Moving Bed Granular Bed Filter Development Program

Topical Report
September 1994

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By:
J.C. Haas
J.W. Prudhomme
K. W. Wilson

Work Performed Under Contract No.: DE-AC21-90MC27423

For
U.S. Department of Energy
Office of Fossil Energy
Federal Energy Technology Center
Morgantown Site
Morgantown, West Virginia

By
Combustion Power Company
Oakland, California

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Federal Energy Technology Center
Morgantown Site
P.O. Box 880
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1.0 INTRODUCTION

Five test arrangements have been designed to support the Granular Bed Filter Development Program as defined in the Test Plan described in Task 3. The first arrangement is a 3.6 ft diameter half filter, with a glass covering along the cross section to allow visual examination of the granular alumina material passing through the filter. This unit will be used to evaluate up to 4 different filter discharge hopper designs and two different air inlet pipe configurations.

The second test arrangement is a 3.6 ft diameter full size filter having refractory lining to simulate actual surface roughness conditions. Results from the half filter testing will be applied to the hopper and inlet pipe design and positioning on the full size filter.

The third test arrangement will examine filter geometry scale up by testing a 6.0 ft diameter full size filter. The 6.0 ft filter will also have refractory lining to simulate actual surface roughness. All three of the filter units will be supported from a common structure and will use a common pneumatic transport system to circulate alumina from the filter drain back to the filter top.

The forth Test Arrangement consists of a small 12 inch diameter fluidizer to measure the minimum fluidization velocity of the 7 mm (approximate size) alumina material to be used in the filter assemblies.

The last Test Unit is used to evaluate relative abrasion characteristics of potential refractory and ceramic materials to be installed in high abrasion areas in the pneumatic transport piping. The unit consists of several 40" diameter cylinders each having a liner sample and alumina material. Each revolution alumina falls on to the liner surface causing some level of abrasion. The test is designed to run for 1000 hrs.

2.0 DESCRIPTION OF PROCESS CONTROLS

2.1 Granular Bed Filter Controls

The instrumentation and valving for the granular bed filter test units are defined on the Piping and Instrument Diagram included in this report. Air is supplied to the filter inlet using one or two blowers, depending on the filter size and capacity. Air flow is controlled manually with butterfly valves at each blower inlet. Flow is measured using an orifice.

For some of the planned tests, ash is introduced into the inlet air stream to determine the effects of ash on alumina material flow characteristics. The ash is from a local coal fired power plant and is metered into the air stream using a small bin with a variable speed, screw conveyor. An eductor is used to overcome the inlet air pressure and pneumatically convey the ash to the filter inlet pipe.

Inside the filter, the ash is captured by the granular alumina material and clean air exits the filter top. The test arrangement is located outdoors so the filter top is open to atmosphere. The filter material and ash drain out the filter bottom through a seal leg to a pneumatic lift pipe to return the alumina back to the filter top for another cycle. During the pneumatic transport process, ash is dislodged from the alumina and the ash exits with the lift air at the de-entrainment Vessel, due to the size and density difference. Instrumentation is positioned on the filter to manually record filter pressure drop, filter seal leg pressure drops, lift pipe pressure drop and de-entrainment vessel pressure. The filter pressure drop versus filter air flow are important performance measurements. The seal leg pressure drop is used to confirm that air is exiting from the filter rather than entering the filter at the seal leg. The out flow of air at the seal leg is necessary to maintain proper ash flow draining from the filter. A bleed line is mounted from the seal leg to the ash collection baghouse to maintain air flow down the seal leg when lift pipe air pressure is higher than the filter pressure.

The alumina circulation rate is controlled by varying the amount of injection air on the "L- Valve" at the base of the seal leg. The alumina flow rate is proportional to the lift pipe pressure drop and is used to set the circulation rate. A sight glass is mounted on the seal leg to visually measure the alumina velocity which is used to confirm the material mass flow. The lift air is supplied by a separate positive displacement type blower. The lift air flow is established by venting excess air at the blower discharge because the blower has fixed speed.

In addition to filter pressure drop, the filter flow characteristics will be determined by measuring the air flow distribution at the filter top using a thermoanemometer (designed for low air velocities). The alumina flow distribution will be determined by the movement of metal rods which descend into the filter with the alumina granules. The 3.6 ft diameter half filter will also allow visual observation of the alumina flow profile.

From the de-entrainment vessel, ash is pneumatically transported to a baghouse where the ash is separated from the air. The ash particles drain from the baghouse hopper to a 55 gallon drum for reuse or disposal. A suction fan is mounted downstream of the baghouse to control the de-entrainment vessel near atmospheric pressure. The fan is controlled manually by adjusting the inlet butterfly, similar to the air supply blowers.

2.2 Alumina Fluidizer Controls

The fluidizer unit is used to measure the minimum fluidization velocity of the 7 mm alumina material. Fluidizing air is supplied by one of the air supply blowers as described in Section 2.1. The unit is operated by gradually increasing the air flow while measuring the pressure drop across the bed until the bed begins to fluidize. The pressure drop versus air flow data as well as visual observation determine when fluidization begins.

2.3 Lift Pipe Liner Abrasion Unit Controls

Candidate refractory and ceramic materials will be tested for abrasion using a rotating drum abrasion test unit. Each refractory sample will be mounted in a separate fabricated enclosed cylinder along with a defined amount of 7 mm alumina. With each revolution alumina will drop on the test sample surface at a velocity similar to that inside the filter pneumatic lift pipe.

Each sample will be fired to typical operating temperatures (~1600 F) and weighed before testing. The cylinders are then assembled together to form one drum which mounts on a standard drum rotator. The 1/2 horsepower drum rotator operates at ~ 10 RPM for 1000 Hours. Each refractory sample is divided into two sections to simplify casting and each weigh approximately 30 lbs, depending on the sample thickness and material. The dust and media will be collected and weighed for mass balance.

3.0 DESCRIPTION OF SAMPLING AND ANALYTICAL EQUIPMENT

- Toledo Digital Scale (0-100 lbs, accuracy to .01 lbs)
- Triple Beam Balance (0-2 kg, accuracy to .1 g)

4.0 EQUIPMENT SPECIFICATIONS

<u>ITEM</u>	<u>MANUFACTURER</u>	<u>STATUS</u>	<u>CAPACITY</u>
Air Supply Blower No.1	Hoffman	Existing	2570 ACFM at 6.3 PSIG
Air Supply Blower No.2	Lamson or Eq.	Rental	2100 ACFM at 6.3 PSIG
Ash Eductor	CPC or Fox	New	2" Dia
Ash Feeder	Acrison or Eq.	Rental	12 Lb/Hr
Granular Bed Filter	CPC	New	3.6 and 6.0 Ft Dia
Bleed Eductor	CPC or Fox	New	1.5" Dia
Lift System PD Blower	PEGO or Eq.	Rental	260 ACFM at 6 PSIG
Baghouse	Micropul	Existing	900 ACFM at 6:1 Air/ Cloth
Suction Fan	Buffalo Forge	Existing	850 ACFM at 16 IWG static DP
Air Compressor	US Rental	Rental	100 SCFM at 100 PSIG
Fluidizer	CPC	New	12" Dia
Abrasion Test Drums	CPC	New	40" Dia
Drum Rotator	Advanced Handling Sys.	New	400 Lbs max at 10 RPM

5.0 INSTRUMENT AND VALVE SPECIFICATIONS

INSTRUMENTS:

PCV	105	Air Pressure Regulator	Any	0-30 PSIG	
PI	105	Regulator Pressure Gauge	Any	0-30 PSIG	
TI	108	Inlet Air Temperature		0-250 F	Bi-metalic
FE	108	Inlet Air Flow Orifice	CPC		
PDI	108	Inlet Air Orifice Dp	Dwyer	0-20 IWG	Magnehelic
PI	108	Inlet Air Pressure	Dwyer	0-5 IWG	Magnehelic
PI	110	GBF Inlet Air Pressure	Dwyer	0-5 IWG	Magnehelic
FI	112	Alumina Velocity Probe	CPC		
FI	115	Air Velocity Anemometer	Alnor		
PCV	116	Air Pressure Regulator			
PI	116	Regulator Pressure Gauge		0-10 PSIG	
PDI	118	Upper Seal Leg Dp	Dwyer	0-2 IWG	Magnehelic
PDI	120	Lower Seal Leg Dp	Dwyer	0-2 IWG	Magnehelic
FI	122	Seal Leg Sight Glass	CPC		
PSV	130	Blower Air Pressure Relief Vlv	by Blower MFG		
TI	135	Lift Air Temperature		0-250 F	Bi-metalic
FE	135	Lift Air Flow Orifice	CPC		
PDI	135	Lift Air Orifice Dp	Dwyer	0-20 IWG	Magnehelic
PI	135	Lift Air Pressure	Dwyer	0-5 PSIG	Magnehelic
FE	138	Injection Air Pitot Tube	Dwyer	1/4" Dia	
PDI	138	Injection Air Pitot Tube Dp	Dwyer	0-5 IWG	Magnehelic
YO	139	Lift Air Restriction Orifice	CPC		
PDI	142	Lift Pipe Dp	Dwyer	0-150 IWG	Magnehelic
PI	145	Deentrainment Vessel Pressure	Dwyer	0-5 IWG	Magnehelic
PDI	152	Baghouse Dp	Dwyer	0-10 IWG	Magnehelic
FE	201	Fluidizer Air Flow Orifice	CPC		
PDI	201	Fluidizer Air Orifice Dp	Dwyer	0-20 IWG	Magnehelic
PI	201	Fluidizer Air Pressure	Dwyer	0-5 PSIG	Magnehelic
TI	201	Fluidizer Air Temperature		0-200 F	Bi-metalic
PDI	205	Fluidizer Distributor Plate Dp	Dwyer	0-100 IWG	Magnehelic
PDI	210	Fluidizer Bed Dp	Dwyer	0-100 IWG	Magnehelic

VALVES:

HV	101	Blower No.1 Inlet Valve	Dezurick or Eq.	8" Dia	Butterfly
HV	102	Blower No.2 Inlet Valve	Dezurick or Eq.	8" Dia	Butterfly
HV	105	Ash Eductor Air Valve	Any	3/4" Dia	Ball
HV	116	Bleed Eductor Air Valve	Any	3/4" Dia	Ball
HV	117	Bleed Isolation Valve	Any	2" Dia	Ball
HV	132	Lift Air Vent Valve	Any	3" Dia	Gate
HV	138	Injection Air Valve	Any	1 1/2" Dia	Gate
HV	155	Baghouse Hopper Valve	Fabri or Eq.	8" Dia	Gate
HV	158	Suction Fan Inlet Valve	Dezurick or Eq.	8" Dia	Butterfly

6.0 UTILITY REQUIREMENTS

6.1 Compressed Air:

Ash Eductor Air	51 SCFM @ 25 psig
Bleed Eductor Air	36 SCFM @ 5 psig
Baghouse Pulse Air	<u>5 SCFM</u> @ 80 psig

Total Air	92 SCFM
-----------	---------

6.1 Electrical: (Installed Horsepower)

Hoffman Blower Motor	125 HP @ 230VAC, 3 phase
Lamson Blower Motor	100 HP @ 230VAC, 3 phase
Suction Fan Motor	5 HP @ 230VAC, 3 phase
Lift Air Blower Motor	15 HP @ 230VAC, 3 phase
Ash Feeder Motor	1/2 HP @ 115VAC, 1 phase
Drum Rotator	1/2 HP @ 115VAC, 1 phase

6.2 Diesel Fuel:

Air Compressor	1.5-2 Gal/Hr
----------------	--------------

7.0 ESTIMATED COSTS

7.1 Task 5: Fabrication and Installation Costs:

Fabrication and installed costs are defined below using the cost format from the Option I Cost Proposal submitted to the U.S. Department of Energy during April, 1994. Some of the equipment costs are higher than originally estimated based on fabricator quotations. Also, some additional equipment must be rented that were originally thought to be available at CPC. These additional costs are listed separately. Every effort will be made to reduce costs in other areas to compensate for cost increases. Section 7.2 provides a detailed breakdown of the cost increases.

	April-1994 Cost Proposal <u>Estimate</u>	<u>Additional Costs</u>
Item 1a: Purchased Parts	\$37,600	\$11,240
Item 1b: Subcont. Items	\$130,035	\$6,460
Item 3: Direct Labor	\$10,172	\$0
Item 4: Labor Overhead	\$15,258	\$0
Item 7: Travel	\$44	\$0

April 1994 Total Task 5 Direct Cost and Overhead \$193,109

Revised Task 5 Total Direct Cost and Overhead \$210,809

7.2 Task 5 Detail of Cost Changes

Item 1a: Purchased Parts

Addition: Added Costs for Half Filter Assy.	\$7,255
Added Costs for Media Fluidizer	\$1,235
Added Costs for Liner Abrasion	
Unit (due to sampling preparation)	<u>\$2,750</u>
Total	\$11,240

Item 1b: Subcontracts

Addition: Rental of PD Blower @\$400/mo	\$1,600	(4 mo)
Rental of Ash Feeder @\$465/mo	\$1,860	(4 mo)
Rental of Air Compressor @\$1000/mo	<u>\$3,000</u>	(3 mo)
Total	\$6,460	

7.3 Total OPTION I Costs

The current cost trend for Option 3 is upward by about 5% based on the above changes in above costs. This is only a small part of the total contract. There are lots of opportunities to offset this trend in other tasks and stay

within budget.

OPTION 1: COMPONENT TEST FACILITY Schedule, 10/5/84															
	MAR	1984 APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	1984 DEC	1985 JAN	FEB	MAR	APR	MAY
Task 2, ID of Tech. Issues	^														
Task 3, Test Plan DOE Review		^													
Task 4, Design of Test Facility DOE Review								^			^	^			
Task 5, Fabrication and Installation Support Structure & Pneumatic System Half Filter - 3.5 Ft Dia Full Circumference Filter - 3.5 Ft Dia Scale Up Filter - 6 Ft Dia Liner Abrasion Test Drum Fluidization Test Unit									^	^		^	^		
Task 6, Test Program Split Filter - 3.5 Ft Dia Full Circumference Filter - 3.5 Ft Dia Scale Up Filter - 6 Ft Dia Liner Abrasion Test Drum Fluidization Test											^	^	^		
Task 7, Topical Report														^	^

9.0 ENGINEERING DRAWINGS

ESTIMATED MAXIMUM FLOW CONDITIONS

	1	2	3	4	5	6	7	8	9
	BLOWER INLET	EDUCTOR AIR INLET	ASH INLET	GBF AIR SUPPLY	GBF SOLIDS OUTLET	LIFT BLOWER INLET	SEAL LEG BLEED AIR	DEV OUTLET	BA
3.6 FT DIA. SPLIT FILTER									
AIR MASS FLOW, LB/MIN	167	~4	1	167	2	17	2	17	
PRESSURE, PSIA	14.7	~26.7	14.7	17.5	17.3	14.7		14.7	
TEMPERATURE, F	80		80	135	125	80	125	125	
AIR VOLUME FLOW, ACFM	2270		14	2100		230		250	
MEDIA FLOW, LB/MIN					120				
ASH FLOW, LB/MIN			6	6	6			6	
3.6 FT DIA. FULL FILTER									
AIR MASS FLOW, LB/MIN	333	~4	1	333	2	17	2	17	
PRESSURE, PSIA	14.7	~39.7	14.7	20.5	19.9	14.7		14.7	
TEMPERATURE, F	80		80	150	140	80	140	140	
AIR VOLUME FLOW, ACFM	4530		14	3670		230		260	
MEDIA FLOW, LB/MIN					240				
ASH FLOW, LB/MIN			6	6	6			6	
6.0 FT DIA FULL FILTER									
AIR MASS FLOW, LB/MIN	400	~4	1	400	2	17	2	17	
PRESSURE, PSIA	14.7	~19.7	14.7	16.4	15.2	14.7		14.7	
TEMPERATURE, F	80		80	120	110	80		110	
AIR VOLUME FLOW, ACFM	5440		14	5200		230		240	
MEDIA FLOW, LB/MIN					240				
ASH FLOW, LB/MIN			12	12	12			12

TESTED MAXIMUM FLOW CONDITIONS

4	5	6	7	8	9	10	11
GBF AIR SUPPLY	GBF SOLIDS OUTLET	LIFT BLOWER INLET	SEAL LEG BLEED AIR	DEV OUTLET	BAGHOUSE ASH REMOVAL FAN INLET	SUCTION	GBF OUTLET
167	2	17	2	17		19	167
17.5	17.3	14.7		14.7		14.1	14.7
135	125	80	125	125		120	70
2100		230		250		290	2230
	120						
6	6			6	6	<.03	<.06
333	2	17	2	17		19	333
20.5	19.9	14.7		14.7		14.0	14.7
150	140	80	140	140		135	70
3670		230		260		300	4440
	240						
6	6			6	6	<.03	<.06
400	2	17	2	17		19	400
16.4	15.2	14.7		14.7		14.2	14.7
120	110	80		110		110	70
5200		230		240		280	5330
	240						
12	12			12	12	<.06	<.12

UNITS SPECIFIED	ORH	JNP	8
DIMENSIONS ARE IN INCHES / MILLIMETERS	OK	SWF	13
TOLERANCES	DWG	JWP	18
FRACTIONAL	STR		
DECIMAL	PRC		
MILLIMETER	PLU	K8W	87
ANGLE	APP	Adm	12
3RD ANGLE PROJECTION	RD	JED	82

REVISIONS			
FOR DESCRIPTION OF CHG SEE E. O.			
NO	BY	DATE	APPR
01	JWP	9-28-94	RD

DEPARTMENT OF ENERGY
MOVING BED GRANULAR BED FILTER
DEVELOPMENT PROGRAM

PROCESS FLOW DIAGRAM

GRANULAR BED FILTER - TEST UNITS

UNLESS OTHERWISE SPECIFIED,
DIMENSIONS ARE IN
INCHES / MILLIMETERS

TOLERANCES
FRACTIONAL $\pm 1/16"$
DECIMAL $\pm .03$
MILLIMETER $\pm .2$
ANGLE $\pm 1^\circ$

2ND ANGLE PROJECTION

DRN	JWP	8-9-94
CHK	JWF	9-24-94
ENG	JWP	8-24-94
STR		
PRC		
PLU	K8W	8/24/94
APP	AJD	8-25-94
REL	JE	8-25-94

PROJ NO.	1181-2210-01-200	CORRECTIVELY	01	NO OF SHES	1	DATE	4/1
SCALE		SHEET	1	OF	1

**COMBUSTION
POWER**

Combustion Power Company, Oakland, California

REVISIONS			
FOR DESCRIPTION OF CHG SEE E.O.			
NO	BY	DATE	APPR
01	JWP	9-29-94	RD

DEPARTMENT OF ENERGY MOVING BED GRANULAR BED FILTER DEVELOPMENT PROGRAM			
TITLE PIPING AND INSTRUMENT DIAGRAM GRANULAR BED FILTER-TEST UNITS			
1. UNITS: INCHES / MILLIMETERS 2. TOLERANCES: FRACTIONAL: 1/16" DECIMAL: .03 MILLIMETER: .2 ANGLE: 1° 3. 3RD ANGLE PROJECTION	DESIGNED: JWP CHECKED: JWP ENGINEER: JWP STR: [blank] PRC: [blank] PLU: R32 APP: [blank] NO: JEO	DATE: 8-2-94 8-24-94 4-24-94 8-25-94 8-25-94	PROJECT NO: 1181-2310-01-300 SCALE: NONE SHEET: 1 of 1
COMBUSTION POWER Combustion Power Company, Oakland, California			

3

UNLESS OTHERWISE SPECIFIED		1/4" 20	AL
DIMENSIONS ARE IN INCHES		1/8" 16	UN
TOLERANCES		1/16" 16	UN
FRACTIONAL	± 1/16"	1/8" 16	UN
DECIMAL	± .03	1/16" 16	UN
ANGLE	± 1°	1/8" 16	UN
		1/16" 16	UN
		1/8" 16	UN
		1/16" 16	UN

ROLL UP DOOR

SHOP AIR
COMPRESSOR
(RENTAL)

6' CHA
W/1

3'-1" (LBF)

①

DETAIL B

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONAL ± 1/16" DECIMAL ± .03 ANGLE ± 1°	DAN
	CHR
	DWG
	STR
	PRC
APP REL	PRJ
	APP
	REL

REVISIONS			
FOR DESCRIPTION OF CHG SEE E O			
NO	BY	DATE	APPR

SECTION A-A

FEEDER

PORTABLE STAND

UNITED STATES SHIPYARD	DRH
DISCREPANCIES ARE IN HUNDREDS	DRK
TOLERANCES	DNC
FRACTIONAL $\leq 1/16"$	STR
DECIMAL $\leq .03$	PRC
ANGLE $\leq 1^\circ$	PRJ
	APP
	REL."

DEPARTMENT OF ENERGY
MOVING BED GRANULAR BED FILTER
DEVELOPMENT PROGRAM

FILTER GENERAL ARRANGEMENT

1181-2940-01-100

CONFIDENTIAL

11.

2 0 2

COMBUSTION
POWER

Combustion Power Company, Menlo Park, California

<u>UNLESS NOTED</u>	DRN	/
DIMENSION IN INCHES	CHK	/
TOLERANCE;	ENG	/
FRACTIONAL $\pm 1/16"$	STR	/
DECIMAL $\pm .03$	PRC	/
ANGLE $\pm 1^\circ$	PRJ	/
	APP	/
	REL	X

Combustion Power Company. Menlo Park, California

1. 5. 25

DETAIL K
(3 PL)

ION F-F

DETAIL M

2N G-G

DETAIL OF

1/2" THK TEMPERED GLASS

3. WELD PER CPC ST1132
2. BREAK ALL SHARP EDGES.
1. STEEL FABRICATION PER CPC ST1133.

NOTES:

DEPARTMENT OF ENERGY
MOVING BED GRANULAR BED FILTER
DEVELOPMENT PROGRAM

FILE

HALF FILTER VESSEL
ASSEMBLY

QND NO. 1181-5010-01-190 0 2 4 D
SCALE NONE SHEET 2 of 2

**COMBUSTION
POWER**

Combustion Power Company, Menlo Park, California

DETAIL A
SCALE: 1 1/2"=1'-0"

DETAIL B
SCALE: 1 1/2"=1'-0"
TYP 4 PL

DETAIL A

SCALE: 1 1/2"=1'-0"

DETAIL B

SCALE: 1 1/2"=1'-0"
TYP 4 PL

6. BRICK SHELVES WILL BE DEFINED BY REFRACTORY CONTRACTOR.

5. REFRACTORY: SUPER-DUTY BRICK OR EQUAL.

4. ALL 3/16" THK. CYLINDRICAL OR CONICAL PARTS SHALL BE JOINED WITH FULL PENETRATION BUTT WELD.

3. BREAK ALL SHARP EDGES.

2. ALLOY STEEL FABRICATION PER CPC ST1133.

1. ALL CARBON STEEL SHAPES AND PLATE MATERIAL PER ASTM A36 OR EQ.

NOTES:

DATE	BY	CHK	APP	REL
7/8/94	EA	JUP	10/15/94	10/15/94
10/14/94	JUP	10/14/94	10/14/94	10/14/94
10/14/94	M. Thomas	10/14/94	10/15/94	10/15/94
10/15/94	A. Davis	10/15/94	10/15/94	10/15/94
10/15/94	R. Boyl	10/15/94	10/15/94	10/15/94

REVISIONS			
FOR DESCRIPTION OF CHG. SEE E. O.			
NO.	BY	DATE	APPR.

SEL)
VESSEL)

BE DEFINED BY REFRACTORY CONTRACTOR.

R-DUTY BRICK OR EQUAL.

INDRICAL OR CONICAL PARTS
TH FULL PENETRATION BUTT WELD.

EDGES.

ATION PER CPC ST1133.

SHAPES AND PLATE MATERIAL
EQ.

WELDING SPECIFICATIONS TOLERANCES ARE IN INCHES / MILLIMETERS TOLERANCES FRACTIONAL ± 1/16" DECIMAL ± .03 MILLIMETER ± .2 ANGLE ± 1°		DIM EA 7/8/94 CHK JUP 10/4/94 DES JUP 10/4/94 BY M. H. C. 10/4/94 PRC PLJ APP A. Davis 10/5/94 REL K. B. 10/5/94		TITLE FILTER VESSEL ASSEMBLIES- 3'-7" DIA. AND 6'-0" DIA.	
1181-5010-02-190		00 02 4 D		SCALE 1/2" = 1'-0" SHEET 1 OF 2	
		COMBUSTION POWER Combustion Power Company, Oceanside, California

VIEW E-E SH 1
SCALE: 1 1/2" = 1'-0"
TYP 2 PL

1181-5010-02-190 00 02 4 D

SCALE 1/2" = 1'-0" SHEET 2 OF 2

COMBUSTION POWER

Combustion Power Company, Oakland, California

TYP FLANGE WELDING DETAIL

2. BREAK ALL SHARP EDGES.

1. STEEL FABRICATION PER CPC ST1133 & WELDING PER CPC ST1132.

NOTES:

<u>UNIT CONVERSIONS</u>		DAY	M.T.	9/7
DIMENSIONS ARE IN INCHES		CHK	JHT	15
TOLERANCES		ENG	JHT	.816
FRACTIONAL	$\pm 1/16"$	STR	Thermo	.714
DECIMAL	$\pm .03$	PRC		
ANGLE	$\pm 1'$	PLU	K. Williams	11/10
		APP	SDB	11/6
		REL	K. Hager	11/1

REVISIONS			
NO.	BY	DATE	APPR

WELDING PER CPC ST 1132.

DEPARTMENT OF ENERGY MOVING BED GRANULAR BED FILTER DEVELOPMENT PROGRAM			
DEV AND FILTER VESSEL INTERNALS			
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES FRACTIONAL $\pm 1/16"$ DECIMAL $\pm .03$ HOLE $\pm .01$	DRW M.J.T. 9/7/94 CHK JUF 15/6/94 ENG JUF 10/6/94 STR Thomas 7/12/94 PRC PRJ K. Williams 10/6/94 APP SJS 10/6/94 MGR K. Hines 10/6/94	1181-5010-10-114 SCALE NONE SHEET 1 OF 2	NO. OF SHEETS TO BE BUILT 2 41D
COMBUSTION POWER Combustion Power Company, Menlo Park, California

SPIDER ASSY. - SCS 1/2-MODEL
 (USING REWORKED NYU MODEL - FOR WELDING
 & DETAILS NOT SHOWN SEE NYU MODEL)

SPIDER
 (3'-)

SPIDER ASSY.
7U MODEL

C8

$\frac{3}{16} \times \frac{1}{2}$ BAR
NEW (2PL)

W.A.F. MODEL
FILTER

SPIDER ASSY. SCS MODEL
(3'-7" I.D. FILTER)

SPIDER ASSY. - SCS MODEL
(6'-0" I.D. FILTER)

UNLESS OTHERWISE SPECIFIED	DRN	
DIMENSIONS ARE IN INCHES	CHK	
TOLERANCES	ENG	
FRACTIONAL $\pm 1/16$	STR	
DECIMAL $\pm .03$	PRC	
ANGLE ± 1	PLG	
	APP	
	REL	

REVISIONS			
FOR DESCRIPTION OF CHG SEE E O			
LTR	BY	DATE	APPR

SPIDER ASSY - SCS MODEL
(6'-0" I.D. FILTER)

DEPARTMENT OF ENERGY
MOVING BED GRANULAR BED FILTER
DEVELOPMENT PROGRAM

DEV AND FILTER VESSEL INTERNALS

UNLESS OTHERWISE SPECIFIED	DRW	
DIMENSIONS ARE IN INCHES	CHK	
TOLERANCES	ENC	
FRACTIONAL $\pm 1/16"$	STR	
DECIMAL $\pm .03$	PRC	
ANGLE $\pm 1'$	PRJ	
	APP	
	REL	

SHEET NO.	1181-5010-10-114	CONTRACT NO.	2	NO. OF SHEETS	410
SCALE	NONE	SHEET	2 OF 2

COMBUSTION
POWER

Combustion Power Company, Menlo Park, California

REVISIONS			
FOR DESCRIPTION OF CHG. SEE E. O.			
LTR.	BY	DATE	APPR.

DEPARTMENT OF ENERGY
MOVING BED GRANULAR BED
FILTER DEVELOPMENT PROG.

MEDIA FLUIDIZER TEST UNIT

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES

TOLERANCES
FRACTIONAL $\pm 1/16"$
DECIMAL $\pm .03$
ANGLE $\pm 1^\circ$

DRN	JWP	8-3-94
CHK		
ENG	JWP	8-17-94
STR		
PRC	JCH	8-24-94
PRJ	ICB	2-23-94
APP		5-25-94
REL		

SIZE	DWG NO.	REV
A	1181-5090-01-107	0
SCALE	SECTION	SHEET 1 OF 1
NONE		

DWG CONFIG.	QTY REQ'D	NEXT ASSEMBLY

**COMBUSTION
POWER**

Menlo Park, California

18 GA COLD ROLLED
CARBON STEEL SHEET
STRETCHER LEVELED
PER ASTM A366

①

SHELF PLATE POSITIONED
IN FIELD

SECTION A-A

NOTE 1. ASSEMBLY MOUNTS ON DRUM
ROTATOR.

UNION PRODUCTION SYSTEMS	DWG	JWP	10
DESIGNS ARE IN	CHK	JEQ	10
NOTES / DIMENSIONS	ENG	CH	10
TOLERANCES	STR		
FRACTIONAL : 1/16"	PRJ	K. B. W.	10
DECIMAL : .01	APP	G. G. G.	10
ANGLES : 1"	REL	K. H. G.	10
3RD ANGLE PROJECTION			

REVISIONS			
FOR DESCRIPTION OF CHG. SEE E. O.			
NO.	BY	DATE	APPR.

SHELF PLATE POSITIONED
IN FIELD

SECTION A-A

TOTAL

PL)

UNITS ON DRUM

DEPARTMENT OF ENERGY
MOVING GRANULAR BED FILTER
DEVELOPMENT PROGRAM

ABRASION TEST UNIT
ASSEMBLY

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES / MILLIMETERS	DRN	JWP	10/16/94
	CHK	JEO	10-6-99
	ENG	JWP	10/6/94
	STR		
TOLERANCES FRACTIONAL ± 1/16" DECIMAL ± .03 MILLIMETER ± .2 ANGLE ± 1°	PRC		
	PRJ	K.S.W.	10/6/94
	APP	GOS	10/6/94
	REL	K. Hays	10/6/94
3-VIEW ANGLE PROJECTION			

1181-5090-02-107 0 1 4

SCALE NONE

COMBUSTION
POWER

Combustion Power Company, Oakland, California