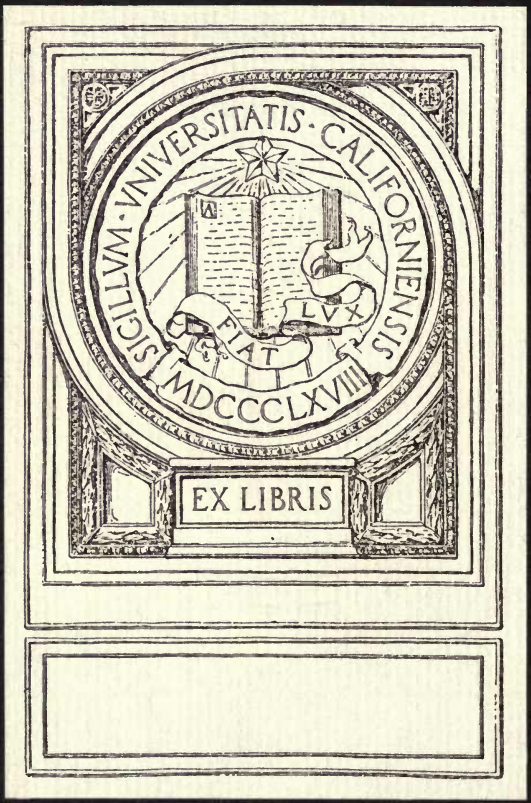
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REPORT OF THE COMMITTEE ON STANDARD TESTS.

WRITTEN FOR THE ELEVENTH ANNUAL MEETING OF THE AMERICAN GAS INSTITUTE, OCTOBER, 1916, BY DR. J. F. WING, CHAIRMAN.

It has been the task of this Committee to comply with an insistent demand for comparable or uniform methods of stating the results of testing or, more broadly, the results of operating a manufacturing unit or plant. The object of this standardization is to facilitate the study of the efficiency of materials, apparatus and methods by comparing the results obtained at different times and places. This object is most nearly attained when the operation and results are reported in a comparable manner.

The task which the Technical Committee set for us, would not be very hard for anybody to do to his own satisfaction. All gas companies have their own forms and methods, more or less complete, and it is this very diversity and independence which creates the demand for standardization in reporting those data which are of interest, and profitable to compare. This diversity of practice makes the committee diffident in expecting its recommendations will be wholly acceptable to all.

The field covered by this report is already large, too large perhaps, and still other details might be included. Since it contains the views of so small a number and the subject is so important, it is offered to the Institute this year as a preliminary report for criticism and for instructions.

In the early days of gas associations, and even in the earlier prehistoric days, when two or three gas men were gathered together, there would be one among them who would modestly

mention the high candle-power he was getting. Then another, whose candle-power was not so high, would complacently inform them about the large yield of gas per pound of coal, which he was producing, and both parties were probably content with their results.

Now, of course, if the physical conditions of the measurements were ignored, their flattering results might not be even true; and if the conditions of operating were only casually noted, it would be difficult for another to divine the reason for the success in some works and to discover the faults in his own.

Many of us can remember how ingeniously the expression "candle-feet per pound," when he first heard it, seemed to reconcile the relations of quality and quantity.

Although changes and improvements were continually taking place, the summary "candle-feet per pound of coal" answered very well as long as good coals were widely available and the annual reviews of the state of the art reported that "there has not been much progress in carbonization," which was not so very long ago, and a production of 80 candle-feet per pound was satisfactory.

This state of affairs changed when in consequence of the poorer quality of much of the gas coal used, and the adoption of improved designs, it became realized that the range in candle-feet per pound extended from 70 to 100, and that the by-products varied quite widely in quality and quantity.

We have in the manufacturing results in water gas plants, also a wide variation at different times and places.

The art of gas manufacture has improved so much, and the urgency of economy is so great, that it is important to study these reported variations in efficiency, and to note the conditions under which they are obtained.

If this collection and exchange of information is to be most productive, it must be carried out quite extensively and in a uniform manner. This necessity has given the impetus for preparing a standard scheme for reporting conditions and results.

It is important to record just what you are doing when you are doing well, so that the same conditions may be followed again. High results are due to close control. Besides, there are still many points in the art which are not understood and which we are hopeful of elucidating. Then again, when some other plant is doing better than your own it is convenient to have a common basis of comparison, and not infrequently, to satisfy yourself that it is doing better.

The most urgent necessity of standardization seems to have arisen within a few years on account of the improvements in manufacture and the different designs of plants. In order to meet changing commercial conditions, and to supply an increased demand for gas, most companies have been expanding or rebuilding the plants, or installing new ones. Some have been enterprising enough to install novel designs after studying plans. But many more have cautiously tried to select an installation after inspecting and comparing the cost and efficiency of several operating plants and have been puzzled over the question of efficiency of production, which is influential in determining a choice, owing to the unfamiliar, or it may be, the incomplete methods of recording the materials used and the results.

Here is a case where comparable and reliable data assist in determining a considerable investment, and in confirming the claims of competing advocates, whose good faith is not questioned.

These designs may be all good in their own peculiar way, that is, superior for some special objective.

The usefulness of this code is for conducting and reporting tests. The form is recommended for reporting manufacturing data. It is profuse and even complicated in detail and still might be extended. But is is thought that any of the data called for might be desired and considered of influence.

Some of the observations may be infrequent. Thus the data not easily subject to change may be taken day and night; but variable data should be observed hourly during a test. In routine manufacturing reports many items could be omitted,

but they should be remembered as points of attention for the proper management of the plant.

"Note the specific object of the test, and keep this in view not only in the work of preparation but also during the progress of the test, and do not let it be obscured by too close attention to matters of minor importance. Whatever the object of the test may be, accuracy and reliability must underlie the work from beginning to end.

"If questions of fulfillment of contract are involved, there should be a clear understanding between all the parties preferably in writing as to the operating conditions, which should obtain during the trial, and as to the methods of testing to be followed unless these are already expressed in the contract itself."

The purpose of a test of a plant or a unit may be to determine the efficiency of the apparatus itself while using familiar materials, the materials in a familiar apparatus, or a variation of the method of operating.

Now any one change in the materials or method of operating involves a long chain of changes in the conditions, which might be illustrated in several ways. Therefore, in order to obtain any valuable and tangible information many data of conditions must be taken, since it is difficult to ascribe the proper cause to an effect.

The scheme does not provide for reporting costs of labor or repairs. These are details of management. They would be apt to be high anyway in a test run for large results.

The test must be preceded by a thorough examination of the plant or apparatus concerned, in order to be certain that it is in good order and that all defects may be remedied, thus avoiding interruptions and the opportunity for deceiving results in a test for efficiency.

Leaks in apparatus, connections, piping and especially valves must be corrected, obstructions in flues and connections sought and removed. All seals and drips must be put in working order. All mechanical apparatus must be inspected and put in order.

The person in charge of the test should have the aid of a sufficient number of assistants so that he may be free to give special attention to any part of the work whenever and wherever it may be required. He should make sure that the instruments and testing apparatus continually give reliable indications and that the readings are correctly recorded. He should also keep in view at all points, the operation of the plant under test and see that the operating conditions determined on are maintained and that nothing occurs either by accident or design to vitiate the data. This last precaution is especially needed in guarantee tests.

A memorandum should be made of every unusual condition and occurrence with the exact time. All observations must be recorded promptly and faithfully in a permanent manner with the time noted on the log sheet, signed by the observer.

In the chemical tests of materials and products, as well as those made for the control of operations, it is recommended that the methods of sampling and analysis proposed by the Committee on Chemical Tests of the American Gas Institute be followed.

In the observation of the data of the physical tests made on the operation or on the products, it is important that all the standards and measuring apparatus should be known to be accurate, within narrow limits. It may seem perfunctory to utter this caution, but often too much confidence is placed in the condition and accuracy of apparatus. Many different instruments have to be used to take all the observations scheduled, some are liable to error for more than one cause, and not the less if they are used infrequently, so that it is not impossible that a critical examination will expose somethin~ This applies to everything from the platform scales to the calorimeter.

The result of the test of a plant is the sum of many factors. If some of the factors are incorrect, one may wonder for 24 hours, at the results of a 24-hour test.

The length of time to be taken for a manufacturing test must be determined by the discretion and convenience of those

interested. One week would appear to be the shortest duration which would give satisfactory and valuable information. If this short period is the limit great care must be taken to avoid unusual conditions, in order to prevent self deception, which is not so probable in a longer test.

It must not be understood that one week is sufficient duration for a serious test of a carbonizing plant. But such a period will give information concerning a variation in the method of operating a water gas plant, and also concerning a variation in the generator fuel, and in coal used in carbonizing apparatus, when the manufacturing conditions are unchanged.

A carbonizing plant responds more slowly than the other to changed conditions of operating on account of the large mass of heated material, therefore it requires much longer to evolve the best conditions for operating the fires and to determine the best conditions for carbonizing the coal.

A further reason for extending the test of a carbonizing plant over a long period is that large quantities of coal are used daily from the storage, and there is much probability that the coal will not be uniform in its condition and even not be from the same source or shipment all the time. Hence too short a period of test may be misleading.

If the object of a guarantee test is to produce a large volume, a period of one week is too short, since it is possible to run that length of time at an abnormal and imprudent intensity, which could not be continued without danger of injuring the setting. Permanency and reliability are important to be proven.

A carbonizing test should extend a month or longer. In a new plant if it is to be a guarantee test, it should not be undertaken before the plant has run long enough to be in normal operation. Formerly when the retorts were all horizontal and rather lightly charged, a month would include the scurfing or burning out time, nowadays it would hardly occur so often. A month is about the shortest period for which the residuals tar and ammonia can be determined satisfactorily. Also, in

case a residue of coal must be measured, there is less per cent. of error after a long period.

A water gas plant should be tested for one week or longer. In this case the efficiency may be determined more quickly, but the workmanship and reliability must also be assured.

It is not necessary to expand this report by including in it directions for testing the quantity and quality of the gas. Authoritative and minute directions for testing station meters are accessible to the Institute members in the Gas Institute *News* for December, 1915, p. 528.

Directions for candle-power observations are given in the valuable report of the Committee on Methods of Taking Candle-power of Gas, published in the PROCEEDINGS of the American Gas Institute for 1907, and in a supplementary report in the PROCEEDINGS for 1908.

The calorific value of the gas in British thermal units should be determined by following the explicit and practical directions, adopted in 1910 by the Joint Committee on Calorimetry for the Second Public Service District in New York, as nearly as circumstances will permit. These regulations were published in the report of the Joint Committee in 1913 and were printed in the PROCEEDINGS of the American Gas Institute for that year.

These directions are based on the work of the Committee on Calorimetry of the American Gas Institute, which was reported in 1908 and 1909 in the PROCEEDINGS. These reports, in pamphlet form, may be obtained from the Secretary.

BY-PRODUCTS.

When we turn from the elegant and accurate methods of determining the quantity and quality of the gas produced, to consider the by-products, coke, tar and ammonia, we find some difficulty in obtaining satisfactory measurements.

Tar and Ammonia.

The tar and ammonia are usually collected in large tanks already containing these products so that reliable measurements cannot be made when a short test run is carried out. If

these are the conditions, the test should continue long enough for the tar and ammonia collected to amount to so much that a slight error in measurement would not make a large percentage of the quantity.

In order to obtain reliable measurements from a short test, separate tanks of small size must be available. Both of these by-products must be tested chemically in order to determine the actual tar and ammonia.

Coke.

The coke made and used as fuel should be reported as dry. When a test, which is of some importance is being made, it all should be weighed, although it is laborious and inconvenient to do so, by some method that can be adapted in the plant.

When the object is to check the production of coke in continuous manufacture, it is out of the question to weigh it all, but periodic weighings should be made to check the measures of yield, breeze and fuel.

The coal carbonized and the water gas generator fuel should be weighed, all the time, either as car loads or as smaller units.

So far we have used the term "coke" in a general sense. In practice it seems desirable to use these definitions. Coke is that portion of the entire product discharged from a retort after carbonization which will pass over a screen having ½-inch square openings.

Breeze is that portion which will pass through these openings.

This distinction is somewhat arbitrary, although it is quite widely accepted.

It is important, for purposes of comparison, that it be specified how the coke should be screened. In practice and commercially, different plants use rotary screens, shaking screens and screens inclined at different angles. These modifications are equivalent to openings of different sizes and are further influenced by the rate of screening.

Take the coke immediately on discharging before it is subjected to other handling. Enough lots should be taken to have

samples representing actual conditions. In horizontal and inclined retorts the coke from a vertical tier must be taken; from vertical retorts and ovens also, it must be taken from several, in order to include all conditions. It is recommended that the coke be forked, then thrown on a ½-inch screen, 3 feet wide by 6 feet long, inclined at an angle of 40° from the horizontal.

Yields of Coke and Breeze.

In order to make the reported yields comparable, it is desirable that the calculations should be made on a basis of dry coke and dry breeze from dry coal. The total product from the retorts on which the determination is to be made should be screened to separate the merchantable coke from the breeze. After screening, the weights of coke and breeze should be determined. Samples of both coke and breeze should be taken immediately after the product has been weighed and moisture determinations made thereon. From the result of these moisture tests the total number of pounds of the dry coke and of the dry breeze should be calculated. The yield of dry coke from dry coal is then calculated by dividing the total number pounds (or tons) of dry coke produced by the total number of pounds (or tons) of dry coal charged in the retorts which were used in the tests.

The net dry coke does often agree in percentage with the result of the crucible test of the coal, but the only way to obtain reliable figures for the yield is to weigh that produced in the operation.

There are some properties of the coke which are important to be noted. The chemical composition is called for in the schedule for reporting the tests. Certain physical properties are important in deciding whether a coke is suitable for service where the most exacting requirements of its quality are demanded, that is, in a blast furnace.

Therefore, the coke may be subjected to several kinds of tests to determine its character.

1st. The shatter test to determine its relative breakage on handling.

2nd. The porosity test.

3rd. The specific gravity test.

4th. The crushing test.

5th. The test for solubility in carbonic acid at high temperatures.

Of all these tests, the results of only the second and third can be expressed absolutely.

The shatter test can be made quite satisfactorily, both as to simplicity and consistency in the results, and gives perhaps the most information about its physical value, since if it is relatively resistant to shattering, it must be quite tough and dense, more suitable for transportation and for ordinary fuel purposes.

The fourth and fifth tests have been studied but have not been developed so that they are entirely dependable, and they are not advocated.

These tests are described in Technical Paper No. 50 of the Bureau of Mines on Metallurgical Coke.

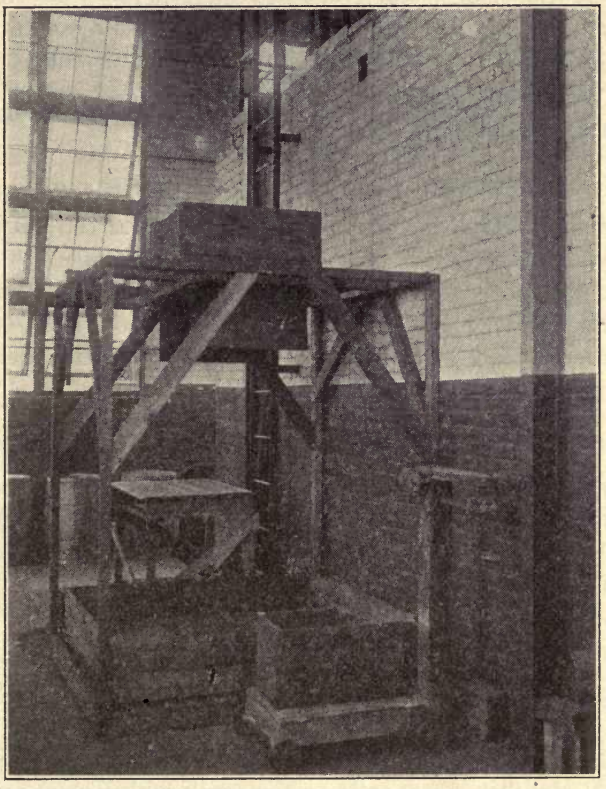
Shatter Test of Coke.

This description is taken from the Technical Paper No. 50, verbatim, except the modification that the sample used should all be over the 2-inch screen.

For a comparative test it seems as applicable to the large oven cokes with each other, as to retort cokes with each other. There is no common basis of comparing cokes from different sources.

"The apparatus for making the test as shown in Fig. 23 consists of a supported box capable of holding 100 pounds of coke, the bottom of the box being 6 feet above a cast-iron plate. The doors on the bottom are so hinged and latched that they will swing freely when opened and will not inpede the fall of the coke. Boards about 8 inches high are placed around the iron plate so that no coke may be lost. With a coke fork a sample of approximately 50 pounds over 2-inch size is placed in the box, no attempt being made to arrange it therein. The entire contents of the box is dropped four times on the iron

plate, the small material and the dust being returned each time with the large coke. After the fourth drop the material is screened on a screen of 2-inch mesh; the coke that remains



Shatter Test Apparatus.

on the screen and what passes through are weighed and the breakage is determined. If the sum of the weights indicates a loss of over 1 per cent. the test is rejected and a new one made."

Method for the Determination of Apparent Specific Gravity.

Weigh out 8 to 10 pieces of representative dry coke, and completely immerse in water in the special tank for at least

5 minutes. Add enough water to fill the tank exactly to a fixed mark near the top, then take out the coke pieces, draining each into the tank for about 30 seconds. By means of a suitable measuring stick, graduated to read liters and tenths, measure the space from the mark down to the water level. This space is equal to the apparent volume of the coke.

$$\frac{\text{Weight of coke (kilos)}}{\text{Apparent volume (liters)}} = \text{Apparent sp. gr. of coke.}$$

Measuring Stick and Special Tank.

The special tank is conveniently a cylindrical can with vertical sides, about 2 feet high and 1 foot in diameter.

For measuring thrust the stick vertically down the side of the tank inside until the stop rests on the top. Zero on the stick then is level with the mark. Take out the stick and take reading down to the point where it is wet.

Method for the Determination of True Specific Gravity.

Apparatus.—A 100 cubic centimeter measuring flask, whose weight alone, and when filled exactly to the mark with the benzol at the temperature of tests, is known. This temperature must be the same as that of the room at the time of making the tests.

Determination.—Fill the flask nearly half full with benzol, then add 30 grams coke (80 mesh or finer), by means of a glass funnel, in such a way that it will drop directly into the benzol, a little at a time. Agitate, by rotary shaking, to eliminate all air, then fill exactly to the mark with benzol and reweigh.

Let A = weight of flask filled with benzol.
Let B = weight of flask alone.
Let C = weight of flask filled with 30 grams coke and benzol.

Then:

$$\frac{0.3\ (A - B)}{30 + A - C} = \text{True sp. gr. of coke.}$$

Calculation for the Determination of Porosity or Percentage of Cellular Space.

$$\frac{\text{True sp. gr.} - \text{app. sp. gr.}}{\text{True sp. gr.}} = \text{Cellular space.}$$

Method for the Determination of Moisture.

For moisture determinations of either coke or breeze, representative samples, preferably not less than 50 pounds, should be taken and carefully weighed. These samples should then be put in a drying closet, which is kept at a temperature of 115° C. The drying closet should be provided with a means for insuring continuous ventilation. After 8 hours the sample may be taken out and weighed. The loss of weight divided by the original weight of the sample is the percentage of moisture.

Weight Balance.

The weight balance from carbonization can be determined with much less difficulty to a close approximation than that from water gas manufacture. But even in the former it must be remembered that there are inevitable losses of deposited pitch and of gas at the charging and discharging of retorts.

The inherent difficulties of measuring, sampling and testing a water-gas plant for a weight balance are very great, and it does not seem advisable to recommend it.

To determine the weight of gas, take the specific gravity at the same temperature as the meter. Then multiply this specific gravity by the weight of a cubic foot of air saturated at this temperature, and by the metered volume of gas corrected for barometric and meter pressure only.

Codes.

The appended codes for reporting tests of carbonizing plants and water-gas-generating apparatus are proposed. The items of the codes are numbered. It is to be noted that those numbered in large type are the most essential ones, which taken together, are short codes in cases where less detail is acquired.

FORM FOR REPORTING TEST OF A COAL CARBONIZING PLANT.

1.

1. Plant at
2. Duration of test, to determine

Description of Carbonizing Apparatus.

3. Name and type of retort or oven setting
4. Number of benches in use
5. Number of retorts in use
6. Dimensions of retort or chamber
7. Material used in retorts and settings
8. Days run since retorts were set or rebuilt
9. Condition of retorts
10. Average time since scurfing
11. Number and size of standpipes per retort
12. Kind of seal for dippipes
13. Method of charging retorts
14. Method of discharging retorts
15. Name and type of furnace
16. Dimensions of furnace
17. Size and description of grate
18. Primary air heated, temperature
19. Secondary air heated, temperature
20. Method of clinker prevention—Waste gas return, steam, etc.
21. Pounds steam per pound coke
22. Nature of air regulation
23. Kind of draught
24. Horse-power of fans, if used
25. Are waste heat boilers used
26. Heating surface, square feet
27. Method of draught for boilers

Description of Materials.

Gas Coal:

28. Kind of coal and source
29. *Condition*: Weathered, fresh, lumpy, fine, wet, dry
30. *Approximate Analysis*:

	Per cent.	Pounds in coal used
Moisture		
Volatile combustible		
Fixed carbon		
Ash		
Total		

31. SULPHUR:
32. *Ultimate Analysis*:
    Hydrogen
    Carbon
    Oxygen
    Nitrogen
    Sulphur
    Ash

    Total

33. B. t. u. per pound

    PRODUCERS:
34. Kind and size of fuel
35. Moisture
36. Volatile combustibles
37. Fixed carbon
38. Ash
39. Sulphur
40. B. t. u. per pound
41. Analysis of ash
42. Fusing point of ash
43. Nature of ash and clinker
44. Fuel gas, kind and source
45. Fuel gas, B. t. u. per cubic foot
46. *Approximate Analysis of Coke Produced*:
    Moisture — Per cent.
    Volatile combustibles
    Fixed carbon
    Ash
47. Sulphur
48. B. t. u. per pound
49. Analysis of ash
50. Fusing point of ash
51. Breeze through ½-inch square openings, per cent.
52. Apparent specific gravity
53. True specific gravity
54. Shatter tests

OPERATION.

55. Average duration of charge
56. Time in retort in continuous system
57. Average weight of charge
58. How is this weight determined

59. Coal carbonized per retort per day
60. Coal carbonized per lineal foot per day
61. Method of weighing total coal
62. Method of weighing total coke
63. How is coke handled
64. Per cent. of retort hours lost for scurfing repairs
65. Fuel gas used per 100 pounds coal
66. Fuel used in furnace per 100 pounds coal
67. B. t. u. in fuel per 100 pounds coal
68. Fuel burned per square foot grate
69. Size of fuel used
70. How is fuel weighed
71. Depth of fuel in producer
72. Producer charging intervals
73. Clinkering intervals
74. Time for clinkering
75. Method of clinkering
76. Cleaning intervals for outlet pipes
77. Per cent. ash discarded
78. Combustible per 100 pounds coal
79. Average temperature outside air
80. Average temperature preheated air, outlet regenerator
81. Average temperature combustion chamber or oven flues
82. Average temperature retort chamber
83. Average temperature retorts
84. Average temperature vertical retorts Top Middle Bottom
85. Average temperature inlet recuperator, waste gas
86. Average temperature outlet recuperator, waste gas
87. Average temperature inlet waste heat boiler
88. Average temperature outlet waste heat boiler
89. Average temperature standpipes
90. Average temperature foul mains Rich main Fuel gas main
91. How often is primary inspected and adjusted
92. How often is secondary inspected and adjusted
93. Air used per cubic foot fuel gas
94. Cubic feet primary mixture per pound fuel
95. Per cent. CO_2 in primary mixture
96. Cubic feet secondary air per pound fuel
97. Per cent. CO_2 in waste gas
98. How is the air measured
99. Pressure under grate
100. Pressure combustion chamber
101. Pressure outlet recuperation

102. Analysis

	Inlet regenerator	Outlet regenerator
CO_2		
O_2		
CO		

103. Leakage per cent.
104. Average pressure at retort outlet
105. Average pressure in foul mains
106. Average pressure at meter inlet
107. Average pressure of barometer
108. Average temperature at meter inlet

Manufacturing Results.

(Computed from Dry Coal.)

109. Gas made by meter	cubic feet
110. Type of meter	
111. Volume correction factor	
112. Gas made corrected to 60° 30 inches barometer and zero pressure at the meter inlet	cubic feet
113. Coal carbonized, as charged	pounds
114. Coal carbonized, dry	pounds
115. Lump coke made, dry	pounds
116. Breeze made, dry	pounds
117. Total coke made, dry	pounds
118. Total coke made, dry	per cent.
119. Gas per pound of coal	cubic feet
120. Gas per retort per day	
121. Average candle-power with burner	
122. Average candle-power with Metropolitan No. 2	
123. Candle-feet per pound with burner	
124. Candle-feet per pound with Metropolitan No. 2	
125. Gas for test taken from	
126. Frequency of tests	
127. Standard used	
128. Oil dew point of gas as tested	
129. Water dew point of gas as tested	
130. Specific gravity of gas	
131. Average B. t. u. in gas	
132. Thermal feet per pound	

133. Analysis of Gas:

	CO_2	Ill.	O_2	CO	H_2	CH_4	N_2
Illuminating							
Fuel							

134. H_2S in gas at foul main — grains in 100 cu. ft.
135. H_2S in gas at inlet purifiers — grains in 100 cu. ft.
136. Cyanogen in gas at foul main — grains in 100 cu. ft.
137. Naphthalene in gas at outlet purifiers — grains in 100 cu. ft.
138. Fixed sulphur in gas at outlet purifiers — grains in 100 cu. ft.
139. Total ammonia recovered — pounds
140. Ammonia made per ton coal — pounds
141. Total tar made, dry — gallons
142. Tar made per ton coal, dry — gallons
143. Free carbon in tar — per cent.
144. Naphthalene in tar — per cent.
145. Distillation of tar, degrees Centigrade:

Moisture to 110°	per cent.	to 270°	per cent.
to 170°	per cent.	to 300°	per cent.
to 235°	per cent.	Residue	per cent.

146. Water evaporated in waste heat boiler — pounds
147. Water evaporated from and at 212° — pounds
148. Water evaporated per net ton carbonized, from and at 212° — pounds
149. Boiler horse-power developed
150. Average steam pressure of waste heat boiler
151. Weight Balance:

1 Ton Coal.			*Products.*	
Moisture	%	lbs.	Water:	
Vol. comb.	%	lbs.	Aqueous drips	lbs.
Fixed carbon	%	lbs.	Absorbed in purifiers	lbs.
Ash	%	lbs.	in tar	lbs.
		2,000 lbs.		
Accounted for		lbs.	Gas, cu. ft. × sp. gr. ×	
			Wet air	lbs.
			Tar, dry	lbs.
			Coke, dry	lbs.
			Total	lbs.
			Less extraneous air	lbs.
			Accounted for	lbs.

FORM FOR REPORTING TEST OF WATER GAS GENERATORS.

CARBURETED WATER GAS GENERATING SETS

1. Plant at
2. Duration of test
3. To determine

DESCRIPTION OF GENERATING APPARATUS.

4. Name of set
5. Outside diameter of generator carbureter superheater
6. Inside diameter of generator carbureter superheater
7. Lining, thickness of brick and asbestos
8. Grate area Average depth of fuel carried
9. Length of fixing brick columns carbureter superheater
10. Number of fixing brick
11. Kind of brick
12. Spacing of brick
13. Number of cleaning doors on generator
14. Size of cleaning doors on generator
15. Kind of grate, fixed or shaking, per cent. of air space
16. Number hours run since recheckering carbureter
17. Distance from oil spray to checker bricks
18. Kind of oil spray

DESCRIPTION OF MATERIALS.

A. *Fuel*:

19. Kind Method of weighing
20. Size Used hot or cold
21. How sampled
22. Approximate analysis: Moisture
    Volatile combustible Fixed carbon
23. Ash Sulphur
24. B. t. u. per pound
25. Analysis of ash
26. Fusing point of ash

B. 27. Enriching oil: Shipper
28. Field Specific gravity
29. Analysis, per cent. to degrees Fahrenheit:

	300°	400°	500°	600°	700°	over 700°

C. 30. Steam: Live or exhaust How measured
31. Saturated . Superheated to
32. Pressure at regulating valve

D. 33. Air: Type of blower used
34. Revolutions and capacity
35. Size generator blast connection
36. Size carbureter blast connection
37. Type of meter used

OPERATION.

Make:

38. Gas made by meter
39. Type of meter when tested
40. Average temperature at meter inlet
41. Average pressure at meter inlet
42. Average barometric pressure
43. Volume correction factor
44. Total gas made corrected to 60° 30 inches barometer and zero pressure at meter inlet
45. Gas made per run
46. Gas made per hour
47. Gas made per hour deducting cleaning time
48. Gas made per set per day
49. Gas made per set per day per square foot grate area

Fuel:

50. Total fuel used as fired
51. Fuel per M as fired
52. Fuel per M dry
53. Fixed carbon per M from analysis
54. Ash and clinker removed during cleans, and discarded to dump
55. Dry ash, etc.
56. Theoretical ash per M from analysis
57. Combustible per M

Oil Results:

58. Oil used by meter
59. Oil used by tank
60. Oil used by tank corrected to temperature of 60°
61. Oil per M, corrected

Gas Tests:

62. Candle-power of gas with burner
63. Candle-power of gas with Metropolitan No. 2 burner
64. Candles per gallon with burner
65. Candles per gallon with Metropolitan No. 2 burner
66. Gas for test taken from
67. Frequency of tests
68. Standard used

69. Oil dew point of gas as tested
70. Water dew point of gas as tested
71. Calorific value of gas at
72. Frequency of tests
73. Kind of calorimeter used
74. B. t. u. per gallon of oil
75. Specific gravity of gas
76. Per cent. CO_2 in finished gas
77. How frequently determined

Blow and Run:

78. Length of blow after clean
79. Nominal length of blow
80. Average actual length of blow
81. Length of purge with blast
82. Generator air per minute
83. Average carbureter air per minute
84. Generator air per M
85. Carbureter air per M
86. Total air per M
87. Average blast pressure under grate
88. Nominal length of run
89. Actual length of run
90. Coaling periods
91. Cleaning periods
92. Total time for cleanings
93. Method of splitting runs
94. Pounds of steam per M

Temperatures:

95. Carbureter base
96. Superheater base
97. Superheater top
98. Outlet wash-box
99. Outlet exhauster
100. Inlet condenser
101. Outlet condenser
102. Inlet tar extractor
103. Inlet purifier
104. Outlet purifier
105. Outlet station meter
106. Atmosphere
107. Air at blast meter
108. Oil in tank
109. Oil entering set

110. Analyses of blast and illuminating gases:

	Illuminating	Blast
CO_2		
O_2		
Illuminants		
CO		
CH_4		
H_2		
N_2		

111. Water gas tar made

112. Distillation of tar, degrees Centigrade:

Moisture to 110°	per cent.	to 270°	per cent.
to 170°	per cent.	to 300°	per cent.
to 235°	per cent.	Residue	per cent.

113. Water gas tar, specific gravity

114. Water gas tar dry, per cent. by weight of oil used

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