Five Key Considerations in Selecting a Powered Air-Purifying Respirator (PAPR) System for Pharmaceuticals Manufacturing

As pharmaceutical and biopharmaceutical manufacturers respond to demands for increased quality, security and regulatory overview, pressure to increase productivity and address key employee health and safety issues is mounting. Loose-fitting Powered Air-Purifying Respirator (PAPR) systems that help protect workers from airborne particles, drug compounds and chemical entities, while also offering excellent visibility, comfort and functionality, can contribute to high productivity.
While PAPRs for use in pharmaceutical and biopharmaceutical operations are required to meet NIOSH standards, including airflow and filtration performance, differences in other areas and requirements where products exceed the NIOSH minimums may provide an improved level of worker protection and comfort.

This white paper explores five such considerations in detail, and could be helpful to you in selecting a PAPR system for your particular application. They include:

- Field of view
- Battery life
- Hood design and cooling
- Blower/battery connections
- Non-incendive systems for hazardous locations

The overall content should help you become more knowledgeable and better able to discuss the capabilities of various PAPR systems with suppliers before choosing. We also invite you to include ILC Dover on your supplier consideration list.
UNOBSCTURED FIELD OF VIEW MAY IMPROVE PRODUCTIVITY THROUGH BETTER VISIBILITY

Field of view may be impacted by internal suspension systems within some hoods, such as headbands, structures or other support mechanisms. Hooded PAPR systems that are held aloft by positive air pressure require no such components and do not interfere with vision.

The visual field for humans with normal eyesight and healthy eyes is typically just under 180° horizontally, so a 180° field of view for a protective hood would seem to make sense. And that is a reasonable minimum target to allow the user to feel comfortable in the hood. With that field of view, a user with their head up and eyes straight ahead would have the same view as without the hood.

However, additional factors must be considered in providing full and comfortable visual acuity for those who have to perform a variety of work functions while wearing the hood. For instance, in a hood with a 180° field of view, visualizing an object outside that range would require rotating the head. But if the hood were to have a larger field of view, say 300°~320°, it would be possible for the user to move his or her eyes only — a glance — to check an object on a table or a readout on a laboratory instrument. This would allow a much more natural work posture and procedure. This is one of the primary reasons ILC Dover offers its Sentinel XT™ clear hood with a full 320° field of view.

Qualitatively, a more natural work environment may also help to reduce worker fatigue.

Choose from hoods that are NIOSH-approved (TC-21C-0901, TC-23C-2742). Also, a hood that securely attaches to protective suits will reduce its movement while employees perform work actions. Hoods with double bibs are especially advantageous. These allow the wearer to tuck the inner bib under the suit’s neck opening and still have an outer bib overlapping the shoulder.

FULL-SHIFT BATTERY LIFE CAN REDUCE DOWNTIME, MAINTENANCE BURDENS

Another factor driving the profitability of pharmaceutical firms is the length of time workers are on production lines. Twelve-hour shifts are not unusual in some drug manufacturing environments. However, the majority of PAPR systems are powered by batteries with run times of four or eight hours. This increases the likelihood of workers interrupting their tasks to leave the production floor for fresh batteries. Newer-generation batteries, such as lithium polymer designs, offer the advantage of longer life, while ILC’s battery-blower combination is the only standard pack unit to offer a 12-hour run time. And it can be recharged quickly and repeatedly.

In addition to less maintenance, 12-hour batteries also mean reduced inventory, compared to four- and eight-hour batteries. Fewer units in stock and less frequent recharging can also help lower maintenance costs.

Sentinel XT™ is a trademark of ILC Dover.
COMFORTABLE HOOD DESIGN AND EFFICIENT COOLING REDUCE IRRITATION AND FATIGUE

Keeping workers comfortable and focused is paramount in today’s productivity-driven drug manufacturing. All PAPR systems meet the NIOSH minimum air-velocity requirement of 6 cfm; however, the Sentinel XT offers up to 8 cfm (33% greater) airflow within the suit, contributing to cooler body temperatures, reduced dehydration and less worker fatigue caused by overheating. This can help make individuals more productive throughout their shifts.

In addition, blower-inflated hoods, such as that of the Sentinel XT, also eliminate internal headbands and forehead contact. This design helps reduce sweat and the incidence of skin chafing, irritation or rash. It also affords extra headroom to accommodate hard hats and safety glasses.

DOUBLE-ENVELOPE ENGINEERING

The Sentinel XT system features a double envelope — the air-moving unit is an internal fan connected to the filters and the breathing hose. This air-moving unit is encased in a rigid outer shell, so it is protected against mechanical damage.

Even in the unlikely event of a fracture or break of the outer shell, the air-moving unit is not affected. It continues delivering filtered air to the breathing hose and hood with no hazardous leakage, increasing the overall reliability of the complete system.

Extended battery life can significantly improve worker productivity. ILC Dover has tested its batteries extensively to ensure 12-hour life before battery voltage falls below 10.5V.

Typical voltage decay for new battery
INTEGRATED DESIGN FOR BLOWER, FILTERS AND BATTERY PACK REDUCES CONNECTIONS, POTENTIAL SNAGS

Many hooded PAPR systems feature complex, cumbersome wiring and cables to connect their components, not to mention irregularly shaped belts and battery or blower surfaces. These design shortcomings invite snags and work interruptions. There is also potential for wires or cables to disconnect from the battery, causing the blower to cease operation, stopping air flow and compromising the wearer's health and safety. He or she then must leave the work area to resecure the battery connections.

A battery pack that is smoothly integrated into the blower assembly, with filters attached directly to the housing, is a wiser and inherently safer design. This eliminates the need for wires, cables or hoses to connect those components.

A seamless belt that is designed to easily connect to and disconnect from the mounted blower and battery is another good choice. It, too, is less susceptible to snags.

Look for PAPR designs that offer this feature. And for workers who are shorter in height or spend a majority of their work time in a seated position, consider a lightweight back harness. The Sentinel XT offers an ergonomic harness that helps move the mass of the blower and battery up to the middle of the back, where it produces less strain and provides added comfort for the wearer. The Sentinel XT’s integrated battery-blower system weighs just 2.2 pounds.

NON-INCENDIVE BLOWERS IMPROVE SAFETY IN HAZARDOUS AREAS

Some pharmaceutical manufacturing suites are classified as hazardous locations. Older PAPRs may only have a certification on their battery — not the entire system. Be sure you select a PAPR system (blower and battery) that is certified as non-incendive. While some PAPR systems for hazardous environments are certified by non-U.S. agencies, and many others are not certified for hazardous location use at all, only ILC Dover's Sentinel XT system is approved by Factory Mutual (FM) Global Group for service in Class I, II and III; Division 2; and Group C, D, E, F and G hazardous locations. Key to its FM approval is its brushless DC blower motor that eliminates brushes, commutators and sparks that can be generated in commutated devices.

Another advantage of the brushless blower motor design is durability. With fewer moving parts than a standard brush motor blower, less mechanical wear and longer service life can be expected. And without the friction and voltage drops that brushes create by dragging against the spinning commutator, a brushless motor is inherently quieter and has a higher torque-to-weight ratio, enabling it to operate with greater efficiency.
DEVELOPMENT AND PRODUCTION TESTING HELPS ENSURE HIGH QUALITY AND RELIABILITY

Because of the crucial nature of personal protective equipment, rigorous quality and performance testing are a must. During product development and production, all facets of the product need to be evaluated for performance through a range of operational scenarios. This includes everything from subsystem testing on the motors, blowers, electronics, batteries and breathing tubes to system-level protection factor in a corn-oil mist chamber outfitted with state-of-the-art particle detectors.

As an outgrowth of our decades-long experience producing life-critical products such as NASA’s spacesuits, ILC Dover is well-equipped with internal laboratories to perform this testing while the product is being designed and developed, and our production and quality staff conduct acceptance testing as the product moves through the fabrication process.
Since 1947, ILC Dover has built a global reputation for out-of-the-box thinking that makes the seemingly impossible possible. Our engineered solutions solve our customers’ most complex challenges through the creative and efficient application of flexible materials often integrated with advanced equipment and hardware.

We look beyond the boundaries of convention to help customers see what could be, and discover the extraordinary possibilities within everyday things. We are a diverse company serving many markets. We are dreamers, engineers, scientists and pragmatists — all dedicated to outperforming tradition to better mankind.

We apply our vast knowledge of materials, soft goods, film-based solutions and design to move the world forward, from advancing spacesuits for astronauts to developing solutions for NASA Mars missions to engineering lighter-than-air vehicles here on Earth. We continue to pioneer the use of flexible containment solutions to support advanced pharmaceutical and biopharmaceutical manufacturing, and we’re revolutionizing the packaging and extraction of bulk liquids to enhance customer profitability and sustainability.

Additionally, we create quick-deploy systems that protect cities and critical infrastructure from floods, and design and manufacture advanced respirators to protect against a range of chemical and biological threats.

Every day, everything we do brings new solutions to light. Are you ready to take your vision beyond boundaries? Let’s talk.