Base Load Power Hub (BLPH)

B-400 HVAC CALCULATION REPORT
(Incl HVAC SYS CALC and HEAT DISSIPATION CALC)
E&I SHELTERS

Document Number: 1724000049-HV-CA-00038

Document Class: 2

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ALEXSISTEMI spa

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Revision / Change Log

Rev.	Description
0	Issue for Review (IFR)
1	Issue for Review (IFR)
2	Accepted for Construction (AFC)
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HOLDS LIST

No.	Description
1	
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1 INTRODUCTION

1.1 PURPOSE OF THE PROJECT

Scope of this document is to report the Cooling and Heating Loads calculations, of the HVAC system provided for the Technical Shelter B-400.

Cooling and Heating loads calculations have been carried out by means of CARRIER II 20 Hourly Analysis Program Version 5.11.

1.2 MEASURING SYSTEM

Length	m, mm
Area	m2, mm2
Volume	3, mm3
Mass	Kg
Airflow	l/s
Pressure	Pa = N/m2, kPa = kN/m2
Temperature	° C
Thermal Load	W, kW
Specific Enthalpy	kJ/kg
Specific Volume	m3/kg

1.3 DESIGN INPUT DATA

Outdoor design conditions:

Summer temperature:	+25°C D.B. (Dry Bulb) with RH 90 %
Winter temperature:	-8,4°C D.B. (Dry Bulb) with RH 100 %
Shelter U-Value:	0,450 W/(m^2 K).
Safe Area	

Indoor design conditions:

Room Pressurization:	+50 Pa
Summer temperature:	+25°C D.B. (Dry Bulb) with RH 30÷70%
Winter temperature:	+15°C D.B. (Dry Bulb) with RH 30÷70%
Internal Load Equipment:	12 kW
ACH Min.:	6
Safe Area	

2 SYSTEM DESCRIPTION

To guarantee the necessary overpressure and internal design temperatures in the summer and winter seasons, two Roof-Top type units have been provided, one duty and one stand-by.

3 ARCHITECTURAL DATA

Geometric data are based on document listed below:

1724000049-AR-DA-00017 Base load power HUB (BLPH) B-400 general arrangement drawing.

3.1 ROOM PRESSURIZATION

In order to guarantee the pressurization, where external doors are provided, fresh air flow requirement to maintain specified positive pressure shall be calculated based on following formula in accord to

ASHRAE:

$Q = Cd * A * Vp = m^3/s$

where ΔP = pressure difference across opening, Pa

Q = Airflow rate, m3/s

Cd = Discharge coefficient for opening, dimensionless (0,625 assumed)

Generally general 0.5 for large gaps and 0,625 for small openings.

A = Leakage area (m^2).

Vp: Velocity through crack area to maintain required pressure (2 ΔP/d) ^0.5

d = Density of air (kg/m^3) assumed 1.225 kg/m^3.

Note:

Leakage area for single leaf door = 0,02 m^2

Container structures, walls, floor and the ceiling are joined together by continuous welding.

Therefore, there isn't air leakage.

Vp for overpressure required 50 Pa = (2 x 50 / 1,225) ^0,5 = 9,03

Single Door overpressure required: (0,625x0,02x9,03) = 0,112 m^3/s that become 0,112x 3600 = 403 m^3/h

Total pressurization air flow equal to 403 m^3/h + 403 m^3/h = 806 m^3/h -> 223,9 l/s

Air change required for room: (B 28,5 m x H 3,3) x 6 = 564,3 m^3/h -> 156,7,1 l/s

According to the calculation above, the pressurizing air flow rate is greater than the ACH required.

So, the fresh air rate will be equal to 223,9 l/s (pressurizing air flow rate).

4 WEATER REPORT FROM HAP CARRIER

Design Weather Parameters & MSHGs

4112 - B 400 05/23/2024
Frigotermica 04:37

Design Parameters:

City Name	..	
Location	..	
Latitude	52.3	Deg.
Longitude	-4.8	Deg.
Elevation	30.0	m
Summer Design Dry-Bulb	25.0	°C
Summer Coincident Wet-Bulb	23.7	°C
Summer Daily Range	8.2	K
Winter Design Dry-Bulb	-8.4	°C
Winter Design Wet-Bulb	-8.4	°C
Atmospheric Clearness Number	1.00	
Average Ground Reflectance	0.20	
Soil Conductivity	1.385	W/(m K)
Local Time Zone (GMT +/- N hours)	1.0	hours
Consider Daylight Savings Time	No	
Simulation Weather Data	N/A	
Current Data is	User Modified	
Design Cooling Months	January to December	

Design Day Maximum Solar Heat Gains

(The MSHG values are expressed in W/m²)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S
January	38.8	38.8	38.8	98.7	308.2	473.1	618.1	687.5	715.2
February	55.8	55.8	72.2	288.0	480.0	639.4	730.3	775.6	780.0
March	74.7	74.7	242.5	454.2	611.0	724.2	761.7	755.4	742.3
April	94.1	186.7	400.6	555.9	679.0	712.3	689.8	650.0	629.4
May	113.0	305.1	487.7	621.3	687.3	680.1	627.5	556.8	529.7
June	156.7	346.4	514.5	633.8	681.4	657.2	591.6	514.4	481.4
July	121.5	292.0	483.9	602.9	676.6	664.8	608.7	547.0	515.0
August	99.5	190.3	383.3	541.5	652.7	690.1	668.2	630.2	608.5
September	78.4	78.4	207.4	425.5	567.6	686.1	722.0	721.7	716.9
October	58.7	58.7	84.1	257.4	462.4	607.7	708.1	747.1	757.4
November	40.0	40.0	40.0	117.9	278.2	473.7	589.8	681.0	706.2
December	31.5	31.5	31.5	44.3	228.7	378.7	538.8	614.4	652.4
Month	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**HOR**	**Mult**
January	695.2	617.9	473.7	306.6	106.1	38.8	38.8	185.7	1.00
February	770.8	727.7	643.5	465.5	291.7	68.1	55.8	353.1	1.00
March	752.0	759.6	711.4	622.6	440.4	251.6	74.7	526.9	1.00
April	649.4	697.7	714.0	674.0	564.6	399.0	191.9	661.6	1.00
May	559.0	630.7	685.8	678.1	624.4	477.2	311.6	738.6	1.00
June	516.8	595.8	664.1	679.6	633.7	511.7	348.8	760.6	1.00
July	548.1	616.6	672.1	670.4	611.6	473.1	308.7	731.3	1.00
August	629.1	674.2	688.9	648.8	544.4	385.3	190.6	652.5	1.00
September	719.3	718.7	685.0	574.3	424.7	206.4	78.4	511.0	1.00
October	748.8	707.9	596.6	464.8	253.0	86.0	58.7	352.7	1.00
November	679.4	594.2	473.7	285.1	117.6	40.0	40.0	189.4	1.00
December	623.5	529.5	397.8	216.4	62.0	31.5	31.5	128.0	1.00

Mult. = User-defined solar multiplier factor.

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5 SYSTEM DESIGN REPORT FROM HAP CARRIER

Air System Sizing Summary for B-400

Project Name: 4112 - B 400 — 05/23/2024
Prepared by: Frigotermica — 04:43

Air System Information

Air System Name	B-400		Number of zones	1	
Equipment Class	PKG ROOF		Floor Area	28.5	m²
Air System Type	SZCAV		Location	.., ..	

Sizing Calculation Information

Calculation Months	Jan to Dec	Zone L/s Sizing	Sum of space airflow rates
Sizing Data	Calculated	Space L/s Sizing	Individual peak space loads

Central Cooling Coil Sizing Data

Total coil load	19.4	kW	Load occurs at	Jul 1400	
Sensible coil load	13.1	kW	OA DB / WB	24.8 / 23.6	°C
Coil L/s at Jul 1400	847	L/s	Entering DB / WB	25.3 / 18.8	°C
Max block L/s	847	L/s	Leaving DB / WB	12.4 / 11.9	°C
Sum of peak zone L/s	847	L/s	Coil ADP	11.0	°C
Sensible heat ratio	0.675		Bypass Factor	0.100	
L/(s kW)	43.7		Resulting RH	42	%
m²/kW	1.5		Design supply temp.	12.0	°C
W/m²	680.1		Zone T-stat Check	1 of 1	OK
Water flow @ 5.6 K rise	N/A		Max zone temperature deviation	0.0	K

Central Heating Coil Sizing Data

Max coil load	8.6	kW	Load occurs at	Des Htg	
Coil L/s at Des Htg	847	L/s	W/m²	301.5	
Max coil L/s	847	L/s	Ent. DB / Lvg DB	8.9 / 17.3	°C
Water flow @ 11.1 K drop	N/A				

Supply Fan Sizing Data

Actual max L/s	847	L/s	Fan motor BHP	0.04	BHP
Standard L/s	844	L/s	Fan motor kW	0.03	kW
Actual max L/(s·m²)	29.72	L/(s·m²)	Fan static	35	Pa

Outdoor Ventilation Air Data

Design airflow L/s	224	L/s	L/s/person	0.00	L/s/person
L/(s·m²)	7.86	L/(s·m²)			

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Zone Sizing Summary for B-400

Project Name: 4112 - B 400 05/23/2024
Prepared by: Frigotermica 04:43

Air System Information

Air System Name **B-400**
Equipment Class ..... **PKG ROOF**
Air System Type ..... **SZCAV**

Number of zones **1**
Floor Area ..... **28.5** m²
Location ..... **.., ..**

Sizing Calculation Information

Calculation Months ..... **Jan to Dec**
Sizing Data ..... **Calculated**

Zone L/s Sizing ..... **Sum of space airflow rates**
Space L/s Sizing ..... **Individual peak space loads**

Zone Terminal Sizing Data

Zone Name	Design Supply Airflow (L/s)	Minimum Supply Airflow (L/s)	Zone L/(s·m²)	Reheat Coil Load (kW)	Reheat Coil Water L/s @ 11.1 K	Zone Htg Unit Coil Load (kW)	Zone Htg Unit Water L/s @ 11.1 K	Mixing Box Fan Airflow (L/s)
Zone 1	847	847	29.72	0.0	-	0.0	-	0

Zone Peak Sensible Loads

Zone Name	Zone Cooling Sensible (kW)	Time of Peak Sensible Cooling Load	Zone Heating Load (kW)	Zone Floor Area (m²)
Zone 1	13.3	Jul 1500	2.2	28.5

Space Loads and Airflows

Zone Name / Space Name	Mult.	Cooling Sensible (kW)	Time of Peak Sensible Load	Air Flow (L/s)	Heating Load (kW)	Floor Area (m²)	Space L/(s·m²)
Zone 1							
B 400	1	13.3	Jul 1500	847	2.2	28.5	29.72

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Ventilation Sizing Summary for B-400

Project Name: 4112 - B 400
Prepared by: Frigotermica

05/23/2024
04:43

1. Summary

Ventilation Sizing Method ..... **Sum of Space OA Airflows**
Design Ventilation Airflow Rate ..... **224** L/s

2. Space Ventilation Analysis

Zone Name / Space Name	Mult.	Floor Area (m^2)	Maximum Occupants	Maximum Supply Air (L/s)	Required Outdoor Air (L/s/person)	Required Outdoor Air (L/(s·m^2))	Required Outdoor Air (L/s)	Required Outdoor Air (% of supply)	Uncorrected Outdoor Air (L/s)
Zone 1									
B 400	1	28.5	0.0	847.0	0.00	0.00	223.9	0.0	223.9
Totals (incl. Space Multipliers)				**847.0**					**223.9**

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Air System Design Load Summary for B-400

Project Name: 4112 - B 400
Prepared by: Frigotermica

05/23/2024
04:43

	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1400 COOLING OA DB / WB 24.8 °C / 23.6 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -8.4 °C / -8.4 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	72 m²	-61	-	72 m²	757	-
Roof Transmission	0 m²	0	-	0 m²	0	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	4 m²	-14	-	4 m²	199	-
Floor Transmission	29 m²	-71	-	29 m²	300	-
Partitions	43 m²	-109	-	43 m²	457	-
Ceiling	29 m²	-71	-	29 m²	300	-
Overhead Lighting	342 W	342	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	12000 W	11999	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 0%	1201	0	10%	201	0
>> Total Zone Loads	-	**13216**	**0**	-	**2214**	**0**
Zone Conditioning	-	13259	0	-	2291	0
Plenum Wall Load	0%	0	-	0	0	-
Plenum Roof Load	0%	0	-	0	0	-
Plenum Lighting Load	0%	0	-	0	0	-
Return Fan Load	623 L/s	0	-	623 L/s	0	-
Ventilation Load	224 L/s	-196	6290	224 L/s	6332	0
Supply Fan Load	847 L/s	31	-	847 L/s	-31	-
Space Fan Coil Fans	-	0	-	-	0	-
Duct Heat Gain / Loss	0%	0	-	0%	0	-
>> Total System Loads	-	**13094**	**6290**	-	**8592**	**0**
Central Cooling Coil	-	13094	6290	-	0	0
Central Heating Coil	-	0	-	-	8592	-
>> Total Conditioning	-	**13094**	**6290**	-	**8592**	**0**
Key:	**Positive values are clg loads Negative values are htg loads**			**Positive values are htg loads Negative values are clg loads**		

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Zone Design Load Summary for B-400

Project Name: 4112 - B 400
Prepared by: Frigotermica

05/23/2024
04:43

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 25.0 °C / 23.7 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -8.4 °C / -8.4 °C		
	OCCUPIED T-STAT 25.0 °C			OCCUPIED T-STAT 15.0 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	72 m²	-48	-	72 m²	757	-
Roof Transmission	0 m²	0	-	0 m²	0	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	4 m²	-12	-	4 m²	199	-
Floor Transmission	29 m²	-58	-	29 m²	300	-
Partitions	43 m²	-89	-	43 m²	457	-
Ceiling	29 m²	-58	-	29 m²	300	-
Overhead Lighting	342 W	342	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	12000 W	11999	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 0%	1208	0	10%	201	0
>> Total Zone Loads	-	13284	0	-	2214	0

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Space Design Load Summary for B-400

Project Name: 4112 - B 400
Prepared by: Frigotermica

05/23/2024
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TABLE 1.1.A. Component Loads For Space "B 400" In Zone "Zone 1"

	DESIGN COOLING COOLING DATA AT Jul 1500 COOLING OA DB / WB 25.0 °C / 23.7 °C OCCUPIED T-STAT 25.0 °C			DESIGN HEATING HEATING DATA AT DES HTG HEATING OA DB / WB -8.4 °C / -8.4 °C OCCUPIED T-STAT 15.0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	72 m²	-48	-	72 m²	757	-
Roof Transmission	0 m²	0	-	0 m²	0	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	4 m²	-12	-	4 m²	199	-
Floor Transmission	29 m²	-58	-	29 m²	300	-
Partitions	43 m²	-89	-	43 m²	457	-
Ceiling	29 m²	-58	-	29 m²	300	-
Overhead Lighting	342 W	342	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	12000 W	11999	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	10% / 0%	1208	0	10%	201	0
>> Total Zone Loads	**-**	**13284**	**0**	**-**	**2214**	**0**

TABLE 1.1.B. Envelope Loads For Space "B 400" In Zone "Zone 1"

				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²·K))	Coeff.	(W)	(W)	(W)
N EXPOSURE						
WALL	50	0.450	-	-33	-	529
E EXPOSURE						
WALL	7	0.450	-	-5	-	77
DOOR	2	1.930	-	-6	-	99
S EXPOSURE						
WALL	7	0.450	-	-5	-	74
W EXPOSURE						
WALL	7	0.450	-	-5	-	77
DOOR	2	1.930	-	-6	-	99

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System Psychrometrics for B-400

Project Name: 4112 - B 400
Prepared by: Frigotermica

05/23/2024
04:43

July DESIGN COOLING DAY, 1400

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
Ventilation Air	Inlet	24.8	0.01804	224	400	-196	6290
Vent - Return Mixing	Outlet	25.3	0.01100	847	425	-	-
Central Cooling Coil	Outlet	12.4	0.00847	847	425	13094	6290
Central Heating Coil	Outlet	12.4	0.00847	847	425	0	-
Supply Fan	Outlet	12.5	0.00847	847	425	31	-
Cold Supply Duct	Outlet	12.5	0.00847	847	425	-	-
Zone Air	-	25.5	0.00847	847	434	13259	0
Zone Direct Exhaust	Outlet	25.5	0.00847	224	434	-	-
Return Plenum	Outlet	25.5	0.00847	623	434	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.207; At site altitude = 1.203 W/(L/s-K)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947.6; At site altitude = 2937.1 W/(L/s)
Site Altitude = 30.0 m

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (W)	T-stat Mode	Zone Cond (W)	Zone Temp (°C)	Zone Airflow (L/s)	CO2 Level (ppm)	Terminal Heating Coil (W)	Zone Heating Unit (W)
Zone 1	13216	Cooling	13259	25.5	847	434	0	0

System Psychrometrics for B-400

Project Name: 4112 - B 400 — 05/23/2024
Prepared by: Frigotermica — 04:43

WINTER DESIGN HEATING

TABLE 1: SYSTEM DATA

Component	Location	Dry-Bulb Temp (°C)	Specific Humidity (kg/kg)	Airflow (L/s)	CO2 Level (ppm)	Sensible Heat (W)	Latent Heat (W)
Ventilation Air	Inlet	-8.4	0.00185	224	400	-6332	0
Vent - Return Mixing	Outlet	8.9	0.00185	847	425	-	-
Central Cooling Coil	Outlet	8.9	0.00185	847	425	0	0
Central Heating Coil	Outlet	17.3	0.00185	847	425	8592	-
Supply Fan	Outlet	17.4	0.00185	847	425	31	-
Cold Supply Duct	Outlet	17.4	0.00185	847	425	-	-
Zone Air	-	15.1	0.00185	847	434	-2291	0
Zone Direct Exhaust	Outlet	15.1	0.00185	224	434	-	-
Return Plenum	Outlet	15.1	0.00185	623	434	0	-

Air Density x Heat Capacity x Conversion Factor: At sea level = 1.207; At site altitude = 1.203 W/(L/s-K)
Air Density x Heat of Vaporization x Conversion Factor: At sea level = 2947.6; At site altitude = 2937.1 W/(L/s)
Site Altitude = 30.0 m

TABLE 2: ZONE DATA

Zone Name	Zone Sensible Load (W)	T-stat Mode	Zone Cond (W)	Zone Temp (°C)	Zone Airflow (L/s)	CO2 Level (ppm)	Terminal Heating Coil (W)	Zone Heating Unit (W)
Zone 1	-2214	Deadband	-2291	15.1	847	434	0	0

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6 COOLING COIL SELECTION

To ensure the good functioning of the unit we chose to select the cooling coil with the following characteristics.

D.B.M. SpA a Socio Unico
Via Ugo La Malfa 10 – 28040 Varallo Pombia (NO) – Italy
Tel. +39 0321 956794 – E mail: sales@dbmcoils.com

23/05/2024

Offer

Contact	
Delivery Schedule	
Goods rendered	ex DBM factory
Packing	Included
Payment	As usual
Offer validity	30 days

NOTE

24 months guarantee according to DBM sales terms

CC User-249-00148/2 0 538 *Rel. 6.5.0.4 01-10-2022*

DESIGN DATA

EXTERNAL FLUID:	**Air**				
Ambient pressure	mmHg	760			
Capacity	**kW**	**21.84**			
Gas quantity	**Sm³/h**	**3050**			
Air treated weight	kg/h	3673	Sensible heat factor		0.67
Inlet temperature	**°C**	**25.70**	Condensed water	kg/h	10.10
Relative humidity	%	52.60	Actual velocity	m/s	2.46
Outlet temperature	**°C**	**11.60**	Pressure drop	Pa	218
Outlet relative humidity	%	95.91	Dry fin pressure drop	Pa	104
INTERNAL FLUID:	**R32**				
Evaporating pressure	**bar(a)**	**10.12**	**Evaporating temperature**	**°C**	**7.00**
Condensing pressure	bar(a)	31.41	Liquid temperature	°C	50.00
Superheating	°C	5.00	Subcooling	°C	2.00
Liquid weight	kg/h	341	Pressure drop	bar	0.02
Distributor diameter	mm	28.00	Distributors pressure drop	bar	0.67
Capillars Ø 5 lenght 550 mm			Capillars pressure drop	bar	0.12

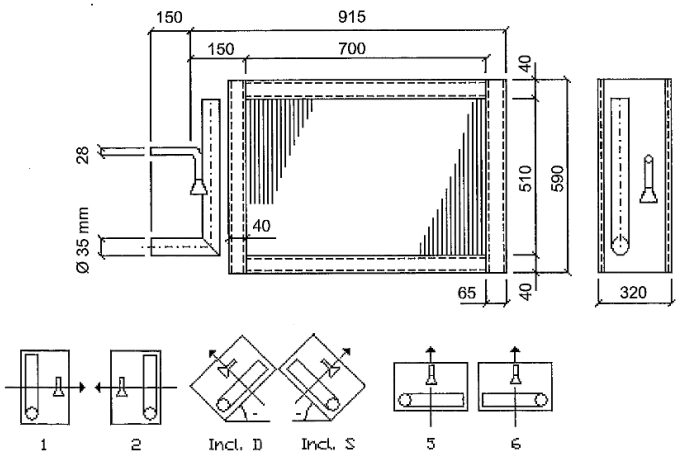
N°·1 Coil CuSn-CuSn-Inox316 P3012ED 8R-17T-700A-2.5pa 17C 35 mm

TECHNICAL FEATURES

Tubes	**CuSn**	**12.45 x 0.35**	mm	Weight	82 Kg
Fins	**CuSn**	**0.20**	mm	Internal volume	14 dm3
Frame	**Inox316**	**1.50 / 1.50**	mm	Total exchange surface	53.25 m2
Manifolds material	**Cu**			**PED 2014/68/UE Cat.**	**Class I**
				Maximum allowable pressur	21.0 bar
				Min/Max allowable temp	-10/80 °C

ACCESSORIES

Certified calculation - Counterflow



7 DESIGN SYSTEM SUMMARY

Below is the system performance:

Fresh Air intake: 806 m³/h -> 224 l/s

Supply Air: 3050 m³/h -> 847,2 l/s

Cooling Coil Capacity: 21,8 kW

Heating Coil Capacity: 8,6 kW

8 DUCT PRESSURE DROP

The HVAC Ducts, have been sized with the criterion of constant pressure drop.

In this paper we have calculated the static pressure drop of the most unfavorable sections of the air duct distribution according to ASHRAE standards.

METHOD:

To calculate the friction losses, the following equation have been used as detailed below. These equations have a wide and internationally recognised application for this kind of calculation.
The friction losses (Dp) in terms of specific energy (mm w.g.) have been evaluated by means of the below equation:

$$Dp = k \times pd$$

where:

- K Accidental Resistance (see value attach in table 1)
- pd Dynamic Pressure (mm w.g) $pd = \frac{c^2 \times \gamma}{2 \times g}$

Where:

- γ: Air density (1,22 Kg/m^3)
- c velocity of air m/s

If the Duct are linear the Dp are independent of Dynamic Pressure but depend of:

$$Dp = 0{,}00117722 \frac{c^{1,9}}{d_{eq}{}^{1,22}}$$

This value is for each meter of linear duct

where:

- c velocity of air m/s
- d_{eq} Diameter of equivalent duct

$$d_{eq} = \frac{4{,}5 \times A}{P}$$

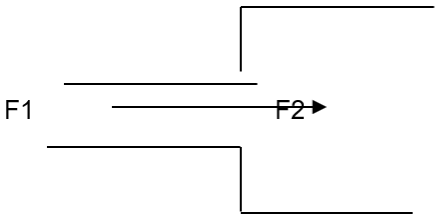
where:

- A Cross section of duct
- P Perimeter

Tab. 1

Pos	Description	K for special peace
1	Linear duct	0
2	Bend 90°	0,1
3	Outlet	1
4	Inlet	0,35
5	Section reduction	0,35

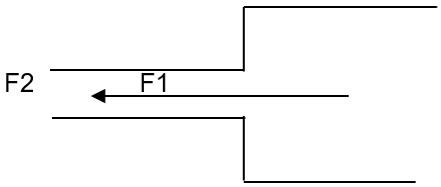
POS .6 Inlet in the Plenum



See detail

AxB/A1xB1	0,1	0,2	0,4	0,6	0,8
K	1	0,7	0,4	0,2	0,1

POS.7 Outlet from Plenum



See detail

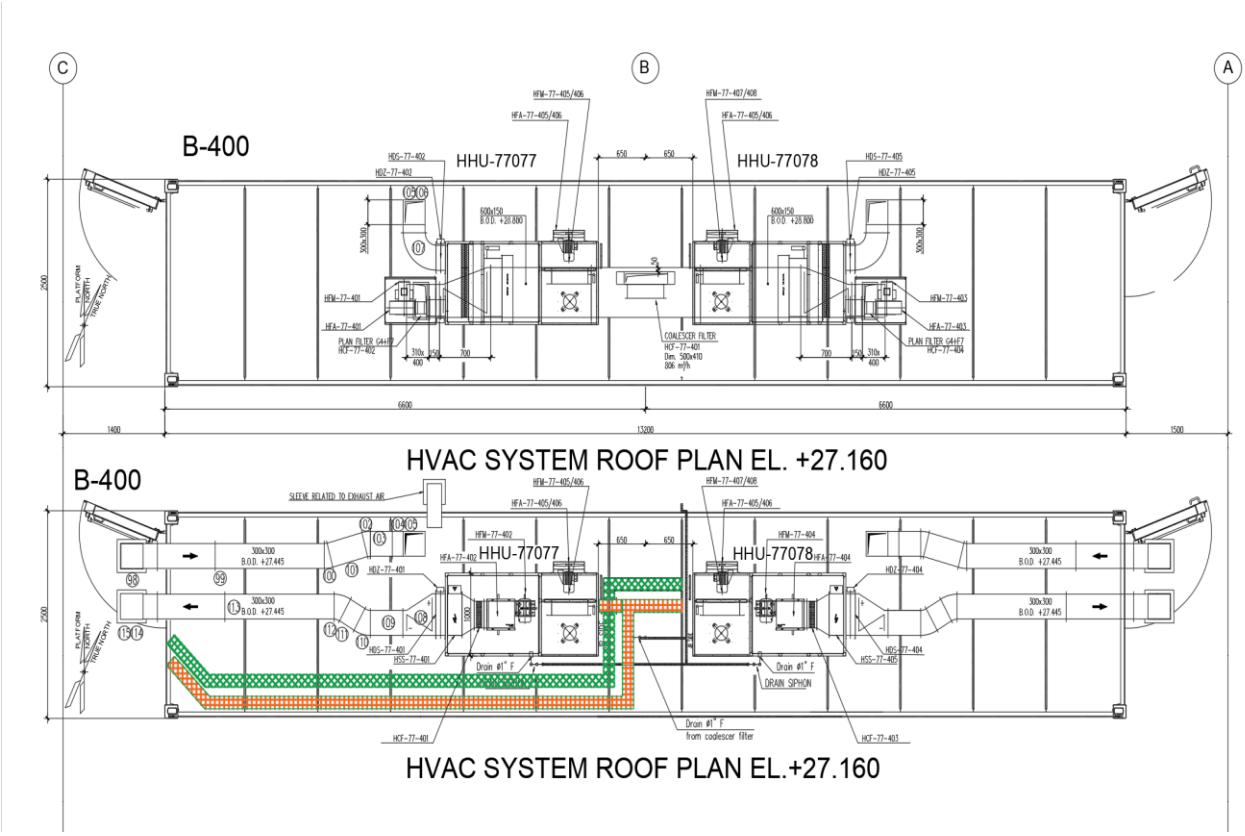
AxB/A1xB1	0,2	0,4	0,6	0,8
K	0,45	0,3	0,2	0,1

B-400 duct layout pressure drop:

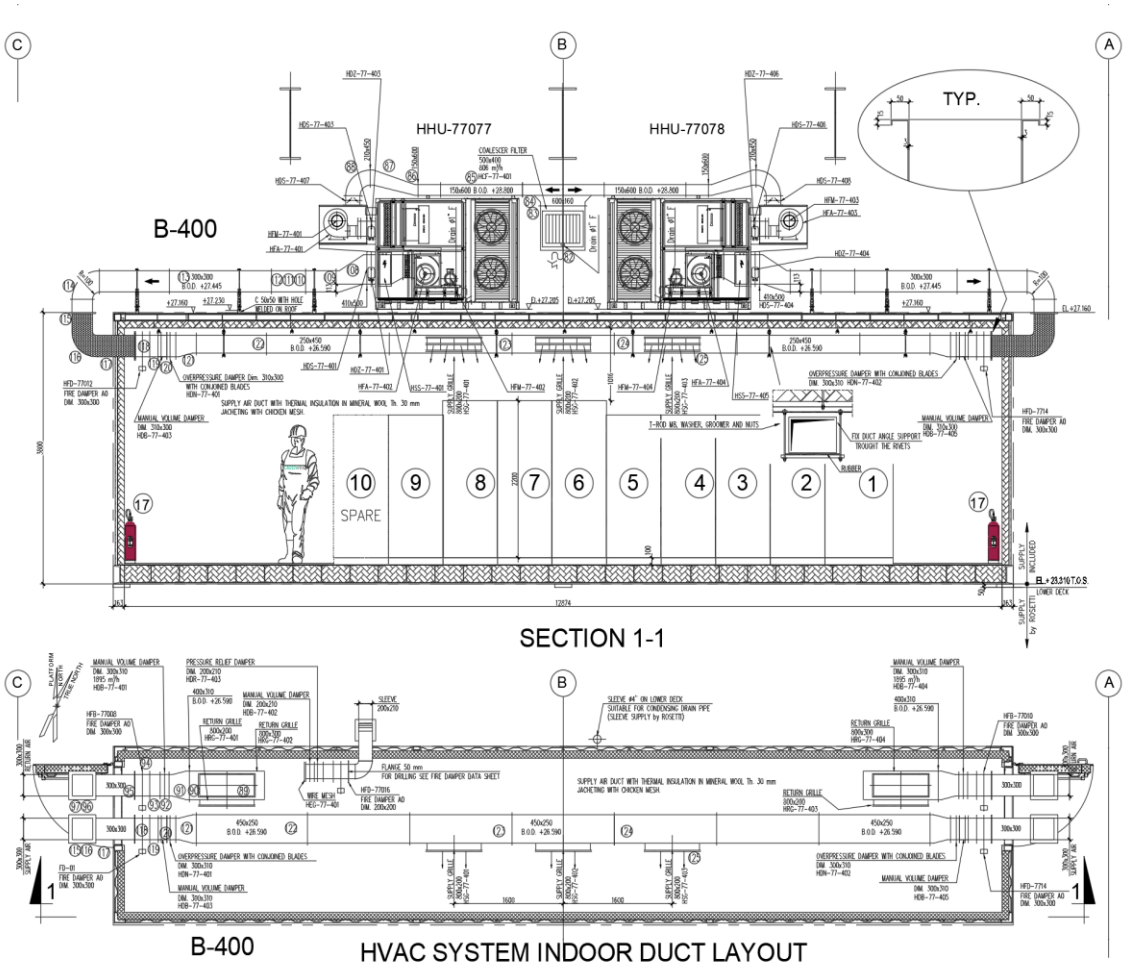
	B-400			Duct pressure loss calculation							
	POS.	Inlet air dimens. (mm)		Outlet air dimens. (mm)		Lenght	Air Flow	Velocity	POS.	Dp for linear duct	DP for special pieces
		A	B	A1	B1	L (mm)	mc/h	m/s		mm w.g.	mm w,g,
HHU-77007 / 77008	**82**	COALESCER FILTER 500 x 400					806			0,00	1,02
	83	600	160	600	160	300	806	2	1	0,01	0,00
	84	600	160	600	150	150	806	2	4	0,00	0,09
	85	600	150	600	150	2132	806	2	1	0,05	0,00
	86	600	150	600	150	0	806	2	7	0,00	0,03
	87	600	150	450	210	730	806	2	5	0,00	0,09
	88	450	210	450	210	0	806	2	2	0,00	0,13
	89	RETURN GRILLES					2244	#VALORE!		0,00	1,02
	90	400	250	400	250	550	2244	6	1	0,07	0,00
	91	400	250	300	300	300	2244	6	5	0,00	0,81
	92	MANUAL VOLUME DAMPER					2244	#VALORE!		0,00	19,60
	93	300	300	300	300	150	2244	7	1	0,03	0,00
	94	FIRE DAMPER					2244	#VALORE!		0,00	1,02
	95	300	300	300	300	770	2244	7	1	0,14	0,00
	96	300	300	300	300	0	2244	7	2	0,00	1,55
	97	300	300	300	300	900	2244	7	1	0,16	0,00
	98	300	300	300	300	0	2244	7	2	0,00	1,55
	99	300	300	300	300	2290	2244	7	1	0,41	0,00
	100	300	300	300	300	0	2244	7	2	0,00	1,55
	101	300	300	300	300	800	2244	7	1	0,14	0,00
	102	300	300	300	300	0	2244	7	2	0,00	1,55
	103	300	300	300	300	300	2244	7	1	0,05	0,00
	104	300	300	300	300	0	2244	7	2	0,00	1,55
	105	300	300	300	300	1000	2244	7	1	0,18	0,00
	106	300	300	300	300	0	2244	7	2	0,00	1,55
	107	300	300	300	300	0	2244	7	2	0,00	1,55
	108	410	500	300	300	415	3050	4	5	0,00	0,35
	109	410	500	410	500	450	3050	4	1	0,02	0,00
	110	300	300	300	300	0	3050	9	2	0,00	2,55
	111	300	300	300	300	230	3050	9	1	0,07	0,00
	112	300	300	300	300	0	3050	9	2	0,00	2,55
	113	300	300	300	300	2430	3050	9	1	0,70	0,00
	114	300	300	300	300	0	3050	9	2	0,00	2,55
	115	300	300	300	300	900	3050	9	1	0,26	0,00
	116	300	300	300	300	0	3050	9	2	0,00	2,55
	117	300	300	300	300	780	3050	9	1	0,22	0,00
	118	FIRE DAMPER					3050	#VALORE!		0,00	1,02
	119	300	300	300	300	125	3050	9	1	0,04	0,00
	120	OVERPRESSURE DAMPER				0	3050	#VALORE!		0,00	6,94
	121	300	300	250	350	300	3050	9	5	0,00	1,79
	122	250	350	250	350	2880	3050	10	1	1,05	0,00
	123	250	350	250	350	1600	2050	7	1	0,30	0,00
	124	250	350	250	350	1600	1050	3	1	0,06	0,00
	125	SUPPLY GRILLE				0	1050	#VALORE!		0,00	0,51
									1	2,53	54,94
									TOTAL LOSS Pa	563,56	

B-400 → DUCT LAYOUT

A:



B:


HHU-77077
HHU-77078
TYP.
B-400
SPARE
SECTION 1-1
B-400
HVAC SYSTEM INDOOR DUCT LAYOUT

9 CONCLUSION

The pressure drops duct layout of the B-400 loss: 563.56Pa

The ducts were built based on the flow rate required by the thermal calculation and the fans were sized based on the pressure loss, obtained with the calculation sheet illustrated above.

The fan's air flow is sufficient to guarantee the required overpressure of 50 Pa.

