

Implementation of Allowable Water Vapor Deduction Guidance

A. Gas Analysis Reports

For any given gas sample, the gas analysis report can include a multitude of heating values reported under different base pressures, different calculation methods, and different assumptions regarding water vapor content. To ensure that the operator has reported the proper heating value on OGOR B, compare the heating value from OGOR B with the correct heating value from the gas analysis report that covers the reporting month.

You can determine the correct heating value using the “Heating Value” spreadsheet available for download at www.blm.gov

Step 1: Using the original gas analysis report in effect for the OGOR B reporting month you are verifying, enter the mole percent of each component shown in the report into cells B10 to B30 (orange cells). Make sure the total in cell B32 is 100.0000 when you are finished. If it isn't, double check the mole percentages you have entered and make sure that all cells for which there is no mole percent given are set to 0.0000. Water vapor, if listed on the gas analysis report, should be 0.0000 unless the operator physically measured the water vapor.

Step 2: Compare the “Dry Real Heating Value” in cell B39 with the value reported on OGOR B. If there is more than one Facility Measurement Point for a lease, communitization agreement (CA), or unit participating area (PA), or a gas analysis became effective mid-month, use the averaging techniques described in IM 2009-186 and compare the average Btu content with that reported on OGOR B.

Step 3: If the heating value you calculated is within ± 2 Btu/scf of what is reported on OGOR B, you are done. Otherwise:

- a. If the reporting month is February 2017 or later, issue an INC under 3175.126(a) and require amended reports, or
- b. If the reporting month is before February 2017, proceed with Steps 4-6.

Step 4: Contact the operator to determine the cause of the error. If the operator indicates they deducted assumed water vapor, ask for the amended gas analysis report that includes the assumed water vapor content as described in Policy Action 1.b through 1.e. and proceed to Step 5. If the operator does not indicate that they deducted water vapor or they cannot provide the amended gas analysis report, proceed with obtaining gas analysis reports based on the absence of water vapor (“dry”) using the procedures outlined in IM 2009-186.

Step 5: Verify the amended gas analysis report that includes assumed water vapor. From the daily quantity transaction record (QTR or volume statement) for the reporting month you are verifying, input the monthly average pressure (in psia) and average temperature into cells B4 and B5, respectively. Cell D30 shows the maximum amount of water (in mole percent) that this gas can hold at the pressure and temperature you entered in cells B4 and B5.

Step 6: Compare the “As-Delivered Real Heating Value” in cell D39 with the value reported on OGOR B. If there is more than one FMP for a lease, CA, or PA, or a gas analysis became effective mid-month, use the averaging techniques described in IM 2009-186 and compare the average Btu content with that reported on OGOR B.

Step 7: If the heating value reported on OGOR B is less than the “As-Delivered Heating Value” in cell D39, follow the procedures in IM 2009-186 to resolve the discrepancy.

B. Gas Volume Statements and Characteristics Reports

Some operators deduct water vapor from the measured volume rather than from the heating value. Identifying this on the Characteristics Report and Quantity Transaction Record (QTR) can be difficult because there are numerous formats of these reports. On the Flowcal characteristics reports, for example, you may see the following under “Calculation Parameters”:

“Water Vapor Corr. Technique: Equivalent Dry Volume”

“Water Vapor Corr. Method: 1955 IGT-Bulletin 8”

You may also see similar statements in the header of “Closed” QTRs from Flowcal. Either of these is an indication that the operator has deducted assumed water vapor content from the measured volume. Normally this is accompanied by a “dry” heating value.

Regardless of the format of report, a recalculation of the volume reported from the QTR using the integral value will detect this and other errors and flag that the operator has not properly calculated volume.

As stated in this IM, the BLM does not allow adjustments to measured volume based on water vapor assumed or measured, and as described in Policy/Action Item 4, you should issue an Incident of Non-compliance if you find this and require the operator to submit amended QTRs without the water vapor deduction.

EXAMPLE

You are verifying the heating value for lease NMNM03551 reported on OGOR B for the month of September 2016 (see Figure 1) using the steps identified in Attachment 1 of this IM. You have requested the latest gas analysis report (see Figure 2) and the QTR for the month of September 2016 (see Figure 3). The FMP is a single lease master meter (Cave Canyon Master, #91601124) that measures all the gas produced from NMNM03551.

Step 1: Enter the mole percentages from the gas analysis into the heating value spreadsheet as shown in Figure 4. Check to make sure that the mole percentages add up to 100.0000 in cell B32 (they do). Also check to make sure that the mole percent of water is 0.0000 (which it is).

Step 2: Compare the “dry” heating value from cell B39 with the reported heating value on OGOR B. In this case, cell B39 shows a dry heating value of 1333.4 Btu/scf and OGOR B shows 1324 Btu/scf.

Step 3: The difference between the two Btu values is more than 2 and this reporting month is before February 2017, so you would proceed with steps 4-6.

Step 4: You contact the operator about this 9 Btu/scf discrepancy and the operator informs you that they deducted assumed water vapor content using the IGT Bulletin 8 methodology. Ask the operator to provide an amended gas analysis statement that includes the assumed water vapor content. You receive the amended gas analysis report as shown in Figure 5.

Step 5: From the QTR for September 2016 (Figure 3), enter the average pressure (83.3 psia) into cell B4 and the average temperature (64.8°F) into cell B5. Based on the IGT Bulletin No. 8 calculations, the maximum amount of water vapor that the gas can hold is 0.3781 mole percent (cell C30), which would result in a heating value of 1328.5 Btu/scf (cell D39).

Step 6: The heating value you calculated from the spreadsheet (1328.5 Btu/scf, Cell D39) still does not match the heating value the operator reported on OGOR B. You should ask the operator for amended reports using a heating value of 1329 Btu/scf. It appears that the operator calculated the water content using the pressure and temperature listed on the gas analysis report (68 psia and 78°F) instead of the average pressure and temperature from the September 2016 QTR. The pressure and temperature that are sometimes shown on the gas analysis report are taken at the time the sample is taken and do not necessarily represent the average pressure and temperature from which you should determine the monthly average water vapor content.

**OIL AND GAS OPERATIONS REPORT
PART B – PRODUCTION DISPOSITION
(OGOR-B)**

OGOR Document Number: 100914190

BLM Case Number: NMNM03551

REPORT TYPE X ORIGINAL MODIFY (DELETE/ADD BY LINE) REPLACE (OVERLAY PREVIOUS REPORT)	MMS LEASE/AGREEMENT NUMBER	AGENCY LEASE/AGREEMENT NUMBER NMNM03551
PRODUCTION MONTH (YYYY-MM) 2016-09	MMS OPERATOR NUMBER 19900	OPERATOR NAME BIXBY OIL AND GAS
OPERATOR LEASE/AGREEMENT NAME	OPERATOR LEASE/AGREEMENT NUMBER	

L I N E	A C T	DISP CODE	METERING POINT	GAS PLANT	API GRAV 99.9	BTU 9999	DISPOSITION VOLUMES		
							OIL/CONDENSATE (BBL)	GAS (MCF)	WATER (BBL)
1	A	01			0.0	1324	0	67620	0
2	A	20			0.0	0	0	129	0
3	A						0	0	0
TOTAL DISPOSITIONS							0	13380	0

Disposition Codes:

- 01 Sales-Subject to Royalty (MEASURED)
- 11 Transferred
- 20 Used on Lease/Agreement
- 27 Water Disposal-Other than Transferred/Injection

Figure 1 – OGOR

EXAMPLE GAS ANALYSIS STATEMENT

ORIGINAL

Do not use these values when calculating monthly 'As Delivered'.

Well/Lease Information

Customer Name: Bixby Oil and Gas
 Well Name: 91601124
 County/State: San Juan/NM
 Location:
 Field:
 Formation:
 Cust. Station No.: 10--5514A

Source: Probe
 Well Flowing? Yes
 Pressure: 68 psia
 Flow Temp: 78 deg F
 Ambient Temp: 51 deg F
 Sample Method: Cylinder/Full&Empty
 Date Sampled: 08/13/2016
 Effective Date: 09/01/2016
 Time Sampled: 11:29 AM
 Sampled By: JKL

Component	Mole %	BTU*
Nitrogen	0.4930	0.00
CO2	1.0710	0.00
Methane	78.6560	794.42
Ethane	8.9570	158.51
Propane	4.3960	110.61
i-Butane	1.0120	32.91
n-Butane	1.7550	57.25
i-Pentane	0.8180	32.73
n-Pentane	0.6780	27.18
Hexanes Plus	2.1640	111.00
Water	0.0000	0.00
TOTAL	100.0000	1324.61

*@14.696 PSIA & 60°F

COMPRESSIBILITY FACTOR (1/Z): 1.0043
 BTU/CU.FT IDEAL @ 14.73 PSIA: 1327.7
 BTU/CU.FT (DRY) (1/Z): 1333.4
 BTU/CU.FT (WET) (1/Z): 1310.2
 DRY BTU @ 15.025 PSIA: 1360.1
 REAL SPECIFIC GRAVITY: 0.7821

CYLINDER #: 1435
 CYLINDER PRESSURE: 70 PSIG
 DATE RUN: 9/16/15 11:45 AM
 ANALYSIS RUN BY: JDR

Note: This is the proper Btu value unless the operator has made a water vapor adjustment under this IM

Figure 2 – Original Gas Analysis Report

BLM DAILY GAS VOLUME STATEMENT

September 2016

Meter # 91601124

Lease: NM-03551

Name: Cave Canyon Master

Original Data

Pressure Base: 14.73 Temperature Base: 60.00 HV Cond: Meter Type: EFM Contract Hr: Midnight
 Status: Active WV Technique: WV Method:

H2O	H2S	O2	He	C1	C2	C3	i-C4	n-C4	i-C5	n-C5	C6+
0.000	0.000	0.000	0.000	78.656	8.957	4.396	1.012	1.755	0.818	0.678	2.164

Tube ID	Orifice ID	Interval	Tap Location	Tap Type	Atmos. Pressure	Calc. Method	Fpv Method
4.026	2.750	1 Hour	Upstream	Flange	11.600 psi	AGA3-1992	AGA8-Detail

Day	Hours Flow	Temp. (°F)	Press (psia)	Mol% Gravity	Mol% CO2	Mol% N2	Flow Extn (in H2O)	Diff (Mcf)	Volume (Mcf)	Heating Value	Energy (MMBtu)
1	0	82.1	13.1	0.7821	1.071	0.493	0	0	0	1324.0	0
2	0	73.3	13.2	0.7821	1.071	0.493	0	0	0	1324.0	0
3	0	75.7	13.0	0.7821	1.071	0.493	0	0	0	1324.0	0
4	0	79.0	12.8	0.7821	1.071	0.493	0	0	0	1324.0	0
5	0	81.6	12.6	0.7821	1.071	0.493	0	0	0	1324.0	0
6	0	86.2	12.5	0.7821	1.071	0.493	0	0	0	1324.0	0
7	0	87.4	13.0	0.7821	1.071	0.493	0	0	0	1324.0	0
8	0	93.1	13.1	0.7821	1.071	0.493	0	0	0	1324.0	0
9	0	78.2	13.3	0.7821	1.071	0.493	0	0	0	1324.0	0
10	0	83.3	13.2	0.7821	1.071	0.493	0	0	0	1324.0	0
11	0	70.0	13.3	0.7821	1.071	0.493	0	0	0	1324.0	0
12	0	83.1	13.4	0.7821	1.071	0.493	0	0	0	1324.0	0
13	12.30	67.3	85.4	0.7821	1.071	0.493	58.1	43.0	1,317	1324.0	1,750
14	23.25	66.9	94.2	0.7821	1.071	0.493	74.4	64.1	3,806	1324.0	5,058
15	24.00	64.6	91.9	0.7821	1.071	0.493	79.0	68.2	4,291	1324.0	5,702
16	24.00	64.7	90.2	0.7821	1.071	0.493	77.7	67.3	4,221	1324.0	5,609
17	24.00	64.9	87.4	0.7821	1.071	0.493	74.5	64.0	4,045	1324.0	5,376
18	24.00	65.4	87.0	0.7821	1.071	0.493	73.6	62.9	3,995	1324.0	5,309
19	24.00	64.3	77.2	0.7821	1.071	0.493	77.3	78.1	4,180	1324.0	5,555
20	24.00	64.6	80.1	0.7821	1.071	0.493	74.7	70.3	4,044	1324.0	5,374
21	24.00	64.5	87.4	0.7821	1.071	0.493	71.7	59.3	3,898	1324.0	5,180
22	24.00	63.5	83.7	0.7821	1.071	0.493	68.6	56.7	3,732	1324.0	4,960
23	24.00	64.8	86.0	0.7821	1.071	0.493	72.1	60.9	3,918	1324.0	5,207
24	24.00	64.6	83.2	0.7821	1.071	0.493	68.7	57.2	3,733	1324.0	4,961
25	24.00	65.4	80.7	0.7821	1.071	0.493	65.5	53.6	3,555	1324.0	4,725
26	24.00	66.1	80.3	0.7						1324.0	4,553
27	24.00	66.5	86.4	0.7						1324.0	4,398
28	24.00	65.5	76.2	0.7						1324.0	4,218
29	24.00	65.8	74.7	0.7						1324.0	4,201
30	24.00	65.7	73.3	0.7821	1.071	0.493	55.9	43.1	3,041	1324.0	4,041
31	24.00	56.2	68.6	0.7821	1.071	0.493	50.5	37.3	2,765	1324.0	3,675
AVG/TOT	443.55	64.8	83.3					58.0	67,620	1324.0	89,867

Use these values in the HV calculator, not the ones on the gas analysis.

Figure 3 – Quantity Transaction Record

heating value with IGT 8 - Microsoft Excel

File Home Insert Page Layout Formulas Data Review View

Clipboard Font Alignment Number Styles Cells Editing

H35

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Heating Value and Relative Density Calculation					Input							
2	Calculations done per GPA 2172-09					Constants							
3						Results							
4	Average pressure:	83.3	psia										
5	Average temperature:	64.8	deg F										
6	GPA 2145 Values												
7	GPA 2145	Dry	As-Del.	Ideal	Molar	b	Total	Total	Total	Total	Total	Total	Total
8	Component	mol%	mol%	HV	mass		HV	mass	b	HV	mass	b	
9													
10	Methane	78.6560	78.359	1010.0	16.0425	0.0116	794.426	12.618	0.009124	791.422	12.571	0.00909	
11	Ethane	8.9570	8.923	1769.7	30.0690	0.0238	158.512	2.693	0.002132	157.913	2.683	0.002124	
12	Propane	4.3960	4.379	2516.1	44.0956	0.0347	110.608	1.938	0.001525	110.190	1.931	0.00152	
13	i-Butane	1.0120	1.008	3251.9	58.1222	0.0441	32.909	0.588	0.000446	32.785	0.586	0.000445	
14	n-Butane	1.7550	1.748	3262.3	58.1222	0.047	57.253	1.020	0.000825	57.037	1.016	0.000822	
15	i-pentane	0.8180	0.815	4000.9	72.1488	0.0576	32.727	0.590	0.000471	32.604	0.588	0.000469	
16	n-pentane	0.6780	0.675	4008.7	72.1488	0.0608	27.179	0.489	0.000411	27.076	0.487	0.000409	
17	Hexane	0.0000	0.000	4755.9	86.1754	0.0778	0.000	0.000	0	0.000	0.000	0	
18	Hexane +	2.1640	2.156	5129.2	93.1887	0.088	110.996	2.017	0.001869	110.577	2.009	0.001862	
19	Heptane	0.0000	0.000	5502.6	100.2019	0.0951	0.000	0.000	0	0.000	0.000	0	
20	Octane	0.0000	0.000	6249.0	114.2285	0.1128	0.000	0.000	0	0.000	0.000	0	
21	Nonane	0.0000	0.000	6996.3	128.2551	0.1307	0.000	0.000	0	0.000	0.000	0	
22	Decane	0.0000	0.000	7742.9	142.2817	0.1556	0.000	0.000	0	0.000	0.000	0	
23	Ethylene	0.0000	0.000	1599.7	28.0532	0.021	0.000	0.000	0	0.000	0.000	0	
24	Propylene	0.0000	0.000	2333.0	42.0797	0.033	0.000	0.000	0	0.000	0.000	0	
25	CO2	1.0710	1.067	0.0	44.0095	0.0195	0.000	0.471	0.000209	0.000	0.470	0.000208	
26	H2S	0.0000	0.000	637.1	34.0809	0.024	0.000	0.000	0	0.000	0.000	0	
27	Nitrogen	0.4930	0.491	0.0	28.0134	0.00442	0.000	0.138	2.18E-05	0.000	0.138	2.17E-05	
28	Oxygen	0.0000	0.000	0.0	31.9988	0.007	0.000	0.000	0	0.000	0.000	0	
29	Helium	0.0000	0.000	0.0	4.0026	0.000	0.000	0.000	0	0.000	0.000	0	
30	Water	0.0000	0.3781	0.0	18.0153	0.065	0.000	0.000	0	0.000	0.068	0.000246	
31													
32	Sums	100.0000	100.0000				1324.611	22.564	0.017	1319.602	22.547	0.017	
33													
34		Dry	As-Delivered										
35	Ideal Heating Value:	1327.7	Btu/scf	1322.7	Btu/scf								
36	Ideal Gravity:	0.7791		0.7785									
37	Zb-gas	0.9957		0.9956									
38	Zb-air	0.9996		0.9996									
39	Real Heating Value:	1333.4	Btu/scf	1328.5	Btu/scf								
40	Relative Density:	0.7821		0.7816									
41													
42													
43													

Figure 4 – Spreadsheet Example

EXAMPLE GAS ANALYSIS STATEMENT

AMENDED WITH WATER VAPOR

Well/Lease Information

Customer Name: Bixby Oil and Gas	Source: Probe
Well Name: 91601124	Well Flowing? Yes
County/State: San Juan/NM	Pressure: 68 psia
Location:	Flow Temp: 78 deg F
Field:	Ambient Temp: 51 deg F
Formation:	Sample Method: Cylinder/Fill&Empty
Cust. Station No.: 10--5514A	Date Sampled: 08/13/2016
	Effective Date: 09/01/2016
	Time Sampled: 11:29 AM
	Sampled By: JKL

Component	Mole %	BTU*
Nitrogen	0.489	0.00
CO2	1.0630	0.00
Methane	78.0910	788.72
Ethane	8.8930	157.37
Propane	4.3640	109.81
i-Butane	1.0050	32.67
n-Butane	1.7420	56.84
i-Pentane	0.8120	32.49
n-Pentane	0.6730	26.98
Hexanes Plus	2.1480	110.20
Water**	0.7178	0.00
TOTAL	100.0000	1315.10

Operator used incorrect pressure and temperature for IGT Bulletin 8 calculation; therefore the "DRY" Btu value shown (1324.0) is incorrect. Use the average pressure and temperature from the Quantity Transaction Record (Fig. 3) when using the spreadsheet

*@14.696 PSIA & 60°F

**Calculated per IGT Bulletin No. 8 (68 psia, 78°F)

COMPRESSIBILITY FACTOR (1/Z): 1.0043	CYLINDER #: 1435
BTU/CU.FT IDEAL @ 14.73 PSIA: 1318.1	CYLINDER PRESSURE: 70 PSIG
BTU/CU.FT (DRY) (1/Z): 1324.0	DATE RUN: 9/16/15 11:45 AM
BTU/CU.FT (WET) (1/Z): 1301.0	ANALYSIS RUN BY: JDR
DRY BTU @ 15.025 PSIA: 1350.5	
REAL SPECIFIC GRAVITY: 0.7811	

Figure 5 – Amended Gas Analysis Report with water vapor