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Agency

Industrial Environmental Research
Laboratory
Research Triangle Park NC 27711

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June 1978

EPA

Preliminary Design and Initial Testing of a Mobile Electrostatic Precipitator

Interagency Energy/Environment R&D Program Report

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REVIEW NOTICE

EPA-600/7-78-096
June 1978

Preliminary Design and Initial Testing of a Mobile Electrostatic Precipitator

by

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Program Element No. EHE624A

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Research Triangle Park, NC 27711

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Research and Development
Washington, DC 20460

DISCLAIMER

ABSTRACT

This report describes the factors considered and the general design concepts of a mobile electrostatic precipitator. This pilot scale device is one of a family of laboratory scale control deivces utilized by the Industrial Environmental Research Laboraoty of the U. S. Environmental Protection Agency located at Research Triangle Park, N. C. The final design and construction of the unit was provided by the Naval Surface Weapons Center at Dahlgren, Virginia.

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SECTION I

INTRODUCTION

This report summarizes the work performed under Contract 68-02-1860 to provide the general design and assistance in the evaluation of a mobile electrostatic precipitator. This test facility was constructed for the Industrial Environmental Research Laboratory of the U. S. Environmental Protection Agency at Research Triangle Park, North Carolina, by the Environmental Sciences Branch, of the Naval Surface Weapons Center at Dahlgren, Virginia.

The mobile electrostatic precipitator test facility was designed to assist the Industrial Environmental Research Laboratory in evaluating the applicability of the E.S.P. to a variety of industrial applications. The test facility design included both a pilot scale electrostatic precipitator and a laboratory van. The two units comprise a self sufficient facility with the exception of the requirements for external sources of electrical energy and water.

SECTION II

DISCUSSION

Southern Research Institute was directed to supply a conceptual design for the mobile test facility and to provide assistance to the E.P.A. during the construction and test of the unit. These services were provided as needed during the period of time that the contract was active. The guidelines for this contract specified in the scope of work were:

1. Mobile unit mounted on trailer suitable for highway travel
2. Three inlet and outlet sampling sites included
3. Minimum of four independent electrical sections
4. Secondary voltage and current meters required
5. Operation up to temperature of 480°C
6. Fans and strip heaters to be included
7. Variable intensity rappers required
8. Include optical instrumentation port
9. Provide guidance in design of data sheet
10. Design 300 cfm cyclone with a D_{50} of 5 microns
11. Include gas flow control devices.

In addition the following items were to be considered for inclusion if practical:

1. Lighted view ports in outlet section
2. Utilize standard E.S.P. electrical insulators
3. Wet and dry operation
4. Variable collection electrode spacing
5. Use precipitator vehicle for laboratory van.

The items in the second group were to serve as suggestions for the Naval Surface Weapons Center in the design of the unit, of these, only the view ports were actually incorporated into the final design of the unit.

The initial design for the electrostatic precipitator was transmitted to the Environmental Protection Agency and the Naval Surface Weapon Center on September 24, 1974. The drawings, reduced and included as Appendix I of the report, served as a conceptual design for the pilot precipitator. The Naval Surface Weapon Center developed the final design of the mobile E.S.P. from these suggestions. Meetings were held between the individual parties at Research Triangle Park, Naval Surface Weapons Center and Southern Research Institute, during the design phase for this mobile test facility.

A number of problems were encountered during the development of the device. Electrical sparkover between the corona wire support system and grounded portion of the system occurred. Similarly, electrical sparking occurred from the point that the high voltage connecting is made to the corona frame. These problems were solved during visits to the Naval Surface Weapon Center.

The power supplies that were delivered from Peschel Instruments also required some modifications. Even though the required voltage and current were stated to meet the specified values when connected to a resistive load, they did not when connected to the corona frame. These problems were corrected by the manufacturer when the transformers were returned.

The design conditions selected for the mobile electrostatic precipitator were intended to include typical operating conditions for full scale installations as near as was practical. A comparision between these conditions for the pilot unit and the majority of field installations are given below in Table I.

It is to be noted that the only significant departure from full scale conditions lies in the electrical sectionalization. It is impractical to duplicate this parameter in pilot units because of size and weight requirements. This departure from comparable conditions generally leads to the ability to operate the pilot unit at voltages and average current densities that are somewhat greater in the pilot unit than is possible in a comparable full scale unit. This factor places a constraint on the permissible operating conditions for the pilot unit when attempting to simulate full scale behavior.

A second departure from full scale conditions is related to gas sneakage past electrified regions. It is difficult to estimate the amount by which this differs between pilot and full scale devices. In general, the relative quantity of dust laden gas that bypasses the electrified region is significantly greater in pilot scale devices than in full scale units. Care was exercised in the design of the pilot scale unit to minimize the effect of gas sneakage.

TABLE I

COMPARISON OF PILOT AND FULL SCALE

E.S.P. PARAMETERS

ITEM	PILOT	FULL SCALE
Specific collection area M^2sec/M^3	20-100	20-150
Wire to plate spacing - cm	13	10-15
Wire to wire spacing - cm	18	10-30
Electrical fields in direction of gas flow	2-5	2-12
Gas velocity M/sec	0.5-2.0	1-2.5
Current density nA/cm^2	5-100	5-80
Plate area per T.R. Set M^2	9	50-750

The mobile E.S.P. and laboratory vans were delivered to the Environmental Protection Agency for final checkout. Tests were conducted to verify the performance of the delivered items. The results of these tests and a discussion of the design of the mobile unit were discussed in a paper[1] given in an E.P.A. sponsored symposium in Denver, Colorado, "Particulate Collection Problems Using Electrostatic Precipitators in the Metallurgical Industry."

Southern Research Institute provided the Environmental Protection Agency with a suggested measurement program and sampling port requirements as a part of this contract. The items required to be measured in the mobile pilot scale precipitator are described below. It is desirable to provide sufficient sampling ports such that all measurements can be made simultaneously. The sampling locations for mass loading and particle size distribution measurement should be in a region where a reasonably uniform gas velocity distribution exists. The other measurements may be made in regions of non-uniform flow without significantly deleterious effects. The following measurements must be made at both the inlet and outlet breechings to the precipitator:

1. Mass loading

2. Particle size 0.3 μm and greater

3. Particle size 0.5 μm and smaller

4. Gas velocity and temperature distribution (can use mass and/or particle size ports)

5. Isokinetic ash sample (dry collection)

6. Particulate resistivity

7. Gas composition

8. Operating temperature

The mass loadings should be made with an EPA Method 5 apparatus. It is desirable to provide for a permanent installation for the control console with semi-permanent sampling rails to support the sampling case and probe.

The sampling ports for the impactors and fine particle sampling should be located at a point that provides for a minimum of interference with the mass train sampling equipment.

The gas velocity distribution can be measured in the sampling points provided for the mass train and size distribution measurements.

Footnote 1. Brumfield, J.L. and Crowson, Fred. "Design and Fabrication of a Mobile Electrostatic Precipitator." Paper #11, Proceedings: Particulate Collection Problems Using ESP's in the Mettalurgical Industry EPA-600/2-77-208, Oct. 1977

The sampling points for isokinetic dry ash samples, particulate resistivity, and gas composition can be located at almost any point, since the gas velocity distribution, turbulence, and gas velocity are not critical to these measurements. The dry isokinetic ash collection is necessary for providing a sample of ash for chemical analysis and laboratory resistivity measurements. Since the Method 5 system utilizes washings and dry filter collection, the dry sample is required. The gas composition sampling point is not critical since the high diffusivity gas components readily maintain good mixing throughout the ducts.

A temperature measurement should be provided in both the inlet and outlet duct with recording capability. These measurements provide information about the stability of the source as well as giving an indication of any gas leakage into the precipitator.

A total gas volume measurement on the outlet duct or stack is desirable because it does not include errors inherent in the velocity traverses. A venturi type meter or a calibrated orifice with pressure drop readout is recommended.

It is also necessary to provide ready access to the secondary voltage and current readings from the precipitator power supplies. These readings should be recorded at regular intervals during the test period.

A follow-up to the initial recommendations were submitted as a report to the Environmental Protection Agency on November 24, 1976. This report described a test plan that should serve to both evaluate the performance of the mobile E.S.P. as well as answer some specific questions about the performance of an electrostatic precipitator experiencing some difficulties in operation. This particular field test was not conducted because of some contractual problems between the utility and the E.S.P. supplier.

This test program included base line tests with the normal coal and a test to evaluate the addition of sodium carbonate to improve the performance. The test program summarized below does not include the tests to evaluate the sodium conditioning but rather represents a two week's test period to evaluate the pilot E.S.P.

The two weeks of field tests were designed to characterize the behavior of the E.S.P. pilot plant under actual field test conditions. This includes tests over a range of gas velocities (SCA's) and a range of applied voltages and current densities.

In each field test condition, coal samples, inlet and hopper fly ash samples, Orsat and sulfur oxide samples, and representative impactor substrate samples should be preserved for later analysis.

Flue gas temperatures and flow rates should be recorded together with individual power supply readings.

The electrostatic precipitator tests recommended are as follows:

TABLE II

MOBILE PILOT ELECTROSTATIC PRECIPITATOR
SHAKEDOWN TESTS NERC LABORATORIES

Pretest

Day 1. Calibrate power supply meters. Prepare gas velocity distribution sampling access.

2-3. Gas velocity distribution inlet, Field 1, inlet; Field 5, outlet

4. Volt-ampere curves - cold gas - hot gas no particulate

5. Make-up day and determine range of velocities available.

Particulate tests - two weeks - two tests at each condition

Current density, na/cm^2	15, 40, 15 with high resistivity
Gas velocity, m/sec	0.6, 1.0
Specific collection area $ft^2/kcfm$	400, 240

Note: The above tests should be conducted at a temperature on the order of 140-160°C (280-300°F).

TABLE III

MOBILE ELECTROSTATIC PRECIPITATOR TESTS

Day 1-2

- Connect unit to access port
- Check electrical supply
- Check meters and instrumentation
- Obtain V-I curves - cold gas
- Operate fan
- Run hot gas V-I curves
- Check mass load in pilot with main duct single point
- Check gas temperature-pilot with main duct
- Measure gas velocity distribution - inlet and outlet
- Inspect through view ports

Day 3

- Stabilize system at flue gas operating temperature
- Set gas velocity
- Obtain V-I curves
- Select operating points for tests
- Select run times and sampling rates
- Run one complete test
  - Mass loadings - inlet and outlet
  - Impactors - inlet and outlet
  - Resistivity
  - Gas analysis

Day 4

- Obtain two complete tests - gas velocity 1.5 m/sec (5 fps)
- S.C.A. = 160 ft^2/kcfm - maximum current density
- Select run times and sampling rates
- Mass loadings, inlet and outlet
- Impactors, inlet and outlet
- Resistivity
- Gas analysis
- Optical density
- Ash and coal samples

Day 5

Repeat Day 4. With current density set at maximum for the inlet field in all sets

Day 6

Repeat Day 5 with current density set at 60% of inlet

Day 7

Reduce data and display for review. Determine if a repeat test is required.

Day 8

Conduct tests at gas velocity of 1 m/sec (SCA = 240)

Day 9

Repeat Day 8 at reduced current density

Day 10

- Conduct tests at 0.6 m/sec (SCA) = 400)
- Maximum current density

Day 11

Repeat Day 10 at reduced current density.

Southern Research Institute next prepared a Pilot Electrostatic Precipitation Operating Guide for the Environmental Protection Agency. This document is included as Appendix II of this report. This guide describes our approach to the philosophy and operational techniques necessary to conduct an effective pilot electrostatic precipitator research program.

SECTION III

FIELD EVALUATIONS

The mobile electrostatic precipitator test facility was exercised in two field tests. The first test was conducted at a stoker fired steam generation system at the State of Maryland Correctional Institution at Hagarstown, Maryland and the second at the Colstrip Power Station, Montana Power Company, Colstrip, Montana. The results of these two tests were reported to the Industrial Environmental Research Laboratory by the respective contractor-operators Monsanto Research and Aerotherm Division of Acurex.

The Maryland tests were conducted to evaluate the collectability of fly ash resulting from the combustion of a combination of pelletized refuse and coal in the stoker fired boiler. This test also served as the initial field test for the pilot E.S.P. as well as a training exercise for their operating personnel. Southern Research Institute provided assistance in developing the test plan as well as operating suggestions during the test period. The tests included a comparison between the operation of the control device while utilizing coal only and coal plus refuse. Southern Research Institute did not review this report.

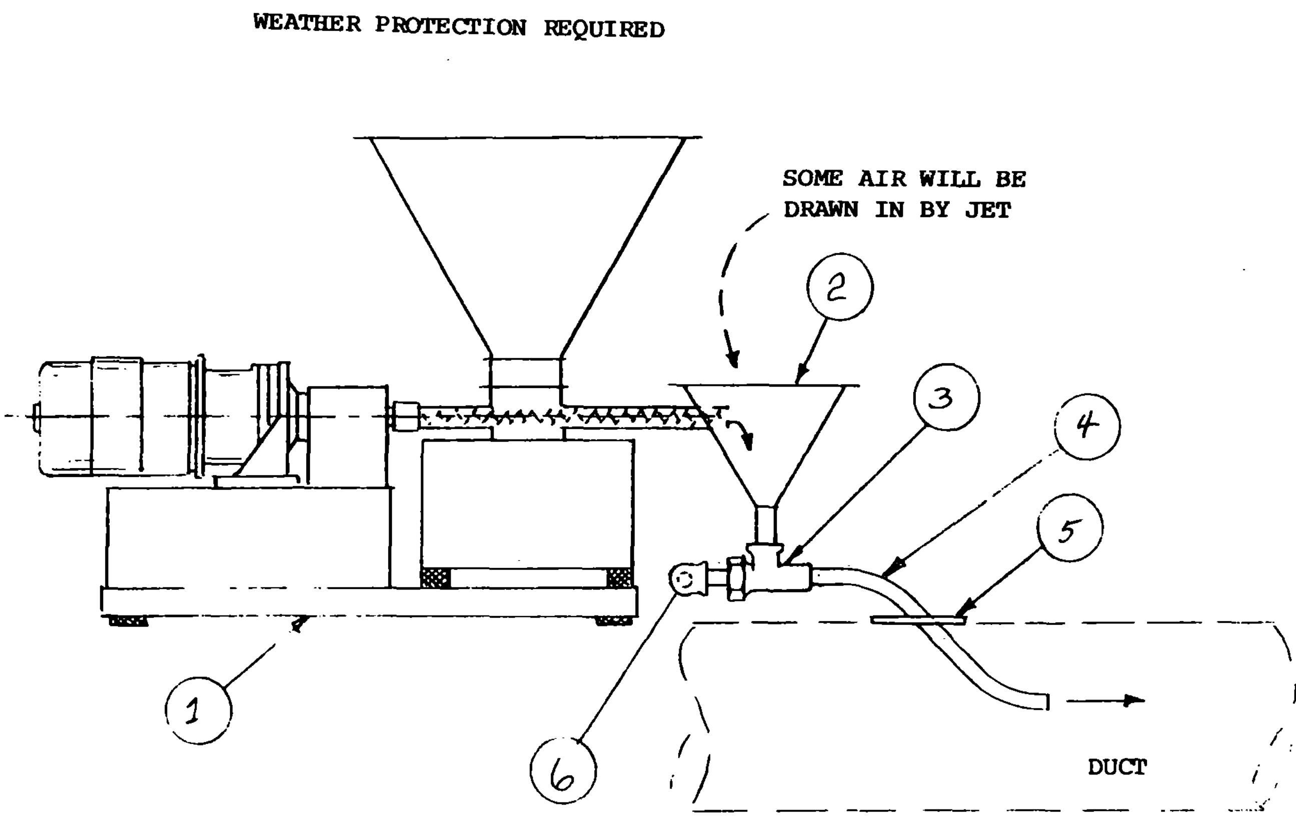
The tests at Colstrip, Montana were designed to evaluate the utility of sodium carbonate injection as a means for improving the collection characterics of fly ash resulting from the combustion of Western low sulfur, low sodium coals. This test consisted of a series of base-line and conditioned tests where the electrical conditioning was provided by the injection of dry sodium carbonate into the particulate laden gas streams at temperatures well below furnace temperatures. The results of the test reported by Aerotherm Division of Acurex Corporation indicate a significant increase in the electrical conditions with a concommitant improvement in the collection efficiency of the pilot precipitator with the injection of the finely divided sodium carbonate into the gas stream.

SECTION IV

DESIGN OF ADDITIONAL ITEMS

Southern Research Institute was also requested to supply designs for a sodium carbonate injection system and a 300 cfm cyclone collector with a D_{50} of five microns. These items were designed as requested. The sodium carbonate injection system was designed according to the sketch shown in Figure 1. Southern Research Institute also supplied to the Environmental Protection Agency a material metering system, a vibra-screw feeder model SCR-20. This system was delivered to the Environmental Protection Agency for use in the shakedown tests at Raleigh-Durham and in the field test at the Colstrip Power Station.

A design for the 300 cfm cyclone was provided to the Environmental Protection Agency as shown in the sketch in Figure 2. We did no fabrication for this cyclone.



1. VIBRASCREW FEEDER SCR-20, 3/8 SCREW, 0 - 0.1 CFH
2. FABRICATED CONNECTION BETWEEN FEEDER & INJECTOR
3. JET INJECTOR, McMASTER-CARR -
   P.O. BOX 4355, CHICAGO , CAT. 4977K-11
4. FABRICATED PIPE
5. COVER PLATE APPROX. 6" DIAM., WELDED TO BENT PIPE
6. COMPRESSED AIR SUPPLY LINE, APPROX. 100 PSIG

Figure 1. Sodium carbonate injection system for E.P.A. pilot E.S.P.

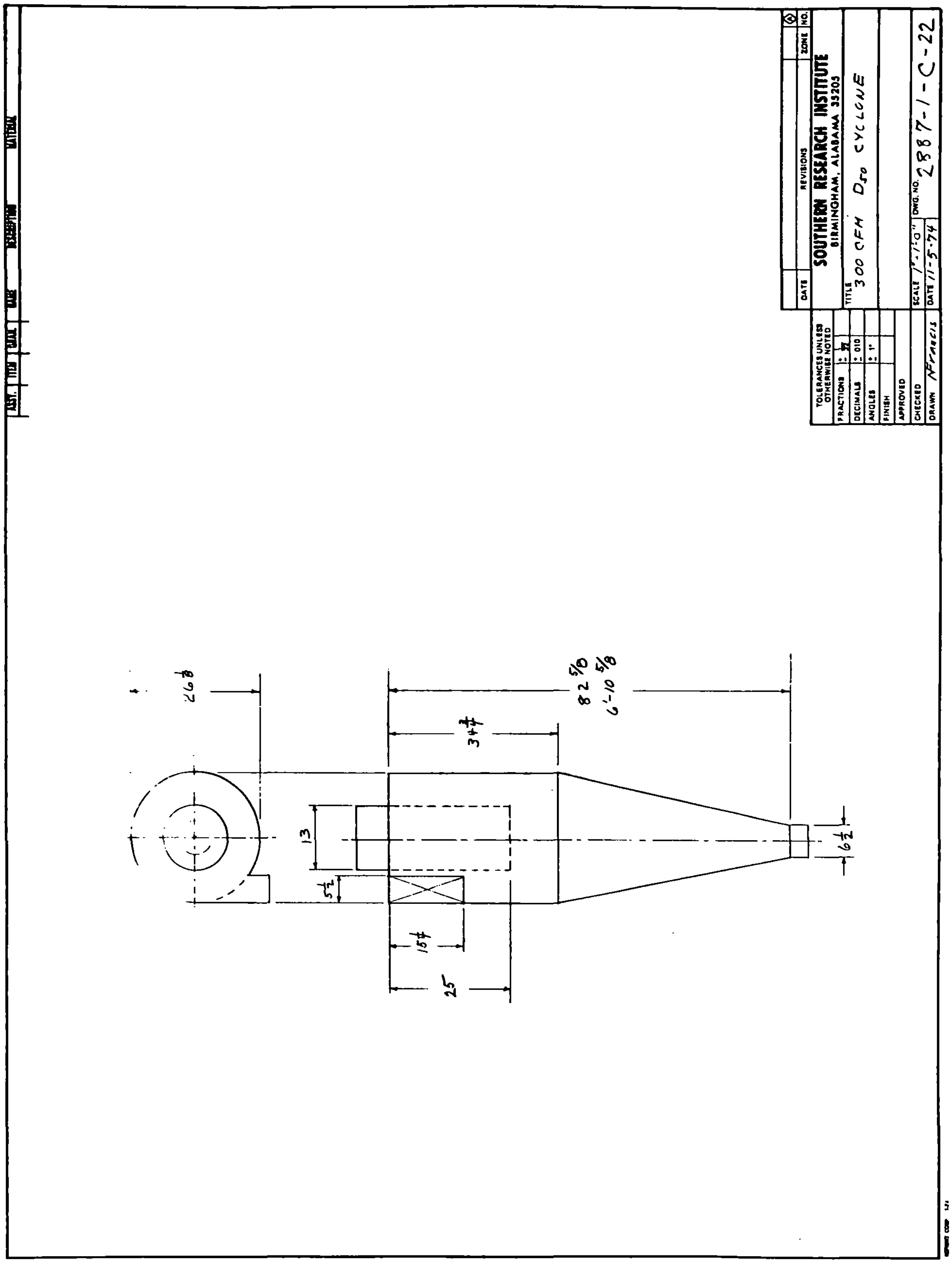


Figure 2. 300 cfm cyclone with a D_{50} of 5 microns.

APPENDIX I

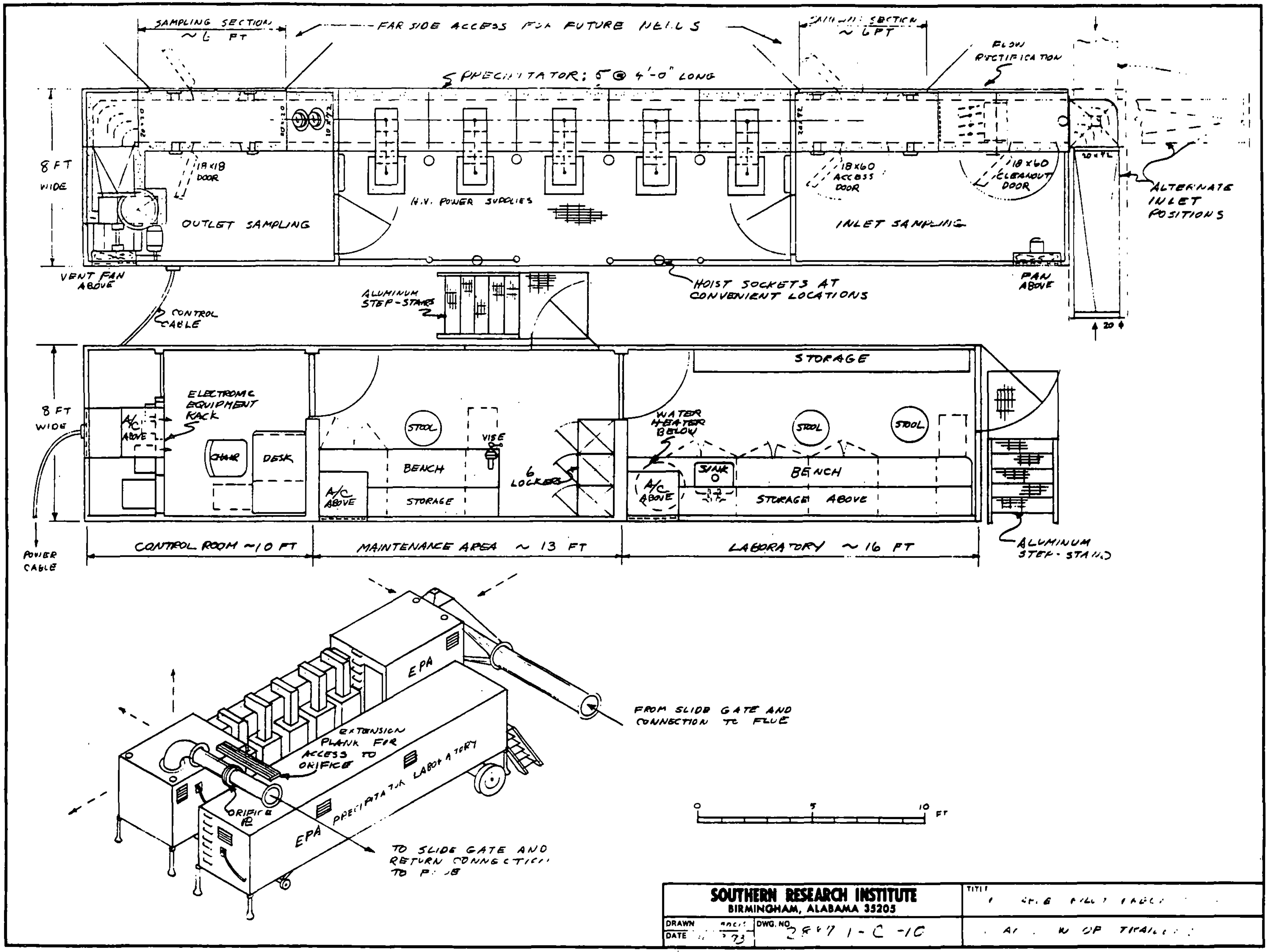
Design Drawings For Use

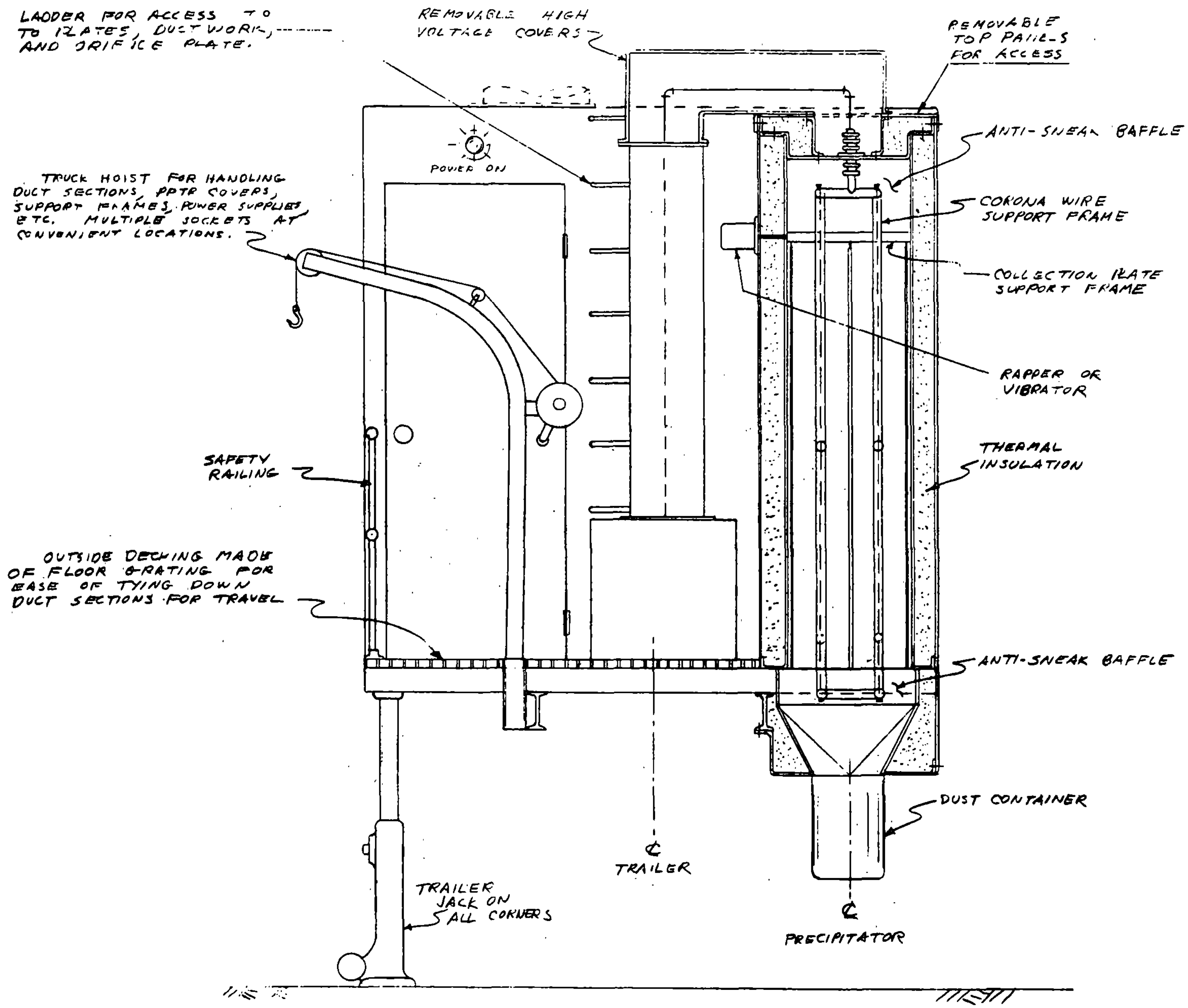
by

NAVAL SURFACE WEAPONS CENTER

for the

MOBILE ELECTROSTATIC PRECIPITATOR


SAMPLING SECTION ~ 6 FT
FAR SIDE ACCESS FOR FUTURE WELLS
SAMPLING SECTION ~ 6 FT
FLOW RECTIFICATION
5 PRECIPITATOR: 5 @ 4'-0" LONG
8 FT WIDE
18 x 18 DOOR
H.V. POWER SUPPLIES
18 x 60 ACCESS DOOR
18 x 60 CLEANOUT DOOR
ALTERNATE INLET POSITIONS
OUTLET SAMPLING
INLET SAMPLING
VENT FAN ABOVE
FAN ABOVE
ALUMINUM STEP-STAIRS
HOIST SOCKETS AT CONVENIENT LOCATIONS
CONTROL CABLE
STORAGE
8 FT WIDE
ELECTRONIC EQUIPMENT RACK
A/C ABOVE
CHAIR
DESK
STOOL
VISE
BENCH
STORAGE
6 LOCKERS
WATER HEATER BELOW
SINK
BENCH
STORAGE ABOVE
POWER CABLE
CONTROL ROOM ~ 10 FT
MAINTENANCE AREA ~ 13 FT
LABORATORY ~ 16 FT
ALUMINUM STEP-STAND
EPA
EXTENSION PLANK FOR ACCESS TO ORIFICE
PRECIPITATOR LABORATORY
ORIFICE
FROM SLIDE GATE AND CONNECTION TO FLUE
TO SLIDE GATE AND RETURN CONNECTION TO FLUE
0 5 10 FT
SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM, ALABAMA 35205
DRAWN
DATE
DWG. NO.
TITLE

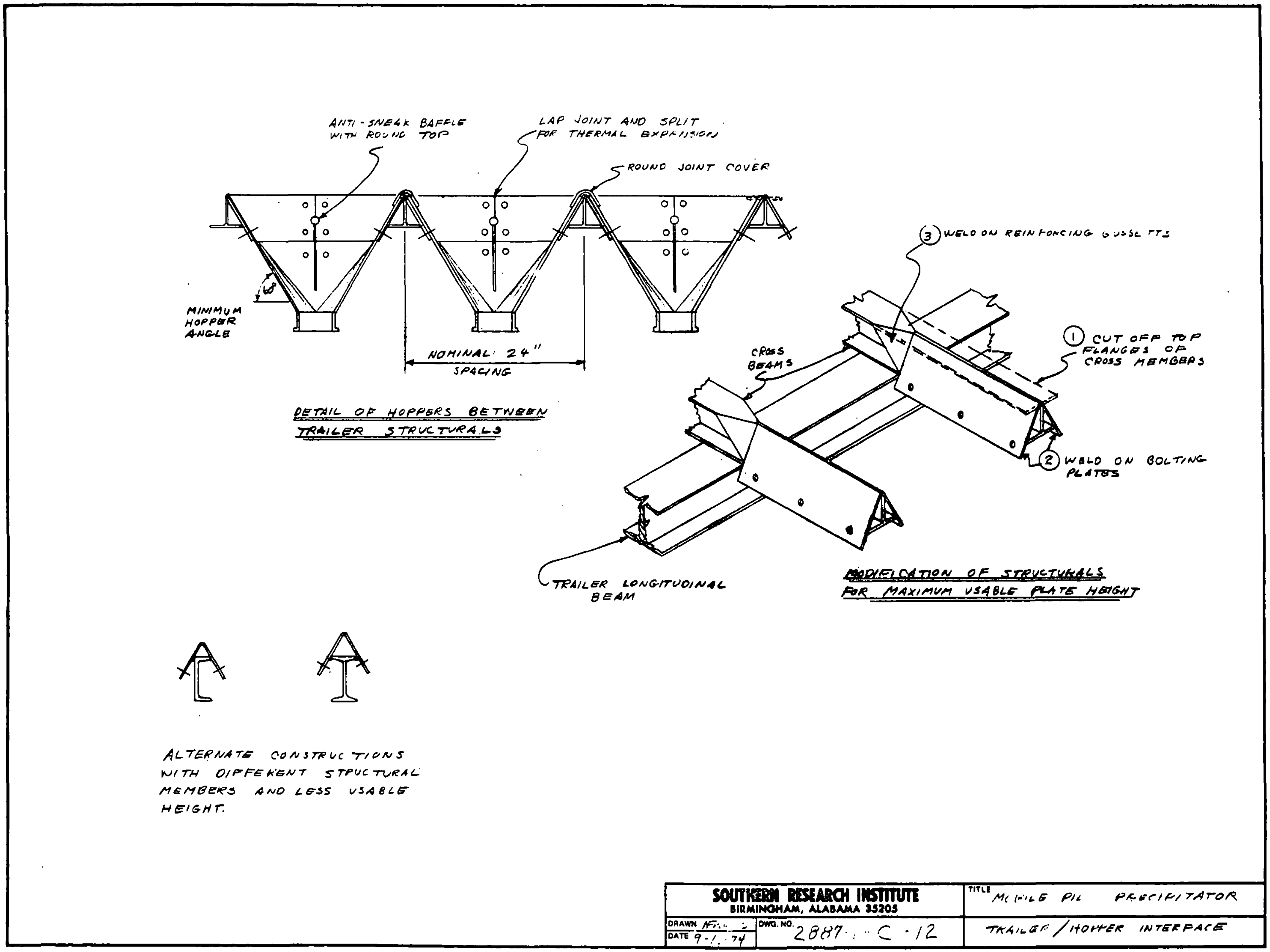


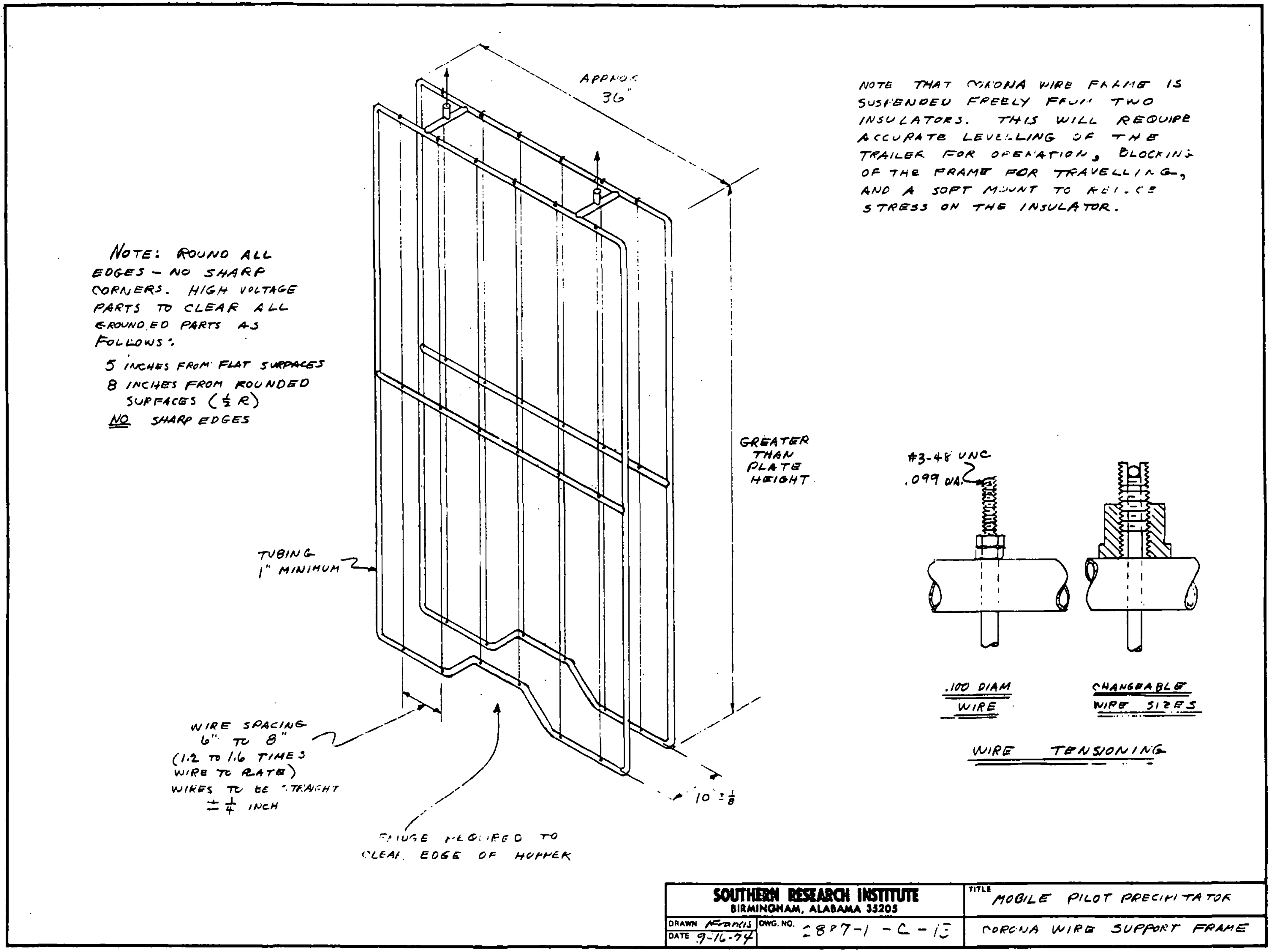
SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM, ALABAMA 35205

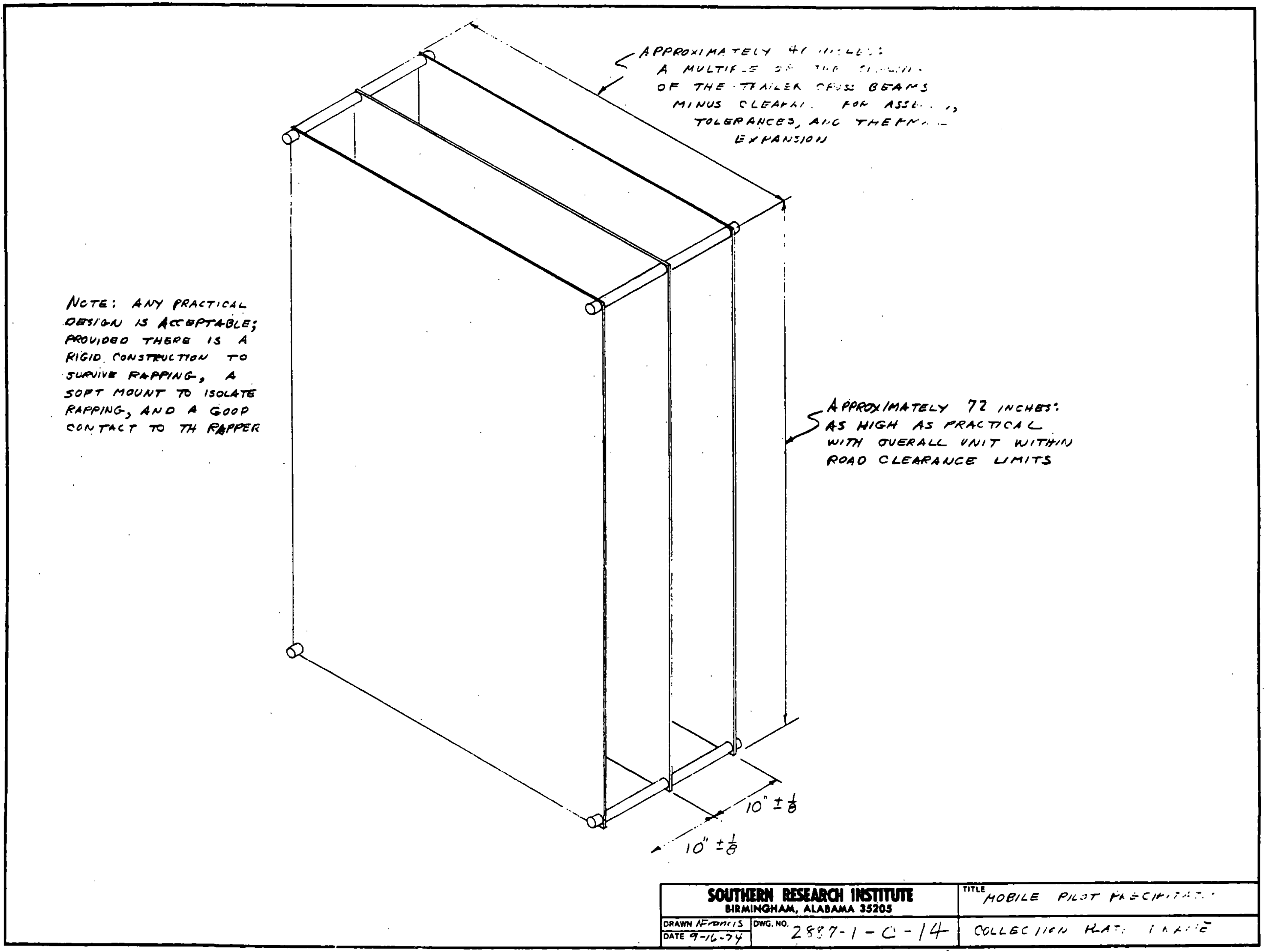
DRAWN Francis | DWG. NO. 2887-1-C-11
DATE 11-19-73

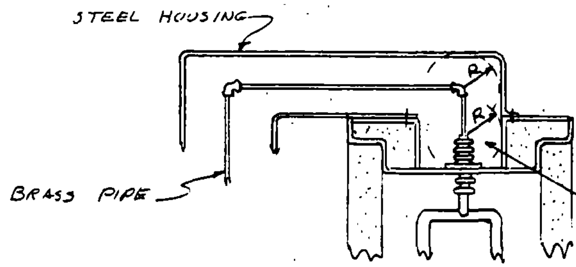
TITLE PORTABLE PILOT PRECIPITATOR

CROSS SECTION


ANTI-SNEAK BAFFLE WITH ROUND TOP
LAP JOINT AND SPLIT FOR THERMAL EXPANSION
ROUND JOINT COVER
MINIMUM HOPPER ANGLE
NOMINAL 24" SPACING
DETAIL OF HOPPERS BETWEEN TRAILER STRUCTURALS
3 WELD ON REINFORCING GUSSETTS
1 CUT OFF TOP FLANGES OF CROSS MEMBERS
CROSS BEAMS
2 WELD ON BOLTING PLATES
TRAILER LONGITUDINAL BEAM
MODIFICATION OF STRUCTURALS FOR MAXIMUM USABLE PLATE HEIGHT
ALTERNATE CONSTRUCTIONS WITH DIFFERENT STRUCTURAL MEMBERS AND LESS USABLE HEIGHT.
SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM, ALABAMA 35205
TITLE MOBILE PILOT PRECIPITATOR
TRAILER/HOPPER INTERFACE
DRAWN
DATE 9-1-74
DWG. NO. 2887-C-12

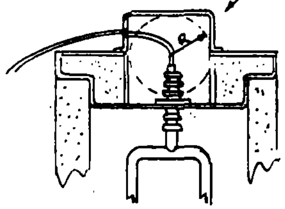

APPROX 36"
NOTE THAT CORONA WIRE FRAME IS SUSPENDED FREELY FROM TWO INSULATORS. THIS WILL REQUIRE ACCURATE LEVELLING OF THE TRAILER FOR OPERATION, BLOCKING OF THE FRAME FOR TRAVELLING, AND A SOFT MOUNT TO REDUCE STRESS ON THE INSULATOR.
NOTE: ROUND ALL EDGES – NO SHARP CORNERS. HIGH VOLTAGE PARTS TO CLEAR ALL GROUNDED PARTS AS FOLLOWS:
5 INCHES FROM FLAT SURFACES
8 INCHES FROM ROUNDED SURFACES (½ R)
NO SHARP EDGES
GREATER THAN PLATE HEIGHT
#3-48 UNC
.099 DIA
TUBING 1" MINIMUM
.100 DIAM WIRE
CHANGEABLE WIRE SIZES
WIRE TENSIONING
WIRE SPACING 6" TO 8" (1.2 TO 1.6 TIMES WIRE TO PLATE)
WIRES TO BE STRAIGHT ± ¼ INCH
10" ± ⅛
FLANGE REQUIRED TO CLEAR EDGE OF HOPPER
SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM, ALABAMA 35205
TITLE MOBILE PILOT PRECIPITATOR
CORONA WIRE SUPPORT FRAME
DRAWN Francis
DATE 9-16-74
DWG. NO. 2877-1-C-13


APPROXIMATELY 41 INCHES:
A MULTIPLE OF THE
OF THE TRAILER CROSS BEAMS
MINUS CLEARANCE FOR ASSEMBLY,
TOLERANCES, AND THERMAL
EXPANSION
NOTE: ANY PRACTICAL DESIGN IS ACCEPTABLE; PROVIDED THERE IS A RIGID CONSTRUCTION TO SURVIVE RAPPING, A SOFT MOUNT TO ISOLATE RAPPING, AND A GOOD CONTACT TO TH RAPPER
APPROXIMATELY 72 INCHES: AS HIGH AS PRACTICAL WITH OVERALL UNIT WITHIN ROAD CLEARANCE LIMITS
10" ± 1/8
10" ± 1/8
SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM, ALABAMA 35205
TITLE MOBILE PILOT
DRAWN N. Francis
DATE 9-16-74
DWG. NO. 2887-1-C-14
COLLECTION PLATE FRAME



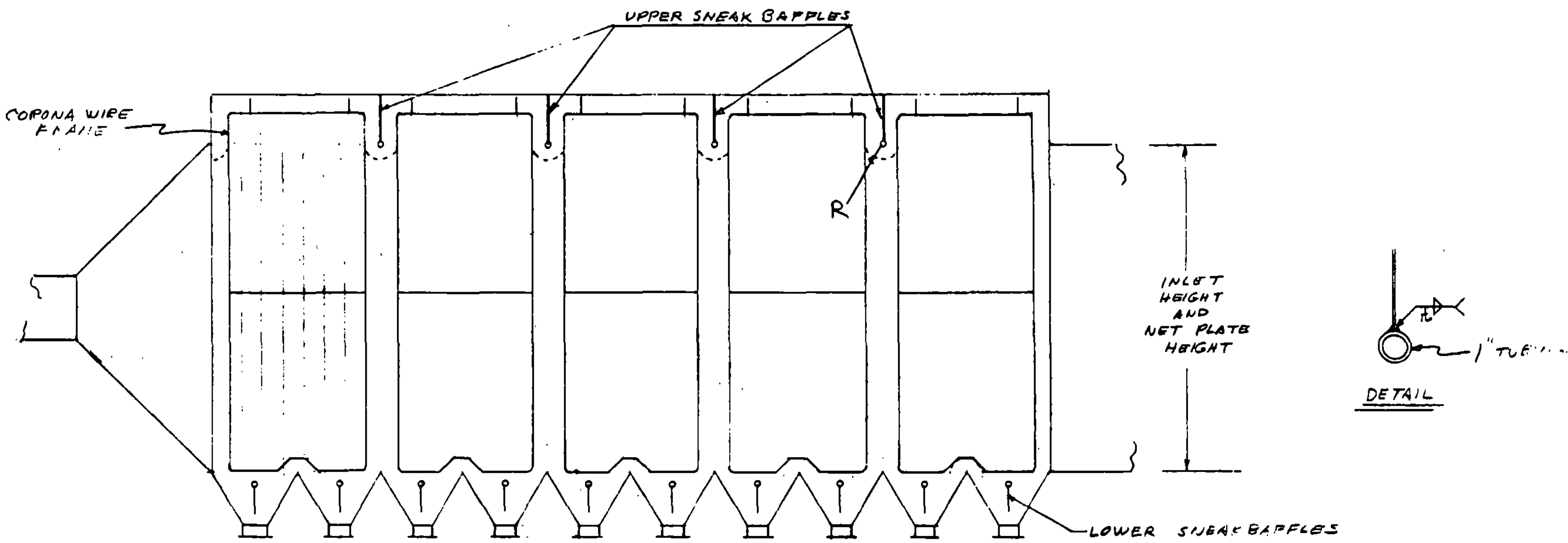
PIPE AND HOUSING HIGH VOLTAGE SUPPLY FOR RUGGEDNESS.

SPACING:
R - 5 INCHES TO FLAT SURFACES
R - 8 INCHES TO ROUNDED SURFACES ($\frac{1}{2}$R)
NO SHARP CORNERS



FLEXIBLE HIGH VOLTAGE CABLE FOR MINIMUM SPACE REQUIREMENT

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205	TITLE MOBILE [illegible]
DRAWN [illegible] DATE 9-[illegible]-74 — DWG. NO. 2[illegible]1-C-15	[illegible] LEADS



LOCATION OF ANTI-SNEAK BAFFLES

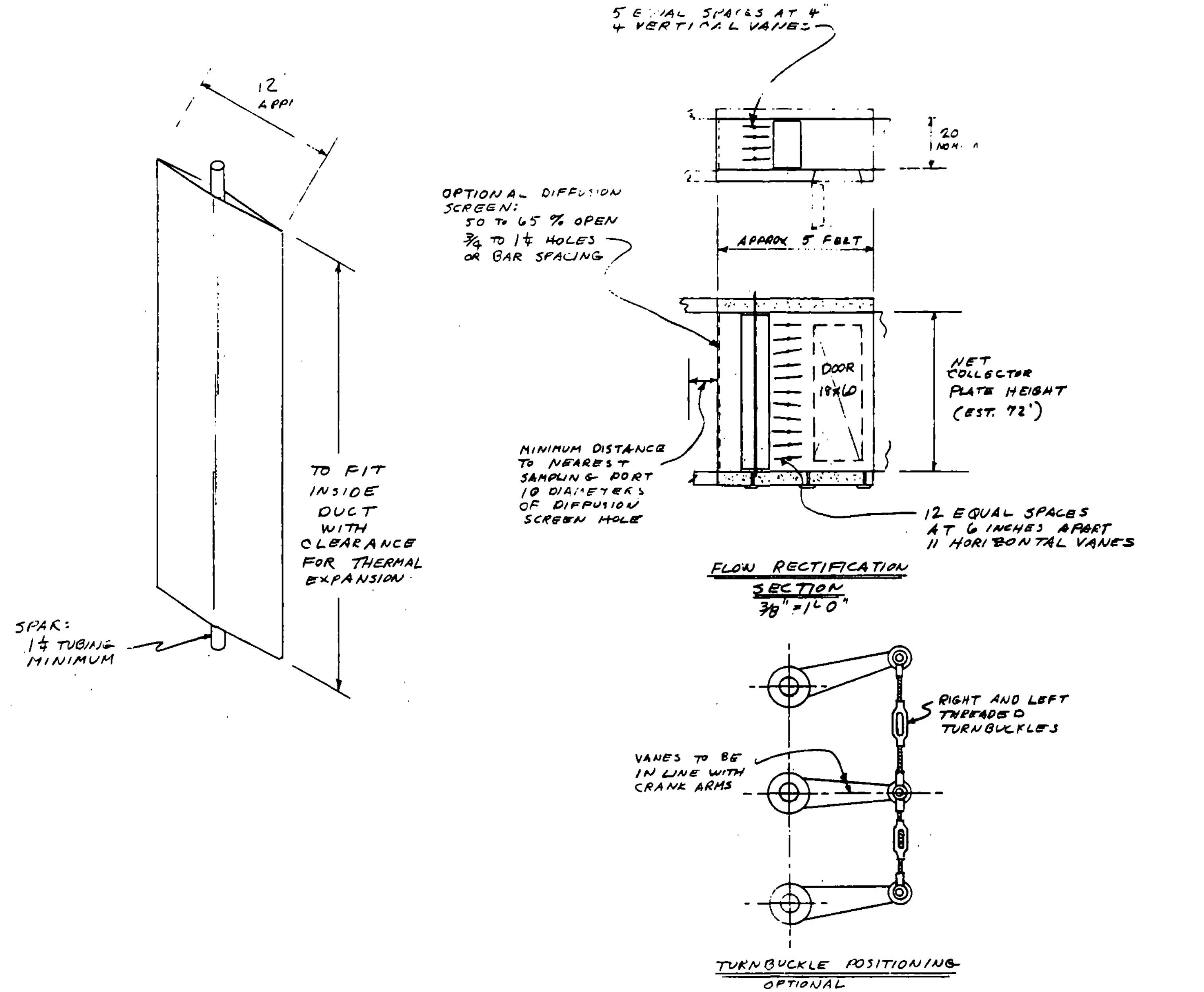
CLEARANCES:

R = 5 INCHES TO FLAT SURFACES OF OPP[illegible]TE POLARITY

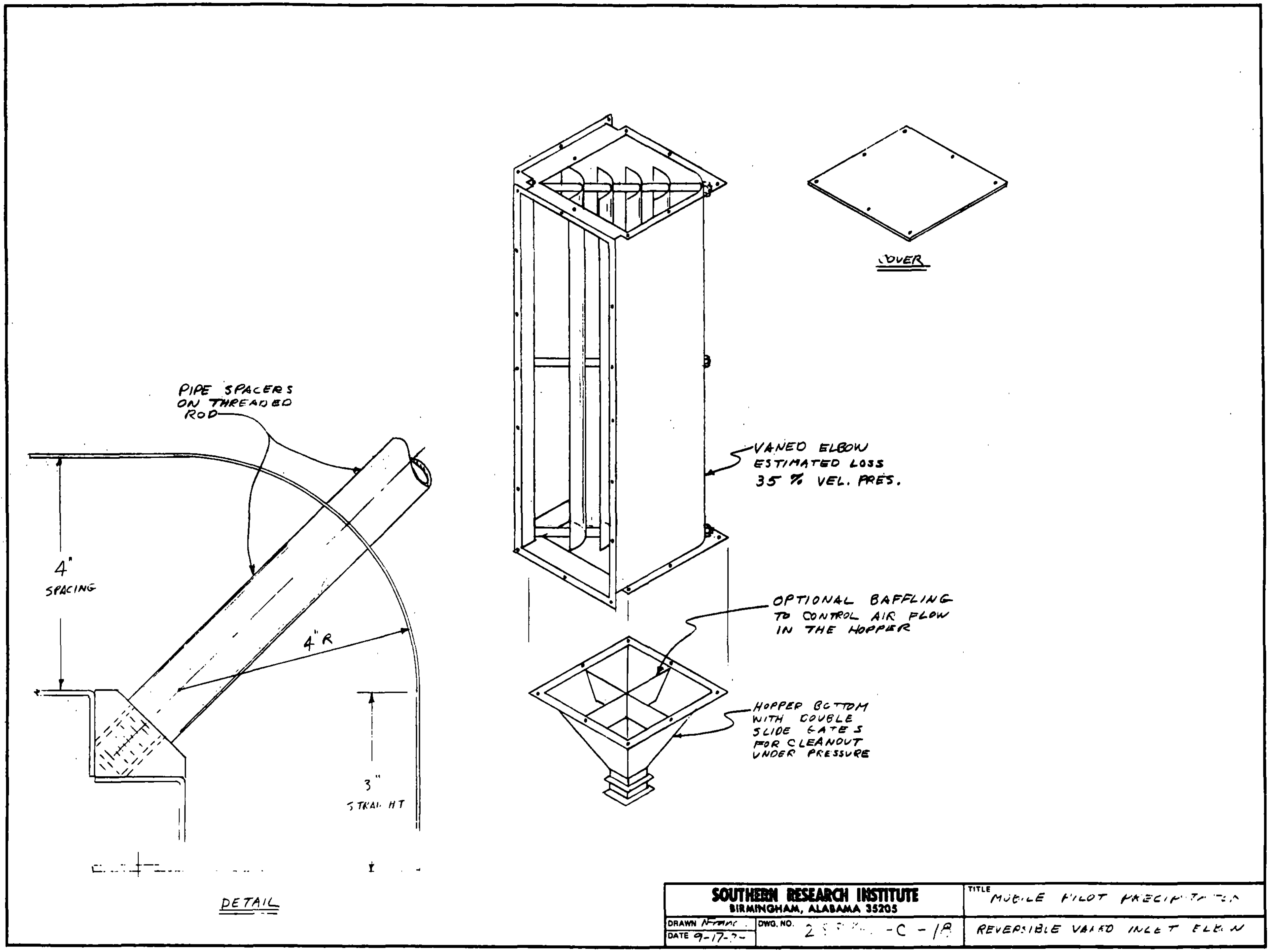
R - 8 INCHES TO ROUNDED SURFACES (½" RADIUS) " "

NO SHARP CORNERS

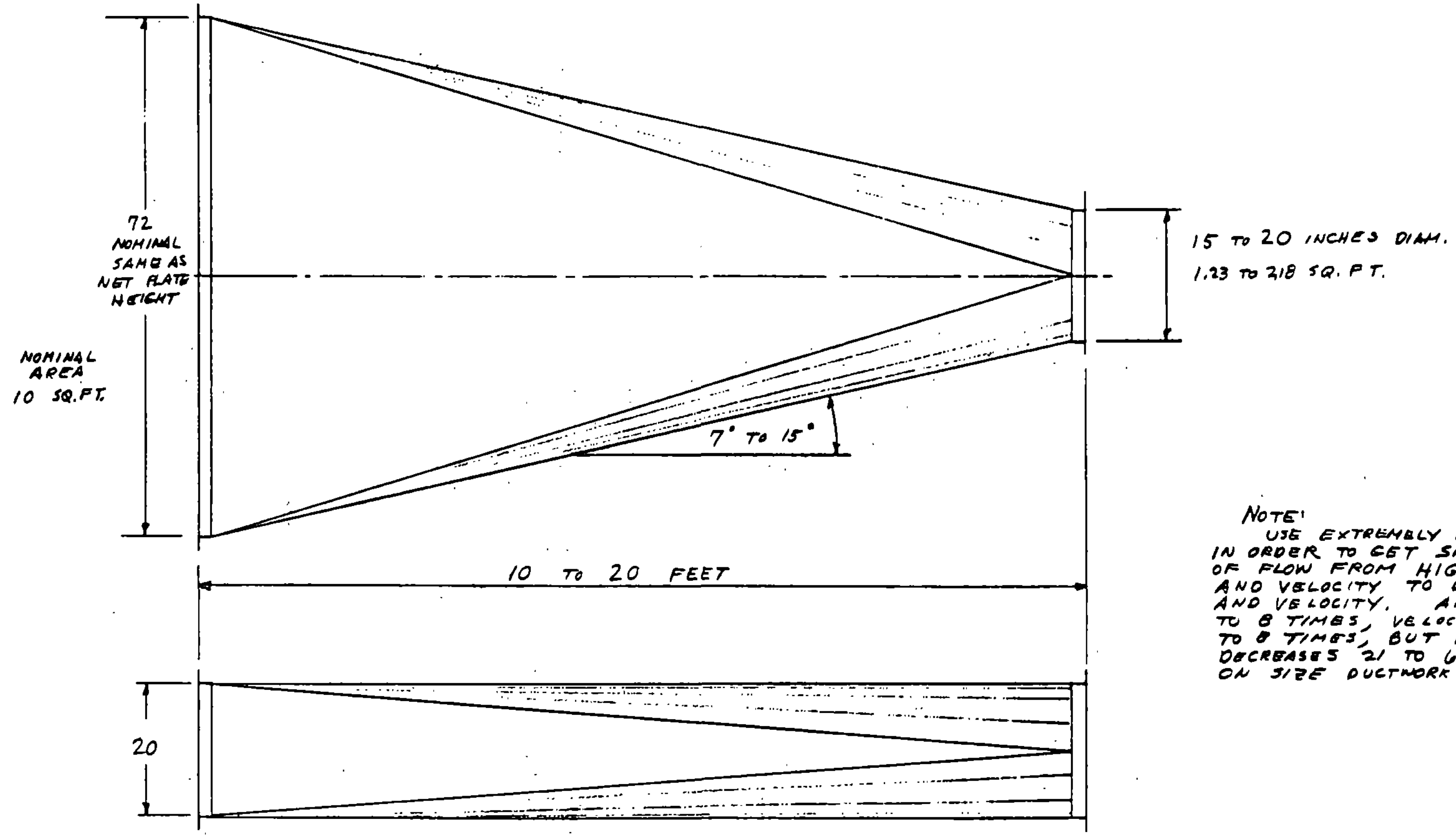
SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE MOBILE PIL[illegible] PR[illegible]CIPITATOR
DRAWN N. Francis DATE 7-16-74	DWG. NO. 2[illegible]7-1-C-16	ANTI-SNEAK BAF[illegible]S



SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE MOBILE PILOT PRECIPITATOR
DRAWN N Francis DATE 9-16-74	DWG. NO. 2887-1-C-17	FLOW RECTIFICATION SECTION

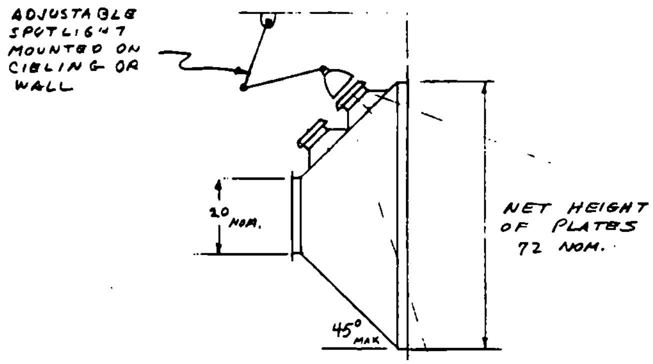


PIPE SPACERS ON THREADED ROD
4" SPACING
4" R
3" STRAIGHT
DETAIL
COVER
VANED ELBOW ESTIMATED LOSS 35 % VEL. PRES.
OPTIONAL BAFFLING TO CONTROL AIR FLOW IN THE HOPPER
HOPPER BOTTOM WITH DOUBLE SLIDE GATES FOR CLEANOUT UNDER PRESSURE
SOUTHERN RESEARCH INSTITUTE
BIRMINGHAM, ALABAMA 35205
TITLE MOBILE PILOT
DRAWN
DATE 9-17-
DWG. NO.
REVERSIBLE VANED INLET

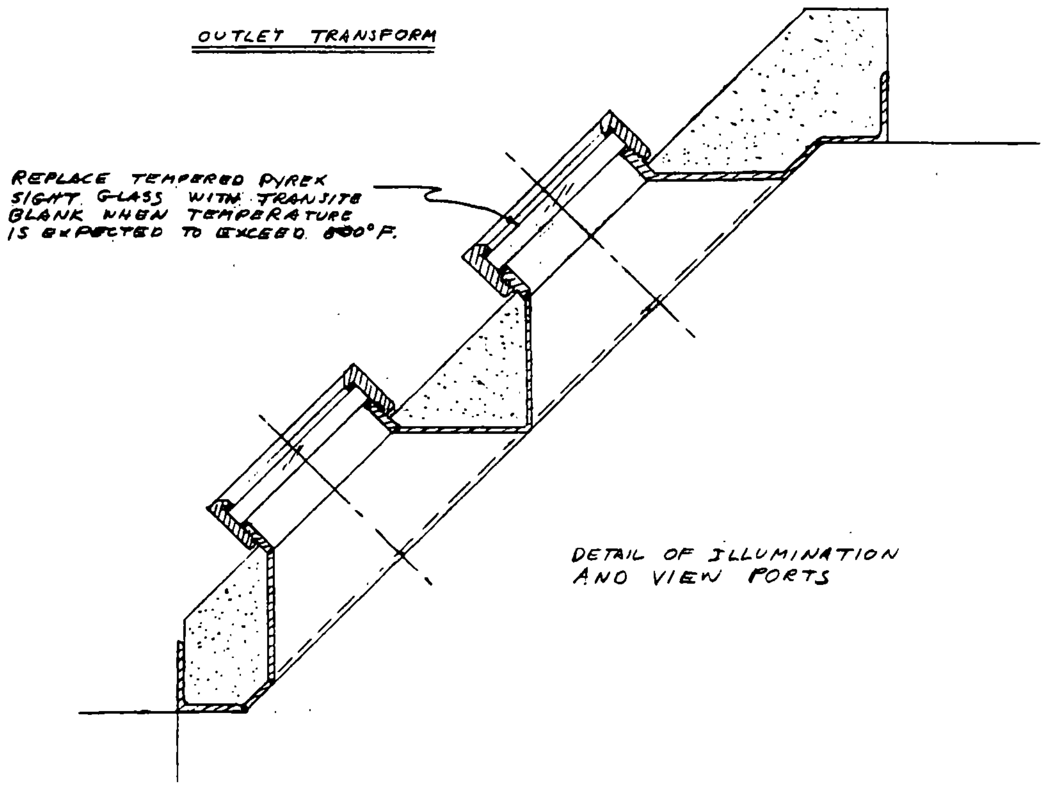


NOTE:
USE EXTREMELY LONG TRANSFOR[illegible]
IN ORDER TO GET SMOOTH TRANSITION
OF FLOW FROM HIGH KINETIC ENERGY
AND VELOCITY TO LOW KINETIC ENERGY
AND VELOCITY. AREA INCREASES 4
TO 8 TIMES, VELOCITY DECREASES 4
TO 8 TIMES, BUT KINETIC ENERGY
DECREASES 21 TO 66 TIMES DEPEND[illegible]
ON SIZE DUCTWORK CHOSEN.

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE MOBILE PILOT PRECIPITATOR
DRAWN [illegible] / DATE 9-17-74	DWG. NO. 2997-1-C-19	INLET TRANSFORM



OUTLET TRANSFORM



DETAIL OF ILLUMINATION AND VIEW PORTS

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205	TITLE MOBILE PILOT [illegible]
DRAWN Francis DATE 9-17-74 — DWG. NO. 2887-1-C-20	OUTLET TRANSFORM

GENERAL NOTE:

IMPORTANT DIMENSIONS ARE SPECIFIED ON DRAWINGS 2887-1-C-10 THRU 20. OTHER DIMENSIONS AND DESIGN DETAILS MAY BE ALTERED FOR CONVENIENCE OF MANUFACTURE, AVAILABILITY OF MATERIALS OR FREEDOM OF DESIGN.

LABORATORY TRAILER NEEDS:

CONTROL SECTION -
- CONTROL PANEL
- DESK/TABLE WITH CHAIR
- CALCULATOR, OFFICE SUPPLIES
- FILE FOR DATA AND REFERENCES

LABORATORY SECTION -
- SINK AREA: SINK WITH DRAIN
  - WATER SUPPLY
  - WATER HEATER
- BALANCE AREA: BALANCE
  - STABLE SUPPORT
  - STOOL
- BENCH AREA: WORK BENCH
  - SHOCK PROOF GLASS STORAGE
  - GLASSWARE
  - LABORATORY EQUIPMENT
  - 110 VAC TERMINAL STRIP
  - EXPENDABLE SUPPLIES
  - HOT P, STIRRERS, ETC.

MAINTENANCE AREA
- WORK BENCH, VISE, TOOLS
- LOCKERS FOR HARD HATS & WORK CLOTHES
- STORAGE FOR STAIRS DURING TRAVEL
- STORAGE FOR EMPTY SAMPLE CONTAINERS

GENERAL
- HEAT AND AIR CONDITIONING
- VENTILATION
- SIDE DOOR FOR DIRECT ACCESS TO PPTR
- LIGHTS (FLUORESCENT FOR LOW PROFILE)
- 110 VAC CONVENIENCE OUTLETS
- STEP STANDS (2)
- JACKS
- WINDOWS OPTIONAL

COMMERCIAL SOURCE

HARDWARE ITEMS AVAILABLE FROM:
McMASTER CARR SUPPLY COMPANY
P.O. BOX 4355 CHICAGO, ILLINOIS [illegible]

- CHAIN HOIST, 750 LB. CAP. CAT # 3250 4T
- HAND TRUCK, CAT # 26 Z123
- TRAILER JACKS # 2942 T16
- MAGNETIZED SPIRIT LEVEL # 2169
- MAINTENANCE WORK BENCH # 477Y22
- LABORATORY STOOLS # 4818X21
- EXTENSION PLANK FOR ACCESS TO ORIFICE 12" WIDE X 10 FT LONG # 8040X1
- LOCKERS, DOUBLE TIER, 12X18, # 4962 X26
- TEMPERED PYREX SIGHT GLASSES 8 3/8 DIAM X 3/4 THICK # 847 P55
- RAPPING VIBRATOR, VARIABLE FREQUENCY # 58 MO 61
- SQUARE MESH PERFORATED METAL 3/4 SQUARES 57 % OPEN 18 GAUGE # 9353 X4
- TURNBUCKLES, STEEL, ¼, EYE & EYE # 3012 X1
- HIGH TEMPERATURE ASBESTOS PACKING FOR SIGHT GLASSES, ALUMINUM FOIL COVERED ¼ X ¼ # 9471
- EXHAUST FANS FOR SAMPLING STATIONS 24" FAN WITH INLET SAFETY GUARD AND AUTOMATIC SHUTTERS # 1916 N11
- WALL LADDER, PERMANENT MOUNT # 7983 Z

SOUTHERN RESEARCH INSTITUTE BIRMINGHAM, ALABAMA 35205		TITLE MOBILE PILOT PRECIPITATOR
DRAWN [illegible] DATE 9-[illegible]	DWG. NO. 2887-1 C-21	GENERAL NOTES

APPENDIX II

PILOT ELECTROSTATIC PRECIPITATOR
OPERATING GUIDE

SORI-EAS-77-040

PILOT ELECTROSTATIC PRECIPITATOR

OPERATING GUIDE

by

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Project No. 3419

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Prepared For

INDUSTRIAL ENVIRONMENTAL RESEARCH LABORATORY
ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, N. C. 27711

January 18, 1977

PILOT ELECTROSTATIC PRECIPITATOR OPERATING GUIDE

Introduction. The operating techniques for utilizing the pilot E.S.P. will be developed as the test personnel become more familiar with the individual characteristics of the particular unit. This document was prepared as a guide for use in the early checkout and performance stages of the device.

Initial Installation and Checkout

The test location should be surveyed prior to moving the test facility to the test site. A sketch of the available space should be prepared and access ports installed. Arrangements for electrical power should be made with plant personnel. A plant contact should be established at this time.

The particulate and gas extraction ports should be located and an acceptable sample extraction nozzle designed. This design should provide for near isokinetic extraction at the mid-range of the anticipated operating volume flow rate.

In some instances, it may be desirable to provide for a sample extraction array and plenum to provide for a more representative sample extraction. In those instances where significant temperature or dust concentration variations occur within the ductwork this alternative should be considered. This plenum design may be equipped with variable cross sections for the sample extraction as a means for maintaining isokinetic sampling over an acceptable range of gas volume flow rates. This variable throat sampling need not always be provided; only in those cases where the fundamental purposes for the test program dictates the need.

The pilot electrostatic precipitator and laboratory trailers should be moved to the test site and located on the predetermined positions. The ductwork should be checked and positioned to determine if the connections are adequate. The internals of the pilot unit should be inspected and corrected while the electrical connections and ductwork are being installed.

After the electrical connections are complete, the test facility fan should be tested. Air load voltage vs current data should be recorded and compared with previous curves. The ash removal system and other auxiliary equipment should be checked.

Initial Tests

At the completion of the installation, inspection and check-out portion, the system should be activated to pull hot particulate laden gas through the test unit. The test unit should be allowed to thermally equilibrate; after which gas velocity distributions and hot gas voltage vs current data should be recorded and analyzed.

If the gas velocity distribution is inadequate, corrections should be made to the inlet system to obtain an acceptable gas flow quality. The V-I data should be provided in order to select an operating point for the power supplies for the tests.

Initial mass, resistivity and gas analysis tests should be performed on the pilot plant. Parallel tests should generally be conducted in the main flue to assure that representative conditions exist in the test unit. These data should be evaluated prior to the initiation of the main test program.

Experimental Test Program

A test plan should be prepared for the main test program prior to moving the equipment to the test site. This test plan should be reviewed for the test crew and task assignments made. At the beginning of the field experimental program, a shakedown test should be conducted. This evaluates the adequacy of equipment, space and port allowances and smoothness of operation. At the completion of the shakedown test, the results should be compiled and the adequacy of the test plan reviewed. A daily test log should of course be maintained for the test.

The complete test program should now be conducted. It is advisable to conduct review meetings between key test personnel at intervals during the actual tests. At these times the adequacy of the tests and any required modifications to the test plan can be discussed.

At the completion of the test program, each key test person should review his data to ascertain that adequate samples have been collected and preserved. These samples should be carefully labeled and packaged for shipment. The daily test log should be reviewed prior to concluding the tests.

Equipment Preparation

The test facility should be carefully disconnected from the test site and prepared for moving to a new location. Specific packing assignments should be prepared with one person responsible for checking prior to departure.

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

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15. SUPPLEMENTARY NOTES IERL-RTP project officer is Dale L. Harmon, Mail Drop 61, 919/541-2925.

16. ABSTRACT The report summarizes work done to provide the general design and assistance in evaluating a mobile electrostatic precipitator (ESP) built for the EPA by the Naval Surface Weapons Center, Dahlgren, Virginia. The mobile test facility was designed to aid IERL-RTP in evaluating ESPs in a variety of industrial applications. The test facility design included both a pilot scale ESP and a laboratory van. The two units comprise a self sufficient facility, except for external sources of electricity and water.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution	Air Pollution Control	13B
Electrostatic Precipitators	Stationary Sources	13I
Mobile Equipment	Particulate	15E
Laboratories		14B
Design		
Tests		
Dust		11G

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