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February 23, 1998

FEB 24 1998

BUREAU OF  
AIR REGULATION

Mr. A. A. Linero, P.E.  
Administrator, New Source Review Section  
Florida Department of Environmental Protection  
Bureau of Air Regulation  
Twin Towers Office Building  
2600 Blair Stone Rd.  
Tallahassee, FL 32399-2400

Subject: Electrostatic Precipitators

Dear Mr. Linero:

In my last week's mailing of the precipitator information provided pursuant to our PSD permit, I omitted the inclusion of the proposal by Environmental Elements which underlies the purchase order you received.

This document contains greater details of the design and of the guarantees for this equipment (see section 4).

Sincerely,

A handwritten signature in cursive script that reads "Fred W. Cohrs".

Fred W. Cohrs  
Vice President

FWC/bs  
Enclosure

ENVIRONMENTAL ELEMENTS CORPORATION  
ELECTROSTATIC PRECIPITATOR

FOR

POLYSIUS CORPORATION

ATLANTA, GEORGIA

FOR

FLORIDA ROCK INDUSTRIES  
THOMPSON S. BAKER CEMENT PLANT

NEWBERRY, FLORIDA

Environmental Elements Corporation  
Proposal Number ACS-95-04-15290-R2110E-FC  
August 11, 1997

TABLE OF CONTENTS

MANAGEMENT SUMMARY

SECTION 1 PROPOSAL SUMMARY

TECHNICAL SECTION

SECTION 2 DESCRIPTION OF EQUIPMENT

SECTION 3 TECHNICAL TABULATION

SECTION 4 OPERATING CONDITIONS AND GUARANTEES

COMMERCIAL CONSIDERATIONS

SECTION 5 PROPOSAL PRICES

SECTION 6 GENERAL CONDITIONS OF SALE  
FOR MATERIAL AND EQUIPMENT

ENVIRONMENTAL ELEMENTS CORPORATION

SECTION 1  
PROPOSAL SUMMARY

SECTION 11. PROPOSAL SUMMARYA. DESIGNATION

Throughout this proposal, Polysius Corporation, Atlanta, Georgia 30339 and Environmental Elements Corporation, Baltimore, Maryland 21203, shall be referred to as "Buyer" and "Seller", respectively.

B. TRADEMARKS

Trademarks of Environmental Elements Corporation, Baltimore, Maryland 21203.

ENELCO®  
RIGITRODE™  
DIGICON®  
OPTI-CON II®  
MODULOK®  
OPTIPULSE™

C. SCOPE -- GENERAL

Seller will design, fabricate and deliver F.O.B. jobsite, two single chamber electrostatic precipitator one to clean the flue gases from the cement preheater kiln with roller mill circuit and one to clean the flue gas from the clinker cooler.

D. SCOPE -- SELLER

Included in the scope of this proposal as part of Seller's supply are:

1. Two single chamber electrostatic precipitators of the floating bottom design with trough hoppers.
2. A pressurized penthouse covering the entire precipitator hot roof for the housing of the high voltage insulators and bus bars, complete with pressurizing blower and insulator heaters.
3. Electric rapping system for the collecting plates, discharge electrodes and gas distribution plates, complete with solid state microprocessor rapper panel.
4. Transformer-rectifiers with digital microprocessor controllers.
5. Inlet and outlet nozzles.
6. Shop paint as described in the proposal.
7. Structural steel to support the precipitator from grade.

8. Access facilities to scope shown on the drawing.
9. Hopper conveyor and dust valve.
10. High dust level alarm system for the precipitator hoppers.
11. Insulation specifications.
12. A resident Construction Advisor/Superintendent. (Monthly rate)
13. Engineering personnel for mechanical and electrical inspections, precipitator start-up, and training of plant personnel. (Per Diem Rate)
14. Six (6) copies of operations and maintenance manuals.

E. SCOPE -- BUYER

Under this proposal, it shall be the responsibility of the Buyer to provide and/or complete the following:

1. Required foundations and anchor bolts.
2. All ductwork to and from precipitator, except inlet and outlet nozzles.
3. Inlet test ports with access thereto.
4. Stack with test ports and access thereto.
5. Dust removal system from the screw conveyor dust valve exit.
6. Performance tests.
7. Ventilated control room for rectifier controls.
8. Motor control center/power distribution panel.
9. Annunciator panel as required.
10. All interconnecting low voltage wiring.
11. Permanent area lighting.
12. Grounding of all precipitator equipment to mill grounding system.
13. Precipitator and nozzle insulation, insulation supports and lagging.
14. Erection of all materials furnished by Seller

F. GENERAL ARRANGEMENT1. Kiln/Mill Precipitator - Proposal Drawing 15290-D3-Rev. 3

ENELCO ESP Model SC 23-16-4x10.5x38T will be single chamber with 23 gas passages on 16 inch centers. The precipitator will have four mechanical and electrical fields in direction of gas flow. Each mechanical field will contain 24 collecting surfaces, 38 feet high by 10.625 feet long. This provides a total field length of 42.5 feet. Each of the four fields is independently powered.

2. Clinker Cooler - Proposal Drawing 15290-D-3 Rev. 3

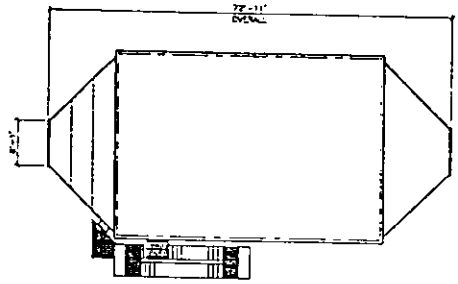
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G. DESIGN FEATURES

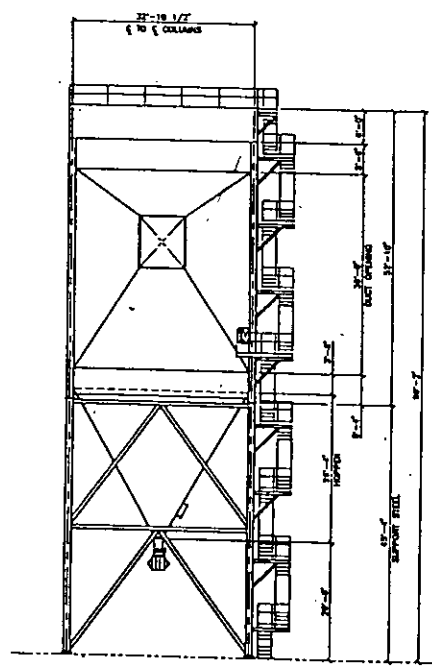
1. The ENELCO electrostatic precipitator utilizes the RIGITRODE discharge electrode. This is a virtually indestructible rigid mast electrode system.
2. Patented MODULOK collecting surfaces are included providing a factory assembled, rigid, baffled, one piece collecting electrode. Field assembly of collecting electrodes is not required.
3. DIGICON OPTIPULSE microprocessor automatic power controllers provide the latest state-of-the-art precipitator control. These user-friendly controllers are among the most intelligent and responsive voltage controllers available today, and include programmable intermittent energization. In-house construction and testing before shipment insures trouble-free field installations.
4. Top mounted electronic impulse rappers, complete with microprocessor controllers, provides an adjustable, essentially maintenance free, rapper system mounted outside of the gas stream.
5. Rigid frame casing construction with no internal struts or bracing to support dust build-ups or disrupt uniform gas flow. Minimal number of support points to grade for ease of site maintenance.
6. Nozzle and hopper designs incorporate minimum 55° sloped sides and no ledges to impede the flow of collected materials.

H. SCHEDULE

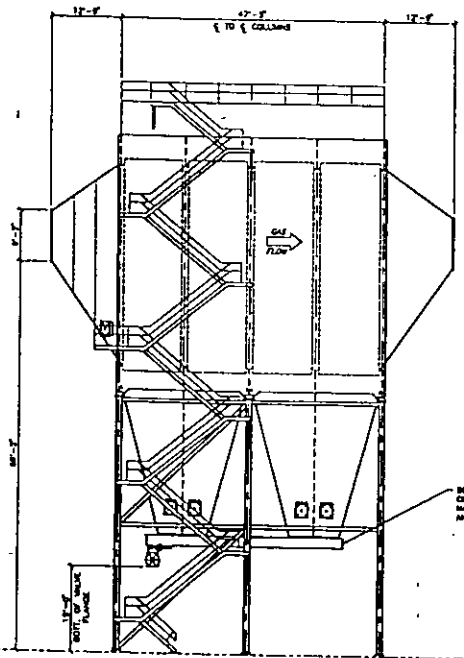
1. Material will be delivered to support erection starting April 1, 1997.



PLAN



INLET ELEVATION



SIDE ELEVATION

BOX TROUGH SCREW CONVEYOR WITH MANUAL SHUTE GATE AND ROTARY VALVE

NOTE: ALL DIMENSIONS ARE APPROXIMATE.

ENVIRONMENTAL ELEMENTS CORPORATION  
 3788 Magnolia Street  
 Baltimore, MD 21227 USA

POLYSIUS CORPORATION FOR FLORIDA ROCK  
 HEWBERY, FLORIDA  
 USA

PRELIMINARY ARRANGEMENT

REV	DATE	DESCRIPTION
3		REMOVED SIZE FROM CONVEYOR
2		REVISED BRACKET SUPPORT STEEL DIMENSIONS
1		ADDED MANUAL SHUTE GATE, REVISED HOPPER PLATFORM & INLET NOZZLE SIZE

SC-23-18-618-S-MK  
 RGD 8-11-87  
 RGD 7-28-87  
 RGT 1-27-87



SECTION 2

DESCRIPTION OF EQUIPMENT

SECTION 22. DESCRIPTION OF EQUIPMENTA. CASING

The precipitator casing is fabricated from 3/16 inch ASTM A-36 steel plate with external columns and stiffeners. The design utilizes rigid frame construction with no internal struts or bracing thus avoiding ledges for dust buildup and disturbance to uniform gas flow. The roof and all internal loads are supported by fabricated plate girders. The design utilizes a "floating bottom" system where the precipitator is anchored at only one point on the support steel. Lubrite sliding plates are provided for the other support points to allow for thermal expansion in all directions.

Seller's shell design allows 4'-5" head room above the top of the dust plates for interior access to perform maintenance or inspection.

Interlocked single wall doors are provided for penthouse roof access. Access to the area above the collecting plates is gained through non-interlocked double wall doors in the precipitator hot roof.

B. NOZZLES

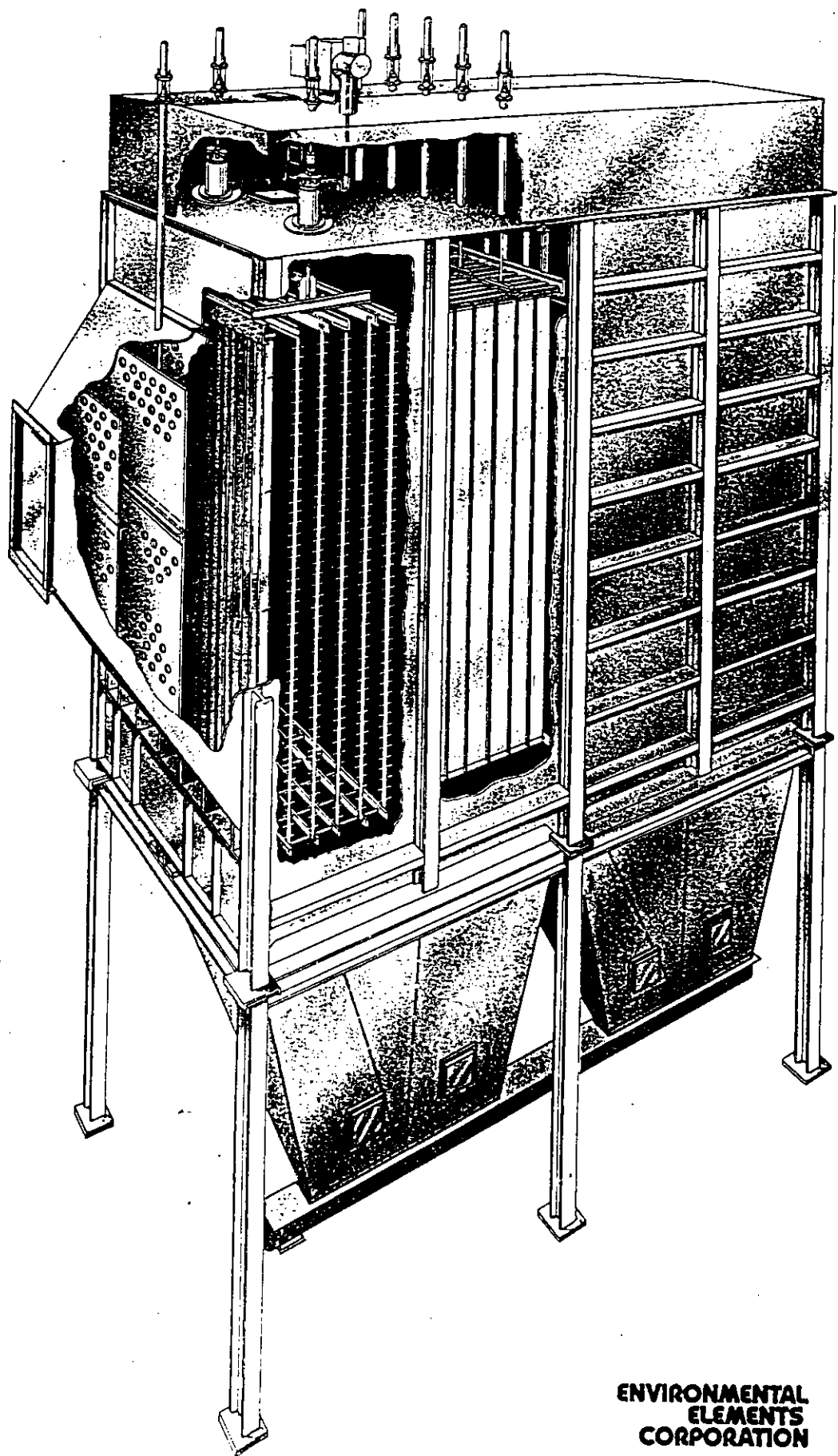
Inlet and outlet nozzles are fabricated from 3/16 inch ASTM A-36 steel with external structural stiffeners of uniform depth to provide full support for insulation and siding. The bottom of the nozzles are sloped 55° with no horizontal ledges to impede free flow of dust fallout inherent with reduction in gas velocity.

The inlet nozzle is complete with three perforated plates to distribute the gas across the face of the treatment zone. The lower 4 inches of the perforated plates are open to allow any dust that falls out in the nozzle to be carried into the inlet field hopper. A double wall, quick-opening, interlocked door is provided in each nozzle for internal inspection and maintenance. Bolted panels are incorporated into the perforated plates for through access.

C. HOPPERS

Trough type hoppers are provided fabricated from 1/4 inch ASTM A-36 steel with external stiffeners of uniform depth to provide support for thermal insulation and siding. The hoppers are designed to support a full dust load. The sides and ends are sloped 60° and 75°, respectively, from the horizontal. The valley angle resulting from this design is 57-1/2°.

The between field baffles are extended to the hopper outlet to eliminate gas bypassing in the hoppers. A double wall interlocked door is provided as shown to permit access into each baffled section of each hopper. Each hopper is provided with high level alarms, strike plates for manual hopper rapping, and dust removal system. Hoppers should not be used for storage.



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D.    HOPPER LEVEL DETECTORS

A Bindicator or equal high level switch is provided for each section of each hopper. This system operates by radio frequency oscillation, which is dampened by a high ash level, producing a proportionate A/C signal. The detector operates a DPDT relay for alarm actuation. The probe is mounted in the side wall of the hopper with the electronics mounted in the hopper area away from high temperatures.

E.    DUST REMOVAL SYSTEM

The dust removal system consists of hopper screw conveyor sized to operate at 25 rpm maximum to reduce wear. The hopper conveyor is designed for normal rated conditions and powered for flooded operation in the event of hopper dust buildup.

To insure positive dust removal a Sprout Bauer, or equal, motor operated rotary dust valve with Type 2 rotor with ni-hard adjustable tips is furnished at the outlet of the hopper conveyor.

F.    PRECIPITATOR SUPPORTING STEEL

Structural steel is provided to support the precipitator as shown on the proposal drawings. All columns, beams, wind bracing and other structural members supplied by Seller for support of the precipitator will be rolled or fabricated from ASTM A-36 steel. Connections will be bolted and the overall structural design will be in accordance with the latest applicable AISC Standard except as noted under Design Conditions. The support steel and bracing is arranged to provide maximum access for maintenance and cleanup.

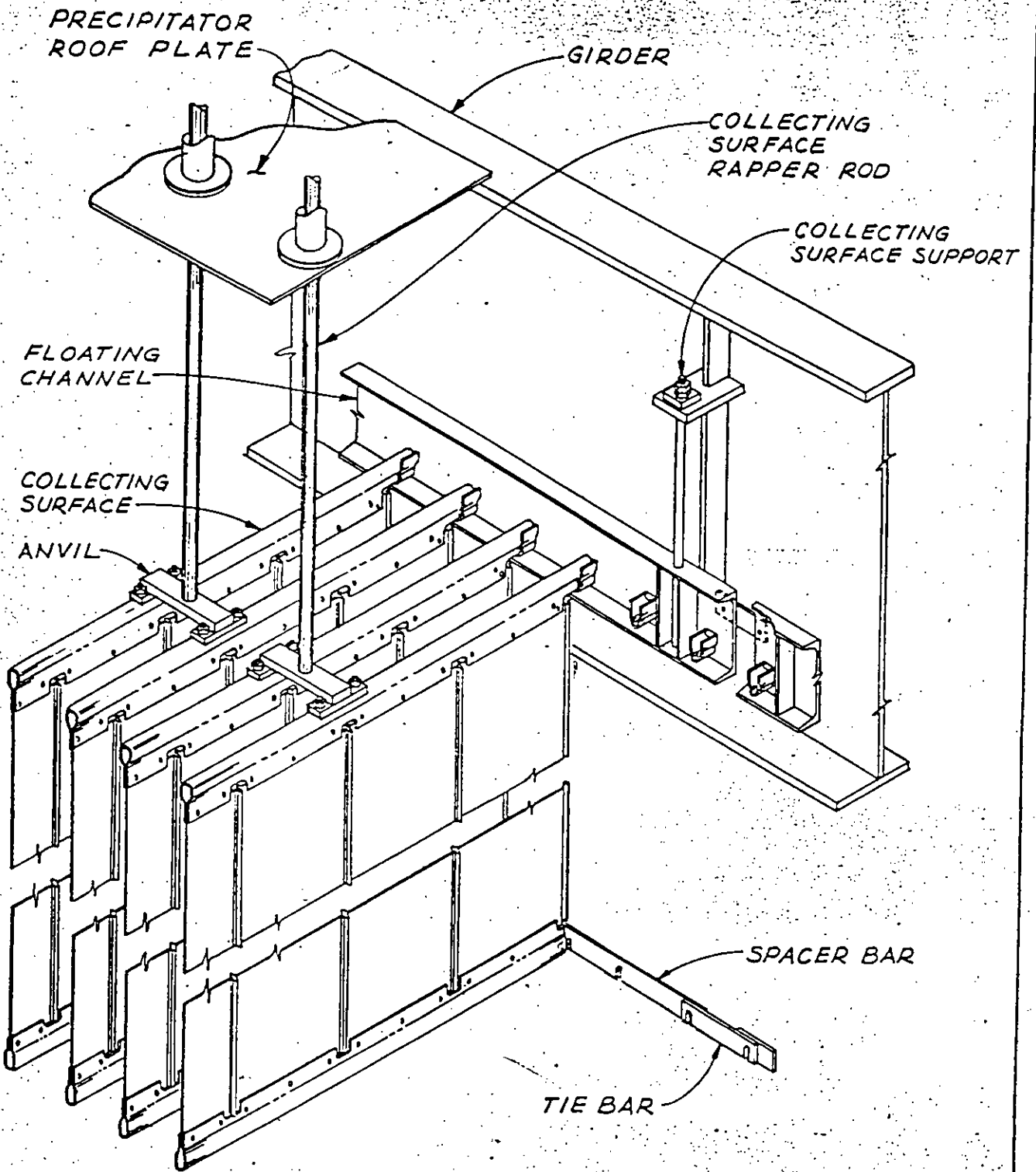
G.    ACCESS FACILITIES

Access facilities are provided to the scope as shown on the proposal drawings. Structural steel is ASTM A-36 designed for 100 psf loading. Stairtreads and grating are galvanized. The handrail will be dual rail using 1-1/4 standard pipe rail and post. Platforms will be provided with 4 inch x 1/4 inch toe plates. Walkways are 36 inch minimum width. Stairways are 30" width.

H.    COLLECTING ELECTRODE SYSTEM -- Drawing No. 1120

Seller's C1010 steel MODULOK collecting surfaces (U.S. Patent # 3,418,792) are roll formed into 18 inch modules having tightly interlocked edges which when factory assembled form a rigid one piece baffled structure, which provides maximum stiffness, optimum gas exposure and minimum field assembly.

The top and bottom edges of each collecting surface are reinforced and stiffened by 7 gauge and 11 gauge respectively tubular structural members which are factory welded to the roll formed collecting surfaces. These members prevent edge effect arc-over where the discharge electrodes enter and leave the collecting field. This horizontal welding at the top and bottom is the only heat applied to the plate during manufacture. This procedure prevents the deformation and "oil-canning" which can easily result when individual modules



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COLLECTING SURFACE  
RAPPER ARRANGEMENT

ELX 2-21-76

DWG. No 1120

are welded together. The collecting surfaces are rapped by electric impact type rappers located on the penthouse roof. Full provision is made in the collecting system suspension for uniform thermal movement up to the maximum design temperature without disturbance to internal alignment.

These collecting surfaces are shipped and lifted into the precipitator shell in nested, upright packages thereby affording maximum protection against handling damage for optimum straightness and uniformity in operation.

I. DISCHARGE ELECTRODE SYSTEM -- Drawing No. 1121

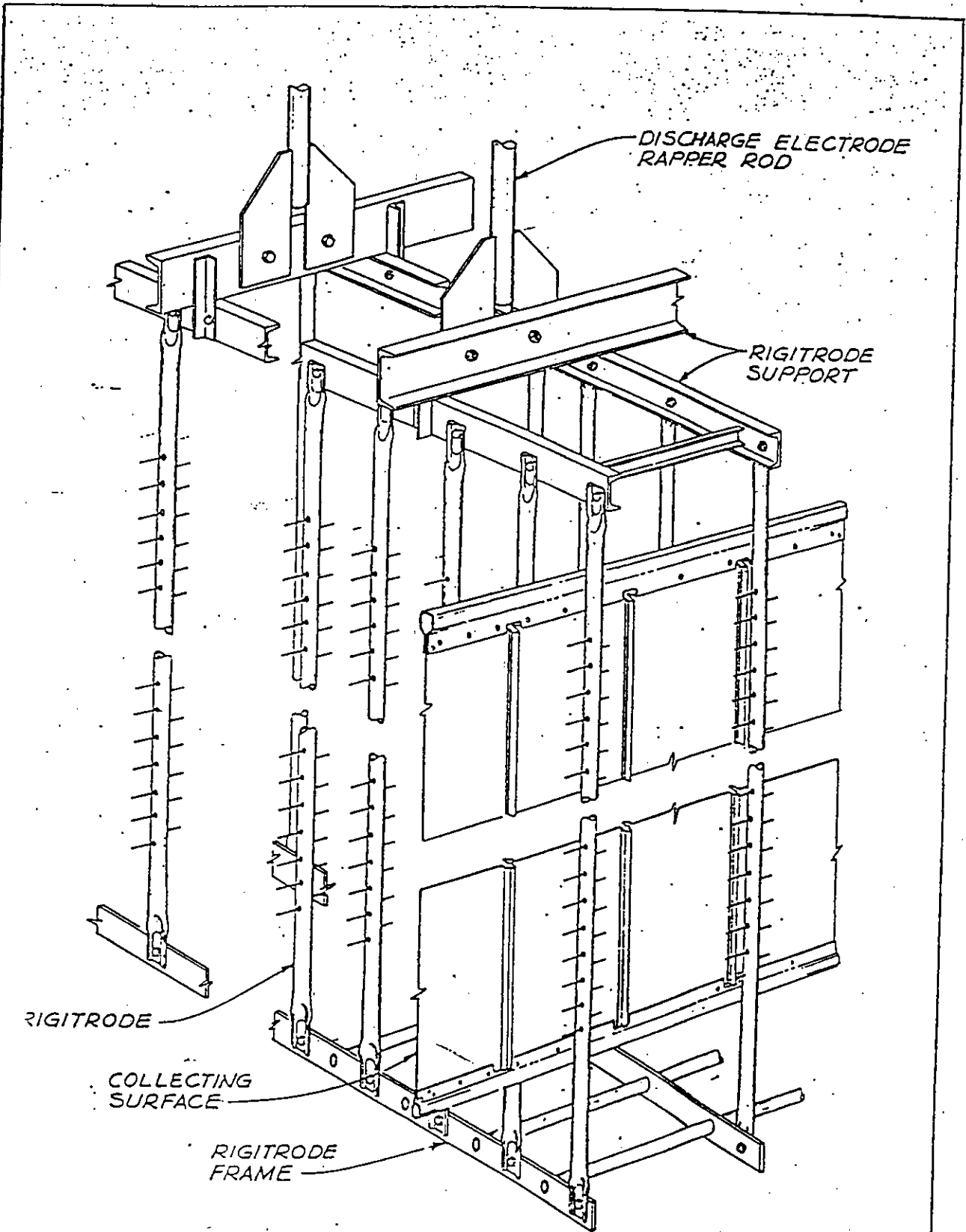
Seller's RIGITRODE electrode is a true unbreakable rigid discharge electrode. The RIGITRODE electrode is a 1-1/2 inch diameter 16 gauge mild steel tube with corona-generating studs welded to it. The studs are 12 gauge and are fully annealed to eliminate fatigue cracking. The RIGITRODE electrode exhibits a low corona onset voltage typical of a pointed discharge electrode. This feature makes it appropriate in inlet fields where dust loadings are high. As voltage is increased, the V-I relationship approaches that of a smooth electrode. This feature allows the same RIGITRODE electrode to be used effectively in outlet fields. Laboratory tests and commercial operation has shown this design to have a unique combination of several characteristics: high sparkover voltage, high field strength and an even current distribution from discrete emission points.

The restoring forces of this system are substantial; therefore, an overfull hopper will not cause permanent misalignment. The system will return to correct alignment when the hopper is emptied, thus avoiding unscheduled outages. Further, the computerized power control (discussed in detail later in this proposal) will protect the power supply and prevent the formation of fused ash in a full hopper.

J. HIGH VOLTAGE SUPPORT -- PENTHOUSE DESIGN -- Drawing No. 1217

Each bus section is supported by two (2) suspension insulators located on the precipitator roof. An epoxy filled glass filament rod connects an externally located rapper to the high voltage support rod to transmit energy while at the same time providing the necessary electrical insulation.

The insulators are housed in a gas-tight 6 foot high penthouse covering the entire roof area. The sides are fabricated from 10 gauge steel. The roof is fabricated from 1/4 inch checker plate to provide a firm walk surface. All rappers, transformer-rectifiers and rapper panels are located on the penthouse roof allowing inspection and maintenance with the precipitator in operation. The penthouse construction reduces the radiator effect of the many projections through the precipitator and eliminates the roof corrosion inherent with the use of individual insulator compartments. The insulators are totally accessible for cleaning and inspection. The penthouse roof is sloped 1/4 inch in 12 inches for drainage. The penthouse is pressurized by a forced air system, sized to supply 100 cfm per insulator, to prevent the entrance of dust into the penthouse and to keep the inside surface of the support insulators clean.



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**RIGITRODE  
DISCHARGE ELECTRODE  
ARRANGEMENT**

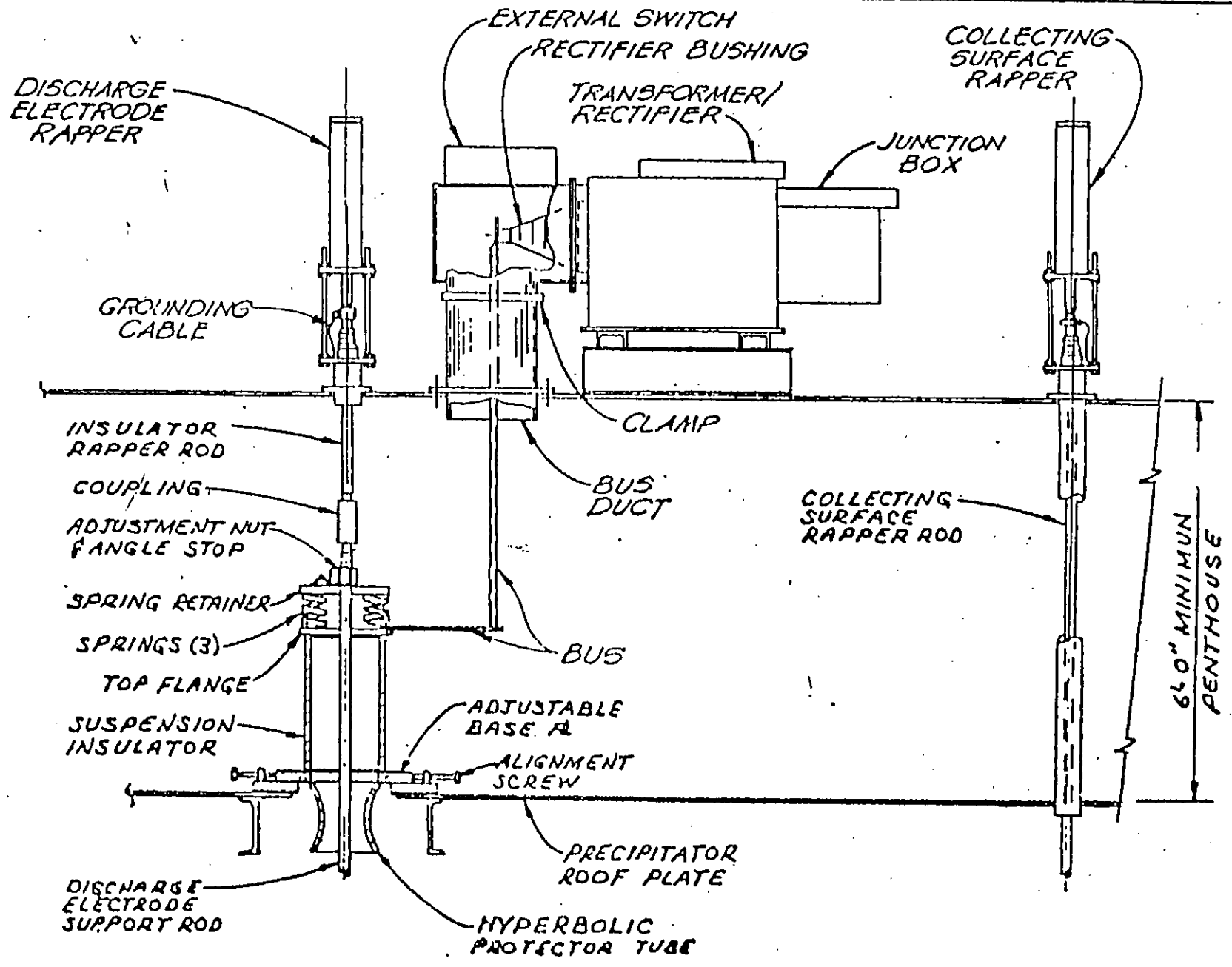
REV.  
ELK 10-25-00

DWG. No. 1121

A.L.W. 2-24

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HIGH VOLTAGE SYSTEM  
PENTHOUSE ARREST



DWG. NO. 1217



K. INSULATOR HEATERS

A 0.4 KW contact heater is provided around each support insulator. Insulator heaters are not essential to operation of the precipitator since the precipitator is normally heated prior to energization. The insulator heaters are included, however, as insurance in the event that the precipitator is energized cold.

L. ELECTRIC IMPULSE RAPPER MODEL ESI-I – Drawing No. 1076

The electric impulse rapper has been specifically designed for rapping the collecting surfaces, discharge electrodes and perforated distribution plates of electrostatic precipitators. The ESI-I is a single impulse gravity impact type rapper consisting of an integral DC coil and steel housing assembly, a 20 pound piston and mounting hardware. Its features include:

Accurate Control. Rapper impact is precisely repeatable. Intensity of impact and frequency of operation are controlled by a microprocessor based controller. With the optional Data Management System, the operating characteristics can be controlled from a remote control room through the CRT.

One Piece Construction. The coil is permanently bonded to the inside of the housing and is totally encapsulated in epoxy to seal out the environment. Long life is assured with this uncomplicated construction.

Lubrication. None is required.

Maintenance Free. The ESI-I requires absolutely no periodic adjustment or maintenance over its entire service life.

Roof Mounting. The rapper is mounted on the roof by means of three (3) support rods. The piston moves freely in and out of the rapper body when striking the rapper rod. The impact does not impart a shock to the housing which eliminates any chance of material fatigue. The rapper is weatherproof for outdoor operation.

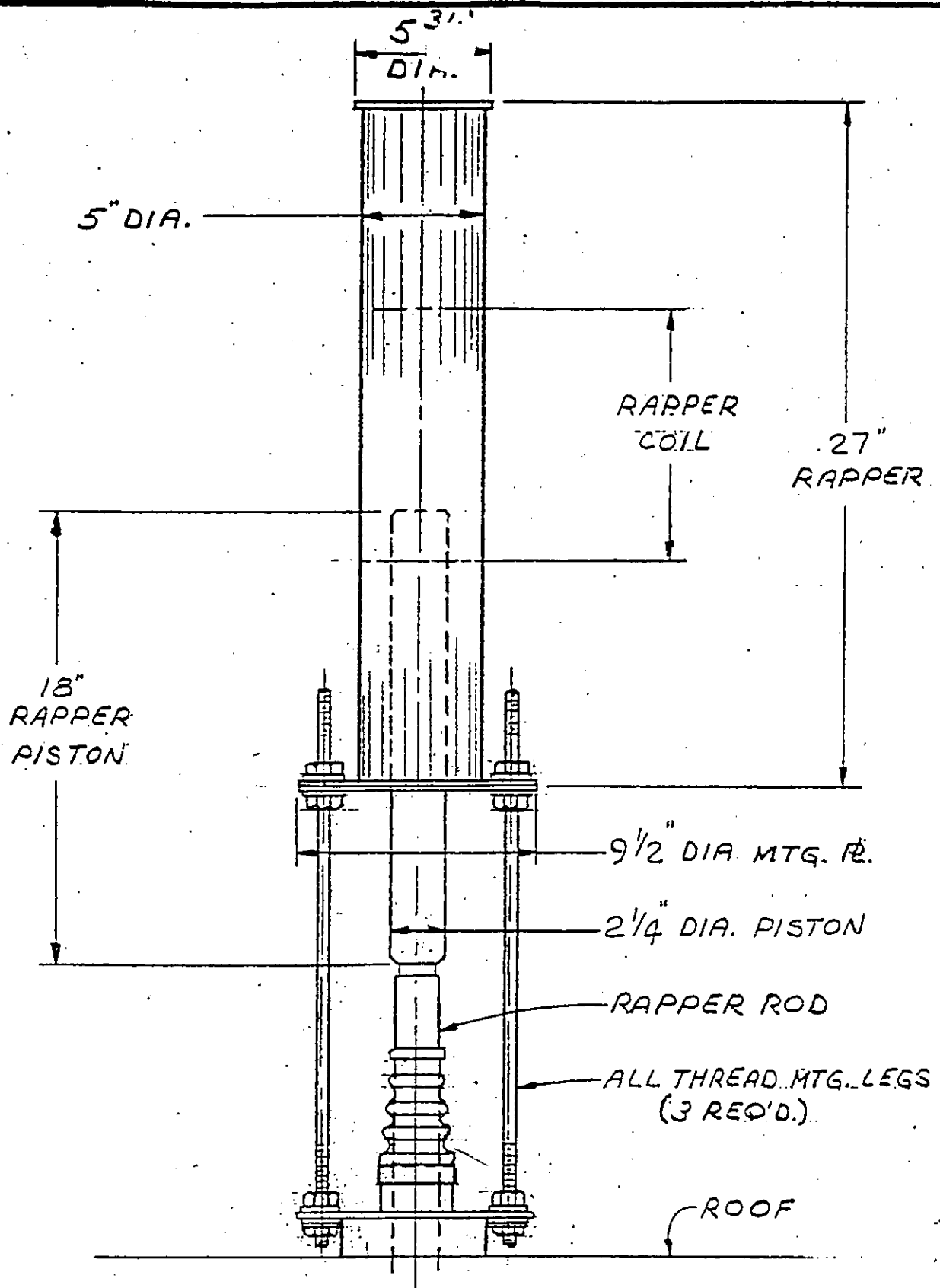
Power Supply. The rapper operates from a 240 volt supply and draws an instantaneous current of 22 amperes maximum. The three (3) wire conductor cable supplied with the rapper is used to make the electrical connections. An additional grounding strap is provided for connecting the housing to the precipitator roof.

Energy Output. Microprocessor controlled output levels are provided.

M. RAPPER CONTROLS

The microprocessor based rapper controls are housed in a NEMA 4 weathertight enclosure.

The rapper control system is designed to operate within ambient temperature limitations of -25°C to 85°C. The rappers for the discharge electrodes and each collecting surface field are individually controlled to permit adjustment of rapper impact intensity and cycle time for each section. Impact is variable up to 10 foot pounds. On time is 1 to 8 half line cycles and



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ESI RAPPER

DWG. NO. 1076

off time is variable from 1 to 999 seconds. Control, rapper status indication and fault detection can be transferred to a remote location by multiplex signals from the optional Data Management System. For further details, see Attachments.

N. TRANSFORMER-RECTIFIER -- Drawing No. C37533

Each field is energized by a high voltage, coolant filled, silicon diode transformer-rectifier. Power is conducted to the precipitator through 3/4 inch A-36 steel bus bar enclosed in a 16 inch round 10 gauge A-36 steel water-tight housing.

The transformer is single phase, liquid cooled with the silicon diode rectifiers immersed in the same tank. Line voltage is regulated by a full range thyristor controller (SCR) which provides automatic power control. The current linear reactor is located in the junction box.

The transformer-rectifiers are furnished with a magnetic liquid level gauge, dial thermometer, drain, low voltage junction box and liquid filled bushings. The units are designed for a 55°C rise, at rated load, based on operation in an average ambient temperature of 40°C providing the maximum daily ambient shall not exceed 50°C. An alarm contact is provided on the temperature gauge.

The high voltage ground switch is integrated into the key interlock system to insure that the transformer-rectifier bushing is grounded before entry can be gained to the precipitator.

O. AUTOMATIC GROUNDING SYSTEM - Drawing No. C29652

The automatic grounding switch is located in the bus duct between the transformer-rectifier and penthouse insulator compartment. The automatic grounding of the high voltage system is solenoid activated when the transformer-rectifiers are deenergized on CO gas detection signal. The automatic grounding system will be provided for the kiln precipitator only.

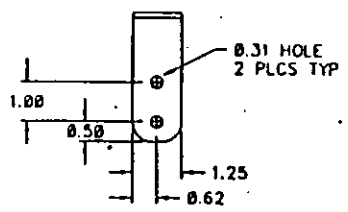
P. RECTIFIER CONTROL CABINETS -- Drawing No. 1224, 1225

Environmental Elements rectifier control cabinets are fabricated as attractive two section (2-PAC) dead front, NEMA 12 enclosures. The cabinets are independent of one another, each containing separate assemblies to apply voltage to the primary of an associated transformer-rectifier at levels determined by a dedicated automatic power controller. Access to all equipment is through the front door allowing easy access for maintenance. Components include the circuit breaker, contactor, control transformer, monitoring circuits, relays, firing circuit and Silicon Controlled Rectifiers (SCR's). The SCR assembly utilizes two (2) SCR's fitted to electrically isolated heat sinks of an appropriate size. The electronic components of the firing circuit are mounted on a printed circuit board attached to the heat sink. The firing circuitry determines the conduction angle (0° to 180°) of the SCR's as a function of the signal from the automatic power control or manual control.

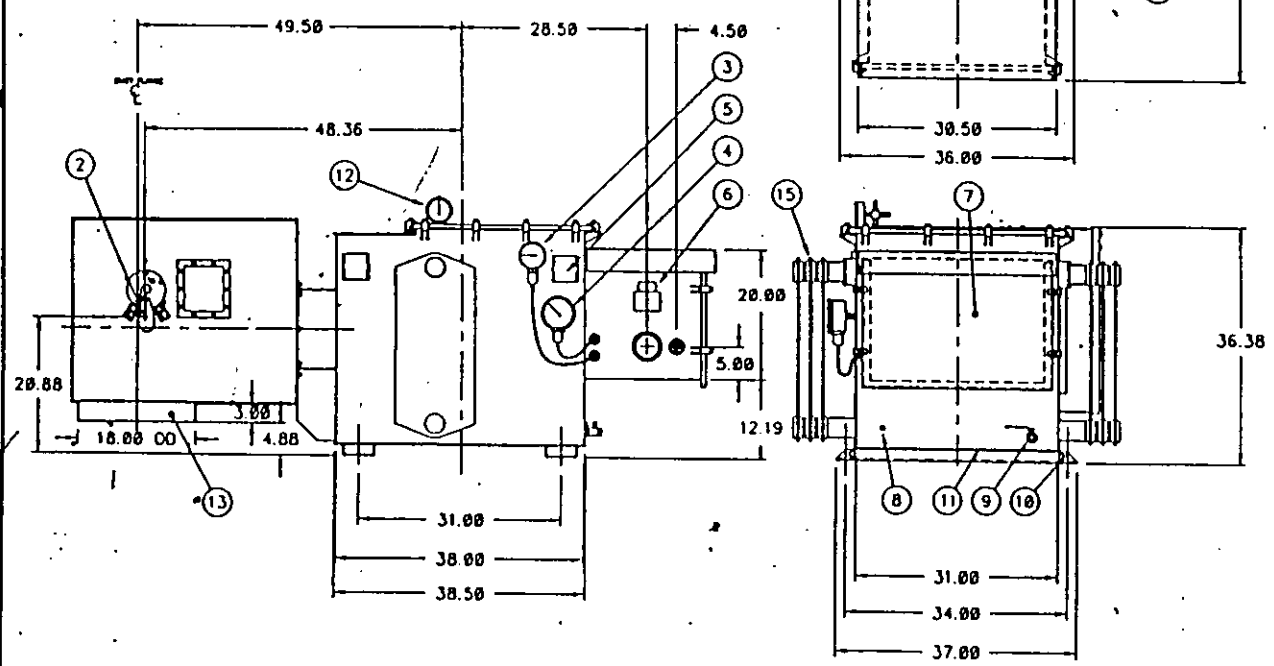
A separately enclosed high impedance linear reactor (CLR) with an iron core and air chimneys in the windings is connected in series with the SCR's to limit primary current surges during sparking.

1 2 3 4 5 6 7 8 9

A  
B  
C  
D  
E  
F



DETAIL "A"  
HIGH VOLTAGE CONTACT



MODEL NUMBER	OUTPUT		APPROX WEIGHT	FLUID CAPACITY	NO. OF RADIATORS	LOC. OF RADIATORS
	K.V.D.C.	M.A.D.C.				
39267	65	750	3000#	120 GAL	2	A, B
39268	65	1000	3300#	120 GAL	3	A, (2)B

- ① HANDHOLE FOR INTERNAL ACCESS WITH REMOVABLE COVER
- ② HIGH VOLTAGE CONTACT SEE DETAIL "A"
- ③ MAGNETIC FLUID LEVEL INDICATOR LOW LEVEL CONTACTS OPTIONAL
- ④ TEMPERATURE INDICATOR MOUNTED IN WELL TO FACILITATE REPLACEMENT OVERTEMP ALARM CONTACTS SHOWN ARE OPTIONAL
- ⑤ LIFTING CHANNEL, C4-7.25# x 4.00 LG. 4 PLC'S
- ⑥ NAMEPLATE LOCATION
- ⑦ LOW VOLTAGE JUNCTION BOX WITH REMOVABLE COVER AND TOP, 1 - 3" CPLG. 1 - 1" CPLG PROVIDED
- ⑧ GROUND BOSS, 1/2-13UNC THREAD WITH THREAD PROTECTIVE PLUG
- ⑨ 0.5" VALVE & PLUG FOR DRAIN OR SAMPLING
- ⑩ MOUNTING HOLES, Ø.75 DIAMETER 4 PLC'S
- ⑪ 0.25" PLATE BOTTOM WITH (2) FORMED STEEL CHANNELS
- ⑫ 0.5" FILL CPLG. WITH PRESSURE RELIEF VALVE PRESSURE-VACUUM GAUGE OPTIONAL
- ⑬ H.V. DUCT FLANGE, 18.00 OD
- ⑭ GROUNDING SWITCH, 2 POSITION EXTERNAL WITH PROVISIONS FOR 2 ZERO BOLT EXTENSION INTERLOCKS. APPROVED LOCKS: KIRK TYPE F, SUPERIOR TYPE B4003, OR EQUIVALENT. REF DWG: D37449
- ⑮ COOLING RADIATOR

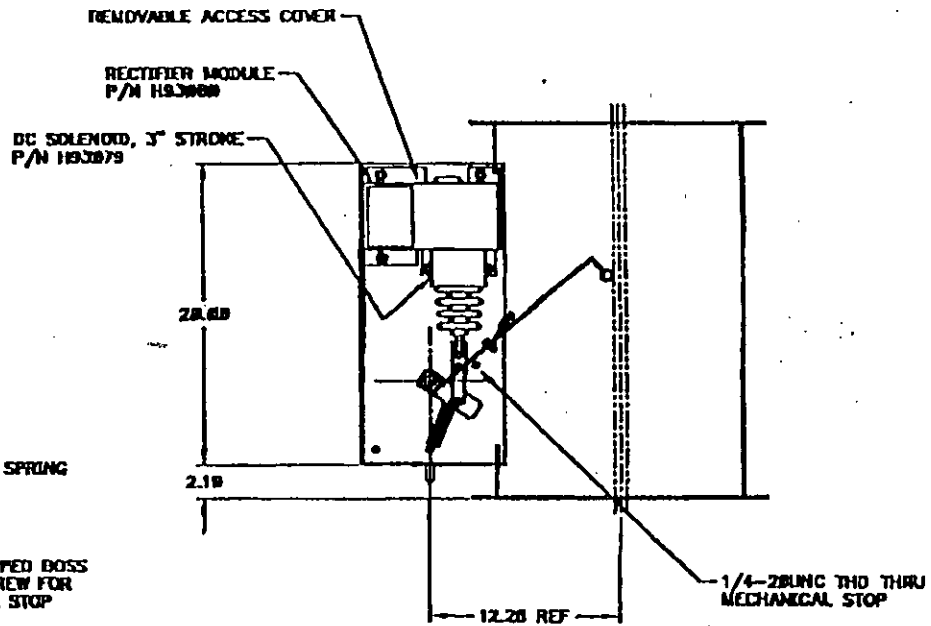
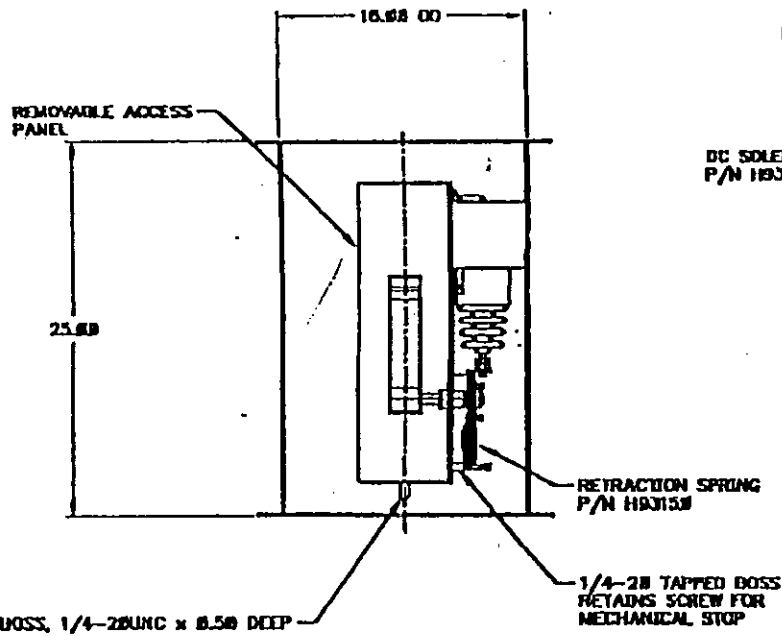
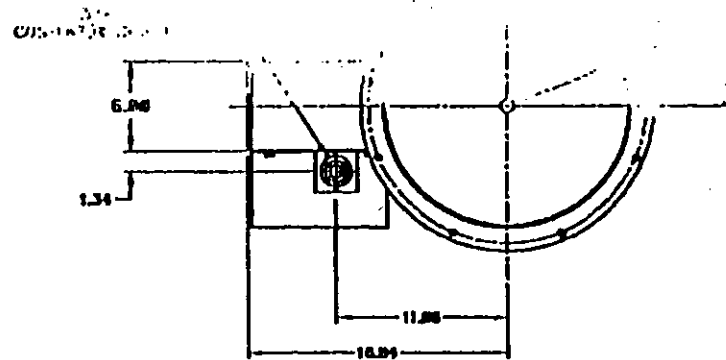
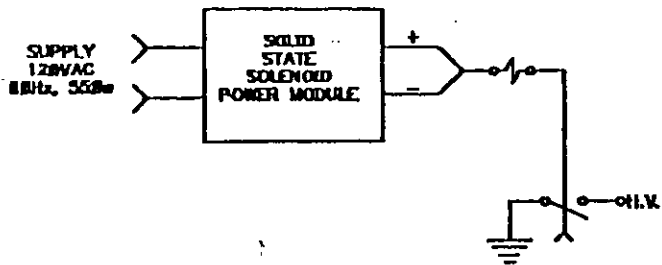
**RVI TRANSFORMERS**  
RISING SUN ROAD, BORDENTOWN, N.J. 08805

ENVIRONMENTAL ELEMENTS		
SCALE	DATE BY	REV
1=14	PGF	3/4/96
DATE BY	REV	
PGF	PGF	C37533

REV	DATE	BY	DESCRIPTION

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APR 24 '95 11:06AM BORDENTOWN NJ



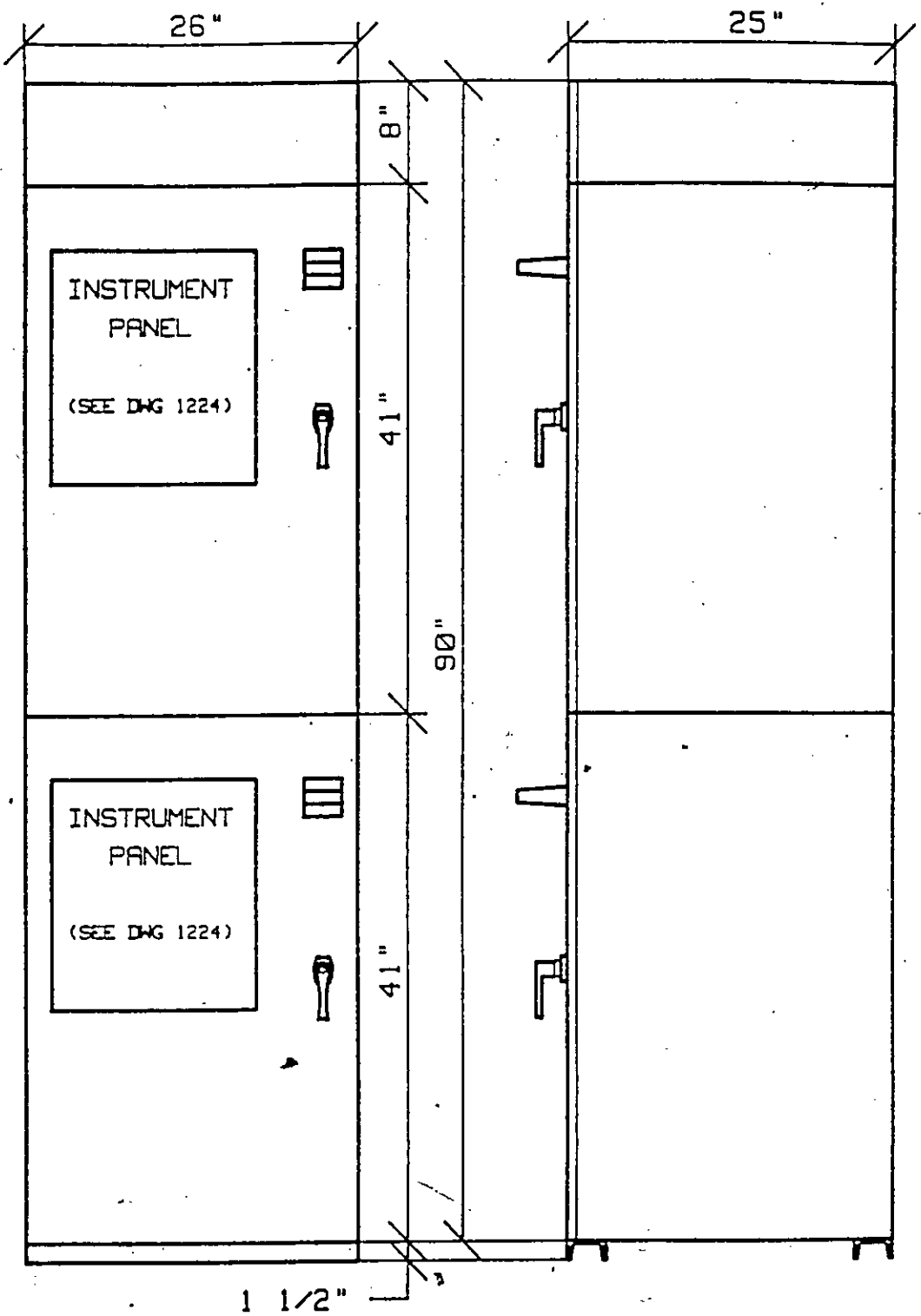
**NOTES:**

1. DUS DUCT IS TO BE SELF SUPPORTING.

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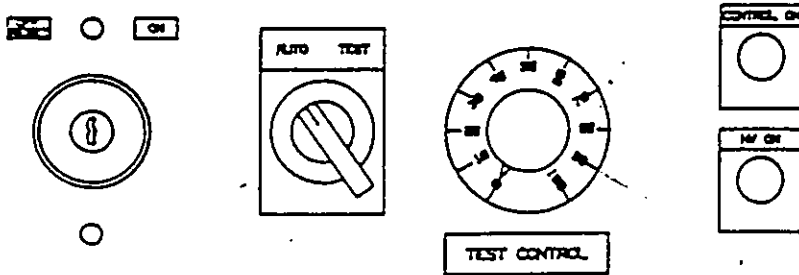
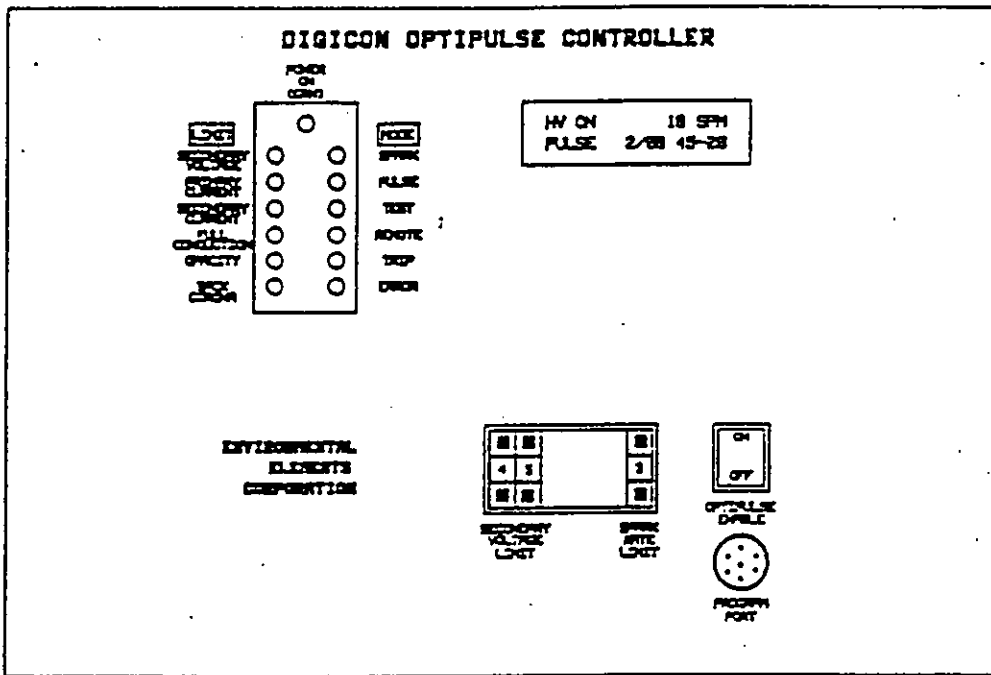
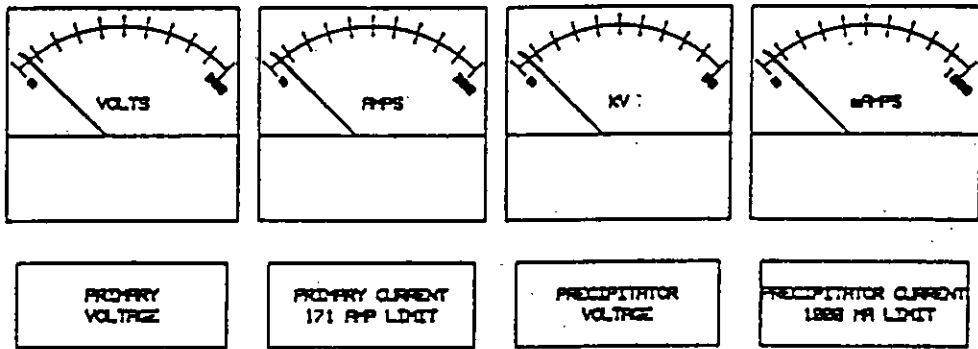
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C			REVISIONS
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A			REVISIONS

DWG. NO. REV. BY



<b>ENVIRONMENTAL ELEMENTS CORPORATION</b>	M.O. NO.	DUAL CONTROL CONSOLE WITH CIRCUIT BREAKER	
	SIZE <b>A</b>	DRAWING NO. 1225	REV.
DRAWN ATD 2-2-87	SCALE	SHEET	

AGE INC. - BALT.



R153

<b>ENVIRONMENTAL ELEMENTS CORPORATION</b>		M.O. NO.      INSTRUMENT PANEL	
DRAWN    J. HAMLIN	SIZE	FSCM NO.	DRAWING NO.      1224
DATE      2-16-87	SCALE		SHEET

The control cabinets also contains a number of features that protect the precipitator and other components. Associated fuses and surge arresters protect the SCR's and metering circuits against external circuit failure and transient current sparks. An electronic overcurrent relay provides additional protection.

To eliminate the manual monitoring of the units, each cabinet contains a DIGICON OPTIPULSE automatic power controller to maintain optimum power input to the precipitator.

Each controller has a two line 32 character alphanumeric Liquid Crystal Display (LCD) located on the front panel which presents a user-friendly interface to the plant operator. Controller faults, operating status and other information are presented in plain English.

Six standard alarms are annunciated through the controller:

- Overcurrent
- Undervoltage
- Overspark
- SCR Phase Imbalance
- High Ambient Temperature
- T-R High Temperature

In the event that power is interrupted due to one of the above mentioned faults, the fault is indicated on the LCD display. An additional three (3) alarm points are available for customized alarming (e.g. SCR high temperature, T-R low liquid level, ...etc.). Process related alarms may also be incorporated into the controller to trip the precipitator field due to such conditions as incomplete combustion in the boiler.

The DIGICON OPTIPULSE controller is described in more detail on the following pages.

Each cabinet is provided with the following meters:

- Primary Current
- Primary Voltage
- Secondary Current
- Secondary Voltage
- Spark Rate (Digital)

The control cabinets are equipped with face mounted breakers. The circuit breaker interrupting capacity is greater than or equal to 50,000 amperes symmetrical. As a safety feature, each cabinet is integrated into the key interlock system.

Where space is limited, the 2-PAC arrangement offers an attractive alternative to conventional rectifier control cabinets which house the automatic power controller, power components and current limiting reactor all in one enclosure.



Q.    DIGICON OPTIPULSE AUTOMATIC POWER CONTROLLER

The DIGICON OPTIPULSE Automatic Power Controller is a microprocessor based controller using the latest state-of-the-art components. The controller is equipped with dual specialized microprocessors for extremely fast processing of operational functions, and a 16K EEPROM for storage of all program parameters. The controller enclosure is NEMA 12, dust tight, and mounted inside the transformer-rectifier control cabinet. The ambient conditions can range from -10°C to +50°C and 0% to 95% humidity. On the front of the controller are two (2) digital selector switches: secondary voltage and spark rate. The controller uses this information to regulate the power level supplied to the precipitator. An additional selector switch is provided to enable the intermittent energization mode of operation. For further details regarding other features including host computer interfacing, user friendly displays and on line program modification capabilities, see Attachments.

R.    UNDERVOLTAGE RELAY PROTECTION

Dust build-up into the electrostatic field is a possibility with failure of the dust removal system. The result is high heat generated due to the resistive ground formed by the dust bridging the space between the discharge and collecting electrodes. This leads to distortion of the discharge and collecting systems. To guard against this, undervoltage protection is built into the controllers to trip the power and sound an alarm in the event of a dead short or ground.

S.    ALARM SYSTEM

Alarm contacts are provided in the following circuits for incorporation into Buyer's annunciator system. These contacts may also be integrated into Seller's optional Data Management System.

1. Transformer-rectifier control cabinet trip.
2. Penthouse blower failure.
3. Rapper failure.
4. High dust level in hoppers.
5. Dust conveying system failure.
6. Dust valve failure.
7. Hopper low temperature.

T.    GROUNDING DEVICES

Grounding devices, permanently located within the penthouse, are provided for attachment to the high voltage frame whenever work is being performed on the system.

U.    ELECTRICAL -- GENERAL

All electrical equipment furnished is in accordance with current accepted engineering practices including the National Electrical Code, NEMA standards and the AIEE standards, wherever they apply. Controls for the high voltage are assembled into self-contained units of standard dead-front switchboard construction.

All control circuits will operate on 120V unless otherwise specified. All pushbutton and indicating lights will be combination type. Terminal boards are furnished in each control panel to which customer's signal circuit or safety circuits may be connected.

#### V. INTERLOCK SYSTEM

Seller's offering is complete with key-interlock system for the portions of the precipitator where high voltage may be a hazard. Access may not be gained to these danger zones without first turning off the power and grounding the appropriate high voltage elements.

Interlocks are provided for the following:

1. Transformer-rectifier control cabinets.
2. Transformer-rectifier grounding switches.
3. Penthouse roof access doors.
4. Hopper access doors.
5. Inlet nozzle door.

#### W. ACCESS DOORS

Seller's standard quick-opening 22 inch x 28 inch access doors are provided. Each opening through thermal insulation will be of double-door construction consisting of a hinged, dogged outer door of ductile iron and a clamped steel inner doorplate, fabricated of 11 gauge carbon steel. Dogs and lugs on the outer door are made of stainless steel to assure free operation in all environments. This dual construction reduces or eliminates the need for insulation at the door area, and the inner plate provides an additional safety feature not found in competitive designs. The hopper inner door plate is provided with a 1-1/2 inch diameter inspection port which allows the operator to determine if the ash level is above the door level. A Viton coated aramid blend fiber gasket with a stainless steel mesh core is provided on the outer door to maintain a gas-tight seal, and positive interlocking is provided to prevent accidental entry. Each door bears a highly visible "Warning" sign made of enameled aluminum.

#### X. SHOP PAINT

External uninsulated surfaces will be cleaned per Specification SSPC-SP-6 and given one (1) coat of zinc rich primer.

#### Y. THERMAL INSULATION

Seller will provide thermal insulation specifications for the electrostatic precipitator system. Three inch thick, 8 pcf, 1000°F mineral wool and 0.032 inch ribbed unpainted aluminum lagging (exterior surfaces) is recommended to insulate the hoppers, inlet nozzle, outlet nozzle precipitator casing and penthouse sides. The penthouse floor should be covered with 3 inches of calcium silicate block insulation. The transformer-rectifier bus duct and the penthouse blower system need not be insulated.

Z. VENDOR'S LIST

The items not manufactured in fabrication shops are furnished by the following suppliers or equal.

Transformer-rectifiers:	NWL
Control Cabinets:	Electronic Power and Control
Rapper Panels:	Forry Incorporated
Hopper Alarms:	Drexelbrook, Bindicator,
Penthouse Blowers:	ACME or Equal
Screw Conveyors:	Jervis B. Webb Co., Summelot or Equal
Dust Valves:	Sprout Bauer or equal

AA. GAS DISTRIBUTION MEDIA AND BAFFLING (WITHOUT MODEL STUDY)

Uniform gas distribution to the precipitator is essential if performance guarantees are to be achieved for the specified service. Included in this proposal are the perforated distribution plates as shown on the proposal drawing. Other vanes, splitters, turning devices and grids as required for uniform gas distribution are to be included in the ductwork contract.

Seller has extensive experience with ductwork configurations and will provide an aerodynamic (not structural) design without additional charge or a model study.

AB. FIRE PROTECTION

The potential for fires exists in all equipment cleaning the exhaust gases from a pyro process where a combustible gas mixture or burning char carryover can occur through improper firing or loss of process control. Risk of fire is minimal where process monitors are installed and maintained to alarm and control a developing hazardous condition. In the rare instance where the process cannot be controlled, the precipitator must be de-energized until conditions are safe for restart.

AC. QUALITY ASSURANCE PLAN

Our Corporate Quality Assurance Section is staffed, trained and equipped to maintain effective quality management of a contract from the time it is awarded until final customer acceptance has been made.

This group routinely provides the following for all contracts:

1. Review of the customer's procurement and technical documents to determine that the requisite requirements have been defined and documented as well as to assure that Seller's resources and capabilities are adequate to meet the requirements.

2. Assist Seller's Purchasing Section in the selection and development of quality fabricators including judgments relative to potential fabricator's abilities to conform to those requisite requirements.
3. Review and assess, for approval, designated fabricator's quality systems including their organizational structure, responsibilities, procedures, processes and resources for implementing quality management to conform to contractual requirements.
4. Schedule source inspection visits by Seller's Quality Assurance Representatives (QAR's) to monitor in-process activities and/or to provide shipping releases.
5. Assure qualifications of all welders to AWS D1.1 for arc welding and AWS C1.1 for spot welding or equivalent as required.
6. Perform system, product and process audits as required to assure conformance and implementation to contractual requirements including the pertinent documentation.

SECTION 3  
TECHNICAL TABULATION

SECTION 33. TECHNICAL TABULATIONA. KILN MILL PRECIPITATOR1. Structural Design Parameters

a. Structural Design	AISC Code throughout
b. Wind Load	90 mph
c. Live Load	50 psf on precipitator roof 100 psf on all access
d. Seismic Zone	1
e. Dust Bulk Density - Structural Volumetric	115 pcf 35 pcf
f. Snow Load	Nil
g. Temperature	750°F
h. Pressure	±25 inches H <sub>2</sub> O

2. Mechanical Design Data

a. Number of Precipitators	1
b. Number of Chambers	1
c. Fields	4
d. Bus Sections Per Field	1
e. Total Number Bus Sections	4
f. Gas Passages	23
g. Spacing of Gas Passages	16 inches
h. Precipitator Casing Dimensions	See Drawing 15290-D-3 Rev. 3
i. Number & Type Hoppers	2 trough

- j. Hopper Material 1/4 inch A-36 steel
- k. Casing Material 3/16 inch A-36 steel
- l. Distribution Plates 12 gauge mild steel
- 3. Collection Surface Systems
  - a. Type of Material Modular Roll Form  
18 gauge Mild Steel
  - b. Baffle Stiffeners Integrally formed on  
18 inch centerlines
  - c. Number and Size of Surfaces 96@10.625'x38'
  - d. Total Active Collecting Surface 74,290 sq. ft.
  - e. Floating Channel Support System Leading and trailing edges of  
each mechanical field
- 4. Discharge Electrode System
  - a. Type 1.5 inch diameter Rigid Tube with  
emitting studs
  - b. Effective Length Per Electrode 38 feet
  - c. Number of Electrodes Per Gas Passage 28
  - d. Total Number Electrodes 644
  - e. Total Effective Length 24,472 feet
  - f. Suspension Insulators
    - (1) Number and Material 8 Alumina
    - (2) Manufacturer Coors
    - (3) Dry Arc-Over K.V. RMS 99.1 KV, 60 Cycle
    - (4) Wet Arc-Over K.V. RMS 97.0 KV, 60 Cycle
    - (5) Leakage Distance 19 3/4 inch

5. Rapping System

- a. Quantity and Type of Rappers                      Electrical impulse
  - (1) Collecting Surfaces                      48 Model ESI-I
  - (2) Discharge Electrodes                      8 Model ESI-I
  - (3) Perforated Distribution Plates                      1 Model ESI-I
  
- b. Weather-Proof Rapper Panels
  - (1) Material                      Steel - NEMA 4
  - (2) Quantity                      1
  - (3) Type                      Solid State
  - (4) Power Transformer                      15 KVA 480/240 volt

6. Electrical

a. Transformer-Rectifiers

- (1) Type                      Silicon
- (2) Voltage Rating                      70kv (DC Avg.)  
83kv (AC) RMS  
118 kv (DC) Peak
- (3) Output Wave Form                      Full Wave

	<u>Quantity</u>	<u>KVA</u>	<u>MA</u>
1st Field	1	100.1	1000
2nd Field	1	100.1	1000
3rd Field	1	100.1	1000
4th Field	1	100.1	1000

- b. T-R Insulation Fluid                      Mineral Oil
  
- c. High Voltage Switch Type                      One per T-R unit, interlocked grounding switch with observation window
  
- d. T-R Control Cabinet                      One per pair of T-R's  
NEMA 12 Construction
  
- e. Type of Control                      Thyristor (SCR)
  
- f. Maximum Ambient Temperature for Electrical Supply and Control Equipment                      40°C



- g. Electrical Supply 480 Volt, 60 Hertz, 3 Phase
- h. Maximum Expected Power Consumption
  - (1) Precipitator (T-R's) 182.7 KW
  - (2) Rappers 2.0 KW
  - (3) Insulator Heaters 3.2 KW
  - (4) Penthouse Blowers 1 1/2 HP
  - (5) Conveyor 25 HP
  - (6) Dust Valve 3 HP
- i. Total Connected Load (Transformer-Rectifier Units) 400.4 KVA
- j. Type of High Voltage Conductor 3/4 inch pipe in 16 inch round or square duct

7. Access Doors

- Penthouse Roof 2, single door, interlocked
- Precipitator Roof 4, double door, non-interlocked
- Nozzles 1, double door, interlocked
- Hoppers 4, double door, interlocked

8. Thermal Insulation - By Erector

- Precipitator Roof 3 inch calcium-silicate block  
AREA = 1558 sq. ft.
- Nozzles, Precipitator Sides 3 inch 8 PCF mineral wool
- Penthouse Sides and Hoppers AREA = 12948 sq. ft.

All lagging will be 0.032 inch ribbed aluminum on exterior surfaces.

9. Dust Removal

a. Hopper Conveyor Kiln ESP

- (1) Quantity and Size One 18" x 36'
- (2) Type - Trough 3/16" A-36 U through  
Screw Full Flight
- (3) Speed 20 rpm
- (4) Capacity @ 46% load 1200 cfh  
@ 100% load 2,614 cfh
- (5) Dust Density Volumetric 35 pcf  
Power 85 pcf
- (6) Drive 25 Hp end mounted reducer
- (7) Motion Sensor By customer

- b. Dust Valve Kiln ESP
- |                         |   |
|-------------------------|---|
| (1) Type                | Sprout Bauer Rotary Valve<br>w/Type 2 Rotar and Ni-Hard |
| (2) Adjustable Tips     |   |
| (3) Quantity and Size   | One Size 2018   |
| (4) Capacity @ 80% Load | 2,500 cfh   |
| (5) Speed               | 18 rpm ←  |
| (6) Drive               | 2 Hp  |
| (7) Motion Sensor       | Shaft Mounted   |
- c. Hopper Conveyor Clinker Cooler ESP
- |                                       |                                    |
|---------------------------------------|------------------------------------|
| (1) Quantity and Size                 | One 14" x 36'                      |
| (2) Type-Trough<br>Screw              | 3/16" A-36 U Trough<br>Full Flight |
| (3) Speed                             | 20 rpm                             |
| (4) Capacity @ 40% Load<br>@100% Load | 510 cfh<br>1274 cfh                |
| (5) Dust Density Volumetric<br>Power  | 35 pcf<br>85 pcf                   |
| (6) Drive                             | 15 Hp end Mounted Reducer          |
| (7) Motion Sensor                     | By Customer                        |
- d. Dust Valve Clinker Cooler ESP
- |                         |   |
|-------------------------|---|
| (1) Type                | Sprout Bauer Rotary Valve<br>w/type 2 Rotar and Ni-Hard |
| (2) Quantity and Size   | Adjustable Tips<br>One Size 1614                        |
| (3) Capacity @ 85% Load | 1250 cfh  |
| (4) Speed               | 20 rpm  |
| (5) Drive               | 1 1/2 Hp  |
| (6) Motion Sensor       | By Customer   |

# Andritz Sprout-Bauer MST Modular Rotary Valve

Rugged construction —  
cast iron, stainless steel, or  
cast iron lined with chrome  
— permits service to 15 psi.

Flow distributor at inlet  
minimizes torque required.

Outboard bearings prevent  
contamination of product.

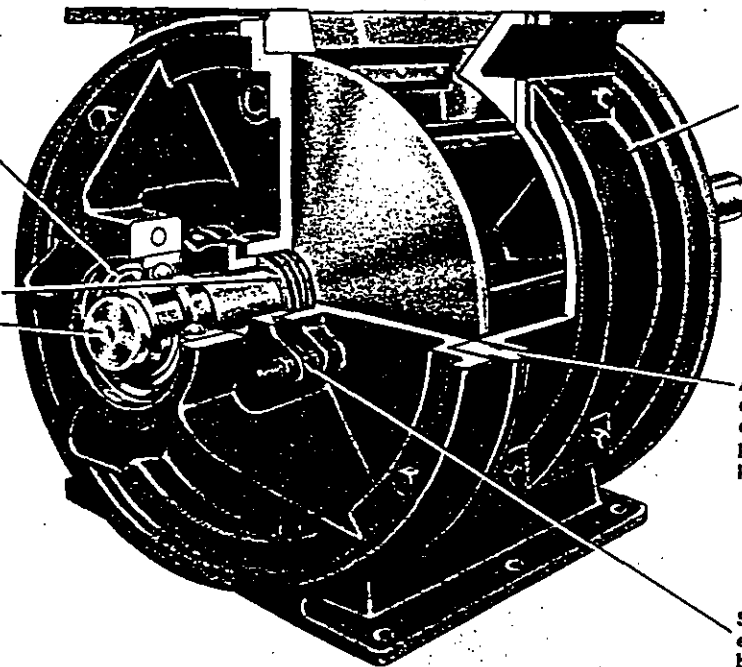
Full-length inspection panel  
allows easy cleaning and  
tip adjustment.

Integral stuffing boxes with  
four packing rings and air  
purge inlets in the end  
plates increase packing  
life and reduce mainte-  
nance costs.

Approximately 3/4-inch  
clearance between closed-  
end rotor and casing end  
plate minimizes packing of  
product.

Precision machining with  
normal radial clearance ro-  
tor-to-tip of 0.002" to 0.004"  
minimizes leakage.

Split packing glands allow  
easy access to stuffing  
boxes and reduce mainte-  
nance time.



Andritz Sprout-Bauer's modular rotary valves offer a wide range of sizes, models and materials of construction for versatile use in most pneumatic conveying and feeding systems. Andritz Sprout-Bauer valves provide rugged, trouble-free performance as feeders and air locks in both vacuum and low-pressure positive systems.

Andritz Sprout-Bauer's modular concept lets you stock fewer parts, reducing inventory costs. And Andritz Sprout-Bauer backs its valves with experienced service technicians and fast, dependable delivery of valves, systems and replacement parts.

## Abrasive and Corrosive Systems

For abrasive applications, the rotor shrouds and the bore of the housing can be hard-surfaced with a variety of abrasive resistant coatings and inlays, including an 1/8-inch stellite-lined housing for extremely abrasive conditions. Highly corrosive-resistant alloys are also available.

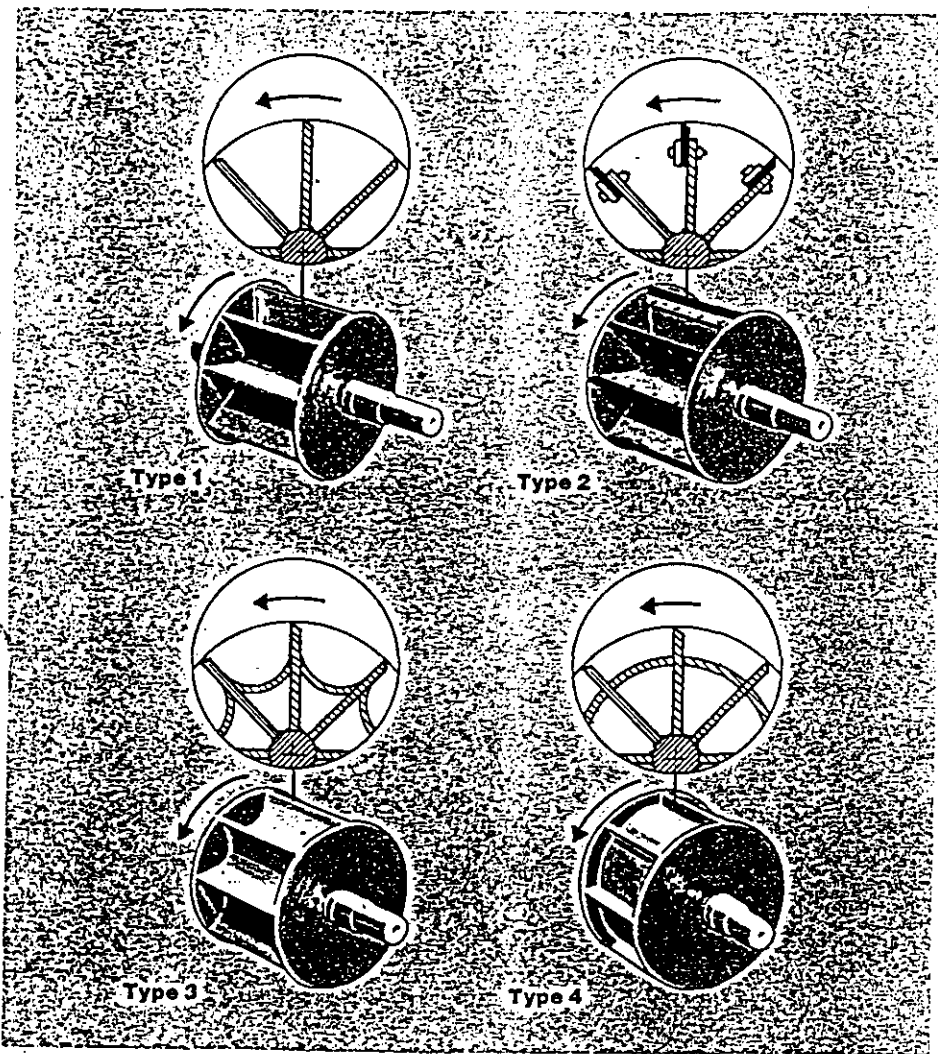
The split packing gland allows easy access to the stuffing boxes, where a minimum of three to four rings of packing maintains a proper seal. When the product is abrasive or difficult to seal, a lantern ring is available. Compressed air is piped into the lantern ring at a pressure one to two pounds above the valve's internal pressure.

## Options

Modular rotary valves are usually equipped with enclosed roller chain drives, parallel shaft motor and reducer or gear-motor drive packages. Other options include:

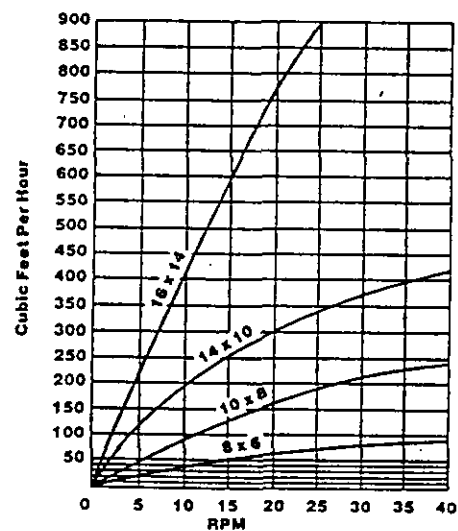
- right-angle gear motors
- variable speed drives
- weather-tight or oil-tight drives
- motion switches
- shearpin sprockets
- lantern rings

# Andritz Sprout-Bauer Rotors



- Eight pockets per rotor
- Type 2 features adjustable tips for close rotor-to-housing clearances, peak valve efficiency and maximum life. Tips are manufactured in abrasion-resistant steel, stainless steel and Ni-hard. Tips are also available in brass, neoprene, teflon and polyurethane.
- Shroud (end plate) periphery, vane edges and adjustable tips may be hard-surfaced to minimize the effects of abrasive materials on the rotor.

Side Inlet Valve Curve



Rotor Displacement (dimensions in inches)

ROTOR SIZE (DIA. X LENGTH IN INCHES)	Rotor displacement in cu. ft./rev.				NORMAL AIRLOCK RPM*	MAXIMUM RECOMMENDED FEEDER RPM*	NORMAL REQUIRED HP*	APPROXIMATE WEIGHTS (lbs.)	
	Type 1	Type 2	Type 3	Type 4				VALVES	DRIVES
0806	.122	.116	.063	.032	45	25	½	173	100
1008	.29	.27	.130	.070	45	25	¾	245	125
1410	.70	.65	.310	.155	45	25	1	443	185
1614	1.3	1.225	.650	.325	45	25	1½	640	250
2018	3.02	2.9	1.150	.575	35	25	2	1205	280
2422	4.95	4.92	2.30	1.15	31	25	3	2285	300

\* Dependent upon characteristics of material handled.

**SCREW CONVEYOR SPECIFICATION SHEET**

**CUSTOMER:** ENVIRONMENTAL ELEMENTS CORP.      **DATE:** 08/07/97  
**CUSTOMER REF:** BOB BROWN      **PAGE:** 2 OF 2  
**SPEC NUMBER:** 230      **PREPARED BY:** TERRY HANDLIN

**DESCRIPTION:** (1) 18" DIA. X 36'-0" LONG CARBON STEEL SCREW

**GENERAL SPECIFICATIONS**

<b>Incline:</b> 0	<b>Mat'l:</b> KILN DUST	<b>Capacity:</b>
<b>Loading:</b> 46% (norm)	<b>Bulk Density:</b> 35.0 PCF (min)	1,200 CFH (normal)
100.0 for H.P.	85.0 PCF (max)	2,612 CFH (max)
		<b>RPM:</b> 20

**CONVEYOR**

**Screw**  
**Flights:** 18S924-R 3/8" TRK  
**Pipe:** 6" SCH 80

**Trough**  
**Type:** FORMED FLANGE  
**Thickness:** 3/16"

**Hanger**  
**Style:** 326  
**Size:** 18 X 3 15/16"  
**Brg.Matl:** HARD IRON

**Cover**  
**Style:** FORMED FLANGED  
**Thickness:** 10 GA  
**Fasteners:** BOLTED

**Trough End Plates**  
**Type:** PEDESTAL  
**Thickness:** 3/8"

**Drive Shaft**  
**Size:** 3 15/16"  
**Mat'l:** 4140 PHT  
**Bolt-Drlg:** 3-BOLT  
**Bearing:** DODGE TYPE E

**Coupling Shaft**  
**Size:** 3 15/16"  
**Mat'l:** 4140 PHT HARDENED  
**Bolt-Drlg:** 3-BOLT

**Tail Shaft**  
**Size:** 3 15/16"  
**Mat'l:** 4140 PHT  
**Bolt-Drlg:** 3-BOLT  
**Bearing:** S-2000 EXPANSION

**Coupling Bolts**  
**Size:** 1 1/8 X 7 3/4"  
**Grade/Matl:** GD 5

**Shaft Seals**  
**Type:** SPLIT GLAND  
**Size:** 3 15/16"

**Gasketing**  
**Mat'l:** 1/4" X 2 HIGH TEMP

**Inlet(s)**  
**Qty:** 2  
**Size:** 19" X 108"

**Discharge(s)**  
**Qty:** 1  
**Size:** 18" X 18"

**Miscellaneous:**  
 OIL BATH CHAIN GUARD  
 MOTION SENSON BRACKET  
 RELIEF HATCH W/LIMIT SWITCH.  
 DRIVE MOUNT  
 SHEAR PIN SPROCKET

**DRIVE**

**Reducer**  
**Mfg:** FALK  
**Size:** 1080FZ3  
**Ratio/Output RPM:** 44.2

**Motor Mount:** SCOOP  
**Slide Base:** N/A  
**Hi-Speed Cplg:** FALT T-10  
**Lo-Speed Cplg:** N/A

**Motor**  
**Mfg:** SIEMENS  
**HP:** 25  
**RPM:** 1750  
**Voltage:** 460/60/3  
**Spec:** RGZESD

**Roller Chain Drive**  
**Ratio:** 2.2:1  
**Chain Size:** RC200  
**Sprocket Teeth:** 15/33  
**V-Belt Drive**  
**Ratio:** N/A  
**Belt Size:** N/A  
**Sheave P.D.:** N/A

**EXCLUSIONS:** MOTION SENSORS BY OTHERS

**REMARKS:** COMPLETE ASSEMBLY AND TEST RUN.  
 (1) COAT SHOP PRIMER  
 INCLUDES DRAWINGS

<b>SUMMERLOT</b>	
<b>ENGINEERED PRODUCTS, INC.</b>	
MAILING ADDRESS	P.O. BOX 5216 TERRE HAUTE, IN 47805
SHIPPING ADDRESS	11655 N. U.S. 41 ROSEDALE, IN 47874
PHONE NUMBERS	(812) 466-7266 OFFICE (812) 466-7269 FAX

**SUMMERLOT ENGINEERED PRODUCTS**  
Screw Conveyor & Screw Feeder Design

Equipment I.D.: KILN DUST CONVEYOR

Time 13:17:41

DATE 08-05-1997

SCREW: DIAMETER: 18 in. PITCH: 18 in.  
PIPE O.D. 6.625 in. SPEED: 20 RPM (Specified)

TROUGH: TYPE: U LENGTH: 63 ft.  
INCLINE: 0 deg. FILL: 45.9336 % (Calculated)

MATERIAL DESCRIPTION: KILN DUST  
DENSITY: 35 lbs./cu.ft. 85 lbs./cu.ft.  
CAPACITY: 1200 CFH (Specified) 1200 CFH (Calculated)

GENERAL FACTORS: MATERIAL FACTOR: 1.5 BEARING FACTOR: 4.4  
INCLINE CAPACITY EFFICIENCY: 100 %

HEIGHT FACTORS:	CAP. FACTOR	HP FACTOR
1. For CUT & FOLDED:	1	1
2. RIDDLE FACTORS:	1	1
3. SCREEN FACTORS:	1	1

HP POWER: CALCULATED 11.69687 HP SUGGESTED MOTOR SIZE: 15 HP  
TORQUE FOR 15 HP MOTOR & 20 RPM: 47250 lb.-in.

Equipment I.D.: SAME AS ABOVE EXCEPT 100% FILL

Time 13:17:43

DATE 08-05-1997

SCREW: DIAMETER: 18 in. PITCH: 18 in.  
PIPE O.D. 6.625 in. SPEED: 20 RPM (Specified)

TROUGH: TYPE: U LENGTH: 63 ft.  
INCLINE: 0 deg. FILL: 100 % (Specified)

MATERIAL DESCRIPTION: KILN DUST  
DENSITY: 35 lbs./cu.ft. 85 lbs./cu.ft.  
CAPACITY: 2612.467 CFH (Calculated)

GENERAL FACTORS: MATERIAL FACTOR: 1.5 BEARING FACTOR: 4.4  
INCLINE CAPACITY EFFICIENCY: 100 %

HEIGHT FACTORS:	CAP. FACTOR	HP FACTOR
1. For CUT & FOLDED:	1	1
2. RIDDLE FACTORS:	1	1
3. SCREEN FACTORS:	1	1

HP POWER: CALCULATED 24.58965 HP SUGGESTED MOTOR SIZE: 25 HP  
TORQUE FOR 25 HP MOTOR & 20 RPM: 78750 lb.-in.

**SUMMERLOT ENGINEERED PRODUCTS**

**Screw Conveyor Screw Deflection & Stress Calculations.**

HP. @ 20 RPM

Time 13:24:28

DATE 08-05-1997

**SCREW SPECIFICATIONS:**

Flighting type:	Sectional
Diameter:	18 inches
Thickness:	.375 inches
Pitch:	18 inches

Pipe or tubing?	Pipe
Nominal size & schedule:	6 inch sch.80
Size:	6.625 inches O.D. x 5.761 inches I.D.
Length:	140 inches
Bare pipe:	0 inches

**Calculated data:**

Screw weight:	536 pounds
Bearing load (opposite bare pipe):	268 pounds
Bearing load (bare pipe end):	268 pounds
Maximum deflection:	.0163 inches
Bending stress:	768 lbs/in <sup>2</sup>
Torsional stress:	3222 lbs/in <sup>2</sup>

**PRINCIPAL STRESS:** 3628 lbs/in<sup>2</sup>

NOTE: Allowable Principal Stress for stainless steel construction is 3500 psi.  
For carbon steel construction 6700 psi is sufficient.

$$SHAFT D.I.A. = \sqrt[3]{\frac{5.1}{12000} \times 1.5 \times \frac{63,000 \times 25}{20}} = 3.684 \text{ use } 3\frac{15}{16} \text{ DIA}$$

SHAFT MAT 4140 P.H.T.

SUMMERLOT ENGINEERED PRODUCTS

Roller chain drive selection

HEADING NOT SPECIFIED

Time 13:05:57

Date 08-06-1997

SELECTED RC DRIVE:

1-Strand RC200 chain,

15 Tooth ( 12.02435 p.d.) driver sprocket @ 44.2 RPM

33 Tooth ( 26.3003 p.d.) driven sprocket @ 20.09091 RPM

Has a caculated HP = 30.23839

Which is good for motor HP up to 25.19866 (with 1.2 service factor.)

Actual ratio = 2.2 :1



**SCREW CONVEYOR SPECIFICATION SHEET**

<b>CUSTOMER:</b>	ENVIRONMENTAL ELEMENTS CORP.	<b>DATE:</b>	08/07/97
<b>CUSTOMER REF:</b>	BOB BROWN	<b>PAGE:</b>	1 OF 2
<b>SPEC NUMBER:</b>	229	<b>PREPARED BY:</b>	TERRY HANDLIN

**DESCRIPTION:** (1) 14" DIA. X 36'-0" LONG CARBON STEEL SCREW  
CONVEYOR WITH FLARED TROUGH

**GENERAL SPECIFICATIONS**

<b>Incline:</b> 0	<b>Mat'l:</b> CLINKER DUST	<b>Capacity:</b>
<b>Loading:</b> 40% (norm)	<b>Bulk Density:</b> 35.0 PCF(min)	510 CFH (normal)
100.0 for H.P.	85.0 PCF(max)	1,274 CFH (max)
		<b>RPM:</b> 20

**CONVEYOR**

<b>Screw</b> Flights: 14S724-R Pipe: 4" SCH 80	<b>Drive Shaft</b> Size: 3 7/16" Mat'l: 4140 PHT Bolt-Drlg: 3-BOLT Bearing: DODGE TYPE E	<b>Shaft Seals</b> Type: SPLIT GLAND Size: 3 7/16"
<b>Trough</b> Type: FLARED Thickness: 3/16"	<b>Coupling Shaft</b> Size: 3 7/16" Mat'l: 4140 PHT HARDENED Bolt-Drlg: 3-BOLT	<b>Gasketing</b> Mat'l: 1/4" X 2" HIGH TEMP
<b>Hanger</b> Style: 326 Size: 14 X 3 7/16" Brg.Matl: HARD IRON	<b>Tail Shaft</b> Size: 3 7/16" Mat'l: 4140 PHT Bolt-Drlg: 3-BOLT Bearing: S-2000 EXPANSION	<b>Inlet(s)</b> Qty: 2 Size: 19" X 108"
<b>Cover</b> Style: FORMED FLANGED Thickness: 10 GA Fasteners: BOLTED	<b>Coupling Bolts</b> Size: 7/8 X 5 3/4" Grade/Matl: GD 5	<b>Discharge(s)</b> Qty: 1 Size: 15" X 15"
<b>Trough End Plates</b> Type: FLARED PEDESTALS Thickness: 5/16"		<b>Miscellaneous:</b> OIL BATH CHAIN GUARD MOTION SENSOR BRACKET RELIEF HATCH W/LIMIT SWITCH. DRIVE MOUNT SHEAR PIN SPROCKET

**DRIVE**

<b>Reducer</b> Mfg: FALK Size: 1070PZ3 Ratio/Output RPM: 46.3  Motor Mount: SCOOP Slide Base: N/A Hi-Speed Cplg: FALT T-10 Lo-Speed Cplg: N/A	<b>Motor</b> Mfg: SIEMENS HP: 15 RPM: 1750 Voltage: 460/60/3 Spec: RG25SD	<b>Roller Chain Drive</b> Ratio: 2.31:1 Chain Size: RC160 Sprocket Teeth: 16T/37T <b>V-Belt Drive</b> Ratio: N/A Belt Size: N/A Sheave P.D.: N/A
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**EXCLUSIONS:** MOTION SENSORS BY OTHERS

**REMARKS:** COMPLETE ASSEMBLY AND TEST RUN.  
(1) COAT SHOP PRIMER  
INCLUDES DRAWINGS

<b>SUMMERLOT ENGINEERED PRODUCTS, INC.</b>	
MAILING ADDRESS	P.O. BOX 5216 TERRE HAUTE, IN 47806
SHIPPING ADDRESS	11655 N. U.S. 41 ROSEDALE, IN 47874
PHONE NUMBERS	(812) 466-7266 OFFICE (812) 466-7269 FAX

SUMMERLOT ENGINEERED PRODUCTS  
Screw Conveyor & Screw Feeder Design

Equipment I.D.: CLINKER COOLER CONVEYOR

Time 11:19:25

DATE 08-06-1997

SCREW: DIAMETER: 14 in. PITCH: 14 in.  
PIPE O.D. 4.5 in. SPEED: 20 RPM (Specified)

TROUGH: TYPE: U LENGTH: 63 ft.  
INCLINE: 0 deg. FILL: 40.00334 % (Calculated)

MATERIAL DESCRIPTION: CLINKER DUST  
DENSITY: 35 lbs./cu.ft. 85 lbs./cu.ft.  
CAPACITY: 510 CFH (Specified) 510 CFH (Calculated)

GENERAL FACTORS: MATERIAL FACTOR: 1.5 BEARING FACTOR: 4.4  
INCLINE CAPACITY EFFICIENCY: 100 %

FLIGHT FACTORS:	CAP. FACTOR	HP FACTOR
CUT or CUT & FOLDED:	1	1
PADDLE FACTORS:	1	1
RIBBON FACTORS:	1	1

HORSEPOWER: CALCULATED 5.60441 HP SUGGESTED MOTOR SIZE: 7-1/2 HP  
TORQUE FOR 7-1/2 HP MOTOR & 20 RPM: 23625 lb.-in.

Equipment I.D.: SAME AS ABOVE EXCEPT 100% FILL

Time 11:19:27

DATE 08-06-1997

SCREW: DIAMETER: 14 in. PITCH: 14 in.  
PIPE O.D. 4.5 in. SPEED: 20 RPM (Specified)

TROUGH: TYPE: U LENGTH: 63 ft.  
INCLINE: 0 deg. FILL: 100 % (Specified)

MATERIAL DESCRIPTION: CLINKER DUST  
DENSITY: 35 lbs./cu.ft. 85 lbs./cu.ft.  
CAPACITY: 1274.894 CFH (Calculated)

GENERAL FACTORS: MATERIAL FACTOR: 1.5 BEARING FACTOR: 4.4  
INCLINE CAPACITY EFFICIENCY: 100 %

FLIGHT FACTORS:	CAP. FACTOR	HP FACTOR
CUT or CUT & FOLDED:	1	1
PADDLE FACTORS:	1	1
RIBBON FACTORS:	1	1

HORSEPOWER: CALCULATED 12.1035 HP SUGGESTED MOTOR SIZE: 15 HP  
TORQUE FOR 15 HP MOTOR & 20 RPM: 47250 lb.-in.

# SUMNERLOT ENGINEERED PRODUCTS

## Screw Conveyor Screw Deflection & Stress Calculations.

HP. @ 20 RPM

Time 11:32:27

DATE 08-06-1997

### SCREW SPECIFICATIONS:

Flighting type:	Sectional
Diameter:	14 inches
Thickness:	.375 inches
Pitch:	14 inches

Pipe or tubing?	Pipe
Nominal size & schedule:	4 inch sch.80
Size:	4.5 inches O.D. x 3.826 inches I.D.
Length:	140 inches
Bare pipe:	0 inches

Calculated data:	
Screw weight:	340 pounds
Bearing load (opposite bare pipe):	170 pounds
Bearing load (bare pipe end):	170 pounds
Maximum deflection:	.0436 inches
Bending stress:	1393 lbs/in <sup>2</sup>
Torsional stress:	5533 lbs/in <sup>2</sup>

PRINCIPAL STRESS:	6273 lbs/in <sup>2</sup>
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NOTE: Allowable Principal Stress for stainless steel construction is 3500 psi.  
For carbon steel construction 6700 psi is sufficient.

# SUMMERLOT ENGINEERED PRODUCTS

## Roller chain drive selection

=====  
HEADING NOT SPECIFIED  
=====

Time 12:52:56

Date 08-06-1997  
=====

SELECTED RC DRIVE:  
=====

1-Strand RC160 chain,  
16 Tooth ( 10.25167 p.d.) driver sprocket @ 46.3 RPM  
37 Tooth ( 23.58328 p.d.) driven sprocket @ 20.02162 RPM  
Has a caculated HP = 18.40563  
Which is good for motor HP up to 15.33803 (with 1.2 service factor.)  
Actual ratio = 2.3125 :1  
=====

SECTION 4

OPERATING CONDITIONS AND GUARANTEES

SECTION 4

4. OPERATING CONDITIONS AND GUARANTEES

A. OPERATING CONDITIONS - KILN/MILL PRECIPITATOR

Process - Type	Preheater Cement Kiln with Roller Mill Circuit	
	<u>Direct</u>	<u>Compound</u>
Mode of Operation	<u>Direct</u>	<u>Compound</u>
Gas Volume ACFM	200,000	194,000
Gas Temperature °F	356/300	220/205
Inlet Particulate Loading gr/ACF	18	25
Dew Point °F	138	115
Collection Efficiency (percent removal)	99.96	99.97
Outlet Particulate Residual gr/ACF	0.007	0.007
Precipitator Gas Velocity (f.p.s.)	2.9'	2.8
Time of Treatment (Sec.)	14.9	15.3
SCA (Ft <sup>2</sup> collecting surface per 1,000 ACFM)	371.5	382.9
Aspect Ratio	1.0	1.0
Pressure Loss (in. H <sub>2</sub> O)	1.0	1.0

B. PERFORMANCE GUARANTEE

1. Direct Operation

With all electrical fields energized under normal conditions of operation with kiln only, as stipulated under "Operating Conditions", when passing 200,000 ACFM of gas through the precipitator, with an inlet loading of 18 gr/ACF or more, the efficiency is guaranteed to 99.96% removal.

Under identical conditions of operation, with an inlet particulate loading of 18 gr/ACF or less, the outlet particulate residual is guaranteed not to exceed 0.007 gr/ACF.

2. Compound Operation

With all electrical fields energized under normal conditions of operation with kiln only, as stipulated under "Operating Conditions", when passing 194,000 ACFM of gas through the precipitator, with an inlet loading of 25 gr/ACF or more, the efficiency is guaranteed to 99.97% removal.

Under identical conditions of operation, with an inlet particulate loading of 25 gr/ACF or less, the outlet particulate residual is guaranteed not to exceed 0.007 gr/ACF.

C. OPERATING CONDITIONS - Clinker Cooler

Process - Type	Clinker Cooler Exhaust
Gas Volume ACFM	160,000
Gas Temperature °F	480
Inlet Particulate Loading gr/ACF	13
Moisture Content (% by volume)*	2 to 3
Collection Efficiency (percent removal)	99.92
Outlet Particulate Residual gr/ACF	0.01
Precipitator Gas Velocity (f.p.s.)	2.3
Time of Treatment (Sec.)	18.5
SCA (Ft <sup>2</sup> collecting surface per 1,000 ACFM)	464.3
Aspect Ratio	1.0
Pressure Loss (in. H <sub>2</sub> O)	1.0

\*Note: Additional moisture may be required.

D. PERFORMANCE GUARANTEE

With all electrical fields energized under normal conditions of operation with kiln only, as stipulated under "Operating Conditions", when passing 160,000 ACFM of gas through the precipitator, with an inlet loading of 13 gr/ACF or more, the efficiency is guaranteed to 99.92% removal.

Under identical conditions of operation, with an inlet particulate loading of 13 gr/ACF or less, the outlet particulate residual is guaranteed not to exceed 0.01 gr/ACF.

Attention is drawn to the fact that the material, workmanship and performance guarantee clauses are contingent upon the Buyer's assuring that the equipment is erected according to plans and specifications.

E. PERFORMANCE TEST

All particulate emission tests will be conducted in accordance with the methods set down by the Environmental Protection Agency in 40 CFR Part 60, Appendix A (Reference Methods), and any subsequent revision to these methods in effect on the date of this proposal. The EPA Method 17 will be used for inlet sampling and the dry, front half of the EPA Method 5 will be used for outlet sampling. Test ports with suitable access are to be furnished with inlet duct and outlet duct or stack to meet EPA and OSHA standards.

Performance tests will be conducted within ninety (90) days after the equipment is first commercially operated, but no later than (Later). Performance testing will be done by an independent testing company mutually acceptable to both Buyer and Seller. The cost of testing will be borne by Buyer. If, through no fault of Seller, performance test cannot be run within the time periods given above, the equipment will be treated as though the performance tests were run and the performance guarantees met.

The performance test shall be deemed "passed" when the Buyer and Seller have analyzed the test results and determined that equipment guarantee has been met. The test results will be available to the Buyer and Seller for said analysis within three (3) weeks after completion of testing. Whatever security Buyer has retained to secure compliance with the performance guarantee shall be due and payable to Seller immediately upon the determination that the performance test has been "passed".

Seller shall have the right to witness testing and to have access to all information acquired by said third party which is relevant to determining whether the equipment has passed the performance test. Seller does not assume the risk that the performance test will be improperly performed, or that tests results will be improperly computed. If, as a result of the fault of either Buyer and/or the third party responsible for conducting the performance test, the determination that the equipment has passed the performance test is delayed, the amount outstanding on the contract price, if any, shall be subject to a per diem interest charge at the maximum rate allowed by law, chargeable from the time the equipment would have passed the performance test but for said fault.

Compliance with the performance criteria on a majority of the tests performed shall constitute fulfillment of the performance guarantee. Seller shall have the right to make, at its own expense, any adjustments, changes, or additions to the equipment in an endeavor to obtain performance in accordance with the guarantee. If Seller in good faith determines that compliance with the performance guarantee is unobtainable, Seller shall forfeit its right to the funds or security retained by Buyer to secure equipment compliance with the guarantee, unless Buyer has not suffered actual damages which are recoverable hereunder.



SECTION 5  
PROPOSAL PRICES

SECTION 5

5. PROPOSAL PRICES

A. MATERIAL

Seller will design, fabricate, deliver F.O.B. jobsite two electrostatic precipitator as described in this proposal and shown on Drawing Number 15290-D-3 Rev. 3 for the sums listed below.

<u>Item</u>	<u>Lbs. Weight</u>	<u>\$ Material</u>	<u>\$ Freight</u>
1. Precipitator and Nozzles	1,046,664	---	---
2. Support Structure	75,800	---	---
3. Access	44,942	---	---
4. Conveyor and Dust Valve	---	---	---
5. Hopper Level Detectors	---	---	---
Total		\$1,414,000	\$65,000

B. PRICE NOTES

1. Material Delivery Terms: F.O.B. jobsite.
2. To obtain a total delivered price the freight price must be added to the material price.
3. Material and freight prices are firm for delivery starting on or about April 1998 based on an award or notice to proceed August 1997. Delays past this date may be subject to escalation.

C. CONSTRUCTION ADVISOR

In the event the equipment is erected by others, the services of a Construction Advisor will be furnished at a per diem or monthly rate of \$13,500 including all living and travel expenses. Material, workmanship and performance guarantees are contingent upon the Buyer's assuring the equipment is erected according to plans and specifications. If Buyer does not purchase the services of the Construction Advisor, no backcharges will be accepted unless authorized in advance by Seller. Guarantees are contingent on an inspection by Seller's engineer prior to start-up to ensure that the equipment is erected according to plans and specifications.

The Construction Advisor will assist as requested in efficient and economical conduct of the work. He will determine if the required materials have been furnished and delivered, assist in the identification of the various items, make recommendations as to sequence and methods of erection, make suggestions as to size and organization of work crews and interpret the drawings and specifications. He will advise Buyer's erection supervisors as to results desired and make such inspections as are deemed necessary to assure that these results are obtained. An inspection of the unit to determine if the equipment is ready for operation will be performed by a Test and Service Engineer.

D. CHECK OUT, TRAINING AND START-UP SERVICES

Following the completion of erection, Seller will provide engineering personnel to make a complete mechanical and electrical check of all work. When certified ready to operate, an engineer will supervise the start-up of the equipment, make final adjustments and instruct the plant personnel in the operation, adjustment and maintenance of the precipitator.

These services will be furnished at the following per-diem rate.

The daily fee per man for traveling days and working days on the jobsite for working time up to but not in excess of eight hours per day will be charged at the following rates:

SIX HUNDRED FIFTY DOLLARS (\$650.00) per Traveling Day to and from Baltimore, Maryland, on any day of the week.

SIX HUNDRED FIFTY DOLLARS (\$650.00) per Working Day, Monday through Friday.

NINE HUNDRED SEVENTY-FIVE DOLLARS (\$975.00) per Working Day on Saturdays.

THIRTEEN HUNDRED DOLLARS (\$1,300.00) per Working Day on Sundays.

Any working time in excess of eight hours per day will be charged at the following rates:

Week Days, Monday through	Friday:	\$122.00 per hour
	Saturdays:	\$122.00 per hour
	Sundays:	\$162.50 per hour

All living and all travel expenses will be charged at actual cost per calendar day, on a seven day per week basis, including traveling days.

Traveling expenses from Baltimore, Maryland, to jobsite, from jobsite to Baltimore, Maryland and local traveling expenses while on the jobsite will be billed at actual costs.

Seller's Field Test & Service Engineer will supervise start-up, testing, training of your operating personnel, do trouble shooting, determine if equipment is ready for operation and perform other related duties requested of him by the Customer.

Since he will be utilized in an advisory capacity, Seller will not be liable for any damages to equipment, loss of time or product, for production rates of workmen and quality of field

workmanship. The Buyer will have the direct responsibility for planning, supervising and executing the work, and under such circumstances, neither Seller nor the Field Test and Service Engineer will be responsible for the progress or cost of the work.

E. SCHEDULE

A firm schedule will be established to meet the specific requirements of the project. The following is typical for these applications:

DRAWINGS

The load diagram and general arrangement drawings showing firm dimensions, loads and interface connections will be mailed within 4 to 6 weeks from date of an order. These drawings will contain all loads and interface dimensions to design the foundations and related equipment. Electrical drawings will be mailed within 8 to 12 weeks from receipt of an order.

Due to the proprietary nature of the detail drawings for the electrostatic precipitator, the only drawings being submitted for approval will be the general arrangement, load diagram and the one line electrical drawings.

The "construction package" drawings, required for erection, will be submitted "for reference" and will not be subject to approval. It is necessary to clarify this point since requisitions will be released into our system to initiate fabrication upon receipt of the approved general arrangement, load diagram and one line electrical drawings.

MATERIAL AND ERECTION

The material can normally be shipped to support an erection schedule starting 7 to 8 months from date of an order. Erection period will normally extend over a 3 to 4 month period dependent on scope of work, weather and labor conditions.

F. MATERIAL TERMS OF PAYMENT

Payment of 10% of the material selling price will be made on submittal of load diagram, General Arrangement and Electrical one line drawing. Monthly, Seller shall submit to Buyer a certified statement showing the degree of completion of work to be shipped under this Contract, and the estimated value of said work in its then state of completion based upon the total material selling price. Seller shall be paid 100% of the amount of such estimated value of said work within twenty (20) days after receipt of such certified statement by Buyer until 95% of the total contract price has been paid.

The retainage of 5% of the material selling price shall be payable to Seller upon successful completion of performance tests, as elsewhere defined, but in no event later than (to be determined). At Seller's option, a letter of credit in the amount of 5% of the material selling price may be substituted for the retention.

## G. TAXES

Buyer shall pay all Federal, State and Local taxes, resulting from this Agreement, including, but not limited to, manufacturer's excise tax, gross receipts tax, sales and use tax or any direct or indirect tax of similar nature, on all or any part of the work performed under this Contract including sales and use taxes on materials purchased by Seller for the erection of the equipment. A tax exemption certificate shall be forwarded to Seller along with the purchase order, if such is applicable to the Equipment or services being furnished. If Seller is required to collect and/or pay such taxes, Buyer shall reimburse Seller for the full amount.

## H. MATERIAL PRICE ADJUSTMENTS

1. The material and freight prices are firm based on delivery starting on or about April 1998. In the event the schedule of delivery and/or erection is delayed after award (through no fault of Seller), the material/erection prices will be subject to escalation, for the time period from the originally scheduled delivery until the revised delivery. The material price will be escalated in accordance with the following:

Seventy percent (70%) of the total material equipment selling price is subject to adjustment based upon the percentage of increase in the U. S. Department of Labor, Wholesale Prices and Indices, Machinery and Equipment, Code 11, Sub-group 114 (General Purpose Machinery).

Thirty percent (30%) of the total material equipment selling price is subject to adjustment based upon the percentage of increase in the U.S. Department of Labor, Wholesale Prices and Indices, Labor SIC34, Fabricated Metal Products Hourly Rate.

If the material is purchased excluding escalation, the computation of the percentage will be based on the average of the index for the month three (3) months prior to initial shipment and the index for the month of final shipment, as compared with the index for the month the contract is signed. The amount of escalation shall be submitted on a separate invoice and will include the computation details.

2. Premium Steel - Prices and delivery are predicated on procurement of steel based on the most economical mill runs and schedules currently in effect. Should Buyer change specified delivery date and request Seller to obtain steel from premium mills or warehouses, Buyer shall reimburse Seller for the additional cost of steel. Such purchases must be authorized in writing by Buyer prior to actual procurement.
3. Extra Material - Seller shall provide additional equipment and materials related to the Equipment requested and authorized by Buyer in writing. Prices, terms, and delivery for the additional equipment and materials will be furnished after Buyer provides Seller with sufficient specifications and information.

Non-Specified Preferences - Seller reserves the right to select purchased components with respect to type and manufacturer unless specified preferences are stated in the Buyer's bidding specifications. Any additional costs (including normal burdens and

markup for overhead and profit) incurred by Seller in meeting Buyer's preference outside the specifications shall be for Buyer's account.

SECTION 6

GENERAL CONDITIONS OF SALE  
FOR MATERIAL AND EQUIPMENT