2945 Washington Ave. St. Louis, MO 63103
877-783-6774 | sales@darwinchambers.com
www.darwinchambers.com

Dear Valued Prospect,

I am writing on behalf of Darwin Chambers Company, LLC, to introduce you to our quality product, our customer-centric philosophy, and our highly-qualified team. We are industry-leading innovators, specializing in critical stability applications as well as standard GMP storage and unique or custom environmental control solutions. With over 12 years of being in business and over 500 completed installations, we are often called upon to provide basis- of-design drawings and documentation, and look forward to the opportunity to earn your business.

We provide and service a wide variety of environmental chambers including warm rooms/incubators, dry or moist rooms, plant growth chambers, pharmaceutical stability rooms, and cold rooms/freezers. Not to mention, all of our products are designed, manufactured, and installed by direct employees, with an acute understanding of the needs of the industry. Our products are all guaranteed and we can export to locations around the globe.

Why use Darwin Chambers? In addition to over a decade of experience in providing rooms of varied complexity, we have perfected highly efficient, eco-friendly technologies and systems. Many of our methods remain vastly superior in performance, unmatched by our competitors. Moreover, we offer:

- A dedicated, internal Service Department, providing full calibration and validation services.
- An industry-leading seven-year warranty on our thermoelectric system for reach in's.
- Entire cooling systems can be installed and replaced, quickly, with simple tools - no refrigeration tools or certified technicians necessary.
- Exceptional temperature and humidity control due to proportional microprocessor control.
- A Precious Fluid Temperature Control Unit (PFTCU) is a proprietary indirect cooling system for walk in's. It utilizes a combination of refrigeration technologies, propylene, glycol/water heat exchange technologies, and the latest temperature control methods in order to out preform conventional refrigeration systems.
- Available extended warranty and preventive maintenance agreements, to most locations within the contiguous USA.
- Free 24/7 technical support via phone or e-mail, throughout the lifetime of your Darwin Chambers product.
- Skilled, knowledgeable staff, to ensure that we ask the right questions, and have a complete understanding of our customer's needs as well as all other regulations, requirements, and project considerations and constraints.
- Flexibility and an expert engineering/design team, to provide innovative and highly customized solutions, in addition to our standard product.
- "Elegant" design. We have the capability to offer the best operational fit for your specific requirements—while typically providing systems that are the most efficient, sustainable, and competitively priced, as well.

If you have any questions or would like to learn more about what we do, please contact our sales department. We look forward to the opportunity to work with you in the future, and thank you for your consideration.

Regards,

Krissie McGrath
Darwin Chambers Co.
Phone/Fax 1-877-783-6774
sales@darwinchambers.com

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TABLE OF CONTENTS

CORPORATE OFFICE
2945 WASHINGTON AVENUE
ST. LOUIS, MISSOURI 63103-1305

2945 Washington Ave. St. Louis, MO 63103
877-783-6774 | sales@darwinchambers.com
www.darwinchambers.com

CAPABILITY STATEMENT

Core Competencies

Darwin Chambers Company is a manufacturer of custom controlled environmental chambers. We provide cutting edge products and services, all guaranteed. Below are lists of our offered products and services.

Products

- Walk-in, Reach-in and Portable style chambers
- FDA / ICH / GMP Stability Test Chambers
- Freezer / Cold Room Chambers
- Incubator / Warm Room Chambers
- Insect Rearing Chambers
- Plant Growth Chambers
- Renovations / Retrofits
- Custom Design
- Ready Made Transportable Concrete Testing Rooms

Past Performance

- Pharmaceutical Industries
- Universities / Researchers
- Biochemistry / Biotechnology
- Science / Medicine Industries

Company Data

- Established in 2003
- Manufacturer of Lab Equipment
- Employees 50+ / Revenue $5-10 million

Bonding Level: $2,000,000.00

EMR: 0.78

Services

- Calibration
- Validation
- Preventative Maintenance
- 24/7 Tech Support

Differentiators

- Unlimited Customization Options
- Leasing Options Available
- 24/7 Technical Support
- Renovations / Retrofits

Registered with SBA, SAM.gov LLC, Missouri S-Corporation

CAGE: 33PX5

DUNS: 141855614

EIN: 43-1990229

NAIC: 238390, 333415, 334513, 423390, 334512

PSC / FSC: 6640, 6636, 6685, 3694

CSI:

Division 11	Equipment
Division 12	Furnishings
Division 13	Special Construction
Division 23	Heating, Ventilating and Air Conditioning

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REFERENCES

Alcami (Celsis Labs)
6200 South Lindbergh Blvd.
St. Louis, MO 63123
Phone: 314-487-6776, ext.146
Contact: Dave Reprogle

Scisafe
2540 Route 130, Cranbury, NJ
Phone: 866-980-8555
Contact: Garrie Richardson
ger@scisafe.com

Jubilant/Hollister Stier
3525 North Regal Street
Spokane, WA 99207
Phone: 210-558-1880
Contact: Mr. James Foss
James_Foss@hollister-site.com

Valeant Pharmaceutical International Inc.
100 Lifesciences Pkwy.
Steinbach, MB R5G 1Z7 Canada
Phone: 763-593-3409
Contact: Dale Robinson

Keytronic
US & Juarez Mexico
Phone: 509-535-4228
Contact: David Nixon
dnixon@keytronicems.com

Ricerca
7528 Auburn Rd
Concord OH, 44077
Phone: 440-357-3456
Contact: Robert Katona
robert.katona@ricerca.com

University of California, Davis
1 Shields Ave. Davis, CA 95616
Phone: 530-752-2592
Contact: Dr. Shirley Luckhart
sluckhart@ucdavis.edu

Cephazone Pharma
250 East Bonita Ave.
Pomona, CA 91767
Phone: 909-392-8900 Contact: Steve Anderson
bigsteve4x42006@yahoo.com

Supernus Pharmaceutical Inc.
1550 E. Gude Dr.
Rockville, MD
Phone: 301-424-2576
Contact: Samii Salar
ssamii@supernus.com

Astellas Pharma Technologies
3300 Marshall Ave.
Norman, OK 73072
Phone: 405-217-6400
Contact: Jo Fleming

Alkem Labratories
1733 Gilsinn Ln.
Fenton, MO 63026
Phone: 636-343-5306, ext. 2512
Contact: Angela Sutterer

US Geographic Services, Columbia, MO/ BlueScope Construction
1540 Genesee St.
Kansas City, MO 64155
Phone: 781-981-5500
Contact: Dan Bieker
dfbieker@bluescopeconstruction.com

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HISTORY OF THE FIRM

Year of Incorporation: 2003 **Corporate Charter:** 18435581 (MO) **Business Type:** Manufacturer **Number of Employees:** 66+

Owners

Chris Barnett
Kevin Barnett

Project Contact Information

Construction Project Managers:
Chris Barnett | Years of Experience: 20 Years
Brian Kopac | Years of Experience: 5 Years | 636-393-9795 | brian.kopac@darwinchambers.com
Matt Husmann | Years of Experience: 19 Years | 314-534-3111 x 212 matt.husmann@darwinchambers.com

Construction Project Coordinator:
Lexis Hardney | Years of Experience: 1 Year | 314-534-3111 x 213 | lexis.hardney@darwinchambers.com

Technical Managers:
Rick Sherman | Years of Experience: 9 Years | 314-534-3111 | ricky.sherman@darwinchambers.com

Technical Engineers:
Muthaian Sethu | Years of Experience: 8 Years | 314-534-3111 x 206 | muthaian.sethu@darwinchambers.com
Fred McEntee | Years of Experience: 7 Years | 314-534-3111 x 217 | fred.mcentee@darwinchambers.com

Sales Managers:
Reach-In | Andrew Heil | Years of Experience: 5 Years | 314-534-3111 x 209 | andrew.heil@darwinchambers.com
Walk-In | Mary Green | Years of Experience: 4 Years | 314-534-3111 x 205 | mary.green@darwinchambers.com

Director of Sales/Marketing:
Krissie McGrath | Years of Experience: 25 Years | 314-534-3111 x 215 | krissie.mcgrath@darwinchambers.com

Comptroller:
Rob Kelch | Years of Experience: 12 Years | 314-534-3111 x 201 | rob.kelch@darwinchambers.com

Office Manager:
Theresa Deemer | Years of Experience: 15 Years | 314-534-3111 x 204 | theresa.deemer@darwinchambers.com

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SECTION

TECHNICAL DRAWINGS

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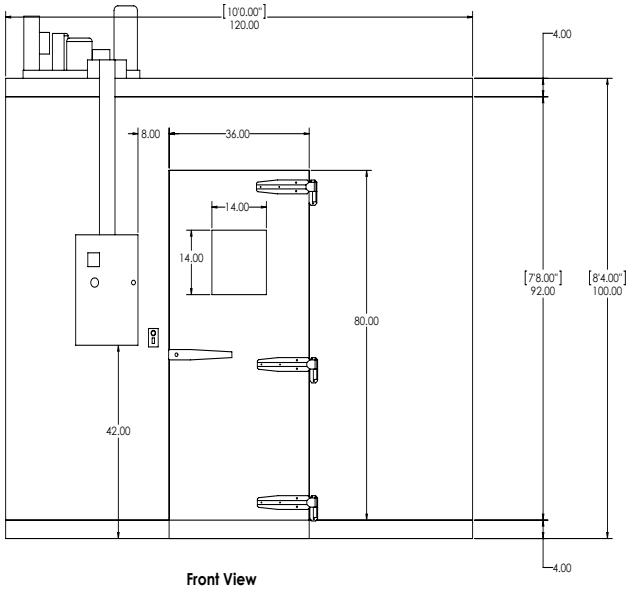
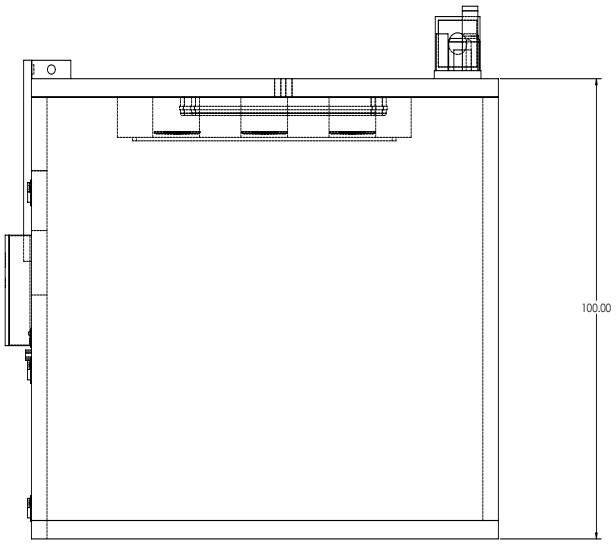
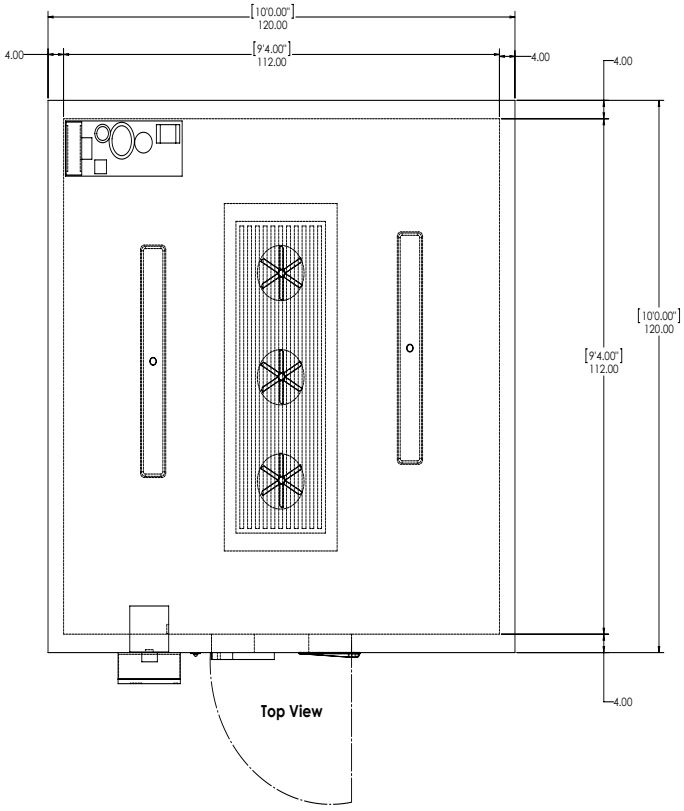


Front View





Top View

Item	Details
Exterior Material	Embossed White Galv.
Interior Material	Embossed White Alum.
Door Details	Door Dimension 36" x 80"
View Port Details	14" x 14"
Ramp Details	No Ramp
Other Notes	

WALKIN ROOM - TEMP ONLY

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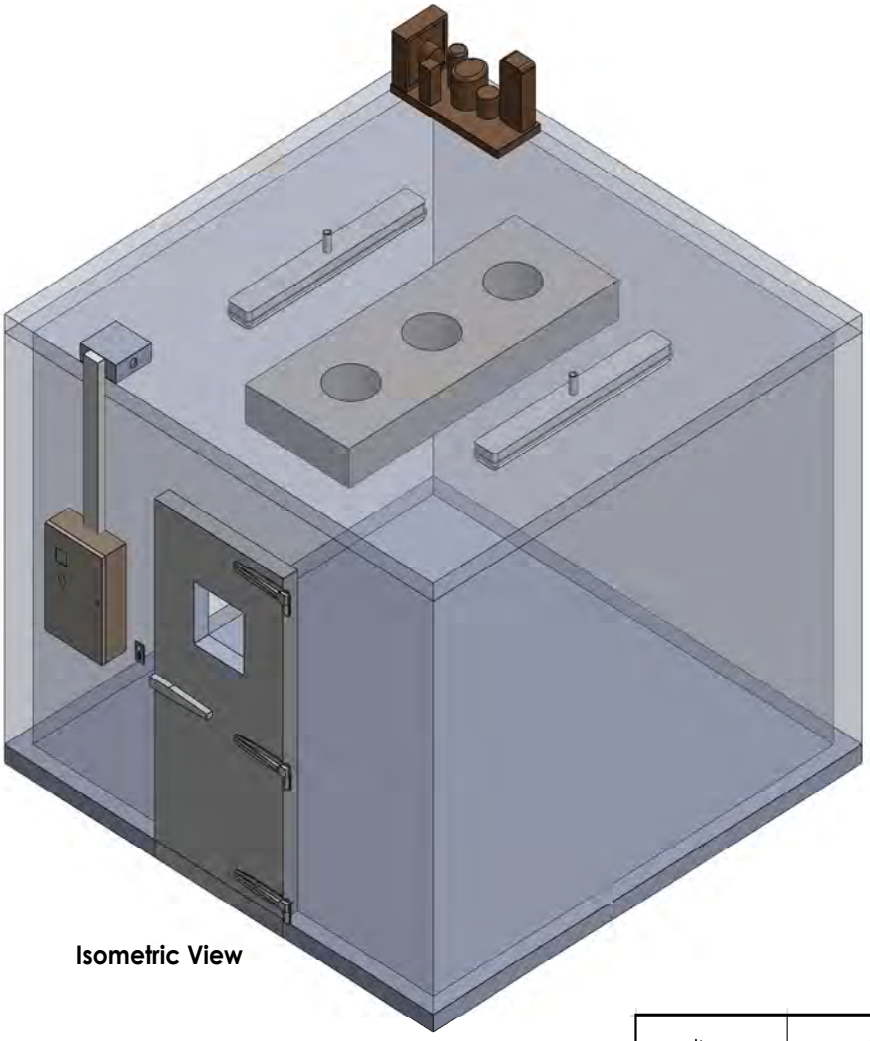

Isometric View

WALKIN ROOM - TEMP ONLY

Item	Details
Exterior Material	Embossed White Galv.
Interior Material	Embossed White Alum.
Door Details	Door Dimension 36" x 80"
View Port Details	14" x 14"
Ramp Details	No Ramp
Other Notes	

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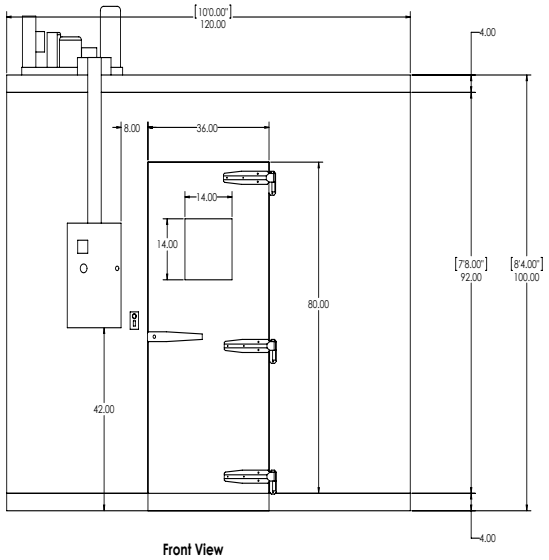
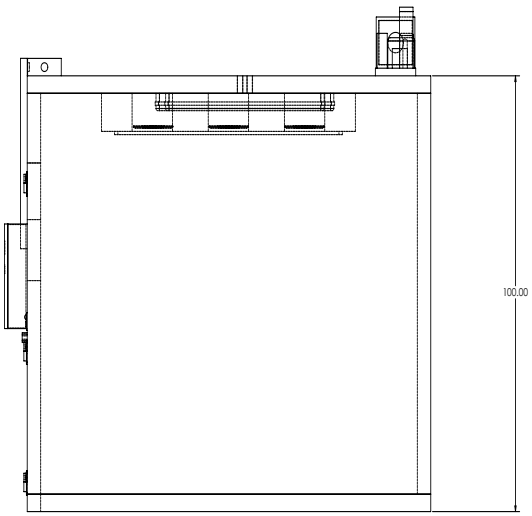
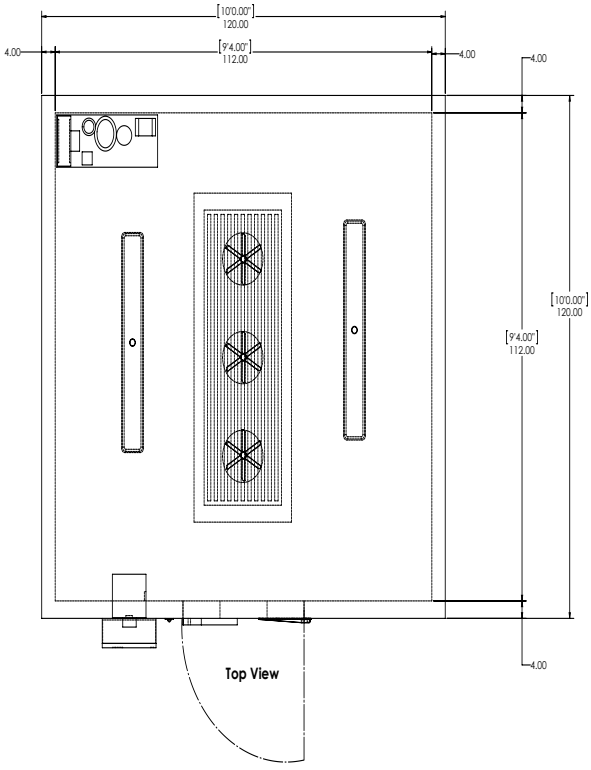


Front View





Top View

Item	Details
Exterior Material	Embossed White Galv.
Interior Material	Embossed White Alum.
Door Details	Door Dimension 36" x 80"
View Port Details	14" x 14"
Ramp Details	2' x 3' INTERNAL Ramp
Other Notes	

WALKIN ROOM - TEMP ONLY

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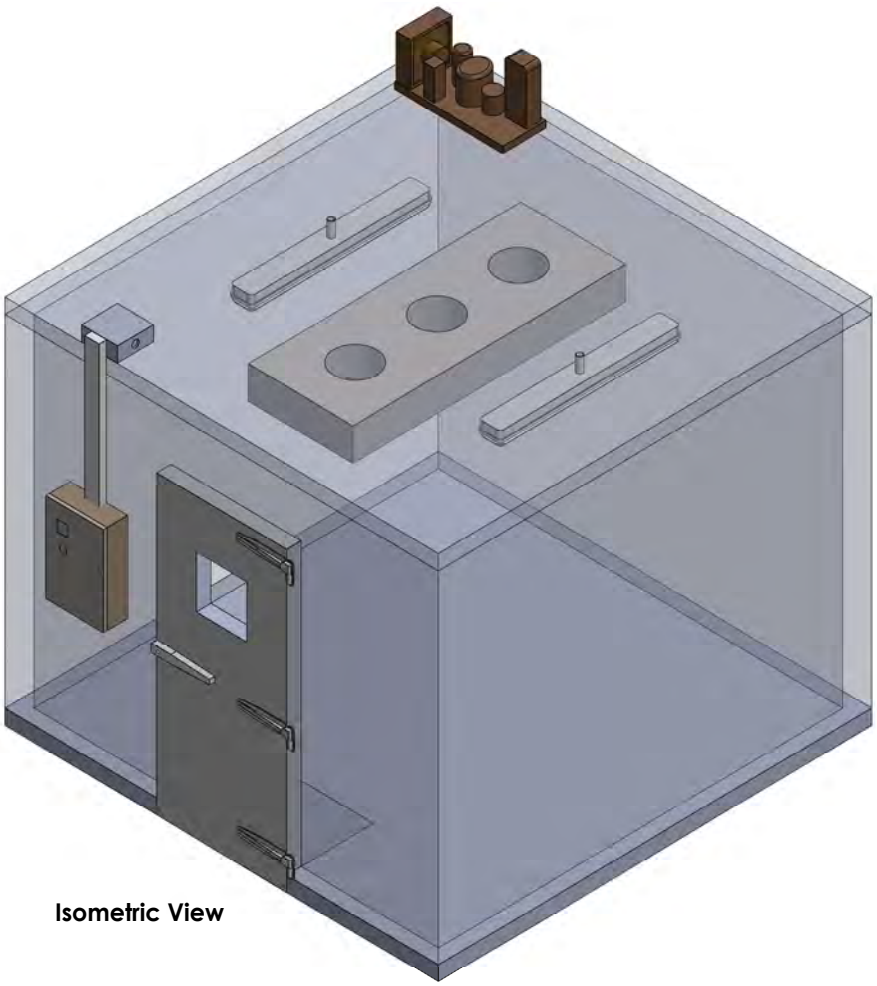

Isometric View

WALKIN ROOM - TEMP ONLY
WITH INTERNAL RAMP

Item	Details
Exterior Material	Embossed White Galv.
Interior Material	Embossed White Alum.
Door Details	Door Dimension 36" x 80"
View Port Details	14" x 14"
Ramp Details	2' x 3' INTERNAL Ramp
Other Notes	

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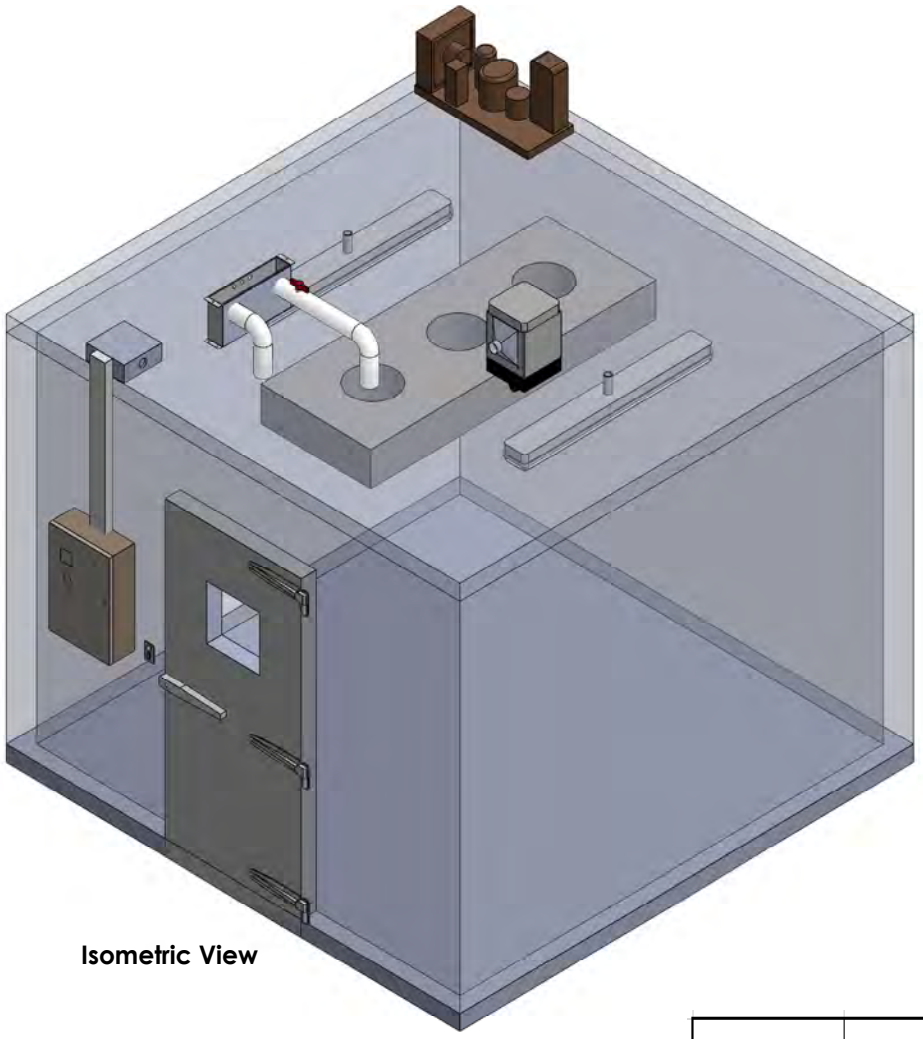

Isometric View

WALKIN ROOM - TEMP AND RH WITH DRYER

Item	Details
Exterior Material	Embossed White Galv.
Interior Material	Embossed White Alum.
Door Details	Door Dimension 36" x 80"
View Port Details	14" x 14"
Ramp Details	No Ramp
Other Notes	

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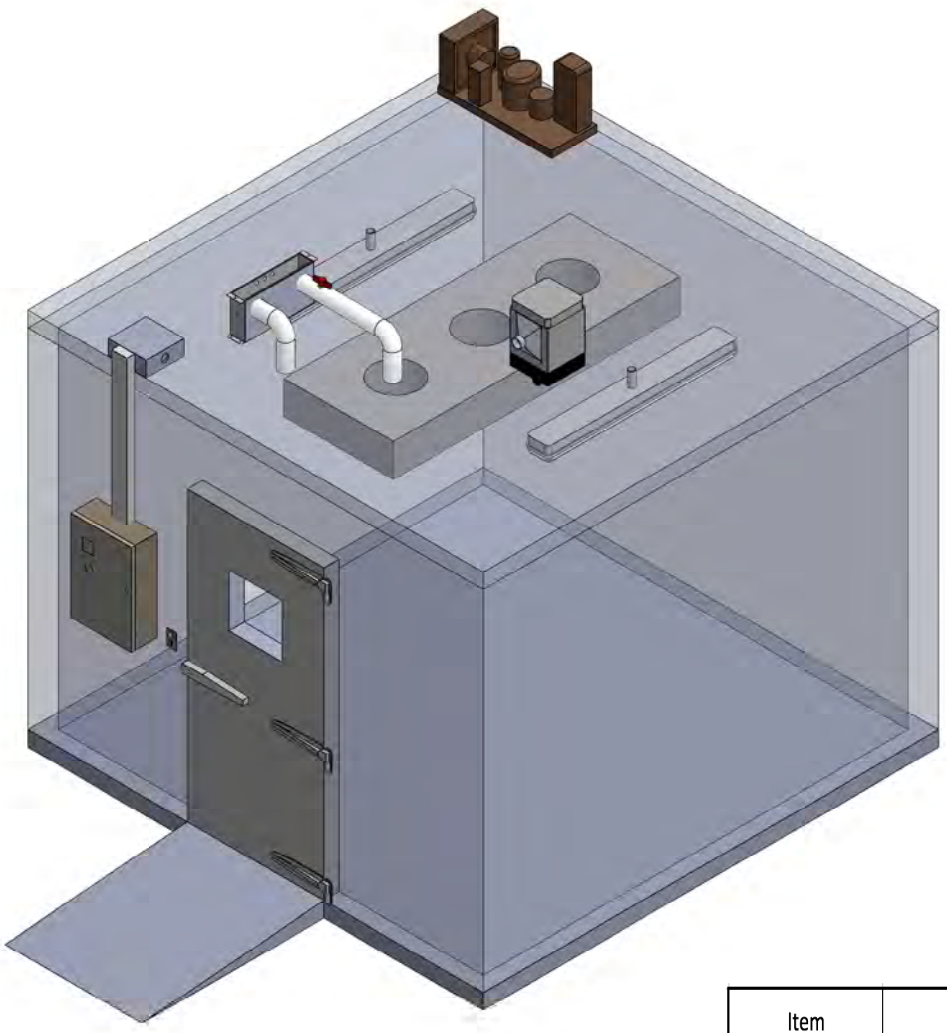

Isometric View

WALKIN ROOM - TEMP AND RH WITH DRYER , EXTERNAL ADA RAMP

Item	Details
Exterior Material	Embossed White Galv.
Interior Material	Embossed White Alum.
Door Details	Door Dimension 36" x 80"
View Port Details	14" x 14"
Ramp Details	3' x 4' External Ramp
Other Notes	

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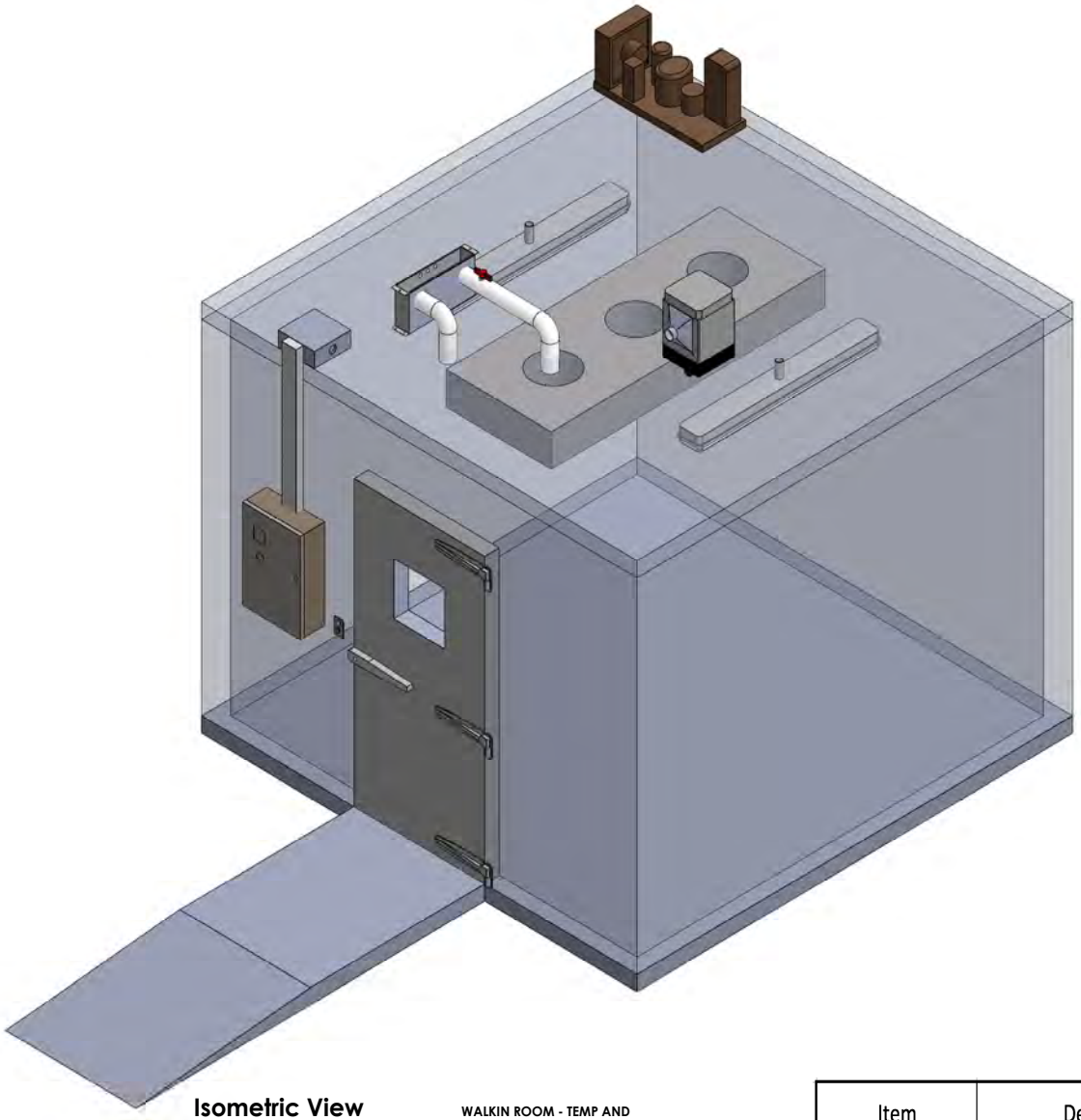

Isometric View

WALKIN ROOM - TEMP AND RH WITH DRYER , EXTERNAL ADA RAMP WITH LANDING

Item	Details
Exterior Material	Embossed White Galv.
Interior Material	Embossed White Alum.
Door Details	Door Dimension 36" x 80"
View Port Details	14" x 14"
Ramp Details	3' x 4' External Ramp
Other Notes	

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SECTION I

ENVIRONMENTAL ROOMS-GENERAL INFORMATION

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ENVIRONMENTAL ROOMS

Darwin Chambers Company designs, manufactures, installs, and services custom chambers of all types and sizes, for a wide array of applications, including: GMP Shelf-Life Testing and Storage, Dry/Moist and Cold Storage for Seed and Agricultural Products, Nutritional Supplements, General Materials Testing, Mold and Fungal Incubation, Photography Storage, Compliant Vivariums (NIH, ALAAC, OLAW, USDA, etc.), more. We have pioneered a number of innovative, resource-saving technologies, from thermoelectric and liquid-circuited cooling systems to ultrasonic humidification. When custom solutions are required, our engineers have the training and experience to ensure that optimal performance does not sacrifice energy efficiency. Temperatures available down to -30° C and up to +60° C, as well as humidity as low as 5% RH and up 95% RH.

Benefits

- Optional on-site validation services that have included multi-point temperature and humidity mapping have repeatedly proven nearly unbelievable uniformity and control results that far surpass FDA/ICH/GMP guidelines.
- Customizable plans, in addition to extensive warranty coverage.
- All rooms are produced with microprocessor controls, high/low alarms, and exceptionally accurate temperature/humidity control.
- No steam boilers used to avoid corrosion over time.
- ADA compliance available with no additional cost to the customer.
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.

Plug and Play

Most conditioning systems can be replaced very quickly in the future due to simple water-type connections. This ease of installation/removal also allows for greatly simplified future relocation.

Reliable & Little Down Time

On many of our systems, our cooling and heating package can be swapped out with a new unit, if ever needed, in minutes rather than the days (or weeks) needed to fix a conventional system. In addition to the time benefits, non-certified technicians can perform the above equipment swap, in contrast to conventional systems that require certified refrigeration technicians.

Easy Redundancy

Our rooms that include an optional redundant refrigeration system allow uninterrupted operation upon a refrigeration failure. The room does not need to be taken out of service during repair, as the failed system can be isolated and serviced with no impact upon the chamber operation.

Standard Features

- 4" to 6" Polyurethane Foam Insulated Panels, R- Value 31+ or Higher
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature And Humidity Uniformity
- Temperature Control At Sensor / Set-Point: ±0.2° C
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Energy Efficient Offering Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- Corrosive Resistant Equipment
- Precision Sizing
- Diurnal Cycling Temperature

Optional Features

- Added Dehumidification and/or Ultrasonic Humidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning system
- Data Logging
- Water-Cooled Or Air-Cooled Condensers
- Custom Lighting Systems
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touchscreen Control Interface

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

DARWIN CHAMBERS

DESIGN SPECIFICATION

CONTROLLED ENVIRONMENT ROOMS

SECTION ONE • GENERAL INFORMATION

1.0 SCOPE OF WORK

1.1 General Provisions

1.1.1 Controlled Environmental Rooms (referred to as "CER's" or "chambers") shall be prefabricated, all metal clad construction; to be furnished and installed as a complete self-contained unit and system, including all essential plenums, mechanical equipment, controls, and all other equipment necessary to maintain the environmental conditions specified.

1.1.2 Factory-trained technicians will deliver chamber components to their final location and complete assembly of chambers in place.

1.1.3 The Controlled Environmental Room Provider (referred to as the "Manufacturer") will furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices that comprise an integral part of each chamber.

1.1.4 Start-up and field testing of chambers will be performed by Manufacturer's trained technicians.

1.1.5 Supportive documentation and training shall be supplied by Manufacturer as specified.

1.1.6 Additional services will be provided, as applicable, as documented and agreed by contract or formal service agreement.

1.1.7 All major components are assembled and factory tested prior to delivery, including air handlers, condensers, and control panels. Documentation of factory testing will be available to owner or architect upon request.

2.0 QUALITY ASSURANCE

2.1 Reference Standards

2.1.1 All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers or air-cooled condensers, humidification/dehumidification equipment, and control panel assemblies.

2.1.2 The latest published edition and applicable addenda of each reference apply:

- ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems
- ANSI/ASHRAE Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings.
- /AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery
- Unit Coolers for Refrigeration
- ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement

- Refrigerant Compressors and Compressor Units

ANSI - B9.1 Safety Code for Mechanical Refrigeration
UL–723 Test for Surface Burning Characteristics of Building Materials.
NFPA - 70 National Electric Code.
NFPA - 79 Electrical Standard for Industrial Machinery.

2.1.3 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

- All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration per ASTM E-283.
- Foam insulation is to be of a non-flammable, non-flame supporting grade with a "K" value of 0.118 BTU I hour I foot squared I degrees Fahrenheit I inch in accordance with ASTM C518.
- Insulation shall have a minimum 97% closed cell structure and "R" factor shall be 31 or greater in a thickness of 4 inches – values in accordance with ASTM C-236IC-1363 methods. Freezer panels (ceilings and walls) to have an "R" value of 38 or greater, and shall be provided in 4" or 5" thicknesses.

2.2 Manufacturer Qualifications

2.2.1 Manufacturer shall have had not less than ten (10) years of successful and regular production of componentsIequipment used for the Project.

2.2.2 Manufacturer of CER systems shall have been in satisfactory operation on at least 50 similar installations for not less than five (5) years.

2.2.3 Manufacturer shall be capable of providing service with a 12-hour notification during normal business hours Monday-Friday. After-hours and weekend response time shall be a maximum of 24 hours upon notification.

2.2.4 Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the ArchitectIEngr. does not have to expend unnecessary time during evaluation.

2.2.5 The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. Additionally, the enclosure must be NSF-approved.

2.2.6 Manufacturer shall inventory factory parts (or a fully compatible upgrade) for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in direct employ, to assure the Owner of reliable service.

2.3 Accepted Manufacturers

2.3.1 Basis of design: Darwin Chambers Company, LLC—St. Louis, Missouri—877-783-6774

2.3.2 Other, in demonstrated compliance with the qualifications set forth within this document.

2.4 Warranty

2.4.1 As applicable, mechanical refrigeration equipment, parts, and labor will be guaranteed in written form for a minimum period of one year from the date of chamber start-up and continuous normal operation. The warranty will guarantee that the chamber(s) will:

- Maintain within the specified tolerance, the selected temperature and/or relative humidity levels.
- Be free from condensate on the outside of the chamber.
- Be free from defects due to faulty materials or workmanship.
- All Parts and labor will be guaranteed in written form from the date of chamber start-up and continuous normal operation, or upon Owner acceptance of certifications and functional test results, whichever is first.

2.4.2 Additionally, written warranties shall be provided covering defects in material, workmanship and performance for the following items, per the following schedule:

- Enclosures: Minimum ten-year warranty covering all items connected with the enclosure, including panels, doors and door hardware.
- As applicable, Compressor(s), Control Panel: Standard three to five-year warranty.

2.5 Installation/Training

2.5.1 Manufacturer will provide highly skilled, factory-trained personnel to perform and oversee installation of chamber enclosure and all components.

2.5.2 Services of a factory-trained technician will be made available for one man-day, minimum, to tune controls and instruct the owner on proper usage and care.

2.6 Testing

2.6.1 An inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with.

2.6.2 Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.0 PRODUCT DATA

3.1 Room Schedule/Operation

Environmental Room, designation #_____
Chamber Operation:

Chamber temperature range: _____ C, _____ C (throughout storage area)

Operational set-point: _____ C.

Chamber humidity range (as applicable): _____%RH, ±_____%RH

Operational set-point: _____%RH.

Chamber size, exterior (actual):_____W x _____L x _____H

3.2 Submittals

3.2.1 Shop Drawings shall be supplied prior to the commencement of manufacture.

3.2.2 Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The Drawings shall include enclosure layout, elevations, dimensions, thicknesses, types and locations of connections and openings, and other pertinent construction and erection details including the routing and diameter of refrigeration tubing and coil condensate drain.

3.2.3 Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (duct, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.

3.2.4 Indicate performance requirements, which include, as a minimum, cooling and heating parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.

3.2.5 Functional Performance Test/Report

- Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.2.6 Operations Manual

- A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics. The data shall include, but is not limited to the following:

  Shop drawings and wiring diagrams
  System components and parts descriptions
  Operating sequences, procedures, instructions, and/or theory of operation
  Specific maintenance and troubleshooting instructions
  Recommended service schedule. Include maintenance schedules for each component part of the systems furnished in this section. Include information on frequency of, and detailed instruction for, maintenance procedures and all items required for each maintenance activity
  Recommended spare parts inventory
  Name and contact information for service provider
  Warranty; to be provided in written form upon delivery, for each chamber

3.3 Delivery, Storage, and Handling

3.3.1 Compliance with recommendations (from point of manufacture) regarding handling and storage of all environmental chamber components before and during construction is mandatory.

3.3.2 Manufacturer shall coordinate with other trades affecting, or affected by this work, to assure the steady progress of all work performed under the contract.

3.3.3 Manufacturer shall replace any panels or components damaged during shipment, storage, or handling with new, identical, factory-supplied components.

SECTION TWO • CONSTRUCTION AND DESIGN

4.0 MATERIAL CONSTRUCTION

4.1 General

4.1.1 Rooms will be furnished as complete functional units with all essential components, piping, control systems, and complete conditioning systems as required in order to satisfy all environmental conditions as specified.

- The CER will be delivered in sections designed to pass without interference through standard doorways.
- All metal and other materials will be shaped and sized as required, with all angles sharp and true. All surfaces will be finished smooth. Punching and shearing will be neatly done. Permanent connections will be welded, riveted, or bolted, with all exposed welds ground smooth and flush with adjacent surfaces.

4.2 Panel Construction

4.2.1 Standard wall panels shall be nominal 4’ in width and 4” thick, designed to be interchangeable.

4.2.2 Corner panels shall be 90X angles with actual 12" exterior horizontal measurements. Nominal 1' and 3' panels shall be used if required to meet job site conditions, and all are gauged for uniformity in size.

4.2.3 Edges of panels shall be tongue and groove with locking facilities foamed-in-place at time of fabrication. Rigidity and uniformity shall meet or exceed industry accepted standards and panel interior construction shall be fabricated to deter biodegradation and moisture retention. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.

- Panel Surfaces: (Standard) nterior, white embossed aluminum. Exterior, white embossed galvanized steel. 304 stainless steel and other surfaces are available.
- Panel locking assemblies shall be accomplished by foamed-in-place locking assemblies.
- Panels are all 100% poured-in-place polyurethane construction, min. R-Value 31+.

4.3 Floor Construction

4.3.1 Rooms may be provided with or without floor panels.

4.3.2 Wall panels will be flat bottom and secured to floor on 24" centers.

4.3.3 f floorless, CER shall be installed on customer-provided recessed slab.

4.3.4 Vinyl screeds shall be utilized coved on both sides, to rest level with the floor.

4.3.5 nsulated floors shall be similar in construction to wall and ceiling panels. Standard floors are designed to accommodate up to 600 lbs. per square foot of evenly distributed weight.

4.3.6 Floor depth shall be a nominal 4 inches. (2" depth is available, where required).

4.3.7 Additional reinforcement of floor panels shall be used as required. Added reinforcement and/or insulation may add to depth, and are provided as custom. Standard floor surface finishes include smooth aluminum or 300 Series stainless steel. Other finishes, textures, coatings, and coverings are available upon request.

4.4 Ceiling Construction

4.4.1 The ceiling will be an industry standard CER type; smooth interior surface finish to match adjacent interior wall panels. LEED EBOM-friendly ceiling structure will be free of unnecessary crevices and obstructions. Where required, support hangers or other reinforcements may be utilized in order to ensure structural integrity. Construction of ceiling will be adequate to support top-mounted mechanical equipment and personnel.

4.5 Door Construction

4.5.1 The door will be an in-fitting, swinging, flush-mounted type, and will have the same metal finish and insulation as adjacent walls. A thermoplastic gasket with a magnetic core will be mounted on the top edge and along both sides of the door that will keep the door closed and form a tight seal. Door gaskets shall be NSF-approved. Construction of door panel will include a welded heavy-duty "U" channel-type reinforced steel frame around the entire perimeter of the door opening to prevent rocking or twisting.

- Standard size 36" W x 80" H. (Most custom sizes/types available upon request.)
- Anti-condensate heater wires shall be concealed behind the metal edge of the doorjamb on all four sides.
- Heaters will be connected to a temperature switch or controller to automatically provide sufficient heat to eliminate condensation and frost under various ambient humidity conditions.
- The door will use a minimum of two cam-lift, self-closing hinges. The door latch will be designed to open the door easily by breaking the magnetic force of the door gasket. The latch will have a key lock, and include an interior safety release handle to prevent accidental lock-in. Door hardware will be satin-finish aluminum or chrome-plated.

5.0 CONTROLS AND INSTRUMENTATION

5.1 Control Console

5.1.1 Manufacturer shall provide a control console incorporating a key-locked acrylic or Lexan door for viewing and protecting the settable controls. Protection Classifications: IP 65 to EN 60529, NEMA 12, including see-through door. The console will be mounted on the chamber exterior, next to the door if possible. The console includes all instruments, controls, switches, indicator lights, alarms, and alarm contacts. The electrical control enclosure shall be labeled/listed by a certified National Testing Lab.

5.2 Control Systems

5.2.1 Unless specified otherwise, controllers shall be self-tuning microprocessor-based PID controls with dual digital LED readout, allowing for continuous display of the both the set-point and actual chamber condition. Controller set-up data will be stored in non-volatile memory and retain settings upon power loss without the use of batteries. Independent controllers will be used to control chamber temperature and chamber humidity.

5.2.2 Temperature control will utilize solid-state microprocessor-based digital controllers with RTD sensing. Sensitivity of the sensor shall be better than 1.0°C throughout specified temperature range. Sensors will be located as required to detect the average temperature within the chamber.

5.2.3 Where applicable, relative humidity control will utilize solid-state microprocessor-based digital control with Rotronic S2 Hygroclip sensing. Sensors will be located as required to detect the average relative humidity within the chamber.

5.2.4 Microprocessor control of light levels, redundant cooling systems, and other variables may be added as a custom option.

5.2.5 Set points shall be set through simple arrow keys on the chamber microprocessor controls. The controllers will simultaneously display both actual and set-point variables. The temperature control system will allow for the operation of the resistance heating elements or hot gas bypass valves through solid state relays (SSR's) according to the controller output. This feature will provide for reducing the total operating cost of the chamber while still providing for the use of the heaters for rapid recovery from an upset in chamber temperature or load.

5.2.6 Alternate microprocessor control systems and (touch-screen) interfaces are available (as standard), upon request.

5.3 Independent High and Low Alarms

5.3.1 Independent High/Low alarms will have SPDT contacts for remote alarm monitoring or phone dialers. Separate alarms for high and low operating variables shall be provided. As applicable, alarm set-points will be digital, measured in degrees Celsius and percent RH.

5.3.2 The contacts will switch upon an alarm condition. Each alarm will have an adjustable delay period of 0-150 minutes before alarm action will occur. Remote alarm contacts will be wired into the control panel terminal block and be ready for hook-up to customer monitoring devices. Remote alarm contacts (relays) will be plug-in replaceable and will have both the NC and NO contacts available. The audible alarm will have a time-delayed silence of 0-60 min.

5.3.3 Integration/connection to existing BMS (Building Maintenance Systems) and other services, is available as a custom option.

5.4 Control and Switch Functions

5.4.1 All will be clearly labeled with non-fading polycarbonate labels requiring no stamping or silkscreen markings that wear off.

5.4.2 All control relays and indicators are solid state for long life and reliability.

5.4.3 All program menus will be logically arranged for intuitive operation.

5.5 Data Recording

5.5.1 Where specified, either a data-logging equipment bundle or else a 10" recorder, with switch-selectable 24-hour or 7-day chart movement, shall be provided. Chart recorders will utilize a 10" circular chart and will be mounted adjacent to the control panel. Recorder accuracy to be ± 1%, full scale (Honeywell DR4300 or equivalent).

5.6 Additional Components/Considerations

5.6.1 Accurate and NIST-traceable temperature sensing using platinum Resistance Temperature Detectors will be used for control and recording instruments.

5.6.2 Single point chamber power connection with over-current protection will be provided in the control panel for all power components.

5.6.3 All wiring identified will be identified with permanent labels for efficient troubleshooting.

5.6.4 Plug-in components will be used wherever feasible.

5.6.5 All components will be mounted on a DIN rail inside the control console for simple retrofit, repair, and diagnosis.

6.0 COOLING EQUIPMENT

6.1 Compressor/Condensing Unit (all cooling systems/components are as applicable)

6.1.1 Where required to maintain conditions as specified, the compressor/condensing unit will be an air-cooled or water-cooled unit, and shall be appropriately sized to provide performance as stated.

6.1.2 As standard, compressor/condensing units are top-mounted. (Remote mounting, and other options are available. All components of the condensing unit will be designed for 125 psi working pressure or 150% of maximum operating pressure; whichever is greater.

6.1.3 The unit will have a minimum of a crankcase pressure regulator, accumulator, vibration absorbers if applicable and thermal protection. Cycling solenoids or fully proportional refrigeration bypass valves will be used in the hot gas line. Isolation solenoids are acceptable for pump down only in the liquid and hot gas line. The condensing unit will be designed for continuous operation for maximum compressor life, to eliminate on and off cycling and to resist RF interference.

6.1.4 Water-cooled units will be provided with water regulating valves to maintain head pressure. The compressor/condensing unit will be linked to an evaporator of matching capacity in one of the following three types of conditioning designs. Refrigerant type will be R-134A or R-404A, unless specified otherwise.

6.1.5 The condensing unit will have a single point electrical connection terminating with a fused disconnect switch as the connection point.

6.2 Conditioning Type

6.2.1 The air-handler will be of copper tube/aluminum fin or copper tube/copper fin and stainless steel coil endplate construction to prevent corrosion.

6.3 Sub-Assembly Quality Control

6.3.1 For systems incorporating the Darwin PFTCU (Precision Fluid Temperature Control Unit), Quality Control testing is completed and documented at the point of manufacture, and the assembled unit (as a closed system) may be shipped with refrigerant, ready for installation by field personnel—without the requirement of a licensed HVAC technician at the installation site.

6.3.2 Otherwise, the above mentioned sub-assemblies (condensing unit, air-handler/evaporator) are evacuated to 500 microns and held at this condition for five hours prior to pre-charging with 150 psig of dry nitrogen. The units are tagged with dry nitrogen charge pressure, temperatures, date, and testing technician's initials. The units are shipped and installed with the "tagging" procedure intact. Upon start up, the nitrogen charge is evacuated and the units are charged with refrigerant. Field installation personnel can readily determine if shipping damage has occurred by comparing the recorded "tag" pressure with current system pressure.

6.4 Refrigerant Piping

6.4.1 Piping carrying refrigerant will be Type L ACR copper with copper fittings. 15% Silver solder or DynaFlow will be used for all joints. Condensate drain lines on chambers above 0.0°C will be PVC or copper tubing. On chambers operating below 0.0°C, drain lines will be type L copper tubing, wrapped with heating cable and covered with Armaflex W insulation. The cable will heat continuously below 0.0°C. Piping for condensing unit water will be Type L copper.

6.5 Insulation

6.5.1 Suction and hot gas refrigeration lines will be insulated with closed-cell foam plastic similar to "Armaflex" or an equivalent.

6.5.2 The material will be tubular in form, and sized in accordance with the pipe size. nsulation thickness will be a minimum of W" for cold rooms and warm rooms, and %" for freezers. Joints will be thoroughly bonded by the adhesive recommended by the insulation.

6.5.3 Manufacturer will meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates, all edges will be sealed to the pipe with sealant. The condenser inlet water line will be insulated with closed-cell foam plastic insulation.

6.6 Performance

6.6.1 As applicable, chambers may have a defined temperature uniformity (see preceding schedule) across the work surface 40" off the floor and to within 12" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with thermocouple, thermistor, or RTD sensing.

6.7 System Capacity

6.7.1 Refrigeration and heating systems will be capable of operation as specified, without running at full capacity, more than 80% of the time under the following conditions:

- Temperature (and humidity, as applicable) specifications assume standard operation in a controlled ambient condition of 72°F, ±8°F and a dew-point at or below 52 °F.
- Up to four door-opening events per hour.
- An additional electrical load of five watts per sq. ft. of floor area.

6.8 Automatic Defrost System

6.8.1 For rooms with set point temperatures below 4° C, provide hot gas bypass defrost with timer and fan delay switch. Set defrost initiation time and duration so that temperature increase is minimized while achieving complete removal of accumulated frost.

7.0 ACCESSORIES I COMPONENTS

7.1 Shelving

7.1.1 Shelving, when specified, will be removable and adjustable. Freestanding shelving will be adjustable on a minimum of 2" centers, four-tier and utilize four 74"or 86" posts. All shelving will be removable without special tools and will typically be constructed of stainless steel or epoxy-coated plated steel, with a guarantee of a minimum of five years corrosion resistance.

7.1.2 Shelving will be open wire unless specified otherwise. Leveling shims/screws will be provided at the base of the posts of freestanding shelving units.

7.2 Humidification

7.2.1 Where specified, humidification shall be achieved via an ultrasonic humidifier, as required to maintain operation as specified.

7.2.2 UV sterilization of supply water shall be provided. Water to be used must meet the following requirements: Conductivity of >0.1j..S, TDS of < 10 ppm at 1-10 Pounds per Square Inch (PSI) of water pressure.

7.2.3 Deionizing filtration systems may be provided, where needed to meet this requirement.

7.3 Dehumidification

7.3.1 As applicable, dehumidification shall be achieved via regenerating desiccant drier, compressed air, or heat-regenerating desiccant drier, to maintain operation as specified.

7.4 Wiring

7.4.1 Interconnecting wiring will be installed in UL Listed PVC conduit within room, and UL listed EMT outside of room. Conduit will be a minimum of Y" trade size, as applicable.

7.5 Lighting

7.5.1 Where specified, Manufacturer will provide vapor-proof LED or fluorescent lighting. The housing will be corrosion-resistant fiberglass or ABS plastic. Fixtures feature a clear prismatic acrylic lens with closed-cell neoprene gasketing bonded to the housing to form a continuous seal for the lens, with cam latches to clamp the lens (diffuser) to the housing.

- Typical light levels are 70 fc., minimum, as measured at 40" above the floor.
- Low temperature fluorescent or incandescent lamps may be supplied for freezers operating at -20°C or below.

7.5.2 Light control options, such as mechanical or microprocessor-controlled cycling for diurnal or circadian studies are available upon request.

7.5.3 Custom light levels, configurations, and full or specified partial spectrum lighting is available upon request.

7.6 Observation Windows

7.6.1 Standard observation windows, when included, shall be centered on door or panel at standard (view) height, unless otherwise specified. Standard size is 14" W x 14" H. Other sizes are available as custom, as door or panel sizing permits. The window will consist of two to three panes of low-e glass with sealed air spaces between them.

7.7 Sleeves/Pass-through Ports

7.7.1 Sleeves for service piping, gas line cables, and drain water lines will be cylindrical in cross section, formed of 1/8" or 3/16" PVC and sealed to the chamber enclosure from both ends with silicone sealant. Sleeves will be of sufficient size to allow a least 1/8" clearance around the service line. The void between service lines and the sleeves inside and out will be sealed with sealant that remains flexible. Caps will be provided to seal pass-throughs used for equipment line passage when not in use.

7.8 Ventilation System

7.8.1 As applicable, ventilation supply and exhaust shall be provided on a continual basis, to achieve required air exchange rates (CFM).

7.8.2 Custom filtration and/or dehumidification of supply and/or exhaust air is available upon request.

SECTION THREE • REQUIREMENTS

8.0 MANUFACTURER REQUIREMENTS

8.1 Installation

The chamber and all conditioning equipment shall be delivered and installed to achieve performance as specified. Chamber conditioning equipment, lighting, and internal electrical wiring will be interconnected. Chamber will be started and field-tested by Manufacturer prior to project completion.

Manufacturer shall seal joints and openings, including penetrations for piping or electrical wiring, in the outside and inside faces of the CER. All room mechanical, electrical and hardware components shall be adjusted, and all exposed surfaces cleaned, after installation.

8.2 Testing

Inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with. All costs related to testing are included in the contract sum.

Manufacturer shall comply with the following requirements, at minimum:

8.2.1 General: Provide all instrumentation and equipment as needed for testing, and perform the specified performance and acceptance tests.

8.2.2 Control temperature set-point: Measure and record room temperature during a continuous 24-hour test period. The room(s) shall maintain the given temperature set-point within ±1.0ºC, unless otherwise specified.

8.2.3 Temperature gradient: Measure and record room temperature during a continuous 24-hour test period. Where applicable, verify that the maximum temperature gradient from floor to ceiling does not exceed 1.0ºC.

8.2.4 Recovery test: Perform recovery test as described previously. All rooms, except for freezers shall recover within 5 minutes.

8.2.5 Internal load test: Each room shall maintain temperature within ±1.0ºC of set-point when operating with the specified number of people, make up ventilation air, and internal heat gain from lighting and equipment.

8.2.6 Rooms with relative humidity control shall be tested for humidity control performance and recovery as applicable and/or agreed.

8.2.7 Documentation: Manufacturer shall submit written reports of all tests. Reports shall indicate testing procedures followed, instruments used, and tabulation of results.

8.2.8 Witnessing of test: Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representatives in writing at least 7 days prior to conducting tests.

9.0 SITE REQUIREMENTS

9.1 General

Manufacturer shall not be responsible for altering existing building or design conditions or pulling in mechanical services for equipment.

9.2 Electrical

Electrical contractor will provide fused disconnects for each condensing unit, as applicable, and connection to condensing unit junction box at a location as directed by Manufacturer. Chamber control panel and interior receptacles will require junction boxes by others.

9.3 Water (Humidity Systems)

As applicable, Darwin Chambers Co. recommends Conductivity of > 0.1JIS, TDS of < 10 ppm at 1-10 Pounds per Square Inch (PSI) of water pressure.

9.4 Plumbing

The plumbing contractor or Owner will provide water supply and return to water-cooled condensing units, water supply and waste disposal site for humidification unit, all services and connections to casework within chamber, and floor drain connections. All final connections to equipment will be made by Owner as directed by Manufacturer.

9.5 Drain Site

Manufacturer will run condensate drain line to sink drain within chamber(s) or to floor drain outside of chambers and within 5 feet or as specified.

9.6 Level Floor

Owner will provide for Manufacturer, a level floor as a base for the prefabricated chamber floor. Floor will not exceed 3/8" in 10 and will not exceed 1/8" within a 2 span.

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SECTION II

ENVIRONMENTAL ROOMS-SPECIALIZED APPLICATIONS

2945 Washington Ave. St. Louis, MO 63103
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FDA/ICH STABILITY WALK-IN ROOMS

Our stability chambers offer superior environmental control for a variety of applications, and are proven to exceed ICH/FDA stability requirements. For this reason, our FDA/ICH chambers are highly sought. Pharmaceutical shelf-life testing, accelerated stability studies, and testing and storage for cosmetics, animal health products, nutritional supplements, general products, medical devices, packaging materials are just a few applications we service.

Benefits

- Outstanding temperature/humidity control and uniformity. FDA/ICH guidelines concerning control performance is easily exceeded. Our typical stability room will produce mapped and validated results of better than ±0.5° C and ±1.0 RH throughout the storage volume of the room. Control at a sensor of ±0.1° C and ±0.3% is normal.
- Precision Fluid Temperature Control Unit cooling system utilizes a combination of refrigerant technologies and glycol/water heat exchange technologies.
- A typical 9'W x 10'D x 8' 4"H walk-In stability room will require fewer than 1000 Watts to operate at 25°C/60% and 30°C/65%. At 40°C/75% the efficiency (typically 500 Watts or less) is even better. This savings can be substantial in comparison to competitors (up to $2500 per year) especially when multiplied by the operation of several rooms.
- Conditioning system can be replaced or relocated quickly due to simple water-type connections.
- Optional on-site validation services that have included multi-point temperature and humidity mapping have repeatedly proven nearly unbelievable uniformity and control results that far surpass FDA/ICH/GMP guidelines. Equipment utilized: Amphenol/Kaye Validator.
- Rooms that include an optional redundant refrigeration system allow uninterrupted operation upon a refrigeration failure. The room does not need to be taken out of service during repair, as the failed system can be isolated and serviced with no impact upon the chamber operation.
- ADA compliance available with no additional cost to the customer.
- Supplied with vapor proof LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.

Standard Features

- 4" Polyurethane Insulated Panels, 100% Foamed-In-Place
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature And Humidity Uniformity
- Humidity Control At Sensor: ±0.3%
- Temperature Control At Sensor / Set-Point: ±0.1° C
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Energy Efficient Offering-Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- UV sterilized ultrasonic humidification
- Temperature Range of 20°C to 40°C
- 25°C/60%, 30°C/60%, 30°C/65%, 40°C/75% capability
- Controls with Auto-tuning, Fuzzy Logic
- Dry Alarm Contacts and Modbus Communication for Connections to Building Management Systems

Optional Features

- Added Dehumidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning
- Data Logging and/or Chart Recorders
- Water-Cooled Or Air-Cooled Condensers
- Custom Lighting Systems
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touch Screen Control Interface
- Electronic Door Lock with Data-Logged Access
- Direct Refrigeration
- Sizes Available to the Nearest Inch

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications with traceable calibration documents.

DARWIN CHAMBERS

DESIGN SPECIFICATION

ICH STABILITY CHAMBERS

CONTROLLED ENVIRONMENT ROOMS

SECTION ONE • GENERAL INFORMATION

1.0 SCOPE OF WORK

1.1 General Provisions

1.1.1 Controlled Environmental Rooms (referred to as "CER's" or "chambers") shall be prefabricated, all metal clad construction; to be furnished and installed as a complete self-contained unit and system, including all essential plenums, mechanical equipment, controls, and all equipment necessary to maintain the specified environmental conditions.

1.1.2 Factory-trained technicians will deliver chamber components to their final location and complete assembly of chambers in place.

1.1.3 The Controlled Environmental Room Provider (referred to as the "Manufacturer") will furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices that comprise an integral part of each chamber.

1.1.4 Start-up and field testing of chambers will be performed by Manufacturer's trained technicians.

1.1.5 Supportive documentation and training shall be supplied by Manufacturer as specified.

1.1.6 Additional services will be provided, as applicable, as documented and agreed by contract or formal service agreement.

1.1.7 CER types included here are Stability Rooms.

1.1.8 All major components are assembled and factory tested prior to delivery, including air handlers, condensers, and control panels. Documentation of factory testing will be available to owner or architect upon request.

2.0 QUALITY ASSURANCE

2.1 Reference Standards

2.1.1 All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers or air-cooled condensers, humidification/dehumidification equipment, and control panel assemblies.

2.1.2 The latest published edition and applicable addenda of a reference apply:

- ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems
- ANSI/ASHRAE Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings.
- /AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery
- Unit Coolers for Refrigeration
- ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement
- Refrigerant Compressors and Compressor Units
  - ANSI - B9.1 Safety Code for Mechanical Refrigeration
  - UL–723 Test for Surface Burning Characteristics of Building Materials.
  - NFPA - 70 National Electric Code.
  - NFPA - 79 Electrical Standard for Industrial Machinery.

2.1.3 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

- All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration per ASTM E-283.
- Foam insulation is to be of a non-flammable, non-flame supporting grade with a "K" value of 0.118 BTU / hour / foot squared / degrees Fahrenheit / inch in accordance with ASTM C518.
- Insulation shall have a minimum 97% closed cell structure and “R” factor shall be 31 or greater in a thickness of 4 inches – values in accordance with ASTM C-236/C-1363 methods.

2.2 Manufacturer Qualifications

2.2.1 The Manufacturer shall have had not less than ten (10) years of successful and regular production of components/equipment used for this Project.

2.2.2 Manufacturer of CER systems shall have been in satisfactory operation on at least 50 similar installations for not less than five (5) years.

2.2.3 The Manufacturer shall be capable of providing service with a 12-hour notification during normal business hours Monday-Friday. Critical after-hours and weekend response time shall be a maximum of 24 hours upon notification.

2.2.4 Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the Architect/Engr. does not have to expend unnecessary time during evaluation.

2.2.5 The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. Additionally, the enclosure must be NSF-approved.

2.2.6 The Manufacturer shall inventory factory parts (or a fully compatible upgrade) for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in Manufacturer’s direct employ to assure the Owner of reliable service.

2.3 Accepted Manufacturers

2.3.1 Darwin Chambers Company, LLC—St. Louis, Missouri—Phone 877-783-6774

2.3.2 Other, in demonstrated compliance with the qualifications set forth within this document.

2.4 Warranty

2.4.1 Mechanical refrigeration equipment, parts, and labor will be guaranteed in written form for a minimum period of one year from the date of chamber start-up and continuous normal operation. The warranty will guarantee that the chamber(s) will:

- Maintain within the specified tolerance, the selected temperature.
- Be free from condensate on the outside of the chamber.
- Be free from defects due to faulty materials or workmanship.
- All Parts and labor will be guaranteed in written form from the date of chamber start-up and continuous normal operation, or upon Owner acceptance of certifications and functional test results, whichever is first.

2.4.2 Additionally, written warranties shall be provided covering defects in material, workmanship and performance for the following items, per the following schedule:

- Enclosures: Ten year warranty covering all items connected with the enclosure, including panels, doors and door hardware.
- Compressor(s), Control Panel: Five year warranty.

2.5 Installation/Training

2.5.1 Chamber Manufacturer will provide highly skilled, factory-trained personnel to perform and oversee installation of chamber enclosure and all components.

2.5.2 Services of a factory-trained technician will be made available for one man-day, minimum, to tune controls and instruct the owner on proper usage and care.

2.6 Testing

2.6.1 An inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with.

2.6.2 Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.0 PRODUCT DATA

3.1 Room Schedule/Operation

Environmental Stability Room, designation #_____

Chamber Operation:

Chamber temperature range: _____°C, ±_____°C (throughout storage area)

Chamber humidity range: _____%RH, ±_____%RH (throughout storage area)

Operational set-point(s): _____°C, at _____%RH; _____°C, at _____%RH;

_____°C, at _____%RH; _____°C, at _____%RH

Chamber size, exterior (actual):_____W x _____L x _____H

3.2 Submittals

3.2.1 Shop Drawings shall be supplied prior to the commencement of manufacture.

3.2.2 Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The Drawings shall include enclosure layout, elevations, dimensions, thicknesses, types and locations of connections and openings, and other pertinent construction and erection details including the routing and diameter of refrigeration tubing and coil condensate drain.

3.2.3 Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (duct, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.

3.2.4 Indicate performance requirements, which include, as a minimum, cooling, heating and humidification/ dehumidification parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.

3.2.5 Provide electrical plan showing all power connections to lighting and equipment, the voltage, amperage, and kW load for each circuit, and control and power wiring schematic.

3.2.6 Submit one sample of wall-mounted control panel, if not manufactured by one of the CER Manufacturers listed under Quality Assurance, item 2.3.

3.2.7 Functional Performance Test/Report

- Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.2.8 Operations Manual

- A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics. The data shall include, but is not limited to the following:
  - Shop drawings and wiring diagrams
  - System components and parts descriptions
  - Operating sequences, procedures, instructions, and/or theory of operation
  - Specific maintenance and troubleshooting instructions
  - Recommended service schedule. Include maintenance schedules for each component part of the systems furnished in this section. Include information on frequency of, and detailed instruction for, maintenance procedures and all items required for each maintenance activity
  - Recommended spare parts inventory
  - Name and contact information for service provider
  - Warranty; to be provided in written form upon delivery, for each chamber.

3.3 Delivery, Storage, and Handling

3.3.1 Compliance with Manufacturer's recommendations regarding handling and storage of all environmental chamber components before and during construction is mandatory.

3.3.2 Coordinate with other trades affecting, or affected by this work, to assure the steady progress of all work performed under the contract. Closely coordinate the delivery and installation of this work with the Contractor's schedule.

SECTION TWO • CONSTRUCTION AND DESIGN

4.0 MATERIAL CONSTRUCTION

4.1 General

4.1.1 Rooms will be furnished as complete functional units with all essential components, piping, control systems, and complete conditioning systems as required to satisfy environmental conditions as specified.

- The CER will be delivered in sections designed to pass without interference through standard doorways.
- All metal and other materials will be shaped and sized as required, with all angles sharp and true. All surfaces will be finished smooth. Punching and shearing will be neatly done. Permanent connections will be welded, riveted, or bolted, with all exposed welds ground smooth and flush with adjacent surfaces.

4.2 Panel Construction

4.2.1 Standard wall panels shall be nominal 4” in width, designed to be interchangeable.

4.2.2 Corner panels shall be 90¼ angles with actual 12” exterior horizontal measurements. Nominal 1' and 3' panels shall be used if required to meet job site conditions, and all are gauged for uniformity in size.

4.2.3 Edges of panels shall be tongue and groove with locking facilities foamed-in-place at time of fabrication. Rigidity and uniformity shall meet or exceed industry accepted standards and panel interior construction shall be fabricated to deter biodegradation and moisture retention. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.

- Panel Surfaces: (Standard) Interior, white embossed aluminum. Exterior, white embossed galvanized steel. (Stainless steel and other finishes available.)
- Panel locking shall be accomplished by foamed-in-place locking assemblies.
- Panels are all 100% poured-in-place polyurethane construction, R-Value 31+.

4.3 Floor Construction

4.3.1 Rooms may be provided with or without floor panels.

4.3.2 Wall panels will be flat bottom and secured to floor on 24” centers.

4.3.3 If floorless, CER shall be installed on customer-provided recessed slab.

4.3.4 Vinyl screeds shall be utilized, coved on both sides, to rest level with the floor.

4.3.5 Insulated floors shall be similar in construction to wall and ceiling panels. Standard floors are designed to accommodate up to 600 lbs. per square foot of evenly distributed weight. Additional reinforcement of floor panels shall be used as required.

4.3.6 Floor depth shall be a nominal 4 inches. Additional reinforcements and insulation may add to depth, and are provided as custom. Standard floor surface finishes include smooth aluminum or 300 Series stainless steel. Other depths, finishes, textures, coatings, and coverings are available upon request.

4.4 Door Construction

4.4.1 The door will be an in-fitting, swinging, flush-mounted type, and will have the same metal finish and insulation as adjacent walls. A thermoplastic gasket with a magnetic core will be mounted on the top edge and along both sides of the door that will keep the door closed and form a tight seal. Door gaskets shall be NSF-approved. Construction of door panel will include a welded heavy-duty "U" channel-type reinforced steel frame around the entire perimeter of the door opening to prevent rocking or twisting.

- Standard size 36” W x 78” H. (Most custom sizes/types available upon request.)
- Anti-condensate heater wires shall be concealed behind the metal edge of the doorjamb on all four sides.
- Heaters will be connected to a temperature switch or controller to automatically provide sufficient heat to eliminate condensation and frost under various ambient humidity conditions.
- The door will use a minimum of two cam-lift, self-closing hinges. The door latch will be designed to open the door easily by breaking the magnetic force of the door gasket. The latch will have a key lock, and include an interior safety release handle to prevent accidental lock-in. Door hardware will be satin-finish aluminum or chrome-plated.

5.0 CONTROLS AND INSTRUMENTATION

5.1 Control Console

5.1.1 Chamber Manufacturer shall provide a control console incorporating a key-locked acrylic or Lexan door for viewing and protecting the settable controls. Protection Classifications: IP 65 to EN 60529, NEMA 12, including see-through door. The console will be mounted on the chamber exterior, next to the door if possible. The console includes all instruments, controls, switches, indicator lights, alarms, and alarm contacts. The electrical control enclosure is labeled/listed by a certified National Testing Lab.

5.2 Control Systems

5.2.1 Controllers shall be Self-Tuning Microprocessor-Based PID Controls with Dual Digital LED Readout of process variables. This allows for continuous display of the both the set-point and chamber condition. Controller set-up data will be stored in non-volatile memory and retain settings upon power loss without the use of batteries. Independent controllers will be used to control the chamber temperature and humidity.

5.2.2 Temperature and humidity control will utilize solid-state microprocessor-based digital controllers with RTD sensing. Sensitivity of the sensor will not be less than 0.1°C and/or 0.1%RH, throughout range. Sensors will be located to detect the average temperature within the chamber.

5.2.3 Temperature and humidity set points shall be set through simple arrow keys on the chamber microprocessor controls. The controllers will simultaneously display both actual and set-point variables. The temperature control system will allow for the operation of the resistance heating elements or hot gas bypass valves through solid state relays (SSR’s) according to the controller output. (This feature will provide for reducing the total operating cost of the chamber while still providing for the use of the heaters for rapid recovery from an upset in chamber temperature or load.)

5.3 Independent High and Low Alarms

5.3.1 Independent High/Low alarms for temperature will have SPDT contacts for remote alarm monitoring or phone dialers. Separate alarms for high and low operating temperatures shall be provided. The alarm set-points will be digital, in degrees Celsius and Percent RH.

5.3.2 The contacts will switch upon an alarm condition. Each alarm will have an adjustable delay period of 0-150 minutes before alarm action will occur. The remote alarm contacts will be wired into the control panel terminal block and be ready for hook-up to customer monitoring devices. Remote alarm contacts (relays) will be plug-in replaceable and will have both the NC and NO contacts available. The audible alarm will have a time-delayed silence of 0-60 min.

5.4 Control and Switch Functions

5.4.1 All will be clearly labeled with non-fading polycarbonate labels requiring no stamping or silkscreen markings that wear off.

5.4.2 All control relays and indicators are solid state for long life and reliability.

5.4.3 All program menus will be logically arranged for intuitive operation.

5.5 Data Recording

5.5.1 Where specified, either a data-logging equipment bundle or else a 10” recorder, with switch-selectable 24-hour or 7-day chart movement, shall be provided. Recorders will utilize a 10" circular chart and will be mounted in the control panel. Recorder accuracy to be ± 1%, full scale (Honeywell DR4300 or equivalent).

5.6 Additional Components

5.6.1 Accurate and NIST-traceable temperature sensing using platinum Resistance

5.6.2 Temperature Detectors will be used for control and recording instruments.

5.6.3 NIST-traceable Rotronic HygroClip RH sensor and controller with calibration certificate.

5.6.4 Single point chamber power connection with over-current protection will be provided in the control panel for all power components.

5.6.5 All wiring will be identified with permanent labels for efficient troubleshooting.

5.6.6 Plug-in components will be used wherever feasible.

5.6.7 All components will be mounted on a DIN rail inside the control console for simple retrofit, repair, and diagnosis.

6.0 COOLING EQUIPMENT

6.1 Compressor/Condensing Unit

6.1.1 The compressor/condensing unit will consist of an air-cooled or water-cooled compressor of the appropriate size to provide performance as specified herein.

6.1.2 The compressor/condensing unit will provide safe and reliable operation in its location on top of the CER. All components of the condensing unit will be designed for 125 psi working pressure or 150% of maximum operating pressure; whichever is greater.

6.1.3 The unit will have a minimum of a crankcase pressure regulator, accumulator, vibration absorbers if applicable and thermal protection. Cycling solenoids or fully proportional refrigeration bypass valves will be used in the hot gas line. Isolation solenoids are acceptable for pump down only in the liquid and hot gas line. The condensing unit will be designed for continuous operation for maximum compressor life, to eliminate on and off cycling and to resist RF interference.

6.1.4 Water-cooled units will be provided with water regulating valves to maintain head pressure. The compressor/condensing unit will be linked to an evaporator of matching capacity in one of the following three types of conditioning designs. Refrigerant type will be R-134A or R-404A, unless specified otherwise.

6.1.5 The condensing unit will have a single point electrical connection terminating with a fused disconnect switch as the connection point.

6.2 Conditioning Type

6.2.1 The air-handler will be of copper tube/aluminum fin or copper tube/copper fin and stainless steel coil endplate construction to prevent corrosion as specified.

6.3 Sub-Assembly Quality Control

6.3.1 For systems incorporating the Darwin PFTCU (Precision Fluid Temperature Control Unit), Quality Control testing is completed and documented at the point of manufacture, and the assembled unit (as a closed system) may be shipped with refrigerant, ready for installation by field personnel—without the requirement of a licensed HVAC technician at the installation site.

6.3.2 Otherwise, the above mentioned sub-assemblies (condensing unit, air-handler/evaporator) are evacuated to 500 microns and held at this condition for five hours prior to pre-charging with 150 psig of dry nitrogen. The units are tagged with dry nitrogen charge pressure, temperatures, date, and testing technician's initials. The units are shipped and installed with the "tagging" procedure intact. Upon start up, the nitrogen charge is evacuated and the units are charged with refrigerant. Field installation personnel can readily determine if shipping damage has occurred by comparing the recorded "tag" pressure with current system pressure.

6.4 Refrigerant Piping

6.4.1 Piping carrying refrigerant will be Type L ACR copper with copper fittings. 15% Silver solder or DynaFlow will be used for all joints. Condensate drain lines on chambers above 0.0°C will be PVC or copper tubing. Piping for condensing unit water will be Type L copper.

6.5 Insulation

6.5.1 Suction and hot gas refrigeration lines will be insulated with closed-cell foam plastic similar to "Armaflex" or an equivalent.

6.5.2 The material will be tubular in form, and sized in accordance with the pipe size. Insulation thickness will be a minimum of ½" for cold rooms and warm rooms, and ¾" for freezers. Joints will be thoroughly bonded by the adhesive recommended by the insulation.

6.5.3 Manufacturer will meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates, all edges will be sealed to the pipe with sealant. The condenser inlet water line will be insulated with closed-cell foam plastic insulation.

6.6 Performance

6.6.1 Chambers will have a defined temperature uniformity (see preceding schedule) across the work surface 40" off the floor and to within 12" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with thermocouple, thermistor, or RTD sensing.

6.7 System Capacity

6.7.1 Refrigeration and heating systems will be capable of operation as specified, without running at full capacity, more than 80% of the time under the following conditions:

- Temperature and humidity specifications assume standard operation in a controlled ambient condition of 72°F, ±8°F and a dew-point at or below 50°F.
- Up to four door-opening events per hour.
- An additional electrical load of five watts per sq. ft. of floor area.

6.8 Automatic Defrost System

6.8.1 For rooms with set point temperatures below 4° C, provide hot gas bypass defrost with timer and fan delay switch. Set defrost initiation time and duration so that temperature increase is minimized while achieving complete removal of accumulated frost.

7.0 ACCESSORIES / COMPONENTS

7.1 Shelving

7.1.1 Shelving, when specified, will be removable and adjustable. Freestanding shelving will be provided, unless otherwise specified. Shelving will be adjustable on a minimum of 2" centers, four-tier and utilize four 74"or 86" posts. All shelving will be removable without special tools and will typically be constructed of stainless steel or epoxy-coated plated steel, with a guarantee of a minimum of five years corrosion resistance.

7.1.2 Shelving will be open wire unless specified other. Leveling shims/screws will be provided at the base of the posts of freestanding shelving units.

7.2 Humidification

7.2.1 Humidification shall be provided by a vapor-producing ultrasonic humidifier, for optimal uniformity and efficiency. UV disinfection shall be incorporated into the humidifier to reduce potential for propagation of bacteriological contaminants.

7.3 Dehumidification

7.3.1 Where specified, dehumidification shall be achieved via refrigerated, compressed air, or heat-regenerating desiccant drier, sized as required to maintain operation as specified.

7.4 Wiring

7.4.1 Interconnecting wiring will be installed in UL Listed PVC conduit within room, and UL listed EMT outside of room. Conduit will be a minimum of ½" trade size, as applicable.

7.5 Lighting

7.5.1 Where specified, Chamber Manufacturer will provide vapor-proof fluorescent lighting. The housing will be corrosion-resistant fiberglass or ABS plastic. Fixtures feature a clear prismatic acrylic lens with closed-cell neoprene gasketing bonded to the housing to form a continuous seal for the lens, with cam latches to clamp the lens (diffuser) to the housing.

- Light levels in chambers to be 70 fc. min., as measured at 40" above the floor.

7.6 Observation Windows

7.6.1 Standard observation windows, when included, shall be centered on door or panel at standard (view) height, unless otherwise specified. Standard size is 14” W x 14” H). Other sizes are available as custom, as door or panel sizing permits. The window will consist of two to three panes of low-e glass with sealed air spaces between them.

7.7 Sleeves/Pass-through Ports

7.7.1 Sleeves for service piping, gas line cables, and drain water lines will be cylindrical in cross section, formed of 1/8" or 3/16" PVC and sealed to the chamber enclosure from both ends with silicone sealant. Sleeves will be of sufficient size to allow a least 1/8" clearance around the service line. The void between service lines and the sleeves inside and out will be sealed with sealant that remains flexible. Caps will be provided to seal pass-throughs used for equipment line passage when not in use.

7.8 Ventilation System

7.8.1 As applicable, ventilation supply and exhaust shall be provided on a continual basis, to achieve required air exchange rates (CFM).

SECTION THREE • REQUIREMENTS

8.0 MANUFACTURER REQUIREMENTS

8.1 Installation

Deliver and install the chamber and all conditioning equipment to achieve performance as outlined. The chamber conditioning equipment, lighting, and internal electrical wiring will be interconnected. The chamber will be started and field-tested by Chamber Manufacturer prior to project completion.

Seal joints and openings, including penetrations for piping or electrical wiring, in the outside and inside faces of walk-in refrigerated storage construction. Adjust all room mechanical, electrical and hardware components, and clean exposed surfaces after installation.

8.2 Testing

Inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with. All costs related to testing are included in the contract sum.

CER Manufacturer shall comply with the following requirements, at minimum:

8.2.1 General: Provide all instrumentation and equipment as needed for testing, and perform the specified performance and acceptance tests.

8.2.2 Control temperature set-point: Measure and record room temperature during a continuous 24-hour test period. The room(s) shall maintain the given temperature set-point within ±1.0°C, unless otherwise specified.

8.2.3 Temperature gradient: Measure and record room temperature during a continuous 24-hour test period. Verify that the maximum temperature gradient from floor to ceiling does not exceed 1.0°C.

8.2.4 Temperature uniformity: Measure and record temperature uniformity during a continuous 24-hour test period, as previously described. Temperature uniformity shall be ±0.5°C, unless specified otherwise.

8.2.5 Recovery test: Perform recover test as described previously. All rooms, except for freezers shall recover within 5 minutes.

8.2.6 Internal load test: Each room shall maintain temperature within ±1.0°C of set-point when operating with the specified number of people, make up ventilation air, and internal heat gain from lighting and equipment.

8.2.7 Rooms with relative humidity control shall be tested for humidity control performance and recovery as applicable and/or agreed.

8.2.8 Documentation: CER Manufacturer shall submit written reports of all tests. Reports shall indicate testing procedures followed, instruments used, and tabulation of results.

8.2.9 Witnessing of test: Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representatives in writing at least 10 days prior to conducting tests.

9.0 SITE REQUIREMENTS

Manufacturer is not responsible for altering existing building or design conditions or pulling in mechanical services for equipment.

9.1 Electrical

Electrical contractor will provide fused disconnects for each condensing unit, as applicable, and connection to condensing unit junction box at a location as directed by Manufacturer. Chamber control panel and interior receptacles will require junction boxes by others.

9.2 Water (Humidity Systems)

As applicable, conductivity of 5µS - 0.06µS, TDS of < 20 ppm at 1-10 Pounds per Square Inch (PSI) of water pressure is recommended.

9.3 Plumbing

The plumbing contractor or Owner will provide water supply and return to water-cooled condensing units, water supply and waste disposal site for humidification unit, all services and connections to casework within chamber, and floor drain connections. All final connections to equipment will be made by Owner as directed by Manufacturer.

9.4 Drain Site

Chamber Manufacturer will run condensate drain line to sink drain within chamber(s) or to floor drain outside of chambers and within 10 feet or as specified.

9.5 Level Floor

Owner will provide for Chamber Manufacturer, a level floor as a base for the prefabricated chamber floor. Floor will not exceed 3/8" in 10' and will not exceed 1/8" within a 2' span.

2945 Washington Ave. St. Louis, MO 63103
877-783-6774 | sales@darwinchambers.com
www.darwinchambers.com

INSECT REARING ROOMS

We have over a decade of highly specialized experience in insect rearing working with researchers to address their needs for studies involving drosophila melanogaster, lepidoptera, coleoptera, mosquitos and other diptera. Mantids, weevils, moths, bees and wolf spiders are among the various insect types we have accommodated over the years.

Benefits

- Exceptionally quiet.
- Lower vibrations than a typical refrigerator.
- Increased energy efficiency.
- We use white aluminum or stainless steel interior finishes. We don't recommend use of uncoated galvanized steel as it may oxidize and cause harm to insects.
- All exposed surfaces are coated with a baked-on finish, to reduce the potential for corrosion to the highest extent possible.
- Filtration or screening of intake air and evaporator housing
- Vestibules, screens, vinyl/air entry curtains and various threshold barriers available.
- Precision Fluid Temperature Control Unit cooling system utilizes a combination of refrigerant technologies and glycol/water heat exchange technologies.
- Ability to shut down all heat or cold producing equipment in the event of a malfunction via standard alarms and redundant safeties.
- Ability to decontaminate the chamber with high heat.
- ADA compliant available interior, exterior ramps, platforms etc.
- We utilize precisely controlled ultrasonic humidification. Very little heat is generated = smaller compressor = lower energy usage. A further benefit is excellent temperature uniformity.
- Site visits are provided as needed, to work with nearly any architectural features and maximize the available work area.
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.
- Optional Diurnal/Circadian light control with available automatic dimming.

Standard Features

- 4-6" Polyurethane Insulated Panels
- Epoxy Coated Air Handlers
- Exceptional Temperature And Humidity Uniformity
- Temperature Control At Sensor: ±0.2° C
- Added Ultrasonic Humidification
- Humidity Control At Sensor: ±0.5%
- High / Low Alarms
- Flexible Configurations
- Energy Efficient
- Non-proprietary Controls
- Pre-tested, Pre-charged Refrigeration Systems
- Diurnal ramping/soaking/cycling of temperature.
- Corrosive Resistant Equipment
- Drastically lower maintenance costs compared to competitors

Optional Features

- Added Dehumidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Added Redundancy in Controls and/or Conditioning
- Touch Screen Control Interface
- Multi-point Digital Recording
- Water-Cooled Or Air-Cooled Condensers
- Custom Lighting Systems
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Vestibules, screens, vinyl/air entry curtains and various threshold barriers available.

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

DARWIN CHAMBERS

DESIGN SPECIFICATION

——— Insect Rearing Chambers ———

CONTROLLED ENVIRONMENT ROOMS

SECTION ONE • GENERAL INFORMATION

1.0 SCOPE OF WORK

1.1 General Provisions

1.1.1 Controlled Environmental Rooms (referred to as “CER” or “chambers”) shall be prefabricated, all metal clad construction; to be furnished and installed as a complete self-contained unit and system, including all essential plenums, mechanical equipment, controls, and all equipment necessary to maintain the specified environmental conditions.

1.1.2 Factory-trained technicians will deliver chamber components to their final location and complete assembly of chambers in place.

1.1.3 The Controlled Environmental Room Provider (referred to as the “Manufacturer”) will furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices that comprise an integral part of each chamber.

1.1.4 Start-up and field testing of chambers will be performed by Manufacturer’s trained technicians.

1.1.5 Supportive documentation and training shall be supplied by Manufacturer as specified.

1.1.6 Additional services will be provided, as applicable, as documented and agreed by contract or formal service agreement.

1.1.7 CER types included here are Insect Rearing Chambers.

1.1.8 All major components are assembled and factory tested prior to delivery, including air handlers, condensers, and control panels. Documentation of factory testing will be available to owner or architect upon request.

2.0 QUALITY ASSURANCE

2.1 Reference Standards

2.1.1 All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers or air-cooled condensers, humidification/dehumidification equipment, and control panel assemblies.

2.1.2 The latest published edition and applicable addenda of a reference apply:

- ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems
- ANSI/ASHRAE Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings.
- AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery
- Unit Coolers for Refrigeration
- ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement
- Refrigerant Compressors and Compressor Units
- ANSI - B9.1 Safety Code for Mechanical Refrigeration
- UL–723 Test for Surface Burning Characteristics of Building Materials.
- NFPA - 70 National Electric Code.
- NFPA - 79 Electrical Standard for Industrial Machinery.

2.1.3 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

- All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration per ASTM E-283.
- Foam insulation is to be of a non-flammable, non-flame supporting grade with a "K" value of 0.118 BTU / hour / foot squared / degrees Fahrenheit / inch in accordance with ASTM C518.
- Insulation shall have a minimum 97% closed cell structure and “R” factor shall be 31 or greater in a thickness of 4 inches – values in accordance with ASTM C-236/C-1363 methods.

2.2 Manufacturer Qualifications

2.2.1 The Manufacturer shall have had not less than ten (10) years of successful and regular production of components/equipment used for this Project.

2.2.2 Manufacturer of CER systems shall have been in satisfactory operation on at least 50 similar installations for not less than five (5) years.

2.2.3 The Manufacturer shall be capable of providing service with a 12-hour notification during normal business hours Monday-Friday. Critical after-hours and weekend response time shall be a maximum of 24 hours upon notification.

2.2.4 Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the Architect/Engr. does not have to expend unnecessary time during evaluation.

2.2.5 The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. Additionally, the enclosure must be NSF-approved.

2.2.6 The Manufacturer shall inventory factory parts (or a fully compatible upgrade) for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in Manufacturer’s direct employ to assure the Owner of reliable service.

2.3 Accepted Manufacturers

2.3.1 Darwin Chambers Company, LLC—St. Louis, Missouri—Phone 877-783-6774

2.3.2 Other, in demonstrated compliance with the qualifications set forth within this document.

2.4 Warranty

2.4.1 Mechanical refrigeration equipment, parts, and labor will be guaranteed in written form for a minimum period of one year from the date of chamber start-up and continuous normal operation. The warranty will guarantee that the chamber(s) will:

- Maintain within the specified tolerance, the selected temperature.
- Be free from condensate on the outside of the chamber.
- Be free from defects due to faulty materials or workmanship.
- All parts and labor will be guaranteed in written form from the date of chamber start-up and continuous normal operation, or upon Owner acceptance of certifications and functional test results, whichever is first.

2.4.2 Additionally, written warranties shall be provided covering defects in material, workmanship and performance for the following items, per the following schedule:

- Enclosures: Ten year warranty covering all items connected with the enclosure, including panels, doors and door hardware.
- Compressor(s), Control Panel: Five year warranty.

2.5 Installation/Training

2.5.1 Chamber Manufacturer will provide highly skilled, factory-trained personnel to perform and oversee installation of chamber enclosure and all components.

2.5.2 Services of a factory-trained technician will be made available for one man-day, minimum, to tune controls and instruct the owner on proper usage and care.

2.6 Testing

2.6.1 An inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with.

2.6.2 Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.0 PRODUCT DATA

3.1 Room Schedule/Operation

Controlled Environmental Room, designation #_____
Chamber Operation:

Chamber temperature range: _____°C, ±_____°C (throughout storage area)

Chamber humidity range: _____%RH, ±_____%RH (throughout storage

area) Operational set-point(s): _°C, at _____%RH; _____°C, at _

_____%RH;

_____°C, at _____%RH; _____°C, at _____%RH

Chamber size, exterior (actual):___W x _____L x _____H

3.2 Submittals

3.2.1 Shop Drawings shall be supplied prior to the commencement of manufacture.

3.2.2 Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The Drawings shall include enclosure layout, elevations, dimensions, thicknesses, types and locations of connections and openings, and other pertinent construction and erection details including the routing and diameter of refrigeration tubing and coil condensate drain.

3.2.3 Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (duct, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.

3.2.4 Indicate performance requirements, which include, as a minimum, cooling, heating and humidification/ dehumidification parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.

3.2.5 Provide electrical plan showing all power connections to lighting and equipment, the voltage, amperage, and kW load for each circuit, and control and power wiring schematic.

3.2.6 Submit one sample of wall-mounted control panel, if not manufactured by one of the CER Manufacturers listed under Quality Assurance, item 2.3.

3.2.7 Functional Performance Test/Report

- Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.2.8 Operations Manual

- A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics. The data shall include, but is not limited to the following:
  - Shop drawings and wiring diagrams
  - System components and parts descriptions
  - Operating sequences, procedures, instructions, and/or theory of operation
  - Specific maintenance and troubleshooting instructions
  - Recommended service schedule. Include maintenance schedules for each component part of the systems furnished in this section. Include information on frequency of, and detailed instruction for, maintenance procedures and all items required for each maintenance activity
  - Recommended spare parts inventory
  - Name and contact information for service provider
  - Warranty; to be provided in written form upon delivery, for each chamber.

3.3 Delivery, Storage, and Handling

3.3.1 Compliance with Manufacturer's recommendations regarding handling and storage of all environmental chamber components before and during construction is mandatory.

3.3.2 Coordinate with other trades affecting, or affected by this work, to assure the steady progress of all work performed under the contract. Closely coordinate the delivery and installation of this work with the Contractor's schedule.

SECTION TWO • CONSTRUCTION AND DESIGN

4.0 MATERIAL CONSTRUCTION

4.1 General

4.1.1 Rooms will be furnished as complete functional units with all essential components, piping, control systems, and complete conditioning systems as required to satisfy environmental conditions as specified.

- The CER will be delivered in sections designed to pass without interference through standard doorways.
- All metal and other materials will be shaped and sized as required, with all angles sharp and true. All surfaces will be finished smooth. Punching and shearing will be neatly done. Permanent connections will be welded, riveted, or bolted, with all exposed welds ground smooth and flush with adjacent surfaces.

4.2 Panel Construction

4.2.1 Standard wall panels shall be nominal 4” in width, designed to be interchangeable.

4.2.2 Corner panels shall be 90¼ angles with actual 12” exterior horizontal measurements. Nominal 1' and 3' panels shall be used if required to meet job site conditions, and all are gauged for uniformity in size.

4.2.3 Edges of panels shall be tongue and groove with locking facilities foamed-in-place at time of fabrication. Rigidity and uniformity shall meet or exceed industry accepted standards and panel interior construction shall be fabricated to deter biodegradation and moisture retention. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.

- Panel Surfaces: (Standard) Interior, white embossed aluminum. Exterior, white embossed galvanized steel. (Stainless steel and other finishes available.)
- Panel locking shall be accomplished by foamed-in-place locking assemblies.
- Panels are all 100% poured-in-place polyurethane construction, R-Value 31+.

4.3 Floor Construction

4.3.1 Rooms may be provided with or without floor panels.

4.3.2 Wall panels will be flat bottom and secured to floor on 24” centers.

4.3.3 If floorless, CER shall be installed on customer-provided recessed slab.

4.3.4 Vinyl screeds shall be utilized, coved on both sides, to rest level with the floor.

4.3.5 Insulated floors shall be similar in construction to wall and ceiling panels. Standard floors are designed to accommodate up to 600 lbs. per square foot of evenly distributed weight. Additional reinforcement of floor panels shall be used as required.

4.3.6 Floor depth shall be a nominal 4 inches. Additional reinforcements and insulation may add to depth, and are provided as custom. Standard floor surface finishes include smooth aluminum or 300 Series stainless steel. Other depths, finishes, textures, coatings, and coverings are available upon request.

4.4 Door Construction

4.4.1 The door will be an in-fitting, swinging, flush-mounted type, and will have the same metal finish and insulation as adjacent walls. A thermoplastic gasket with a magnetic core will be mounted on the top edge and along both sides of the door that will keep the door closed and form a tight seal. Door gaskets shall be NSF-approved. Construction of door panel will include a welded heavy-duty "U" channel-type reinforced steel frame around the entire perimeter of the door opening to prevent rocking or twisting.

- Standard size 36” W x 78” H. (Most custom sizes/types available upon request.)
- Anti-condensate heater wires shall be concealed behind the metal edge of the doorjamb on all four sides.
- Heaters will be connected to a temperature switch or controller to automatically provide sufficient heat to eliminate condensation and frost under various ambient humidity conditions.
- The door will use a minimum of two cam-lift, self-closing hinges. The door latch will be designed to open the door easily by breaking the magnetic force of the door gasket. The latch will have a key lock, and include an interior safety release handle to prevent accidental lock-in. Door hardware will be satin-finish aluminum or chrome-plated.

5.0 CONTROLS AND INSTRUMENTATION

5.1 Control Console

5.1.1 Chamber Manufacturer shall provide a control console incorporating a key-locked acrylic or Lexan door for viewing and protecting the settable controls. Protection Classifications: IP 65 to EN 60529, NEMA 12, including see-through door. The console will be mounted on the chamber exterior, next to the door if possible. The console includes all instruments, controls, switches, indicator lights, alarms, and alarm contacts. The electrical control enclosure is labeled/listed by a certified National Testing Lab.

5.2 Control Systems

5.2.1 Controllers shall be Self-Tuning Microprocessor-Based PID Controls with Dual Digital LED Readout of process variables. This allows for continuous display of the both the set-point and chamber condition. Controller set-up data will be stored in non-volatile memory and retain settings upon power loss without the use of batteries. Independent controllers will be used to control the chamber temperature and humidity.

5.2.2 Temperature and humidity control will utilize solid-state microprocessor-based digital controllers with RTD sensing. Sensitivity of the sensor will not be less than 0.1°C and/or 0.1%RH, throughout range. Sensors will be located to detect the average temperature within the chamber.

5.2.3 Temperature and humidity set points shall be set through simple arrow keys on the chamber microprocessor controls. The controllers will simultaneously display both actual and set-point variables. The temperature control system will allow for the operation of the resistance heating elements or hot gas bypass valves through solid state relays (SSR’s) according to the controller output. (This feature will provide for reducing the total operating cost of the chamber while still providing for the use of the heaters for rapid recovery from an upset in chamber temperature or load.)

5.3 Independent High and Low Alarms

5.3.1 Independent High/Low alarms for temperature will have SPDT contacts for remote alarm monitoring or phone dialers. Separate alarms for high and low operating temperatures shall be provided. The alarm set-points will be digital, in degrees Celsius and Percent RH.

5.3.2 The contacts will switch upon an alarm condition. Each alarm will have an adjustable delay period of 0-150 minutes before alarm action will occur. The remote alarm contacts will be wired into the control panel terminal block and be ready for hook-up to customer monitoring devices. Remote alarm contacts (relays) will be plug-in replaceable and will have both the NC and NO contacts available. The audible alarm will have a time-delayed silence of 0-60 min.

5.4 Control and Switch Functions

5.4.1 All will be clearly labeled with non-fading polycarbonate labels requiring no stamping or silkscreen markings that wear off.

5.4.2 All control relays and indicators are solid state for long life and reliability.

5.4.3 All program menus will be logically arranged for intuitive operation.

5.5 Data Recording

5.5.1 Where specified, either a data-logging equipment bundle or else a 10” recorder, with switch-selectable 24-hour or 7-day chart movement, shall be provided. Recorders will utilize a 10" circular chart and will be mounted in the control panel. Recorder accuracy to be ± 1%, full scale (Honeywell DR4300 or equivalent).

5.6 Additional Components

5.6.1 Accurate and NIST-traceable temperature sensing using platinum resistance

5.6.2 Temperature Detectors will be used for control and recording instruments.

5.6.3 NIST-traceable Rotronic HygroClip RH sensor and controller with calibration certificate.

5.6.4 Single point chamber power connection with over-current protection will be provided in the control panel for all power components.

5.6.5 All wiring will be identified with permanent labels for efficient troubleshooting.

5.6.6 Plug-in components will be used wherever feasible.

5.6.7 All components will be mounted on a DIN rail inside the control console for simple retrofit, repair, and diagnosis.

6.0 COOLING EQUIPMENT

6.1 Compressor/Condensing Unit

6.1.1 The compressor/condensing unit will consist of an air-cooled or water-cooled compressor of the appropriate size to provide performance as specified herein.

6.1.2 The compressor/condensing unit will provide safe and reliable operation in its location on top of the CER. All components of the condensing unit will be designed for 125 psi working pressure or 150% of maximum operating pressure; whichever is greater.

6.1.3 The unit will have a minimum of a crankcase pressure regulator, accumulator, vibration absorbers if applicable and thermal protection. Cycling solenoids or fully proportional refrigeration bypass valves will be used in the hot gas line. Isolation solenoids are acceptable for pump down only in the liquid and hot gas line. The condensing unit will be designed for continuous operation for maximum compressor life, to eliminate on and off cycling and to resist RF interference.

6.1.4 Water-cooled units will be provided with water regulating valves to maintain head pressure. The compressor/condensing unit will be linked to an evaporator of matching capacity in one of the following three types of conditioning designs. Refrigerant type will be R-134A or R-404A, unless specified otherwise.

6.1.5 The condensing unit will have a single point electrical connection terminating with a fused disconnect switch as the connection point.

6.2 Conditioning Type

6.2.1 The air-handler will be of copper tube/aluminum fin or copper tube/copper fin and stainless steel phenolic coated coil endplate construction to prevent corrosion as specified.

6.3 Sub-Assembly Quality Control

6.3.1 For systems incorporating the Darwin PFTCU (Precision Fluid Temperature Control Unit), Quality Control testing is completed and documented at the point of manufacture, and the assembled unit (as a closed system) may be shipped with refrigerant, ready for installation by field personnel—without the requirement of a licensed HVAC technician at the installation site.

6.3.2 Otherwise, the above mentioned sub-assemblies (condensing unit, air-handler/evaporator) are evacuated to 500 microns and held at this condition for five hours prior to pre-charging with 150 psig of dry nitrogen. The units are tagged with dry nitrogen charge pressure, temperatures, date, and testing technician's initials. The units are shipped and installed with the "tagging" procedure intact. Upon start up, the nitrogen charge is evacuated and the units are charged with refrigerant. Field installation personnel can readily determine if shipping damage has occurred by comparing the recorded "tag" pressure with current system pressure.

6.4 Refrigerant Piping

6.4.1 Piping carrying refrigerant will be Type L ACR copper with copper fittings. 15% Silver solder or DynaFlow will be used for all joints. Condensate drain lines on chambers above 0.0°C will be PVC or copper tubing. Piping for condensing unit water will be Type L copper.

6.5 Insulation

6.5.1 Suction and hot gas refrigeration lines will be insulated with closed-cell foam plastic similar to "Armaflex" or an equivalent.

6.5.2 The material will be tubular in form, and sized in accordance with the pipe size. Insulation thickness will be a minimum of ½" for cold rooms and warm rooms, and ¾" for freezers. Joints will be thoroughly bonded by the adhesive recommended by the insulation.

6.5.3 Manufacturer will meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates, all edges will be sealed to the pipe with sealant. The condenser inlet water line will be insulated with closed-cell foam plastic insulation.

6.6 Performance

6.6.1 Chambers will have a defined temperature uniformity (see preceding schedule) across the work surface 40" off the floor and to within 12" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with thermocouple, thermistor, or RTD sensing.

6.7 System Capacity

6.7.1 Refrigeration and heating systems will be capable of operation as specified, without running at full capacity, more than 80% of the time under the following conditions:

- Temperature and humidity specifications assume standard operation in a controlled ambient condition of 72°F, ±8°F and a dew-point at or below 50°F.
- Up to four door-opening events per hour.
- An additional electrical load of five watts per sq. ft. of floor area.

6.8 Automatic Defrost System

6.8.1 For rooms with set point temperatures below 4° C, provide hot gas bypass defrost with timer and fan delay switch. Set defrost initiation time and duration so that temperature increase is minimized while achieving complete removal of accumulated frost.

7.0 ACCESSORIES / COMPONENTS

7.1 Shelving

7.1.1 Shelving, when specified, will be removable and adjustable. Freestanding shelving will be provided, unless otherwise specified. Shelving will be adjustable on a minimum of 2" centers, four-tier and utilize four 74"or 86" posts. All shelving will be removable without special tools and will typically be constructed of stainless steel or epoxy-coated plated steel, with a guarantee of a minimum of five years corrosion resistance.

7.1.2 Shelving will be open wire unless specified other. Leveling shims/screws will be provided at the base of the posts of freestanding shelving units.

7.2 Humidification

7.2.1 Humidification shall be provided by a vapor-producing ultrasonic humidifier, for optimal uniformity and efficiency. UV disinfection shall be incorporated into the humidifier to reduce potential for propagation of bacteriological contaminants.

7.3 Dehumidification

7.3.1 Where specified, dehumidification shall be achieved via refrigerated, compressed air, or heat-regenerating desiccant drier, sized as required to maintain operation as specified.

7.4 Wiring

7.4.1 Interconnecting wiring will be installed in UL Listed PVC conduit within room, and UL listed EMT outside of room. Conduit will be a minimum of ½" trade size, as applicable.

7.5 Lighting

7.5.1 Where specified, Chamber Manufacturer will provide vapor-proof LED lighting. The housing will be corrosion-resistant fiberglass or ABS plastic. Fixtures feature a clear prismatic acrylic lens with closed-cell neoprene gasketing bonded to the housing to form a continuous seal for the lens, with cam latches to clamp the lens (diffuser) to the housing.

- Light levels in chambers to be 70 fc. min., as measured at 40" above the floor.

7.6 Observation Windows

7.6.1 Standard observation windows, when included, shall be centered on door or panel at standard (view) height, unless otherwise specified. Standard size is 14” W x 14” H). Other sizes are available as custom, as door or panel sizing permits. The window will consist of two to three panes of low-e glass with sealed air spaces between them.

7.7 Sleeves/Pass-through Ports

7.7.1 Sleeves for service piping, gas line cables, and drain water lines will be cylindrical in cross section, formed of 1/8" or 3/16" PVC and sealed to the chamber enclosure from both ends with silicone sealant. Sleeves will be of sufficient size to allow a least 1/8" clearance around the service line. The void between service lines and the sleeves inside and out will be sealed with sealant that remains flexible. Caps will be provided to seal pass-throughs used for equipment line passage when not in use.

7.8 Ventilation System

7.8.1 As applicable, ventilation supply and exhaust shall be provided on a continual basis, to achieve required air exchange rates (CFM), and pressure differentials for ACL-1, ACL-2 or ACL-3.

SECTION THREE • REQUIREMENTS

8.0 MANUFACTURER REQUIREMENTS

8.1 Installation

Deliver and install the chamber and all conditioning equipment to achieve performance as outlined. The chamber conditioning equipment, lighting, and internal electrical wiring will be interconnected. The chamber will be started and field-tested by Chamber Manufacturer prior to project completion.

Seal joints and openings, including penetrations for piping or electrical wiring, in the outside and inside faces of walk-in refrigerated storage construction. Adjust all room mechanical, electrical and hardware components, and clean exposed surfaces after installation.

8.2 Testing

Inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with. All costs related to testing are included in the contract sum.

CER Manufacturer shall comply with the following requirements, at minimum:

8.2.1 General: Provide all instrumentation and equipment as needed for testing, and perform the specified performance and acceptance tests.

8.2.2 Control temperature set-point: Measure and record room temperature during a continuous 24-hour test period. The room(s) shall maintain the given temperature set-point within ±1.0°C, unless otherwise specified.

8.2.3 Internal load test: Each room shall maintain temperature within ±1.0°C of set-point when operating with the specified number of people, make up ventilation air, and internal heat gain from lighting and equipment.

8.2.4 Rooms with relative humidity control shall be tested for humidity control performance and recovery as applicable and/or agreed.

8.2.5 Documentation: CER Manufacturer shall submit written reports of all tests. Reports shall indicate testing procedures followed, instruments used, and tabulation of results.

8.2.6 Witnessing of test: Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representatives in writing at least 10 days prior to conducting tests.

9.0 SITE REQUIREMENTS

Manufacturer is not responsible for altering existing building or design conditions or pulling in mechanical services for equipment.

9.1 Electrical

Electrical contractor will provide fused disconnects for each condensing unit, as applicable, and connection to condensing unit junction box at a location as directed by Manufacturer. Chamber control panel and interior receptacles will require junction boxes by others.

9.2 Water (Humidity Systems)

As applicable, conductivity of >0.1µS, TDS of < 10 ppm at 1-10 Pounds per Square Inch (PSI) of water pressure is recommended.

9.3 Plumbing

The plumbing contractor or Owner will provide water supply and return to water-cooled condensing units, water supply and waste disposal site for humidification unit, all services and connections to casework within chamber, and floor drain connections. All final connections to equipment will be made by Owner as directed by Manufacturer.

9.4 Drain Site

Chamber Manufacturer will run condensate drain line to sink drain within chamber(s) or to floor drain outside of chambers and within 5 feet or as specified.

9.5 Level Floor

Owner will provide for Chamber Manufacturer, a level floor as a base for the prefabricated chamber floor. Floor will not exceed 3/8" in 10' and will not exceed 1/8" within a 2' span.

2945 Washington Ave. St. Louis, MO 63103
877-783-6774 | sales@darwinchambers.com
www.darwinchambers.com

INCUBATOR / WARM ROOMS

Our walk-in incubators offer reliable, efficient environmental controls for a variety of applications, including: microbiology, life science, drosophila-rearing, mosquito rearing, insect Incubation, stock storage, biologic culture incubation and ALAAC, OLAW, USDA, NIH-compliant vivariums.

Benefits

- Temperature conditioning system can be serviced or relocated quickly, due to a pre-charged and self-contained design.
- Available high temperature decontamination.
- Heat provided to incubators through one of three ways: ambient heat, hot-gas bypass refrigeration, or electric heat.
- Temperature ranges from 5° C to 60° C, 15° C to 37° C, 32° C to 60° C, etc.
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.
- ADA compliance available with no additional cost to the customer.
- Conditioning System Features: quick installation, extended reliability, efficient operation, precision control, simple servicing, low GWP, and low total cost of ownership.

Standard Features

- 4-6" Polyurethane Insulated Panels
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature And Humidity Uniformity
- Temperature Control At Sensor / Set-Point: ±0.2° C
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Energy Efficient Offering Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- Controls with Auto-tuning, Fuzzy Logic

Optional Features

- Humidity Control At Sensor: ±0.5%.
- Added Dehumidification and/or Ultrasonic Humidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning
- Stainless Steel Construction
- Data Logging
- Water-Cooled Or Air-Cooled Condensers
- Custom Lighting Systems
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touch Screen Control Interface
- Electronic Door Lock with Data-Logged Access
- High Temperature Decontamination

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

DARWIN CHAMBERS

DESIGN SPECIFICATION

——— Incubator/Warm Rooms ———

CONTROLLED ENVIRONMENT ROOMS

SECTION ONE • GENERAL INFORMATION

1.0 SCOPE OF WORK

1.1 General Provisions

1.1.1 Controlled Environmental Rooms (referred to as "CER's" or "chambers") shall be prefabricated, all metal clad construction; to be furnished and installed as a complete self- contained unit and system, including all essential plenums, mechanical equipment, controls, and all equipment necessary to maintain the specified environmental conditions.

1.1.2 Factory-trained technicians will deliver chamber components to their final location and complete assembly of chambers in place.

1.1.3 The Controlled Environmental Room Provider (hereinafter referred to as the "Manufacturer") will furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices that comprise an integral part of each chamber.

1.1.4 Start-up and field testing will be performed by Manufacturer's trained technicians.

1.1.5 Supportive documentation and training shall be supplied by Manufacturer as specified.

1.1.6 Additional services will be provided, as applicable, as documented and agreed by contract or formal service agreement.

1.1.7 CER types included here are Incubator Rooms.

1.1.8 All major components are assembled and factory tested prior to delivery, including air handlers, condensers, and control panels. Documentation of factory testing will be available to owner or architect upon request.

2.0 QUALITY ASSURANCE

2.1 Reference Standards

2.1.1 All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers or air-cooled condensers, humidification/dehumidification equipment, and control panel assemblies.

2.1.2 The latest published edition and applicable addenda of a reference apply:

- ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems
- ANSI/ASHRAE Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings.
- /AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery
- Unit Coolers for Refrigeration
- ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement

- Refrigerant Compressors and Compressor Units
    - ANSI - B9.1 Safety Code for Mechanical Refrigeration
    - UL–723 Test for Surface Burning Characteristics of Building Materials.
    - NFPA - 70 National Electric Code.
    - NFPA - 79 Electrical Standard for Industrial Machinery.

2.1.3 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

- All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration per ASTM E-283.
- Foam insulation is to be of a non-flammable, non-flame supporting grade with a "K" value of 0.118 BTU / hour / foot squared / degrees Fahrenheit / inch in accordance with ASTM C518.
- Insulation shall have a minimum 97% closed cell structure and “R” factor shall be 31 or greater in a thickness of 4 inches – values in accordance with ASTM C-236/C- 1363 methods.

2.2 Manufacturer Qualifications

2.2.1 The Manufacturer shall have had not less than ten (10) years of successful and regular production of components/equipment used for this Project.

2.2.2 Manufacturer of CER systems shall have been in satisfactory operation on at least 50 similar installations for not less than five (5) years.

2.2.3 The Manufacturer shall be capable of providing service with a 12-hour notification during normal business hours Monday-Friday. Critical after-hours and weekend response time shall be a maximum of 24 hours upon notification.

2.2.4 Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the Architect/Engr. does not have to expend unnecessary time during evaluation.

2.2.5 The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. Additionally, the enclosure must be NSF-approved.

2.2.6 The Manufacturer shall inventory factory parts (or a fully compatible upgrade) for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in Manufacturer’s direct employ to assure the Owner of reliable service.

2.3 Accepted Manufacturers

2.3.1 Darwin Chambers Company, LLC—St. Louis, Missouri—Phone 877-783-6774

2.3.2 Other, in demonstrated compliance with the qualifications set forth within this document.

2.4 Warranty

2.4.1 Mechanical refrigeration equipment, parts, and labor will be guaranteed in written form for a minimum period of one year from the date of chamber start-up and continuous normal operation. The warranty will guarantee that the chamber(s) will:

- Maintain within the specified tolerance, the selected temperature.

- Be free from condensate on the outside of the chamber.
- Be free from defects due to faulty materials or workmanship.
- All Parts and labor will be guaranteed in written form from the date of chamber start-up and continuous normal operation, or upon Owner acceptance of certifications and functional test results, whichever is first.

2.4.2 Additionally, written warranties shall be provided covering defects in material, workmanship and performance for the following items, per the following schedule:

- Enclosures: Ten year warranty covering all items connected with the enclosure, including panels, doors and door hardware.
- Dehumidifier (as applicable): Three year warranty.
- Compressor(s)(as applicable), Control Panel: Five year warranty.

2.5 Installation/Training

2.5.1 Chamber Manufacturer will provide highly skilled, factory-trained personnel to perform and oversee installation of chamber enclosure and all components.

2.5.2 Services of a factory-trained technician will be made available for one man-day, minimum, to tune controls and instruct the owner on proper usage and care.

2.6 Testing

2.6.1 An inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with.

2.6.2 Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.0 PRODUCT DATA

3.1 Room Schedule/Operation

Environmental Incubation Room, designation #_____
Chamber Operation:

Chamber temperature range: _____°C, ±_____°C (throughout storage area)

Chamber humidity range (as applicable): _____%RH, ±_____%RH (throughout storage area)

Operational set-point(s): _____°C, (at _____%RH); _____°C, (at _____%RH);

Chamber size, exterior (actual):_____W x _____L x _____H

3.2 Submittals

3.2.1 Shop Drawings shall be supplied prior to the commencement of manufacture.

3.2.2 Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The drawings shall include enclosure layout, elevations, dimensions, types and locations of connections and openings, and other pertinent construction and erection details including routing and diameter of refrigeration tubing and coil condensate drain.

3.2.3 Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (ducts, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.

3.2.4 Indicate performance requirements, which include, as a minimum, humidification, dehumidification, cooling, and heating parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.

3.2.5 Provide electrical plan showing all power connections to lighting and equipment, the voltage, amperage, and kW load for each circuit, and control and power wiring schematic.

3.2.6 Submit one sample of wall mounted control panel, if not manufactured by one of the CER Manufacturers listed under Quality Assurance, item 2.3.

3.2.7 Functional Performance Test/Report

- Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.2.8 Operations Manual

- A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics. The data shall include, but is not limited to the following:
    - Shop drawings and wiring diagrams
    - System components and parts descriptions
    - Operating sequences, procedures, instructions, and/or theory of operation
    - Specific maintenance and troubleshooting instructions
    - Recommended service schedule. Include maintenance schedules for each component part of the systems furnished in this section
    - Recommended spare parts inventory
    - Name and contact information for service provider
    - Warranty; to be provided in written form upon delivery, for each chamber

3.3 Delivery, Storage, and Handling

3.3.1 Compliance with Manufacturer's recommendations regarding handling and storage of all environmental chamber components before and during construction is mandatory.

3.3.2 Coordinate with other trades affecting, or affected by this work, to assure the steady progress of all work performed under the contract. Closely coordinate the delivery and installation of this work with the Contractor's schedule.

SECTION TWO • CONSTRUCTION AND DESIGN

4.0 MATERIAL CONSTRUCTION

4.1 General

4.1.1 Rooms will be furnished as complete functional units with all essential components, piping, control systems, and complete conditioning systems as required to satisfy environmental conditions as specified.

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4.2 Panel Construction

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4.2.2 Corner panels shall be 90¼ angles with actual 12” exterior horizontal measurements. Nominal 1' and 3' panels shall be used if required to meet job site conditions, and all are gauged for uniformity in size.

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4.3.3 If floorless, CER shall be installed on customer-provided recessed slab.

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4.3.6 Floor depth shall be a nominal 4 inches. Additional reinforcements and insulation may add to depth, and are provided as custom. Standard floor surface finishes include smooth aluminum or 300 Series stainless steel. Other depths, finishes, textures, coatings, and coverings are available upon request.

4.4 Ceiling Construction

4.4.1 The ceiling will be an industry standard CER type; smooth interior surface finish to match adjacent interior wall panels. LEED EBOM-friendly ceiling structure will be free of unnecessary crevices and obstructions. Where required, support hangers or other reinforcements may be utilized in order to ensure structural integrity. Construction of ceiling will be adequate to support top-mounted mechanical equipment and personnel.

4.5 Door Construction

4.5.1 The door will be an in-fitting, swinging, flush-mounted type, and will have the same metal finish and insulation as adjacent walls. A thermoplastic gasket with a magnetic core will be mounted on the top edge and along both sides of the door that will keep the door closed and form a tight seal. Door gaskets shall be NSF-approved. Construction of door panel will include a welded heavy-duty "U" channel-type reinforced steel frame around the entire perimeter of the door opening to prevent rocking or twisting.

- Standard size 36” W x 80” H. (Most custom sizes/types available upon request.)
- Anti-condensate heater wires shall be concealed behind the metal edge of the doorjamb on all four sides.
- Heaters will be connected to a temperature switch or controller to automatically provide sufficient heat to eliminate condensation and frost under various ambient humidity conditions.
- The door will use a minimum of two cam-lift, self-closing hinges. The door latch will be designed to open the door easily by breaking the magnetic force of the door gasket. The latch will have a key lock, and include an interior safety release handle to prevent accidental lock-in. Door hardware will be satin-finish aluminum or chrome-plated.

5.0 CONTROLS AND INSTRUMENTATION

5.1 Control Console

5.1.1 Chamber Manufacturer shall provide a control console incorporating a key-locked acrylic or Lexan door for viewing and protecting the settable controls. Protection Classifications: IP 65 to EN 60529, NEMA 12, including see-through door. The console will be mounted on the chamber exterior, next to the door if possible. The console includes all instruments, controls, switches, indicator lights, alarms, and alarm contacts. The electrical control enclosure is labeled/listed by a certified National Testing Lab.

5.2 Control Systems

5.2.1 Controllers shall be Self-Tuning Microprocessor-Based PID Controls with Dual Digital LED Readout of process variables. This allows for continuous display of the both the set-point and chamber condition. Controller set-up data will be stored in non-volatile memory and retain settings upon power loss without the use of batteries. Independent controllers will be used to control the chamber temperature and humidity.

5.2.2 Temperature and/or humidity control will utilize solid-state microprocessor-based digital controllers with RTD sensing. Sensitivity of the sensor will not be less than 0.1°C and/or 0.1%RH, throughout range. Sensors will be located to detect the average temperature within the chamber.

5.2.3 Temperature and/or humidity set points shall be set through simple arrow keys on the chamber microprocessor controls. The controllers will simultaneously display both actual and set-point variables. The temperature control system will allow for the operation of the resistance heating elements or hot gas bypass valves through solid state relays (SSR's) according to the controller output. This feature will provide for reducing the total operating cost of the chamber while still providing for the use of the heaters for rapid recovery from an upset in chamber temperature or load.

5.3 Independent High and Low Alarms

5.3.1 Independent High/Low alarms for temperature will have SPDT contacts for remote alarm monitoring or phone dialers. Separate alarms for high and low operating temperatures shall be provided. The alarm set-points will be digital, in degrees Celsius and Percent RH.

5.3.2 The contacts will switch upon an alarm condition. Each alarm will have an adjustable delay period of 0-150 minutes before alarm action will occur. The remote alarm contacts will be wired into the control panel terminal block and be ready for hook-up to customer monitoring devices. Remote alarm contacts (relays) will be plug-in replaceable and will have both the NC and NO contacts available. The audible alarm will have a time-delayed silence of 0-60 min.

5.3.3 Integration/connection to existing BMS (Building Maintenance Systems) and other services, is available as a custom option.

5.4 Control and Switch Functions

5.4.1 All will be clearly labeled with non-fading polycarbonate labels requiring no stamping or silkscreen markings that wear off.

5.4.2 All control relays and indicators are solid state for long life and reliability.

5.4.3 All program menus will be logically arranged for intuitive operation.

5.5 Data Recording

5.5.1 Where specified, either a data-logging equipment bundle or else a 10" recorder, with switch-selectable 24-hour or 7-day chart movement, shall be provided. Recorders will utilize a 10" circular chart and will be mounted in the control panel. Recorder accuracy to be ± 1%, full scale (Honeywell DR4300 or equivalent).

5.6 Additional Components

5.6.1 Accurate and NIST-traceable temperature sensing using platinum Resistance

5.6.2 Temperature Detectors will be used for control and recording instruments.

5.6.3 NIST-traceable Rotronic HygroClip RH sensor and controller with calibration certificate.

5.6.4 Single point chamber power connection with over-current protection will be provided in the control panel for all power components.

5.6.5 All wiring will be identified with permanent labels for efficient troubleshooting.

5.6.6 Plug-in components will be used wherever feasible.

5.6.7 All components will be mounted on a DIN rail inside the control console for simple retrofit, repair, and diagnosis.

6.0 COOLING EQUIPMENT

6.1 Compressor/Condensing Unit (If Applicable)

6.1.1 The compressor/condensing unit will consist of an air-cooled or water-cooled compressor of the appropriate size to provide performance as specified herein.

6.1.2 The compressor/condensing unit will provide safe and reliable operation in its location on top of the CER. All components of the condensing unit will be designed for 125 psi working pressure or 150% of maximum operating pressure; whichever is greater.

6.1.3 The unit will have a minimum of a crankcase pressure regulator, accumulator, vibration absorbers if applicable and thermal protection. Cycling solenoids or fully proportional refrigeration bypass valves will be used in the hot gas line. Isolation solenoids are acceptable for pump down only in the liquid and hot gas line. The condensing unit will be designed for continuous operation for maximum compressor life, to eliminate on and off cycling and to resist RF interference.

6.1.4 Water-cooled units will be provided with water regulating valves to maintain head pressure. The compressor/condensing unit will be linked to an evaporator of matching capacity in one of the following three types of conditioning designs. Refrigerant type will be R-134A or R-404A, unless specified otherwise.

6.1.5 The condensing unit will have a single point electrical connection terminating with a fused disconnect switch as the connection point.

6.2 Conditioning Type

6.2.1 The air-handler will be of copper tube/aluminum fin or copper tube/copper fin and stainless steel coil endplate construction to prevent corrosion as specified.

6.3 Sub-Assembly Quality Control

6.3.1 For systems incorporating the Darwin PFTCU (Precision Fluid Temperature Control Unit), Quality Control testing is completed and documented at the point of manufacture, and the assembled unit (as a closed system) may be shipped with refrigerant, ready for installation by field personnel—without the requirement of a licensed HVAC technician at the installation site.

6.3.2 Otherwise, the above mentioned sub-assemblies (condensing unit, air-handler/evaporator) are evacuated to 500 microns and held at this condition for five hours prior to pre-charging with 150 psig of dry nitrogen. The units are tagged with dry nitrogen charge pressure, temperatures, date, and testing technician's initials. The units are shipped and installed with the "tagging" procedure intact. Upon start up, the nitrogen charge is evacuated and the units are charged with refrigerant. Field installation personnel can readily determine if shipping damage has occurred by comparing the recorded "tag" pressure with current system pressure.

6.4 Refrigerant Piping

6.4.1 Piping carrying refrigerant will be Type L ACR copper with copper fittings. 15% Silver solder or DynaFlow will be used for all joints. Condensate drain lines on chambers above 0.0°C will be PVC or copper tubing. Piping for condensing unit water will be Type L copper.

6.5 Insulation

6.5.1 Suction and hot gas refrigeration lines will be insulated with closed-cell foam plastic similar to "Armaflex" or an equivalent.

6.5.2 The material will be tubular in form, and sized in accordance with the pipe size. Insulation thickness will be a minimum of ½" for cold rooms and warm rooms, and ¾" for freezers. Joints will be thoroughly bonded by the adhesive recommended by the insulation.

6.5.3 Manufacturer and will meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates, all edges will be sealed to the pipe with sealant. The condenser inlet water line will be insulated with closed-cell foam plastic insulation.

6.6 Performance

6.6.1 Temperature Uniformity: Chambers will have a defined temperature uniformity across the work surface 40" off the floor and to within 6" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with thermocouple or RTD sensing. Control Temperature Tolerance: ± 0.2°C.

6.6.2 Door Opening Recovery Period: Following a fifteen second door opening, the chamber temperature will recover within three minutes. Specified Temperature (typical): 15°C to 40°C. Specified Uniformity: ± 0.5°C on a horizontal plane 40" above chamber floor.

6.6.3 Humidity Uniformity: Chambers will have a defined humidity uniformity across the work surface 40" off the floor and to within 6" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with RH sensing.

6.7 System Capacity

6.7.1 Refrigeration and heating systems will be capable of operation as specified, without running at full capacity, more than 80% of the time under the following conditions:

- Temperature and humidity specifications assume standard operation in a controlled ambient condition of 72°F, ±8°F and a dew-point at or below 52°F.
- Up to four door-opening events per hour.
- An additional electrical load of five watts per sq. ft. of floor area.

7.0 ACCESSORIES / COMPONENTS

7.1 Shelving

7.1.1 Shelving, when specified, will be removable and adjustable. Freestanding shelving will be provided, unless otherwise specified. Shelving will be adjustable on a minimum of 2" centers, four-tier and utilize four 74"or 86" posts. All shelving will be removable without special tools and will typically be constructed of stainless steel or epoxy-coated plated steel, with a guarantee of a minimum of five years corrosion resistance.

7.1.2 Shelving will be open wire unless specified otherwise. Leveling shims/screws will be provided at the base of the posts of freestanding shelving units.

7.2 Humidification

7.2.1 Where specified, humidification shall be provided by a vapor-producing ultrasonic humidifier, for optimal uniformity and efficiency. UV disinfection shall be incorporated into the humidifier to reduce potential for propagation of bacteriological contaminants.

7.2.2 Humidification control may be achieved via microprocessor controller, for relatively tight control, or via (manual) mechanical control, for those applications with only a very loose RH uniformity/tolerance requirement.

7.3 Dehumidification

7.3.1 As applicable, dehumidification shall be achieved via refrigerated, compressed air, or heat-regenerating desiccant drier, as required to maintain operation as specified.

7.4 Wiring

7.4.1 Interconnecting wiring will be installed in UL Listed PVC conduit within room, and UL listed EMT outside of room. Conduit will be a minimum of ½" trade size, as applicable.

7.5 Lighting

7.5.1 Unless otherwise specified, Chamber Manufacturer will provide vapor-proof fluorescent lighting.

- Housings will be corrosion-resistant fiberglass or ABS plastic. Fixtures feature a clear prismatic acrylic lens with closed-cell neoprene gasketing bonded to the housing to form a continuous seal for the lens, with cam latches to clamp the lens (diffuser) to the housing.
- Light levels in chambers to be 70 fc. min., as measured at 40" above the floor.

7.5.2 Diurnal/Controlled Lighting: Where specified, Chamber Manufacturer will provide independent control of lighting, typically for simulation of diurnal light conditions.

- Available light control options include, but are not limited to; microprocessor control of timed dimming, staggered, or on/off conditions, manual time-clock or switched control of staggered or on/off conditions, and stability enhancement of available natural light.

- Available lighting options include, but are not limited to; LED or fluorescent lamps in full or partial spectrum and intensity as specified. 48” T8 vapor-proof florescent lamps are provided as standard for most rooms.

7.6 Observation Windows

7.6.1 Standard observation windows, when included, shall be centered on door or panel at standard (view) height, unless otherwise specified. Standard size is 14” W x 14” H). Other sizes are available as custom, as door or panel sizing permits. The window will consist of a minimum two to three panes of low-e glass with sealed air spaces between them.

7.7 Sleeves/Pass-through Ports

7.7.1 Sleeves for service piping, gas line cables, and drain water lines will be cylindrical in cross section, formed of 1/8" or 3/16" PVC and sealed to the chamber enclosure from both ends with silicone sealant. Sleeves will be of sufficient size to allow a least 1/8" clearance around the service line. The void between service lines and the sleeves inside and out will be sealed with sealant that remains flexible. Caps will be provided to seal pass-throughs used for equipment line passage when not in use.

7.8 Ventilation Systems

7.8.1 Incubator rooms will be provided with exhaust fans and filtered air intakes for the following ventilation rate: One air change per hour, minimum, with conditioned air from surrounding space or air handler.

7.8.2 Conditioned make-up air will be brought into the chamber through an air intake housing fitted with a filter frame and replaceable filter. The intake will be both adjustable and capable of being fully closed.

SECTION THREE • REQUIREMENTS

8.0 MANUFACTURER REQUIREMENTS

8.1 Installation

Deliver and install the chamber and all conditioning equipment to achieve performance as outlined. The chamber conditioning equipment, lighting, and internal electrical wiring will be interconnected. The chamber will be started and field-tested by Chamber Manufacturer prior to project completion.

Seal joints and openings, including penetrations for piping or electrical wiring, in the outside and inside faces of walk-in refrigerated storage construction. Adjust all room mechanical, electrical and hardware components, and clean exposed surfaces after installation.

8.2 Testing

Inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with. All costs related to testing are included in the contract sum.

CER Manufacturer shall comply with the following requirements, at minimum:

8.2.1 General: Provide all instrumentation and equipment as needed for testing, and perform the specified performance and acceptance tests.

8.2.2 Control temperature set-point: Measure and record room temperature during a continuous 24-hour test period. The room(s) shall maintain the given temperature set-point within ±1.0°C, unless otherwise specified.

8.2.3 Temperature gradient: Measure and record room temperature during a continuous 24-hour test period. Verify that the maximum temperature gradient from floor to ceiling does not exceed 1.0°C.

8.2.4 Temperature uniformity: Measure and record temperature uniformity during a continuous 24-hour test period, as previously described. Temperature uniformity shall be ±0.5°C, unless specified otherwise.

8.2.5 Recovery test: Perform recover test as described previously. All rooms, except for freezers shall recover within 5 minutes.

8.2.6 Internal load test: Each room shall maintain temperature within ±1.0°C of set-point when operating with the specified number of people, make up ventilation air, and internal heat gain from lighting and equipment.

8.2.7 Rooms with relative humidity control shall be tested for humidity control performance and recovery as applicable and/or agreed.

8.2.8 Documentation: CER Manufacturer shall submit written reports of all tests. Reports shall indicate testing procedures followed, instruments used, and tabulation of results.

8.2.9 Witnessing of test: Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representatives in writing at least 10 days prior to conducting tests.

9.0 SITE REQUIREMENTS

Chamber Manufacturer is not responsible for altering existing building or design conditions or pulling in mechanical services for equipment.

9.1 Electrical

Electrical contractor will provide fused disconnects for each condensing unit, as applicable, and connection to condensing unit junction box at a location as directed by Manufacturer. Chamber control panel and interior receptacles will require junction boxes by others.

9.2 Water (Humidity Systems)

As applicable, Darwin Chambers Co. recommends Conductivity of > 0.1µS, TDS of < 10 ppm at 1-10 Pounds per Square Inch (PSI) of water pressure.

9.3 Plumbing

The plumbing contractor or Owner will provide water supply and return to water-cooled condensing units, water supply and waste disposal site for humidification unit, all services and connections to casework within chamber, and floor drain connections. All final connections to equipment will be made by Owner as directed by Manufacturer.

9.4 Drain Site

Chamber Manufacturer will run condensate drain line to sink drain within chamber(s) or to floor drain outside of chambers and within 5 feet or as specified.

9.5 Level Floor

Owner will provide for Manufacturer, a level floor as a base for the prefabricated chamber floor. Floor will not exceed 3/8" in 10' and will not exceed 1/8" within a 2' span.

2945 Washington Ave. St. Louis, MO 63103
877-783-6774 | sales@darwinchambers.com
www.darwinchambers.com

COLD ROOMS

Our walk-in cold rooms offer reliable, efficient environmental controls for a variety of applications; including: GMP Storage and Cold Storage for Seed and Agricultural Products, Nutritional Supplements, and more. Our cold rooms are typically supplied with desiccant or refrigeration based dehumidification in order to maintain a low dew-point and prevent ice accumulation on both product and equipment surfaces. Typical temperatures for our cold rooms range from of 0° C to 10° C.

Benefits

- Tight temperature control for reliability and accuracy
- Tight temperature uniformity of ±.5° C or better throughout the room.
- Work with any space constraints, flexible custom applications.
- Conditioning system can be replaced or relocated quickly due to simple water-type connections.
- Precision Fluid Temperature Control Unit cooling system utilizes a combination of refrigerant technologies and glycol/water heat exchange technologies
- Eco-friendly and typically require fewer than 1000 Watts to operate
- System can be restored by a technician with no down time on the chamber.
- Special accessories that allow uninterrupted operation and great convenience.
- ADA compliance available with no additional cost to the customer.
- Simple, easy-to-use, easy-to-service control systems.
- Oversize evaporator fan coil eliminates the need for a defrost at 4° C or more.
- Smooth ceiling, aluminum or steel, for optimal performance over competitors who use egg crate ceiling. Egg crate ceilings promote mold growth, difficult to service equipment, difficult to clean, and interfere with lighting and airflow.
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.

Standard Features

- 4" to 6" Polyurethane Foam Insulated Panels, R- Value 31+ or Higher
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature Uniformity
- Temperature Control At Sensor / Set-Point: ±0.2° C
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Energy Efficient Offering Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- Corrosive Resistant Equipment
- Precision Sizing
- Diurnal Cycling Temperature

Optional Feature

- Added Dehumidification and/or Ultrasonic Humidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning system
- Data Logging
- Water-Cooled Or Air-Cooled Condensers
- Custom Lighting Systems
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touchscreen Control Interface

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

DARWIN CHAMBERS

DESIGN SPECIFICATION

COLD ROOMS

CONTROLLED ENVIRONMENT ROOMS

SECTION ONE • GENERAL INFORMATION

1.0 SCOPE OF WORK

1.1 General Provisions

1.1.1 Controlled Environmental Rooms (referred to as "CER's" or "chambers") shall be prefabricated, all metal clad construction; to be furnished and installed as a complete self- contained unit and system, including all essential plenums, mechanical equipment, controls, and all equipment necessary to maintain the specified environmental conditions.

1.1.2 Factory-trained technicians will deliver chamber components to their final location and complete assembly of chambers in place.

1.1.3 The Controlled Environmental Room Provider (hereinafter referred to as the "Manufacturer") will furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices that comprise an integral part of each chamber.

1.1.4 Start-up and field testing of chambers will be performed by Manufacturer's trained technicians.

1.1.5 Supportive documentation and training shall be supplied by Manufacturer as specified.

1.1.6 Additional services will be provided, as applicable, as documented and agreed by contract or formal service agreement. General Provisions.

1.1.7 CER types included here are Cold Rooms (Walk-In Coolers).

1.1.8 All major components are assembled and factory tested prior to delivery, including air handlers, condensers, and control panels. Documentation of factory testing will be available to owner or architect upon request.

2.0 QUALITY ASSURANCE

2.1 Reference Standards

2.1.1 All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers or air-cooled condensers, and control panel assemblies.

2.1.2 The latest published edition and applicable addenda of each reference apply:

- ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems
- ANSI/ASHRAE Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings.
- /AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery
- Unit Coolers for Refrigeration
- ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement

- Refrigerant Compressors and Compressor Units
    - ANSI - B9.1 Safety Code for Mechanical Refrigeration
    - UL–723 Test for Surface Burning Characteristics of Building Materials.
    - NFPA - 70 National Electric Code.
    - NFPA - 79 Electrical Standard for Industrial Machinery.

2.1.3 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

- All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration per ASTM E-283.
- Foam insulation is to be of a non-flammable, non-flame supporting grade with a "K" value of 0.118 BTU / hour / foot squared / degrees Fahrenheit / inch in accordance with ASTM C518.
- Insulation shall have a minimum 97% closed cell structure and minimum “R” factor shall be 31+ (values in accordance with ASTM C-236/C-1363 methods).

2.2 Manufacturer Qualifications

2.2.1 The Manufacturer shall have had not less than ten (10) years of successful and regular production of components/equipment used for this Project.

2.2.2 Manufacturer of CER systems shall have been in satisfactory operation on at least 50 similar installations for not less than five (5) years.

2.2.3 The Manufacturer shall be capable of providing service with a 12-hour notification during normal business hours Monday-Friday. Critical after-hours and weekend response time shall be a maximum of 24 hours upon notification.

2.2.4 Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the Architect/Engr. does not have to expend unnecessary time during evaluation.

2.2.5 The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. Additionally, the enclosure must be NSF-approved.

2.2.6 The Manufacturer shall inventory factory parts (or a fully compatible upgrade) for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in Manufacturer’s direct employ to assure the Owner of reliable service.

2.3 Accepted Manufacturers

2.3.1 Darwin Chambers Company, LLC—St. Louis, Missouri—Phone 877-783-6774

2.3.2 Other, in demonstrated compliance with the qualifications set forth within this document.

2.4 Warranty

2.4.1 Mechanical refrigeration equipment, parts, and labor will be guaranteed in written form for a minimum period of one year from the date of chamber start-up and continuous normal operation. The warranty will guarantee that the chamber(s) will:

- Maintain within the specified tolerance, the selected temperature.

- Be free from condensate on the outside of the chamber.
- Be free from defects due to faulty materials or workmanship.
- All Parts and labor will be guaranteed in written form from the date of chamber start-up and continuous normal operation, or upon Owner acceptance of certifications and functional test results, whichever is first.

2.4.2 Additionally, written warranties shall be provided covering defects in material, workmanship and performance for the following items, per the following schedule:

- Enclosures: Ten year warranty covering all items connected with the enclosure, including panels, doors and door hardware.
- Compressor(s), Control Panel: Five year warranty.

2.5 Installation/Training

2.5.1 Chamber Manufacturer will provide highly skilled, factory-trained personnel to perform and oversee installation of chamber enclosure and all components.

2.5.2 Services of a factory-trained technician will be made available for one man-day, minimum, to tune controls and instruct the owner on proper usage and care.

2.6 Testing

2.6.1 An inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with.

2.6.2 Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.0 PRODUCT DATA

3.1 Room Schedule/Operation

Environmental Room, designation #_____
Chamber Operation:

Chamber temperature range: _____°C, ±_____°C (throughout storage area)

Operational set-point: _____°C; control at sensor: ± _____°C.

Chamber size, exterior (actual):_____W x _____L x _____H

3.2 Submittals

3.2.1 Shop Drawings shall be supplied prior to the commencement of manufacture.

3.2.2 Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The Drawings shall include enclosure layout, elevations, dimensions, thicknesses, types and locations of connections and openings, and other pertinent construction and erection details including the routing and diameter of refrigeration tubing and coil condensate drain.

3.2.3 Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (duct, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.

3.2.4 Indicate performance requirements, which include, as a minimum, cooling and heating parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.

3.2.5 Provide electrical plan showing all power connections to lighting and equipment, the voltage, amperage, and kW load for each circuit, and control and power wiring schematic.

3.2.6 Submit one sample of wall-mounted control panel, if not manufactured by one of the CER Manufacturers listed under Quality Assurance, item 2.3.

3.2.7 Functional Performance Test/Report

- Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.2.8 Operations Manual

- A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics. The data shall include, but is not limited to the following:
    - Shop drawings and wiring diagrams
    - System components and parts descriptions
    - Operating sequences, procedures, instructions, and/or theory of operation
    - Specific maintenance and troubleshooting instructions
    - Recommended service schedule. Include maintenance schedules for each component part of the systems furnished in this section.
    - Recommended spare parts inventory
    - Name and contact information for service provider
    - Warranty; to be provided in written form upon delivery, for each chamber

3.3 Delivery, Storage, and Handling

3.3.1 Compliance with Manufacturer's recommendations regarding handling and storage of all environmental chamber components before and during construction is mandatory.

3.3.2 Coordinate with other trades affecting, or affected by this work, to assure the steady progress of all work performed under the contract. Closely coordinate the delivery and installation of this work with the Contractor's schedule.

3.3.3 Manufacturer shall replace any panels or components damaged during shipment, storage, or handling with new, identical, factory-supplied components.

SECTION TWO • CONSTRUCTION AND DESIGN

4.0 MATERIAL CONSTRUCTION

4.1 General

4.1.1 Rooms will be furnished as complete functional units with all essential components, piping, control systems, and complete conditioning systems as required to satisfy environmental conditions as specified.

- The CER will be delivered in sections designed to pass without interference through standard doorways.
- All metal and other materials will be shaped and sized as required, with all angles sharp and true. All surfaces will be finished smooth. Punching and shearing will be neatly done. Permanent connections will be welded, riveted, or bolted, with all exposed welds ground smooth and flush with adjacent surfaces.

4.2 Panel Construction

4.2.1 Standard wall panels shall be nominal 4’ in width and 4” thick, designed to be interchangeable.

4.2.2 Corner panels shall be 90¼ angles with actual 12” exterior horizontal measurements. Nominal 1' and 3' panels shall be used if required to meet job site conditions, and all are gauged for uniformity in size.

4.2.3 Edges of panels shall be tongue and groove with locking facilities foamed-in-place at time of fabrication. Rigidity and uniformity shall meet or exceed industry accepted standards and panel interior construction shall be fabricated to deter biodegradation and moisture retention. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.

- Panel Surfaces: (Standard) Interior, white embossed aluminum. Exterior, white embossed galvanized steel.
- Panel locking shall be accomplished by foamed-in-place locking assemblies.
- Panels are all 100% poured-in-place polyurethane construction, R-Value 31+.

4.3 Floor Construction

4.3.1 Rooms may be provided with or without floor panels.

4.3.2 Wall panels will be flat bottom and secured to floor on 24” centers.

4.3.3 If floorless, CER shall be installed on customer-provided recessed slab.

4.3.4 Vinyl screeds shall be utilized, coved on both sides, to rest level with the floor.

4.3.5 Insulated floors shall be similar in construction to wall and ceiling panels. Standard floors are designed to accommodate up to 600 lbs. per square foot of evenly distributed weight.

4.3.6 Floor depth shall be a nominal 4 inches. Additional reinforcements and insulation may add to depth, and may be provided as custom. Standard floor surface finishes include smooth aluminum or 300 Series stainless steel. Other depths, finishes, textures, coatings, and coverings are available upon request.

4.4 Ceiling Construction

4.4.1 The ceiling will be an industry standard CER type; smooth interior surface finish to match adjacent interior wall panels. LEED EBOM-friendly ceiling structure will be free of unnecessary crevices and obstructions. Where required, support hangers or other reinforcements may be utilized in order to ensure structural integrity. Construction of ceiling will be adequate to support top-mounted mechanical equipment and personnel.

4.5 Door Construction

4.5.1 The door will be an in-fitting, swinging, flush-mounted type, and will have the same metal finish and insulation as adjacent walls. A thermoplastic gasket with a magnetic core will be mounted on the top edge and along both sides of the door that will keep the door closed and form a tight seal. Door gaskets shall be NSF-approved. Construction of door panel will include a welded heavy-duty "U" channel-type reinforced steel frame around the entire perimeter of the door opening to prevent rocking or twisting.

- Standard size 36” W x 80” H. (Most custom sizes/types available upon request.)
- Anti-condensate heater wires shall be concealed behind the metal edge of the doorjamb on all four sides.
- Heaters will be connected to a temperature switch or controller to automatically provide sufficient heat to eliminate condensation and frost under various ambient humidity conditions.
- The door will use a minimum of two cam-lift, self-closing hinges. The door latch will be designed to open the door easily by breaking the magnetic force of the door gasket. The latch will have a key lock, and include an interior safety release handle to prevent accidental lock-in. Door hardware will be satin-finish aluminum or chrome-plated.

5.0 CONTROLS AND INSTRUMENTATION

5.1 Control Console

5.1.1 Chamber Manufacturer shall provide a control console incorporating a key-locked acrylic or Lexan door for viewing and protecting the settable controls. Protection Classifications: IP 65 to EN 60529, NEMA 12, including see-through door. The console will be mounted on the chamber exterior, next to the door if possible. The console includes all instruments, controls, switches, indicator lights, alarms, and alarm contacts. The electrical control enclosure shall be labeled/listed by a certified National Testing Lab.

5.2 Control Systems

5.2.1 Unless specified otherwise, controllers shall be self-tuning microprocessor-based PID controls with dual digital LED readout of process variables, allowing for continuous display of both set-point and actual conditions. Controller set-up data will be stored in non-volatile memory and retain settings upon power loss without the use of batteries.

5.2.2 Temperature control shall utilize a solid-state microprocessor-based digital controller with RTD sensing. Sensitivity of the sensor will not be less than 0.1°C throughout the range. Sensors will be located to detect the average temperature within the chamber.

5.2.3 Temperature set points shall be set through simple arrow keys on the chamber microprocessor controller. The temperature control system will allow for the operation of resistance heating elements or hot gas bypass valves through solid state relays (SSR’s) according to controller output. This feature will provide for reducing the total operating cost of the chamber while still providing for the use of the heaters for rapid recovery from an upset in chamber temperature or load.

5.3 Independent High and Low Alarms

5.3.1 Independent High/Low alarms for temperature will have SPDT contacts for remote alarm monitoring or phone dialers. Separate alarms for high and low operating temperatures shall be provided. (Typical alarm set-points are digital, in degrees Celsius.)

5.3.2 The contacts will switch upon an alarm condition. Each alarm will have an adjustable delay period of 0-150 minutes before alarm action will occur. The remote alarm contacts will be wired into the control panel terminal block and be ready for hook-up to customer monitoring devices. Remote alarm contacts (relays) will be plug-in replaceable and will have both the NC and NO contacts available. The audible alarm will have a time-delayed silence of 0-60 min.

5.3.3 Integration/connection to existing BMS (Building Maintenance Systems) and other services, is available as a custom option.

5.4 Control and Switch Functions

5.4.1 All will be clearly labeled with non-fading polycarbonate labels requiring no stamping or silkscreen markings that wear off.

5.4.2 All control relays and indicators are solid state for long life and reliability.

5.4.3 All program menus will be logically arranged for intuitive operation.

5.5 Data Recording

5.5.1 Where specified, either a data-logging equipment bundle or else a 10” recorder, with switch-selectable 24-hour or 7-day chart movement, shall be provided. Recorders will utilize a 10" circular chart and will be mounted in the control panel. Recorder accuracy to be ± 1%, full scale (Honeywell DR4300 or equivalent).

5.6 Additional Components

5.6.1 Accurate and NIST-traceable temperature sensing using platinum Resistance

5.6.2 Temperature Detectors will be used for control and recording instruments.

5.6.3 Single point chamber power connection with over-current protection will be provided in the control panel for all power components.

5.6.4 All wiring will be identified with permanent labels for efficient troubleshooting.

5.6.5 Plug-in components will be used wherever feasible.

5.6.6 All components will be mounted on a DIN rail inside the control console for simple retrofit, repair, and diagnosis.

6.0 COOLING EQUIPMENT

6.1 Compressor/Condensing Unit

6.1.1 The compressor/condensing unit will consist of an air-cooled or water-cooled compressor of the appropriate size to provide performance as specified herein.

6.1.2 The compressor/condensing unit will provide safe and reliable operation in its location on top of the CER. All components of the condensing unit will be designed for 125 psi working pressure or 150% of maximum operating pressure; whichever is greater.

6.1.3 The unit will have a minimum of a crankcase pressure regulator, accumulator, vibration absorbers if applicable and thermal protection. Cycling solenoids or fully proportional refrigeration bypass valves will be used in the hot gas line. Isolation solenoids are acceptable for pump down only in the liquid and hot gas line. The condensing unit will be designed for continuous operation for maximum compressor life, to eliminate on and off cycling and to resist RF interference.

6.1.4 Water-cooled units will be provided with water regulating valves to maintain head pressure. The compressor/condensing unit will be linked to an evaporator of matching capacity in one of the following three types of conditioning designs. Refrigerant type will be R-134A or R-404A, unless specified otherwise.

6.1.5 The condensing unit will have a single point electrical connection terminating with a fused disconnect switch as the connection point.

6.2 Conditioning Type

6.2.1 The air-handler will be of copper tube/aluminum fin or copper tube/copper fin and stainless steel coil endplate construction to prevent corrosion.

6.3 Sub-Assembly Quality Control

6.3.1 For systems incorporating the Darwin PFTCU (Precision Fluid Temperature Control Unit), Quality Control testing is completed and documented at the point of manufacture, and the assembled unit (as a closed system) may be shipped with refrigerant, ready for installation by field personnel—without the requirement of a licensed HVAC technician at the installation site.

6.3.2 Otherwise, the above mentioned sub-assemblies (condensing unit, air-handler/evaporator) are evacuated to 500 microns and held at this condition for five hours prior to pre-charging with 150 psig of dry nitrogen. The units are tagged with dry nitrogen charge pressure, temperatures, date, and testing technician's initials. The units are shipped and installed with the "tagging" procedure intact. Upon start up, the nitrogen charge is evacuated and the units are charged with refrigerant. Field installation personnel can readily determine if shipping damage has occurred by comparing the recorded "tag" pressure with current system pressure.

6.4 Refrigerant Piping

6.4.1 Piping carrying refrigerant will be Type L ACR copper with copper fittings. 15% Silver solder or DynaFlow will be used for all joints. Condensate drain lines on chambers above 0.0°C will be PVC or copper tubing. Piping for condensing unit water will be Type L copper.

6.5 Insulation

6.5.1 Suction and hot gas refrigeration lines will be insulated with closed-cell foam plastic similar to "Armaflex" or an equivalent.

6.5.2 The material will be tubular in form, and sized in accordance with the pipe size. Insulation thickness will be a minimum of ½" for cold rooms and warm rooms, and ¾" for freezers. Joints will be thoroughly bonded by the adhesive recommended by the insulation.

6.5.3 Manufacturer will meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates, all edges will be sealed to the pipe with sealant. The condenser inlet water line will be insulated with closed-cell foam plastic insulation.

6.6 Performance

6.6.1 Chambers will have a defined temperature uniformity (see preceding schedule) across the work surface 40" off the floor and to within 12" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with thermocouple, thermistor, or RTD sensing.

6.7 System Capacity

6.7.1 Refrigeration and heating systems will be capable of operation as specified, without running at full capacity, more than 80% of the time under the following conditions:

- Temperature specifications assume standard operation in a controlled ambient condition of 72°F, ±8°F and a dew-point at or below 52°F.
- Up to four door-opening events per hour.
- An additional electrical load of five watts per sq. ft. of floor area.

6.8 Automatic Defrost System

6.8.1 For rooms with set point temperatures below 4° C, provide hot gas bypass defrost with timer and fan delay switch. Set defrost initiation time and duration so that temperature increase is minimized while achieving complete removal of accumulated frost.

7.0 ACCESSORIES / COMPONENTS

7.1 Shelving

7.1.1 Shelving, where applicable, will be removable and adjustable. Freestanding shelving will be provided, unless otherwise specified. Shelving will be adjustable on a minimum of 2" centers, four-tier and utilize four 74"or 86" posts. All shelving will be removable without special tools and will typically be constructed of stainless steel or epoxy-coated plated steel, with a guarantee of a minimum of five years corrosion resistance.

7.1.2 Shelving will be open wire unless specified otherwise. Leveling shims/screws will be provided at the base of the posts of freestanding shelving units.

7.2 Dehumidification

7.2.1 Where required for efficiency and to ensure performance as specified, dehumidification of intake air shall be achieved via refrigerated, compressed air or heat-regenerating desiccant drier, as recommended by system designer or CER Manufacturer.

7.3 Wiring

7.3.1 Interconnecting wiring will be installed in UL Listed PVC conduit within room, and UL listed EMT outside of room. Conduit will be a minimum of ½" trade size, as applicable.

7.4 Lighting

7.4.1 Where specified, Manufacturer will provide vapor-proof fluorescent lighting. The housing will be corrosion-resistant fiberglass or ABS plastic. Fixtures feature a clear prismatic acrylic lens with closed-cell neoprene gasketing bonded to the housing to form a continuous seal for the lens, with cam latches to clamp the lens (diffuser) to the housing.

- Light levels in chambers to be 70 fc. min., as measured at 40" above the floor.

7.5 Observation Windows

7.5.1 Standard observation windows, when included, shall be centered on door or panel at standard (view) height, unless otherwise specified. Standard size is 14” W x 14” H). Other sizes are available as custom, as door or panel sizing permits. The window will consist of two to three panes of low-e glass with sealed air spaces between them.

7.6 Sleeves/Pass-through Ports

7.6.1 Sleeves for service piping, gas line cables, and drain water lines will be cylindrical in cross section, formed of 1/8" or 3/16" PVC and sealed to the chamber enclosure from both ends with silicone sealant. Sleeves will be of sufficient size to allow a least 1/8" clearance around the service line. Caps will be provided to seal pass-throughs used for equipment line passage when not in use.

7.7 Ventilation System

7.7.1 As applicable, ventilation supply and exhaust shall be provided on a continual basis, to achieve required air exchange rates (CFM).

SECTION THREE • REQUIREMENTS

8.0 MANUFACTURER REQUIREMENTS

8.1 Installation

Deliver and install the chamber and all conditioning equipment to achieve performance as outlined. The chamber conditioning equipment, lighting, and internal electrical wiring will be interconnected. The chamber will be started and field-tested by Manufacturer prior to project completion.

Seal joints and openings, including penetrations for piping or electrical wiring, in the outside and inside faces of walk-in refrigerated storage construction. Adjust all room mechanical, electrical and hardware components, and clean exposed surfaces after installation.

8.2 Testing

Inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with. All costs related to testing are included in the contract sum.

CER Manufacturer shall comply with the following requirements, at minimum:

8.2.1 General: Provide all instrumentation and equipment as needed for testing, and perform the specified performance and acceptance tests.

8.2.2 Control temperature set-point: Measure and record room temperature during a continuous 24-hour test period. The room(s) shall maintain the given temperature set-point within ±1.0°C, unless otherwise specified.

8.2.3 Temperature gradient: Measure and record room temperature during a continuous 24- hour test period. Verify that the maximum temperature gradient from floor to ceiling does not exceed 1.0°C.

8.2.4 Temperature uniformity: Measure and record temperature uniformity during a continuous 24-hour test period, as previously described. Temperature uniformity shall be ±0.5°C, unless specified otherwise.

8.2.5 Recovery test: Perform recovery test as described previously. All rooms, except for freezers shall recover within 5 minutes.

8.2.6 Internal load test: Each room shall maintain temperature within ±1.0°C of set-point when operating with the specified number of people, make up ventilation air, and internal heat gain from lighting and equipment.

8.2.7 Documentation: CER Manufacturer shall submit written reports of all tests. Reports shall indicate testing procedures followed, instruments used, and tabulation of results.

8.2.8 Witnessing of test: Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representatives in writing at least 10 days prior to conducting tests.

9.0 SITE REQUIREMENTS

Chamber Manufacturer is not responsible for altering existing building or design conditions or pulling in mechanical services for equipment.

9.1 Electrical

Electrical contractor will provide fused disconnects for each condensing unit, as applicable, and connection to condensing unit junction box at a location as directed by Manufacturer. Chamber control panel and interior receptacles will require junction boxes by others.

9.2 Plumbing

The plumbing contractor or Owner will provide water supply and return to water-cooled condensing units, all services and connections to casework within chamber, and floor drain connections. All final connections to equipment will be made by Owner as directed by Manufacturer.

9.3 Drain Site

Chamber Manufacturer will run condensate drain line to sink drain within chamber(s) or to floor drain outside of chambers and within 5 feet or as specified.

9.4 Level Floor

Owner will provide for Manufacturer, a level floor as a base for the prefabricated chamber floor. Floor will not exceed 3/8" in 10' and will not exceed 1/8" within a 2' span.

2945 Washington Ave. St. Louis, MO 63103
877-783-6774 | sales@darwinchambers.com
www.darwinchambers.com

MATERIAL TEST/CURE ROOMS

Our walk-in Materials Test and Cure Rooms offer reliable, efficient environmental controls for a variety of applications including shelf-life testing and storage, ceramic and concrete wet and dry cure regimens (including ASTM-compliant units), thermal shock chambers, general, medical and packaging materials.

Benefits

- Nearly unlimited Customizable options.
- Flexible configurations/room-sizes are modular and reconfigurable.
- Conformity with standards is assured.
- Air flow systems are specially engineered to meet the requirement of each individual chamber.
- With ease, our curing rooms can maintain your desired temperature and humidity, they are the ideal place for curing your cement specimens for further testing.
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.

Standard Features

- Temperature / Humidity Uniformity
- Conformity with Standards
- Non-Proprietary Controls
- Ongoing Sustainability
- Pre-tested and Pre-charged Refrigeration Systems
- No Burn Permits Required
- Remote Monitoring / Alarming
- Simple Redundancy Options
- Calibration, Validation and Preventive Maintenance

Optional Features

- Back-up control / Conditioning
- Stainless Steel and Special Surfacing
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Humidification and Desiccant Dehumidification, with UV Disinfection
- Multi-Point Digital Recording
- 4-6" Foamed Polyurethane Panels
- Water-Cooled or Air-Cooled Condensers
- Available Service Agreements
- Unlimited Door / View Window Sizing
- Can Accommodate Rapid Cycling
- 700 lbs/ft^2 Floor is Standard; High-Load
- Capacity Available to 5,000 lbs./ft2
- Evenly-Distributed Weight
- High-Density Shelving Systems
- Touch Screen Control Interface

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

DARWIN CHAMBERS

DESIGN SPECIFICATION

MATERIAL TEST/CURE ROOM

CONTROLLED ENVIRONMENT ROOMS

SECTION ONE • GENERAL INFORMATION

1.0 SCOPE OF WORK

1.1 General Provisions

1.1.1 Controlled Environmental Rooms (hereinafter referred to as "CER's" or "chambers") shall be prefabricated, all metal clad construction; to be furnished and installed as a complete self-contained unit and system, including all essential plenums, mechanical equipment, controls, and components necessary to maintain environmental conditions as specified.

1.1.2 Factory-trained technicians will deliver chamber components to their final location and complete assembly of chambers in place.

1.1.3 The Controlled Environmental Room Provider (hereinafter referred to as the "Manufacturer") will furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices that comprise an integral part of each chamber.

1.1.4 Start-up and field testing of chambers will be performed by Manufacturer's trained technicians.

1.1.5 Supportive documentation and training shall be supplied by Manufacturer as specified.

1.1.6 Additional services will be provided, as applicable, as documented and agreed by contract or formal service agreement.

1.1.7 CER types included here are Material Test and Cure Rooms.

1.1.8 All major components are assembled and factory tested prior to delivery, including air handlers, condensers, and control panels. Documentation of factory testing will be available to owner or architect upon request.

2.0 QUALITY ASSURANCE

2.1 Reference Standards

2.1.1 All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers or air-cooled condensers, humidification/dehumidification equipment, and control panel assemblies.

2.1.2 The latest published edition and applicable addenda of a reference apply:

- ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems
- ANSI/ASHRAE Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings.
- /AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery
- Unit Coolers for Refrigeration
- ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement
- Refrigerant Compressors and Compressor Units
  - ANSI - B9.1 Safety Code for Mechanical Refrigeration
  - UL–723 Test for Surface Burning Characteristics of Building Materials.
  - NFPA - 70 National Electric Code.
  - NFPA - 79 Electrical Standard for Industrial Machinery.

2.1.3 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

- All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration per ASTM E-283.
- Foam insulation is to be of a non-flammable, non-flame supporting grade with a "K" value of 0.118 BTU / hour / foot squared / degrees Fahrenheit / inch in accordance with ASTM C518.
- Insulation shall have a minimum 97% closed cell structure and “R” factor shall be 31 or greater in a thickness of 4 inches – values in accordance with ASTM C-236/C-1363 methods.

2.2 Manufacturer Qualifications

2.2.1 The Manufacturer shall have had not less than ten (10) years of successful and regular production of components/equipment used for this Project.

2.2.2 Manufacturer of CER systems shall have been in satisfactory operation on at least 50 similar installations for not less than five (5) years.

2.2.3 The Manufacturer shall be capable of providing service with a 12-hour notification during normal business hours Monday-Friday. After-hours and weekend response time shall be a maximum of 24 hours upon notification.

2.2.4 Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the Architect/Engr. does not have to expend unnecessary time during evaluation.

2.2.5 The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. Additionally, the enclosure must be NSF-approved.

2.2.6 The Manufacturer shall inventory factory parts or else a fully compatible upgrade for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in Manufacturer’s direct employ to assure the Owner of reliable service.

2.3 Accepted Manufacturers

2.3.1 Darwin Chambers Company, LLC—St. Louis, Missouri—Phone 877-783-6774

2.3.2 Other, in demonstrated compliance with the qualifications set forth within this document.

2.4 Warranty

2.4.1 Mechanical refrigeration equipment, parts, and labor will be guaranteed in written form for a minimum period of one year from the date of chamber start-up and continuous normal operation. The warranty will guarantee that the chamber(s) will:

- Maintain within the specified tolerance, the selected temperature.
- Be free from condensate on the outside of the chamber.
- Be free from defects due to faulty materials or workmanship.
- All Parts and labor will be guaranteed in written form from the date of chamber start-up and continuous normal operation, or upon Owner acceptance of certifications and functional test results, whichever is first.

2.4.2 Additionally, written warranties shall be provided covering defects in material, workmanship and performance for the following items, per the following schedule:

- Enclosures: Ten year warranty.
- Dehumidifier (as applicable): Three year warranty.
- Compressor(s): Five year warranty.

2.5 Installation/Training

2.5.1 Chamber Manufacturer will provide highly skilled, factory-trained personnel to perform and oversee installation of chamber enclosure and all components.

2.5.2 Services of a factory-trained technician will be made available for one man-day, minimum, to tune controls and instruct the owner on proper usage and care.

2.6 Testing

2.6.1 An inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with.

2.6.2 Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.0 PRODUCT DATA

3.1 Room Schedule/Operation

Environmental Stability Room, designation #_____

Chamber Operation:

Chamber temperature range: _____°C, ±_____°C (throughout storage area)

Chamber humidity range, as applicable: _____%RH, ±_____%RH (throughout storage area)

Operational set-point(s): _____°C, (at _____%RH); _____°C, (at _____%RH);

_____°C, (at _____%RH); _____°C, (at _____%RH)

Ramp rate, or regimen, as applicable: _____

Chamber size, exterior (actual):_____W x _____L x _____H

3.2 Submittals

3.2.1 Shop Drawings shall be supplied prior to the commencement of manufacture.

3.2.2 Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The Drawings shall include enclosure layout, elevations, dimensions, thicknesses, types and locations of connections and openings, and other pertinent construction and erection details including the routing and diameter of refrigeration tubing and coil condensate drain.

3.2.3 Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (duct, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.

3.2.4 Indicate performance requirements, which include, as a minimum, cooling, heating and humidification/ dehumidification parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.

3.2.5 Provide electrical plan showing all power connections to lighting and equipment, the voltage, amperage, and kW load for each circuit, and control and power wiring schematic.

3.2.6 Functional Performance Test/Report

- Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.2.7 Operations Manual

- A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics. The data shall include, but is not limited to the following:
  - Shop drawings
  - Wiring diagrams
  - System components and parts descriptions
  - Operating sequences, procedures, instructions, and/or theory of operation
  - Specific maintenance and troubleshooting instructions
  - Recommended service schedule. Include maintenance schedules for each component part of the systems furnished in this section. Include information on frequency of, and detailed instruction for, maintenance procedures and all items required for each maintenance activity
  - Recommended spare parts inventory
  - Name and contact information for service provider
  - Warranty; to be provided in written form upon delivery, for each chamber

3.3 Delivery, Storage, and Handling

3.3.1 Compliance with Manufacturer's recommendations regarding handling and storage of all environmental chamber components before and during construction is mandatory.

3.3.2 Coordinate with other trades affecting, or affected by this work, to assure the steady progress of all work performed under the contract. Closely coordinate the delivery and installation of this work with the Contractor's schedule.

SECTION TWO • CONSTRUCTION AND DESIGN

4.0 MATERIAL CONSTRUCTION

4.1 General

4.1.1 Rooms will be furnished as complete functional units with all essential components, piping, control systems, and complete conditioning systems, as required to satisfy environmental conditions as specified.

- The CER will be delivered in sections designed to pass without interference through standard doorways.
- All metal and other materials will be shaped and sized as required, with all angles sharp and true. All surfaces will be finished smooth. Punching and shearing will be neatly done. Permanent connections will be welded, riveted, or bolted, with all exposed welds ground smooth and flush with adjacent surfaces.

4.2 Panel Construction

4.2.1 Standard wall panels shall be nominal 4” in width, designed to be interchangeable. Some freezer and wide-range rooms may require 5” panel thicknesses.

4.2.2 Typical corner panels shall be 90¼ angles with actual 12” exterior horizontal measurements. Nominal 1' and 3' panels may be used if required to meet job site conditions, and all are gauged for uniformity in size.

4.2.3 Edges of panels shall be tongue and groove with locking facilities foamed-in-place at time of fabrication. Rigidity and uniformity shall meet or exceed industry accepted standards and panel interior construction shall be fabricated to deter biodegradation and moisture retention. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.

- Panel Surfaces: (Standard) Interior, white embossed aluminum. Exterior, white embossed galvanized steel. (Stainless steel and other finishes available.)
- Panel locking assemblies shall be accomplished by foamed-in-place locking assemblies.
- Panels are all 100% poured-in-place polyurethane construction, R-Value 31+.

4.3 Floor Construction

4.3.1 Material Test and Cure Rooms are typically provided without floor panels, to be installed on a customer-provided recessed slab. Floor drain shall be provided by customer/owner, for moist-cure applications.

4.3.2 Where specified, insulated floors shall be similar in construction to wall and ceiling panels. Standard floors are designed to accommodate up to 600 lbs. per square foot of evenly distributed weight. Additional reinforcement of floor panels shall be used as required.

- Standard floor depth shall be a nominal 4 inches. Additional reinforcements and insulation may add to depth, and are provided as custom. Standard floor surface finishes include smooth aluminum or 300 Series stainless steel. Other finishes, textures, coatings, and coverings are available upon request.

4.4 Door Construction

4.4.1 The door will be an in-fitting, swinging, flush-mounted type, and will have the same metal finish and insulation as adjacent walls. A thermoplastic gasket with a magnetic core will be mounted on the top edge and along both sides of the door that will keep the door closed and form a tight seal. Door gaskets shall be NSF-approved. Construction of door panel will include a welded heavy-duty "U" channel-type reinforced steel frame around the entire perimeter of the door opening to prevent rocking or twisting.

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- Anti-condensate heater wires shall be concealed behind the metal edge of the doorjamb on all four sides.
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5.1 Control Console

5.1.1 Chamber Manufacturer shall provide a control console incorporating a key-locked acrylic or Lexan door for viewing and protecting the settable controls. Protection Classifications: IP 65 to EN 60529, NEMA 12, including see-through door. The console will be mounted on the chamber exterior, next to the door if possible. The console includes all instruments, controls, switches, indicator lights, alarms, and alarm contacts. The electrical control enclosure shall be labeled/listed by a certified National Testing Lab.

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5.2.2 Temperature and/or humidity control shall utilize solid-state microprocessor-based digital controllers with RTD sensing. Sensitivity of the sensor will not be less than 0.1°C and/or 0.1%RH, throughout range. Sensors will be located to detect the average temperature within the chamber.

5.2.3 Temperature and/or humidity set points shall be set through simple arrow keys on the chamber microprocessor controls. The controllers will simultaneously display both actual and set-point variables. The temperature control system will allow for the operation of the resistance heating elements or hot gas bypass valves through solid state relays (SSR’s) according to the controller output. This feature will provide for reducing the total operating cost of the chamber while still providing for the use of the heaters for rapid recovery from an upset in chamber temperature or load.

5.3 Independent High and Low Alarms

5.3.1 Independent High/Low alarms for temperature will have SPDT contacts for remote alarm monitoring or phone dialers. Separate alarms for high and low operating temperatures shall be provided. The alarm set-points will be digital, in degrees Celsius and Percent RH.

5.3.2 The contacts will switch upon an alarm condition. Each alarm will have an adjustable delay period of 0-150 minutes before alarm action will occur. The remote alarm contacts will be wired into the control panel terminal block and be ready for hook-up to customer monitoring devices. Remote alarm contacts (relays) will be plug-in replaceable and will have both the NC and NO contacts available. The audible alarm will have a time-delayed silence of 0-60 min.

5.4 Control and Switch Functions

5.4.1 All will be clearly labeled with non-fading polycarbonate labels requiring no stamping or silkscreen markings that wear off.

5.4.2 All control relays and indicators are solid state for long life and reliability.

5.4.3 All program menus will be logically arranged for intuitive operation.

5.5 Data Recording

5.5.1 Where specified, either a data-logging equipment bundle or else a 10” recorder, with switch-selectable 24-hour or 7-day chart movement, shall be provided. Recorders will utilize a 10" circular chart and will be mounted in the control panel. Recorder accuracy to be ± 1%, full scale (Honeywell DR4300 or equivalent).

5.6 Additional Components

5.6.1 Accurate and NIST-traceable temperature sensing using platinum Resistance

5.6.2 Temperature Detectors will be used for control and recording instruments.

5.6.3 NIST-traceable Rotronic HygroClip RH sensor and controller with calibration certificate.

5.6.4 Single point chamber power connection with over-current protection will be provided in the control panel for all power components.

5.6.5 All wiring will be identified with permanent labels for efficient troubleshooting.

5.6.6 Plug-in components will be used wherever feasible.

5.6.7 All components will be mounted on a DIN rail inside the control console for simple retrofit, repair, and diagnosis.

6.0 COOLING EQUIPMENT

6.1 Compressor/Condensing Unit

6.1.1 The compressor/condensing unit will consist of an air-cooled or water-cooled compressor of the appropriate size to provide performance as specified herein.

6.1.2 The compressor/condensing unit will provide safe and reliable operation in its location on top of the CER. All components of the condensing unit will be designed for 125 psi working pressure or 150% of maximum operating pressure; whichever is greater.

6.1.3 The unit will have a minimum of a crankcase pressure regulator, accumulator, vibration absorbers (if applicable), and thermal protection.

6.1.4 Cycling solenoids or fully proportional refrigeration bypass valves will be used in the hot gas line. Isolation solenoids are acceptable for pump down only in the liquid and hot gas line. The condensing unit will be designed for continuous operation for maximum compressor life, to eliminate on and off cycling and to resist RF interference.

6.1.5 Water-cooled units will be provided with water regulating valves to maintain head pressure. The compressor/condensing unit will be linked to an evaporator of matching capacity in one of the following three types of conditioning designs. Refrigerant type will be R-134A or R-404A, unless specified otherwise.

6.1.6 The condensing unit will have a single point electrical connection terminating with a fused disconnect switch as the connection point.

6.2 Conditioning Type

6.2.1 The air-handler will be of copper tube/aluminum fin or copper tube/copper fin and stainless steel coil endplate construction to prevent corrosion as specified.

6.3 Sub-Assembly Quality Control

6.3.1 For systems incorporating the Darwin PFTCU (Precision Fluid Temperature Control Unit), Quality Control testing is completed and documented at the point of manufacture, and the assembled unit (as a closed system) may be shipped with refrigerant, ready for installation by field personnel—without the requirement of a licensed HVAC technician at the installation site.

6.3.2 Otherwise, the above mentioned sub-assemblies (condensing unit, air-handler/evaporator) are evacuated to 500 microns and held at this condition for five hours prior to pre-charging with 150 psig of dry nitrogen. The units are tagged with dry nitrogen charge pressure, temperatures, date, and testing technician's initials. The units are shipped and installed with the "tagging" procedure intact. Upon start up, the nitrogen charge is evacuated and the units are charged with refrigerant. Field installation personnel can readily determine if shipping damage has occurred by comparing the recorded "tag" pressure with current system pressure.

6.4 Refrigerant Piping

6.4.1 Piping carrying refrigerant will be Type L ACR copper with copper fittings. 15% Silver solder or DynaFlow will be used for all joints. Condensate drain lines on chambers above 0.0°C will be PVC or copper tubing. On chambers operating below 0.0°C, drain lines will be type L copper tubing, wrapped with heating cable and covered with Armaflex ½“ insulation. The cable will heat continuously below 0.0°C. Piping for condensing unit water will be Type L copper.

6.5 Insulation

6.5.1 Suction and hot gas refrigeration lines will be insulated with closed-cell foam plastic similar to "Armaflex" or an equivalent.

6.5.2 The material will be tubular in form, and sized in accordance with the pipe size. Insulation thickness will be a minimum of ½" for cold rooms and warm rooms, and ¾" for freezers. Joints will be thoroughly bonded by the adhesive recommended by the insulation.

6.5.3 Manufacturer will meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates, all edges will be sealed to the pipe with sealant. The condenser inlet water line will be insulated with closed-cell foam plastic insulation.

6.6 Performance

6.6.1 Chambers will have a defined temperature uniformity (see preceding schedule) across the work surface 40" off the floor and to within 12" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with thermocouple, thermistor, or RTD sensing.

6.7 System Capacity

6.7.1 Refrigeration and heating systems will be capable of operation as specified, without running at full capacity, more than 80% of the time under the following conditions:

- Temperature and humidity specifications assume standard operation in a controlled ambient condition of 72°F, ±8°F and a dew-point at or below 50°F.
- Up to four door-opening events per hour.
- An additional electrical load of five watts per sq. ft. of floor area.

6.8 Automatic Defrost System

6.8.1 For rooms with set point temperatures below 4° C, provide hot gas bypass defrost with timer and fan delay switch. Set defrost initiation time and duration so that temperature increase is minimized while achieving complete removal of accumulated frost.

7.0 ACCESSORIES / COMPONENTS

7.1 Shelving

7.1.1 Shelving, when specified, will be removable and adjustable. Freestanding shelving will be provided, unless otherwise specified. Shelving will be adjustable on a minimum of 2" centers, four-tier and utilize four 74"or 86" posts. All shelving will be removable without special tools and will typically be constructed of stainless steel or epoxy-coated plated steel, with a guarantee of a minimum of five years corrosion resistance.

7.1.2 Shelving will be open wire unless specified other. Leveling shims/screws will be provided at the base of the posts of freestanding shelving units.

7.2 Humidification

7.2.1 For moist-cure, and similar material test applications, humidification may be provided by droplet-producing systems, with atomizing heads in quantities sufficient to achieve saturation levels as specified.

7.2.2 For most other applications requiring added humidification, RH levels shall be increased by utilizing a vapor-producing ultrasonic humidifier, for optimal uniformity and efficiency.

- UV disinfection shall be incorporated into the humidifier to reduce potential for propagation of bacteriological contaminants.

7.3 Dehumidification

7.3.1 Where specified, dehumidification shall be achieved via refrigerated, compressed air, or heat-regenerating desiccant drier, as required to maintain operation as specified.

7.4 Wiring

7.4.1 Interconnecting wiring will be installed in UL Listed PVC conduit within room, and UL listed EMT outside of room. Conduit will be a minimum of ½" trade size, as applicable.

7.5 Lighting

7.5.1 Where specified, Chamber Manufacturer will provide vapor-proof fluorescent lighting. The housing will be corrosion-resistant fiberglass or ABS plastic. Fixtures feature a clear prismatic acrylic lens with closed-cell neoprene gasketing bonded to the housing to form a continuous seal for the lens, with cam latches to clamp the lens (diffuser) to the housing.

- Light levels in chambers to be 70 fc. min., as measured at 40" above the floor.
- LED, low temperature ballast fluorescents, or incandescent lighting may be specified for some applications.

7.6 Observation Windows

7.6.1 Standard observation windows, when included, shall be centered on door or panel at standard (view) height, unless otherwise specified. Standard size is 14” W x 14” H). Other sizes are available as custom, as door or panel sizing permits. The window will consist of two to three panes of low-e glass with sealed air spaces between them.

7.7 Sleeves/Pass-through Ports

7.7.1 Sleeves for service piping, gas line cables, and drain water lines will be cylindrical in cross section, formed of 1/8" or 3/16" PVC and sealed to the chamber enclosure from both ends with silicone sealant. Sleeves will be of sufficient size to allow a least 1/8" clearance around the service line. The void between service lines and the sleeves inside and out will be sealed with sealant that remains flexible. Caps will be provided to seal pass-trough’s used for equipment line passage when not in use.

7.8 Ventilation Systems

7.8.1 As applicable, ventilation supply and exhaust shall be provided on a continual basis, to achieve required air exchange rates (CFM).

7.9 Heaters

7.9.1 As applicable, electric reheat shall be achieved via nichrome wire heating elements supported by ceramic insulators.

SECTION THREE • REQUIREMENTS

8.0 MANUFACTURER REQUIREMENTS

8.1 Installation

Deliver and install the chamber and all conditioning equipment to achieve performance as outlined. The chamber conditioning equipment, lighting, and internal electrical wiring will be interconnected. The chamber will be started and field-tested by Chamber Manufacturer prior to project completion.

Seal joints and openings, including penetrations for piping or electrical wiring, in the outside and inside faces of walk-in refrigerated storage construction. Adjust all room mechanical, electrical and hardware components, and clean exposed surfaces after installation.

8.2 Testing

Inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with. All costs related to testing are included in the contract sum.

CER Manufacturer shall comply with the following requirements, at minimum:

8.2.1 General: Provide all instrumentation and equipment as needed for testing, and perform the specified performance and acceptance tests.

8.2.2 Control temperature set-point: Measure and record room temperature during a continuous 24-hour test period. The room(s) shall maintain the given temperature set-point within ±1.0°C, unless otherwise specified.

8.2.3 Temperature gradient: Measure and record room temperature during a continuous 24-hour test period. Verify that the maximum temperature gradient from floor to ceiling does not exceed 1.0°C.

8.2.4 Temperature uniformity: Measure and record temperature uniformity during a continuous 24-hour test period, as previously described. Temperature uniformity shall be ±0.5°C, unless specified otherwise.

8.2.5 Recovery test: Perform recover test as described previously. All rooms, except for freezers shall recover within 5 minutes.

8.2.6 Internal load test: Each room shall maintain temperature within ±1.0°C of set-point when operating with the specified number of people, make up ventilation air, and internal heat gain from lighting and equipment.

8.2.7 Rooms with relative humidity control shall be tested for humidity control performance and recovery as applicable and/or agreed.

8.2.8 Documentation: CER Manufacturer shall submit written reports of all tests. Reports shall indicate testing procedures followed, instruments used, and tabulation of results.

8.2.9 Witnessing of test: Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representatives in writing at least 10 days prior to conducting tests.

9.0 SITE REQUIREMENTS

Chamber Manufacturer is not responsible for altering existing building or design conditions or pulling in mechanical services for equipment.

9.1 Electrical

Electrical contractor will provide fused disconnects for each condensing unit, as applicable, and connection to condensing unit junction box at a location as directed by Manufacturer. Chamber control panel and interior receptacles will require junction boxes by others.

9.2 Water (Humidity Systems)

As applicable, Darwin Chambers Co. recommends Conductivity of 5µS - 0.06µS, TDS of < 20 ppm at 1-10 Pounds per Square Inch (PSI) of water pressure.

9.3 Plumbing

The plumbing contractor or Owner will provide water supply and return to water-cooled condensing units, water supply and waste disposal site for humidification unit, all services and connections to casework within chamber, and floor drain connections. All final connections to equipment will be made by Owner as directed by Manufacturer.

9.4 Drain Site

Chamber Manufacturer will run condensate drain line to sink drain within chamber(s) or to floor drain outside of chambers and within 10 feet or as specified.

9.5 Level Floor

Owner will provide for Chamber Manufacturer, a level floor as a base for the prefabricated chamber floor. Floor will not exceed 3/8" in 10' and will not exceed 1/8" within a 2' span.

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ARCHIVAL STORAGE ROOMS

Darwin Chambers Company's NFPA, GSA, and NARA Directive 1571-compliant Archival Storage Chambers are engineered to provide maximum value, efficiency and conformance with all applicable standards and codes. Archival chambers provide environmental controls for storing records and materials (including paper documents and items with high fibrous content, various films, microfiche, and photographic materials) that require permanent protection for storage and preservation. Our high-performance systems are offered with nearly unlimited operational fail safes, including full system and control redundancy. In addition to keyed entry, numerous security options are also available, due to the often irreplaceable nature of the materials to be stored and preserved in this type of chamber. Our chambers are engineered to accommodate the loads and unique requirements of the specific materials to be stored, with industry-leading control and uniformity of both temperature and humidity variables. Design considerations include both functional and operational efficiencies and reliability, the safety and comfort of operating personnel, and the ongoing protection of the archived materials from fire, water, light degradation, pests, mold and natural contaminants, pollutants and other man-made threats.

Benefits

- Desired set-points can be achieved depending on the nature of the preserved media.
- Books, papers, and paintings: 10°C (50°F), 30% RH
- Film, photographs, microfilm: 1.7°C (35°F), 35% RH
- Allows exceptional temperature control anywhere within the range of 0°C to 21°C (32°F to 70°F)
- The standard chambers do not include humidification but it can be added as an option for unusual applications.
- We incorporate an innovative dryer control system that maximizes performance while lowering energy requirements and increasing reliability
- In contrast to existing control systems that cycle dehumidification systems on and off, decreasing life span and causing erratic control, the Darwin solution accurately modulates the dryer output, maximizing reliability and producing tight control
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.

Standard Features

- 4" to 6" Polyurethane Foam Insulated Panels, R- Value 31+ or Higher
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature And Humidity Uniformity
- Temperature Control At Sensor / Set-Point: ±0.2° C
- Humidity Control At Sensor: ±0.5%.
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Energy Efficient Offering Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- Corrosive Resistant Equipment
- Precision Sizing
- Diurnal Cycling Temperature
- Regenerating Desiccant Dryer ??

Optional Features

- Added Ultrasonic Humidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning system
- Data Logging
- Water-Cooled Or Air-Cooled Condensers
- Custom Lighting Systems
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touchscreen Control Interface
- Vestibules and Intermediate Conditioning Spaces Available
- Decontamination Options ??
- UV Filtration of Interior Lighting ??
- Desiccant Dehumidification Redundancy Options ??

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

DARWIN CHAMBERS

DESIGN SPECIFICATION

ARCHIVAL STORAGE CHAMBERS

CONTROLLED ENVIRONMENT ROOMS

SECTION ONE • GENERAL INFORMATION

1.0 SCOPE OF WORK

1.1 General Provisions

1.1.1 Controlled Environmental Rooms (referred to as "CER's" or "chambers") shall be prefabricated, all metal clad construction; to be furnished and installed as a complete self-contained unit and system, including all essential plenums, mechanical equipment, controls, and components as necessary to maintain environmental conditions as specified.

1.1.2 Factory-trained technicians will deliver chamber components to their final location and complete assembly of chambers in place.

1.1.3 The Controlled Environmental Room Provider (referred to as the "Manufacturer") will furnish and install refrigeration piping, electrical power wiring, control wiring and connections to all devices that comprise an integral part of each chamber.

1.1.4 Start-up and field testing of chambers will be performed by factory-trained technicians.

1.1.5 Supportive documentation and training shall be supplied by Manufacturer as specified.

1.1.6 Additional services will be provided, as applicable, as documented and agreed by contract or formal service agreement.

1.1.7 CER types included here are Archival Storage Rooms.

1.1.8 All major components are assembled and factory tested prior to delivery, including air handlers, condensers, and control panels. Documentation of factory testing will be available to owner or architect upon request.

2.0 QUALITY ASSURANCE

2.1 Reference Standards

2.1.1 All major components shall have applicable UL, AMCA, NEMA, ASME, ANSI and AHRI certifications which include motors, compressors, evaporator fan and evaporator coils, water-cooled condensers or air-cooled condensers, humidification/dehumidification equipment, and control panel assemblies.

2.1.2 For quality assurance, compliance with NARA Directive 1571, Appendix A, Photographic Media (all types) is mandatory.

2.1.3 The latest published edition and applicable addenda of each reference apply:

- ANSI/ASHRAE Standard 15 Safety Standard for Refrigeration Systems
- ANSI/ASHRAE Standard 90.1 (Energy Standard for Buildings Except Low-Rise Residential Buildings.
- /AHRI - 420 Performances Rating of Forced-Circulation Free-Delivery
- Unit Coolers for Refrigeration
- ANSI/AHRI - 540 Standard for Performance Rating of Positive Displacement
- Refrigerant Compressors and Compressor Units
  - ANSI - B9.1 Safety Code for Mechanical Refrigeration

  - UL–723 Test for Surface Burning Characteristics of Building Materials.
  - NFPA - 70 National Electric Code.
  - NFPA - 79 Electrical Standard for Industrial Machinery.
- 36 C.F.R. 1250 – Archives & Records
- ISO 18920:2011 – Imaging materials, Processed photographic reflection prints, Storage practices

2.1.4 All materials, installation and workmanship shall comply with the applicable requirements and standards addressed within the following references:

- All joints to be tongue and groove for structural strength and to provide vapor barrier to prevent heat loss and moisture infiltration per ASTM E-283.
- Foam insulation is to be of a non-flammable, non-flame supporting grade with a "K" value of 0.118 BTU / hour / foot squared / degrees Fahrenheit / inch in accordance with ASTM C518.
- Insulation shall have a minimum 97% closed cell structure and “R” factor shall be 31 or greater in a thickness of 4 inches – values in accordance with ASTM C-236/C-1363 methods.

2.2 Manufacturer Qualifications

2.2.1 The Manufacturer shall have had not less than ten (10) years of successful and regular production of components/equipment used for this Project.

2.2.2 The Manufacturer shall have previously supplied archival storage of this type and, upon request, shall provide evidence of sole responsibility for successfully supplying and installing at least 50 similar chambers for not less than five (5) years.

2.2.3 The Manufacturer shall be capable of providing service with a 12-hour notification during normal business hours Monday-Friday. Critical after-hours and weekend response time shall be a maximum of 24 hours upon notification.

2.2.4 Any deviations from the specification, including type of finishes as set forth herein, shall be listed in detail, separate from product data submissions described above, and such that the Architect/Engr. does not have to expend unnecessary time during evaluation.

2.2.5 The CER design and installation shall conform to the referenced standards in this section and also conform to applicable codes, ordinances and regulations governing the use and safety of refrigerant gases. Additionally, the enclosure must be NSF-approved.

2.2.6 The Manufacturer shall inventory factory parts (or else a fully compatible upgrade) for a minimum of five (5) years and have experienced refrigeration service technicians and mechanics in Manufacturer’s direct employ, to assure the Owner of reliable service.

2.3 Accepted Manufacturers

2.3.1 Darwin Chambers Company, LLC—St. Louis, Missouri—Phone 877-783-6774

2.3.2 Other, in demonstrated compliance with the qualifications set forth within this document.

2.4 Warranty

2.4.1 Mechanical refrigeration equipment, parts, and labor will be guaranteed in written form for a minimum period of one year from the date of chamber start-up and continuous normal operation. The warranty will guarantee that the chamber(s) will:

- Maintain within the specified tolerance, the selected temperature.
- Be free from condensate on the outside of the chamber.
- Be free from defects due to faulty materials or workmanship.
- All Parts and labor will be guaranteed in written form from the date of chamber start-up and continuous normal operation, or upon Owner acceptance of certifications and functional test results, whichever is first.

2.4.2 Additionally, written warranties shall be provided covering defects in material, workmanship and performance for the following items, per the following schedule:

- Enclosures: Ten year warranty covering all items connected with the enclosure, including panels, doors and door hardware.
- Compressor(s), Control Panel: Five year warranty.

2.5 Installation/Training

2.5.1 Manufacturer will provide highly skilled, factory-trained personnel to perform and oversee installation of chamber enclosure and all components.

2.5.2 Services of a factory-trained technician will be made available for one man-day, minimum, to tune controls and instruct the owner on proper usage and care.

2.6 Testing

2.6.1 An inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with.

2.6.2 Functional Performance Test / Report: Submit written report which includes the findings from the system performance test made on site; state the test was performed in accordance with the specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.0 PRODUCT DATA

3.1 Room Schedule/Operation (Standard)

Environmental Room, designation #_____
Chamber Operation:

Chamber temperature set-point: _____°C, ±_____°C (throughout storage area)

Chamber humidity set-point (as applicable): _____%RH, ±_____%RH

Chamber size, exterior (actual):_____W x _____L x _____H

3.2 Submittals

3.2.1 Shop Drawings shall be supplied prior to the commencement of manufacture.

3.2.2 Shop Drawings shall be verified by the Contractor to assure clearances, utilities, and other interfaces. The Drawings shall include enclosure layout, elevations, dimensions, thicknesses, types and locations of connections and openings, and other pertinent construction and erection details including the routing and diameter of refrigeration tubing and coil condensate drain.

3.2.3 Indicate the room's structural (floor, columns, etc.) architectural (walls, ceilings, etc.) mechanical (duct, equipment, etc.) and electrical (panels, conduits, etc.) components that are immediately adjacent to the CER.

3.2.4 Indicate performance requirements, which include, as a minimum, cooling and heating parameters and capacities. Provide refrigeration piping schematic showing all components and their respective size or capacity, air schematic and written sequence.

3.2.5 Provide electrical plan showing all power connections to lighting and equipment, the voltage, amperage, and kW load for each circuit, and control and power wiring schematic.

3.2.6 Functional Performance Test/Report

- Submit written report which includes the findings from the system performance test made on site, as per specified test requirements; state the test design requirements and results attained; state the system complies with the specified operational requirements; and indicate whether the system has passed, or reason why the system failed the test.

3.2.7 Operations Manual

- A complete comprehensive instruction and maintenance manual shall be provided with each CER. The manual shall include sequential operating instructions, routine preventative maintenance instructions, and complete schematics. The data shall include, but is not limited to the following:
  - Shop drawings
  - Wiring diagrams
  - System components and parts descriptions
  - Operating sequences, procedures, instructions, and/or theory of operation
  - Specific maintenance and troubleshooting instructions
  - Recommended service schedule. Include maintenance schedules for each component part of the systems furnished in this section. Include information on frequency of, and detailed instruction for, maintenance procedures and all items required for each maintenance activity
  - Recommended spare parts inventory
  - Name and contact information for service provider
  - Warranty; to be provided in written form upon delivery, for each chamber

3.3 Delivery, Storage, and Handling

3.3.1 Compliance with Manufacturer's recommendations regarding handling and storage of all environmental chamber components before and during construction is mandatory.

3.3.2 Coordinate with other trades affecting, or affected by this work. Closely coordinate the delivery and installation of this work with the Contractor's schedule.

SECTION TWO • CONSTRUCTION AND DESIGN

4.0 MATERIAL CONSTRUCTION

4.1 General

4.1.1 Rooms will be furnished as complete functional units with all essential ductwork and ductwork connection points, piping, control systems, and complete conditioning systems as required to satisfy environmental conditions as specified.

- The CER will be delivered in sections designed to pass without interference through standard doorways.
- All metal and other materials will be shaped and sized as required, with all angles sharp and true. All surfaces will be finished smooth. Punching and shearing will be neatly done. Permanent connections will be welded, riveted, or bolted, with all exposed welds ground smooth and flush with adjacent surfaces.

4.2 Panel Construction

4.2.1 Standard wall panels shall be nominal 4” in width, designed to be interchangeable.

4.2.2 Typical corner panels shall be 90¼ angles with actual 12” exterior horizontal measurements. Nominal 1' and 3' panels may be used if required to meet job site conditions, and all are gauged for uniformity in size.

4.2.3 Edges of panels shall be tongue and groove with locking facilities foamed-in-place at time of fabrication. Rigidity and uniformity shall meet or exceed industry accepted standards and panel interior construction shall be fabricated to deter biodegradation and moisture retention. Structural metal, wood, or fiberglass material shall not be used between interior and exterior surfaces.

- Panel Surfaces: (Standard) Interior, white embossed aluminum. Exterior, white embossed galvanized steel.
- Panel locking assemblies shall be accomplished by foamed-in-place locking assemblies.
- Panels are all 100% poured-in-place polyurethane construction, R-Value 31+.

4.3 Floor Construction

4.3.1 Wall panels will be flat bottom and secured to floor on 24” centers.

4.3.2 Vinyl screeds shall be utilized coved on both sides, to rest level with the floor.

4.3.3 Insulated floors shall be similar in construction to wall and ceiling panels. Standard floors are designed to accommodate up to 600 lbs. per square foot of evenly distributed weight. Additional reinforcement of floor panels shall be used as required.

4.3.4 Standard floor depth shall be a nominal 4 inches. Additional reinforcements and insulation may add to depth, and are provided as custom. Standard floor surface finishes include smooth aluminum or 300 Series stainless steel. Other finishes, depths, textures, coatings, and coverings are available upon request.

4.4 Door Construction

4.4.1 The door will be an in-fitting, swinging, flush-mounted type, and will have the same metal finish and insulation as adjacent walls. A thermoplastic gasket with a magnetic core will be mounted on the top edge and along both sides of the door that will keep the door closed and form a tight seal. Door gaskets shall be NSF-approved. Construction of door panel will include a welded heavy-duty "U" channel-type reinforced steel frame around the entire perimeter of the door opening to prevent rocking or twisting.

- Standard size 36” W x 78” H. (Most custom sizes/types available upon request.)
- Anti-condensate heater wires shall be concealed behind the metal edge of the doorjamb on all four sides.
- Heaters will be connected to a temperature switch or controller to automatically provide sufficient heat to eliminate condensation and frost under various ambient humidity conditions.
- The door will use a minimum of two cam-lift, self-closing hinges. The door latch will be designed to open the door easily by breaking the magnetic force of the door gasket. The latch will have a key lock, and include an interior safety release handle to prevent accidental lock-in. Door hardware will be satin-finish aluminum or chrome-plated.

5.0 CONTROLS AND INSTRUMENTATION

5.1 Control Console

5.1.1 Manufacturer shall provide a control console incorporating a key-locked acrylic or Lexan door for viewing and protecting the settable controls. Protection Classifications: IP 65 to EN 60529, NEMA 12, including see-through door. The console will be mounted on the chamber exterior, next to the door if possible. The console includes all instruments, controls, switches, indicator lights, alarms, and alarm contacts. The electrical control enclosure is labeled/listed by a certified National Testing Lab.

5.2 Control Systems

5.2.1 Controllers shall be Self-Tuning Microprocessor-Based PID Controls with Dual Digital LED Readout. This allows for continuous display of the both the set-point and chamber condition. Controller set-up data will be stored in non-volatile memory and retain settings upon power loss without the use of batteries. Independent controller will be used to control the chamber temperature.

5.2.2 Temperature control will utilize solid-state microprocessor-based digital controllers with RTD sensing. Sensitivity of the sensor shall be better than 1.0°C throughout specified temperature range. Sensors will be located to detect the average temperature within the chamber.

5.2.3 Relative humidity control will utilize solid-state microprocessor-based digital control with Rotronic S2 Hygroclip sensing. Sensors will be located to detect the average relative humidity within the chamber.

5.2.4 Microprocessor control of light levels and other variables may be added as an option.

5.2.5 Set points shall be set through simple arrow keys on the chamber microprocessor controls. The controllers will simultaneously display both actual and set-point variables. The temperature control system will allow for the operation of the resistance heating elements or hot gas bypass valves through solid state relays (SSR's) according to the controller output. This feature will provide for reducing the total operating cost of the chamber while still providing for the use of the heaters for rapid recovery from an upset in chamber temperature or load.

5.2.6 Alternate microprocessor control systems and (touch-screen) interfaces are available (as standard), upon request.

5.3 Independent High and Low Alarms

5.3.1 Independent High/Low alarms for temperature will have SPDT contacts for remote alarm monitoring or phone dialers. Separate alarms for high and low operating temperatures shall be provided. The alarm set-points will be digital, in degrees Celsius.

5.3.2 The contacts will switch upon an alarm condition. Each alarm will have an adjustable delay period of 0-150 minutes before alarm action will occur. The remote alarm contacts will be wired into the control panel terminal block and be ready for hook-up to customer monitoring devices. Remote alarm contacts (relays) will be plug-in replaceable and will have both the NC and NO contacts available. The audible alarm will have a time-delayed silence of 0-60 min.

5.4 Control and Switch Functions

5.4.1 All will be clearly labeled with non-fading polycarbonate labels requiring no stamping or silkscreen markings that wear off.

5.4.2 All control relays and indicators are solid state for long life and reliability.

5.4.3 All program menus will be logically arranged for intuitive operation.

5.5 Data Recording

5.5.1 Where specified, either a data-logging equipment bundle or else a 10" recorder, with switch-selectable 24-hour or 7-day chart movement, shall be provided. Chart recorders will utilize a 10" circular chart and will be mounted in the control panel. Recorder accuracy to be ± 1%, full scale (Honeywell DR4300 or equivalent).

5.6 Additional Components

5.6.1 Accurate and NIST-traceable temperature sensing using platinum Resistance

5.6.2 Temperature Detectors will be used for control and recording instruments.

5.6.3 Single point chamber power connection with over-current protection will be provided in the control panel for all power components.

5.6.4 All wiring identified will be identified with permanent labels for efficient troubleshooting.

6.0 COOLING EQUIPMENT

6.1 Compressor/Condensing Unit

6.1.1 The compressor/condensing unit will consist of an air-cooled or water-cooled compressor of the appropriate size to provide performance as specified herein.

6.1.2 The compressor/condensing unit will provide safe and reliable operation in its location on top of the CER. All components of the condensing unit will be designed for 125 psi working pressure or 150% of maximum operating pressure; whichever is greater.

6.1.3 The unit will have a minimum of a crankcase pressure regulator, accumulator, vibration absorbers if applicable and thermal protection. Cycling solenoids or fully proportional refrigeration bypass valves will be used in the hot gas line. Isolation solenoids are acceptable for pump down only in the liquid and hot gas line. The condensing unit will be designed for continuous operation for maximum compressor life, to eliminate on and off cycling and to resist RF interference.

6.1.4 Water-cooled units will be provided with water regulating valves to maintain head pressure. The compressor/condensing unit will be linked to an evaporator of matching capacity in one of the following three types of conditioning designs. Refrigerant type will be R-134a, unless specified otherwise.

6.1.5 The condensing unit will have a single point electrical connection terminating with a fused disconnect switch as the connection point.

6.2 Conditioning Type

6.2.1 The air-handler will be of copper tube/aluminum fin or copper tube/copper fin and stainless steel coil endplate construction to prevent corrosion.

6.3 Sub-Assembly Quality Control

6.3.1 For systems incorporating the Darwin PFTCU (Precision Fluid Temperature Control Unit), Quality Control testing is completed and documented at the point of manufacture, and the assembled unit (as a closed system) may be shipped with refrigerant, ready for installation by field personnel—without the requirement of a licensed HVAC technician at the installation site.

6.3.2 Otherwise, the above mentioned sub-assemblies (condensing unit, air-handler/evaporator) are evacuated to 500 microns and held at this condition for five hours prior to pre-charging with 150 psig of dry nitrogen. The units are tagged with dry nitrogen charge pressure, temperatures, date, and testing technician's initials. The units are shipped and installed with the "tagging" procedure intact. Upon start up, the nitrogen charge is evacuated and the units are charged with refrigerant. Field installation personnel can readily determine if shipping damage has occurred by comparing the recorded "tag" pressure with current system pressure.

6.4 Refrigerant Piping

6.4.1 Piping carrying refrigerant will be Type L ACR copper with copper fittings. 15% Silver solder or DynaFlow will be used for all joints. Condensate drain lines on chambers above 0.0°C will be PVC or copper tubing. On chambers operating below 0.0°C, drain lines will be type L copper tubing, wrapped with heating cable and covered with Armaflex ½“ insulation. The cable will heat continuously below 0.0°C. Piping for condensing unit water will be Type L copper.

6.5 Insulation

6.5.1 Suction and hot gas refrigeration lines will be insulated with closed-cell foam plastic similar to "Armaflex" or an equivalent.

6.5.2 The material will be tubular in form, and sized in accordance with the pipe size. Insulation thickness will be a minimum of ½" for cold rooms and warm rooms, and ¾" for freezers. Joints will be thoroughly bonded by the adhesive recommended by the insulation.

6.5.3 Manufacturer will meet local and state fire and smoke requirements. Penetrations of the insulation must be thoroughly sealed to form a complete vapor barrier. Wherever the insulation terminates, all edges will be sealed to the pipe with sealant. The condenser inlet water line will be insulated with closed-cell foam plastic insulation.

6.6 Performance

6.6.1 Chambers will have a defined temperature uniformity (see preceding schedule) across the work surface 40" off the floor and to within 12" of the walls. The uniformity is the variation between points across the plane as measured by a multi-point recorder with thermocouple, thermistor, or RTD sensing.

6.7 System Capacity

6.7.1 Refrigeration and heating systems will be capable of operation as specified, without running at full capacity, more than 80% of the time under the following conditions:

- Temperature (and humidity, as applicable) specifications assume standard ambient operation in a controlled ambient condition of 72°F, ±8°F and a dew-point at or below 50°F.
- Up to four door-opening events per hour.
- An additional electrical load of five watts per sq. ft. of floor area.

6.8 Automatic Defrost System

6.8.1 For rooms with set point temperatures below 4° C, provide hot gas bypass defrost with timer and fan delay switch. Set defrost initiation time and duration so that temperature increase is minimized while achieving complete removal of accumulated frost.

7.0 ACCESSORIES / COMPONENTS

7.1 Shelving

7.1.1 Shelving, when specified, will be removable and adjustable. Freestanding shelving will be provided, unless otherwise specified. Shelving will be adjustable on a minimum of 2" centers, four-tier and utilize four 74"or 86" posts. All shelving will be removable without special tools and will typically be constructed of stainless steel or epoxy-coated plated steel, with a guarantee of a minimum of five years corrosion resistance.

7.1.2 Shelving will be open wire unless specified other. Leveling shims/screws will be provided at the base of the posts of freestanding shelving units.

7.1.3 High-density and custom shelving options are available upon request.
(Please note: Provision of furnishings for Archival Storage Rooms by the CER Manufacturer is strongly recommended, due to the potential impact of certain types of fixtures and accessories on the performance and intended purpose of these rooms.)

7.2 Dehumidification

7.2.1 As applicable, dehumidification shall typically be achieved via heat-regenerating desiccant drier, sized as required to maintain operation as specified.

7.3 Wiring

7.3.1 Interconnecting wiring will be installed in UL Listed PVC conduit within room, and UL listed EMT outside of room. Conduit will be a minimum of ½" trade size, as applicable.

7.4 Lighting

7.4.1 Where specified, Manufacturer will provide vapor-proof fluorescent lighting. The housing will be corrosion-resistant fiberglass or ABS plastic. Fixtures feature a clear prismatic acrylic lens with closed-cell neoprene gasketing bonded to the housing to form a continuous seal for the lens, with cam latches to clamp the lens (diffuser) to the housing.

- Light levels in chambers to be 70 fc. min., as measured at 40" above the floor.
- UV filtration shall be provided as required to comply with all applicable standards.

7.5 Observation Windows

7.5.1 Standard observation windows, when included, shall be centered on door or panel at standard (view) height, unless otherwise specified. Standard size is 14” W x 14” H). Other sizes are available as custom, as door or panel sizing permits. The window will consist of two to three panes of low-e glass with sealed air spaces between them.

7.6 Sleeves/Pass-through Ports

7.6.1 Sleeves for service piping, gas line cables, and drain water lines will be cylindrical in cross section, formed of 1/8" or 3/16" PVC and sealed to the chamber enclosure from both ends with silicone sealant. Sleeves will be of sufficient size to allow a least 1/8" clearance around the service line. The void between service lines and the sleeves inside and out will be sealed with sealant that remains flexible. Caps will be provided to seal pass-throughs used for equipment line passage when not in use.

7.7 Ventilation System

7.7.1 As applicable, ventilation supply and exhaust shall be provided on a continual basis, to achieve required air exchange rates (CFM).

7.8 Staging

7.8.1 Where required to prevent potential damage to stored materials, either a vestibule or an interim staging compartment shall be provided for documents and materials being moved in and out of certain types of conditioned spaces.

SECTION THREE • REQUIREMENTS

8.0 MANUFACTURER REQUIREMENTS

8.1 Installation

Deliver and install the chamber and all conditioning equipment to achieve performance as outlined. The chamber conditioning equipment, lighting, and internal electrical wiring will be interconnected. The chamber will be started and field-tested by Manufacturer prior to project completion.

Seal joints and openings, including penetrations for piping or electrical wiring, in the outside and inside faces of walk-in refrigerated storage construction. Adjust all room mechanical, electrical and hardware components, and clean exposed surfaces after installation.

8.2 Testing

Inspection shall be performed to assure that all joints are tight, all components are present, and in proper relationship to each other, and the general and specific requirements of this specification have been complied with. All costs related to testing are included in the contract sum.

Manufacturer shall comply with the following requirements, at minimum:

8.2.1 General: Provide all instrumentation and equipment as needed for testing, and perform the specified performance and acceptance tests.

8.2.2 Control temperature set-point: Measure and record room temperature during a continuous 24-hour test period. The room(s) shall maintain the given temperature set-point within ±1.0°C, unless otherwise specified.

8.2.3 Temperature gradient: Measure and record room temperature during a continuous 24-hour test period. Verify that the maximum temperature gradient from floor to ceiling does not exceed 1.0°C.

8.2.4 Recovery test: Perform recover test as described previously. All rooms, except for freezers shall recover within 5 minutes.

8.2.5 Internal load test: Each room shall maintain temperature within ±1.0°C of set-point when operating with the specified number of people, make up ventilation air, and internal heat gain from lighting and equipment.

8.2.6 Rooms with relative humidity control shall be tested for humidity control performance and recovery as applicable and/or agreed.

8.2.7 Documentation: Manufacturer shall submit written reports of all tests. Reports shall indicate testing procedures followed, instruments used, and tabulation of results.

8.2.8 Witnessing of test: Owner's representative shall be given the option of witnessing and confirming test results. Notify owner's representatives in writing at least 10 days prior to conducting tests.

9.0 SITE REQUIREMENTS

Manufacturer is not responsible for altering existing building or design conditions or pulling in mechanical services for equipment.

9.1 Electrical

Electrical contractor will provide fused disconnects for each condensing unit, as applicable, and connection to condensing unit junction box at a location as directed by Manufacturer. Chamber control panel and interior receptacles will require junction boxes by others.

9.2 Plumbing

The plumbing contractor or Owner will provide water supply and return to water-cooled condensing units, water supply and waste disposal site for humidification unit, all services and connections to casework within chamber, and floor drain connections. All final connections to equipment will be made by Owner as directed by Manufacturer.

9.3 Drain Site

Manufacturer will run condensate drain line to sink drain within chamber(s) or to floor drain outside of chambers and within 10 feet or as specified.

9.4 Level Floor

Owner will provide for Manufacturer, a level floor as a base for the prefabricated chamber floor. Floor will not exceed 3/8" in 10' and will not exceed 1/8" within a 2' span.

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SECTION III

ENVIRONMENTAL ROOMS-ADDITIONAL ROOM TYPES

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FREEZER ROOMS

Darwin Chambers Company Freezer Rooms are designed for maximum reliability, efficiency, and stability. Our standard freezers will accommodate a -20°C set-point with a control tolerance ±0.5°C, or better. Many are custom-engineered for a wide variety of applications, including freeze-thaw test regimens in accordance with ASTM C666, GMP stability storage from 4°C to -30°C, wide-range test material test chambers, and mortuary/cadaver storage freezers. Our freezer rooms are typically supplied with desiccant or refrigeration- based dehumidification in order to maintain a low dew-point and prevent ice accumulation on both product and equipment surfaces.

Benefits

- Tight temperature control for reliability and accuracy.
- Tight temperature uniformity of ±.5° C or better throughout the room.
- Work with any space constraints, flexible custom applications.
- Redundancy options that allow uninterrupted operation for critical applications.
- ADA compliance available with no additional cost to the customer.
- Simple, easy-to-use, easy-to-service control systems.
- Smooth ceiling, aluminum or steel, for optimal performance over competitors who use egg crate ceiling. Egg crate ceilings promote mold growth, difficult to service equipment, difficult to clean, and interfere with lighting and airflow.

Standard Features

- 4" to 6" Polyurethane Foam Insulated Panels, R- Value 31+ or Higher
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature Uniformity
- Temperature Control At Sensor / Set-Point: ±0.2° C
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Incandescent Lighting
- Energy Efficient Offering Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- Corrosive Resistant Equipment
- Precision Sizing
- Diurnal Cycling Temperature

Optional Features

- Added Dehumidification
- Ethernet / Remote Monitoring / Alarming
- Unlimited Door / View Window Sizing
- Stainless Steel / Special Surfaces
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning system
- Data Logging
- Custom Lighting Systems
- High Density Shelving
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touchscreen Control Interface
- Back-Up Control and/or Conditioning
- Water-Cooled or Air-Cooled Condensers
- Can Accommodate Rapid Cycling

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

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PLANT GROWTH ROOMS

Darwin Chambers Company provides Plant Growth Rooms that are engineered for maximum value, sustainability, and conformance with USDA-APHIS standards, as applicable. Our plant growth rooms are modular, reconfigurable, and are offered both as standard and as entirely customizable systems—from panel configuration to available surface finishes, to nearly unlimited lighting and humidification/water distribution options, to movable, adjustable storage and racking/shelving options—we can work to meet each researcher's unique and specific requirements. Temperatures available down to 10° C and go up to 40° C. In addition to our standard T8 and T5 lighting options, we have teamed up with LumiGrow, the leading provider of smart horticultural lighting solutions. Both reach-ins and rooms can incorporate the LumiGrow lamps.

Benefits

- Exceptionally quiet, solid-state thermoelectric or liquid-circuited cooling with electric reheat.
- Eco-friendly and efficient.
- No risk of corrosion
- Various threshold barrier options.
- Optional on-site validation services that have included multi-point temperature and humidity mapping have repeatedly proven nearly unbelievable uniformity and control results that far surpass FDA/ICH/GMP guidelines.
- Customizable plans, in addition to extensive warranty coverage.
- All rooms are produced with microprocessor controls, high/low alarms, and exceptionally accurate temperature/humidity control.
- ADA compliance available with no additional cost to the customer.
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.

Standard Features

- 4" to 6" Polyurethane Foam Insulated Panels, R- Value 31+ or Higher
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature And Humidity Uniformity
- Temperature Control At Sensor / Set-Point: ±0.2° C
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Energy Efficient Offering Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- Corrosive Resistant Equipment
- Precision Sizing
- Diurnal Cycling Temperature
- T8 and T5 Lighting Options
- 24 Hour Mechanical Light Timer

Optional Features

- Added Dehumidification and/or Ultrasonic Humidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning system
- Data Logging
- Water-Cooled Or Air-Cooled Condensers
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View Ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touchscreen Control Interface
- LumiGrow Lighting Options

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

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VIVARIUM ROOMS

Darwin Chambers Company ALAAC, OLAW, USDA, and NIH-compliant Vivarium Rooms are designed for maximum value, sustainability, and conformance with applicable standards. We have over a decade of experience in working with researchers to provide humane and often precise conditions to meet their unique and specific needs. Vivariums are commonly defined as a place, such as a in laboratory, where live animals and/or plants are kept under conditions simulating a natural environment. Often, these contain both plants and animals, within a micro-ecosystem, often with controlled stability or controlled change of environmental variables. We offer various surface finishes, including all stainless steel, which are easy to maintain and may be sterilized to cleanroom standards. Compartmentalized enlosures are offered, which are modular and reconfigurable. Our rooms will accommodate plants as needed (we also provide plant growth chambers), and we offer control of humidification in conformance with current ALAAC mandates, sufficient air exchanges, available HEPA filtration of intake and/or exhaust air, standard screened equipment housings, and other such considerations.

Benefits

- Heating and/or conditioning system can be replaced or relocated quickly due to simple water-type connections.
- Special accessories that allow uninterrupted operation and client convenience are available.
- Temperatures over 50° C come equipped with remote fan motors for superior heating efficiency and distribution.
- Available temperature ranges from 20° C to 60° C, 37° C typical set point.
- Supplied with LED lights which emit significantly more light per unit of input energy than fluorescent bulbs. They also produce less radiant heat, and with less heat used, the cooling requirement for the controlled environment is diminished and the total energy used by an LED-equipped chamber is substantially reduced.
- ADA compliance available with no additional cost to the customer.

Standard Features

- 4-6" Polyurethane Insulated Panels
- Embossed White Aluminum Interior Surface Finish
- Embossed White Galvanized Steel Exterior Surface Finish
- Exceptional Temperature And Humidity Uniformity
- Temperature Control At Sensor / Set-Point: ±0.2° C
- High / Low Alarms
- Flexible Configurations
- Complies With LEED Standards
- Energy Efficient Offering Lowered Maintenance Costs
- Pre-tested, Pre-charged Refrigeration Systems
- Non-proprietary Controls
- Controls with Auto-tuning, Fuzzy Logic

Optional Features

- Humidity Control At Sensor: ±0.5%.
- Added Dehumidification and/or Ultrasonic Humidification
- Extended Temperature And Humidity Ranges
- Stainless Steel / Special Surfaces
- Ethernet / Remote Monitoring / Alarming
- Corrosive Resistant Equipment
- Added Redundancy in Controls and/or Conditioning
- Stainless Steel Construction
- Data Logging
- Water-Cooled Or Air-Cooled Condensers
- Custom Lighting Systems
- High Density Shelving
- Unlimited Door / View Window Sizing
- Insulated Glass View ports
- High Weight Capacity Flooring
- Calibration / Validation / Maintenance Services
- Touch Screen Control Interface
- Electronic Door Lock with Data-Logged Access

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

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RENOVATIONS

Darwin Chambers Company can renovate or refurbish reach-in chambers and rooms from a variety of manufacturers for a wide array of applications.

With documented experience turning out-of specification /older/poorly designed systems into validated stability chambers, Darwin Chambers can provide solutions when all-new construction is neither feasible nor recommended.

Walk-In rooms that do not meet uniformity (or other) requirements, can often be retro-fitted with newer equipment, controls, or design changes, in order to meet specifications that—in many instances—greatly exceed the OEM requirements (if there were any, to begin with). Whether the project is a drywall/stick-built 25°C/60% ICH room, or a 20-year-old panelized room (provided by a manufacturer that is no longer in business); solutions can be implemented to vastly increase reliability, accuracy, uniformity ,and efficiency of the chamber.

Utilizing newer technologies and designs, many of the problems inherent in older systems; such as inefficient steam-boilers, insufficient air-flow, inadequate insulation, poor wiring, leaking refrigeration components, poor controls, etc., can be eliminated. Upon completion of work, documentation, warranties, performance, efficiency, and peace of mind will be provided to take the place of what is often a huge headache.

Here are a few examples of the solutions we offer:

- 4” insulated panel rooms: In most cases, near to brand-new results can be obtained with the addition of our systems and controls. The result is often a quick turn-around time, cost savings, and excellent performance.
- Drywall/stick-built rooms: It is possible in some cases, to increase performance and to comply with FDA/GMP / ICH standards. While this style of construction is by no means the best, recommended method to maintain tight temperature and humidity requirements, some performance specifications can be met with the correct application of newer equipment and controls. Darwin Chambers has the proven capability to take rooms that are often giant problems and turn them into sustainable solutions that meet your specific needs.
- Older reach-in chambers: Often, the enclosures are in good condition, but the equipment is very out-of-date. Darwin Chambers can modify and/or replace any components necessary to meet requirements. Typical changes include: newer refrigeration systems, thermoelectric cooling, ultrasonic humidification, dehumidifying/drying systems, PID controls alarms, BMS connectivity, security enhancements, etc.
- Custom chambers: Specification and design assistance services are available to enable custom enclosures, and to meet more stringent requirements. Darwin Chambers technicians and engineers are experienced with a wide variety of control applications, and are available to provide any level of assistance needed.

Chamber Validation Services

- Validation/Qualification services typically include single point validation, documented validation protocol specific to (each) chamber, and execution of the protocol. Personalized protocols are encouraged.

The Darwin Advantage

All installed instrumentation is calibrated to NIST traceable standards and provided with a calibration form. In-house, factory calibrations are performed using state-of-the-art equipment with great accuracies. These reports are three-point verifications, traceable calibration documents.

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SECTION IV

SERVICES

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PREVENTIVE MAINTENANCE & EXTENDED WARRANTY SERVICES

Darwin Chambers Company offers a thorough preventive maintenance package to help protect your investment and provide peace of mind. A listing of available services follows.
Please note, not all services may be applicable to a specific chamber model or type.

Control Panel Check-Out

- Verify that there are no loose wires
- Measure voltage/amps for all motors
- Measure voltage/amps for all heaters
- Verify all alarms function properly
- Verify window heaters are operational
- Verify door heaters are operational
- Verify chamber ceiling lights and light switch are operational

Humidifier Check-Out

- Verify there is not any mineral deposits
- Measure voltage/amps of each humidifier
- Remove any scale build-up inside the humidifier
- Check water supply pressure
- Check for any leaks or signs of corrosion

Condensing Unit/Plenum Check-Out

- Check refrigerant charge
- Check compressor oil level
- Check system operating pressures
- Check CPR pressure setting
- Check capillary tubes do not rub
- Verify no oil traces are present
- Verify no leaks are present
- Clean the condenser coils if needed
- Measure compressor voltage/amps
- Measure crankcase heater voltage/amps
- Measure condenser fan voltage/amps
- Check for any abnormal noise or vibration

Desiccant Dryer Check-Out

- Verify no fault indications exist on front panel and that no lights are burned out
- Check the react outlet air temperature
- Verify proper operation of damper actuators
- Verify proper rotation of drive motor
- Verify process air blower is operational
- Inspect desiccant wheel for dirt or debris
- Inspect desiccant wheel gaskets for wear
- Clean the process air filter
- Check for abnormal noise or vibration

Call 1-877-783-6774

or Email

calsandvals@darwinchambers.com

for a service quote today!

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CALIBRATIONS

We understand the critical role that calibrations have in your regulated industry, which is why we use extremely precise calibration standards. The use of these standards will ensure that your instruments are calibrated to a standard (NIST National Institute of Standards and Technology), in order to meet or exceed manufacturer's specifications.

We can also offer programs that are tailored to fit your needs, such as single point or loop calibrations and verifications.

Our procedure provides a 3-point "as-found" calibration verification. The "as-found" readings are documented and verified to be within the manufacturer's tolerance, if found within the tolerances the device is then returned to service. If any instrument exceeds the tolerance, we will promptly notify you, so that you may take the necessary steps to document the event.

Additionally, if the "as-found" readings are not within the manufacturer's tolerance, the instrument is then calibrated using the manufacturer's calibration procedure. After completing the calibration, the instrument's "as-left" readings are documented using the same three points from the calibration verification to ensure the instrument is reading within the manufacturer's tolerance.

All personnel performing instrument calibrations will be trained on the most recent revision of company calibration Standard Operating Procedures (SOPs).

What is the process? What can I expect?

Call 1-877-783-6774
or Email
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for a service quote today!

Once an order for services is received, we send our formal acknowledgment and confirm scheduling.

Typically, our technicians will arrive either 2-4 weeks from the date of purchase order, or as agreed, on an annual or semi-annual schedule. The work onsite generally takes about one day (per chamber) to complete.

Our factory-trained technicians are friendly, reliable, knowledgeable, and always professional in appearance and demeanor.

Why Choose Darwin Chambers?

- **Value** - Darwin Chambers offers competitive pricing for exceptional quality. We provide specific information on our equipment, because we typically offer the best and most efficient options available to meet the stated requirement. In an industry where reputation is crucial to success, we have experienced continuous growth, primarily as a result of our customer's ongoing satisfaction with the value we provide.

- **Dependability** – We keep our appointments, stand by our results, and with more than a decade of experience in the field, Darwin Chambers can be relied upon to continue our customer relationships and honor our contracts far into the future.

- **Expertise** – Our factory-trained technicians are appropriately certified and credentialed professionals, capable of troubleshooting potential issues, explaining and clarifying technical details, and recommending custom solutions.

- **Availability** – Our headquarters are centrally located, in order to help reduce potential travel costs and facilitate timely arrival of personnel to your worksite. Where needed, we partner with reliable local professionals, in order to ensure critical support availability. In addition, Darwin Chambers' Service Department provides 24/7 technical support free of charge (via phone or e-mail) throughout the lifetime of our reach-in and walk-in chambers.

- **Customer Satisfaction** –It's simple enough to say that w have a lot of happy customers--but the proof is in the numbers: A documented 99% of all respondents to our Customer Satisfaction Survey over the past 5 years, have replied that they were satisfied with the services provided, and would be likely to use Darwin Chambers' services again. The vast majority would recommend Darwin Chambers Service Department to a friend or colleague.

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VALIDATIONS

What Validation Services Does Darwin Chambers Offer?

For purposes of clarity, validations are referred to throughout the corresponding literature and relevant documentation as qualifications, due to the fact that we are specifically engaged in assisting our clients with their Validation Process.

A true qualification package should...

- Consist of calibration records of all instrumentation used during the qualification
- Provide documented evidence the chamber's instruments are in a current calibrated state.

Full Qualification services are typically described in terms of a three-part process...

The Installation Qualification (IQ) is utilized for providing documented verification that all key aspects of the design, procurement, and installation adhere to the design intention.

The Operational Qualification (OQ) is utilized for providing documented verification that the systems and subsystems perform as intended at all anticipated operating ranges (normally performed with an unloaded chamber).

The Performance Qualification (PQ) is utilized for providing documented verification that the process does what it is intended to do, in the correct and anticipated manner (normally performed with either a simulated or actual product load in the chamber).

What Is The Process? What Can I Expect?

Once an order for services is received, we send our formal acknowledgement, confirm scheduling, and proceed with a protocol that is tailored to your specific needs.

In order to provide a trouble-free qualification, Darwin Chambers recommends a start-up commissioning checklist and protocol review be performed prior to the execution of the protocol. This will ensure that your equipment is performing in accordance with the manufacturer's specifications, and that all necessary documentation is in place.

Typically, two weeks after protocol approval, our technicians will arrive. Work onsite generally takes one week per chamber to complete.

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or Email
calsandvals@darwinchambers.com
for a service quote today!

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A Kaye Validator is used exclusively for execution of our qualification testing and demonstrations. Prior to the execution, all thermocouples receive a 2-point calibration and a mid-point verification, and all Relative Humidity sensors used for data collection receive 2-point calibration and customer set-point verification. The chamber is then tested for the duration specified in the OQ (24-Hours, standard).

The PQ is subsequently tested for the duration specified, and includes a door opening recovery demonstration. After completion, the thermocouples and RH sensors receive 3-point calibration verifications. The data (max. and min.) are collected and presented using the Kaye Qualification Report and Qualification Summary Report. Any deviations encountered during testing are documented in the protocol with an approved deviation report and mentioned again in an executor's summary report.

Validation/Qualification deliverables include: The completed protocol and executor's summary report. Qualification data is reported in both table and graphical form in the executor's summary, in order to visually display all results.

Why Choose Darwin Chambers?

- **Value** - Darwin Chambers offers competitive pricing for exceptional quality. We provide specific information on our equipment and component parts, because we typically offer the best and most efficient options available to meet the stated requirement.
- **Dependability** – We keep our appointments, stand by our results, and with more than a decade of experience in the field, Darwin Chambers can be relied upon to continue our customer relationships and honor our contracts far into the future.
- **Expertise** – Our factory-trained technicians are appropriately certified and credentialed professionals, capable of troubleshooting potential issues, explaining and clarifying technical details, and recommending custom solutions.
- **Availability** – Our headquarters are centrally located, in order to help reduce potential travel costs and facilitate timely arrival of personnel to your worksite. Where needed, we partner with reliable local professionals, in order to ensure critical support availability. In addition, Darwin Chambers' Service Department provides 24/7 technical support free of charge (via phone or e-mail) throughout the lifetime of our reach-in and walk-in chambers.
- **Customer Satisfaction** – Nearly all respondents to our Customer Satisfaction Survey over the past 5 years, have replied that they were satisfied with the services provided, and would be likely to use Darwin Chambers' services again. The vast majority would recommend Darwin Chambers Service Department to a friend or colleague.

- **For more information, call 877-783-6774 - or - e-mail calsandvals@darwinchambers.com**

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KAYE Validator

Features and Advantages

The Kaye Validator...

- Simplifies the entire validation process by reducing setup time and minimizing sensor handling; thereby automating sensor calibrations, neatly organizing study data, and generating regulatory required reports.
- Meets FDA guidelines for protecting electronic data (21 CFR Part 11)
- Prevents unauthorized access via user ID and password for critical operations
- Creates secure results using files that cannot be used if tampered with
- Creates printed or spreadsheet reports from a single protected file
- Protects data with internal memory if USB drive fills up or printer runs out of paper
- Saves data with battery back-up for up to 30 minutes if system loses power
- Plug-in Sensor Modules minimize sensor handling and save calibration time
- Eliminates the need for quick disconnects on each input
- Stores calibration offsets, allowing the software to link module with a specific instrument. From storage to instrument, sensors are ready for mmediate use

Most importantly, the Kaye Validator features a report generator that enables the grouping of calculations into customized, easy-to-read reports. The system organizes the test data in a spreadsheet format, saving analysis time and speeding access to critical process data.

The Kaye Validator...

- Provides flexibility to operate standalone or with PC during testing
- Calibrates sensors and runs qualification studies with or without a PC
- Features easy-to-read data for up to 12 sensors per screen with menu-prompted displays
- Enhances viewing on PC screens such as trending of live data
- Offers more flexibility to set up your test
- Separates sensors in up to four groups, e.g., independent reports for distribution and penetration or for qualifying multiple chambers
- Writes unique headers and comments for each group
- Sets conditions for automation starting and stopping of exposure and qualification
- Calculates lethality using base temperature, Z and D values
- Provides condition of lethality calculation based upon chamber pressure
- Includes interval min., max., avg., and standard deviation calculations
- Saves time analyzing data
- Generates new spreadsheet formatted reports for each group: easy to read
- Creates Summary report to view test results at a glance
- Simplifies tracking of validation data since all results of Setup, Calibration and Qualification are kept in a single protected file
- Prints reports individually or all at once
- Locates files quickly because they are saved by descriptive name, author and date
- Monitors critical events and generates messages
- Trends inputs and calculations on-line
- Eliminates hassles to document exceptions
- Eliminates need to circle exceptions, write comments by hand, or use spreadsheet software to recalculate data
- Documents a failed sensor, but user can exclude bad data from calculations
- Captures user comments as part of standard report

And there is much more..

- The Kaye Validator accepts up to 36 inputs in any combination of thermocouple, voltage, or current inputs
- Provides total system accuracy of 0.28°C with improved noise immunity
- Meets European requirements for fast data storage of one sampler per second
- Is supported by fully validated hardware, software and firmware documentation
- Simplifies your SOP development using 22-page standard operating procedure

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SECTION V

APPENDICES

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SINGLE SOURCE JUSTIFICATION

To Whom It May Concern,

Regarding potential sources of, and the many possible methods for, constructing controlled environments—Darwin Chambers Company respectfully submits the following reasons for selecting a single, experienced provider of walk-in environmental chambers:

Efficiencies related to purchasing and procurement

- Less work and risk are involved in vetting vendors or suppliers for a single, turn-key project, as opposed to multiple sources and potential service providers.
- Costs related to resale, shipping, and even overall product pricing are typically eliminated or reduced.
  - Fewer resellers involved, tends to translate into lower costs for the buyer.
  - Most environmental room providers enjoy OEM pricing and reduced rates on component parts purchased regularly, in bulk.
  - Freight is typically discounted, from a single point of manufacture, and potential component delays are generally avoided.
    - -Should any delay or issues occur; timely, satisfactory resolution becomes the responsibility of the room supplier.

Compatibility of component parts and software

- A room that has been supplied as an independent, complete, turn-key product is designed so all integral parts and software are purposed, tested, and known to work together as intended, to provide operation as specified.
- Any changes to the design or operation of the controlled environment room, and any accessories offered by a single-source supplier, will have been tested and known to work well with the room components provided; guaranteed to work in combination without resulting fault, failure, or usage other than intended.
- An ethical supplier of environmental rooms and chambers will utilize proprietary components openly, in instances where to do so is deemed in the customer's best interest due to innovation or unique advantages offered.
  - An independent buyer who has not specialized in environmental rooms and chambers may not be aware of purchasing a proprietary component or system, and may not be as familiar with the cost and quality of available alternates or operational requirements for each and every part.
  - Non-proprietary parts may also result in lower replacement costs.

Design integrity and efficiency

- An experienced supplier will ensure that the entire system is designed or approved by qualified, degreed engineers.
- The more solid-state and well designed a system is, the more reliable it will be, as well as energy-efficient—due to fewer points of failure, and optimal sizing and placement of component parts.
- If the provider is a specialist in the type of chamber required, they may be aware of newer technologies and superior solutions that are less commonly known or that are application-specific.
- Warranties and installation considerations
- An experienced supplier will ensure that the room is installed by (or with the aid of) factory-trained, qualified technicians.
  - Improper installation or lack of owner training may result in voided warranties, operational failures, or costly damage to product.
- Commissioning of a chamber should be done by trained professionals, with validatable results, proper documentation, and using the correct equipment.

Lowered total cost of ownership (TCO)

- A single supplier may contractually guarantee its ongoing ability to replace all components as well as consumables over a specified period of time.
- A single source should be able to offer lower pricing on maintenance agreements and extended warranty services, when servicing the supplier's own product.
- A single source can provide pricing in advance for required consumables, eliminating the potential for cost increases and...well, surprises.
- In many instances, the services of a trained or certified technician are not required.
- The room provider should offer documentation and skilled support to help avoid unnecessary service calls.
- When the room provider is able to offer a system that uses energy and other resources more efficiently, long-term utility costs are lower, adding up over time.

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SINGLE SOURCE JUSTIFICATION

Document deliverables and record-keeping

- An Operations Manual, detailing significant components and assemblies for each room purchased, as well as maintenance and operation/programming advice should always be provided by a single-source room supplier.
  - When components are assembled from multiple sources, information provided may be incomplete. Drawings, wiring diagrams, and maintenance advice may become the responsibility of the owner/operator or consultant.
- An experienced room provider will offer detailed submittal documentation and drawings, and maintain some record of product serial numbers and design, as well as transactional information.
  - Audits, service calls, or future re-sale or re-purposing of a room may require the availability of in-depth documentation.

Liability--Who's ultimately responsible for operation as specified?

- Higher risk related to guaranteeing the results from components and labor provided by others, usually translates into higher prices from whomever takes ultimate responsibility for chamber operation and dependability.
  - Often, this falls to the supplier of the control systems, although experienced installers will have their own disclaimers or related risk-based pricing.
- When multiple sources and suppliers are contracted, operational failures may be more difficult to troubleshoot and resolve.
  - Technicians for one supplier may be unfamiliar with components or assemblies provided by others.
  - Claims or guarantees pertaining to a specific part are often more difficult to identify and enforce, when applied to the operation of a larger, complex system provided by others.

"Value-added" benefits

- Sometimes, a single source supplier may be able to provide free upgrades, accessories, or additional services that would otherwise come at an added cost.
  - For example, Darwin Chambers Company offers free 24/7 technical support to all our customers via phone or internet.
- The environmental room supplier/manufacturer typically offers comprehensive warranties that exceed those offered by the individual component part manufacturers.
  - The entire room is guaranteed to perform as a complete and functional system, with fewer limitations on usage and available product support.
  - Whenever the component warranty offers coverage for a greater period of time, this is almost always passed on to the customer.

In summary, cost, efficiency, operational capability, reliability, liability, and even peace of mind are all factors to consider in determining how to proceed with your controlled environment project. Of course, we would be pleased to be chosen as your provider or consultant, but even more importantly—this advice is offered to help our potential and future customers understand more fully, the risks and advantages that their selection will entail.

Please let me know if you have any questions--and thank you for considering Darwin Chambers Company.

Regards,

Krissie McGrath
Darwin Chambers Co., LLC

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WARRANTY

Darwin Chambers Company, LLC (Darwin Chambers) -- Warrants its products are
free from defects in material and workmanship, subject to the conditions and limitations set forth below, for a period of:

- 10 Years For Modular Panels*
- 3 Years For Each Compressor
- 2 Years All Parts Warranty
- 1 Year Labor Warranty

Darwin Chambers will either repair or replace any part of its products that prove defective by reason of improper workmanship or materials, if it may be reasonably established to our satisfaction that Darwin Chambers is at fault for said defect. If Darwin Chambers is then unable to repair or replace the original component provided with a functionally equivalent one, it will refund the current value of the product at the time the warranty claim is made.

Our limited warranty does not cover any damage to the product that results from abnormal mechanical or environmental conditions, abuse, accident, improper installation or maintenance to any part of the equipment by others, misuse, insufficient or excessive electrical supply, natural disaster, or any unauthorized disassembly, repair, or modification.

This limited warranty covers only replacements for defective Darwin Chambers products, as described above. Darwin Chambers does not cover under warranty, and is not liable for, any loss of product placed within the environmental rooms, or any costs associated with diagnosing the source of system problems or installing, removing, or servicing Darwin Chambers products unless specified herein. In the event of a claim, Darwin Chambers' sole obligation shall be to replace our product with its equivalent or the best possible substitute.

Free Technical Support

In addition to the Operations Manuals, Darwin Chambers offers free technical support on its products. Please use our support service prior to requesting an RMA or contacting a third party service provider. Darwin Chambers' free technical support is available by phone or fax at 877-783-6774 (US and Canada), or email, at technicalsupport@darwinchambers.com.

Replacement requests will ONLY be accepted through Darwin Chambers Company, LLC, directly. Further, Darwin Chambers reserves the right to refuse any returned product that is improperly packaged for shipping. Significantly delayed reporting of any known issues may result in voided warranty.

NOTE: Consumables (i.e., chart paper refills, filters, lights, and ultrasonic transducers) are not covered under warranty unless explicitly stated and acknowledged by Darwin Chambers Company, although such items may be included in a maintenance agreement.

* 10 years from date of delivery to installation site, except that coatings warranty shall be a two year warranty.

DARWIN CHAMBERS

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STANDARD TERMS AND CONDITIONS OF SALE

THE CONTRACT

I. In these Terms and Conditions of Sale (hereafter "Conditions"), "Darwin" means Darwin Chambers Company, LLC. "Purchaser" means the company, firm, individual or other party with whom Darwin contracts.

II. The acceptance of any order or specification, and terms of payment relating to same, is subject to approval by Darwin's management. All sales contracts shall be effective only when approved and acknowledged, in writing, by Darwin's management. Changes to orders that have already been accepted by Darwin must also be confirmed in writing and accepted by Darwin, and where the changes result in an increase in the original cost, the additional costs shall be paid to Darwin by the Purchaser.

III. All contracts entered into between Darwin and the Purchaser shall be subject to these Conditions. In the event that the Purchaser has not received a copy of these Conditions in relation to a specific order, these Conditions shall still apply to the contract provided they had previously been made available to the Purchaser.

IV. Any description contained in Darwin's estimates, brochures, website, or other promotional or informational material is intended to present a general description of Darwin's products only. Specifications are subject to change without notice. Only that description as contained in the approved submittal and final written contract between Darwin and the Purchaser shall be considered final and actual.

V. All prices quoted are exclusive of taxes and bonding, unless specifically stated otherwise. Unless stated otherwise, taxes and bonding are payable by the Purchaser. Darwin Chambers Company is not responsible for duties, tariffs, or export- related fees. Certifications, inspections, and licensing not required at the point of manufacture are not included, unless explicitly stated otherwise by Darwin Chambers Company. All sales are final; all terms, warranties, representations, and products are offered and intended for domestic sale and/or use, unless specifically stated otherwise.

DELIVERY AND COMPLETION

I. Unless stated otherwise, shipping and installation dates are based upon prompt receipt of all necessary information by Darwin including signed approval drawings where appropriate. All scheduling information is provided and Darwin shall make its best efforts to see that delivery is made within the time estimated, but is subject to delays caused directly or indirectly by matters beyond its control. In no event shall the failure to deliver shipment in the time estimated give rise to damages or be considered cause for cancellation of the order where the delay is the result of circumstances beyond Darwin's control.

II. Unless otherwise agreed to in writing, the risk in the goods that Darwin agrees to supply shall pass to the Purchaser as soon as delivery to the Address has been affected. Risk for the goods rests with the Purchaser during the installation and commissioning phase.

PAYMENT

I. The Purchaser shall make payment to Darwin in accordance with the payment terms as defined in the purchase order, contract, or order acknowledgment. If no other schedule has been agreed to, payment in full shall be made within 365 days or within 90 days of the substantial completion and delivery of the goods, whichever comes first.

II. Darwin shall have a right of action against the Purchaser for the price of the goods whenever the payment of the price becomes due, whether or not the goods have been received by the Purchaser. Even though risk has passed to the Purchaser when delivery of the goods is made to the address, ownership in the goods shall not pass to the Purchaser until such time as total payment has been recieved by Darwin.

III. In addition to any other rights of Darwin, interest is payable on all overdue accounts (past 60 days) at the rate of 1.5% per month, or 18% per year.

IV. Where the Purchaser defaults under the contract or any contract with Darwin in respect of payment on the due date of any sum due to Darwin, Darwin, without liability, may postpone any further shipments or may cancel the contract or any other contract between Darwin and the Purchaser, including any warranty obligations, but without prejudice to any right which Darwin may have against the Purchaser in respect of the Purchaser's default.

CANCELLATION

Unless otherwise agreed to by Darwin, once accepted by Darwin, orders shall not be subject to cancellation by the Purchaser, unless the Purchaser fully compensates Darwin for all costs incurred, either directly or indirectly, to the extent that they are recoverable at law.

POSTPONEMENT

If, after goods have been ordered by the Purchaser, the Purchaser seeks a (cumulative) postponement of delivery of those goods in excess of 60 days; Darwin shall invoice, and the Purchaser shall pay to Darwin, the price of the goods according to the original schedule and terms of payment, as if delivery had been effected at the time originally agreed to. Further, the Purchaser shall be responsible for any extra costs resulting from the handling and storage of the goods, including insurance premiums. Prices quoted do not include extra costs of handling, warehousing and insuring goods.

Name:
Date:

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STANDARD TERMS AND CONDITIONS OF SALE

INSTALLATION AND TESTING

I. When Darwin is contracted to perform product installation, the Purchaser shall advise Darwin, in writing, of the date on which the site will be ready for the installation of the goods. In the event that the site is not in a condition such that the installation can be completed on the specified date, the Purchaser shall compensate Darwin for any direct or indirect costs incurred as a result of the delay, to the extent that they are recoverable at law.

II. Similarly, when Darwin is contracted to test equipment, the Purchaser shall advise Darwin, in writing, of the date on which the site and goods will be ready for testing. In the event that the site is not in a condition such that the testing can be completed on the specified date, the Purchaser shall compensate Darwin for any direct or indirect costs incurred as a result of the delay, to the extent that they are recoverable at law.

III. A written warranty for each room shall be provided to the Purchaser by Darwin upon completion, which shall have full force of effect upon receipt of payment in full by Darwin for the entire amount of the contract or purchase order (and all subsequent change orders and agreed modifications.)

PROPRIETARY INFORMATION

Any technical information furnished by Darwin to the Purchaser relating to or as a result of an order shall be considered confidential unless otherwise indicated by Darwin, in writing, or unless required to be disclosed by governmental authority. Where the Purchaser is a general contractor, such information may be disclosed to the ultimate owner and/or user(s). In any event, such information shall not be reproduced, used or disclosed to others without Darwin's prior written consent, and shall be returned to Darwin upon request.

CONSTRUCTION AND SEVERABILITY

All Conditions in this document shall prevail over and supersede any contrary or inconsistent terms or conditions or other documents issued by the Purchaser, whether they have been communicated in the past or are communicated in the future. In the event that any provision of these Conditions is determined to be invalid or unenforceable, the remainder of the Conditions shall remain valid and enforceable to the maximum extent so as to achieve, as closely as possible, the original intentions.

APPLICABLE LAWS

Unless otherwise agreed, the laws of the State of Missouri shall govern if any dispute arises hereunder.

DISCLAIMER

Darwin Chambers Company warrants that all products provided will be as specified and free from defects in materials and workmanship. Darwin makes no other warranties, nor representations of any kind whatsoever, whether expressed or implied, except that of title, and all implied warranties including any warranty of merchantability and fitness for a particular purpose are hereby disclaimed. Darwin (including its directors, officers, employees and agents) assumes no liability for indirect, incidental or consequential damages of any kind, including but not limited to lost profits, business interruption, or loss or damage arising out of the existence of any potentially harmful bacterial agents, odors, or any other substances, products or bi-products produced by, released by, or arising out of organic sources. Some jurisdictions do not allow the limitation or exclusion of liability for incidental or consequential damages, so the foregoing limitation or exclusion may not apply. In no event shall the liability of Darwin exceed the purchase price of the specific good giving rise to the alleged loss.

LIMITATION OF LIABILITY

Total aggregate liability for damages of any nature, regardless of form of action, shall in no event exceed the amount paid by you to Darwin Chambers Company, or its affiliates for the component upon which liability is based. In no event shall Darwin Chambers Company, or its affiliates be liable for indirect, incidental, special, exemplary, punitive, or consequential damages of any nature including, but not limited to, loss of profits, revenue, production, or use, business interruption, or procurement of substitute goods or services arising out of or in connection with the use or performance of any Darwin Chambers product, whether based on contract or tort, including negligence, or any other legal theory, even if Darwin Chambers Company or any of its affiliates has been advised of the possibility of such damages.

The recommendations and suggestions regarding product application and use that are offered in the provided Operations Manual, in our product brochures, or information provided by any employee, broker, reseller, or distributor on behalf of Darwin Chambers Company, are provided as a guide in the use of our product and do not, in and of themselves, constitute a guarantee of product performance since Darwin Chambers Company has no control over the use to which other parties may apply the information or product. Darwin Chambers Company further recommends that operators and users of our Products ensure that the intended use does not violate any Federal, State, or Local law—including, as applicable, statutes regarding the treatment and disposal of hazardous wastes and associated materials. All disposal of materials must be in compliance with Federal, State and Local laws and is the sole responsibility of the Purchaser.

Name:
Date:

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ETHICS POLICY

Darwin Chambers Company strives to maintain the highest standards of ethical conduct and corporate responsibility through the application of the following principles:

- Compliance with all pertinent national and international laws and regulations shall be required.
- Darwin Chambers Company is an equal opportunity employer.
- Potential conflicts of interest shall be openly declared and efficiently addressed to ensure that no such conflict ever be allowed to degrade our product, performance or reputation.
- Due to the high standards for both our product and professionalism that we maintain, we shall welcome competitive challenges and shall refuse to engage in any practices designed to unfairly exclude others in a competitive bid situation.
- Improper payments of any kind are strictly prohibited. Similarly, no gift whose value is material and which may be interpreted as a form of inducement should be accepted or offered by or on behalf of Darwin Chambers Company employees.
- All discussion of competing companies or products in the marketplace should be restricted to a provable, factual comparison of materials and system operation, components and features.
- Reporting of business performance should be undertaken in such a way that senior management is fully and properly informed concerning the business' true performance, risks and opportunities in a timely manner.
- All estimates and reporting to partners or customers, whether potential or established, shall be made in good faith and to the best of our ability or knowledge under the given circumstances.
- We seek to influence our suppliers to operate to similar high standards as ourselves.
- We strive to make a positive contribution to society as a whole, and specifically the communities we serve and in which we operate.
    - In order to achieve these goals we have become active members of the United States Green Building Council, participants of the United Nations Global Compact and a small business resource for Energy Star.

All employees have a duty to follow the principles set out in this policy statement. It is the responsibility of senior management to ensure that all employees who directly or indirectly report to them are fully aware Darwin Chambers Company's policies and values while engaged in the daily conduct of the company's business. It is also the responsibility of senior management to lead by example, and to demonstrate the highest standards of integrity in carrying out their duties on behalf of the company.

Regards,

Christopher N. Barnett,
President of Darwin Chambers Company

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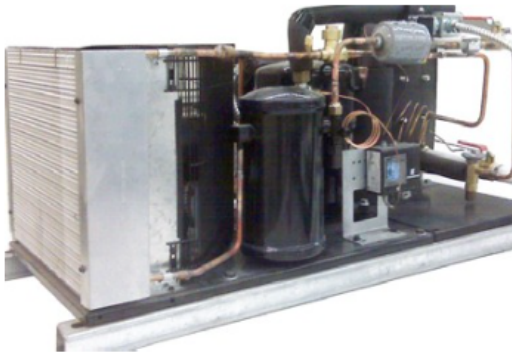
PRECISION FLUID TEMPERATURE CONTROL UNIT

Introducing An Innovative Solution

The Darwin Chambers Precision Fluid Temperature Control Unit (PFTCU) is an indirect cooling system utilizing a combination of refrigeration technologies, glycol/water heat exchange technologies, and the latest temperature control methods to outperform conventional refrigerat systems in environmental chamber applications.



Precision Fluid Temperature Control Unit - Benefits

1. Refrigeration system is entirely self-contained, no on-site brazing is required, water connections are typically made using cross-linked polyethylene (PEX) or equivalent.
2. Refrigeration system is entirely pre-built, pressure tested, vacuumed (lengthy process ensuring micron levels achieved and maintained well below 500 microns), charged (from a digital scale to predetermined levels), energized, and tested in the factory to ensure the system runs properly before shipment.
3. System requires a relatively small quantity of refrigerant, no refrigerant is circulated into the environmental room and no refrigerant circulates through piping to and from evaporator.
4. Because the PFTCU is pre-charged/tested, there is considerably less time spent installing system, only water (glycol/water) connections are made.
5. Because refrigerant is only in the cooling unit, leak testing and repairs are readily performed. If entire replacement is ever needed, the entire cooling system can be replaced (wiring and piping included) in less than 30 minutes.
6. Because propylene glycol is continuously circulated through room, a large, rapid temperature rise is avoided during failure of cooling unit.
7. Redundant cooling systems need only be placed in-line with one another, with nothing but the addition of a small amount of piping and ball valves for disconnection. Failure of one system will not contaminate or compromise the piping of the other system or the room evaporator/air handler.
8. Small leaks in the evaporator/air handler will take an exceptional amount of time to cause a temperature rise. The propylene/glycol mixture does not escape through microscopic holes nearly as fast (months instead of minutes) as refrigerant gas.
9. Pressure on piping is drastically less than compared to refrigeration piping, 1 or 2 psi compared to up to 100+ psi with refrigerant gas. In rare instances of leaks in the room evaporator/air handler, the fluid level can simply be topped off and the system can be serviced weeks, months, or years later – at the customer's convenience.
10. Entire cooling system can be installed and replaced, quickly, with simple tools - no refrigeration tools or certified technicians necessary.
11. Because the PFTCU can operate in two modes, cooling/heating with refrigeration and cooling/heating with continuously circulating fluid, this system is more efficient and inexpensive to operate. As one should expect, a large refrigeration system should not be required to maintain temperatures near or above 40C. With the PFTCU, the compressor is de-energized when the desired temperature goes to higher levels and only the ultra-efficient (and reliable) circulator pump is used to cool the room. No other manufacturer has this capability.
12. Service costs are reduced, sound levels are minimized, energy expense is reduced, and temperature control/uniformity is un-matched

In addition to the points above, Darwin Chambers has generated extensive documentation, through the course of numerous validation studies, that prove temperature control/uniformity (and as a direct consequence, relative humidity control/uniformity) is simply unmatched by any other environmental chamber manufacturer.

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REACH-IN ENVIRONMENTAL CHAMBERS

Darwin Chambers Company, LLC manufactures environmental chambers, laboratory incubators, and stability testing chambers. Our environmental test chambers and stability chambers are used in the pharmaceutical industry, as well as our temperature-controlled incubators. Darwin Chambers also provides stock laboratory refrigerators, laboratory freezers, insect growth chambers (insect-rearing chambers), freeze-thaw chambers, and thermal cycling chambers. In addition to these models, custom reach-in chambers can be made to your specifications.

Standard Features and Construction

Our reach-in chambers are offered as standard with 300 series stainless steel fronts and brushed finish aluminum sides and back. Darwin Chambers Company carries full stainless steel (exterior and interior) models, as well. Casters are standard on every upright chamber.

KB Series environmental chambers, PH Series stability chambers, DB Series incubators, stability refrigerators, and insect growth chambers all come standard with Fuji PXG4 microprocessor controllers. Available options include timed lighting, glass doors, chart recorders, dehumidification systems, remote PC control, temperature and humidity data loggers, CO2 control, and access ports.

Chamber Types and Applications

Darwin Chambers Company provides refrigeration systems with hot-gas bypass to achieve desired cooling performance in our environmental cold stability/storage chambers and wide-range units, among others. This system is reliable and has been in service for decades. In fact, it is commonly used by most environmental chamber manufacturers.

However, to maintain temperature ranges above 15°C and below 60°C, our thermoelectric stability chambers are highly recommended. These chambers have been designed for reliability, performance, and ease of service. As a bonus, they are more reliable, quiet enough to go into the lab (as quiet as a home refrigerator), have better uniformity, and are easier to repair. They put out less total heat than a normal refrigeration compressor system—sometimes making an air conditioning upgrade unnecessary.

Thermoelectrically-cooled environmental chambers are detailed in our stability chambers (website) section, due to their usage in supporting ICH/FDA conditions (such as 25°C/60%RH, 30°C/65%RH, and 40°C/75%RH). Keep in mind, when adding a significant heat load or requiring conditions below 20°C, compressor-type refrigeration units will be a better fit. For these, and for applications involving a wider temperature range, please consider our DB Series incubators and KB Series environmental chambers.

Applications/Product Offerings Include

- Pharmaceutical Stability Test Chambers
- Insect Rearing
- Ambient Storage Chambers for the Aerospace Industry
- Energy Efficiency Testing Chamber
- Film Storage Chamber
- Entomological Rearing Chamber
- Electronic Burn-In Testing
- Machine Testing Enclosures
- Lexan Enclosures for Bench-Top Testing
- Roll-In Bottle Incubation Chambers
- Industrial Dry Chambers
- Polymer Storage Chambers
- Plant Growth Chambers