Metal-Asia

Commercial Proposal for Supply

Climate Control Systems for Air-Supported Structures: Ventilation, Heating, Air Conditioning

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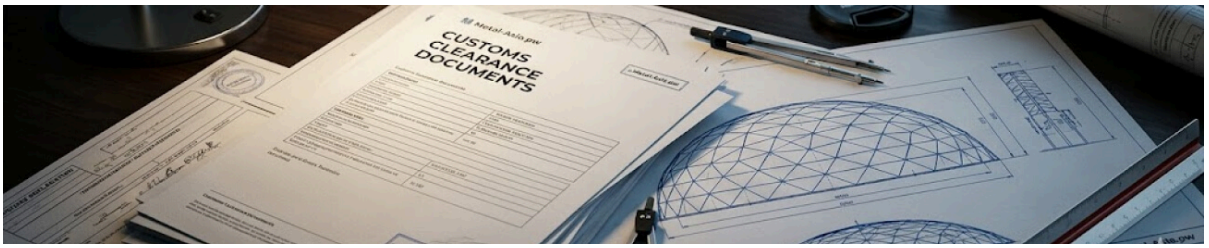
Executive Summary

Climate control systems for Air-Supported Structures (ASS) constitute a mission-critical engineering package integrating three primary functions: structural overpressure maintenance (150–500 Pa), supply-exhaust ventilation (3 ACH), and thermal conditioning across operational temperatures from -50 °C to +70 °C. Improper equipment specification results in pressure instability, condensation accumulation, fuel overconsumption, and emergency failure scenarios. Metal-Asia.pw delivers integrated climate system packages with redundant configurations, automated building management systems (BMS), and energy optimization protocols — all factory-tested and commissioned by certified supervisors.



Insulated equipment enclosure with integrated ventilation, heating, and automation systems

Market Challenges in Unassisted Climate System Procurement

International facility operators and EPC contractors face critical specification failures when sourcing ASS climate equipment independently:

- Undersized ventilation capacity: Air handling units rated below 3 ACH causing moisture accumulation, internal condensation on membrane surfaces, and mold propagation
- Absence of redundant air handling: Single-point failure in primary ventilation resulting in dome deflation within 15–30 minutes, catastrophic structural collapse risk
- Incorrect thermal power calculation: Heating generators undersized for regional climate loads causing inability to maintain +18 °C internal temperature at -30 °C ambient, or conversely, oversized units cycling inefficiently with 40% fuel waste
- Missing variable frequency drives (VFD): Constant-speed fan operation consuming 30–40% excess electrical energy versus demand-responsive modulation
- Inappropriate fuel source selection: Natural gas equipment specified for non-gasified regions, diesel generators for sites without fuel storage infrastructure, electric heating for grid-constrained facilities
- Missing air recirculation systems: Conditioned air discharged to atmosphere rather than recirculated, 25% thermal energy loss

- Excessive noise emission: Ventilation equipment operating above 70 dB(A) creating occupational health violations and community complaints
- Absence of remote monitoring: No SMS/email alarm notification, requiring 24/7 on-site attendance for critical parameter oversight
- Missing seasonal mode automation: Manual switching between winter/summer configurations causing delayed response to weather fronts and energy waste

Our Solution: Integrated Climate System Package with Energy Optimization

Metal-Asia.pw provides integrated procurement and engineering services for industrial climate control systems from China, including thermal load calculations, equipment specification, factory acceptance testing, and commissioning supervision. Our supply chain compliance program ensures CE-marked equipment, ISO 9001 manufacturing audits, and full documentation packages for international warranty claims and insurance underwriting.

Ventilation System

System Functions

Function	Description
Structural	Creation and maintenance of 150–500 Pa internal overpressure ensuring membrane structural form
Ventilatory	3 ACH (Air Changes per Hour) per industrial ventilation standards, air quality maintenance
Leakage compensation	Continuous airflow replacement through airlock doors, seam micro-permeation, and operational openings
Pressure regulation	Automatic adjustment in response to wind gusts and snow load variations

Ventilation System Equipment Package

Item	Description	Qty	Technical Specification
1	Primary air handling unit	1 pc	Supply-exhaust with heat exchanger, 3 ACH capacity; fan power calculated per dome volume
2	Redundant air handling unit	1 pc	Identical to primary; automatic failover activation on primary fault
3	Emergency autonomous compressor	1 pc	Monoblock: fan + diesel engine + automation + control panel + acoustic enclosure; air injection independent of grid power
4	Building Management System (BMS) / PLC controller	1 pc	36+ parameter display; automatic primary-to-redundant switching
5	Acoustic enclosure	1 pc	Galvanized steel; external mounting; noise reduction to 50–70 dB(A) primary / 70–85 dB(A)

Item	Description	Qty	Technical Specification
			redundant
6	Air recirculation system	1 set	Recovers conditioned air for thermal energy conservation
7	Pressure sensors	2+ pcs	Range 0–1000 Pa, accuracy ±5 Pa
8	Wind sensors	1+ pcs	Anemometer; automatic pressure adjustment on gust detection
9	Variable frequency drives (VFD)	Per calculation	Fan speed modulation; energy savings up to 30%

Ventilation Unit Technical Parameters

Parameter	Specification
Airflow capacity	Dome volume × 3 ACH (m³/h)
Operating overpressure	150–500 Pa
Pressure regulation range	0–1000 Pa
Fan power	5–75 kW (dome size dependent)
Fan speed control	Variable frequency drive (VFD)
Fan drive type	Direct-coupled (beltless) — eliminates tension maintenance
Noise level (primary unit)	50–70 dB(A)
Noise level (redundant unit)	70–85 dB(A)
Noise level (silent mode, optional)	Below 50 dB(A) with additional silencers
Fan type	Axial / Centrifugal
Housing material	Galvanized steel / Stainless steel
Protection class	IP54 / IP65

Ventilation Capacity Calculation by Dome Size

Dome Size	Area m²	Volume m³	Airflow m³/h	Fan Power kW
20×40×8 m	800	6,400	19,200	5–7.5
30×60×10 m	1,800	18,000	54,000	11–15
40×80×12 m	3,200	38,400	115,200	18.5–22
60×120×18 m	7,200	129,600	388,800	37–45
80×160×25 m	12,800	320,000	960,000	75–90

Dome Size	Area m²	Volume m³	Airflow m³/h	Fan Power kW
100×200×30 m	20,000	600,000	1,800,000	110–132

Heating System

Heat Source Options

Heat Source	Application	Advantages	Limitations
Natural gas	Gasified regions	Lowest fuel cost, clean combustion, automatic control	Gas pipeline infrastructure required
LPG (liquefied petroleum gas)	Non-gasified regions	Mobility, autonomy, rapid deployment	Higher fuel cost, storage tank requirements
Diesel fuel	All regions	Autonomy, reliability, widespread availability	Higher cost, odor, storage tank requirements
Fuel oil	Industrial facilities	Lowest fuel cost for large volumes	Storage complexity, combustion residue
District heating (hot water)	Co-located with CHP/central boiler	Maximum cost efficiency	External network dependency
Electricity	Small facilities, backup	Simplicity, cleanliness	High cost, grid capacity constraints
Solid fuel (biomass, coal)	Agricultural, remote sites	Independence, low cost	Manual loading, ash handling
Heat pump	Moderate climates	High efficiency (COP 3–5)	High capital cost, limited extreme cold performance
Combined source	Critical facilities	Maximum reliability	System complexity

Heating System Equipment Package

Item	Description	Qty	Technical Specification
1	Air heater / heating generator	Per calculation	Power calculated per formula: Q = V × ΔT × k / 860 (kW)
2	Insulated equipment enclosure	1 pc	Insulated doors, automatic lighting, electric convection heater; adapted for temperate and arctic climates
3	Automatic heating control system	1 set	Automatic heating, air injection, calculated temperature and pressure maintenance per set parameters

Item	Description	Qty	Technical Specification
4	Conditioned air recirculation system	1 set	Minimizes electric heater cycling frequency; high energy efficiency
5	Heat exchanger	1 pc	Air-to-air or air-to-water; efficiency ≥70%
6	Arctic-specification air heaters	Per calculation	Operational to -60 °C ambient
7	Temperature sensors (internal/external)	2+ pcs	Accuracy ±0.5 °C, range -60 to +60 °C
8	Humidity sensors	1+ pcs	Accuracy ±3%, range 0–100% RH

Heating Generator Technical Parameters

Parameter	Specification
Thermal power	50–5,000 kW (dome size and climate zone dependent)
Airflow capacity	2,000–200,000 m³/h
Air temperature rise	ΔT = 20–40 °C (supply vs. exhaust differential)
Guaranteed internal temperature (at -25 to -30 °C ambient)	+18 °C
Guaranteed internal temperature (at extreme -50 °C ambient)	+10 to +15 °C (with enhanced equipment)
Heating generator efficiency	≥85% (gas/diesel)
Burner type	Atmospheric / Forced-draft
Heat exchanger material	Stainless steel / Galvanized steel
Protection class	IP54
Noise level	60–75 dB(A)

Thermal Power Calculation by Dome Size

Dome Size	Area m²	Volume m³	ΔT (internal -30 / external)	k (heat loss coefficient)	Thermal Power kW
20×40×8 m	800	6,400	48 °C	2.0	715
30×60×10 m	1,800	18,000	48 °C	2.0	2,011
40×80×12 m	3,200	38,400	48 °C	2.0	4,290
60×120×18 m	7,200	129,600	48 °C	2.0	14,476
80×160×25 m	12,800	320,000	48 °C	2.0	35,721

Dome Size	Area m²	Volume m³	ΔT (internal -30 / external)	k (heat loss coefficient)	Thermal Power kW
100×200×30 m	20,000	600,000	48 °C	2.0	67,000

> Formula: Q = V × ΔT × k / 860, where Q = power (kW), V = volume (m³), ΔT = temperature differential (°C), k = heat loss coefficient (1.5–2.5 for ASS), 860 = conversion factor from kcal/h to kW.

Energy Conservation Measures

Measure	Savings
Double-layer membrane (air gap insulation)	Up to 30% heating cost reduction
Triple-layer membrane (ENERGY P)	Up to 40% heating cost reduction
Variable frequency drives on ventilation fans	Up to 30% electrical savings
Conditioned air recirculation	Up to 25% fuel savings
Translucent membrane (daylight utilization)	Up to 70% lighting cost reduction
Automatic temperature setback (night mode)	Up to 15% heating cost reduction

Air Conditioning System

Application Scope

- Hot climate regions (Middle East, Southeast Asia, Southern Europe, Central/South America)
- Internal temperature maintenance at +22 to +25 °C with +40 °C ambient
- Humidity control (40–60% RH) for sensitive storage and processing applications
- Pharmaceutical, electronics, and precision agriculture facilities with strict microclimate requirements

Air Conditioning Equipment Package

Item	Description	Qty	Technical Specification
1	Air conditioner (split / centralized)	Per calculation	Cooling capacity: Qcool = V × ΔTcool × kcool / 860 (kW)
2	Outdoor unit (compressor-condenser)	Per calculation	Installed in equipment enclosure or separate technical room
3	Indoor unit (air cooler)	Per calculation	Integrated into ventilation ductwork
4	Refrigerant piping	Per calculation	Copper tubes with thermal insulation

Item	Description	Qty	Technical Specification
5	Air dehumidification system	Per calculation	Rotary or condensation-type dehumidifier
6	Temperature and humidity sensors	2+ pcs	Accuracy ±0.5 °C / ±3% RH

Air Conditioning Technical Parameters

Parameter	Specification
Cooling capacity	20–2,000 kW (dome size dependent)
Operating ambient temperature	+15 to +70 °C
Guaranteed internal temperature (at +40 °C ambient)	+22 to +25 °C
Internal humidity	40–60% RH
Refrigerant	R410A / R32 / R134a (environmentally compliant)
Energy efficiency class	A / A+ / A++
Noise level	55–70 dB(A)

Cooling Capacity Calculation by Dome Size

Dome Size	Area m²	Volume m³	ΔTcool (internal +24 / external +40)	kcool	Cooling Capacity kW
20×40×8 m	800	6,400	16 °C	2.5	298
30×60×10 m	1,800	18,000	16 °C	2.5	837
40×80×12 m	3,200	38,400	16 °C	2.5	1,786
60×120×18 m	7,200	129,600	16 °C	2.5	6,023
80×160×25 m	12,800	320,000	16 °C	2.5	14,884

> Formula: Qcool = V × ΔTcool × kcool / 860, where Qcool = cooling capacity (kW), V = volume (m³), ΔTcool = temperature differential (°C), kcool = cooling load coefficient (2.0–3.0 for ASS in hot climates).

Insulated Equipment Enclosure

Parameter	Specification
Frame material	Steel profile 60×40×2 mm, 40×40×2 mm
Cladding	Sandwich panels (PUR / mineral wool), 80–100 mm thickness
Thermal conductivity	≤0.04 W/(m·K)
Doors	Insulated, steel, reinforced hinges, locking device
Lighting	Automatic (motion sensor)
Heating	Electric convection heater, 1–3 kW
Ventilation	Forced supply-exhaust
Protection class	IP54
Dimensions	3×2×2.5 m (standard) / custom
Weight	500–1,500 kg
Installation location	External to ASS, adjacent to anchor contour

Emergency and Redundant Systems

Scenario	System Response
Grid power failure	Automatic redundant air handling unit startup; automatic emergency diesel generator (EDG) activation
Primary fan failure	Automatic switching to redundant fan; alarm notification on BMS panel
Pressure drop below critical threshold	Emergency alarm; all redundant systems activate; automatic airlock door sealing
Fire / membrane breach	Emergency alarm; emergency exit door activation (brief pressure loss permitted); personnel evacuation
Extreme cold event	Automatic heating power increase; transition to maximum thermal protection mode

Automation and Building Management System (BMS)

Displayed Parameters

Parameter	Range	Unit
Internal overpressure	0–1000	Pa
Internal temperature	-60 to +60	°C
External temperature	-60 to +60	°C
Internal humidity	0–100	% RH
Wind speed	0–50	m/s

Parameter	Range	Unit
Snow load	0–500	kg/m²
Methane concentration (CH4)	0–100	% LEL
Carbon monoxide (CO)	0–500	ppm
Carbon dioxide (CO2)	0–5,000	ppm
Primary fan status	On/Off/Alarm	—
Redundant fan status	On/Off/Alarm	—
EDG status	On/Off/Alarm	—
Heating power	0–100	%
Fuel consumption	0–999	L/h
Airlock door status	Open/Closed/Alarm	—

Operational Modes

Mode	Description
Winter	Maximum heating, minimum ventilation, elevated pressure (snow load compensation)
Summer	Minimum heating, maximum ventilation, air conditioning (if equipped)
Transition	Automatic adjustment per temperature sensor feedback
Night	Reduced temperature (+12 to +15 °C), energy conservation
Emergency	Maximum power on all redundant systems, alarm activation
Maintenance	Manual override, automation disabled for service procedures

Climate System Maintenance Schedule

Frequency	Activity
Daily	Visual BMS panel inspection, pressure and temperature verification
Weekly	Ventilation unit filter inspection and cleaning as required
Monthly	Drive belt tension check (if applicable), bearing lubrication
Quarterly	Heating generator service (filter replacement, oil change, burner inspection)
Annually	Full ventilation unit overhaul, sensor calibration, airlock door seal inspection
Pre-winter	Heating equipment verification, fuel reserve confirmation, enclosure insulation check
Pre-summer	Air conditioning verification, condenser cleaning, refrigerant charge verification

Why Metal-Asia.pw — Direct Access, Transparency, Compliance

- Precise engineering calculations for climate equipment matched to facility size and regional climate data
- Equipment sourced directly from certified manufacturers without intermediary markups
- Dedicated quality control division: third-party DNT, UT inspection, chemical composition verification against EN/ASTM standards
- Complete supply package: primary + redundant + emergency equipment as standard configuration
- BMS with remote monitoring and SMS/email alarm notification
- Installation supervision and commissioning with operator certification
- Warranty and post-warranty service with spare parts inventory
- Tender documentation support for public and private procurement frameworks

Contact Information

For detailed service specifications and portfolio references, visit Metal-Asia.pw.

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Request climate system sizing and quotation — email zakaz@metal-asia.pw with dome dimensions and regional climate data