

Canada
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National Research Council

PROJECT CASE STUDY

Pre Seal Air Leakage
12.6%

Post Seal Air Leakage
0.15%

Total Leakage Reduction
98.8%

This document is about a case study conducted by the National Research Council Canada on sealing ductwork in a biosafety level 3 (BSL-3) laboratory research facility to meet stringent standards for ventilation performance.



About
National Research Council

The National Research Council Canada is the primary national agency of the Government of Canada dedicated to science and technology research and development. Headquartered in Ottawa with a legacy spanning over 100-years, NRC is the largest federal research and development organization in Canada.

About
The Project

In pursuit of Level 3 Facility certification (biosafety level 3 facility cetification) for the M54 Animal Health Lab at the Human Health Therapeutics Research Centre, 1200 Montreal Road, Ottawa, the National Research Council (NRC) faced a major challenge: passing the stringent ASME N511 pressure decay test.

According to Section 1.13 (Duct Testing) of the specifications, all duct systems—supply, return, and exhaust—must exhibit less than 1% leakage. To meet these rigorous standards, NERVA Energy partnered with the NRC, employing advanced Aeroseal technology. This innovative solution effectively seals ductwork from the inside, ensuring compliance and enhancing system efficiency. *See appedix for a definition of biosafety level 3 facility.*

Client Objectives



The primary objective for the Human Health Therapeutics Research Centre at building M-54 was to seal the ductwork to less than 1% total leakage. Achieving this threshold was essential to pass the demanding ASME N511 pressure decay test, a prerequisite for the Level 3 Facility certification.

The NRC's Human Health Therapeutics Research Centre boasts a comprehensive array of capabilities, designed to propel the preclinical development of innovative, multi-functional antibody-based therapeutics. This is accomplished through strategic collaborations with industry leaders, academic institutions, and governmental bodies.

Facilities at M-54 are equipped with state-of-the-art resources supporting a range of scientific pursuits including:

- Animal resources
- Electrophysiology
- Genomics
- Immune monitoring core
- Immuno-oncology
- In vitro pharmacology
- Pre-clinical imaging and in vivo pharmacology

This suite of capabilities ensures that M-54 remains at the forefront of therapeutic research and development.



Challenges & Problems

Despite the inherently high standards for ventilation in research laboratories, M54, as an older facility, faced significant challenges in maintaining duct airtightness. Aging sealing materials and mechanical retrofits often contributed to decreased ventilation performance and unexpected duct leakage.

The operational complexities of Building M54 compounded these challenges. As a fully operational research hub equipped with extensive biotechnology resources, accessing the ductwork hidden above ceiling tiles was particularly problematic. The advanced equipment setup restricted visibility and physical access, making any intervention intricate.

Additionally, the bustling daily operations and strict schedules of employees limited the available times for maintenance work to evenings and weekends, further complicating project execution. The extensive network of ductwork, HEPA filtration units, and air registers added another layer of complexity, as pinpointing leakage sources without intrusive dismantling of ceilings and walls was a formidable task.



Scope of Work

1. **System Evaluation**
   Performance assessment of the existing ventilation systems.

2. **Inspection and Assessment**
   Detailed review of filters, heating coils, HEPA boxes, diffusers, and the overall condition of the ductwork infrastructure.

3. **Leak Identification**
   Removed all duct insulation and performed soap testing in accessible areas. For regions with limited visibility and challenging access, we utilized high-capacity smoke candles for testing, positioning multiple observers to detect any leaks effectively.

4. **Airflow Auditing**
   Comprehensive audits conducted before and after sealing interventions to measure and quantify duct leakage and overall ventilation performance.

5. **Manual Repairs**
   Addressing major deficiencies, such as reconnecting disconnected ducts and improving seals around openings and branches.

6. **Preparation for Sealing**
   Implementing measures such as bypassing coils and blocking air handling units and diffusers to ready the system for sealing.

7. **Sealing Process**
   Application of aerosolized sealant through pressurization of ductwork, sealing from the inside out, with continuous monitoring to achieve desired airtightness.

8. **Validation of Results:**
   Coordination with third-party testing to confirm that the total leakage rate remains below 12 cfm at 1.25 times the operating system pressure (equivalent to 2” WG or 500 Pa).

9. **Reporting**
   Production of a detailed project report documenting all Measurement & Verification protocols for client review and regulatory compliance.

Project Overview
& Final Results

System: **AHU-1B**

Rated size of System: **2,735 CFM**

Operating Pressure: **250 Pa**

Testing protocol for ASME N511 pressure decay test:

- Total leakage rate to remain below 12 cfm at 1.25 times the operating system pressure (equivalent to 2" WG or 500 Pa).
- System should take at least 4 seconds to drop from 160 to 90 Pa.

PRE-SEAL
AIR LEAKAGE

344.0 CFM of Leakage, equivalent to a **16.3 Square Inch Hole**, or **12.6%** of the system capacity.

POST-SEAL
AIR LEAKAGE

4.2 CFM of Leakage, equivalent to a **0.2 Square Inch Hole**, or **0.15%** of the system capacity.

TOTAL LEAKAGE
REDUCTION

98.8%

Appendix A
Definition of a Biosafety Level 3 Facility

Biosafety Level 3 (BSL-3)

Once again building on the two prior biosafety levels, a biosafety level 3 (BSL-3) laboratory typically conducts research into or work on microbes that are either indigenous or exotic and can cause serious or potentially lethal disease through inhalation. Common examples of microbes found in BSL-3 labs include yellow fever, West Nile virus, and the bacteria that causes tuberculosis.

Microbes found within biosafety level 3 settings are so serious that work is often strictly controlled and registered through the appropriate government agencies. Laboratory personnel are also under medical surveillance and may require immunizations for the microbes they work with.

Common safety controls within a BSL-3 lab include:

- The use of PPE, including goggles and gloves; respirators may also be required
- The use of solid-front wraparound gowns, scrub suits, and/or coveralls is often required
- Access to a hands-free sink and eyewash station available near the exit
- Sustained directional airflow to draw air into the laboratory from clean areas toward potentially contaminated areas (exhaust air cannot be recirculated)
- Self-closing set of locking doors with access away from general building corridors

Access to a BSL-3 laboratory is restricted and controlled at all times.



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