



Steam Energy Loss and Environmental Pollutants Generated by Blow-through Failure of One Steam Trap

Typical drip/tracer trap: 5/64" orifice, 150 psig inlet, 0-65 psig outlet, live steam loss of 27 lb/hr, operating 8,400 hours per year.

Fuel Properties and Usage										Pollutants Generated						Fuel Costs	
Type	Firing Method	Heating Value			Analysis				Quantity Used Per Year	P. M. lb/yr	SOx, lb/yr	NOx, lb/yr	CO, lb/yr	CO ₂ , lb/yr	Total C, ton/yr	Unit Cost	Annual Cost
		HHV	LHV	Units	S	C	H	Ash									
Bituminous Coal	Pulv., dry btm	14,310	13,847	Btu/lb	1.0%	81.6%	5.0%	6.1%	11.9 tons	727	465	250	7.2	35.66	9.7	\$57 / ton	\$679
	Pulv., wet btm	14,310	13,847	Btu/lb	1.0%	81.6%	5.0%	6.1%	11.9 tons	509	465	405	7.2	35.66	9.7		
	Spreader St	14,310	13,847	Btu/lb	1.0%	81.6%	5.0%	6.1%	11.9 tons	715	465	167	60	35.61	9.7		
	Overfeed St	14,310	13,847	Btu/lb	1.0%	81.6%	5.0%	6.1%	11.9 tons	191	465	89	72	35.61	9.7		
Sub-Bituminous Coal	Pulv., dry btm	10,650	10,094	Btu/lb	1.4%	60.4%	6.0%	3.6%	16.4 tons	589	801	343	9.8	36.20	9.9	\$44 / ton**	\$719
	Pulv., wet btm	10,650	10,094	Btu/lb	1.4%	60.4%	6.0%	3.6%	16.4 tons	412	801	556	9.8	36.20	9.9		
	Spreader St	10,650	10,094	Btu/lb	1.4%	60.4%	6.0%	3.6%	16.4 tons	981	801	229	82	36.15	9.9		
	Overfeed St	10,650	10,094	Btu/lb	1.4%	60.4%	6.0%	3.6%	16.4 tons	262	801	123	98	36.13	9.9		
	Hand fired	10,650	10,094	Btu/lb	1.4%	60.4%	6.0%	3.6%	16.4 tons	245	710	49	1472	35.05	9.9		
Distillate #2 Oil	Industrial or Comm. Boiler	138,750	130,431	Btu/gal	1.0%	87.2%	12.9%	—	2531 gal	5.1	359	51	12.7	28.82	7.9	\$0.55 / gal	\$1,392
Residual #5 Oil	Industrial or Comm. Boiler	146,438	138,379	Btu/gal	3.0%	87.9%	11.3%	—	2385 gal	23.9	1123	131	11.9	30.56	8.3	\$0.41 / gal	\$978
Natural Gas	Indust. Boiler	—	1,051	Btu/cf	—	0.0337 lb/cf	—	—	0.314 mmcf	0.94	† 0.19	44	11	19.39	5.3	\$4.05 / mcf	\$1,272
	Comm. Boiler	—	1,051	Btu/cf	—	0.0337 lb/cf	—	—	0.314 mmcf	0.94	† 0.19	31	6.3	19.40	5.3		

Source: Air Pollutant Emission Factors (Document AP-42), U.S. Environmental Protection Agency.

† Note: SOx emissions for natural gas are based on "average" sulfur content of 0.2 grains per CCF. Specification limits, and Sox emissions, could be several orders of magnitude larger.

** Estimated Cost.

Units: ton = U.S. short ton = 0.91 metric ton

cf = cubic foot

mcf = thousand cubic feet

mmcf = million cubic feet

Steam Loss Comparison For Various Operating Conditions and Orifice Sizes								
Drip & Tracer Traps				Base	Process Traps			
Pres. psig	Orifice Size, in.	Steam Loss			Pres. psig	Orifice Size, in.	Steam Loss	
		lb/hr	Ratio				lb/hr	Ratio
150	5/64"	27	1.0	30	1/8	12.0	0.45	
150	No. 38	42	1.54	30	1/4	48	1.79	
150	1/8	69	2.56	30	1/2	192	7.15	
300	5/64"	51	1.91	125	1/8	38	1.40	
300	No. 38	79	2.95	125	1/4	150	5.58	
300	1/8	132	4.89	125	1/2	602	22.3	

The chart above gives the pollutants generated because of the extra steam required due to a blow-through failure. The steam loss calculation allows for the expected amount of condensate going through the orifice, and gives only the live steam loss, not the steam normally condensed by the application. The pollutants generated will depend upon the actual fuel analysis, which can vary widely. The actual release to the atmosphere will also depend upon the pollution control equipment installed.

The chart at the left shows live steam loss for a variety of trap orifice sizes and operating conditions. Use the "steam loss ratio" as a multiplier with the pollution data above to find the impact of failure for other sizes of traps.

Key:	
HHV	High Heating Value
LHV	Low Heating Value
S	Sulfur
C	Carbon
H	Hydrogen
Total C	Weight of Carbon emissions to atmosphere
P.M.	Particulate Matter
SOx	Sulfur Oxides
NOx	Nitrogen Oxides
CO	Carbon Monoxide
CO ₂	Carbon Dioxide

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	Bituminous Coal											Sub-Bituminous Coal								
	Pres. psig	Orifice Size, in.	Steam Loss lb/hr	Fuel Used		*Pollutants Generated						Fuel Used		*Pollutants Generated						
				tons/yr	\$/yr	P.M. lb/yr	SOx, lb/yr	NOx, lb/yr	CO, lb/yr	CO2, lb/yr	Total C, ton/yr	tons/yr	\$/yr	P.M. lb/yr	SOx, lb/yr	NOx, lb/yr	CO, lb/yr	CO2, lb/yr	Total C, ton/yr	
Process Traps	30	1/8	12	5.3	\$304	325	208	112	3.2	16.1	4.4	7.1	\$314	429	350	100	36	15.7	4.3	
	30	1/4	48	21	\$1,217	1302	832	448	12.8	63.8	17.4	29	\$1,257	1715	1400	400	143	63.3	17.3	
	30	1/2	192	85	\$4,866	5208	3330	1793	51.2	255.5	69.7	114	\$5,029	6858	5601	1600	572	252.6	69	
	125	1/8	38	17.0	\$968	1036	663	357	10.2	51.0	13.9	23	\$1,001	1365	1115	319	114	50.1	13.7	
	125	1/4	150	68.0	\$3,874	4145	2650	1427	41	201.6	55	91	\$4,005	5462	4460	1274	455	201.3	55	
	125	1/2	602	271.8	\$15,494	16581	10601	5708	163	813.9	222	364	\$16,021	21846	17841	5097	1821	805.2	220	
Drip & Tracer Traps	150	5/64	27	11.9	\$679	727	465	250	7.2	35.6	9.7	16.4	\$719	981	801	229	82	36.2	9.9	
	150	No. 38	42	18.4	\$1,047	1121	717	386	11.0	55.0	15.0	25	\$1,109	1512	1235	353	126	55.6	15.2	
	150	1/8	69	31	\$1,739	1861	1190	641	18	91.7	25	42	\$1,842	2511	2051	586	209	91.5	25	
	300	5/64	51	23	\$1,307	1398	894	481	13.8	69.7	19	31	\$1,384	1887	1541	440	157	69.5	19	
	300	No. 38	79	35	\$2,014	2156	1378	742	21	106.3	29	48	\$2,133	2909	2375	679	242	106.1	29	
	300	1/8	132	59	\$3,345	3580	2289	1232	35	176.0	48	81	\$3,542	4830	3945	1127	403	179.4	49	

These charts give worked-out pollution generated data for a variety of orifice sizes and operating conditions. The fuel properties and costs are taken from the chart on the opposite side.

	Distillate Oil											Residual Oil							Natural Gas								
	Pres. psig	Orifice Size, in.	Steam Loss lb/hr	Fuel Used		*Pollutants Generated						Fuel Used		*Pollutants Generated					Fuel Used		*† Pollutants Generated						
				gal/yr	\$/yr	P.M. lb/yr	SOx, lb/yr	NOx, lb/yr	CO, lb/yr	CO2, lb/yr	Total C, ton/yr	gal/yr	\$/yr	P.M. lb/yr	SOx, lb/yr	NOx, lb/yr	CO, lb/yr	CO2, lb/yr	Total C, ton/yr	CCF/yr	\$/yr	P.M. lb/yr	SOx, lb/yr	NOx, lb/yr	CO, lb/yr	CO2, lb/yr	Total C, ton/yr
Process Traps	30	1/8	12	1106	\$608	2.2	157	22	5.5	12.5	3.4	1042	\$427	10.4	491	57	5.2	13.2	3.6	1372	\$556	0.41	0.08	19	4.8	8.4	2.3
	30	1/4	48	4423	\$2,433	8.8	628	88	22	50.2	13.7	4169	\$1,709	41.7	1964	229	21	52.8	14.4	5489	\$2,223	1.65	0.33	17	19	33.7	9.2
	30	1/2	192	17691	\$9,730	35	2512	354	88	201.6	55	16675	\$6,837	167	7854	917	83	212.6	58	21955	\$8,892	6.59	1.32	307	77	135.6	37
	125	1/8	38	3522	\$1,937	7.0	500	70	17.6	40.0	10.9	3320	\$1,361	33	1564	183	16.6	42.2	11.5	4371	\$1,770	1.31	0.26	61	15	27.1	7.4
	125	1/4	150	14089	\$7,749	28	2001	282	70	161.3	44	13280	\$5,445	133	6255	730	66	168.6	46	17484	\$7,081	5.25	1.05	245	61	106.3	29
125	1/2	602	56355	\$30,995	113	8002	1127	282	641.4	175	53118	\$21,778	531	25019	2922	266	674.5	184	69938	\$28,325	21.0	4.20	979	245	432.5	118	
Drip & Tracer Traps	150	5/64	27	2531	\$1,392	5.1	359	51	12.7	29	7.9	2385	\$978	23.9	1123	131	11.9	30.4	8.3	3141	\$1,272	0.94	0.19	44	11.0	19.4	5.3
	150	No. 38	42	3901	\$2,146	7.8	554	78	20	44.4	12.1	3677	\$1,508	36.8	1732	202	18	46.6	12.7	4841	\$1,961	1.45	0.29	68	17	30.1	8.2
	150	1/8	69	6478	\$3,563	13.0	920	130	32	73.7	20.1	6106	\$2,504	61.1	2876	336	31	77.7	21.2	8040	\$3,256	2.41	0.48	113	28	49.5	13.5
	300	5/64	51	4867	\$2,677	9.7	691	97	24	55.3	15.1	4588	\$1,881	46	2161	252	23	58.3	15.9	6040	\$2,446	1.81	0.36	85	21	37.4	10.2
	300	No. 38	79	7503	\$4,127	15	1065	150	38	84.3	23	7072	\$2,900	71	3331	389	35	91.6	25	9312	\$3,771	2.79	0.56	130	33	58.6	16
300	1/8	132	12460	\$6,853	25	1769	249	62	143.0	39	11745	\$4,815	117	5532	646	59	150.3	41	15464	\$6,263	4.64	0.93	216	54	95.3	26	

* Source: Air Pollutant Emission Factors (Document AP-42), U.S. Environmental Protection Agency.

† Note: SOx emissions for natural gas are based on "average" sulfur content of 0.2 grains per CCF. Specification limits, and Sox emissions, could be several orders of magnitude larger.