

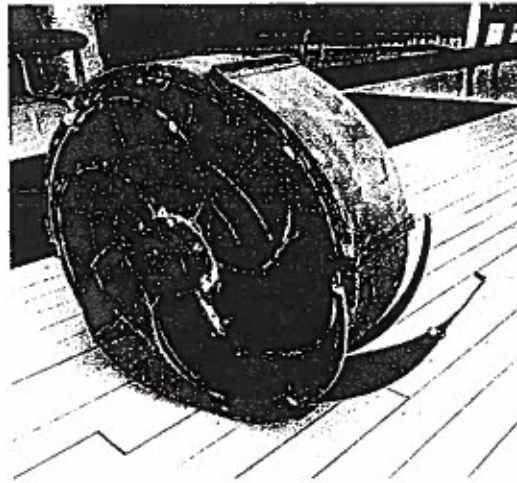


**youngstown  
thermal**

# **City Hall**

## **Billing Meter Failure Report**

### **For Steam Service**



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**Energy Engineer**  
**March 21, 2017**

**236 N Champion Street**  
**Youngstown, OH 44503**



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## STEAM METER FAILURE REPORT

The amount of steam that City Hall has been using has been deteriorating since 2012. When Youngstown Thermal opened up the meter it was severely damaged as a result of steam traps blowing through to the condensate return system. The failure of the wheel is shown in a photograph within this report. When steam traps blow through hot condensate melts the solder that holds the copper wheel in place.

The purpose of this study is to support the invoice that has been presented to the City for under billing during the last 4+ years. An engineering analysis of the relationship between heating degree days and steam sales is linear as shown on graph that shows sales vs. monthly heating degree days. A separate graph showing annual heating degree days vs. sales is also included to determine the relationships for the City Hall building. These relationships were used to develop the revenues that should have been measured had the meter been operating correctly. A new meter has been installed.

The annual cost for steam sales including gross receipts tax is calculated to be \$107,419 per year based on the 10 year heating degree day chart that is included with this report.

In 2013 City Council changed our rate structure so that there is a demand (or capacity) component to our rate structure. Historically steam systems did not charge demand and energy, however 2012 presented very low heating degree days (a record) and heating systems have adjusted to a demand and energy component because the utility simply cannot take the risk for weather on a go-forward basis. The cost of producing steam is at least 70% to 80% fixed costs whether for an in-building or district system.

*new  
meter was  
broke =  
didn't fix*

Our worksheet shows the calculation for under billing to be \$141,570 during the recent four year period. The under billing in 2013 was not substantial but in the last 3 years apparently the meter deteriorated further, creating substantial under billing. In 2015 it was over 50% error in the meter. Recently, the meter completely failed which brought the company's attention to the historical problem.

Condensate meters always fail by reading slow. Any malfunction in the meter causes the meter to turn slower than normal due to friction. For this reason, our larger customers are all outfitted with steam meters.

When meters have demonstrated that they've been reading slow, steam utilities revert to calculations for the building based on previous historical records. The graph that shows monthly heating degree days vs. steam usage indicates that there is little energy conservation at City Hall. In 2008 for the high degree day periods steam was measured at higher than trend lines. This suggests that the building has been operated without changing its efficiency for use of steam.

## City of Youngstown - City Hall Steam Traps Blowing Through Ruin Meter

Year	HDD	Calculated Sales (Mlbs)	Measured Sales (Mlbs)	Calculated Sales (\$)	Billed Sales (\$)	Under Billing (\$)
2008	6310	5,328.36	4,976.00	\$105,237.42	\$105,237.42	\$0.00
2009	6195	5,179.13	5,415.00	\$114,521.84	\$114,521.84	\$0.00
2010	5988	4,910.53	5,316.00	\$112,428.08	\$112,428.08	\$0.00
2011	6024	4,957.24	4,918.00	\$104,010.78	\$104,010.78	\$0.00
2012	5362	4,098.23	4,223.00	\$89,312.23	\$89,312.23	\$0.00
2013	6326	5,349.12	4,413.00	\$107,419.00	\$94,108.00	\$13,311.00
2014	6733	5,877.24	3,547.00	\$107,419.00	\$71,974.00	\$35,445.00
2015	5724	4,567.96	1,601.00	\$107,419.00	\$53,968.00	\$53,451.00
2016	5646	4,466.75	1,544.00	\$107,419.00	\$76,616.00	\$30,803.00
2017	1733		14.00	\$42,732.00	\$34,172.00	\$8,560.00
		<b>44,734.56</b>	<b>35,967.00</b>	<b>\$997,918.35</b>	<b>\$856,348.35</b>	<b>\$141,570.00</b>

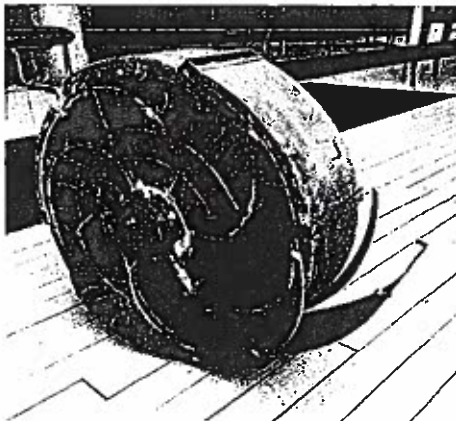
**Note:**

**Youngstown Thermal's 2013 Approved Price Structure**

Base	\$20.101/Mlb
Gross Receipts Tax at 4.75%	0.9548
<b>Total</b>	<b>\$21.0558/Mlb</b>

Avg HDD* Energy	*5471 Mlb x \$5.101 = \$27,907.57
+2008 Demand	4976 Mlb x \$15.00 = \$74,640.00
<b>Total</b>	<b>= \$102,547.60</b>
w/Gross Receipts @4.75%	<b>= \$107,419.00</b>

\*Failed meter data is substituted with historical data HDD data or 6420 HDD which predicts 5471 Mlb. Actual use was 5316 Mlbs in 2010. Both years were below



The photo shown here is the as found condition of Youngstown Thermal's meter at City Hall. It failed because the City had steam traps blowing through their system which melted the solder, which holds the copper wheel together. It appears from the data that the process started after 2012.

## Historical Use Rate City of Youngstown (Mlbs)

Mlbs

Month	2002	2003	2004	2005	2006	2007	2008	2009
Jan	925	1,221	1,275	1,127	883	1,024	1,087	1,239
Feb	876	1,067	1,181	1,001	913	1,063	978	962
Mar	729	698	714	990	844	547	768	748
Apr	366	406	353	279	77	382	129	300
May	144	101	69	81	5	13	6	4
Jun	4	109	9	6	3	3	6	3
Jul	1	9	8	5	3	2	5	3
Aug	0	7	6	5	2	3	5	3
Sep	0	35	0	4	2	2	4	2
Oct	374	600	241	149	267	73	321	458
Nov	968	633	773	661	376	599	695	576
Dec	1,022	1,010	1,036	1,164	618	1,125	972	1,117
<b>Total</b>	<b>5,409</b>	<b>5,896</b>	<b>5,665</b>	<b>5,472</b>	<b>3,993</b>	<b>4,836</b>	<b>4,976</b>	<b>5,415</b>

Mlbs

Month	2010	2011	2012	2013	2014	2015	2016	2017
Jan	1,088	1,176	1,026	911	1,027	320	428	14
Feb	1,142	912	775	868	774	519	330	0
Mar	607	659	320	884	586	304	130	
Apr	291	237	464	205	147	108	80	
May	127	66	40	41	7	20	12	
Jun	16	0	0	0	0	1	0	
Jul	5	0	0	0	0	0	0	
Aug	5	0	0	0	0	4	0	
Sep	2	2	0	0	0	0	0	
Oct	382	272	242	131	136	62	39	
Nov	582	723	589	580	304	114	152	
Dec	1,069	871	767	793	566	149	373	
<b>Total</b>	<b>5,316</b>	<b>4,918</b>	<b>4,223</b>	<b>4,413</b>	<b>3,547</b>	<b>1,601</b>	<b>1,544</b>	<b>14</b>

### Historical Heating Degree Days

HDD											Avg	
Month	'80	'91	'92	'93	'94	'95	'96	'97	'98	'99		Normal
Jan	925	1183	1115	1044	1438	1096	1273	1236	951	1208	1283	1147
Feb	863	927	960	1121	1091	1113	1134	894	781	902	1095	979
Mar	731	745	919	950	929	776	1043	862	790	987	890	873
Apr	488	399	515	526	452	572	567	617	478	439	531	505
May	306	102	264	239	364	213	318	415	111	170	268	250
Jun	75	26	108	70	58	20	33	52	106	76	62	62
Jul	20	0	12	3	5	20	29	19	2	7	8	12
Aug	6	3	55	8	39	0	12	45	7	21	22	20
Sep	141	165	168	192	158	169	141	148	83	139	129	160
Oct	357	360	523	481	429	353	434	435	401	450	435	422
Nov	603	768	721	732	581	869	904	817	663	614	720	727
Dec	918	999	1005	1099	922	1238	971	1007	892	1016	1101	1007
<b>Total</b>	<b>5433</b>	<b>5675</b>	<b>6385</b>	<b>6485</b>	<b>6464</b>	<b>6439</b>	<b>6859</b>	<b>6547</b>	<b>5265</b>	<b>6029</b>	<b>6544</b>	<b>6154</b>

Normal	6560	6560	6560	6544	6544	6544	6544	6544	6544	6544
Avg temp	50.1	49.5	47.6	47.3	47.3	47.4	46.3	47.1	50.6	48.5
Td Jul-Jun	#REF!	5427	6174	6434	6847	6922	7017	6587	6668	5930

Notes  
1) \* Normals \* changed in 1993.

HDD											Avg	
Month	'2000	'01	'02	'03	'04	'05	'06	'07	'08	'09		Normal
Jan	1208	1174	968	1412	1412	1209	866	1082	1100	1427	1243	1166
Feb	936	921	898	1179	1066	1005	1005	1305	1115	989	1057	1042
Mar	697	990	844	834	788	1008	862	786	984	811	878	860
Apr	515	427	479	466	498	467	403	585	387	471	502	478
May	197	205	337	275	160	347	270	158	316	209	252	247
Jun	65	66	39	96	90	26	73	47	32	53	71	59
Jul	28	27	6	7	7	0	7	12	0	18	18	11
Aug	33	1	8	13	52	8	3	17	16	19	28	17
Sep	175	171	68	135	85	42	150	87	72	80	148	107
Oct	350	360	511	491	417	386	498	247	465	472	439	420
Nov	785	511	758	597	661	631	626	747	767	548	708	693
Dec	1334	902	1108	1028	1074	1178	851	1026	1056	1098	1076	1066
<b>Total</b>	<b>6323</b>	<b>5755</b>	<b>6024</b>	<b>6533</b>	<b>6310</b>	<b>6307</b>	<b>5614</b>	<b>6099</b>	<b>6310</b>	<b>6195</b>	<b>6420</b>	<b>6147</b>

Normal	6544	6544	6485	6451	6451	6420	6420	6420	6420	6420
Avg temp	47.7	49.2	49.5	47.1	47.8	47.7	49.6	48.3	47.8	48.1
Td Jul-Jun	5885	6488	5537	6721	6285	6358	5724	6099	6070	6336

Notes  
1) Normals based on 1961-90  
2) Normals changed in 2002, based on 1971-00  
3) Normals changed in 2003 (Feb-1057 to 1091)-2  
4) Normals changed in 2005 (Feb-1057 to 1085)-2

HDD											Avg	
Month	2010	'11	'12	'13	'14	'15	'16	'17	'18	'19		Normal
Jan	1233	1341	1042	1089	1395	1344	1199	1002			1215	1206
Feb	1056	1032	892	1082	1229	1078	957	731			1025	1007
Mar	682	935	478	975	1078	988	614				878	822
Apr	320	478	527	494	476	443	545				502	469
May	153	185	101	190	205	137	246				252	174
Jun	30	48	41	56	28	42	34				69	48
Jul	11	0	0	13	7	7	6				8	6
Aug	7	10	6	25	24	22	0				27	13
Sep	119	111	184	151	141	50	40				146	114
Oct	414	431	423	365	388	393	325				439	391
Nov	711	553	785	824	829	530	601				708	690
Dec	1252	900	882	1062	933	690	1079				1076	971
<b>Total</b>	<b>5988</b>	<b>6024</b>	<b>5362</b>	<b>6326</b>	<b>6733</b>	<b>5724</b>	<b>5648</b>	<b>1733</b>	<b>0</b>	<b>0</b>	<b>6345</b>	<b>4354</b>

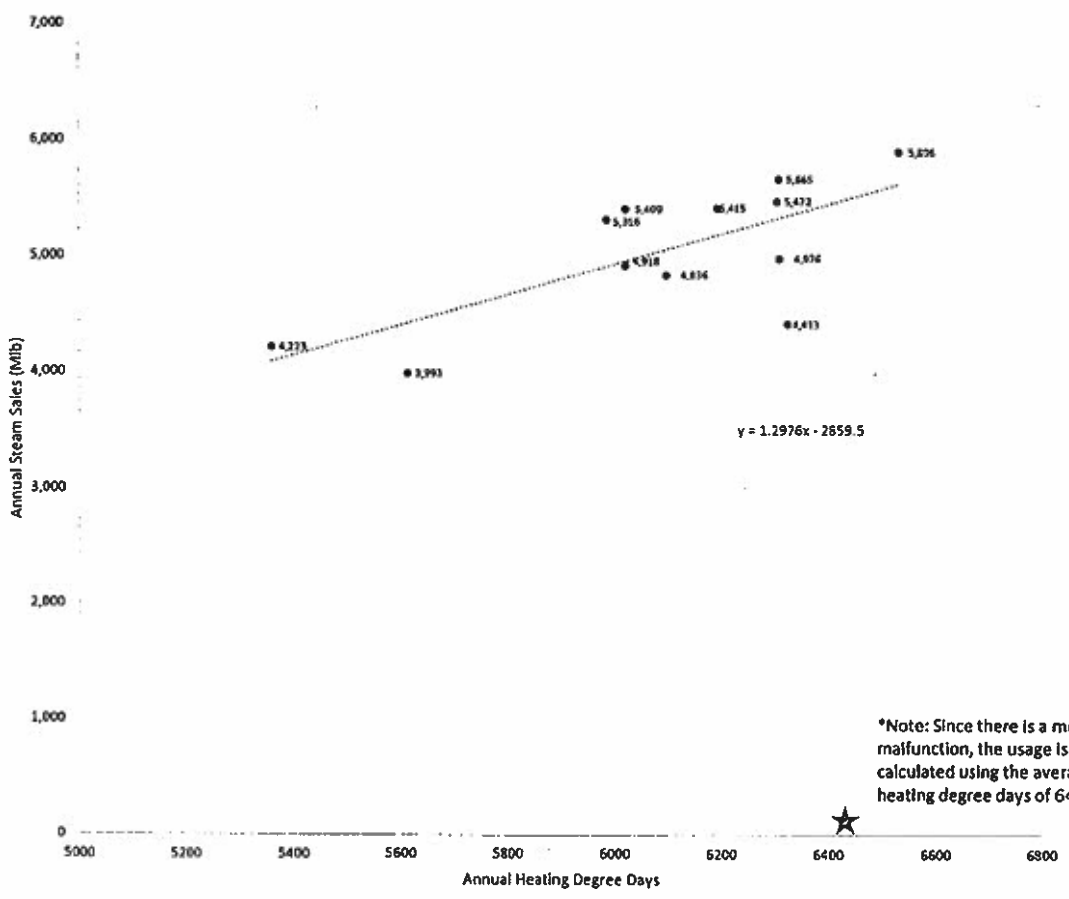
Normal	6451	6451	6451	6451	6451	6451	6451	6451	6451	6451
Avg temp	48.6	48.5	50.3	47.7	46.6	49.3	49.6	60.3	65.0	65.0
Td Jul-Jun	6709	6533	5087	8166	6351	6354	5287	3784	0	0

Notes: Normals changed in 2013 to 30 year ave 1982 to 2012





### City of Youngstown Sales vs. Annual Heating Degree Days Analysis



\*Note: Since there is a meter malfunction, the usage is calculated using the average heating degree days of 6420



## Historical Annual Use Vs. Heating Degree Days Youngstown City Hall

Year	Mlb/Year	HDD
2008	4976	6310
2009	5415	6195
2010	5316	5988
2011	4918	6024
2012	4223	5362

2013	4413	6326	Meter Problem
2014	3547	6733	Meter Problem
2015	1601	5724	Meter Problem
2016	1544	5646	Meter Problem
2017	14		Meter Problem

Note: Normal HDD is 6420 and 2008 through 2013 were all below normal: 2014 was exceptionally cold at 6733 HDD.

## Predictability of Usage Compared to Metered Data Youngstown City Hall

### Measured vs. Predicted

2008	-7.00%	Measured was low
2009	4.50%	Measured was high
2010	8.30%	Measured was high
2011	-0.80%	Measured was low
2012	3.05%	Measured was high
<b>Net</b>	<b>8.05%</b>	<b>Measured was high</b>

Variance:  $\frac{8\%}{5 \text{ years}} = 1.6\%/year$  - This is within an expected range.

The 1.6% per year range is within an engineer's expected range considering when cold weather occurs, i.e. weekdays vs. weekends, etc., as well as other variables.