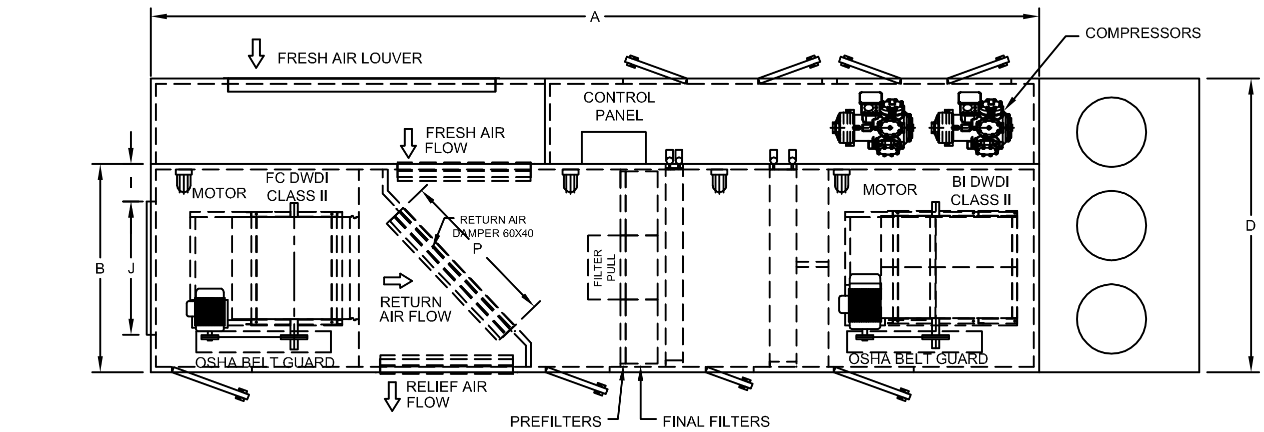
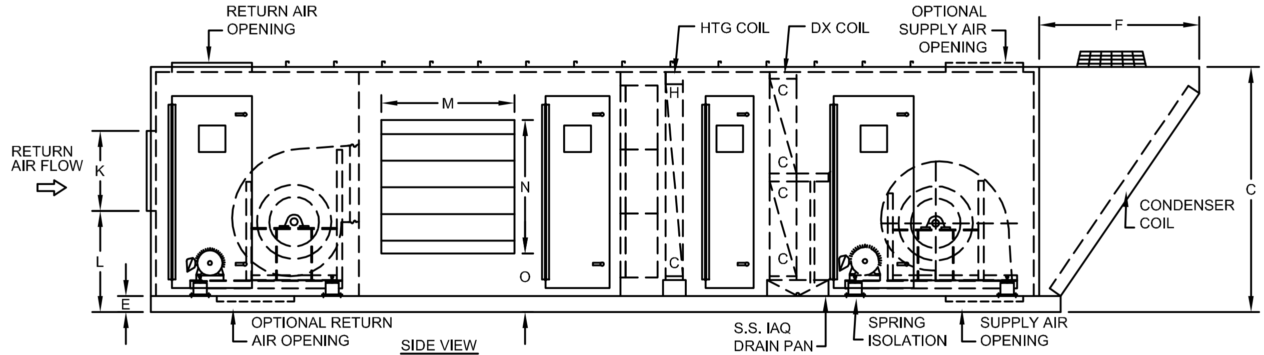
AH Series with Mix Box, Packaged Cooling, Supply and Return Air Blower



TOP VIEW



SIDE VIEW

NOTES:

1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES.
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

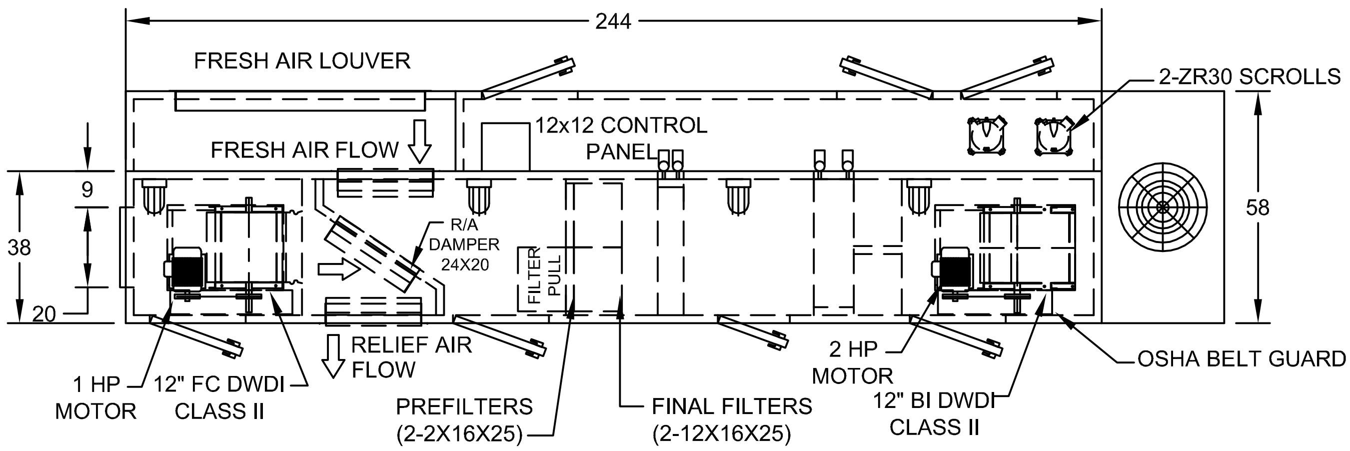
MODEL	CFM	A	B	C	D	E	F	I	J	K	L	M	N	O	P	HTG COIL QTY/SIZE	DX COIL QTY/SIZE	S/A MOTOR (HP)	S/A FAN (inch)	R/A MOTOR (HP)	R/A FAN (inch)	R/A DAMPER HEIGHTx WIDTH	PREFILTER QTY/SIZEX2"	FINAL FILTER QTY/SIZEX12"	CONTROL PANEL SIZE
AH-20-RA-RO	2000	244	38	38	58	4	30-5/8	9	20	14	17	24	20	11	24	1-25x32	1-25x32	2	12	1	12	20x24	2-16x25	2-16x25	24x24
AH-60-RA-RO	6000	260	54	49	74	4	30-5/8	12	30	20	16	35	30	12	40	1-40x48	1-36x48	5	15	3	15	25x40	2-24x24,2-24x12	2-24x24,2-24x12	24x24
AH-80-RA-RO	8000	280	66	61	100	4	45-7/8	15	36	25	20	36	35	16	42	1-48x60	1-48x60	10	18	5	18	30x42	4-24x24	4-24x24	24x24
AH-120-RA-RO	12000	295	78	61	114	4	45-7/8	14	50	30	20	40	45	9	60	1-48x72	1-48x72	15	20	7.5	20	30x60	6-24x24	6-24x24	24x30
AH-150-RA-RO	15000	303	78	79	110	4	60	14	50	30	20	40	45	17	60	1-60x72	2-30x72	20	22	10	22	30x60	6-24x24,3-24x12	6-24x24,3-24x12	24x30
AH-180-RA-RO	18000	333	78	92	110	6	60	14	50	30	38	50	50	25	60	1-72x72	2-35.5x72	20	27	10	27	40x60	9-24x24	9-24x24	24x30
AH-210-RA-RO	21000	345	90	92	122	6	60	15	60	40	38	52	55	23	72	1-72x84	2-35.5x84	30	30	15	30	40x72	9-24x24,3-24x12	9-24x24,3-24x12	24x30
AH-240-RA-RO	24000	360	102	92	134	6	60	21	60	36	38	52	55	24	72	1-72x96	2-35.5x96	25	33	15	33	40x72	12-24x24	12-24x24	24x30
AH-320-RA-RO	32000	420	114	107	146	6	88	20	74	40	37	90	55	34	90	1-96x108	2-43x108	30	36	15	36	55x90	16-24x24	16-24x24	24x30
AH-400-RA-RO	40000	430	138	109	170	6	88	29	80	43	36	90	66	25	108	1-96x132	2-44x132	40	40	20	40	55x108	20-24x24	20-24x24	24x30
AH-480-RA-RO	48000	450	162	112	194	8	88	31	100	48	32	90	82	18	134	1-96x156	2-44.5x156	50	44	25	44	55x134	24-24x24	24-24x24	24x30
AH-600-RA-RO	60000	472	162	133	194	8	88	31	100	52	45	90	82	32	134	1-120x156	2-55x156	60	48	30	48	55x134	30-24x24	30-24x24	24x30
AH-700-RA-RO	70000	550	180	135	212	10	88	35	110	58	50	112	78	35	134	1-120x166	2-55x166	75	54	40	54	65x134	35-24x24	35-24x24	24x30

Rev	By	Revision Description	Date

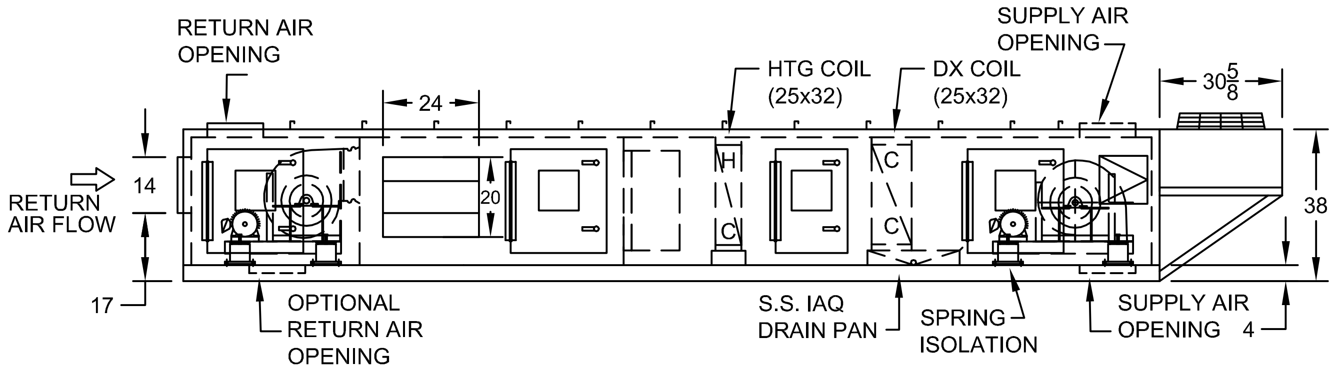
ICE WESTERN SALES

TITLE
ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/6"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-1



TOP VIEW



SIDE VIEW

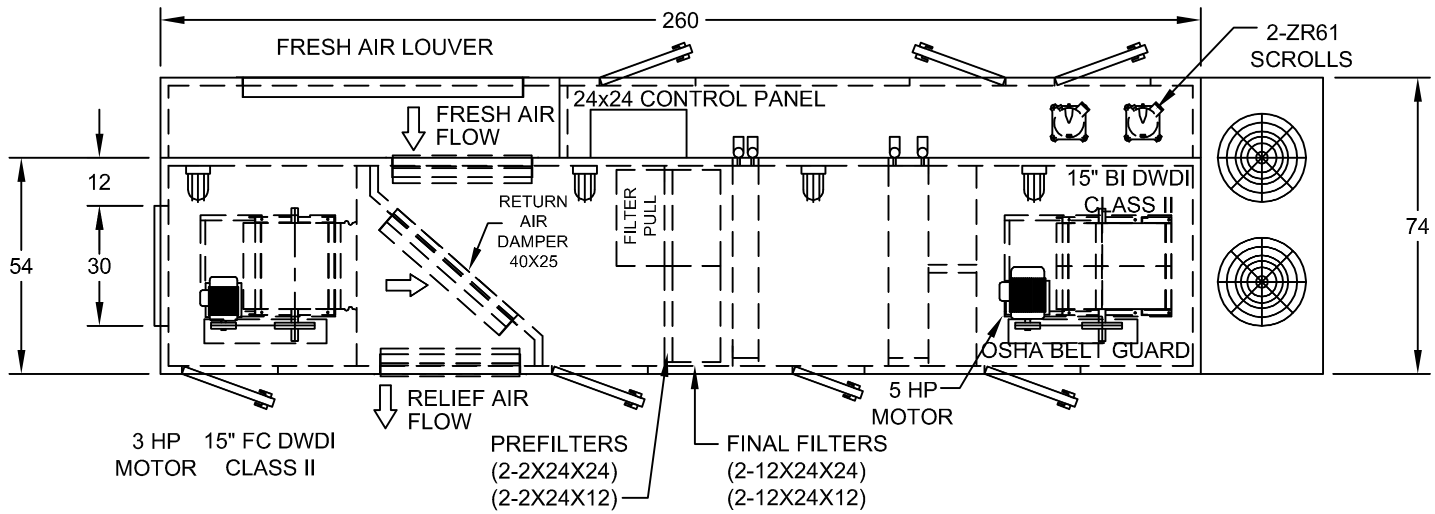
NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

Rev	By	Revision Description	Date

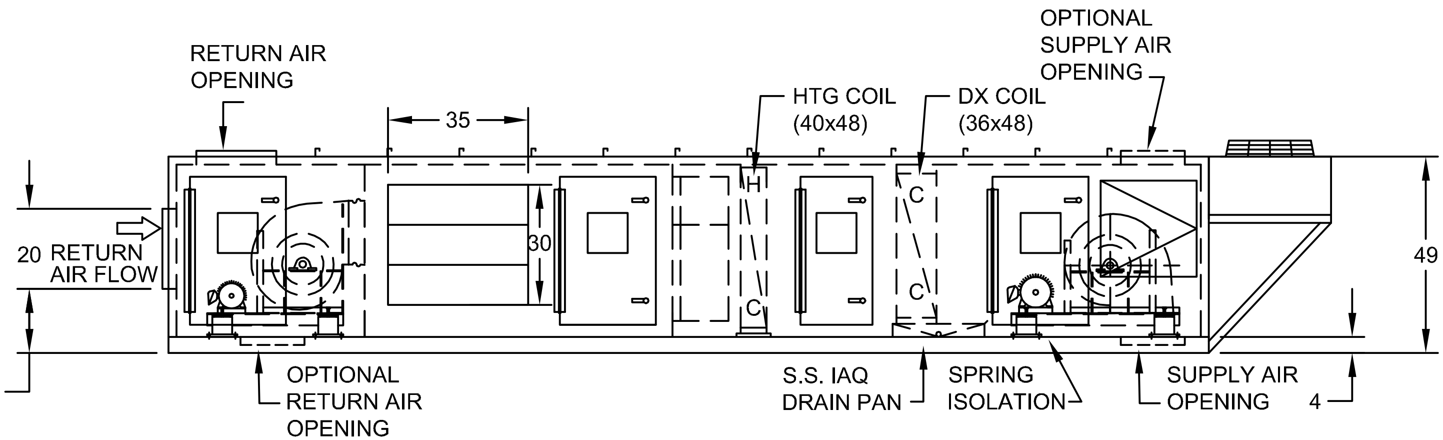
ICG WESTERN SALES

TITLE
2,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-20-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-2



TOP VIEW



SIDE VIEW

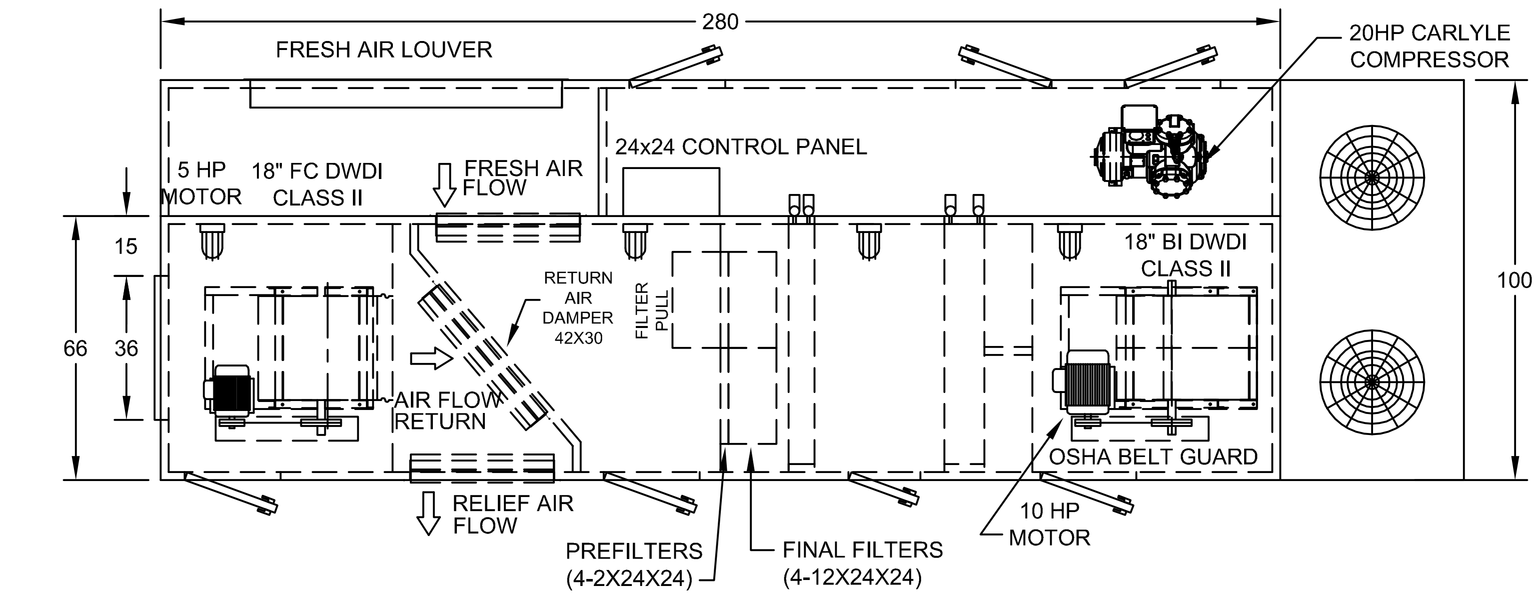
NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

Rev	By	Revision Description	Date

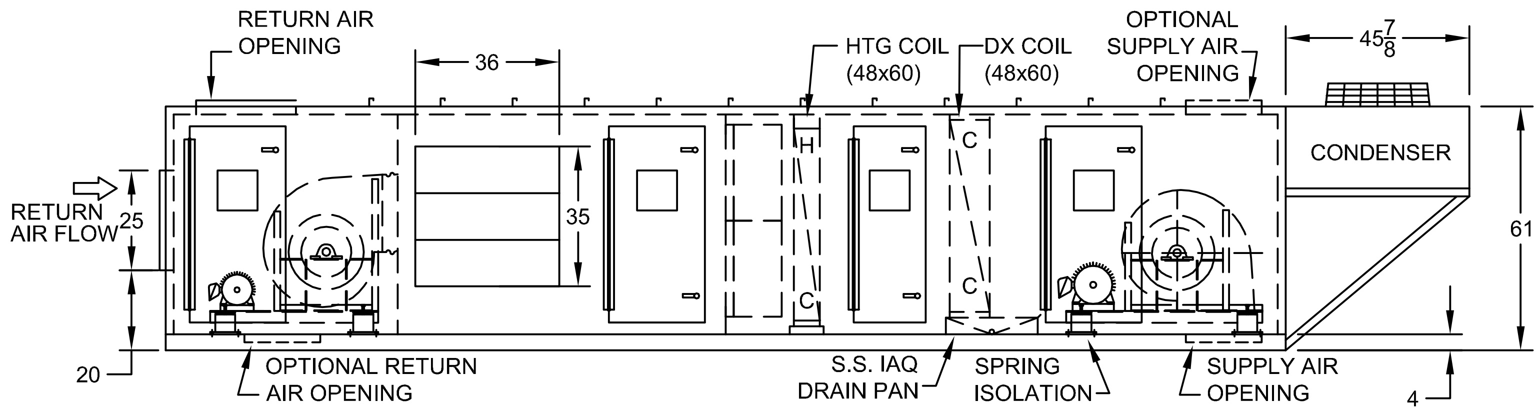
ICG WESTERN SALES

TITLE
6,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-60-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE	DRW. NO.
		1/4"=1'	
CHK. BY	DATE	JOB NO.	PAGE
			D-3



TOP VIEW



SIDE VIEW

NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
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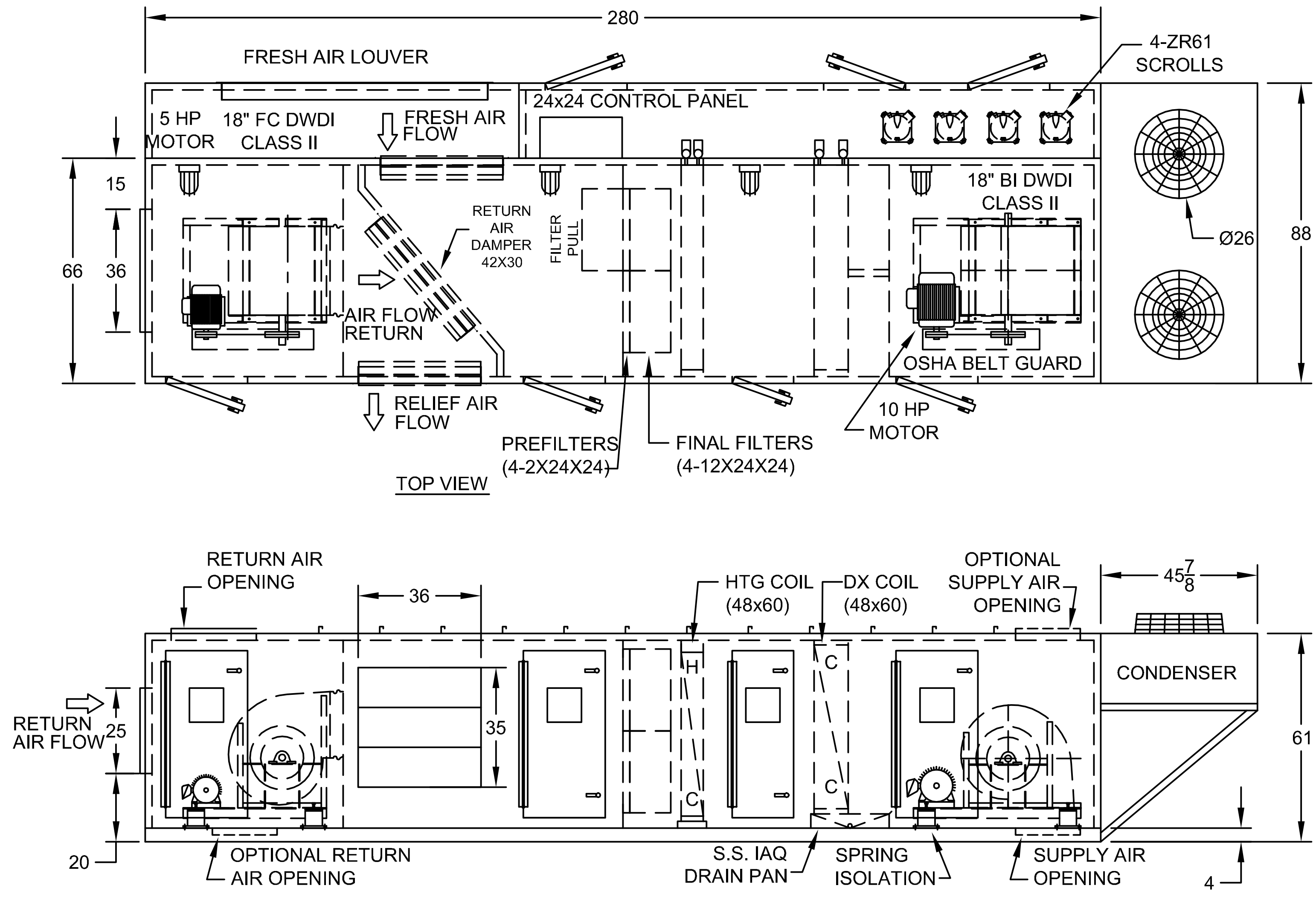
Rev	By	Revision Description	Date

ICE WESTERN SALES

TITLE 8,000CFM ROOFTOP AIR HANDLING UNIT MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER MODEL: AH-80-BI-R/A-RO				
DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-4



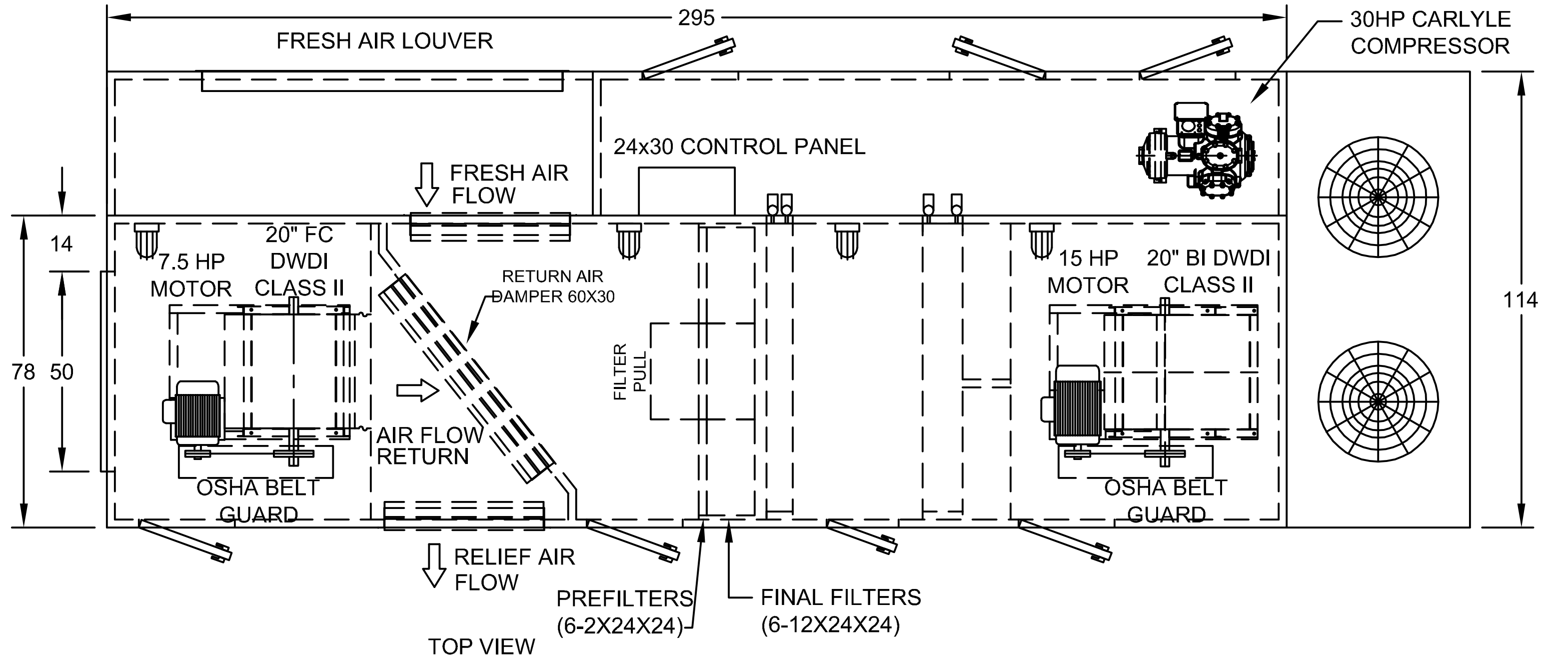
NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

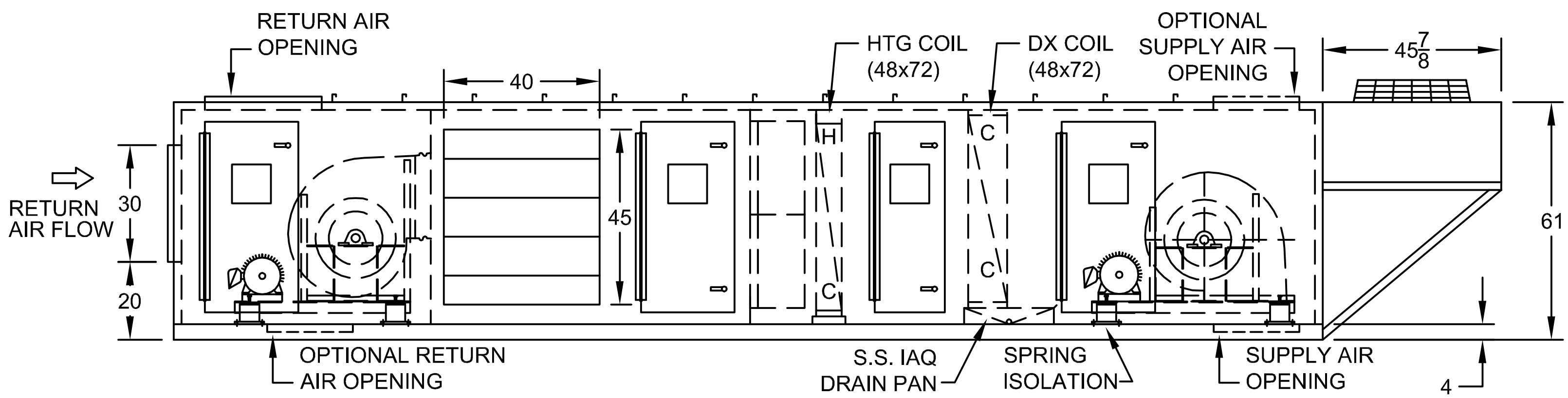
Rev	By	Revision Description	Date

ICG WESTERN SALES

TITLE
8,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-80-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-5



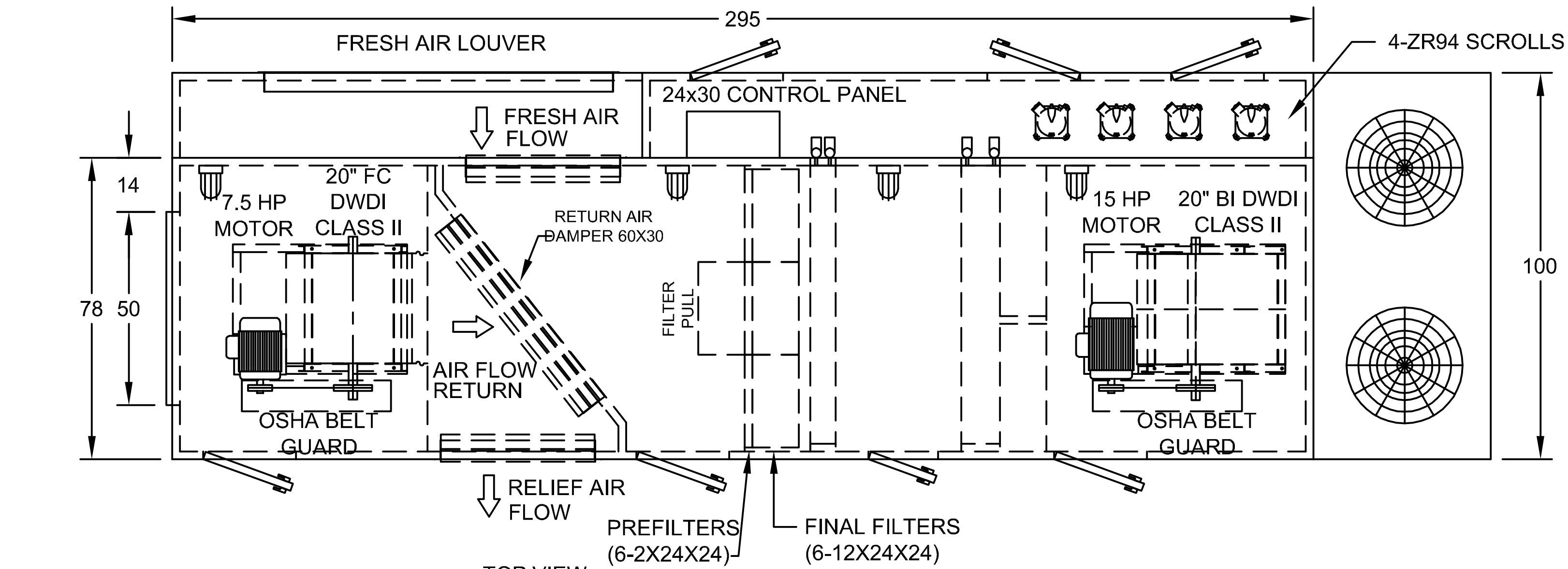


NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

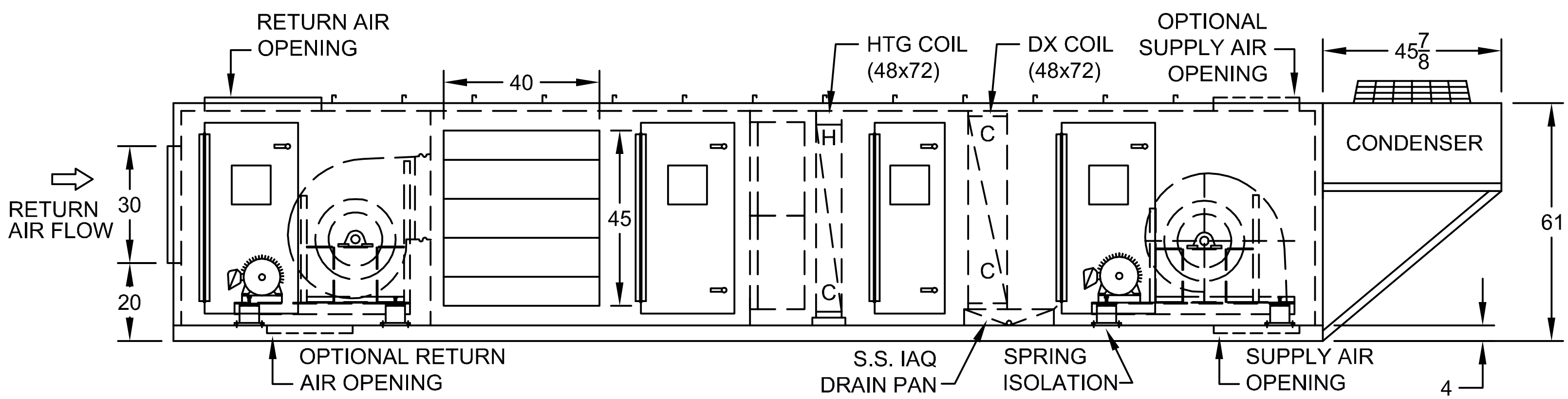
Rev	By	Revision Description	Date

ICE WESTERN SALES

TITLE 12,000CFM ROOFTOP AIR HANDLING UNIT MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER MODEL: AH-120-BI-R/A-RO				
DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-6



TOP VIEW



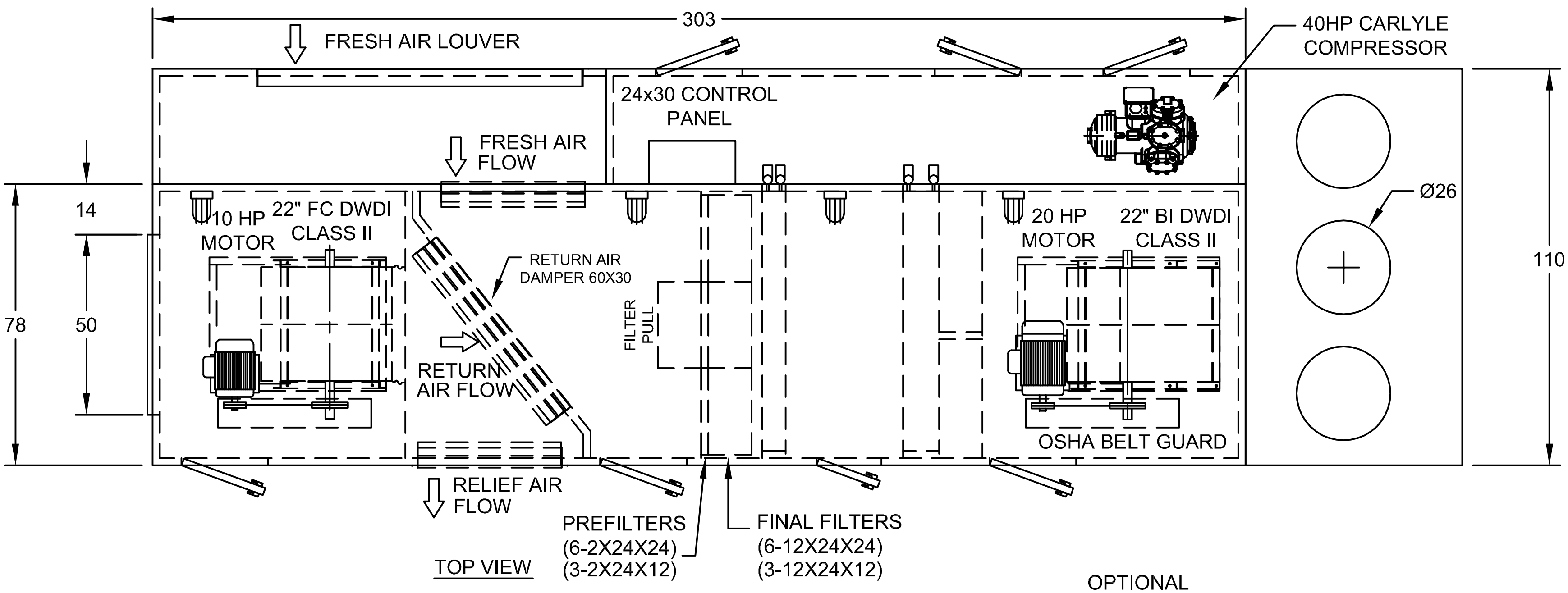
SIDE VIEW

NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

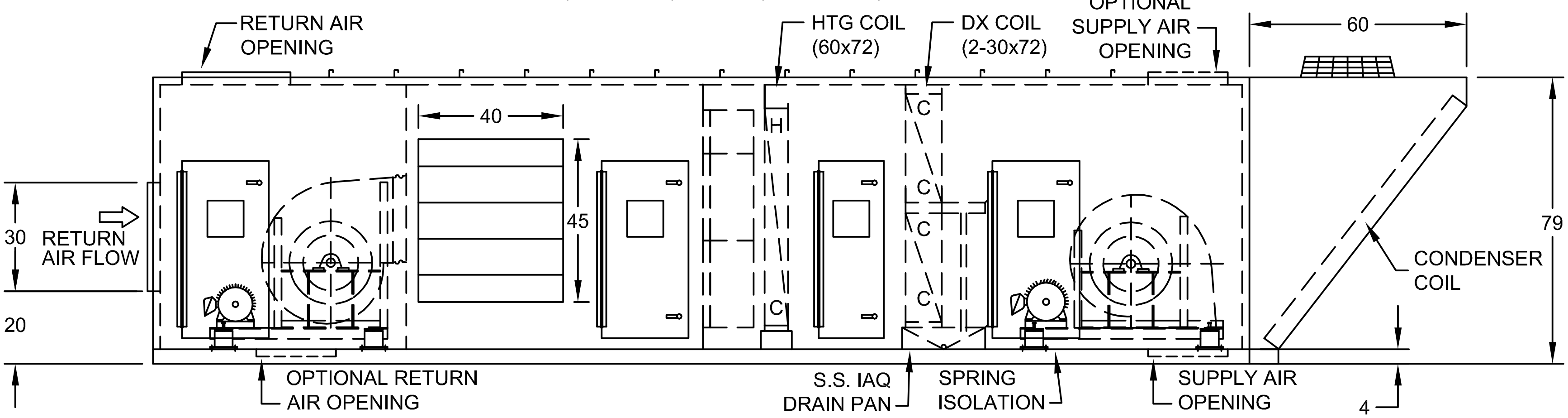
Rev	By	Revision Description	Date

ICG WESTERN SALES

TITLE 12,000CFM ROOFTOP AIR HANDLING UNIT MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER MODEL: AH-120-BI-R/A-RO				
DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-7



TOP VIEW



SIDE VIEW

NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
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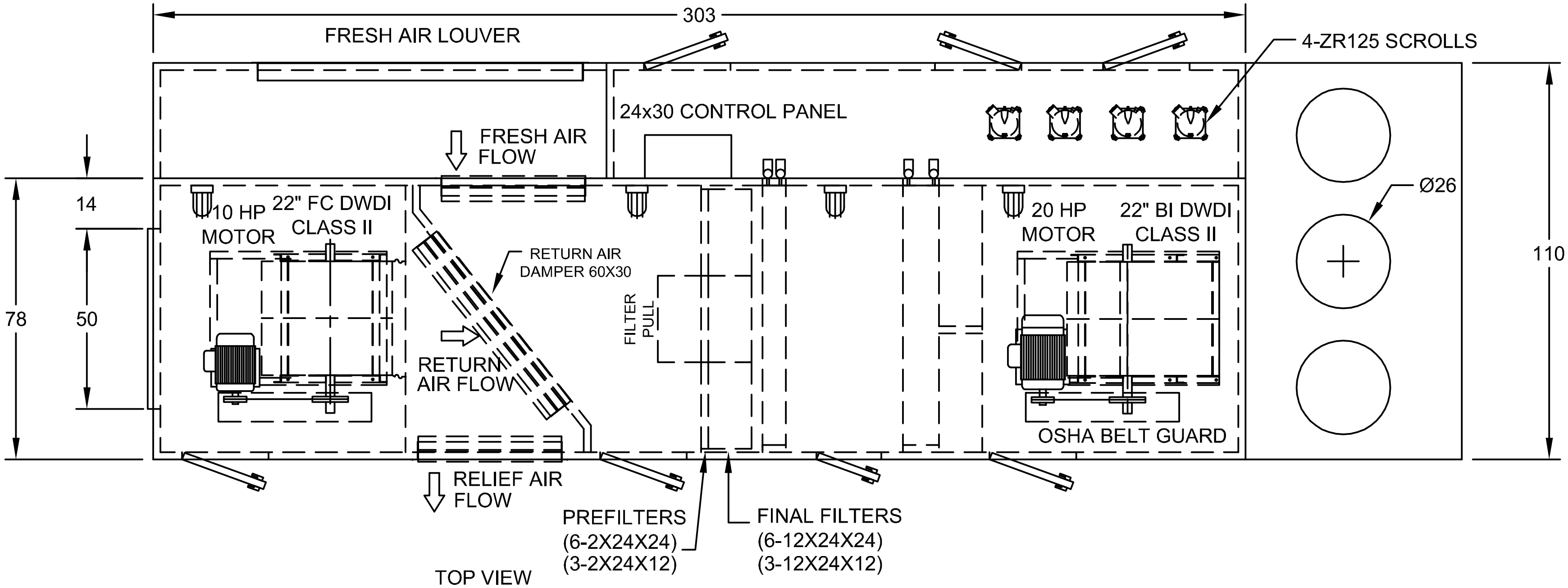
Rev	By	Revision Description	Date

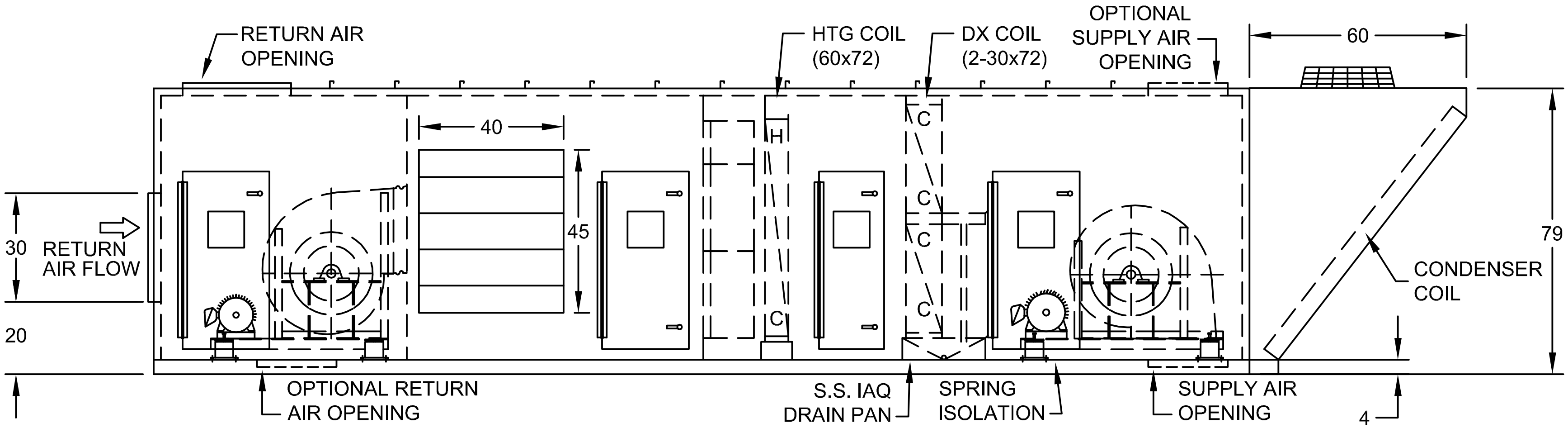
ICG WESTERN SALES

TITLE
15,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-150-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-8



TOP VIEW



SIDE VIEW

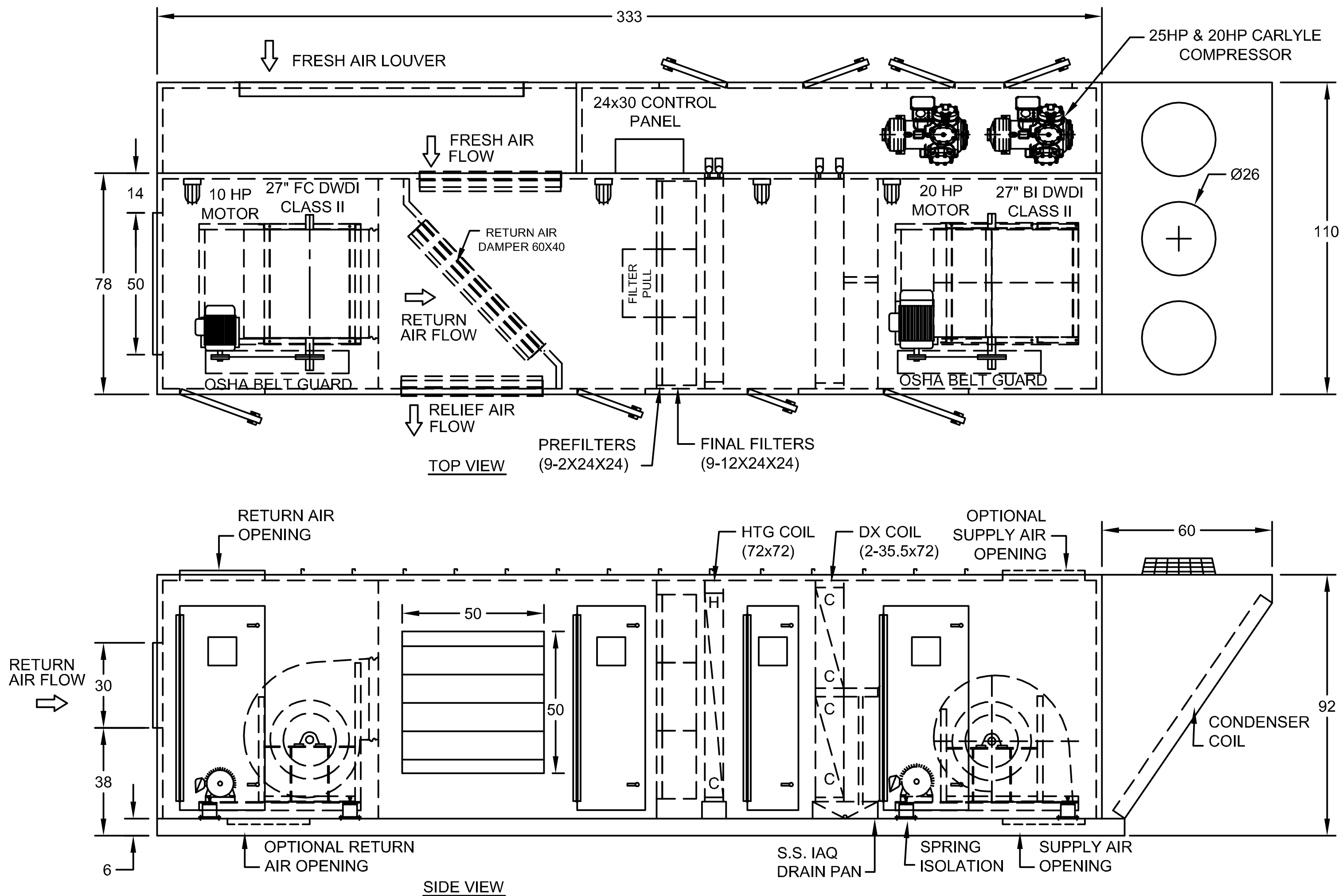
NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

Rev	By	Revision Description	Date

ICE WESTERN SALES

TITLE
15,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-150-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-9



NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

Rev	By	Revision Description	Date

ICE WESTERN SALES

TITLE 18,000CFM ROOFTOP AIR HANDLING UNIT MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER MODEL: AH-180-BI-R/A-RO			
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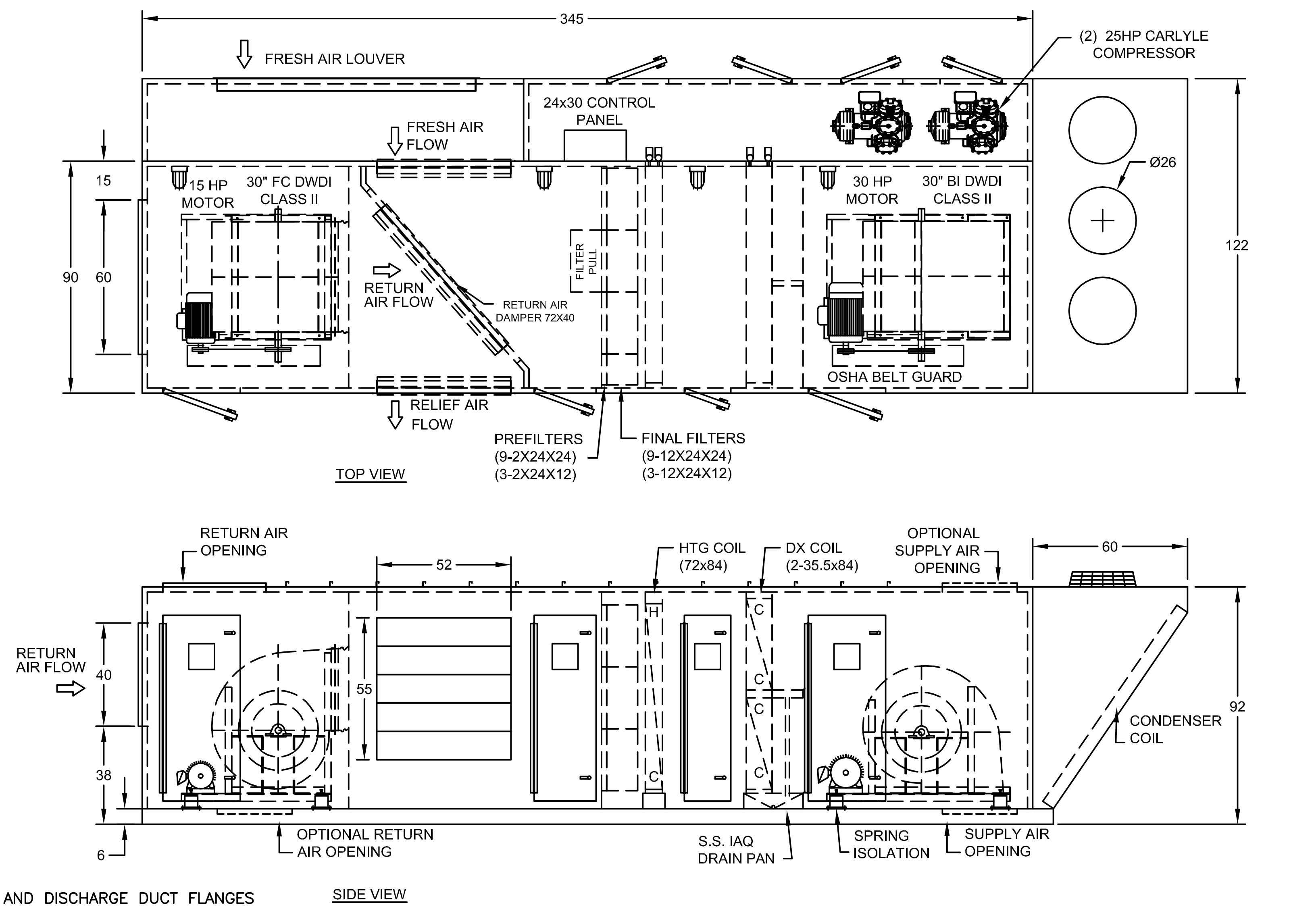
CHK. BY	DATE	JOB NO.	PAGE D-10



NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
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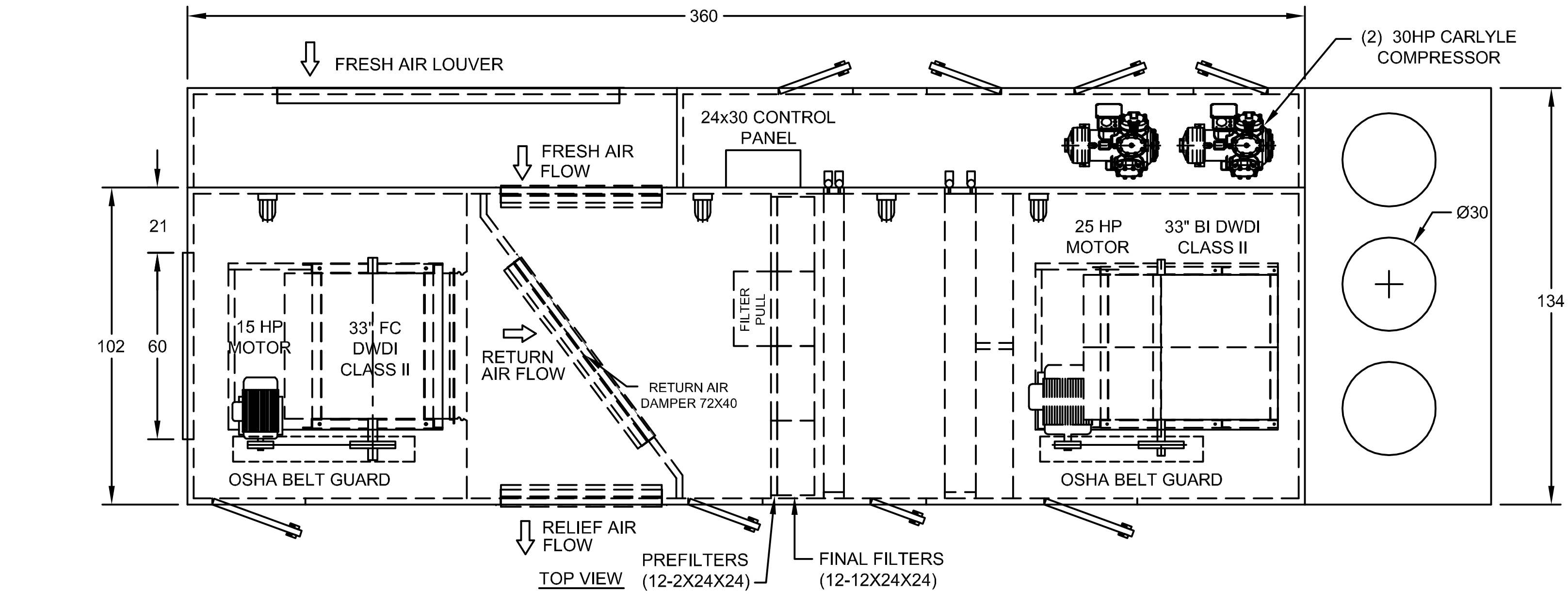
Rev	By	Revision Description	Date

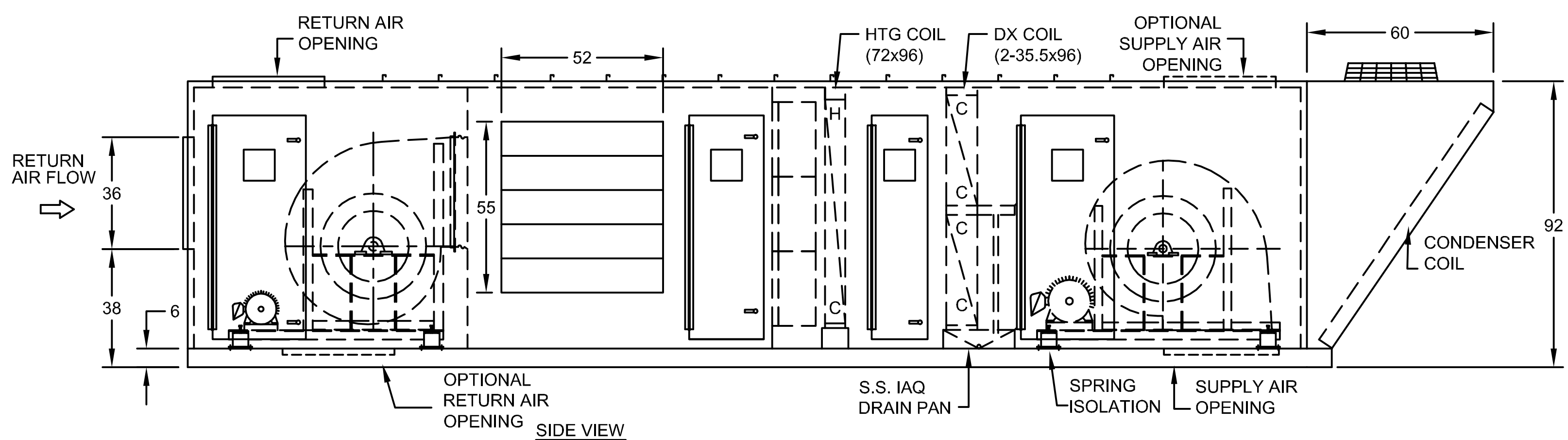
ICE WESTERN SALES

TITLE
21,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-210-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/4"=1'	DRW. NO.
CHK. BY	DATE		JOB NO.

PAGE D-11



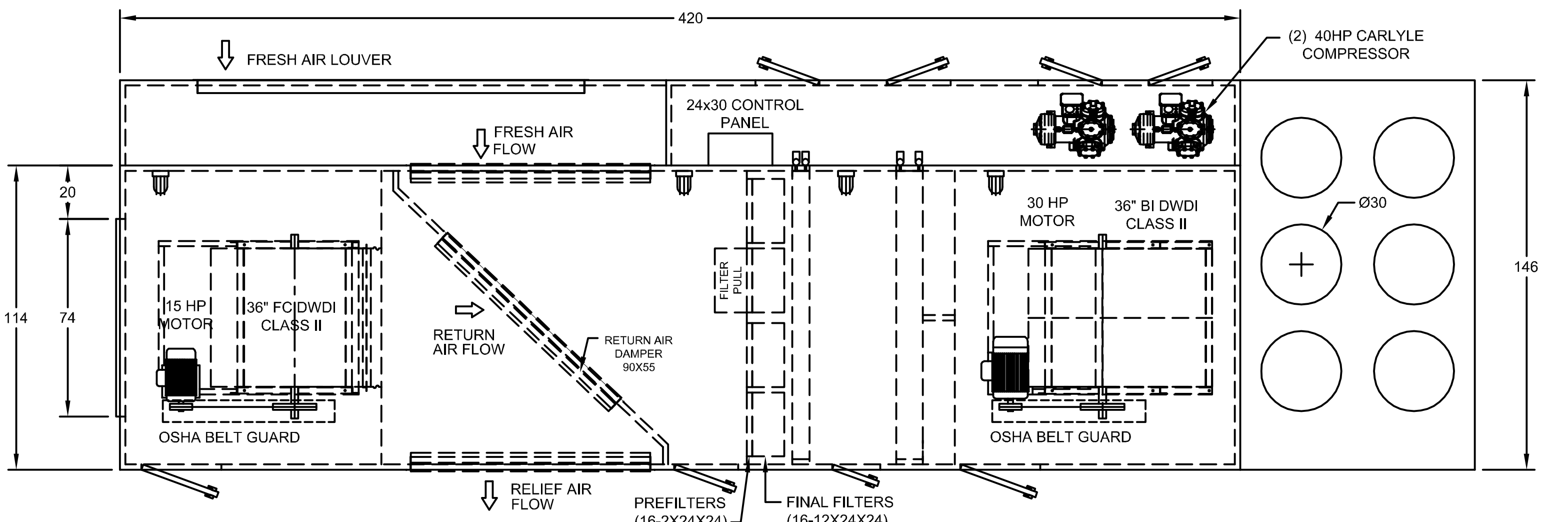


NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

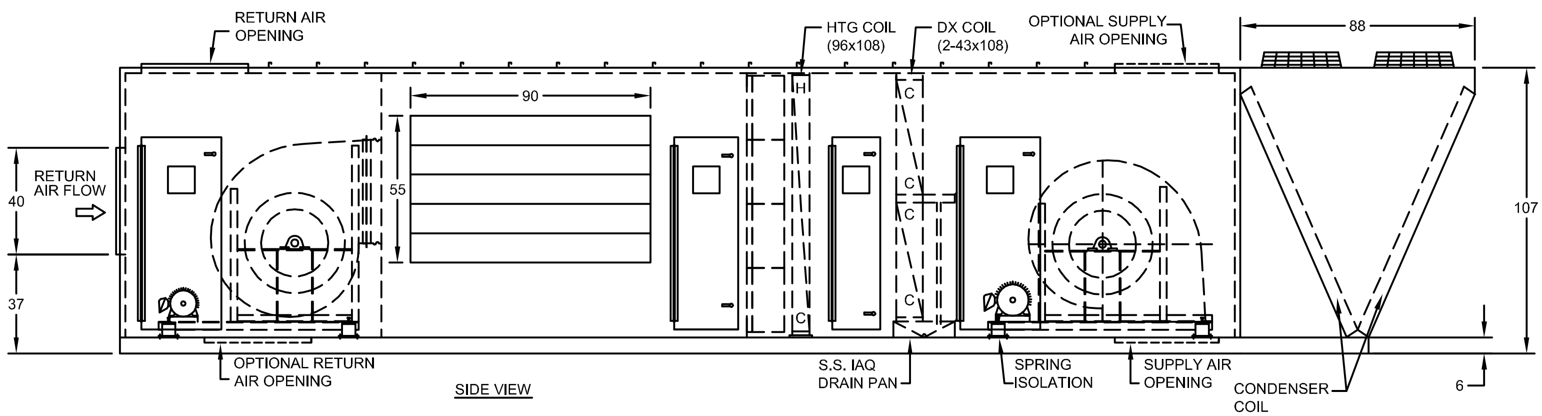
Rev	By	Revision Description	Date

ICE WESTERN SALES

TITLE 24,000CFM ROOFTOP AIR HANDLING UNIT MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER MODEL: AH-240-BI-R/A-RO				
DRAWN BY	ISSUED BY	SCALE 1/5"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-12



TOP VIEW



SIDE VIEW

NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
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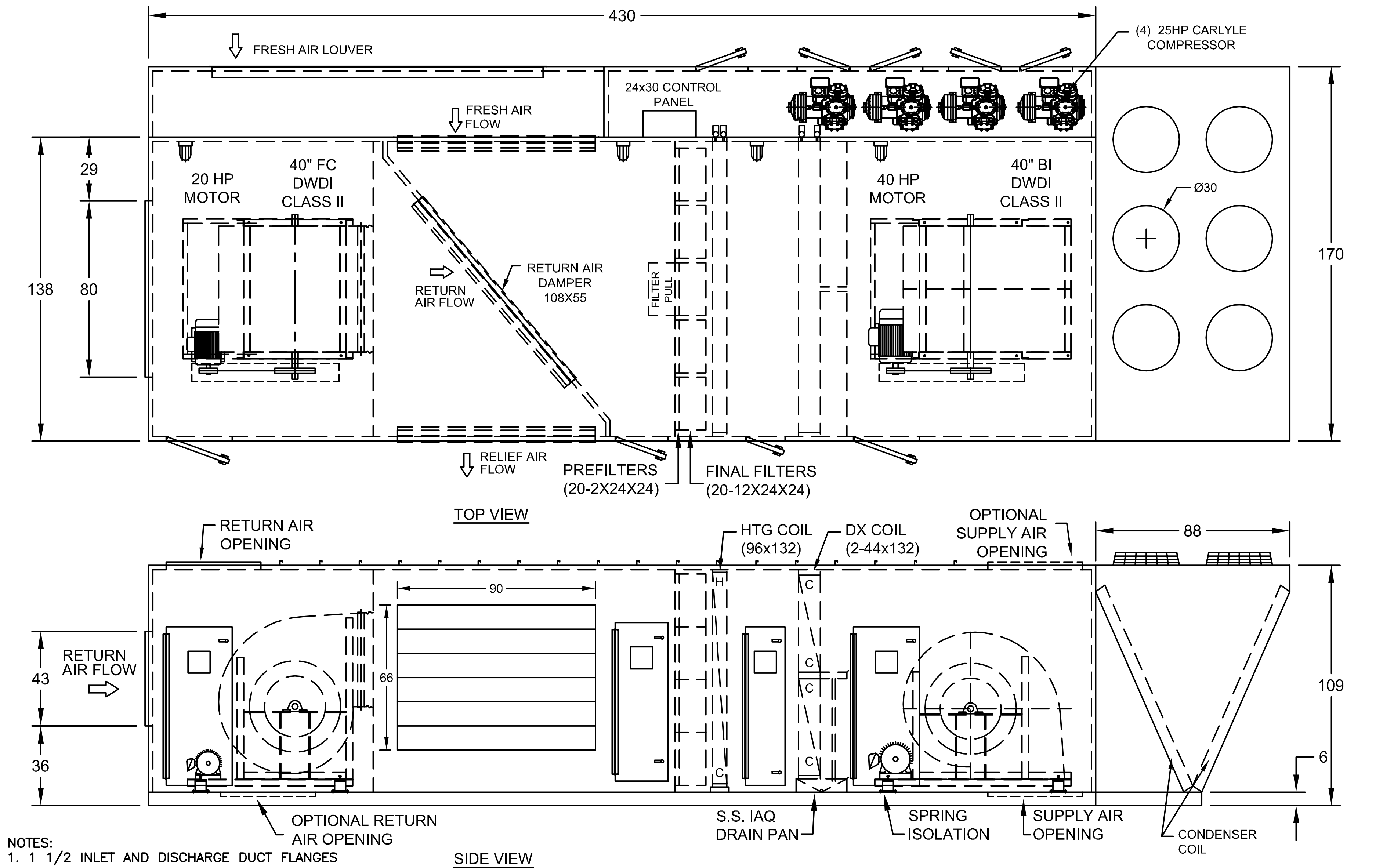
Rev	By	Revision Description	Date

WESTERN SALES

TITLE 32,000CFM ROOFTOP AIR HANDLING UNIT MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER MODEL: AH-320-BI-R/A-RO				
DRAWN BY	ISSUED BY	SCALE 1/6"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-13



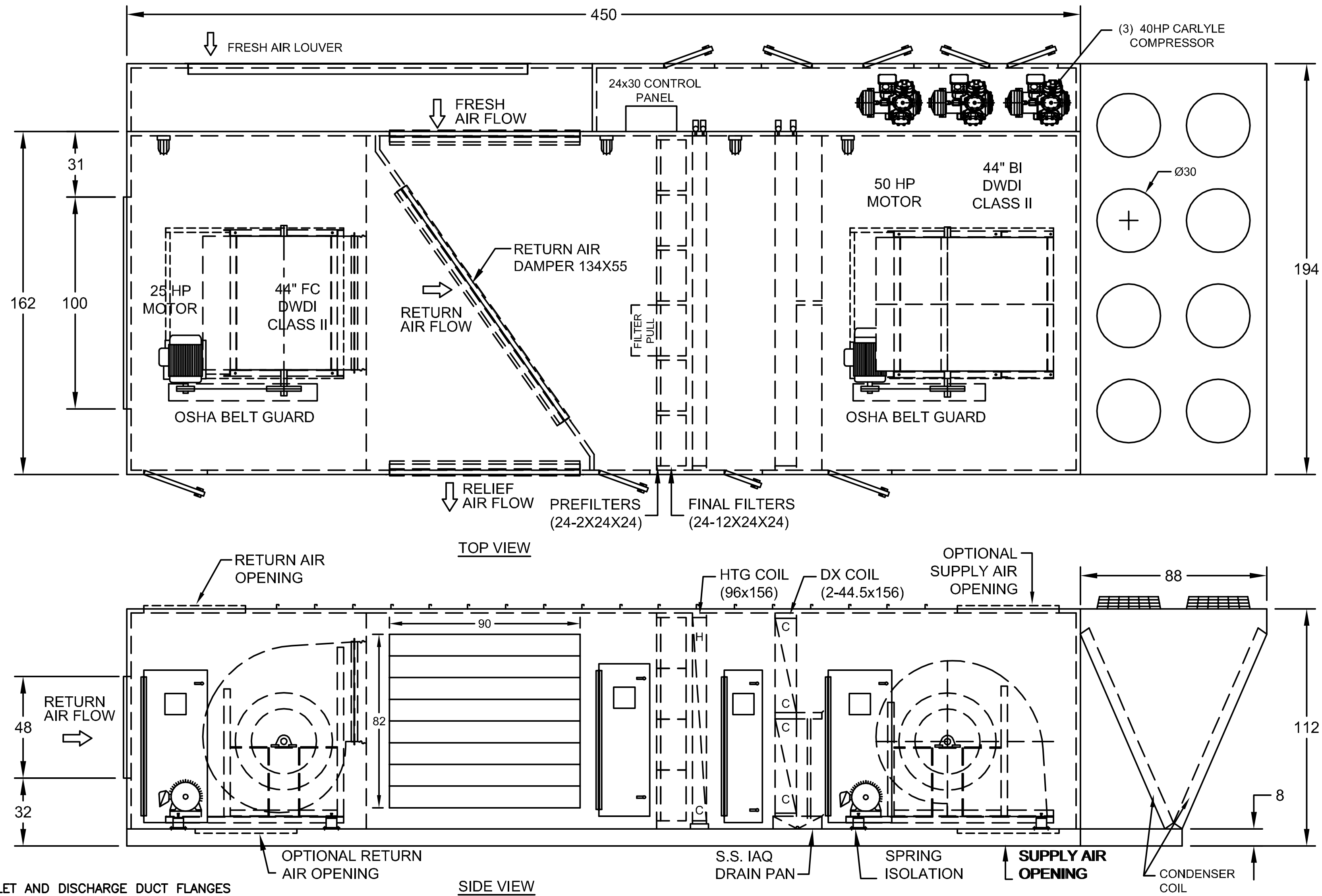
NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE.

Rev	By	Revision Description	Date

ICE WESTERN SALES

TITLE
40,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-400-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 3/16"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-14



NOTES:

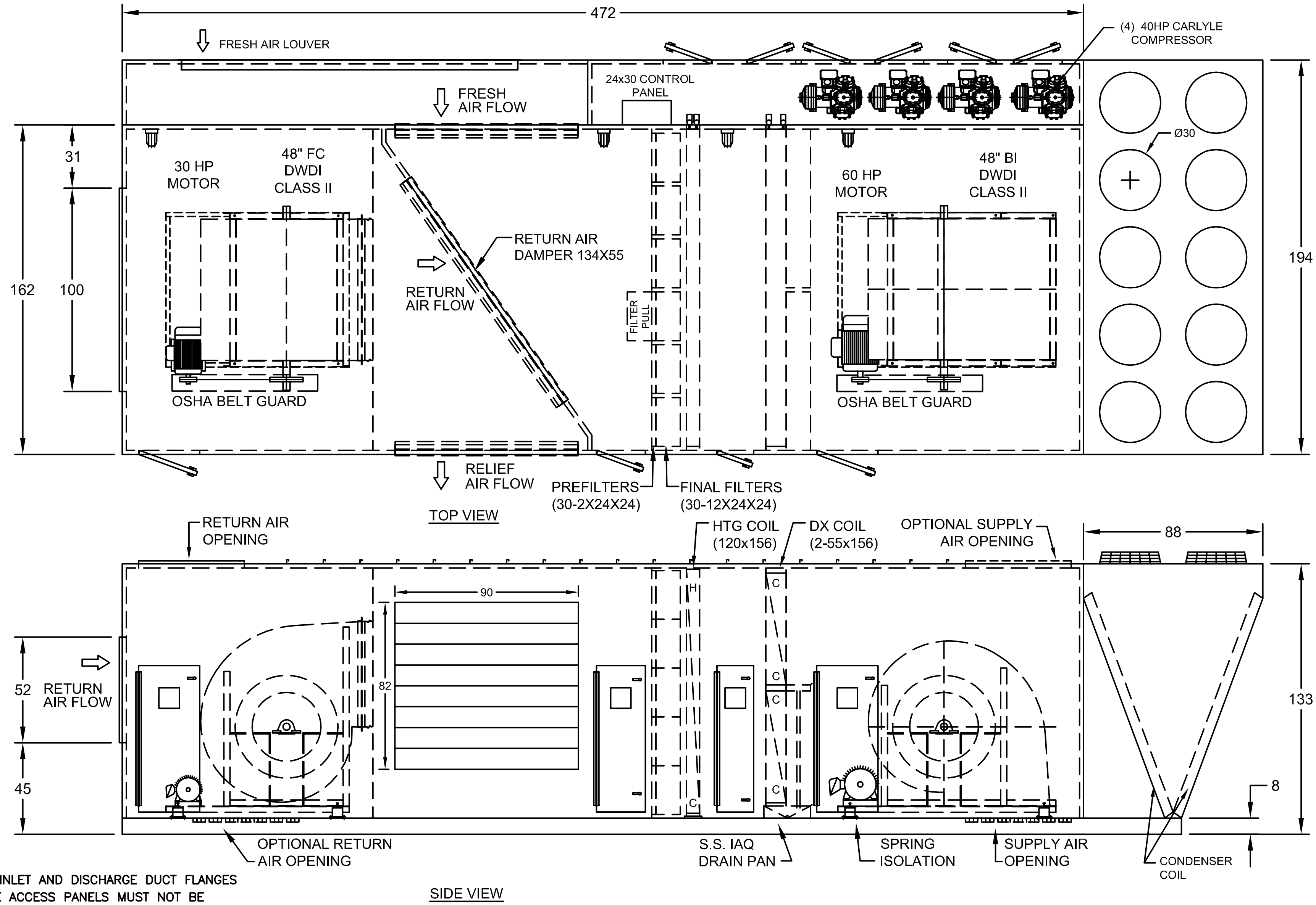
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
3. DIMENSIONS ARE SUBJECT TO MANUFACTURING TOLERANCES. FOR REFERENCE USE ONLY, SUBJECT TO CHANGE WITHOUT NOTICE

Rev	By	Revision Description	Date

ICG WESTERN SALES

TITLE
48,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-480-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/6"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-15



NOTES:

1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
2. SERVICE ACCESS PANELS MUST NOT BE OBSTRUCTED RECOMMENDED CLEARANCE 24 INCHES.
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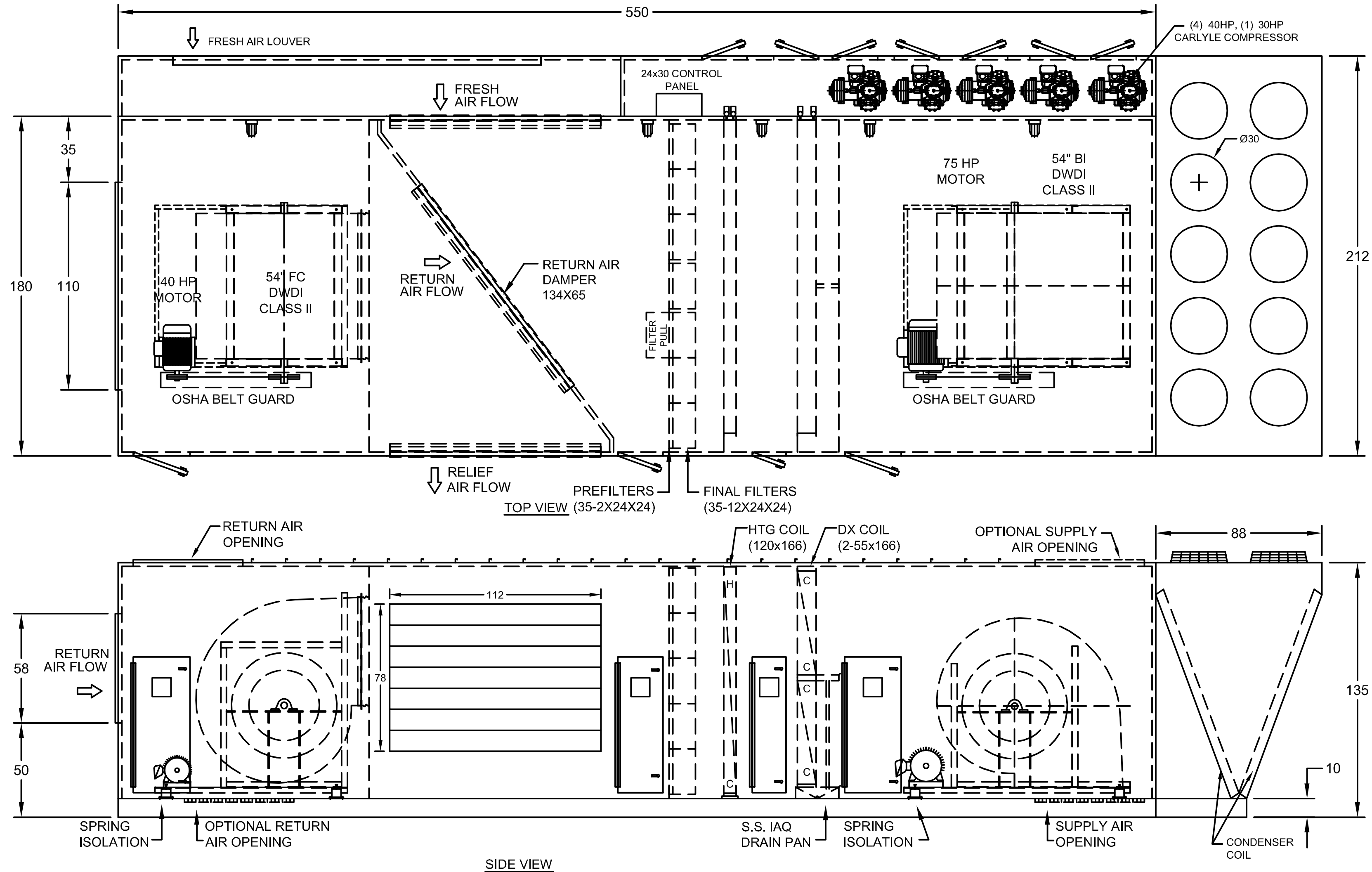
Rev	By	Revision Description	Date

ICG WESTERN SALES

TITLE
60,000CFM ROOFTOP AIR HANDLING UNIT
MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER
MODEL: AH-600-BI-R/A-RO

DRAWN BY	ISSUED BY	SCALE 1/6"=1'	DRW. NO.	
CHK. BY	DATE		JOB NO.	PAGE D-16



NOTES:
1. 1 1/2 INLET AND DISCHARGE DUCT FLANGES
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Rev	By	Revision Description	Date

WESTERN SALES

TITLE 70,000CFM ROOFTOP AIR HANDLING UNIT MIXING BOX c/w RELIEF, HEATING WATER COILS, PACKAGED DX COOLING, RETURN AIR BLOWER, SUPPLY AIR BLOWER MODEL: AH-700-BI-R/A-RO			
DRAWN BY	ISSUED BY	SCALE 1/7"=1'	DRW. NO.
CHK. BY	DATE	JOB NO.	PAGE D-17

AH SERIES w/MIX BOX, PACKAGED COOLING, SUPPLY AND RETURN BLOWER TYPICAL SPECIFICATIONS

CASING

The unit exterior casing shall be heavy gauge G90 rated bonderized steel. Unit roof shall feature standing seam construction. The entire unit casing shall be insulated with 1-in. thick 1.5-lb. (2-in. thick 1.5-lb.) fiberglass insulation with hard neoprene backing in a sandwich wall fashion (22-gauge solid liner). The unit exterior shall be finished with industrial enamel (catalyzed epoxy) paint. An integral welded iron channel frame shall support the unit casing. The structural iron frame shall be sandblasted, primed and finished with industrial enamel (catalyzed epoxy) paint.

BLOWER/MOTOR SECTION

The fan section and motor assembly shall be constructed in accordance with the requirements of the Air Moving and Conditioning Association (AMCA). The assembly shall be designed to house the fan(s), bearings, motor, and v-belts, which shall be selected for at least 50% above the rated motor capacity. The fan(s) and motor shall be mounted on a welded unitary base made of angle iron frame. The frame shall be sandblasted, primed and finished with industrial enamel (catalyzed epoxy) paint. The unitary base shall be provided with seismic spring vibration isolation. The blower section shall have a hinged access door with Ventlock handles to allow easy maintenance of filters and belts. The NEMA T-Frame motor shall be mounted on an adjustable base located within the fan section. The blower wheel shall be statically and dynamically balanced, and mounted on a turned, ground and polished shaft with rigid bearing supports. The shaft shall be designed with a maximum operating speed not exceeding 75% of the first critical speed. The bearings shall be split taper lock ball bearing type L20 minimum life of 100,000 hours (L10 200 kHr).

Fan performance shall be based on tests conducted in accordance with AMCA Standard Test Code for Air moving Devices. (All fans shall have sharply rising pressure characteristic extending throughout the operating range and continuing to rise well beyond the efficiency peak to assure quiet and stable operation under all conditions. Horsepower characteristics shall be truly non-overloading and shall reach a peak in the normal selection area.) Fan manufacturer shall provide sound power ratings in the eight octave bands, which shall be based on AMCA Standard 300-67, test, setup number one. Sound power ratings shall be referenced 10-12 watts. A factory dynamic balance shall be made on all fans after their assembly. An IRD or PMC analyzer shall be used to measure velocity, and the final reading shall not exceed 0.1 inches per second. The exact level of vibration shall be recorded on the fan as proof of the final dynamic balance at the factory.

COOLING CONTROLS

Cooling control shall be achieved via a Honeywell T775 multi-stage sequencer. The sequencer shall be controlled with an analog signal provided by the discharge air thermostat. As the discharge air thermostat requires cooling the signal shall increase, thereby turning on the stages at specific set points. The set points shall be set with appropriate offset and differential to ensure accurate discharge temperature is maintained. The stages are to be sequenced without turning on and off of compressors to minimize unnecessary wear on the compressors. Upon sensing a call for cooling from the space, the compressors shall provide full cooling until the space sensor is satisfied, upon which time the cooling shall revert to discharge air control. A low discharge temperature set point with a large differential shall be set to prevent the compressor from cycling on and off. The compressor will remain on low setting until cooling is disabled manually or the ambient temperature falls below the minimum set point.

ELECTRICAL CONTROL EQUIPMENT

Electrical assembly and components shall be in strict accordance with the latest provisions and requirements of the National Electric Code. Control cabinet shall be designed and constructed to ETL specifications. A safety disconnect switch shall be mounted on the unit. The controls shall be located in a weatherproof cabinet. Provisions for service padlocking shall be provided. The following items shall be located within the cabinet: fuses, starters, control relays, timing and holding relays, resistors and numbered terminal strips. All components shall be labeled and cross-referenced to control and field wiring diagrams. The control circuit shall be 24V, single phase. Wiring shall be neatly run in "PANDUIT" wiring duct. Low and/or line voltage thermostats shall be furnished shipped loose for installation by others. Unit shall be equipped with automatic low limit freeze protection with bypass timer.

DAMPERS & FILTER SECTION

The dampers are to be galvanized steel (aluminum airfoil low leak) type (with seals). The dampers shall be equipped with 2-position (modulating) actuators. The filters shall be 2" pleated throwaway type with minimum of 85% arrestance and 30% efficiency. Filter access shall be through a latched and gasketed access doors located on both sides of the unit. (Final filters shall be 4 or 12 inch high efficiency cartridge filters.)

REMOTE CONTROL PANELS

Remote NEMA 1(12) locking control panel shall be equipped with summer/off/winter switch and blower on, burner on, flame failure and loaded filter lights. (A remote adjustment potentiometer shall control damper positioning.) (An LCD display shall provide system temperature and set points.)

FLUID COILS

Fluid coils are intended for use with water, glycol, or other appropriate heat transfer fluids. Coils are to be designed to maximize performance under specified conditions with minimal air-side pressure drop.
All water coils designed with 1/2” or 5/8” tubes are to be ARI performance certified and shall bear the ARI symbol.
Tubes and return bends shall be constructed from seamless UNS C12200 copper conforming to ASTM B224 and ASTM E527. Properties shall be O50 light annealed with a maximum grain size of 0.040 mm.
Tubes are to mechanically expanded into fins (secondary surface) for maximum heat transfer. Materials are to be 3/8” diameter x (0.014, 0.022) wall thickness, 1/2” diameter x (0.016, 0.025) wall thickness, or 5/8” diameter x (0.020, 0.025, 0.035, 0.049) wall thickness.
Secondary surface (fins) shall be of the plate-fin design using aluminum or copper, with die-formed collars. Fin design to be flat, waffle, or sine-wave in a staggered tube pattern to meet performance requirements.

Collars will hold fin spacing at specified density, and cover the entire tube surface. Aluminum properties are to be Alloy 1100 per ASTM B209, with O (soft) temper; copper is to be Alloy 11000 per ASTM B152-06 with soft (anneal) temper. Fins are to be free of oils and oxidation.
Headers are to be constructed of seamless UNS C12200, Type L (drawn) copper material sized to match specified connection size. Type K (drawn) copper headers and Schedule 40 steel headers shall be offered as optional materials.
Die-formed copper end caps are brazed on the inside of the headers, unless spun-closed (for sizes up to 1-3/8”). 1/4” vents and drains are to be provided for all fluid coils.
Connection material shall be copper, or Schedule 40 steel or red brass pipe. The type of connection is to be sweat type, MPT or FPT, grooved, or flanged as required.
Coil casing material shall be of G90 galvanized steel, 16 gauge minimum. Heavier material, stainless steel, copper, or aluminum casing are to be provided as required.
Intermediate tube supports are to be provided on all coils 48” and longer fin length. Coil casing on top and bottom of coils are to have double-flange construction, allowing for vertical stacking of coils.
All coils are to be brazed with minimum 5% silver content (BCup-3) filler material to insure joint integrity. Low-fuming, flux-coated bronze braze-weld material is to be used for ferrous to non-ferrous joints.
Coils shall be tested at 550 psig using dry nitrogen, submerged under water. Dual-operator verification shall determine that all coils are leak-free.
Fluid coils shall be designed to withstand 300ºF maximum operating fluid temperature, and 250 psig maximum operating pressure.

EVAPORATOR COILS

Evaporator coils are intended for use with a wide range of applications and refrigerant types. Coils are to be designed to maximize performance under specified conditions with minimal air-side pressure drop.
Coils shall be UL recognized as Refrigerant Containing Component. Coils to be used with refrigerant R-410A shall have undergone cycle testing, and shall be safety listed with 750 psig rating.
Tubes and return bends shall be constructed from seamless UNS C12200 copper conforming to ASTM B224 and ASTM E527. Properties shall be O50 light annealed with a maximum grain size of 0.040 mm.
Tubes are to mechanically expanded into fins (secondary surface) for maximum heat transfer. Materials are to be 3/8” diameter x (0.014, 0.022) wall thickness, 1/2” diameter x (0.016, 0.025) wall thickness, or 5/8” diameter x (0.020, 0.025, 0.035, 0.049) wall thickness.
Secondary surface (fins) shall be of the plate-fin design using aluminum or copper, with die-formed collars. Fin design to be flat, waffle, or sine-wave in a staggered tube pattern to meet performance requirements.
Collars will hold fin spacing at specified density, and cover the entire tube surface. Aluminum properties are to be Alloy 1100 per ASTM B209, with O (soft) temper; copper is to be Alloy 11000 per ASTM B152-06 with soft (anneal) temper. Fins are to be free of oils and oxidation.
Headers are to be constructed of seamless UNS C12200, Type L (drawn) copper material sized to match specified connection size. Type K (drawn) copper headers shall be offered as optional material.
Die-formed copper end caps are brazed on the inside of the headers, unless spun-closed (for sized up to 1-3/8”).
Evaporator coils shall be designed with brass liquid distributors (as required), and copper sweat suction connections. Distributors shall be capped using soft-solder for ease of cap removal; suction connections shall be capped.

Coil casing material shall be of G90 galvanized steel, 16 gauge minimum. Heavier material, stainless steel, copper, or aluminum casing are to be provided as required.
Intermediate tube supports are to be provided on all coils 48" and longer fin length. Coil casing on top and bottom of coils are to have double-flange construction, allowing for vertical stacking of coils.
All coils are to be brazed with minimum 5% silver content (BCup-3) filler material to insure joint integrity.
Coils shall be tested at 550 psig using dry nitrogen, submerged under water. Dual-operator verification shall determine that all coils are leak-free.
Coils shall be shipped with nitrogen charge to verify leak-free integrity, and to prevent moisture migration into coil.
Coils shall be certified to withstand 750 psig working pressure.

CONDENSER COILS

Condenser coils are intended for use with a wide range of applications and refrigerant types. Coils are to be designed to maximize performance under specified conditions with minimal air-side pressure drop.
Coils shall be UL recognized as Refrigerant Containing Component. Coils to be used with refrigerant R-410A shall have undergone cycle testing, and shall be safety listed with 750 psig rating.
Tubes and return bends shall be constructed from seamless UNS C12200 copper conforming to ASTM B224 and ASTM E527. Properties shall be O50 light annealed with a maximum grain size of 0.040 mm.
Tubes are to mechanically expanded into fins (secondary surface) for maximum heat transfer. Materials are to be 3/8" diameter x (0.014, 0.022) wall thickness, 1/2" diameter x (0.016, 0.025) wall thickness, or 5/8" diameter x (0.020, 0.025, 0.035, 0.049) wall thickness.
Internally enhanced rifled or cross-hatched tubes can be offered as an option.
Secondary surface (fins) shall be of the plate-fin design using aluminum or copper, with die-formed collars. Fin design to be flat, waffle, or sine-wave in a staggered tube pattern to meet performance requirements.
Collars will hold fin spacing at specified density, and cover the entire tube surface. Aluminum properties are to be Alloy 1100 per ASTM B209, with O (soft) temper; copper is to be Alloy 11000 per ASTM B152-06 with soft (anneal) temper. Fins are to be free of oils and oxidation.
Headers are to be constructed of seamless UNS C12200, Type L (drawn) copper material sized to match specified connection size. Type K (drawn) copper headers shall be offered as optional material.
Die-formed copper end caps are brazed on the inside of the headers, unless spun-closed (for sized up to 1-3/8").
Condenser coils shall be designed with copper sweat connections, and shall be shipped with caps on connections.
Coil casing material shall be of G90 galvanized steel, 16 gauge minimum. Heavier material, stainless steel, copper, or aluminum casing are to be provided as required.
Coils designed for hot-gas applications shall have oversized tube sheet holes for hot gas feeds to allow for free expansion and contraction of tubes during operation.
Intermediate tube supports are to be provided on all coils 48" and longer fin length. Coil casing on top and bottom of coils are to have double-flange construction, allowing for vertical stacking of coils.
All coils are to be brazed with minimum 5% silver content (BCup-3) filler material to insure joint integrity.
Coils shall be tested at 550 psig using dry nitrogen, submerged under water. Dual-operator verification shall determine that all coils are leak-free.

Coils shall be shipped with nitrogen charge to verify leak-free integrity, and to prevent moisture migration into coil.
Coils shall be certified to withstand 750 psig working pressure.

REFRIGERATION COMPRESSORS

Compressors shall be either hermetic or semi-hermetic type.

A) Semi-Hermetic- Semi-hermetic reciprocating compressors shall be provided on systems with total cooling capacity of 25 Tons and larger. Up to 40 tons a single compressor will be used and multiple semi-hermetic compressors over 40 Tons. Compressors shall be completely factory assembled, piped, insulated, internally wired and tested. Units shall be shipped in one piece and come fully charged with refrigerant and filled with compressor oil. Units shall be rated in accordance with ARI standards. The refrigerant system shall be leak tested, evacuated and refrigerant charged at the factory. Compressors shall be suction gas cooled and come with integral spring vibration isolators, oil level sight glass, discharge mufflers, vibrasorbers, automatic reversible oil pump, oil filter screen. Oil charging valve, crankcase heater which de-energizes during compressor operation, liquid line service valves. Unit shall also have the following safety control features:
    - Low pressure cutout
    - High pressure cutout, manual reset
    - Adjustable low ambient lockout
    - Liquid line solenoids incorporating pump down system
    - Anticycling time device (to prevent excessive cycling and premature wear on compressor and contactors) and phase and brownout protection.
    - Oil failure control

   Provide cylinder suction pressure unloaders for capacity control, with minimum steps required to provide coil frost protection, based on refrigerant circuit suction temperatures. Provide filter dryers, sight glasses and compressor service valves for each individual compressor. Provide hot gas bypass for each compressor. Compressor staging to be provided by a Honeywell T775 Series standalone controller mounted in the unit.

B) Hermetic compressors- Compressors shall be set on resilient neoprene mounts and complete with line voltage break internal overload protection, internal pressure relief valve and crankcase heater. Each unit shall have a minimum of two compressors. Whereby a unit utilizing two compressors the first stage compressor must be a digital scroll operating with a Emerson EC3 series stand-alone superheat controller with a built in synchronization control for the digital scroll. Unit will provide a turndown on cooling. Multiple refrigeration circuits shall be separate from each other. Refrigeration circuits shall be complete with liquid line filter-driers, and service ports fitted with Schraeder fittings. Units shall incorporate load compensated thermal expansion valves with external equalizers (electronic expansion valves on digital systems) and combination sight glass moisture indicators. System charge will be designed for 10 degrees Fahrenheit. Each system shall be factory run and adjusted prior to shipment. Controls shall include:
    - Compressor motor contactors
    - Overload protection control
    - Cooling relays

- Ambient compressor lockout
- Dual pressure controls
- Anti-cycle timers
- Hot gas bypass on lead compressor to maintain adequate suction pressure in the event of low loads
  (only when digital scrolls are not being used)

Packaged units shall operate down to 50 degrees Fahrenheit as standard. Minus 40 refrigeration systems are available as an option. Compressors shall be located on the side of the unit in a service enclosure complete with hinged access doors.

PROCESS OF SELECTION OF EVAPORATOR COILS, CONDENSER COILS AND COMPRESSORS:

1) Evaporator coil selection

Direct Expansion Coils

In direct expansion coils, it is important that the coil be uniformly cool throughout its surface and also that the circuiting be such that the compressor be somewhat protected from unevaporated refrigerant. The type of coil feeding which is commonly used is the dry expansion, or thermal expansion valve type system. With the use of a thermal valve on a coil, there are two (2) important design factors. There normally would be more than one refrigerant feed through the coil in order to keep the refrigerant pressure drop within practical limits and to reduce the corresponding penalty in increased evaporating temperature. Required suction superheat in the coil is normally obtained within the coil itself and not by any external device. The feeds in these coils are designed so that they handle the same load and are generally exposed to the same temperatures. The distributor used must be effective for distributing both liquid and vapor as the entering refrigerant will be a mixture of the two. The distributing tubes from the distributor are normally small diameter tubes such as 1/4” or 5/16” O.D. However, they can be smaller or larger depending upon the load which they are to carry. Coils are oftentimes constructed to use one thermal valve per coil, or there may be two (2) or more thermal valves per coil, depending upon the coil design for the specific requirement. In air cooling coils, the air usually blows at right angles to the tubes. In coils having more than one row in the direction of air flow, the media in the tubes may be circuited in various ways. The parallel and counterflow arrangements are common in direct expansion coils with the counterflow arrangement being generally accepted as the standard.

Applications

A cooling coil does, at certain conditions, have a problem of possible water blow-off from the fins. On some coils, water would blow-off at velocities of 400 FPM, or less, while on others there will be no problem at velocities of over 600 FPM. This problem is entirely dependent upon the particular design of the coil relative to the type of fin, the fin spacing, etc. If there is a danger of water blowing off from cooling coils, eliminator plates normally would be installed on the leaving air side of the coil to catch this water and run it into the drain pan. When cooling coils are stacked one above the other, it is desirable to have drip troughs below each coil so that the condensate from the upper coils does not run down over the lower coils in the bank. Occasionally, cooling coils are sprayed with water to increase heat transfer and to more closely approach saturation for the leaving air. When a bypass is used on a cooling coil, it often at times becomes difficult to hold the humidity as can be understood if part of the air does not go through the coil.

Coil Selection

In selecting coils, there are several design factors which must be considered.

1. The specific duty – whether cooling or dehumidifying, and the capacity required to maintain a certain balance.
2. Temperature of the entering air dry bulb and wet bulb if dehumidification is to take place, and dry bulb only if it is to be dry cooling.
3. The available cooling media with temperatures, pressures, etc.
4. Dimensional requirements.
5. Air volume and allowable resistances.
6. Allowable refrigerant – side resistance.
7. Any individual installation requirement such as type of control to be used, etc.

The cooling media is often dictated by what happens to be available, and also whether it is a new installation or an existing installation. The problem of space available is also influenced in the same manner. The air quantity should be based on good design practice, but, here again, conditions in an existing system may dictate this factor. The air side resistance will influence the fan size required as well as the speed and motor horsepower.

The rating of a coil is based on uniform velocity over the face of the coil and, if in the installation this velocity is not uniform, there can be a major effect on the coil performance. Bringing air into a coil at odd angles, or by blocking off part of the coil will generally give trouble. The most common complaint, when the air volume is reduced on a given system, is due to the filters becoming so filled with dirt that the air volume has been so decreased as to affect the coil performance very materially. Proper design and regular and careful servicing will tend to eliminate these difficulties.

Cooling Coils

Cooling and dehumidifying coils are usually selected within these limits:

Entering air dry bulb: 60º~100 º F.
Entering air wet bulb: 50º~80º F.
Air face velocities: 300~800 FPM.
Volatile refrigerant temperatures: 25º ~55º F. at coil suction.

Direct Expansion Coil Selection

In selecting direct expansion coils, the following points should be given consideration:

1. A direct expansion coil is normally selected to handle a given refrigeration load. It should be borne in mind that the load is often at times determined by the capacity of the condensing unit. This could affect the coil selection and the type of circuiting to be used on the coil.
2. When direct expansion coils are selected to operate at suction temperatures of 32-35º, care must be taken. If the entering air temperature is reduced, the suction temperature could drop below

freezing which would result in frost formation on the coil surface. Either the coil should be selected at a higher suction temperature under maximum entering air conditions, or a back pressure regulating valve should be used in the suction line to prevent the suction temperature in the coil from being below a pre-set temperature.

3. The coil should be installed for counterflow operation with the suction connection being on the entering air side of the coil. The purpose here is to maintain a temperature difference between the coil surface temperature and the leaving refrigerant temperature, thus providing one of the control means for the thermostatic expansion valve. As this temperature difference becomes small, the location of the suction header becomes more important. If we neglect the minor effect of pressure drop in an evaporator, the temperature of the refrigerant is constant. The importance of counterflow operation from a capacity standpoint in a direct expansion coil is far less important than in a water coil where there is a major change in the water temperature passing through the coil.

The ratio of total heat or sensible heat removed varies in normal air conditioning applications from 1.0 to about 1.65 with sensible heat then being from 60-100% of the total, depending on the application. On most comfort air conditioning installations, the coil face velocities would be between 400-600 FPM with 500 FPM being a very common velocity. Refrigerant temperatures will vary from 35-50º where dehumidification is required. Where no dehumidification is required, the coil is selected on dry bulb temperatures and sensible heat.

The performance of coils doing both sensible and latent cooling must, of necessity, be determined by laboratory tests. The coil capacity must of consequence balance with the capacity of the related equipment such as the compressor and the temperature of the circulating air. The current industry standards call for ratings of factory assembled self-contained air conditioners at 33.4 CFM per 1,000 BTU of cooling capacity. This is approximately 400 CFM per ton of refrigeration. The use of an 80º dry bulb and 67º wet bulb for the entering air is also considered standard and typical. The selection of cooling coils for field-fabricated installations necessitates the use of coil manufacturers' rating tables. The tables would be approached on the basis of the load division as calculated for the particular job. When critical industrial applications are being designed, it becomes necessary to use the best of engineering practices in determining such things as air volume to be circulated, refrigerant temperature, etc. The air volume to be circulated is technically based on the internal sensible heat load of the room, and, when this value is deviated from, it is normally for circulation reasons, or outlet air temperature reasons. Re-heat is required for many good comfort air conditioning installations. The use of re-heat will enable the design condition to be maintained regardless of the outdoor air conditions. The majority of problems with air conditioning systems exist when the cooling requirement is considerably below that of the design conditions. This is especially true in areas where the outside air dewpoints are high with the light load condition than having a greater proportion of latent load and a lower proportion of sensible load. In hot, dry climates, the light load problem is not as difficult.

2) Compressor selection

A) Number of compressors required – This is usually determined by the number of stages of cooling required. Where a space or return air thermostat is used a maximum of two compressors are required. When a discharge air controller is used to control supply temperature a maximum of 4 compressors are selected. In the end, the total number of Btu/hr capacity of the DX coil divided by the number of compressors will provide us with the Btu/hr capacity of each compressor. Then by using the tables provided by the compressor manufacturer a compressor is selected.

B) Type of compressors:

1) Hermetic scroll compressors – typically used on lower tonnage equipment up to 20 tons of cooling for R22, R134A, R407C and R410A refrigerants.
2) Semi-Hermetic reciprocating compressors – selected on R22, R134A & R407C systems whereby total cooling capacity is over 25 tons.

3) Condenser coil selection

Condensers

Air cooled condensers consist of an enclosure containing one or more fans and motors to move air through a finned coil, usually at a rate of 500 to 1000 CFM per compressor HP. Smaller fans are mounted on the motor shaft and run at a motor speed from 850 to 1500 rpm; while 30" and larger diameter fans are belt driven at tip speeds up to 8000 ft/min to maintain an acceptable noise level. (Tip speed = fan diameter (ft) x 3.14 x rpm). For each fan diameter and coil design there is an optimum speed at which energy efficiency is the highest possible. Well-designed condensers run near the most efficient fan speed.

Air flow through the condenser may be either horizontal or vertical; larger outdoor condensers are normally designed for vertical air flow to minimize the effect of adverse winds on air delivery and to provide a more wind-resistant structure. In either case, the fan and motor are usually located so as to draw air through the coil to obtain uniform air distribution and avoid preheating the condenser air by the motor before it enters the coil.

The condenser coil is usually made with 3/8" OD or 1/2" copper tubes on 1" to 1-1/2" centers, and aluminum fins spaced from 8 to 16 per inch. Closer fin spacings are sometimes used; but for most applications, particularly if used year 'round', 14 pfi is the practical maximum for trouble-free and energy-efficient operation.

For best efficiency, the condenser coil should be from one to four rows deep. Sometimes, to achieve a compact size, coils are made 6 or even 8 rows deep. As the air moves through each successive row of coil, it accepts more heat and its temperature increases. The warmer the air, the less the temperature difference between condensing refrigerant and the air, so that the capacity gained by adding more rows of coil becomes less and less.