SHEET NUMBER	SHEET NAME
M001	MECHANICAL ABBREVIATIONS AND SYMBOLS
M101	MECHANICAL FLOOR PLAN
M102	MECHANICAL REFRIGERANT PIPING LAYOUT PLAN
M150	MECHANICAL ROOF PLAN
M501	MECHANICAL DETAILS
M502	MECHANICAL DETAILS
M590	MECHANICAL SPECIFICATIONS
M591	MECHANICAL SPECIFICATIONS
M592	MECHANICAL SPECIFICATIONS
M593	MECHANICAL SPECIFICATIONS
M601	MECHANICAL SCHEDULE
M701	HALTON DRAWINGS
M702	HALTON DRAWINGS
M703	HALTON DRAWINGS
M704	HALTON DRAWINGS
M705	HALTON DRAWINGS

RESPONSIBILITY MATRIX

THIS SCHEDULE IS PROVIDED FOR QUICK REFERENCE ONLY.
THE GENERAL CONTRACTOR IS RESPONSIBLE FOR ALL WORK DESCRIBED IN THE CONSTRUCTION DOCUMENTS.
CONFLICTS BETWEEN THIS SCHEDULE AND THE REST OF THE CONTRACT DOCUMENTS SHALL BE BROUGHT TO THE ARCHITECT'S ATTENTION PRIOR TO BEGINNING WORK.

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	X			X			GENERAL CONTRACTOR SCOPE OF WORK TO INCLUDE RIGGING, CURBS, AND ACCESSORIES
23.2.2 ROOFTOP UNIT CURBS	X			X			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 UNIT CURBS		X		X			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. 27 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	X			X			
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. 26
23.5.4 DUCTED AND NON-DUCTED HEATING AND COOLING UNITS	X			X			
23.5.5 MAKE UP AIR UNITS		X		X			SUPPLIED BY VENDOR NO. 26
23.5.6 ELECTRIC PATIO HEATERS	X			X			
23.5.7 CONDENSING UNITS	X			X			
23.5.8 RGF PHI SYSTEM	X			X			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 12 VENDOR SUBSTITUTION IS NOT PERMITTED
23.6 KITCHEN EXHAUST WITH FIRE SUPPRESSION SYSTEM							
23.6.1 HOOD CONTROL PANEL		X		X			SUPPLIED BY VENDOR NO. 26
23.6.2 KITCHEN EXHAUST HOOD		X		X			SUPPLIED BY VENDOR NO. 26
23.6.3 STRUCTURAL SUPPORT	X			X			
23.6.4 ELECTRICAL AND CONTROL WIRING	X			X			
23.6.5 ANSUL SYSTEM		X		X			SUPPLIED BY VENDOR NO. 26 GENERAL CONTRACTOR TO COORDINATE AND FACILITATE SYSTEM SIGN-OFF
23.6.6 ANSUL WIRING AND UTILITIES CONNECTION	X			X			
23.6.7 ANSUL GAS VALVE		X		X			SUPPLIED BY VENDOR NO. 26
23.7 COMMISSIONING ACTIVITIES							
23.7.1 GREASE EXHAUST WATER LEAKAGE TEST	X			X			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 10 VENDOR SUBSTITUTION IS NOT PERMITTED
23.7.2 TESTING AIR BALANCE (TAB) REPORT	X			X			GENERAL CONTRACTOR TO PURCHASE FROM VENDOR NO. 12 VENDOR SUBSTITUTION IS NOT PERMITTED

SYMBOLS

HEATING-VENTILATING-AIR CONDITIONING

SYMBOL	DESCRIPTION
T	THERMOSTAT
S	REMOTE SENSOR
	SUPPLY DIFFUSER
	RETURN OR EXHAUST GRILLE
	SUPPLY OR FRESH AIR DUCT (SA OR FA)
	RETURN OR EXHAUST AIR DUCT (RA OR EA)
10/6	RECTANGULAR DUCT FIRST FIGURE IS SIDE SHOWN
SIZE	ROUND DUCT
VOLUME DAMPER PLAN	VOLUME DAMPER (ELEV AND PLAN)
	TURNING VANES
CFM / SIZE	SUPPLY REGISTER OR GRILLE (R OR G)
CFM / SIZE	RETURN REGISTER OR GRILLE (R OR G)
CFM / SIZE	FRESH AIR INTAKE (FA)
	SQUARE CEILING DIFFUSER (SUPPLY)
D	CONDENSATE OR VACUUM PUMP DISCHARGE
G	GAS LINE
RL	REFRIGERANT LIQUID LINE
RS	REFRIGERANT SUCTION LINE
MD	MOTORIZED DAMPER

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CONSULTANTS:
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www.schnackel.com
SE JOB# 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 42695
REGISTERED PROFESSIONAL ENGINEER
Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

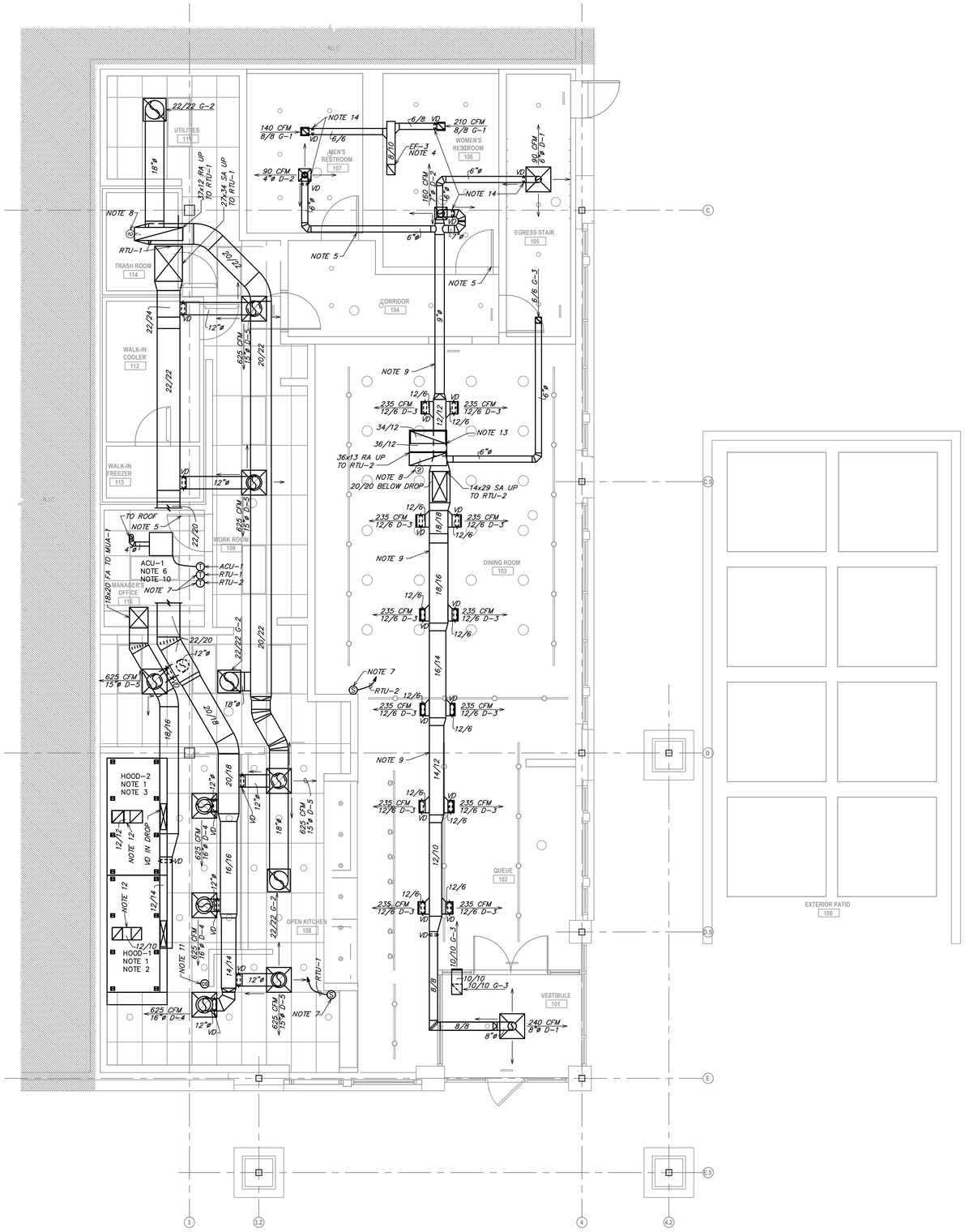
HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL ABBREVIATIONS & SYMBOLS

DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M001



1 MECHANICAL FLOOR PLAN
SCALE: 1/4" = 1'-0"

GENERAL NOTES:

A. EXISTING CONDITIONS ARE BASED ON RECORD DRAWINGS PROVIDED BY THE OWNER AND/OR LIMITED FIELD VERIFICATION BY OTHERS. 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 CORD.
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 SUPPLY AND UNTEMPERED OUTDOOR AIR DUCTWORK VISIBLE TO THE PUBLIC SHALL BE INTERNALLY LINED AND PAINTED TO MATCH THE SURROUNDING AREA. DUCT WRAP INSULATION IS NOT PERMITTED IN THESE AREAS.
O. EXPOSED SPIRAL DUCT TO BE GALVANIZED FINISH, FREE FROM SCRATCHES, DENTS OR BLEMISHES AND PAINTED TO MATCH THE SURROUNDING AREA. DUCT SHALL BE INTERNALLY LINED AND SEALED WITH DUCT SEALER COMPLETELY CONCEALED WITHIN THE DUCT JOINT. NO EXPOSED SEALER OR TAPE WILL BE ACCEPTED.
P. PROVIDE REMOTE VOLUME DAMPER CONTROL MANUFACTURED BY YOUNG REGULATOR OR UNITED ENERTECH FOR DAMPERS LOCATED ABOVE INACCESSIBLE CEILINGS. LOCATE CONTROLLER ABOVE ACCESSIBLE CEILING LOCATION.
Q. 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.
R. 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.
S. ALL ROOFING WORK SHALL BE PERFORMED BY LANDLORD'S APPROVED ROOFING CONTRACTOR AT TENANT'S EXPENSE, IF REQUIRED IN LEASE OR TENANT CRITERIA MANUAL.
T. ROOF MOUNTED EQUIPMENT SHALL BE LABELED WITH THE TENANT NAME AND SPACE NUMBER WITH 3" HIGH WEATHER PROOF LETTERS.
U. ALL GREASE EXHAUST DUCTWORK SHALL BE PROVIDED WITH 3" FOIL FACED THERMAL-CERAMIC INSULATION FOR GREASE DUCTS. INSULATION SHALL MEET NFPA 96 AND ASTM E 2336 REQUIREMENTS.
V. GREASE DUCT LEAKAGE TESTING MUST BE PERFORMED PRIOR TO CONCEALMENT OF THE DUCTWORK.
W. 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.
X. AT THE COMPLETION OF CONSTRUCTION AN NEBB, AABC OR TABB CERTIFIED AIR BALANCE REPORT SHALL BE SUBMITTED TO THE ENGINEER AND LANDLORD. THE BALANCING MUST BE COMPLETED BY AN INDEPENDENT, THIRD PARTY CONTRACTOR WITH NO TIES TO THE INSTALLING CONTRACTORS.
Y. DISPOSE OF ALL EQUIPMENT NOT REUSED AS A PART OF THE NEW WORK AS DIRECTED BY THE OWNER. THE OWNER RESERVES THE FIRST RIGHT OF SALVAGE ON ALL EQUIPMENT AND MATERIALS.
Z. THE CONTRACTOR SHALL OBTAIN A COPY OF THE LANDLORD'S TENANT CRITERIA MANUAL. TENANT CRITERIA MANUAL IS AN INTEGRAL PART OF THIS CONTRACT. CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING WITH LANDLORD REQUIREMENTS AT NO ADDITIONAL COST TO THE TENANT.
AA. PARTS OF THE BASE BUILDING SYSTEMS THAT FALL INTO LEASE LINE SHALL REMAIN UNDISTURBED UNLESS NOTED OTHERWISE.
AB. PROVIDE ALL NECESSARY WIRING, RELAYS, DETECTORS, COMPONENTS, ETC., FOR FIRE ALARM OR CONTROL SYSTEM INTERLOCK IF APPLICABLE. VERIFY WITH PERSONNEL BEFORE BID.

HVAC NOTES:

1. NEW HALTON GREASE EXHAUST HOOD TO BE FURNISHED BY OWNER FOR INSTALLATION BY THE MECHANICAL CONTRACTOR. SEE HALTON SHEETS M701 THROUGH M705 FOR ADDITIONAL INFORMATION. BALANCE HOOD MAKE-UP AIR AND EXHAUST COLLARS AS NOTED ON THE HOOD SCHEDULE. PROVIDE FULL SIZE TRANSITION MAKE-UP AIR DUCT FROM COLLAR TO MAKE-UP AIR MAIN DUCT AS INDICATED ON PLANS.
2. TRANSITION FROM HOOD EXHAUST COLLAR AS INDICATED ON PLANS AND EXTEND 12/10 KITCHEN HOOD GREASE EXHAUST DUCTWORK UP TO GREASE EXHAUST FAN ON ROOF. SEE SHEET M150 FOR CONTINUATION. GREASE DUCT SHALL BE WRAPPED WITH TWO (2) LAYERS OF THERMAL CERAMICS FAST WRAP XL, 1 1/2" THICK WITH 3" PERIMETER AND LONGITUDINAL OVERLAPS OR EQUIVALENT U.L. LISTED GREASE DUCT WRAP FOR ZERO CLEARANCE TO COMBUSTIBLES. REFER TO DETAIL ON SHEET M501 FOR ADDITIONAL INFORMATION.
3. TRANSITION FROM HOOD EXHAUST COLLAR AS INDICATED ON PLANS AND EXTEND 12/12 KITCHEN HOOD GREASE EXHAUST DUCTWORK UP TO GREASE EXHAUST FAN ON ROOF. SEE SHEET M150 FOR CONTINUATION. GREASE DUCT SHALL BE WRAPPED WITH TWO (2) LAYERS OF THERMAL CERAMICS FAST WRAP XL, 1 1/2" THICK WITH 3" PERIMETER AND LONGITUDINAL OVERLAPS OR EQUIVALENT U.L. LISTED GREASE DUCT WRAP FOR ZERO CLEARANCE TO COMBUSTIBLES. REFER TO DETAIL ON SHEET M501 FOR ADDITIONAL INFORMATION.
4. PROVIDE 8/8 EXHAUST AIR DUCT UP TO EF-3 ON ROOF.
5. CONTRACTOR SHALL UNDERCUT DOOR 3/4".
6. PROVIDE REFRIGERANT LINES FROM ASHP-1 ON ROOF TO ACU-1 IN ROOM 108. 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.
7. 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. THERMOSTATS SERVING THE SAME TEMPERATURE ZONE SHALL BE INTERLOCKED TO PREVENT SIMULTANEOUS HEATING AND COOLING. PROVIDE REMOTE TEMPERATURE SENSORS AS INDICATED ON PLAN. COORDINATE LOCATION WITH WALL GRAPHICS LAYOUT.
8. DUCT SMOKE DETECTOR ON RETURN 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.
9. ROUTE EXPOSED SUPPLY DUCT AT 16'-0" ABOVE FINISHED FLOOR. COORDINATE ROUTING AND MOUNTING HEIGHT WITH LIGHTING FIXTURES. TYPICAL OF EXPOSED DUCTWORK.
10. PROVIDE NEW ACU AS NOTED ON PLANS AND AS SCHEDULED ON SHEET M601.
11. CARBON MONOXIDE DETECTOR TO BE INTERLOCKED WITH GAS VALUE AND AUDIBLE ALARM. REFER TO ELECTRICAL AND PLUMBING SHEETS FOR ADDITIONAL INFORMATION.
12. PROVIDE CLEANOUTS ON GREASE EXHAUST DUCTWORK AS REQUIRED BY CODE. REFERENCE SHEET M501, DETAIL 5, FOR ADDITIONAL INFORMATION.
13. TOP OPEN RETURN AIR DUCT. PROVIDE OPENING WITH 1/4" MESH GALVANIZED SCREEN.
14. PROVIDE REMOTE VOLUME DAMPER AS INDICATED ON PLANS. REFERENCE SHEET M502, DETAIL 5, FOR ADDITIONAL INFORMATION.

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SE JOB# 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 12695
REGISTERED PROFESSIONAL ENGINEER

Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

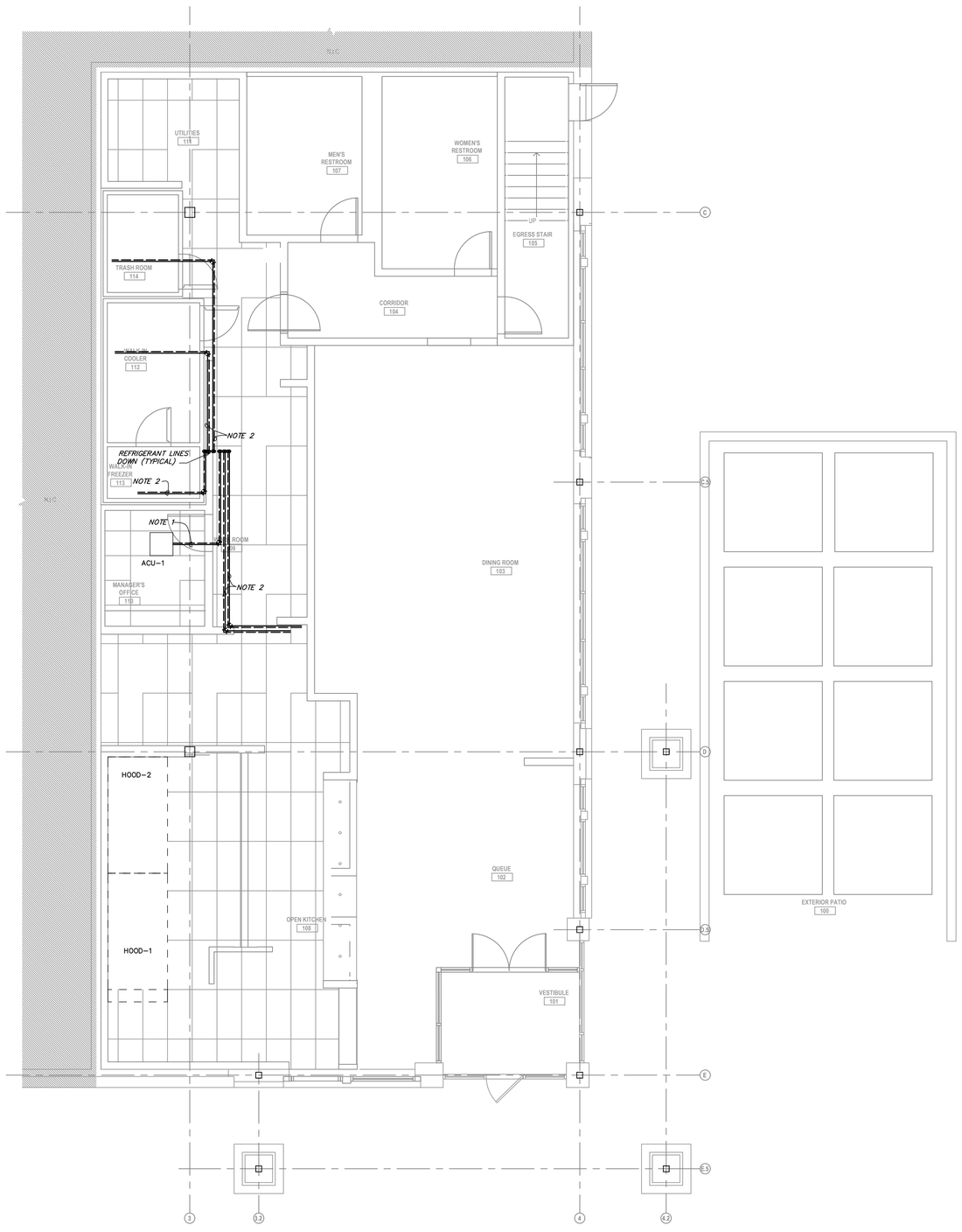
HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL FLOOR PLAN

DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M101



1 MECHANICAL REFRIGERANT PIPING LAYOUT PLAN
SCALE: 1/4" = 1'-0"

GENERAL NOTES:

A. EXISTING CONDITIONS ARE BASED ON RECORD DRAWINGS PROVIDED BY THE OWNER AND/OR LIMITED FIELD VERIFICATION BY OTHERS. 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 CORD.
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 SUPPLY AND UNTEMPERED OUTDOOR AIR DUCTWORK VISIBLE TO THE PUBLIC SHALL BE INTERNALLY LINED AND PAINTED TO MATCH THE SURROUNDING AREA. DUCT WRAP INSULATION IS NOT PERMITTED IN THESE AREAS.
O. EXPOSED SPIRAL DUCT TO BE GALVANIZED FINISH, FREE FROM SCRATCHES, DENTS OR BLEMISHES AND PAINTED TO MATCH THE SURROUNDING AREA. DUCT SHALL BE INTERNALLY LINED AND SEALED WITH DUCT SEALER COMPLETELY CONCEALED WITHIN THE DUCT JOINT. NO EXPOSED SEALER OR TAPE WILL BE ACCEPTED.
P. PROVIDE REMOTE VOLUME DAMPER CONTROL MANUFACTURED BY YOUNG REGULATOR OR UNITED ENERTECH FOR DAMPERS LOCATED ABOVE INACCESSIBLE CEILINGS. LOCATE CONTROLLER ABOVE ACCESSIBLE CEILING LOCATION.
Q. 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.
R. 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.
S. ALL ROOFING WORK SHALL BE PERFORMED BY LANDLORD'S APPROVED ROOFING CONTRACTOR AT TENANT'S EXPENSE, IF REQUIRED IN LEASE OR TENANT CRITERIA MANUAL.
T. ROOF MOUNTED EQUIPMENT SHALL BE LABELED WITH THE TENANT NAME AND SPACE NUMBER WITH 3" HIGH WEATHER PROOF LETTERS.
U. ALL GREASE EXHAUST DUCTWORK SHALL BE PROVIDED WITH 3" FOIL FACED THERMAL-CERAMIC INSULATION FOR GREASE DUCTS. INSULATION SHALL MEET NFPA 96 AND ASTM E 2336 REQUIREMENTS.
V. GREASE DUCT LEAKAGE TESTING MUST BE PERFORMED PRIOR TO CONCEALMENT OF THE DUCTWORK.
W. 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.
X. AT THE COMPLETION OF CONSTRUCTION AN NEBB, AABC OR TABB CERTIFIED AIR BALANCE REPORT SHALL BE SUBMITTED TO THE ENGINEER AND LANDLORD. THE BALANCING MUST BE COMPLETED BY AN INDEPENDENT, THIRD PARTY CONTRACTOR WITH NO TIES TO THE INSTALLING CONTRACTORS.
Y. DISPOSE OF ALL EQUIPMENT NOT REUSED AS A PART OF THE NEW WORK AS DIRECTED BY THE OWNER. THE OWNER RESERVES THE FIRST RIGHT OF SALVAGE ON ALL EQUIPMENT AND MATERIALS.
Z. THE CONTRACTOR SHALL OBTAIN A COPY OF THE LANDLORD'S TENANT CRITERIA MANUAL. TENANT CRITERIA MANUAL IS AN INTEGRAL PART OF THIS CONTRACT. CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING WITH LANDLORD REQUIREMENTS AT NO ADDITIONAL COST TO THE TENANT.
AA. PARTS OF THE BASE BUILDING SYSTEMS THAT FALL INTO LEASE LINE SHALL REMAIN UNDISTURBED UNLESS NOTED OTHERWISE.
AB. PROVIDE ALL NECESSARY WIRING, RELAYS, DETECTORS, COMPONENTS, ETC., FOR FIRE ALARM OR CONTROL SYSTEM INTERLOCK IF APPLICABLE. VERIFY WITH PERSONNEL BEFORE BID.

HVAC NOTES

1. PROVIDE REFRIGERANT LINES FROM ASHP-1 ON ROOF TO ACU-1 ABOVE KITCHEN OFFCIE SPACE 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.
2. PROVIDE REFRIGERANT LINES FROM CONDENSING UNIT ON ROOF 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. REFER TO KITCHEN EQUIPMENT VENDOR DRAWINGS FOR ADDITIONAL INFORMATION. ADJUST ROUTING AS NECESSARY IN FIELD FOR ANY OBSTACLES.

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SE JOB# 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 12955
REGISTERED PROFESSIONAL ENGINEER
Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

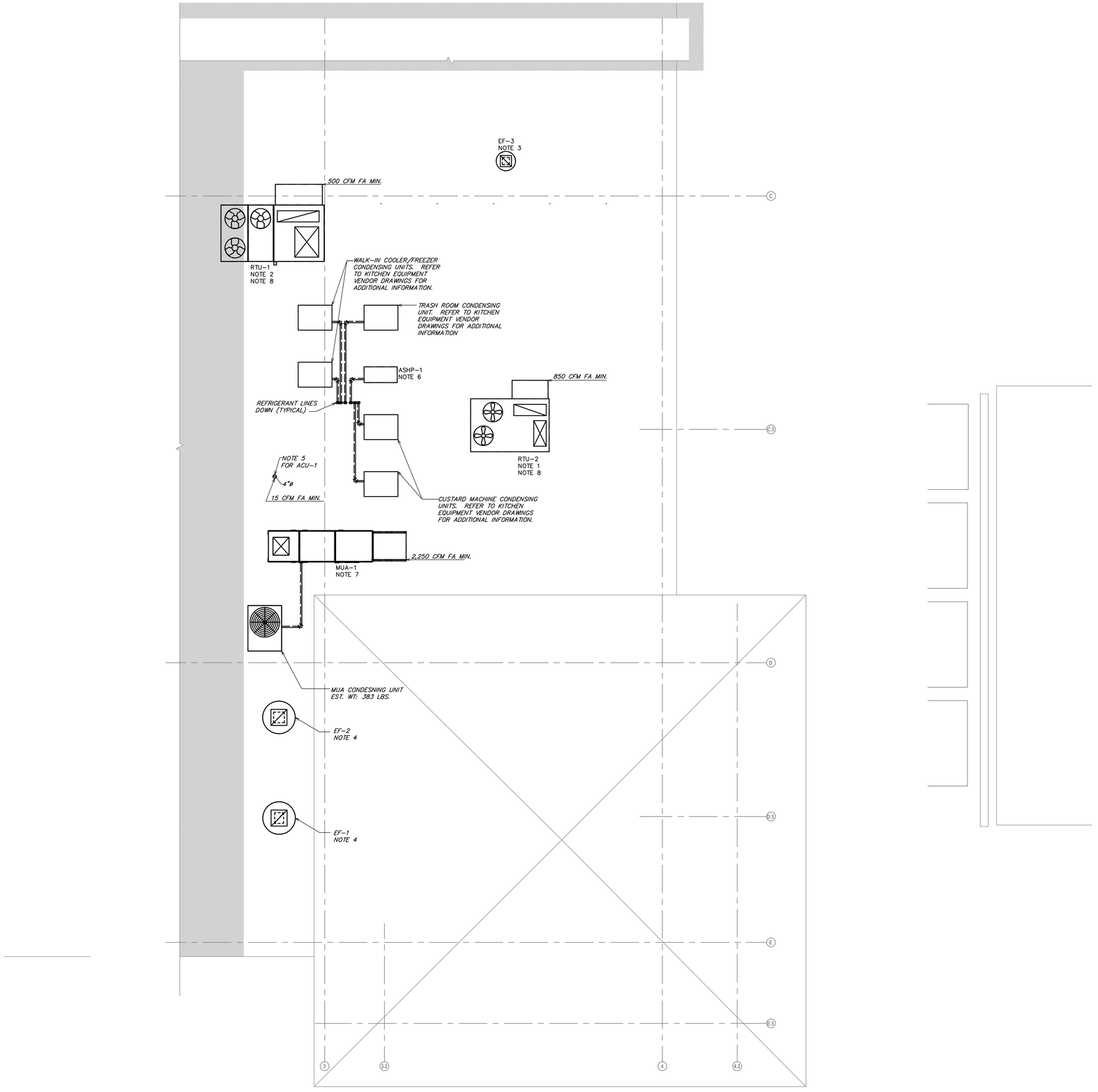
HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL REFIGERANT PIPING LAYOUT PLAN

DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M102



1 MECHANICAL ROOF PLAN
SCALE: 1/4" = 1'-0"

GENERAL NOTES:

A. EXISTING CONDITIONS ARE BASED ON RECORD DRAWINGS PROVIDED BY THE OWNER AND/OR LIMITED FIELD VERIFICATION BY OTHERS. 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 CORD.
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 SUPPLY AND UNTEMPERED OUTDOOR AIR DUCTWORK VISIBLE TO THE PUBLIC SHALL BE INTERNALLY LINED AND PAINTED TO MATCH THE SURROUNDING AREA. DUCT WRAP INSULATION IS NOT PERMITTED IN THESE AREAS.
O. EXPOSED SPIRAL DUCT TO BE GALVANIZED FINISH, FREE FROM SCRATCHES, DENTS OR BLEMISHES AND PAINTED TO MATCH THE SURROUNDING AREA. DUCT SHALL BE INTERNALLY LINED AND SEALED WITH DUCT SEALER COMPLETELY CONCEALED WITHIN THE DUCT JOINT. NO EXPOSED SEALER OR TAPE WILL BE ACCEPTED.
P. PROVIDE REMOTE VOLUME DAMPER CONTROL MANUFACTURED BY YOUNG REGULATOR OR UNITED ENERTECH FOR DAMPERS LOCATED ABOVE INACCESSIBLE CEILINGS. LOCATE CONTROLLER ABOVE ACCESSIBLE CEILING LOCATION.
Q. 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.
R. 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.
S. ALL ROOFING WORK SHALL BE PERFORMED BY LANDLORD'S APPROVED ROOFING CONTRACTOR AT TENANT'S EXPENSE, IF REQUIRED IN LEASE OR TENANT CRITERIA MANUAL.
T. ROOF MOUNTED EQUIPMENT SHALL BE LABELED WITH THE TENANT NAME AND SPACE NUMBER WITH 3" HIGH WEATHER PROOF LETTERS.
U. ALL GREASE EXHAUST DUCTWORK SHALL BE PROVIDED WITH 3" FOIL FACED THERMAL-CERAMIC INSULATION FOR GREASE DUCTS. INSULATION SHALL MEET NFPA 96 AND ASTM E 2336 REQUIREMENTS.
V. GREASE DUCT LEAKAGE TESTING MUST BE PERFORMED PRIOR TO CONCEALMENT OF THE DUCTWORK.
W. 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.
X. AT THE COMPLETION OF CONSTRUCTION AN NEBB, AABC OR TABB CERTIFIED AIR BALANCE REPORT SHALL BE SUBMITTED TO THE ENGINEER AND LANDLORD. THE BALANCING MUST BE COMPLETED BY AN INDEPENDENT, THIRD PARTY CONTRACTOR WITH NO TIES TO THE INSTALLING CONTRACTORS.
Y. DISPOSE OF ALL EQUIPMENT NOT REUSED AS A PART OF THE NEW WORK AS DIRECTED BY THE OWNER. THE OWNER RESERVES THE FIRST RIGHT OF SALVAGE ON ALL EQUIPMENT AND MATERIALS.
Z. THE CONTRACTOR SHALL OBTAIN A COPY OF THE LANDLORD'S TENANT CRITERIA MANUAL. TENANT CRITERIA MANUAL IS AN INTEGRAL PART OF THIS CONTRACT. CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING WITH LANDLORD REQUIREMENTS AT NO ADDITIONAL COST TO THE TENANT.
AA. PARTS OF THE BASE BUILDING SYSTEMS THAT FALL INTO LEASE LINE SHALL REMAIN UNDISTURBED UNLESS NOTED OTHERWISE.
AB. PROVIDE ALL NECESSARY WIRING, RELAYS, DETECTORS, COMPONENTS, ETC., FOR FIRE ALARM OR CONTROL SYSTEM INTERLOCK IF APPLICABLE. VERIFY WITH PERSONNEL BEFORE BID.

HVAC NOTES:

1. PROVIDE NEW RTU AS NOTED ON PLANS AND AS SCHEDULED ON SHEET M-601. FIELD VERIFY EXACT LOCATION.
2. EXISTING CARRIER 48HJD017 ROOFTOP UNIT TO BE REPLACED, RE-USE EXISTING CURB. VERIFY EXACT LOCATION IN THE FIELD. SEE SHEET M-601 FOR ROOFTOP UNIT SCHEDULE. INSTALLATION MAY REQUIRE TRANSITION CURB ADAPTOR, RETAIL AIR SYSTEMS, CUSTOM CURB, OR EQUAL MANUFACTURER.
3. PROVIDE NEW EXHAUST FAN AS NOTED ON PLANS AND SCHEDULED ON SHEET M-601. THE CONTRACTOR SHALL FIELD VERIFY THAT THE LOCATION SHOWN IS A MINIMUM OF 10'-0" FROM ANY OUTDOOR AIR INTAKE.
4. NEW HALTON GREASE EXHAUST FAN TO BE PROVIDED BY OWNER FOR INSTALLATION BY MECHANICAL CONTRACTOR. SEE HALTON SHEETS M701 THROUGH M705 FOR ADDITIONAL INFORMATION. CONTRACTOR SHALL FIELD VERIFY THAT THE LOCATION SHOWN IS A MINIMUM OF 10'-0" FROM ANY OUTDOOR AIR INTAKE.
5. PROVIDE GOOSENECK TERMINATION FOR OUTDOOR AIR INTAKE FOR ACU-1. CONTRACTOR SHALL FIELD VERIFY THAT THE LOCATION IS A MINIMUM OF 10'0" FROM ANY EXHAUST/FLUE TERMINATION.
6. PROVIDE REFRIGERANT LINES FROM ASHP-1 ON ROOF TO ACU-1 IN ROOM 108. 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.
7. NEW HALTON MAKE-UP AIR UNIT TO BE PROVIDED BY OWNER FOR INSTALLATION BY THE MECHANICAL CONTRACTOR. SEE HALTON SHEET M-701 THROUGH M-705 FOR ADDITIONAL INFORMATION.
8. RGF PHI-PKG14-24V UV SYSTEM TO BE PROVIDED AND INSTALLED BY NTAB. REFER TO RESPONSIBILITY MATRIX ON SHEET M-001 FOR ADDITIONAL INFORMATION.

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		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

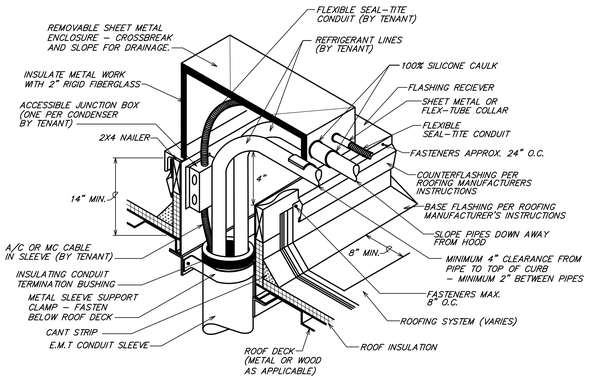
HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL ROOF PLAN

DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M150



7 CONDENSER REFRIGERANT LINE PIPING AND POWER THROUGH ROOF DECK

NOT TO SCALE

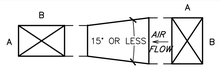
MAXIMUM HALF OF DUCT PERIMETER	PAIR AT 10 FT. SPACING		PAIR AT 8 FT. SPACING		PAIR AT 5 FT. SPACING		PAIR AT 4 FT. SPACING	
	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD	STRAP	WIRE/ ROD
P/2 = 30"	1" x 22 GA.	10 GA. (.135")	1" x 22 GA.	10 GA. (.135")	1" x 22 GA.	12 GA. (.106")	1" x 22 GA.	12 GA. (.106")
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.

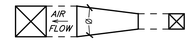
NOTES:
1. DIMENSIONS OTHER THAN GAUGE ARE IN INCHES.
2. TABLES ALLOW FOR DUCT WEIGHT, 1 LB./SF INSULATION WEIGHT AND NORMAL REINFORCEMENT AND TRAPEZE WEIGHT, BUT NO EXTERNAL LOADS.
3. STRAPS ARE GALVANIZED STEEL; OTHER MATERIALS ARE UNCOATED STEEL.
4. ALLOWABLE LOADS FOR P/2 ASSUME THAT DUCTS ARE 16 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.

4 RECTANGULAR DUCT HANGER TABLE

NOT TO SCALE



TRANSFORMATION



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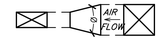

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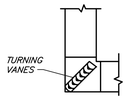
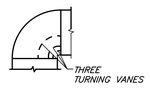
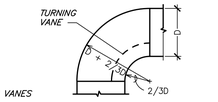


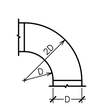
90° ELBOW
45° ELBOW SIMILAR



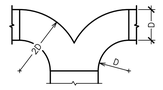
NO THROAT RADIUS



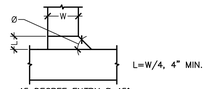
SHORT RADIUS



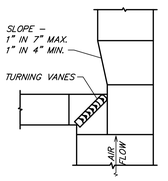
FULL RADIUS



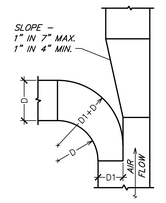
SUPPLY OR RETURN WYE
(RECTANGULAR DUCT)



45 DEGREE ENTRY Ø 45°
BRANCH TAKE-OFF
FITTING



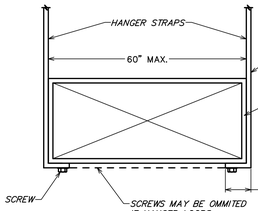
90° ELBOW TAKE-OFF
USE ONLY IN AREAS
WHERE SPACE IS LIMITED



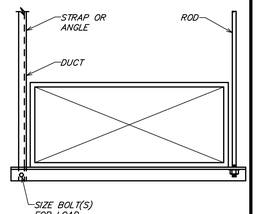
FULL RADIUS ELBOW
TAKE-OFF

1 DUCTWORK DETAILS

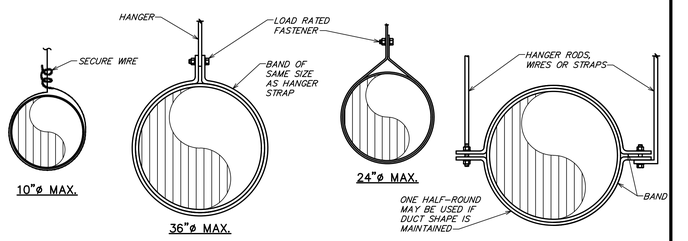
NOT TO SCALE



STRAP HANGER



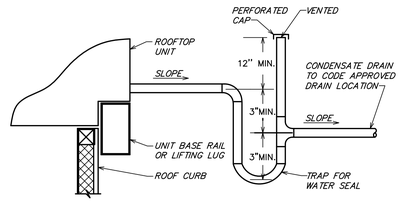
TRAPEZE HANGER



NOTE: HANGERS MUST NOT DEFORM DUCT SHAPE

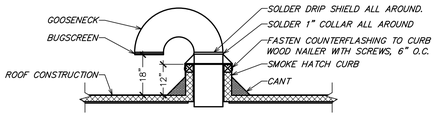
2 DUCT HANGER DETAIL

NOT TO SCALE



8 ROOF TOP UNIT CONDENSATE DETAIL

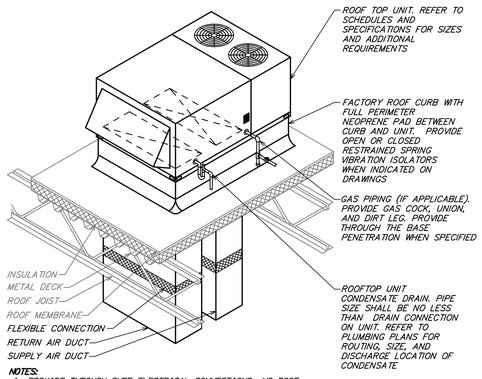
NOT TO SCALE



ALL COUNTERFLASHING DRIP SHIELD AND EXPOSED DUCTWORK SHALL BE 18 GA. GALVANIZED SHEETMETAL ALL SOLDERED AIR-TIGHT CONSTRUCTION

9 GOOSENECK WEATHERHOOD DETAIL

NOT TO SCALE

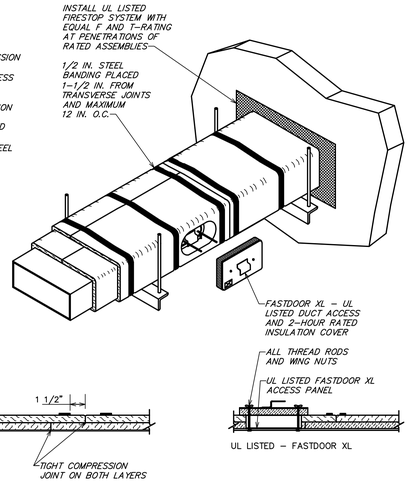


NOTES:
1. PROVIDE THROUGH CURB ELECTRICAL CONNECTIONS. NO ROOF PENETRATIONS OF ELECTRICAL CONDUITS WILL BE ACCEPTABLE.
2. DUCT SMOKE DETECTOR SHALL BE MOUNTED AND INSTALLED PER LOCAL CODES.

10 TYPICAL ROOF TOP UNIT DETAIL

NOT TO SCALE

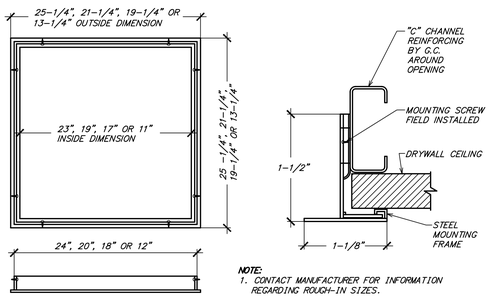
NOTES:
1. *THERMAL CERAMICS FIREMASTER FASTWRAP XL IS TESTED TO ASTM E2336 AND UL LISTED PER HNKT.G18 TO PROVIDE ZERO CLEARANCE TO COMBUSTIBLES AND TO PROVIDE A 1 OR 2 HOUR EXPOSURE. THROUGH PENETRATIONS FIRESTOP SYSTEMS ARE TESTED IN ACCORDANCE WITH ASTM E 814 (UL 1479). ICC-ES APPROVAL PER REPORT ESR 2213 OR EST 2832.*
2. *COMPLIANT TO THE FOLLOWING CODES:*
   NFPA 96
   INTERNATIONAL MECHANICAL CODES
   UNIFORM MECHANICAL CODE
   CALIFORNIA MECHANICAL CODE
3. *INSULATION APPLIED IN TWO LAYERS WITH TIGHT COMPRESSION JOINT ON BOTH LAYERS AT ALL JOINTS.*
4. *MINIMUM 16 GAUGE CARBON STEEL (OR 18 GAUGE STAINLESS STEEL) RECTANGULAR OR ROUND GREASE EXHAUST DUCT.*
5. *INSTALL UL LISTED AND LIQUID TIGHT THERMAL CERAMICS FASTDOOR XL ACCESS DOORS AT ALL CHANGES IN DIRECTION AND AT MINIMUM EVERY 20 FT ON HORIZONTAL RUNS.*
6. *SUPPORT HANGER SYSTEMS DO NOT NEED TO BE WRAPPED PROVIDED THE HANGER RODS ARE MINIMUM OF 3/8" IN. DIAMETER AND SUPPORTS ARE MINIMUM 2 2 X 1/8 IN. STEEL ANGLE OR SMACNA EQUIVALENT SUPPORT SYSTEM.*
7. *THERMAL CERAMICS DUCT WRAP SHALL BE INSTALLED DIRECTLY ONTO THE DUCT AND APPLIED FROM THE HOOD CONNECTION TO THE CONNECTION OF THE FAN.*
8. *THERMAL CERAMICS DUCT ENCLOSURE SYSTEM SHALL BE INSTALLED IN STRICT ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS AND UL LISTINGS.*



** DETAIL COURTESY OF MORGAN THERMAL CERAMICS.

5 FIREMASTER FASTWRAP XL DETAIL

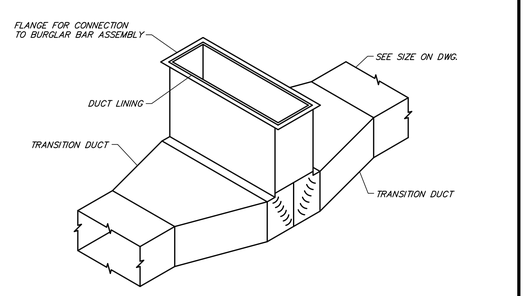
NOT TO SCALE



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

6 TYPICAL DRYWALL MOUNTING FRAME DETAIL

NOT TO SCALE



3 TYPICAL ROOF TOP UNIT TEE CONNECTION

NOT TO SCALE

Bergmeyer
www.bergmeyer.com
LA - 800 South Figueroa St. Suite 1610, Los Angeles, CA 90017, 212.337.1090
BOS - 51 Sleeper St. 5th Floor, Boston, MA 02210, 617.542.1025

CONSULTANTS:
Schnackel engineers
800-581-0963
www.schnackel.com
SE JOB# 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 42955
REGISTERED PROFESSIONAL ENGINEER
Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

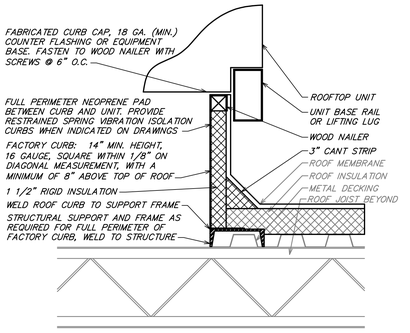
HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL DETAILS

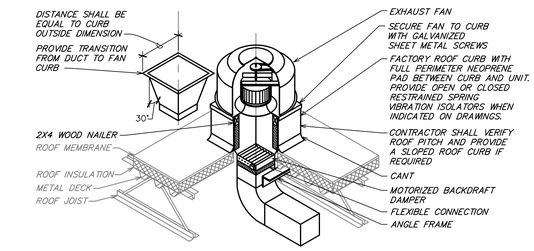
DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M501

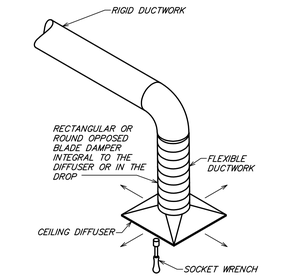


NOTES:
1. CUT AND PATCH EXISTING ROOFING AS REQUIRED FOR NEW CURB INSTALLATION.
2. CURB SHALL BE SHIMMED LEVEL; PROVIDE TAPERED ROOF CURB IF REQUIRED.
3. SECURELY INSTALL CURB TO ROOF STRUCTURE; USE FASTENERS AS REQUIRED BY ROOF CONSTRUCTION.

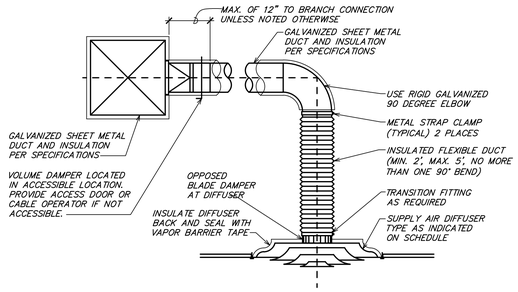
13 ROOF CURB DETAIL
NOT TO SCALE



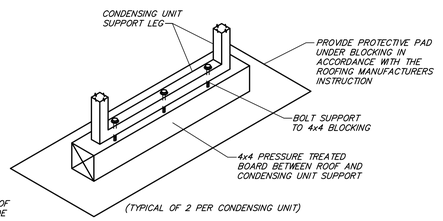
9 ROOF EXHAUST FAN DETAIL
NOT TO SCALE



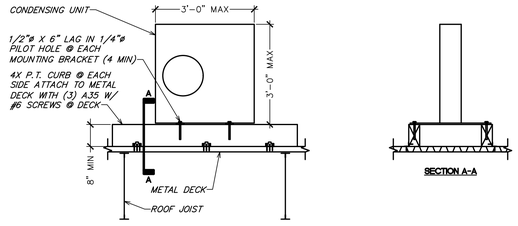
5 REMOTE VOLUME DAMPER CONTROLLER
NOT TO SCALE



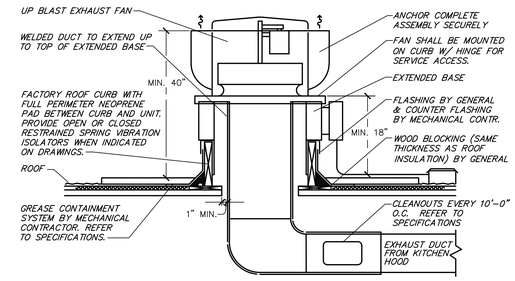
1 TYPICAL DIFFUSER CONNECTION
NOT TO SCALE



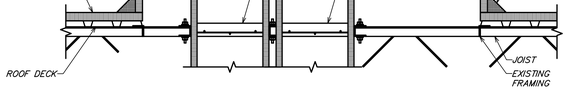
10 CONDENSING UNIT SUPPORT DETAIL
NOT TO SCALE



6 CONDENSING UNIT ANCHOR DETAIL (METAL)
NOT TO SCALE

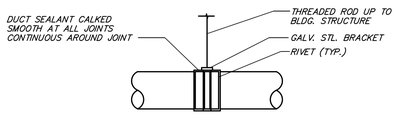


2 KITCHEN HOOD EXHAUST FAN
NOT TO SCALE

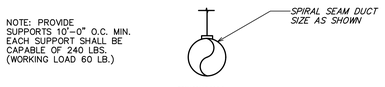


GENERAL NOTES APPLICABLE TO THIS DETAIL:
A. THROUGH THE CURB ELECTRICAL CONNECTIONS, ROOF PENETRATIONS OF ELECTRICAL CONDUIT WILL NOT BE ACCEPTABLE.

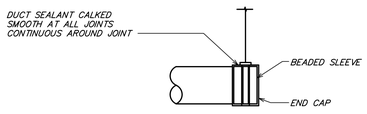
14 ROOF TOP UNIT ANCHOR DETAIL
NOT TO SCALE



LONGITUDINAL

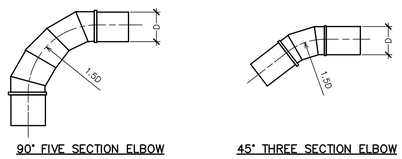


SECTION

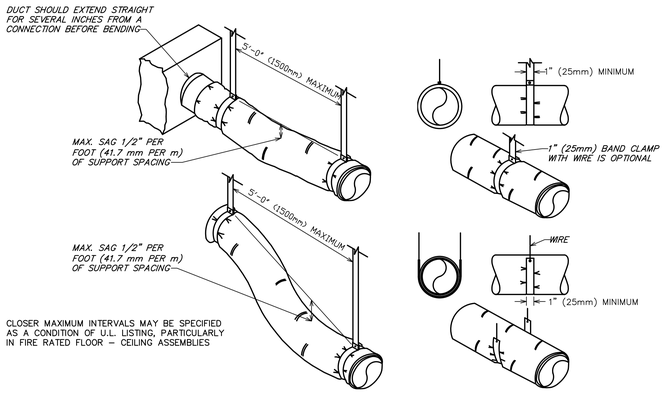


END CAP ELEVATION

11 EXPOSED ROUND DUCT SUPPORT DETAIL
NOT TO SCALE



12 TYPICAL ROUND DUCT FITTINGS
NOT TO SCALE

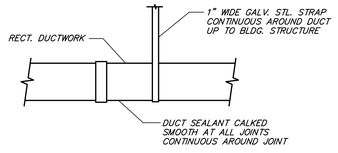


7 FLEXIBLE DUCT SUPPORTS
NOT TO SCALE

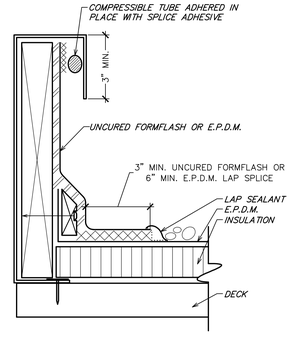
DIA.	WIRE DIA.	ROD	STRAP
10" DN	ONE 12 GA.	1/4"	1" x 22 GA.
11–18"	TWO 12 GA. OR ONE 8 GA.	1/4"	1" x 22 GA.
19–24"	TWO 10 GA.	1/4"	1" x 22 GA.
25–36"	TWO 8 GA.	3/8"	1" x 20 GA.
37–50"	–	TWO 3/8"	TWO 1" x 20 GA.
51–60"	–	TWO 3/8"	TWO 1" x 18 GA.
61–84"	–	TWO 3/8"	TWO 1" x 16 GA.
85–96"	–	TWO 1/2"	TWO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

8 ROUND DUCT HANGER TABLE
NOT TO SCALE



3 EXPOSED RECTANGULAR DUCT SUPPORT DETAIL
NOT TO SCALE



4 CURB FLASHING DETAIL
NOT TO SCALE

Bergmeyer
www.bergmeyer.com
LA - 800 South Figueroa St. Suite 1600 Los Angeles, CA 90017 212.337.1090
BOS - 51 Sleeper St. 5th Floor Boston, MA 02210 617.542.1025

CONSULTANTS:

Schnackel engineers
800-581-0963
www.schnackel.com
SE JOB#: 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 42655
REGISTERED PROFESSIONAL ENGINEER
Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL DETAILS

DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M502

SECTION 230000 – HVAC GENERAL CONDITIONS
SECTION 230548 – VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
SECTION 230593 – TESTING, ADJUSTING, AND BALANCING FOR HVAC
SECTION 230713 – DUCT INSULATION
SECTION 230713.13 – GREASE DUCT FIREPROOFING
SECTION 230719 – HVAC PIPING INSULATION
SECTION 232300 – REFRIGERANT PIPING
SECTION 233100 – HVAC DUCTS AND CASINGS
SECTION 233300 – AIR DUCT ACCESSORIES
SECTION 233423 – HVAC POWER VENTILATORS
SECTION 233700 – AIR OUTLETS AND INLETS
SECTION 237413 – PACKAGED OUTDOOR ROOF TOP UNITS – GAS FIRED
SECTION 238127 – SMALL SPLIT-SYSTEM HEATING AND COOLING
SECTION 23 0800 – COMMISSIONING OF HVAC
SECTION 23 0993 – SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

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, cure, protect, clean, connect, and place into operation into the work."
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, embedded 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, amendments, and ordinances. Also perform all work in accordance with the Americans with Disabilities Act (ADA) and the Authority Having Jurisdiction (AHJ) including Fire Marshal(s).
B. Perform work in accordance with Landlord requirements, including any Tenant Criteria Manuals and Lease Exhibits, where applicable.
C. Perform work in accordance with the requirements of 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), 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 ductwork, piping, equipment, and accessories. Follow these drawings in laying out the work and verify spaces 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. Any existing conditions indicated in the Contract Documents are based on information drawings 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 duct fabrication.
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 and shop drawings for HVAC ductwork.
g. Provide product data for air duct accessories.
h. Provide product data and shop drawings for HVAC power ventilators.
i. Provide product data and shop drawings for air outlets and inlets.
j. Provide product data and shop drawings for packaged rooftop units.
2. Submittals other 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 sections 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, listing 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 and 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.
5. Electrical Characteristics: Verify that proper power supply is available prior to ordering equipment. Verify proper 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 and to the owner. 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 both 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. Code or utility company requirements shall supersede any conflicting 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 WARRANTY AND GUARANTEE
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 at his option, provided the selected material meets 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 for the execution of this work.
C. Plan, lay out, 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 may be altered to suit the conditions with engineer approval, prior to the installation of 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 contract with the factory 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 interlock 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 as indicated on the Drawings.
B. Verify all equipment locations prior to rough-in. Maintain adequate equipment service clearance per manufacturer and code.
C. Verify routing of all ductwork and piping in field prior to fabrication or installation. Verify adequate clearance with structure, light 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, pipe, 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, completed status, and suitable operation of each system. Tests shall be conducted under the supervision of the Architect.

3.05 CLEANING AND REPAIR
A. Clean fire suppression parts to remove harmful materials.
B. Clean exposed surfaces of all ductwork pipe, equipment, and accessories of all dirt, debris, splatter, and other deleterious materials. Follow the manufacturer's recommendations for cleaning as applicable.
C. Repair or replace damaged ductwork, pipe, equipment, and accessories, as directed by and to the satisfaction of the Architect, where marring or disfigurement has occurred. All pipe, 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 Engineer.
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 locations of control devices including valves 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. One set 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. Equipment:
1. Fans, axial and centrifugal
2. Condensing units and air source heat pumps
3. Furnaces and fan coil units

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

PART 2 PRODUCTS

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

2.02 VIBRATION ISOLATORS
A. Spring Hanger:
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. Misalignment: Capable of 20 degree hanger rod misalignment.
4. For Exterior and Humid Areas: Hot dipped galvanized housings and neoprene coated springs.
B. Neoprene Pad Isolators:
1. Rubber or neoprene waffle pads.
a. Hardness: 30 durometer.
b. Thickness: Minimum 1/2 inch.
c. Maximum Loading: 50 psi.
d. Rib Height: Maximum 0.7 times width.
2. Configuration: Single layer.
C. Rubber Mount or Hanger: Molded rubber designed for 0.4 inch deflection with threaded insert.
D. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions.
B. 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.
C. Selection of type, thickness and deflection 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 below.

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 22" diameter wheel:
1. Base: Rubber Mount or Hanger
2. Condensing units and air source heat pumps.
a. Slab on grade:
1. Base: Concrete Housekeeping Pad.
2. Isolation: Neoprene Pad, Rubber Mount or Glass Fiber Pad.
b. Above grade floor or roof structures:
1. Base: Plastic or Fiber Cement Pad.
2. Isolation: Neoprene Pad, Rubber Mount or Glass Fiber Pad.
3. Furnaces and fan coil units.
a. Floor mounted (all locations):
1. Base: Concrete Housekeeping Pad.
2. Isolation: Neoprene Pad, Rubber Mount or Glass Fiber Pad.
b. Suspended:
1. Isolation: Rubber or Spring Hanger.

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. Measurement of final operating condition of HVAC systems.
C. Independent agency requirements.

1.02 SUBMITTALS
A. Vendor: Testing, adjustment, and balancing shall be provided by National TAB (NTAB). No alternates.
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, adjusting, and balancing.
2. Provide reports in bound manuals, complete with index page and indexing tabs, with cover identification at front and side. 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 that; 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 to provide uniform temperatures, eliminate drafts and objectionable noises during the first year of occupancy, including one full heating and one full cooling season, after the acceptance of the final balancing report.

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-1, AABC National Standards for Total System Balance.
2. ASHRAE Std 111, Practices for Measurement, 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 contractor.
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 15 percent of design.

3.03 RECORDING AND ADJUSTING
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 traverse 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 noises.
E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters. Do not use diffuser, grille or register integral dampers for balancing adjustments unless the plans do not indicate duct mounted devices.
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 on air supply units, including filter and coil pressure drops, and total pressure across the fan. 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 blending.
J. Where modulating dampers are provided, take measurements and balance at extreme conditions and at all intermediate operating conditions specified in the sequence of control. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

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

3.06 MINIMUM DATA TO BE REPORTED
A. Report (as applicable to the project):
1. Summary Comments:
a. Design versus 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 driven 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, 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

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.

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 25/50, maximum, when tested in accordance with ASTM E 84, NFPA 255, or UL 723.
B. Manufacturer: Knauf Fiber Glass; Johns Manville Corporation; Owens 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 Water Vapor Sorption: 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: 0.029 ng/Pa s m (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: Incombustible glass fiber complying with ASTM C 1071; flexible blanket, rigid board, or 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.
1. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
2. Service Temperature: Up to 250 degrees F.
3. Rated Velocity on Coated Air Side for Air 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 inches 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 vapor barrier jacket.
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 with or without standard vapor barrier jacket.
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.
3. Install without sag on undersside of duct. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct off trapeze hangers and insert spacers.
4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
E. Duct and Plenum Liner Application:
1. Adhere insulation 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 and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. 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 crawl spaces, attics or other unconditioned areas:
1. Flexible Glass Fiber Duct Insulation: 3 inches thick.
D. Supply air ducts exposed in finished areas:
1. Flexible Glass Fiber Duct Liner Insulation: 1 inches thick.
E. Return or exhaust air ducts exposed in finished areas: None.

END OF SECTION

SECTION 230713.13 – GREASE DUCT FIREPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Fire resistant duct wrap for kitchen hood exhaust ventilation ducts (grease ducts).
B. Firestopping at duct penetrations through fire rated walls and floors.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Acceptable Manufacturer: 3M Fire Protection Products, Inc.; Unifrax FyreWrap; Morgan Thermal Ceramics.

2.02 MATERIALS
A. Grease Duct Fireproofing: Material applied directly to metal ducts and achieving two-hour fire rated separation when tested in accordance with UL 2221 or ASTM E2336 by independent testing agency.
1. Surface Burning Characteristics: Flame spread index of 0 and smoke developed index of 0, when tested in accordance with ASTM E 84, both blanket and foil.
2. Combustibility: Non-combustible, when tested in accordance with ASTM E 136.
3. Flexibility: Capable of being formed around corners and shapes by hand.
4. Surface: Foil or other damage resistant surface; fiber not exposed after installation.
5. Accommodation For Duct Access Doors and Panels: Capable of being installed to achieve fire rating without impeding access.
6. Acceptable Product: 3M Fire Barrier Duct Wrap; fire resistant inorganic blanket encapsulated with scrim-reinforced foil facing.
B. Fasteners: Non-combustible; use one or both of the following to attach fireproofing to ducts:
1. Banding: Steel or stainless steel, 1/2 inch wide, minimum, and 0.015 inch thick, minimum; with steel banding clips.
2. Insulation Pins: Copper-coated steel impalement pins, minimum 12 gage, for welded attachment, with galvanized steel self-locking washers, 1-1/2 inch square or diameter; or equivalent sized cup-head pins.
C. Access Panel Hardware: Galvanized threaded rods, sleeves, washers, and wing nuts as specified in manufacturer's instructions.
D. Tape: Aluminum foil tape for sealing exposed fiber edges and repairing tears in facing.
E. Firestopping: Material tested in conjunction with fireproofing, in accordance with ASTM E 814, to achieve fire rated penetration seal at duct penetrations through fire rated assemblies.
1. Fire Rating: Same or greater than rating of penetrated assembly.
2. Acceptable Products: 3M Fire Barrier 1000 N/S, 1003 S/L, and 2000+ Silicone Sealants, as required by tested assembly.

PART 3 EXECUTION

3.01 EXAMINATION
A. Do not begin installation until substrates have been properly prepared.
B. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.02 PREPARATION
A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION
A. Install in strict accordance with manufacturer's instructions and as indicated on the Drawings.
B. 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.
C. Install fireproofing on entire surface of ducts indicated, except where Contract Documents explicitly indicate 3-sided or 2-sided installation.
D. At penetrations of ducts through fire rated assemblies (walls, floors, roofs), extend fireproofing through the opening and seal annular space between fireproofing and edge of opening with firestopping.
E. Fasten fireproofing to ducts using either banding or insulation pins welded directly to surface of duct; do not use adhesives.
F. Install firestopping on supports and hangers unless hanger rods are at least 3/8 inch in diameter, spaced not more than 60 inches on center along length of duct, and horizontal supports are at least 2 by 2 by 1/4 inch steel angle or equivalent SMACNA support system.
G. Access Panels: Do not block access; install fireproofing so that panel can be removed and reinstalled without damaging fireproofing.
H. Seal all cut edges and ends and repair tears in facing using aluminum foil tape.

END OF SECTION

SECTION 230719 – HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Cooling condensate drain piping insulation.
B. Refrigerant 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.
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. Insulation: ASTM C 547 and ASTM C 795; semi-rigid, noncombustible, end grain adhered to jacket.
1. 'K' value: ASTM C 177, 0.24 at 75 degrees F.
2. Maximum service temperature: 650 degrees F.
3. Maximum moisture absorption: 0.2 percent by volume.
D. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E 96/E 96M of 0.02 perm-inches.
E. Vapor Barrier Lap Adhesive: Compatible with insulation.
F. Insulating Cement/Mastic: ASTM C 195; hydraulic setting on mineral wool.
G. Fibrous Glass Fabric:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Blanket: 1.0 lb/cu ft density.
3. Weave: 5x5.
H. Indoor Vapor Barrier Finish:
1. Cloth: Untreated; 9 oz/sq yd weight.
2. Vinyl emulsion type acrylic, compatible with insulation, black color.
I. 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 complying 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
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. Moisture Vapor Permeability: 0.002 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: -40 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. Application: Piping 2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
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 insulating material suitable for the planned temperature range.
D. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions.
E. Exposed Piping: Locate insulation and cover seams in least visible locations.

3.02 SCHEDULE
A. Cooling Systems:
1. 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.
B. Refrigerant Suction:
a. Glass Fiber Insulation:
1. Pipe Size Range: All Sizes.
a. Thickness: 3/4 inch.
b. Flexible Elastomeric Cellular Foam Insulation:
1. Pipe Size Range: All Sizes.
a. Thickness: 3/4 inch.
C. Refrigerant Hot Gas:
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 232300 – REFRIGERANT PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Piping.
B. Refrigerant.
C. Moisture and liquid indicators.
D. Filter–driers.
E. Expansion valves.

1.02 SYSTEM

PART 2 PRODUCTS

2.01 PIPING
A. Copper Tube: ASTM B 280, H58 hard drawn or O60 soft annealed.
1. Fittings: ASME B16.22 wrought copper.
2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy.
B. Copper Tube to 7/8 inch OD: ASTM B 88 (ASTM B 88M), Type K (A), annealed.
1. Fittings: ASME B16.26 cast copper.
2. Joints: Flared.
C. Pipe Supports and Anchors:
1. Conform to ASME B31.5, ASTM F 708, MSS SP-58, MSS SP-69, and MSS SP-89.

2.02 REFRIGERANT
A. Provide refrigerant as specified by the manufacturer of the refrigeration equipment.

2.03 MOISTURE AND LIQUID INDICATORS
A. Manufacturers:
1. Henry Technologies; Parker Hannifin/Refrigeration and Air Conditioning; Sporlan Valve Company.
B. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator with removable element cartridge and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 500 psi.

2.04 FILTER-DRIERS:
A. Manufacturers;
1. Flow Controls Division of Emerson Electric; Parker Hannifin/Refrigeration and Air Conditioning; Sporlan Valve Company.
B. Performance:
1. Flow Capacity – Liquid Line: As required by capacities indicated on the Drawings, minimum, rated in accordance with ARI 710.
2. Flow Capacity – Suction Line: As required by capacities indicated on the Drawings, minimum, rated in accordance with ARI 730.
3. Pressure Drop: 2 psi, maximum, when operating at full connected evaporator capacity.
4. Design Working Pressure: 350 psi, minimum.
C. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, activated charcoal, and filtration to 40 microns, with secondary filtration to 20 microns; of construction that will not pass into refrigerant lines.
D. Construction: UL listed.
1. Replaceable Core Type: Steel shell with removable cap.
2. Sealed Type: Copper shell.
3. Connections: As specified for applicable pipe type.

2.05 EXPANSION VALVES
A. Manufacturers:
1. Flow Controls Division of Emerson Electric; Parker Hannifin/Refrigeration and Air Conditioning; Sporlan Valve Company.
B. Angle or Straight Through Type: ARI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, adjustable superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb.
C. Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 10 degrees F superheat. Select to avoid being undersized at full load and excessively oversized at part load.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install refrigeration specialties in accordance with manufacturer's instructions.
B. 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 contract with the factory 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.
C. Follow ASHRAE Std 15 procedures for charging and purging of systems and for disposal of refrigerant.
D. Fully charge completed system with refrigerant after testing.

3.02 FIELD QUALITY CONTROL
A. Test refrigeration system in accordance with ASME B31.5.
B. Hydrostatic test shall be performed on piping system. Provide test report to engineer and owner.

3.03 IDENTIFICATION
A. Provide manufacturer's standard pre-printed, semi-rigid snap-on or permanent adhesive, pressure-sensitive vinyl pipe markers. Color code pipe markers to comply with ANSI A13.1. Install pipe markers on each HVAC piping system and include arrows to show normal direction of flow. Locate pipe markers and color bands wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations. Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code: Green for Cooling; Yellow for Heating; Yellow/Green for combination Cooling and Heating; Brown for Energy Reclamation; Blue for other equipment types. Conform to ANSI A13.1 for Hazardous Equipment. Provide stenciled signs for equipment identification at Contractor's option or where distance of required identification requires lettering larger than 1 inch height. Stencil paint shall be exterior type, oil-based, alkyd enamel, minimum 1-1/4 inch height or greater as required for long distance identification, white or black color for best contrast. Provide duct markers or provide stenciled signs and arrows indicating ductwork service and flow direction in black or white lettering for best contrast with duct or insulation color. Locate markers maximum 50 feet along each duct side and within 5 feet of all control and balancing dampers or branch ducts more than 25 feet length and within 5 feet on each side of wall, floor, and ceiling penetrations. Provide additional markers in congested areas or at multiple duct runs as required for clarity.

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. Double wall insulated round ductwork.
E. Kitchen hood ductwork, Type 1 grease hoods.
F. 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 table of equivalent rectangular and round ducts, only after approval of the Engineer. Sizes shown on design drawings are air dimensions. 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, 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 manufacturers.
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. Aluminum Connectors and Bar Stock: Alloy 6061–T651 or of equivalent strength.
D. Insulated Flexible 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 polymer film supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
a. Pressure Rating: 4 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 configuration and compatible with substrates, 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. Ductwork Exposed to the Weather: Hard cast VersaGrip 102, (VG–102), UL 181–AM compliant duct joint sealer, as manufactured by Carlisle, with fiberglass scrim tape reinforcement on all seams and joints, lateral and longitudinal.
F. Hanger Rod: ASTM A 36/A 36M; steel; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK FABRICATION
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 not possible and where rectangular elbows must be used, 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 electric welded. Prime coat welded joints.
E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.
F. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank–out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.03 DUCT MANUFACTURERS
A. Metal–Fab, Inc.; SEMCO 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 material, 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 Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner 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 gage 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 prior to preparation of ductwork shop drawings and prior to the fabrication of any ductwork.
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 dimension, 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 inside a metal ring.
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 slips 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 feet maximum length of flexible duct held in place with strap or clamp. Longer duct lengths are acceptable if depicted on the design drawings and noted per local code. A maximum of one 90 degree bend, or equivalent, will be allowed in flexible duct runs.
L. During construction provide temporary closures of metal or taped polyethylene on open ducts to prevent construction dust from entering ductwork systems.
M. 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 sealer completely contained within the joint. Duct tape will not be permitted in exposed locations. If round duct is indicated in exposed locations, it must be spiral. No exposed duct sealer, tape or longitudinal joints will be accepted in exposed finished areas. Line all exposed supply air ductwork.
N. Kitchen hood exhaust, Type 1: Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.
O. 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 dye 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 welds on all sides.
P. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.
Q. 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 contract with the factory 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.

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 obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass 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.

3.05 IDENTIFICATION
A. Provide manufacturer's standard pre-printed, semi-rigid snap-on or permanent adhesive, pressure-sensitive vinyl pipe markers. Color code pipe markers to comply with ANSI A13.1. Install pipe markers on each HVAC piping system and include arrows to show normal direction of flow. Locate pipe markers and color bands wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations. Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code: Green for Cooling; Yellow for Heating; Yellow/Green for combination Cooling and Heating; Brown for Energy Reclamation; Blue for other equipment types. Conform to ANSI A13.1 for Hazardous Equipment. Provide stenciled signs for equipment identification at Contractor's option or where distance of required identification requires lettering larger than 1 inch height. Stencil paint shall be exterior type, oil-based, alkyd enamel, minimum 1-1/4 inch height or greater as required for long distance identification, white or black color for best contrast. Provide duct markers or provide stenciled signs and arrows indicating ductwork service and flow direction in black or white lettering for best contrast with duct or insulation color. Locate markers maximum 50 feet along each duct side and within 5 feet of all control and balancing dampers or branch ducts more than 25 feet length and within 5 feet on each side of wall, floor, and ceiling penetrations. Provide additional markers in congested areas or at multiple duct runs as required for clarity.

3.06 FIELD QUALITY CONTROL
A. Supply duct leakage test shall be performed. Provide test report to engineer and owner.

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; Prefco 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 sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
E. End Bearings: Except in round duct to 12 inches and smaller, provide end bearings. On 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 NFPA 90A, minimum density 30 oz per sq yd.
a. Net Fabric Width: Approximately 2 inches wide.
2. Metal: 3 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. Fabrication: Rigid and close–fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ducts, install minimum 1 inch thick insulation with sheet metal cover.
1. 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 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, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for 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 access to all dampers and control elements located above inaccessible ceiling areas. Provide minimum 12 x 12 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated. Provide 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
D. Provide balancing dampers at points on 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 register assembly. Do not locate dampers closer than 5 feet or 10 duct diameters from the air terminal device, whichever is greater.
F. At fans and motorized equipment associated with 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.

END OF SECTION

SECTION 233423 – HVAC POWER VENTILATORS

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Roof exhausters.
B. Kitchen range hood exhausters.

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.

2.03 ROOF EXHAUSTERS AND VENTILATORS
A. Fan Unit: V–belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.
B. Roof Curb: 20 inch high above the finished roof surface (compensate for roof insulation thickness at fan location) self–flashing of galvanized steel or aluminum construction with continuously welded seams, built–in cant strips, insulation and curb bottom, and factory installed nailer strip.
C. Disconnect Switch: Factory wired, non–fusible, in housing for thermal overload protected motor.
D. Backdraft Damper: Motor actuated (or gravity damper if depicted on design drawings), aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.
E. Sheaves: Cast iron or steel, dynamically balanced, bored to fit shafts and keyed; variable and adjustable pitch motor sheave selected so required rpm is obtained with sheaves set at mid–position; fan shaft with self–aligning pre–lubricated ball bearings.
F. Kitchen hood exhausters shall be upblast with grease tray, ventilated double wall curb and hinged curb adapter base for cleaning. Hood exhausters shall comply with requirements of NFPA 96.

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 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, accessories, and noise level.

1.03 QUALITY ASSURANCE
A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70. Test and rate louver performance in accordance with AMCA 500–L.
B. 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–core, or architectural plaque diffuser to discharge air in 360 degree pattern with sectorizing baffles where 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 fully adjustable pattern and removable face.
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 steel frame and 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 lay–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/GRILLES
A. Type: Streamlined and individually adjustable blades, 3/4 inch minimum depth, 3/4 inch maximum spacing with spring or other 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 20 gage minimum frame, or 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.

2.06 WALL EXHAUST AND RETURN REGISTERS/GRILLES
A. Type: Streamlined blades, 3/4 inch minimum depth, 3/4 inch maximum spacing, with spring or other device to set blades, vertical face.
B. Frame: 1–1/4 inch margin with countersunk screw mounting.
C. Fabrication: Steel frames and blades, with factory off–white enamel finish.
D. Damper (if specified on drawings): 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 237413 – PACKAGED OUTDOOR ROOF TOP UNITS – GAS FIRED

PART 1 GENERAL

1.01 SECTION INCLUDES
A. Packaged roof top units.
B. Thermostat controls.
C. Roof mounting curb and base.
D. Economizer.
E. Power exhaust.

PART 2 PRODUCTS

2.01 MANUFACTURERS
A. Carrier Corporation; Trane Inc.; Lennox Industries; York; AAON Incorporated.

2.02 AIR CONDITIONING UNITS
A. General: Roof mounted units having gas burner and electric refrigeration.
B. Description: Self–contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, heat exchanger and burner, controls, dx filters, refrigerant cooling coil and compressor, dry bulb economizer and power exhaust fan where indicated on the Drawings, condenser coil and condenser fan.
C. Electrical Characteristics: As scheduled on the Drawings.
D. Disconnect Switch: Factory mount disconnect switch on equipment.

2.03 FABRICATION
A. Cabinet: Steel with baked enamel finish, including access panels with screwdriver operated flush cam type fasteners or doors with piano hinges with locking handles. Structural members shall be minimum 18 gage, with access doors or panels of minimum 20 gage.
B. Insulation: one inch thick neoprene coated glass fiber with edges protected from erosion.
C. Heat Exchangers: Aluminized steel or stainless steel where indicated on the Drawings, of welded construction.
D. Supply Fan: Forward curved centrifugal type, resiliently mounted with V–belt drive, adjustable variable pitch motor pulley, and rubber isolated hinge mounted motor or direct drive as indicated. Isolate complete fan assembly.
1. Fans for units with a mechanical cooling capacity greater than or equal to 65,000 Btu/h shall have not fewer than two stages of fan control.
E. Air Filters: 2 inch thick disposable media in metal frames.
F. Roof Mounting Curb: Galvanized steel, channel frame, insulated with gaskets, nailer strips. Provide roof curb of adequate height to provide a unit mounting height of 12" or greater above the top of the roof surface with the curb mounted to the building structure. Roof curb height must compensate for the roof insulation thickness to meet this requirement.
G. Vibration Isolation Curb: Only when indicated on the Drawings.

2.04 BURNER
A. Gas Burner: Induced draft or forced draft type burner with adjustable combustion air supply, pressure regulator, gas valves, manual shut–off, intermittent spark or glow coil ignition, flame sensing device, and automatic 100 percent shut–off pilot.
B. Gas Burner Safety Controls: Energize ignition, limit time for establishment of flame, prevent opening of gas valve until pilot flame is proven, stop gas flow on ignition failure, energize blower motor, and after air flow proven and slight delay, allow gas valve to open.
C. High Limit Control: Temperature sensor with fixed stop at maximum permissible setting, de–energize burner on excessive bonnet temperature and energize burner when temperature drops to lower safe value.
D. Supply Fan Control: Temperature sensor sensing bonnet temperatures and independent of burner controls, with provisions for continuous fan operation.

2.05 EVAPORATOR COIL
A. Provide copper tube aluminum fin coil assembly with galvanized drain pan and connection.
B. Provide capillary tubes or thermostatic expansion valves for units of 6 tons capacity and less, and thermostatic expansion valves and alternate row circuiting for units 7.5 tons cooling capacity and larger.

2.06 COMPRESSOR
A. Provide hermetic or semi–hermetic compressors, 3600 rpm maximum, resiliently mounted with positive lubrication, crankcase heater, high and low pressure safety controls, motor overload protection, suction and discharge service valves and gage ports, and filter drier.
B. Time delay: Five minute time off circuit to delay compressor start.
C. Outdoor thermostat to energize compressor above 35 degrees F ambient.

2.07 CONDENSER COIL
A. Provide copper tube aluminum fin coil assembly with subcooling rows and coil guard.
B. Provide direct drive propeller fans, resiliently mounted with fan guard, motor overload protection, wired to operate with compressor.

2.08 MIXED AIR CASING
A. Dampers: Provide outside, return, and relief dampers with damper operator and control package to automatically vary outside air quantity. Outside air damper to fall to closed position. Relief dampers may be gravity balanced.
B. Gaskets: Provide tight fitting dampers with edge gaskets maximum leakage 5 percent at 2 inches pressure differential.
C. Damper Motor: 24 volt with gear train sealed in oil.
D. Damper Operator, Units 7.5 Ton Cooling Capacity and Larger: 24 volt with gear train sealed in oil with spring return on.
E. Mixed Air Controls: Maintain selected supply air temperature and return dampers to minimum position on call for heating and above 75 degrees F ambient, or when ambient air temperature exceeds return air temperature.

2.09 INTEGRATED ECONOMIZER:
A. Economizer shall be furnished and installed complete with outside air and relief dampers and controls.
B. Provide low–leakage, opposed blade dampers
1. Meet all leakage requirements of applicable energy code.
C. Economizer shall be capable of introducing up to 100% outdoor air for minimum ventilation as well as free cooling.
D. Damper actuator shall be electronic, fully modulating design.
E. Construction, the outdoor hood shall be pre-painted and fully integrated with the unit.
F. Dry Bulb Control: Provide dry bulb sensor capable of measuring temperature of outdoor air and controlling economizer cut–in point at the most economical level. High level cutoff shall be set per applicable energy code.
1. Provide economizer Fault Detection and Diagnostics (FDD).

2.10 POWER EXHAUST:
A. Package shall include exhaust fan(s) and damper for units with economizer to prevent over-pressurization of building including integral pressure controls.

2.11 WATER LEVEL MONITORING DEVICE:
A. Liquid level monitoring device shall be installed inside the primary drain pan. This device shall shut off the equipment served in the event that the primary drain becomes restricted. Devices installed in the drain line shall not be permitted.

2.12

2.13 OPERATING CONTROLS
A. Provide low voltage, adjustable thermostat to control heater stages in sequence with delay between stages, compressor and condenser fan, and supply fan to maintain temperature settings.
1. Include system selector switch (off–heat–auto–cool) and fan control switch (auto–on).
2. The Mechanical Contractor shall provide all control wiring between thermostat and unit control panel and any required remote sensors.
3. Locate thermostat in room as shown.
4. Electric solid state microcomputer based room thermostat, located as indicated. Provide remote temperature sensors when indicated on the Drawings.
a. Room thermostat shall incorporate:
1. Automatic switching from heating to cooling.
2. Preferential rate control to minimize overshoot and deviation from set point.
3. 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.
4. Set–up for four separate temperatures per day.
5. Instant override of set point for continuous or timed period from one hour to 31 days.
6. Short cycle protection.
7. Programming based on weekdays, Saturday and Sunday.
8. Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on–auto.
b. Room thermostat display shall include:
1. Time of day.
2. Actual room temperature.
3. Programmed temperature.
4. Day of week.
5. System mode indication: heating, cooling, auto, off, fan auto, fan on.
6. Stage (heating or cooling) operation.

PART 3 EXECUTION

3.01 INSTALLATION
A. Install in accordance with manufacturer's instructions and NFPA 90A.
B. Mount units on factory built roof mounting curb providing watertight enclosure to protect ductwork and utility services. Install roof mounting curb level. Install roof mounting curb so that it bears on the building structure, not on top of the roof deck or roofing materials. Provide restraints where required by local codes.
C. Provide cooling condensate drain piping (and overflow piping if required) to approved location. Condensate piping shall be Schedule 40 galvanized steel pipe, Type L copper tube, or PVC pipe. Contractor shall verify 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.

E. All thermostat, humidistat (if required), damper interlock and other low voltage control wiring shall be installed by the Mechanical Contractor. The Electrical Contractor will furnish only the power system connections shown on the Electrical Drawings. All other control and interlock wiring is the responsibility of the Mechanical Contractor.

END OF SECTION

SEQUENCE OF OPERATION

A. FAN COIL UNIT/Air Conditioning Unit CONTROL
During occupied hours, operate fan coil unit supply fan continuously and open outdoor air damper to maintain minimum ventilation. Cycle stage(s) of DX cooling and electric heating to maintain room thermostat set point (75 degrees Fahrenheit cooling, 72 degrees Fahren

SECTION 23 0800 – COMMISSIONING OF HVAC

PART 1 GENERAL

1.01 SUMMARY

A. See Section 01 9113 – General Commissioning Requirements for overall objectives; comply with the requirements of Section 01 9113.

B. This section covers the Contractor's responsibilities for commissioning; each subcontractor or installer responsible for the installation of a particular system or equipment item to be commissioned is responsible for the commissioning activities relating to that system or equipment item.

C. The Commissioning Authority (CA) directs and coordinates all commissioning activities 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. Special Ventilation: Hoods, 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 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 as-built; revise and resubmit when substantial changes are made.

B. DRAFT Functional Test Procedures for Control System: Detailed written plan indicating the procedures to be followed to test, checkout 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. Process 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; list 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 calibration 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 and Trend Logs.

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 as-built set of control drawings.
3. Full as-built sequence of operations for each piece of equipment.
4. 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. Floor.
   b. Room number.
   c. Room name.
   d. Air handler unit ID.
   e. Reference drawing 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 HVAC drawings with their control system designations.
9. Maintenance instructions, including 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. Valves and valve actuators.
    h. Dampers and damper actuators.
    i. Program setups (software program printouts).

E. 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 air–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 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 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 required 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 Functional Test Procedures.

B. Furnish additional information requested by the Commissioning Authority.

C. Prepare a preliminary schedule for HVAC pre-start 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 will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing 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 cost of sheaves and belts that may be required for testing, adjusting, and balancing.

F. Provide test holes in ducts and plenums where directed to allow air measurements and air balancing; close with an approved plug.

G. Provide temperature and pressure taps in accordance with the Contract Documents.

3.02 INSPECTING AND TESTING – GENERAL

A. Submit startup plans and startup reports for each item of equipment or other assembly to be commissioned.

B. Perform the Functional Tests directed by the Commissioning Authority for each item of equipment or other assembly to be commissioned.

C. Provide two–way radios for use during testing.

D. Valve/Damper Stroke 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 adjust output zero signal 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 operational of Normally Open or Normally closed positions of all valves/dampers by means of normal operating mode tests plus removal of power to confirm proper closure or opening upon failure of power or control signal.
7. Perform valve/damper leakage testing on all dampers by applying normal operating pressure with the valve/damper in the closed position and measure either the delta T across coils or airflow through dampers to confirm compliance with specification requirements for dampers and zero leakage for valves.
8. 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 to normal.
   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 to normal.
    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. Isolation Valve or System Valve Leak Check: For valves not by coils.

1. With full pressure in the system, command or move valve closed.
2. Use an ultra–sonic flow meter to detect flow or leakage.

G. Deficiencies: Correct deficiencies and re–inspect or 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 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 or provide sufficient training for the TAB technicians to operate the system without assistance.

3.04 CONTROL SYSTEM FUNCTIONAL TESTING

A. 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 submittal.

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 of the control system constitutes demonstration and trend logging of control points monitored by the control system.

1. The scope of trend logging is partially specified; trend log up to 50 percent more points than specified at no extra cost to Owner.
2. Perform all trend logging specified in Functional Test procedures.

E. Functionally Test integral or stand–alone controls in conjunction with the Functional Tests of the equipment they are attached to, including any 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 central computer.
5. That field panels read the same time as the central 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 (plug–ins) 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 command features.
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 responses.
16. Fire protection and suppression systems interfaces.
17. Security system interlocks.
18. That points that are monitored only, having no control function, are reporting properly to 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 specified but not specified to be setup are actually installed.

H. Perform and submit trend logging on the following using the control system, for minimum period of 5 days including one weekend, if the control points are monitored by the control system:

1. Duty cycling, if applicable.
2. Demand limiting, including over–ride of limiting.
3. Sequential staging ON of equipment; optionally demonstrate manually.
4. Optimum start–stop functions.
5. Sequencing 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.

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. Provide classroom and hands–on training of Owner's designated personnel on operation and maintenance of the HVAC system, control system, and related items indicated to be commissioned. Return for follow up training not less than 30 days after initial training and not more than 6 months after initial training.

C. Provide professional digital video recording of all instruction sessions and deliver two copies on DVD's to the Owner for future reference.

D. TAB Review: Instruct Owner's personnel for minimum eight hours, after completion of TAB, on the following:

1. Review final TAB report, explaining the layout and meanings of each data type.
2. Discuss any outstanding deficient items in the report and how they may affect the proper delivery of air or water.
3. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.
4. Discuss any temporary settings and steps to finalize them for any areas that are not finished.
5. Other salient information that may be useful for facility operations, relative to TAB.

E. HVAC Control System Training: Perform training in at least three phases:

1. Phase 1 – Basic Control System: Provide minimum of 16 hours of actual training on the control system itself. Upon completion of training, each attendee, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
   a. This training may be held on–site or at the manufacturer's facility.
   b. If held off–site, the training may occur prior to the final completion of the system installation.
   c. For off–site training, Contractor shall pay expenses of up to two attendees.
2. Phase 2 – Integrating with HVAC Systems: Provide minimum of 16 hours of on–site, hands–on training after completion of Functional Testing. Include instruction on:
   a. The specific hardware configuration of installed systems in this facility and specific instruction for operating the installed system, including interfaces with other systems, if any.
   b. Security levels, alarms, system start–up, shut–down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
   c. Trend logging and monitoring features (setups, change of state, totalization, etc.), including setting up, executing, downloading, viewing both tabular and graphically and printing trends; provide practice in setting up trend logging and monitoring during training session.
   d. Every display screen, allowing time for questions.
   e. Use of keypad or plug–in laptop computer at the zone level.
   f. Use of remote access to the system via phone lines or networks.
   g. Setting up and changing an air terminal unit controller.
   h. Graphics generation.
   i. Point database entry and modifications.
   j. Understanding DDC field panel operating programming, when applicable.
3. Phase 3 – Post–Occupancy: Six months after occupancy conduct minimum of 16 hours of training. Tailor training session to questions and topics solicited beforehand from Owner. Also be prepared to address topics brought up and answer questions concerning operation of the system.

F. Provide the services of manufacturer representatives to assist instructors where necessary.

G. Provide the services of the HVAC controls instructor at other training sessions, when requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

END OF SECTION

SECTION 23 0993 – SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This Section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. This Section provides the intended sequence of operation for each piece of controlled equipment. Other Sections of this Specification indicate the requirements for direct digital control systems, energy management systems, packaged factory controls or conventional analog control systems. Equipment, devices, and system components required for control systems are specified in other Sections. Wherever the sequences contained herein indicate control by a thermostat or EMS sensor/controller, the Temperature Control Contractor shall furnish EMS sensor/controllers for digital control systems or a thermostat for conventional analog control systems as specified in other sections of this Specification.

C. Sequence of operation for:

1. Air terminal units.
   a. Electric.
      1) Cooling only variable volume.
      2) Automatic heating/cooling changeover variable volume.
   b. Single duct variable volume.
      1) Cooling only.
      2) Cooling with reheat.
         (a) Electric reheat.
2. Cabinet heaters.
   a. Electric.
   b. Freeze protection.
3. Central station air handling units.
   a. Freeze protection.
   b. Over–pressure shutdown control.
   c. Face and bypass preheat coil.
   d. Outside air damper, non–economizer systems.
   e. Humidifier.
   f. Outside, return and relief dampers, economizer systems.
   g. Demand controlled ventilation.
   h. Electric heating.
   i. Direct expansion cooling.
   j. Multi–zone systems.
   k. Induction systems.
   l. Supply air fan static pressure control.
   m. Return air fan static pressure control.
4. Constant air dampers.
5. Combustion air heaters.
   a. Electric.
   d. Freeze protection.
6. Electrical rooms and telephone rooms.
   a. Exhaust ventilation.
   b. Air conditioning.
7. Emergency generators.
   a. Indoor unit ventilation dampers.
   b. Status monitoring and load control.
8. Fan coil units.
   a. Electric heating.
   b. Direct expansion cooling.
   c. Heat pump heating/cooling.
   d. Automatic changeover.
   e. Variable speed supply fan.
   f. Outside air damper, non–economizer systems.
   g. Outside, return and relief dampers, economizer systems.
   h. Demand controlled ventilation.
   i. Freeze protection.
9. Heating coils.
   c. Electric.
   d. Freeze protection.
10. Induction units.
11. Radiant panels.
12. Radiation and convectors.
   a. Electric.
13. Refrigeration systems.
14. Unit heaters.
   a. Electric.
   b. Gas.
15. Exhaust fans.
   a. General duty building exhaust fans
   b. Specific duty exhaust fans.
16. Make–up air fans.
   a. Electric.
   b. Gas.
   c. Direct expansion cooling.
   d. Evaporative cooling.
   e. Freeze protection.
   f. Variable speed control.
   g. Building pressure control.
17. Fresh air fans.
   a. Electric.
   b. Gas.
   c. Direct expansion cooling.
   d. Evaporative cooling.
   e. Freeze protection.
   f. Variable speed control.
   g. Building pressure control.
18. Control of packaged HVAC equipment containing factory mounted controls.
   a. Single Zone Systems.
19. Heat pump systems.
   a. Heat exchanger.
   b. Heat pump loop pump.
   c. Heat pump unit controls.
   d. Heat pump unit controls – Economizer and demand control ventilation.
20. Smoke evacuation and smoke control systems.
21. Stairway pressurization systems.
22. Water metering and billing software.
23. Natural gas metering and billing software.

1.02 RELATED REQUIREMENTS

A. Section 23 0913 – Instrumentation and Control Devices for HVAC.

1.03 SYSTEM DESCRIPTION

A. Equipment performance, controls and accessories shall be as scheduled on the Drawings and specified herein. Inclusion in both locations is not a prerequisite to inclusion in the Contract. Equipment, controls and accessories specified in either location shall be included in the Contract. Provide all necessary controls, accessories and connections as required for a complete, functional system for all systems indicated on the Drawings.

B. All wiring of control systems including connections to controlled devices external to the control systems shall be included in the temperature controls contract as a part of the Mechanical Contract. The Electrical Contractor will only furnish power connections to devices at the locations indicated on the Electrical Drawings. Review the Electrical Drawings for locations where power connections will be provided. This Contractor shall provide all additional necessary power and control wiring for a complete and functional system.

C. Provide all conduit and electrical wiring where required. Wiring shall be installed in conduit where wiring is concealed in inaccessible areas of ceilings, walls, attics and floors. Conduit shall be installed in all locations required by applicable local and national codes. Other locations may be installed utilizing plenum rated cabling without conduit, provided that all cabling is neatly and adequately supported. Independent of all other systems, equipment, ductwork, etc. Where cable trays exist, all wiring shall utilize the cable tray path, except at direct run outs to equipment or control connections.

D. All control settings and set points shall be individually adjustable. Set points specified in this Section shall be used as a guide for initial setup and may require subsequent adjustment to achieve the desired system functionality and performance.

1.04 SUBMITTALS

A. Submittals:

Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.

1. Preface: 1 or 2 paragraph overview narrative of the system describing its purpose, components and function.
2. State each sequence in small segments and give each segment a unique number for referencing in Functional Test procedures; provide a complete description regardless of the completeness and clarity of the sequences specified in the Contract Documents.
3. Include at least the following sequences:
   a. Start–up.
   b. Warm–up mode.
   c. Normal operating mode.
   d. Unoccupied mode.
   e. Shutdown.
   f. Safety control sequences and equipment staging.
   g. Temperature and pressure control, such as setbacks, setups, resets, etc.
   h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
   i. Effects of power or equipment failure with all standby component functions.
   j. Sequences for all alarms and emergency shut downs.
   k. Seasonal operational differences and recommendations.
   l. Interactions and interlocks with other systems.
4. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
5. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.

B. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.

1. Label with settings, adjustable range of control and limits.
2. Include flow diagrams for each control system, graphically depicting control logic.
3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
5. Include all monitoring, control and virtual points specified in elsewhere.
6. Include a key to all abbreviations.

C. Points List: Submit list of all control points indicating at least the following for each point.

1. Name of controlled system.
2. Point abbreviation.
3. Point description; such as dry bulb temperature, airflow, etc.
4. Display unit.
5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
8. Calculated point (Yes / No); i.e. a "virtual" point generated from calculations of other point values.

D. Project Record Documents: Record actual locations of components and setpoints of controls, including changes to sequences made after submission of shop drawings.

1.05 QUALITY ASSURANCE

A. Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the State in which the Project is located.

B. Code or utility company requirements shall supersede any conflicting requirements of this Section.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.01 AIR TERMINAL UNITS

A. Schedule: Control terminal air units based on the programmed time and temperature schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures based on programming.

B. Single–duct Bypass:

1. Cooling Mode Only:
   a. Central air system supplies cool air.
   b. On a rise in space temperature above the set–point, the bypass damper modulates open, increasing airflow to the space while simultaneously closing the bypass damper.
   c. On a fall in space temperature below the set–point, the bypass damper modulates closed, reducing the airflow to the space while simultaneously opening the bypass damper.
   d. Provide minimum airflow with field set, minimum stop.
2. Automatic Heating/Cooling Changeover:
   a. Cooling Mode (Supply air system in cooling mode below 75 degrees F (24 degrees C)).
      1) On a rise in space temperature above set–point, the bypass damper modulates open, increasing the flow of cool air to the space while simultaneously closing the bypass damper.
      2) On a fall in space temperature below the set–point, the bypass damper modulates closed, reducing the airflow to the space while simultaneously opening the bypass damper.
   b. Heating Mode (Supply air system in heating mode above 78 degrees F (26 degrees C)).
      1) On a rise in space temperature above set–point, the bypass damper modulates closed, reducing the flow of warm air to the space while simultaneously opening the bypass damper.
      2) On a fall in space temperature below the set–point, the bypass damper modulates open, increasing the flow of warm air to the space while simultaneously closing the bypass damper.

C. Single–duct Variable Volume:

1. Cooling Only:
   a. On a rise in space temperature, the damper will modulate to provide maximum airflow.
   b. As space temperature decreases, the damper will modulate down to its minimum airflow.
2. Cooling with Reheat:
   a. On a rise in space temperature above the cooling set–point, the unit modulates to its maximum airflow.
   b. As the space temperature falls below the cooling set–point, the unit modulates to its minimum airflow.
   c. As the space temperature continues to fall to the heating set–point, the terminal modulates to its heating minimum airflow. At this point, the heat will be staged on as follows:
      1) Stage electric heating coil in increments provided by the coil manufacturer.

D. Dual–Duct:

1. As the space temperature rises above the cooling set–point, the primary airflow is modulated from the cooling minimum airflow to the cooling maximum airflow.
2. As the space temperature falls below the heating set–point, the secondary airflow is modulated from the heating minimum airflow to the heating maximum airflow.
3. Between the heating and cooling set–points, both the primary airflow and secondary airflow are modulated to maintain dual mixing minimum.

E. Fan–powered:

1. Series Units:
   a. Series–fan runs continuously via control interlock with the AHU supply fan.
   b. The air valve modulates the primary airflow in response to space temperature with the reheat de–energized.
   c. Reheat is activated to increase discharge temperature when further decrease in primary airflow will not maintain space temperature.
2. Parallel Units:
   a. The primary air valve delivers cooled air to the unit outlet.
   b. Upon decrease in space temperature beyond control of the primary air valve, the fan is simultaneously energized along with the first stage of heat.
   c. Parallel fan delivers warm plenum air from the controlled space to the unit outlet, mixing with the primary air before entering the space.

3.02 CABINET HEATERS

A. Time Schedule: Control cabinet heaters based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable.

B. Single temperature room thermostat with night set back or EMS sensor/controller, set at 68 degrees F (20 degrees C) during the occupied mode and 15 degrees F (8 degrees C) cooler during the unoccupied mode. Maintain constant space temperature by cycling unit fan motor. Close two way valve when fan motor is not operating.

C. Single temperature thermostat or EMS sensor/controller on return heating line de–energizes unit on temperatures below 95 degrees F (35 degrees C).

D. Single temperature thermostat or EMS sensor/controller on steam supply line de–energizes unit on temperatures below 200 degrees F. (93 degrees C).

E. Single temperature room thermostat or EMS sensor/controller set at 68 degrees F (20 degrees C) during the occupied mode and 15 degrees F (8 degrees C) cooler during the unoccupied mode maintains constant space temperature by cycling unit fan motor and electric heating elements. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C) .

F. Freeze Protection: Stop fans and close outside air dampers and open heating coil valves to 100% open if temperature ahead of coils is below 37 degrees F (3 degrees C); signal alarm. (Except pre–heat coils.)

3.03 CENTRAL STATION AIR HANDLING UNITS

A. Time Schedule: Start and stop supply and return fans. Determine fan status by pressure differential switches. If the fan fails to start as commanded, signal an alarm. Whenever the supply fan is de–energized, as sensed by the status switch, the outside and exhaust air dampers shall be closed and the return air damper shall be open, the heating and cooling valves shall be closed or positioned as described below and the humidifier (if any) shall be locked out.

1. Control central fan systems based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with adjustable night setback of temperatures, where applicable.

B. Safety Devices:

1. Freeze Protection: Stop fans and close outside air dampers and open heating coil valves (if any) to 100% open if temperature ahead of coils is below 37 degrees F (3 degrees C); signal alarm. (Except pre–heat coils.)
2. Smoke Detector: Stop fans, close outside dampers, and close smoke dampers if smoke is detected; signal alarm.
3. Provide an over limit differential pressure sensor between the supply and return duct at each fan to shut the fan down in the event of a high static pressure condition and signal an alarm. Over limit static pressure setting shall be 0.5 inches (adjustable) above design static pressure for the fan. This shutdown shall allow manual or automatic reset after a predetermined time period (30 minutes, adjustable).

C. Face and Bypass Preheat Coil:

1. When outside air temperature is below 40 degrees F (5 degrees C), fully open preheat coil valve to heating regardless of the operating mode of the fan.
2. When fan is running and the outside temperature is below 40 degrees F (5 degrees C), maintain the mixed air temperature set point by modulating the face and bypass dampers, leaving the preheat coil valve fully open.
3. When fan is running and the outside air temperature is above 40 degrees F (5 degrees C), maintain the mixed air temperature setpoint by modulating heating coil valve.
4. When the fan is running and the outside air temperature is above 55 degrees F (12 degrees C) heating coil valve shall be closed and the face and bypass dampers shall be indexed to full bypass.

D. Outside Air Damper, Non–Economizer Systems: When supply fan is running, open outside air damper to supply quantity of outside air indicated on the Drawings. Close outside air damper in unoccupied mode.

E. Humidifier: When supply fan is running, humidistat (located in return air or wall if indicated on the Drawings) reset from outdoor air temperature modulates normally closed humidifier valve. Set outdoor reset to 50 percent relative humidity at 70 degrees F (21 degrees C) and 15 percent relative humidity at –30 degrees F (–35 degrees C).

F. Outside, Return, and Relief Dampers:

1. When supply fan is not running, outside and relief dampers are closed and return damper is open.
2. When supply fan is running, dampers are controlled and operate with outside and relief dampers opening, and return damper closing.
3. For cooling, and outside air temperatures below 55 degrees F (12 degrees C), modulate dampers to maintain mixed air temperature of 55 degrees F (12 degrees C) .
4. For cooling and outside air temperatures above 55 degrees F (12 degrees C) compare return and outside air temperatures. If return air temperature is lower, drive outside damper to minimum, close relief damper, and open return damper.
5. For outside air temperatures above 79 degrees F (26 degrees C), drive outside damper to minimum, close relief damper, and open return damper.
6. For heating, drive outside damper to minimum, close relief damper, and open return damper.
7. Minimum outside air position shall be as determined by the demand controlled ventilation control specified below (if any), or outside air quantity indicated on the Drawings.
8. Close outside air damper in unoccupied mode unless there is a call for cooling and the outside air enthalpy is below the return air enthalpy.

G. Demand Controlled Ventilation: The minimum outdoor air flow rate is established by the required outdoor air flow with no occupants and the required outdoor air flow at design occupancy. The damper positions corresponding to these two airflow rates shall be set in conjunction with the balance contractor. The outdoor air damper shall modulate between the no occupants position and the design occupancy position as the space CO2 concentration varies from 400 ppm (ambient) to 1,500 ppm (adjustable). If CO2 concentration exceeds 1,500 ppm (adjustable), signal an alarm. Close outside air damper in unoccupied mode.

H. Dual temperature thermostat or EMS sensor/controller set at 55 degrees F (12 degrees C) maintains constant duct temperature by modulating two–way heating control valve.

I. Dual temperature thermostat or EMS sensor/controller set at 55 degrees F (22 degrees C) maintains constant duct temperature by staging the electric heating elements.

J. Dual temperature thermostat or EMS sensor/controller set at 55 degrees F (12 degrees C) maintains constant duct temperature during the occupied mode and 10 degrees F (6 degrees C) warmer during the unoccupied mode by staging the available refrigeration compressors, unloaders and hot gas bypass on the condensing unit(s).

K. Multizone System:

1. Space sensor set at 75 degrees F (24 degrees C), maintains constant space temperature during the day and 15 degrees F (8 degrees C) cooler at night by modulating zone dampers.
2. Room calling for heating modulates reheat coil valve.
3. Discharge air temperature prior to zone reheat coil shall be maintained in accordance with outdoor reset schedule by modulating the cooling coil valve in conjunction with the outdoor air system.

L. Dual Duct System:

1. Control hot deck temperature in accordance with outdoor reset schedule by modulating reheat coil valve.
2. Control hot deck at minimum 135 degrees F (57 degrees C) at outdoor temperature of minus 30 degrees F (minus 35 degrees C), and minimum 75 degrees F (24 degrees C) at outdoor temperature of 75 degrees F (24 degrees C), with straight line relationship between.
3. Maintain cold deck temperature of 55 degrees F (12 degrees C) by modulating cooling coil valve.
4. Reset hot and cold deck temperatures. Room calling for greatest heating resets hot deck control temperature.
5. Room thermostat or EMS sensor/controller calling for greatest cooling resets cold deck temperature.

M. Induction System:

1. Control deck temperature in accordance with outdoor reset schedule by modulating heating and cooling coil valves and outdoor air economizer if present.
2. Control deck temperature at maximum 75 degrees F (24 degrees C) at outdoor temperature of 0 degrees F (–35 degrees C) , and minimum 55 degrees F (12 degrees C) at outdoor solar compensated temperature of 75 degrees F (24 degrees C) and above, with straight line relationship between.

N. Maintain constant supply air static pressure to the setpoint indicated on the equipment schedule on the Drawings by modulating the supply fan variable frequency drive speed control. Locate three averaging sensors upstream of the three most remote supply air branch duct take offs to control static pressure.

O. Maintain constant building pressure of 0.05 inches wg (12 Pa) measured at the grade level lobby by modulating the return air fan variable frequency drive speed control.

3.04 COMBUSTION AIR DAMPERS.

A. The Temperature Control Contractor shall furnish the "fail–open" dampers and actuators for the combustion air system. Interlock damper actuators with the respective water heater and boiler control panels so that the combustion air dampers open when the water heaters or boilers are firing.

B. Single temperature room thermostat or EMS sensor/controller set at 85 degrees F (29 degrees C) shall open the combustion air dampers if the boiler room temperature exceeds setpoint.

3.05 COMBUSTION AIR HEATERS

A. Single temperature room thermostat or EMS sensor/controller set at 68 degrees F (20 degrees C) maintains constant room temperature by modulating two–way heating control valve as follows:

1. When outside air temperature is below 40 degrees F (5 degrees C), fully open coil valve to heating regardless of the operating mode of the fan.
2. When fan is running and the outside temperature is below 40 degrees F (5 degrees C), maintain the mixed air temperature set point by modulating the face and bypass dampers, leaving the heating coil valve fully open.
3. When fan is running and the outside air temperature is above 40 degrees F (5 degrees C), maintain the mixed air temperature setpoint by modulating heating coil valve.
4. When the fan is running and the outside air temperature is above 55 degrees F (12 degrees C) heating coil valve shall be closed and the face and bypass dampers shall be indexed to full bypass.

B. Single temperature room thermostat or EMS sensor/controller set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor and electric heating elements. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C) .

C. Single temperature room thermostat or EMS sensor/controller set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor and modulating gas burner.

D. Freeze Protection: Stop fans and close outside air dampers and open heating coil valves (if any) to 100% open if temperature downstream of coils is below 37 degrees F (3 degrees C); signal alarm and stop all combustion equipment in the room(s) served.

3.06 ELECTRICAL ROOMS AND TELEPHONE ROOMS

A. On room temperatures above 85 degrees F (29 degrees C) open intake damper and start exhaust fan. Interlock damper with exhaust fan operation.

B. On room temperatures above 85 degrees F (29 degrees C) activate air conditioning equipment.

C. On room temperatures above 90 degrees F (32 degrees C), signal alarm.

3.07 EMERGENCY GENERATORS

A. When the generator is not running, outside and exhaust dampers are closed and recirculation damper is open.

B. When generator is running, dampers are controlled and operate with outside and exhaust dampers opening, and recirculating dampers closing, to maintain room temperature of 85 degrees F (30 degrees C).

C. Provide solenoid valve to shut off fuel supply when generator is not operating.

D. Digital control system shall monitor the generator to determine normal vs. emergency power conditions to control any necessary load shed or lockouts required while on emergency power operation as indicated on the Drawings or specified herein.

3.08 FAN COIL UNITS

A. Time Schedule: Control fan coil units based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable.

B. Supply fan shall run continuously during the occupied period and cycle during the unoccupied period based on a demand for heating or cooling.

C. Dual temperature thermostat or EMS sensor/controller set at 72 degrees F (22 degrees C) maintains constant space temperature during the day and 15 degrees F (8 degrees C) cooler at night by modulating two–way control heating valve .

D. Dual temperature thermostat or EMS sensor/controller set at 72 degrees F (22 deg

air damper in unoccupied mode.

J. Outside, Return, and Relief Dampers:
1. When supply fan is not running, outside and relief dampers are closed and return damper is open.
2. When supply fan is running, dampers are controlled and operate with outside and relief dampers opening, and return damper closing.
3. For cooling, and outside air temperatures below 55 degrees F (12 degrees C), modulate dampers to maintain mixed air temperature of 55 degrees F (12 degrees C) .
4. For cooling and outside air temperatures above 55 degrees F (12 degrees C) compare return and outside air enthalpies. If return air enthalpy is lower, drive outside damper to minimum, close relief damper, and open return damper.
5. For outside air temperatures above 79 degrees F (26 degrees C), drive outside damper to minimum, close relief damper, and open return damper.
6. For heating, drive outside damper to minimum, close relief damper, and open return damper.
7. Minimum outside air position shall be as determined by the demand controlled ventilation control specified below (if any), or outside air quantity indicated on the Drawings.
8. Close outside air damper in unoccupied mode, unless there is a call for cooling and the outside air enthalpy is below the return air enthalpy.

K. Humidifier: When supply fan is running, humidistat (located in return air or on wall if indicated on the Drawings) reset from outdoors modulates normally closed humidifier valve. Set outdoor reset to 50 percent relative humidity at 70 degrees F (21 degrees C) and 15 percent relative humidity at –30 degrees F (–35 degrees C).

L. Demand Controlled Ventilation: The minimum outdoor air flow rate is established by the required outdoor air flow with no occupants and the required outdoor air flow at design occupancy. The damper positions corresponding to these two airflow rates shall be set in conjunction with the balance contractor. The outdoor damper shall modulate between the no occupants position and the design occupancy position as the space CO2 concentration varies from 400 ppm (ambient) to 1,500 ppm (adjustable). If CO2 concentration exceeds 1,500 ppm (adjustable), signal an alarm. Close outside air damper in unoccupied mode.

M. Freeze Protection: Stop fans and close outside air dampers and open heating coil valves (if any) to 100% open if temperature ahead of coils is below 37 degrees F (3 degrees C); signal alarm. (Except pre-heat coils.)

3.09 HEATING COILS

A. Time Schedule: Control heating coils based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable.

B. Single temperature thermostat or EMS sensor/controller set at 75 degrees F (24 degrees C) maintains constant space temperature during the day and 15 degrees F (8 degrees C) cooler at night by modulating two-way control heating valve .

C. Single temperature thermostat or EMS sensor/controller on steam heating line de-energizes unit on temperatures below 200 degrees F. (93 degrees C.)

D. Single temperature room thermostat or EMS sensor/controller set at 75 degrees F (24 degrees C) maintains constant space temperature by energizing electric heaters.

E. 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.

3.10 INDUCTION UNITS

A. Time Schedule: Control induction units based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable.

B. Dual temperature thermostat or EMS sensor/controller maintains constant space temperature at 75 degrees F (24 degrees C) during the occupied mode and 10 degrees F (6 degrees C) reset during the unoccupied mode by modulating two-way heating and cooling valve(s).

C. 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.

3.11 RADIANT PANELS

A. Time Schedule: Control radiant panels based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable.

B. Single temperature thermostat or EMS sensor/controller maintains constant space temperature set at 75 degrees F (24 degrees C) during the day and 15 degrees F (8 degrees C) cooler at night by modulating two-way control heating valve .

C. 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.

3.12 RADIATION AND CONVECTORS

A. Time Schedule: Control radiation and convectors based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable..

B. Single temperature thermostat or EMS sensor/controller set at 75 degrees F (24 degrees C) maintains constant space temperature during the day and 15 degrees F (8 degrees C) cooler at night by modulating two-way control heating valve .

C. Single temperature room thermostat or EMS sensor/controller set at 75 degrees F (24 degrees C) maintains constant space temperature by energizing electric heaters.

D. 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.

3.13 REFRIGERATION SYSTEMS

A. Time Schedule: Control refrigeration systems based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable.

B. Maintain temperatures of the refrigerated areas at setpoints to be determined by the Owner's operating personnel by cycling refrigeration systems and signaling stepped capacity controls.

3.14 UNIT HEATERS

A. Time Schedule: Control unit heaters based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with night setback of temperatures, where applicable.

B. Single temperature room thermostat or EMS sensor/controller with night set back, set at 68 degrees F (20 degrees C) during the occupied mode and 15 degrees F (8 degrees C) cooler during the unoccupied mode maintains constant space temperature by cycling unit fan motor. Close two way valve when fan motor is not operating.

C. Single temperature thermostat or EMS sensor/controller on steam heating line de-energizes unit on temperatures below 200 degrees F. (93 degrees C.)

D. Single temperature room thermostat or EMS sensor/controller set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor and energizing electric heating elements. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C).

E. Single temperature room thermostat or EMS sensor/controller set at 68 degrees F (20 degrees C) maintains constant space temperature by cycling unit fan motor and firing gas burner.

F. 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.

3.15 EXHAUST FANS

A. General building exhaust fans
1. Time Schedule: Start and stop exhaust fan based on the programmed time schedule as determined by the Owner's operating personnel.

B. Specific purpose exhaust fans shall be interlocked with the respective equipment as indicated on the Drawings. Provide necessary sensors and relays to allow control system to accurately sense equipment operation and activate fan systems accordingly. Interlock make up air units/fans and air handling systems providing make up air for exhaust systems as required to provide 100% make up air to all operating exhaust fans.

3.16 MAKE UP AIR UNITS/FANS

A. Time Schedule: Start and stop make up air fans based on the programmed time schedule as determined by the Owner's operating personnel.

B. Maintain the integrity of the packaged control equipment and sequences. The packaged unit controls shall operate such functions as the burner modulation, high limit and low limit safeties, etc. All set point, occupancy, staging and shutdown capabilities shall be controlled by the temperature control system.

C. The control system shall monitor and indicate at the operators console the status of the unit including:
1. System on/off status.
2. System operating mode (heating/cooling/ventilation).
3. Discharge air temperature.
4. Discharge air temperature setpoint (where applicable).

D. Control system shall be able to control any of the following functions:
1. Turn the system on or off.
2. Control the number of stages of heating or cooling (if any) to be utilized based on room or duct temperature conditions.
3. Change occupied or unoccupied temperature setpoints.
4. Change equipment operating mode (heating/cooling/off).
5. Modify occupancy schedules by unit.

E. Single temperature duct thermostat or EMS sensor/controller, set at 60 degrees F (15 degrees C), maintains constant discharge temperature by modulating two-way heating coil valve as follows:
1. When outside air temperature is below 40 degrees F (5 degrees C), fully open coil valve to heating regardless of the operating mode of the fan.
2. When fan is running and the outside temperature is below 40 degrees F (5 degrees C), maintain the supply air temperature set point by modulating the face and bypass dampers, leaving the heating coil valve fully open.
3. When fan is running and the outside air temperature is above 40 degrees F (5 degrees C), maintain the supply air temperature setpoint by modulating heating coil valve.
4. When the fan is running and the outside air temperature is above 55 degrees F (12 degrees C) heating coil valve shall be closed and the face and bypass dampers shall be indexed to full bypass.

F. Single temperature duct thermostat or EMS sensor/controller set at 60 degrees F (15 degrees C) maintains constant discharge temperature by staged energizing electric heating elements. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C).

G. Single temperature duct thermostat or EMS sensor/controller set at 60 degrees F (15 degrees C) maintains constant discharge temperature by firing modulating gas burner.

H. Single temperature duct thermostat or EMS sensor/controller set at 80 degrees F (27 degrees C) maintains discharge air temperature by staging refrigeration compressors. Provide unloaders and hot gas bypass on first stage of refrigeration compressors.

I. Freeze Protection: Stop fan and close outside air damper and open heating coil valves (if any) to 100% open if temperature after heating coil is below 37 degrees F (3 degrees C); signal alarm.

J. Maintain constant fresh air duct static pressure to the set point as determined by the fresh air system balancing to maintain the air flows indicated on the drawings. Maintain constant static pressure regardless of the fresh air damper positions by modulating the fresh air fan variable frequency drive speed control. Locate three averaging sensors upstream of the three most remote supply air branch duct take offs to control static pressure. Stage, unload and/or cycle heating/cooling sequences (if any) accordingly.

K. Maintain constant building pressure of 0.05 inches wg (12 Pa) measured at the grade level lobby by modulating the fresh air fan variable frequency drive speed control as required. Provide sufficient time dampening to avoid control system hunting due to the normal opening and closing of doors. Stage, unload and/or cycle heating/cooling sequences (if any) accordingly.

3.17 FRESH AIR FANS

A. Time Schedule: Start and stop fresh air fans based on the programmed time schedule as determined by the Owner's operating personnel.

B. Maintain the integrity of the packaged control equipment and sequences. The packaged unit controls shall operate such functions as the burner modulation, high limit and low limit safeties, etc. All set point, occupancy, staging and shutdown capabilities shall be controlled by the temperature control system.

C. The control system shall monitor and indicate at the operators console the status of the unit including:
1. System on/off status.
2. System operating mode (heating/cooling/ventilation).
3. Discharge air temperature.
4. Discharge air temperature setpoint (where applicable).

D. Control system shall be able to control any of the following functions:
1. Turn the system on or off.
2. Control the number of stages of heating or cooling (if any) to be utilized based on room or duct temperature conditions.
3. Change occupied or unoccupied temperature setpoints.
4. Change equipment operating mode (heating/cooling/off).
5. Modify occupancy schedules by unit.

E. Single temperature duct or room thermostat as indicated, or EMS sensor/controller, set at 68 degrees F (20 degrees C), maintains constant setpoint temperature by modulating two-way heating coil valve as follows:
1. When outside air temperature is below 40 degrees F (5 degrees C), fully open coil valve to heating regardless of the operating mode of the fan.
2. When fan is running and the outside temperature is below 40 degrees F (5 degrees C), maintain the air temperature set point by modulating the face and bypass dampers, leaving the heating coil valve fully open.
3. When fan is running and the outside air temperature is above 40 degrees F (5 degrees C), maintain the air temperature setpoint by modulating heating coil valve.
4. When the fan is running and the outside air temperature is above 55 degrees F (12 degrees C) heating coil valve shall be closed and the face and bypass dampers shall be indexed to full bypass.

F. Single temperature duct or room thermostat as indicated, or EMS sensor/controller set at 68 degrees F (20 degrees C) maintains constant setpoint temperature by cycling unit fan motor and energizing electric heating elements. Integral thermostat continues fan operation until element temperature falls below 100 degrees F (38 degrees C).

G. Single temperature duct or room thermostat as indicated, or EMS sensor/controller set at 68 degrees F (20 degrees C) maintains constant setpoint temperature by cycling unit fan motor and firing gas burner.

H. Single temperature duct or room thermostat as indicated, or EMS sensor/controller set at 80 degrees F (27 degrees C) maintains constant setpoint air temperature by staging refrigeration compressors. Provide unloaders and hot gas bypass on first stage of refrigeration compressors.

I. Freeze Protection: Stop fan and close outside air damper and open heating coil valves (if any) to 100% open if temperature after heating coil is below 37 degrees F (3 degrees C); signal alarm.

J. Maintain constant fresh air duct static pressure to the set point as determined by the fresh air system balancing to maintain the air flows indicated on the drawings. Maintain constant static pressure regardless of the fresh air damper positions by modulating the fresh air fan variable frequency drive speed control. Locate three averaging sensors upstream of the three most remote supply air branch duct take offs to control static pressure. Stage, unload and/or cycle heating/cooling sequences (if any) accordingly.

K. Maintain constant building pressure of 0.05 inches wg (12 Pa) measured at the grade level lobby by modulating the fresh air fan variable frequency drive speed control as required. Provide sufficient time dampening to avoid control system hunting due to the normal opening and closing of doors. Stage, unload and/or cycle heating/cooling sequences (if any) accordingly.

3.18 CONTROL OF PACKAGED HVAC EQUIPMENT CONTAINING FACTORY MOUNTED CONTROLS.

A. Single Zone Systems
1. Time Schedule: Control HVAC equipment based on the programmed time schedule as determined by the Owner's operating personnel. Provide occupied/unoccupied mode control with adjustable night setback of temperatures, where applicable.
2. Maintain the integrity of the packaged control equipment and sequences. The packaged unit controls shall operate such functions as the economizer operations, burner modulation, high limit and low limit safeties, etc. All set point, occupancy, staging and shut-down capabilities shall be controlled by the temperature control system.
3. The control system shall monitor and indicate at the operators console the status of the unit including:
a. System on/off status.
b. System on/off command status.
c. Supply fan status.
d. Return fan status (if present).
e. Exhaust fan status (if present).
f. System operating mode (heating/cooling/ventilation).
g. Discharge air temperature.
h. Discharge air temperature setpoint (where applicable).
i. Mixed air temperature.
j. Outdoor air temperature and humidity.
k. Return air temperature and humidity.
l. Space temperature (where applicable).
m. Space temperature setpoint (where applicable).
n. Compressor status, individually by compressor.
4. Control system shall be able to control any of the following functions:
a. Turn the system on or off.
b. Control the number of stages of heating or cooling to be utilized based on room or duct temperature conditions.
c. Change occupied or unoccupied temperature setpoints.
d. Change equipment operating mode (heating/cooling/off).
e. Modify occupancy schedules by unit.

3.19 HEAT PUMP SYSTEMS

A. Heat Exchanger: When the heat pump return water temperature rises above 90 degrees F (32 degrees C), the two position diverter valve shall position to divert heat pump return water through the heat exchanger and the condenser water pump shall start. Upon a shut down signal from the program clock or EMS controller, or a reduction in the heat pump return water temperature to below 85 degrees F (29 degrees C) all equipment (condensing water pump, cooling tower) shall stop and the diverter valve shall bypass the heat exchanger. Water temperatures above 105 degrees F (40 degrees C) or below 45 degrees F (7 degrees C) shall signal an alarm.

B. Condensing Water Pumps: Allow start on proof of water in cooling tower sump and on outdoor temperature above 32 degrees F (0 degrees C). A temperature controller sensing condenser supply water temperature to the building shall modulate the variable speed pump from 10% to 100% speed as required to maintain a condenser water supply temperature of 82 degrees F (28 degrees C) adjustable as first stage cooling. Second stage cooling shall modulate the cooling tower fan as indicated below. Alternate duty between condensing water pumps and log hours of operation separately for each pump. Upon failure of one pump, the system shall report an alarm condition and automatically start the alternate pump.

C. Heat Pump Loop Pumps: Heat pump loop variable speed pumps shall be controlled by system differential pressure. Alternate duty between heat pump loop water pumps and log hours of operation separately for each pump. Upon failure of one pump, the system shall report an alarm condition and automatically start the alternate pump. Refer to "Hydronic Pressure Control" sequence for variable speed operation of the Heat Pump Loop Pumps.

D. Cooling Tower: A temperature controller sensing condenser supply water temperature to the building shall control the cooling tower fan. Controller shall modulate the variable speed fan to maintain 82 degrees F (28 degrees C) condenser water supply temperature. The cooling tower fan shall not run unless the condenser water pump is running.

E. Heating Water Supply System: The boilers shall be provided with multi-stage controllers to individually fire the boilers as required to maintain a supply water temperature of 180 degrees F (82 degrees C) in the HWS loop during the heating season. One of the HWS pump shall run continuously during the heating season and be shut down at outdoor temperatures above 50 degrees F (10 degrees C). The boilers shall be locked out when the HWS pump is not operating. The two HWS pumps shall be arranged for alternating duty by the EMS computer. The run time of each pump shall be individually logged and reported at the operator's console.

F. Heat Pump Return Temperature: Controller in heat pump return water shall modulate the three–way diverter valve in the heating water supply system to maintain minimum 70 degrees F (21 degrees C) heat pump supply water temperature. Upon a shut down signal from the DDC controller the control valve shall bypass the heat pump loop water.

G. Heat Pump Unit Controls: Control system for the individual heat pump units shall be furnished by the equipment manufacturer. The program clock or energy management functions listed below must be integrated with the packaged controls furnished by the heat pump manufacturer. During the occupied mode as indicated by the program clock or EMS controller, the unit shall provide heating and cooling functions as specified by the unit manufacturer. During the unoccupied mode, the unit shall provide heating only at the night setback temperature as set by the room set/back thermostat or EMS sensor/controller. Heat pump control (heat, cool, occupied or unoccupied) shall be individually addressable for each heat pump unit. Heat pump supply fans shall run continuously during the occupied mode. This feature shall be individually programmable for each heat pump.

H. Heat Pump Unit Controls – Economizer and Demand Control Ventilation: Unit control shall be as specified in the Heat pump Unit specification. In addition to the standard unit controls, the Temperature Control Contractor shall provide control of a modulating, enthalpy controlled outdoor air economizer. During the occupied mode as indicated by the from the program clock or EMS controller, the return air, relief air and fresh air dampers shall be modulated in sequence in response to the cooling requirements of the space and the outdoor air enthalpy as compared to the return air enthalpy (differential enthalpy control). Fresh air damper shall modulate from the minimum position as indicated on the drawings to 100% outdoor air during economizer mode. The fresh air damper shall also modulate based on input from the carbon dioxide sensor located in the return duct. The minimum outdoor airflow rate is established by the required outdoor airflow with no occupants and the required outdoor airflow at design occupancy. The damper positions corresponding to these two airflow rates shall be set in conjunction with the balance contractor. The outdoor air damper shall modulate between the no occupants position and the design occupancy position as the space CO2 concentration varies from 400 ppm (ambient) to 1,500 ppm (adjustable). If CO2 concentration exceeds 1,500 ppm (adjustable), signal an alarm. Damper position shall not exceed 15% during heating mode unless the unit is equipped with a pre-heat coil upstream of the heat pump unit inlet. During the unoccupied mode, the fresh air and relief air dampers shall close and the unit shall provide heating only due to operation controlled from the program clock or DDC sensor and controller. The Temperature Control Contractor shall coordinate with the Fire Alarm Contractor for proper connection of smoke shutdown detectors and relays.

I. Geothermal Well Field Monitoring: Provide BTU meters at inlet and outlet of Geothermal well field piping in mechanical room and log information to EMS system.

J. 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.

3.20 SMOKE EVACUATION AND CONTROL SYSTEMS

A. The Mechanical Contractor shall furnish and install all air handling equipment and dampers required by the system. The Electrical Contractor will furnish and install power supply circuits and motor starting units for all motors in the system and power to all panels and control systems. The Fire Alarm Contractor will be responsible for all detection, initiation and control circuits from the smoke or water flow detection devices to the control circuits of the motor starting units and damper operators for all system components. All sequence and logic components shall be furnished and installed by the Fire Alarm Contractor. The Temperature Control Contractor shall coordinate with the mechanical contractor to ensure interlock of all dampers with their respective exhaust and supply fans.

3.21 STAIRWAY PRESSURIZATION SYSTEMS

A. The Mechanical Contractor shall furnish and install all air handling equipment and dampers required by the system. The Electrical Contractor will furnish and install power supply circuits and motor starting units for all motors in the system and power to all panels and control systems. The Fire Alarm Contractor will be responsible for all detection, initiation and control circuits from the smoke or water flow detection devices to the control circuits of the motor starting units and damper operators for all system components. All sequence and logic components shall be furnished and installed by the Fire Alarm Contractor. The Temperature Control Contractor shall coordinate with the mechanical contractor to ensure interlock of all dampers with their respective exhaust and supply fans.

3.22 WATER METERING AND BILLING SOFTWARE

A. Provide a complete software package to electronically monitor the water usage of each Tenant water meter and all Landlord water meters as indicated on the drawings or required for the number of Tenant bays indicated on the leasing drawings. The system shall provide the following minimum functions:
1. Real–time device metering information, event information and historical profile data. The software shall support the number of devices required to service all Tenant spaces and all Landlord/House water meters, plus the capacity to add at least 20% additional devices.
2. The software shall allow users to be granted privileges based on their user ID and password, to perform various functions in the system including configuration and billing functions.
3. The software shall create graphical load profiles from historical data. Data shall be able to be displayed from individual meters, or user defined groups of meters.
4. The software shall provide tools to manage the historical database files by providing a means to archive and restor historical data.
5. The software shall include the capability to create user selected name tags for each meter in the system.
6. Provide automated billing software that allows the user to allocate the water consumption costs. Cost allocation shall be based on cubic feet of usage. In addition, the water billing system shall provide the following minimum features:
a. The water billing system shall allow the generation of individual water bills by distributing utility costs for the water usage to user defined "customers" including the ability to add capital cost or other allocated additional costs in either fixed monthly charges or percentage mark–ups within the system, based on a user configured customer billing parameters table.
b. The billing system shall produce professional quality, accurate bills and/or reports using the information collected from the water usage meters automatically, once all billing parameters and meter assignments have been set in the system.
c. The billing system shall support multiple utility rate structures, individually assignable by customer.
d. The billing system shall allow optional utility charges such as sewer use fees, taxes, adjustments, etc. to be allocated to the customers.
e. The billing system shall save data in an industry standard database system for future use and processing.
f. The billing system shall provide an export feature to export customer bills and or reports to Microsoft Excel and Word program formats.

END OF SECTION

1. Real–time device metering information, event information and historical profile data. The software shall support the number of devices required to service all Tenant spaces and all Landlord/House natural gas meters, plus the capacity to add at least 20% additional devices.
2. The software shall allow users to be granted privileges based on their user ID and password, to perform various functions in the system including configuration and billing functions.
3. The software shall provide tools to manage the historical database files by providing a means to archive and restore historical data.
4. The software shall create graphical load profiles from historical data. Data shall be able to be displayed from individual meters, or user defined groups of meters.
5. The software shall include the capability to create user selected name tags for each meter in the system.
6. Provide automated billing software that allows the user to allocate the natural gas consumption costs. Cost allocation shall be based on a per 1000 cubic feet or per MBH of usage, depending on the rate schedules selected. In addition, the natural gas billing system shall provide the following minimum features:
a. The natural gas billing system shall allow the generation of individual natural gas bills by distributing utility costs for the natural gas usage to user defined "customers" including the ability to add capital cost or other allocated additional costs in either fixed monthly charges or percentage mark–ups within the system, based on a user configured customer billing parameters table.
b. The billing system shall produce professional quality, accurate bills and/or reports using the information collected from the natural gas consumption meters automatically, once all billing parameters and meter assignments have been set in the system.
c. The billing system shall support multiple utility rate structures, individually assignable by customer.
d. The billing system shall allow optional utility charges such as capital facility fees, taxes, adjustments, etc. to be allocated to the customers.
e. The billing system shall save data in an industry standard database system for future use and processing.
f. The billing system shall provide an export feature to export customer bills and or reports to Microsoft Excel and Word program formats.

END OF SECTION

Bergmeyer

LA - 800 South Figueroa St. Suite 1220 Los Angeles, CA 90017 213.337.1080

BOS - 51 Sleeper St. 5th Floor Boston, MA 02210 617.542.1025

www.bergmeyer.com

CONSULTANTS:

Schnackel engineers

800-581-0963

www.schnackel.com

SE JOB#: 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 42995
REGISTERED PROFESSIONAL ENGINEER

Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL SPECIFICATIONS

DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M593

CODE: 2015 INTERNATIONAL MECHANICAL CODE

SYSTEM 1

ROOM #	NAME	Az AREA (FT2)	TABLE 403.3.1.1 OCCUPANCY CATEGORY	TABLE 403.3.1.1 Rp PEOPLE OA (CFM/PER)	TABLE 403.3.1.1 Ra AREA OA (CFM/FT2)	TABLE 403.3.1.1 OCCUPANT DENSITY (#/1000 FT2)	Pz (#)	Rp*Pz	Ra*Az	Vbz (CFM)	TABLE 403.3.1.1.1.2 Ez	Voz (CFM)	Vpz MAX SUPPLY (CFM)	Vpzm MIN SUPPLY (CFM)	Zp	INTERPOLATED TABLE 403.3.1.1.2.3.2 Ev
108	OPEN KITCHEN	522	NO LISTING	0.0	0.00	0	8	0	0	0	0.80	0	2505	2505	0.000	1.00
109	WORK ROOM	572	NO LISTING	0.0	0.00	0	6	0	0	0	0.80	0	2445	2445	0.000	1.00
114	TRASH ROOM	48	NO LISTING	0.0	0.00	0	0	0	0	0	0.80	0	0	0	0.000	1.00
111	UTILITIES	85	NO LISTING	0.0	0.00	0	0	0	0	0	0.80	0	50	50	0.000	1.00
		1,225					14	0	0	0		0	5000	5000	0.000	1.00

OUTDOOR AIR CALCULATIONS PER EQUATION 4-1:

SYMBOL	VALUE	DESCRIPTION
Ps =	14	SYSTEM POPULATION
SPz =	14	ZONE POPULATION
D =	1.00	OCCUPANT DIVERSITY
Vou =	0	UNCORRECTED OUTDOOR AIR INTAKE
Zp (max) =	0.000	ZONE PRIMARY OUTDOOR AIR FRACTION (MAXIMUM)
Ev =	1.00	SYSTEM VENTILATION EFFICIENCY
SVpz =	5000	ZONE PRIMARY AIRFLOW
Vot =	0	CODE REQUIRED OUTDOOR AIRFLOW RATE, CFM
Vot =	0	DESIGN OUTDOOR AIRFLOW RATE, CFM

SYSTEM 2

ROOM #	NAME	Az AREA (FT2)	TABLE 403.3.1.1 OCCUPANCY CATEGORY	TABLE 403.3.1.1 Rp PEOPLE OA (CFM/PER)	TABLE 403.3.1.1 Ra AREA OA (CFM/FT2)	TABLE 403.3.1.1 OCCUPANT DENSITY (#/1000 FT2)	Pz (#)	Rp*Pz	Ra*Az	Vbz (CFM)	TABLE 403.3.1.1.1.2 Ez	Voz (CFM)	Vpz MAX SUPPLY (CFM)	Vpzm MIN SUPPLY (CFM)	Zp	INTERPOLATED TABLE 403.3.1.1.2.3.2 Ev
101	VESTIBULE	77	CORRIDORS	0.0	0.06	0	0	0	5	5	0.80	6	0	0	0.000	1.00
102	QUEUE	353	SALES	7.5	0.12	15	8	60	42	102	0.80	128	360	360	0.355	0.79
103	DINING ROOM	694	CAFETERIA/FAST FOOD DINING	7.5	0.18	100	56	420	125	545	0.80	681	2700	2700	0.252	0.90
104	CORRIDOR	93	CORRIDORS	0.0	0.06	0	0	0	6	6	0.80	7	0	0	0.000	1.00
105	EGRESS STAIR	127	CORRIDORS	0.0	0.06	0	0	0	8	8	0.80	10	90	90	0.106	1.00
106	WOMENS RESTROOM	140	NO LISTING	0.0	0.00	0	0	0	0	0	0.80	0	160	160	0.000	1.00
107	MENS RESTROOM	116	NO LISTING	0.0	0.00	0	0	0	0	0	0.80	0	90	90	0.000	1.00
		1,600					64	480	185	665		831	3400	3400	0.355	0.79

OUTDOOR AIR CALCULATIONS PER EQUATION 4-1:

SYMBOL	VALUE	DESCRIPTION
Ps =	64	SYSTEM POPULATION
SPz =	64	ZONE POPULATION
D =	1.00	OCCUPANT DIVERSITY
Vou =	665	UNCORRECTED OUTDOOR AIR INTAKE
Zp (max) =	0.355	ZONE PRIMARY OUTDOOR AIR FRACTION (MAXIMUM)
Ev =	0.79	SYSTEM VENTILATION EFFICIENCY
SVpz =	3400	ZONE PRIMARY AIRFLOW
Vot =	837	CODE REQUIRED OUTDOOR AIRFLOW RATE, CFM
Vot =	840	DESIGN OUTDOOR AIRFLOW RATE, CFM

SYSTEM 3

ROOM #	NAME	Az AREA (FT2)	TABLE 403.3.1.1 OCCUPANCY CATEGORY	TABLE 403.3.1.1 Rp PEOPLE OA (CFM/PER)	TABLE 403.3.1.1 Ra AREA OA (CFM/FT2)	TABLE 403.3.1.1 OCCUPANT DENSITY (#/1000 FT2)	Pz (#)	Rp*Pz	Ra*Az	Vbz (CFM)	TABLE 403.3.1.1.1.2 Ez	Voz (CFM)	Vpz MAX SUPPLY (CFM)	Vpzm MIN SUPPLY (CFM)	Zp	INTERPOLATED TABLE 403.3.1.1.2.3.2 Ev
110	MANAGERS OFFICE	73	OFFICE SPACES	5.0	0.06	5	2	10	4	14	0.80	18	350	350	0.051	1.00
		73					2	10	4	14		18	350	350	0.051	1.00

OUTDOOR AIR CALCULATIONS PER EQUATION 4-1:

SYMBOL	VALUE	DESCRIPTION
Ps =	2	SYSTEM POPULATION
SPz =	2	ZONE POPULATION
D =	1.00	OCCUPANT DIVERSITY
Vou =	14	UNCORRECTED OUTDOOR AIR INTAKE
Zp (max) =	0.051	ZONE PRIMARY OUTDOOR AIR FRACTION (MAXIMUM)
Ev =	1.00	SYSTEM VENTILATION EFFICIENCY
SVpz =	350	ZONE PRIMARY AIRFLOW
Vot =	14	CODE REQUIRED OUTDOOR AIRFLOW RATE, CFM
Vot =	15	DESIGN OUTDOOR AIRFLOW RATE, CFM

FAN COIL/ACU CONTROL MATRIX

SETPOINT/CONTROL	RTU-1 KITCHEN	RTU-2 DINING	ACU-1 OFFICE
SETPOINTS			
COOLING - OCCUPIED SETPOINT	75 F	75 F	75 F
COOLING - UNOCCUPIED SETPOINT	80 F	80 F	80 F
HEATING - OCCUPIED SETPOINT	70 F	70 F	70 F
HEATING - UNOCCUPIED SETPOINT	60 F	60 F	60 F
HUMIDITY SETPOINT	60%	60%	60%

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

SUPPLY FAN			
ON DURING OCCUPIED MODE	YES	YES	YES
CYCLE WITH LOADS DURING OCCUPIED HOURS	YES	YES	YES
VARIALBE VOLUME - MODULATE FAN SPEED	YES	YES	YES

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

AIR BALANCE SCHEDULE

EQUIPMENT TAG	SUPPLY AIRFLOW (CFM)	OUTDOOR AIRFLOW (CFM)	RETURN AIRFLOW (CFM)	EXHAUST AIRFLOW (CFM)	OA/SA (%)	REMARKS
RTU-1	5,000	500	4,500		10%	
RTU-2	3,400	850	2,550		25%	
MUA-1	2,250	2,250	0		100%	
ACU-1	350	15	335		4%	
EF-1				1,430		
EF-2				1,630		
EF-3				350		
TOTAL =	11,000	3,615	7,385	3,410		
RESULTING BUILDING PRESSURIZATION =				205 CFM		
PRESSURIZATION PERCENTAGE =				1.9 %		

DIFFUSERS, GRILLES AND REGISTERS

MARK	SERVICE	LOCATION	CEILING TYPE	MOUNTING TYPE	MANUFACTURER	MODEL NUMBER	REMARKS
D-1	SUPPLY	CEILING	GYP. BOARD	LAY-IN	TITUS	TMSA XX 24x24 3 26	[1,2,4,6,7]
D-2	SUPPLY	CEILING	GYP. BOARD	LAY-IN	TITUS	TMSA XX 12x12 3 26	[1,2,4,6,7]
D-3	SUPPLY	DUCT	NA	SURFACE	TITUS	30RL X X 1 26	[1,5-7]
D-4	SUPPLY	CEILING	AC TILE	LAY-IN	TITUS	PAR XX 24x24 3 26	[1,2,5-7]
D-5	SUPPLY	CEILING	AC TILE	LAY-IN	TITUS	TMSA XX 24x24 3 26	[1,2,6,7]
G-1	EXHAUST	CEILING	GYP. BOARD	SURFACE	TITUS	50F X X 1 26	[1,3,5-7]
G-2	RETURN	CEILING	AC TILE	LAY-IN	TITUS	50F X X 3 26	[1-3,5,6]
G-3	RETURN/TRANSFER	VARIES	GYP. BOARD	SURFACE	TITUS	50F X X 3 26	[1-3,5,6]

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 SHALL BE PREFINISHED TO MATCH CEILING/WALL/EXPOSED DUCT COLOR. COORDINATE WITH ARCHITECT.
7. PROVIDE DIFFUSERS AND GRILLES WITH NO EXPOSED MOUNTING SCREWS.

AIR SOURCE HEAT PUMPS

MARK	LOCATION	SERVES	NOMINAL COOL (TONS)	HEATING AT 47F (MBH)	ELECTRICAL VOLT	PH	MCA	MOCP	SEER /EER	HSPF /COP	MANUFACTURER	MODEL NUMBER	REMARKS
ASHP-1	ROOF	ACU-1	0.75	10.0	208	1	15.0	20	19.0/13.0	10.0/3.10	CARRIER	38MAQ	[1,2]

REMARKS:
1. PROVIDE EQUIPMENT WITH SCCR GREATER THAN THE AVAILABLE FAULT CURRENT AT THE EQUIPMENT OR UPSTREAM PANELBOARD. REFER TO THE ELECTRICAL ONE LINE DIAGRAM AND PANEL SCHEDULES FOR AVAILABLE FAULT CURRENT AT UPSTREAM PANELBOARD.
2. PROVIDE HAIL GUARD.

DUCTLESS SPLIT SYSTEMS

MARK	COOLING NOMINAL (TONS)	COOLING TOT (MBH)	COOLING SEN (MBH)	HEATING OUT (MBH)	SUPPLY AIR (CFM)	FAN (WATT)	ELECTRICAL VOLT	PH	MCA	MOCP	SEER /EER	CARRIER MODEL NUMBER	REMARKS
ACU-1	0.8	10.41	8.22	10.55	353	46	208	1	0.2	NA	19.0/13.0	40MBCQ09	[1,2]

REMARKS:
1. PROVIDE CONDENSATE PUMP.
2. INDOOR UNIT POWER PROVIDED FROM OUTDOOR UNIT.

EXHAUST FANS

MARK	LOCATION	SERVICE	AIRFLOW (CFM)	EXTERNAL STATIC (IN H2O)	SONES	MOTOR DATA FAN (HP)	VOLT	PH	RPM	MANUFACTURER	MODEL NUMBER	REMARKS
EF-1	ROOF	HOOD 1	-	-	-	-	-	-	-	HALTON	-	[4]
EF-2	ROOF	HOOD 2	-	-	-	-	-	-	-	HALTON	-	[4]
EF-3	ROOF	RESTROOMS	350	0.50	7.5	1/8	115	1	1,550	GREENHECK	G-095-D	[1-3]

REMARKS:
1. PROVIDE SOLID STATE SPEED CONTROL.
2. PROVIDE MOTORIZED BACKDRAFT DAMPER.
3. PROVIDE MINIMUM 12 INCH HEIGHT ROOF CURB.
4. REFERENCE HALTON DRAWINGS FOR ADDITIONAL INFORMATION.

ROOF TOP UNITS

MARK	COOLING SEN (MBH)	COOLING TOT (MBH)	COOLING COOL (TON)	HEATING IN (MBH)	HEATING OUT (MBH)	SUPPLY AIR (CFM)	EXT. S.P. (IN)	ELECTRICAL FAN BHP	VOLT	PH	MCA	MOCP	WEIGHT (LBS)	SEER /EER	CARRIER MODEL NUMBER	REMARKS
RTU-1	118.3	151.4	12.5	240.0	195.0	5,000	0.70	2.3	460	3	28.0	30	1,974	/13.9	48HCFD14	[1-3,6-14]
RTU-2	80.8	103.6	8.5	224.0	184.0	3,400	0.70	1.8	460	3	19.0	25	1,265	/13.9	48HCFD09	[1,2,4,5,7-14]

CARRIER IS THE BASIS OF DESIGN. NO EXCEPTIONS.

COOLING CAPACITIES ARE BASED ON AHRI STANDARD 210/240 OR 340/360: 80°F DB/ 67°F WB INDOOR ENTERING AIR TEMPERATURE, 95°F DB AIR ENTERING OUTDOOR FAN. SCHEDULED UNIT MAY DIFFER FROM AHRI STANDARD CFM.

REMARKS:
1. PROVIDE EQUIPMENT WITH SCCR GREATER THAN THE AVAILABLE FAULT CURRENT AT THE EQUIPMENT OR UPSTREAM PANELBOARD. REFER TO THE ELECTRICAL ONE LINE DIAGRAM AND PANEL SCHEDULES FOR AVAILABLE FAULT CURRENT AT UPSTREAM PANELBOARD.
2. PROVIDE WITH FACTORY INSTALLED DISCONNECT, UNPOWERED CONVENIENCE OUTLET, THROUGH THE BASE ELECTRICAL CONNECTION.
3. PROVIDE ADAPTOR CURB.
4. PROVIDE WITH 14 INCH HEIGHT ROOF CURB.
5. PROVIDE WITH DRY BULB ECONOMIZER AND BAROMETRIC RELIEF DAMPER.
6. PROVIDE WITH DRY BULB ECONOMIZER AND POWER EXHAUST.
7. ECONOMIZER SHALL INCLUDE FAULT DETECTION DIAGNOSTICS (FDD). DAMPER LEAKAGE SHALL MEET APPLICABLE ENERGY CODE.
8. PROVIDE WITH CONDENSER COIL HAIL GUARD.
9. DUCT SMOKE DETECTOR ON THE RETURN 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.
10. UNITS WITH COOLING CAPACITY GREATER THAN OR EQUAL TO 65 MBH SHALL HAVE MULTI-STAGE CAPABILITY PER APPLICABLE ENERGY CODE.
11. ECONOMIZER SHALL MEET ALL LOCAL ENERGY CODE REQUIREMENTS.
12. PROVIDE CORROSION PROTECTION - PHENOLIC EPOXY COATING, FACTORY APPLIED TO CONDENSER AND EVAPORATOR COILS. 2
13. PROVIDE WATER LEVEL MONITORING DEVICE IN DRAIN PAN TO SHUT OFF UNIT IF THE DRAIN LINE BECOMES RESTRICTED. 2
14. EQUIPMENT SHALL BE OBTAINED THROUGH SHAKE SHACK NATIONAL ACCOUNT. CONTACT CARRIER CORPORATION FOR PROPOSALS:
    BOB ECKWEILER
    CARRIER RETAIL STRATEGIC ACCOUNTS
    EMAIL: BOB.ECKWEILER@CARRIER.UTC.COM
    PHONE: (973) 222-6742

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.)
RTU-1	BLOWER CABINET	PHI-PKG14-24V	14"	3,000-8000 CFM	< 0.02 PPM	2.25"W x 19.5"L x 1.75"D	SHIP LOOSE	11W	115 VAC	24 VAC	0.50A	2 LBS
RTU-2	BLOWER CABINET	PHI-PKG14-24V	14"	3,000-8000 CFM	< 0.02 PPM	2.25"W x 19.5"L x 1.75"D	SHIP LOOSE	11W	115 VAC	24 VAC	0.50A	2 LBS

Bergmeyer
www.bergmeyer.com
LA - 800 South Figueroa St. #1080, Los Angeles, CA 90017, 212.337.1090
BOS - 51 Sleeper St. 4th Floor, Boston, MA 02210, 617.542.1025

CONSULTANTS:

Schnackel engineers
800-581-0963
www.schnackel.com

SE JOB#: 200402

SEAL/ SIGNATURE:

NO.	BY	DATE	DESCRIPTION
3		2022-03-04	IFC
2		2022-01-06	HEALTH DEPT. COMMENTS
	HC	2021-09-23	PERMIT/BID SET
	HC	2020-12-28	75% SET
	HC	2020-10-19	DD SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

100 DERBY STREET, SUITE 505,
HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

MECHANICAL SCHEDULES

DRAWN BY:	RAS
CHECKED BY:	GRS
JOB NO:	20081.00

M601

RESERVED FOR DOCUMENT BINDING

HOOD INFORMATION TABLE

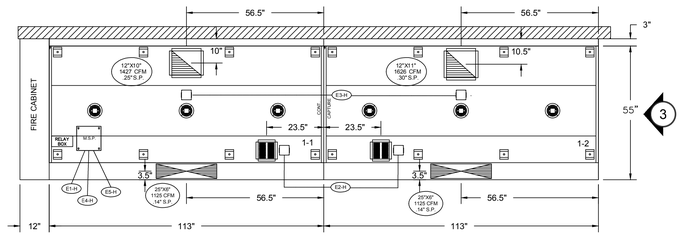
HOOD NUMBER	HOOD MODEL	EXHAUST AIR FLOW REQUIREMENTS						GREASE EXTRACTOR				HOOD CONSTRUCTION	HOOD WEIGHT (LBS)	SUPPLY AIR REQUIREMENTS				
		EXHAUST CFM	T.A.B. PORT STATIC PRESSURE	TOTAL HOOD STATIC PRESSURE	EXHAUST COLLAR			QTY.	SIZE		TYPE			SUPPLY CFM	SUPPLY STATIC PRESSURE	SUPPLY COLLAR		
					QTY.	LENGTH	WIDTH		L	H						QTY.	LENGTH	WIDTH
1-1	KVC	1427	0.14"	0.25"	1	12"	10"	5	20"	13"	KSA	ALL 18 GA. 304 S.S.	832	1125	0.14"	1	25"	6"
								1	11"	13"								
1-2	KVC	1626	0.18"	0.30"	1	12"	11"	5	20"	13"	KSA	ALL 18 GA. 304 S.S.	832	1125	0.14"	1	25"	6"
								1	11"	13"								

TOTAL EXH. CFM = 3053

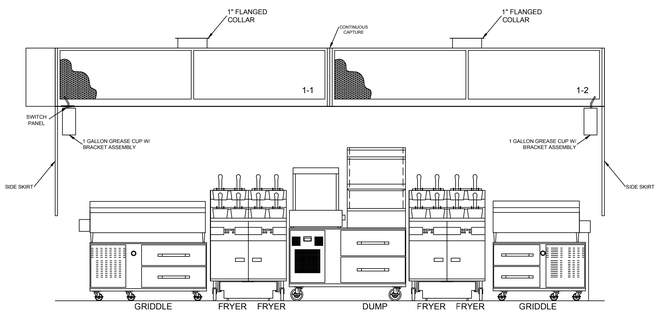
TOTAL SUPPLY CFM = 2250

ELECTRICAL CONNECTION SCHEDULE

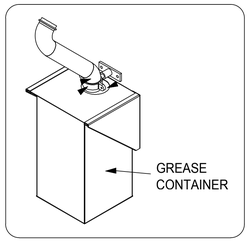
CONNECTION #	CONNECTION DESCRIPTION	FROM	TO
E1-H	120V, 15AMP - HOOD LIGHT POWER - 3 WIRES	BUILDING SOURCE	HOOD 1-1
E2-H	FIELD CONNECTION FOR HOOD LIGHTS	HOOD 1-1	HOOD 1-2
E3-H	FIELD CONNECTION FOR TEMP SENSORS	HOOD 1-1	HOOD 1-2
E4-H	120V/1PH - MOTOR STARTER POWER	BUILDING SOURCE	HOOD 1-1
E5-H	120V/1PH - MOTOR STARTER POWER	BUILDING SOURCE	HOOD 1-1



1 ITEM # 1-1, 1-2
PLAN VIEW



2 ITEM # 1-1, 1-2
ELEVATION VIEW



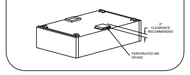
NOTE
T-STAT IS FACTORY PRE-SET FOR 95 DEGREES, IF SPACE CONDITIONS EXCEED 95 DEGREES WITHOUT COOKING TAKING PLACE, THEN A FIELD ADJUSTMENT OF THE T-STAT WILL BE REQUIRED BY PERSONNEL OTHER THAN HALTON. T-STAT IS A SAFETY INTERLOCK ONLY. IT IS NOT INTENDED AS A PRIMARY MEANS OF ENGAGING THE EXHAUST FAN.

3 ITEM # 1-1, 1-2
SECTION VIEW

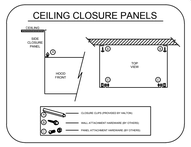
CAPTURE JET CLEARANCE DETAIL

Capture Jet ® Fan Cover Clearance

Patented Capture Jet ® technology perimeter air jets improve capture and containment by creating a downward curtain of air that prevents escape of air in the space above and around the Capture Jet ® air intake cover on the top of the Halton hood. Please leave 2 inches of clearance on the top and sides of the perforated Capture Jet ® intake cover to allow unimpeded entrance of air into the Capture Jet ® fan.



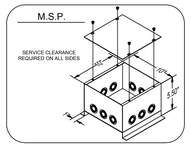
CEILING CLOSURE PANELS



NOTE

THE HOODS SHOWN ON THIS DRAWING IS DESIGNED AS THOUGH A SINGLE EXHAUST FAN WILL BE USED FOR HOOD 1-1 & HOOD 1-2. ONE TIMER PANEL IS REQUIRED PER EXHAUST FAN. IT IS THE RESPONSIBILITY OF THE F.S.E.C. TO INFORM HALTON OF THE NUMBER OF EXHAUST FANS BEING UTILIZED ON THIS PROJECT.

M.S.P.



GENERAL SPECIFICATIONS

1- HOOD CONSTRUCTION AND DESIGN MEETS NFPA 96 AND UL 710 STANDARD.

2- HOOD IS NSF AND ETL LISTED UNDER THE FOLLOWING FILE NUMBER: ETL #1031432OAPRT-001

3- ALL INSTALLATION WORK IS TO BE PERFORMED BY QUALIFIED PERSONS AND IN ACCORDANCE WITH STATE AND LOCAL BUILDING CODE REQUIREMENTS.

4- THE INSTALLATION SHALL BE IN ACCORDANCE WITH NFPA 96, REMOVAL OF SMOKE AND GREASE LADEN VAPORS FROM COMMERCIAL COOKING EQUIPMENT.

5- ALL EXHAUST DUCTWORK AND TRANSITIONS ARE TO BE PROVIDED BY THE HVAC CONTRACTOR.

6- CLEARANCE FROM HOOD AND DUCTS TO COMBUSTIBLE MATERIAL SHALL BE PER APPLICABLE BUILDING CODES.

7- FOR PROPER OPERATION OF THE HOOD SYSTEM, IT IS THE RESPONSIBILITY OF THE GENERAL CONTRACTOR TO HAVE THE HOOD BALANCED AND TESTED TO ENSURE THAT THE EXHAUST AND SUPPLY REQUIREMENTS OF THE HOOD ARE MET.

INSTALLATION REQUIREMENTS

KITCHEN EQUIPMENT CONTRACTOR'S REQUIREMENTS

1- PROVIDE DRAWINGS TO APPROPRIATE TRADES REFERENCING UTILITY SERVICE AND COORDINATE FINAL CONNECTION.

2- DELIVER, ASSEMBLE AND INSTALL HALTON SYSTEM PER DRAWING.

3- FURNISH WIRING AND PLUMBING DIAGRAMS TO END USER.

4- THE K.E.C MUST INFORM HALTON OF ANY CHANGES IN EQUIPMENT OR BUILDING STRUCTURE. FIELD MODIFICATIONS ARE THE RESPONSIBILITY OF THE K.E.C.

5- IF HALTON MANUAL EXHAUST VOLUME DAMPERS ARE PROVIDED, THE K.E.C. IS RESPONSIBLE FOR THEIR INSTALLATION OR TO MAKE ARRANGEMENTS WITH OTHER TRADES FOR THEIR INSTALLATION.

6- IF HALTON MODEL KVL BACKSHELF STYLE HOODS ARE PROVIDED, THE K.E.C. IS RESPONSIBLE FOR THE INSTALLATION OF THE CAPTURE-JET FAN.

ELECTRICAL CONTRACTOR'S REQUIREMENTS

1- PROVIDE AND CONNECT ALL REQUIRED VOLTAGES, CONNECTORS, WIRING, CONDUIT, ETC., PER NEC AND ALL APPLICABLE LOCAL CODES.

ELECTRICAL EQUIPMENT REQUIREMENTS

FLUORESCENT LIGHT FIXTURE
40 WATT MAX BULB= .67 AMP EA.

RECESSED INCANDESCENT LIGHT FIXTURE
150 WATT MAX BULB= 1.25 AMP EA.

GLOBE INCANDESCENT LIGHT FIXTURE
100 WATT MAX BULB= .83 AMP EA.

LED LIGHT FIXTURES= .30 AMP EA.

CAPTURE JET FAN= .72 AMP EA

ALL HOOD CIRCUITS ARE NOT TO EXCEED 15 AMP

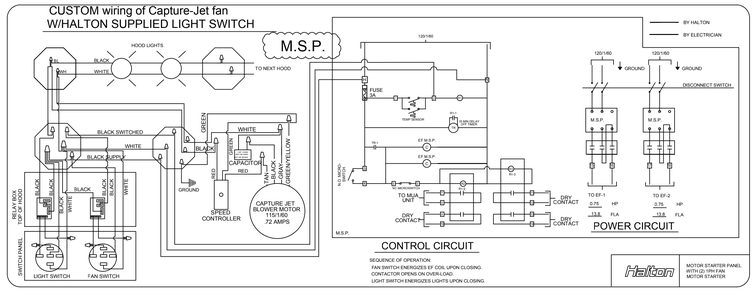
LIGHT BULBS, IF REQUIRED, ARE TO BE PROVIDED BY OTHERS

CEILING HEIGHT NOTE

IF HALTON COMPANY IS TO PROVIDE CEILING CLOSURE PANELS, THE EXACT DIMENSION OF THE FINISHED CEILING HEIGHT MUST BE PROVIDED PRIOR TO RELEASE.

FINISHED CEILING HEIGHT A.F.F.: _____

CUSTOM wiring of Capture-Jet fan W/HALTON SUPPLIED LIGHT SWITCH



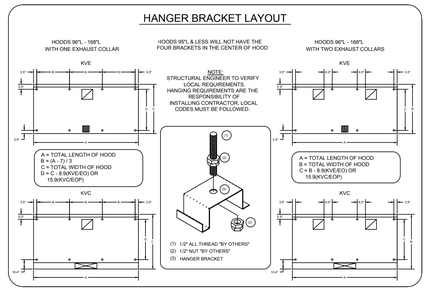
CONTROL CIRCUIT

SEQUENCE OF OPERATION
FAN SWITCH ENERGIZES EF COIL UPON CLOSING.
CONTACTOR OPENS ON OVERLOAD.
LIGHT SWITCH ENERGIZES LIGHTS UPON CLOSING.

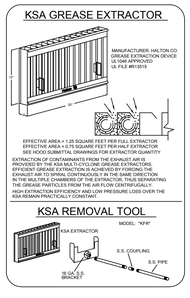
POWER CIRCUIT

MOTOR STARTER PANEL WITH (2) 15Yr FAN MOTOR STARTER

HANGER BRACKET LAYOUT



KSA GREASE EXTRACTOR



KSA REMOVAL TOOL

PERFORMANCE CRITERIA

OTHER MANUFACTURERS WISHING TO OFFER AN ALTERNATE TO THE SPECIFIED MANUFACTURER MUST APPLY FOR PERMISSION TO DO SO IN WRITING FROM THE OFFICE OF THE SPECIFYING CONSULTANT. APPLICATION MUST BE RECEIVED BY THE CONSULTANT AT LEAST TEN WORKING DAYS PRIOR TO THE BID DATE. ANY ALTERNATE SYSTEM MUST MEET CONSTRUCTION AND PERFORMANCE REQUIREMENTS AND EFFICIENCIES AS OUTLINED IN THIS SPECIFICATION.

REQUESTS FOR APPROVAL MUST INCLUDE GREASE FILTRATION PERFORMANCE DATA (MICRON SIZE VS EXTRACTION EFFICIENCY) AND MANUFACTURERS OWN EXHAUST AIR FLOW CALCULATIONS BASED ON THE CONVECTIVE HEAT LOAD OF COOKING EQUIPMENT BENEATH THE HOOD.

EFFICIENCY COMPARISON DATA TO BE PERFORMED IN ACCORDANCE WITH THE MOST CURRENT ASTM STANDARD F1704 AND INCLUDE RESULTS FOR THE REQUIRED CAPTURE AND CONTAINMENT EXHAUST AIR FLOW IN ACCORDANCE WITH THE "TEST METHOD TO DETERMINE THE THRESHOLD OF CAPTURE AND CONTAINMENT" DATA MUST INCLUDE THERMAL IMAGING RESULTS VALIDATING CONFORMANCE TO ASTM F1704 AND SUPPLY AIR TEMPERATURE REQUIREMENT OF 74°F.

MAKE UP AIR WILL BE CALCULATED SO THAT THE SAME AMOUNT OF AIR WILL BE TAKEN FROM THE ZONE AS IS REQUIRED BY THE SPECIFIED SYSTEM. AN ADDITIONAL LOAD CANNOT BE PLACED ON THE KITCHEN HVAC SYSTEM.

MANUFACTURER MUST PROVIDE A WRITTEN GUARANTEE OF PERFORMANCE, ENSURING THE SPECIFYING ENGINEER THAT THE SYSTEM WILL PERFORM TO THE ENGINEER'S SATISFACTION WHEN INSTALLED AND BALANCED ACCORDING TO DESIGN AIR FLOWS AND RESULTS OF ASTM STANDARD F1704 TEST. (AS DETERMINED BY TAB PORTS AND PRESSURE VS. AIR FLOW CURVES.) CONSULTANT RESERVES THE RIGHT TO REJECT ANY SYSTEM WHICH, WHEN INSTALLED, DOES NOT PROVIDE CAPTURE AND CONTAINMENT AT THE THRESHOLD FLOW RATE DETERMINED IN ASTM F1704. REJECTED SYSTEM MUST BE REPLACED WITH SPECIFIED SYSTEM, WITH ALL REPLACEMENT COSTS PAID BY MANUFACTURER OF REJECTED SYSTEM.

ANY CHANGES IN THE SPECIFIED SIZING OF POWER WIRING, FAN SIZE, HORSEPOWER REQUIREMENTS, OR GAS LINES DUE TO THE USE OF ANY SYSTEM OTHER THAN THAT WHICH IS SPECIFIED IS THE RESPONSIBILITY OF THE ALTERNATE HOOD MANUFACTURER, AND MUST BE COORDINATED BY THE HOOD MANUFACTURER AND CONTRACTORS INVOLVED.

THIS DRAWING MUST BE CHECKED, SIGNED AND RETURNED TO THE APPROPRIATE FACTORY. PLEASE VERIFY THE FOLLOWING:

1. ALL DIMENSIONAL INFORMATION, MOUNTING POSITIONS AND CLEARANCES
2. THE MODEL AND TYPE OF COOKING EQUIPMENT.

NOTE TO APPROVER
ANY CHANGES IN COOKING EQUIPMENT SUCH AS INCREASED ENERGY INPUTS OR EQUIPMENT ADDITIONS MAY AFFECT HOOD PERFORMANCE. HALTON MUST BE NOTIFIED OF THESE CHANGES OCCUR, A RECALCULATION EXHAUST AIRFLOW MAY BE REQUIRED.

APPROVED BY _____ DATE _____

APPROVED FOR FABRICATION ☐ WITH CHANGES AS NOTED
☐ WITH NO CHANGES ☐ REVISE AND RESUBMIT

MAIL APPROVED DRAWINGS TO APPROPRIATE FACTORY BELOW:

HALTON CO. (CANADA)
1021 BREVIK PLACE
MISSISSAUGA, ON L4W 3R7
(905) 624-0260

WEBSITE: www.halton.com

HALTON CO. (USA)
101 INDUSTRIAL DRIVE
SCOTTSVILLE, KY 42164
270 237 5400

REV.	REVISION DESCRIPTION	BY	DATE
1	CHANGED TO 2 120V INPUTS ON MEP, MOVED GREASE CUPS	SKM	03.03.21

PROJECT: SHAKE SHACK
LOCATION: HINGHAM, MA
DRAWN BY: NC
DATE: 12.14.20
SCALE: NOT TO SCALE
CONSULTANT:

DRAWING TITLE: HOOD DETAILS
DRAWING No.: U20-925
REV. NO.: 1
SHEET NO.: 1 of 5

Halton

Bergmeyer

BOS
51 Sleeper St.
5th Floor
Boston, MA 02210
617.542.1025

LA
800 South Figueroa St.
Suite 1650
Los Angeles, CA 90017
212.337.1090

www.bergmeyer.com

CONSULTANTS:

Schnackel engineers
800-581-0963
www.schnackel.com
SE JOB# 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 42695
REGISTERED PROFESSIONAL ENGINEER
Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

HALTON DRAWINGS

DRAWN BY: RAS
CHECKED BY: GRS
JOB NO: 20081.00

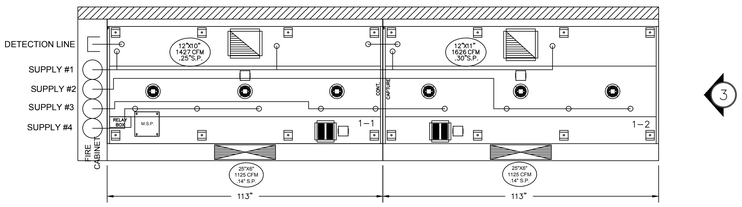
M701

RESERVED FOR DOCUMENT BINDING

ANSUL R-102 OVERLAPPING FIRE SUPPRESSION SYSTEM

MOUNTED IN FIRE CABINET:

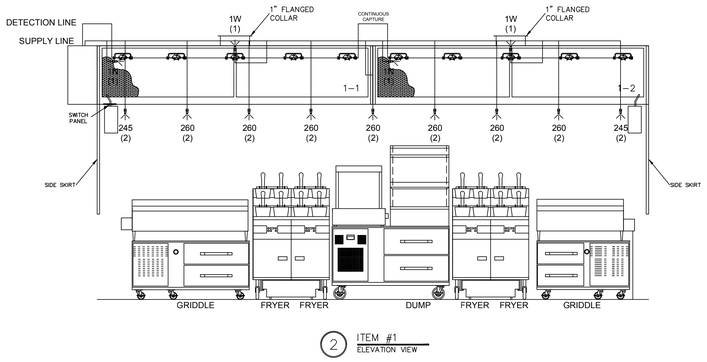
1 - OEM REGULATED RELEASE
1 - REGULATED ACTUATOR
4 - 3 GALLON TANKS



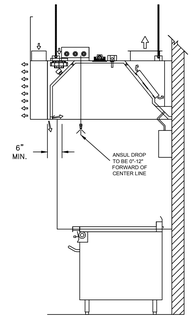
1 ITEM #1 PLAN VIEW

ALL ANSUL DROPS TO HAVE SWIVELS

NOTE
T-STAT IS FACTORY PRE-SET FOR 95 DEGREES, IF SPACE CONDITIONS EXCEED 95 DEGREES WITHOUT COOKING TAKING PLACE, THEN A FIELD ADJUSTMENT OF THE T-STAT WILL BE REQUIRED BY PERSONNEL OTHER THAN HALTON. T-STAT IS A SAFETY INTERLOCK ONLY. IT IS NOT INTENDED AS A PRIMARY MEANS OF ENGAGING THE EXHAUST FAN.



2 ITEM #1 ELEVATION VIEW



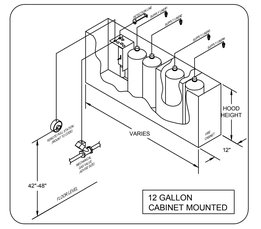
3 ITEM #1 SECTION VIEW

1) ANSUL R-102 FIRE SYSTEM
2) FOUR TANK SYSTEM (12 GALLON)
3) 3/8" BLACK IRON PIPING (CONCEALED)
3/8" S.S. APPLIANCE DROPS (EXPOSED)
4) MECHANICAL GAS VALVE = (ADVISE SIZE)

FLOW POINT CHART

ANSUL R-102 FLOW POINT CALCULATION

NOZZLE TYPE	NOZZLE FLOW PT.	NOZZLE QUANTITY	TOTAL FLOW PT.
3N	3	0	#
290	2	0	#
260	2	7	##
245	2	2	#
230	2	0	#
2W	2	0	#
2120	2	0	#
1W	1	2	#
1N	1	2	#
1F	1	0	#
1/2N	1/2	0	#
TOTAL FLOW POINTS USED			##
MAX. SYSTEM FLOW POINTS:			24 (12 GALLON)



ANSUL NOTES

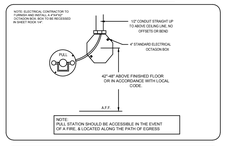
GENERAL NOTES:

1. THIS INSTALLATION IS TO BE MADE IN ACCORDANCE WITH THE R-102 INSTALLATION MANUAL AND IN ACCORDANCE WITH ALL STATE AND LOCAL CODES.
2. THE WIRE ROPE FOR THE DETECTOR AND REMOTE PULL STATION IS TO BE INSTALLED BY AN AUTHORIZED AND FACTORY TRAINED DISTRIBUTOR OR SERVICE REPRESENTATIVE.
3. THIS INSTALLATION IS TO BE INSPECTED, PUT INTO OPERATION AND CERTIFIED BY AN AUTHORIZED AND FACTORY TRAINED DISTRIBUTOR OR SERVICE REPRESENTATIVE.
4. ELECTRICAL CONTACTS AND WIRING FOR APPLIANCE SHUT OFF TO BE PROVIDED BY THE ELECTRICAL CONTRACTOR.
5. ANSUL R-102 RESTAURANT FIRE SUPPRESSION SYSTEMS HAVE BEEN TESTED AND ARE LISTED BY UNDERWRITERS' LABORATORIES INC. AS PRE-ENGINEERED SYSTEMS, AND WHEN INSTALLED AS SHOWN ON THIS DRAWING SHALL COMPLY WITH ALL RELEVANT ANSUL INSTALLATION RECHARGE INSPECTION AND MAINTENANCE MANUALS AND SHALL COMPLY WITH NFPA 96 WHEN INSTALLED AND CERTIFIED BY AUTHORIZED TRAINED ANSUL DISTRIBUTORS IN ACCORDANCE WITH THE MANUAL.
6. ALL AGENT DISTIBUTION PIPING AND DETECTION CONDUIT HOOD PENETRATIONS MUST BE PROPERLY SEALED IN ACCORDANCE WITH NFPA 96.

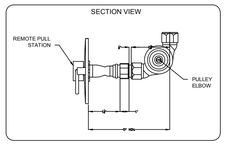
DISTRIBUTION PIPING REQUIREMENT NOTES:

1. PIPE SHALL BE 3/8" SCHEDULE 40 BLACK IRON, CHROME PLATED OR STAINLESS STEEL UNLESS OTHERWISE NOTED.
2. FINAL NOZZLE LOCATION MAY NOT VARY FROM LOCATION SHOWN.

MANUAL PULL DETAIL



SECTION VIEW



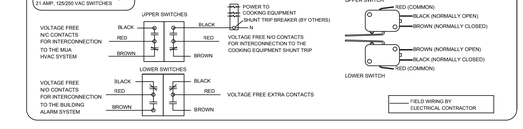
NOTE:
HALTON COMPANY WILL SUPPLY ANSUL COMPONENTS AND PRE-PIPED HOODS PER PUBLISHED ANSUL GUIDELINES AND RECOMMENDATIONS. IT IS THE RESPONSIBILITY OF THE F.S.E.C. TO INFORM HALTON OF ANY SPECIAL REQUIREMENTS OF THE LOCAL JURISDICTION PRIOR TO RELEASE OF EQUIPMENT.

NOTE:
ALL PIPING FOR LOW PROXIMITY APPLIANCE PROTECTION SHALL BE PROVIDED & INSTALLED BY THE INSTALLING ANSUL DISTRIBUTOR & NOT BY HALTON.

NOTE:
HAND HELD EXTINGUISHERS, IF REQUIRED, ARE TO BE PROVIDED BY OTHERS.

ANSUL MICROSWITCH DETAIL

ANSUL SNAP ACTION SWITCHES. CONTACTS SHOWN WITH AUTOMAN IN THE COCKED POSITION (READY) 21 AMP, 125/250 VAC SWITCHES



THIS DRAWING MUST BE CHECKED, SIGNED AND RETURNED TO THE APPROPRIATE FACTORY BY THE CUSTOMER BEFORE ANY MANUFACTURING WILL BE DONE.

1. ALL DIMENSIONAL INFORMATION, MOUNTING POSITIONS AND CLEARANCES
2. FIELD LOCATION AND TYPE OF COOKING EQUIPMENT.

NOTE TO CUSTOMER:
ANY CHANGES TO COOKING EQUIPMENT SUCH AS INCREASED ENERGY INPUTS OR EQUIPMENT POSITION MAY AFFECT EXHAUST AIRFLOW. HALTON MUST BE NOTIFIED IF ANY OF THESE CHANGES ARE MADE AFTER INSTALLATION DRAWINGS ARE APPROVED.

☐ REVISE AND RESUBMIT

APPROVED FOR FABRICATION
☐ WITH NO CHANGES ☐ WITH CHANGES AS NOTED

APPROVED BY: DATE

MAIL APPROVED DRAWINGS TO APPROPRIATE FACTORY BELOW:

HALTON CO. (USA)
101 INDUSTRIAL DRIVE
SCOTTSVILLE, KY 42164
1-270-237-5600

☐ HALTON CO. (CANADA)
1021 BREVIK PLACE
MISSISSAUGA, ON L4W 3R7
1-905-624-0001

WEBSITE: www.halton.com

REV.	REVISION DESCRIPTION	BY	DATE
NO CHANGE			

PROJECT: SHAKE SHACK
LOCATION: HINGHAM, MA
DRAWN BY: NC
DATE: 12.14.20
SCALE: NOT TO SCALE
CONSULTANT:

Halton

DRAWING TITLE: FIRE SYSTEM DETAILS

DRAWING No.: U20-925

REV. NO.: 1 SHEET NO.: 2 of 5

Bergmeyer
BOS - 51 Sleeper St. 6th Floor Boston, MA 02210 617.542.1025
LA - 800 South Figueroa St. Suite 1600 Los Angeles, CA 90017 212.337.1090
www.bergmeyer.com

CONSULTANTS:
Schnackel engineers
800-581-0963
www.schnackel.com
SE #ORM 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL ELECTRICAL No. 42695
REGISTERED PROFESSIONAL ENGINEER
Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

HALTON DRAWINGS

DRAWN BY: RAS
CHECKED BY: GRS
JOB NO: 20081.00

M702

MUA CHART

DATA	IMPERIAL	METRIC
Model	MUA-DGX-2800	
Max. Supply Air	2800 CFM	- l/s
Design Supply Air	2250 CFM	- l/s
Internal S.P.	2.03" W.G.	- PA
External S.P.	0.65" W.G.	- PA
Total S.P.	2.68" W.G.	
Motor	3 hp	
Power	1.36 bhp	
Full Load AMPS	4.8	
Motor RPM	1800	
Voltage/Phase/HZ	480/3/60	
Fan RPM	2032 @ 60 HZ	
Mounting	Exterior	
Blower Model	ANPA 14	
Material Type	G90 Galv. 20GA.	
Paint Color	Unpainted	
Weight	1877 lbs	- kg

HEATING INFORMATION

Gas Type	Natural	
Min. Gas Pressure	8" W.C.	
Max. Gas Pressure	14" W.C.	
Gas Line Size	1/2"	
Discharge Temperature	85.0°F	
Temperature Rise	79.1°F	
Heat Input MBH	208.9	
Heat Output MBH	192.2	

COOLING INFORMATION

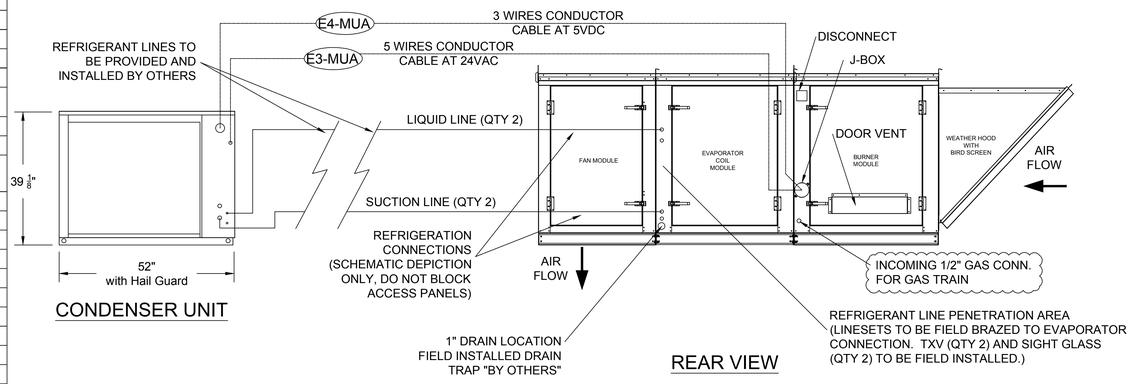
Cooling Coil Inlet DB Temp.	91.2°F	
Cooling Coil Inlet WB Temp.	73.8°F	
Cooling Coil Exit DB Temp.	64.0°F	
Cooling Coil Exit WB Temp.	63.8°F	
Cooling Coil Total Capacity	67.8 MBH	
Cooling Coil Sensible Capacity	66.1 MBH	
Cooling Coil Latent Capacity	1.7 MBH	

STANDARD FEATURES

- ✓ 1" Duct Board Insulation Double Wall
- ✓ Unit Mounted Controls
- ✓ Neoprene Fan Isolators
- ✓ Direct Spark Gas Train
- ✓ R-410A DX Cooling Coil
  - Copper Tubes/Aluminum Fins
- ✓ Belt Drive Fan (Comefri ATLI)
- ✓ Stainless Drain Pan and Drain

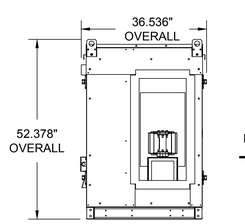
OPTIONS

- ✓ TXV, Filter Dryer, Sight Glass (Shipped Loose)
- ✓ Cooling Coil Shipped Charged w/ Nitrogen
- ✓ Galvanized Cooling Coil Frame
- ✓ Unit Mounted Heat Controls
- ✓ Unit Mounted Call for Cooling
- ✓ Intake Hood w/ 2" Alum. Mesh Filters & Birdscreen
- ✓ MERV 8 Filtered Intake
- ✓ Insulated Roof Curb w/ Wood Nailer
- ✓ Motorized Intake Damper
- ✓ DOWN Discharge
- ✓ Variable Speed (Powerflex 523 VFD)
- ✓ Cooling Coil Moisture Elimiator

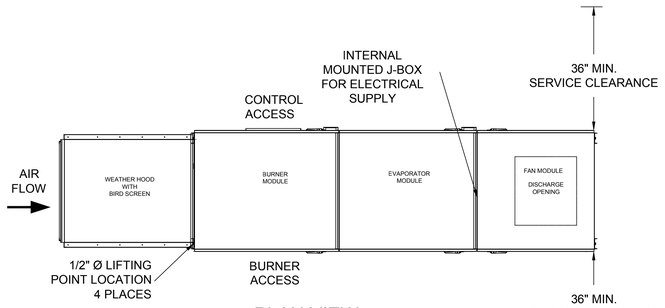


CONDENSER UNIT

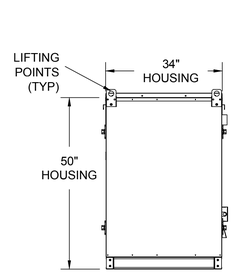
REAR VIEW



INLET VIEW



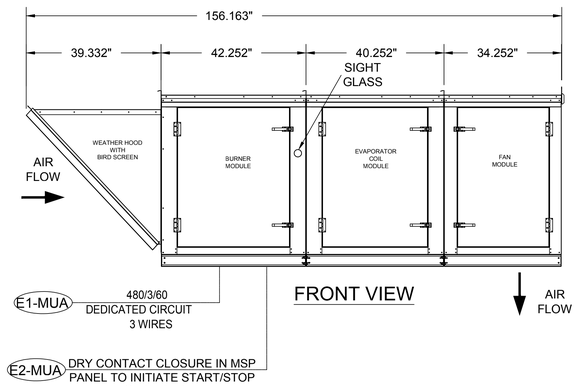
PLAN VIEW



OUTLET VIEW

NOTE:

LIFTING POINTS ARE NOT TO BE USED AS ANCHORS FOR SUSPENDED MOUNTING. THEY ARE FOR LIFTING ONLY



FRONT VIEW

ELECTRICAL CONNECTION WILL COME UP THROUGH CURB INTO BOTTOM OF UNIT

SPECIFICATIONS

GAS INFORMATION
MIDCO 6" SS BURNER
PRESSURE REGULATOR SUPPLIED
RTC GAS CONTROLS
DISCHARGE TEMPERATURE DIAL MOUNTED IN UNIT
HIGH TEMP LIMIT SWITCH SET TO 140°F

ELECTRICAL INFORMATION
480V / 3PH / 60Hz SUPPLY
INTEGRAL NON-FUSED DISCONNECT SWITCH
PREMIUM EFFICIENCY MOTOR
INTEGRAL MOTOR STARTER WITH THERMAL OVERLOADS
FIRE PROTECTION INTERLOCK
REMOTE START/STOP
50% MUA TURN DOWN

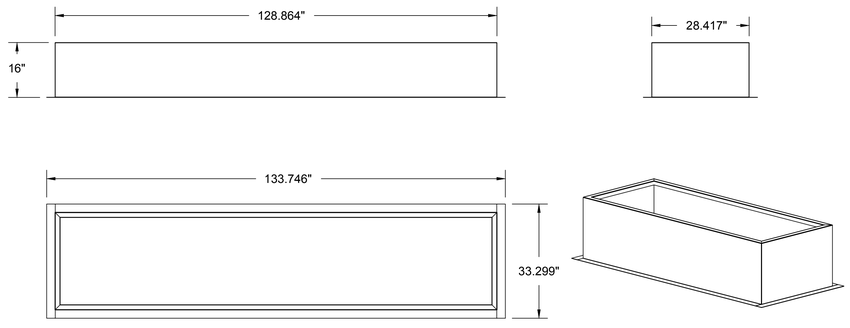
EQUIPMENT SPECIFICATIONS
ENTERING AIR THERMOSTAT/LOW TEMPERATURE CUTOUT
EXTERNAL PROFILE ADJUSTMENT WITH PRESSURE GAUGE
GALVANIZED FINISH
0" CLEARANCE ON TOP & BOTTOM OF UNIT
UNIT SHIPS ASSEMBLED IN ONE PIECE
1" CLEARANCE TO COMBUSTIBLE ON ENDS
LISTED 18" FROM COMBUSTIBLE ON SIDES

ITEM #MUA-1

ELECTRICAL SCHEDULE

CONNECTION #	CONNECTION DESCRIPTION	FROM	TO
E1-MUA	208/3/60 - FAN MOTOR POWER - 3 WIRES	BUILDING SOURCE	MUA UNIT
E2-MUA	DRY CONTACT CLOSURE PROVIDED BY OTHERS	HOOD 1-1	MUA UNIT
E3-MUA	5 WIRES CONDUCTOR CABLE - 24VAC	MUA UNIT	CONDENSER UNIT
E4-MUA	3 WIRES CONDUCTOR CABLE - 5VDC	MUA UNIT	CONDENSER UNIT

ROOF CURB DETAIL



THIS DRAWING MUST BE CHECKED, SIGNED AND RETURNED TO THE APPROPRIATE FACTORY PRIOR TO FABRICATION.
1. ALL DIMENSIONAL INFORMATION, MOUNTING POSITIONS AND CLEARANCES.
2. SPECIFIC CONFIGURATION TYPE OF COOKING EQUIPMENT.
NOTE TO APPROVER
ANY CHANGES IN COOKING EQUIPMENT SUCH AS INCREASED ENERGY INPUTS OR EQUIPMENT POSITION MAY AFFECT EXHAUST AIRFLOW. HALTON MUST BE NOTIFIED IF ANY OF THESE CONDITIONS CHANGE AFTER HOOD FABRICATION DRAWINGS ARE RELEASED.

☐ REVISE AND RESUBMIT
APPROVED FOR FABRICATION
☐ WITH CHANGES AS NOTED
☐ WITH NO CHANGES
APPROVED BY
DATE

MAIL APPROVED DRAWINGS TO APPROPRIATE FACTORY BELOW:
HALTON CO. (CANADA)
1021 BREVIK PLACE
MISSISSAUGA, ON L4W 3R7
1-(905)-624-0201

HALTON CO. (USA)
101 INDUSTRIAL DRIVE
SCOTTSVILLE, KY 42164
1-270-237-5600

WEBSITE: www.halton.com

REV.	REVISION DESCRIPTION	BY	DATE
1	ADDED E2,3,4 CONNECTIONS	SKM	03.03.21

PROJECT: SHAKE SHACK
LOCATION: HINGHAM, MA
DRAWN BY: NC
DATE: 12.14.20
SCALE: NOT TO SCALE
CONSULTANT:

Halton

DRAWING TITLE: MUA-DGX-2800
DRAWING No.: U20-925
REV. NO.: 1
SHEET NO.: 3 of 5

Bergmeyer

BOS - 51 Sleeper St. 4th Floor Boston, MA 02210 617.542.1025

LA - 800 South Figueroa St. Suite 1580 Los Angeles, CA 90017 212.337.1090

www.bergmeyer.com

CONSULTANTS:

Schnackel engineers
800-581-0963
www.schnackel.com
SE JOB# 200523

SEAL/ SIGNATURE:

COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 42955
REGISTERED PROFESSIONAL ENGINEER

Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

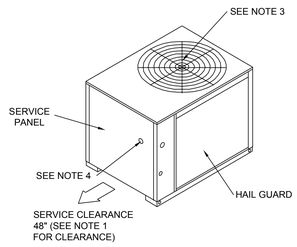
HALTON DRAWINGS

DRAWN BY: RAS
CHECKED BY: GRS
JOB NO: 20081.00

M703

ITEM #CU-1

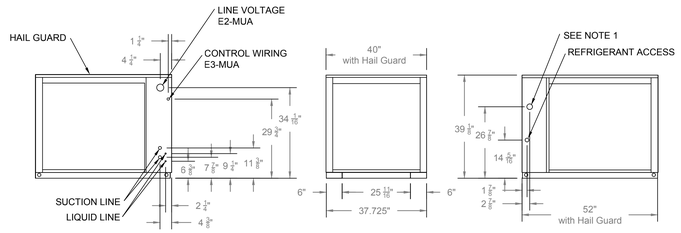
TRANE

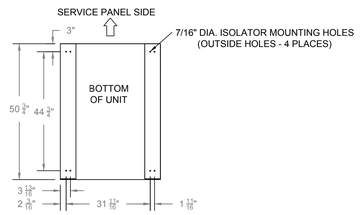


Notes:

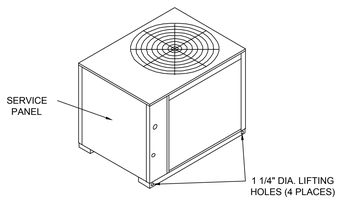
1. Acess opening is for field installed Bayloam accessory.
2. Minimum clearance for proper operation is 36" from walls, shrubbery, privacy fences, etc. Minimum clearance between adjacent units is 72". Recommended service clearance is 48".
3. Top discharge area should be unrestricted for 100" minumum. Unit should be placed so roof run-off water does not pour directly on unit.
4. Outdoor Air Temperature Sensor opening (Do Not Block Opening)

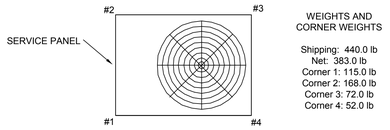
Hailguards - TTA
Condenser Coil Protection from Hail, Vandals, Etc. Perforated, Painted Galvanized Steel Factory Installed.
TTA Microchannel - General
Weatherproofed steel mounting/lifting rails Hermetic scroll compressors Microchannel condenser coils on select models Plate fin condenser coils Fans and motors Standard operating range 50-125°F (min. 0°F with low ambient accessory) Nitrogen holding charge Certified and rated in accordance with AHRI and DOE standards Certified to UL 1995
TTA Microchannel - Casing
Zinc coated, heavy gauge, galvanized steel Weather resistant baked enamel finish Meets ASTM B117, 672 hour spray test Removable single side maintenance access panels Lifting handles in maintenance access panels Unit base provisions for forklift and/or crane lifting
Refrigerations System - Dual Compressor
Two (2) separate and independent refrigerant circuits Each refrigeration circuit equiped with integral subcooling circuit Front or rear refrigerant line connections
Two (2) direct drive hermetic scroll compressors Suction gas-cooled motors w/ ± 10% voltage utilization range of unit nameplate voltage Crankcase Heaters Internal temperature and current sensitive motor overloads No compressor suction and/or discharge valves (reduced vibration/sound) Factory installed liquid line filter drier Phase loss/reverse rotation monitor Liquid line service ports Suction line service ports External high pressure cutout devices
TTA Microchannel - Condenser Coil (Microchannel)
Microchannel coils burst tested by the manufacturer Coils shall be leak tested to ensure the pressure integrity Factory pressure and leak tested to 660 psig Perforated steel hail guards factory installed
TTA Microchannel - Condenser Fan
26" or 28" propeller fan(s) Direct drive Statically and dynamically balanced
TTA Microchannel - Condenser Motor(s)
Permanently lubricated totally enclosed or open construction Built-in current and thermal overloads Ball or sleeve bearing type
TTA Microchannel - Controls
Choice of electromechanical or microprocessor Completely internally wired Numbered and colored wires Contactor pressure lugs or terminal block Unit external mounting location for disconnect device Single point power entry
TTA Controls: Electro-Mechanical
24V control circuit Control transformer Thermostat compatible Anti-Short Cycle Timer





10 TON COOLING CONDENSER (DUAL COMPRESSOR)
DIMENSIONAL DRAWING





WEIGHTS AND LOAD POINT LOCATION FOR CONDENSER
WEIGHT AND RIGGING

CONDENSER COIL SPECIFICATIONS

10 Ton Trane TTA 480V

Unit Function	Cooling
Voltage	480/60/3
Refrigeration Circuit/Stage	Dual Compressors/Dual Circuit
Unit Tonnage	10 Tons
Refrigerant	R-410A Refrigerant
Controls	Electromechanical

Factory Installed Accessories
Condenser Coil Hail/Vandal Guard Kit

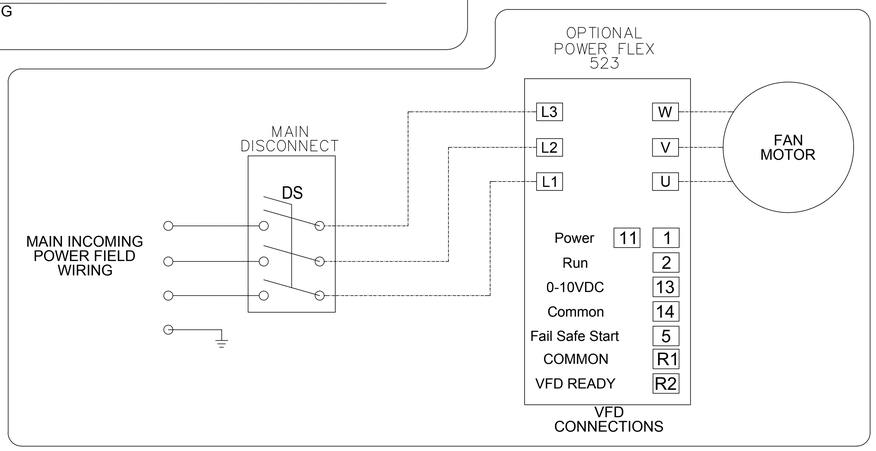
Electrical Data Condenser

Electrical Data	
Model:	TTA12043D
Unit Operating Voltage:	187-253
Minimum Circuit Ampacity:	41.0
Maximum Fuse Size:	50.0
Maximum Circuit Breaker:	50.0
Compressor Motor	
No.:	2
Volts:	480
Phase:	3
Amp-RLA:	16.2/16.2
Amp-LRA:	110/110
Condenser Fan Motor	
No.:	1
Volts:	480
Phase:	1
Amp-FLA:	2.1
Amp-LRA:	14.4

Compressor	
Number:	Scroll
No. Compressor/Tons:	2/4.3
System Data (7)	
No. Refrigerant Circuits:	2
Suction Line (in.) OD	1 1/8" Horizontal & Vertical
Liquid Line (in.) OD	1/2"

ELECTRICAL SCHEDULE

CONNECTION #	CONNECTION DESCRIPTION	FROM	TO
E3-MUA	5 WIRES CONDUCTOR CABLE - 24VAC	MUA UNIT	CONDENSER UNIT
E4-MUA	3 WIRES CONDUCTOR CABLE - 5VDC	MUA UNIT	CONDENSER UNIT
E5-MUA	208/3/60 - FAN MOTOR POWER - 3 WIRES	BUILDING SOURCE	CU-1



THIS DRAWING MUST BE CHECKED, SIGNED AND RETURNED TO THE APPROPRIATE FACTORY BEFORE ANY EQUIPMENT IS MANUFACTURED.
1. ALL DIMENSIONAL INFORMATION, MOUNTING POSITIONS AND CLEARANCES
2. THE CLASSIFICATION AND TYPE OF COOKING EQUIPMENT.
NOTICE TO PURCHASER:
ANY CHANGES IN COOKING EQUIPMENT SUCH AS INCREASED ENERGY INPUTS OR EQUIPMENT POSITION MAY AFFECT EXHAUST AIRFLOW. HALTON MUST BE NOTIFIED IF ANY OF THESE CONDITIONS EXIST SO THAT APPLICATION DRAWINGS AND QUOTATION CAN BE REVISED.
☐ REVISE AND RESUBMIT
APPROVED FOR FABRICATION ☐ WITH CHANGES AS NOTED
☐ WITH NO CHANGES
APPROVED BY: DATE

MAIL APPROVED DRAWINGS TO APPROPRIATE FACTORY BELOW:
HALTON CO. (CANADA) ☐
1021 BREVIK PLACE
MISSISSAUGA, ON L4W 3R7
1-905-624-0901

HALTON CO. (USA) ☒
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SCOTTSVILLE, KY 42164
1-270-237-3600
WEBSITE: www.halton.com

REV.	REVISION DESCRIPTION	BY	DATE
	ELECTRICAL SCHEDULE	SKM	03.03.21

PROJECT: SHAKE SHACK
LOCATION: HINGHAM, MA
DRAWN BY: NC
DATE: 12.14.20
SCALE: NOT TO SCALE
CONSULTANT:
Halton

DRAWING TITLE: MUA-DGX-2800
DRAWING No.: U20-925
REV. NO.: 1
SHEET NO.: 4 of 5

Bergmeyer
BOS - 51 Sleeper St. 4th Floor Boston, MA 02210 617.542.1025
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CONSULTANTS:
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www.schnackel.com
SE #ORM 200023

SEAL/ SIGNATURE:
COMMONWEALTH OF MASSACHUSETTS
GREGORY ROY SCHNACKEL
ELECTRICAL
No. 42695
REGISTERED PROFESSIONAL ENGINEER
Date: 06/07/2021

NO.	BY	DATE	DESCRIPTION
		2021-06-07	PERMIT/BID SET
		2020-12-28	75% SET

SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

HALTON DRAWINGS

DRAWN BY: RAS
CHECKED BY: GRS
JOB NO: 20081.00

M704

DOCUMENT BINDING

RESERVED FOR DOCUMENT BINDING

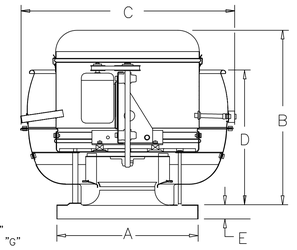
FAN INFORMATION TABLE

FAN NO	MODEL	QTY	CFM	S.P.	H.P.	VOLTAGE	AMPS	ACCESSORIES
EF-1	HSTXDRHUL1575SC	1	1427	0.80"	3/4	115/1/60	13.8	MOUNT & WIRE DISCONNECT – SPEED CONTROL – 22-1/2" SQ GALV SF CURB 24" HIGH VENTED – LABEL UL/CUL 762, LISTED RESTAURANT – GREASE CONTAINER – HINGE KIT
EF-2	HSTXDRHUL1575SC	1	1626	0.85"	3/4	115/1/60	13.8	MOUNT & WIRE DISCONNECT – SPEED CONTROL – 22-1/2" SQ GALV SF CURB 24" HIGH VENTED – LABEL UL/CUL 762, LISTED RESTAURANT – GREASE CONTAINER – HINGE KIT

NOTE:

ON ROOF UNITS, ANCHOR THE FAN SECURELY TO THE CURB. ANCHORING THROUGH THE VERTICAL PORTION OF THE CURB CAP FLANGE IS RECOMMENDED. USE A MINIMUM OF FOUR LAG BOLTS OR OTHER SUITABLE FASTENERS.

HTXDRHUL

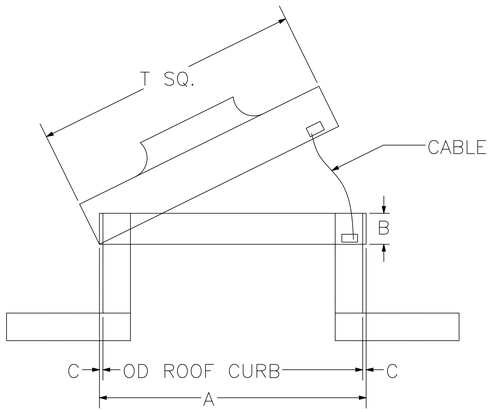


DAMPER OD = "F"
ROOF OPENING = "G"
CURB OD = "H"

TAG	SIZE	A	B	C	D	E	F	G	H	J	K	SHIP'G WT.-LESS MOTOR
EF-1	15	24"	27.63"	36.5"	22.63"	2"	18"	19.5"	22.50"	19.50"	23.75"	140
EF-2	15	24"	27.63"	36.5"	22.63"	2"	18"	19.5"	22.50"	19.50"	23.75"	140

NOTE:

ELECTRICAL CONNECTIONS TO BE MADE ON HINGE SIDE OF FAN.

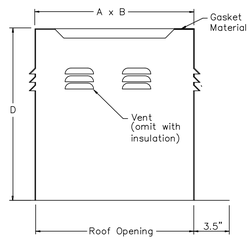


CURB

CURB TYPE: GSFRC

OPTIONS: (as noted below)

1) 4 VENTS
2) NO DAMPER SHELF



TAG	QTY	DESCRIPTION	MATERIAL GUAGE	A	B	C	D	ROOF OPENING	OPTIONS
EF-1	1	GSFRC 22.5	18	22.5"	22.5"	1.5"	24"	19.50" x 19.50"	1,2
EF-2	1	GSFRC 22.5	18	22.5"	22.5"	1.5"	24"	19.50" x 19.50"	1,2

THIS DRAWING MUST BE CHECKED, SIGNED AND RETURNED TO THE APPROPRIATE FACTORY. PLEASE VERIFY THE FOLLOWING:

1. ALL DIMENSIONAL INFORMATION, MOUNTING POSITIONS AND CLEARANCES.
2. THE LOCATION AND TYPE OF COOKING EQUIPMENT.

NOTE TO APPROVER

ANY CHANGES IN COOKING EQUIPMENT SUCH AS INCREASED ENERGY INPUTS OR EQUIPMENT ARRANGEMENT AFTER DUCTWORK HAS BEEN FABRICATED MAY RESULT IN ANY OF THESE CHANGES OCCUR, A RECALCULATION EXHAUST AIRFLOW MAY BE REQUIRED.

☐ REVISE AND RESUBMIT

APPROVED FOR FABRICATION

☐ WITH NO CHANGES ☐ WITH CHANGES AS NOTED

APPROVED BY DATE

MAIL APPROVED DRAWINGS TO APPROPRIATE FACTORY BELOW:

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1-270-237-5900

WEBSITE: WWW.HALTON.COM

REV.	DESCRIPTION	BY	DATE
1	NO CHANGE	SKM	03.03.21
2			
3			
4			
5			
6			
7			

PROJECT: SHAKE SHACK
LOCATION: HINGHAM, MA
DRAWN BY: NC
DATE: 12.14.20
SCALE: NOT TO SCALE
CONSULTANT: Halton

DRAWING TITLE: FAN DETAILS
DRAWING No.: U20-925
REV. NO.: 1
SHEET NO.: 5 of 5

Bergmeyer

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SHAKE SHACK

SHAKE SHACK - DERBY STREET SHOPS

HINGHAM, MA 02043
SHACK #1356

PERMIT/BID SET

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CHECKED BY: GRS
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M705