

LIFE SCIENCES

SAMPLE GROWTH, STORAGE, AND PRESERVATION SYSTEMS

The rapid increase of Life Sciences research in laboratory and medical facilities has expanded the demand for high purity gases such as nitrogen and carbon dioxide for use in sample growth and preservation applications. The distinct properties of these gases combined with the particular requirements of the systems pose numerous challenges to those designing, installing, and operating incubation systems along with cryogenic storage and preservation equipment. CONCOA's broad and flexible line of high purity equipment allows the user to design a complete, high-precision gas delivery system for use in any Life Sciences application worldwide.



526/527 SERIES AUTOMATIC SWITCHOVERS

The 526 Series brass and 527 Series stainless steel switchovers provide a continuous supply of high purity (up to grade 6.0+) gas from high pressure cylinders for cell culture incubator or bioreactor installations. An optional line regulator ensures constant downstream pressure. For a continuous supply of high purity carbon dioxide or nitrous oxide, the 526 CD Series switchover with integral heaters may be used. CONCOA switchovers feature 316L stainless steel diaphragms, metal-to-metal seals, and check valves in hose inlet glands to maintain system integrity. Options include purge valves, remote alarm, and pressure switch gauges or transducers for remote alarm integration. For larger installations or those requiring longer run times, CONCOA switchovers can be expanded using the 52 Series manifold manifold system.



538 SERIES INTELLISWITCH II™

The fully automatic 538 Series IntelliSwitch II delivers an uninterrupted supply of high purity gases from liquid or high pressure cylinders. For sizable incubator or bioreactor installations using liquid cylinders as a gas source, the intelligent 538 Series with microprocessor control lowers yearly gas cost by eliminating liquid cylinder vent loss and excess residual return. Electronic source controls allow change from high pressure to any pressure liquid cylinders at the push of a button. Web server technology provides remote monitoring, secure system configuration, and email notification of real-time system status and events. The industry's first fully automatic switchover designed with flexibility in mind, the 538 Series IntelliSwitch II is a reliable and cost-effective solution for active life science applications using liquid cylinder primary and either high pressure or liquid cylinder reserves.



Depicted: Typical dual-stack incubator systems. At left, the dual-stack incubators are supplied by a 526 CD Series automatic switchover from primary and secondary high pressure cylinders, with outlet pressure between 6 and 15 PSIG flowing directly into the incubators. Middle dual-stack incubators are supplied from a 538 Series IntelliSwitch II automatic switchover from primary and secondary liquid carbon dioxide and nitrogen cylinders with outlet pressure set between 50 and 100 PSIG. The 55S Series Point-of-Use Panel provides final line pressure control to the incubator, with outlet pressure set between 6 and 15 PSIG. Oxygen deficiency monitors at the gas source and near the incubators will alarm if an oxygen deficiency condition is detected. For continuous system operation, the Altos 2 Series cylinder pressure annunciator located near the incubators will provide audible and visual warnings of cylinder depletion.



55S SERIES POINT-OF-USE PANELS

The 55S Series Point-of-Use Panel provides final line pressure control for one or two gases and individual isolation control for up to four streams of each gas. Ideally suited to supply carbon dioxide and nitrogen to incubators, the panel features 316L stainless steel regulators and isolation valves with metal diaphragms and 1 x 10⁻⁸ scc/sec helium leak integrity. Capable of regulating full cylinder pressure, the panel ensures safe use in the event of a failure upstream. Additionally, an optional pipe-away relief valve prevents damage to the instrument in the unlikely event of panel regulator failure. With a wide variety of installation and orientation options, the 55S Series Point-of-Use Panel is an ideal choice for final delivery of gases in cell culture applications.



ALTOS 2 CYLINDER PRESSURE ALARM

The CONCOA Altos 2 Remote Alarm, designed to interface with any CONCOA gas delivery system, provides notification of impending cylinder switchover to ensure the continuous delivery of gases used in incubation and cryogenic storage. Unlike a typical annunciator, the 24V Altos 2 accepts input from either pressure switches or transducers. The status of all inputs is displayed locally with high visibility, multicolor LEDs, turning red when an input exits its normal condition. Three dry contact relay outputs, which can connect to the facility alarm system, allow the user to access status for each channel plus a master alarm. Installing the Altos 2 in a visible area outside the laboratory or process facility optimizes system function and efficiency.



580 SERIES AIR SAFETY MONITORS

To ensure safe breathing air in life science applications, CONCOA offers a variety of air safety monitors, including the 580 Series Oxygen Deficiency Monitor, Carbon Dioxide Monitor, Dual Oxygen/Carbon Dioxide Monitor, and others. As required by OSHA 29 CFR 1910, monitors should be installed in gas storage and use areas, cryogenic freezer rooms, incubator or grow rooms, and laboratory or industrial locations where liquefied or compressed gases may accumulate and pose a health hazard. Equipped with long-lasting sensor cells, built-in alarm indicators, "smart" electronics, and maintenance-free calibration, CONCOA 580 Series Air Safety Monitors provide accurate and rapid response to changes in air quality over a wide range of temperature and humidity conditions and do not drift due to weather or temperature.



577 SERIES CryoWiz™

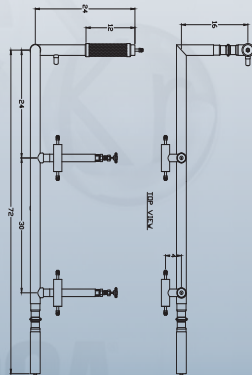
The CONCOA 577 Series CryoWiz™ cryogenic switchover is specifically designed to connect multiple supply sources of cryogenic liquid nitrogen to freezers, control rate freezers, environmental chambers, and other critical cryogenic systems. The CryoWiz uses a proprietary algorithm and precise pressure and temperature sensors to monitor the demand for and supply of the liquid nitrogen. With a unique insulated switching mechanism, high flow pneumatic valves, and hot gas bypass programming, the CryoWiz automatically switches sources with virtually no change in delivered cryogenic temperature. For a complete cryogenic solution, a variety of customizable options designed to work with the 577 Series CryoWiz are available.



Depicted: Typical two-freezer system supplied by CryoWiz switchover from primary and secondary cryogenic liquid nitrogen cylinders. Hot gas is piped away to an external vent, and condensation is drained through building plumbing. Oxygen deficiency monitors at the source and near the freezers are connected to the CryoWiz, which will alarm and stop the flow of cryogen if a low-level warning is received. The CryoWiz has a local audible and visual alarm for onboard emergency monitoring. Additionally, the CryoWiz is attached to the building TCP/IP network via Ethernet, allowing access of its onboard web server and enabling notification emails. Significantly larger installations are possible; contact CONCOA for more information.

VACUUM-JACKETED CRYOGENIC PIPING SYSTEMS

In any cryopreservation application, the efficient distribution of liquid nitrogen from the source to the point-of-use is crucial for success and has a significant impact on ongoing costs. A vacuum-jacketed piping system, customized by CONCOA engineers to take into account the specific laboratory or room constraints, ensures that the liquid cryogen reaches the intended location in the most timely and cost-effective manner possible. CONCOA understands that the longer the vacuum-jacketed piping system, the more difficult it is to sustain the vacuum and prevent heat transfer to the outer pipe. Hence, CONCOA is committed to providing the highest quality and most cost-effective custom vacuum-jacketed pipeline solution while meeting specific application requirements and ensuring optimal thermal efficiency at every stage.



57V SERIES CRYOGENIC HEADERS AND HOSES

The CONCOA 57V cryogenic headers and hoses, designed to work with the CONCOA 577 CryoWiz cryogenic switchover system, provides a complete cryogenic solution for continuous liquid nitrogen supply. 57V cryogenic headers are constructed from vacuum-insulated rigid pipe. Multi-layer insulation (MLI) and getter materials are employed to maintain a high thermal efficiency for low heat leak. The annular space is evacuated at a pressure of 1×10^{-6} mm Hg under 250°F (121°C) heat and tested with a helium mass spectrometer with 1×10^{-9} cc/sec sensitivity. The headers come as simplex for one side or duplex for both sides in either standard 18" (458 mm) or compact 10" (254mm) on center spacing. The 57V Series cryogenic headers use vacuum-jacketed flexible hoses with CGA 295 swivel end connections for easy installation and leak tight seals. Custom designs and custom downstream vacuum-jacketed pipelines are also available.



Sizing Carbon Dioxide Gas Requirements For Cell Culture Incubators

Duty Cycle

Properly growing the irreplaceable biological samples typically found in incubators requires an uninterrupted, continuously available supply of gas. To accurately size the supply system, the daily demand for carbon dioxide must be estimated for each incubator supplied from the same source based on the equipment's duty cycle expressed in liters per minute (LPM). The equipment's duty cycle is affected by the frequency with which the chamber is opened, so demand is relatively minimal given the short flow of gas required to restore conditions in the incubator. Active operations use a 30% duty cycle, while normal operations use 10%. **Table 1** below compares duty cycles against total daily and weekly carbon dioxide demand per incubator. This rate doubles for dual stack incubators.

Duty Cycle % of 6 LPM Flow	30%	20%	10%
LPM at Duty Cycle	1.8	1.2	0.6
Liters Per Day	2592	1728	864
Lbs of Carbon Dioxide Per Day	10.45	6.97	3.48
Lbs of Carbon Dioxide Per Week/Incubator	73.15	48.79	24.36

High Pressure and Liquid Cylinder Recommendations

To ensure a sufficient supply of carbon dioxide, the available gas from the source must be capable of providing one week of operation per incubator. Using the duty cycle and corresponding weekly demand per incubator from Table 1 above, the total weekly demand of high purity gas can be calculated. **Table 2** below shows the recommended number of high pressure or liquid cylinders required for one week's supply based on the total number of incubators in the installation.

Number of Incubators	1 to 2	3 to 8	8 to 12	12 to 24	25 to 50	51 to 75
Number of High Pressure Cylinders	2	4	8	14	N/A	N/A
50 lb Net Content	100 lbs	200 lbs	400 lbs	600 lbs		
Number of Liquid Cryogenic Cylinders	N/A	N/A	2	2	4	6
375 lb Net Content			750 lbs	750 lbs	1500 lbs	2250 lbs
*N/A = Not appropriate for number of incubators						

Efficient Design of Cryogenic Storage and Preservation Systems

The safe, efficient delivery of liquid nitrogen to control rate and cryogenic storage freezers is essential to maintaining the integrity of critical and possibly irreplaceable samples. Ensuring an uninterrupted, on demand supply of liquid nitrogen sufficient to provide one week of operation requires gas delivery equipment designed for the unique demands of cryogenic systems. CONCOA makes the following recommendations for the safe and efficient delivery of cryogen in storage and preservation applications:

- Employ an automatic cryogenic switchover equipped with a hot-gas bypass feature in order to guarantee cryogen at the right temperature whenever liquid is needed.
- Automatic switchover systems must offer multiple cryogen delivery algorithms to ensure a proper fit for a variety of applications.
- Cryogenic delivery equipment must integrate pipe-away relief valves to protect against over-pressurization.
- Automatic switchover systems must be web server enabled with event log and email notifications to allow remote monitoring.
- Equipment must offer Keep Full and On Demand modes to accommodate a variety of operating conditions.

