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REPORT ON NEGATIVE ENCLOSURE TESTING

Atlanta Facility

Indoor Air System (IA-1)

Sterigenics US, LLC
2015 Spring Road, Suite 650
Oak Brook, IL 60523
Client Reference No. 172076.000.OJ

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COMMITMENT TO QUALITY

To the best of our knowledge, the data presented in this report are accurate, complete, error free and representative of the actual emissions during the test program. Clean Air Engineering operates in conformance with the requirements of ASTM D7036-04 Standard Practice for Competence of Air Emission Testing Bodies.

Report Writer:

May 27, 2020

______________________________ ______________________________

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Date

I hereby certify that the information contained within the final test report has been reviewed and, to the best of my ability, verified as accurate.

Independent Report and Appendix Reviewer:

May 27, 2020

______________________________ ______________________________

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REPORT REVISION HISTORY

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ACRONYMS & ABBREVIATIONS

AAS (atomic absorption spectrometry)
acfm (actual cubic feet per minute)
ACI (activated carbon injection)
ADL (above detection limit)
AIG (ammonia injection grid)
APC (air pollution control)
AQCS (air quality control system(s))
ASME (American Society of Mechanical Engineers)
ASTM (American Society for Testing and Materials)
BDL (below detection limit)
Btu (British thermal units)
CAM (compliance assurance monitoring)
CARB (California Air Resources Board)
CCM (Controlled Condensation Method)
CE (capture efficiency)
°C (degrees Celsius)
CEMS (continuous emissions monitoring system(s))
CFB (circulating fluidized bed)
CFR (Code of Federal Regulations)
cm (centimeter(s))
COMS (continuous opacity monitoring system(s))
CT (combustion turbine)
CTI (Cooling Technology Institute)
CTM (Conditional Test Method)
CVAAS (cold vapor atomic absorption spectroscopy)
CVAFS (cold vapor atomic fluorescence spectrometry)
DI H_2O (de-ionized water)
%dv (percent, dry volume)
DLL (detection level limited)
DE (destruction efficiency)
DCI (dry carbon injection)
DGM (dry gas meter)
dscf (dry standard cubic feet)
dscfm (dry standard cubic feet per minute)
dscm (dry standard cubic meter)
ESP (electrostatic precipitator)
FAMS (flue gas adsorbent mercury speciation)
°F (degrees Fahrenheit)
FB (field blank)
FCC (fluidized catalytic cracking)
FCCU (fluidized catalytic cracking unit)
FEGT (furnace exit gas temperatures)
FF (fabric filter)
FGD (flue gas desulfurization)
FIA (flame ionization analyzer)
FID (flame ionization detector)
FPD (flame photometric detection)
FRB (field reagent blank)
FSTM (flue gas sorbent total mercury)
ft (feet or foot)
ft^2 (square feet)
ft^3 (cubic feet)
ft/sec (feet per second)
FTIR (Fourier Transform Infrared Spectroscopy)
FTRB (field train reagent blank)
g (gram(s))
GC (gas chromatography)
GFAAS (graphite furnace atomic absorption spectroscopy)
GFC (gas filter correlation)
gr/dscf (grains per dry standard cubic feet)
> (greater than)/ ≥ (greater than or equal to)
g/s (grams per second)
H_2O (water)
HAP(s) (hazardous air pollutant(s))
HI (heat input)
hr (hour(s))
HR GC/MS (high-resolution gas chromatography and mass spectrometry)
HRVOC (highly reactive volatile organic compounds)
HSRG(s) (heat recovery steam generator(s))
HVT (high velocity thermocouple)
IC (ion chromatography)
IC/PCR (ion chromatography with post column reactor)
ICP/MS (inductively coupled argon plasma mass spectroscopy)
ID (induced draft)
in. (inch(es))
in. H_2O (inches water)
in. Hg (inches mercury)
IPA (isopropyl alcohol)
ISE (ion-specific electrode)
kg (kilogram(s))
kg/hr (kilogram(s) per hour)
< (less than)/ ≤ (less than or equal to)
L (liter(s))
lb (pound(s))
lb/hr (pound per hour)
lb/MMBtu (pound per million British thermal units)
lb/TBtu (pound per trillion British thermal units)
lb/lb-mole (pound per pound mole)
LR GC/MS (low-resolution gas chromatography and mass spectrometry)
m (meter)
m^3 (cubic meter)
MACT (maximum achievable control technology)
MASS® (Multi-Point Automated Sampling System)
MATS (Mercury and Air Toxics Standards)
MDL (method detection limit)
µg (microgram(s))
min. (minute(s))
mg (milligram(s))
ml (milliliter(s))
MMBtu (million British thermal units)
MW (megawatt(s))
NCASI (National Council for Air and Stream Improvement)
ND (non-detect)
NDIR (non-dispersive infrared)
NDO (natural draft opening)
NESHAP (National Emission Standards for Hazardous Air Pollutants)
ng (nanogram(s))
Nm^3 (Normal cubic meter)
% (percent)
PEMS (predictive emissions monitoring systems)
PFGC (pneumatic focusing gas chromatography)
pg (picogram(s))
PJFF (pulse jet fabric filter)
ppb (parts per billion)
PPE (personal protective equipment)
ppm (parts per million)
ppmdv (parts per million, dry volume)
ppmwv (parts per million, wet volume)
PSD (particle size distribution)
psi (pound(s) per square inch)
PTE (permanent total enclosure)
PTFE (polytetrafluoroethylene)
QA/QC (quality assurance/quality control)
QI (qualified individual)
QSTI (qualified source testing individual)
QSTO (qualified source testing observer)
RA (relative accuracy)
RATA (relative accuracy test audit)
RB (reagent blank)
RE (removal or reduction efficiency)
RM (reference method)
scf (standard cubic feet)
scfm (standard cubic feet per minute)
SCR (selective catalytic reduction)
SDA (spray dryer absorber)
SNCR (selective non-catalytic reduction)
STD (standard)
STMS (sorbent trap monitoring system)
TBtu (trillion British thermal units)
TEOM (Tapered Element Oscillating Microbalance)
TEQ (toxic equivalency quotient)
ton/hr (ton per hour)
ton/yr (ton per year)
TSS (third stage separator)
USEPA or EPA (United States Environmental Protection Agency)
UVA (ultraviolet absorption)
WFGD (wet flue gas desulfurization)
%wv (percent, wet volume)

1. PROJECT OVERVIEW

TEST PROGRAM SUMMARY

Sterigenics US, LLC (Sterigenics) contracted CleanAir Engineering (CleanAir) to complete negative enclosure (NE) verification testing on the Indoor Air System (IA-1) at the facility, located in Atlanta, Georgia.

The main objective of this test program was to perform verification testing to demonstrate that IA-1 meets 100% ethylene oxide (EtO) capture as requested in a Georgia Department of Natural Resources (DNR) Environmental Protection Division (EPD) letter to Sterigenics, dated October 9, 2019, entitled "Re: Request for additional information regarding Application No. 27153 received July 31, 2019 Sterigenics U.S., LLC, Atlanta, AIRS No: 06700093." The letter requested that Sterigenics conduct testing and engineering analyses to evaluate the modifications proposed in Application No. 27153. The modifications included the construction and implementation of a facility indoor air system that captures all fugitive emissions, removes emissions via a dry bed adsorption (DBA) system, and then exhausts effluent gas via a dedicated stack.

A summary of the test program results is presented below. Section 2 Results provides a more detailed account of the test conditions and data analysis.

Table 1-1:
Summary of Results

Source Constituent	Result	Standard[1]
Indoor Air Control System		
EtO Capture efficiency (%)	100	100

[1] Standard requested in Georgia DNR EPD letter to Sterigenics dated October 9, 2019 entitled "Re: Request for additional information regarding Application No. 27153 received July 31, 2019 Sterigenics U.S., LLC, Atlanta, AIRS No: 06700093".

TEST PROGRAM DETAILS

PARAMETERS

The test program included the following measurements:

- EtO capture efficiency, in percent (%);
- Identification and area determination of each natural draft opening (NDO);
- Ratio of total NDO area to total NE surface area;
- direction of air flow through all NDOs;
- Pressure differential between the interior and exterior of NE affected areas in inches of water (in. H_2O).

Schedule

Testing was performed on March 24, 2020. The on-site schedule followed during the test program is outlined in Table 1-2.

Table 1-2:
Test Schedule

Location	Parameter	Date	Start Time	End Time
IA-1	NDO Identification, NE Dimensional Measurements	03/24/20	08:00	12:00
IA-1	NDO Direction Flow	03/24/20	13:00	14:00
IA-1	NE Pressure Differential	03/24/20	14:35	15:37

Discussion

Ethylene Oxide Capture Efficiency Determination

Since 40 CFR 63.7, Subpart O does not specify the means of demonstrating 100% capture efficiency, CleanAir evaluated the enclosure surrounding the affected facility against a set of criteria ensuring 100% capture. The criteria for NE verification included the following:

1. the total area of all NDOs shall not exceed 5% of the total NE surface area;
2. the direction of air flow through all NDOs shall be into the enclosure;
3. All areas contained by the NE shall be under negative pressure;
4. All access doors and windows where areas are not included as NDOs and are not included in the calculations are closed during routine operation of the process;
5. All EtO emissions must be captured and contained for discharge through a control device.

An NDO enclosure area ratio (NEAR) was calculated to determine compliance with the first criteria. The NEAR was below the allowable limit of 5%. The direction of flow through each NDO during testing was into the NE. Each area in the NE was under negative pressure during testing. NE access points not considered NDOs were closed during testing, and all airflow in the indoor air system is captured and discharged through control devices. These were all verified on-site.

NDO identification and descriptions are presented in Table 2-2 on the following page. A detailed NE description, including floor and ceiling schematics, is discussed in Section 3 of this report. The NE was split into three areas designated Zone A, Zone B, and Zone C. Detailed sketches of NDOs and NE walls are included in Appendices C and D, respectively, of this report. Directional flow and pressure differential testing methodology is discussed in Section 4 of this report.

End of Section

2. RESULTS

This section summarizes the test program results. Additional results are available in the report appendices.

Table 2-1:
IA-1 – Capture Efficiency Criteria Evaluation

NE VERIFICATION CRITERIA	Value / Observation During Test	Acceptable? (yes, no, or n/a)
1. The total area of all NDO's shall not exceed 5 percent of the surface area of the enclosures four walls, floor and ceiling.	*0.031%*	**YES**
2. The direction of air flow through all NDO's shall be into the enclosure.	*IN*	**YES**
3. The pressure differential across the enclosure shall be negative.	*≈ -0.0295"H_2O*	**YES**
4. All access doors and windows that were not included as NDO's above shall remain closed during source operation.[1]	*Verified*	**YES**
5. All EtO must be captured and contained for discharge through a control device.[1]	*Verified*	**YES**

If all of the above criteria are met, then an enclosure is considered to be a negative enlcosure and the EtO capture efficiency can be assumed to be 100%.

Table 2-2:
IA-1 – NDO Identification

NDO	Description	Dimensions (W x H)	Area (ft^2)
Zone A			
A-1	Mandoor Louver near Chamber #7	22" x 22"	3.36
A-2	Ceiling Louver in SE Corner	4' x 4'	16.0
Zone B			
B-1	Ceilcote Scrubber Room Drainage Outlet	35" x 1"	0.24
B-2	Ceilcote Scrubber Room East Wall Louver	4' x 4'	16.0
Zone C			
C-1	Shipping Dock 16 with Truck (gaps around seals)	2 @ 1" x 10', 1 @ 4.5" x 9'	5.05
C-2	Shipping Dock 17 with Truck (gaps around seals)	2 @ 1" x 10', 1 @ 4.5" x 9'	5.05
Total NDO Area			
A_{NDO}	Total area of NDOs (ft^2)		**45.70**

Table 2-3:
IA-1 – NEAR Calculation

NE Area	Surface Area (SA) (ft^2)	Description
Zone A		
Floor	14,120	Chamber Room floor
Ceiling	14,120	Chamber Room ceiling, contains NDO A-2
North Wall	2,088	Chamber Room North wall, contains NDO A-1, multiple mandoors
South Wall	2,088	Chamber Room South wall, EtO storage door
East Wall	3,714	Chamber Room East wall, receiving speed door, door to transfer corridor
West Wall	3,918	Chamber Room West wall, 1 mandoor, garage door for chamber transfer
Zone B		
Floor	11,561	Transfer corridor floor, Ceilcote Scrubber Room floor
Ceiling	11,561	Transfer corridor ceiling, Ceilcote Scrubber Room ceiling
North Wall	4,464	Preconditioning room wall, receving wall
South Wall	4,728	Transfer corridor wall, Ceilcote Scrubber Room South Wall, contains NDO B-1
East Wall	1,056	Ceilcote Scrubber Room East wall, contains NDO B-2
West Wall	1,296	Preconditioning East wall, transfer corridor wall excluded
Zone C		
Floor	25,090	Shipping area floor, Aeration Room floor, AAT Scrubber Room floor
Ceiling	25,090	Shipping area ceiling, Aeration Room ceiling, AAT Scrubber Room ceiling
North Wall	4,448	Shipping area North wall, contains NDO C-1 & C-2, AAT Scrubber Room North wall
South Wall	4,652	Shipping area South wall, Aeration Room South wall
East Wall	5,908	Shipping area East wall, Aeration Room East wall
West Wall	5,440	Shipping area West wall, AAT Scrubber Room West wall
NE Total	**145,342**	
NE Total Area	145,342	
NDO Total Area	45.70	
NE Total Surface Area[1]	145,296	
NEAR	**0.031%**	*Limit = < 5%*

[1] NE total area minus NDO total area

Table 2-4:
IA-1 – NDO Directional Flow

	Directional Flow					
NDO ID	***1***	***2***	***3***	***4***	***5***	***6***
A-1	*IN*	*IN*	*IN*	*IN*	*IN*	*IN*
A-2	*IN*	*IN*	*IN*	*IN*	*IN*	*IN*
B-1	*IN*	*IN*	*IN*	*IN*	*IN*	*IN*
B-2	*IN*	*IN*	*IN*	*IN*	*IN*	*IN*
C-1	*IN*	*IN*	*IN*	*IN*	*IN*	*IN*
C-2	*IN*	*IN*	*IN*	*IN*	*IN*	*IN*

Start: 13:00
Stop: 14:00

Total # of Trials:	36
Total Number of 'IN':	36
% 'IN':	**100%**

Table 2-5:
IA-1 – Pressure Differential

NE Area	Zone A		Zone B - TC[1]		Zone B - CS[2]	
Run	Time (hh:mm)	Pressure Drop (in H_2O)	Time (hh:mm)	Pressure Drop (in H_2O)	Time (hh:mm)	Pressure Drop (in H_2O)
1	14:20	-0.0390	14:35	-0.0211	14:50	-0.0078
2	14:23	-0.0540	14:38	-0.0274	14:53	-0.0173
3	14:26	-0.0451	14:41	-0.0298	14:56	-0.0195
4	14:29	-0.0427	14:44	-0.0360	14:59	-0.0200
5	14:32	-0.0493	14:47	-0.0278	15:02	-0.0076
	Average	**-0.0460**	**Average**	**-0.0284**	**Average**	**-0.0145**
	Maximum	**-0.0540**	**Maximum**	**-0.0360**	**Maximum**	**-0.0200**
	Minimum	**-0.0390**	**Minimum**	**-0.0211**	**Minimum**	**-0.0076**

NE Area	Zone C - AR/SA[3]		Zone C - AAT[4]		*NE (Overall)*	
Run	Time (hh:mm)	Pressure Drop (in H_2O)	Time (hh:mm)	Pressure Drop (in H_2O)	Time (hh:mm)	Pressure Drop (in H_2O)
1	15:07	-0.0102	15:25	-0.0459	*N/A*	↓
2	15:10	-0.0178	15:28	-0.0607		
3	15:13	-0.0125	15:31	-0.0442		
4	15:16	-0.0048	15:34	-0.0484		
5	15:19	-0.0086	15:37	-0.0398		
	Average	**-0.0108**	**Average**	**-0.0478**	***Average***	***-0.0295***
	Maximum	**-0.0178**	**Maximum**	**-0.0607**	***Maximum***	***-0.0607***
	Minimum	**-0.0048**	**Minimum**	**-0.0398**	***Minimum***	***-0.0048***

Limit: ≥ 0.0000

[1] Transfer corridor
[2] Ceilcote Scrubber Room
[3] Aeration room / Shipping area
[4] AAT Scrubber Room

End of Section

3. DESCRIPTION OF INSTALLATION

PROCESS DESCRIPTION

Sterigenics US, LLC operates a commercial contract sterilization facility in Atlanta, Georgia, which utilizes EtO to sterilize its customers' product. It also has the ability to use propylene oxide to treat nutmeats.

When EtO is used for medical device sterilization, the medical devices must have a specifically-defined sterilization process, which is validated for a specific sterilization chamber or chambers. The Atlanta facility uses 10 sterilization chambers ranging in size from five pallets to up to 30 pallets. While all 10 sterilization chambers are similar in design, each chamber may only process products approved for that chamber and cannot process other products that have not been validated and approved by the appropriate regulatory agency for that specific chamber.

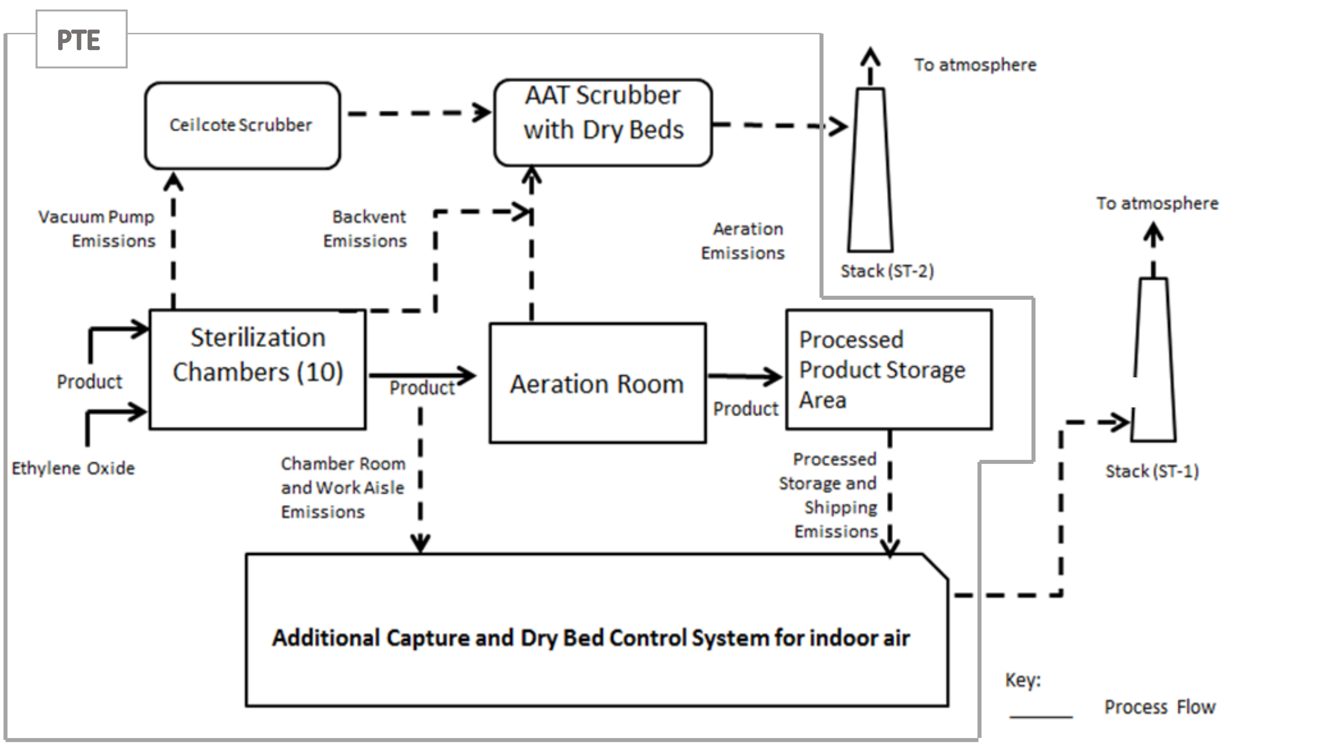
The sterilization process begins with evacuating the air from the chamber and introducing nitrogen (N_2). While under negative pressure inside the chamber, EtO is introduced into the sterilization chamber to sterilize the product. Once EtO is introduced, the dwell stage can last from 30 minutes to up to several hours, according to the validated cycle for the product. Once complete, the sterilization chamber vacuum pumps remove most of the EtO from the chamber by exhausting and purging with N_2 multiple times. Vacuum pump emissions are routed to the ceilcote wet acid scrubber, which is then routed to the existing Advanced Air Technologies (AAT) wet acid scrubber with dry bed reactor, then to additional polishing beds, and finally to a common stack.

Once the sterilization chamber process is complete and the chamber door is partially opened, the backvent fan activates to extract residual amounts of EtO from the chamber. This fan remains on while the chamber door is open. After 15 minutes, the pallets of product are removed from the sterilization chamber and placed into aeration rooms to further off-gas residual EtO. Both the backvents and aeration rooms are ducted to the AAT and treated with dry bed reactors, and then to a common stack.

A negative pressure system has been installed to capture air internally from chamber rooms, work aisles, processed product storage, and shipping areas. This captured air is ducted to a new dry bed control system consisting of 18 dry beds and then to a dedicated stack.

The testing reported in this document was performed on the facility negative pressure (NP) system. Testing was performed in areas deemed part of the negative pressure area. A schematic of the process is shown in Figure 3-1 on the following page.

Figure 3-1:
Process Schematic



Negative Enclosure Description

General

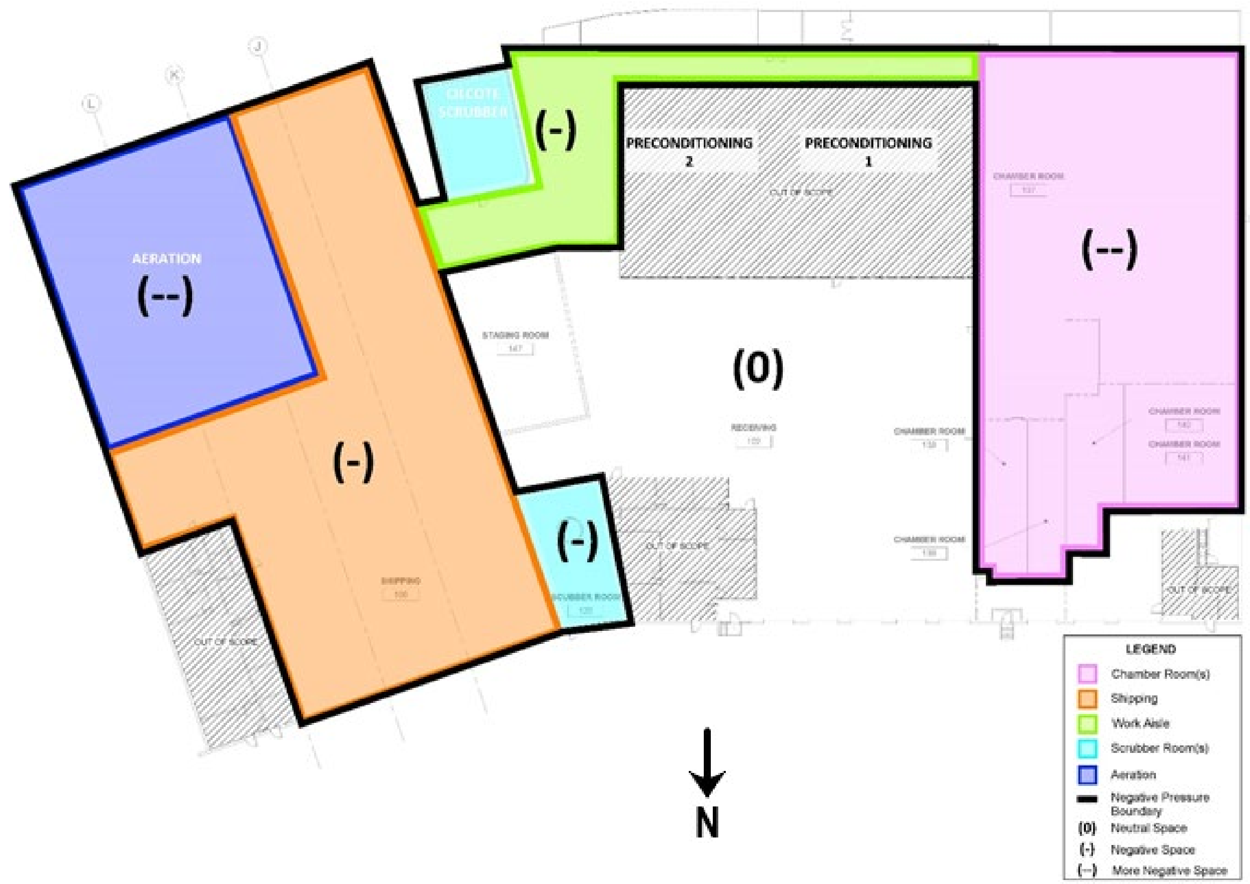
The NE consists of three zones: Zone A, Zone B, and Zone C. Zone A includes the chamber room area. Zone B includes the ceilcote scrubber room and the corridor abutting the pre-conditioning room where sterilized pallets are transferred via forklift from the chamber room to the aeration room. For the purposes of this report, this is referred to as the work aisle or transfer corridor. Zone C includes the shipping area, aeration room, and AAT scrubber enclosure. The receiving area and pre-conditioning room are not included in the NE.

Six NDOs were identified during testing: A-1, A-2, B-1, B-2, C-1, and C-2. Locations, dimensions, descriptions, and areas are listed in Table 3-1.

Access in and out of the NE to/from non-NE areas include several mandoors and garage speed doors. All mandoors and garage speed doors remain closed during normal operations. Garage speed doors are movement-activated, allowing them to automatically open and close. These doors provide passthrough for forklifts and product for only seconds at a time. The NE contains many mothballed louvers and vents that are either capped or disconnected from the indoor air system. Each cap and disconnection were verified on-site.

A general NE layout, with NE area and negative pressure design overlay, is presented in Figure 3-2.

Figure 3-2:
Facility NE Layout and Pressure Plan



IA-1 System

The IA-1 system consists of a network of ducts that are routed to a bank of dry beds, then exhausted out of a dedicated stack. The dry beds are located in the receiving area outside of the NE. Flow is induced through the system via a blower on the roof. The blower is controlled by an Allen-Bradley Panelview Plus 1250 operator interface and is rated for approximately 18,000 cfm. All indoor air in the NE is routed to a control device: air from the aeration room and south end of the shipping area is routed to the AAT scrubber, air from back vents during transfer and chamber room outlet ducts during non-transfer periods are routed to the AAT scrubber, and air from all other areas in the NE are routed to the DBA system. Air flow in the system is controlled by a series of dampers that can dictate the quantity of air being induced from each zone. When proportionately more air is being drawn from a specific zone, the configuration is labeled as “strategic air from Zone *X*.” During directional flow and pressure differential testing, the configuration was strategic air from Zone B.

The IA-1 ductwork schematic is presented in Figures 3-3 through 3-5. The ductwork is highlighted in blue.

Figure 3-3:
IA-1 – Zone A Schematic

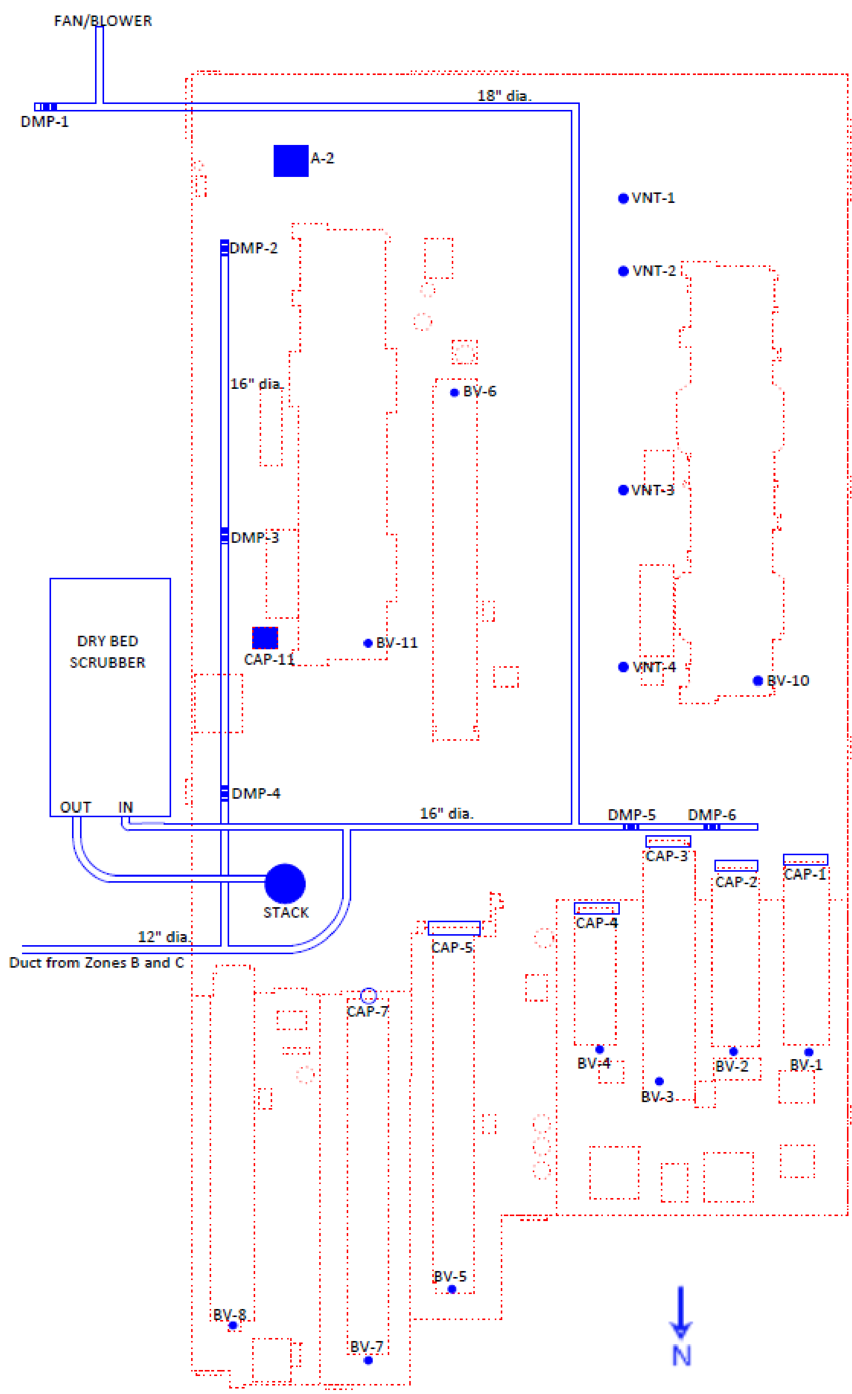


Figure 3-4:
IA-1 – Zone B Schematic

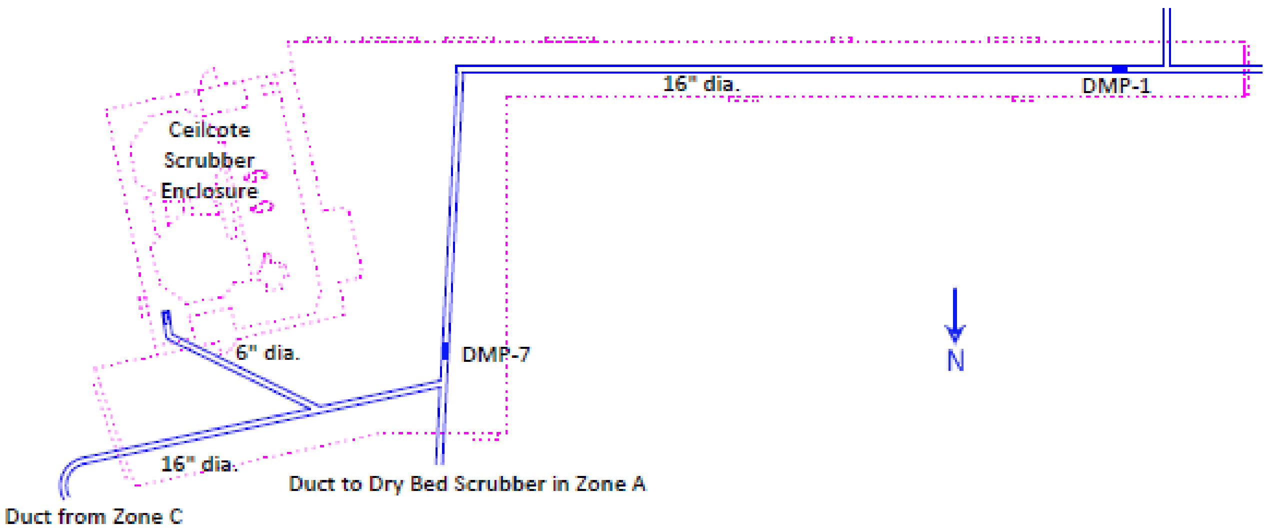
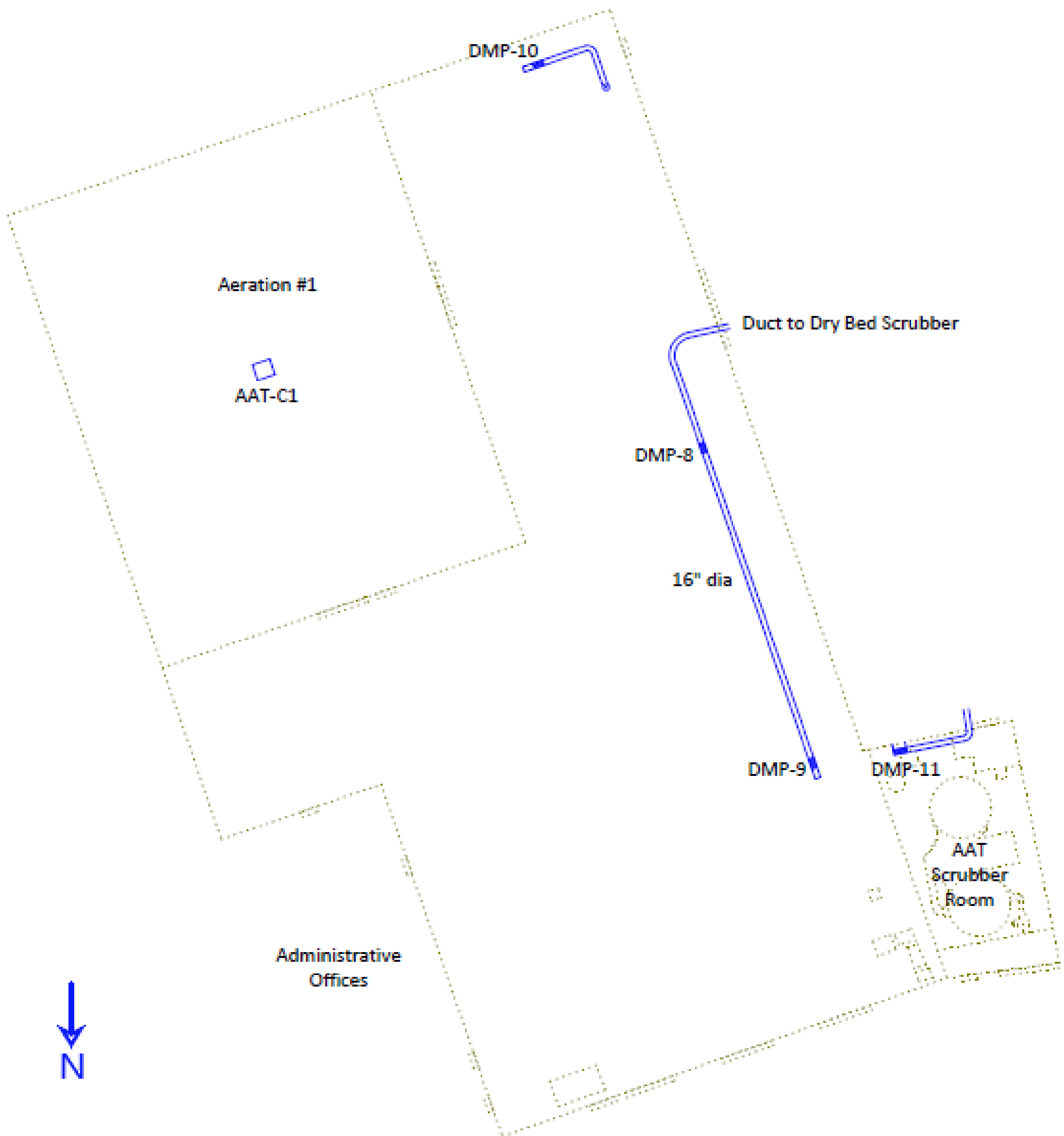


Figure 3-5:
IA-1 – Zone C Schematic



A ductwork schematic features index is presented in Table 3-1.

Table 3-1:
IA-1 – System Features Index

Feature	Description	Dimensions
Zone A - IA-1 System Feature Index		
DMP-1	Damper 1. Located in Zone B corridor outside of boiler room. 16" diameter duct.	16" dia.
A-2	NDO. Ceiling louver.	4x4'
DMP-2	Damper 2. Duct draws air from chamber room area to dry bed scrubber	16" dia.
DMP-3	Damper 3. Duct draws air from chamber room area to dry bed scrubber	16" dia.
DMP-4	Damper 4. Duct draws air from chamber room area to dry bed scrubber	16" dia.
DMP-5	Damper 5. Duct draws air from chamber room area to dry bed scrubber	16" dia.
DMP-6	Damper 6. Duct draws air from chamber room area to dry bed scrubber	16" dia.
VNT-1	Ceiling vent 1. Open when BV closed. Closed when BV open. Ductwork goes to AAT scrubber.	14" dia.
VNT-2	Ceiling vent 2. Open when BV closed. Closed when BV open. Ductwork goes to AAT scrubber.	14" dia.
VNT-3	Ceiling vent 3. Open when BV closed. Closed when BV open. Ductwork goes to AAT scrubber.	14" dia.
VNT-4	Ceiling vent 4. Open when BV closed. Closed when BV open. Ductwork goes to AAT scrubber.	14" dia.
BV-1	Back vent: Chamber 1.	8" dia.
BV-2	Back vent: Chamber 2.	8" dia.
BV-3	Back vent: Chamber 3.	8" dia.
BV-4	Back vent: Chamber 4.	8" dia.
BV-5	Back vent: Chamber 5.	12" dia.
BV-6	Back vent: Chamber 6.	16" dia.
BV-7	Back vent: Chamber 7.	12" dia.
BV-8	Back vent: Chamber 8. Note: there is no chamber 9.	12" dia.
BV-10	Back vent: Chamber 10.	16" dia.
BV-11	Back vent: Chamber 11.	16" dia.
CAP-1	Chamber 1 unused vent cap.	8 x 1'
CAP-2	Chamber 2 unused vent cap.	8 x 1'
CAP-3	Chamber 3 unused vent cap.	8 x 1'
CAP-4	Chamber 4 unused vent cap.	8 x 1'
CAP-5	Chamber 5 unused vent cap.	6' x 8"
CAP-7	Chamber 7 unused vent cap.	12" dia.
CAP-11	Ceiling louver above chamber 11 remains shut/capped.	3 x 3'
DRY BED SCRUBBER	A bank of dry catalyst scrubber beds. Air is supplied from ceiling ductwork in Zones A, B and C and is exhausted to the stack.	--
STACK	Rooftop emission point downstream from dry bed scrubber.	--
Zone B - IA-1 System Feature Index		
DMP-1	Damper 1. Located in Zone B corridor outside of boiler room. 16" diameter duct.	16" dia.
DMP-7	Damper 7. Located in the Work Aisle. Controls strategic air. 6" diameter duct.	6" dia.
Zone C - IA-1 System Feature Index		
DMP-8	Damper 8. Duct draws air from processed shipping area to dry bed scrubber. 16" dia. duct.	16" dia.
DMP-9	Damper 9. Duct draws air from processed shipping area to dry bed scrubber. 16" dia. duct.	16" dia.
DMP-10	Damper 10. Duct draws air from shipping area to AAT scrubber. 16" dia. duct.	16" dia.
DMP-11	Damper 11. Duct draws air from AAT Scrubber Room to AAT-VNT. 6" dia. duct.	6" dia.
AAT-C1	Blower/fan in Aeration #1 area. Air is ducted to AAT Scrubber.	1.5 x 1.5'

NE Zones

Zone A

Zone A includes the chamber room area. Two NDOs are located in Zone A; A-1 and A-2. Refer to Table 2-2 for Zone A NDO details.

The chamber room consists of 10 sterilization chambers equipped with back vents, two east garage speed doors, and several mandoors. When chamber doors are opened, back vents are activated and routed to the AAT scrubber. When chamber doors are closed, there are four outlet ducts that are activated and routed to the AAT scrubber. During directional flow and pressure differential testing, Chamber 10 door was open and Chamber 11 door was ajar. Unsterilized product is transferred via forklift from the pre-conditioning room to the chamber room through the northernmost east garage speed door. There is routine traffic through this door only during peak operation hours. The door opens and closes automatically. Sterilized product is transferred via forklift out of the chamber room through the southernmost east garage speed door. This door is used one to two times a day. The area of the shared wall between Zone A and Zone B is excluded in the NEAR calculation, since it is contained within the NE.

Periodically, delivered EtO drums are transferred from the receiving area through the chamber room to the drum storage area. The drums are transferred into the chamber room through a north mandoor and are then carted to the drum storage area on the south side of the chamber room through a mandoor backed up by strip curtains. During transfer, as an administrative facility rule, only one of the doors is allowed open at a time.

A 3’ x 3’ forced draft louver is located above the westernmost mandoor on the north side of the chamber room and draws about 4,725 cfm into the chamber room. An anemometer was utilized to approximate air velocity, in feet per minute (fpm), coming into the chamber room via the louver. The anemometer specifications are presented in Appendix A of this report.

A floor plan of Zone A is presented in Figure 3-6 on the following page. Zone A features index is presented in Table 3-2 on page 15.

Figure 3-6:
Zone A – Floor Plan

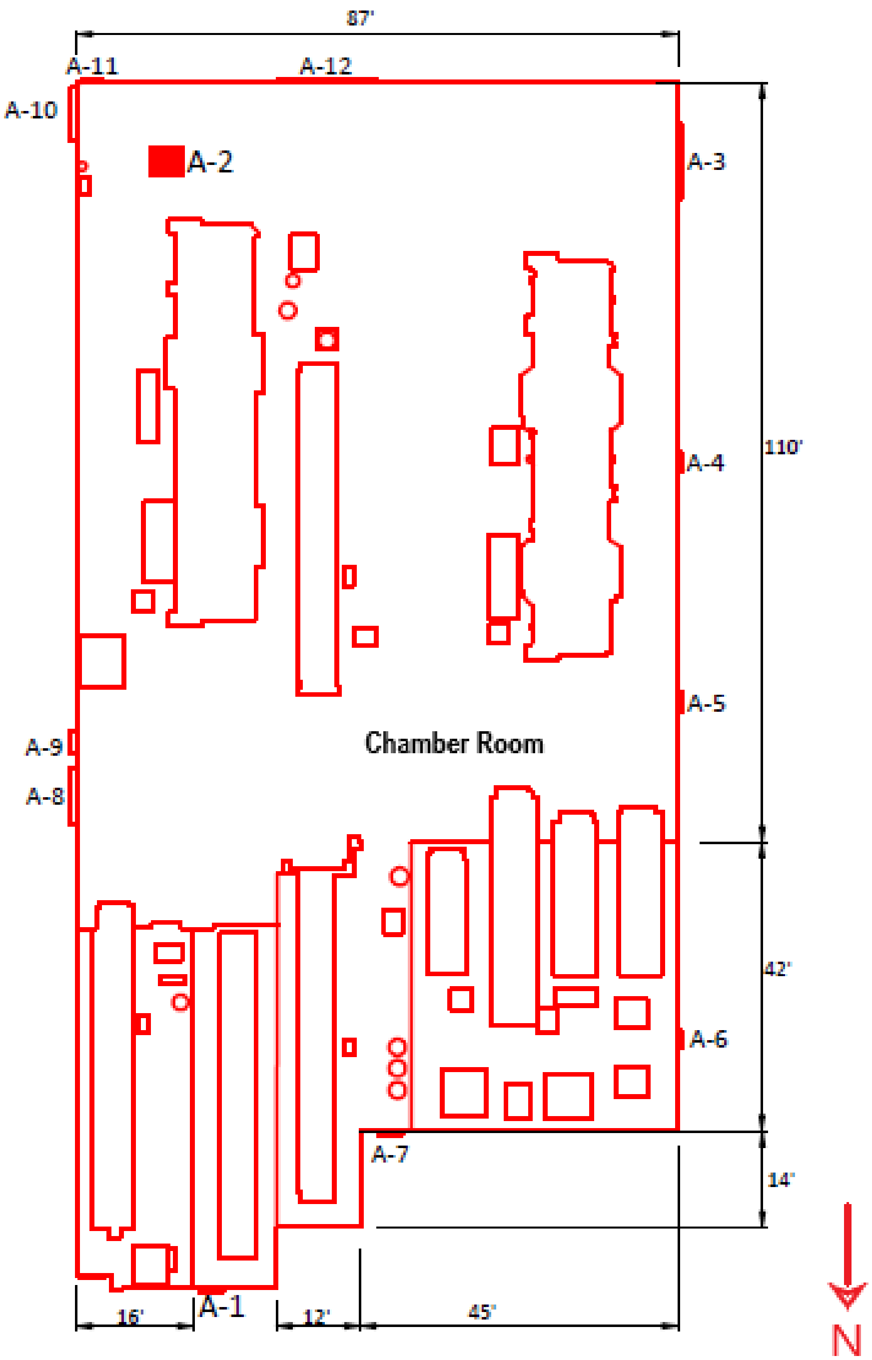


Table 3-2:
Zone A – System Features Index

Feature	Description	Dimensions
Zone A Floor Feature Index		
A-1	NDO. Louver on the bottom of door	1.83 X 1.83’
A-2	NDO. Ceiling Louver.	4’ x 4’
A-3	Garage door. Only opens to add/remove chambers.	16.5 x 16.25’
A-4	Mandoor. Normally closed.	3.5 x 6.83’
A-5	Former NDO. Capped.	3.5 x 3.5’
A-6	Former NDO. Capped.	3.5 x 3.5’
A-7	Mandoor. Normally closed.	3.5 x 6.83’
A-8	Garage speed door. Automatically closes.	10 x 10’
A-9	Mandoor. Normally closed.	3.5 x 10’
A-10	Garage speed door. Opens once per day. This is the same feature as B-10	10 x 7.5’
A-11	Mandoor. Normally closed.	3.5 x 6.83’
A-12	Garage door reduced to smaller strip curtain door (4’x7’).	14 x 9.5’

Zone B

Zone B includes the ceilcote scrubber room and the work aisle. Two NDOs are located in Zone B: B-1 and B-2. Refer to Table 2-2 for Zone B NDO details. Both Zone B NDOs are located in the ceilcote scrubber room. NDO B-1 is the terminus of a water drainage outlet running along the west side of the ceilcote scrubber room. The outlet is an opening in the wall approximately 2’ in width, 6” in height and is mainly covered by a plastic curtain. The NDO area is considered the gaps between the curtain and gutter.

Zone B includes several mandoors and several garage doors. All mandoors remain closed during normal operation. Sterilized product is transferred via forklift out of the chamber room through the west garage speed door. Four regular garage doors are located on the south side of the work aisle. One of the work aisle garage doors adjoins the boiler room, and the other three garage doors adjoin storage areas. A large garage speed door is located on the north side of the work aisle and adjoins the receiving area. The large garage speed door is used approximately once a day. An open pathway approximately 10’ x 12’ connects Zone B and Zone C. The area of the shared wall containing the open pathway is excluded in the NEAR calculation since it is contained within the NE.

The work aisle abuts the pre-conditioning room. The pre-conditioning room walls and ceiling do not entirely reach the ceiling of the NE. There is approximately 2.5’ of headspace above the pre-conditioning room. This surface area is included in the NEAR calculation.

A floor plan of Zone B is presented in Figure 3-7 on the following page. Zone B features index is presented in Table 3-3 on the following page.

Figure 3-7:
Zone B – Floor Plan

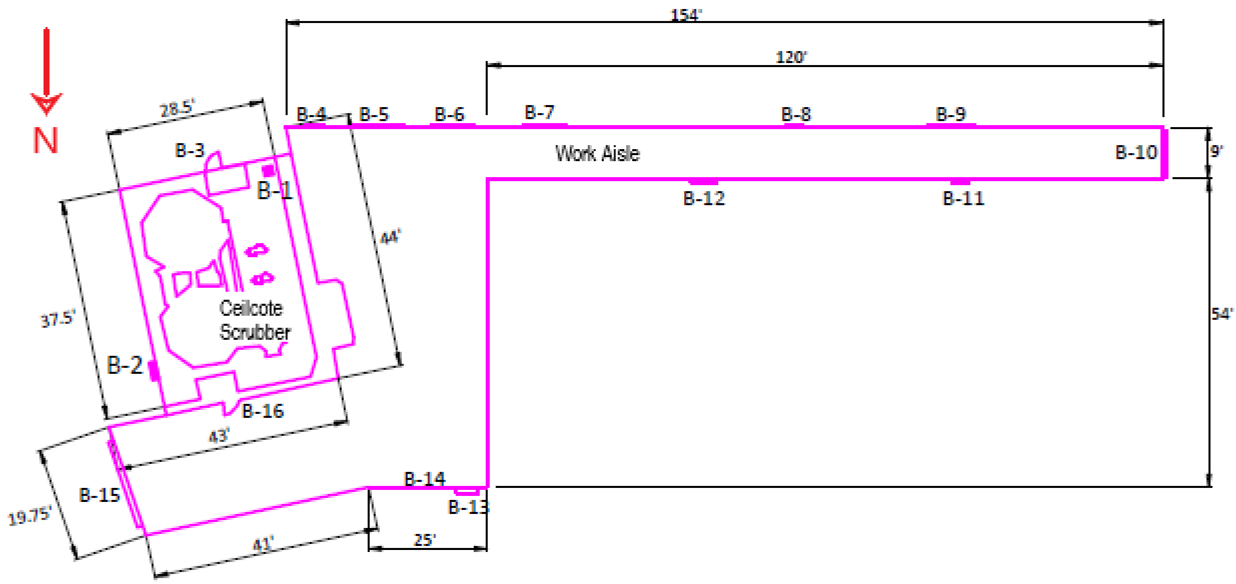


Table 3-3:
Zone B – System Features Index

Feature	Description	Dimensions
Zone B Floor Feature Index		
B-1	NDO. Drainage opening.	
B-2	NDO. Wall louver.	4 x 4’
B-3	Mandoor.	3 x 7’
B-4	Mandoor.	3 x 6.83’
B-5	Garage door.	10 x 10’
B-6	Garage door.	10 x 10’
B-7	Garage door.	10 x 10’
B-8	Mandoor.	3 x 7’
B-9	Garage door. (10’W x 12’H)	10 x 12’
B-10	Speed door. Opens once per day. This is the same feature as A-10.	10 x 7.5’
B-11	Mandoor.	3 x 7’
B-12	Mandoor.	3 x 7’
B-13	Mandoor.	3 x 7’
B-14	Garage speed door. Rarely opened (10’W x 14’H).	10 x 14’
B-15	Open pathway to Zone C. Same feature as C-8.	10 x 12’
B-16	Mandoor.	3.5 x 7’

Zone C

Zone C includes the shipping area, aeration room, and AAT scrubber enclosure. Two NDOs are located in Zone C: C-1 and C-2. Refer to Table 2-2 for Zone C NDO details. The areas of NDO C-1 and C-2 are considered the gaps between the shipping docks and dock seals, and stationed semi-trucks. The NDO areas are considered variable, depending on positioning of the semi-truck at the dock. Gaps were measured at both docks and area dimensions were averaged. For purposes of this report, the NDO areas for C-1 and C-2 are considered equal.

There are three docks in the shipping area. As a facility administrative rule, only two docks are allowed to receive a semi-truck at a time.

The shipping area abuts administrative offices. The administrative offices walls and ceiling do not entirely reach the ceiling of the NE. There is approximately 14’ of headspace above the administrative offices. This surface area is included in the NEAR calculation. HVAC ducts from the top of the offices are routed directly above to the roof where it is exhausted. These ducts are isolated from the NE indoor air and are not part of IA-1.

There are no NDOs in the aeration room. The aeration room has two garage speed doors acting as access points for product to be delivered. There is a louver connecting the shipping area to the aeration room located above the north garage speed door. These doors automatically open and close. A centrally-located fan in the ceiling of the aeration room draws residual EtO-contaminated air to the AAT scrubber. The aeration room walls and ceiling do not entirely reach the ceiling of the NE. There is approximately 2’ of headspace above the aeration room. This surface area is included in the NEAR calculation.

The AAT scrubber room is isolated from the shipping area. The access point to the scrubber room is a small manual garage door that abuts the receiving area and is closed during normal operation. There are no NDOs in the AAT scrubber room.

A floor plan of Zone C is presented in Figure 3-8 on the following page. Zone C features index is presented in Table 3-4 on page 19.

Figure 3-8:
Zone C – Floor Plan

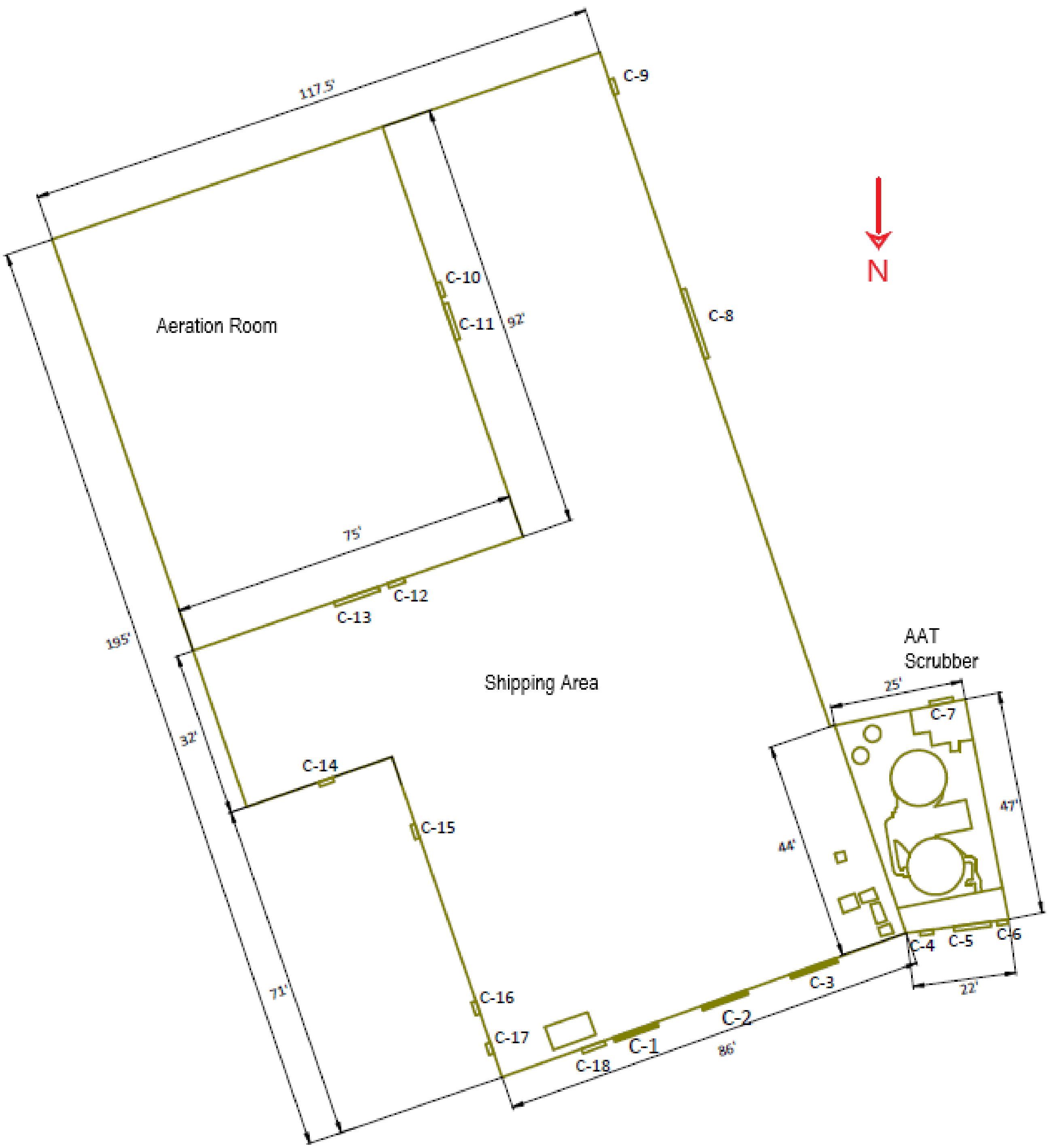


Table 3-4:
Zone C – System Features Index

Feature	Description	Dimensions
Zone C Floor Feature Index		
C-1	NDO. Shipping door. Dock 16.	9.25 X 10'
C-2	NDO. Shipping door. Dock 17.	9.25 X 10'
C-3	Alternate shipping door. Not an NDO. Dock 18.	9.25 X 10'
C-4	Mandoor.	3 x 7'
C-5	Garage door.	8 x 10'
C-6	4' high exit door.	3 x 7'
C-7	Garage door.	6 x 8'
C-8	Open pathway to Zone B. Same feature as B-15.	10 x 12'
C-9	Exit Mandoor.	3 x 7'
C-10	Mandoor.	3 x 7'
C-11	Speed garage door.	8 x 11'
C-12	Mandoor.	3 x 7'
C-13	Speed garage door 8 x 11'. Louver above door 6 x 2'.	8 x 11'
C-14	Mandoor.	3 x 7'
C-15	Mandoor.	3 x 7'
C-16	Mandoor.	3 x 7'
C-17	Mandoor.	3 x 7'
C-18	Old NDO. Sealed.	4 x 6'

End of Section

4. METHODOLOGY

PROCEDURES AND REGULATIONS

The test program sampling measurements followed procedures and regulations outlined by the United States Environmental Protection Agency (USEPA) and the Georgia DNR EPD. Appendix A includes specifications of sampling apparatuses.

CleanAir follows specific QA/QC procedures outlined in the individual methods and in USEPA "Quality Assurance Handbook for Air Pollution Measurement Systems: Volume III Stationary Source-Specific Methods," EPA/600/R-94/038C. Additional QA/QC measures are outlined in CleanAir's internal Quality Manual.

METHODOLOGY DISCUSSION

NDO IDENTIFICATION / NE DIMENSIONAL MEASUREMENTS / NEAR

NDOs were identified, logged, and measured during testing. An NDO is defined as any permanent opening in the NE that is not connected to a duct in which a fan is installed. Dimensions for all NE area walls, floors, and ceilings were measured during testing. Areas were calculated based on measurements collected on-site. An NEAR was calculated as the total area of NDO as a percentage of total NE surface area. The dimensions of the enclosure were measured with a tape measure, measuring wheel, and laser distance finder.

DIRECTIONAL FLOW

The direction of flow through each NDO was observed at 10-minute intervals for one hour. Direction of flow was verified using smoke tubes.

DIFFERENTIAL PRESSURE

Pressure drop across the NE was measured with a calibrated electronic micromanometer. The micromanometer was placed in a centralized location within an NE area and a length of Tygon tubing was ran to a location outside of the NE. Five pressure drop measurements were recorded in five NE areas: the chamber room, the work aisle, the ceilcote scrubber room, the shipping/aeration room areas, and the AAT scrubber room. Pressure drops were recorded over a period of 12 minutes in each NE area tested. Individual pressure drop measurements were not measured in the aeration room because the aeration room is contained by the shipping area and there was no NDO identified within the confines of the area.

The micromanometer used to measure pressure drop has a recommended maximum length of tubing specification of 18'. Tubing used to measure pressure drop during testing was greater than 18'. A bench study regarding the effect of length of tubing on the micromanometer used during testing was conducted by CleanAir post-mobilization. The results of the study are presented in Appendix A of this report. The study concluded that there is negligible statistical bias in readings for tubing up to 300'.

An approximate NE face velocity was calculated to further verify that the NE is under negative pressure. The calculated face velocity into the NE is approximately 286 fpm. The face velocity was calculated as the difference of the average stack volumetric flow observed on the Allen-Bradley Panelview Plus 1250 operator interface (17,800 cfm) and the volumetric flow calculated at the Zone A forced draft louver (4,725 cfm), divided by the total NDO area (45.70 ft). An anemometer was utilized to approximate air velocity, in fpm, coming into the chamber room via the louver. The anemometer specifications are presented in Appendix A of this report. This number is an estimate and should be considered with discretion. EPA promulgated methods were not used to calculate volumetric flow. Air pressure, temperature, and molecular weight of the volumetric flows measured were assumed to be approximately equal and near standard conditions.

End of Section

5. APPENDIX

Appendix A: Test Equipment Specifications and Calibrations

Appendix B: NE Evaluation Data Sheets

Appendix C: NDO Log and Sketches

Appendix D: NE Area Wall Sketches

Appendix E: CleanAir Resumes and Certifications

APPENDIX A: TEST EQUIPMENT SPECIFICATIONS AND CALIBRATIONS

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Shortridge AirData Multimeter ADM-860C

Rental and Application Notes:

- Shipping Weight: 21 lbs.
- Air velocity readings are displayed as local density, true air velocity or flow.
- Internal calibration, temperature compensation, range selection and zeroing are fully automatic with each reading. No external adjustments needed.
- Memory can hold up to 100 readings for individual recall and can give a reading total and average.
- The max. recommended length of pneumatic tubing for the measurement of airflow, velocity or differential pressure is 18 ft. Minimum is ID 3/16".

Specifications:

- Weight: 32 oz.
- Dimensions: 6" x 6.4" x 2.7".
- Power: 120VAC, 60 Hz, 8w.
- Output: RS-232.
- Response Time: 1 sec. at high pressure inputs, 7sec. at inputs less than 0.003wc. Extrememly low presure/flow/velocity inputs require longer sample times.
- Air Velocity: 25-29,000 fpm w/ standard pitot tube, 25-5,000 fpm w/ AirFoil probe, 25-2,500 fpm w/ VelGrid.
- Air Bleed: Each pressure measurement requires a small volume of air to pass through the meter. The pressure source must be capable of supplying this volume without significant depletion to ensure accurate measurements.
- Absolute Pressure: 10 - 40 in Hg. Max. safe pressure is 60 psi. Accuracy: ± 2% of reading ±0.1 in Hg from 14-40 in Hg.
- Differential Pressure: 0.0001-60.00wc. Max. safe pressure is 20 psid. Accuracy: ± 2% of reading ±0.001wc from 0.05-50wc.
- Opertational Temperature: 40°F - 104°F.
- Connections: 1/4" OD slip-on for 3/16" ID soft tubing.

The measured effect of the length of pneumatic tubing on differential pressure measurements

The Shortridge AirData Multimeter (ADM) operating manual states: "TUBING: The maximum recommended length of pneumatic tubing for the measurement of air flow, velocity, or differential pressure is 18 feet."

Due to the logistics in taking either static pressure readings or velocity pressure readings the length of the pneumatic tubing varies and can possible be up to 300 feet in length.

Experimental Set-up

To measure the effects of the pneumatic tubing length the following controlled measurements were made using an EPA designed and certified wind tunnel.

100 measurements were made at each of the following lengths of tubing attached to the ADM:

- 15 feet,
- 30 feet,
- 50 feet,
- 100 feet
- 300 feet.

The measurements were made to represent the static pressure between two locations such as in and out of an enclosure or taking duct/stack static pressure. One hundred readings were taken with each line length. Conditions in the wind tunnel were set to represent a low static pressure. Setup included:

- the (+) line is connected to the pitot at one end and the Shortridge ADM (+) inlet
- the (-) line is open to atmosphere on the pitot and the Shortridge ADM (-)
- the face of the pitot is perpendicular to the flow
- static pressure measure in tunnel was -0.0390 measured with an inclined manometer

Results

Results showed relatively small differences in static reading – differences are in the third decimal place. Using the 15-foot as the standard, the differences between 15 and 30, 50 and 100 are virtually identical and very close to zero. The 300-foot length of tubing does show a slight negative bias in the average static reading compared to the 15-foot length – again these differences are in the third decimal place – about 0.0015. Note that this negative bias represents a worst-case scenario because it would possibly result in a smaller differential pressure drop than expected from a shorter length of tubing.

The ADM specification for accuracy is…"Accuracy is ±0.001 in wc from 0.0500 to 50.00 in wc." However, this controlled testing showed a real-world accuracy (precision) of approximately 0.004 in wc (2 x STDEV). Since the 0.0015 bias in the 300-foot line is less than the measurement precision of 0.0040, the bias is not significant.

Therefore, these data demonstrate that a tubing length up to 300 feet has a negligible effect on the differential pressure reading.

Figure 1-1 presents a summary of the data for the static pressure reading and Figure 1-2 shows a graphical representation of the statistical analysis.

CleanAir ENGINEERING

Figure 1-1:
Summary of Static Readings

Steady-flow conditions in wind tunnel set at 5.00Hz. All measurements taken between 1100 and 1230, 5 April 2020, by Jason Fugiel and Josh Myers

Static pressure:	-0.039	inH2O
Temperature:	67.9	F
Atmospheric:	29.13	inHg
Approx Velocity:	8.5	ft/s
RH:	27	%

Differential Pressures in inH2O (abs. value). + only is out of flow, and is reading static pressure.

15ft Static	30ft Static	50ft Static	100ft Static	300ft Static

	15ft Static	30ft Static	50ft Static	100ft Static	300ft Static
Sum	3.9187	3.9122	3.9116	3.9074	3.8582
Average	0.0392	0.0391	0.0391	0.0391	0.0386
High	0.0409	0.0405	0.0406	0.0425	0.0449
Low	0.0370	0.0373	0.0376	0.0370	0.0362
Sum Sqrt.	19.7947	19.7782	19.7772	19.7663	19.6407
Average S	0.1979	0.1978	0.1978	0.1977	0.1964
High Sqrt.	0.2022	0.2012	0.2015	0.2062	0.2119
Low Sqrt.	0.1924	0.1931	0.1939	0.1924	0.1903

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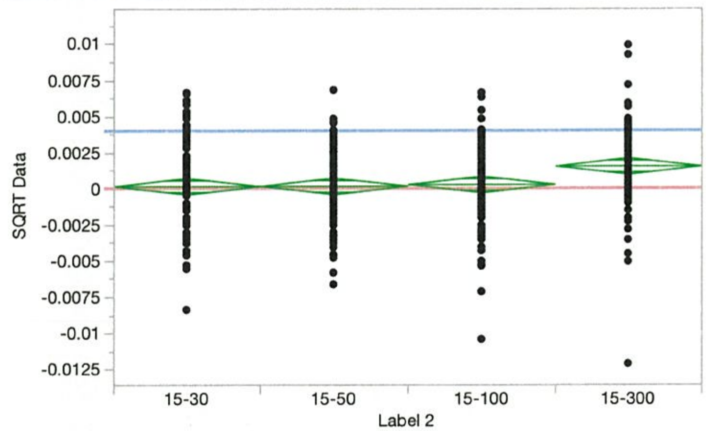
Figure 1-2:
Data Statisical Analysis

1. The differences between results from the 15-foot tubing length and each of the other lengths were found.
2. An Analysis of Variance (ANOVA) was performed for each set of differences. This is shown in the Figure.
3. The height of each green diamond shows the 95% confidence interval for the average of each set of differences.
4. The red line is zero difference. The blue line is the approximate real-world precision of the Shortridge instrument as measured by this study.
5. For the 30-foot, 50-foot, and 100-foot tubing lengths, the results are indistinguishable from the 15-foot length.
6. For the 300-foot length, the difference is measurable but is less than the precision of the instrument. Therefore, the difference is not significant.

Oneway Analysis of SQRT Data By Label 2



Oneway Anova

Summary of Fit

Rsquare	0.039336
Adj Rsquare	0.032059
Root Mean Square Error	0.002874
Mean of Response	0.000541
Observations (or Sum Wgts)	400

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Label 2	3	0.00013390	0.000045	5.4050	0.0012*
Error	396	0.00327018	8.258e-6		
C. Total	399	0.00340408			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
15-30	100	0.000165	0.00029	-0.0004	0.00073
15-50	100	0.000176	0.00029	-0.0004	0.00074
15-100	100	0.000284	0.00029	-0.0003	0.00085
15-300	100	0.001540	0.00029	0.00098	0.00211

Std Error uses a pooled estimate of error variance

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

Customer ID: 007814 S/N: M08663
Customer: CLEAN AIR INSTRUMENT RENTAL City: PALATINE State: IL
As-Received Model #: ADM-860C Converted to Model #: Order #: R191507
PO #: Customer Eqpt ID#: Calibration Due Date:

This instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Test accuracy ratio is 4:1 for pressures and temperature. Quality Assurance Program and calibration procedures meet the requirements for ANSI/NCSL Z540-1, ISO 17025, MIL-STD 45662A and manufacturer's specifications. Calibration accuracy is certified when meters are used with properly functioning accessories only. All Uncertainties are expressed in expanded terms (twice the calculated uncertainty). This report shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated. For limitations on use, see Shortridge Instruments, Inc. Instruction Manual for the use of AirData Multimeters. Procedure used: Procedure for Differential Pressure, Absolute Pressure and Temperature Recalibration of AirData Multimeters SIP-CP02 Revision: 30 Dated: 04/04/16

Calibration Technician(s): [signatures] Calibration Date: 05/20/2019
Calibration Approved by: Title: Date: 05/21/2019

AS-Received By: UR	FINAL Test By: ML	Test By:
Date 05-20-2019 Rh 26 %	Date 05/20/19 Rh 28 %	Date Rh %
Ambient Temperature 75 °F	Ambient Temperature 75 °F	Ambient Temperature NA °F
Barometric Pressure 28.25 In Hg	Barometric Pressure 28.21 In Hg	Barometric Pressure In Hg
All within spec (YES) NO NA	All within spec (YES) NO	All within spec YES NO

ABSOLUTE PRESSURE TEST (in Hg)

TEST METER TOLERANCE = ± 2.0 % ± .1 in Hg AS-RECEIVED TEST WITHIN SPEC (YES) NO N/A See Notes

Pressure Standard: Heise #02-R S/N: 41741/42451 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #04-R S/N: 41743/42453 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #06-R S/N: 41742/42452-1 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #08-R S/N: 42186/43328 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #10-R S/N: 42203/43352 As-Rcvd (Test 2) Test 3
Pressure Standard: Heise #12A-R S/N: 45605/48491 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #14-R S/N: 43412/45043-1 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #16-R S/N: 43413/45044 (As-Rcvd) Test 2 Test 3
Pressure Standard: Heise #18-R S/N: 44581/46845 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #20-R S/N: 44582/46847 As-Rcvd Test 2 Test 3

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
14.0	14.00	13.8	-1.43	14.08	14.0	-.57			
28.4	28.25	28.2	-.18	28.21	28.1	-.39		NA	
40.0	40.00	39.9	-.25	40.16	40.1	-.15			

DIFFERENTIAL PRESSURE TEST (in wc)

TEST METER TOLERANCE = ± 2.0 % ± 0.001 in wc AS-RECEIVED TEST WITHIN SPEC (YES) NO N/A See Notes

Pressure Standard: Heise #01-L S/N: 41739/42449 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #01-R S/N: 41739/42446 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #02-L S/N: 41741/42454 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #03A-L S/N: 45570/48461 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #03A-R S/N: 45570/48460 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #04-L S/N: 41743/42456 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #05-L S/N: 41740/42450 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #05-R S/N: 41740/42447 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #06-L S/N: 41742/42455 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #07-L S/N: 42185/42186 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #07-R S/N: 42185/43326 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #08-L S/N: 42186/43329 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #09-L S/N: 42202/43351 As-Rcvd (Test 2) Test 3
Pressure Standard: Heise #09-R S/N: 42202/43350 As-Rcvd (Test 2) Test 3
Pressure Standard: Heise #10-L S/N: 42203/43353 As-Rcvd (Test 2) Test 3
Pressure Standard: Heise #11-L S/N: 43165/44551-1 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #11-R S/N: 43165/44730 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #12A-L S/N: 45605/48490 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #13-L S/N: 43415/45041 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #13-R S/N: 43415/45039 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #14-L S/N: 43412/45045 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #15-L S/N: 43416/45042 (As-Rcvd) Test 2 Test 3
Pressure Standard: Heise #15-R S/N: 43416/45040 (As-Rcvd) Test 2 Test 3
Pressure Standard: Heise #16-L S/N: 43413/45046 (As-Rcvd) Test 2 Test 3
Pressure Standard: Heise #17-L S/N: 44579/46842 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #17-R S/N: 44579/46841 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #18-L S/N: 44581/46846 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #19-L S/N: 44580/46844 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #19-R S/N: 44580/46843 As-Rcvd Test 2 Test 3
Pressure Standard: Heise #20-L S/N: 44582/46848 As-Rcvd Test 2 Test 3

Approx Set Pt	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff	Standard	Test Meter	% Diff
.0500	.0503	.0502	-.20	.0501	.0501	0			
.1250	.1256	.1255	-.08	.1259	.1258	-.08			
.2250	.2252	.2250	-.09	.2258	.2255	-.13			
1.000	1.027	1.028	.10	1.015	1.012	-.30			
2.000	2.050	2.047	-.15	2.015	2.015	0			
3.600	3.621	3.610	-.30	3.613	3.605	-.22		NA	
4.400	4.409	4.419	.23	4.442	4.449	.16			
27.00	27.12	27.17	.18	27.50	27.54	.15			
50.00	50.32	50.28	-.08	50.65	50.56	-.18			
Overange	NA	✓	NA	NA	✓	NA	NA		NA

Shortridge Instruments, Inc.
7855 East Redfield Road Scottsdale, Arizona 85260
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CleanAir
This certification corresponds to CleanAir asset # 205847

AIRDATA MULTIMETER CERTIFICATE OF RECALIBRATION

S/N: M08663
Order #: R191507

LOW VELOCITY CONFIRMATION (FPM)

TEST METER TOLERANCE = ± 3.0% ± 7 FPM   AS-RECEIVED TEST WITHIN SPEC (YES) NO N/A See Notes

Vel Eqv Trans Std: S/N: M02009 As-Rcvd Test 2 Test 3 Vel Eqv Trans Std: S/N: M10840 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M02803 As-Rcvd (Test 2) Test 3 Vel Eqv Trans Std: S/N: M10897 (As-Rcvd) Test 2 Test 3
Vel Eqv Trans Std: S/N: M02903 As-Rcvd Test 2 Test 3 Vel Eqv Trans Std: S/N: M10901 As-Rcvd Test 2 Test 3
Vel Eqv Trans Std: S/N: M10839 As-Rcvd Test 2 Test 3 Vel Eqv Trans Std: S/N: M13492 As-Rcvd Test 2 Test 3

Approx Set Point	Standard	Test Meter	Diff	Standard	Test Meter	Diff	Standard	Test Meter	Diff
100	107	107	0	103	104	1		N/A	
500	526	527	1	503	502	-1			

ADM-880C, ADM-870/870C and ADM-860/860C models are read in AirFoil Mode. ADM-850/850L models are read in Pitot Tube Mode.

TEMPERATURE TEST - AIRDATA MULTIMETER (° F)

TEST METER TOLERANCE = ± 0.2° F   AS-RECEIVED TEST WITHIN SPEC (YES) NO N/A See Notes

RTD Simulator: S/N 249 (As-Rcvd) (Test 2) Test 3 Set Point: (35.6° F) 95° F 154.4° F
RTD Simulator: S/N 250 (As-Rcvd) (Test 2) Test 3 Set Point: 35.6° F (95° F) 154.4° F
RTD Simulator: S/N 253 (As-Rcvd) (Test 2) Test 3 Set Point: 35.6° F 95° F (154.4° F)
RTD Simulator: S/N 254 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 256 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 257 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 292 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 293 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 294 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 313 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 314 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 315 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 316 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 317 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F
RTD Simulator: S/N 318 As-Rcvd Test 2 Test 3 Set Point: 35.6° F 95° F 154.4° F

RTD Simulator Temperature Equivalent Set Point	Test Meter	Difference	Test Meter	Difference	Test Meter	Difference
35.60	35.6	0	35.6	0		
95.00	94.8	-.2	94.8	-.2	N/A	
154.40	154.4	0	154.4	0		

NOTES:

The enclosed ADM Calibration Standards for Pressure and Temperature form(s) is/are an integral part of this calibration and must remain with this Certificate of Calibration. Note: There may be more than one such form included that pertains to this calibration.

CleanAir
This certification corresponds to CleanAir asset # 205847

Shortridge Instruments, Inc.
7855 East Redfield Road Scottsdale, Arizona 85260
(480) 991-6744 • Fax (480) 443-1267 • www.shortridge.com

Order Number: R191507 Serial Number: M08663 Test Type: Initial (As-Received) (Final)

ABSOLUTE PRESSURE STANDARDS

ADM #02-R	S/N: 41741/42451	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 04/30/19	Due Date: 04/2020
ADM #04-R	S/N: 41743/42453	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/28/18	Due Date: 11/2019
ADM #06-R	S/N: 41742/42452-1	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/10/18	Due Date: 08/2019
ADM #08-R	S/N: 42186/43328	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/22/19	Due Date: 03/2020
ADM #10-R	S/N: 42203/43352	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/21/19	Due Date: 01/2020
ADM #12A-R	S/N: 45605/48491	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 07/31/18	Due Date: 07/2019
ADM #14-R	S/N: 43412/45043-1	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/28/18	Due Date: 09/2019
ADM #16-R	S/N: 43413/45044	Heise Model: PPM-2	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/20/19	Due Date: 02/2020
ADM #18-R	S/N: 44581/46845	Heise Model: PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/08/18	Due Date: 05/2019
ADM #20-R	S/N: 44582/46847	Heise Model: PPM-2	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 06/08/18	Due Date: 06/2019

#02-R, 04-R, 06-R, 08-R, 10-R, 12A-R, 14-R, 16-R Rated Accuracy: 0.05% fs (0.0305 in Hg) Range: 0-30 psia Resolution: 0.01 Uncertainty: < 0.0358

#18-R, 20-R Rated Accuracy: 0.05% fs (0.0305 in Hg) Range: 0-60 in Hg Resolution: 0.001 Uncertainty: < 0.0358

DIFFERENTIAL PRESSURE STANDARDS

ADM #01-L	S/N: 41739/42449	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 05/01/19	Due Date: 04/2020
ADM #01-R	S/N: 41739/42446	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 05/01/19	Due Date: 04/2020
ADM #02-L	S/N: 41741/42454	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 05/01/19	Due Date: 04/2020
ADM #03A-L	S/N: 45570/48461	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/28/18	Due Date: 11/2019
ADM #03A-R	S/N: 45570/48460	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/28/18	Due Date: 11/2019
ADM #04-L	S/N: 41743/42456	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 11/28/18	Due Date: 11/2019
ADM #05-L	S/N: 41740/42450	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/07/18	Due Date: 08/2019
ADM #05-R	S/N: 41740/42447	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/13/18	Due Date: 08/2019
ADM #06-L	S/N: 41742/42455	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 09/07/18	Due Date: 08/2019
ADM #07-L	S/N: 42185/42186	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/26/19	Due Date: 03/2020
ADM #07-R	S/N: 42185/43326	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/26/19	Due Date: 03/2020
ADM #08-L	S/N: 42186/43329	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 03/25/19	Due Date: 03/2020
ADM #09-L	S/N: 42202/43351	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/23/19	Due Date: 01/2020
ADM #09-R	S/N: 42202/43350	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/23/19	Due Date: 01/2020
ADM #10-L	S/N: 42203/43353	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 01/23/19	Due Date: 01/2020
ADM #11-L	S/N: 43165/44551-1	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/07/18	Due Date: 07/2019
ADM #11-R	S/N: 43165/44730	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 08/08/18	Due Date: 07/2019
ADM #12A-L	S/N: 45605/48490	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 07/30/18	Due Date: 07/2019
ADM #13-L	S/N: 43415/45041	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 10/03/18	Due Date: 09/2019
ADM #13-R	S/N: 43415/45039	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 10/04/18	Due Date: 09/2019
ADM #14-L	S/N: 43412/45045	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 10/02/18	Due Date: 09/2019
ADM #15-L	S/N: 43416/45042	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/22/19	Due Date: 02/2020
ADM #15-R	S/N: 43416/45040	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/22/19	Due Date: 02/2020
ADM #16-L	S/N: 43413/45046	Heise Model: PPM-1	Mfgd by Dresser Industries	Calibrated by Ashcroft	Calibration Date: 02/21/19	Due Date: 02/2020
ADM #17-L	S/N: 44579/46842	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/10/18	Due Date: 05/2019
ADM #17-R	S/N: 44579/46841	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/11/18	Due Date: 05/2019
ADM #18-L	S/N: 44581/46846	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 05/09/18	Due Date: 05/2019
ADM #19-L	S/N: 44580/46844	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 06/15/18	Due Date: 06/2019
ADM #19-R	S/N: 44580/46843	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 06/18/18	Due Date: 06/2019
ADM #20-L	S/N: 44582/46848	Heise Model: PPM-1	Mfgd & Calibrated by Ashcroft, Inc.		Calibration Date: 06/15/18	Due Date: 06/2019

#01-L, 03A-L, 05-L, 07-L, 09-L, 11-L, 13-L, 15-L, 17-L, 19-L Rated Accuracy: > 0.07% fs (0.000175 in wc) Range: 0.0-0.25 in wc Res.: 0.00001 Uncertainty: < 0.00035

#01-R, 03A-R, 05-R, 07-R, 09-R, 11-R, 13-R, 15-R, 17-R, 19-R Rated Accuracy: > 0.06% fs (0.003 in wc) Range: 0.0-5.0 in wc Res.: 0.0001 Uncertainty: < 0.00346

#02-L, 04-L, 06-L, 08-L, 10-L, 12A-L, 14-L, 16-L, 18-L, 20-L Rated Accuracy: > 0.06% fs (0.03 in wc) Range: 0.0-50.0 in wc Res.: 0.001 Uncertainty: < 0.0346

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Shortridge Instruments, Inc.
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Shortridge Instruments, Inc. AirData Multimeter Calibration Equipment

Customer Order Number, Meter Serial Number, and Test Type are referenced on page 1

LOW VELOCITY EQUIVALENT CONFIRMATION STANDARDS

Vel Eqv Transfer Standard S/N: M02009	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/07/18	Due Date: 12/2019
Vel Eqv Transfer Standard S/N: M02803	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 04/22/19	Due Date: 01/2020
Vel Eqv Transfer Standard S/N: M02903	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/07/18	Due Date: 12/2019
Vel Eqv Transfer Standard S/N: M10839	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/07/18	Due Date: 12/2019
Vel Eqv Transfer Standard S/N: M10840	Model ADM-870C	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/07/18	Due Date: 12/2019
Vel Eqv Transfer Standard S/N: M10897	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 01/17/19	Due Date: 01/2020
Vel Eqv Transfer Standard S/N: M10901	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 12/07/18	Due Date: 12/2019
Vel Eqv Transfer Standard S/N: M13492	Model ADM-870C	Mfg'd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 08/15/18	Due Date: 08/2019

Rated Accuracy: Velocity ± 1.5 % ± 3.5 fpm   Range: 100-5000 fpm   Resolution: 0.1   Uncertainty: <5.00 fpm at 100 fpm; <7.50 fpm at 500 fpm

TEMPERATURE STANDARDS

RTD Simulator S/N: 249	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/16	Due Date: 03/2020
RTD Simulator S/N: 250	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/16	Due Date: 03/2020
RTD Simulator S/N: 253	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/16	Due Date: 03/2020
RTD Simulator S/N: 254	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/07/16	Due Date: 04/2020
RTD Simulator S/N: 256	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/07/16	Due Date: 04/2020
RTD Simulator S/N: 257	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/07/16	Due Date: 04/2020
RTD Simulator S/N: 292	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 12/21/15	Due Date: 12/2019
RTD Simulator S/N: 293	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 12/21/15	Due Date: 12/2019
RTD Simulator S/N: 294	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 12/21/15	Due Date: 12/2019
RTD Simulator S/N: 313	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/18	Due Date: 03/2022
RTD Simulator S/N: 314	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/18	Due Date: 03/2022
RTD Simulator S/N: 315	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 03/16/18	Due Date: 03/2022
RTD Simulator S/N: 316	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/16/18	Due Date: 04/2022
RTD Simulator S/N: 317	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/16/18	Due Date: 04/2022
RTD Simulator S/N: 318	Model RTD-1000/500	Mfgd by General Resistance	Calibrated by IET Labs	Calibration Date: 04/16/18	Due Date: 04/2022

Rated Accuracy: 0.025% of setting   Range: 100.00 Ω to 11111.10 Ω   Resolution: 0.01 Ω   Uncertainty: ≤ 32 ppm

Thermometer #1 S/N 8A089/Thermistor S/N A410660	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 08/16/17	Due Date: 08/2019
Thermometer #2 S/N 8B104/Thermistor S/N 871507	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 11/07/18	Due Date: 10/2020
Thermometer #5 S/N B11780/Thermistor S/N B10505	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 03/07/19	Due Date: 03/2021
Thermometer #6 S/N B11782/Thermistor S/N B10509	Model 1504/5610	Mfgd by Hart Scientific	Calibrated by Fluke	Calibration Date: 02/20/18	Due Date: 02/2020
Thermometer #7 S/N B49938/Thermistor S/N B482202	Model 1504/5610	Mfgd and Calibrated by Fluke		Calibration Date: 09/26/17	Due Date: 09/2019

Rated Accuracy(combined): 0.0324° F   Range: 32° F to 176° F   Resolution: 0.001° F   Combined Uncertainty with Baths: ≤ 0.040° F

Temp Transfer Standard S/N M00136	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 10/04/18	Due Date: 10/2019
Temp Transfer Standard S/N M96100	Model ADM-870	Mfgd & Calibrated by Shortridge Instruments, Inc.	Calibration Date: 03/07/19	Due Date: 03/2020

Rated Accuracy: 0.03° F   Range: 33° F to 158° F   Resolution: 0.01° F   Uncertainty: < 0.023° F

Total combined Uncertainty for MultiTemp and TemProbe testing : ≤ 0.046° F

This form must remain with the Certificate of Calibration corresponding to the Customer Order Number and Meter Serial Number referenced on page 1.

CleanAir®
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CleanAir

SPEC SHEET

Oemga HHF142B-V Vane Anemometer

Rental and Application Notes

- Shipping Weight: ~ 10 lbs.
- High-quality instrument providing accurate air velocity and volume flow measurements
- Automatically calculates the volume flow rate from the duct
- The duct size is automatically stored in memory on turn-off and up to 10 unique duct sizes can be stored and recalled for frequent use.
- Optional umbilical extention and support rods are available uppon request

	Specifications
Weight	2lbs
Dimensions	16.5" x 3.25" x 1.5"
Power	3 "AA" alkaline batteries
Range	0.2 to 40.00 MPS (40 to 7800FPM)
Accuracy	+/- 1% of reading / + 1 Digita
Outputs	0 - 5 V analog signal
Operating Temperature	0° C to 50° C (32° F to 122° F) Probe: -20° C to 100° C (-4° F to 212° F)
Probe Diammeter	2.75"
Battery	NiMH rechargeable pack 4.8V max
Display	0.5" LCD, 4 -digits

Tektronix®

Certificate of Calibration

15256195

Instrument Identification

Company ID: 77065
CLEAN AIR INSTRUMENT RENTALS
GARY ZAPEL
500 WEST WOOD ST.
PALATINE, IL 60067

PO Number: 65675 70 65800

Instrument ID: **208871**
Manufacturer: OMEGA
Description: VANE ANEMOMETER

Model Number: HHF142
Serial Number: 1017702

Accuracy: ±1% of reading, ±1 digit.

Certificate Information

Reason For Service: CALIBRATION
Type of Cal: NORMAL
As Found Condition: IN TOLERANCE
As Left Condition: IN TOLERANCE
Procedure: 33K6-4-1769-1 VELOCITY, TEMP, AND FLOW REV: 9/30/15
Remarks:

Technician: RYAN EDWARDS
Cal Date 03Jan2020
Cal Due Date: 03Jan2021
Interval: 12 MONTHS
Temperature: 23.0 C
Humidity: 34.0 %

Tektronix certifies the performance of the above instrument has been verified using test equipment of known accuracy, which is traceable to the International System of Units (SI), National Metrology Institutes (NIST, NPL, PTB), derived from ratio type measurements, compared to reference materials or recognized consensus standards. The policies and procedures comply with ANSI/NCSL Z540.1-1994.
The quality system complies with ISO9001.

This certificate shall not be reproduced, except in full, without the written consent of Tektronix.

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Approved By: RYAN EDWARDS
Service Representative

Issue Date: 1/3/2020

Calibration Standards

NIST Traceable#	Inst. ID#	Description	Manufacturer	Model	Cal Date	Date Due
14942883	38-1005980	PITOT TUBE AIRFLOW SYSTEM	SYPRIS	AF12319/PX653	16Aug2019	16Feb2021
14330222	38-1018828	TEMP/HUMIDITY PROBE	VAISALA	HMP45A	30Jan2019	30Jan2020
14333248	38-1037024	BAROMETRIC TRANSDUCER	OMEGADYNE	PX02K1-28A5T	31Jan2019	31Jan2020

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Certificate of Calibration

15256195

Calibration Standards

NIST Traceable#	Inst. ID#	Description	Manufacturer	Model	Cal Date	Date Due
14302838	B0023974	DATA ACQUISITION/SWITCH UNIT	AGILENT	34970A	22Jan2019	22Feb2020
15123132	C100008	HIGH ACCURACY PRESSURE TRANSDUCER	MKS INSTRUMENTS	120AD-00001RCU	30Oct2019	30Apr2021
14550342	H058567	DIGITAL PRESSURE GAGE	MENSOR	2101	09Apr2019	09Jun2020

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Product Information

Description

The Bosch BLAZE™ GLM 42 135 Ft. Laser Measure is a fully featured, easy-to-use tool, with a display guide that uses words, letters and icons to walk the user through each measurement process. The easy-to-read backlit color display improves the visibility and usability of the laser measure. It provides real-time length, length, area, volume and indirect measuring functions, and it has a 20-measurement storage capability and addition/subtraction functionality. This tool includes default real-time measurement mode, adjusting the measurement the closer to or further from the target the laser measure is. The digital bubble vial provides a visual reference when measuring horizontal distances. Thanks to its laser precision technology and real-time measurement mode, it takes instant and reliable measurements up to 135 Ft., to size up the job in seconds. It is accurate up to ±1/16 In. And it fits in any pocket for easy access.

- Easy-to-read backlit color display – illuminates numbers in dark areas with resolution, allowing work in low-light conditions
- Default real-time measurement mode – provides accurate measurement that automatically adjusts closer to or farther from the target
- Easy-to-use display guide - walks the user through each measurement process
- Multiple measuring features – includes real-time length, length, area, volume and indirect functions, and addition/subtraction capability

- Memory storage – provides storage for up to 20 measurements
- Accuracy and long-range measuring – provides accuracy up to 1/16 In. and measures up to a 135 Ft. range
- Digital bubble level – provides a visual reference when measuring horizontal distances
- Compact size – fits in any pocket for easy access

Specifications	
Sub-Brand	BLAZE
Series Name	N/A
Minimum Distance (Feet)	0
Maximum Distance (Feet)	135
Accuracy at Maximum Distance	1/16-in
Backlit Display	Yes
Belt Clip	No
Rechargeable	No
Battery Type	Alkaline
Batteries Included	Yes
Case Included	Yes
Warranty	2-year
Use Location	Outdoor
Wi-Fi Compatibility	No
Works with iOS	No
App Compatibility	No
UNSPSC	27111800
Works with Android	No
Bluetooth Compatibility	No
Hand Strap Included	Yes

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APPENDIX B: NE EVALUATION DATA SHEETS

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Area of NDO's

	NDO ID	NDO Description	NDO Dimensions		NDO Area (ft^2)
1)	A-1	North end mandoor louver	22" x 22"		3.36
2)	A-2	Ceiling louver	4' x 4'		16.0
3)	B-1	Ceilcote scrubber room drainage	2 x 5" x 1"		0.07
			+ 2 x 8" x 1"	+	0.11
			+ 1 x 9" x 1"	+	0.06
					0.24
4)	B-2	Ceilcote scrubber room wall louver	4' x 4'		16.0
5)	C-1	Dock 16 shipping door with truck	2 x 1" x 10'		1.67
			+ 1 x 4.5" x 9'	+	3.38
					5.05
6)	C-2	Dock 17 shipping door with truck	2 x 1" x 10'		1.67
			+ 1 x 4.5" x 9'	+	3.38
					5.05
				Total NDO Area =	**45.70**

Surface Area of Enclosure

Surface Area Description		Surface Area Dimensions	SA Area (ft^2)
Zone A			
	Floor	(87' x 172') - (4' x 3') - (6' x 12') - (20' x 38')	14120
	Ceiling	(87' x 172') - (4' x 3') - (6' x 12') - (20' x 38')	14120
	North Wall	87' x 24'	2088
	South Wall	87' x 24'	2088
	East Wall	((49' + 3' + 120' - 8.5' - 20') x 24') + (20' x 13.5')	3714
	West Wall	(152' x 24') + (14' x 13.5') + (6' x 13.5')	3918
Zone B			
	Floor	5081' + (120' x 54)	11561
	Ceiling	5081' + (120' x 54)	11561
	North Wall	(41' x 24') + (25' x 24') + (120' x 24')	4464
	South Wall	(43' x 24') + (154' x 24')	4728
	East Wall	(37.5' x 24') + (6.5' x 24')	1056
	West Wall	54' x 24'	1296
Zone C			
	Floor	(195' x 123') + ((22' x 47') + (1/2 x 3' x 47'))	25090
	Ceiling	(195' x 123') + ((22' x 47') + (1/2 x 3' x 47'))	25090
	North Wall	(123' x 24') + (22' x 68')	4448
	South Wall	(123' x 24') + (25' x 68')	4652
	East Wall	195' x 24') + (21' x (28 - 24')) + (26' x (68' - 24'))	5908
	West Wall	195' x 24') + (21' x (28 - 24')) + (26' x (68' - 24')) - (19.5' x 24')	5440

Total Surface Area of Enclosure = 145342

Total Surface Area of Enclosure Minus Total NDO Area = 145296.30

NEAR = 0.031%

3/24/20

NDO Directional Flow Datasheet

Client: Sterigenics
Project No: 14004
Unit: Production ~ Area 1
Method of verification: Dräger Tubes

Facility: Atlanta
Date: 3/24/20
Start Time: 13:00 Stop Time: 14:00
Operator: Kenny Sullivan

Notes: all IN, observations made with smoke tubes

NDO ID	Time/Direction						Notes
C-1	13:00/in	1310/in	1320/in	1330/in	1340/in	1350/in	Dock 16
C-2	1301/in	1311/in	1321/in	1331/in	1341/in	1351/in	Dock 17
B-1	1302/in	1312/in	1322/in	1332/in	1342/in	1352/in	Cenlease Damage
B-2	1303/in	1313/in	1323/in	1333/in	1342/in	1353/in	Cenlease Louver
A-1	1305/in	1314/in	1324/in	1334/in	1344/in	1355/in	Mandoor Louver
A-2	1307/in	1316/in	1326/in	1337/in	1347/in	1357/in	Ceiling Louver
	* All observations were IN						

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DS 204 Directional Flow
EXCL/MR.R0-01/00

QA/QC [signature]
Date 3/24/20

NE Pressure Drop Datasheet

Client: Sterigenics
Project No: 14004
Unit: Production IA-1
Instrument: Shortridge micromanometer
Airdata multimeter ADM-860C

Facility: Atlanta
Date: 3/24/20
Start Time: 1420 Stop Time: 15:40
Operator: Kenny Sullivan

Notes:
tygon
Ref pressure = ~~tube~~ ran outside facility i.e. ambient pressure

NE Area	Time/Δp						Notes
~~Zone A~~ vs 3/24	~~1420~~ 1435	1438	1441	1444	1447		~~Manometer~~
Zone B - corridor	1 -0.0247	1 -0.0294	1 -0.0227	1 -0.0354	1 -0.0391		~~Near Chamber 6~~
	2 -0.0197	2 -0.0220	2 -0.0320	2 -0.0419	2 -0.0375		Transfer corridor
	3 -0.0206	3 -0.0252	3 -0.0310	3 -0.0280	3 -0.0120		
	4 -0.0217	4 -0.0308	4 -0.0255	4 -0.0326	4 -0.0231		
	5 -0.0186	5 -0.0290	5 -0.0380	5 -0.0371	5 -0.0275		
Avg	-0.0211	-0.0270	-0.0304	-0.0360	-0.0278	-0.0284	
~~Zone B corridor~~ vs	1420	1423	1426	1429	1432		vs ~~Transfer~~
Zone A	1 -0.0429	1 -0.0592	1 -0.0341	1 -0.0396	1 -0.0489		~~Corridor~~
	2 -0.0352	2 -0.0558	2 -0.0500	2 -0.0378	2 -0.0510		manometer near
	3 -0.0329	3 -0.0566	3 -0.0459	3 -0.0443	3 -0.0490		Chamber 6
	4 -0.0394	4 -0.0486	4 -0.0476	4 -0.0452	4 -0.0502		
	5 -0.0444	5 -0.0498	5 -0.0479	5 -0.0467	5 -0.0462		
Avg	-0.0390	-0.0540	-0.0451	-0.0427	-0.0492	-0.0460	
Zone B - Coilcote	1450	1453	1456	1459	1502		
	1 -0.0103	1 -0.0334	1 -0.0216	1 -0.0475	1 -0.0086		Coilcote
	2 -0.0067	2 -0.0150	2 -0.0197	2 -0.0078	2 -0.0037		Scrubber
terminus	3 -0.0085	3 -0.0403	3 -0.0114	3 -0.0178	3 -0.0164		Room
just outside	4 -0.0027	4 -0.0158	4 -0.0305	4 -0.0196	4 -0.0061		
drainage NDO	5 -0.0090	5 -0.0122	5 -0.0145	3 -0.0068	5 -0.0032		
Avg	-0.0078	-0.0173	-0.0195	-0.0200	-0.0078	-0.0145	
		→					
		Terminus out the Monitor					

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DS 204 Pressure Drop
EXCL/MR.R0-01/00

QA/QC
Date 3/24/20

NE Pressure Drop Datasheet

Client: Sterigenics
Project No: 14004
Unit: Production - IA-1
Instrument: Shortridge Micromanometer

Facility: Atlanta
Date: 3/24/20
Start Time: 14:20 Stop Time: 15:40
Operator: Kenny Sullivan

Notes:

NE Area	Time/Δ p						Notes
Zone C - shipping/aeration room	1507	1510	1513	1516	1519		shipping area near racks
	1 -0.0154	-0.0141	-0.0139	-0.0028	-0.0055		
	2 -0.0076	-0.0213	-0.0093	-0.0046	-0.0106		
	3 -0.0043	-0.0180	-0.0099	-0.0034	-0.0142		
	4 -0.0122	-0.0207	-0.0137	-0.0062	-0.0012		
	5 -0.0113	-0.0149	-0.0156	-0.0069	-0.0116		
Avg	-0.0102	-0.0178	-0.0125	-0.0048	-0.0092	-0.0108	
Zone C - NAT	1525	1528	1531	1534	1537		NAT Sanitizer Room
1	-0.0456	1 -0.0795	1 -0.0364	1 -0.0536	1 -0.0385		
2	-0.0409	2 -0.0570	2 -0.0334	2 -0.0515	2 -0.0362		
3	-0.0386	3 -0.0696	3 -0.0386	3 -0.0447	3 -0.0389		
4	-0.0524	4 -0.0421	4 -0.0573	4 -0.0436	4 -0.0385		
5	-0.0521	5 -0.0554	5 -0.0552	5 -0.0489	5 -0.0498		
Avg	-0.0459	-0.0607	-0.0441	-0.0485	-0.0404	-0.0478	

DS 204 Pressure Drop
EXCL/MR.R0-01/00

QA/QC [signature]
Date 3/24/20

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End of Appendix

APPENDIX C: NDO LOG AND SKETCHES

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NDO Log Datasheet

Client:	Sterigenics	Project No:	14004
Plant:	Atlanta		
Date:	3/24/20		
Initials:	[signature]		

NDO Identification No.	NDO Description/Dimensions	Total Area (ft^2)	Notes
A-1	Mandoor louver behind Chamber #7, 22"x22", zone A	3.36	
A-2	Zone A south side ceiling louver, 4'x4'	16.0	
B-1	Zone B Calcote Scrubber/Room drainage outlet, (see notes)	0.24	area under drape: 2x5"x1", 2x8"x1", 1x9"x1"
B-2	Zone B Calcote Scrubber Room east wall louver, 4'x4'	16.0	
C-1	Zone C Dock 16 shipping door, (see notes)	5.05	area not sealed: 2x1"x10', 1x4.5"x9' (approximately)
C-2	Zone C dock 17 shipping door, (see notes)	5.05	area not sealed: 2x1"x10', 1x4.5"x9'

QA/QC [signature]
Date 3/24/20

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DS 204 NDO Measurement
EXCL/MR.R0-01/00

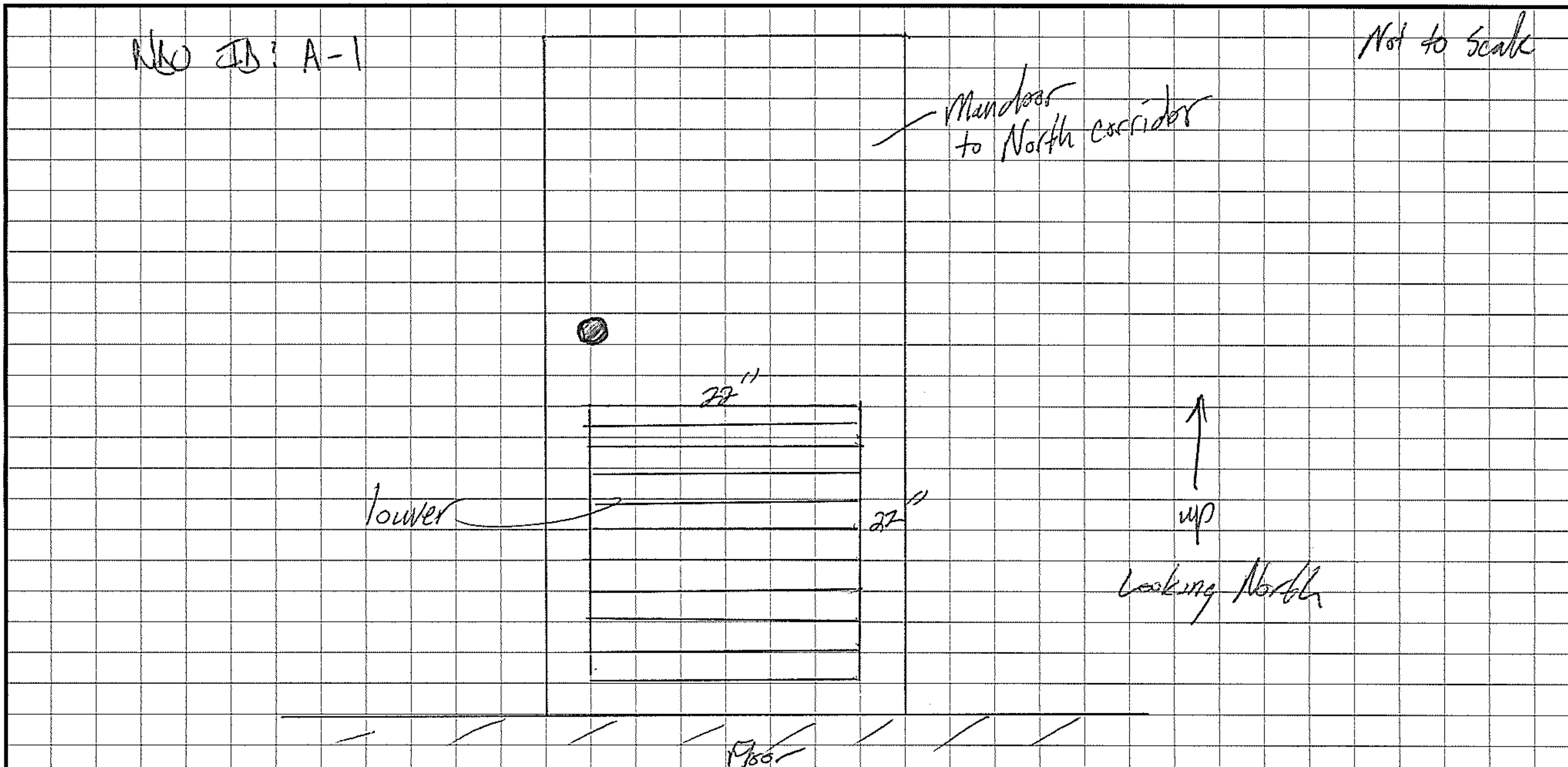
NDO Sketch Datasheet

Location: North Wall Chamber Room Zone A

Client: Sterigenics	Project No: 14004
Plant: Atlanta	Surface Name(s):
Date: 2/19/20	Zone A N wall
Initials	

Notes: NDO A-1, Mandoor Louver 22" x 22"
Located North wall, Zone A, Near chamber #7

Indicate location & NDO Id.



Orientation/Scale:

QA/QC
Date 3/24/20

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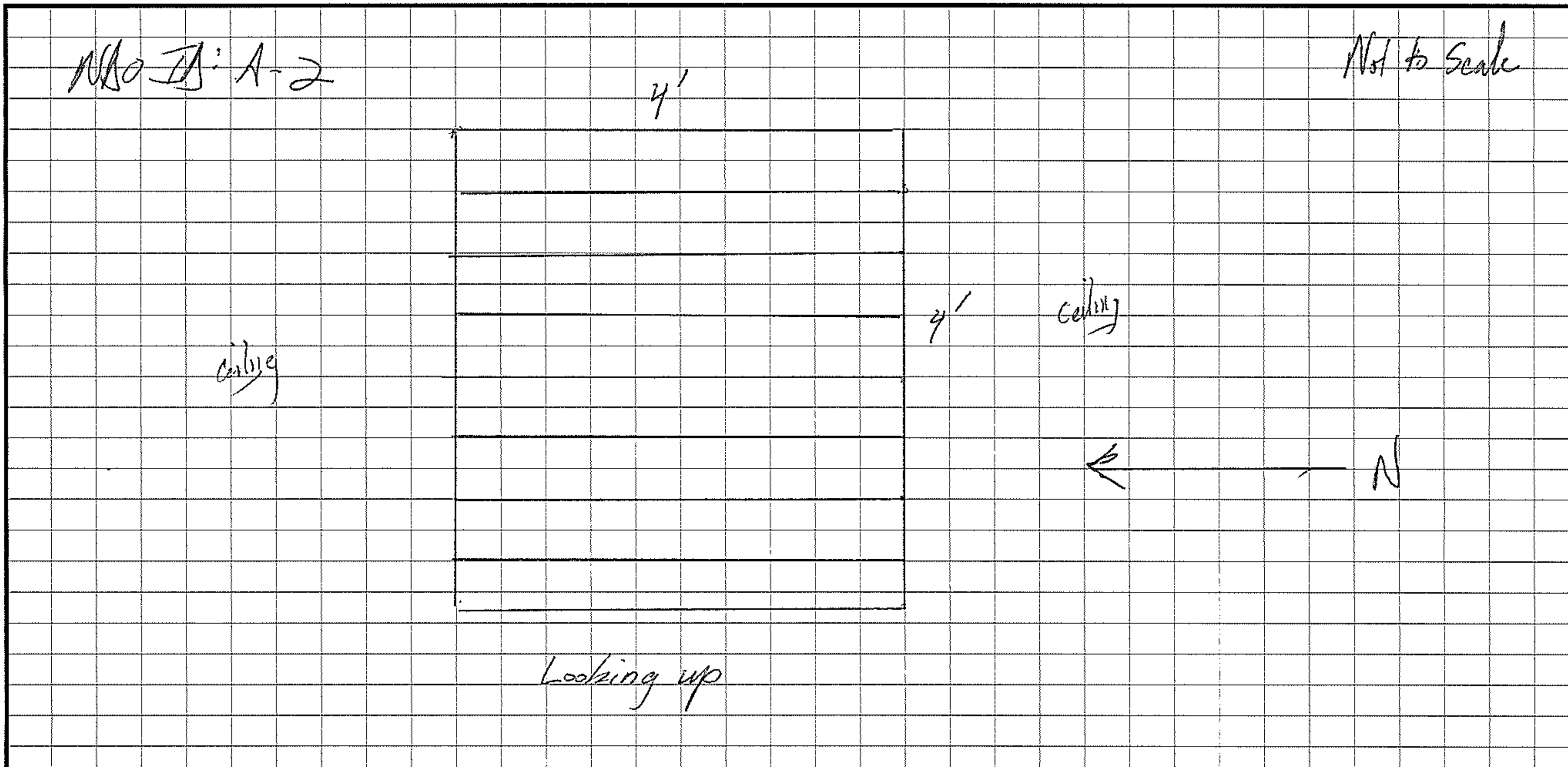
NDO Sketch Datasheet

Location: Zone A Ceiling (SE corner)

Client: Sterigenics	Project No: 14004
Plant: Atlanta	Surface Name(s):
Date: 3/24/20	Zone A, Ceiling
Initials	

Notes: NDO ID A-2
Ceiling Louver 4' x 4', near southeast corner

Indicate location & NDO Id.



Orientation/Scale:

DS 204 NDO Sketch
EXCL/MR.R0-01/00

QA/QC
Date 3/24/17

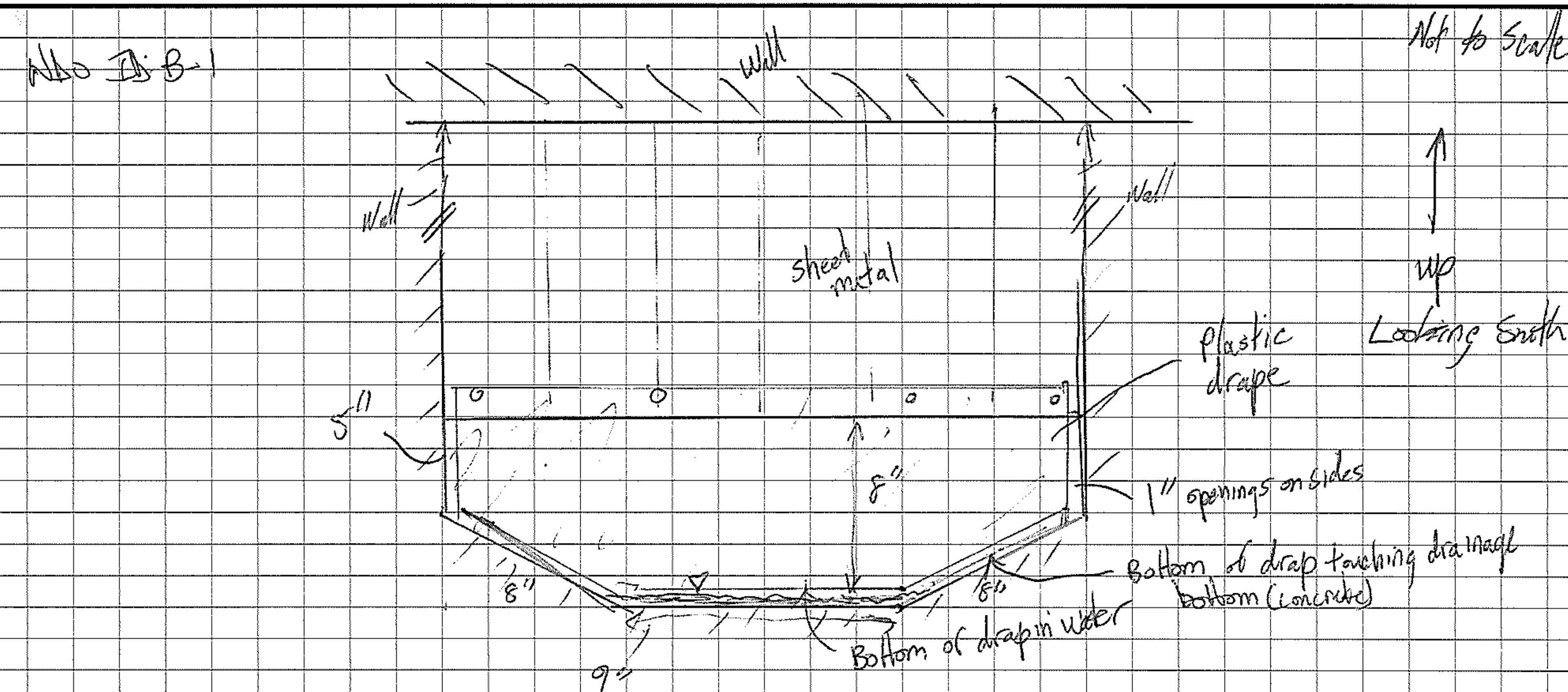
NDO Sketch Datasheet

Location: Zone B Ceilcote Room

Client: Sterigenics	Project No: 14004
Plant: Atlanta	Surface Name(s):
Date: 3/24/20	Zone B, South wall
Initials	Ceilcote Room

Notes: NDO B-1
Ceilcote scrubber Room, South wall, drainage opening

Indicate location & NDO Id.



Orientation/Scale:

DS 204 NDO Sketch
EXCL/MR.R0-01/00

QA/QC
Date

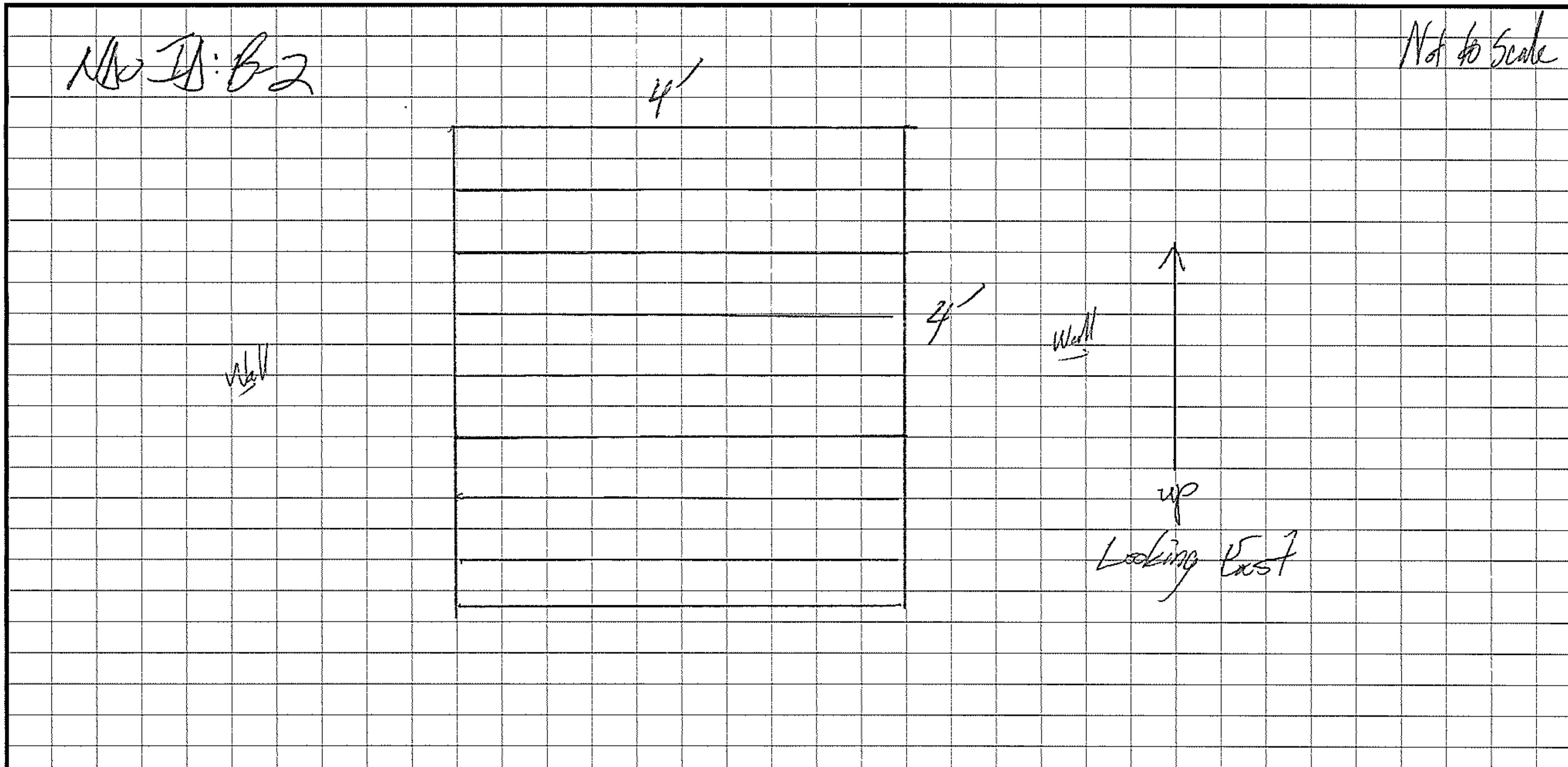
NDO Sketch Datasheet

Location: Zone B Curecake Room

Client: Sterigenics	Project No: 14004
Plant: Atlanta	Surface Name(s):
Date: 3/24/20	East Wall, Curecake
Initials	

Notes: NDO B-2 Wall Louver 4' x 4'

Indicate location & NDO Id.



Orientation/Scale:

DS 204 NDO Sketch
EXCL/MR.R0-01/00

QA/QC
Date 3/24/20

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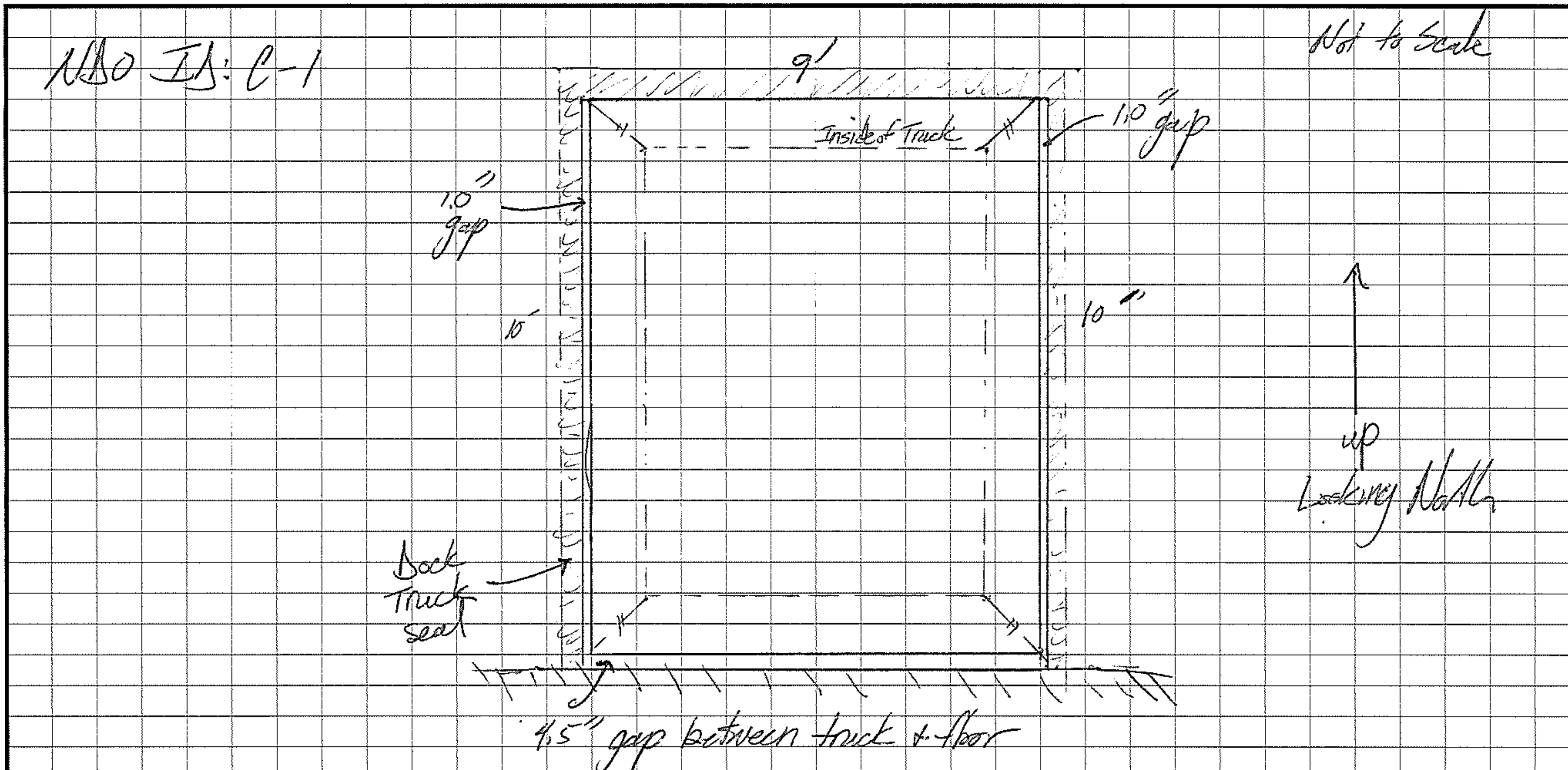
NDO Sketch Datasheet

Location: North Wall Dock 16 Zone C

Client:	Sterigenics	Project No:	14004
Plant:	Atlanta	Surface Name(s):	
Date:	3/24/20	North Wall, zone C	
Initials	[signature]	shipping area	

Notes: NDO C-1 Shipping door @ Dock 16 with truck at Dock
NDO = openings around truck gaps

Indicate location & NDO Id.



Orientation/Scale:

QA/QC [signature]
Date 3/24/20

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DS 204 NDO Sketch
EXCL/MR.R0-01/00

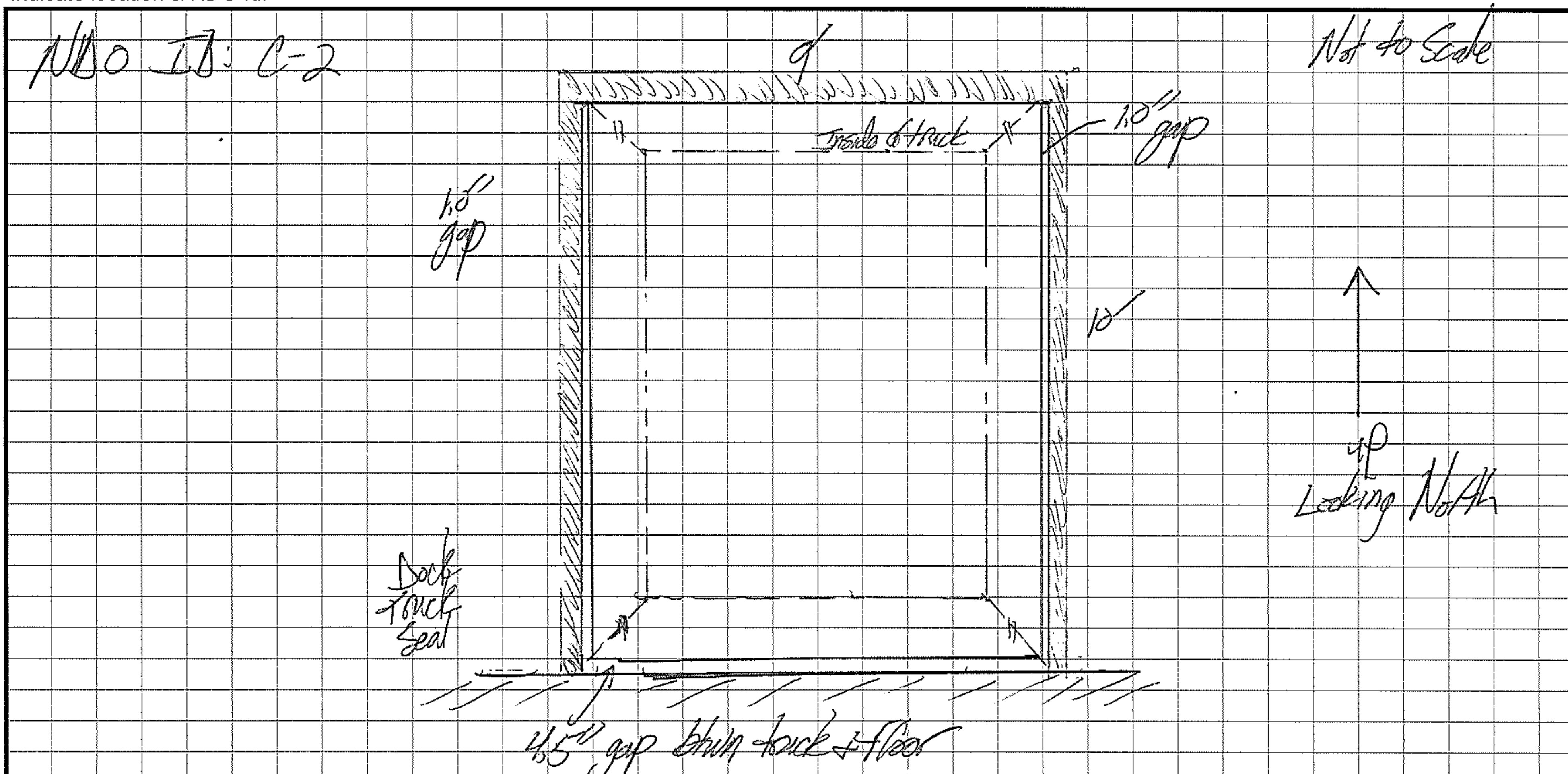
NDO Sketch Datasheet

Location: North Wall Dock 17 Zone C

Client: Sterigenics	Project No: 14004
Plant: Atlanta	Surface Name(s):
Date: 3/24/20	North Wall Zone C
Initials	Shipping Area

Notes: NDO C-2 shipping door @ Dock 17 with truck @ Dock
NDO = openings around truck gaps

Indicate location & NDO Id.



Orientation/Scale:

DS 204 NDO Sketch
EXCL/MR.R0-01/00

QA/QC
Date 3/24/20

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APPENDIX D: NE AREA WALL SKETCHES

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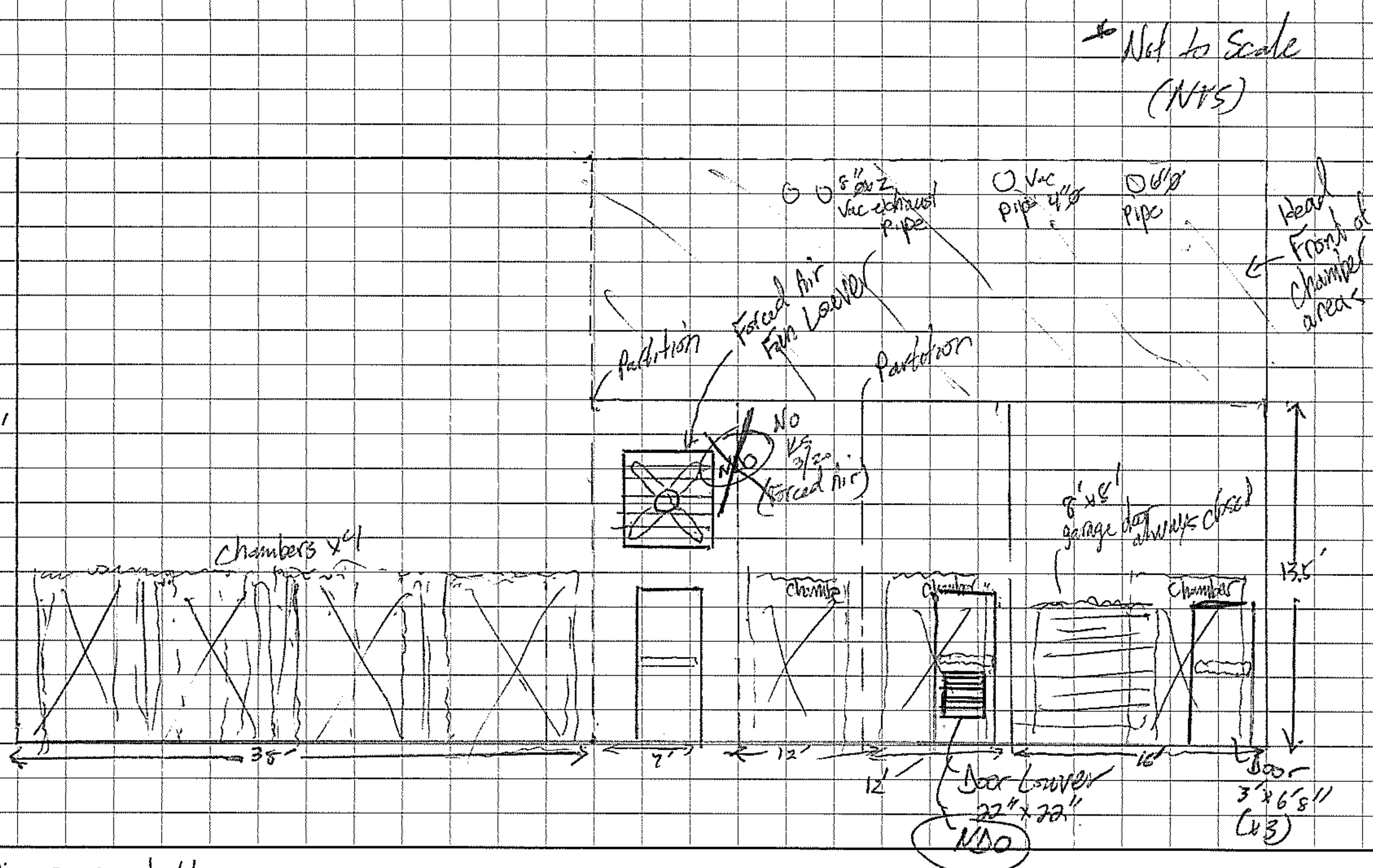
Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: North Wall Chamber Room (Zone A)

Client: Sterigenics	Project No: 14004
Plant: Atlanta	
Date: 2/19/20	
Initials	

Notes: 2 NDO's: Fan ~~Louver~~ + Door Louver
KJS - Not NDO (forced draft)



Orientation/Scale: Facing North

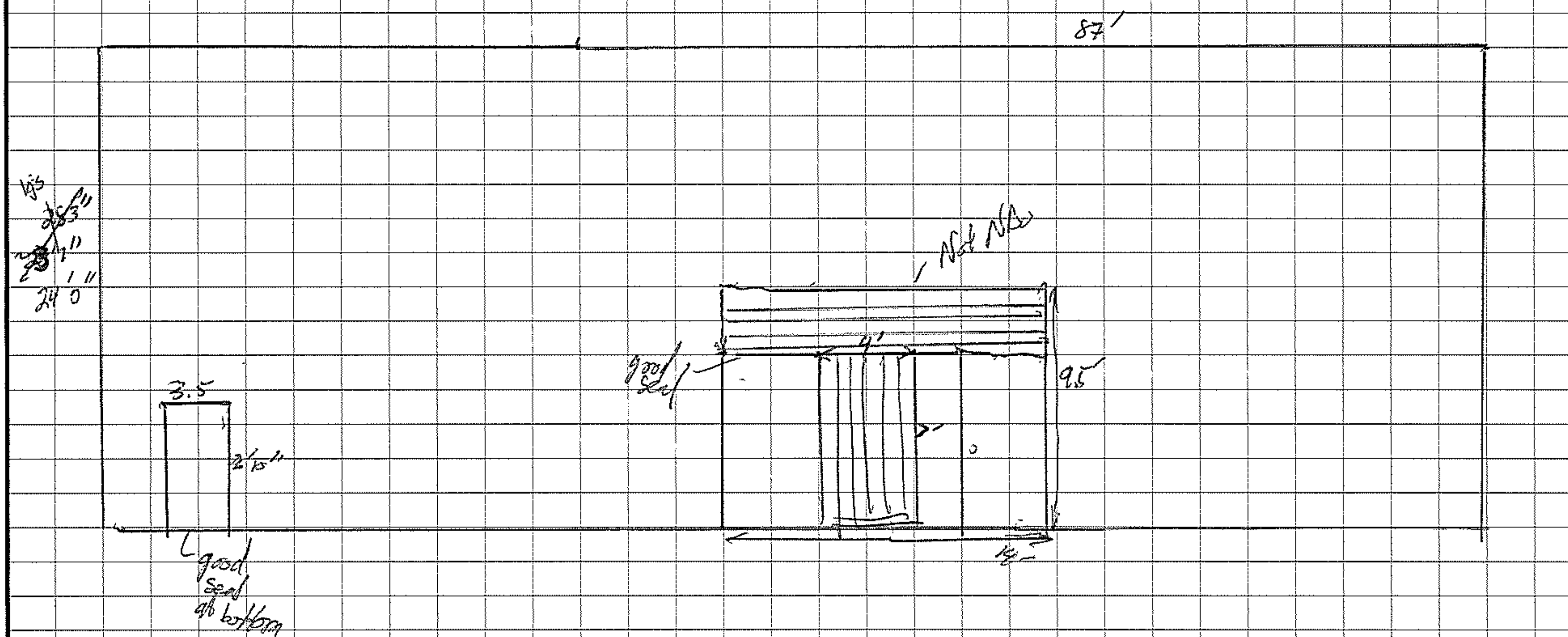
QA/QC
Date 2/19/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: South Wall Chamber Room (Zone A)

Client: Sterigenics	Project No: 14004
Plant: Atlanta	
Date: 2/19/20	
Initials	

Notes:
- Strip curtain used for EO drum transfer (blew in when I opened garage door)
- Garage Door Remains closed when no E.O drum transfer
- other door remains closed
-



Orientation/Scale: Facing South

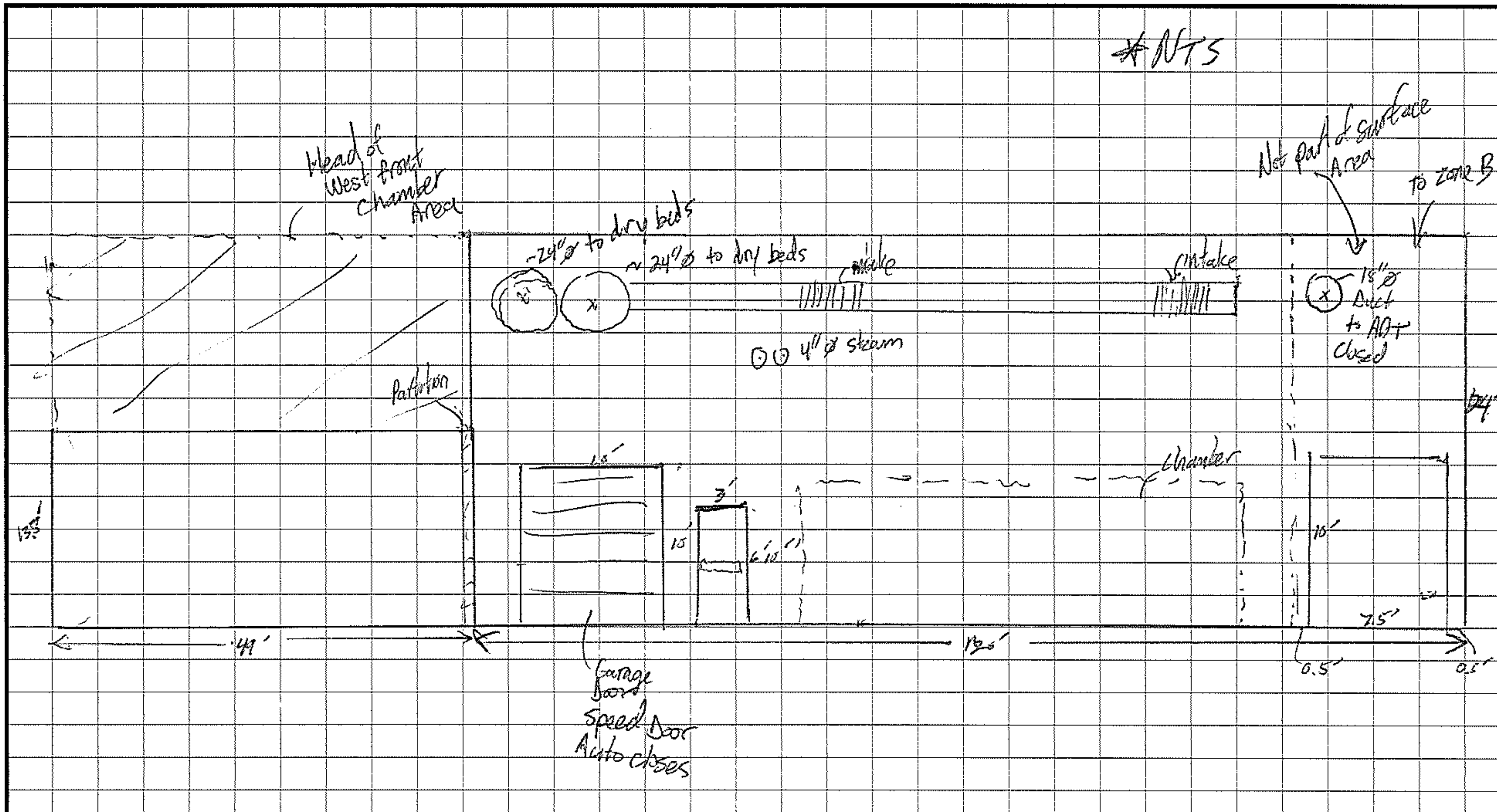
QA/QC
Date 2/17/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: East Wall chamber Room (Zone A)

Client: Sterigenics	Project No:	14004
Plant: Atlanta		
Date: 2/19/20		
Initials		

Notes:
- Right side (south) Not part of Surf. Area for NEAR
- Garage door = Speed door



Orientation/Scale: Facing East

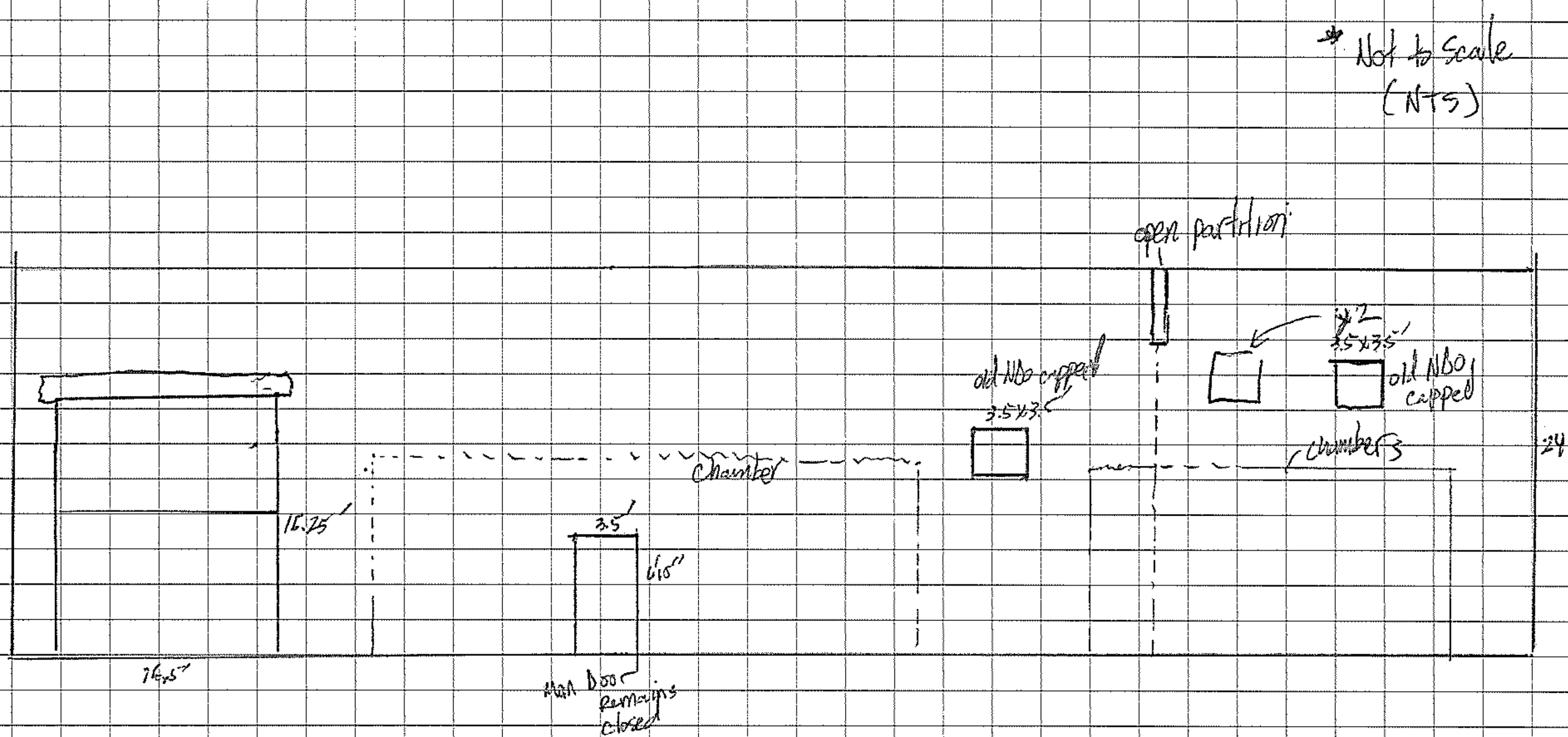
QA/QC
Date 2/19/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: West Wall Chamber Room (Zone A)

Client:	Sterigenics	Project No: 14004
Plant:	Atlanta	
Date:	2/19/20	
Initials	[signature]	

Notes: No NAOs
Garage Door Remains closed (used for adding/removing chambers



Orientation/Scale: Facing West

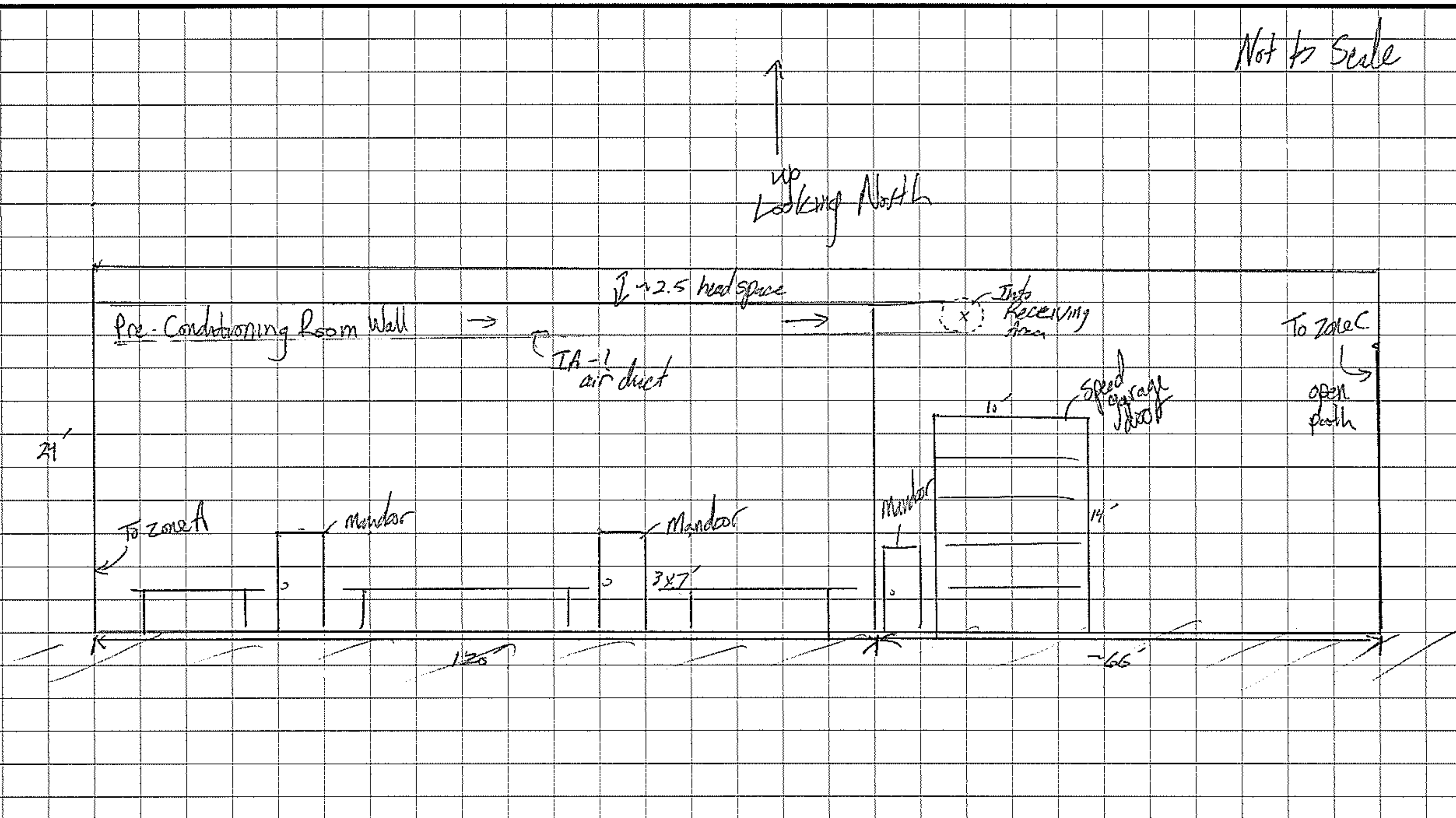
QA/QC [signature]
Date 2/19/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: North Wall Zone B

Client:	Sterigenics	Project No:	14004
Plant:	Atlanta		
Date:	3/24/20		
Initials	[initials]		

Notes: No NAO's



Orientation/Scale: Facing North

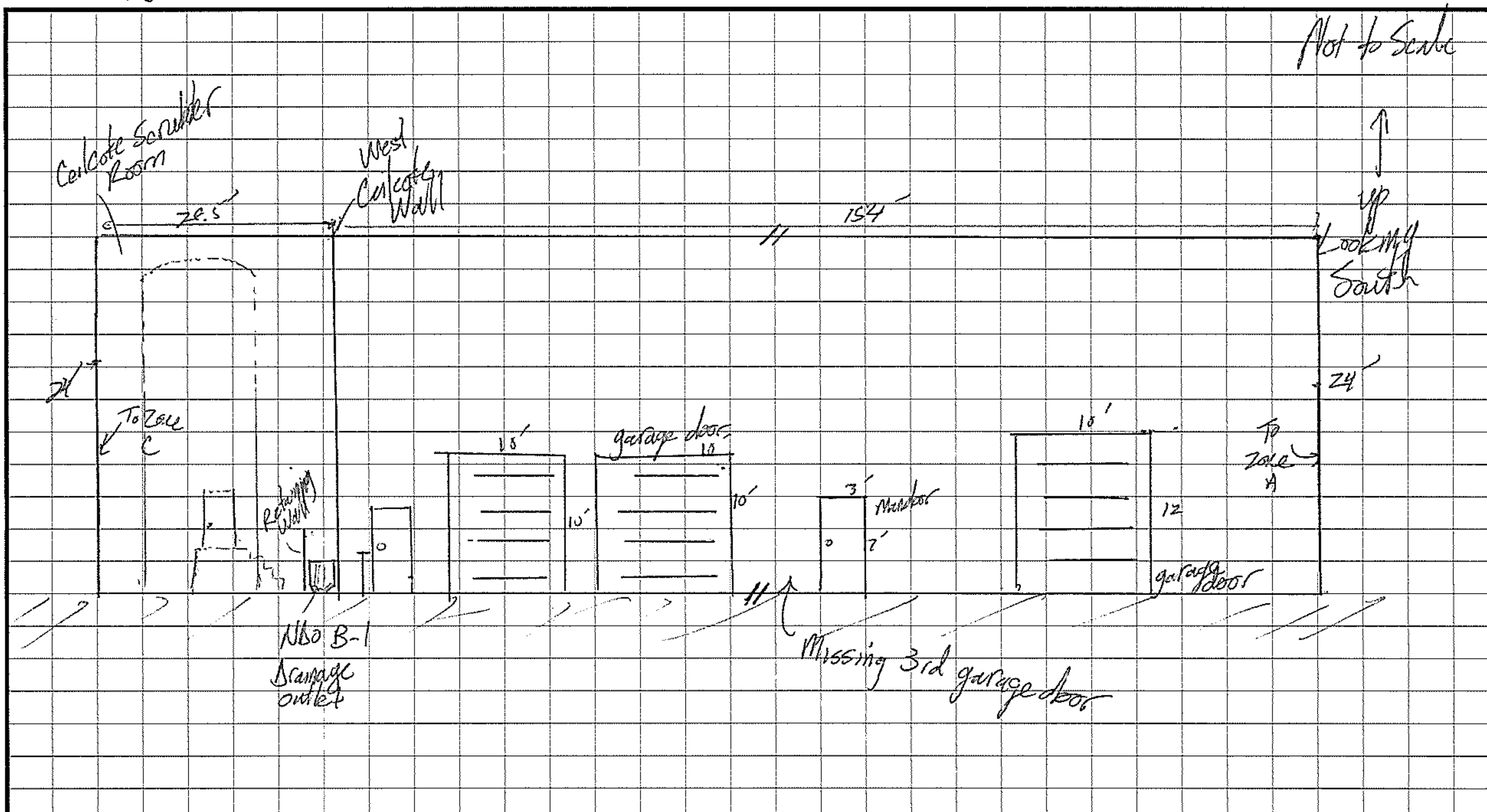
QA/QC [signature]
Date 3/24/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: South Wall Zone B

Client:	Sterigenics	Project No:	14004
Plant:	Atlanta		
Date:	3/24/20		
Initials	[illegible]		

Notes: 2 NBO : Ceilcote Scrubber Room Drainage outlet



Orientation/Scale: Looking South

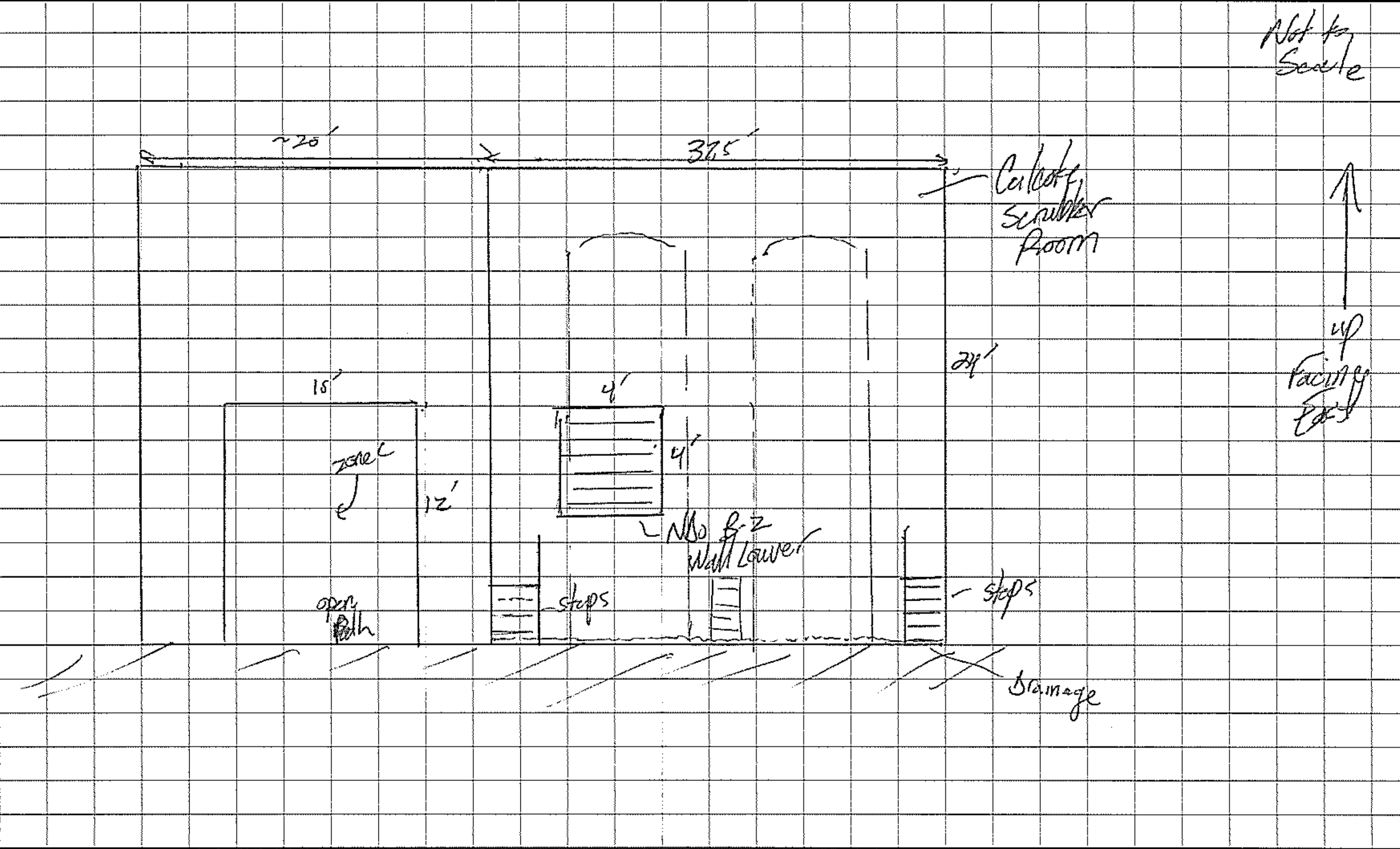
QA/QC [illegible]
Date 3/24/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: East Wall Zone B

Client: Sterigenics	Project No: 14004
Plant: Atlanta	
Date: 3/24/20	
Initials	

Notes: 7 NIO: Celcote Scrubber Wall Louver



Orientation/Scale: Facing East

QA/QC

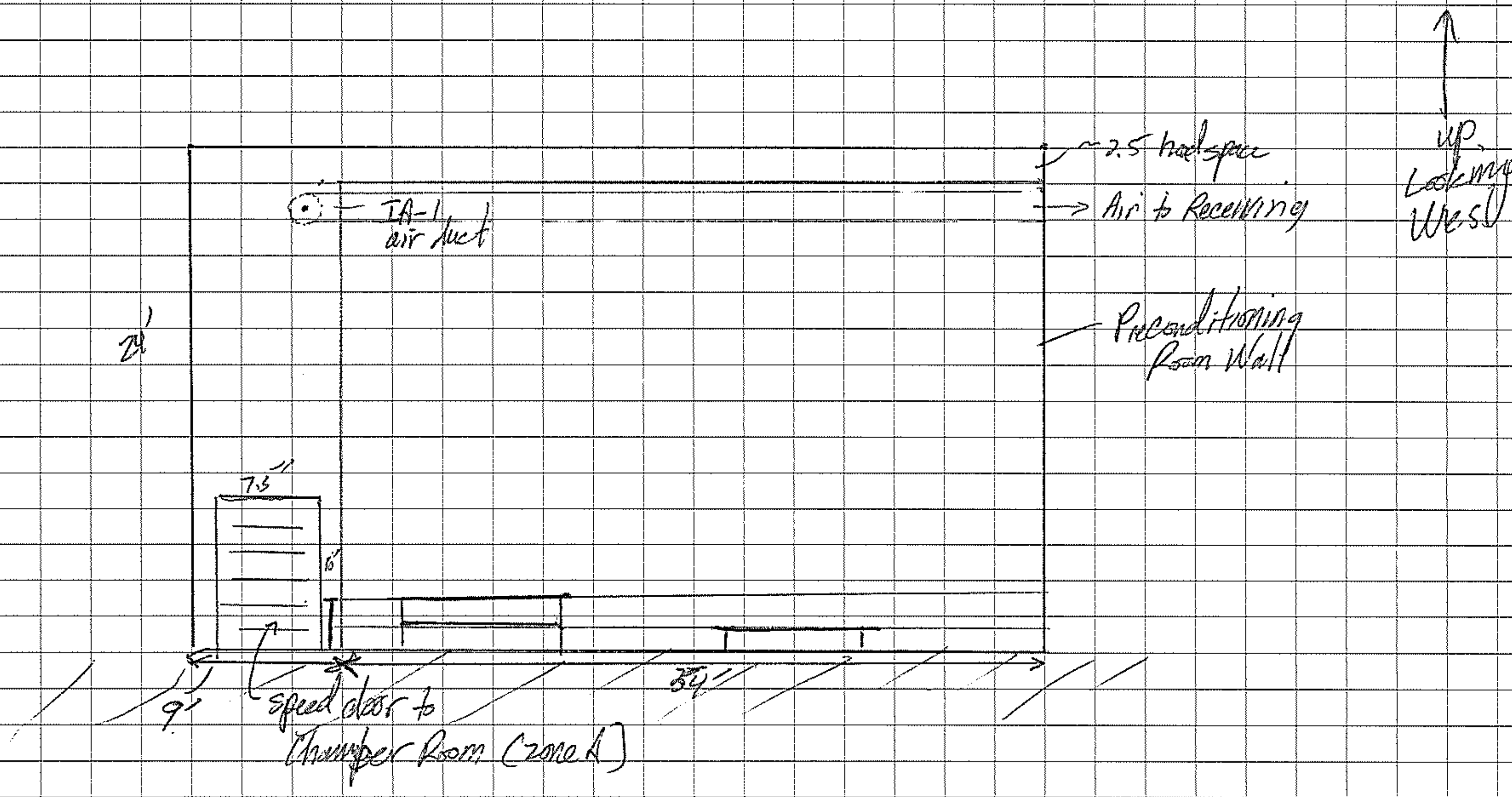
Date 3/24/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: West Wall Zone B

Client:	Sterigenics	Project No:	14004
Plant:	Atlanta		
Date:	3/24/20		
Initials			

Notes: No NAO's



Orientation/Scale: Looking West

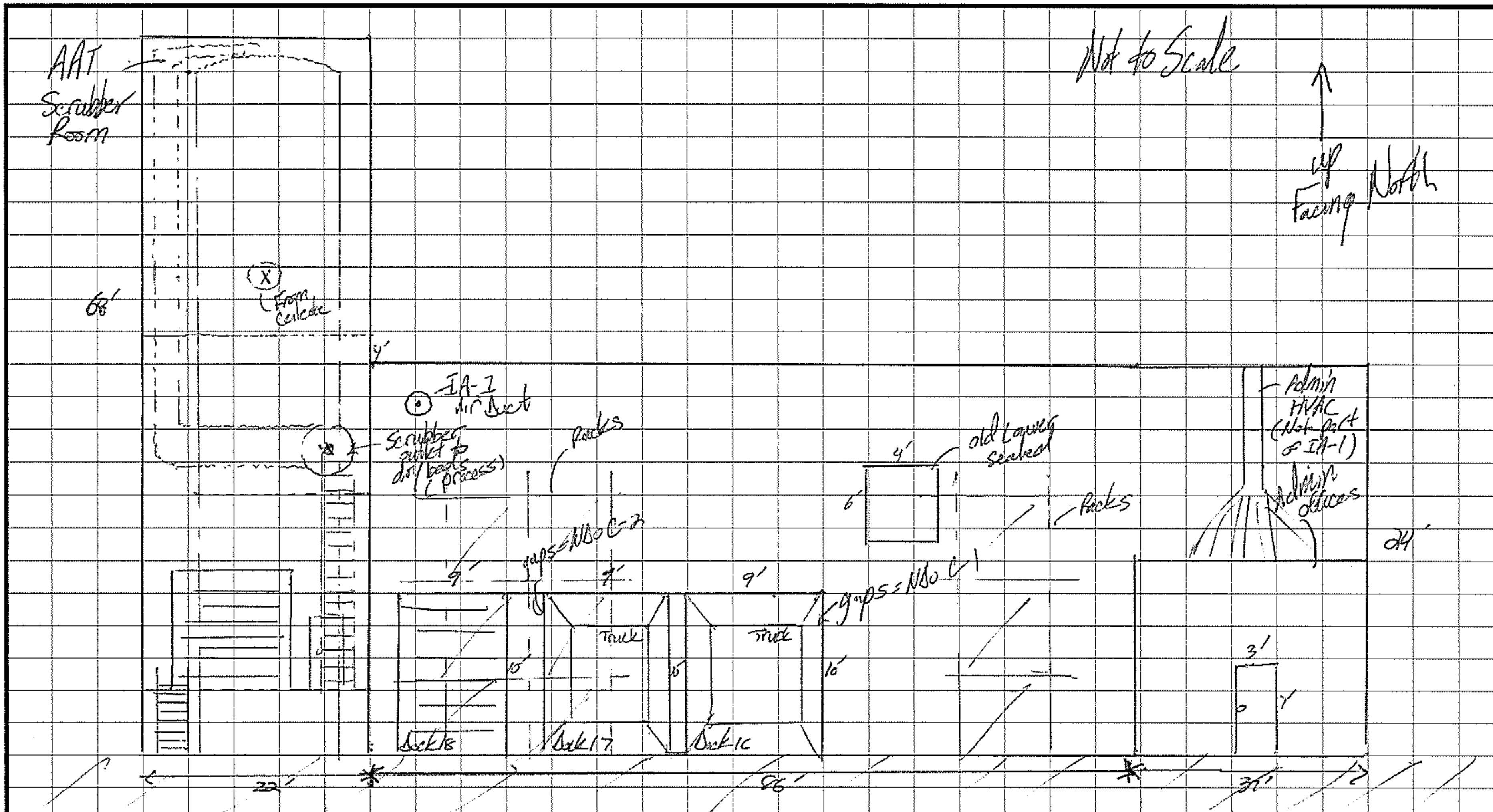
QA/QC
Date 3/24/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: North Wall Zone C (Shipping)

Client:	Sterigenics	Project No:	14004
Plant:	Atlanta		
Date:	3/24/20		
Initials			

Notes: 2 NDO's - Dock 16 + 17 truck seal gaps



Orientation/Scale: Facing North

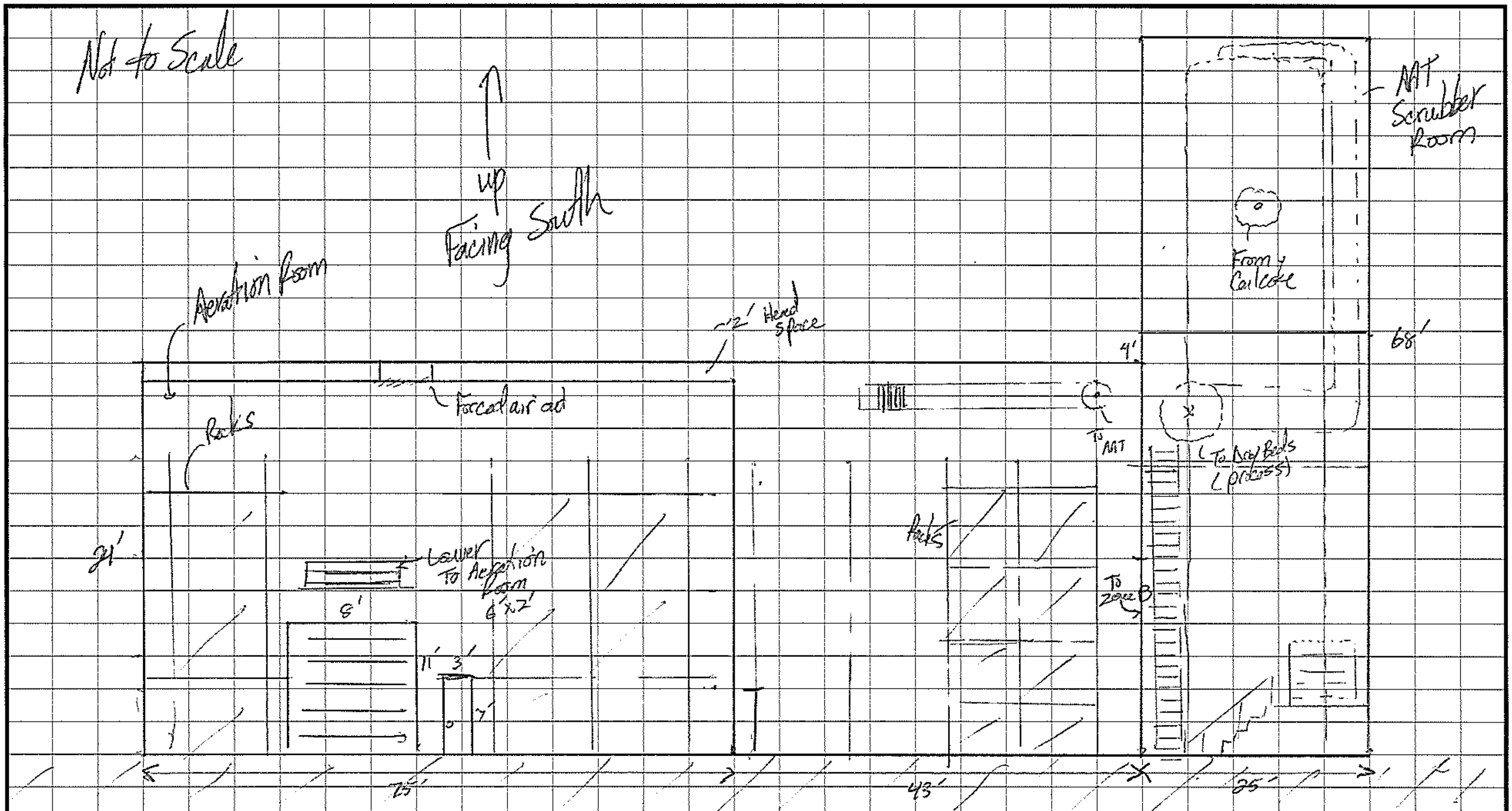
QA/QC
Date 3/24/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: South Wall Zone C

Client: Sterigenics	Project No: 14004
Plant: Atlanta	
Date: 3/24/20	
Initials	

Notes: No NRO's



Orientation/Scale: Facing South

QA/QC

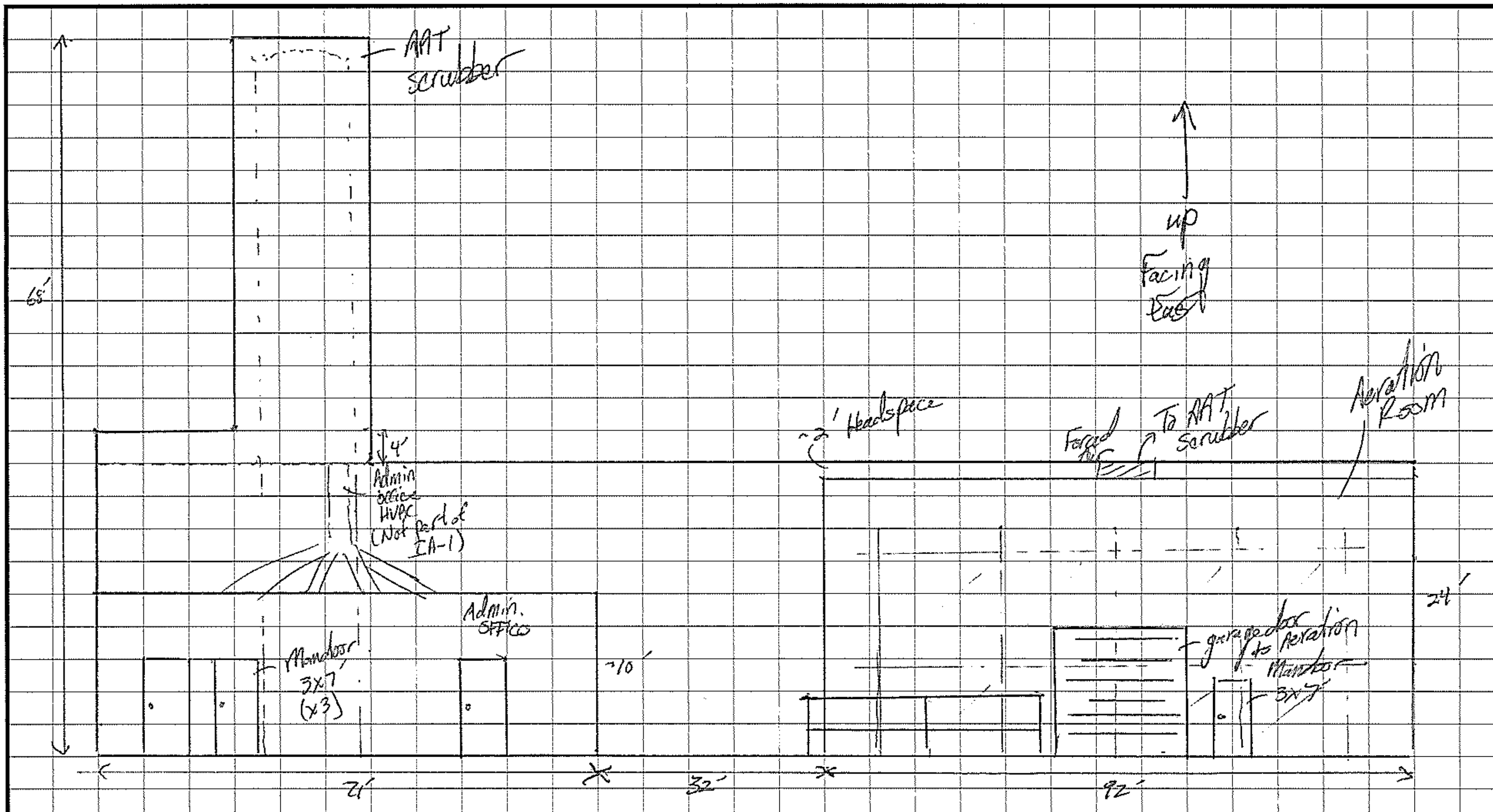
Date 3/24/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: East Wall Zone C

Client: Sterigenics	Project No: 14004
Plant: Atlanta	
Date: 3/24/20	
Initials	

Notes: No NAO's



Orientation/Scale: Facing East

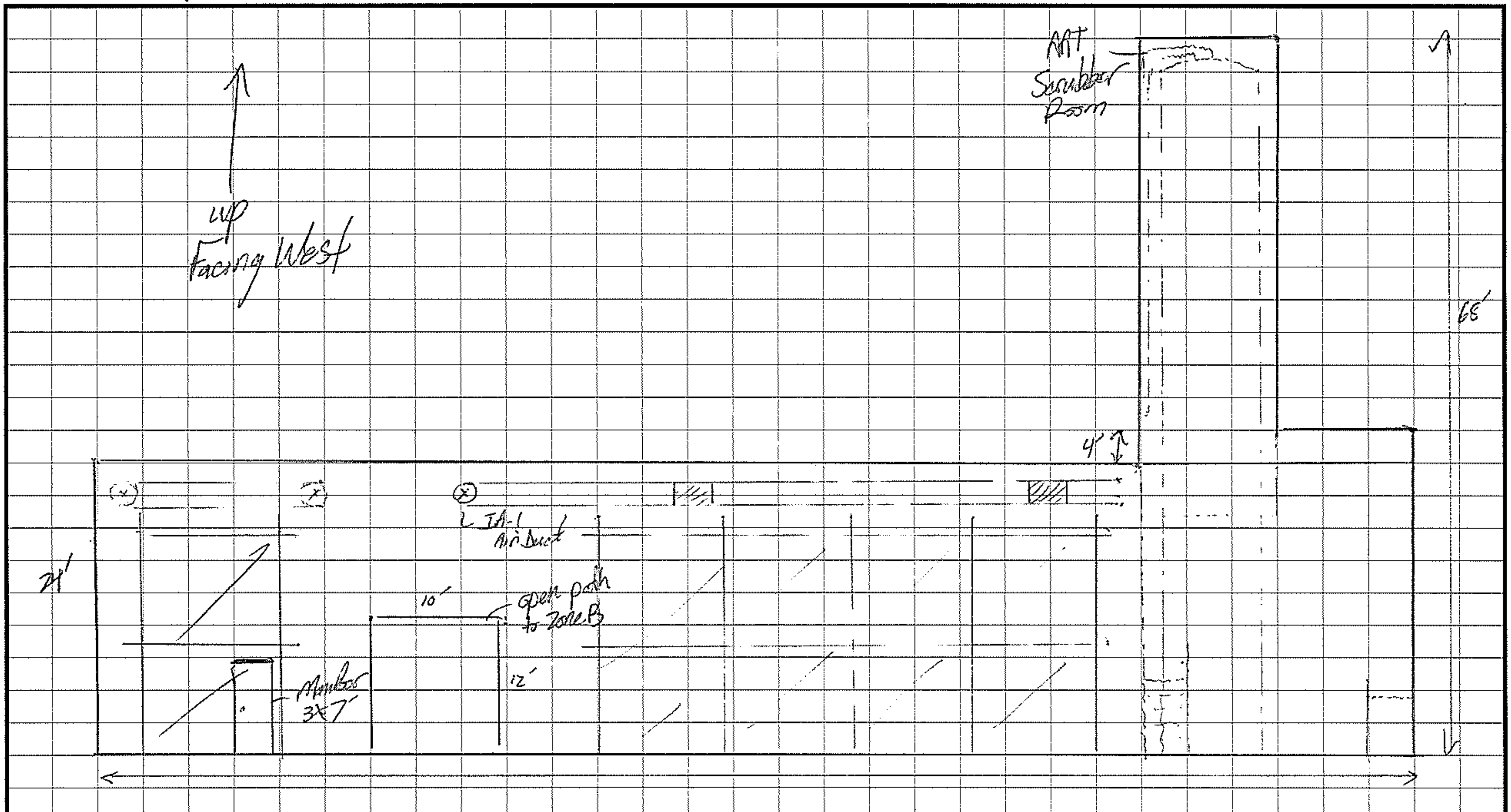
QA/QC
Date 3/24/20

Enclosure Floor/Wall/Ceiling Plan - Sketch Datasheet

Location: West Wall Zone C

Client:	Sterigenics	Project No:	14004
Plant:	Atlanta		
Date:	3/24/20		
Initials			

Notes: No NAO's



Orientation/Scale: Facing West

QA/QC
Date 3/24/20

APPENDIX E: CLEANAIR RESUMES AND CERTIFICATIONS

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CleanAir

Ken Sullivan

Project Manager

Professional Profile

Mr. Sullivan has 10 years of experience in wet method and instrumental testing for engineering, diagnostic, performance guarantee, and compliance purposes. Initially hired as a field technician in 2009, Mr. Sullivan started leading test programs in 2011, and has been project managing since 2014. Mr. Sullivan has been involved with projects utilizing EPA Methods 1 through 29, 201, 201A, 202, 320, Conditional Test Method (CTM) 027, CTM-013, and Other Test Methods (OTM) 027 and OTM-028, from the planning stage to field testing and reporting. In addition, Mr. Sullivan has extensive experience leading Engineers and Field Technicians to execute applicable EPA methods for numerous projects worth hundreds of thousands of dollars to clients. Through his experience, he has attained valuable testing skills, such as setting up and operating continuous emissions monitoring systems (CEMS) for various pollutants, on-site mercury analysis with an Ohio Lumex spectrometer, on-site laboratory analysis for numerous methods, experience in Micro GC (gas chromatography), and in FTIR (Fourier Transform Infrared Spectrometer) analysis.

Mr Sullivan has been responsible for compliance and diagnostic test programs performed in a multitude of states across the country. He has also been responsible for engineering and consulting studies performed in Canada, Netherlands, Spain, and South Africa.

Relevant Experience

Coal Industry; Labadie and Meramec, MO

Led a large field crew in executing various EPA methods, including 30B, 5/202, 29, 26, 3A, 7E, and 10 at multiple locations to determine design variables for retrofitted wet scrubbers. Set-up and operated a CEMS showing real-time NO_X, O_2, CO_2, and CO emissions. Performed on-site mercury analysis with an Ohio Lumex spectrometer in accordance with EPA Method 30B. Assisted in determining the concentration deviation between elemental and oxidized mercury at the stack to establish scrubber performance, carbon injection interference, and other design constraints.

Natural Gas Delivery (Pipeline); Middlebourne, WV

Project managed a test program to determine sources and locations of black powder along various points of the pipeline, by utilizing a personally designed modified EPA Method 17 sampling apparatus. Led field execution, collected samples and recovered sample filters on-site while maintaining communication with the client and several other parties involved to resolve the issue of equipment malfunction and degradation due to the black powder buildup.

Manufacturing Industry; Apeldoorn, Netherlands

Planned, managed, led, and executed this job from start to finish. Ran an FTIR and performed EPA Methods 320 and 25A to provide the client with carbon monoxide, hydrocarbon, and formaldehyde diagnostic data at several key points along the process line. Processed and analyzed a plethora of raw data into utile and interpretable formats and drafted an in-depth report.

Carbon Capture; Cohasset, MN

Project managed a test program designed to determine the input/output chemistry of a non-commercial scale carbon capture system prototype. The test program included measurements for over 20 compounds of interest, utilizing FTIR, GC-FPD, Micro GC, FID, UV, and photometric technologies. Developed extensive analysis that included studies in atom balance, removal, minimum detection limit, and exponential decay.

Coal Industry; Secunda, South Africa

Aided in accumulating dust concentration data and mass loading at various points in the Fluidized Catalytic Cracking Unit (FCCU), utilizing EPA Method 17. Was involved in on-site recovery and particle size analysis, and used a TESTO 350XL to determine effluent gas composition. Also trained a South African testing company how to efficiently and accurately execute methods concerning filterable particulate matter (FPM) collection.

Oil Refining Industry; Detroit, MI

Aided multi-million net-worth client in meeting new emission limits required by a permit issued by the Michigan Department of Environmental Quality (MDEQ) and Sierra Club due to implications of the Detroit Heavy Oil Upgrade Project (DHOUP). Executed several different methods, including EPA Methods 1, 2, 3A, 4, 5/202, 6C, 7E, 25A, 10, and 18, and ASTM Draft CCM, at various locations throughout the Detroit refinery. Managed every test program from planning to reporting.

Professional Certifications & Qualifications

OSHA 10-Hour
NSC CPR/AED Certification
NSC First-Aid Certification

Qualified Source Testing Individual (QSTI) Test Exams (Certificate No. 2012-711):

- Group 1 (Manual Gas Volume and Flow Measurements and Isokinetic Particulate Sampling Methods) – exam passed on 10/22/2015 (certification attached)
- Group 2 (Manual Gaseous Pollutants Source Sampling Methods) – exam passed on 4/28/2016 (certification attached)
- Group 3 (Gaseous Pollutants Source Sampling Methods) – exam passed on 4/27/2016 (certification attached)
- Group 4 (Hazardous Metals Measurement Methods) – exam passed on 6/1/2017 (certification attached)

Qualified Individual (QI)

Field Test Leader	Ohio Lumex (EPA Method 30B Analysis)	EPA Methods 320/321 (Extractive FTIR)	Field Laboratory
Project Manager	Modified EPA Conditional Test Method 013 / Draft ASTM Controlled Condensation Method		

Education

Bachelor of Science in Civil Engineering with a focus in Environmental and Atmospheric Sciences (with honors), 2009
University of Illinois; Urbana-Champaign

Bachelor of Science in Physics, 2006
Elmhurst College; Elmhurst, Illinois

SOURCE EVALUATION SOCIETY

Qualified Source Testing Individual

LET IT BE KNOWN THAT

KENNETH J. SULLIVAN

HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS

ISSUED THIS 22ND DAY OF OCTOBER 2015 AND EFFECTIVE UNTIL OCTOBER 21ST, 2020

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Theresa Lowe, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

CERTIFICATE NO. 2012-711

SOURCE EVALUATION SOCIETY CORPORATE SEAL 1995 NORTH CAROLINA

SOURCE EVALUATION SOCIETY

Qualified Source Testing Individual

LET IT BE KNOWN THAT

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HAS SUCCESSFULLY PASSED A COMPREHENSIVE EXAMINATION AND SATISFIED EXPERIENCE REQUIREMENTS IN ACCORDANCE WITH THE GUIDELINES ISSUED BY THE SES QUALIFIED SOURCE TEST INDIVIDUAL REVIEW BOARD FOR

MANUAL GASEOUS POLLUTANTS SOURCE SAMPLING METHODS

ISSUED THIS 28TH DAY OF APRIL 2016 AND EFFECTIVE UNTIL APRIL 27TH, 2021

Peter R. Westlin, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

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GASEOUS POLLUTANTS INSTRUMENTAL SAMPLING METHODS

ISSUED THIS 27TH DAY OF APRIL 2016 AND EFFECTIVE UNTIL APRIL 26TH, 2021

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Theresa Lowe, QSTI/QSTO Review Board

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HAZARDOUS METALS MEASUREMENT METHODS

ISSUED THIS 1ST DAY OF JUNE 2017 AND EFFECTIVE UNTIL MAY 31ST, 2022

Peter R. Westlin, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

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Bill Ansell

Midwest Engineering Group Technical Leader and Sr. Project Manager

Professional Profile

Mr. Ansell has over 30 years of experience in the environmental field in the areas of air emissions testing and consulting. He was initially hired as a Field Engineer. Since 1988, Mr. Ansell has been involved with projects utilizing EPA, ASTM, NIOSH, ASME methods from the planning stage through field execution and reporting. In addition, Mr. Ansell has extensive process and control device knowledge across a variety of industries including:

- municipal and medical waste combustors;
- petrochemical industries and refineries;
- utility and institutional coal, oil, and natural gas-fired boilers;
- foundries and steel mills;
- simple and combined cycle gas turbines;
- printing and coating facilities;
- automotive assembly plants;
- glass plants;
- food processing facilities;
- ammunition plants; and
- pulp and paper mills, as well as other industrial sources.

Mr. Ansell was responsible for projects performed in 30 states as well as China, South Korea, Puerto Rico, Morocco, and the Bahamas.

Relevant Experience

Automotive Assembly Plant; Mishawaka, IN

Project Manager and Field Test Leader for a VOC capture and destruction efficiency test program conducted on the e-coat, prime, and topcoat paint lines at an automotive assembly plant. Project included verifying that enclosures surrounding paint lines met criteria for permanent and temporary total enclosures per EPA Method 204. VOC emissions from five sources to the control device, as well as fugitive VOC emissions from 16 sources, were determined simultaneously, following EPA Methods 1-4, 25A, and 204B. Tests were conducted with a nine-man test crew

Yeast Production Facility; Memphis, TN

Project Manager and Field Test Leader for annual VOC emission test programs to meet requirements of the facility's Title V Permit and 40 CFR 63, Subpart CCCC - National Emissions Standards for Hazardous Air Pollutants: Manufacturing of Nutritional Yeast. Client monitors brew ethanol concentrations during production instead of installing fermenter exhaust monitors. NESHAP requires testing to develop a brew to exhaust correlation calculation relating the brew ethanol concentration during fermentation to THC emissions concentration as propane. Test programs were conducted over complete production batches, 13 to 31 hours in duration requiring multiple test crews for 24-hour coverage on-site.

Paper Mill; Rhinelander, WI

Project Manager and Field Test Leader for a VOC capture and destruction efficiency test program on a thermal oxidizer system serving a paper coater line. The test program included the construction of a temporary total enclosure (TTE), including a fugitive vent system to prevent VOC concentrations from building up within the enclosure, which surrounded the coater to allow the VOC capture efficiency to be determined and the process to be operated normally.

Project Manager and Field Test Leader for performance and compliance test programs on coal and natural gas-fired boilers, including the initial certification and annual RATA for SO_2, NO_X, CO, HCl, and PM CEMS, as well as sorbent trap mercury emissions testing.

Coal-Fired Power Plant (Wet Scrubber); Huntington, UT

Project Manager and Field Test Leader for a wet flue gas desulfurization (FGD) system performance guarantee test program at a coal-fired power plant. The FGD test program included determining SO_2 emissions from the FGD system as well as determining overall FGD system pressure drop, stoichiometry ratio, gypsum oxidation level and percent solids dewatering. The sound pressure levels for new operating equipment related to the FGD system, including slurry pumps and ID Booster Fans, were measured as well.

Limestone slurry and gypsum slurry samples were collected and analyzed to determine reagent / byproduct quality, limestone consumption rates and scrubber stoichiometry. Preliminary particulate, SO_2 and SO_3 results were determined on-site.

Coal-Fired Power Plant (SCR, ACI, Dry FGD); Big Stone City, ND

Project Manager and Field Test Leader for a boiler pressure part modification and separated over fire air (SOFA) system, dry flue gas desulfurization (DFGD) system, activated carbon injection (ACI) system, selective catalytic reduction (SCR) system, and centrifugal ID fan system performance guarantee test program on a coal-fired boiler. The boiler pressure and SOFA tests included measuring pressure losses, heat output, and unburned carbon. The SCR performance tests included measuring pressure loss, power consumption, SO_2, SO_3, NO_X and ammonia emissions and ammonia distribution. The ACI system tests included measuring flue gas flow rate and composition, powdered activated carbon (PAC) injection rate, and sound pressure levels around ACI process equipment. The DFGD system tests included measuring flue gas flow rate and composition, filterable and condensable particulate matter (FPM and CPM), SO_2, SO_3, HCl, lime stoichiometry, power consumption, pressure loss, and sound pressure levels around specified DFGD equipment. The ID Fan performance tests included measuring flue gas temperatures, static and total pressures, and 3-D flow rates, including pitch and yaw angles and axial velocity.

The test program was conducted in a single mobilization using a 13-man test crew over an 11-day period. Preliminary analytical results for SO_2, SO_3, HCl, FPM, and ammonia were performed on-site by CleanAir personnel.

Coal-Fired Power Plant (SNCR and SCR); Healy, AK

Project Manager and Field Test Leader for SCR and SNCR performance guarantee test programs on two coal-fired boilers: one with SNCR system and one with SCR system. The SNCR test program included determining ammonia slip and ammonia emissions. The SCR test program included determining NO_X removal efficiency, SO_2 to SO_3 oxidation rate, and ammonia slip. Preliminary analytical results for SO_2, SO_3, and ammonia were performed on-site by CleanAir personnel.

Petrochemical Refinery; Morris, Illinois

Project Manager and Test Leader for multiple test programs on polyethylene and polypropylene production processes and waste gas flares at a petrochemical facility. The test programs included determining concentrations and mass emission rates of THCs and specific VOCs. VOC sampling programs included both collecting integrated grab samples in Tedlar bags or impingers for analysis by gas chromatography (GC) with multiple detectors, as well as direct interface sampling with GC/FID.

Test programs ranged from two-day test programs with two crew members to week-long, round the clock test programs with large test crews at multiple sources. Most test programs included on-site sample analysis using GC/FID.

Coal-Fired Power Plant (SCR, DSI, and AH); Fruitland, NM

Project Manager and Test Leader for a performance test program conducted on dry sorbent injection (DSI), SCR, and tri-sector air pre-heater (APH) systems installed on a coal-fired boiler. The DSI and SCR testing included the determination of SO_2 to SO_3 conversion rate, NO_X removal efficiency, NO_X to ammonia distribution, ammonia slip, boundary to boundary and intermediate pressure drops, power consumption, sound pressure levels of system components, hydrated urea and hydrated lime consumption, and particulate emissions from material handling duct collectors.

Tri-sector APH testing included determining primary and secondary air draft losses and flue gas draft loss. The air to gas leakage across the APH, as well as outlet temperature (without leakage), were also determined.

The test program was conducted in a single mobilization using a 15man test crew over an 11-day period. Preliminary analytical results for SO_2, SO_3, HCl, FPM, and ammonia were performed on-site by CleanAir personnel.

Combined Cycle Gas Turbine; Bundang, South Korea

Project Manager for an emissions test program conducted on a combined cycle gas turbine generator to collect data for completing construction permits for future similar installations in the United States. Pollutant emissions determined included FPM and CPM, NO_X, CO, THC, methane, ethane, propane, propylene, iso-butane, butane and butene. Preparation and mobilization for the project, including the shipment of all test equipment and reagents, were conducted in a period of less than two weeks.

Professional Certifications & Qualifications

OSHA 10-Hour
Hazardous Materials Shipping Certification
NSC CPR/AED Certification
NSC First-Aid Certification

Qualified Source Testing Individual (QSTI) Test Exams (Certificate No. 2008-271):

- Group 1 (Manual Gas Volume and Flow Measurements and Isokinetic Particulate Sampling Methods) – exam passed on 03/10/2017 (certification attached)
- Group 2 (Manual Gaseous Pollutants Source Sampling Methods) – exam passed on 06/01/2017 (certification attached)
- Group 3 (Gaseous Pollutants Source Sampling Methods) – exam passed on 06/01/2017 (certification attached)
- Group 4 (Hazardous Metals Measurement Methods) – exam passed on 07/09/2015 (certification attached)

Qualified Individual (QI)

Field Test Leader	Field Laboratory	Project Manager
Performance Specification 11 (PS11 – Particulate Matter)	SW-846 Test Method 0011 (Aldehydes & Ketones)	SW-846 Test Method 0030/0031 (Volatile Organic Compounds)
Performance Specification 12B (PS12B – Mercury Using Sorbent Trap)	EPA Method 22 (Fugitive Emissions)	EPA Methods 23 / SW-846 0010/0023A (PCDD/PCDF/SVOC)
EPA Method 25 (Total Gaseous Non-Methane Organics)	Trace Metals	EPA Method 204 (Permanent or Temporary Total Enclosure)
SW-846 Test Method 0061 / EPA Method 306 (Chromium)	Conditional Test Method 027 (Ammonia)	Other Test Method 29 (Hydrogen Cyanide)
Modified EPA Conditional Test Method 013 Controlled Condensation Method	CARB Method 501 (Size Distribution of Particulate Matter)	

Education

Southern Illinois University; Carbondale, Illinois
Bachelor of Science in Mechanical Engineering Technology, 1988

William Rainey Harper College; Palatine, Illinois
Associate of Arts in Liberal Arts, 1985

SOURCE EVALUATION SOCIETY

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LET IT BE KNOWN THAT

WILLIAM F. ANSELL, Jr.

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MANUAL GAS VOLUME MEASUREMENTS AND ISOKINETIC PARTICULATE SAMPLING METHODS

ISSUED THIS 10TH DAY OF MARCH 2017 AND EFFECTIVE UNTIL MARCH 9TH, 2022

Peter R. Westlin, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

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Theresa Lowe, QSTI/QSTO Review Board

Bruce Randall QSTI/QSTO Review Board

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MANUAL GASEOUS POLLUTANTS SOURCE SAMPLING METHODS

ISSUED THIS 1ST DAY OF JUNE 2017 AND EFFECTIVE UNTIL MAY 30TH, 2022

Peter R. Westlin, QSTI/QSTO Review Board

J. Wade Bice, QSTI/QSTO Review Board

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HAZARDOUS METALS MEASUREMENT SAMPLING METHODS

ISSUED THIS 9TH DAY OF JULY 2015 AND EFFECTIVE UNTIL JULY 8TH, 2020

Peter R. Westlin, QSTI/QSTO Review Board

Peter S. Pakalnis, QSTI/QSTO Review Board

Theresa Lowe, QSTI/QSTO Review Board

C. David Bagwell, QSTI/QSTO Review Board

Karen D. Kajiya-Mills , QSTI/QSTO Review Board

Glenn C. England, QSTI/QSTO Review Board

CERTIFICATE NO. 2008-271

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