



*Schust Engineering, Inc.*

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Industrial Facility  
Midwest

Re: Facility Ventilation Audit

Schust Engineering, Inc. is pleased to provide the following technical report evaluating the ventilation of your facility.

The purposes of this audit are to apply ACGIH industrial ventilation engineering practices to reduce the high temperatures between both annealing ovens and develop plans to incorporate fresh air and tempered makeup air within the manufacturing department. Ventilation control measures may require a source of cooler replacement air; an evaporative or mechanically cooled source, a velocity cooling method, or any combination thereof, are possible means of cooling. Exhaust ventilation may be used to remove excessive heat and/or humidity if a replacement source of cooler air is available. In many manufacturing operations, which do not lend themselves to local exhaust, general ventilation within the manufacturing area will be required.

During the field engineering audit temperature measurements were taken at ground level between the annealing ovens, during the month of April, with an average outside temperature of 35°F. An average temperature of 93°F was taken about three feet from the walls of both annealing ovens. The temperature above the annealing oven at an access ladder location averaged 93°F. No temperature readings were taken closer to the roofline because the overhead crane was in operation and could not be locked out during Schust Engineering's field audit.

Current building ventilation equipment was observed, measured, catalogued, and evaluated to determine the effectiveness of this equipment. The heat around the annealing ovens was measured to determine the rising air current being produced as a result of the heat.

The entire building is currently under a negative pressure, causing fume from the pickle line area in the north end of the building to migrate south into the rest of the plant. The pickle line area is under a negative pressure, but with the rest of the building under a negative pressure as well, the fume tends to migrate into the rest of the plant.

New exhaust and supply equipment is being proposed to help improve the overall conditions inside the building. In addition, this new supply equipment will establish a positive

pressure in the main building helping to prevent migration of pickle room fume into the rest of the building.

The air velocity and volume as a result of the heat from the annealing ovens was determined using the hot process calculation from the Industrial Ventilation Manual. The velocity of the hot air column was determined, and using this number along with the surface area of the furnace, a volume was calculated. The air temperature above the furnaces was measured at 93°F, resulting in a velocity of 55 fpm for the hot air column above the ovens. The resultant draft upward for the west oven is 22,550 cfm, and for the east oven 20,800 cfm, giving a total of 43,350 cfm. Calculations are based upon the ACGIH Industrial Ventilation Manual Edition 24 Hot process. The above-calculated volumes were used to establish the sizes of the exhaust fans over these ovens. The fans proposed are sized for approximately three times the volume, to help account for additional air being drawn in from the surrounding plant.

There are two (2) existing general exhaust fans located between the annealing ovens that are providing very little exhaust air volume for the annealing ovens. It was requested by the industrial facility to have both exhaust fans removed from operation and the related estimated exhaust air volume of approximately 47,942 cfm be added to four (4) new exhaust fans that will be located directly above each annealing oven. The exhaust air volume will be 37,000 cfm for each exhaust fan for a total of 148,000 cfm of exhaust, giving a surplus of 104,650 cfm above the 43,350 cfm hot air current being produced from the ovens. Reference drawing # -A02

Because of the distance from the annealing ovens to the roof line and the fact that no capture hood can be installed closer to the annealing oven because of the crane rail. Additional exhaust air volume will be required to exhaust the hot air column from the annealing ovens and because of the air from the surrounding manufacturing department becoming entrained in the rising hot air column.

Another option to improve the capture of the hot air column from the annealing ovens would be to enclose the building roof trusses into a capture hood directly above each annealing oven. The size of the enclosed roof truss capture hood would be based upon ACGIH rectangular high canopy hood. By installing a large canopy hood directly above both annealing ovens the capture efficiency of the hot air column by the exhaust fans would be improved. The difficulty enclosing the roof trusses into a canopy hood is that the annealing ovens will have to be shut down, so that work can safely be performed above the ovens.

Location of the four (4) new exhaust fans is very critical to help remove unwanted heat from the building. One (1) exhaust fan for each annealing line must be located directly above the annealing oven at the open hydrogen flame area and the other exhaust fan for each annealing oven shall be located directly to the south at the discharge end of the annealing oven.

The building is currently under a negative pressure, and the proposed new exhaust will increase the negative pressure on the building. This negative pressure situation is causing fume from the pickle line to migrate into the rest of the plant. One main purpose of this audit is to help prevent this pickle line fume from migrating throughout the plant. With this large negative pressure, tempered air make-up is being proposed around the perimeter of the building. The existing exhaust (minus #17 #18 exhaust fans) along with the proposed new exhaust brings the total exhaust from the building to 246,808 cfm. This large negative pressure on the building

means that make up air is required to get the building to a positive pressure condition. Schust Engineering is proposing three (3) new tempered air make-up units each rated for 70,000 cfm for a total of 210,000 cfm. These air make-up units are to each have a distribution duct system with louvers to disperse the fresh make-up air. These tempered make-up air units are to be located one (1) each on the East, South, and West Sides of the building. The idea is to flush the tempered air in from the sides towards the large concentration of exhaust points in the center of the building above the annealing ovens.

There is one (1) existing makeup air unit that needs to be repaired or replaced. This unit is located along the south end of the east wall and provides tempered makeup air for the electric motor room and supply air to the basement cooling fans. We were informed that this tempered makeup air heat exchanger is defective and should be replaced. It would be our recommendation to replace this unit with a 70,000 CFM unit and divide the tempered discharge air between the basement area (35,000cfm) and install a duct run through the electric motor room and discharge into the main building at the MKW-100 machine (35,000cfm), reference drawing # -A02. This recommendation would provide much needed fresh tempered air for the manufacturing machine in this area and also for this corner of the manufacturing building that has no tempered fresh air. The replacement of the existing tempered air make-up unit would help provide the much needed positive pressure in the building.

In addition to the tempered air make-up, three (3) fresh air fans are proposed above the annealing ovens to blow cooler outside air down between the ovens where worker stations are located. Reference drawing # -A02 The concept behind this fresh air fan is to blow cooler outside air down between the ovens helping to push the warmer air upwards toward the exhaust fans. The proposed fresh air fans are rated for 10,000 cfm each giving a total of 30,000 cfm. The purpose of this air is to mix with the hot air between the ovens, therefore lowering the air temperature to a more comfortable level for the workers. With the fresh air fans at 30,000 cfm, and the four (4) tempered air make-up units at 70,000 cfm each, the new proposal includes 310,000 cfm of supply air into the building.

The addition of the tempered air make-up units, and the fresh air fan, gives 310,000 cfm of supply air. The existing exhaust fans (minus #17 & #18) along with the proposed new exhaust fans give 246,808 cfm of exhaust from the building. This results in an overall positive pressure on the building of 63,192 cfm. The pickle line area is under a negative pressure, and the rest of the building would be under a positive pressure, which would help keep the fumes from migrating into the manufacturing plant.

## EXISTING EXHAUST FANS

The industrial facility exhaust fans: Some of the air exhaust volume was measured and some were estimated, due to the fact that most of the exhaust fans information tags are missing.

### 1) North end pickle line dust collector exhaust fan

- Twin City Fan
- Serial # 270 BAE-SW
- Serial # 10-290483-1-1
- Hp 30, RPM 1770, 230/460/3/60
- Dust Collector shot blast.
- Volume unknown???

### 2) Pickle room east wall Panel exhaust fan.

- No data 42" sq.
- Used Aerovent fan data for estimate size 36, 3/4hp @ 1/4" SP =9,500 CFM

### 3) Pickle Roof Vent.

- 42" round

### 4) Pickle Roof Vent.

- 42" round

### 5) Pickle Scrubber Exhaust Fan.

- Met Pro Unit.
- Air volume 8,000 CFM

### 6) Pickle roof exhaust fan

- Motor running, but fan not
- 5' square.
- No data
- Used Aerovent fan data size 54, 1/4" SP @ 2HP @ 20,219 CFM

7) West High Bay Wall Panel Exhaust fans.

- Two (2) Panel exhaust fans.
- 42" sq
- No data
- Same as above estimated @  $9,500\text{CFm} \times 2 = 19,000\text{ CFM}$

8) West High Bay Roof Exhaust fan

- Southwest side of west bay
- Swartwout Fiber Aire
- 44" sq.
- 128 FCB
- No data
- Estimated Twin City roof exhaust @  $\frac{1}{4}"$  SP @ 7,400 CFM

9) West High Bay Roof Vent

- 42" round

10) Middle High Bay North Roof Vent.

- 42" round

11) Middle High Bay West Machine VAC Exhaust.

- South Vac Machine exhaust
- No fan data
- 14" diameter duct -1.0690sq.ft.
- .04 AVP – 800 FPM
- Measured air exhaust volume 855 ACFM @ 75F

12) Middle High bay West Machine VAC Exhaust.

- North Vac machine exhaust.
- 14" diameter duct – 1.0690 sq.ft.
- .03 AVP – 700 FPM
- Measured air exhaust volume 748 ACFM @ 75F

13) Middle High Bay West Machine Scrubber Exhaust.

- 14" Dia. duct.
- Estimated exhaust air volume 1200 CFM

14) Middle High Bay East Machine VAC Exhaust

- South 13" x 17" – 1.5 sq.ft.
- .03 AVP – 700 FPM
- 1,050 ACFM @ 70F

15) Middle High Bay East Machine VAC Exhaust

- North 13" x 17" – 1.5 sq.ft.
- .03 AVP – 700 FPM
- 1,050 ACFM @ 70F

16) Middle High Bay East Machine Scrubber Exhaust.

- 14" Dia. duct.
- Estimated exhaust air volume 1200 CFM

17) Middle Bay Roof Exhaust Fan

- South Exhaust fan 60" diameter
- 69" sq.
- No data
- Used Aerovent Size 60, ¼" SP @ 3HP @ 27,723 CFM

18) Middle Bay Roof Exhaust Fan

- North Exhaust fan 48" diameter
- 69" sq
- No data
- Used Aerovent Size 54, ¼" SP @ 2HP @ 20,219 CFM

19) East High Bay

- Southeast corner Panel Exhaust fan.
- 62" sq.
- No data
- Estimated Aerovent Size 54 @ ¼" Sp @ 19,750 CFM

20) East High Bay Machine Scrubber Exhaust Fan

- 18" Dia.
- Estimated exhaust air volume 1,200 CFM

21) Scrubber Room East Wall Exhaust Fan

- Panel Fan
- No data
- 62" sq.
- Estimated same as above 19,750 CFM

22) Two (2) Scrubber Exhaust fans.

- 32" Diameter duct – 5.585 sq.ft.
- .35 AVP – 2350 FPM
- 13,124 ACFM @ 70F
- Two exhaust fans operating for total of 26,249 ACFM @ 70F

23) Southeast Oil reclaim room

- Roof Exhaust Fan
- No Data
- 6' diameter
- Aerovent size 54, ¼"SP @ 2HP @ 20,219 CFM

## RECOMMENDATIONS

1. Remove #17 & #18 exhaust fans from operation located between both annealing ovens and cap roof curbs. Reference drawing # -A01 & A02.
2. Install four (4) roof mounted new exhaust fans rated at 37,000 CFM above both annealing ovens. One (1) exhaust fan for each annealing oven shall be installed directly over the oven hydrogen flame and the other exhaust fan for each annealing oven shall be installed at the discharge end of each oven. Reference drawing # -A02
3. Install three (3) roof mounted air supply fans rated at 10,000 CFM each for a total of 30,000 CFM based upon drawing # -A02. Two (2) supply fans shall be installed for the west-annealing oven and one (1) supply fan shall be installed for the east-annealing oven. Both units shall have a distribution duct system with discharge louvers rated between 1,500 & 2,500 FPM
4. Install three (3) new makeup air units rated at 70,000 CFM. Reference drawing # -A02. Install discharge duct distribution system with discharge louvers rated approximately 1,500 & 2,500 FPM.
5. Replace existing AMU with a new 70,000 cfm makeup air unit and divide the discharge air between the basement and MKW-100-mill machine. Approximately 35,000 cfm for the basement and 35,000 for MKW-100-mill machine. Reference drawing # -A02.



## SUMMARY

Ventilation control measures may require a source of cooler replacement air, an evaporative or mechanically cooled source, as velocity cooling method or any combination thereof. Exhaust ventilation may be used to remove excessive heat and/or humidity if a replacement source of cooler air is available. In many manufacturing operations, which do not lend themselves to local exhaust, general ventilation within the manufacturing area will be required.

All calculations are based upon the ACGIH Industrial Ventilation Manual Edition 24 Hot process. There are two (2) existing general exhaust fans located in between both annealing ovens that are providing very little exhaust air volume for the annealing ovens. Requested by the industrial facility to have both exhaust fans removed (#17 & #18) from operation and there related estimated exhaust air volume of approximately 47,942 cfm be added to four (4) new exhaust fans that will be located directly above each annealing oven. The exhaust air volume will be 37,000 cfm for each exhaust fan for a total of 148,000 cfm of exhaust, giving a surplus of 104,650 cfm above the 43,350 cfm hot air current being produced from the ovens. Reference drawing # -A02

There is one (1) existing makeup air unit that needs to be replaced with a 70,000 CFM unit and divide the discharge tempered air between the basement area (35,000cfm) and install a duct run through the electric motor room and discharge into the main building at the MKW-100 machine (35,000cfm), reference drawing # -A02. This recommendation would provide much needed fresh tempered air for the manufacturing machine in this area and also for this corner of the manufacturing building that has no tempered fresh air.

Three (3) fresh air fans rated at 10,000 cfm each are proposed for the annealing ovens to provide cooler outside air down between the ovens where worker stations are located Reference drawing # -A02. The concept behind these fresh air fans is to blow cooler outside air down between the ovens helping to push the warmer air upwards toward the exhaust fans. With these fresh air fans at 30,000 cfm, and the four (4) tempered air make-up units at 70,000 cfm each, the new proposal includes 310,000 cfm of supply air into the building. The existing building exhaust fans (minus #17 & #18) along with the proposed new exhaust fans give 246,808 cfm of exhaust from the building. This results in an overall positive pressure for the building of 63,192 cfm.

## **EQUIPMENT SPECIFICATIONS**

### ***Roof Mounted Exhaust Fans***

Quantity:

- 4 Belt Driven Type Upblast Roof Exhaust Fan complete with the following:
- 37,000 CFM @ .125" ESP @ 70 Deg. F. @ 0' Elevation
  - 10 HP 1800 RPM TEFC EPAct Rated Premium Efficient
  - Motor for 460/3/60 Electrical Operation
  - Heavy Gauge Construction
  - Arrangement #9 Belt Driven with Motor out of the Airstream
  - 48" Diameter Aluminum Seven (7) Bladed Propeller
  - Carbon Steel Construction
  - Gravity Operated Stack Cap with Butterfly Dampers
  - Inline Axial Fan
  - Fan Housing Access Door
  - Heavy Duty Motor Base
  - Motor Cover for Motor, Motor Sheave & Belts
  - Shaft Seal
  - Fabricated Base Section
  - Flat Type 5 Pre-Fabricated Roof Curb
  - Constant Speed V-Belt Drives
  - Fan Painted with Standard Industrial Gray Enamel
  - Fan Suitable for Airstream Temperatures up to 140 Deg. F.
  - Fan Shipped Factory Tested & Assembled (four pieces)
  - Fan Shaft RPM @ 816 RPM
  - Fan Shaft BHP @ 6.59 BHP
  - Fan Outlet Velocity @ 2897 RPM
  - Approximate dbA @ 5' of 80

### ***Roof Mounted Air Supply Fans***

Quantity:

- 3 Belt Driven Type Hooded Roof Air Supply Fans complete with the following:
- 10,000 CFM @ 1 ½" ESP @ 70 Deg. F. @ 0' Elevation
  - 7 ½ HP 1800 RPM TEFC EAct Rated Premium Efficient
  - Motor for 460/3/60 Electrical Operation
  - Heavy Gauge Construction
  - Arrangement #9 Belt Driven with Motor out of the Airstream
  - 28" Diameter Aluminum Seven (7) Bladed Propeller
  - Carbon Steel Construction
  - Hooded Inlet with Birdscreen
  - Entrance Orifice
  - Inline Axial Fan with Fixed Vanes
  - Fan Housing Access Door
  - Heavy Duty Motor Base
  - Motor Cover for Motor, Motor Sheave & Belts
  - Shaft Seal
  - Fabricated Base Section with Spool Piece
  - Flat Type 5 Pre-Fabricated Roof Curb
  - Constant Speed V-Belt Drives
  - Fan Painted with Standard Industrial Gray Enamel
  - Fan Suitable for Airstream Temperatures up to 140 Deg. F.
  - Fan Shipped Factory Tested & Assembled (four pieces)
  - Fan Shaft RPM @ 1469 RPM
  - Fan Shaft BHP @ 4.85 BHP
  - Fan Outlet Velocity @ 2297 RPM
  - Approximate dbA @ 5' of 80

## ***Direct Gas Fired Air Supply Units***

Quantity:

- 4 Direct Gas Fired Centrifugal SWSI Air Make-Up Unit, complete with the following features and accessories:

- Three (3) vertical units.
- One (1) horizontal unit.
- 70,000 CFM @ 1" ESP
- 7,120,000 BTU Heat Output
- 85 Deg. F. Temperature Rise
- 50 HP 1800 RPM TEFC EPAct Rated Premium Efficiency Motor for 460/3/60 Electrical Operation
- Weathertight Construction
- 100% Outside Air Only Unit
- Casing Shall be 16 Gauge Aluminized Steel Welded to a Structural Steel Framework
- Painted Exterior will consist of a High Quality Prime Coat and a Finish Coat of Machinery Enamel with Rust Inhibitors
- Maxon NP Burner or Approved Equivalent (30:1 Turndown Ratio)
- Non-Overloading Airfoil Type Impeller of Single Width Single Inlet Design
- Ball or Spherical Roller Bearings Rated for an L10 life of 100,000 Hours or More
- Maxitrol Electronic Series 14 Discharge Temperature Control
- 2 ½" IRI / FM Approved Gas Pipe Train
- Designed to Meet ANSI Z83.4 & Z83.1 Standards
- Control Panel shall be Similar to a NEMA 3R and include Fused Disconnect Switch, Motor Starter, 120 & 24 Volt Transformers, Control Circuit Fuse, and Flame Relay
- Remote Operating Station with Summer/Winter/Off Switch, Temperature Thermostat, and Circuit Analyzer Lights
- Honeywell Solid State Flame Safeguard System
- Mild Weather Stat
- Remote Flame Reset
- Low Temperature Limit Safety Switch
- High Temperature Limit Safety Switch
- High Gas Pressure Safety Switch
- Low Gas Pressure Safety Switch
- High & Low Air Flow Proving Safety Switch
- Inlet Hood with Birdscreen
- Two Position Motorized Inlet Damper

- 11 Light Circuit Analyzer in Unit & Remote Station
- Lighted Control & Gas Enclosures
- Two Year Limited Parts Warranty & 90 Day Labor Warranty
- Vertical Leg Mounted Outdoor Unit Configuration
- Three (3) 72" Tall Support Legs
- Service Platform with Access Ladder for three (3)

***Note:***

- a) *The Gas Fired Air Make-Up Units require a maximum of 5 psi and a minimum of 1-psi gas pressure to operate the burner properly. **A gas pressure regulator is not included in the above pricing.***

**ESTIMATED BUDGET  
FOR  
EQUIPMENT INSTALLATION**

**A. Installation services for three (3) fresh air fans.**

1. Provide design engineering for fan locations & discharge duct system.
2. Fabricate and install discharge duct system.
3. Provide and install discharge Titus drum louvers.
4. Install the above listed fresh air intake fans & roof curbs.

NOTE: The industrial facility will provide roofing contractor & materials to provide weather tight seal for fresh air intake fan roof curbs.

5. Provide and install A&B fused combination starters for each exhaust fan.
6. Provide and install electrical wiring from each exhaust fan starter to exhaust fan field Non-fused disconnect switch and to electric motor.

NOTE: The industrial facility will be responsible for power feed to each starter panel.

7. Field management services.

**B. Demolitions of two (2) existing roof exhaust fans & installation services to install four (4) exhaust fans.**

1. Provide design engineering for fan locations.
2. Remove the existing two (2) exhaust fans and provide & install galvanize sheet cap for roof curbs.
3. Remove conduit & wiring from exhaust fan back to each exhaust fan starter.
4. Install the above listed four exhaust fans & roof curbs.

NOTE: The industrial facility will provide roofing contractor & materials to provide weather tight seal for exhaust fan roof curbs.

5. Provide and install A&B fused combination starters for each exhaust fan.
6. Provide and install electrical wiring from each exhaust fan starter to exhaust fan field Non-fused disconnect switch and to electric motor.

NOTE: The industrial facility will be responsible for power feed.

7. Field management services.

**C. Installation Services for three (3) new air makeup units.**

1. Provide design engineering for concrete pad, duct system, equipment location, electrical, gas piping and installation services.
2. Install concrete pad for each unit.
3. Install AMU.
4. Fabricate and install outlet duct system & wall flashing materials.
5. Provide and install Titus drum louvers.
6. Provide conduit and wiring for remote control units.

NOTE: The industrial facility will be responsible for power feed to each AMU panel. The industrial facility will also provide natural gas piping to each makeup air unit gas train. The Gas Fired Air Make-Up Units require a maximum of 5-psi and a minimum of 1-psi gas pressure to operate the burner properly. **A gas pressure regulator is not included in the above pricing.**

7. Startup and commissioning services for each AMU.
8. Field management services.

**C. Demo existing AMU unit & installation services for one (1) new air makeup units listed above.**

1. Provide design engineering for concrete pad, duct system, equipment location, electrical, gas piping and installation services.
2. Demo existing indirect fired AMU.

NOTE: The industrial facility will be responsible for disposal of unit and along with removal & disposal of any hazards materials from AMU unit.

3. Install concrete pad for each unit.
4. Install AMU.
5. Fabricate and install outlet duct system & three (3) wall flashing materials.
6. Provide and install Titus drum louvers.

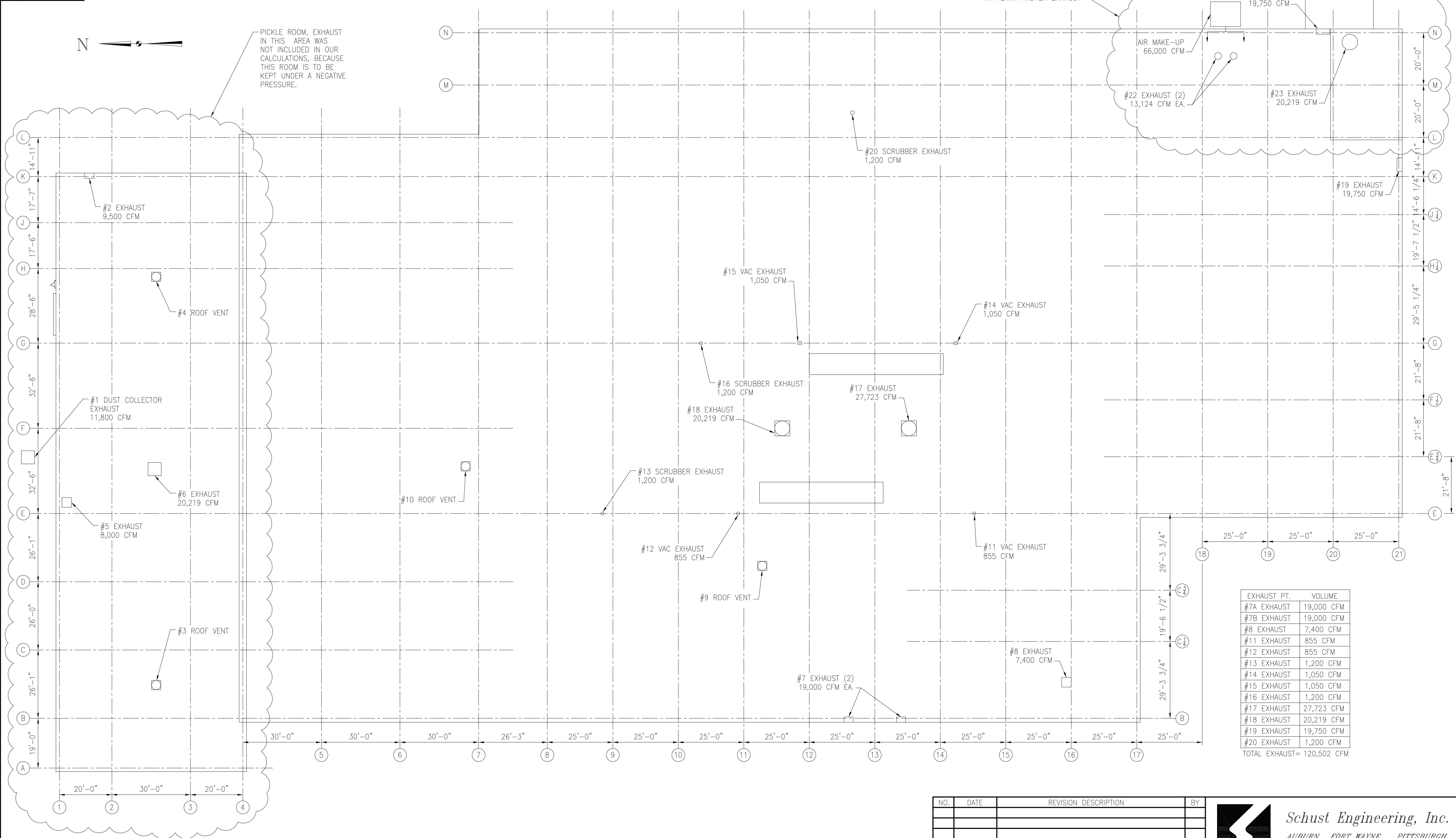
7. Provide conduit and wiring for remote control unit.

NOTE: The industrial facility will be responsible for power feed to each AMU panel. The industrial facility will also provide natural gas piping to each makeup air unit gas train. The Gas Fired Air Make-Up Units require a maximum of 5-psi and a minimum of 1-psi gas pressure to operate the burner properly. **A gas pressure regulator is not included in the above pricing.**

8. Startup and commissioning services for each AMU.
9. Field management services.



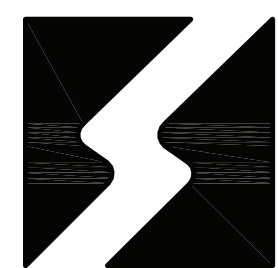
## **APPENDIX**



EXHAUST PT.	VOLUME
#7A EXHAUST	19,000 CFM
#7B EXHAUST	19,000 CFM
#8 EXHAUST	7,400 CFM
#11 EXHAUST	855 CFM
#12 EXHAUST	855 CFM
#13 EXHAUST	1,200 CFM
#14 EXHAUST	1,050 CFM
#15 EXHAUST	1,050 CFM
#16 EXHAUST	1,200 CFM
#17 EXHAUST	27,723 CFM
#18 EXHAUST	20,219 CFM
#19 EXHAUST	19,750 CFM
#20 EXHAUST	1,200 CFM
TOTAL EXHAUST=	120,502 CFM

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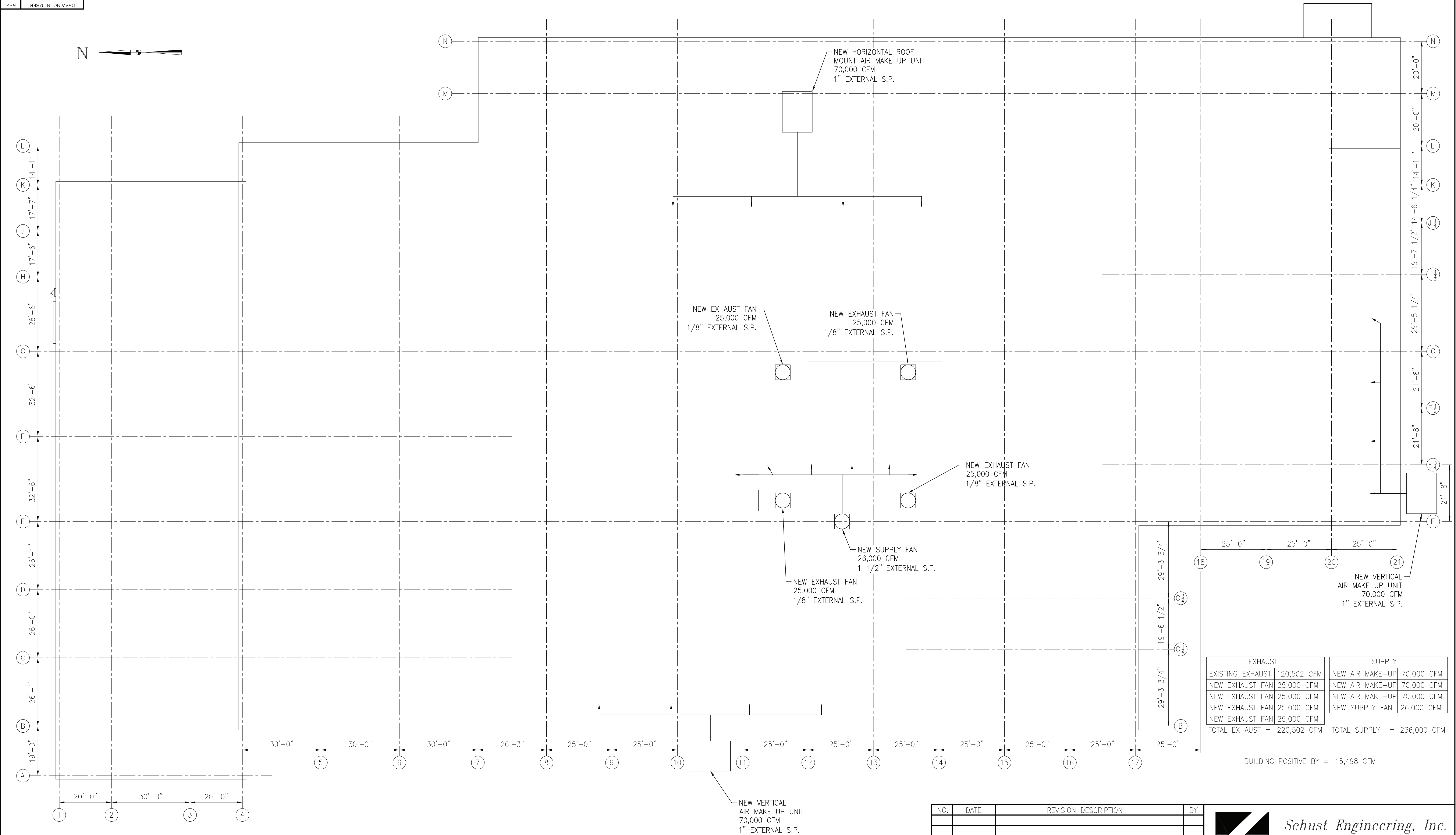
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*Schust Engineering, Inc.*

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INDIANA INDIANA PENNSYLVANIA

DRAWN BY	DWG. DATE	CHECKED BY	DWG. SCALE	DRAWING NUMBER	REV.
JRS			1/16"=1'-0"	-A01	



EXHAUST		SUPPLY	
EXISTING EXHAUST	120,502 CFM	NEW AIR MAKE-UP	70,000 CFM
NEW EXHAUST FAN	25,000 CFM	NEW AIR MAKE-UP	70,000 CFM
NEW EXHAUST FAN	25,000 CFM	NEW AIR MAKE-UP	70,000 CFM
NEW EXHAUST FAN	25,000 CFM	NEW SUPPLY FAN	26,000 CFM
NEW EXHAUST FAN	25,000 CFM		
TOTAL EXHAUST = 220,502 CFM		TOTAL SUPPLY = 236,000 CFM	

BUILDING POSITIVE BY = 15,498 CFM

NO.	DATE	REVISION DESCRIPTION	BY



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