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HVAC Contractor Design/Builds Cutting Edge Industrial Ventilation System for Manufacturer

Fabric duct with in-duct tensioning system facilitates energy efficient VFD's; heat recovery from laser, welding and paint processes saves thousands of energy dollars.

Peosta, Iowa--A mechanical contractor's innovative industrial ventilation design is saving the Mi-T-M Corp. tens of thousands of dollars annually in energy savings. The state-of-the-art system provides indoor air quality (IAQ) for quality assurance painting, welding and laser cutting production line processes as well as employee air comfort.

Peosta, Iowa-based Mi-T-M, which is one of the world's top three industrial power equipment manufacturers, retrofitted a 420,000-square-foot former warehouse into one of the nation's most sophisticatedly HVAC-controlled and aesthetically pleasing industrial production facilities. However, it wouldn't have been possible without a design team consisting of Mi-Ti-M's former Director of Operations, Patrick Siegert; Daniel Fens, design/build engineer at project mechanical contractor, All Seasons Heating & Cooling, Dubuque, Iowa; factory engineers at fabric HVAC duct manufacturer, DuctSox Corp., Peosta; and mechanical equipment manufacturer, Titan Air Inc., Osseo, Wis.,

An ordinary contractor might have simply installed a conventional rooftop ventilation system and exhaust fans with spiral metal duct. All Seasons is no ordinary contractor however. The 30-year-old industrial/commercial/residential mechanical contractor, which specializes in design/build geothermal, industrial and custom home HVAC sales and service, thought well outside the box and took advantage of recent HVAC technology advancements.

For example, the design team used the first industrial application of DuctSox's new Skelecore FTS, fabric ductwork in-duct cylindrical tensioning system and combined it with high efficiency TA Series make-up air units from Titan and industrial filtration systems by Donaldson Inc., Minneapolis, Minn.

The uniqueness of the system is derived from All Seasons division of the concrete tilt-up facility into six zones, each having their own make-up air system that's efficiently activated for partial or comprehensive ventilation or heating only when their respective production lines are operating. The design's efficiency is facilitated by variable frequency drives (VFD), modulating natural gas valves and a variety of building pressurization sensors and controls overseen by the Metasys building automation system (BAS) manufactured by Johnson Controls, Milwaukee, Wis.

Using VFD's with Fabric Duct

The 42-year-old Mi-T-M, which manufacturers a host of industrial and residential gas-powered and electric equipment such as air compressors, generators, and pressure washers, has used conventional fabric duct in two of its other six buildings on its nearly 20-acre campus. Mi-T-M is a fabric duct advocate, according to Siegert, because of its light weight, superior air distribution and labor-saving installation time of up to 60-percent versus spiral

metal duct. "I think a factory without previous experience might have been skeptical of fabric ductwork, but our last two systems have performed great for years," said Siegert.

However, if not for the Skelecore FTS concept--which maintains a 100-percent fabric inflation--the project would have necessitated metal supply duct and its comparatively exorbitant installation costs. Skelecore FTS, which was originally designed to appease architects and building owners that didn't like all fabric duct's inherent deflated appearance or wrinkling during idle or throttled air handler periods, makes textile duct and the design team's variable speed airflow possible. The rule of thumb on VFD use with conventional textile duct is static pressure loss will occur if the fabric is deflated 30 percent of more during operation. Therefore, the in-duct tensioning system's ability to maintain a 100-percent inflation, regardless of airflow, enables any airflow dictated by the BAS and eliminates the need of metal ductwork.

Consequently, using fabric duct also reduced ductwork installation costs by 75-percent versus metal duct, according to Jerry Tigges, All Seasons' project supervisor. Hanging six 180-foot runs (ranging from 32 to 60-inch diameters) would have taken four times longer with metal. Instead, Tigges and just one other crew member hung one duct run per day, which weighed a total of 400-pounds versus 1,800-pounds of metal.

Siegert said conventional fabric ductwork (without an in-duct tension system) wouldn't have been a good choice because HVAC system startups and the duct inflation process would have dislodged settled ductwork surface dust down onto the dust-free paint environment of the powder coat production lines equipped by Midwest Finishing Systems, Hartland, Wis., and Nordson, Westlake, Ohio.

VFDs and Heat Recovery

The variable airflow is key to the building's efficiency. The ventilation system exhausts heat and airborne byproducts of nine Mitsubishi lasers and 50 Genesis Systems Group welding stations via metal duct to three 22,000-cfm and one 30,000-cfm outdoor Donaldson Torit air cleaners. Building pressure sensors and the BAS offset the exhaust with outdoor air to maintain a positive building pressure and optimum space temperature.

Bringing in a capacity of nearly 100,000 cfms of outdoor air is expensive to heat during Iowa's winters. Therefore, heat from the powder coat ovens and the other heat-producing processes is recovered by the Torits and then filtered, cleaned and ducted to any of the six make-up air systems to energy-efficiently preheat outdoor air. "The heat recovery saved Mi-T-M tens of thousands in energy last winter because they never needed to fire up auxiliary furnaces for heating the space," said Fens. "Over the lifespan of the building the potential energy savings could amount to tens of thousands of dollars."

Although little fine-tuning was done on the original project design, Fens admits the aftermarket programming of all operational sequencing has been challenging due to the many production line variables. Thus, Fens and Siegert continue tweaking the system to fit Mi-T-M's evolving production schedules and to perfect building pressure while maintaining the highest degree of space temperature and IAQ through the least amount of energy use.

"We think we've combined a cutting-edge HVAC system with the greenest production equipment such as top-of-the-line ovens and highly-insulated powder coating equipment and built one of the most innovative and efficient industrial production facilities in the world," said Siegert.