DRYAIR Turnkey Dry Room Standards

Manufacturers of moisture sensitive or hygroscopic products can realize substantial productivity and quality increases, along with greatly reduced energy consumption by utilizing an efficient Dry Room for production. Lithium battery, pharmaceutical and food manufacturers, as well as many other specialized applications have been using dry rooms successfully for many years. A Dry Room, built by *DRYAIR*, can provide you these special advantages:

- Vapor tight construction (panels, seams and air locks) reduces moisture sources to personnel load and makeup air load, and improve system stability and efficiency.
- *DRYAIR* turnkey responsibility assures single-source guarantee on room meeting specifications and reduced management cost for client.
- Wall panel system facilitates room expansion or relocation; Improves efficient use of the panel system and avoids overlapping investment.
- All components are sourced from world-class suppliers improving stability of the system, prolonging service life, and assuring the user more investment return.
- *DRYAIR's* global experience in Turnkey Dry Room fabrication
- Heat Recovery technology provides lower energy costs.
- Professional design, strict material selection, and *DRYAIR's* disciplined Dry Room fabrication process ensures safe and efficient operation.

Dry Room Design

DRYAIR Dry Room systems are custom-designed to meet all specific design requirements. Design criteria include eight critical variables from which our dry room design considers:

- Maximum number of people operating in the room
- The specified temperature, humidity control level, and cleanliness requirements
- The available space for room construction, product, personnel doors, equipment doors, conveyer openings, etc.*
- Regeneration heat source for ZCH-Series unit (electric, steam or natural gas)
- Illumination, fire rating, or explosion safe requirements
- Applications: Lithium battery, pharmaceutical, food manufacturer, document / currency storage, marine, small industrial, residential, or specialized
- Sensible internal heat load or moisture load factors*
- Room exhaust and pressure difference requirements

** The control level and the personnel moisture load in the space dictate the requirements for the size of the dehumidification air handling system required to maintain the room at specifications. With careful design, desiccant dehumidification systems capable of delivering air to a minimum of 0.007g/kg (-65℃ dew point) can be integrated into the dry room construction thereby allowing room operating levels as low as 1% R.H. to be maintained.*

** Where floor space is available, a ZCH-Series dehumidification unit adjacent to the dry room reduces the possibility of moisture infiltration into the conditioning system, and eliminates long runs of ductwork. If this design cannot be utilized, a rooftop ZCH-Series dehumidification system can be incorporated.*

Dry Room Selection Procedure

When all variables needed for the selection procedure are established by the end user, *DRYAIR* will provide a complete *Dry Room Proposal*. Our expertise in this application has enabled *DRYAIR* to pre-fabricate many of the components utilized, thus placing all dry room orders on fast-track construction schedules.

Dry Room Specifications

General Design

Dry Rooms furnished and installed by *DRYAIR*, are completely self-contained units. They include all essential mechanical conditioning equipment, controls, and plenums/ ductwork designed to maintain the dry room at -35℃ +/-2º, 1% R.H. (0.197g/kg). Applications requiring Ultra low dew points (-60℃ +/-2º), are attainable.

Submittals & Operation Manuals

Submittals will include shop drawings which indicate (1) all room dimensions and construction features, (2) electrical wiring diagram and electrical parts list, (3) mechanical system schematic with refrigeration circuit, and a complete vendors' parts list for all components. The Operating / Maintenance Manual will detail sequential startup, operation, and shutdown with all pertinent control data and schematics.

Start-up & Instruction Period

At completion of room installation and start-up, *DRYAIR* will provide an engineering representative for complete instruction in the operation of the room, including controls and all related systems.

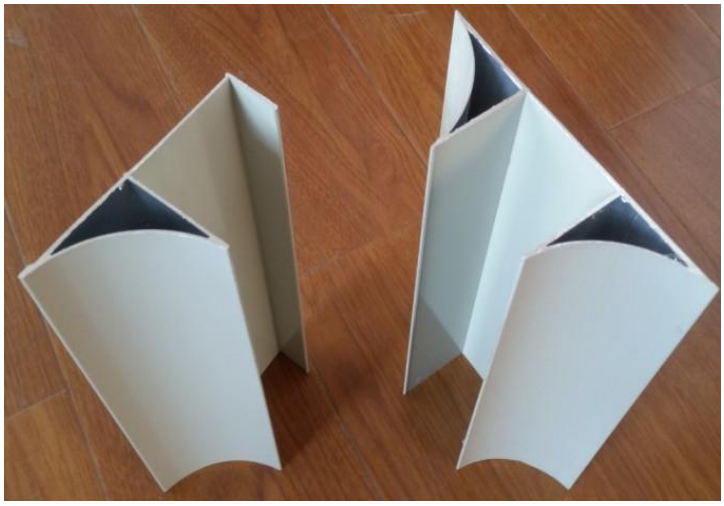
Warranty

Installation and ability to maintain the specified control level for temperature and humidity will be guaranteed for one-year from the date of startup and/or customer approval that the room meets specifications.

Room Shell Construction

Wall & Roof Panels

- All *DRYAIR* Dry Rooms will utilize prefabricated, double-wall rock wool magnesium oxide pre-painted steel panels for all walls and roof, allowing future room expansion or disassembly for relocation.
- Wall and roof panels will be constructed of 3" thick rigid board form rock wool with 5mm magnesium oxide board and 0.5mm pre-painted steel skins bonded to each side of the foam core. The wall and roof steel surfaces will be covered with a strippable film which will remain adhered to the panel until the room is assembled to protect against accidental scratches or markings. Panel construction materials and colors can be customized to match specific application.



- Optional fire-proof and explosion-proof panels and other custom fabricated panels can also be provided if required.

Panel Fastening System

Panels will be assembled using specially designed aluminum extrusions, which pull the panels firmly together to form a tight seal. Fastener extrusions will provide a sheath-type closure over the full length of all joined sections which not only make the system look elegant and beautiful, but also ease relocation and disassembly. All connection between fastening extrusions and panels and edges of the panels will be sealed with silicone to prevent air and moisture infiltration along seams.

Floors

Dry Room floors will be fabricated on the existing surface and covered with self-leveling epoxy floor paint; Dry Room floors include thick paint film, wear-resistance, waterproofing, as well as permeability resistance, high flatness, non-combustible and anti-static features.

Doors & Airlock

Standard doors will be fabricated using steel, and equipped with a hydraulic door closer or electric slide rail. All gaps between the door and frame are carefully treated with gasket to reduce air leakage. The door perimeter and frame will be made of steel with gasket material on three-sides and an automatic up-down gasket seal on the bottom. A viewing window will be included in each door. Viewing windows are made of double-tempered glass which has excellent sound insulation, thermal and moisture protection. Dry Room airlock(s) are included to prevent moisture infiltration. The airlock can also be served as a dressing area for clean room clothing. The airlock is designed to be maintained at a positive pressure of no less than 5 Pascal (0.02") of pressure, to prevent air/moisture infiltration. Standard airlocks are provided with the same LED lighting and ceiling structure as the dry room. An inductive switch is used to minimize energy consumption.

Air Distribution

Airflow from *DRYAIR-ZCH* systems are ducted through full-seam welded stainless steel for minimal infiltration of ambient air and moisture. All exterior ductwork is aluminum-laminated for good appearance and is also rubber-insulated to minimize heating/cooling load. Ducted air from the dehumidification system is delivered into metal perforated air-distribution ceiling board or HEPA Fan Filter Units (FFU) modules, delivering treated air uniformly downwards throughout all of the workspace. Air will return to the conditioning system through grills in the walls or columns.

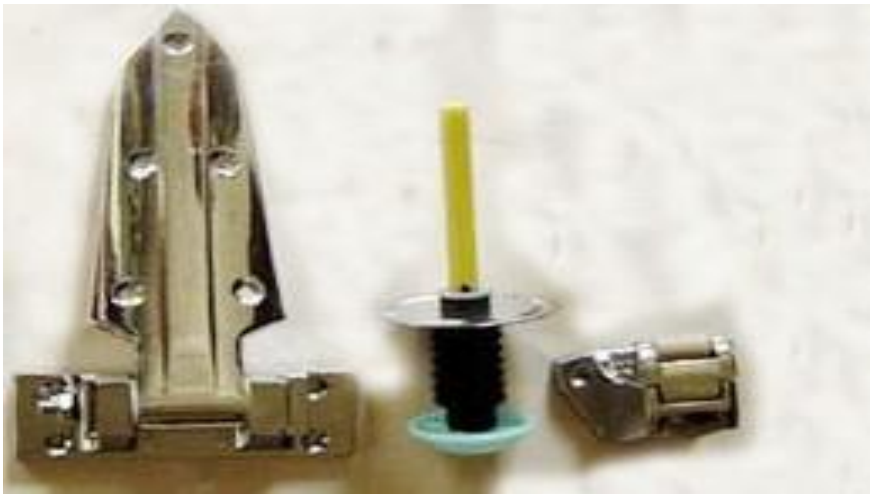
Lighting & Fire Protection

Dry Rooms include interior T5 LED fluorescent lights to evenly distribute lighting throughout the room; each light is equipped with an electronic ballast to improve luminous effect and minimize energy consumption. High-intensity discharge lighting can also be provided if required.

- *Emergency lighting* will be installed in each room with spare-power lighting designed to last no less than 60 minutes.
- National or industrial standard *Emergency Exit s*igns will be installed around

each corner. Each emergency door will be properly labeled as “Emergency Exit” for clear and easy evacuation.

- *Emergency Doors* are equipped with *putter fire locks* with an inside release handle in the lock for emergency situations. The user only need to use strength of no more than 130N to push handle so emergency doors can be opened from inside.



- *Emergency Glass* located on the door ~50mm from the floor is available; a special hammer can be used to break the glass for evacuation.

Dry Room Utilities

Electrical

Electrical supply for room power, lighting, condensing units and dehumidifiers will be brought into the control panel by an electrical contractor.

Water

Utility water for any water-cooled condensing units will be provided by the end user. A drain for the water discharge and the coil condensate pan will be provided within 5 ft. by the end user or general contractor.

Instruments & Control Systems

Siemens PLC Control Systems

Siemens S7-200 Control Systems provide the operator with access to all ZCH-Series functions via a single interactive touch-screen. It is a reliable system for precisely controlling dehumidifier reactivation energy, as well as the multiple cooling coils that provide low dew points and comfortable dry room temperature control.
Siemens S7 Control Systems can be upgraded or expanded by modifying engineering software as additional *ZCH-Series* systems are added. The engineering software can provide a graphic presentation of the ZCH-Series system to access and track all dry room variables, including room temperature, coil temperatures, compressor discharge temperature, and multiple point dew points.

Optional: GPRS Remote Control SIM card can be installed to enable DRYAIR Worldwide Service access to our engineers; online consultation, system service and troubleshooting from our headquarters can be provided to help reduce maintenance costs and insure that systems always perform at optimal conditions.

Humidity Control & Recording

Room operating temperature and humidity will be sensed using an industrial control sensor. The output of this sensor will then be recorded in the control system, temperature and humidity recorder mounted in each control panel as an integral component. Dew point sensors can also be utilized as an option. Control panels will always be equipped with high-humidity alarms, which can be set to bring on any backup dehumidification equipment, provided if the room goes into high humidity alarm. The alarm will be automatic and resetting so that once the room humidity is lowered to the desired level, the instrument is able to respond accurately in the future.

Temperature Control

Room temperature control can be accomplished using refrigeration and/or reheat. A PID controller will modulate final cooling or heating based on actual conditions versus set point. Room temperatures are recorded on the recorder and automatic resetting high/low temperature alarms will be provided.