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Direct Method Determination of the Gas Content of Coal: Procedures and Results

By W. P. Diamond and J. R. Levine

UNITED STATES DEPARTMENT OF THE INTERIOR

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DIRECT METHOD DETERMINATION OF THE GAS CONTENT OF COAL: PROCEDURES AND RESULTS

by

W. P. Diamond[1] and J. R. Levine[2]

ABSTRACT

The explosion hazard of methane-air mixtures has become an increasingly serious mine planning problem, and an advance assessment of methane gas potential can therefore be essential for a safe and economic mine development program. As part of its coal mine health and safety program, the Bureau of Mines has developed a simple, inexpensive test to measure the methane content of coal samples obtained from exploration cores. The gas content of coal per unit weight as determined by the direct method test can be used as a basis for a preliminary estimate of mine ventilation requirements, and to determine if degasification of the coalbed in advance of mining should be considered.

Since the Bureau began measuring the gas content of coal samples in 1972, experience has led to equipment and procedural changes, the most significant of which has been the development of a ball mill for crushing the coal sample to release the residual gas at the end of the desorption test period. This revised procedure replaces the crushing box and graphical methods described in earlier Bureau publications.

The results of 583 direct method tests are summarized in tabular form. These results include data on the gas content of 125 coalbeds in 15 States.

INTRODUCTION AND HISTORICAL DEVELOPMENT

The Bureau of Mines originally became interested in determining the methane content of virgin coal as an aid in estimating the amount of methane that would be released in an active mine. The method developed for this purpose (3-5)[3] was a variation on a method reported by French researchers in 1970 (2). The primary differences between the procedures were that the method

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[3]Underlined numbers in parentheses refer to items in the list of references preceding the appendixes.

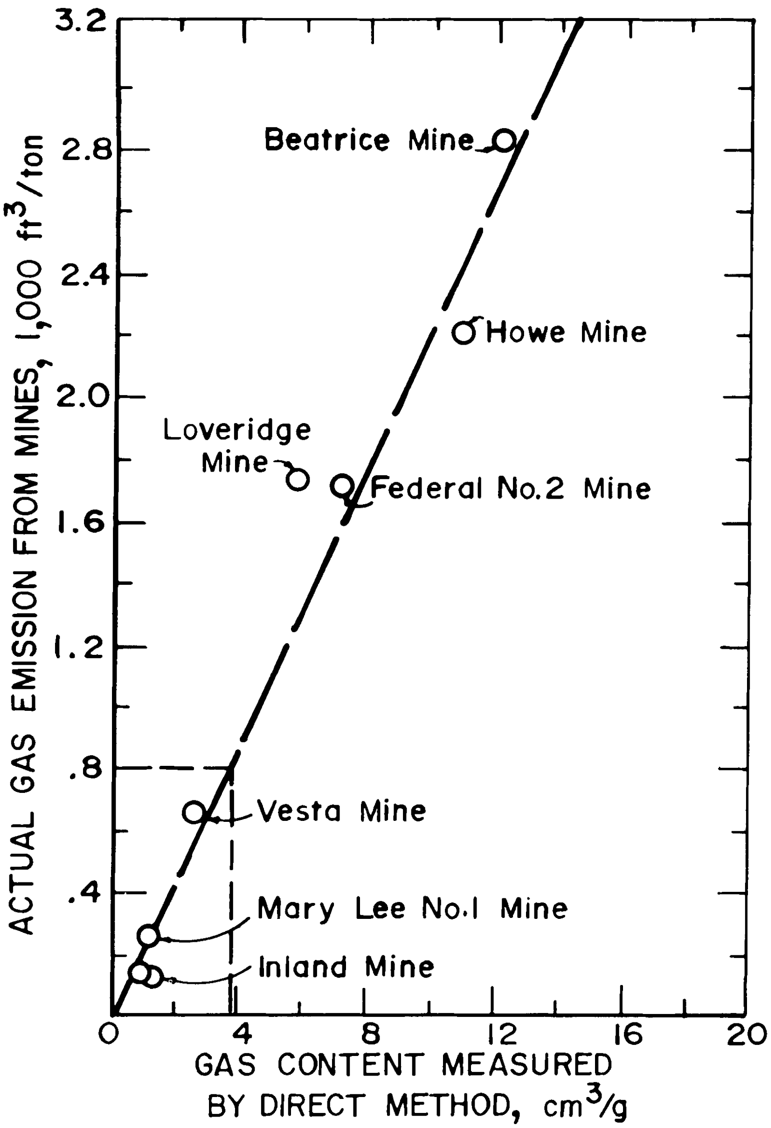

FIGURE 1. - Gas content of coal versus actual mine emission.

investigated by the Bureau used samples of virgin coal from exploration cores, and the French researchers reported results on drill cuttings taken from holes drilled into coalbeds from working faces underground.

The Bureau's initial research results were used to construct a graph (fig. 1) that related direct method test values to the actual measured methane emissions of nearby mines. The correlation was good for large, deep mines, with a sustained coal production of at least several thousand tons a day that had been in operation for several years. A complete discussion of the use of this graph is available (4).

The Bureau's original test method included a crushing procedure to indirectly measure the volume of gas remaining in the coal sample after desorption ceased. This procedure involved crushing the coal sample in a jaw crusher within a sealed, clear plastic box. The box was purged of air prior to crushing and filled with nitrogen. The operator worked inside the sealed box through flexible rubber sleeves as shown in figure 2. After the coal was crushed, gas samples were taken for compositional analysis. The percent methane in the sample was used in conjunction with the free space volume inside the box to calculate the volume of gas released by the crushing procedure.

The crushing box procedure was cumbersome and time consuming; therefore, research efforts were directed toward developing a graphical procedure for estimating the residual gas. Several coal sample physical and chemical variables associated with the gas content data base were evaluated for possible estimating parameters. After evaluating all the available data, it was determined that a graphical procedure based on the friable or blocky

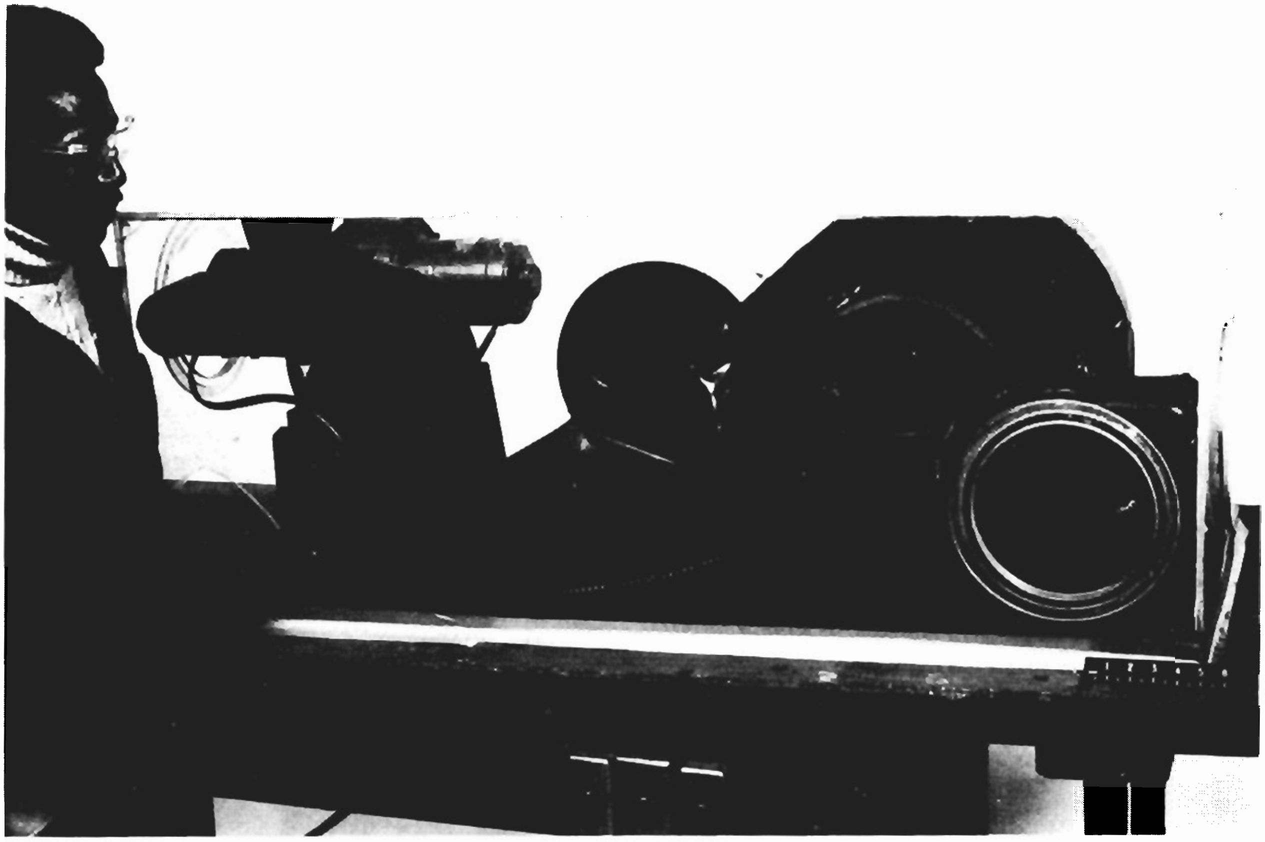

FIGURE 2. - Crushing box used in original procedure for determining residual gas.

character of the individual coal sample, and the amount of lost and desorbed gas at a specific time cutoff would provide an acceptable estimate of residual gas (5).

However, subsequent to the development of the graphical procedure and the acquisition of a substantially larger data base, Bureau researchers determined that the graphical method was not sufficiently reliable. The problem with the graph was that it was based on residual gas data obtained from the crushing box. It was found that the plastic covering of the box did not always seal properly, and the rubber sleeves periodically developed leaks. It was not known exactly when the box began leaking, or on which previous samples leaks had developed; therefore, the reliability of the residual gas results was in question. Because the graphical procedure was based on the results from the crushing box, the graph could not be considered valid.

To improve the reliability of the gas content testing procedure, a new crushing method that would allow the direct measurement of the volume of residual gas has been developed. This method uses a sealed ball mill crushing apparatus that will be discussed in detail in the "Equipment and Procedures" section of this report. Comparison of data obtained by this direct method with estimates from the graph have further confirmed that the graphical procedure is not always reliable.

Gas content determinations have been completed on 583 individual coal samples since the first test was completed in 1972. The testing procedure has evolved to provide more complete and reliable data. A summary of the test results and an indication of the reliability of those results is presented in Appendix A.

ACKNOWLEDGMENTS

The cooperation of numerous coal and gas companies and State and Federal agencies, in providing exploratory coal cores for gas content determinations, is greatly appreciated. While under contract to the Bureau of Mines and the Department of Energy (DOE), the staffs of the Colorado Geological Survey and the Utah Geological and Mineral Survey collected a substantial number of coal samples that provided the first comprehensive data base of gas in western coalbeds. Appreciation is also extended to DOE for giving the Bureau access to gas content data collected by their contractors. Slyvester Sudduth, of the Pittsburgh (Pa.) Research Center, Bureau of Mines, is gratefully acknowledged for his contribution of sample testing in the laboratory.

EQUIPMENT AND PROCEDURES

Sampling

Coal samples for gas content testing are usually obtained by the Bureau from exploratory coreholes of private coal companies. Because of quality testing needs of coal companies, it is generally possible to obtain only enough sample for one gas test on a coalbed. Therefore, it has been Bureau practice to obtain the cleanest section of coal; that is, coal without obvious extraneous shale, pyrite, or other noncoal inclusions. Multiple testing, or even testing of the entire coalbed, would be the preferable sampling procedure.

The person collecting the coal samples in the field must be present at the site when the coalbed is cored. To calculate a portion of the total gas content, that person must accurately record the exact times of coalbed encounter, start of core retrieval, and elapse time until the sample is sealed in the sample container.

Test Equipment

Figure 3 shows sample containers of several shapes and sizes that have been constructed for various testing purposes. The standard container (can A) used by the Bureau is made from a 12-inch piece of aluminum pipe, having an inside diameter of 4 inches. A top flange and bottom plate have been welded to the pipe section, and a removable lid that attaches to the top flange can be fitted with a gage and various types of valve assemblies. A diagram of this canister is presented in appendix B. Valves with a quick-connect capability are preferred if a large number of samples are tested at the same time.

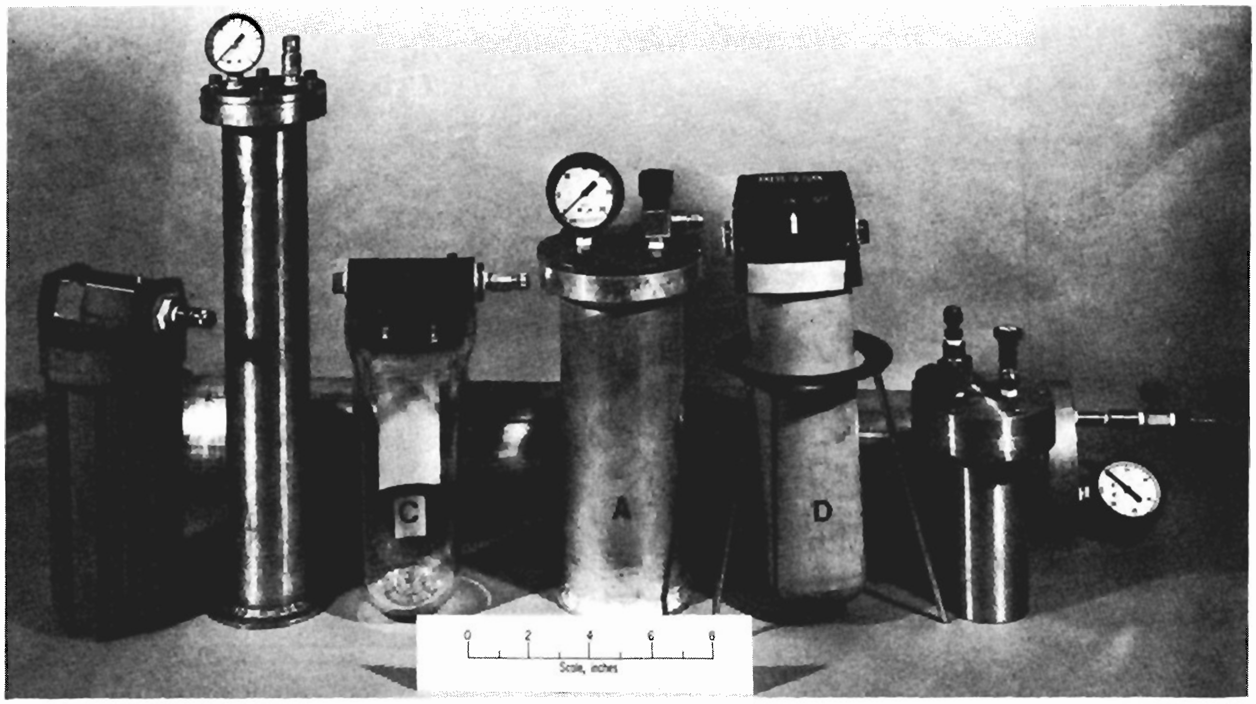

FIGURE 3. - Sample containers used for direct method testing of coal samples. Can A—standard container, cans B, C, and D—plastic water filter containers.

A less expensive alternative to the metal canisters are the various plastic water filter housings (cans B, C, and D) available from many plumbing supply outlets. These containers are sometimes awkward to use because of their rounded bottoms (cans C and D), or because of the difficulty of opening and/or sealing the large screw-type caps. Thus, standard metal containers are preferred because of their flat bottoms and durability, especially in long-term collection programs. In general, any container that can be easily sealed airtight, can contain about 2,000 grams of sample, and can hold approximately 50 pounds of internal pressure would be adequate for the test.

It has been suggested that containers of greater length, perhaps even long enough to hold an entire core of a coalbed should be used for testing. Although it would be preferable to test the entire core, several complications may arise in using large containers. Occasionally, a sample container will leak, invalidating the test. If six individual 1-foot sections of a 6-foot coalbed are tested separately, a leak in one can is of little consequence. But if the entire 6 feet is placed in one can, and it leaks, few usable data are obtained. Coal samples that are friable and very gassy will usually give off large volumes of gas early in the desorption procedure. If very large amounts of coal of this type are sealed into a large canister, then bleeding the large volume of gas into the measuring apparatus, which will be described later, can require an excessive amount of time which can invalidate the calculation of the lost gas.

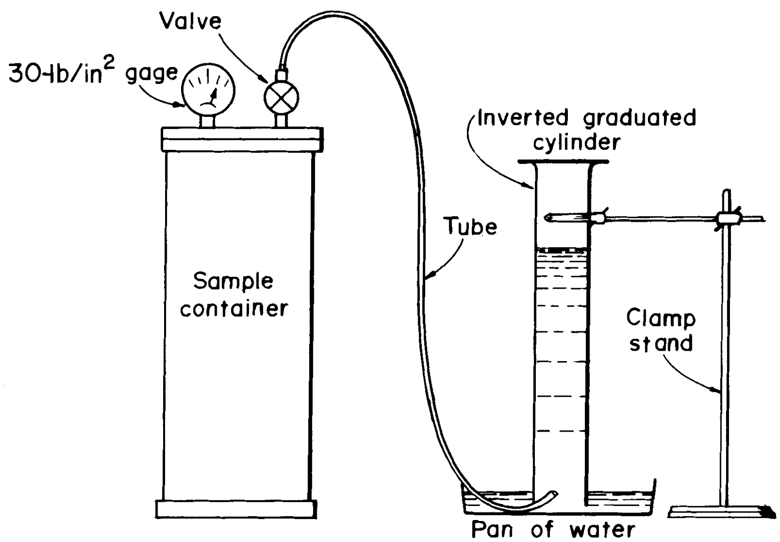

FIGURE 4. - Equipment for direct method testing of coal samples.

The equipment (fig. 4) needed to measure the actual volume of gas desorbing from the coal sample consists of an inverted graduated cylinder sitting in a pan filled with water and a ring stand and clamps to hold the graduated cylinder in place. The desorbed gas that collects in the canister is periodically bled into the graduated cylinder and measured as the volume of water displaced. This procedure is performed both at the drill site and subsequently, in the laboratory.

Calculation of Gas Content

The gas content of a particular sample is composed of lost, desorbed, and residual gas, each of which is determined by slightly different techniques. A core sample actually begins to desorb gas before it is sealed in the sample container. The amount of this lost gas depends on the drilling medium and the time required to retrieve, measure, and describe the core and seal the sample in the can. The shorter the time required to collect the sample and seal it into the can, the greater the confidence in the lost gas calculation. In general, because of its speed, wire line retrieval of the core is preferable to conventional coring. If air or mist is used in drilling, it is assumed that the coal begins desorbing gas immediately upon penetration by the core barrel. With water, desorption is assumed to begin when the core is halfway out of the hole; that is, when the gas pressure is assumed to exceed that of hydrostatic head.

The lost gas can be calculated by a graphical method based on the relationship that for the first few hours of emission, the volume of gas given off is proportional to the square root of the desorption time. A plot of the cumulative emission after each reading against the square root of the time that the sample has been desorbing ideally would produce a straight line.

A sample of experimental data (table 1) and supplementary information used to construct a lost gas graph follows:

Drilling medium--water.

Time coalbed encountered (A)--12:01 a.m.

Time core started out of hole (B)--12:30 a.m.

Time core reached surface (C)--12:40 a.m.

Time core sealed in canister (D)--12:50 a.m.

Lost gas time: (D-A) if air or mist is used

$$(D-C) + \frac{C-B}{2} \text{ if water is used}$$

$$(12{:}50-12{:}40) + \frac{(12{:}40-12{:}30)}{2}$$

$$= 10 + \frac{10}{2}$$

= 15 minutes.

TABLE 1. - Data for lost gas graph

Reading	Time, a.m.	Time since placed in can, min	$\sqrt{\text{Time in can+15}}$, $min^{1/2}$	Gas released, cm^3	Total gas, cm^3
1..............	12:50	0	3.87	0	0
2..............	1:05	15	5.48	92	92
3..............	1:20	30	6.71	84	176
4..............	1:35	45	7.75	55	231
5..............	1:50	60	8.66	36	267
6..............	2:05	75	9.49	40	307
7..............	2:20	90	10:25	33	340

The resulting graph is shown in figure 5. The intercept on the X axis is the square root of the elapsed time (lost gas time) in minutes from the time gas desorption begins and the sample is sealed in the container. The estimated value of the lost gas is the point at which the constructed line intercepts the negative Y axis.

The desorbed gas is simply the total volume of gas drained from the sample and measured in the graduated cylinder. The desorbing of a sample is generally allowed to continue until a very low emission rate is obtained, generally an average of less than 10 cm^3 of gas per day for 1 week. The time required to reach this low rate of emission will vary considerably and is affected by many things, including the size of the sample, the physical characteristics of the coal, and the amount of gas contained in the sample.

At the point at which it is determined to discontinue the measurement of desorbed gas, the coal sample will usually still contain gas. To complete the gas determination procedures, the amount of residual gas must be measured. The procedure recommended by the Bureau is to crush the coal in a sealed ball mill. The ball mill constructed for crushing coal (fig. 6) was fabricated from a piece of 1/4-inch-wall, 7-inch-diameter steel pipe. A steel plate was welded to the bottom, and a lid was fitted to the top. At the top, a short section of pipe with 1-inch wall thickness was welded inside the 7-inch pipe

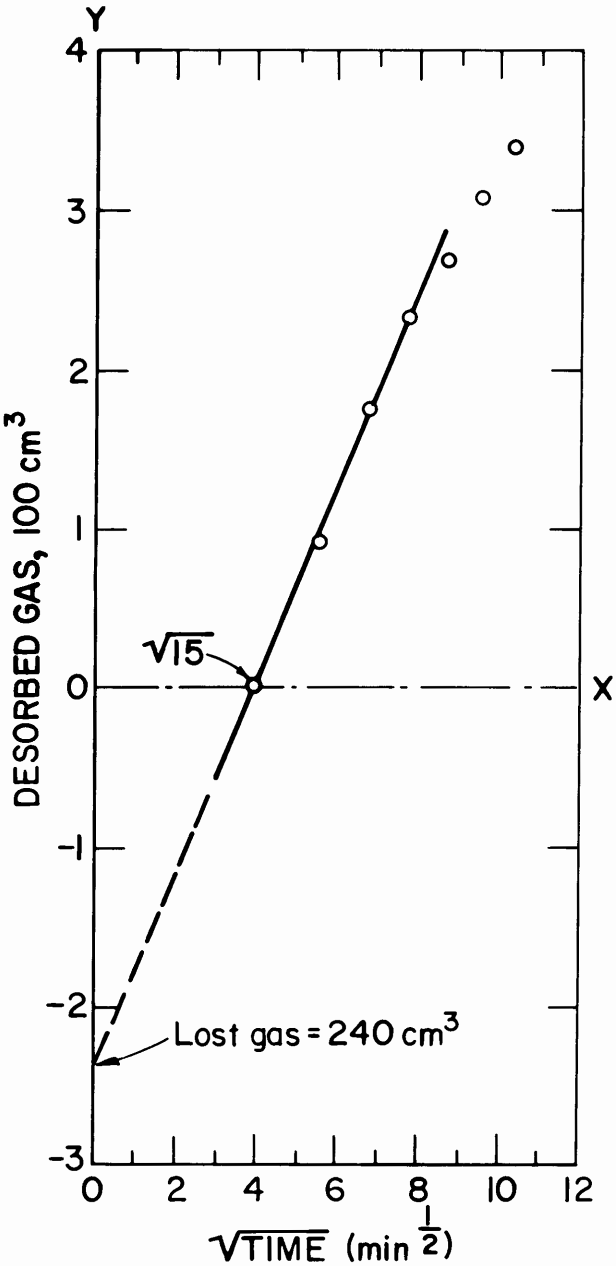

FIGURE 5. - Lost gas graph.

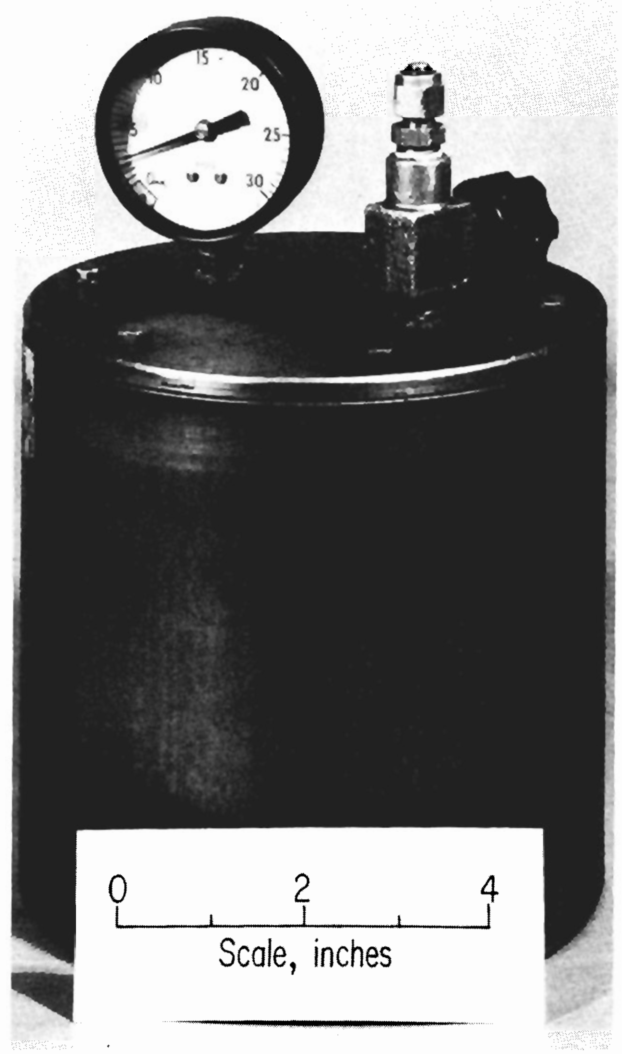

FIGURE 6. - Ball mill used to crush coal for new residual gas determinations procedure.

to provide sufficient surface area for machining a groove for an O-ring seal and for bolt holes to secure the lid. A diagram of the ball mill is presented in appendix B.

A trial-and-error procedure was used to determine the type of grinding media that would efficiently crush coal to a fine powder in a reasonably short time period. The standard grinding media used by the Bureau comprises 2 1-inch-diameter hexagonal steel rods, 2.5 and 3.2 inches long; and 4 2-inch, 24 1-inch, and 100 0.5-inch steel balls. Coal sample weights of less than 1,000 grams are generally preferable for complete crushing. The larger the volume of sample, the greater the cushioning effect on the grinding media and the greater the possibility of large amounts of uncrushed coal. The Utah Geological and Mineral Survey has recently constructed a ball mill similar to that used by the Bureau, except that it has three vertical fins on the interior of the mill. The fins reportedly reduce the cushioning effect of the accumulated powder and reduce the time required to crush the sample completely.

The ball mill is tumbled on a roller machine (fig. 7) for approximately 1 hour to crush the coal. The mill is allowed to cool to room temperature, and the volume of gas released is then measured by the water displacement method. The crushed powder and any uncrushed lumps are weighed separately. The volume of gas released is attributed only to the crushed powder. A set of residual gas data and calculation procedure follows:

FIGURE 7. - Roller machine for tumbling coal samples in ball mill.

Weight of crushed powder--735 grams.

Weight of uncrushed lumps--45 grams.

Volume of gas bleed off--1,082 cm^3.

$$\text{Residual gas calculation} = \frac{\text{Gas bleed off, cm}^3}{\text{Weight of sample crushed to powder, grams}}$$

$$= \frac{1{,}082 \text{ cm}^3}{735 \text{ grams}}$$

$$= 1.5 \text{ cm}^3/\text{g}.$$

Theoretically, it is possible to crush a coal sample in the ball mill at any point after collection and to obtain the total gas content (excluding lost gas) of the sample. This procedure is generally not considered appropriate if maximum information from the sample is desired. By crushing the sample before the desorption process is complete, it is impossible to obtain the relative amounts of desorbed and residual gas. This distinction is important because the actual residual gas, which will not desorb from the sample while sealed in the canister, probably represents gas that will not flow to a degasification borehole and possibly represents gas that will not be emitted into a mine atmosphere. It is true that during the process of mining coal, the coal is broken up into variously sized pieces; however, the majority of these pieces will not usually duplicate the very fine powder that the ball mill produces in the residual gas procedure.

The total gas content of a particular sample is the volume of lost gas and desorbed gas divided by the total sample weight plus the residual gas content. The calculation procedure and sample data set follow:

Lost gas--240 cm^3.

Desorbed gas--3,246 cm^3.

Total sample weight--780 grams.

Residual gas--1.5 cm^3/g.

$$\text{Total gas} = \frac{\text{Lost gas + desorbed gas}}{\text{Total sample weight}} + \text{residual gas}$$

$$= \frac{240 \text{ cm}^3 + 3{,}246 \text{ cm}^3}{780 \text{ grams}} + 1.5 \text{ cm}^3/\text{g}$$

$$= 4.5 + 1.5$$

$$= 6.0 \text{ cm}^3/\text{g}.$$

Auxiliary Test Procedures

Proximate, ultimate, and Btu analyses are obtained on the crushed powder from the residual gas test. These test results can be used to further evaluate the gas content results on a practical and theoretical basis. Because the gas content is presented on a volume-to-weight ratio, the presence of noncoal material, primarily shale and pyrite--which adds weight but not gas storage capacity--can produce seemingly erroneous data. Thus two samples from the same coalbed core may have gas contents varying by several cubic centimeters per gram if one sample contains appreciably higher noncoal material. The coal analysis will help determine if noncoal material is influencing the total gas content.

Theoretical studies on the influence of depth of burial on the gas content are preferably done on a clean coal, thus removing the noncoal material variable from the evaluation. However, because coalbeds do contain noncoal material, the actual in-place methane in a particular volume of coal should be related to the as-received coal data.

Theoretically, the gas content of coal is influenced by the rank of the coal, with higher ranks generally having higher gas contents. The coal analysis can be used to determine the apparent rank of the coal by ASTM Standard D388 (1) for evaluation of the rank parameter.

Gas samples should be obtained periodically during the desorption testing of coal samples. Gas compositional analysis will provide information on the gas quality, especially what, if any, gases other than hydrocarbons are present.

SUMMARY

The Bureau has developed and refined a simple, inexpensive testing procedure to directly determine the gas content of coal samples obtained from exploration coal cores. The procedures for determining the lost and desorbed gas in a coal sample have remained essentially the same, but the residual gas determination procedure has been revised. The current recommended residual gas procedure involves crushing the coal sample at the end of the desorption period in a sealed ball mill and then measuring the liberated gas directly by a water displacement method.

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APPENDIX A.--RESULTS OF DIRECT METHOD GAS CONTENT DETERMINATIONS ON U.S. COAL SAMPLES

Table A-1 is a compilation of direct method test results on coal samples collected between 1972 and mid-1979. The results are listed alphabetically by coalbed. To better evaluate the total gas content of each sample, the component parts of the total are listed. The major physical and chemical variables known to affect the gas content of coal samples are provided if available. Space limitations preclude the listing of all detailed data associated with each sample, but this information is available for specific samples from the Bureau's Pittsburgh Research Center. The Bureau has also published detailed geologic studies related to the occurrence of methane in selected coal measures. A bibliography of these papers, as well as other topics related to the occurrence and premining drainage of methane, is available from the Bureau of Mines, Methane Control Group, P.O. Box 18070, Pittsburgh, Pa. 15236.

Discussion of Data Presented in Table A-1

Coalbed: Coalbed names are generally those assigned by the cooperating coal companies or by other agencies supplying samples or data to the Bureau. If the name of the coalbed is unknown, either the formation name is listed or the sample is cataloged by the State name followed by (unc) for uncorrelated. A (?) following the coalbed name indicates that the name is probably correct, but the coal may be miscorrelated. The following abbreviations for different benches of the same coalbed are used in association with the coalbed name: U = upper, M = middle, and L = lower.

State and County: Coal companies are generally reluctant to permit publication of the exact location of their exploratory coreholes. The location of sample collection sites are therefore identified only by the State and county.

Sample depth, feet: The measured depth of the bottom of the sample placed in the desorption container, rounded off to the nearest foot.

Lost gas, cm^3: That portion of the total gas content lost before the coal sample was sealed in the canister, estimated by the graphical procedure described in the text. A dash in the lost gas column indicates that the lost gas could not be calculated, usually because of incomplete sample data.

Desorbed gas, cm^3: That portion of the total gas content liberated from the sample while sealed in the collection container and measured directly by the water displacement method described in the text.

Gas content, cm^3/g, excluding residual gas: Determined by adding the lost and desorbed gas and dividing by the total sample weight; represents the gas that desorbed from the sample naturally. This may be the only valid gas content data for those samples for which residual gas was determined by the crushing box or graphical procedures. This value is probably less than the actual total gas content of those samples.

Residual gas, cm^3, and method of calculation: That portion of the total gas content of the sample remaining in the coal at the end of the desorption period, which will not freely desorb from the coal while sealed in the container. The residual gas has been determined by three methods as described in the text: CB = crushing box, G = graphical, and BM = ball mill. The crushing box method was determined to be unreliable; therefore, the graphical procedure based on the crushing box data must be considered unreliable. The residual gas data obtained from the ball mill is considered valid. A dash in this column indicates that this value was not determined, usually because the donors did not want the samples to be crushed.

Total gas content, cm^3/g: Determined by adding the column labeled Gas content, excluding residual gas, and the Residual gas column. The total gas content (subject to the validity of the residual gas) represents the gas content of the coal sample on an as-received basis.

Apparent rank: Determined from coal analysis data by the method described in ASTM Standards D388 (1). The abbreviations (samples from all coal groups may not appear in table A-1) correspond to the following standard coal groups:

M-Ant--Meta-anthracite.
Ant--Anthracite.
Semi Ant--Semianthracite.
LV--Low-volatile bituminous.
MV--Medium-volatile bituminous.
HV-A--High-volatile A bituminous.
HV-B--High-volatile B bituminous.
HV-C--High-volatile C bituminous.
Sub-A--Subbituminous A.
Sub-B--Subbituminous B.
Sub-C--Subbituminous C.
Lig-A--Lignite A.
Lig-B--Lignite B.

A dash in the apparent rank column indicates that a rank determination could not be made because of the lack of coal analysis data.

Percent ash, as-received: Data are presented to permit an evaluation of the possible effect of the amount of ash on the total gas content of the sample. Because the mineral matter represented by the ash in the coal analysis adds weight, but generally no gas, an abnormally low gas content may be measured if a high mineral matter content is present. A dash in this column indicates that a coal analysis was not obtained on the sample.

Code: Assigned to each coal sample processed for gas content determination by the Bureau. All inquiries concerning specific samples should refer to these code numbers.

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Alabama (unc).....	Ala.	Jefferson...	810	175	2,370	6.3	0.0 BM	6.3	HV-A	15.6	225
			1,130	60	1,072	3.6	1.1 BM	4.7	HV-A	30.6	226
			1,224	120	1,653	4.9	.5 BM	5.4	MV	22.6	227
			1,514	1,520	11,900	8.0	.4 BM	8.4	MV	39.9	229
Alma..............	W.Va.	Mingo.......	754	20	90	.3	.0 G	.3	-	8.9	171
	N.Mex.		819	53	571	.9	.6 G	1.5	-	-	197
			855	46	432	.7	.5 G	1.2	-	-	195
			869	28	90	.2	.1 G	.3	-	-	193
			934	82	464	.8	.5 G	1.3	-	-	196
			963	54	70	.2	.1 G	.3	-	-	192
			972	30	790	1.3	1.7 BM	3.0	HV-A	5.7	340
			996	36	317	.5	.3 G	.8	-	-	194
			1,005	30	641	1.2	2.4 BM	3.6	HV-A	3.7	333
			1,031	56	986	1.0	.2 G	1.2	HV-A	3.3	170
			1,046	30	226	.5	2.4 BM	2.9	HV-A	5.5	332
			1,059	36	445	1.1	2.3 BM	3.4	HV-A	3.1	188
American..........	Ala.	Pickens.....	1,495	320	1,805	4.2	.2 BM	4.4	HV-B	11.1	234
Anderson..........	Mont.	Rosebud.....	62	26	37	.1	.0 BM	.1	Sub-C	4.3	636
Bald Knoll........	Utah	Garfield....	274	80	220	.3	.1 G	.4	-	-	110
Ballard...........	Utah	Grand.......	192	0	2	.0	.0 BM	.0	HV-B	3.2	766
			198	0	0	.0	.0 BM	.0	HV-B	7.0	770
			254	31	141	.1	.2 BM	.3	HV-B	20.3	774
Ballard...........	Utah	Grand.......	297	0	0	.0	.0 BM	.0	HV-B	37.6	703
			336	0	0	.0	.0 BM	.0	HV-C	10.1	704
			371	0	0	.0	.2 BM	.2	HV-B	12.7	776
			394	0	0	.0	.0 BM	.0	HV-C	10.2	706
			410	0	57	.1	.0 BM	.1	HV-B	6.1	710
			416	0	0	.0	.0 BM	.0	HV-B	11.7	713
			423	0	5	.0	.0 BM	.0	HV-B	9.1	715

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Ballard (?).......	Utah	Grand.......	861	0	0	0.0	0.5 BM	0.5	HV-A	8.7	785
Ballard (U).......	Utah	Grand.......	505	79	253	.5	.3 BM	.8	HV-B	2.7	811
Ballard (L).......	Utah	Grand.......	530	-	1,120	1.3	.2 BM	1.5	HV-B	11.5	813
Bear Canyon.......	Utah	Emery.......	971	3	39	.0	.0 G	.0	-	-	108
Beckley...........	W.Va.	Raleigh.....	558	32	333	.3	.1 CB	.4	-	-	35
			588	28	3,313	4.5	.3 G	4.8	-	-	36
			653	430	7,805	4.7	.8 BM	5.5	-	-	37
			655	880	14,967	9.7	1.8 BM	11.5	-	-	38
			740	890	16,641	13.1	.6 CB	13.7	-	-	45
			830	1,660	17,787	14.5	.8 CB	15.3	-	-	46
			850	1,720	9,630	8.7	.6 G	9.3	-	-	39
			852	2,880	16,160	11.2	.8 G	12.0	-	-	40
			875	1,880	17,214	13.5	.9 CB	14.4	-	-	43
			990	640	12,920	12.2	.9 CB	13.1	-	-	44
			1,198	1,400	14,903	9.8	.1 G	9.9	-	-	41
			1,200	1,900	14,016	10.8	.0 G	10.8	-	-	42
Beckwith..........	Utah	Emery.......	1,075	30	92	.1	.0 BM	.1	HV-A	10.9	728
Big & Little Dirty	Wash.	Pierce......	468	1,300	5,741	2.5	.0 BM	2.5	-	50.6	827
			485	830	5,278	1.5	.0 BM	1.5	-	39.6	828
Black Creek.......	Ala.	Jefferson...	537	360	4,251	3.0	.7 BM	3.7	HV-A	2.7	223
Blue Creek........	Ala.	Jefferson...	297	160	3,633	3.2	.8 BM	4.0	HV-A	21.1	219
Briar Hill(No. 5A)	Ill.	Clay........	1,078	130	758	.5	.5 BM	1.0	HV-B	10.5	849
Brookville........	Pa.	Allegheny...	1,020	250	5,210	2.7	-	2.7	-	-	936
			1,020	235	5,979	2.5	-	2.5	-	-	937
Brookwood.........	Ala.	Pickens.....	683	155	1,217	2.4	2.6 BM	5.0	HV-A	12.4	230

Canyon............	Wyo.	Campbell....	224	0	10	.0	.0 BM	.0	Sub-C	9.4	736
			225	0	10	.0	.0 BM	.0	Sub-C	5.2	737
			227	0	10	.0	.0 BM	.0	Sub-C	4.4	738
			228	0	0	.0	.0 BM	.0	Sub-C	5.2	739
			229	0	0	.0	.0 BM	.0	Sub-C	5.6	740
			230	0	0	.0	.0 BM	.0	Sub-C	11.8	741
			254	0	0	.0	.0 BM	.0	Sub-C	29.9	742
Canyon or Cook....	Wyo.	Campbell....	303	64	45	.1	.0 BM	.1	Sub-C	22.3	631
			309	32	74	.2	.0 BM	.2	Sub-C	5.1	632
			339	80	25	.1	.0 BM	.1	Sub-C	4.0	633
Carbonera.........	Utah	Grand.......	109	0	0	.0	.0 BM	.0	HV-B	25.7	748
			118	0	26	.0	.0 BM	.0	HV-B	3.0	764
			194	0	765	.6	.2 BM	.8	HV-B	26.1	817
			239	0	1,567	1.0	.4 BM	1.4	HV-B	6.2	818
			279	50	1,384	1.1	.3 BM	1.4	HV-B	2.6	819
Castlegate........	Utah	Carbon......	1,016	545	4,720	3.7	1.0 CB	4.7	-	-	106
			1,953	41	163	.3	.2 G	.5	-	-	97
Castlegate A......	Utah	Carbon......	194	0	108	.1	.0 BM	.1	HV-A	5.9	366
			570	95	2,241	2.4	.3 BM	2.7	HV-B	5.1	718
			591	66	708	1.1	1.5 BM	2.6	HV-A	3.0	364
			593	68	720	1.0	1.2 BM	2.2	HV-A	6.5	365
			758	108	390	.5	.5 BM	1.0	HV-A	5.9	762
			779	0	0	.0	.3 BM	.3	HV-A	5.8	826
			826	69	82	.2	1.1 BM	1.3	HV-B	4.9	514
			1,004	57	695	.8	1.3 BM	2.1	HV-A	4.9	369
			1,197	0	5	.0	3.9 BM	3.9	HV-A	6.0	383
			1,217	178	11,084	6.8	.3 BM	7.1	HV-A	7.8	726
			1,335	130	8,198	6.7	.4 BM	7.1	HV-A	4.7	802
			1,646	60	44	.1	.1 G	.2	-	-	96
			1,939	98	247	.4	2.3 BM	2.7	HV-A	10.9	823
			2,173	220	4,706	5.7	2.3 G	8.0	-	-	95
			2,559	143	3,982	5.1	.8 BM	5.9	HV-A	5.1	345
			2,643	69	7,568	8.0	.9 BM	8.9	HV-A	5.5	696
			2,656	80	8,956	9.2	.2 BM	9.4	HV-A	5.5	717
			3,016	42	459	.7	1.2 BM	1.9	HV-A	6.6	720
			3,025	98	2,689	3.4	1.2 BM	4.6	HV-A	6.5	803
			3,355	160	784	1.7	.9 BM	2.6	HV-A	7.1	719

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Castlegate B......	Utah	Carbon......	316	0	256	0.4	1.1 BM	1.5	HV-B	4.8	373
			353	0	85	.3	.8 BM	1.1	HV-A	8.9	382
			441	0	44	.0	1.2 BM	1.2	HV-B	6.9	495
			504	70	680	.6	1.1 BM	1.7	HV-B	6.0	542
			511	37	592	.6	.4 BM	1.0	HV-A	3.8	543
			737	130	787	1.2	1.8 BM	3.0	HV-A	4.3	537
			776	0	0	.0	1.4 BM	1.4	HV-B	7.1	513
			973	75	318	.5	.6 BM	1.1	HV-B	6.0	368
Castlegate B Rider	Utah	Carbon......	1,234	149	5,292	6.4	.8 BM	7.2	HV-A	3.9	727
Castlegate C......	Utah	Carbon......	198	0	199	.2	.5 BM	.7	HV-B	4.7	371
Castlegate C......	Utah	Emery.......	301	224	794	1.3	.0 G	1.3	-	-	99
Castlegate C......	Utah	Carbon......	556	64	451	.6	.7 BM	1.3	HV-B	3.5	362
			563	110	682	.7	.7 BM	1.4	HV-B	5.2	363
			898	-	213	.2	.5 BM	.7	HV-B	4.5	367
Castlegate C......	Utah	Emery.......	1,249	10	320	.4	.0 G	.4	-	-	98
Castlegate C......	Utah	Carbon......	3,292	420	6,964	10.2	.4 BM	10.6	HV-A	5.9	747
Castlegate D......	Utah	Carbon......	149	0	294	.2	.5 BM	.7	HV-A	6.8	370
Castlegate D......	Utah	Emery.......	161	51	366	.7	.0 G	.7	-	-	100
			170	33	450	.8	.0 G	.8	-	-	101
Castlegate D......	Utah	Carbon......	1,101	0	0	.0	1.5 BM	1.5	HV-A	6.5	500
			1,136	90	5,747	5.4	.8 BM	6.2	HV-A	4.4	697
			1,308	44	93	.1	2.8 BM	2.9	HV-A	8.4	538
			1,431	134	863	1.0	.0 G	1.0	-	-	102

Cedar Grove (L)...	W.Va.	Mingo.......	684	40	205	.2	.0 G	.2	-	2.6	174
			704	78	953	1.9	1.2 G	3.1	-	-	205
			819	20	142	.3	.2 G	.5	-	-	201
			833	30	317	.6	.5 G	1.1	-	-	202
			842	50	99	.8	.5 G	1.3	-	-	204
			842	18	27	.1	.1 BM	.2	HV-A	3.3	331
			851	31	60	.2	.1 G	.3	-	-	200
			862	38	766	2.6	1.9 BM	4.5	HV-A	2.8	341
			878	56	561	.8	.5 G	1.3	-	-	203
			913	-	135	.4	1.4 BM	1.8	HV-A	2.7	330
			923	17	499	1.5	1.3 BM	2.8	HV-A	13.8	339
			936	36	64	.1	.1 G	.2	-	-	198
			943	22	100	.2	.1 G	.3	-	-	199
			949	28	636	1.0	2.7 BM	3.7	HV-A	3.8	334
			996	100	1,150	.9	.1 G	1.0	HV-A	5.4	175
			1,037	42	360	.8	2.7 BM	3.5	HV-A	3.3	191
Chesterfield......	Utah	Grand.......	736	0	0	.0	.3 BM	.3	HV-B	11.3	781
			743	0	0	.0	.3 BM	.3	HV-B	7.8	783
Christensen (?)...	Utah	Garfield....	695	0	3	.0	.0 BM	.0	HV-C	4.8	546
Christensen.......	Utah	Garfield....	713	45	118	.2	.0 BM	.2	HV-C	3.4	700
			726	75	62	.2	.0 BM	.2	HV-C	5.1	701
			780	0	0	.0	.0 BM	.0	HV-C	5.1	702
Clarion...........	W.Va.	Barbour.....	819	230	4,951	4.9	.3 CB	5.2	HV-A	20.3	176
			822	101	3,286	3.3	.3 CB	3.6	HV-A	20.9	177
Clarion...........	Pa.	Allegheny...	970	165	5,280	2.9	-	2.9	-	-	935
Coalburg..........	W.Va.	Mingo.......	506	13	32	.1	.1 G	.2	-	-	208
Cobb..............	Ala.	Pickens.....	1,173	350	1,920	2.8	.1 BM	2.9	-	61.4	232
Colorado J-J......	Colo.	Rio Blanco..	55	0	1	.0	.0 BM	.0	HV-C	3.3	312
			516	0	0	.0	.0 BM	.0	HV-C	4.1	313

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Colorado (unc)....	Colo.	Las Animas..	101	170	158	0.4	0.3 BM	0.7	MV	39.0	535
			168	800	1,057	3.4	.2 BM	3.6	MV	29.6	536
			311	170	3,390	2.5	.2 BM	2.7	LV	36.2	663
			484	890	2,031	2.8	.0 BM	2.8	MV	35.2	533
			501	1,110	2,719	5.0	.0 BM	5.0	MV	19.0	665
Colorado (unc)....	Colo.	Mesa........	584	0	0	.0	.0 BM	.0	HV-C	6.3	359
Colorado (unc)....	Colo.	Moffat......	648	20	51	.1	.0 BM	.1	HV-C	8.0	732
Colorado (unc)....	Colo.	Huerfuno....	677	300	185	1.5	.1 BM	1.6	MV-A	14.0	667
Colorado (unc)....	Colo.	Las Animas..	718	52	88	.2	1.4 BM	1.6	HV-A	11.3	671
Colorado (unc)....	Colo.	Moffat......	724	0	0	.0	.0 BM	.0	HV-C	5.9	733
Colorado (unc)....	Colo.	Las Animas..	733	3,300	10,176	7.6	.3 BM	7.9	MV	28.9	654
Colorado (unc)....	Colo.	Moffat......	775	50	334	.5	.0 BM	.5	HV-C	4.0	734
			807	40	56	.1	.0 BM	.1	HV-C	5.2	735
Colorado (unc)....	Colo.	Las Animas..	811	370	3,086	1.5	.1 BM	1.6	-	74.2	655
			813	115	74	.2	.0 BM	.2	HV-A	20.7	672
			825	65	56	.1	.0 BM	.1	HV-A	15.6	673
			829	130	755	.8	.0 BM	.8	-	78.9	532
			873	70	505	.6	.6 BM	1.2	-	55.6	656
Colorado (unc)....	Colo.	Huerfano....	898	370	157	1.5	.0 BM	1.5	HV-A	7.8	669
Colorado (unc)....	Colo.	Las Animas..	963	130	260	.5	.6 BM	1.1	HV-A	18.3	657
			966	70	270	.3	.7 BM	1.0	HV-A	20.8	658
Colorado (unc)....	Colo.	Mesa........	992	0	24	.1	.4 BM	.5	HV-C	12.9	360
Colorado (unc)....	Colo.	Las Animas..	1,006	130	745	.8	.4 BM	1.2	HV-A	12.9	659
Colorado (unc)....	Colo.	Huerfano....	1,009	300	32	.9	.0 BM	.9	HV-A	8.2	666
Colorado (unc)....	Colo.	Las Animas..	1,014	170	445	.8	1.9 BM	2.7	HV-A	12.3	689
Colorado (unc)....	Colo.	Huerfano....	1,017	30	54	.1	.0 BM	.1	HV-A	13.9	670
Colorado (unc)....	Colo.	Las Animas..	1,030	90	320	.5	1.2BM	1.7	HV-A	17.3	660
			1,032	160	335	.5	1.1 BM	1.6	HV-A	21.3	661
			1,054	480	4,731	2.3	.0 BM	2.3	-	66.3	651
			1,064	850	9,448	6.0	.0 BM	6.0	-	56.4	652
Colorado (unc)....	Colo.	Huerfano....	1,076	90	48	.5	.0 BM	.5	HV-A	9.0	662
			1,142	550	134	1.2	.8 BM	2.0	HV-A	16.0	668
Colorado (unc)....	Colo.	Las Animas..	1,692	3,400	14,255	11.0	.0 BM	11.0	MV	11.7	653
			1,793	8,300	18,098	15.3	.0 BM	15.3	MV	15.7	664

Cook or Wall......	Wyo.	Campbell....	400	40	74	.1	.0 BM	.1	Sub-C	12.6	634
Danville (No. 7)..	Ill.	Clay........	995	129	1,289	.8	.5 BM	1.3	HV-B	12.1	844
			997	123	1,450	.9	.3 BM	1.2	HV-B	12.7	845
Dietz.............	Mont.	Rosebud.....	162	27	15	.1	.0 BM	.1	Sub-C	3.4	630
Elkorn No. 3......	Ky.	Perry.......	400	20	734	1.2	.5 G	1.7	-	-	184
Emery.............	Utah	Garfield....	1,031	160	74	.2	.2 G	.4	-	-	111
Ferron............	Utah	Emery.......	85	-	437	.3	.2 BM	.5	HV-B	5.3	749
			99	0	0	.0	.0 BM	.0	HV-A	16.4	725
			240	0	0	.0	.0 BM	.0	HV-B	18.2	731
Ferron (U)........	Utah	Sevier......	344	0	0	.0	-	.0	-	-	298
Ferron (L)........	Utah	Sevier......	585	0	0	.0	-	.0	-	-	299
Fish Creek........	Utah	Carbon......	1,728	295	1,754	4.1	2.0 G	6.1	-	-	292
Flat Canyon.......	Utah	Emery.......	1,368	51	56	.2	.1 G	.3	-	-	112
Freeport..........	Pa.	Allegheny...	695	420	5,205	1.8	-	1.8	-	-	932
			695	330	961	.4	-	.4	-	-	933
Freeport (U)......	Pa.	Allegheny...	488	210	2,535	1.9	2.3 BM	4.2	-	7.3	515
			489	307	2,295	1.7	1.8 BM	3.5	HV-A	7.0	516
			490	234	189	.2	1.4 BM	1.6	HV-A	27.9	517
			491	366	3,222	2.6	2.3 BM	4.9	HV-A	6.2	518
			492	318	2,969	2.5	2.4 BM	4.9	HV-A	5.0	519
			493	366	2,799	2.5	2.2 BM	4.7	HV-A	6.6	520
			494	346	192	1.5	1.8 BM	3.3	HV-A	30.6	521
			595	170	1,147	.8	1.1 BM	1.9	-	-	135
Freeport (U)......	Pa.	Westmoreland	598	290	1,391	1.0	2.4 BM	3.4	-	-	136
Freeoirt (U)......	Pa.	Greene......	706	-	1,825	1.1	.5 CB	1.6	-	-	142
			892	240	3,531	2.4	.3 G	2.7	-	-	137
			937	140	3,176	4.0	.7 CB	4.7	-	-	139
			1,058	126	1,552	6.9	.3 CB	7.2	-	-	138
			1,072	170	1,198	2.8	.6 CB	3.4	-	-	140

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Fruitland.........	N.Mex.	San Juan....	399	92	640	1.4	0.0 BM	1.4	HV-B	7.7	694
			399	20	163	.3	.0 BM	.3	HV-B	6.1	695
			1,475	368	2,320	3.3	.9 BM	4.2	HV-A	12.2	206
			1,485	208	1,849	2.1	1.7 BM	3.8	-	-	207
Fruitland (U).....	N.Mex.	San Juan....	280	0	32	.1	.0 BM	.1	HV-C	23.7	676
			295	130	275	.5	.0 BM	.5	HV-C	23.9	674
			318	95	237	.3	.0 BM	.3	HV-C	24.3	675
			465	40	1,525	3.9	.0 BM	3.9	HV-C	10.8	498
			642	62	2,068	2.2	.0 BM	2.2	HV-C	23.3	496
Fruitland (L).....	N.Mex.	San Juan....	587	47	1,755	2.5	.0 BM	2.5	HV-B	8.8	499
			589	0	0	.0	.3 BM	.3	HV-B	11.7	354
			736	58	1,609	1.9	.1 BM	2.0	HV-C	13.0	497
Gillespie.........	Ala.	Pickens.....	1,663	160	1,955	4.6	4.8 BM	9.4	HV-A	13.4	235
Gilson............	Utah	Carbon......	476	0	0	.0	1.6 BM	1.6	HV-B	4.6	758
			483	0	0	.0	.5 BM	.5	HV-A	3.5	750
Gilson............	Utah	Emery.......	2,340	68	653	.8	.0 G	.8	-	-	115
Harrisburg (No. 5)	Ill.	Jefferson...	793	360	943	.8	.2 CB	1.0	-	-	152
Harrisburg (No. 5)	Ill.	White.......	909	260	3,470	2.4	.5 BM	2.9	HV-B	13.0	864
Harrisburg (No. 5)	Ill.	Wayne.......	1,013	122	3,387	2.4	.9 G	3.3	-	-	151
			1,069	185	2,140	1.6	.7 G	2.3	-	-	150
Harrisburg (No. 5)	Ill.	Clay........	1,090	200	974	.9	.3 BM	1.2	HV-B	12.5	850
Hartshorne (U)....	Okla.	Le Flore....	823	1,554	15,903	14.9	.6 G	15.5	-	-	217
Hartshorne (L)....	Okla.	Le Flore....	175	185	8,625	2.3	.2 G	2.5	-	-	27
			252	500	15,960	4.8	.9 G	5.7	-	-	26
			318	806	8,212	8.0	.7 BM	8.7	LV	6.3	20
			356	1,050	23,310	10.1	.7 G	10.8	-	-	29
			488	6,500	54,300	10.5	.7 G	11.2	-	-	21
			489	1,850	16,670	10.2	.7 G	10.9	-	-	25
			516	2,700	36,665	11.1	.7 G	11.8	-	-	22
			553	1,150	8,117	12.8	.3 G	13.1	-	-	33

			556	1,000	15,690	10.2	.7 G	10.9	-	-	28
			561	3,000	40,495	10.8	.7 G	11.5	-	-	23
			571	1,250	28,575	11.0	.8 G	11.8	-	-	24
			892	3,948	12,390	16.0	.8 G	16.8	-	-	216
			1,439	3,850	16,074	16.3	.8 G	17.1	-	-	31
			1,440	3,500	14,419	15.1	.9 G	16.0	-	-	32
Herrin (No. 6)....	Ill.	Jefferson...	733	1,120	1,730	1.8	.1 CB	1.9	-	-	154
Herrin (No. 6)....	Ill.	White.......	782	450	4,405	3.5	.4 BM	3.9	HV-B	7.9	865
Herrin (No. 6)....	Ill.	Wayne.......	902	220	1,356	1.2	.2 G	1.4	-	-	159
			972	280	2,213	2.0	.7 G	2.7	-	-	153
Herrin (No. 6)....	Ill.	Clay........	1,035	160	1,100	.6	.3 BM	.9	HV-B	9.6	846
			1,036	180	956	.6	.5 BM	1.1	HV-B	11.1	847
Hiawatha..........	Utah	Emery.......	89	0	0	.0	.2 BM	.2	HV-A	6.9	297
			357	21	38	.0	.0 G	.0	-	-	125
			449	150	553	.7	.0 G	.7	-	-	126
			617	20	856	.9	.1 G	1.0	-	-	124
			873	29	53	.1	.0 G	.1	-	-	123
Indiana No. 6.....	Ind.	Knox........	364	93	1,754	1.2	.4 G	1.6	-	-	157
Indiana No. 7.....	Ind.	Knox........	343	110	2,083	1.7	.9 G	2.6	-	-	158
Ivie..............	Utah	Sevier......	757	0	0	.0	-	.0	-	-	374
			813	0	84	.1	-	.1	-	-	375
Ivie (U)..........	Utah	Emery.......	82	32	55	.1	.0 G	.1	-	-	113
			277	28	55	.1	.1 G	.2	-	-	114
Jagger............	Ala.	Jefferson...	355	1,150	1,743	5.3	.9 BM	6.2	HV-A	5.1	220
Jawbone...........	Va.	Dickenson...	431	2,225	10,307	7.2	.8 BM	8.0	MV	7.1	501
			431	950	5,845	3.6	1.2 BM	4.8	MV	35.6	502
Jefferson.........	Ala.	Jefferson...	481	960	2,640	3.5	1.2 BM	4.7	HV-A	11.5	221
Kenilworth........	Utah	Emery.......	246	40	479	.8	.0 G	.8	-	-	116
			2,450	262	3,912	6.7	3.1 G	9.8	-	-	117
Kenilworth........	Utah	Carbon......	2,821	0	2	.0	2.2 BM	2.2	HV-A	8.8	548
			2,827	95	661	.9	1.7 BM	2.6	HV-A	6.0	549
			3,177	580	6,413	10.6	.4 BM	11.0	HV-A	7.2	746

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Kittanning (U)....	W.Va..	Barbour.....	486	198	800	0.7	1.9 BM	2.6	HV-A	22.5	485
			487	216	3,560	2.2	2.2 BM	4.4	HV-A	15.2	486
			489	520	5,395	3.4	2.8 BM	6.2	HV-A	7.4	487
			490	114	1,960	2.4	2.7 BM	5.1	HV-A	18.3	488
			546	396	5,590	5.4	1.9 BM	7.3	HV-A	10.6	503
			547	534	1,530	1.3	2.0 BM	3.3	HV-A	11.7	504
			548	300	3,895	4.1	2.5 BM	6.6	HV-A	8.5	505
			549	168	1,875	1.8	.6 BM	2.4	HV-A	38.0	506
			610	58	5,175	4.6	1.2 BM	5.8	HV-A	17.6	792
			611	50	3,435	4.7	1.7 BM	6.4	HV-A	17.3	793
			612	46	4,905	4.3	1.5 BM	5.8	HV-A	11.7	794
			708	118	2,389	2.4	.2 CB	2.6	-	-	131
Kittanning (U)....	Pa.	Allegheny...	834	260	4,321	3.5	.1 CB	3.6	-	-	133
			834	30	289	.3	.1 CB	.4	-	-	109
			834	160	2,472	3.3	.1 CB	3.4	-	-	190
Kittanning (U)....	W.Va.	Upshur......	840	43	713	.8	.5 CB	1.3	-	-	127
Kittanning (M)	Ohio	Harrison....	585	155	1,788	1.5	1.3 BM	2.8	HV-A	20.8	853
			586	155	1,752	1.7	1.7 BM	3.4	HV-A	12.0	852
			587	110	1,523	2.0	1.7 BM	3.7	HV-A	7.4	854
Kittanning (M)....	Pa.	Allegheny...	801	500	11,066	5.0	-	5.0	-	-	934
Kittanning (M)....	W.Va.	Upshur......	909	135	1,578	1.4	0.9 CB	2.3	-	-	128
			911	132	1,646	1.5	1.0 CB	2.5	-	-	129
			912	95	1,529	1.4	.9 CB	2.3	-	-	130
Kittanning (L)....	W.Va.	Braxton.....	76	48	170	.2	.3 BM	.5	HV-A	29.8	522
			77	104	430	.4	.4 BM	.8	HV-A	21.1	523
			78	67	60	.2	.6 BM	.8	HV-A	10.4	524
			92	60	120	.1	.3 BM	.4	HV-A	30.0	525
			93	59	215	.2	.7 BM	.9	HV-A	4.8	526
			94	77	200	.3	.7 BM	1.0	HV-A	4.1	527
			146	56	40	.2	.0 BM	.2	HV-A	28.6	528
			149	45	30	.1	.0 BM	.1	HV-A	11.0	529
			151	79	325	.3	.0 BM	.3	HV-A	7.2	530
			154	89	130	.2	.4 BM	.6	HV-A	10.4	531
			405	13	125	.1	.1 BM	.2	-	61.8	679

Kittanning (L)....	W.Va..	Braxton.....	407	19	180	.2	.4 BM	.6	MV	28.9	680
			408	12	125	.1	.3 BM	.4	HV-A	29.1	681
			409	18	120	.1	.1 BM	.2	-	56.7	682
			410	54	395	.2	.4 BM	.6	HV-A	32.5	683
			411	24	270	.3	.6 BM	.9	HV-A	9.2	684
			413	32	313	.3	.3 BM	.6	HV-A	33.6	685
			414	45	390	.3	.6 BM	.9	HV-A	16.6	686
Kittanning (L)....	W.Va.	Barbour.....	535	342	4,695	4.0	1.9 BM	5.9	HV-A	11.0	489
			536	364	4,990	3.8	1.9 BM	5.7	HV-A	7.9	490
			537	348	5,125	3.1	1.3 BM	4.4	HV-A	26.0	491
			538	207	120	.2	1.6 BM	1.8	HV-A	11.5	492
			539	225	6,435	4.4	1.4 BM	5.8	HV-A	6.2	493
			540	462	4,970	4.2	1.4 BM	5.6	HV-A	14.8	494
			593	200	95	.3	1.9 BM	2.2	HV-A	14.7	507
			594	340	5,935	4.1	1.7 BM	5.8	HV-A	12.8	508
			595	540	5,670	4.3	1.4 BM	5.7	HV-A	22.2	509
			596	314	5,335	7.1	2.1 BM	9.2	HV-A	5.0	510
			597	522	1,780	2.2	1.9 BM	4.1	HV-A	9.0	511
Kittanning (L)....	Pa.	Indiana.....	624	100	730	.6	.2 BM	.8	-	-	143
Kittanning (L)....	W.Va.	Barbour.....	651	102	4,435	5.2	1.0 BM	6.2	HV-A	33.0	795
			652	108	5,272	6.0	1.3 BM	7.3	HV-A	25.0	796
			653	154	6,887	6.9	1.2 BM	8.1	HV-A	13.6	797
			654	118	4,500	7.3	1.8 BM	9.1	HV-A	7.1	798
			806	105	1,504	1.1	.3 CB	1.4	-	-	132
Kittanning (L)....	Pa.	Westmoreland	1,060	940	12,745	10.7	.5 BM	11.2	LV	8.1	134
Mahoning (?)......	Pa.	Allegheny...	703	300	1,959	1.6	.0 CB	1.6	-	-	179
Mammoth...........	Pa.	Schuylkill..	1,719	0	356	.2	.2 BM	.4	Ant	6.3	286
Mary Lee (U)......	Ala.	Walker......	639	252	1,919	2.1	.6 CB	2.7	-	-	47
			724	125	896	.7	.9 CB	1.6	-	-	48
Mary Lee (U)......	Ala.	Jefferson...	1,047	2,690	10,331	10.7	.0 BM	10.7	LV	10.5	252
			1,047	2,380	16,749	16.8	.2 BM	17.0	LV	28.8	253
			1,077	2,020	28,905	15.8	.0 BM	15.8	LV	21.3	247
			1,086	850	5,994	6.5	.3 CB	6.8	-	-	49
			1,111	7,280	59,159	12.4	.1 BM	12.5	LV	14.5	241
Mary Lee (U)......	Ala.	Tuscaloosa..	1,701	255	10,473	12.4	.6 G	13.0	-	-	50
Mary Lee (U)......	Ala.	Pickens.....	2,185	250	2,357	3.2	3.0 BM	6.2	HV-A	10.2	236

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Mary Lee (L)......	Ala.	Jefferson...	1,053	270	5,519	13.4	0.2 BM	13.6	LV	30.2	254
			1,056	5,110	14,283	15.2	.1 BM	15.3	LV	9.3	264
			1,057	3,170	5,687	5.1	.0 BM	5.1	MV	9.1	265
			1,073	1,010	18,503	14.8	.2 BM	15.0	LV	9.0	246
			1,074	1,010	17,055	14.1	.1 BM	14.2	LV	8.3	249
			1,076	1,670	19,817	15.7	.0 BM	15.7	LV	9.1	245
			1,076	830	16,997	14.5	.3 BM	14.8	LV	7.2	250
			1,078	640	9,874	10.8	.5 BM	11.3	-	-	263
			1,080	1,380	12,640	9.9	.5 BM	10.4	MV	10.7	262
			1,082	1,200	9,680	10.6	.2 BM	10.8	MV	13.1	261
			1,086	4,480	45,923	12.8	.4 BM	13.2	MV	10.5	248
			1,089	2,270	15,171	16.9	.1 BM	17.0	LV	9.7	215
			1,092	2,160	19,961	15.0	.1 BM	15.1	LV	9.4	251
			1,099	390	13,989	9.6	.7 BM	10.3	MV	8.7	255
			1,099	240	3,464	7.6	.5 BM	8.1	-	-	260
			1,099	725	8,448	12.9	.7 CB	13.6	-	-	51
			1,102	600	10,654	10.7	.4 BM	11.1	MV	9.2	259
			1,103	470	14,404	10.4	.5 BM	10.9	LV	9.0	256
			1,120	680	15,194	16.0	.3 BM	16.3	LV	7.2	244
			1,123	900	15,757	13.4	.3 BM	13.7	MV	9.9	243
			1,125	1,540	14,457	11.6	.3 BM	11.9	MV	8.1	242
			1,126	520	6,279	15.1	.2 BM	15.3	LV	8.2	239
			1,127	1,990	16,599	14.9	.1 BM	15.0	LV	7.5	238
			1,130	1,400	15,300	15.5	.1 BM	15.6	LV	7.0	240
Mary Lee (L)......	Ala.	Tuscaloosa..	1,704	760	13,955	14.1	.7 G	14.8	-	-	52
			1,705	270	9,085	10.7	.4 G	11.1	-	-	53
			1,706	260	7,661	11.3	.4 G	11.7	-	-	54
			1,913	240	10,647	9.2	.6 G	9.8	-	-	55
			1,935	770	15,331	15.5	.1 CB	15.6	-	-	56
			2,185	1,800	15,986	15.8	1.6 CB	17.4	-	-	57
Mary Lee (L)......	Ala.	Pickens.....	2,231	240	3,513	2.6	3.3 BM	5.9	HV-A	8.1	237
Mary Lee (L)......	Ala.	Tuscaloosa..	2,285	1,270	14,669	12.5	1.4 BM	13.9	-	-	58

Menefee Fm........	Colo.	La Plata....	295	40	105	.1	.1 G	.2	-	-	160
			311	145	91	.2	.1 G	.3	-	-	161
Mercer............	Pa.	Allegheny...	1,110	210	2,710	1.5	-	1.5	-	-	938
Mesa Verde Fm.....	Colo.	Rio Blanco..	686	670	346	2.9	0.1 BM	3.0	-	53.5	829
			699	1,342	250	0.6	.8 BM	1.4	-	68.4	830
			760	400	351	1.7	.8 BM	2.5	HV-B	22.8	833
			771	216	270	0.8	.0 BM	0.8	-	84.4	832
			774	364	329	1.7	.0 BM	1.7	-	86.4	831
			803	425	262	1.9	.6 BM	2.5	HV-B	11.1	835
			805	490	353	1.4	.2 BM	1.6	-	46.2	836
			987	245	617	1.2	1.2 BM	2.4	HV-B	4.4	837
			1,584	130	768	.6	.1 BM	.7	HV-B	8.6	791
			1,604	200	164	.5	.0 BM	.5	HV-B	4.5	790
Milldale..........	Ala.	Pickens.....	741	100	1,115	2.5	2.9 BM	5.4	HV-A	8.8	231
Morley............	Colo.	Las Animas..	872	200	1,603	3.3	.5 BM	3.8	HV-A	19.6	743
			872	360	6,589	4.2	.4 BM	4.6	HV-A	16.9	789
			879	100	3,183	2.7	.5 BM	3.2	HV-A	31.0	787
New Castle (?)....	Ala.	Jefferson...	191	400	2,850	3.5	.6 BM	4.1	HV-A	14.7	218
New Castle........	Ala.	Tuscaloosa..	2,132	1,675	20,357	15.6	1.9 BM	17.5	-	-	34
O'Connor (L)......	Utah	Carbon......	628	0	18	.0	.0 G	.0	-	-	294
			1,458	0	4	.0	.0 G	.0	-	-	293
O'Connor (U)......	Utah	Carbon......	700	0	11	.0	.0 G	.0	-	-	295
			1,016	0	0	.0	.0 G	.0	-	-	296
Ohio No. 5 or 6...	Ohio	Harrison....	599	116	1,710	1.6	1.2 BM	2.8	HV-A	7.8	840
			600	106	1,670	1.6	1.3 BM	2.8	HV-A	11.1	841
			602	230	2,490	1.8	1.9 BM	3.7	HV-A	5.8	842
Orchard...........	Pa.	Schuylkill..	1,359	0	340	.2	.0 BM	.2	Ant	38.6	288
			1,373	0	604	.4	.5 BM	.9	Ant	22.7	289

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Palisade..........	Utah	Grand.......	409	0	0	0.0	0.0 BM	0.0	HV-B	6.7	778
			493	12	48	.0	.0 BM	.0	HV-B	6.3	721
			618	23	565	.8	.3 BM	1.1	HV-B	11.2	815
			624	20	85	.1	.0 BM	.1	HV-B	20.9	722
			627	0	0	.0	.0 BM	.0	HV-B	27.9	723
			654	0	0	.0	.0 BM	.0	HV-B	7.8	724
Palisade Zone.....	Colo.	Mesa.........	813	45	1,085	1.3	1.1 BM	2.4	HV-A	12.0	361
			1,290	70	5,113	6.5	.5 BM	7.0	HV-A	5.2	358
Peach Mountain....	Pa.	Schuylkill..	685	9,400	37,430	18.4	.4 BM	18.8	Ant	15.6	210
			685	5,850	36,480	20.5	1.1 BM	21.6	Ant	12.1	211
Pittsburgh........	Pa.	Washington..	427	950	2,450	2.2	1.6 CB	3.8	-	-	65
Pittsburgh........	Pa.	Greene......	581	195	3,712	3.3	3.7 BM	7.0	HV-A	8.8	863
			582	194	3,895	3.7	3.5 BM	7.2	HV-A	9.8	862
			590	134	3,127	3.0	3.9 BM	6.9	HV-A	7.6	866
			593	94	2,465	3.0	4.3 BM	7.3	HV-A	6.7	867
			610	157	5,505	4.5	1.7 BM	6.2	HV-A	6.7	800
			612	168	5,650	4.9	2.6 BM	7.5	HV-A	5.8	799
			622	164	3,410	3.8	3.4 BM	7.2	HV-A	8.3	858
			624	117	3,570	3.5	3.5 BM	7.0	HV-A	22.9	859
			626	192	4,755	3.5	3.5 BM	7.0	HV-A	7.1	860
			666	122	3,860	3.4	2.2 BM	5.6	HV-A	9.6	861
			675	240	3,603	2.8	1.2 CB	4.0	-	-	62
			678	289	5,652	4.1	.6 BM	4.7	HV-A	10.0	283
			680	318	6,647	4.7	1.2 BM	5.9	HV-A	8.3	284
			680	300	3,836	3.3	3.2 CB	6.5	-	-	63
			681	132	5,986	5.5	1.7 BM	7.2	HV-A	8.7	276
			682	340	5,297	3.6	1.6 BM	5.2	HV-A	4.7	285
			701	256	3,853	3.8	3.6 BM	7.4	HV-A	5.8	856
			703	276	4,278	3.8	4.0 BM	7.8	HV-A	7.4	857
			705	273	3,271	3.9	4.4 BM	8.3	HV-A	7.8	855
			716	189	2,085	4.0	3.7 BM	7.7	HV-A	5.5	822
			720	147	2,430	2.1	3.4 BM	5.5	HV-A	7.0	820
			749	23	734	1.5	3.1 BM	4.6	HV-A	30.7	646

			750	135	3,470	3.5	3.1	BM	6.6	HV-A	5.0	647
			752	100	3,375	3.2	3.2	BM	6.4	HV-A	8.3	648
			753	122	3,463	3.4	2.9	BM	6.3	HV-A	6.0	649
			755	160	3,304	3.4	2.9	BM	6.3	HV-A	7.7	650
			762	637	22,574	4.0	2.0	BM	6.0	HV-A	6.1	266
			762	545	16,490	3.8	.5	BM	4.3	HV-A	11.6	267
			762	402	13,195	4.2	1.1	BM	5.3	HV-A	4.5	268
			762	98	9,943	1.6	1.2	BM	2.8	HV-A	9.4	269
			778	135	2,913	3.5	1.8	G	5.3	-	-	64
			786	73	3,143	2.0	3.6	BM	5.6	-	-	59
Pittsburgh........	W.Va.	Marion......	850	855	6,392	3.9	2.6	CB	6.5	-	-	66
			850	700	5,365	4.4	2.6	CB	7.0	-	-	67
Pittsburgh........	Pa.	Greene......	953	605	22,912	4.4	.5	BM	4.9	HV-A	15.3	270
			955	403	23,101	4.2	1.6	BM	5.8	HV-A	3.7	272
			957	105	18,096	3.2	1.1	BM	4.3	HV-A	4.8	273
			960	91	15,322	2.6	1.4	BM	4.0	HV-A	5.3	274
			961	403	23,204	3.8	1.8	BM	5.6	HV-A	3.3	275
			1,276	94	1,852	2.2	3.8	BM	6.0	-	-	61
			1,280	224	3,113	3.4	3.5	BM	6.9	-	-	60
Pittsburgh Rider..	Pa.	Greene......	743	36	1,110	1.8	2.1	BM	3.9	HV-A	17.4	644
			748	46	1,993	2.9	2.5	BM	5.4	HV-A	13.1	645
			954	203	13,252	2.5	1.3	BM	3.8	HV-A	11.5	271
			1,272	177	2,353	2.9	3.9	BM	6.8	-	-	72
Pocahontas No. 3..	W.Va.	Wyoming.....	778	560	12,926	7.6	1.3	CB	8.9	-	-	18
Pocahontas No. 3..	Va.	Buchanan....	1,316	1,600	11,558	11.4	.8	G	12.2	-	-	1
			1,430	2,087	5,230	13.5	.1	CB	13.6	-	-	19
			1,518	3,880	22,588	14.3	.2	CB	14.5	-	-	2
			1,528	2,300	12,011	14.1	1.0	G	15.1	-	-	3
			1,551	2,150	12,541	16.2	1.1	G	17.3	-	-	4
			1,554	1,650	11,435	15.6	1.1	G	16.7	-	-	5
			1,589	1,400	16,475	15.3	1.1	G	16.4	-	-	6
			1,621	1,700	10,880	10.8	.7	G	11.5	-	-	7
			1,621	1,700	11,410	11.5	.8	G	12.3	-	-	8
			1,737	1,400	9,685	10.5	.4	G	10.9	-	-	9
			1,764	1,350	14,833	16.7	1.2	G	17.9	-	-	10
			1,845	600	9,530	10.3	.7	G	11.0	-	-	11
			1,999	500	10,620	14.8	1.0	G	15.8	-	-	12
			2,022	1,150	15,778	15.3	1.1	G	16.4	-	-	13
			2,036	1,350	15,690	16.5	1.1	G	17.6	-	-	14
			2,108	300	12,460	13.0	.9	G	13.9	-	-	16
			2,143	200	8,184	9.9	.7	G	10.6	-	-	15

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Pond Creek........	Ky.	Pike........	125	240	1,210	1.4	0.7 CB	2.1	-	-	185
Pond Creek........	Ky.	Martin......	400	51	1,134	1.4	.4 G	1.8	-	-	186
Pond Creek........	Ky.	Pike........	500	85	1,097	.9	.3 CB	1.2	-	-	187
Pond Creek Rider..	W. Va.	Mingo.......	1,070	30	296	.6	2.6 BM	3.2	HV-A	2.7	329
Pratt.............	Ala.	Tuscaloosa..	1,365	2,200	8,163	14.1	1.0 CB	15.1	-	-	209
Pratt.............	Ala.	Pickens.....	1,428	180	1,925	2.8	.2 BM	3.0	HV-A	28.0	233
Primrose..........	Pa.	Schuylkill..	1,541	0	779	.4	.0 BM	.4	Ant	13.2	287
Redstone..........	W.Va.	Monongalia..	738	768	4,360	3.6	.3 CB	3.9	-	-	145
			746	378	3,421	3.9	.2 CB	4.1	-	-	144
Redstone..........	W.Va.	Marion......	836	110	2,320	2.0	.4 CB	2.4	-	-	147
Redstone..........	W.Va.	Wetzel......	1,099	110	495	.7	.1 CB	.8	-	-	146
Rees..............	Utah	Garfield....	607	0	0	.0	.0 BM	.0	HV-C	8.4	544
			620	28	39	.1	.0 BM	.1	HV-C	5.2	545
Rock Canyon.......	Utah	Carbon......	436	72	251	.4	.9 BM	1.3	HV-B	4.8	756
			1,706	690	1,756	2.6	.4 BM	3.0	HV-B	4.9	310
Rock Canyon (U)...	Utah	Emery.......	2,340	61	1,813	1.7	.5 G	2.2	-	-	118
Rock Canyon (L)...	Utah	Emery.......	2,353	55	3,277	3.3	1.4 G	4.7	-	-	119
Seeleyville.......	Ill.	Wayne.......	1,293	114	1,485	1.3	.4 G	1.7	-	-	155
			1,295	400	2,552	1.9	.6 G	2.5	-	-	156
Seeleyville.......	Ill.	Clay........	1,352	215	775	1.1	.4 BM	1.5	HV-B	19.8	851
Sewell............	W.Va.	Raleigh.....	680	960	8,987	8.8	.5 CB	9.3	-	-	183
			700	220	3,196	2.8	1.3 CB	4.1	-	-	182
Sewell............	W.Va.	Braxton.....	981	250	2,780	2.6	.2 G	2.8	-	-	181
Sewickley.........	W.Va.	Monongalia..	60	278	227	.3	.4 CB	.7	-	-	84
Sewickley.........	Pa.	Washington..	450	42	103	.1	1.0 BM	1.1	HV-A	17.1	149
Sewickley.........	Pa.	Greene......	589	150	4,332	3.5	1.4 BM	4.9	HV-A	9.0	280
			590	167	5,571	3.6	1.8 BM	5.4	HV-A	8.4	281
			592	128	4,038	4.1	1.3 BM	5.4	HV-A	11.4	282

			643	62	1,858	2.7	3.0 BM	5.7	HV-A	8.9	641
			645	86	2,460	2.2	1.8 BM	4.0	HV-A	10.0	642
			646	71	2,509	2.7	2.5 BM	5.2	HV-A	10.8	643
			669	55	1,320	.7	1.8 BM	2.5	-	-	75
Sewickley.........	W. Va.	Monongalia..	672	130	4,570	4.2	1.0 CB	5.2	-	-	78
Sewickley.........	Pa.	Greene......	675	292	6,016	4.4	.3 CB	4.7	-	-	77
			1,181	158	1,591	1.7	2.6 BM	4.3	-	-	76
Smirl (?).........	Utah	Garfield....	443	55	48	.1	.0 G	.1	-	-	121
Smirl.............	Utah	Kane........	754	27	58	.1	.0 G	.1	-	-	120
Sunnyside.........	Utah	Carbon......	374	77	2,743	3.6	.9 BM	4.5	HV-B	6.6	808
Sunnyside.........	Utah	Emery.......	917	0	0	.0	.3 BM	.3	HV-A	3.2	754
			926	10	382	.4	.0 BM	.4	HV-A	1.5	752
			1,204	118	139	.3	.0 BM	.3	HV-A	4.3	729
Sunnyside (L).....	Utah	Emery.......	1,799	274	2,628	2.8	.0 G	2.8	-	-	122
Tunnel............	Pa.	Schuylkill..	604	1,300	21,660	13.3	.7 BM	14.0	Ant	5.9	212
			606	1,200	15,802	11.9	.7 BM	12.6	Ant	7.9	213
			608	975	22,675	16.4	1.9 BM	18.3	Ant	7.5	214
Utah A............	Utah	Emery.......	390	30	20	.1	.0 G	.1	-	-	107
Utah K (U).......	Utah	Kane........	480	0	10	.0	.0 BM	.0	HV-C	3.6	315
Utah K (L).......	Utah	Kane........	492	0	36	.0	.0 BM	.0	HV-C	4.5	316
Utah M	Utah	Kane........	536	0	88	.1	.0 BM	.1	HV-C	3.5	317
Utah M	Utah	Kane........	575	0	106	.1	.0 BM	.1	HV-C	6.5	318
Utah N............	Utah	Kane........	653	0	268	.2	.0 BM	.2	HV-C	2.9	319
Utah P (U)........	Utah	Kane........	714	0	350	.2	.0 BM	.2	HV-B	4.7	320
Utah Subseam......	Utah	Carbon......	2,821	0	0	.0	2.2 BM	2.2	HV-A	6.1	372
Utah Subseam 1....	Utah	Carbon......	1,394	1,394	6,217	7.8	.8 BM	8.6	HV-A	5.9	698
			1,504	1,504	9,735	6.7	.7 BM	7.4	HV-A	20.8	751
			2,084	2,084	5,949	8.7	1.2 BM	9.9	HV-A	9.0	843

TABLE A-1. - Results of direct method gas content determinations on U.S. coal samples--Continued

Coalbed	State	County	Sample depth, feet	Lost gas, cm^3	Desorbed gas, cm^3	Gas content, cm^3/g excluding residual gas	Residual gas, cm^3/g, and method of calculation	Total gas content, cm^3/g	Apparent rank	Percent ash, as-received	Code
Utah Subseam 2....	Utah	Carbon......	937	40	96	0.1	1.8 BM	1.9	HV-B	7.7	512
			1,437	187	5,643	6.4	2.0 BM	8.4	HV-A	5.3	547
			1,514	92	1,035	.9	1.5 BM	2.4	HV-A	5.7	541
			1,742	0	0	.0	1.5 BM	1.5	HV-A	5.2	539
			2,110	115	460	1.0	1.1 BM	2.1	HV-A	6.6	824
			2,187	150	1,202	1.5	1.0 G	2.5	-	-	104
Utah Subseam 3....	Utah	Carbon......	963	55	1,501	1.2	.6 BM	1.8	HV-A	6.4	699
			1,552	1	13	.0	.5 BM	.5	HV-A	10.5	825
			1,762	0	0	.0	2.3 BM	2.3	HV-A	6.8	540
			2,222	55	114	.2	.2 G	.4	-	-	105
Utah (unc)........	Utah	Emery.......	130	73	497	.7	.1 G	.8	-	-	103
Utah (unc)........	Utah	Carbon......	285	41	1,820	2.4	.5 BM	2.9	HV-B	4.6	804
			355	28	1,285	1.3	.9 BM	2.2	HV-B	9.7	806
			504	91	1,557	1.7	.3 BM	2.0	HV-A	9.5	809
			2,058	870	5,869	6.7	1.4 BM	8.1	HV-A	5.8	344
			2,081	168	5,349	5.7	.4 BM	6.1	HV-B	4.5	343
Vermejo Fm........	Colo.	Huerfano....	111	553	51	.6	.4 G	1.0	-	-	162
			155	731	82	.7	.4 G	1.1	-	-	163
Vermejo Fm........	Colo.	Las Animas..	859	280	4,409	4.2	.6 BM	4.8	HV-A	12.2	788
			874	10	280	.3	.2 BM	.5	HV-A	42.5	744
			1,032	200	847	2.2	.6 BM	2.8	HV-A	25.9	745
Wadge.............	Colo.	Routt.......	336	62	165	.2	.0 G	.2	-	-	164
			1,284	0	0	.0	.0 G	.0	-	-	165
			1,393	312	49	.3	.2 G	.5	-	-	166
Wall (?)..........	Wyo.	Campbell....	424	76	29	.2	.0 BM	.2	Sub-B	6.0	635
Washington........	Pa.	Greene......	369	17	1,350	1.0	.9 BM	1.9	HV-A	35.5	637
Watkins E.........	Colo.	Arapahoe....	135	40	25	.1	.0 BM	.1	Lig-A	30.5	868
			145	60	35	.2	.0 BM	.2	Lig-A	29.6	869

Waynesburg........	Pa.	Greene......	257	69	2,558	1.6	.3 BM	1.9	HV-A	23.9	277
			346	86	2,459	2.0	.5 BM	2.5	HV-A	17.7	278
			350	66	4,050	2.6	.4 BM	3.0	HV-A	19.7	279
Waynesburg........	W.Va.	Monongalia..	401	310	1,240	2.5	.3 CB	2.8	-	-	90
			402	88	2,844	2.4	.3 CB	2.7	-	-	91
Waynesburg........	Pa.	Greene......	432	44	1,944	1.4	1.1 BM	2.5	HV-A	19.2	639
			434	61	1,595	1.1	2.0 BM	3.1	HV-A	16.6	640
			458	66	1,584	1.2	2.6 BM	3.8	-	-	87
			972	93	2,117	2.1	1.0 BM	3.1	-	-	89
			974	60	1,978	1.8	2.7 BM	4.5	-	-	88
Waynesburg Rider..	Pa.	Greene......	429	54	1,131	.9	.8 BM	1.7	HV-A	27.1	638
Williams Fork Fm..	Colo.	Moffat......	150	20	226	.4	.0 BM	.4	HV-C	3.4	691
			157	35	226	.4	.0 BM	.4	HV-C	1.9	692
			183	70	85	.2	.0 BM	.2	HV-C	3.3	688
			197	50	30	.1	.0 BM	.1	HV-C	3.3	687
			289	30	103	.1	.0 BM	.1	HV-C	5.3	690
			298	20	80	.1	.0 BM	.1	HV-C	3.0	693
Williams Fork Fm..	Colo.	Delta.......	531	-	149	.2	.0 BM	.2	HV-C	3.7	342
			714	320	1,018	5.6	.0 BM	5.6	HV-C	11.7	314
Williams Fork Fm..	Colo.	Rio Blanco..	2,115	-	74	.1	.0 BM	.1	-	-	335
			2,134	284	234	.8	.2 BM	1.0	HV-C	3.8	336
			2,231	-	177	.5	.0 BM	.5	-	-	337
			2,250	460	153	1.3	.0 BM	1.3	-	-	338
Wolf Creek (U)....	Colo.	Routt.......	488	10	32	.0	.0 BM	.0	-	-	167
			1,104	0	112	.1	.1 G	.2	-	-	168
Wolf Creek (L)....	Colo.	Routt.......	1,123	40	118	.1	.1 G	.2	-	-	169

APPENDIX B.--DIAGRAMS OF STANDARD DIRECT METHOD TEST SAMPLE CONTAINER AND BALL MILL

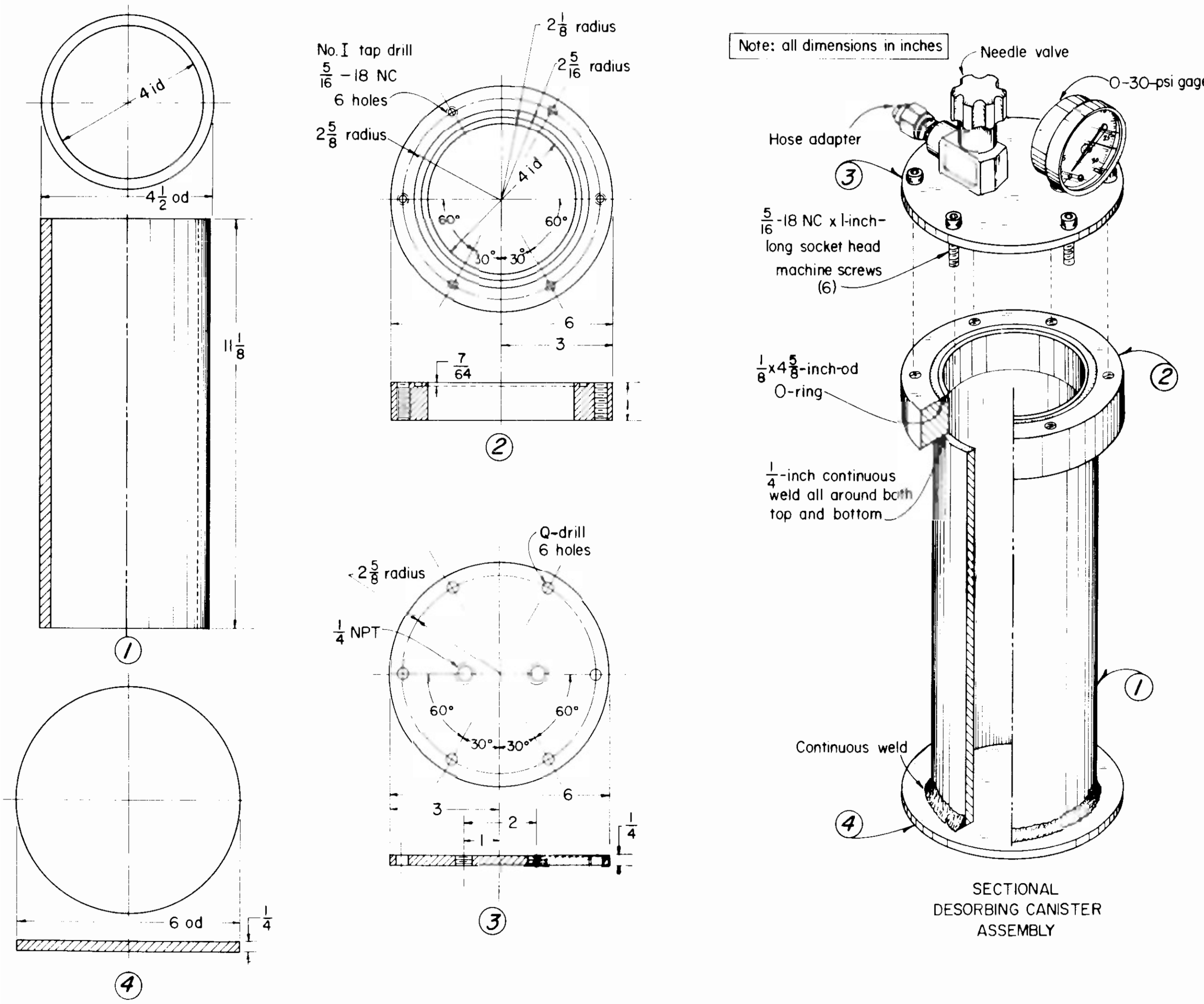

FIGURE B-1. - Standard direct method test sample container.

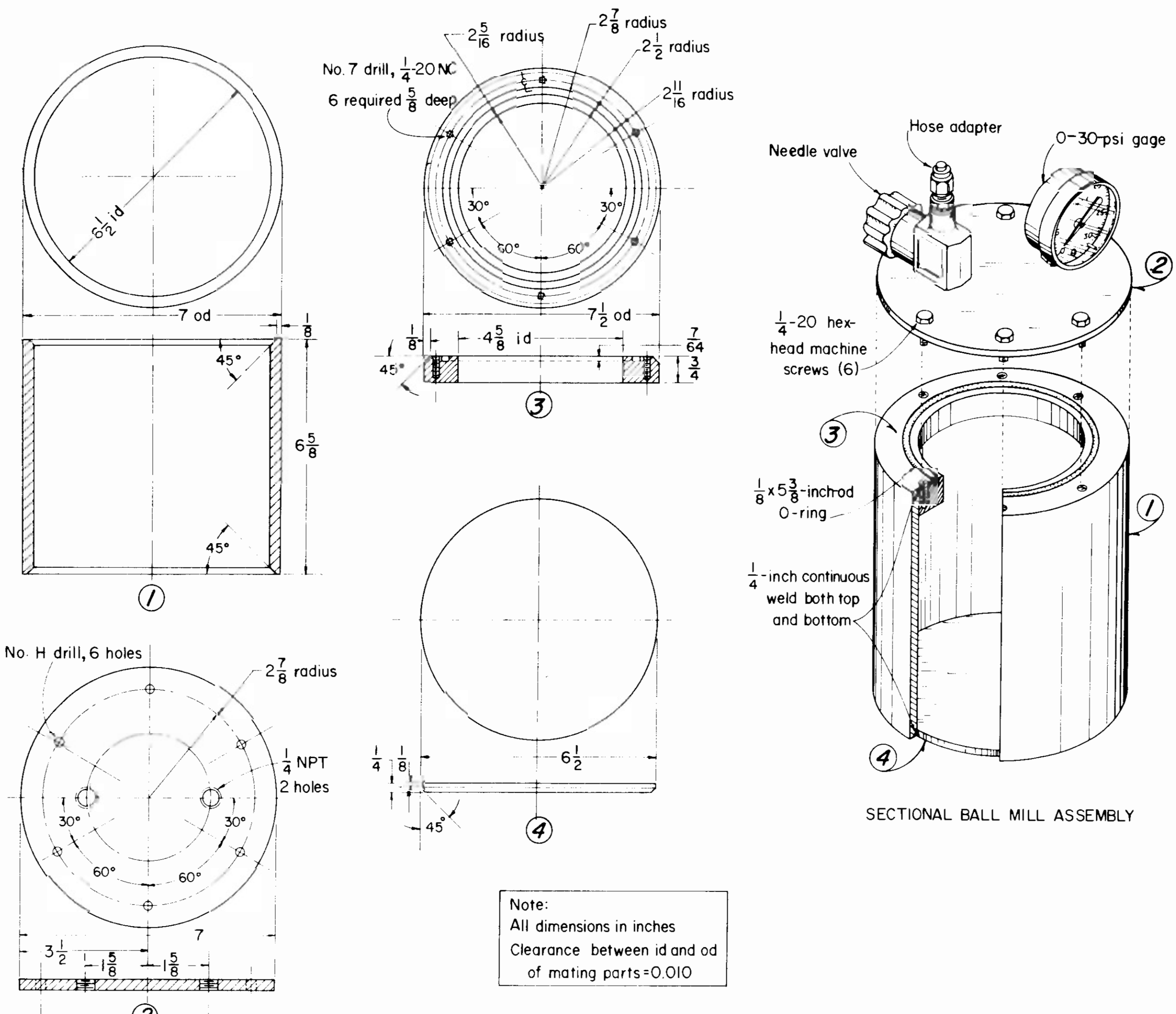

FIGURE B-2. - Ball mill used to crush coal for new residual gas determination procedure.

APPENDIX C.--FIELD DATA COLLECTION FORM FOR DIRECT METHOD TEST

Sample No. ______________________ Date ____________

Company ______________________ Person collecting core ____________

Drilling Company ______________________ Hole No. ____________

Hole location ______________________________________

State ______________________ County ____________

Coalbed ____________ Core size ____________ Barrel length ____________

Coalbed thickness ____________ Type of core retrieval ____________

Depth to base of coalbed ____________ Surface elevation ____________

Roof rock ____________ Drilling media ____________

Floor rock ____________ Air temperature ____________

Condition of sample, type of coal ______________________

Seam description ______________________________________

____

Sample interval ______________________________________

Cylinder No. ________ Cylinder wt. ________ Coal sample wt. (grams) ________

Time coalbed encountered (A) ____________ Time coring started ____________

Time core started out of hole (B) ____________ Time coring completed ____________

Time core reached surface (C) ______________________

Time core sealed in canister (D) ______________________

RESULTS

Lost gas time: (D-A) if air or mist is used ______________________

$(D-C) + \left(\frac{C-B}{2}\right)$ if water is used ______________________

Lost gas (cm^3) ______________________

Gas from canister (cm^3) ______________________

Residual gas from crushing (cm^3/g) ______________________

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