

NO. 3 GAS CRACKING PLANT
5,000,000 CU. FT. ETHYLENE PER DAY

Copy No. 1

GAS PROCESS ENGINEERING AND
DEVELOPMENT DEPT. FILE

PART II

FURNACES

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FLOW SHEET

ENGINEERING DEPARTMENT

CARBIDE AND CARBON CHEMICALS CORPORATION

SOUTH CHARLESTON, WEST VIRGINIA

FEBRUARY 3, 1937

PLAINTIFF'S
EXHIBIT

76043.00

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NO. 3 GAS CRACKING PLANT

5,000,000 CU. FT. ETHYLENE PER DAY

PART II

FURNACES

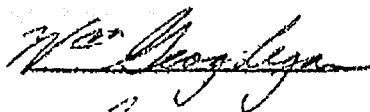
FOREWORD

This covers the apparatus list, valve list, piping specifications, and flow sheet for the design of the 1,250,000 cu.ft. per day furnaces for the new South Charleston cracking plant. Discussion and calculations on this furnace design will be found in the Appendix to Part II. The item numbers herein given will be identical for all furnaces, and refer to flow sheet SK-15945. Eighteen furnaces will be initially installed.

Inlet gas will be heated progressively in these furnaces by gaseous combustion products to the cracking temperature. Upon discharge, it will be quenched by a water spray, and fed to a collecting header which will lead it away for further treatment.

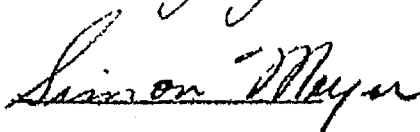
Written by:

Wm. Geoghegan



Approved by:

Simon Meyer



APPARATUS LIST

Item Numbers Refer to SK-15945

RG3-201 - FURNACE

For housing heat-absorbing tubing and heat-liberating combustion equipment.

To be constructed in general agreement with the remodeled No. 10 South Charleston furnace, as shown on SK-15936, Work Order HF-546. It may be considered as embodying the following parts:

(a) Steel Work

To carry out the general design shown on SK-15936.

(b) Refractory Walk and Arch

To be constructed similar to No. 1 South Charleston furnace, as shown on drawing A-58513, with additions as necessitated by design as given on SK-15936. Materials shall follow these specifications:

Firebrick	-	Harbison-Walker Franklin Crown loose-texture firebrick, or equivalent.
Insulating brick	-	Babcock and Wilcox K-22, Armstrong 2500° F., or equivalent
Insulation	-	Johns-Manville "Superex"
Wall Sheathing	-	1/2" "Transite" board
Cement	-	Brick are to be laid up with B&W No. 80 Airset Cement

(c) Roof

Method of construction to be similar to No. 1 furnace, as shown on drawing B-51673. Use of a new refractory shape will be necessary due to change in roof contour to accomodate enlarged preheater.

(d) Foundation

Construct according to drawing A-48075.

(e) Seal Plates for Preheater Floor

To prevent seepage of hot combustion gases through furnace arch to preheater flue. This will consist of sheets of Allegheny "55", 20 gauge, 48" x 90", laid across the preheater floor, lapped in such a way as to provide a gas seal. These are to be covered with one 2-1/2" layer of firebrick to protect against damage during removal or installation of coils.

RG3-202 - CONVECTION PREHEATER

This will perform the first part of the preheating of the raw material before it enters the cracking tubes. It will consist of 60 passes of 300 lbs./sq.in. Seamless Steel pipe, Grade "A", A.S.T.M. Specification A-106, 4-1/2" O.D. x 0.237" wall (4" std. pipe size), for temperature range 750° - 850° F. The passes will be connected by welded-on extra heavy return bends, cast steel, 6"-center-to-center. The coils shall be tested for tightness before installation in the furnace using air at 30 lb./sq.in. gauge pressure. Under this test, neither tubes, return bends, nor welds shall show any leakage, as revealed by painting with soapsud solution.

RG3-203 - CONVECTION PREHEATER BRACKETS

These are to provide a support for the convection preheater tube bundles, and to maintain the tubes in proper alignment in the flue. They will consist of gray cast iron brackets, made and assembled according to SK-15944.

RG3-204 - RADIANT PREHEATER

This will complete the preheating of the raw material before entrance to the cracking tubes. It will consist of 30 passes of 4" O.D. x 3-1/2" I.D. centrifugally-cast alloy tubes of the following composition:

Chromium	28%
Nickel	6%
Silicon	1.5%
Carbon	0.4% (Maximum)
Iron	Remainder

The tubes will be connected by welded-on return bends, 6" center-to-center, of the same composition. The coils shall be tested before installation as outlined under Item RG3-202.

RG3-205 - RADIANT PREHEATER BRACKETS

To support the radiant preheater tubes and to maintain them in alignment in the flue. Cast chrome iron brackets of the same composition as the tubes of Item RG3-204, made and assembled in accordance with SK-15943, will be used.

RG3-206 - CRACKING TUBES

In these the raw material will be subjected to the high temperatures required for cracking. There will be 6 passes of centrifugally-cast tubing of the composition specified for Item RG3-204, 3" ID x 3-5/8" OD, connected by 7" center-to-center return bends of the same composition.

These tubes shall be tested for tightness as prescribed for Item RG3-202.

RG3-207 - QUENCHER

In this, the cracked gases are cooled by a water spray. It is to be fabricated of a 6" std. cast steel cross, and will use a bronze Spray Engineering Company "Spraco" #10A full-cone nozzle, capacity 27.5 G.P.M. at 25 lb./sq.in. pressure differential.

18 items

RG3-208 - RAW MATERIAL FLOW METER

To meter the raw material entering the furnace. Use Westcott meter, flush panel mounting, 0" to 50" differential, 0# to 100# pressure spring, 24-hour clock.

Recommended supplier - Metric Metal Works.

18 items

RG3-208A - ORIFICE FLANGES

To provide mounting for Orifice Plate, Item RG3-208B. Use 4" 250 lb. orifice flanges, flange type pressure connections.

18 items

RG3-208B - ORIFICE PLATE

To furnish the primary impulse for the flow meter, Item RG3-208. Use 2.000" 18-8 stainless steel orifice plate, to fit 4" 250 lb. flanges.

✓ *18 items*

RG3-209 - RAW MATERIAL PRESSURE GAUGE

To indicate pressure of raw material entering the furnace tubes. Use 5" U.S.Gauge Company, Fig. 500 iron case, nickel plated ring, back pressure connection, for flush panel mounting, 0 to 50 lb. range.

18 items
RG3-210 - FUEL FLOW METER

To meter the fuel gas consumed by the furnace. To be identical with Item RG3-208.

RG3-210A - ORIFICE FLANGES

To provide mounting for Orifice Plate, Item RG3-210B. Use 4" 250 lb. orifice flanges, flange type pressure connections.

RG3-210B - ORIFICE PLATE

To furnish the primary impulse for the flow meter Item RG3-210. Use 1.000" 18-8 stainless steel orifice plate, to fit 4" 250 lb. flanges.

✓ *18*
RG3-211 - FUEL PRESSURE GAUGE

5" dia 50#
To read pressure of fuel gas fed to inspirator manifold. To be identical with Item RG3-209.

RG3-212 - HIGH PRESSURE INSPIRATOR

To form the correct fuel-air mixture for combustion, and to deliver it to the burner, Item RG3-213. Use Surface Combustion Company's #A-57 inspirator, equipped with #28 spud. Spud capacity 1070 C.F.H. at 25 lb. pressure, handling gas of 0.37 specific gravity.

RG3-213 - BURNER

To feed the fuel-air mixture to the combustion chamber for burning. This is to be a copy of the cast iron burner used in the Whiting Acetone Cracking furnace, as shown on drawing A-60459. However, the dimensions are to be changed to conform to the smaller gas cracking furnace. The burner nozzle I.D. is to be 3" instead of 5-1/2", and other dimensions are to be altered to conform to this, and to a burner block of section 12-1/2" x 12-1/2" rather than 15" x 15". The refractory burner tip to be used is the Selas Company's "Refrak" screen to correspond to Selas burner #113-3.

RG3-214 - BURNER BLOCK

To provide a refractory tunnel in which combustion of the fuel-air mixture may take place. This will be a cast sillimanite block, made of P.B. Sillimanite ramming mix, compacted by air hammer to the maximum practical density, thoroughly dried, and burned. It will be a rectangular block, extending completely through the furnace wall, and having a flaring combustion tunnel through the center. Outside dimensions of block 12-1/2" x 12-1/2" x 20".

Recommended supplier - Chas. Taylor Sons Company

18

RG3-215 - PRESSURE GAUGE ON INSPIRATOR

To read pressure of fuel gas at spud of Inspirator, Item RG3-212. Use U.S. Gauge Company's No. 500-S, 0-50# range, 2-1/2" face, steel case, hard rubber finish.

RG3-216 - 226 Inclusive - HIGH PRESSURE INSPIRATORS

Identical with Item RG3-212.

RG3-227 - 237 Inclusive - BURNERS

To correspond to Items RG3-216 - 226 respectively.

Identical with Item RG3-213.

RG3-238 - 248 Inclusive - BURNER BLOCKS

To correspond with Items RG3-216-226, respectively.

Identical with Item RG3-214.

18 ea.

RG3-249 - 259 - Inclusive - PRESSURE GAUGES ON INSPIRATORS

To correspond to Items RG3-216 - 226, respectively.
Identical with Item RG3-215.

✓

18

RG3-260 - FURNACE OUTLET PRESSURE GAUGE

5" Dial 0-50"

To indicate the pressure of the raw material at the furnace outlet. Identical with Item RG3-209.

18

5" Dial 50"

RG3-261 - QUENCHER WATER PRESSURE GAUGE

To indicate the pressure of the water supplied to the quencher. Identical with Item RG3-209.

✓ 18
RG3-262 - DRAFT CONTROL

To assist combustion by regulating draft to maintain a constant predetermined combustion chamber pressure. Use A.W.Cash Company, Type 90 controller, installed similar to Drawing A-53007, C&CCC, Whiting, Indiana. To operate on compressed air supply at 25 lb. gage, and to maintain any set draft from +.05" H2O to -0.5" H2O within a maximum variation limit of ± 0.01 " H2O.

RG3-263 - DAMPER

To throttle breeching passage to control draft. To be actuated by power cylinder of Draft Control RG3-262. To be a butterfly valve set in breeching similar to method shown on drawing A-53007, C&CCC., Whiting, Indiana, with any changes in dimensions necessary to adapt it to new furnace design.

#RG3-264 - VENTURI THERMOCOUPLE THROAT

To provide a flow of flue gases at high velocity over a thermocouple in order to obtain as true as possible a reading of stack temperatures.

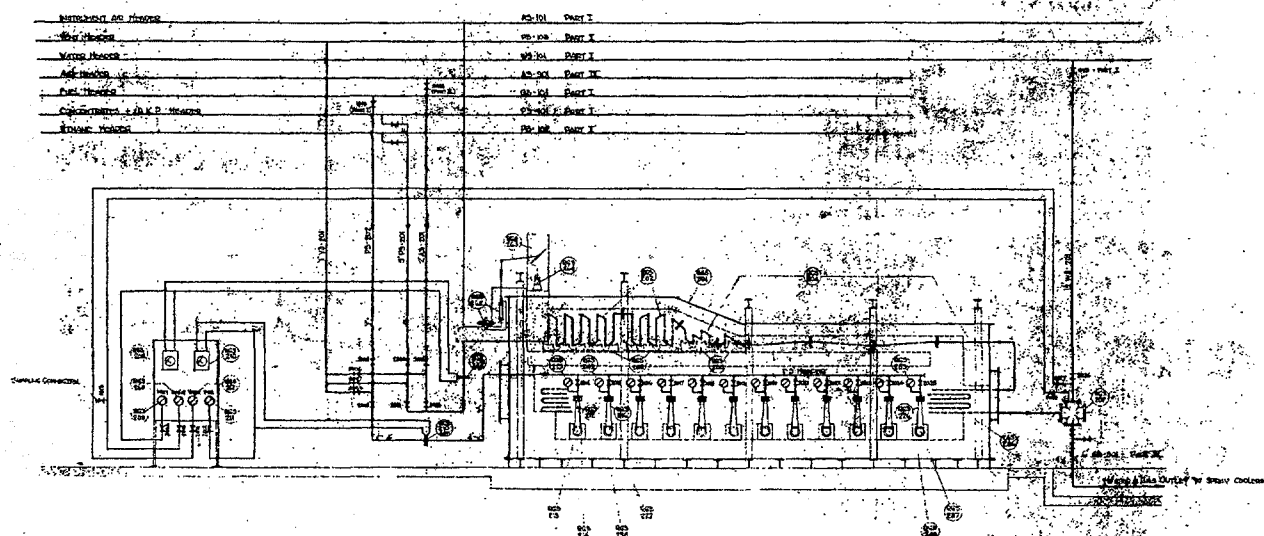
This will take the form of a 3" diameter collecting nozzle and tube, the tube having a venturi throat in which the thermocouple tip will be located. The tube will connect to a flue passage which bypasses the damper, Item RG3-263, so that the full available stack draft will at all times be producing a flow of hot gases over the thermocouple tip. The details of construction and installation are shown on SK-15588, attached to this report.

VALVE LIST

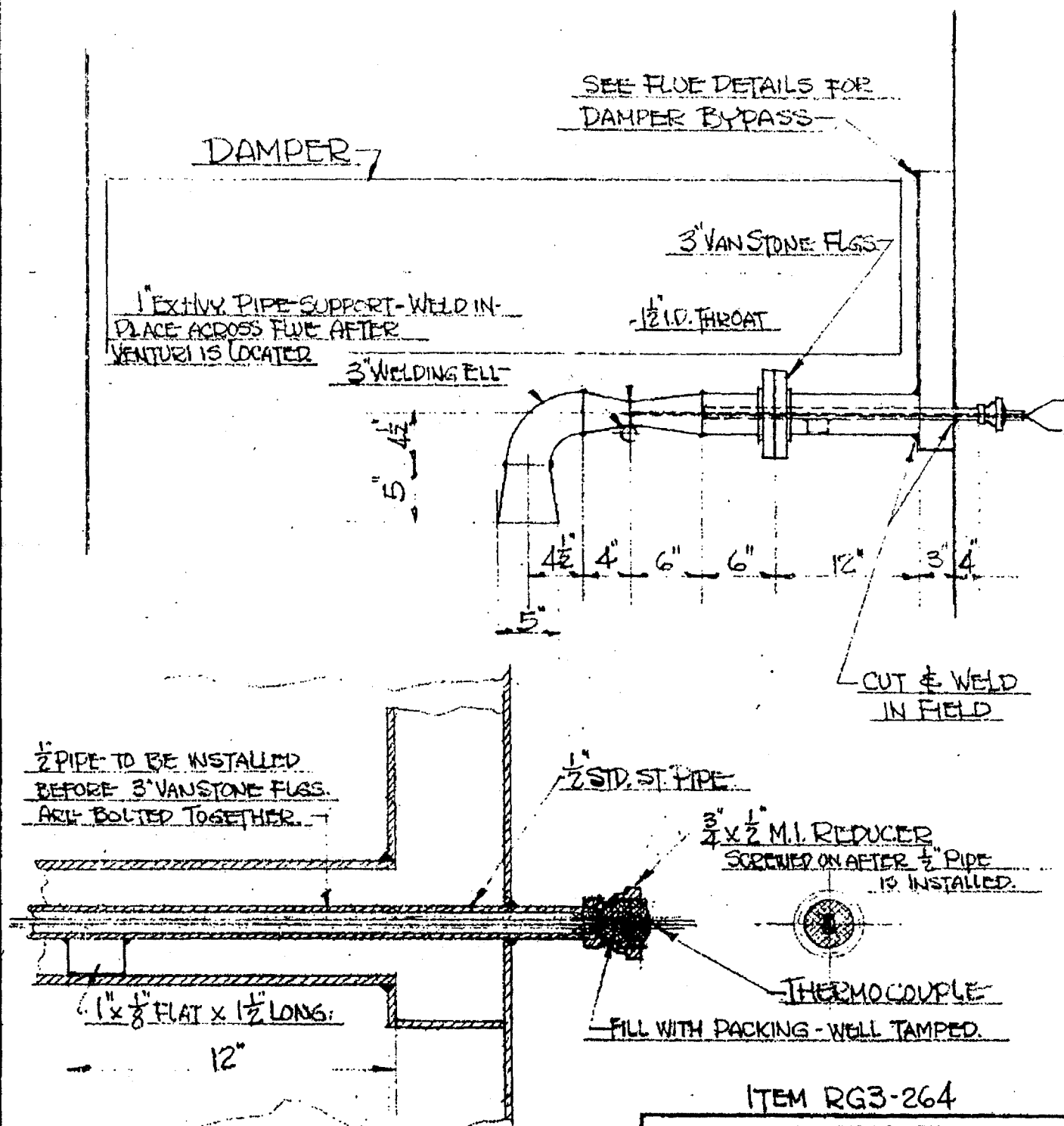
Valve No.	Location	Size	Service	Specification
2000	P-201	3"	Shut-off	Powell Fig. 1781 ^{Crane #75} 6
2001	P-201	3"	Control	Powell Fig. 1781
2002	P-202	2"	Shut-off	Lunkenheimer #16P : 190
2003	P-202	2"	Control	Lunkenheimer #16P
2004	A-201	2"	Shut-off	Powell Fig. 1781 72
2005	A-201	2"	Control	Powell Fig. 1781
2006	V-201	1"	Shut-off	Powell Fig. 478 ✓
2007	V-201	1"	Shut-off	Powell Fig. 478
2008	V-201	1"	Shut-off	Powell Fig. 478
2009	RG3-209	1/2"	Shut-off	Vogt #9803
2010	RG3-260	1/2"	Shut-off	Vogt #9803
2011	RG3-261	1/2"	Shut-off	Vogt #9803
2012	RG3-211	1/2"	Shut-off	Vogt #9803
2013	RG3-260	1/2"	Shut-off	Vogt #9803
2014	RG3-212	3/4"	Shut-off	Lunkenheimer #16P
2015 to 2025, incl.	RG3-216-226 incl. respectively	3/4"	Shut-off	Lunkenheimer #16P
2026	W-201	1-1/2"	Shut-off	Crane #440
2027	RG3-207	1/2"	Shut-off	Crane #1
2028	RG3-207	1/2"	Shut-off	Vogt #9803

PIPING LIST

Line No.	Description	Size	Material	Construction	Pipe Dope	Gaskets	Working Press.
P-201	Raw material feed to furnaces	3" & 4"	Std. black steel	Welded	--	1/16" Durabla	50 X
P-202	Fuel feed to furnace	2", 4" & 2"	Std. black steel	Welded	--	1/16" Durabla	25 X
A-201	Air feed to furnace	2"	Std. black steel	Screwed	Red lead	--	2 X
V-201	Vent line	1"	Std. black steel	Screwed	Red lead	--	2 2 H
W-201	Water feed to quencher	1-1/2"	Std. galv. steel	Screwed and Flanged	Red lead	1/16" Rainbow	50 OK



ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION	ITEM	QTY	DESCRIPTION
1. GAS INLET	1	1/2" NPT	2. GAS OUTLET	1	1/2" NPT	3. GAS FLOW METER	1	1/2" NPT	4. GAS PRESSURE GAUGE	1	1/2" NPT	5. GAS TEMPERATURE GAUGE	1	1/2" NPT	6. GAS DENSITY GAUGE	1	1/2" NPT
7. GAS VISCOSITY GAUGE	1	1/2" NPT	8. GAS COMPOSITION GAUGE	1	1/2" NPT	9. GAS FLOW CONTROLLER	1	1/2" NPT	10. GAS PRESSURE CONTROLLER	1	1/2" NPT	11. GAS TEMPERATURE CONTROLLER	1	1/2" NPT	12. GAS DENSITY CONTROLLER	1	1/2" NPT
13. GAS VISCOSITY CONTROLLER	1	1/2" NPT	14. GAS COMPOSITION CONTROLLER	1	1/2" NPT	15. GAS FLOW RECORDER	1	1/2" NPT	16. GAS PRESSURE RECORDER	1	1/2" NPT	17. GAS TEMPERATURE RECORDER	1	1/2" NPT	18. GAS DENSITY RECORDER	1	1/2" NPT
19. GAS VISCOSITY RECORDER	1	1/2" NPT	20. GAS COMPOSITION RECORDER	1	1/2" NPT												



ITEM RG3-264

ENGINEERING DEPT.
CARBIDE & CARBON CHEMICALS CORP.
NEW YORK

SOUTH CHARLESTON, W. VA. WORKS
TITLE GAS CRACKING PLANT No. 3
VENTURI WELL FOR THERMOCOUPLE

Drawn by L.S.L. Ch'd by

App'd by

Date 2-11-37 Scale

SK-15588