X			
23.2 ROOF CURBS							
23.2.1 EXHAUST FAN CURBS	NA			NA			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.2 ROOFTOP UNIT CURBS	NA			NA			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.3 CONDENSING UNIT CURBS	X			X			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.4 MAKE UP AIR AND DOAS UNIT CURBS	NA			NA			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.5 KITCHEN EXHAUST FAN CURBS	X			X			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.3 HVAC DUCTWORK SYSTEM COMPONENTS							
23.3.1 HVAC DUCTWORK	X			X			
23.3.2 INSULATION AND FIRE WRAP	X			X			GENERAL CONTACTOR SCOPE OF WORK TO INCLUDE TENANT FIT OUT FROM LANDLORD POINT OF CONNECTION
23.3.3 DAMPERS	X			X			
23.3.4 SMOKE DETECTORS	X			X			
23.3.5 SUPPLY, RETURN, AND EXHAUST GRILLS AND REGISTERS	X			X			
23.4 MECHANICAL PIPING SYSTEM COMPONENTS							
23.4.1 WALK-IN COOLER AND FREEZER REFRIGERATION		X			X		WALK-IN COOLER AND FREEZER SUPPLIED BY VENDOR NO. 103 GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE PIPING INSTALLATION AND FINAL CONNECTION
23.4.2 REFRIGERATION FOR OTHER HVAC EQUIPMENT	X			X			
23.4.3 CHILLED WATER			X	X			
23.4.4 CONDENSER WATER	NA			NA			
23.4.5 HEATING HOT WATER			X	X			
23.4.6 VALVES AND ACCESSORIES (E.G. AIR VENTS)	X			X			
23.5 HVAC EQUIPMENT							GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING FOR ALL ROOFTOP EQUIPMENT
23.5.1 SUPPLY FAN	X			X			
23.5.2 TOILET EXHAUST FAN	X			X			
23.5.3 KITCHEN EXHAUST FAN	X			X			SUPPLIED BY VENDOR NO. 102
23.5.4 DUCTED AND NON-DUCTED HEATING AND COOLING UNITS	X			X			
23.5.5 MAKE UP AIR AND DOAS UNITS	X			X			SUPPLIED BY VENDOR NO. 102
23.5.6 ELECTRIC PATIO HEATERS	NA			NA			
23.5.7 HVAC CONDENSING UNITS	NA			NA			
23.5.8 REFRIGERATION CONDENSING UNITS		X			X		GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 7 VENDOR SUBSTITUTION IS NOT PERMITTED
23.5.9 HGI PHI SYSTEM	X			X			
23.6 KITCHEN EXHAUST WITH FIRE SUPPRESSION SYSTEM							
23.6.1 HOOD CONTROL PANEL		X		X			SUPPLIED BY VENDOR NO. 102
23.6.2 KITCHEN EXHAUST HOOD		X		X			SUPPLIED BY VENDOR NO. 102
23.6.3 STRUCTURAL SUPPORT	X			X			
23.6.4 ELECTRICAL AND CONTROL WIRING	X			X			
23.6.5 ANSUL OR TANK FIRE SUPPRESSION SYSTEM		X		X			SUPPLIED BY VENDOR NO. 102 GENERAL CONTRACTOR TO COORDINATE AND FACILITATE SYSTEM SIGN-OFF
23.6.6 ANSUL OR TANK WIRING AND UTILITIES CONNECTION	X			X			
23.6.7 ANSUL OR TANK GAS VALVE		X		X			SUPPLIED BY VENDOR NO. 102
23.7 COMMISSIONING ACTIVITIES							
23.7.1 GREASE EXHAUST WATER LEAKAGE TEST	X			X			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 6 VENDOR SUBSTITUTION IS NOT PERMITTED
23.7.2 TESTING AIR BALANCE (TAB) REPORT	X			X			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 7 VENDOR SUBSTITUTION IS NOT PERMITTED

SUBMITTAL MATRIX

GENERAL CONTRACTORS TO ALSO REVIEW ARCHITECTRUAL SPECIFICATIONS AS NOTED IN PLANS IN PLAN SECTION 700 OF THE ARCHITECTURAL PACKAGE FOR REQUIRED SUBMITTALS THAT MIGHT NOT BE LISTED BELOW.

SUBMITTAL DECRIPTION	Required Review Time (Business Days)	Number of Hard Copies	Shop Drawings	Physical Sample Required	Submittal Required for Record	Submittal After Permit Only
Anchor Bolts Shops	5	X			X	
ATAS-Detailed Shop DWGS(Submitted by Owner Vendor to Owner/AOR prior to const.)	5	X				X
Concrete Mix Design	5	X			X	
Construction Prefunctional Checklists	5	X				X
Decorative Metal Shop Drawings	5	X				
Diffusers, Grills & Registers	5	X			X	
Doors, Frames & Hardware	7	X			X	
Ductwork Layout (If there are significant changes in field)	5	X			X	
Electrical Distribution Equipment	5	X				
Elevator & Vertical Transportation Shop Drawings	5	X				X
Epoxy Floor	5	X				X
Fire Alarm Shop Drawings & Device Cut Sheets	5	x			X	
Fire Sprinkler Shop Drawings, Hydraulic Calculations & Device Cut Sheets	5	x				X
HVAC Equipment(If Carrier – Submitted by Owner Vendor to Owner/AOR prior to const.)	5	x			X	
Light Fixtures(Submitted by Owner Vendor to Owner/AOR prior to construction)	5	X			X	
MEP Tests, Start-Up, and Programming Reports	5	X			X	
Millwork – Material Submittals (if differs from spec)	5	X	X	X		
Millwork – Shop Drawings (custom items & design features only)	5	X				
Restroom Partitions	5	X			X	
Plumbing Fixtures	5	X			X	
Railing Shop Drawings	5	X				X
Rebar	5	X			X	
Stair Shop Drawings	5	X				X
Structural Steel Shop Drawings	7	X			X	
Storefront – product data Submittal (If different from specified)	5	X				
Storefront – Shop Drawings	5	X				
Tile (If differs from spec)	5	X			X	
Window Film	5	X				

SYMBOLS*

HEATING - VENTILATING - AIR CONDITIONING

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	100 KW LOW PRESSURE 2.5 KW MEDIUM PRESSURE(MP) 2.5 KW HIGH PRESSURE		AUTOMATIC CONTROL VALVE		SUPPLY DIFFUSER/ GRILLE OR REGISTER
	CONDENSATE (LOW PRESSURE) CONDENSATE (MEDIUM PRESSURE) CONDENSATE (HIGH PRESSURE)		PRESSURE REGULATING VALVE (PRV)		RETURN OR EXHAUST DUCT MAIN OR RISE
	HOT WATER SUPPLY (HEATING)		SAFETY RELIEF VALVE		SOUND TRAP
	HOT WATER RETURN (HEATING)		BALL VALVE		SUPPLY REGISTER OR GRILLE (R OR G)
	EXHAUST STEAM		BLOW OFF VALVE		RETURN REGISTER OR GRILLE (R OR G)
	STEAM CONDENSATE RETURN		3 WAY VALVE (MAY APPLY)		FRESH AIR INTAKE (FA)
	CHILLED WATER SUPPLY		THERMOSTATIC TRAP		ROUND CEILING DIFFUSER (SUPPLY)
	CHILLED WATER RETURN		GATE VALVE		ROUND CEILING DIFFUSER (SUPPLY AND RETURN)
	CONDENSATE OR TRAP DRAIN		AIR ELIMINATOR		SQUARE CEILING DIFFUSER (SUPPLY)
	HUMIDIFICATION LINE		AUTOMATIC BALANCING VALVE		SQUARE CEILING DIFFUSER (SUPPLY AND RETURN)
	FUEL OIL SUPPLY		SOLENOID VALVE (REFRIGERANT)		SQUARE CEILING DIFFUSER (SUPPLY AND RETURN)
	FUEL OIL RETURN		THERMOSTATIC EXPANSION VALVE (TERV)		SQUARE CEILING DIFFUSER STEEL NECK FINISH
	FUEL OIL VENT		BACK PRESSURE VALVE		SQUARE CEILING DIFFUSER (SUPPLY AND RETURN)
	GAS LINE		SIGHT GLASS		SQUARE CEILING DIFFUSER STEEL NECK FINISH
	REFRIGERANT LIQUID LINE		ROUND DUCT RISER		SQUARE CEILING DIFFUSER (SUPPLY AND RETURN)
	REFRIGERANT SUCTION LINE		FAN COIL UNIT AND MARK		GRAVITY DAMPER
	REFRIGERANT HOT GAS DISCHARGE LINE		UNIT HEATER-PROPELLER TYPE & MARK		MOTORIZED DAMPER
	CONDENSER WATER		CABINET UNIT HEATER & MARK		FIRE DAMPER
	CONDENSER WATER RETURN		FIN TUBE, MARK AND CAPACITY		SMOKE DAMPER
	BOILER BLOW OFF		CONVECTOR AND MARK		COMBINATION FIRE/SMOKE DAMPER
	EXHAUST STEAM		UNIT VENTILATOR AND MARK		TWO AND THREE DAMPER
	CONDENSATE RETURN		RECTANGULAR DUCT (SIZE AND FLOW DIRECTION)		BACKDRAFT DAMPER
	ATOMIZING REFRIGERANT		ROUND DUCT		EQUIPMENT NUMBER
	VENTING		CANVAS CONNECTION		HEATING PIPING NUMBER
	EXPANSION JOINT		VOLUME DAMPER (SIZE AND FLOW)		EXHAUST FAN RISER NUMBER
	THERMOMETER		TURNING VANES		UNDERCUT DOOR
	PRESSURE GAGE		EXTRACTOR		REMOTE SENSOR
					THERMOSTAT

*NOT ALL SYMBOLS MAY BE PRESENT ON PLANS

Bergmeyer
www.bergmeyer.com
LA
CO
BOS

CONSULTANTS:

Schnackel engineers
New York • Miami • Cincinnati • Los Angeles • Carlsbad • Honolulu
www.schnackel.com
MEP/ FP ENGINEER
3030 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER GREGORY ROY SCHNACKEL OF CALIFORNIA
No. M33099
Date: 08/01/25

NO.	BY	DATE	DESCRIPTION
1	GRS	2025-08-20	ADDENDUM A
2	GRS	2025-09-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

MECHANICAL ABBREVIATIONS & SYMBOLS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.01

M001

GENERAL 2022 CALIFORNIA GREEN BUILDING STANDARDS CODE NOTES:

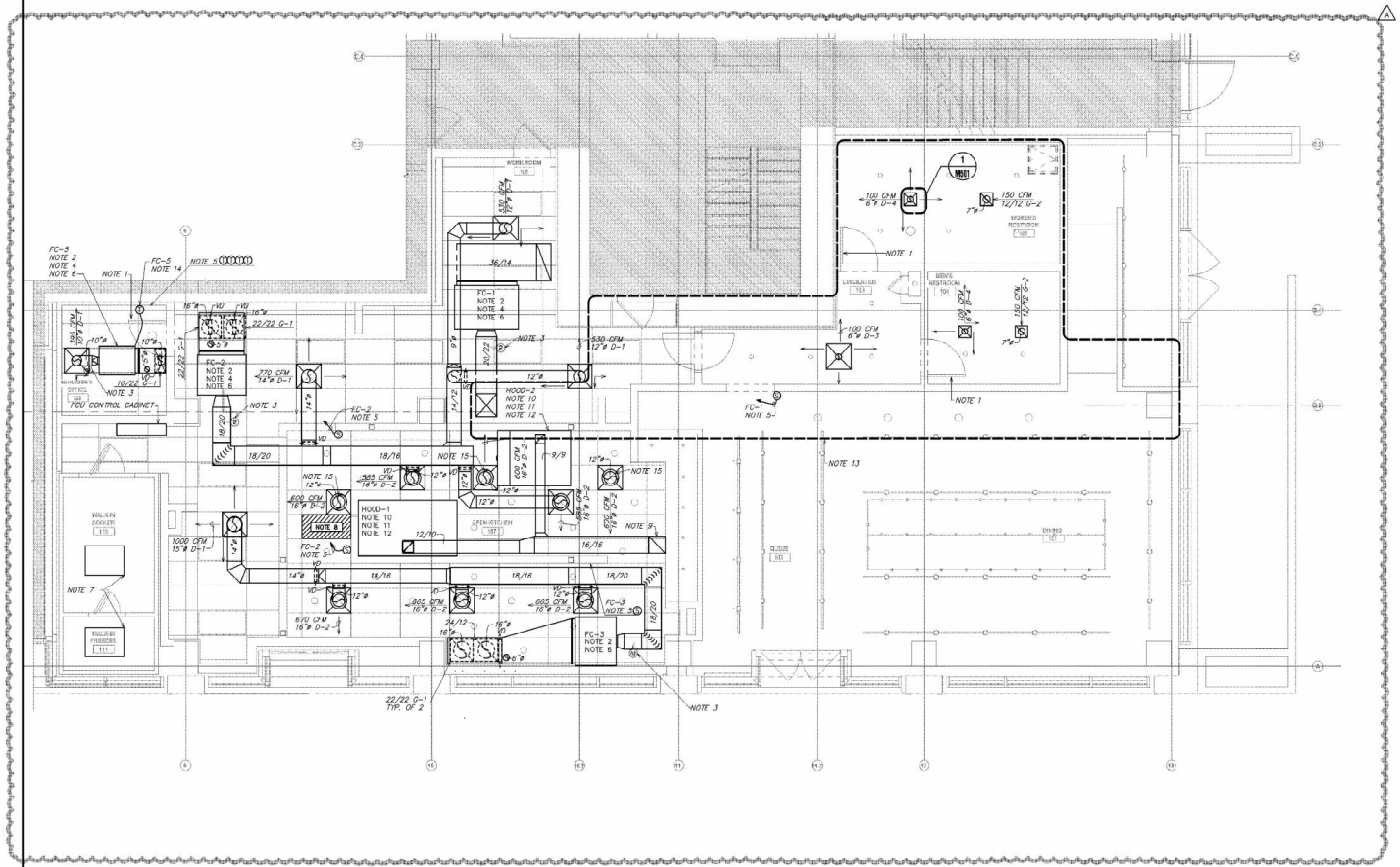
A. TESTING AND ADJUSTING OF SYSTEMS SHALL BE REQUIRED PER SECTION 5.410.4 FOR NEW BUILDINGS WITH FLOOR AREA LESS THAN 10,000 SQUARE FEET OR NEW SYSTEMS TO SERVE AN ADDITION OR ALTERATION SUBJECT TO SECTION 303.1.
B. DEVELOP A WRITTEN PLAN OF PROCEDURES FOR TESTING AND ADJUSTING SYSTEMS. SYSTEMS TO BE INCLUDED FOR TESTING AND ADJUSTING SHALL INCLUDE, AS APPLICABLE TO THE PROJECT. THE SYSTEMS LISTED IN SECTION 5.410.4.2.
C. PERFORM TESTING AND ADJUSTING PROCEDURES IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND APPLICABLE STANDARDS ON EACH SYSTEM. BEFORE A NEW SPACE-CONDITIONING SYSTEM SERVING A BUILDING OR SPACE IS OPERATED FOR NORMAL USE, BALANCE THE SYSTEM IN ACCORDANCE WITH THE PROCEDURES DEFINED BY NATIONAL STANDARDS LISTED IN SECTION 5.410.4.3.1.
E. AFTER COMPLETION OF TESTING, ADJUSTING, AND BALANCING, PROVIDE A FINAL REPORT OF TESTING SIGNED BY THE INDIVIDUAL RESPONSIBLE FOR PERFORMING THESE SERVICES.
F. PROVIDE THE BUILDING OWNER OR REPRESENTATIVE WITH DETAILED OPERATING AND MAINTENANCE INSTRUCTIONS AND COPIES OF GUARANTEES/WARRANTIES FOR EACH SYSTEM PRIOR TO FINAL INSPECTION. O&M INSTRUCTIONS SHALL BE CONSISTENT WITH OSHA REQUIREMENTS IN CCR, TITLE 8, SECTION 5142 AND OTHER RELATED REGULATIONS.
G. INCLUDE A COPY OF ALL INSPECTION VERIFICATIONS AND REPORTS REQUIRED BY THE ENFORCING AGENCY.
H. HVAC EQUIPMENT USED DURING CONSTRUCTION SHALL USE RETURN AIR FILTERS WITH A MERV 8, BASED UPON ASHRAE 33.2-1999, OR AN AVERAGE EFFICIENCY OF 30 PERCENT BASED UPON ASHRAE 52.1-1992. REPLACE ALL FILTERS IMMEDIATELY PRIOR TO OCCUPANCY, OR, IF THE BUILDING IS OCCUPIED DURING ALTERATION, AT THE CONCLUSION OF CONSTRUCTION.
I. AT THE TIME OF ROUGH INSTALLATION AND DURING STORAGE ON THE CONSTRUCTION SITE AND UNTIL FINAL STARTUP OF THE HEATING, COOLING, AND VENTILATING EQUIPMENT, ALL DUCT AND OTHER RELATED AIR DISTRIBUTION COMPONENT OPENINGS SHALL BE COVERED WITH TAPE, PLASTIC, SHEETMETAL OR OTHER METHODS ACCEPTABLE TO THE ENFORCING AGENCY TO REDUCE THE AMOUNT OF DUST, WATER OR DEBRIS WHICH MAY ENTER THE SYSTEM
J. IN MECHANICALLY VENTILATED BUILDINGS, PROVIDE REGULARLY OCCUPIED AREAS OF THE BUILDING WITH AIR FILTRATION MEDIA FOR OUTSIDE AND RETURN AIR THAT PROVIDES AT LEAST A MINIMUM EFFICIENCY REPORTING VALUE (MERV) OF 13. MERV 13 FILTERS SHALL BE INSTALLED PRIOR TO OCCUPANCY, AND RECOMMENDATIONS FOR MAINTENANCE WITH FILTERS OF THE SAME VALUE SHALL BE INCLUDED IN THE OPERATION AND MAINTENANCE MANUAL.
K. INSTALLATIONS OF HVAC, REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT SHALL COMPLY WITH SECTIONS 5.508.1.1 AND 5.508.1.2.
L. INSTALL HVAC AND REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT THAT DO NOT CONTAIN CFCS.
M. INSTALL HVAC AND REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT THAT DO NOT CONTAIN HALONS.
N. ADHESIVES, SEALANTS, AND CAULKS USED ON THE PROJECT SHALL MEET THE REQUIREMENTS OF SECTIONS 5.504.4.1 THROUGH 5.504.4.6.

GENERAL NOTES:

A. EXISTING CONDITIONS ARE BASED ON RECORD DRAWINGS PROVIDED BY THE OWNER. CONTRACTOR SHALL ADJUST TO ACTUAL FIELD CONDITIONS AT NO ADDITIONAL EXPENSE TO THE PROJECT.
B. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFICATION OF ALL EXISTING CONDITIONS PRIOR TO SUBMITTING THE BID. NO ADDITIONAL COMPENSATION WILL BE PROVIDED FOR ANY EXTRAS DUE TO THE CONTRACTOR'S FAILURE TO VISIT THE PROJECT SITE PRIOR TO SUBMITTING THE BID. ANY DISCREPANCIES SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER FOR RESOLUTION.
C. ALL CONTRACTORS SHALL REVIEW A COMPLETE SET OF CONSTRUCTION DOCUMENTS.
D. CONTRACTORS SHALL FAMILIARIZE THEMSELVES WITH DEMOLITION WORK PRIOR TO BIDDING AND START OF WORK. CONTRACTOR IS RESPONSIBLE TO DEMOLISH ALL EXISTING AS REQUIRED FOR INSTALLATION/CONSTRUCTION OF NEW WORK.
E. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH ALL APPLICABLE GOVERNMENT AND LOCAL CODES.
F. MECHANICAL CONTRACTOR SHALL FIELD COORDINATE WITH ELECTRICAL CONTRACTOR FOR ALL POWER REQUIREMENTS.
G. ALL CONTRACTORS SHALL REVIEW A COMPLETE SET OF CONSTRUCTION DOCUMENTS AND COOPERATE WITH THE OTHER TRADES SO THAT THE INSTALLATION OF ALL EQUIPMENT MAY BE PROPERLY COORDINATED.
H. ALL EQUIPMENT FURNISHED SHALL FIT THE SPACE AVAILABLE WITH CONNECTIONS IN THE REQUIRED LOCATIONS AND WITH ADEQUATE SPACE FOR OPERATING AND SERVICING. THE DRAWINGS ARE GENERALLY DIAGRAMMATIC AND INDICATE THE INTENT OF THE INSTALLATION WHILE THE SPECIFICATIONS AND EQUIPMENT LIST DENOTE THE TYPE AND QUALITY OF MATERIAL AND WORKMANSHIP TO BE USED. THE DRAWINGS SHALL NOT BE SCALED FOR EXACT MEASUREMENTS. WHERE A CONFLICT EXISTS BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, THE HIGHER AND/OR MORE COSTLY STANDARD WILL APPLY. THE CONTRACTOR SHALL PROMPTLY NOTIFY THE ENGINEER WHOSE DECISION SHALL BE FINAL. NO ALLOWANCE WILL BE MADE SUBSEQUENTLY IN THIS REGARD IN DEFAULT OF THE CONTRACTOR AFTER AWARD OF THE CONTRACT.
I. COORDINATE DUCT ROUTING AND HEIGHTS WITH GENERAL CONTRACTOR. VERIFY ALL CLEARANCES BEFORE STARTING WORK.
J. THE CONTRACTOR SHALL INSTALL ALL PIPING, DUCTWORK AND EQUIPMENT AS REQUIRED TO CONFORM TO THE STRUCTURE, AVOID OBSTRUCTIONS, PRESERVE CEILING HEIGHTS AND HEADROOM AND MAKE ALL EQUIPMENT REQUIRING MAINTENANCE OR REPAIR ACCESSIBLE.
K. ALL DUCT CONNECTIONS TO HVAC EQUIPMENT MUST BE MADE WITH FLEXIBLE CONNECTORS.
L. DO NOT ATTACH ANYTHING TO DECK ABOVE. ATTACH TO STRUCTURE (I.e. BEAMS, JOISTS,) ONLY. DUCT HANGERS SHALL BE INSTALLED IN ACCORDANCE WITH LOCAL CODE. ALL CONNECTIONS TO JOISTS SHALL BE MADE AT THE TOP CHRD.
M. ALL DUCT DIMENSIONS INDICATED ARE CLEAR INSIDE DIMENSIONS. ALL SUPPLY AND UNINSULATED OUTDOOR AIR DUCTWORK SHALL BE LINED WITH 1" ACOUSTICAL DUCT LINER OR WRAPPED WITH 1-1/2" THICK FIRE RETARDANT FIBERGLASS WITH A REINFORCED ALUMINUM FOIL JACKET AND SHALL BE APPROVED FOR USE BY SMACNA AND NAIMA. RETURN AIR TRANSFER DUCTS AND RETURN DUCTWORK WITHIN 10 FEET OF THE UNIT FAN SHALL BE LINED WITH 1" ACOUSTICAL DUCT LINER.
N. ALL EXPOSED DUCTWORK SHALL BE INSTALLED AS NOTED ON PLANS OR AS INDICATED BY THE ARCHITECT.
O. PROVIDE REMOTE VOLUME DAMPER CONTROL MANUFACTURED BY YOUNG REGULATOR OR UNITED ENERTECH FOR DAMPERS LOCATED ABOVE INACCESSIBLE CEILINGS. LOCATE CONTROLLER ABOVE ACCESSIBLE CEILING LOCATION.
P. REFRIGERANT PIPING SHALL BE SIZED PER MANUFACTURER'S RECOMMENDATIONS. PROVIDE ALL ACCESSORIES AS REQUIRED BY MANUFACTURER FOR COMPLETE WORKING SYSTEM, INCLUDING ANY ACCESSORIES ASSOCIATED WITH LONG LENGTH APPLICATIONS WHERE APPLICABLE.
Q. TENANT'S CONTRACTOR SHALL BE RESPONSIBLE FOR THE FIELD VERIFICATION OF ALL UTILITY RUNS AND/OR OTHER IMPROVEMENTS LOCATED ON THE PREMISES PRIOR TO BIDDING. TENANT'S CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR ALL COSTS RELATING TO THE RELOCATION OF, DAMAGE TO, REPAIR OF ANY EXISTING UTILITY RUNS AND/OR IMPROVEMENTS WHICH ARE DAMAGED AS A RESULT OF TENANT'S WORK IN OR AROUND THE PREMISES.
R. GREASE DUCT LEAKAGE TESTING MUST BE PERFORMED PRIOR TO CONCEALMENT OF THE DUCTWORK.
S. MECHANICAL CONTRACTOR SHALL PROVIDE TENANT WITH A WRITTEN ONE (1) YEAR MANUFACTURER'S WARRANTY ON ALL HVAC EQUIPMENT PROVIDED AND / OR INSTALLED. THE WARRANTY SHALL INCLUDE ALL LABOR, MATERIALS AND THREE (3) ROUTINE SERVICES INCLUDING FILTER CHANGES DURING A ONE (1) YEAR PERIOD.
T. AT THE COMPLETION OF CONSTRUCTION AN NEBB, AABC OR TABB CERTIFIED AIR BALANCE REPORT SHALL BE SUBMITTED TO THE ENGINEER AND LANDLORD. PRIOR TO SCHEDULING BALANCING, COORDINATE WITH LANDLORD'S FIELD REPRESENTATIVE FOR THE VENDOR LISTED BELOW. IF APPROVED, THE BALANCING SHALL BE COMPLETED BY NATION TAB. CONTACT WILL TURNBOUGH AT WILL@NATIONTAB.COM OR 314-824-0844. NATIONAL TAB TO ALSO PERFORM COMMISSIONING FOR ALL SMAC SHOP PROVIDED EQUIPMENT.
U. PARTS OF THE BASE BUILDING SYSTEMS THAT FALL INTO LEASE LINE SHALL REMAIN UNDISTURBED UNLESS NOTED OTHERWISE.
V. PROVIDE ALL NECESSARY WIRING, RELAYS, DETECTORS, COMPONENTS, ETC., FOR FIRE ALARM OR CONTROL SYSTEM INTERLOCK IF APPLICABLE. VERIFY WITH BUILDING PERSONNEL BEFORE BID.

HVAC NOTES:

1. CONTRACTOR SHALL UNDERCUT DOOR 1/4".
2. PROVIDE NEW FC UNIT AS NOTED ON PLANS AND AS SCHEDULED ON SHEET M601.
3. DUCT SMOKE DETECTOR ON SUPPLY SIDE DUCT AND SHUTDOWN RELAY SHALL BE FURNISHED BY THE ELECTRICAL CONTRACTOR FOR INSTALLATION BY THE MECHANICAL CONTRACTOR. ALL WIRING SHALL BE BY THE ELECTRICAL CONTRACTOR.
4. PROVIDE FULL SIZE RETURN AIR DUCT.
5. PROVIDE NEW FULLY DIGITAL 7 DAY PROGRAMMABLE TYPE THERMOSTAT WITH REMOTE SENSING CAPABILITIES, AUTO CHANGE OVER AND AUTO SET BACK. MOUNT THERMOSTAT AT 48" ABOVE FINISHED FLOOR. COORDINATE INSTALLATION LOCATION OF THERMOSTAT/CONTROLS WITH ARCHITECT AND CONSTRUCTION MANAGER. REFERENCE A401 FOR ADDITIONAL INFORMATION. THERMOSTATS SERVING THE SAME TEMPERATURE ZONE SHALL BE INTERLOCKED TO PREVENT SIMULTANEOUS HEATING AND COOLING. PROVIDE REMOTE TEMPERATURE SENSORS AS INDICATED ON PLAN. COORDINATE SENSOR INSTALLATION LOCATION WITH WALL GRAPHICS LAYOUT AND CONSTRUCTION MANAGER.
6. FAN COIL TO BE INSTALLED TO PERMIT SERVICE ACCESS.
7. CONDENSER/HEATER CONDENSING UNITS. SHOWN FOR REFERENCE ONLY.
8. THIS SPACE IS RESERVED FOR CEILING ACCESS TO MECHANICAL PLATFORM ABOVE THE CEILING. NO PIPING OR DUCTWORK SHALL PASS THROUGH THIS ZONE.
9. GREASE EXHAUST DUCTWORK TO RISE AFTER CONNECTION TO HOOD-2 TO PERMIT CONNECTION TO FCU-1. REFERENCE SHEET M101B FOR CONTINUATION.
10. NEW CAPTIVEAIRE GREASE EXHAUST HOOD TO BE FURNISHED BY OWNER FOR INSTALLATION BY THE MECHANICAL CONTRACTOR. SEE CAPTIVEAIRE SHEETS FOR ADDITIONAL INFORMATION. BALANCE HOOD EXHAUST AS NOTED ON CAPTIVEAIRE SHEETS. VERIFY ALL MANUFACTURER AND CODE REQUIRED CLEARANCES ARE MAINTAINED. NOTIFY ARCHITECT IF ANY CONFLICTS OCCUR.
11. HOOD MANUFACTURER TO PROVIDE A "KIT" TO FASTEN THE BOTTOM FLANGE OF THE HOOD TO THE WALL, WITH ONE FASTENER FOR STUD WALL, SIL-BOND RTV 4500 ALUMINUM SILICONE SEALANT OR APPROVED SIMILAR, TO BE APPLIED BY GENERAL CONTRACTOR PRIOR INSTALLED FOR ANY REMAINING SMALL GAPS. HOOD FASTENING "KIT" DETAIL TO BE INCLUDED IN MANUFACTURER DRAWINGS. REFERENCE SHEET M601, DETAIL 11, FOR ADDITIONAL INFORMATION.
12. TRANSITION FROM HOOD EXHAUST COLLAR AND EXTEND KITCHEN HOOD GREASE EXHAUST DUCTWORK TO PCU ON EXISTING LOUVER AS INDICATED ON THE PLANS. FIELD VERIFY EXACT LOCATION. GREASE EXHAUST DUCTWORK TO BE VAUGHAN AIR DURA DUCT SINGLE WALL KITCHEN EXHAUST DUCT. COORDINATE WITH LANDLORD AS REQUIRED. PROVIDE CLEANOUTS ON GREASE DUCTWORK AS REQUIRED BY CODE. TYPICAL OF GREASE EXHAUST DUCTWORK. DUCTWORK TO MAINTAIN ALL CODE REQUIRED CLEARANCES. TYPICAL FOR ALL GREASE EXHAUST DUCTWORK.
13. REFERENCE SHEET M101A FOR FLOATED DUCTWORK ABOVE 16 FEET A.F.F.
14. PROVIDE NEW FULLY DIGITAL 7 DAY PROGRAMMABLE TYPE THERMOSTAT WITH AUTO CHANGE OVER AND AUTO SET BACK. MOUNT THERMOSTAT AT 48" ABOVE FINISHED FLOOR. COORDINATE INSTALLATION LOCATION OF THERMOSTAT/CONTROLS WITH ARCHITECT AND CONSTRUCTION MANAGER. REFERENCE A401 FOR ADDITIONAL INFORMATION.
15. SA DUCT UP. REFERENCE M101B FOR CONTINUATION.



LEGEND
LANDLORD WORK
NEW WORK
NEW TO LL CONNECTION

MECHANICAL FLOOR PLAN - BELOW MECHANICAL PLATFORM - UP TO 16'-0" A.F.F.

1/4" = 1'-0"

1

Bergmeyer
www.bergmeyer.com
BOS
CO
LA
1 Beacon St. Suite 1500 Boston, MA 02108 617.939.1000
1 Maritime Plaza Suite 2100 San Francisco, CA 94111 415.981.1010
3 Park Plaza Suite 1000 Irvine, CA 92614 949.553.1010
2 Seaport Ln. 6th Floor Boston, MA 02210 617.939.1000
1145 17th St. Suite 2100 Denver, CO 80202 720.420.1010
1960 Oxford St. Suite 3 Berkeley, CA 94709 510.665.3700

CONSULTANTS:

Schnackel engineers
New York • Marin • Crestline • Los Angeles • Gardena • Honolulu
323.681.0882 www.schnackel.com

MEP/ FP ENGINEER:
3020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER — GREGORY ROY SCHNACKEL — No. M34696 — STATE OF CALIFORNIA
Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-05-30	ADDENDUM A
2	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

MECHANICAL FLOOR PLAN - BELOW MECHANICAL PLATFORM - 1

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.00

M101A

FAN COIL SEQUENCE OF OPERATIONS

THE OUTDOOR AIR SYSTEM SHALL BE EQUIPPED WITH AN INSULATED MOTORIZED DAMPER TO BE CONTROLLED VIA TIME CLOCK. FULLY CLOSED DURING UNOCCUPIED HOURS AND FULLY OPEN DURING OCCUPIED HOURS.

WHEN FULLY OPEN, A FREEZE STAT INSTALLED BEFORE THE HYDRONIC COIL IS TO SENSE THE INCOMING AIR TEMPERATURE. IF THE TEMPERATURE DROPS BELOW 37°F., THE FREEZE STAT WILL ENABLE POWER TO AN ELECTRIC DUCT HEATER, PREHEATING THE AIR BEFORE REACHING THE HYDRONIC COILS TO PREVENT FREEZING.

A SECONDARY AIR TEMPERATURE DOWNSTREAM OF THE HYDRONIC UNIT WILL MONITOR THE DISCHARGE TEMPERATURE OF AND PROVIDE CONFIRMATION THAT THE FREEZE PROTECTION HEATER IS ACTIVE. IF THE DISCHARGE DROPS BELOW 34°F AND THE HEATER CIRCUIT IS ENERGIZED, THE MOTORIZED DAMPER SHALL CLOSE TO PREVENT FREEZING.

IF THE MOTORIZED DAMPER CLOSES TO THE SEQUENCE LISTED ABOVE, A SIGNALING DEVICE WILL DISPLAY THE CLOSED CONDITION.

THE SYSTEM CAN BE RESET TO NORMAL OPERATION VIA MANUAL ACTIVATION OR THROUGH A PREPROGRAMMED TIME INTERVAL.

AHU SEQUENCE OF OPERATIONS

THE OUTDOOR AIR SYSTEM SHALL BE EQUIPPED WITH AN INSULATED MOTORIZED DAMPER TO BE INTERLOCKED WITH THE OPERATION OF EF-1.

WHEN FULLY OPEN, A FREEZE STAT INSTALLED BEFORE THE HYDRONIC COIL IS TO SENSE THE INCOMING AIR TEMPERATURE. IF THE TEMPERATURE DROPS BELOW 40°F., THE FREEZE-STAT WILL ENABLE HOT WATER RECIRCULATION FROM THE BUILDING HEATING HOT WATER SUPPLY, HEATING THE INCOMING AIR.

A SECONDARY AIR TEMPERATURE DOWNSTREAM OF THE UNIT WILL MONITOR THE DISCHARGE TEMPERATURE OF AND PROVIDE CONFIRMATION THAT THE FREEZE PROTECTION IS ACTIVE. IF THE DISCHARGE DROPS BELOW 34°F AND WATER HEATING CIRCUIT IS ACTIVE, THE MOTORIZED DAMPER SHALL CLOSE TO PREVENT FREEZING.

IF THE MOTORIZED DAMPER CLOSES TO THE SEQUENCE LISTED ABOVE, A SIGNALING DEVICE WILL DISPLAY THE CLOSED CONDITION.

THE SYSTEM CAN BE RESET TO NORMAL OPERATION VIA MANUAL ACTIVATION OR THROUGH A PREPROGRAMMED TIME INTERVAL.

GENERAL 2022 CALIFORNIA GREEN BUILDING STANDARDS CODE NOTES:

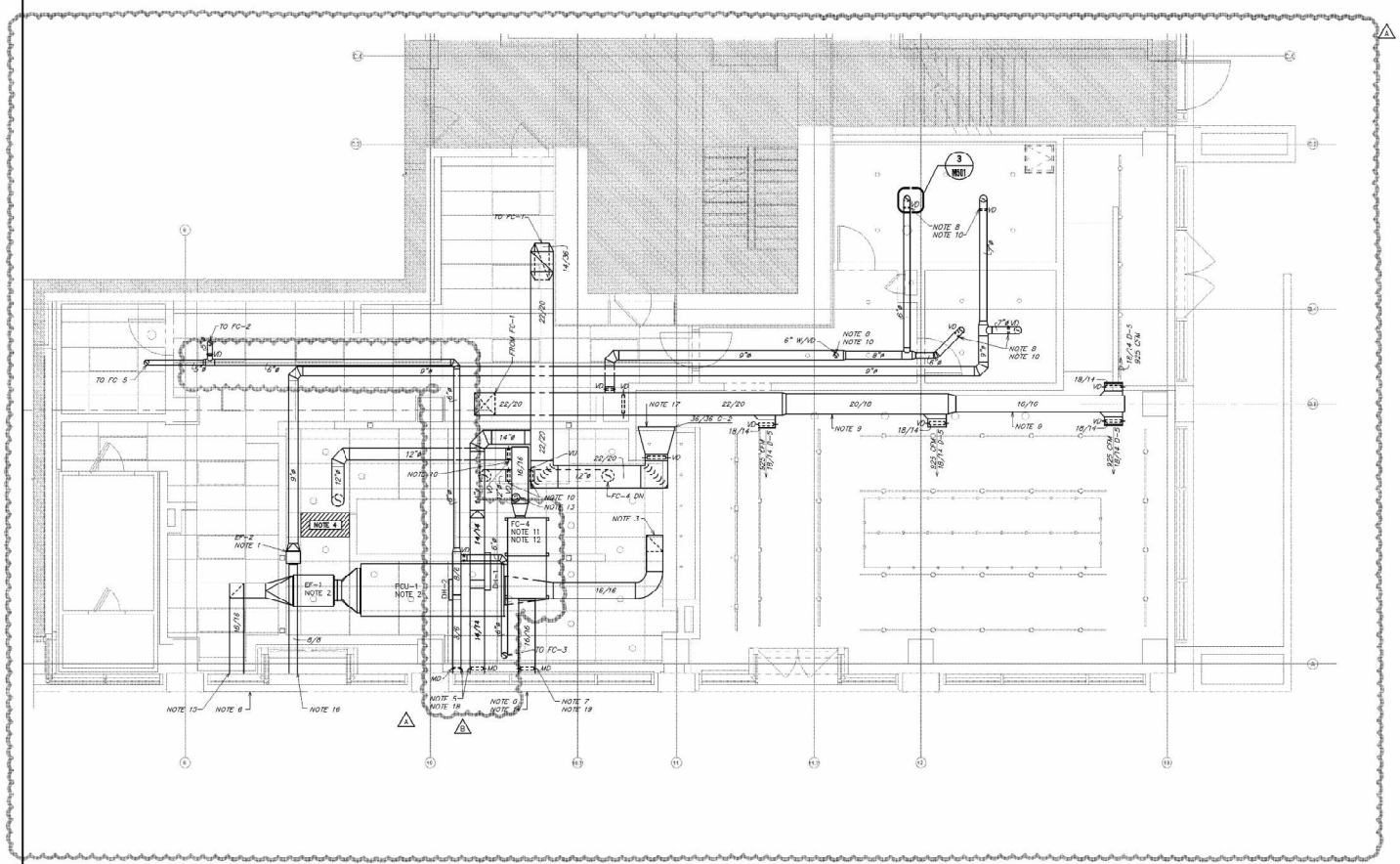
A. TESTING AND ADJUSTING OF SYSTEMS SHALL BE REQUIRED PER SECTION 5.410.4 FOR NEW BUILDINGS WITH FLOOR AREA LESS THAN 10,000 SQUARE FEET OR NEW SYSTEMS TO SERVE AN ADDITION OR ALTERATION SUBJECT TO SECTION 303.1.
B. DEVELOP A WRITTEN PLAN OF PROCEDURES FOR TESTING AND ADJUSTING SYSTEMS. SYSTEMS TO BE INCLUDED FOR TESTING AND ADJUSTING SHALL INCLUDE, AS APPLICABLE TO THE PROJECT, THE SYSTEMS LISTED IN SECTION 5.410.4.2.
C. PERFORM TESTING AND ADJUSTING PROCEDURES IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND APPLICABLE STANDARDS ON EACH SYSTEM. BEFORE A NEW SPACE-CONDITIONING SYSTEM SERVING A BUILDING OR SPACE IS OPERATED FOR NORMAL USE, BALANCE THE SYSTEM IN ACCORDANCE WITH THE PROCEDURES DEFINED BY NATIONAL STANDARDS LISTED IN SECTION 5.410.4.3.1.
E. AFTER COMPLETION OF TESTING, ADJUSTING, AND BALANCING, PROVIDE A FINAL REPORT OF TESTING SIGNED BY THE INDIVIDUAL RESPONSIBLE FOR PERFORMING THESE SERVICES.
F. PROVIDE THE BUILDING OWNER OR REPRESENTATIVE WITH DETAILED OPERATING AND MAINTENANCE INSTRUCTIONS AND COPIES OF GUARANTEES/WARRANTIES FOR EACH SYSTEM PRIOR TO FINAL INSPECTION. O&M INSTRUCTIONS SHALL BE CONSISTENT WITH USMA REQUIREMENTS IN GOR, TITLE 8, SECTION 5142 AND OTHER RELATED REGULATIONS.
G. INCLUDE A COPY OF ALL INSPECTION VERIFICATIONS AND REPORTS REQUIRED BY THE ENFORCING AGENCY.
H. HVAC EQUIPMENT USED DURING CONSTRUCTION SHALL USE RETURN AIR FILTERS WITH A MERV 8, BASED UPON ASHRAE 33.2-1999, OR AN AVERAGE EFFICIENCY OF 30 PERCENT BASED UPON ASHRAE 52.1-1992. REPLACE ALL FILTERS IMMEDIATELY PRIOR TO OCCUPANCY, OR, IF THE BUILDING IS OCCUPIED DURING ALTERATION, AT THE CONCLUSION OF CONSTRUCTION.
I. AT THE TIME OF ROUGH INSTALLATION AND DURING STORAGE ON THE CONSTRUCTION SITE AND UNTIL FINAL STARTUP OF THE HEATING, COOLING, AND VENTILATING EQUIPMENT, ALL DUCT AND OTHER RELATED AIR DISTRIBUTION COMPONENT OPENINGS SHALL BE COVERED WITH TAPE, PLASTIC, SHEETMETAL OR OTHER METHODS ACCEPTABLE TO THE ENFORCING AGENCY TO REDUCE THE AMOUNT OF DUST, WATER OR DEBRIS WHICH MAY ENTER THE SYSTEM
J. IN MECHANICALLY VENTILATED BUILDINGS, PROVIDE REGULARLY OCCUPIED AREAS OF THE BUILDING WITH AIR FILTRATION MEDIA FOR OUTSIDE AND RETURN AIR THAT PROVIDES AT LEAST A MINIMUM EFFICIENCY REPORTING VALUE (MERV) OF 13. MERV 13 FILTERS SHALL BE INSTALLED PRIOR TO OCCUPANCY, AND RECOMMENDATIONS FOR MAINTENANCE WITH FILTERS OF THE SAME VALUE SHALL BE INCLUDED IN THE OPERATION AND MAINTENANCE MANUAL.
K. INSTALLATIONS OF HVAC, REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT SHALL COMPLY WITH SECTIONS 5.508.1.1 AND 5.508.1.2.
L. INSTALL HVAC AND REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT THAT DO NOT CONTAIN CFCS.
M. INSTALL HVAC AND REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT THAT DO NOT CONTAIN HALONS.
N. ADHESIVES, SEALANTS, AND CAULKS USED ON THE PROJECT SHALL MEET THE REQUIREMENTS OF SECTIONS 5.504.4.1 THROUGH 5.504.4.6.

GENERAL NOTES:

A. EXISTING CONDITIONS ARE BASED ON RECORD DRAWINGS PROVIDED BY THE OWNER. CONTRACTOR SHALL ADJUST TO ACTUAL FIELD CONDITIONS AT NO ADDITIONAL EXPENSE TO THE PROJECT.
B. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFICATION OF ALL EXISTING CONDITIONS PRIOR TO SUBMITTING THE BID. NO ADDITIONAL COMPENSATION WILL BE PROVIDED FOR ANY EXTRAS DUE TO THE CONTRACTOR'S FAILURE TO VISIT THE PROJECT SITE PRIOR TO SUBMITTING THE BID. ANY DISCREPANCIES SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER FOR RESOLUTION.
C. ALL CONTRACTORS SHALL REVIEW A COMPLETE SET OF CONSTRUCTION DOCUMENTS.
D. CONTRACTORS SHALL FAMILIARIZE THEMSELVES WITH DEMOLITION WORK PRIOR TO BIDDING AND START OF WORK. CONTRACTOR IS RESPONSIBLE TO DEMOLISH ALL EXISTING AS REQUIRED FOR INSTALLATION/CONSTRUCTION OF NEW WORK.
E. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH ALL APPLICABLE GOVERNMENT AND LOCAL CODES.
F. MECHANICAL CONTRACTOR SHALL FIELD COORDINATE WITH ELECTRICAL CONTRACTOR FOR ALL POWER REQUIREMENTS.
G. ALL CONTRACTORS SHALL REVIEW A COMPLETE SET OF CONSTRUCTION DOCUMENTS AND COOPERATE WITH THE OTHER TRADES SO THAT THE INSTALLATION OF ALL EQUIPMENT MAY BE PROPERLY COORDINATED.
H. ALL EQUIPMENT FURNISHED SHALL FIT THE SPACE AVAILABLE WITH CONNECTIONS IN THE REQUIRED LOCATIONS AND WITH ADEQUATE SPACE FOR OPERATING AND SERVICING. THE DRAWINGS ARE GENERALLY DIAGRAMMATIC AND INDICATE THE INTENT OF THE INSTALLATION WHILE THE SPECIFICATIONS AND EQUIPMENT LIST DENOTE THE TYPE AND QUALITY OF MATERIAL AND WORKMANSHIP TO BE USED. THE DRAWINGS SHALL NOT BE SCALED FOR EXACT MEASUREMENTS. WHERE A CONFLICT EXISTS BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, THE HIGHER AND/OR MORE COSTLY STANDARD WILL APPLY. THE CONTRACTOR SHALL PROMPTLY NOTIFY THE ENGINEER WHOSE DECISION SHALL BE FINAL. NO ALLOWANCE WILL BE MADE SUBSEQUENTLY, IN THIS REGARD OR DETAIL OF THE CONTRACTOR AFTER AWARD OF THE CONTRACT.
I. COORDINATE DUCT ROUTING AND HEIGHTS WITH GENERAL CONTRACTOR. VERIFY ALL CLEARANCES BEFORE STARTING WORK.
J. THE CONTRACTOR SHALL INSTALL ALL PIPING, DUCTWORK AND EQUIPMENT AS REQUIRED TO CONFORM TO THE STRUCTURE, AVOID OBSTRUCTIONS, PRESERVE CEILING HEIGHTS AND HEADROOM AND MAKE ALL EQUIPMENT REQUIRING MAINTENANCE OR REPAIR ACCESSIBLE.
K. ALL DUCT CONNECTIONS TO HVAC EQUIPMENT MUST BE MADE WITH FLEXIBLE CONNECTORS.
L. DO NOT ATTACH ANYTHING TO DECK ABOVE. ATTACH TO STRUCTURE (i.e. BEAMS, JOISTS) ONLY. DUCT HANGERS SHALL BE INSTALLED IN ACCORDANCE WITH LOCAL CODE. ALL CONNECTIONS TO JOISTS SHALL BE MADE AT THE TOP CHRD.
M. ALL DUCT DIMENSIONS INDICATED ARE CLEAR INSIDE DIMENSIONS. ALL SUPPLY AND UNTREATED OUTDOOR AIR DUCTWORK SHALL BE LINED WITH 1" ACOUSTICAL DUCT LINER OR WRAPPED WITH 1-1/2" THICK FIRE RETARDANT FIBERGLASS WITH A REINFORCED ALUMINUM FOIL JACKET AND SHALL BE APPROVED FOR USE BY SMACNA AND NAIMA. RETURN AIR TRANSFER DUCTS AND RETURN DUCTWORK WITHIN 10 FEET OF THE UNIT FAN SHALL BE LINED WITH 1" ACOUSTICAL DUCT LINER.
N. ALL EXPOSED DUCTWORK SHALL BE INSTALLED AS NOTED ON PLANS OR AS INDICATED BY THE ARCHITECT.
O. PROVIDE REMOTE VOLUME DAMPER CONTROL MANUFACTURED BY YOUNG REGULATOR OR UNITED ENERTECH FOR DAMPERS LOCATED ABOVE INACCESSIBLE CEILINGS. LOCATE CONTROLLER ABOVE ACCESSIBLE CEILING LOCATION.
P. REFRIGERANT PIPING SHALL BE SIZED PER MANUFACTURER'S RECOMMENDATIONS. PROVIDE ALL ACCESSORIES AS REQUIRED BY MANUFACTURER FOR COMPLETE WORKING SYSTEM, INCLUDING ANY ACCESSORIES ASSOCIATED WITH LONG LENGTH APPLICATIONS WHERE APPLICABLE.
Q. TENANT'S CONTRACTOR SHALL BE RESPONSIBLE FOR THE FIELD VERIFICATION OF ALL UTILITY RUNS AND/OR OTHER IMPROVEMENTS LOCATED ON THE PREMISES PRIOR TO BIDDING. TENANT'S CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR ALL COSTS RELATING TO THE RELOCATION OF, DAMAGE TO, REPAIR OF ANY EXISTING UTILITY RUNS AND/OR IMPROVEMENTS WHICH ARE DAMAGED AS A RESULT OF TENANT'S WORK IN OR AROUND THE PREMISES.
R. GAS-SIDE LEAK TESTING MUST BE PERFORMED PRIOR TO CONCEALMENT OF THE DUCTWORK.
S. MECHANICAL CONTRACTOR SHALL PROVIDE TENANT WITH A WRITTEN ONE (1) YEAR MANUFACTURER'S WARRANTY ON ALL HVAC EQUIPMENT PROVIDED AND / OR INSTALLED. THE WARRANTY SHALL INCLUDE ALL LABOR, MATERIALS AND THREE (3) ROUTINE SERVICES INCLUDING FILTER CHANGES DURING A ONE (1) YEAR PERIOD.
T. AT THE COMPLETION OF CONSTRUCTION AN NEBB, AABC OR TABB CERTIFIED AIR BALANCE REPORT SHALL BE SUBMITTED TO THE ENGINEER AND LANDLORD. PRIOR TO SCHEDULING BALANCING, COORDINATE WITH LANDLORD'S FIELD REPRESENTATIVE FOR THE VENDOR LISTED BELOW. IF APPROVED, THE BALANCING SHALL BE COMPLETED BY NATION TAB. CONTACT WILL TURNBOUGH AT WILL@NATIONTAB.COM OR 314-824-0844. NATIONAL TAB TO ALSO PERFORM COMMISSIONING FOR ALL SMAC SHOP PROVIDED EQUIPMENT.
U. PARTS OF THE BASE BUILDING SYSTEMS THAT FALL INTO LEASE LINE SHALL REMAIN UNDISTURBED UNLESS NOTED OTHERWISE.
V. PROVIDE ALL NECESSARY WIRING, RELAYS, DETECTORS, COMPONENTS, ETC., FOR FIRE ALARM OR CONTROL SYSTEM INTERLOCK IF APPLICABLE. VERIFY WITH BUILDING PERSONNEL BEFORE BID.

HVAC NOTES:

1. PROVIDE NEW EXHAUST FAN AS NOTED ON PLANS AND AS SCHEDULED ON SHEET M601. CONNECT TO EXISTING STOREFRONT LOUVER. FIELD VERIFY EXACT LOCATION. FAN TO BE INSTALLED ABOVE PCU AND TO ALLOW SERVICE ACCESS FROM PCU SERVICE PLATFORM.
2. NEW CAPTIVEAIRE POLLUTION CONTROL UNIT (PCU-1) AND EXHAUST FAN (EF-1) TO BE FURNISHED BY OWNER FOR INSTALLATION BY THE MECHANICAL CONTRACTOR. SEE CAPTIVEAIRE SHEETS FOR ADDITIONAL INFORMATION. VERIFY ALL MANUFACTURER AND CODE REQUIRED CLEARANCES ARE MAINTAINED. NOTIFY ARCHITECT IF ANY CONFLICTS OCCUR. VERIFY INSTALLATION HEIGHT AND LOCATION WITH ARCHITECTURAL AND STRUCTURAL PLANS.
3. GREASE EXHAUST DUCTWORK TO DROP DOWN TO HOODS FROM PCU-1. REFERENCE SHEET M101A FOR CONTINUATION.
4. THIS SPACE IS RESERVED FOR CEILING ACCESS TO MECHANICAL PLATFORM ABOVE THE CEILING. NO PIPING OR DUCTWORK SHALL PASS THROUGH THIS ZONE.
5. PROVIDE LOW LEAKAGE MOTORIZED OUTDOOR AIR DAMPER. INTERLOCK THE DAMPER WITH TIME CLOCK. WHEN THE SPACE IS UNOCCUPIED, THE MOTORIZED DAMPER IS TO BE FULLY CLOSED. WHEN THE SPACE IS TO BE OCCUPIED, THE MOTORIZED DAMPER TO BE SET TO PERMIT THE OUTDOOR AIR INDICATED ON SHEET M601, AIR DAMPER SCHEDULE. EACH MOTORIZED DAMPER IS TO BE CONFIGURED AS A FAIL-CLOSE SYSTEM, AND TO BE EQUIPPED WITH A FREEZE-STAT. IF THE TEMPERATURE IS BELOW 35°F, THE MOTORIZED DAMPER SHALL CLOSE.
6. EXISTING STOREFRONT LOUVERS TO REMAIN. PROVIDE FULL SIZED INSULATED PLENUM BOX AND INSULATED BLANK OFF PANELS IF NOT ALREADY EQUIPPED.
7. OPERATION OF FC-4 AND ASSOCIATED MOTORIZED DAMPER TO BE INTERLOCKED WITH PCU-1/EF-1. THE MOTORIZED DAMPER SHALL BE FULLY OPEN WHEN PCU-1/EF-1 IS ACTIVE AND FULLY CLOSED WHEN PCU-1/EF-1 IS INACTIVE. REFERENCE THE AIR DAMPER SCHEDULE ON SHEET M001 FOR ADDITIONAL INFORMATION.
8. PROVIDE REMOTE VOLUME DAMPER AS INDICATED ON PLANS. REFERENCE SHEET M601, DETAIL 3, FOR ADDITIONAL INFORMATION. TYPICAL OF DIFFUSERS/GRILLES INSTALLED IN DIFF. BOARD CEILINGS.
9. DUCTWORK TO BE TO BE INSTALLED WITH CENTER OF DUCT AT 21 FEET A.F.F. COORDINATE FINAL INSTALLATION HEIGHT WITH CONSTRUCTION MANAGER AND ARCHITECT. COORDINATE ROUTING AND MOUNTING HEIGHT WITH LIGHTING FIXTURES. VERIFY FINAL COLOR/FINISH OF EXPOSED DUCTWORK WITH ARCHITECT.
10. BALANCE DAMPER TO PROVIDE THE AIRFLOW INDICATED ON SHEET M101A.
11. FAN COIL TO BE INSTALLED ABOVE THE PCU AND ACCESSIBLE FROM THE SERVICE PLATFORM.
12. PROVIDE NEW FC UNIT AS NOTED ON PLANS AND AS SCHEDULED ON SHEET M601.
13. PROVIDE WITH DUCT MOUNTED DISCHARGE AIR TEMPERATURE SENSOR. CONTROLS TO BE LOCATED IN MANAGERS OFFICE.
14. VERIFY IF EXISTING LOUVER IS EQUIPPED WITH INSULATED PLENUM BOX. IF NOT, PROVIDE INSULATED PLENUM BOX WITH A MINIMUM FREE AREA OF 6.91 SQUARE FEET FOR ALL OUTDOOR AIR INTAKES. ANY UNUSED AREA OF THE LOUVER CAN BE BLANKED OFF.
15. VERIFY IF EXISTING LOUVER IS EQUIPPED WITH INSULATED PLENUM BOX. IF NOT, PROVIDE INSULATED PLENUM BOX WITH A MINIMUM FREE AREA OF 2.0 SQUARE FEET FOR KITCHEN HOOD EXHAUST. ANY UNUSED AREA OF THE LOUVER CAN BE BLANKED OFF. PROVIDE INSULATED BLANK OFF PANELS AS REQUIRED.
16. VERIFY IF EXISTING LOUVER IS EQUIPPED WITH INSULATED PLENUM BOX. IF NOT, PROVIDE INSULATED PLENUM BOX WITH A MINIMUM FREE AREA OF 0.5 SQUARE FEET FOR RESTROOM EXHAUST. ANY UNUSED AREA OF THE LOUVER CAN BE BLANKED OFF. PROVIDE INSULATED BLANK OFF PANELS AS REQUIRED.
17. RETURN GRILLE TO BE MOUNTED AS HIGH AS CONDITIONS ALLOW. COORDINATE EXACT INSTALLATION LOCATION AND FINAL COLOR/FINISH LOCATION WITH ARCHITECT AND CONSTRUCTION MANAGER. VERIFY RETURN AIR HAS A PATH NOT LESS THAN 4"x24" OPEN TO THE SPACE ABOVE.
18. FC AND ASSOCIATED MOTORIZED DAMPER TO OPERATE PER SEQUENCE OF OPERATIONS LISTED ON THIS SHEET.
19. AHU-1 AND ASSOCIATED MOTORIZED DAMPER TO OPERATE PER SEQUENCE OF OPERATIONS LISTED ON THIS SHEET. THE ECONOMIZER IN THE AHU SHALL HAVE THE HEATING COILS PLACED BEFORE THE COOLING COILS RELATIVE TO THE OUTDOOR AIRFLOW DIRECTION TO PERMIT FREEZE PROTECTION.



MECHANICAL FLOOR PLAN - MECHANICAL PLATFORM AND ABOVE - ABOVE 16'-0" A.F.F.

1/4" = 1'-0"

Bergmeyer
www.bergmeyer.com
BOS
• 265 Franklin St. 6th Floor Boston, MA 02110 617.939.1000
CO
• 1144 Walnut St. Suite 200 Boulder, CO 80302 303.443.1922
LA
• 1055 Wilshire Blvd. Suite 1980 Los Angeles, CA 90017 213.533.0966

CONSULTANTS:

Schnackel engineers
New York • Miami • Crestview • Los Angeles • Destin • Honolulu
833-681-0960 www.schnackel.com

MEP/ FP ENGINEER:
3600 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER — GREGORY SCOTT SCHNACKEL — No. M33099 — STATE OF CALIFORNIA

Date: 08/01/25

NO	BY	DATE	DESCRIPTION
3	GRS	2025-09-17	ADDENDUM B
2	GRS	2025-08-18	ADDENDUM A
1	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2024-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

MECHANICAL FLOOR PLAN - MECHANICAL PLATFORM AND ABOVE

DRAWN BY:	RR
CHECKED BY:	GSS
JOB NO:	30245549.00

M101B

GENERAL 2022 CALIFORNIA GREEN BUILDING STANDARDS CODE NOTES:

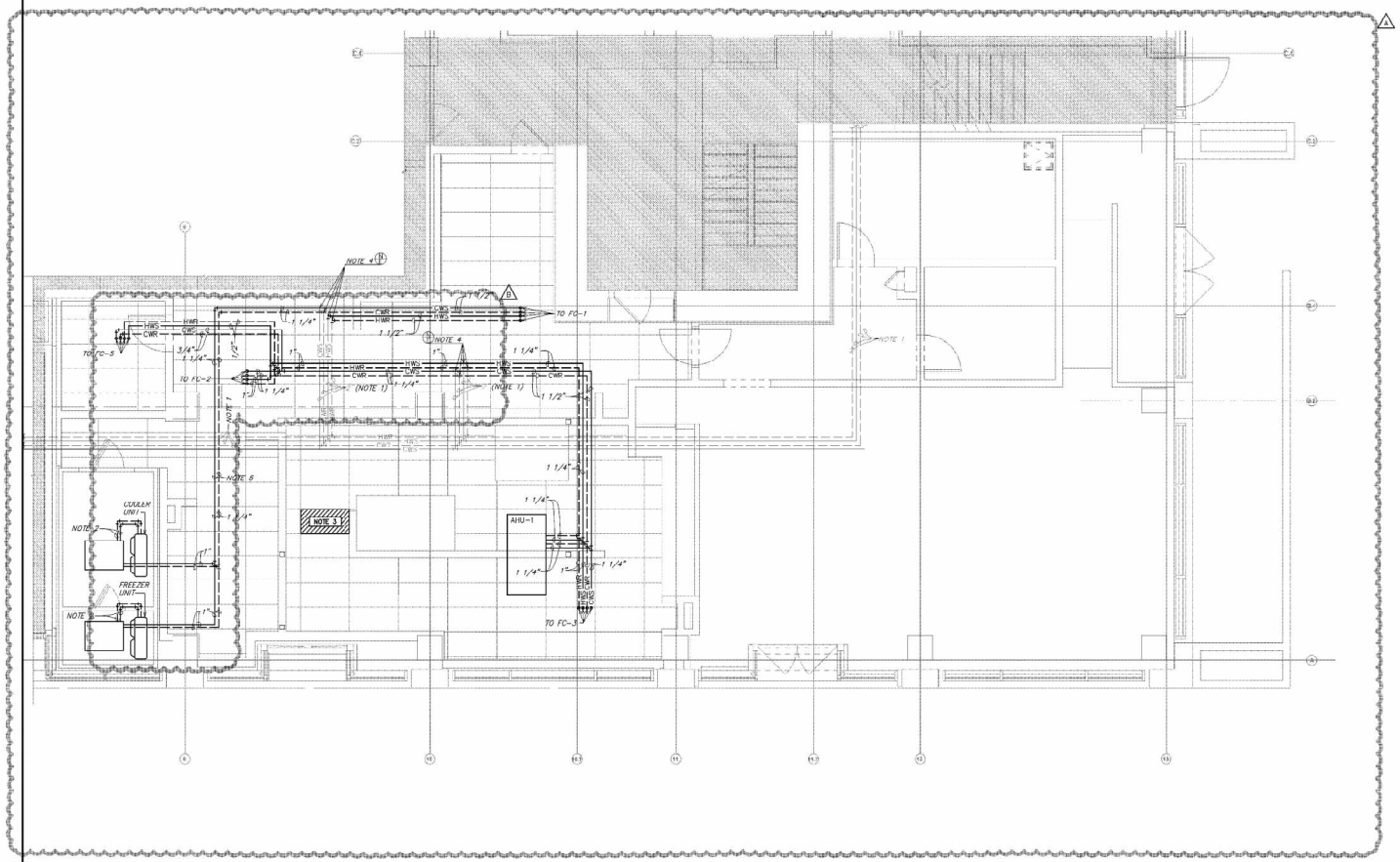
A. TESTING AND ADJUSTING OF SYSTEMS SHALL BE REQUIRED PER SECTION 5.410.4 FOR NEW BUILDINGS WITH FLOOR AREA LESS THAN 10,000 SQUARE FEET OR NEW SYSTEMS TO SERVE AN ADDITION OR ALTERATION SUBJECT TO SECTION 303.1.
B. DEVELOP A WRITTEN PLAN OF PROCEDURES FOR TESTING AND ADJUSTING SYSTEMS. SYSTEMS TO BE INCLUDED FOR TESTING AND ADJUSTING SHALL INCLUDE, AS APPLICABLE TO THE PROJECT: THE SYSTEMS LISTED IN SECTION 5.410.4.2.
C. PERFORM TESTING AND ADJUSTING PROCEDURES IN ACCORDANCE WITH MANUFACTURER'S SPECIFICATIONS AND APPLICABLE STANDARDS ON EACH SYSTEM.
D. BEFORE A NEW SPACE-CONDITIONING SYSTEM SERVING A BUILDING OR SPACE IS OPERATED FOR NORMAL USE, BALANCE THE SYSTEM IN ACCORDANCE WITH THE PROCEDURES DEFINED BY NATIONAL STANDARDS LISTED IN SECTION 5.410.4.3.1.
E. AFTER COMPLETION OF TESTING, ADJUSTING, AND BALANCING, PROVIDE A FINAL REPORT OF TESTING SIGNED BY THE INDIVIDUAL RESPONSIBLE FOR PERFORMING THESE SERVICES.
F. PROVIDE THE BUILDING OWNER OR REPRESENTATIVE WITH DETAILED OPERATING AND MAINTENANCE INSTRUCTIONS AND COPIES OF GUARANTIES/WARRANTIES FOR EACH SYSTEM PRIOR TO FINAL INSPECTION. O&M INSTRUCTIONS SHALL BE CONSISTENT WITH OSHA REQUIREMENTS IN CCR, TITLE 8, SECTION 5142 AND OTHER RELATED REGULATIONS.
G. INCLUDE A COPY OF ALL INSPECTION VERIFICATIONS AND REPORTS REQUIRED BY THE ENFORCING AGENCY.
H. HVAC EQUIPMENT USED DURING CONSTRUCTION SHALL USE RETURN AIR FILTERS WITH A MERV 8, BASED UPON ASHRAE 33.2-1999, OR AN AVERAGE EFFICIENCY OF 30 PERCENT BASED UPON ASHRAE 52.1-1992. REPLACE ALL FILTERS IMMEDIATELY PRIOR TO OCCUPANCY, OR, IF THE BUILDING IS OCCUPIED DURING ALTERATION, AT THE CONCLUSION OF CONSTRUCTION.
I. AT THE TIME OF ROUGH INSTALLATION AND DURING STORAGE ON THE CONSTRUCTION SITE AND UNTIL FINAL STARTUP OF THE HEATING, COOLING, AND VENTILATING EQUIPMENT, ALL DUCT AND OTHER ISOLATED AIR DISTRIBUTION COMPONENT OPENINGS SHALL BE COVERED WITH TAPE, PLASTIC, SHEETMETAL OR OTHER METHODS ACCEPTABLE TO THE ENFORCING AGENCY TO REDUCE THE AMOUNT OF DUST, WATER OR DEBRIS WHICH MAY ENTER THE SYSTEM.
J. IN MECHANICALLY VENTILATED BUILDINGS, PROVIDE REGULARLY OCCUPIED AREAS OF THE BUILDING WITH AIR FILTRATION MEDIA FOR OUTSIDE AND RETURN AIR THAT PROVIDES AT LEAST A MINIMUM EFFICIENCY REPORTING VALUE (MERV) OF 13. MERV 13 FILTERS SHALL BE INSTALLED PRIOR TO OCCUPANCY, AND RECOMMENDATIONS FOR MAINTENANCE WITH FILTERS OF THE SAME VALUE SHALL BE INCLUDED IN THE OPERATION AND MAINTENANCE MANUAL.
K. INSTALLATIONS OF HVAC, REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT SHALL COMPLY WITH SECTIONS 5.508.1.1 AND 5.508.1.2.
L. INSTALL HVAC AND REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT THAT DO NOT CONTAIN CFCS.
M. INSTALL HVAC AND REFRIGERATION AND FIRE SUPPRESSION EQUIPMENT THAT DO NOT CONTAIN HALONS.
N. ADHESIVES, SEALANTS, AND CAULKS USED ON THE PROJECT SHALL MEET THE REQUIREMENTS OF SECTIONS 5.504.4.1 THROUGH 5.504.4.6.

GENERAL NOTES:

A. EXISTING CONDITIONS ARE BASED ON RECORD DRAWINGS PROVIDED BY THE OWNER. CONTRACTOR SHALL ADJUST TO ACTUAL FIELD CONDITIONS AT NO ADDITIONAL EXPENSE TO THE PROJECT.
B. CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD VERIFICATION OF ALL EXISTING CONDITIONS PRIOR TO SUBMITTING THE BID. NO ADDITIONAL COMPENSATION WILL BE PROVIDED FOR ANY EXTRAS DUE TO THE CONTRACTOR'S FAILURE TO VISIT THE PROJECT SITE PRIOR TO SUBMITTING THE BID. ANY DISCREPANCIES SHALL BE IMMEDIATELY REPORTED TO THE ENGINEER FOR RESOLUTION.
C. ALL CONTRACTORS SHALL REVIEW A COMPLETE SET OF CONSTRUCTION DOCUMENTS.
D. CONTRACTORS SHALL FAMILIARIZE THEMSELVES WITH DEMOLITION WORK PRIOR TO BIDDING AND START OF WORK. CONTRACTOR IS RESPONSIBLE TO DEMOLISH ALL EXISTING AS REQUIRED FOR INSTALLATION/CONSTRUCTION OF NEW WORK.
E. ALL WORK SHALL BE COMPLETED IN ACCORDANCE WITH ALL APPLICABLE GOVERNMENT AND LOCAL CODES.
F. MECHANICAL CONTRACTOR SHALL FIELD COORDINATE WITH ELECTRICAL CONTRACTOR FOR ALL POWER REQUIREMENTS.
G. ALL CONTRACTORS SHALL REVIEW A COMPLETE SET OF CONSTRUCTION DOCUMENTS AND COOPERATE WITH THE OTHER TRADES SO THAT THE INSTALLATION OF ALL EQUIPMENT MAY BE PROPERLY COORDINATED.
H. ALL EQUIPMENT FURNISHED SHALL FIT THE SPACE AVAILABLE WITH CONNECTIONS IN THE REQUIRED LOCATIONS AND WITH ADEQUATE SPACE FOR OPERATING AND SERVICING. THE DRAWINGS ARE GENERALLY DIAGRAMMATIC AND INDICATE THE INTENT OF THE INSTALLATION WHILE THE SPECIFICATIONS AND EQUIPMENT LIST DENOTE THE TYPE AND QUALITY OF MATERIAL AND WORKMANSHIP TO BE USED. THE DRAWINGS SHALL NOT BE SCALED FOR EXACT MEASUREMENTS. WHERE A CONFLICT EXISTS BETWEEN THE DRAWINGS AND THE SPECIFICATIONS, THE HIGHER AND/OR MORE COSTLY STANDARD WILL APPLY. THE CONTRACTOR SHALL PROMPTLY NOTIFY THE ENGINEER WHOSE DECISION SHALL BE FINAL. NO ALLOWANCE WILL BE MADE SUBSEQUENTLY IN THIS REGARD ON BEHALF OF THE CONTRACTOR AFTER AWARD OF THE CONTRACT.
I. COORDINATE DUCT ROUTING AND HEIGHTS WITH GENERAL CONTRACTOR. VERIFY ALL CLEARANCES BEFORE STARTING WORK.
J. THE CONTRACTOR SHALL INSTALL ALL PIPING, DUCTWORK AND EQUIPMENT AS REQUIRED TO CONFORM TO THE STRUCTURE, AVOID OBSTRUCTIONS, PRESERVE CEILING HEIGHTS AND HEADROOM AND MAKE ALL EQUIPMENT REQUIRING MAINTENANCE OR REPAIR ACCESSIBLE.
K. ALL DUCT CONNECTIONS TO HVAC EQUIPMENT MUST BE MADE WITH FLEXIBLE CONNECTORS.
L. DO NOT ATTACH ANYTHING TO DECK ABOVE. ATTACH TO STRUCTURE (i.e. BEAMS, JOISTS,) ONLY. DUCT HANGERS SHALL BE INSTALLED IN ACCORDANCE WITH LOCAL CODE. ALL CONNECTIONS TO JOISTS SHALL BE MADE AT THE TOP CHRD.
M. ALL DUCT DIMENSIONS INDICATED ARE CLEAR INSIDE DIMENSIONS. ALL SUPPLY AND UNTEMPERED OUTDOOR AIR DUCTWORK SHALL BE LINED WITH 1" ACOUSTICAL DUCT LINER OR WRAPPED WITH 1-1/2" THICK FIRE RETARDANT FIBERGLASS WITH A REINFORCED ALUMINUM FOIL JACKET AND SHALL BE APPROVED FOR USE BY SMACNA AND NAIMA. RETURN AIR TRANSFER DUCTS AND RETURN DUCTWORK WITHIN 10 FEET OF THE UNIT FAN SHALL BE LINED WITH 1" ACOUSTICAL DUCT LINER.
N. ALL EXPOSED DUCTWORK SHALL BE INSTALLED AS NOTED ON PLANS OR AS INDICATED BY THE ARCHITECT.
O. PROVIDE REMOTE VOLUME DAMPER CONTROL MANUFACTURED BY YOUNG REGULATOR OR UNITED ENERTECH FOR DAMPERS LOCATED ABOVE INACCESSIBLE CEILINGS. LOCATE CONTROLLER ABOVE ACCESSIBLE CEILING LOCATION.
P. REFRIGERANT PIPING SHALL BE SIZED PER MANUFACTURER'S RECOMMENDATIONS. PROVIDE ALL ACCESSORIES AS REQUIRED BY MANUFACTURER FOR COMPLETE WORKING SYSTEM, INCLUDING ANY ACCESSORIES ASSOCIATED WITH LONG LENGTH APPLICATIONS WHERE APPLICABLE. ADJUST ROUTING AS NECESSARY IN FIELD FOR ANY OBSTACLES. COORDINATE EXACT LOCATION AND ROUTING WITH CONSTRUCTION MANAGER AND LANDLORD. CONDENSING UNITS ARE TO BE MOUNTED ON TOP OF THE COOLER/FREEZER UNIT. SHOWN FOR REFERENCE ONLY.
Q. TENANT'S CONTRACTOR SHALL BE RESPONSIBLE FOR THE FIELD VERIFICATION OF ALL UTILITY RUNS AND/OR OTHER IMPROVEMENTS LOCATED ON THE PREMISES PRIOR TO BIDDING. TENANT'S CONTRACTOR SHALL ALSO BE RESPONSIBLE FOR ALL COSTS RELATING TO THE RELOCATION OF, DAMAGE TO, REPAIR OF ANY EXISTING UTILITY RUNS AND/OR IMPROVEMENTS WHICH ARE DAMAGED AS A RESULT OF TENANT'S WORK IN OR AROUND THE PREMISES.
R. GREASE DUCT LEAKAGE TESTING MUST BE PERFORMED PRIOR TO CONCEALMENT OF THE DUCTWORK.
S. MECHANICAL CONTRACTOR SHALL PROVIDE TENANT WITH A WRITTEN ONE (1) YEAR MANUFACTURER'S WARRANTY ON ALL HVAC EQUIPMENT PROVIDED AND / OR INSTALLED. THE WARRANTY SHALL INCLUDE ALL LABOR, MATERIALS AND THREE (3) ROUTINE SERVICES INCLUDING FILTER CHANGES DURING A ONE (1) YEAR PERIOD.
T. AT THE COMPLETION OF CONSTRUCTION AN NEBB, AABC OR TABB CERTIFIED AIR BALANCE REPORT SHALL BE SUBMITTED TO THE ENGINEER AND LANDLORD. PRIOR TO SCHEDULING BALANCING, COORDINATE WITH LANDLORD'S FIELD REPRESENTATIVE FOR THE VENDOR LISTED BELOW. IF APPROVED, THE BALANCING SHALL BE COMPLETED BY NATION TAB. CONTACT WILL TURNBOUGH AT WILL@NATIONALTAB.COM OR 314-824-0844. NATIONAL TAB TO ALSO PERFORM COMMISSIONING FOR ALL SMART START PROVIDED EQUIPMENT.
U. PARTS OF THE BASE BUILDING SYSTEMS THAT FALL INTO LEASE LINE SHALL REMAIN UNDISTURBED UNLESS NOTED OTHERWISE.
V. PROVIDE ALL NECESSARY WIRING, RELAYS, DETECTORS, COMPONENTS, ETC., FOR FIRE ALARM OR CONTROL SYSTEM INTERLOCK IF APPLICABLE. VERIFY WITH BUILDING PERSONNEL BEFORE BID.

HVAC NOTES:

1. EXISTING LANDLORD CHILLED WATER, HEATING HOT WATER, AND BTU METERING SYSTEMS TO REMAIN. FIELD VERIFY EXACT LOCATIONS.
2. KITCHEN EQUIPMENT CONTRACTOR TO PROVIDE REFRIGERANT LINES FROM CONDENSING UNITS TO KITCHEN EQUIPMENT AS NOTED ON PLANS. LINES SHALL BE SIZED ACCORDING TO MANUFACTURER'S SPECIFICATIONS. PROVIDE ALL ACCESSORIES AS REQUIRED BY MANUFACTURER FOR COMPLETE WORKING SYSTEM, INCLUDING ANY ACCESSORIES ASSOCIATED WITH LONG LENGTH APPLICATIONS WHERE APPLICABLE. ADJUST ROUTING AS NECESSARY IN FIELD FOR ANY OBSTACLES. COORDINATE EXACT LOCATION AND ROUTING WITH CONSTRUCTION MANAGER AND LANDLORD. CONDENSING UNITS ARE TO BE MOUNTED ON TOP OF THE COOLER/FREEZER UNIT. SHOWN FOR REFERENCE ONLY.
3. THIS SPACE IS RESERVED FOR CEILING ACCESS TO MECHANICAL PLATFORM ABOVE THE CEILING. NO PIPING OR DUCTWORK SHALL PASS THROUGH THIS ZONE.
4. CONNECT NEW CHWS/R AND HWS/R TO EXISTING PIPING AS INDICATED ON PLANS. TYPICAL OF NEW TO EXISTING CONNECTIONS. CONTRACTOR TO FIELD VERIFY SIZE AND LOCATION OF EXISTING PIPING. NOTIFY ENGINEER IN ADVANCE OF ANY DISCREPANCIES.
5. PROVIDE CHILLED WATER PIPING TO KITCHEN EQUIPMENT CONDENSING UNITS. COORDINATE WITH KITCHEN EQUIPMENT VENDOR.



LEGEND
LANDLORD WORK
NEW WORK
NEW TO LL CONNECTION

MECHANICAL REFRIGERANT PIPING LAYOUT PLAN

1/4" = 1'-0"
0'-0" 2'-0" 4'-0"

1

Bergmeyer
www.bergmeyer.com
BOS: 1 Bowdoin Square 7th Floor Boston, MA 02114 617-939-0000
LA: 1 Whitney St. Suite 200 Oakland, CA 94619 510-658-1966
CO: 1144 Walnut St. Suite 300 Boulder, CO 80302 303-335-0966

CONSULTANTS:

Schnackel engineers
New York Miami Cincinnati Los Angeles Seattle Honolulu
513-681-0883 www.schnackel.com

MEP/ FP ENGINEER:
3020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER GREGORY ROY SCHNACKEL No. M33090 STATE OF CALIFORNIA
Date: 08/01/25

NO	BY	DATE	DESCRIPTION
3	GRS	2025-09-17	ADDENDUM 6
2	GRS	2025-08-26	ADDENDUM 4
1	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2024-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

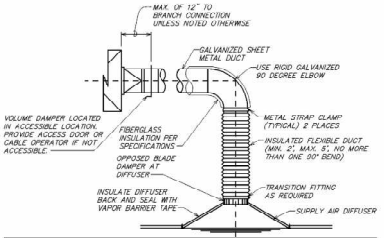
IFC SET

MECHANICAL PIPING LAYOUT PLAN

3

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.00

M102



SEISMIC REQUIREMENT NOTES:

A. AIR TERMINALS WEIGHING LESS THAN 20 POUNDS SHALL BE POSITIVELY ATTACHED TO THE MAIN RUNNER.

B. AIR TERMINALS WEIGHING BETWEEN 20 POUNDS AND 56 POUNDS SHALL HAVE TWO 12 GAUGE HANGER WIRES CONNECTED FROM THE TERMINAL TO THE STRUCTURE ABOVE AND SHALL BE POSITIVELY ATTACHED TO THE MAIN RUNNER. THE HANGER WIRES MAY BE SLACK.

C. AIR TERMINALS WEIGHING MORE THAN 56 POUNDS SHALL HAVE INDEPENDENT SUPPORT FROM THE STRUCTURE ABOVE.

D. HANGER WIRES SHALL MEET THE SAME INSTALLATION REQUIREMENTS AS VERTICAL SUSPENSION WIRES.

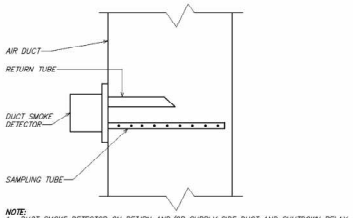
9 TYPICAL DIFFUSER CONNECTION – SEISMIC
NOT TO SCALE

SEISMIC BRACING AND SIZING

BRACE SIZING		BRACING SPACING		
BRACE SIZE	MAXIMUM LENGTH	PIPE SIZE	MAXIMUM HANGER SPACING	MAXIMUM BRACE SPACING* (SEE NOTE B)
2" x 2" x 3/16" ANGLE	6'-0"	UP TO 1 1/2"	7'-0"	NOT REQUIRED
2 1/8" x 2 1/8" x 3/16" ANGLE	8' 0"	2"	10' 0"	NOT REQUIRED
3" x 3" x 3/16" ANGLE	10'-0"	2 1/2" TO 3"	10'-0"	7'-0"
3 1/2" x 3 1/2" x 1/4" ANGLE	11'-6"	4" AND UP	10'-0"	10'-0"
4" x 4" x 1/4" ANGLE	13'-0"			
3" DIAM. PIPE	13'-0" TO 18'-0"			

NOTES:
A. DUCTS WHICH ARE LARGER THAN OR EQUAL TO 6 SQUARE FEET IN CROSS SECTION AREA SHALL BE BRACED LATERALLY 2" 0" ON CENTERS WITH 2" x 2" x 3/16" ANGLE.
*B. BRACING CAN BE OMITTED ON ALL PIPING SUSPENDED BY INDIVIDUAL HANGERS 12" OR LESS IN LENGTH FROM THE TOP OF PIPE TO THE BOTTOM OF THE SUPPORT FOR THE HANGER.

10 SEISMIC BRACE SCHEDULE
NOT TO SCALE



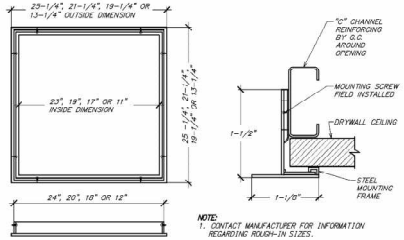
NOTE:
1. DUCT SMOKE DETECTOR ON RETURN AND/OR SUPPLY SIDE DUCT AND SHUTDOWN RELAY SHALL BE FURNISHED BY THE ELECTRICAL CONTRACTOR FOR INSTALLATION BY THE MECHANICAL CONTRACTOR. ALL WIRING SHALL BE BY THE ELECTRICAL CONTRACTOR.

7 DUCT SMOKE DETECTOR DETAIL
NOT TO SCALE

DIA.	WIRE DIA.	ROD	STRAP
10" DN	ONE 12 GA.	1/4"	1" x 22 GA.
11-18"	TWO 12 GA. OR ONE 8 GA.	1/4"	1" x 22 GA.
19-24"	TWO 10 GA.	1/4"	1" x 22 GA.
25-36"	TWO 8 GA.	3/8"	1" x 20 GA.
37-50"	–	TWO 3/8"	TWO 1" x 20 GA.
51-60"	–	TWO 3/8"	TWO 1" x 18 GA.
61-84"	–	TWO 3/8"	TWO 1" x 16 GA.
85-96"	–	TWO 1/2"	TWO 1 1/2" x 16 GA.

NOTES:
1. STRAPS ARE GALVANIZED STEEL. RODS ARE UNCOATED OR GALVANIZED STEEL. WIRE IS BLACK ANNEALED, BRIGHT BASIC OR GALVANIZED STEEL. ALL ARE ALTERNATIVES.
2. TABLE ALLOWS FOR CONVENTIONAL WALL THICKNESS, AND JOINT SYSTEMS PLUS ONE LB/SF OF INSULATION WEIGHT. IF HEAVIER DUCTS ARE TO BE INSTALLED, ADJUST HANGER SIZES TO BE WITHIN THEIR LOAD LIMITS.

5 ROUND DUCT HANGER TABLE
NOT TO SCALE



NOTE:
1. CONTACT MANUFACTURER FOR INFORMATION REGARDING ROUGH-IN SIZES.

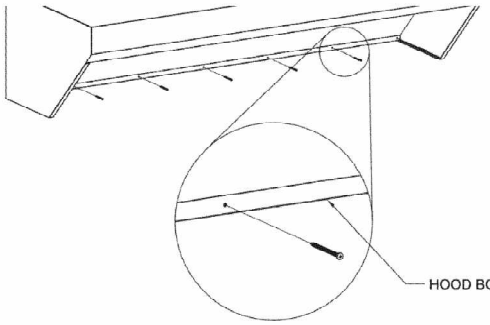
1 TYPICAL DRYWALL MOUNTING FRAME DETAIL
NOT TO SCALE

MAXIMUM HALF OF DUCT PERIMETER	PAIR AT 10 FT. SPACING		PAIR AT 8 FT. SPACING		PAIR AT 5 FT. SPACING		PAIR AT 4 FT. SPACING	
	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD
P/2 = 30"	1" x 22 GA.	10 GA. (.35")	1" x 22 GA.	10 GA. (.135")	1" x 22 GA.	12 GA. (.106")	1" x 22 GA.	12 GA. (.106")
P/2 = 72"	1" x 18 GA.	3/8"	1" x 20 GA.	1/4"	1" x 22 GA.	1/4"	1" x 22 GA.	1/4"
P/2 = 96"	1" x 16 GA.	3/8"	1" x 18 GA.	3/8"	1" x 20 GA.	3/8"	1" x 22 GA.	1/4"
P/2 = 120"	1 1/2" x 16 GA.	1/2"	1" x 16 GA.	3/8"	1" x 18 GA.	3/8"	1" x 20 GA.	1/4"
P/2 = 168"	1 1/2" x 16 GA.	1/2"	1 1/2" x 16 GA.	1/2"	1" x 16 GA.	3/8"	1" x 18 GA.	3/8"
P/2 = 192"	---	1/2"	1 1/2" x 16 GA.	1/2"	1" x 16 GA.	3/8"	1" x 16 GA.	3/8"
P/2 – 193" UP	SPECIAL ANALYSIS REQUIRED							

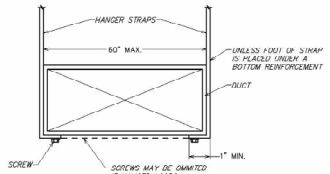
WHEN STRAPS ARE LAP JOINED USE THESE MINIMUM FASTENERS:	SINGLE HANGER MAXIMUM ALLOWABLE LOAD	
	STRAP	WIRE OR ROD (DIA.)
1" x 18, 20, 22 GA. – TWO #10 OR ONE 1/4" BOLT 1" x 16 GA. – TWO 1/4" DIA. 1" x 16 GA. – TWO 3/8" DIA. PLACE FASTENERS IN SERIES, NOT SIDE BY SIDE.	1" x 22 GA. – 260 LBS. 1" x 20 GA. – 320 LBS. 1" x 18 GA. – 420 LBS. 1" x 16 GA. – 700 LBS. 1 1/2" x 16 GA. – 1100 LBS.	0.106" – 80 LBS. 0.135" – 120 LBS. 0.162" – 160 LBS. 1/4" – 270 LBS. 3/8" – 680 LBS. 1/2" – 1250 LBS. 5/8" – 2000 LBS. 3/4" – 3000 LBS.

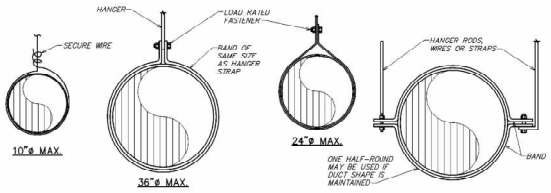
NOTES:
1. DIMENSIONS OTHER THAN GAUGE ARE IN INCHES.
2. TABLES ALLOW FOR DUCT WEIGHT 1 LB./SF INSULATION WEIGHT AND NORMAL REINFORCEMENT AND TRAPEZE WEIGHT, BUT NO EXTERNAL LOADS.
3. SYMBOLS ARE GALVANIZED STEEL. ALUMINUM MAILMEALS ARE UNCOATED STEEL.
4. ALLOWABLE LOADS FOR P/2 ASSUME THAT DUCTS ARE 16 GA. MAXIMUM, EXCEPT THAT WHEN MAXIMUM DUCT DIMENSION (W) IS OVER 60" THEN P/2 MAXIMUM IS 1.25 W.
5. 12, 10 OR 8 GA. WIRE IS STEEL OF BLACK ANNEALED, BRIGHT BASIC OR GALVANIZED TYPE.
6. DUCTS SHALL BE SUPPORTED AT INTERVALS NOT EXCEEDING 10 FEET.

8 RECTANGULAR DUCT HANGER TABLE
NOT TO SCALE



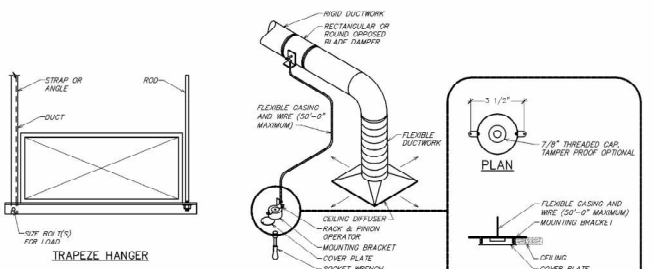
11 HOOD FASTENING DETAIL
NOT TO SCALE



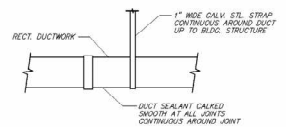


NOTE: HANGERS MUST NOT DEFORM DUCT SHAPE

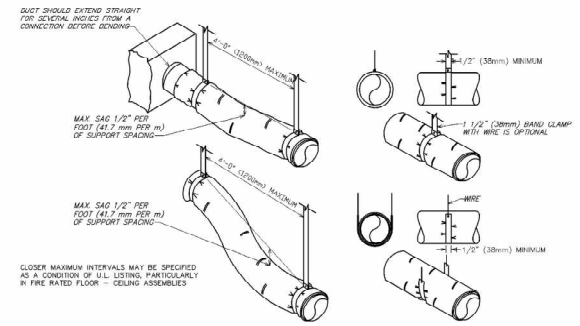
6 DUCT HANGER DETAIL
NOT TO SCALE



3 REMOTE VOLUME DAMPER CONTROLLER
NOT TO SCALE



4 EXPOSED RECTANGULAR DUCT SUPPORT DETAIL
NOT TO SCALE



2 FLEXIBLE DUCT SUPPORTS
NOT TO SCALE

Bergmeyer
www.bergmeyer.com
CO
LA
BOS

CONSULTANTS:

Schnackel engineers
New York • Miami • Cincinnati • Los Angeles • Seattle • Honolulu
MEP/ ENGINEER
9020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER GREGORY ROY SCHNACKEL No. M33098 STATE OF CALIFORNIA
Date: 08/01/25

NO	BY	DATE	DESCRIPTION
	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2024-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

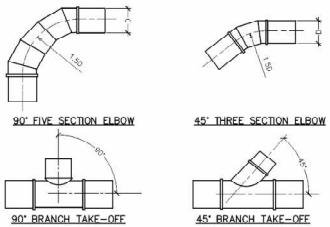
1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

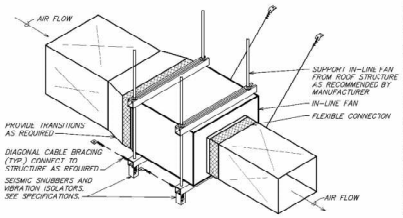
MECHANICAL DETAILS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245548.00

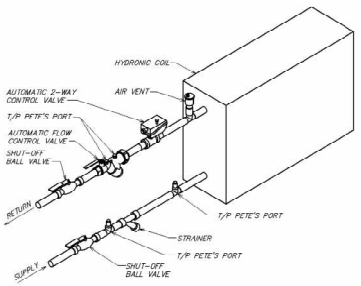
M501



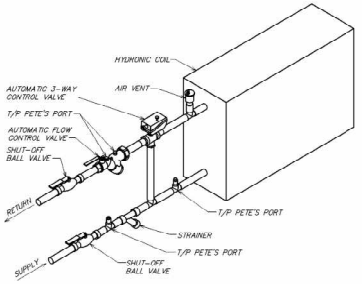
6 TYPICAL ROUND DUCT FITTINGS
NOT TO SCALE



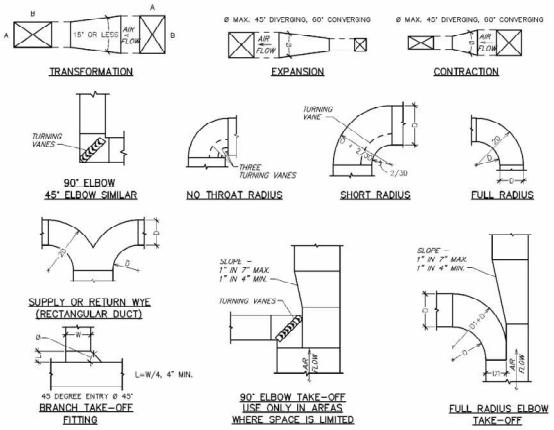
7 IN-LINE FAN DETAIL
NOT TO SCALE



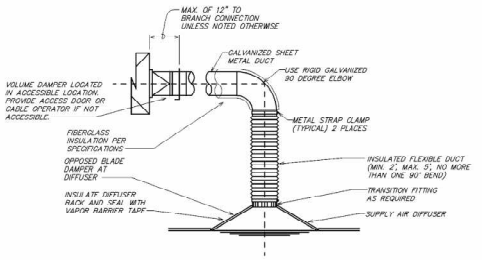
4 HYDRONIC COIL CONNECTION 2 WAY
NOT TO SCALE



5 HYDRONIC COIL CONNECTION 3 WAY
NOT TO SCALE

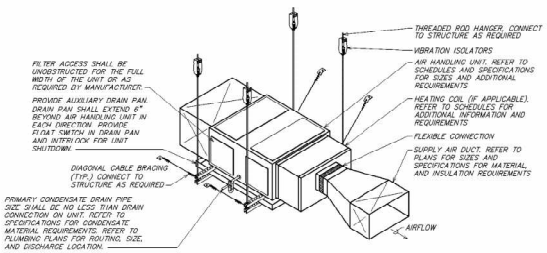


1 DUCTWORK DETAILS
NOT TO SCALE



SEISMIC REQUIREMENTS:
– ATTACH ALL CEILING AIR TERMINALS SHALL BE SUPPORTED DIRECTLY BY THE CEILING MAIN RUNNERS OR BY SUPPLEMENTAL FRAMING WHICH IS SUPPORTED BY MAIN RUNNERS AND POSITIVELY ATTACHED WITH SCREWS OR OTHER APPROVED CONNECTORS.
– SURFACE MOUNTED FIXTURES SHALL BE ATTACHED TO A MAIN RUNNER WITH A POSITIVE CLAMPING DEVICE MADE OF MATERIAL WITH A MINIMUM OF 14 GAGE. ROTATIONAL SPRING CLAMPS DO NOT COMPLY.

2 TYPICAL DIFFUSER–DRYWALL CEILING–SEISMIC
NOT TO SCALE



NOTES:
1. DUCT SMOKE DETECTOR SHALL BE MOUNTED AND INSTALLED PER LOCAL CODE REQUIREMENTS.

3 TYPICAL HORIZONTAL AHU DETAIL
NOT TO SCALE

Bergmeyer
www.bergmeyer.com
LA
CO
BOS
CONSULTANTS:
Schnackel engineers
MEP/ FP ENGINEER
9020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7660

SEAL/ SIGNATURE:

NO	BY	DATE	DESCRIPTION
1	GRS	2023-09-27	ADDENDUM 6
2	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

MECHANICAL DETAILS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.00

M502

SPECIFICATIONS TABLE OF CONTENTS

SECTION 230000 – HVAC GENERAL CONDITIONS

PART 1 GENERAL

1.01 APPLICABILITY
A. This section supplements all sections of the Specifications for Division 23 and shall apply to all phases of work hereinafter specified, shown on the Drawings, or required to provide a complete installation of approved HVAC systems.

1.02 DEFINITIONS
A. "Work" is hereby defined as, "The construction and services required by the Contract Documents whether completed or partially completed and includes all labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The work may constitute the whole or a part of the project."
B. "Furnish", is hereby defined as, "To supply and deliver, unload, and inspect for damage."
C. "Install" is hereby defined as, "To unpack, assemble, erect, apply, place, finish, protect, clean, condition, and adjust for proper operation."
D. "Provide", is hereby defined as, "To furnish and install."
E. "Connect" is hereby defined as, "To bring service to the equipment and make final attachment including necessary ductwork, piping, wiring, etc."
F. "Concealed" is hereby defined as, "Hidden from sight in chases, furred spaces, shafts, hung ceilings, enclosed in construction, in crawl spaces, or buried."
G. "Exposed" is hereby defined as, "Not installed underground nor concealed as defined by the Specifications."
H. "Drawings" is hereby defined as, "All plans, details, equipment schedules, diagrams, sketches, etc. issued for the construction of the work."

1.03 CODES AND STANDARDS
A. Perform work in accordance with the applicable Building Code, Electrical Code, Fire Code, Mechanical Code, Plumbing Code, Energy Code, and all other applicable codes, ordinances, and ordinances. Also perform all work in accordance with the Americans with Disabilities Act (ADA) and the Authority Having Jurisdiction (AHJ) including the Fire Marshal.
B. Perform work in accordance with Landlord requirements, including any Tenant Criteria Manuals and Leases Exhibits, where applicable.
C. Perform work in accordance with the applicable utility companies serving the project. Make all arrangements with the utility companies for proper coordination of the work.
D. Recognized Standards: Design, manufacture, testing and method of installation of all apparatus and materials furnished under the requirements of these Specifications shall conform to the latest publications or standard rules of Underwriters Laboratories, Inc. (U.L.), American Society for Testing and Materials (ASTM), American National Standards Institute (ANSI), and National Electrical Code (NEC), National Fire Protection Association (NFPA), American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), and the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
E. The Contract Documents shall take precedence where the Contract Documents exceed code, Landlord, utility, or recognized standards requirements.

1.04 PERMITS AND FEES
A. Permits, licenses, fees, inspections and arrangements required for the work under this Contract shall be obtained by the Contractor at his expense, unless otherwise indicated.

1.05 CONTRACT DRAWINGS
A. The Contractor is responsible to obtain, fully understand, and coordinate the work with the complete set of Contract Documents. Any required corrections, including all associated costs, arising from issues caused by the Contractor's failure to understand and/or coordinate the work with the complete set of Contract Documents are the Contractor's sole responsibility.
B. Work under these sections is diagrammatic unless indicated otherwise and is intended to convey the scope of work and indicate the general arrangement of equipment. Follow these Drawings in laying out work. Check the Drawings of all the trades and verify measurements for the installation of these materials and equipment. Wherever a question exists as to the exact intended location of ductwork, piping, or equipment, obtain instructions from the Architect before proceeding with the work.
C. Notify the Architect for resolution if a discrepancy is discovered within the Contract Documents. Failure of the Contractor to notify the Architect of discrepancies shall result in the resolution becoming the Contractor's responsibility and subject to the Architect's review and possible rejection. Should the Architect reject a discrepancy resolution of which they were not notified, the Contractor is fully responsible to correct the installation, including all associated costs, until approval of the installation is given by the Architect.

1.06 EXISTING CONDITIONS
A. Verify all existing conditions prior to beginning work.
B. The existing conditions indicated in the Contract Documents are based on information gatherings provided by others and possibly limited field verification. The Contractor shall adjust for actual field conditions at no additional expense to the Owner.
C. The Contractor shall visit the project site, review existing conditions against the Contract Documents, and familiarize himself with the work prior to bidding and start of the work. By signing the Contract, the Contractor acknowledges the site visit has been completed and the existing conditions are accepted.
D. The Contractor shall notify the Architect of major discrepancies in writing so the appropriate modifications to the design can be made without delay to the project. The Contractor assumes full responsibility of adjusting for discrepancies of which the Architect is not informed.

1.07 SUBMITTALS
A. Shop Drawings:
1. Furnish the following submittals to the Architect for review by the Engineer:
a. Provide product data and shop drawings for vibration isolation.
b. Provide balancing firm qualifications and final test report for Testing, Adjusting, and Balancing.
c. Provide product data for duct insulation.
d. Provide product data for grease duct fireproofing (if specified).
e. Provide product data for HVAC piping insulation.
f. Provide product data for hydronic piping.
g. Provide product data and shop drawings for HVAC ductwork.
h. Provide product data for all duct accessories.
i. Provide product data and shop drawings for HVAC power ventilators.
j. Provide product data and shop drawings for air outlets and inlets.
k. Provide product data and shop drawings for air handling and fan coil units.
2. Submittals received later than those listed above will not be reviewed and will be returned stating as such.
3. Shop drawings shall be prepared by a manufacturer's representative, and shall contain names of the manufacturer and cut sheets of equipment to be used on the project. Use manufacturer's specification sheets identified by number indicated on drawings or schedules. Indicate catalog number on the cut sheets. As applicable, provide construction data, weight and dimensional data, voltage ratings, performance data, rating data, pump curves, fan curves and sound data as part of the shop drawing submittal.
4. Submittals are reviewed only for general compliance with the Contract Documents. Dimensions, quantities and details are not checked during submittal review. Review of the submittals does not relieve the Contractor of the responsibility for providing all materials, equipment and accessories necessary for a complete and operational system meeting the requirements of the project and the intent of the Contract Documents. The responsibility for the proper fabrication of materials and equipment lies solely with the submitting Contractor.
5. Electrical Characteristics: Verify that proper power supply is available prior to ordering equipment. Verify power voltage, phase and current rating of power supply and inform Engineer of any deviations prior to order, connection of equipment or start-up. Responsibility for verification of proper power supply voltage and any product returns or damage resulting from incorrect connections shall rest with this Contractor.

B. Test Reports: Provide Testing, Adjusting, and Balancing (TAB) and Commissioning reports to the Architect for review by the Engineer. All other reports shall be provided to the Owner.

1.08 QUALITY ASSURANCE
A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum five years experience.
B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years experience.
C. Products:
1. Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
D. All equipment and components shall be free of all rust/corrosion or any visible damage. All items not complying with this requirement shall be replaced without any change in the Contract amount.
E. Equipment performance and accessories shall be as scheduled on the Drawings and specified herein. Inclusion in bold: locations is not a prerequisite to inclusion in the Contract. Equipment and accessories specified in either location shall be included in the Contract. Provide all necessary accessories and connections as required for a complete, functional system, including all required components reasonably inferred to as necessary although such components may or may not be specifically indicated in the Contract Documents.
F. Specific safety company requirements shall supersede any requirements of this section.

1.09 DELIVERY, STORAGE, AND HANDLING
A. Rooftop Equipment: Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.
B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.
C. Protect dampers and accessories from damage to operating linkages, blades and finishes.
D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
E. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage remove motors from equipment and store separately.

1.10 WARRANTIES
A. Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.
B. Provide one year manufacturer warranty for pumps.
C. Provide three year manufacturers warranty for solid state ignition modules.
D. Provide five year manufacturers warranty for compressors, heat exchangers, condensing units, and electronic air cleaners.

PART 2 PRODUCTS

2.01 SUBSTITUTIONS
A. The manufacturers listed are listed to set minimum standards for quality, design, and functionality. The products of other manufacturers may be submitted, at the Contractor's option, during shop drawing review unless indicated otherwise. The products of other manufacturers shall meet or exceed all requirements of the Contract Documents. The Contractor accepts all responsibility for costs and coordination issues arising out of the substitution of materials or equipment, and the coordination of such substitutions with all other contractors and subcontractors.
B. The Contractor may use any of the following ductwork, piping or insulation materials as listed, provided they are submitted and meet with the approval of all state, local authorities and any utility company requirements. Verification of compliance of the selected material is the sole responsibility of the Installing Contractor.

PART 3 EXECUTION

3.01 COORDINATION OF WORK
A. Examine the Contract Documents as a whole for the work of other trades. Coordinate all work accordingly.
B. Promptly report to the Architect any delay or difficulties encountered in the installation of the work, which might prevent prompt and proper installation, or make it unsuitable to connect with or receive the work of others. Failure to so report shall constitute an acceptance of the work of other trades as being fit and proper to receive the work of this trade.
C. Proc. by cut, and coordinate the work with all trades well enough in advance so that it proceeds with a minimum of interference to work that has not been completed and work that is in progress. Inform all trades of openings required for the work and provide all special frames, sleeves, and anchor bolts required. The HVAC system layout maybe altered to suit the conditions with engineer approval, prior to the installation if any work and without additional cost to the Owner. Conflicts arising from lack of coordination shall be this Contractor's responsibility.
D. Perform all work in conformity with the Contract Documents and afford other trades reasonable opportunity for the execution of their work. Properly connect and coordinate this work with the work of other trades at such time and in such a manner as not to delay or interfere with their work.
E. All roofing penetrations shall be flashed and weather sealed by the roofing manufacturer's authorized roofing contractor at this Contractor's expense. This Contractor shall coordinate with the manufacturer's authorized roofing contractor for the specific roofing system applicable to this project. The use of an unauthorized roofing contractor may result in removal and replacement of the penetration systems at this Contractor's expense.
F. All temperature control wiring, thermostat wiring, damper interlock wiring, control panel interface wiring and miscellaneous low voltage wiring associated with the equipment furnished or installed under this contract shall be furnished and installed by the mechanical contractor or his sub-contractor. All wiring installed under this contract shall be in full compliance with the National Electrical Code, all State and local codes and requirements of the Electrical Specifications for this project.

3.02 EXAMINATION
A. Verify field measurements are indicated on the Drawings.
B. Verify that equipment locations prior to rough-in. Maintain adequate equipment service clearance per manufacturer's recommendations and code.
C. Verify routing of all ductwork and piping in field prior to fabrication or installation. Verify adequate clearance with lighting fixtures, and ceiling heights.
D. Verify that proper fuel and power supply is available for connection.

3.03 INTERFACE WITH OTHER PRODUCTS
A. Install all ductwork, piping, equipment, and accessories to preserve fire resistance rating of partitions and other elements, using materials and methods specified.

3.04 FIELD QUALITY CONTROL
A. Provide tests as necessary to establish the adequacy, quality, safety, completion status, and suitable operation of each system. Tests shall be conducted under the supervision of the Architect.

3.05 CLEANING AND PROTECTION
A. Clean fire suppression parts to remove harmful materials.
B. Clean interior and exterior of HVAC equipment, and accessories of all dirt, debris, soiled insulation, and miscellaneous materials. Follow the manufacturer's recommendations for cleaning as applicable.
C. Repair or replace damaged equipment, pipe and accessories as directed by and to the satisfaction of the Architect, where marring or disfigurement has occurred. All pipes, equipment and accessories shall be new.

3.06 PROJECT CLOSEOUT
A. Project Record Documents: At project closeout, provide one printed copy and one electronic copy of the project record documents to the Owner. Record documents will not be reviewed by the Architect.
B. Record Drawings: Information contained on project record drawings shall include, as a minimum:
1. Actual locations of all equipment, ductwork, air inlets/outlets, accessories, etc.
2. Actual routing of ductwork with sizes and elevations.
3. Actual routing of piping with sizes and elevations and volume dampers.
C. Operation and Maintenance Data: Provide descriptive literature, maintenance and operation data for all hvac equipment, control systems, accessories, and materials used. Include maintenance procedures, intervals, and parts list of each item installed under this contract. Include all manufacturer's guarantees and warranties.
D. Maintenance Materials: At project closeout, furnish to the Owner the following:
1. Two sets of replacement filters for all hvac equipment.
2. The maintenance contract for the hvac system, if applicable.
E. Test Reports: Submit to the Owner all testing reports.

END OF SECTION

SECTION 230548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Vibration Isolators.
B. Seismic restraints.
C. Equipment:
1. Fans, axial and centrifugal
2. Hydronic HVAC units

1.02 SUBMITTALS
A. Product Data: Provide schedule of vibration isolator type with location and load at each.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Isolation Technology, Inc.; Kinetics Noise Control, Inc.; Mason industries.

2.02 VIBRATION ISOLATORS
A. Open Spring Isolators:
1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
3. Seismic Pads: Size for minimum deflection of 0.06 inch; meet requirements for neoprene pad isolators.
4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

B. Restrained Spring Isolators:
1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
2. Spring Mounts: Provide with leveling devices, minimum 0.25 inch thick neoprene sound pads, and zinc chromate plated hardware.
3. Seismic Pads: Size for minimum deflection of 0.06 inch; meet requirements for neoprene pad isolators.
4. Restraint: Provide heavy mounting frame and limit stops.
5. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

C. Closed Spring Isolators:
1. Type: Closed spring mount with top and bottom housing separated with neoprene pad isolators.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance.
4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

D. Restrained Closed Spring Isolators:
1. Type: Closed spring mount with top and bottom housing separated with neoprene pad isolators.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
3. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25 inch clearance and limit stops.
4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

E. Spring Hangers:
1. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection. Color code springs for load carrying capacity.
2. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators or rubber hanger with threaded insert.
3. Units: Air Terminal Units: Air Inlets and Outlets
4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.

F. Neoprene Pad Isolators:
1. Rubber or neoprene waffle pads.
a. Minimum Size: 12 inches square.
b. Thickness: Minimum 1/2 inch.
c. Maximum Loading: 50 psi.
d. Rib Height: Maximum 0.7 times width.
2. Configuration: Single layer.

G. Rubber Mount or Hanger: Molded rubber designed for 0.4 inch deflection with threaded insert.

H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

2.03 SEISMIC RESTRAINTS
A. Type: Non-directional and double acting unit consisting of interlocking steel members resistant to corrosion.
B. Elements: Replaceable neoprene, minimum of 0.75 inch thick with minimum 1/8 inch dir grid.
C. Capacity: 4 times load assigned to mount groupings at 0.4 inch deflection.
D. Attachment Plate: Design and actual (if applicable)
1. Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
C. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shims removal.
D. Provide flexible connections on all piping and ductwork connections to equipment. Refer to other sections of this Specification for the acceptable types of flexible connectors to be used.
E. Selection of type, thickness and detection of vibration isolation shall be by the vibration control manufacturer based on the specific equipment type and size, as scheduled on the Drawings and indicated.
F. Noise Transmission: Provide isolation for piping, and ductwork mounted on isolators. Each hanger/support shall have a minimum of four seismic snubbers located close to isolators. Snub equipment designated for post-disaster use to 0.125 inch maximum clearance. Other snubbers shall have clearance between 0.13 inch and 0.25 inch.

3.02 SCHEDULES
A. Equipment Isolation Schedule: (Minimum deflection as sized by the isolation equipment manufacturer.)
1. Fans, axial and centrifugal:
a. Small fans up to 25" diameter wheel: Rubber Mount or Hanger
2. Hydronic HVAC equipment:
a. Floor mounted (all locations):
1. Base: Concrete housekeeping Pad.
2. Isolation, 5 ton capacity and smaller: Pad, Rubber Mount or Glass Fiber Pad.
3. Isolation, 6 ton capacity and larger: Spring: Open or Closed.
b. Suspended 3.5 ton capacity and smaller:
1. Isolation: Rubber Hanger.
c. Suspended 3.5 ton capacity and larger:
1. Isolation: Spring Hanger, Open or Closed.

END OF SECTION

SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Testing, adjustment, and balancing of air systems:
1. Air handling units: Packaged heating and/or cooling equipment; Fans. (Exhaust and supply); Coils; Terminal equipment: Air inlets and outlets. (Diffusers, grilles, louvers, etc.)
B. Testing, adjustment, and balancing of hydronic systems:
1. Pumps; Boilers; Coils; Heat exchangers; Terminal equipment.
C. Measurement of final operating condition of HVAC systems.
D. Noise measurements.

1.02 SUBMITTALS
A. Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract. Provide TAB Agency qualifications.
B. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Submit to the Construction Manager within two weeks after completion of testing, building, and balancing.
2. Provide reports in bound manuals, complete with index page and indexing tabs, with cover identification at front and spine edge. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat and equipment locations.
3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports: Where the TAB standard being followed recommends a report format use this; otherwise, follow ASHRAE Std 111.
5. Include the following on the title page of each report:
a. Name, address and telephone number of testing, Adjusting, and Balancing Agency.
b. Project: Name; location; Engineer; Contractor, Report date.

1.03 WARRANTY
A. The Balancing Contractor shall be prepared to return to the site at no additional cost to re-adjust air quantities as required by unusual weather temperatures, eliminate drafts and objectionable noises during the first year of occupancy, maximum. All pipes, equipment and accessories shall be new.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS
A. Perform total system balance in accordance with one of the following:
1. AABC MN-11, AABC National Standards for total system balance.
2. NEBB Procedural Standards for Testing, Adjusting and Balancing of Building Heating, Ventilation, Air Conditioning, and Refrigeration Systems.
3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
4. SMACNA HVAC Systems Testing, Adjusting, and Balancing.
B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the Project.
C. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
D. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this Section with a minimum of five years experience.
2. Certified by one of the following:
a. AABC, Associated Air Balance Council; upon completion submit AABC National Performance Guaranty.
b. NEBB, National Environmental Balancing Bureau.
c. TABB, The Testing, Adjusting, and Balancing Bureau of National Energy Management Institute.
3. The TAB Agency must be a completely independent, third party balancing contractor with no financial, common owners or other ties to the installing contractors.
E. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 ADJUSTMENT TOLERANCES
A. Air Handling Systems; Air Outlets and Inlets; Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.03 RECORDING
A. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
B. Mark on the Drawings the locations where test and other critical measurements were taken and cross reference the location in the final report.

3.04 AIR SYSTEM PROCEDURE
A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.
B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
C. Measure air quantities at air inlets and outlets.
D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
E. Use volume control devices to regulate air quantities only to extend their adjustments do not create objectionable air motion or sound levels. If duct volume dampers do not provide sufficient control, provide additional dampers at no cost.
F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required at no additional expense to the Owner. Vary branch air quantities by damper regulation.
G. Measure static air pressure conditions at supply air units, including filter and coil pressure drops, and take pressure across the following: Make allowances for 50 percent loading of filters.
H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions in all operating modes as indicated in the sequence of control.
I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
J. Where modulating dampers are provided, take measurements and balance at extreme conditions. Record settings for extreme conditions indicated in the sequence of control. Balance variable volume systems for maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

3.05 WATER SYSTEM PROCEDURE
A. Adjust water systems to provide required or design quantities.
B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on pressure difference across various heat transfer elements in the system.
C. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
D. Effect system balance with automatic control valves fully open to heat transfer elements.
E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use throttling valves or shut-off valves for balancing unless indexed for balance point.
F. Where available pump capacity is less than total flow requirements or individual system points fall low in any part may be simulated by temporary restriction at flow to other parts.

3.06 SCOPE
A. Equipment Requiring Testing, Adjusting, and Balancing (if present on the project):
1. HVAC Pumps; Boilers; Air Handling Equipment; Air Packaged heating and/or Cooling Equipment; All Coils; All Heat Exchangers; Terminal Heat Transfer Units; Air Terminal Units; Air Inlets and Outlets

3.07 MINIMUM DATA TO BE REPORTED
A. Report (as applicable to the project):
1. Summary Comments:
a. Design vs. final performance
b. Notable characteristics of system
c. Summary of outdoor and exhaust flows to indicate amount of building pressurization
d. Nomenclature used throughout report and test conditions.
B. Electric Motors and drives:
1. Manufacturer; Model/Frame; HP/BHP; Phase, voltage, amperage; nameplate, actual, no load; RPM; Service factor; Sheave Make/Size/Bore
2. V-Belt Drives: Identification/location: Required driver RPM; Driven sheave, diameter and RPM; Belt, size and quantity.
C. Cooling and Heating Coils:
1. Identification/number; Manufacturer
2. Air flow, design and actual
3. Air pressure drop, design and actual
4. Entering and leaving air DB and WB temperature, design and actual
5. Water flow rate, design and actual (if applicable)
6. Water pressure drop, design and actual (if applicable)
7. Entering and leaving water temperature, design and actual (if applicable)
D. Air Moving Equipment:
1. Manufacturer; Model number; Serial number; Arrangement/Class/Discharge
2. Air flow, specified and actual
3. Inlet; Discharge; Total static pressure (total external), specified and actual
E. Air Distribution Tests:
1. Air terminal number
2. Room number/location
3. Terminal type
4. Terminal size
5. Area factor
6. Design velocity
7. Design air flow
8. Test (final) velocity
9. Test (final) air flow
10. Percent of design air flow
F. Terminal Unit Data:
1. Manufacturer
2. Type, constant, variable, single, dual duct
3. Identification/number
4. Model number
5. Size
6. Minimum static pressure
7. Minimum design air flow
8. Maximum design air flow
9. Maximum actual air flow
10. Inlet static pressure.

END OF SECTION

SECTION 230713 – DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Duct Insulation.
B. Duct liner.
C. Insulation jackets.
D. Supply, return or exhaust ducts in ceiling spaces.
E. Supply, return or exhaust ducts in interior unconditioned areas.
F. Supply, return or exhaust ducts in exposed locations.
G. Outside air intake ducts.

1.02 FIELD CONDITIONS
A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION
A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/90, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
B. Manufacturer: Insulation Owens Corning; Johns Manville Corporation; Thermo Corning Corp.; CertainTeed Corporation.

2.02 GLASS FIBER, FLEXIBLE
A. Insulation: ASTM C 553; flexible, noncombustible blanket.
1. "K" value: 0.31 at 75 degrees F, when tested in accordance with ASTM C 518.
2. Maximum Service Temperature: 450 degrees F.
3. Maximum moisture absorption: 5.0 percent by weight.
B. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.025 perm/inch Vap/Pu s in (0.02 perm inch), when tested in accordance with ASTM E 96/E 96M.
3. Secure with pressure sensitive tape.
C. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
D. Outdoor Vapor Barrier Mastic:
1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
E. Tie Wire: Annealed steel, 16 gage.

2.03 DUCT LINER
A. Insulation: Inorganicglass glass fiber complying with ASTM C 1071, flexible blanket, factory applied, and preformed round liner board, impregnated surface and edges coated with acrylic polymer shown to be fungus and bacteria resistant by testing to ASTM G 21 and G 22.
1. Thickness: 1 inch.
2. Service Temperature: Up to 250 degrees F.
3. Maximum Velocity on Exterior Side for Fire Erosion: 5,000 fpm, minimum.
4. Minimum Noise Reduction Coefficients:
a. 1/2 Inch Thickness: 0.30.
b. 1 Inch Thickness: 0.45.
c. 1-1/2 Inch Thickness: 0.60.
d. 2 Inch Thickness: 0.70.
B. Adhesive: Waterproof, fire-retardant type.
C. Liner Fasteners: Galvanized steel, self-adhesive pad or impact applied with integral, or press-on head.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions and NAIMA National Insulation Standards.
B. Insulated ducts conveying air below ambient temperature:
1. Provide insulation with vapor barrier jackets.
2. Finish with tape and joint sealer.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
C. Insulated ducts conveying air above ambient temperature:
1. Provide insulation with vapor barrier jackets.
2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
D. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
2. Secure insulation without vapor barrier with staples, tape, or wires. Install without sag on underside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
3. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
4. Stop and paint insulation around access doors and damper operators to allow operation without disturbing wrapping.
E. Duct and Plenum Liner Application:
1. Secure liner to duct with adhesive for 90 percent coverage.
2. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards – Metal and Flexible for spacing.
3. Seal end and transverse joints. Seal cost and transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Install duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.02 SCHEDULES
A. The Contractor may use any of the following insulating materials, at his option, provided the selected material meets with the approval of all State, local authorities and utility company requirements. Verification of compliance of the selected insulating material and thickness with all State and local codes and utility company requirements is the sole responsibility of the installing Contractor.
B. Supply air ducts in ceiling spaces:
1. Flexible Glass Fiber Duct Insulation: 1-1/2 inches thick.
2. Flexible Glass Fiber Duct Liner Insulation: 1 inches thick.
C. Supply, return or exhaust air ducts in equal spaces, attics or other unconditioned areas:
1. Flexible Glass Fiber Duct Insulation: 3 inches thick.
D. Supply air ducts exposed in finished rooms:
1. Flexible Glass Fiber Duct Liner Insulation: 1 inches thick.
E. Return or exhaust air ducts exposed in finished rooms: None.
F. Outside air intake ducts (unterspaced):
1. Flexible Glass Fiber Duct Insulation: 1-1/2 inches thick.
2. Rigid Glass Fiber Duct Insulation: 1-1/2 inches thick.
3. Flexible Glass Fiber Duct Liner Insulation: 1 inches thick.
4. Rigid Glass Fiber Duct Liner Insulation: 1 inches thick.
G. Outside air intake ducts (semi-conc.):

END OF SECTION

SECTION 230719 – HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Heating hot water piping insulation.
B. Chilled water piping insulation.
C. Cooling condensate drain piping insulation.

PART 2 PRODUCTS

2.01 REQUIREMENTS FOR ALL PRODUCTS OF THIS SECTION
A. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
B. The Contractor may use any of the following insulating/jacketing materials, at his option, provided the selected material meets with the approval of all State, local authorities and utility company requirements. Verification of compliance of the selected insulating/jacketing material is the sole responsibility of the installing Contractor.

2.02 GLASS FIBER
A. Manufacturers: Knauf Insulation; Johns Manville Corporation; Owens Corning Corp.; CertainTeed Corporation; Schuller International.
B. Insulation: ASTM C 547 and ASTM C 795; rigid molded, noncombustible.
1. "K" value: ASTM C 177, 0.24 at 75 degrees F.
2. Maximum service temperature: 850 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.
C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film, low permeance, complying with ASTM E 96/E 96M Service factor; Sheave Make/Size/Bore.
1. Water Vapor Permeance: 0.02 perm or less.
2. Secure with self-sealing longitudinal laps and butt strips.
D. Adhesive: Compatible with insulation.
E. Insulating Cement/Mastic: ASTM C 195; hydraulic setting on mineral wool.
F. Field-Applied Jacket:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Adhesive: 1.5 lb/sq ft density.
3. Primer: As recommended by insulation manufacturer.
G. Weather Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.
H. Insulating Cement: ASTM C 449/C 449M.

2.03 FLEXIBLE ELASTOMERIC CELLULAR INSULATION
A. Manufacturer: Armacell International.
B. Insulation: Preformed flexible elastomeric cellular rubber insulation comprising with ASTM C 534 Grade 3, use molded tubular material wherever possible.
1. Minimum Service Temperature: –40 degrees F.
2. Maximum Service Temperature: 220 degrees F.
3. Connection: Waterproof vapor barrier adhesive.
C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

2.04 JACKETS

1	GRS	2025-09-30 ADDENDUM A
	GRS	2025-09-04 IFC
	GRS	2025-02-20 PERMIT/BID SET
NO.	BY	DATE DESCRIPTION

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #16325

IFC SET

MECHANICAL SPECIFICATIONS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30261549.01

M590

Bergmeyer
CO
1 Beacon St, 15th Floor, Boston, MA 02108
T 617.939.1100
LA
1055 West 7th St, Suite 2260, Los Angeles, CA 90017
T 213.533.1484
BOS
1 Beacon St, 15th Floor, Boston, MA 02108
T 617.939.1100
www.bergmeyer.com

CONSULTANTS:

Schnackel engineers
New York • Atlanta • Cincinnati • Los Angeles • Berkeley • Honolulu
510-841-0982 www.schnackel.com
MEP/ ENGINEER
3033 S 72ND ST
OMAHA NE 68124
TEL 402.391.7680

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER – GREGORY ROY SCHNACKEL – No. M33090 – STATE OF CALIFORNIA
Date: 08/01/25

A. PVC Plastic.
1. Manufacturers: Knauf Fiber Glass; Johns Manville Corporation; Owens Corning Corp.; CertainTeed Corporation.
2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: 0 degrees F.
b. Maximum Service Temperature: 150 degrees F.
c. Maximum Vapor Permeability: 0.02 perm inch, maximum, when tested in accordance with ASTM E 96/E 96M.
d. Thickness: 10 mil.
e. Connections: Brush on welding adhesive.
3. Covering Adhesive Mastic: Compatible with insulation.

B. ABS Plastic.
1. Jacket: One piece molded type fitting covers and sheet material, off-white color.
a. Minimum Service Temperature: -10 degrees F.
b. Maximum Service Temperature of 180 degrees F.
c. Moisture Vapor Permeability: 0.012 perm inch, when tested in accordance with ASTM E 96/E 96M.
d. Thickness: 30 mil.
e. Connections: Brush on welding adhesive.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install in accordance with NAIMA National Insulation Standards.
C. Inserts and Shields:
1. Applications: Piping 2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and insert.
3. Insert location: Between support shield and piping and under the finish jacket.
4. Insert configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
5. Insert material: Hydrous calcium silicate insulation or other heavy density insulation suitable for the piping and temperature range.
D. Continue insulation through walls, floors and other openings, except active pipe penetrations. Finish at supports, protrusions, and interruptions.

3.02 SCHEDULE
A. Heating Systems:
1. Heating Water Supply and Return:
a. Glass Fiber Insulation:
1. Pipe Size Range: Up to 1 1/2 inch:
a. Thickness: 1 1/2 inch.
2. Pipe Size Range: 2 inch and larger:
a. Thickness: 2 inch.
B. Cooling Systems:
1. Chilled Water:
a. Glass Fiber Insulation:
1. Pipe Size Range: Up to 1 1/2 inch:
a. Thickness: 1 inch.
2. Pipe Size Range: 2 inch and larger:
a. Thickness: 1 1/2 inch.
b. Flexible Elastomeric Cellular Foam Insulation:
1. Pipe Size Range: Up to 1 1/2 inch:
a. Thickness: 1 inch.
2. Pipe Size Range: 2 inch and larger:
a. Thickness: 1 1/2 inch.
9 Cold Condensate Drains
a. Glass Fiber Insulation:
1. Pipe Size Range: All Sizes.
a. Thickness: 1/2 inch.
b. Flexible Elastomeric Cellular Foam Insulation:
1. Pipe Size Range: All Sizes.
a. Thickness: 1/2 inch.

END OF SECTION

SECTION 230800 - COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY
A. Commissioning to be completed by National Test and Balance. Coordinate with Will Turnbaugh at 314-854-6224 or will @ nationaltab.com
B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system shall participate in the commissioning process. Responsibilities for the commissioning activities relating to that system or equipment item.
C. The Commissioning Authority (CA) directs and coordinates all commissioning activities and provides Pre-functional Checklists and Functional Test Procedures for Contractor's use.
D. The entire HVAC system is to be commissioned, including commissioning activities for the following specific items:
1. Control system.
2. Major and minor equipment items.
3. Piping systems and equipment.
4. Ductwork and accessories.
5. Terminal units.
6. Sound control devices.
7. Vibration control devices.
8. Variable frequency drives.
9. Air distribution systems, pressurization, exhaust, etc.
10. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
11. Indoor Air Quality Procedures: The Commissioning Authority will coordinate Contractor will execute; see Section 01 5719.
E. The Pre-functional Checklist and Functional Test requirements specified in this section are in addition to, not a substitute for, inspection or testing specified in other sections.

1.02 RELATED REQUIREMENTS
A. Section 23 0993 – Sequence of Operations for HVAC Controls.
B. Section 23 0593 – Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS
A. ASHRAE Guideline 1.1 – The HVAC Commissioning Process, 2012.

1.04 SUBMITTALS
A. Updated Submittals: Keep the Commissioning Authority informed of all changes to control system documentation made during programming and setup, revise and resubmit when substantial changes are made.
B. DRAFT Pre-functional Checklists and Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, shakedown and adjust the control system prior to full system Functional Testing; include at least the following for each type of equipment controlled:
1. System name.
2. List of devices.
3. Step-by-step procedures for testing each controller after installation, including:
a. Process of verifying proper hardware and wiring installation.
b. Process of downloading programs to local controllers and verifying that they are addressed correctly.
c. Procedure of performing operational checks of each controlled component.
d. Plan and process for calibrating valve and damper actuators and all sensors.
e. Description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
4. Copy of proposed log and field checkout sheets to be used to document the process; include space for initial and final read values during verification of each point and space to specifically indicate when a sensor or controller has "passed" and is operating within the contract parameters.
5. Description of the instrumentation required for testing.
6. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the Commissioning Authority and TAB contractor for this determination.
C. Startup Reports, Pre-functional Checklists, and Trend Logs: Submit for approval of Commissioning Authority before use.
D. HVAC Control System O&M Manual Requirements: In addition to documentation specified elsewhere, compile and organize at minimum the following data on the control system:
1. Specific step-by-step instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. Provide an index and clear table of contents. Include the detailed technical manual for programming and customizing control loops and algorithms.
2. Full up-built set of control drawings.
3. Full as-built sequence of operations for each piece of equipment.
4. Full points list; in addition to the information on the original points list submittal, include a listing of all rooms with the following information for each room:
a. Building.
b. Room number.
c. Room name.
d. Air handler unit ID.
e. Terminal device number.
f. Air terminal unit tag ID.
g. Heating and/or cooling valve tag ID.
h. Minimum air flow rate.
i. Maximum air flow rate.
5. Full print out of all schedules and set points after testing and acceptance of the system.
6. Full as-built print out of software program.
7. Electronic copy on disk of the entire program for this facility.
8. Marking of all system sensors and thermostats on the as-built floor plan and in the schematic drawings of the control system designations.
9. Maintenance and troubleshooting sensor calibration requirements and methods by sensor type, etc.
10. Control equipment component submittals, parts lists, etc.
11. Warranty requirements.
12. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
13. Organize and subdivide the manual with permanently labeled tabs for each of the following data in the given order:
a. Sequences of operation.
b. Control drawings.
c. Points lists.
d. Controller and/or module data.
e. Thermostats and timers.
f. Sensors and DP switches.
g. Control valves and valve actuators.
h. Dampers and damper actuators.
i. Program setups (software program printouts).

F. Project Record Documents:
1. Submit updated version of control system documentation, for inclusion with operation and maintenance data.
2. Show actual locations of all static and differential pressure sensors (air, water and building pressure) and all flow stations on project record drawings.

F. Draft Training Plan:
1. Follow the recommendations of ASHRAE Guideline 1.1.
2. Control system manufacturer's recommended training.
3. Demonstration and instruction on function and overrides of any local packaged controls not controlled by the HVAC control system.

G. Training Manuals:
1. Provide three extra copies of the controls training manuals in a separate manual from the O&M manuals.

H. Submittals are reviewed only for general compliance with the Contract Documents. Dimensions, quantities and details are not checked during submittal review. Review of submittals by the Commissioning Authority or Contractor of the responsibility for providing all materials and equipment and constructing systems and performing and operational system meeting the requirements of the project and the intent of the Contract Documents. The responsibility for coordination of substituted materials and equipment lies solely with the substituting Contractor.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT
A. Provide all standard testing equipment required to perform startup and initial checkout and receipt functional performance testing; unless otherwise noted such testing equipment will NOT become the property of Owner.
B. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.

PART 3 EXECUTION

3.01 PREPARATION
A. Cooperate with the Commissioning Authority in development of the Pre-functional Checklists and Functional Test Procedures.
B. Furnish additional information requested by the Commissioning Authority.
C. Prepare a preliminary schedule for HVAC pipe and duct system testing, flushing and cleaning, equipment start up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update the schedule as appropriate.
D. Notify the Commissioning Authority when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing and other commissioning activities not yet performed is ready so as-not-to-delay construction; testing ahead of schedule is not a grounds for a change order and will delay construction. Testing ahead of schedule is grounds for a finding that the Commissioning Authority has the scheduling information needed to efficiently execute the commissioning process.
E. Put all HVAC equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
1. Include coat of sheaves and belts that may be required for testing, adjusting, ad balancing.
F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; plug with an approved plug.
G. Provide temporary pressure taps in accordance with the Contract Documents.

3.02 INSPECTING AND TESTING – GENERAL
A. Submit startup forms, reports, and Pre-functional Checklists for each item before the item is ready to be commissioned; do not request that the Commissioning Authority perform the functional tests directed by the Commissioning Authority for each item of equipment or system until the Contractor's own testing is complete.
B. Provide two-way radios for use during the testing.
C. Provide Owner Orientation, Startup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and actuator output has been signed as required.
4. Command valve/damper open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. Verify proper operationalities of Normally Open or Normally closed positions of all valves/dampers by means of temporarily removing the sensing hose plug removal of actuator to confirm proper closure or opening upon failure of power or control signal.
7. Perform valve/damper leakage tests on all dampers in the system during normal operating pressure with the valve/damper in the closed position and measure against the data T sensors specified in the sequences to confirm compliance with specification requirements for dampers and zero leakage for valves.
B. If actual valve/damper position does not reasonably correspond, replace actuator.
9. Closure for Heating Coil Valves – Normally Open:
a. Set heating setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe valve open.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set heating setpoint to 20 degrees F (11 degrees C) below room temperature.
f. Observe the valve close.
g. For pneumatics, by override in the control system, increase pressure to valve by 3 psi (20 kPa) (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change.
h. Restore to normal.
10. Closure for Cooling Coil Valves – Normally Closed:
a. Set cooling setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe the valve close.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set cooling setpoint to 20 degrees F (11 degrees C) below room temperature.
f. Observe valve open.
g. For pneumatics, by override in the control system, increase pressure to valve by 3 psi (20 kPa) (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change.
h. Restore to normal.

E. Coil Valve Leak Tests:
1. Method 1 – Water Temperature With 2-Way Valve:
a. Calibrate water temperature sensors on each side of coil to be within 0.2 degree F. (0.1 degree C.) of each other.
b. Turn off air handler fans; shut down outside air dampers. Keep pump running.
c. Command valve to closed position and verify valve are open.
d. Observe the sensors and record temperature.
e. Override normally open valves to the closed position.
f. After 10 minutes observe water delta T across coil. If it is greater than 2 degrees F (one degree C), leakage is probably occurring. Read zero stroke to close tighter.
g. Repeat test until compliance is achieved.
2. Method 2 – Temperature With 2 or 3-Way Valve: Water leak-by less than 10 percent will likely not be detected with this method.
a. Calibrate air temperature sensors on each side of coil to be within 0.2 degree F. (0.1 degree C.) of each other.
b. Air handler fans should be on.
c. Chang mixed air discharge air setpoint, override values or bleed or square box pneumatic controller so that the valve is open.
d. After 3 minutes observe air delta t across coil. If it is greater than 2 degrees F (one degree C), leakage is probably occurring.
e. Read valve stroke to close tighter.
f. Repeat test until compliance is achieved.
3. Method 3 – Coil Drain Down – Not for 3-way valves.
a. Put systems in normal mode.
b. If cooling coil valve, remove all coil for cooling; if heating coil valve, put system in full cooling.
c. Close isolation valve on supply side of coil, open air bleed port, open drain-down cock and drain water from coil.
d. If water does not stop draining, there may be a leak through the control valve.
e. Return all to normal when done.

F. Isolation Valve or Setaver Valve Leak Checks: For valves not by coils.
1. With full pressure on the system, measure at each side of valve to determine if there is any leakage.
2. Use an ultra-sonic flow meter to detect flow or leakage.
G. Defective Valves: Where valves are found to leak in excess of the allowable, or, with respect to re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION:
A. TAB: Testing, adjusting, and balancing of HVAC.
B. Coordinate commissioning schedule with TAB schedule.
C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Pre-functional Checklists, calibrations, startup and component functional tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
F. Provide a qualified control system technician to operate the controls to assist the TAB technicians; provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING
A. Pre-functional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submitted.
B. Do not start Functional Testing until all controlled components have themselves been successfully functionally tested in accordance with the Contract Documents.
C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
D. Functional Testing if the control system constitutes demonstration and trend logging of control points monitored by the control system.
1. The control system shall be capable of providing trend log up to 50 percent more points than listed in the points list at no extra cost to Owner.
2. Perform all trend logging specified in the Sequences of Operations and Checklists and submit files.
E. Functionality Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including all interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
1. Setpoint changing features and functions.
2. Sensor calibrations.
G. Demonstrate to the Commissioning Authority:
1. That all specified functions and features are set up, debugged and fully operable.
2. That scheduling features are fully functional and setup, including holidays.
3. That all graphic screens and value readouts are completed.
4. Correct date and time setting in control computer.
5. That field points read the same time on the control computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
6. Functionality of field panels using local operator keypads and local ports (play-by) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
7. Power failure and battery backup and power-up restart functions.
8. Global commands functions.
9. Security and access codes.
10. Occupant over-rides (manual, telephone, key, keypad, etc.).
11. O&M schedules and alarms.
12. Occupancy sensors and controls.
13. "After hours" use tracking and billing.
14. Communications to remote sites.
15. Fire alarm interlocks and response.
16. Fire and smoke damper compression systems interfaces.
17. Security system interfaces.
18. That points that are monitored only, having no control function, are operating properly for the control system.
19. All control strategies and sequences not tested during controlled equipment testing.
20. Trend logging and graphing features that are specified.
21. Other integrated tests specified in the Contract Documents.
22. That control system features that are included but not specified to be setup are actually installed.

H. Perform and submit trend logging on the following using the control system showing minimum period of 5 days including one weekend; if the control points are monitored by the control system:
1. Duty cycling, if specified.
2. Demand limiting, including over-ride of limiting.
3. Optimum start/stop; if operational optionally demonstrate manually.
4. Optimum start-stop functions.
5. Miscellaneous equipment current or status for duty cycling and demand limiting.
6. Equipment or building kW or current for demand limiting.
7. Equipment optimum start/stop functions.

I. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS
A. Add design intent documentation furnished by Engineer to manuals prior to submission to Owner.
B. Submit manuals related to items that were commissioned to Commissioning Authority for review before final submittal to Owner.
C. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING
A. Demonstrate operation and maintenance of HVAC system to Owner personnel: If during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
B. These demonstrations are in addition to, and not a substitute for, Pre-functional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
C. Provide classroom and hands-on training of Owner's designated personnel on operation of the HVAC system. The scope of training shall match that of equipment items included in the Contract Documents, including but not limited to those listed in this Section and those listed in other Sections.
1. Provide training in the operation and maintenance of each item of equipment and each system, including any special maintenance requirements and procedures.
2. Provide a professional digital video recording of all instruction sessions and deliver two copies on DVD's to the Owner for future reference.
D. TAB Reviews' Instruction Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and actuator output has been signed as required.
4. Command valve/damper open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. Verify proper operationalities of Normally Open or Normally closed positions of all valves/dampers by means of temporarily removing the sensing hose plug removal of actuator to confirm proper closure or opening upon failure of power or control signal.
7. Perform valve/damper leakage tests on all dampers in the system during normal operating pressure with the valve/damper in the closed position and measure against the data T sensors specified in the sequences to confirm compliance with specification requirements for dampers and zero leakage for valves.
B. If actual valve/damper position does not reasonably correspond, replace actuator.
9. Closure for Heating Coil Valves – Normally Open:
a. Set heating setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe valve open.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set heating setpoint to 20 degrees F (11 degrees C) below room temperature.
f. Observe the valve close.
g. For pneumatics, by override in the control system, increase pressure to valve by 3 psi (20 kPa) (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change.
h. Restore to normal.
10. Closure for Cooling Coil Valves – Normally Closed:
a. Set cooling setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe the valve close.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set cooling setpoint to 20 degrees F (11 degrees C) below room temperature.
f. Observe valve open.
g. For pneumatics, by override in the control system, increase pressure to valve by 3 psi (20 kPa) (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change.
h. Restore to normal.

E. Coil Valve Leak Tests:
1. Method 1 – Water Temperature With 2-Way Valve:
a. Calibrate water temperature sensors on each side of coil to be within 0.2 degree F. (0.1 degree C.) of each other.
b. Turn off air handler fans; shut down outside air dampers. Keep pump running.
c. Command valve to closed position and verify valve are open.
d. Observe the sensors and record temperature.
e. Override normally open valves to the closed position.
f. After 10 minutes observe water delta T across coil. If it is greater than 2 degrees F (one degree C), leakage is probably occurring. Read zero stroke to close tighter.
g. Repeat test until compliance is achieved.
2. Method 2 – Temperature With 2 or 3-Way Valve: Water leak-by less than 10 percent will likely not be detected with this method.
a. Calibrate air temperature sensors on each side of coil to be within 0.2 degree F. (0.1 degree C.) of each other.
b. Air handler fans should be on.
c. Chang mixed or discharge air setpoint, override values or bleed or square box pneumatic controller so that the valve is open.
d. After 3 minutes observe air delta t across coil. If it is greater than 2 degrees F (one degree C), leakage is probably occurring.
e. Read valve stroke to close tighter.
f. Repeat test until compliance is achieved.
3. Method 3 – Coil Drain Down – Not for 3-way valves.
a. Put systems in normal mode.
b. If cooling coil valve, remove all coil for cooling; if heating coil valve, put system in full cooling.
c. Close isolation valve on supply side of coil, open air bleed port, open drain-down cock and drain water from coil.
d. If water does not stop draining, there may be a leak through the control valve.
e. Return all to normal when done.

F. Isolation Valve or Setaver Valve Leak Checks: For valves not by coils.
1. With full pressure on the system, measure at each side of valve to determine if there is any leakage.
2. Use an ultra-sonic flow meter to detect flow or leakage.
G. Defective Valves: Where valves are found to leak in excess of the allowable, or, with respect to re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION:
A. TAB: Testing, adjusting, and balancing of HVAC.
B. Coordinate commissioning schedule with TAB schedule.
C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Pre-functional Checklists, calibrations, startup and component functional tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
F. Provide a qualified control system technician to operate the controls to assist the TAB technicians; provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING
A. Pre-functional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submitted.
B. Do not start Functional Testing until all controlled components have themselves been successfully functionally tested in accordance with the Contract Documents.
C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
D. Functional Testing if the control system constitutes demonstration and trend logging of control points monitored by the control system.
1. The control system shall be capable of providing trend log up to 50 percent more points than listed in the points list at no extra cost to Owner.
2. Perform all trend logging specified in the Sequences of Operations and Checklists and submit files.
E. Functionality Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including all interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
1. Setpoint changing features and functions.
2. Sensor calibrations.
G. Demonstrate to the Commissioning Authority:
1. That all specified functions and features are set up, debugged and fully operable.
2. That scheduling features are fully functional and setup, including holidays.
3. That all graphic screens and value readouts are completed.
4. Correct date and time setting in control computer.
5. That field points read the same time on the control computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
6. Functionality of field panels using local operator keypads and local ports (play-by) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
7. Power failure and battery backup and power-up restart functions.
8. Global commands functions.
9. Security and access codes.
10. Occupant over-rides (manual, telephone, key, keypad, etc.).
11. O&M schedules and alarms.
12. Occupancy sensors and controls.
13. "After hours" use tracking and billing.
14. Communications to remote sites.
15. Fire alarm interlocks and response.
16. Fire and smoke damper compression systems interfaces.
17. Security system interfaces.
18. That points that are monitored only, having no control function, are operating properly for the control system.
19. All control strategies and sequences not tested during controlled equipment testing.
20. Trend logging and graphing features that are specified.
21. Other integrated tests specified in the Contract Documents.
22. That control system features that are included but not specified to be setup are actually installed.

H. Perform and submit trend logging on the following using the control system showing minimum period of 5 days including one weekend; if the control points are monitored by the control system:
1. Duty cycling, if specified.
2. Demand limiting, including over-ride of limiting.
3. Optimum start/stop; if operational optionally demonstrate manually.
4. Optimum start-stop functions.
5. Miscellaneous equipment current or status for duty cycling and demand limiting.
6. Equipment or building kW or current for demand limiting.
7. Equipment optimum start/stop functions.

I. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS
A. Add design intent documentation furnished by Engineer to manuals prior to submission to Owner.
B. Submit manuals related to items that were commissioned to Commissioning Authority for review before final submittal to Owner.
C. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING
A. Demonstrate operation and maintenance of HVAC system to Owner personnel: If during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
B. These demonstrations are in addition to, and not a substitute for, Pre-functional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
C. Provide classroom and hands-on training of Owner's designated personnel on operation of the HVAC system. The scope of training shall match that of equipment items included in the Contract Documents, including but not limited to those listed in this Section and those listed in other Sections.
1. Provide training in the operation and maintenance of each item of equipment and each system, including any special maintenance requirements and procedures.
2. Provide a professional digital video recording of all instruction sessions and deliver two copies on DVD's to the Owner for future reference.
D. TAB Reviews' Instruction Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and actuator output has been signed as required.
4. Command valve/damper open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. Verify proper operationalities of Normally Open or Normally closed positions of all valves/dampers by means of temporarily removing the sensing hose plug removal of actuator to confirm proper closure or opening upon failure of power or control signal.
7. Perform valve/damper leakage tests on all dampers in the system during normal operating pressure with the valve/damper in the closed position and measure against the data T sensors specified in the sequences to confirm compliance with specification requirements for dampers and zero leakage for valves.
B. If actual valve/damper position does not reasonably correspond, replace actuator.
9. Closure for Heating Coil Valves – Normally Open:
a. Set heating setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe valve open.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set heating setpoint to 20 degrees F (11 degrees C) below room temperature.
f. Observe the valve close.
g. For pneumatics, by override in the control system, increase pressure to valve by 3 psi (20 kPa) (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change.
h. Restore to normal.
10. Closure for Cooling Coil Valves – Normally Closed:
a. Set cooling setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe the valve close.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set cooling setpoint to 20 degrees F (11 degrees C) below room temperature.
f. Observe valve open.
g. For pneumatics, by override in the control system, increase pressure to valve by 3 psi (20 kPa) (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change.
h. Restore to normal.

E. Coil Valve Leak Tests:
1. Method 1 – Water Temperature With 2-Way Valve:
a. Calibrate water temperature sensors on each side of coil to be within 0.2 degree F. (0.1 degree C.) of each other.
b. Turn off air handler fans; shut down outside air dampers. Keep pump running.
c. Command valve to closed position and verify valve are open.
d. Observe the sensors and record temperature.
e. Override normally open valves to the closed position.
f. After 10 minutes observe water delta T across coil. If it is greater than 2 degrees F (one degree C), leakage is probably occurring. Read zero stroke to close tighter.
g. Repeat test until compliance is achieved.
2. Method 2 – Temperature With 2 or 3-Way Valve: Water leak-by less than 10 percent will likely not be detected with this method.
a. Calibrate air temperature sensors on each side of coil to be within 0.2 degree F. (0.1 degree C.) of each other.
b. Air handler fans should be on.
c. Chang mixed or discharge air setpoint, override values or bleed or square box pneumatic controller so that the valve is open.
d. After 3 minutes observe air delta t across coil. If it is greater than 2 degrees F (one degree C), leakage is probably occurring.
e. Read valve stroke to close tighter.
f. Repeat test until compliance is achieved.
3. Method 3 – Coil Drain Down – Not for 3-way valves.
a. Put systems in normal mode.
b. If cooling coil valve, remove all coil for cooling; if heating coil valve, put system in full cooling.
c. Close isolation valve on supply side of coil, open air bleed port, open drain-down cock and drain water from coil.
d. If water does not stop draining, there may be a leak through the control valve.
e. Return all to normal when done.

F. Isolation Valve or Setaver Valve Leak Checks: For valves not by coils.
1. With full pressure on the system, measure at each side of valve to determine if there is any leakage.
2. Use an ultra-sonic flow meter to detect flow or leakage.
G. Defective Valves: Where valves are found to leak in excess of the allowable, or, with respect to re-test, as applicable, at no extra cost to Owner.

3.03 TAB COORDINATION:
A. TAB: Testing, adjusting, and balancing of HVAC.
B. Coordinate commissioning schedule with TAB schedule.
C. Review the TAB plan to determine the capabilities of the control system toward completing TAB.
D. Provide all necessary unique instruments and instruct the TAB technicians in their use; such as handheld control system interface for setting terminal unit boxes, etc.

E. Have all required Pre-functional Checklists, calibrations, startup and component functional tests of the system completed and approved by the Commissioning Authority prior to starting TAB.
F. Provide a qualified control system technician to operate the controls to assist the TAB technicians; provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING
A. Pre-functional Checklists for control system components will require a signed and dated certification that all system programming is complete as required to accomplish the requirements of the Contract Documents and the detailed Sequences of Operation documentation submitted.
B. Do not start Functional Testing until all controlled components have themselves been successfully functionally tested in accordance with the Contract Documents.
C. Using a skilled technician who is familiar with this building, execute the Functional Testing of the control system as required by the Commissioning Authority.
D. Functional Testing if the control system constitutes demonstration and trend logging of control points monitored by the control system.
1. The control system shall be capable of providing trend log up to 50 percent more points than listed in the points list at no extra cost to Owner.
2. Perform all trend logging specified in the Sequences of Operations and Checklists and submit files.
E. Functionality Test integral or stand-alone controls in conjunction with the Functional Tests of the equipment they are attached to, including all interlocks with other equipment or systems; further testing during control system Functional Test is not required unless specifically indicated below.
F. Demonstrate the following to the Commissioning Authority during testing of controlled equipment; coordinate with commissioning of equipment.
1. Setpoint changing features and functions.
2. Sensor calibrations.
G. Demonstrate to the Commissioning Authority:
1. That all specified functions and features are set up, debugged and fully operable.
2. That scheduling features are fully functional and setup, including holidays.
3. That all graphic screens and value readouts are completed.
4. Correct date and time setting in control computer.
5. That field points read the same time on the control computer; sample 10 percent of field panels; if any of those fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
6. Functionality of field panels using local operator keypads and local ports (play-by) using portable computer/keypad; demonstrate 100 percent of panels and 10 percent of ports; if any ports fail, sample another 10 percent; if any of those fail test all remaining units at no extra cost to Owner.
7. Power failure and battery backup and power-up restart functions.
8. Global commands functions.
9. Security and access codes.
10. Occupant over-rides (manual, telephone, key, keypad, etc.).
11. O&M schedules and alarms.
12. Occupancy sensors and controls.
13. "After hours" use tracking and billing.
14. Communications to remote sites.
15. Fire alarm interlocks and response.
16. Fire and smoke damper compression systems interfaces.
17. Security system interfaces.
18. That points that are monitored only, having no control function, are operating properly for the control system.
19. All control strategies and sequences not tested during controlled equipment testing.
20. Trend logging and graphing features that are specified.
21. Other integrated tests specified in the Contract Documents.
22. That control system features that are included but not specified to be setup are actually installed.

H. Perform and submit trend logging on the following using the control system showing minimum period of 5 days including one weekend; if the control points are monitored by the control system:
1. Duty cycling, if specified.
2. Demand limiting, including over-ride of limiting.
3. Optimum start/stop; if operational optionally demonstrate manually.
4. Optimum start-stop functions.
5. Miscellaneous equipment current or status for duty cycling and demand limiting.
6. Equipment or building kW or current for demand limiting.
7. Equipment optimum start/stop functions.

I. If the control system, integral control components, or related equipment do not respond to changing conditions and parameters appropriately as expected, as specified and according to acceptable operating practice, under any of the conditions, sequences, or modes tested, correct all systems, equipment, components, and software required at no additional cost to Owner.

3.05 OPERATION AND MAINTENANCE MANUALS
A. Add design intent documentation furnished by Engineer to manuals prior to submission to Owner.
B. Submit manuals related to items that were commissioned to Commissioning Authority for review before final submittal to Owner.
C. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.06 DEMONSTRATION AND TRAINING
A. Demonstrate operation and maintenance of HVAC system to Owner personnel: If during any demonstration, the system fails to perform in accordance with the information included in the O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
B. These demonstrations are in addition to, and not a substitute for, Pre-functional Checklists and demonstrations to the Commissioning Authority during Functional Testing.
C. Provide classroom and hands-on training of Owner's designated personnel on operation of the HVAC system. The scope of training shall match that of equipment items included in the Contract Documents, including but not limited to those listed in this Section and those listed in other Sections.
1. Provide training in the operation and maintenance of each item of equipment and each system, including any special maintenance requirements and procedures.
2. Provide a professional digital video recording of all instruction sessions and deliver two copies on DVD's to the Owner for future reference.
D. TAB Reviews' Instruction Setup and Check:
1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
2. Set pump/fan to normal operating mode.
3. Command valve/damper closed; visually verify that valve/damper is closed and actuator output has been signed as required.
4. Command valve/damper open; verify position is full open and adjust output signal as required.
5. Command valve/damper to a few intermediate positions.
6. Verify proper operationalities of Normally Open or Normally closed positions of all valves/dampers by means of temporarily removing the sensing hose plug removal of actuator to confirm proper closure or opening upon failure of power or control signal.
7. Perform valve/damper leakage tests on all dampers in the system during normal operating pressure with the valve/damper in the closed position and measure against the data T sensors specified in the sequences to confirm compliance with specification requirements for dampers and zero leakage for valves.
B. If actual valve/damper position does not reasonably correspond, replace actuator.
9. Closure for Heating Coil Valves – Normally Open:
a. Set heating setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe valve open.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set heating setpoint to 20 degrees F (11 degrees C) below room temperature.
f. Observe the valve close.
g. For pneumatics, by override in the control system, increase pressure to valve by 3 psi (20 kPa) (do not exceed actuator pressure rating) and verify valve stem and actuator position does not change.
h. Restore to normal.
10. Closure for Cooling Coil Valves – Normally Closed:
a. Set cooling setpoint 20 degrees F (11 degrees C) above room temperature.
b. Observe the valve close.
c. Remove control air or power from the valve and verify that the valve stem and actuator position do not change.
d. Restore valve to open.
e. Set cooling setpoint to 20 degrees F (11 degrees

c. Use rigid joints unless otherwise indicated.
d. Three flexible joints may be used in lieu of a flexible connector.
4. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-69 unless indicated otherwise.
C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges, unions, or grooved coupling as required to facilitate disconnection of components for servicing; do not use direct welded, brazed or threaded connections.
1. Where grooved joints are used in piping, provide grooved valve/equipment connections if available. If not available, provide flanged ends and grooved flange adapters.
D. Valves: Provide valves where indicated and as follows:
1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch gate valves with cap; pipe to nearest floor drain.
2. For throttling, bypass, or manual flow control services, use globe or ball valves.
3. For shut-off and to isolate parts of systems or vertical risers, use ball valves.
E. Welding Materials and Procedures: Conform to ASME (BPV IX).

2.02 MATERIALS
A. The Contractor may use any of the following piping materials, at his option, provided the selected material meets with the approval of all State, local authorities and utility company requirements. Verification of compliance of the selected piping material is the sole responsibility of the Installing Contractor. Only metallic piping systems will be allowed in return air plenum ceiling space.

2.03 HEATING WATER PIPING
A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A 234/A 234M, wrought steel welding type fittings; AWS D1.1 welded.
2. Threaded Joints: ASTM B 16.3, malleable iron fittings.
3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
B. Steel Pipe Sizes 12 Inch and Over: ASTM A 53/A 53M, 0.375 inch wall, black, using one of the following joint types:
1. Welded Joints: ASTM A 234/A 234M, wrought steel welding type fittings; AWS D1.1 welded.
2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
C. Copper Tube: ASTM B 88 (ASTM B 88M), Type K (A), drawn, using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
a. Solder: ASTM B 32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
b. Braze: AWS A5.8/A5.8M BCuP copper/silver alloy.
2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.04 CHILLED WATER PIPING
A. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black, using one of the following joint types:
1. Welded Joints: ASTM A 234/A 234M, wrought steel welding type fittings; AWS D1.1 welded.
2. Threaded Joints: ASTM B 16.3, malleable iron fittings.
3. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
R Steel Pipe Cross 12 Inch and Over: ASTM A 53/A 53M, 0.375 inch wall, black; using one of the following joint types:
1. Welded Joints: ASTM A 234/A 234M, wrought steel welding type fittings; AWS D1.1 welded.
2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
C. Copper Tube: ASTM B 88 (ASTM B 88M), Type K (A), hard drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings.
a. Solder: ASTM B 32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
b. Braze: AWS A5.8/A5.8M BCuP copper/silver alloy.
2. Grooved Joints: AWWA C606 grooved tube, fittings of same material, and copper-tube-dimension mechanical couplings.
3. Tee Connections: Mechanically extracted collars with notched and dimpled branch tube.

2.05 EQUIPMENT DRAINS AND OVERFLOWS
Steel Pipe: ASTM A 53/A 53M, Schedule 40 galvanized; using one of the following joint types:
1. Threaded Joints: Galvanized cast iron, or ASME B16.3 malleable iron fittings.
2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
B. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn; using one of the following joint types:
1. Solder Joints: ASME B16.18 cast brass/bronze or ASME B16.22 solder wrought copper fittings; ASTM B 32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
2. Grooved Joints: AWWA C606 grooved pipe, fittings of same material, and mechanical couplings.
C. PVC Pipe: ASTM D 1785, Schedule 40, or ASTM D 2241, SDR 21 or 26. (Not permitted in plenum return ceilings.)
1. Fittings: ASTM D 2466 or D2467, PVC.
2. Joints: Solvent welded.
D. PVC Pipe Sizes 3 Inch and Larger: ASTM D 1785, Schedule 80, or ASTM D 2241, SDR 21 or 26. (Not permitted in plenum return ceilings.)
1. Fittings: ASTM D 2466 or D2467, PVC.
2. Joints: Solvent welded.
E. ABS Pipe: ASTM D 2680 or D2751. (Not permitted in plenum return ceilings.)
1. Fittings: ASTM D 2751.
2. Joints: Solvent welded with ASTM D 2235 cement.

2.06 PIPE HANGERS AND SUPPORTS
Conform to ASME B31.9 or MSS SP-58, 69 & 89.

2.07 UNIONS, FLANGES, AND COUPLINGS
A. Unions for Pipe 2 Inches and Under:
1. Ferrous Piping: 150 psig malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.
B. Mechanical Couplings for Grooved and Shouldered Joints: Two or more curved housing segments with keys or other engaging pipe groove, circular O-profile gasket, and bolts to secure and compress gasket.
1. Dimensions and Testing: In accordance with AWWA C606.
2. Housing Materials: Malleable iron or ductile iron, galvanized.
3. Gasket Material: EPDM suitable for operating temperature range from -30 degrees F to 230 degrees F.
4. Bolts and Nuts: Hot dipped galvanized or zinc-electroplated steel.
5. When pipe is field grooved, provide coupling manufacturer's grooving tools.
6. Manufacturers: Victaulic Company; Gruvlok.
C. Dielectric Connections: Union or waterway fitting with water impervious isolation barrier and one galvanized or plated steel end and one copper tube end, and types to match pipe joint used.
D. Flanges for Pipe Over 2 Inches:
1. Ferrous Piping: 150 psig forged steel, slip-on.
2. Copper Piping: Bronze.
3. Gaskets: 1/16 inch thick preformed neoprene.

2.08 BALL VALVES
A. Manufacturers: Conbraco Industries; Nibco, Inc.; Milwaukee Valve Company.
B. Up To and Including 2 Inches:
1. Bronze one piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle, solder or threaded ends.
C. Over 2 Inches:
1. Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.

2.09 FLOW CONTROLS
A. Manufacturers: ITT Bell & Gossett; Griswold Controls; Taco, Inc.
B. Construction: Class 125, Brass or bronze body with union on inlet, temperature and pressure test plug on inlet and outlet.
C. Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Install piping to ASME B31.5 or B31.9 requirements, as applicable.
C. Pipe Hangers and Supports: Install in accordance with ASME B31.9, ASTM F 708, or MSS SP-69.
D. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

END OF SECTION

SECTION 233100 – HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Metal ductwork.
B. Nonmetal ductwork.
C. Round spiral ductwork.
D. Kitchen hood ductwork, Type 1 grease hoods.
E. Duct cleaning.

1.02 PERFORMANCE REQUIREMENTS
A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE Equivalent Rectangular and Round Duct Sizes table, based on constant friction. Size other round duct sizes using engineering practice. Contractor may increase duct size without engineer approval, provided all ceiling and shaft clearances can be maintained. Additional charges for increased duct size will not be accepted by the owner.
B. Report all conflicts with structure or other obstructions, prior to fabrication of any ductwork. Suitable adjustments in the sizes of ducts shall be accommodated without any additional expense to the Owner.

1.03 SUBMITTALS
A. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems. No ductwork shall be fabricated until engineer approved shop drawings have been received by the Contractor. Identify on ductwork shop drawings any deviations in sizes or shapes made necessary by the obstructions of other trades.
B. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, duct area, and leakage rate, following SMACNA (LEAK) – HVAC Air Duct Leakage Test Manual.

1.04 REGULATORY REQUIREMENTS
A. Construct ductwork to NFPA 90A, NFPA 90B, and NFPA 96 standards.
B. Code or utility company requirements shall supersede any conflicting requirements of this Section.

1.05 FIELD CONDITIONS
A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturer.
B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 MATERIALS
A. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.
B. Steel Ducts: ASTM A 1008/A 1008M, Designation CS, cold rolled commercial steel.
C. Aluminum Ducts: ASTM B 209 (ASTM B 209M), aluminum sheet, alloy 3003-H14 temper, sheet form, or ASTM B 221, Alloy 6063-T832 or equivalent strength.
D. Insulation for Round Ducts:
1. The Contractor may use any of the following ductwork materials, at his option, provided the selected material meets with the approval of all State, local authorities and utility company requirements. Verification of compliance of the selected ductwork material is the sole responsibility of the Installing Contractor.
2. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
b. Maximum Velocity: 4000 fpm.
c. Temperature Range: -10 degrees F to 160 degrees F.
d. Minimum R-Value: 4.2 or greater as required by the applicable energy codes
3. Black polyfilm film supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
a. Pressure Rating: 6 inches WG positive and 0.5 inches WG negative.
b. Maximum Velocity: 4000 fpm.
c. Temperature Range: -20 degrees F to 175 degrees F.
d. Minimum R-Value: 4.2 or greater as required by the applicable energy codes
4. Multiple layers of aluminum laminate supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
a. Pressure Rating: 10 inches WG positive and 1.0 inches negative.
b. Maximum Velocity: 4000 fpm.
c. Temperature Range: 20 degrees F to 210 degrees F.
d. Minimum R-Value: 4.2 or greater as required by the applicable energy codes
5. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
b. Maximum Velocity: 4000 fpm.
c. Temperature Range: -20 degrees F to 210 degrees F.
d. Minimum R-Value: 4.2 or greater as required by the applicable energy codes
6. UL 181, Class 0, interlocking spiral of aluminum foil, fiberglass insulation; aluminized vapor barrier film.
a. Pressure Rating: 8 inches WG positive or negative.
b. Maximum Velocity: 5000 fpm.
c. Temperature Range: -20 degrees F to 250 degrees F.
d. Minimum R-Value: 4.2 or greater as required by the applicable energy codes
E. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint closure under pressure and temperature conditions, and recommended by manufacturer for pressure-class of ducts.
2. VOC Content: Not more than 250 g/L, excluding water.
3. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero when tested in accordance with ASTM E 84.
4. For Use With Flexible Ducts: UL labeled.
5. Duct Exposed to the Weather: Hard cast VersaGrip 102, (VG 102), UL 181-AM compliant duct joint sealer, as manufactured by Carlisle, with construction and pressure class, and longitudinal.
F. Hanger Rod: ASTM A 36/A 36M, steel; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK ACCESSORIES
A. Fabricate, support and seal in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline, where space allows. Use square throat elbows only where space does not allow, provide turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or continuously welded. Do not use screws or welded joints.
E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree tees or laterals are allowed by the drawings.
F. Where ducts are connected to exterior wall louvers and outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct; pinned black on exterior side; seal to louver frame and duct.

2.03 DUCT MANUFACTURERS
A. Metal-Flex, Inc.; SEACO Incorporated; United McGill Corporation.

2.04 MANUFACTURED METAL DUCTWORK AND FITTINGS
A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated. Provide duct materials, gages, reinforcing, and sealing for operating pressures indicated.
B. Round Spiral Ducts: Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gages heavier metal than duct.
C. Double Wall Insulated Round Ducts: Round spiral lockseam duct with galvanized steel outer wall, 1 inch thick fiberglass insulation, perforated galvanized steel inner wall; fitting with solid inner wall.
D. Transverse Duct Connector System: SMACNA "TC" rated duct connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and clips.

2.05 KITCHEN HOOD EXHAUST DUCTWORK, TYPE 1
A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and NFPA 96.
B. Construct of 16 gauge carbon steel or 18 gage stainless steel, using continuous external welded joints.

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine drawings for the Architectural, Structural, Electrical and all other trades that are prepared in conjunction with these drawings and prior to the fabrication of any duct work.
B. Resolve any conflicts encountered with the Engineer prior to fabrication.
C. Identify on ductwork shop drawings any deviations in sizes or shapes made necessary by the obstructions of other trades.

3.02 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
C. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible.
D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material around can.
E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.
G. Use double nuts and lock washers on threaded rod supports.
H. Connect flexible ducts to metal ducts with draw bands.
I. Support flexible duct runs every five feet in the horizontal direction to avoid dips and sags.
J. Connect terminal units to supply ducts with one foot maximum length of flexible duct. Do not use flexible duct to change direction.
K. Connect diffusers to low pressure ducts directly or with 5 foot maximum length of flexible duct held in place with strap or clamp. Longer duct lengths are acceptable if approved by the engineer on the design drawings and allowed by local code. A maximum of one 90 degree bend, or equivalent, will be allowed in flexible duct connections.
L. During construction provide temporary openings for dust control. Install temporary filters on open ductwork to prevent construction dust from entering ductwork system. All exposed ducts in finished areas must be completely free from all dents or imperfections in the galvanized coating and shall be sealed CAREFULLY AND NEATLY with duct compound where contained within the joint. Duct wrap will not be permitted in exposed locations.
M. Kitchen hood exhaust, Type 1: Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.
N. For all hood systems, perform all required regulatory duct leakage and weld tests in the presence of the code official, including but not limited to light tests and smoke tests, to demonstrate the integrity of the duct construction prior to the installation of any insulation that prevents visual inspection of the ductwork on all sides.
O. Provide cleanouts in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.
P. Moisture laden vapor exhaust: Use welded steel for ductwork exposed to view and stainless steel or Grade Fiber Reinforced Plastic where concealed and not located in return air plenums. If located in return air plenums, use stainless steel ductwork. Weld or caulk all seams and joints water tight.
Q. At exterior wall louvers, seal duct to louver frame and install blank-out panels, insulated.

3.03 CLEANING
A. Clean duct system and force air at high velocity through duct to remove accumulated dust or clean with high power vacuum machines. To be sufficient air, clean to half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, during cleaning.

3.04 SCHEDULES
A. Ductwork Material:
B. The Contractor may use any of the following ductwork materials, at his option, provided the selected material meets with the approval of all State, local authorities and utility company requirements. Verification of compliance of the selected piping material is the sole responsibility of the Installing Contractor.
1. Low Velocity Supply (Heating Systems): Galvanized Steel, Aluminum.
2. Low Velocity Supply (System with Cooling Coils): Galvanized Steel, Aluminum.
3. Return and Relief: Galvanized Steel, Aluminum.
4. General Exhaust: Galvanized Steel, Aluminum.
5. Outside Air Intake: Galvanized Steel.
6. Kitchen Hood Exhaust, Type 1: Carbon Steel, Stainless Steel, Constructed per NFPA 96.
C. Ductwork Pressure Class:
1. Low Velocity Supply (Heating Systems): Scheduled System ESP+0.25", round up to next higher pressure class.
2. Low Velocity Supply (Systems with Cooling): Scheduled System ESP +0.5", round up to next higher pressure class.
3. Return and Relief: 1 inch.
4. General Exhaust: Scheduled System ESP +1.0", round up to next higher pressure class.
5. Outside Air Intake: 1 inch.
6. Kitchen Hood Exhaust: See drawings for maximum fan static pressure plus 50% additional.

END OF SECTION

SECTION 233300 – AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Air turning devices/extractors.
B. Volume control dampers.
C. Flexible duct connections.
D. Duct access doors.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS
A. Manufacturers: Krueger; Ruskin Company; Titus.
B. Multi-blade device with blades aligned in short dimension; steel or aluminum construction; with individually adjustable blades, mounting straps.

2.02 VOLUME CONTROL DAMPERS
A. Manufacturers: Louvers & Dampers, Inc.; Nailor Industries Inc.; Ruskin Company; Pratico Inc.
B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated.
C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade size 8 inch wide, maximum damper height 72 inches; galvanized steel or aluminum channel frame with suitable hardware.
E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. In multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings.
F. The contractor shall provide either a mechanical or electrical cable operated system wherever dampers are located in non-accessible areas.
1. Mechanical cable operator system shall be similar and equal to Young Regulator Company, "Bowden Cable Control" system including damper, flexible cable with casing and concealed ceiling regulator control.
2. Electrically operated damper control system shall be similar and equal to United Enertech Corporation, "Power Balance" system including motor operated damper, RJ-11 plenum rated cabling and flush ceiling or wall mounted RJ-11 jack in remote plate. Include one hand held battery pack operator pack to be delivered to the Owner upon completion of the balancing.

2.03 FLEXIBLE DUCT CONNECTIONS
A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated.
B. Flexible Duct Connections: Fabric crimped into metal edging strip.
1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to codes
a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 5 inches wide, 24 gage thick galvanized steel.

2.04 DUCT ACCESS DOORS
A. Manufacturers: Acudor Products Inc.; Nailor Industries Inc.; Ruskin Company; SEMCO Incorporated.
B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards – Metal and Flexible, and as indicated.
C. Fabricate doors rigid and close-fitting of galvanized steel with sealing gaskets and quick-latch locking devices. For insulated ducts, install minimum 1 inch thick insulation with same material used.
1. Sizes Less Than 12 Inches Square: Secure with sash locks.
2. Up to 18 Inches Square: Provide two hinges and two sash locks.
D. Access doors with sheet metal screw fasteners are not acceptable.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards – Metal and Flexible. Duct Construction and pressure class.
B. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide minimum 8 x 8 inch size for hand access. Where duct is too small for hand access, provide doors sufficiently large to reach both balancing dampers only. Review locations prior to fabrication.
C. Locate all dampers and control elements in accessible areas wherever possible to avoid access doors. Provide ceiling access doors for all dampers and control elements located above inaccessible ceiling areas. Provide minimum 12 x 12 inch size for hand access. For 13 inch size or 360 degree pattern where shown and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
D. Provide balancing dampers at points as supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
E. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or slip duct assembly. Do not locate dampers closer than 5 feet or 10 duct diameters from the air terminal device, whichever is greater.
F. At connections to exterior walls and where connected to outdoor air ducts, provide flexible duct connections immediately adjacent to the equipment.
G. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

AIR PURIFICATION DEVICES

Model: PHI-PRGI4-24V Specifications

LISTING: UL 1598; 2008 (3rd Edition)
FACTORY UV-PHI CELL
INSTALLATION: RTU PACKAGED UNIT / BLOWER CABINET

PART 1 GENERAL

1.01 SUMMARY
A. This section includes hydro-peroxide, Super-Oxide Ions, & Hydroxide Ion's delivered via PHI technology through packaged heating and cooling units capable of supplying 3,000 to 6,000 CFM of supply air to the indoor space.

1.02 QUALITY ASSURANCE
A. All models shall be UL listed and comply with safety standards UL 1598; 2008 (3rd Edition) and CSA Standard C22.2 No. 250.0-2008

1.03 WARRANTY
A. All units shall be provided with the following standard warranties:
1. 2-year or 18,000 hours from initial startup. National IAQ provides service plan. The pH cell & UV light replacement 10,000 hour replacements are performed at no cost. The cell is to be returned for refurbishing via Renew-Ox Service after initial installation.
B. This warranty shall not apply if:
1. The equipment is not installed by a qualified installer per the manufacturer's installation instructions shipped with the product.
2. The equipment is misused or neglected, or not maintained per the manufacturer's maintenance instructions.
3. The equipment is not operated within its published capacity.
4. The invoice is not paid within the terms of the sales agreement.

PART 2 PRODUCTS

2.01 GENERAL
A. MULTI-ZONE one piece packaged PHI Unit-Air Purification System.

2.02 HOUSING
A. Unit(s) shall be constructed of aluminum structural pop-rivets. All metal shall be ONC bent for precise assembly.
1. Quad Metallic Target
2. UV-C bulb
3. Electronic Enclosure (24VAC input power Jack)
4. Magnetic mounting feet for easy placement and installation in the Blower Cabinet.

Model: REVE HALO Specifications

LISTING: UL 1598; 2008 (3rd Edition)
FACTORY UV-PHI CELL
INSTALLATION: FAN COIL / BLOWER CABINET

PART 1 GENERAL

1.04 SUMMARY
B. This section includes hydro-peroxide, Super-Oxide Ions, & Hydroxide Ion's delivered via PHI technology through packaged heating and cooling units capable of supplying 800 to 2,400 CFM of supply air to the indoor space.

1.05 QUALITY ASSURANCE
B. All models shall be UL listed and comply with safety standards UL 1598; 2008 (3rd Edition) and CSA Standard C22.2 No. 250.0-2008.

1.06 WARRANTY
C. All units shall be provided with the following standard warranties:
1. 2-year or 18,000 hours from initial startup. National TAB provided service plan. The pH cell & UV light replacement 10,000 hour replacements are performed at no cost if Bullseye TAB is providing Renew-Ox Service after initial installation.
D. This warranty shall not apply if:
1. The equipment is not installed by a qualified installer per the manufacturer's installation instructions shipped with the product.
2. The equipment is misused or neglected, or not maintained per the manufacturer's maintenance instructions.
3. The equipment is not operated within its published capacity.
4. The invoice is not paid within the terms of the sales agreement.

PART 2 PRODUCTS

2.03 GENERAL
A. MULTI-ZONE one piece packaged PHI Unit-Air Purification System.

2.04 HOUSING
A. Unit(s) shall be constructed of aluminum structural pop-rivets. All metal shall be ONC bent for precise assembly.
1. Quad Metallic Target
2. UV-C bulb
3. Electronic Enclosure (24VAC input power Jack)
4. Magnetic mounting feet for easy placement and installation in the Blower Cabinet.

END OF SECTION

SECTION 233423 – HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Kitchen range hood exhaustors.
B. Cabinet and ceiling fans.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Greenheck; Loren Cook Company; PennBarry; CaptiveAire.

2.02 POWER VENTILATORS – GENERAL
A. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.
B. Sound Ratings: AMCA 301, tested to AMCA 300, and bearing AMCA Certified Sound Rating Seal.
C. Fabrication: Conform to AMCA 99.
D. UL Compliance: UL listed and labeled, designed, manufactured, and tested as suitable for the purpose specified and indicated.
E. Kitchen hood exhaustors shall be cabinet with grease tray, ventilated double wall housing, hinged top for ease of cleaning. Hood exhaustors shall comply with requirements of NFPA 96.

2.03 CABINET AND CEILING FANS
A. Centrifugal Fan Units: V-belt or direct driven with galvanized steel housing lined with acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge.
B. Disconnect Switch: Cord and plug in housing for thermal overload protected motor.
C. Grille: Aluminum with baked white enamel finish or molded white plastic as specified on the Drawings.
D. Backdraft Damper: Gravity actuated, aluminum blade construction, felt edged with offset hinge pin, nylon bearings, blades linked.
E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheaves selected so required rpm is obtained with sheaves set at mid-position; fan shaft with self-aligning pre-lubricated ball bearings.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Provide sheaves required for final air balance at no additional expense to the project.
C. Hung Cabinet Fans:
1. Install fans with resilient mountings and flexible electrical leads.
2. Install flexible connections specified between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
D. Provide gravity backdraft dampers on outlet from cabinet and ceiling fans and as indicated.

END OF SECTION

SECTION 233700 – AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Rectangular ceiling diffusers.
B. Perforated face ceiling diffusers.
C. Grid core exhaust and return grilles.
D. Wall registers and grilles.

1.02 SUBMITTALS
A. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and remarks.

1.03 QUALITY ASSURANCE
A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
B. Test and rate louver performance in accordance with AMCA 500-L.
C. Code requirements shall supersede any conflicting requirements of this Section.

1.04 QUALIFICATIONS
A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Titus; Krueger; Price Industries; Nailor Industries Inc.; Hart & Cooley; Ruskin; Greenheck.

2.02 RECTANGULAR CEILING DIFFUSERS
A. Type: Square, adjustable pattern, stamped, multi-cone, or architectural plaque diffusers; deep or shallow pattern as indicated; diffuser size, mounting, and options as indicated.
B. Frame: Inverted T-bar type. In plaster ceilings, provide plaster frame and ceiling frame. (To allow lift-out removal of the diffuser without removal of the plaster frame.)
C. Fabrication: Steel with baked enamel off-white finish.
D. Accessories: Opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.03 PERFORATED FACE CEILING DIFFUSERS
A. Type: Perforated face with removable face.
B. Frame: 1-1/4 inch margin with countersunk screw mounting. In plaster ceilings, provide plaster frame and ceiling frame. (To allow lift-out removal of the diffuser without removal of the plaster frame.)
C. Fabrication: Steel with baked enamel off-white finish.
D. Accessories: Opposed blade damper and multi-louvered equalizing grid with damper adjustable from diffuser face.

2.04 GRID CORE EXHAUST AND RETURN GRILLES
A. Type: Fixed grilles of 1/2 x 1/2 x 1 inch louvers.
B. Fabrication: Aluminum with factory off-white enamel finish.
C. Frame: 1-1/4 inch margin with countersunk screw mounting.
D. Frame: Channel lip-in frame for suspended grid ceilings where face size exceeds 18 x 18 inch.
E. Damper (if specified on drawings): Integral, gang-operated, opposed blade type with removable key operator, operable from face.

2.05 WALL SUPPLY REGISTERS AND GRILLES
A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or silver device to set blades, horizontal face, double deflection.
B. Frame: 1-1/4 inch margin with countersunk screw mounting and gasket.
C. Fabrication: Steel with 20 gage minimum frames and 22 gage minimum blades, steel and aluminum with 0.050 inch thick minimum frame, of aluminum extrusions, with factory off-white enamel finish.
D. Damper: Integral, gang operated opposed blade type with removable key operator, operable from face.
E. Rough Service: Provide front pivoted or welded in place blades, securely fastened to be immobile.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
C. Install diffusers to ductwork with air tight connection.
D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.
E. Paint ductwork visible behind air outlets and inlets matte black.

END OF SECTION

SECTION 238219 – FAN COIL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fan coil units, hydronic.
B. Controls.
C. Room thermostats.

PART 2 PRODUCTS

2.01 FAN-COIL UNITS
A. Manufacturers: Carrier Corporation; Daikin Applied; Trane Inc.
B. Units: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 200 psi and 220 degrees F. Provide slip and jay casing cut, easily removable for cleaning, with drain connection.
C. Cabinet: 0.0598 inch thick steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet.
D. Finish: Manufacturer's standard enamel of color selected by the architect on any visible surface of cabinet and panels.
E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven through adjustable motor sheave.
F. Motor: Provide ECM motor for sizes less than 1 horsepower. Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
G. Control: Multiple speed switch, factory wired, located in cabinet. Additional control requirements:
H. Filter: Easily removed 1 inch thick glass fiber throw-away type, located to filter before coil.
I. Mixing Dampers: Where indicated, mixing sections with dampers.

2.02 ACCESSORY EQUIPMENT
A. Room Thermostat: Wall-mounted, electric solid state microcomputer based room thermostat with remote sensor to maintain temperature setting; low-voltage with following features:
1. System selector switch (heat-off-cool) and fan control switch (auto-on).
2. Automatically switching from heating to cooling.
3. Preferential rate control to minimize overshoot and deviation from setpoint.
4. Automatic Start Capabilities: Controls shall be capable of automatically adjusting the daily start time of the HVAC system in order to bring each space to the desired occupied temperature immediately prior to scheduled occupancy.
5. Set-up for four separate temperatures per day.
6. Instant override of setpoint for continuous or timed period from one hour to 31 days.
7. Short cycle protection.
8. Programming based on every day of the week.
9. Selection features including degree F or degree C display, 12 or 24 hour clock, keypad lockout, remote sensor, fan on-auto.
10. Battery backup to prevent program loss.
11. Thermostat display:
a. Time of day.
b. Actual room temperature.
c. Programmed setpoint temperature.
d. Day of week.
e. System operating indication: heating, cooling, fan auto, off, and on, auto or on, off.

PART 2 EXECUTION

3.01 INSTALLATION
A. Fan-Coil Units: Install as indicated and as instructed by the manufacturer. Coordinate to assure correct recess size for recessed units. Coordinate installation clearances to ensure ease of filter replacement and servicing of the equipment. Provide hinged access doors (rated where necessary) where required to service equipment.
1. Hydronic Units:
a. On inlet provide:
1. Automatic Air Vent with Ball Stop Valve, Ball Valve, Strainer, Automatic Control Valve, Union
b. On outlet provide: Union, Balancing Valve, Ball Valve
B. Units with cooling coils: Connect drain pans to condensate drain.

END OF SECTION

Bergmeyer
www.bergmeyer.com
LA
1 .
1180 South Figueroa St.
Suite 1080
Los Angeles, CA 90017
213.533.1500

SD
1 .
3 Harbor Dr.
Suite 200
Sausalito, CA 94965
415.339.1500

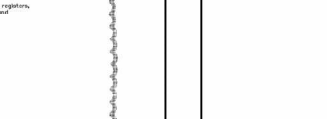
BOS
1 .
2 Seaport St.
6th Floor
Boston, MA 02210
617.896.1500

CONSULTANTS:

Schnackel engineers
New York/Metro/Mid-Atlantic/Los Angeles & Santa Monica

609.581.0883
MEP/ ENGINEER
3600 S 72ND ST
OMAHA NE 68124
TEL 402.391.7680

SEAL/ SIGNATURE:



1	GRS	2025-09-30	ADDENDUM A
2	GRS	2025-09-04	IFC
3	GRS	2025-12-20	PERMIT/BID SET
NO.	BY	DATE	DESCRIPTION

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXF

Air System Sizing Summary for BLOCK LOAD

Project Name: 240348hvac_for_FA_20250219114509.FAPinal — 02/19/2025
Prepared by: Schnackel Engineers — 11:59AM

Air System Information

Air System Name	BLOCK LOAD	Number of zones	1
Equipment Class	SPLT AHU	Floor Area	3041.0 ft²
Air System Type	SZCAV	Location	Oakland AP, California

Sizing Calculation Information

Zone and Space Sizing Method:

Zone CFM	Peak zone sensible load	Calculation Months	Jan to Dec
Space CFM	Individual peak space loads	Sizing Data	Calculated

Central Cooling Coil Sizing Data

Total coil load	18.9 Tons	Load occurs at	Sep 1500
Total coil load	226.3 MBH	OA DB / WB	83.0 / 63.0 °F
Sensible coil load	219.3 MBH	Entering DB / WB	77.2 / 62.6 °F
Coil CFM at Sep 1500	9378 CFM	Leaving DB / WB	55.6 / 54.2 °F
Max block CFM	9378 CFM	Coil ADP	53.2 °F
Sum of peak zone CFM	9378 CFM	Bypass Factor	0.100
Sensible heat ratio	0.969	Resulting RH	47 %
ft²/Ton	161.3	Design supply temp.	55.0 °F
Btu/(hr-ft²)	74.4	Zone T-stat Check	1 of 1 OK
Water flow @ 10.0 °F rise	N/A	Max zone temperature deviation	0.0 °F

Central Heating Coil Sizing Data

Max coil load	128.8 MBH	Load occurs at	Des Htg
Coil CFM at Des Htg	9378 CFM	BTU/(hr-ft²)	42.3
Max coil CFM	9378 CFM	Ent. DB / Lvg DB	65.3 / 78.0 °F
Water flow @ 20.0 °F drop	N/A		

Supply Fan Sizing Data

Actual max CFM	9378 CFM	Fan motor BHP	1.54 BHP
Standard CFM	9377 CFM	Fan motor kW	1.22 kW
Actual max CFM/ft²	3.08 CFM/ft²	Fan static	0.60 in wg

(2) LOAD CALCULATIONS

RTU/ACU CONTROL MATRIX

SETPOINT/CONTROL	FC-1 (DINING)	FC-2,3 (KITCHEN)	AHU-1 (MAKE-UP AIR)	FC-5 (OFFICE)
SETPOINTS				
COOLING – OCCUPIED SETPOINT	75 F	75 F	75 F	75 F
COOLING – UNOCCUPIED SETPOINT	80 F	80 F	80 F	80 F
HEATING – OCCUPIED SETPOINT	70 F	70 F	70 F	70 F
HEATING – UNOCCUPIED SETPOINT	60 F	60 F	60 F	60 F
ECONOMIZER UPPER LIMIT SETPOINT	NA	NA	NA	NA

ACCESSORIES				
HVAC SYSTEM OCCUPIED/UNOCCUPIED MODE – PROGRAMMABLE THERMOSTAT	YES	YES	YES	YES
REMOTE TEMPERATURE SENSOR	YES	YES	NO	YES
MOTORIZED OUTDOOR AIR DAMPER	YES	YES	YES	YES
INTEGRATED ECONOMIZER	NO	NO	NO	NO
ECONOMIZER FAULT DETECTION	NO	NO	NO	NO
BAROMETRIC RELIEF	NO	NO	NO	NO
POWERED EXHAUST RELIEF	NO	NO	NO	NO
DEHUMIDIFICATION (HOT GAS REHEAT)	NO	NO	NO	NO

SUPPLY FAN				
ON DURING OCCUPIED MODE	YES	YES	YES	YES
VARIABLE VOLUME – MODULATE FAN SPEED	NO	NO	NO	NO

SAFETIES AND INTERLOCKS				
SUPPLY AIR SMOKE DETECTOR	YES	YES	NO	NO
LOW LIMIT FREEZESTAT	YES	YES	YES	YES
FIRE ALARM CONTOL PANEL INTERLOCK	YES	YES	YES	YES
KITCHEN EXHAUST SYSTEM INTERLOCK	YES	YES	YES	YES

AIR BALANCE SCHEDULE

EQUIPMENT TAG	SUPPLY AIRFLOW (CFM)	OUTDOOR AIRFLOW (CFM)	RETURN AIRFLOW (CFM)	EXHAUST AIRFLOW (CFM)	OA/SA (%)	REMARKS
FC-1	4,000	710	3,290		18%	
FC-2	3,000	50	2,950		2%	
FC-3	3,000	75	2,925		3%	
AHU-1	1,800	1,800	0		100%	MUA
FC-5	395	15	380		4%	
EF-1				2,050		HOOD-1
EF-2				300		RESTROOM
TOTAL =	12,195	2,650	9,545	2,350		
RESULTING BUILDING PRESSURIZATION =				300	CFM	
PRESSURIZATION PERCENTAGE =				2.5	%	

CARRIER EQUIPMENT SHALL BE OBTAINED THROUGH SHAKE SHACK NATIONAL ACCOUNT. CONTACT CARRIER CORPORATION FOR PROPOSALS:
KEN REVILLA
CARRIER RETAIL STRATEGIC ACCOUNTS
EMAIL: KEN.REVILLA@CARRIER.COM
PHONE: (954) 218-0070

OA DAMPER TABLE

UNIT	AIRFLOW (CFM)
FC-1	710
FC-2	50
FC-3	75
AHU-1	1800
FC-5	15

DUCT HEATER

MARK	SERVICE	AIRFLOW (CFM)	DUCT WIDTH (IN)	DUCT HEIGHT (IN)	HEATING INPUT (kW)	STEP	VOLT	PH	HEATING OUTPUT (MBH)	TEMP RISE (F)	MANUFACTURER	MODEL NUMBER	REMARKS
DH-1	FC-1	710	14	14	5.0	4	208	1	6.8	8.9	INDEECO	QUA	1-6
DH-2	FC-2,3,5	140	8	6	0.5	1	208	1	1.7	11.2	INDEECO	QUA	1-4

REMARKS:
1. PROVIDE 24 VOLT MAGNETIC CONTACTORS FOR HEATER CONTROL.
2. PROVIDE POWER DISCONNECT SWITCH.
3. PROVIDE AIRFLOW SWITCH.
4. PROVIDE HIGH TEMPERATURE LIMIT SWITCH.
5. PROVIDE SCR CONTROL.

AIR HANDLING UNITS

MARK	COOLING SEN (MBH)	COOLING TOT (MBH)	COOLING ROWS	COOLING FLOW (GPM)	COOLING EWT (F)	COOLING LWT (F)	HEATING TOT (MBH)	HEATING ROWS	HEATING FLOW (GPM)	HEATING EWT (F)	HEATING LWT (F)	SUPPLY AIR (CFM)	EXT. S.P. (IN)	ELECTRICAL BHP	ELECTRICAL VOLT	ELECTRICAL PH	CARRIER MODEL NUMBER	REMARKS
AHU-1	35.7	35.7	4	4.7	45	60	66.2	2	8.3	116.5	100.5	1,800	0.70	1.1	208	3	39LA03	1-5

CARRIER IS THE BASIS OF DESIGN. NO EXCEPTIONS.
CAPACITY BASED ON: COOLING 80°F DB/ 67°F WB INDOOR ENTERING AIR. HEATING 70°F DB ENTERING AIR.

REMARKS:
1. PROVIDE AUXILIARY DRAIN PAN.
2. PROVIDE HANGERS AND VIBRATION ISOLATION FOR SUSPENSION FROM STRUCTURE.
3. PROVIDE WATER LEVEL MONITORING DEVICE IN DRAIN PAN TO SHUT OFF UNIT IF THE DRAIN LINE BECOMES RESTRICTED.
4. UNITS WITH COOLING CAPACITY GREATER THAN OR EQUAL TO 65 MBH SHALL HAVE MULTI-STAGE CAPABILITY PER APPLICABLE ENERGY CODE.
5. PROVIDE WITH COMBINATION FILTER/MIXING BOX.

FAN COIL UNITS

MARK	COOLING SEN (MBH)	COOLING TOT (MBH)	COOLING ROWS	COOLING FLOW (GPM)	COOLING EWT (F)	COOLING LWT (F)	HEATING TOT (MBH)	HEATING ROWS	HEATING FLOW (GPM)	HEATING EWT (F)	HEATING LWT (F)	SUPPLY AIR (CFM)	EXT. S.P. (IN)	ELECTRICAL HP	ELECTRICAL VOLT	ELECTRICAL PH	CARRIER MODEL NUMBER	REMARKS
FC-1	105.9	147.3	6	19.5	45	60	118.4	2	14.4	116.5	100	4,000	0.70	2.0	208	3	42BHE40	1-4
FC-2	64.2	77.0	4	10.2	45	60	38.1	1	4.6	116.5	100	3,000	0.70	1-1/2	208	3	42DHE30	1-4
FC-3	64.2	77.0	4	10.2	45	60	38.1	1	4.6	116.5	100	3,000	0.70	1-1/2	208	3	42BHE30	1-4
FC-4	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	6
FC-5	9.0	11.8	4	1.6	45	60	5.5	1	0.7	116.5	100	395	0.30	–	208	1	42CEA04	1-5

CARRIER IS THE BASIS OF DESIGN. NO EXCEPTIONS.
CAPACITY BASED ON: COOLING 80°F DB/ 67°F WB INDOOR ENTERING AIR. HEATING 68°F DB ENTERING AIR.

REMARKS:
1. PROVIDE AUXILIARY DRAIN PAN.
2. PROVIDE HANGERS AND VIBRATION ISOLATION FOR SUSPENSION FROM STRUCTURE.
3. DUCT SMOKE DETECTOR ON THE SUPPLY SIDE DUCT AND SHUTDOWN RELAY SHALL BE FURNISHED BY THE ELECTRICAL CONTRACTOR FOR INSTALLATION BY THE MECHANICAL CONTRACTOR. ALL WIRING SHALL BE BY THE ELECTRICAL CONTRACTOR.
4. PROVIDE WATER LEVEL MONITORING DEVICE IN DRAIN PAN TO SHUT OFF UNIT IF THE DRAIN LINE BECOMES RESTRICTED.
5. CONFIGURE WITH 3 SPEED EC MOTOR AND POTENTIONMETER.
6. UNIT REMOVED FROM THE PLANS.

EXHAUST FANS

MARK	LOCATION	SERVICE	AIRFLOW (CFM)	EXTERNAL STATIC PRESSURE (IN H2O)	SONES	MOTOR DATA FAN (W)	MOTOR DATA (W)	MOTOR DATA (W)	RPM	MANUFACTURER	MODEL NUMBER	REMARKS
EF-1	ROOF	HOOD 1	–	–	–	–	–	–	–	CAPTIVEAIRE	–	4,5
EF-2	NONE	RESTROOM	300	0.70	5.8	250.0	145	1,052	GREENHECK	SQ-225-3VG	31,32

REMARKS:
1. PROVIDE SOLID STATE SPEED CONTROL.
2. PROVIDE MOTORIZED BACKDRAFT DAMPER.
3. NOT USED
4. REFERENCE CAPTIVEAIRE DRAWINGS FOR ADDITIONAL INFORMATION.
5. FAN A PART OF THE CAPTIVEAIRE PCII PACKAGE

DIFFUSERS, GRILLES AND REGISTERS

MARK	SERVICE	LOCATION	CEILING TYPE	MOUNTING TYPE	MANUFACTURER	MODEL NUMBER	REMARKS
D-1	SUPPLY	CEILING	AC TILE	LAY-IN	TITUS	TMS XX 24x24 3 26	1,2,6
D-2	SUPPLY	CEILING	AC TILE	LAY-IN	TITUS	PAR XX 24x24 3 26	1,2,6
D-3	SUPPLY	CEILING	AC TILE	LAY-IN	TITUS	OMNI XX 24x24 3 26	1,2,6,7
D-4	SUPPLY	CEILING	AC TILE	LAY-IN	TITUS	OMNI XX 12x12 3 26	1,2,6,7
D-5	SUPPLY	ROOF	NA	SURFACE	TITUS	300RL X X 1 26	1,5,6,7
G-1	RETURN	CEILING	AC TILE	LAY-IN	TITUS	50F X X 3 26	1,3,6,7
G-2	EXHAUST	CEILING	GYP. BOARD	LAY-IN	TITUS	50F X X 3 26	1,3-7

REMARKS:
1. TITUS IS THE BASE OF DESIGN. KRUEGER, PRICE, NAILOR, CARNES ARE EQUAL. NO EXCEPTIONS.
2. SEE PLAN FOR NECK SIZE.
3. PROVIDE 1/2" X 1/2" X 1" CORE.
4. PROVIDE WITH MODEL TRM FRAME.
5. SEE PLAN FOR SIZE.
6. DIFFUSERS/GRILLES SHALL BE FINISHED TO MATCH CEILING/WALL/EXPOSED DUCT COLOR. COORDINATE WITH ARCHITECT.
7. PROVIDE DIFFUSERS AND GRILLES WITH NO EXPOSED MOUNTING SCREWS.

UV SYSTEMS

UNIT NO.	PLACEMENT	PHI CELL MODEL #	UV/CELL SIZE	RANGE	INDOOR PPM TARGET	SIZE	TRANSFORMER	POWER	IN VOLT	OUT VOLT	MCA	WEIGHT (LBS.)
FC-1	BLOWER CABINET	PHI-PKG14-24V	14"	3,000-8,000 CFM	< 0.02 PPM	2.25"W x 18.5"L x 1.75"D	SHIP LOOSE	11W	115 VAC	24 VAC	0.70A	2 LBS
FC-2	BLOWER CABINET	PHI-PKG14-24V	14"	3,000-8,000 CFM	< 0.02 PPM	2.25"W x 18.5"L x 1.75"D	SHIP LOOSE	11W	115 VAC	24 VAC	0.70A	2 LBS
FC-3	BLOWER CABINET	PHI-PKG14-24V	14"	3,000-8,000 CFM	< 0.02 PPM	2.25"W x 18.5"L x 1.75"D	SHIP LOOSE	11W	115 VAC	24 VAC	0.70A	2 LBS
FC-4	SUPPLY AIR DUCT	REME HALO 24V	11"	250-2,400 CFM	< 0.02 PPM	6.50"W x 14.25"L x 7.50"D	SHIP LOOSE	17W	115 VAC	24 VAC	0.70A	6 LBS
FC-5	SUPPLY AIR DUCT	REME HALO 24V	11"	250-2,400 CFM	< 0.02 PPM	6.50"W x 14.25"L x 7.50"D	SHIP LOOSE	17W	115 VAC	24 VAC	0.70A	6 LBS

Bergmeyer
www.bergmeyer.com
LA
CO
BOS

CONSULTANTS:

Schnackel engineers
New York • Miami • Crestview • Los Angeles • Destin • Honolulu
800-681-0863
www.schnackel.com
MEP/ FP ENGINEER
9020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER — GREGORY ROY SCHNACKEL — No. M34696 — STATE OF CALIFORNIA — Date: 08/01/25

NO	BY	DATE	DESCRIPTION
3	GRS	2025-09-27	ADDENDUM B
2	GRS	2025-05-30	ADDENDUM A
1	GRS	2025-04-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2024-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

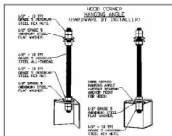
1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

MECHANICAL SCHEDULES

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30348348.00

M601



HANGING ANGLE DETAIL

HOOD STYLE / MODEL	450 DEGREES cfm/ft.	600 DEGREES cfm/ft.	700 DEGREES cfm/ft.
CANOPY ND-2	150	200	250
CANOPY ND-2 W/ END PANELS	105	140	175
SLOPED SND-2	228	304	–
ISLAND ND-2W	269	300	380
ISLAND ND-3	346	422	475

ETL HOOD LISTING DETAIL

EXHAUST CFM = LENGTH OF HOOD X CFM/LINFT. (LOAD)

SUPPLY CFM = EXHAUST CFM X PERCENTAGE REQUIRED

TOTAL DUCT AREA (sq. in.) = 144 X $\frac{\text{CFM}}{\text{FPM(*)}}$

DUCT LENGTH = $\frac{\text{TOTAL DUCT AREA}}{\text{DUCT WIDTH}}$

* CAPTIVEAIRE VENTILATOR DUCT SIZES ARE CALCULATED BASED ON EXHAUST VELOCITY OF 1500 FPM EXISTING AREA & SUPPLY VELOCITY OF 1000 FPM.

CALCULATIONS UTILIZED

CAPTIVE-AIRE HOODS BUILT IN COMPLIANCE WITH:

Listed under ETL File number 3054804-001/002

BUILDING CODES

CAPTIVE-AIRE HOODS HAVE OPTIONAL CLEARANCE REDUCTION SYSTEMS AVAILABLE AS FOLLOWS:

MATERIAL	CLEARANCE REDUCTION SYSTEM
NON-COMBUSTIBLE	NONE REQUIRED
LIMITED-COMBUSTIBLE	3" UNINSULATED STANDOFF
COMBUSTIBLE	1" INSULATED STANDOFF

CLEARANCE TO COMBUSTIBLES

INSTALLATION

1. ALL ELECTRICAL "PIGTAIL" CONNECTIONS ARE RELATED INTERCONNECTIONS BY ELECTRICAL CONTRACTORS.
2. ALL PLUMBING "FIELD" CONNECTIONS AND RELATED INTERCONNECTIONS BY PLUMBING CONTRACTORS.
3. HANGING BRACKETS LOCATED AND WELDED AS SHOWN ON PLANS. ALL OTHER HANGER MATERIALS PROVIDED BY INSTALLING CONTRACTORS.
4. ALL CONNECTIONS FROM CAPTIVEAIRE HOOD FOR MECHANICAL CONVENIENCE PLANS.
5. LOCKING EQUIPMENT TO SHUT OFF IN EVENT OF FIRE.
6. SWIVEL HOSE TO SWING ON IN CASE OF FIRE.
7. ALL LIGHT FIXTURES SHOWN INSTALLED BY CAPTIVEAIRE ARE FACTORY WIRED, INTERCONNECTING BETWEEN HOODS AND TO SWITCHES ARE BY ELECTRICAL CONTRACTOR.
8. LAMPS FOR LIGHT FIXTURES TO BE INSTALLING CONTRACTORS.
9. SEISMIC RESTRAINTS ARE RESPONSIBILITY OF INSTALLING CONTRACTOR.
10. INSTALLING CONTRACTORS ASSUME ALL RELEASED RESPONSIBILITY FOR VERIFICATION OF DIMENSIONAL DATA CONTAINED ON THESE DOCUMENTS FOR ACCURACY, INTERFERENCE, AND COORDINATION OF EQUIPMENT AND UTILITIES PRIOR TO RELEASE FOR PRODUCTION OF EQUIPMENT SHOWN.

BALANCE

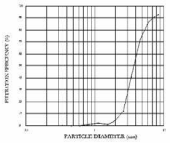
11. KITCHEN HOODS MUST BE BALANCED WITH KITCHEN.
12. KITCHEN SHALL BE NEGATIVE WITH RESPECT TO SURROUNDINGS.
13. RESTAURANT SHALL BE POSITIVE WITH RESPECT TO AMBIENT PRESSURE.

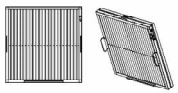
ADDITIONAL

14. WRITTEN HOOD DIMENSIONS HAVE PRECEDENCE OVER SCALE.
15. HEIGHTS AND "APPROXIMATE" ITEMS OR RAW EQUIPMENT MODELS NEEDED TO BE VERIFIED AT FACTORY PRIOR TO MANUFACTURING PLANS/SHOP.

GENERAL NOTES

FILTER COLLECTION EFFICIENCY





CaptiveAire Captrate Solo Filter
ETL Listed Grease Extracting Filters
Made From 430 Stainless Steel

FILTER DETAIL

FOR QUESTIONS, CALL THE
Eastern PA Mechanical
REGION 108
PHONE: (267) 504 - 4126
EMAIL: reg108@captiveaire.com

HOOD INFORMATION – JOB#7295515

HOOD NO	TAG	MODEL	MANUFACTURER	LENGTH	MAX COOKING TEMP	TYPE	APPLIANCE DUTY	DESIGN CFM/FT	TOTAL EXH CFM	EXHAUST PLENUM RISER(S) WIDTH	LENG	HEIGHT	DIA	CFM	VEL	SP	HOOD CONSTRUCTION	HOOD CONFIG END TO END	ROW
1	Hood (Grill)	5430 ND-2	CAPTIVEAIRE	7' 11"	450 DEG	1	MEDIUM	150	1188	10"	11"	4"		1188	1555	-0.468"	430 SS WHERE EXPOSED	ALONE	ALONE
2	Hood (Fryer)	5430 ND-2	CAPTIVEAIRE	4' 11"	600 DEG	1	HEAVY	175	860	9"	9"	4"		860	1529	-0.494"	430 SS WHERE EXPOSED	ALONE	ALONE

HOOD INFORMATION

HOOD NO	TAG	FILTER(S) TYPE	QTY	HEIGHT	LENGTH	EFFICIENCY @ 7 MICRONS	LIGHT(S) QTY	TYPE	WIRE GUARD	UTILITY CABINET(S) LOCATION	SIZE	FIRE SYSTEM TYPE	FIRE SYSTEM SIZE	ELECTRICAL MODEL #	SWITCHES QUANTITY	FIRE SYSTEM PIPING	HOOD HANGING WEIGHT
1	Hood (Grill)	CAPTRATE SOLO FILTER	5	20"	16"	80% SEE FILTER SPEC	2	RECESSED ROUND	NO							YES	487 LBS
2	Hood (Fryer)	CAPTRATE SOLO FILTER	3	20"	16"	80% SEE FILTER SPEC	2	RECESSED ROUND	NO	LEFT	12"x54"x30"	TANK FS	4.0/4.0/4.0			YES	714 LBS

HOOD OPTIONS

HOOD NO	TAG	OPTION
1	Hood (Grill)	FIELD WRAPPER 18.00" HIGH FRONT, LEFT, RIGHT.
		RIGHT END STANDOFF (FINISHED) 1" WIDE 54" LONG INSULATED.
		BALANCE DAMPERS.
		INSULATION FOR BACK OF HOOD.
		RISER SENSOR INSTALL 6IN PLEN.
		LEFT VERTICAL END PANEL 27" TOP WIDTH, 21" BOTTOM WIDTH, 80" HIGH INSULATED 430 SS.
		RIGHT WALL AS END PANEL.
2	Hood (Fryer)	FIELD WRAPPER 12.00" HIGH FRONT, LEFT, RIGHT.
		RIGHT QUARTER END PANEL 23" TOP WIDTH, 0" BOTTOM WIDTH, 23" HIGH 430 SS
		LEFT QUARTER END PANEL 23" TOP WIDTH, 0" BOTTOM WIDTH, 23" HIGH 430 SS.
		BALANCE DAMPERS.
		INSULATION FOR BACK OF HOOD.
		RISER SENSOR INSTALL 6IN PLEN.

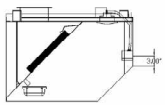
WALL-MOUNT UTILITY CABINET

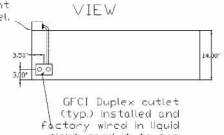
HOOD NO	LOCATION	SIZE	UTILITY CABINET(S) FIRE SYSTEM TYPE	FIRE SYSTEM SIZE	ELECTRICAL MODEL #	SWITCHES QUANTITY	WEIGHT
1	WALL MNT	12"x48"x30"	PCU TANK	4.0/4.0	PCU-CAS-TANK	2 OTHER	340.00 LBS

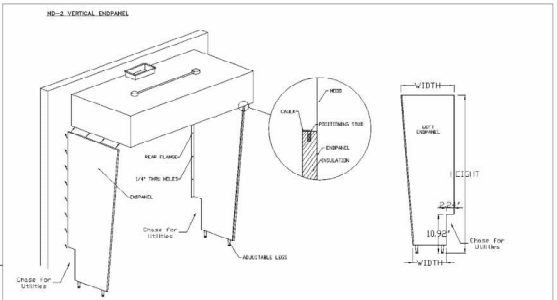
CLEARANCE TO COMBUSTIBLES

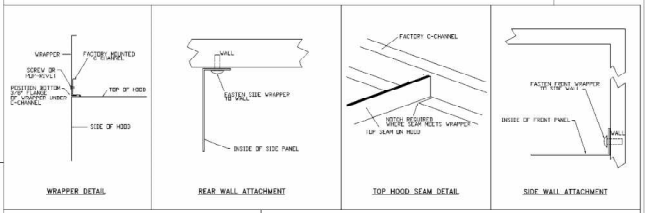
HOODS #	SURFACE	*CLEARANCE
1	TOP	18"
	FRONT	0"
	BACK	0"
	LEFT	18"
	RIGHT	0"
2	TOP	18"
	FRONT	0"
	BACK	0"
	LEFT	0"
	RIGHT	18"

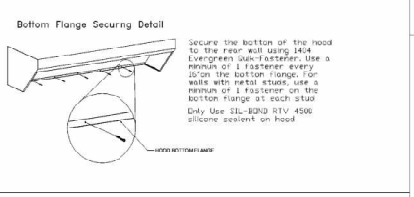
- * CLEARANCE TO COMBUSTIBLES CONFORMS TO UL 710 STANDARD.
- HOOD MOUNTED UTILITY CABINETS REQUIRE 36" SERVICE CLEARANCE.

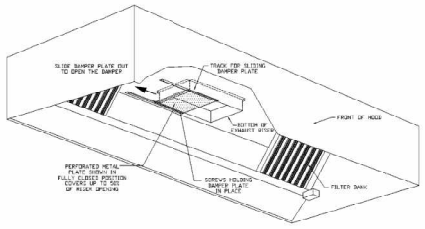




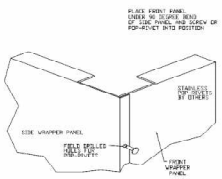




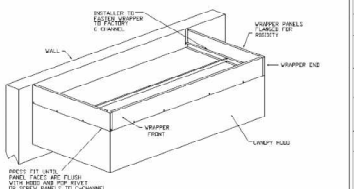




BALANCING DAMPER DETAIL



FRONT CORNER ASSEMBLY



COMPLETED WRAPPER ASSEMBLY

CAPTIVE-AIRE
Eastern PA Mechanical
225 E City Line Avenue, Suite #103, Bala Cynwyd, PA 19004 PHONE: (267) 504 - 4126 EMAIL: reg108@captiveaire.com

REVISIONS

DESCRIPTION	DATE

Shake Shack-1635-Berkeley,CA(Kitchen)

DATE: 1/23/2025

DWG.#: 7295515

DRAWN BY: joe.shilloo

SCALE: 3/4" = 1'-0"

MASTER DRAWING

SHEET NO. 1

Bergmeyer
www.bergmeyer.com
LA
1 W. Colorado Blvd. Suite 200
Pasadena, CA 91105
626.795.1666
BOS
1 Beacon St. 6th Floor
Boston, MA 02108
617.426.1500

CONSULTANTS:

Schnackel engineers
New York • Maine • Chicago • Los Angeles • Seattle • Honolulu
631.581.0160 www.schnackel.com
MEP/ FP ENGINEER
3020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7660

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER — GREGORY ROY SCHNACKEL — No. M33099 — STATE OF CALIFORNIA
Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-08-01	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

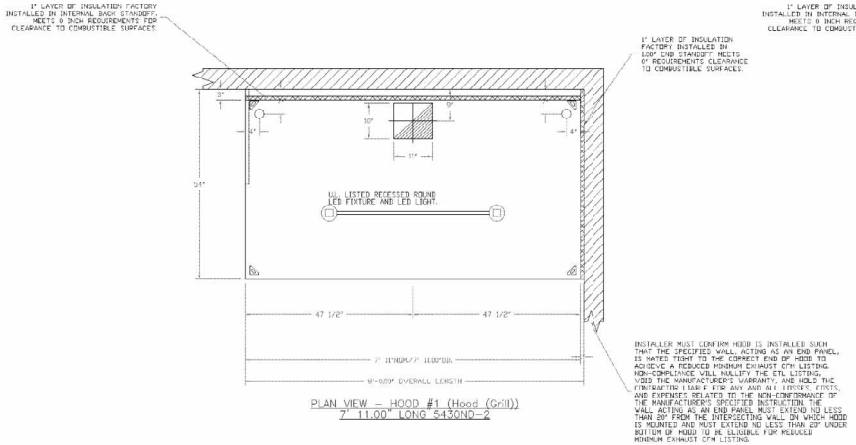
1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

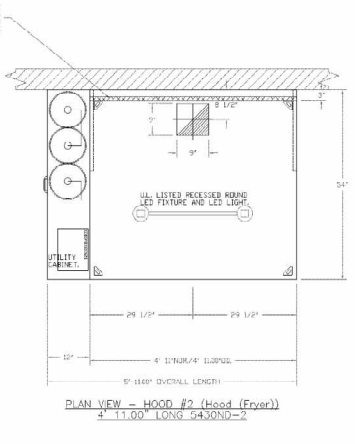
CAPTIVEAIRE DRAWINGS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	3054548.01

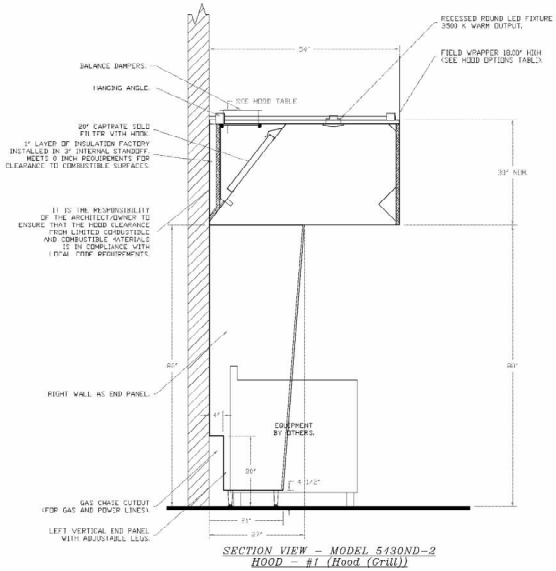
M701



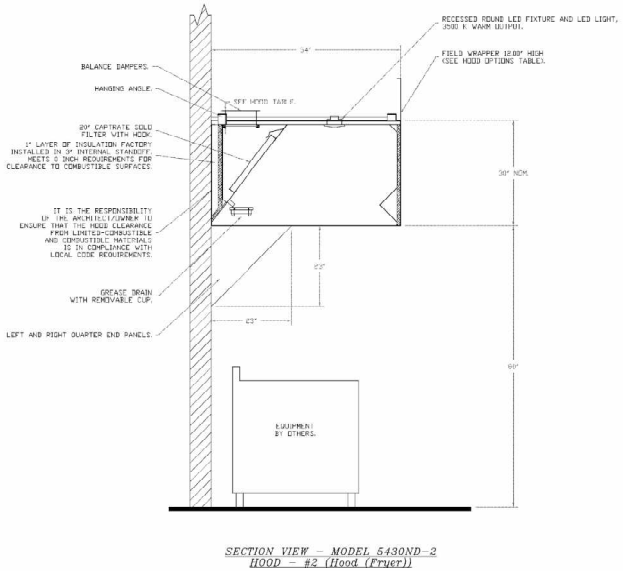
PLAN VIEW – HOOD #1 (Hood (Grill))
7' 11.00" LONG 5430ND-2



PLAN VIEW – HOOD #2 (Hood (Fryer))
4' 11.00" LONG 5430ND-2



SECTION VIEW – MODEL 5430ND-2
HOOD – #1 (Hood (Grill))



SECTION VIEW – MODEL 5430ND-2
HOOD – #2 (Hood (Fryer))

REVISIONS

	DESCRIPTION	DATE
△		
△		
△		
△		

CAPTIVEAIRE

Eastern PA Mechanical

225 E City Line Avenue, Suite #103, Bala Cynwyd, PA 19004 PHONE: (267) 504 - 4176 EMAIL: mgt1240@captivaire.com

Shake Shack-1635-Berkeley,CA(Kitchen)

DATE: 1/23/2025

DWG.#: /295515

DRAWN BY: joe.shilloo

SCALE: 3/4" = 1'-0"

MASTER DRAWING

SHEET NO. 2

Bergmeyer

BOS
1 Beacon St.
6th Floor
Boston, MA 02108
617.357.5577

CO
1144 Walnut St.
Suite 200
Cincinnati, OH 45202
513.621.1919

LA
633 Bercut Drive
Suite 100
Los Angeles, CA 90017
213.533.1500

www.bergmeyer.com

CONSULTANTS:

Schnackel engineers
New York • Atlanta • Cincinnati • Los Angeles • Seattle • Honolulu
800.681.0882 www.schnackel.com

MEP/ FP ENGINEER
3030 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER — GREGORY ROY SCHNACKEL — No. M33096 — STATE OF CALIFORNIA

Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-08-01	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

CAPTIVEAIRE DRAWINGS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.01

M702

FIRE SYSTEM INFORMATION JOB#7295515

FIRE SYSTEM NO	TAG	TYPE	SIZE	MAX FP	DESIGN FP	INSTALLATION	
						SYSTEM	LOCATION ON HOOD
1		TANK FS	4.0/4.0/4.0	60	41	FIRE CABINET LEFT	LEFT, HOOD 2
2		PCU TANK	4.0/4.0	24	24	WALL UTILITY CABINET LEFT	N/A

GAS VALVE(S)

FIRE SYSTEM NO	TAG	TYPE	SIZE	SUPPLIED BY
1		SC ELECTRICAL	1.000	CAPTIVEAIRE SYSTEMS

NOTES
- FIELD PIPE DROPS AS SHOWN
- PIPING, ELBOWS, TEES, AND NOZZLES SUPPLIED BY CAS.
- FIELD INSTALLED DROPS FACTORY WILL PROVIDE QTY 2 60IN LONG PIECES OF CHROME PLATED PIPING SHIPPED LOOSE TO BE FIELD-INSTALLED.
- SHIP LOOSE DROPS FACTORY WILL PROVIDE THE EXACT CHROME PIPE LENGTH NEEDED SHIPPED LOOSE TO BE FIELD-INSTALLED.
- RELOCATE NOZZLES IF FLOW PATTERN IS BLOCKED BY SHELVING, SALAMANDERS, ETC.
- OVERLAPPING COVERAGE SHALL NOT BE USED ON ANY APPLIANCE WITH AN OBSTRUCTION.
- IF APPLICABLE, EXTENDED PRE-PIPED DROPS ARE SHIPPED LOOSE.
- FACTORY PIPING EXTENDS A MAXIMUM OF 6" ABOVE THE TOP OF THE HOOD.

- APPLIANCE DIMENSIONS LISTED REPRESENT THE COOKING SURFACE SIZE, NOT THE OVERALL APPLIANCE SIZE.

- THIS FIRE SYSTEM COMPLIES WITH U.L. 300 REQUIREMENTS.

- DL-F NOZZLE PART NUMBER REPLACES 3070-3/8H-10-SS

JOB #: 7295515.
JOB NAME: SHAKE SHACK-1635-BERKELEY,CA(KITCHEN).

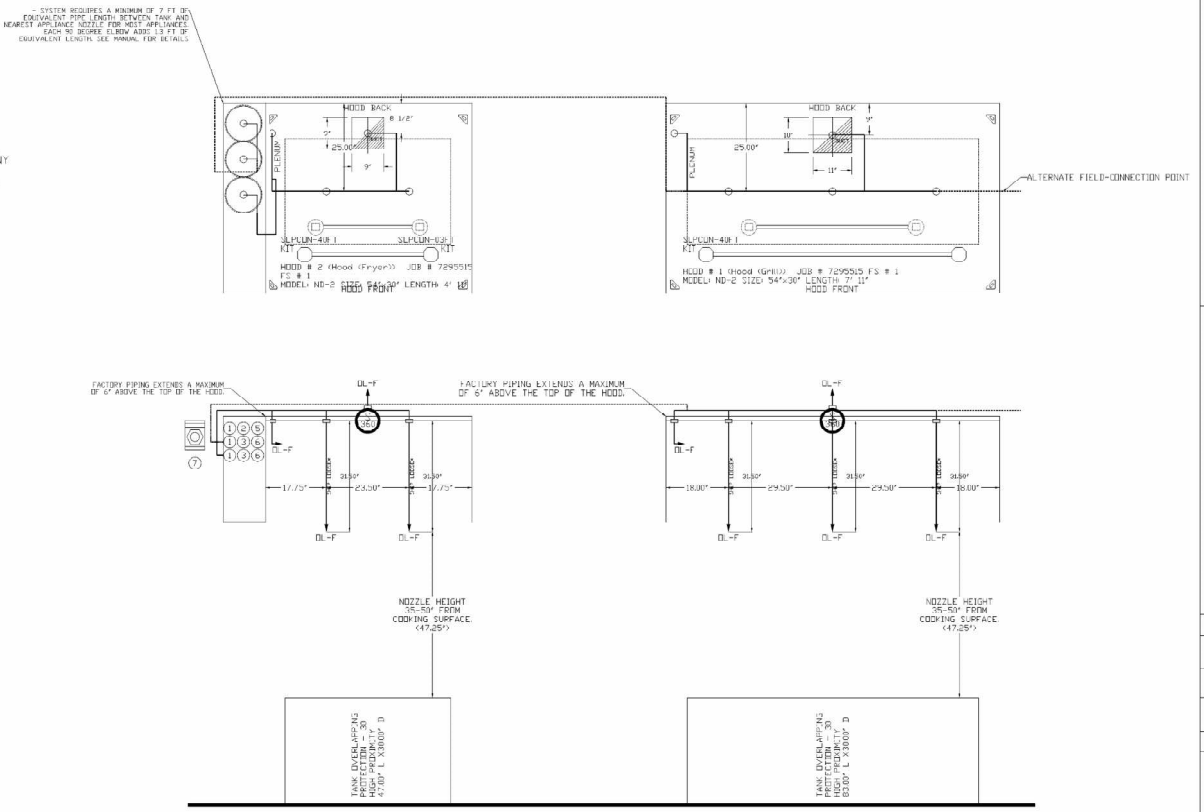
SYSTEM SIZE: TANK-SP-3 DESIGN FP: 41, MAXIMUM FP: 60.
HOOD # 1: 7' 11.00" LONG x 54" WIDE x 30" HIGH.
RISER # 1 SIZE: 10" x 11".
HOOD # 1 METAL BLOW-OFF CAPS INCLUDED.
HOOD # 2: 4' 11.00" LONG x 54" WIDE x 30" HIGH.
RISER # 1 SIZE: 9" x 9".
HOOD # 2 METAL BLOW-OFF CAPS INCLUDED.

- HEAVY-DUTY APPLIANCES (RATED 600°F) WILL REQUIRE AN ADDITIONAL DOWNSTREAM FIRESTAT IN THE EVENT THAT THE DUCTWORK CONTAINS ANY HORIZONTAL RUNS OVER 25 FT IN LENGTH.
- MEDIUM TO LIGHT-DUTY APPLIANCES (RATED 450°F) WILL NOT REQUIRE ANY ADDITIONAL DOWNSTREAM DETECTION.

AGENT DISTRIBUTION PIPING LIMITATIONS	
PIPE SECTION	MAX PIPE LENGTH (FT)
MAX SUPPLY LINE TO FIRST OVERLAPPING NOZZLE	42
OVERLAPPING NOZZLE APPLIANCE BRANCH	10
DEDICATED NOZZLE APPLIANCE BRANCH	10

LEGEND – FIRE CABINET TANK SYSTEM

1 4 GALLON TANK.
2 PRIMARY ACTUATOR RELEASE.
3 SECONDARY ACTUATOR RELEASE.
4 PRESSURE SUPERVISION SWITCH.
5 PRIMARY HOSE ASSEMBLY.
6 SECONDARY HOSE ASSEMBLY.
7 REMOTE MANUAL ACTUATION DEVICE.



REVISIONS

DESCRIPTION	DATE

CAPTIVEAIRE

225 E City Line Avenue, Suite #103, Bala Cynwyd, PA 19004 PHONE: (267) 564 - 4126 EMAIL: mg104@captiveaire.com

Eastern PA Mechanical

Shake Shack-1635-Berkeley,CA(Kitchen)

DATE: 1/23/2025

DWG.#: 7295515

DRAWN BY: joe.shilbe

SCALE: 3/4" = 1'-0"

MASTER DRAWING

SHEET NO. 3

Bergmeyer

www.bergmeyer.com

LA
811 Wilshire Figueroa St.
Suite 1080
Los Angeles, CA 90017
213.955.1066

BOS
1 Marina Park Dr.
6th Floor
Boston, MA 02210
617.350.0450

CO
1144 W Vine St.
Suite 200
Colorado, CO 80905
719.955.1066

CONSULTANTS:

Schnackel engineers
New York • Miami • Cincinnati • Los Angeles • Seattle • Honolulu
800.681.0982 www.schnackel.com

MEP/ FP ENGINEER
3020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER GREGORY ROY SCHNACKEL No. M33096 STATE OF CALIFORNIA
Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-08-01	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2024-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

CAPTIVEAIRE DRAWINGS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30345549.00

M703

EXHAUST FAN INFORMATION – JOB#7295515

FAN UNIT NO	TAG	QTY	FAN UNIT MODEL #	MANUFACTURER	CFM	ESP	RPM	MOTOR ENCL	HP	BHP	PHASE	VOLT	FLA	WEIGHT (LBS)	SONES
1	PCU-1	1	SIF20DD	CAPTIVEAIRE	2040	1.700	1691	TEFC,PREMIUM	5.000	2.6690	3	460	6.6	1699	23.3

FAN OPTIONS

FAN UNIT NO	TAG	QTY	DESCRIPTION
1	PCU-1	1	SIF – STAINLESS STEEL HOUSING CONSTRUCTION
		1	SIF 20– SS LDV SP STRAIGHT DISCHARGE– SQUARE TO ROUND DISCHARGE ADAPTER
		1	SIF20 – INLET – STANDARD 20" DUCT CONNECTION
		1	PCU-SIZE 2 SIF-20 HESS
		1	RUBBER VIBRATION ISOLATORS (SET OF 4), IS016 THRU IS022
		1	SIF – HORIZONTAL FLOOR MOUNT – PRE-INSTALLED MOUNTS (11-36)
		1	POLLUTION CONTROL UNIT WITH PREFILTER, DUAL HIGH EFFICIENCY, AND DUAL DOOR CONTROL FILTERS WITH INSTALLED ELECTRIC DETECTION SYSTEM. PRESET TO ACTIVATE AT 360° F. SIZE 2
		1	2 YEAR PARTS WARRANTY

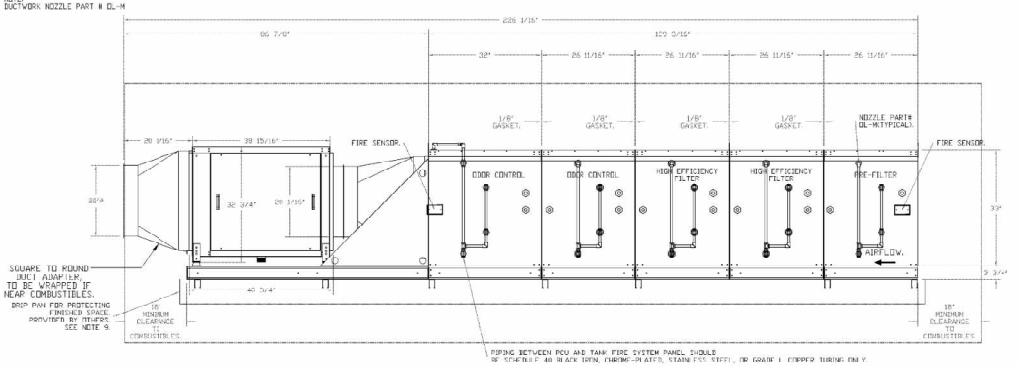
FAN ACCESSORIES

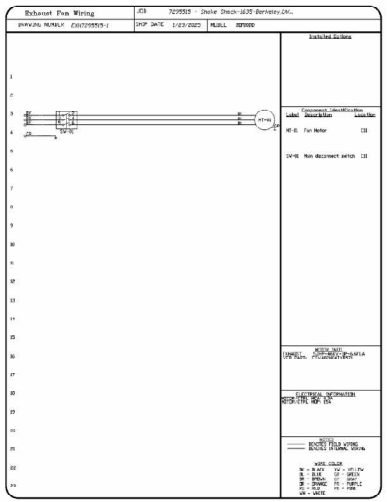
FAN UNIT NO	TAG	EXHAUST			SUPPLY			
		GREASE CUP	GRAVITY DAMPER	WALL MOUNT	SIDE DISCHARGE	GRAVITY DAMPER	MOTORIZED DAMPER	WALL MOUNT
1	PCU-1							

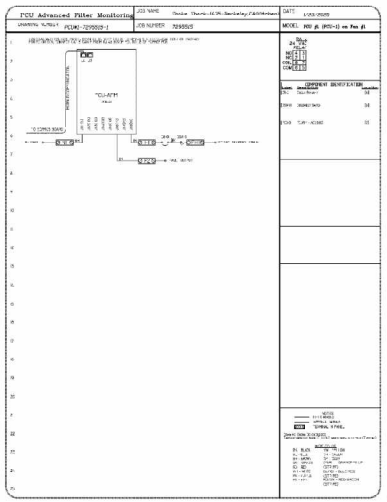
POLLUTION CONTROL UNIT FIRE SYSTEM

FAN #1 SIF20DD-HESS-UL762 – EXHAUST FAN (PCU-1) – POLLUTION CONTROL UNIT WITH FIRE SYSTEM PIPING AND DETECTION INSTALLED. INCLUDES STEEL PRE FILTER MODULE, HIGH EFFICIENCY MERV 15 FILTER MODULE, HIGH EFFICIENCY MERV 15 FILTER MODULE, AND DUAL DOOR CONTROL MODULES PREPPED WITH DOWNSTREAM PROTECTION. ELECTRIC FIRE DETECTOR AND NOZZLES ARE INCLUDED.

NOTE:
DUCTWORK NOZZLE PART # DL-M







CAPTIVEAIRE
Eastern PA Mechanical
225 E City Line Avenue, Suite #103, Bala Cynwyd, PA 19004 PHONE: (267) 594 - 4126 EMAIL: hsgf136@captivaire.com

REVISIONS

DESCRIPTION	DATE

Shake Shack-1635-Berkeley,CA(Kitchen)

DATE: 1/23/2025

DWG.#: /295515

DRAWN BY: joe.shilloo

SCALE: 3/4" = 1'-0"

MASTER DRAWING

SHEET NO. 4

Bergmeyer
www.bergmeyer.com
LA
CO
BOS

CONSULTANTS:

Schnackel engineers
New York/Miami/La Cruz/Los Angeles/Seattle/Honolulu
MEP/ FP ENGINEER
3020 S 72ND ST
OMAHA NE 68124
TEL 402.397.7660

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER GREGORY ROY SCHNACKEL No. M33099 STATE OF CALIFORNIA
Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

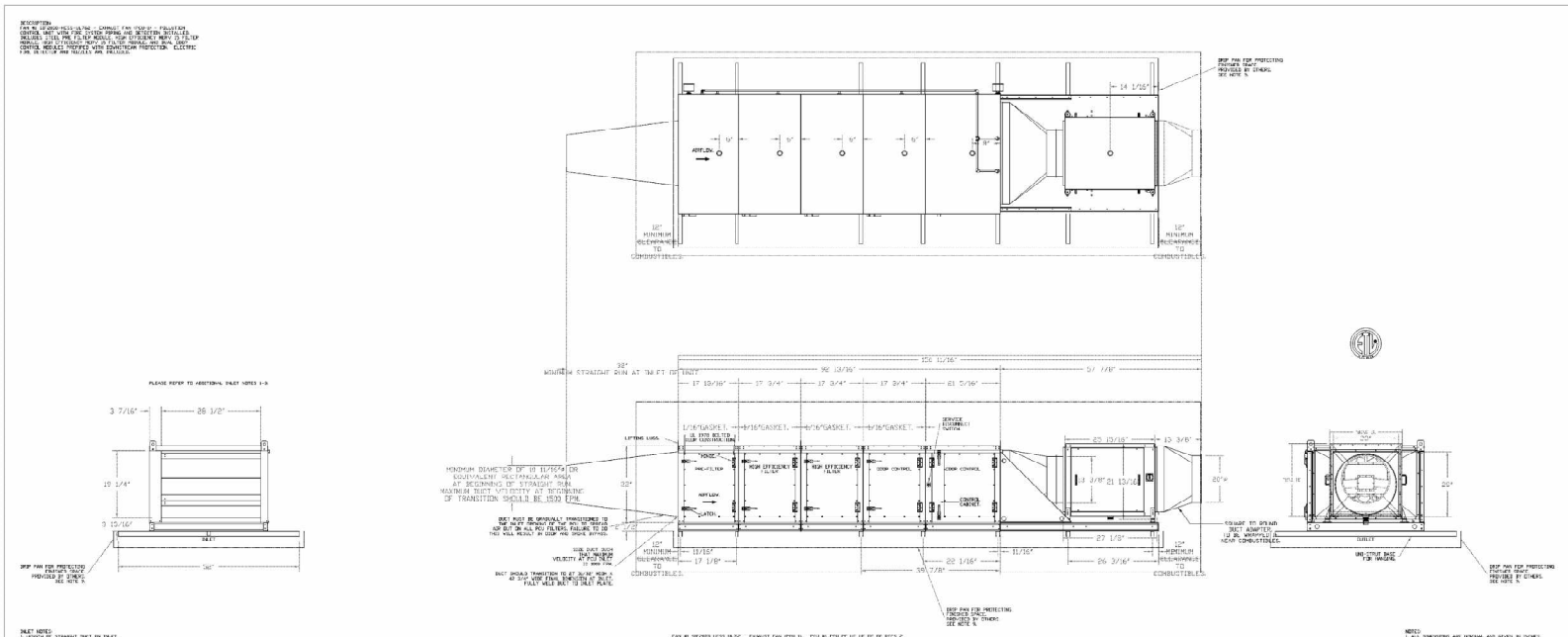
1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

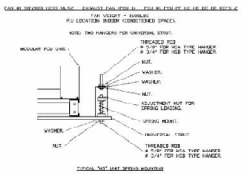
IFC SET

CAPTIVEAIRE DRAWINGS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.00

M704





PCU FILTER SPECIFICATIONS					
		(LISTED U.L. - 2998)			
MODULE	FILTER TYPE	FILTER EFFICIENCY	QTY	SIZE	SPILLCAMS (w/ VCI)
1	CAPTRATE SOLO	MERV 8	6	20X25X2	0.135
2	HIGH EFFICIENCY	MERV 15	6	20X25X4	0.129
3	HIGH EFFICIENCY	MERV 15	6	20X25X4	0.129
4	DC 1000L CARBON	N/A	6	20X25X4	0.482
5	DC 1000L CARBON	N/A	6	20X25X4	0.482
					1.617

REVISIONS

	DESCRIPTION	DATE
1		
2		
3		
4		

CAPTIVEAIRE

225 E City Line Avenue, Suite #103, Bala Cynwyd, PA, 19004 PHONE: (267) 594 - 4126 EMAIL: mgf136@captiveair.com

www.captiveair.com

Eastern PA Mechanical

Shake Shack-1635-Berkeley,CA(Kitchen)

DATE: 1/23/2025

DWG.#: /295515

DRAWN BY: joe.shilloo

SCALE: 1/2" = 1'-0"

MASTER DRAWING

SHEET NO. 5

Bergmeyer

www.bergmeyer.com

BOS
- 2 Seaport Ln. 6th Floor Boston, MA 02210 617.951.2400

CO
- 1144 York St. Suite 200 Denver, CO 80206 303.830.1980

LA
- 633 Bloom Figueroa St. Suite 1080 Los Angeles, CA 90017 213.955.1988

CONSULTANTS:

Schnackel engineers

New York • Miami • Cincinnati • Los Angeles • Seattle • Honolulu
800-681-0982 www.schnackel.com

MEP/ FP ENGINEER
9020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7660

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER GREGORY ROY SCHNACKEL STATE OF CALIFORNIA

No. M33099

Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	PKN SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

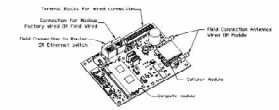
CAPTIVEAIRE DRAWINGS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.01

M705

ELECTRICAL PACKAGE – JOB#7295515

NO	TAG	PACKAGE #	LOCATION	SWITCHES		OPTION	FANS CONTROLLED					
				LOCATION	QUANTITY		FAN TAG	TYPE	Φ	HP	VOLT	FLA
1		SF-310109MA	WALL MOUNT IN SS BOX	UTILITY CABINET LEFT	1 LIGHT 1 FAN	SMART CONTROLS THERMOSTATIC CONTROL W/ RELAY ON/OFF WITH SUPPLY	PCU-1	EVAPORATIVE	3	5.00	460	6.6
2		PCU-CAS-TANK	WALL UTILITY CABINET LEFT	NO SWITCHES	2 OTHER							



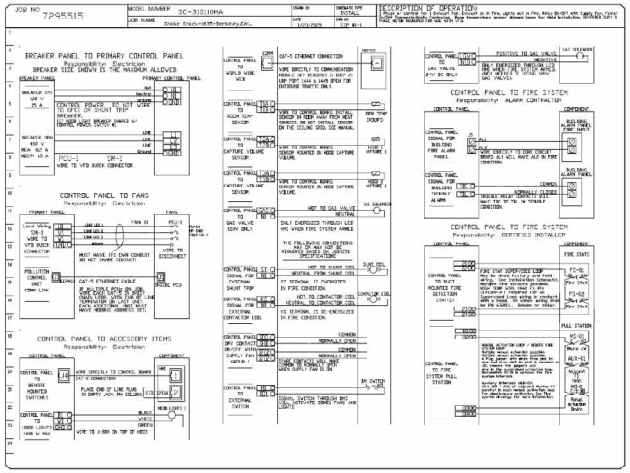
CASlink Monitor and Control

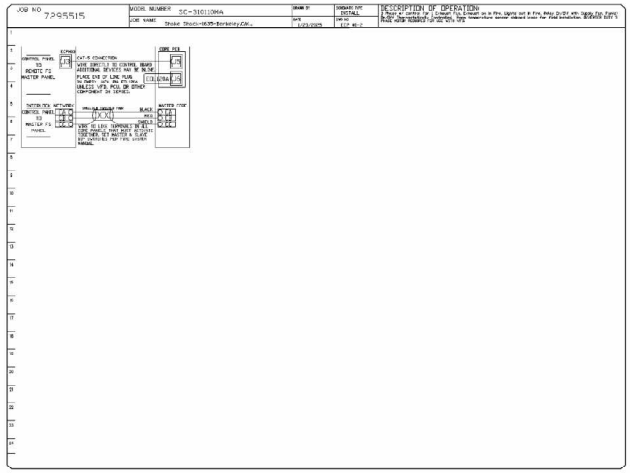
Hood control panel to support communications to cloud-based Building Management System.
- *Hood Control Panel to allow cloud-based Building Management System to monitor all points listed in MONITORING AND CONTROL POINTS LIST.*
- *Hood Control Panel to allow cloud-based Building Management System to control parameters outlined as CONTROL in the points list.*
- *Hood Control Panel to allow cloud-based Building Management System to implement SYSTEM SUNNOMIZER control strategies for fully integrated Building Management.*

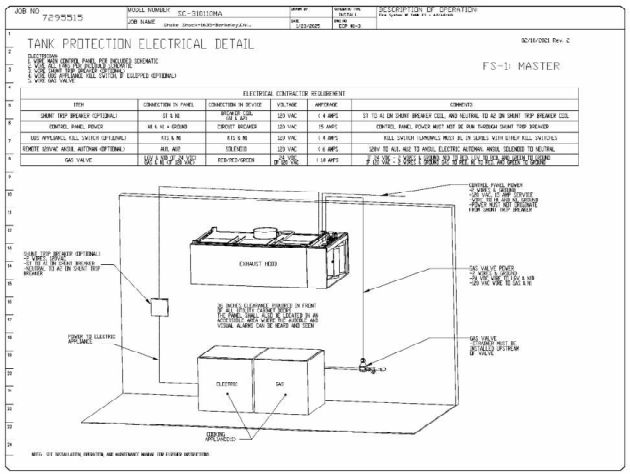
MONITORING AND CONTROL POINTS LIST

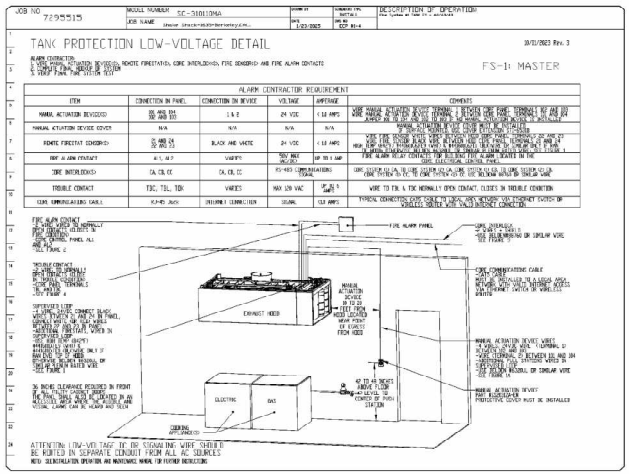
SF Package	Function
Room Temperature	MONITOR
Duct Temperature(s)	MONITOR
MUA Discharge Temperature	MONITOR
Kitchen RTU Discharge Temperature	MONITOR
Fan Speed	MONITOR
Fan Amperage	MONITOR
Fan Power	MONITOR
VFD Faults	MONITOR
Controller Faults	MONITOR
Fan Faults	MONITOR
PCU Filter Dirty Percentages	MONITOR
Fire Condition	MONITOR
CORE Fire System	MONITOR
Building Pressures	MONITOR
Prep Fans Button	MONITOR & CONTROL
Fans Button	MONITOR & CONTROL
Lights Button	MONITOR & CONTROL
Wash Button	MONITOR & CONTROL

SF Package	Function
Room Temperature(s)	MONITOR
Duct Temperature(s)	MONITOR
MUA Discharge Temperature	MONITOR
Kitchen RTU Discharge Temperature	MONITOR
Controller Faults	MONITOR
Fan Faults	MONITOR
Fan Status	MONITOR
PCU Faults	MONITOR
PCU Filter Dirty Percentages	MONITOR
Fire Condition	MONITOR
CORE Fire System	MONITOR
Building Pressures	MONITOR
Fans Button(s)	MONITOR & CONTROL
Lights Button(s)	MONITOR & CONTROL
Wash Button	MONITOR & CONTROL









REVISIONS	
DESCRIPTION	DATE

CAPTIVEAIRE

Eastern P.A. Mechanical

225 E City Line Avenue, Suite #193, Bala Cynwyd, PA. 19004 PHONE: (267) 594 - 4156 EMAIL: rsgil06@captivaire.com

Shake Shack-1635-Berkeley,CA(Kitchen)

DATE: 1/23/2025

DWG.#: 7295515

DRAWN BY: Joe.shilloo

SCALE: 3/4" = 1'-0"

MASTER DRAWING

SHEET NO. 6

Bergmeyer

www.bergmeyer.com

CO
- 1 Mifflin Wharf Plaza, Suite 300, Cincinnati, OH 45215, 513.651.3500
- 1 Marina Park Dr., 6th Floor, Boston, MA 02210, 617.896.4300

LA
- 633 North Figueroa St., Suite 1080, Los Angeles, CA 90017, 213.533.1066

CONSULTANTS:

Schnackel engineers
New York/Atlantic Coastline Los Angeles • Gasoline • Honolulu
800.681.0982 www.schnackel.com

MEP/ ENGINEER:
9020 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER — GREGORY SCOTT SCHNACKEL — No. M33099 — STATE OF CALIFORNIA

Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-08-04	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2024-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

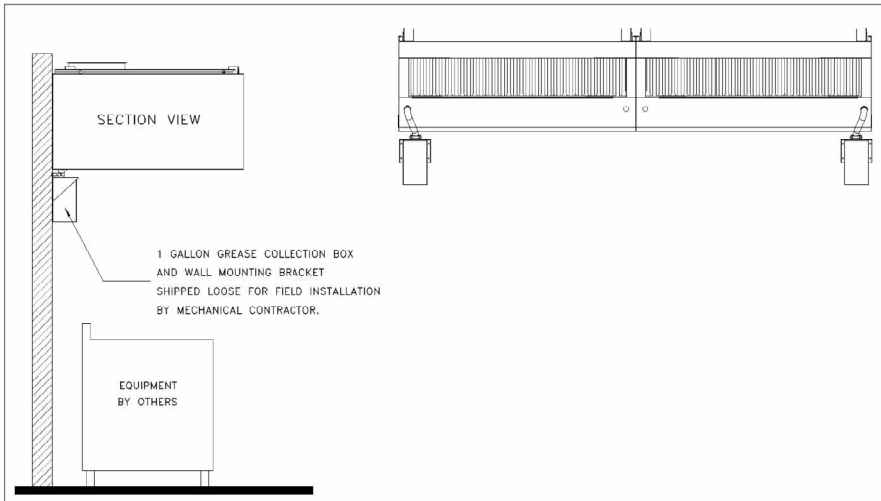
1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

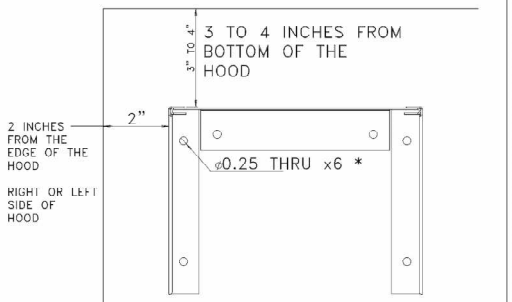
IFC SET

CAPTIVEAIRE DRAWINGS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245549.01

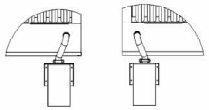
M706

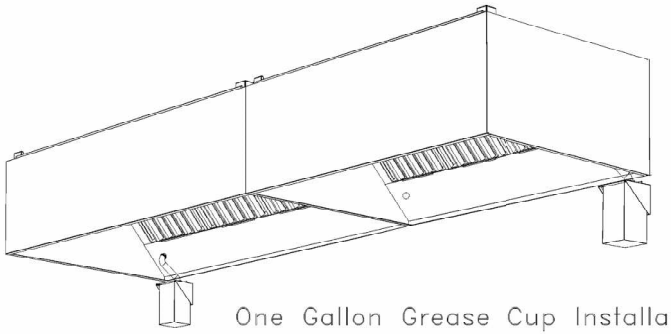




* Mounting hardware not included
**Must be mounted to stud or wall anchor

Left & Right hand Grease Cup Install



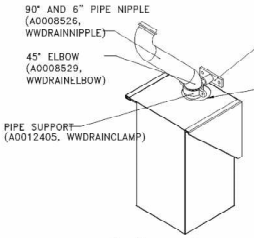


One Gallon Grease Cup Installation

Instructions below outline single, or dual, one gallon grease cup installation for ND-2 hood models.

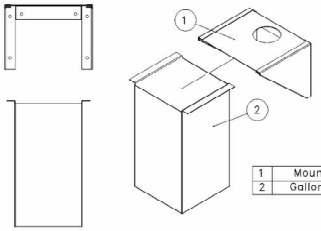
The one gallon grease cup comes as an assembly of stainless steel wall mounting bracket and one gallon cup. The mounting bracket should be installed 2" from the edge of the containment plenum and 3'-4" below the bottom of the hood.

Piping from the hood grease drain should route to the opening of the grease cup, but not into the cup, otherwise the cup will not be able to be removed and emptied.



Support the bottom of the drain pipe using 1.5" adjustable pipe support
Do not allow drain pipe to drop into the grease cup, otherwise cup will catch when removing and cleaning the grease cup

Gallon Grease Cup Assembly



1	Mounting Bracket
2	Gallon Grease Cup

1 GALLON GREASE COLLECTION BOX
AND WALL MOUNTING BRACKET
SHIPPED LOOSE FOR FIELD INSTALLATION
BY MECHANICAL CONTRACTOR.

REVISIONS

DESCRIPTION	DATE

CAPTIVEAIRE

Eastern PA Mechanical

225 E City Line Avenue, Suite #163, Bala Cynwyd, PA, 19004 PHONE: (267) 594 - 4176 EMAIL: hsgf136@captivaire.com

Shake Shack-1635-Berkeley,CA(Kitchen)

DATE: 1/23/2025

DWG.#: /295515

DRAWN BY: joe.shilbo

SCALE: 3/4" = 1'-0"

MASTER DRAWING

SHEET NO. 7

Bergmeyer

www.bergmeyer.com

BOS
One Beacon St.
6th Floor
Boston, MA 02108
617.357.5400

CO
2 N Tejon St.
Suite 700
Colorado, CO 80903
719.520.1466

LA
800 Wilshire Blvd.
Suite 1080
Los Angeles, CA 90017
213.533.1466

CONSULTANTS:

Schnackel engineers

New York • Marina Cinelli • Los Angeles • Seattle • Honolulu
800.681.0982 www.schnackel.com

MEP/ FP ENGINEER
3030 S 72ND ST
OMAHA NE 68124
TEL 402.391.7880

SEAL/ SIGNATURE:

REGISTERED PROFESSIONAL ENGINEER GREGORY ROY SCHNACKEL No. M33099 OF CALIFORNIA

Date: 08/01/25

NO	BY	DATE	DESCRIPTION
1	GRS	2025-08-01	IFC
	GRS	2025-02-20	PERMIT/BID SET
	GRS	2025-01-30	75% SET

SHAKE SHACK

SHAKE SHACK BERKELEY

1960 OXFORD STREET, SUITE F
BERKELEY, CA 94704
SHACK #1635

IFC SET

CAPTIVEAIRE DRAWINGS

DRAWN BY:	RR
CHECKED BY:	GRS
JOB NO:	30245548.00

M707