

# CASE STUDY



## Central Vacuum System Engineered for Performance, Safety, and Global Scalability for Premier Industrial Pet Food Manufacturer

### Company Overview

The company is a global leader in premium pet food manufacturing, and conducts research into the specific nutritional needs of dogs and cats. With locations all over the world, their global distribution of premium dry and wet pet food brands is unmatched. The facility is located in Tennessee, USA.

#### SERVICES PROVIDED:

- Design-build engineering
- Structural design
- Integration
- BIM
- Piping network



### Project Overview

This project put Air Dynamics to the test—tasked with delivering what would become one of the most advanced central vacuum systems in the world. The client had previously encountered disappointing results with numerous suppliers of central vacuum performance and inadequate user controls, raising the bar for both reliability and innovation. Air Dynamics was challenged to engineer a fully customizable, scalable solution that could seamlessly integrate into any facility with minimal redesign. The system needed to incorporate cutting-edge user interfaces, real-time customizable data feedback, a hygienic, bacteria-resistant design, and the flexibility to expand as the facility's needs evolved.

### The Challenge

Implementing a standardized central vacuum system across a complex, existing facility posed multiple layers of challenges. During the initial meeting, the teams discussed current challenges, operational goals, and system limitations, concluding with a scheduled site visit. The primary issue identified was the ease with which operators could unintentionally overload an already underperforming system—intensifying frequent clogging and downtime. The client had previously implemented a lock-out method at each aspiration port in an attempt to manage usage; however, the solution proved ineffective due to consistent operator bypass. This was the first major challenge.



*Inefficient housekeeping techniques.*

**Space Constraints:** The second major challenge involved navigating space constraints and precisely integrating the system into an existing brownfield facility. The design had to incorporate a mezzanine while avoiding interference with existing structural bracing, piping, and outdoor concrete Ts—an essential factor in minimizing demolition and installation costs. Additionally, the piping network required careful consideration of roof loads and other structural elements. These conditions significantly increased the complexity of the layout, requiring more indirect routing to maintain optimal system performance without compromising the integrity of the facility.

**Clean Design Standards:** The third challenge involved meeting the strict clean design standards required for food manufacturing environments. While Air Dynamics has extensive experience integrating clean design principles into systems for food processors, standardized solutions typically do not account for these additional requirements. As a result, the entire system had to be custom designed and built for seamless integration into the facility. This included everything from the air/material separator (AMS) to the exhausters, platform, structural supports, hangers, and operator tool housings—each component engineered to align with sanitary design best practices.



*BIM rendering to show drops in piping network.*



*Layout for new CV-48 units in confined space.*



## OTHER CHALLENGES

**BIM Integration:** Air Dynamics utilized Building Information Modeling (BIM) to design the system layout with precision, ensuring seamless integration into the customer's facility while minimizing interference with existing structures. It was mutually agreed that the customer would retain responsibility for the cable tray layout to maintain alignment with their internal standards and infrastructure planning.

**Zone Delineation:** The facility was divided into two distinct operational zones—Red Zone and Blue Zone—each with unique manufacturing processes and strict cross-contamination controls. System design and engineering had to account for these requirements, as well as future expansion within each zone, ensuring compliance with zoning boundaries while maintaining flexibility for long-term growth.

Additional challenges included incorporating an **energy-saving mode to reduce operating costs**, ensuring the system **met strict plant noise limits**, and designing the equipment for **rapid installation to minimize downtime**.

The final challenge was ensuring the system was repeatable and scalable for global standardization. The client aimed to partner with a single provider for vacuum systems across international facilities, each with varying budgets and infrastructure. To meet this need, the system was modularly designed—divided into interchangeable sections that could adapt to different integration and design requirements while minimizing additional engineering.



## The Solution

### PRE-ACCEPTANCE

Before the project was awarded, the proposal phase focused on a cornerstone of Air Dynamics' project approach: **communication**. In a multidisciplinary setting, not all stakeholders are subject matter experts. That's why Air Dynamics places a strong emphasis on education—bridging knowledge gaps and ensuring that all parties understand the system, its value, and its implications.

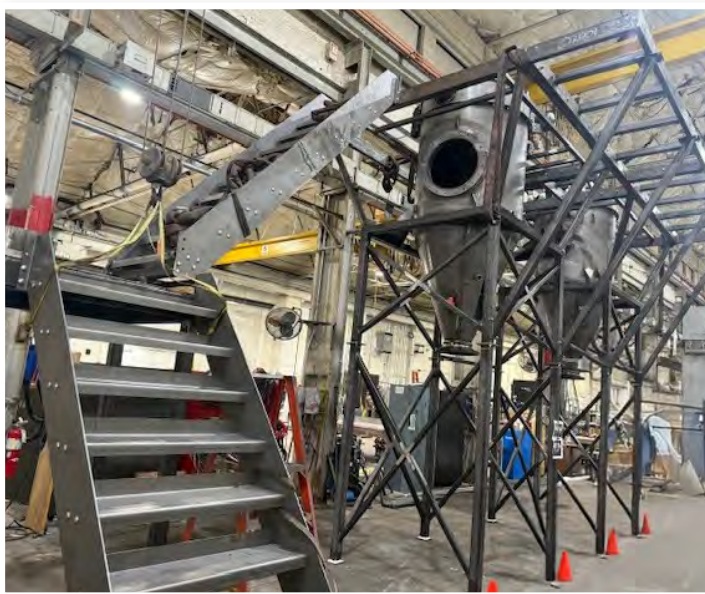
*The client came to the table with a clear vision of what they needed. It was Air Dynamics' responsibility to translate that vision into a feasible, engineered solution—delivered in a clear, digestible format. This included illustrating the expected outcomes, identifying value-added opportunities, and transparently presenting risks, challenges, and costs. Air Dynamics believes that strategic alliances are built not only on good news, but on honesty and clarity. The client appreciated this open, collaborative approach, which became a key factor in earning their trust and ultimately the project.*



CV frame painted for customer's red zone.

### AMS and Frame Design & Manufacturing

Following project approval, a second site visit was conducted to finalize critical measurements and execution planning. To ensure clear communication and continuity, a single project manager oversaw all phases—coordinating cross-departmental collaboration and keeping system planning tightly aligned with the client's goals.



Inhouse manufacturing and assembly of CVs and stair system.

The project was divided into three major components: **AMS (Air/Material Separator) and frame, piping, and electrical**. All core system components—including AMS units, electrical panels, HMI panels, and supporting assemblies—were designed, engineered, manufactured, and assembled in-house at Air Dynamics' York, PA facility. This centralized, vertically integrated process ensured quality control, reduced lead times, and allowed for continuous innovation throughout the project lifecycle.

Air Dynamics was selected to provide a centralized vacuum system solution tailored to the client's high-performance operational requirements. The CV-48-21 model was chosen for its ability to support up to six operators simultaneously using 2" I.D. tools without compromising system performance. While the standard CV-48-21 served as the base model, significant modifications were engineered to meet the customer's clean design specifications, combustible dust safety requirements, and brand-specific component preferences.

### Engineering for Clean Design & Compliance

Due to the presence of combustible dust, explosion venting was modified to match the material's Kst value. The client specified their preferred explosion vent brand, which was integrated into the design and safely vented to atmosphere. Similarly, the rotary valve model was chosen at the client's request to simplify maintenance and ensure familiarity.

Platform and frame design followed strict hygienic standards—eliminating hard-to-clean surfaces and ensuring pest-resistant construction. All structural load calculations were completed by Air Dynamics and verified by the client's structural engineer prior to fabrication. The dual-CV platform minimized floor space usage, integrating standard components while preserving a 3-foot clearance zone for maintenance access.

### Space Constraints & Mezzanine Integration

To address facility limitations, vacuum producers were mounted on a mezzanine. This shortened the exhaust run and enabled implementation of an energy-saving operating mode. The elevated installation also reduced system noise, keeping levels below plant restrictions. During modeling, interference with concrete drop Ts—omitted from the Navisworks model—required rerouting of clean air piping, which was swiftly resolved through onsite adjustments.

### Complex Piping Network Design

BIM integration proved essential. Air Dynamics used Navisworks to plan and route over 60 drop points and 10 piping mains. Although the model was not 100% accurate, onsite validations and agile design changes ensured system performance. Each fitting—reducers, couplings,



hangers—was precisely called out in the installation package for a single-mobilization install. Five of eight piping mains were dedicated to individual AMS units to prevent cross-contamination between facility zones and ensure redundancy. The remaining three mains allow future expansion. All system calculations and performance specs were completed in-house.

### Commissioning & Leak Testing

Upon installation, ultrasonic leak detection was performed to identify and eliminate any performance losses. Initial testing showed slight degradation at peak usage. Once sealed, the system supported full operation with no performance drop—even under maximum load.

### Operator Tools & Storage

Custom Tool Housings were fabricated in-house using 5S principles and clean design methodology. Designed to avoid contact with walls and floors per sanitation standards, the housings offered secure, accessible storage for floor-specific tools—improving organization and cleanliness across the facility.



## Results

From the moment the CV-48-21 Central Vacuum System was energized, its performance exceeded expectations. Material was swiftly drawn from the most distant point in the facility and deposited into the designated waste receptacle in seconds. An unintentional stress test followed when pipe caps—left behind by mechanical installers—were forcefully propelled through the system. Despite their full pipe diameter and potential to cause a blockage, the system's powerful airflow handled the obstruction flawlessly. Observing this, the client's site manager remarked simply, ***"Well, we know it works."***

Following this event, Air Dynamics conducted a thorough system review to confirm there were no lingering obstructions—especially vital in a food manufacturing environment where foreign objects can elude detection. The incident inadvertently demonstrated the system's resilience, underscoring its reliability in real-world conditions.

Commissioning was completed without issue. The CV-48-21 passed all dry and wet testing protocols, including verification of full capacity operation for six simultaneous users. On-site airflow measurements validated system efficiency, while IntelliAccess™ control panels provided accurate, real-time performance data across all zones. Only one follow-up visit was required to address a minor adjustment at a user port—previously documented in a Tech Note.

All installation aspects—including ductwork, piping, wiring, and mechanical integration—were completed within tight spatial constraints. The design met strict clean-



Vacuum drop control display indicating usage.

liness standards, including tool and housing hygiene. Even where deviations from the BIM model required routing changes, performance and compliance remained uncompromised. The system maintained zone integrity with no cross-contamination, and its network was confirmed clean, secure, and scalable for future expansion.

The energy-saving mode was fully tested and validated, providing both reduced power usage and a quieter operating environment. While exact decibel levels were difficult to isolate due to concurrent facility processes, the system stayed within acceptable ambient noise ranges. Final installation was completed to the client's satisfaction, with only minimal, non-impactful post-shipment modifications.



## Conclusion

The CV-48-21 Central Vacuum System delivered proven performance, robust reliability, and operational excellence. As a result, the client commissioned a second unit for a separate facility. Drawing on documented lessons, standardized components, and refined processes, Air Dynamics engineered the follow-up system in a fraction of the original time. This repeatable success underscores the strategic value, scalability, and long-term return on investment of the CV-48-21 platform.