Contents

B GSE F-TYPE CAS Unit

Model Number Nomenclature

BGAC	-	03	3	-	4	S	H	-	27
1		**2**	**3**		**4**	**5**	**6**		**7**

1 – B GSE Air Conditioner

2 –Nominal Cooling Capacity

02 = 20 Tons

03 = 30 Tons

3 – Refrigerant

2 = R134a

3 = R410a

4 – Voltage & Frequency

3 = 380 VAC/50 Hz
4 = 460 VAC/60 Hz
5 = 515 VAC/60 Hz

5 – Ambient Temperature Rating

H = High Ambient Rating

130°F (54°C) DB/72°F (22°C) WB

S = Standard Ambient Rating

Humid: 97°F (36°C) DB/76°F (24°C) WB

Dry: 112°F (44°C) DB/70°F (21°C) WB

6 – Configuration

H = Hanger/Stand Mount
ME = Mobile Electric
MD = Mobile Diesel

7 – Heat

27 = 27 kW

CAS Unit Design Summary

1. Introduction

1.1. The B GSE BGAC air conditioning units are an OEM product manufactured for B GSE and are a packaged specialized high-pressure air conditioning system. The system is designed for use in the aviation services industry. The primary function of this equipment is to provide conditioned air for fighter type aircraft including the F35, F16, FA-18 and the T-50.

2. Commercial Standard Reference

2.1. Note: These standards are used as a reference or general guide unless specifically directed that the unit shall be certified per the standard.

UL 1995 4th edition	Heating and Cooling Equipment
CSA C22.2 236-11	Heating and Cooling Equipment
ASTM B117	(2007) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASHRAE 15	(2007) Safety Standard for Refrigeration Systems
ASHRAE 34	(2004; Addenda's a,b,c,e,f,k,n,o,p,q,r,s,u 2006; Supp to Addenda's 2006; Addenda's g,h 2006) Designation and Safety Classification of Refrigerants
NEMA MG 1	(2014) Motors and Generators
NEMA MG 2	(2014) Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators

3. Certification

3.1. The unit shall be listed with a Nationally Recognized Testing Laboratory (NRTL) to UL 1995 and CSA C22.2 236-05.

4. Physical Characteristics

Stand Mount

Length:	105 in.	(2667mm)
Height:	39 in.	(991mm)
Width:	70 in.	(1776mm)

Weight: 4620 lbs. (2095 kg)

5. General

5.1. The system's actual cooling capacity is defined by the combination of its airflow (mass) and static pressure rated at the rated ambient conditions. The cooling capacity (airflow, static pressure, and discharge temperature) is established at the unit's outlet.

5.2. The system shall be designed for outdoor use.

5.3. The system shall be designed for a two-year parts warranty and shall have a predicable cost for extended warranties up to and including five years. As a standard, the internal cost of warranty for this unit should be less than 1.0% of the average sales revenue for the product.

5.4. The life of the system shall be designed to withstand 10 years or 25,000 hours with an expected annual usage of a maximum 2,500 hours per year. This is a design standard only and shall not to be quoted as actual life of the unit as the unit life is highly dependent on preventative maintenance and environmental factors.

5.5. The average outdoor sound pressure level of the unit shall be 75 dBA or lower at a distance greater than 15 feet from the unit when measured in a free field environment.

5.6. Selection of the condenser fan, compressors, evaporator blower, and the unit's grilles and louvers shall be contingent on capability to achieve the required sound pressure levels.

5.7. The unit shall be designed to achieve a Mean Time Before Critical Failure of 5,000 hours (MTBCF).

5.8. The average operational availability of the units shall be designed to exceed 95% (annual).

5.9. The unit shall be designed to achieve a Mean Time to Repair (MTTR) of 2.5 hours (not including refrigerant recovery and recharge time).

5.10. Quality processes shall be in accordance with B GSE's quality management system.

6. Performance

BGAC 60 HZ	
Model Number	**Supply Airflow lb./min (kg/m)**
BGAC-023-4SH-27	75 (34)
BGAC-033-4SH-27	100 (45.3)
BGAC-023-4HH-27	75 (34)
BGAC-033-4HH-27	100 (45.3)

BGAC 50 HZ	
Model Number	**Supply Airflow lb./min (kg/m)**
BGAC-023-3SH-27	65 (29)
BGAC-033-3SH-27	90 (41)
BGAC-023-3HH-27	65 (29)
BGAC-033-3HH-27	90 (41)

60 Hz Cooling Application Data			
Model	**DB/WB**	**Cooling Capacity**	**Btu/Hr. (kW)**
BGAC-023-4SH-27	**97°F/76°F (36°C/24°C)**	**Total**	194,464 (57.6)
		Sensible	137,902 (40.4)
	112°F/70°F (44°C/21°C)	**Total**	168,860 (49.5)
		Sensible	152,048 (44.6)
BGAC-033-4SH-27	**97°F/76°F (36°C/24°C)**	**Total**	264,301 (77.5)
		Sensible	184,689 (54.1)
	112°F/70°F (44°C/21°C)	**Total**	228,721 (67.1)
		Sensible	203,673 (59.7)
BGAC-023-4HH-27	**97°F/76°F (36°C/24°C)**	**Total**	TBD
		Sensible	TBD
	130°F/71°F (54.4°C/21.6°C)	**Total**	TBD
		Sensible	TBD
BGAC-033-4HH-27	**97°F/76°F (36°C/24°C)**	**Total**	TBD
		Sensible	TBD
	130°F/71°F (54.4°C/21.6°C)	**Total**	TBD
		Sensible	TBD

50 Hz Cooling Application Data			
Model	**DB/WB**	**Cooling Capacity**	**Btu/Hr. (kW)**
BGAC-023-3SH-27	**97°F/76°F (36°C/24°C)**	**Total**	TBD
		Sensible	TBD
	112°F/70°F (44°C/21°C)	**Total**	TBD
		Sensible	TBD
BGAC-033-3SH-27	**97°F/76°F (36°C/24°C)**	**Total**	TBD
		Sensible	TBD
	112°F/70°F (44°C/21°C)	**Total**	TBD
		Sensible	TBD
BGAC-023-3HH-27	**97°F/76°F (36°C/24°C)**	**Total**	TBD
		Sensible	TBD
	130°F/71°F (54.4°C/21.6°C)	**Total**	TBD
		Sensible	TBD
BGAC-033-3HH-27	**97°F/76°F (36°C/24°C)**	**Total**	TBD
		Sensible	TBD
	130°F/71°F (54.4°C/21.6°C)	**Total**	TBD
		Sensible	TBD

7. General Construction

7.1. The unit design shall consist of a powder coated welded tubular galvanized steel frame with powder coated steel covers, doors, and grilles.
7.2. All major components must be removable via removable panels, removable grilles, or through the roof.
7.3. The base unit shall be constructed for mounting on a stationary stand or mobile cart (diesel or electric).
7.4. Parts weighing 50 pounds or more which must be removed for inspection, cleaning, or repair, shall have lifting eyes or lugs.
7.5. The unit shall discharge the condenser exhaust air vertically.
7.6. The outlet shall be an 8" ID outlet with a flanged connection.
7.7. The outlet shall contain a motorized damper to prevent supply air backdraft and airflow control.
7.8. The backdraft damper and damper motor shall be rated for the expected discharge air pressure and CAS hanger system back pressure.

8. Paint / Finish

8.1. The system frame, covers, doors, and grilles shall be powder coated as a standard RAL 9001, but options shall provide for powder coating per the customer's color requirements.
8.2. The frame, covers, doors, and grilles coating material shall provide corrosion resistance to a minimum of a 500-hour ASTM B117 salt spray test using a 5% sodium chloride solution. Immediately after completion of the test, the specimen shall show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark.
8.3. For uncoated galvanized components the cut edges of the galvanized surfaces where hot-dip galvanized sheet steel is used shall be coated with a zinc-rich coating conforming to ASTM D520, Type I.
8.4. Optional component coatings (spray on) for corrosive environments (fan blade, condenser motor, and blower motor) shall be gray urethane RAL 7001.
8.5. Optional coil coatings shall protect refrigeration coils and tubing in corrosive applications. The following coil coating options shall be available at an increased cost and lead time:

8.5.1. Aquafin®
8.5.2. Heresite®
8.5.3. Thermogaurd®
8.5.4. Blygold®
8.5.5. Electrofin®
8.5.6. Noranda Black Coated Fin Stock
8.5.7. Urethane Paint

9. Electrical System

9.1. The electrical system shall be configurable for 3 Ph. 480 VAC, 60Hz, 3 Ph. 380 VAC, 50 Hz or 3 Ph. 515 VAC, 60 Hz control power systems.

9.2. The unit shall have a single point wiring connection for the incoming power supply and a main electrical disconnect.

9.3. The unit shall have an auto reset three phase monitor which provides for protection against over/under voltage protection and phase reversal protection.

9.4. All wiring shall be protected where it passes through bulkheads.

9.5. Electrical components and installation shall be in compliance to UL and CSA requirements per UL 1995.

9.6. All electrical components in the control box shall be labeled coinciding with the electrical schematic and wiring diagram.

9.7. Wiring shall be documented such that wire routing is the same for every unit.

9.8. An evaporator blower Variable Frequency Drive (VFD) shall provide for soft starting of the evaporator blower and for supply air mass flow control.

9.9. The condenser fans shall be speed controlled to maintain an optimal head pressure set point.

10. Unit Control system

10.1. The BGAC unit shall be controlled by a standalone general use controller and have the capability to connect to a building automation system including BACnet (ARC156, MS/TP, and PTP), Modbus (RTU & ASCII), N2, and LonWorks. The controller shall have remote access support over the Internet/Intranet, or modem.

10.2. The control system shall be capable of communicating all data to a remote integrated DDC processor through a single shielded cable. The data shall include as a minimum all system operating conditions, capacity controls, trouble, and safety shutdown conditions.

10.3. Adjustable Operation Controls:

- 10.3.1. Leaving air temperature control.
- 10.3.2. Leaving air volume flow rate control.
- 10.3.3. Air pressure.
- 10.3.4. Adjustable timer or automated controls to prevent a compressor from short cycling.
- 10.3.5. Load limiting
- 10.3.6. System capacity control to adjust the unit capacity in accordance with the system load and the programmable set points. Controls shall automatically re-cycle the aircraft cooling unit on power interruption.
- 10.3.7. Startup and head pressure controls to allow system operation at all ambient temperatures down to -10°F.
- 10.3.8. Fan sequencing for air-cooled condenser.
- 10.3.9. Evaporator coil defrost control.

10.4. Monitoring Capabilities: During normal operations, the control system shall be capable of monitoring and displaying the following operating parameters. Access and operation of display shall not require opening or removing any panels or doors.
    10.4.1. Leaving air temperatures.
    10.4.2. Leaving air flow rate.
    10.4.3. Leaving air pressure.
    10.4.4. Self-diagnostic.
    10.4.5. Operation status.
    10.4.6. Operating hours.
    10.4.7. Number of starts.
    10.4.8. Compressor status (on or off).
    10.4.9. Refrigerant discharge and suction pressures.
10.5. Programmable Set points: The control system shall be capable of being reprogrammed directly at the unit. No parameters shall be capable of being changed without first entering a security access code. The programmable set points shall include the following as a minimum:
    10.5.1. Leaving Air Temperature.
    10.5.2. Leaving Air Flow Rate.
10.6. Safety Controls with Manual Reset: System shall operate CAS units in response to activation of local control panels and other system sensors to maintain preconditioned air temperatures and flow rates.
    10.6.1. High discharge air pressure.
    10.6.2. High condenser refrigerant discharge pressure protection.
    10.6.3. High motor winding temperature protection.
    10.6.4. Motor current overload and phase loss protection.
10.7. Safety Controls with Automatic Reset: Aircraft cooling unit shall be provided with the following safety controls which automatically shut down the aircraft cooling unit and which provide automatic reset.
    10.7.1. Over/under voltage protection.
    10.7.2. Phase reversal protection.
10.8. Operational Mode: Preconditioned air system shall have following modes of operation at a minimum.
    10.8.1. Quick Cool Mode:
        10.8.1.1. Quick cool mode shall quickly purge and cool the piping system by opening motorized quick cool purge valves at the end of the system and operating multiple CAS units. All valves at utility station drops shall be closed.
        10.8.1.2. When temperature sensors at end of system are satisfied, system shall switch to normal mode and quick cool purge valves shall close.
    10.8.2. Normal Mode:

10.8.2.1. System shall operate CAS units in response to activation of local control panels and other system sensors to maintain preconditioned air temperatures and flow rates.

10.8.3. Remote Alarm:

10.8.3.1. During the initiation of a safety shutdown, an aircraft cooling unit's control system shall be capable of activating a remote alarm at the direct digital controls system.

11. Electrical Control Panel

11.1. The electrical control system shall be contained in a fabricated enclosure rated for outdoor use (IP54) and the control enclosure sizes shall be configured for the largest size unit and remain common for all unit sizes.

11.2. Permanent heat-shrink labeling or adhesive backed labeling of all wiring (corresponding to the wiring diagram) shall be a standard for all models.

11.3. All applicable electrical components shall be din rail mounted.

11.4. All components shall be labeled corresponding to the wiring diagram.

11.5. Wire bundles shall be wrapped and secured.

11.6. The units control box shall be powder coated pure white, RAL 9001, per B GSE's Paint Specification Procedure.

12. Local Controls

12.1. Each connection point in the preconditioned air system shall have a local control panel. Local control panels shall be wired to control valve and to a master control panel.

12.2. Panels shall have emergency stop, stop, and start buttons.

12.3. Panels shall have green light when in operation, red light when stopped and yellow light when system is in alarm.

13. Inlet Air Filter

13.1. The BGAC unit shall be configured for a minimum of 1" thick filter material and have provisions for an option for 2" thick filter material.

13.2. The supply air filter shall be at minimum a single stage MERV 5 rated and washable.

13.3. The inlet and inlet filter arrangement shall not impose a pressure drop of more than 1" H2O with a clean filter.

14. Refrigeration System

14.1. The refrigerant system shall be configured for R-410a as standard, with R-134a as an option for high ambient conditions. Provisions for both refrigerants and refrigerant components shall be made in the unit frame without modification.

14.2. The refrigeration system shall be constructed of Type ACR (or greater) refrigeration grade piping per ASTM B280.
14.3. The refrigeration system shall be constructed to avoid the use of vibration absorbers by using copper tube U bends on the discharge line of the compressor
14.4. The refrigeration system piping shall be sized to allow for adequate oil return to the crankcase of the compressor and not impose excessive pressure drop.
14.5. The refrigeration system shall be designed that no part or portion of the copper tubing contacts another metal part.
14.6. The internal/enclosed refrigeration system shall be designed such that any straight section of pipe longer than 30 inches is supported by a rubber lined clamp.
14.7. The refrigeration system shall be designed to accommodate 1/2" insulation on the suction line from the exit of the evaporator to the suction line inlet of the compressor.
14.8. The refrigeration systems thermal expansion valve shall be a mechanical valve and incorporate provisions for an electronic hot gas bypass valve.
14.9. The refrigeration system shall use pre-bent tube where possible to eliminate solder joints and all solder joints shall use a 15% AG sliver solder or DYNAFLOW® PhosCopper Brazing Alloy. During soldering, the joint shall be purged with nitrogen.
14.10. The refrigeration system shall NOT incorporate the use of short elbows.
14.11. The refrigeration system shall contain ¼" access valves (Schrader type) in the suction line (3 each), discharge line (2 each), and liquid line (2 each) for switches, transducers, and servicing.
14.12. The refrigeration system shall have type T thermocouples permanently attached for factory testing and field evaluation of refrigerant charge levels.
14.13. The refrigeration system shall contain manual reset high discharge pressure switches and auto reset low refrigerant pressure switches for compressor protection and a time delay to prevent compressor short cycling. The suction pressure switch may be substituted by a transducer with the system controller providing means for the low suction compressor protection and time delay.
14.14. Each refrigeration system shall contain a means of capacity reduction through one of the following methods:
    14.14.1. An electronic stepper motor controlled hot gas bypass valve controlled by a stepper motor interface board (IB). Input signals to the IB shall be from a suction line mounted pressure transducer or from the systems controller.
    14.14.2. VFD compressor (s)
    14.14.3. Digital scroll compressor(s)

15. Evaporator Blower

15.1. The unit shall be configured with a single-stage belt driven centrifugal high-pressure blower.

15.2. The blower's drive system shall be a micro-groove, multi-ribbed belt with a dual-bearing backside automatic tensioner.
15.3. The blower shall have an integral cooling system for the belt, tensioner/idler, and spindle.
15.4. The spindle assembly shall be permanently lubed using ABEC 9 precision bearings.
15.5. Inlet connection shall be 5 inches and discharge shall be 3.5 inches.
15.6. The evaporator blower configuration shall be such that outside air is drawn across one evaporator coil and discharged into another evaporator.
15.7. The performance of the evaporator blower shall meet the performance requirements at the exit of the unit (with losses due to the duct or hose not included).
15.8. The pressure blower's motor shall be:
    15.8.1. NEMA Premium efficiency, TEFC, severe duty motor rated for use with a VFD or "VFD ready"
    15.8.2. A motor with a minimum of a 1.15 service factor.
    15.8.3. A motor with grease-able bearings with a grease relief outside the enclosure.

16. Evaporator Coil

16.1. The evaporator coil shall be sized for a maximum velocity of 450 fpm to prevent water entrainment in the conditioned air.
16.2. The evaporator coil envelope for each system size shall be sized for the largest unit capacity.
16.3. The evaporator coil envelope shall be sized for R-410a refrigerant and configured for R-134a in the same envelope (with a reduction in capacity) for extreme high ambient applications.
16.4. The evaporator coil distribution tubes shall be insulated with rigid polyurethane foam, minimum of 2 lbs/ft^3 density, minimum of 90 percent closed cell, CFC-free, with a maximum K-factor of 0.14 at 75 degrees F per ASTM C518 and a minimum compressive strength of 30 PSI.
16.5. The downstream evaporator coil's hair pins and return bends shall be sealed using epoxy to prevent air losses.

17. Condensate Drain

17.1. The condensate shall drain to a field installed drainage system via a flexible plastic pipe connection at the rear (outside) of the unit.
17.2. No condensate shall drip from any part of the unit except the drain during or after operation.
17.3. Condensate from the upstream plenum shall be controlled by a shut off valve to prevent excessive air pressure loss

18. Condenser Coil

18.1. The condenser coil shall be sized for a maximum velocity of 900 ft/min.

18.2. The condenser coil envelope shall be sized for the largest unit capacity and then configurable to accommodate smaller capacity coils using the same envelope.

18.3. The condenser coil envelope shall be sized for the largest size required for R-410a refrigerant with R-134a as optional for an extreme high ambient requirement.

19. Condenser Fan

19.1. The condenser fans shall be direct-driven axial fans constructed according to the following:

19.1.1. The fan blades shall be an aerodynamic-optimized sickle-blade profile design patterned with a serrated trailing edge and winglets on the outer edge for energy and noise-optimized operation.

19.1.2. The drive motor shall be an external rotor motor rated with an IP54 protection class and rated for the required airflow and static pressure.

19.1.3. The motor shall have maintenance-free ball bearings sealed on both sides with long-term lubrication.

19.1.4. The fan assembly shall be rated for vertical up mounting and rated for an ambient temperature range of -31°F to 158°F

19.1.5. The fan motor and blade shall be mounted in a sturdy mounting frame and protected by grilles on the discharge side.

19.1.6. The fan assembly shall be factory balanced to prevent vibration.

20. Structural Base (Optional)

20.1. The unit shall fit to an optional structural galvanized or stainless-steel base (welded or bolted) or support legs.

20.2. The structural base individual components shall be isolated from the building structure by means of vibration isolators with published load ratings.

20.3. Vibration isolators shall have isolation characteristics as recommended by the manufacturer for the unit supplied and the service intended.

21. Unit Labeling

21.1. Each B GSE BGAC unit shall be fitted with a permanent ratings plate.

21.2. The BGAC BGAC unit shall have stick on labeling indicating appropriate warnings and cautions per UL1995 and UL 969.

21.3. The BGAC shall have stick on labeling appropriate for branding and commercial markings per UL 969.

21.4. For units manufactured in accordance with a third party listing, the data tag shall bear the listing bodies marking in the negative space to the lower right of the information at the bottom.

22. Manuals/Training

22.1. A manual will be supplied with each unit and shall contain:
- 22.1.1. Installation instructions
- 22.1.2. Operation instructions
- 22.1.3. Maintenance guidelines

22.2. Manual shall be accompanied by
- 22.2.1. System wiring diagrams
- 22.2.2. Spare Parts List

22.3. Training documentation shall be developed and include:
- 22.3.1. Operator Training
- 22.3.2. Maintenance Training

23. Testing

23.1. Each unit model will have the following tests:
- 23.1.1. First Article Test Plan
  - 23.1.1.1. Specification compliance test plan
  - 23.1.1.2. This test plan demonstrates the models compliance to the unit specification.
- 23.1.2. Summary of the specification compliance test results
  - 23.1.2.1. This summary summarizes the models test results.

23.2. Production Test Plan
- 23.2.1. Production Test Plan
  - 23.2.1.1. This production test plan is a shortened plan which will be used on each unit produced.
- 23.2.2. Production Test Results
  - 23.2.2.1. The results of each production test are record and filed as a permanent record demonstrating the unit is produced and performs according to the design.