PRRS FORTRESS ++
POSITIVE PRESSURE VENTILATION DESIGN

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www.ventexperts.com

++ PATENT PENDING
TO FILTER OR NOT TO FILTER

• COST OF PRRS: $8.00 PER PIG PER OUTBREAK PER WEANED PIG. FINISHING PERFORMANCE NOT CALCULATED.

• COST OF FILTERS: $2.00 PER PIG OVER LIFE OF BUILDING.

• HISTORICALLY 70% REDUCTION IN OUTBREAK FREQUENCY.
MAJOR FILTER/VENT DESIGN CONCEPTS

NEGATIVE PRESSURE
Filtered inlets for winter or summer
Filtered cool cell wall for summer
Exhaust fans on room wall

POSITIVE PRESSURE
Filtered air supply for inlet fans
Inlet fans on room wall
Exhaust damper on room wall

PUSH-PULL POSITIVE
Filtered air supply for inlet fans
Inlet fans on wall
Exhaust fans on room wall
Inlet fans slightly higher capacity

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Filtered air supply for inlet fans
Inlet fans on gables
Exhaust damper on room wall
Patent pending

SEASONAL FILTRATION
PRRS FORTRESS ++
Filtered air supply for inlet fans
Inlet fans and filters in gables
Negative pressure summer vent
Negative pressure winter vent
Patent pending

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NEGATIVE PRESSURE FILTRATION

CHALLENGES

• High energy consumption
• Requires extensive caulking and sealing
• May require duplicating filters: winter inlets vs cool cells
• Backdraft of non-filtered air is a major problem
• Used because most current facilities have negative pressure ventilation

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NEGATIVE PRESSURE FILTRATION
SIX SOURCES OF BACKDRAFT INFILTRATION

• Personnel entrance, exit, biosecurity breach.
• Building materials and methods.
• Live animal entrance and exit.
• Mortality exits
• Pit pumpout backdraft.
• Ventilation backdraft.

++ PATENT PENDING
“Does it make sense to invest in filters and intense biosecurity and then rely on a truckload of caulk to be the key to success?”
FILTRATION INNOVATIONS FROM MIDWEST ENVIRONMENTAL

- PRRS BLOCKADE  Negative Pressure Filtered Farm
- Z WALL SYSTEM  Anti-backdraft fan shutter system
- BIOSECURE LOADOUT SYSTEMS  Positive pressure airlock loadout rooms
- BIOSECURE OFFICE AND ENTRY  Simple, effective airlock entry for personnel and supplies.
- PRRS FORTRESS  Positive pressure filtered ventilation system.

MIDWEST ENVIRONMENTAL SPECIALISTS, INC.
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++ PATENT PENDING
SHUTTER WALL: SIZE OUTLET CALCULATED FOR AIRFLOW AND BIOSECURITY

MINIMUM VENT FANS
CONTINUOUS OPERATION

VENTILATION EXHAUST FANS-STAGED
OLDER POSITIVE PRESSURE DESIGNS

• Frequently used in boar studs
• Commonly used as a modified tunnel vent
• Concern with building deterioration
• Air distribution and uniformity an issue
• Often considered impractical for large farms
• “Push:Pull” systems favored but costly due to double number of fans

++ PATENT PENDING
++ WHY NOW?

INNOVATIVE DESIGN CONCEPT AND NEW TECHNOLOGY MAKE THE ++ SYSTEM PRACTICAL AND RELIABLE, ESPECIALLY FOR FILTERED BARNs

• Overpressure ventilation system eliminates concern for deterioration in attic.
• New control technology allows managing static pressure differential and air flow accurately.
• Panelized building structure eliminates concern for deterioration of walls
• MUNTERS DRIVE variable output fans, high pressure capability, energy efficiency, low maintenance.

++ PATENT PENDING
++ POSITIVE PRESSURE SCHEMATIC

Building Attic
OVERPRESSURE CHAMBER: "high" pressure space

FANS TO PRESSURIZE ATTIC WITH COOLED/FILTERED AIR

P1

CEILING AIR INLETS

Ventilation air flows through inlets responding to pressure difference between overpressure and room pressure.

Building Animal living space
ROOM PRESSURE "low" pressure space

T1 P2 T2

Backdraft shutters prevent pressure drop in windy conditions

SENSOR:
P1: PRESSURE SENSOR, ATTIC OVERPRESSURE
P2: PRESSURE SENSOR, ROOM PRESSURE
T1: TEMPERATURE SENSOR, ROOM TEMPERATURE
T2: TEMPERATURE SENSOR, ROOM TEMPERATURE

CONTROL FUNCTION:
STAGES FANS TO MAINTAIN CONSTANT OVERPRESSURE
STAGES OUTLET DAMPER TO MAINTAIN CONSTANT ROOM PRESSURE
STAGES CEILING INLETS TO REGULATE VOLUME OF VENT AIR ENTERING ROOM
STAGES ON COOLING OR HEATING AS NEEDED

OUTDOOR
UNFILTERED
AIR AT AMBIENT
TEMPERATURE

COOLED AIR

FILTERED

COOLED AND FILTERED

AIR CHAMBER

OUTLET DAMPER
Adjustable curtain opening maintains constant room pressure. Provides outlet for metabolic gasses and moisture.

COOLING AIR FILTER WALL
SENSOR:
P1: PRESSURE SENSOR, ATTIC OVERPRESSURE
P2: PRESSURE SENSOR, ROOM PRESSURE
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++ PATENT PENDING
GABLE DESIGN:
20' X 154'
(18) FANS
540 filters

FARROWING BARN
Use for 2 gables

(18) VXS1 M Drive Fans
RO: 56.25 W x 57.75 H
Cone OD: 65°
Protect insulation from fan draft

540 filters

Chamber between filter wall and fans must be airtight biosecure.
Indicated by red border.

Fan access stairway
Fan access platform 4' X 110' (size optional)

Each 6 filter grid = 75 3/4" x 51 1/4"
Filter wall = 154" tall + stemwall

Custom trusses to accommodate 154" tall filter wall

(30) filter segments, 3 grids each 6 filters high 3 wide
540 filters

26" fan to pressurize hallway

Building CL

8' X 70' COOL CELL EACH SIDE OF HALLWAY

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**COMPONENT 1: ENVIRONMENTAL CONTROL**
- Regulates all components to maintain correct ventilation rate and air quality. Internet accessible.
- Cooling runs at upper critical temperature.
- Desired room temperature (DRT): temperature increases.
- Heat runs at lower critical temperature.

**COMPONENT 2: ROOM INLETS**
- Inlets adjust to maintain desired room temperature and air quality.
- Inlets open to increase ventilation rate to room on temperature rise.
- Inlets close to decrease ventilation rate to room on temperature fall.

**COMPONENT 3: ROOM OUTLETS**
- Outlet damper adjusts to maintain desired room static pressure.
- Opens to maintain pressure at higher ventilation rate.
- Closes to maintain pressure at lower ventilation rate.

**COMPONENT 4: VENTILATION FANS**
- Fans modulate to increase/decrease air volume to maintain constant attic pressure.
- Increase speed or ventilation rate to maintain constant attic pressure and air flow.
- Decrease speed or ventilation rate to maintain constant attic pressure and air flow.

**COMPONENT 5: AIR FILTERS**
- All air entering the facility is filtered to reduce risk of viral infection of livestock.
- Volume of filtered air increases or decreases based on capacity of ventilation fans.

++ PATENT PENDING
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<th>Inlet Capacity</th>
<th>Fan Capacity* (test 120675)</th>
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++ PATENT PENDING
FAN WALL IN GABLE

++ PATENT PENDING
GABLE END FILTER WALL

++ PATENT PENDING
GABLE END FILTERS

++ PATENT PENDING
POSITIVE PRESSURE BARN EXTERIOR WALL STRUCTURE

48" Roll seal or insulated curtain wall outlet damper

45" ID Z Wall shutter wall for backdraft protection

Base wall: 48" insulated concrete or EPS Panel

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Z WALL AT CURTAIN OUTLET

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OUTLET CURTAIN
Pit pumpout cover

++ PATENT PENDING
# Building GEST

**Room 1 of 2**

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<th>WT RANGE</th>
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**# PIGS TTL**

| 2400 |

**Per Pig**

| 15 | 20 | 322 | 276 |

## Stage Vent %

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<tr>
<th>Step</th>
<th>Analog %</th>
<th>CFM/Fan</th>
<th># of Fans</th>
<th>Total CFM</th>
<th>CFM Jump</th>
<th>Min % at 0.20&quot; SP</th>
<th>HO Fan</th>
<th>0.30° WC</th>
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## Airflow by Stage

![Airflow by Stage](chart.png)
GEST 2  Nov 27 performance

++ PATENT PENDING
GEST 2 Nov 29 performance
(windy day)
VENTILATION COMPARISON

NEGATIVE PRESSURE

FANS
• Several models and sizes required (190)
• Varying energy efficiency
• Require frequent maintenance and cleaning
• Average cfm/watt of typical design: 13.2

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FANS
• Usually only one model (108)
• Variable speed/variable output
• Very high efficiency
• Located in “clean” space
• Virtually no maintenance
• Access to fans outside of pig space.
• Cfm/watt of MUNTERS DRIVE fan:
  16.0 (13.8 high/17.9 low)
  (18% reduction)
VENTILATION COMPARISON

NEGATIVE PRESSURE

INLETS:
• Regulated by ventilation stage or static pressure
• Actuated recommended

OUTLET DAMPER:
• Not used

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INLETS:
• Regulated by temperature
• Actuated required

OUTLET DAMPER:
• Maintains correct room static pressure
• Curtain, Roll Seal, or door

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VENTILATION COMPARISON

NEGATIVE PRESSURE

CONTROLS:
• One required per room

EVAPORATIVE COOLING:
• Location varies with ventilation design.

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CONTROLS:
• One required per building
• Internet access

EVAPORATIVE COOLING:
• Located outside of filters for “dirty side” maintenance

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MUNTERS DRIVE FAN

- Low maintenance direct drive: no belts or bearings to service.
- Efficient “EC” motor technology
- Ideal for high static pressure operation.
- Up to 40% energy savings
- Variable speed/variable output
- High quality cast aluminum propeller and fiberglass housing.
- Significantly reduced wiring costs.

++ PATENT PENDING
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<th>SYSTEM COMPARISON</th>
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PRRS FORTRESS ++
POSITIVE PRESSURE FILTRATION RETROFIT

1. Insulate roof line
2. Install “dormers” to use as air inlets for cooling and filters.
3. Install actuated ceiling inlets for full top ventilation.
4. Install outlet dampers to regulate room pressure
5. Install “M Drive” variable output direct drive fans in dormers

++ PATENT PENDING
Pipe drive to lift outlet curtain or door
OUTLET CURTAIN
INSULATED DOOR OUTLETS ON OFFSET RIDGE BARN

++ PATENT PENDING
2 Dormers on farrowing barn
GDU SITE CONCEPT

20' 100' x 200' pig space 20'

40' x 40' office/loadout/supply

Room exhaust dampers
Filter wall
Pit exhaust dampers
Cooling wall
Fans

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WHAT WE HAVE LEARNED

• Air quality and distribution extremely good
• Constant attic pressure is a key; variable speed fans essential
• Lower ventilation rates may be possible.
• Biosecurity considerations: all leaks outward
• Multiple inlet zones in large buildings
WHAT WE DON’T KNOW

• Are wind breaks needed?
• Is filter life what we expect?
• How does operating cost compare?
• Are other controls for PP on the horizon? (currently Fancom, Maximus, Dicam)
• What is best outlet design?
• Is there any building deterioration?
• Is higher pressure operation feasible?

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FUTURE

• Additional filter research needed

• Variety of test labs with different results
  LMS, Blue Heaven, University, Manufacturers

• BESS Laboratory type universal testing needed
  Funding from manufacturers and testing fees?
  Test for air flow, fractional efficiency, media decay, etc.
  Testing protocols established by governing board

• New filter media development
  Nano-particle, high airflow, minipleat disposable, prefilters

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