Chart No. M-1131

Armstrong

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

Typical drip/tracer trap: 5/64" orifice, 10 bar inlet, 0 bar outlet, live steam loss of 11.8 kg/hr, operating 8400 hours per year.

Fuel Properties and Usage										Pollutants Generated				
Type	Firing Method	Heating Value			Analysis				Quantity Used per Year	P.M., kg/yr	SOx, kg/yr	NOx, kg/yr	CO, kg/yr	Total C, ton/yr
		HHV	LHV	Units	S	C	H	Ash						
Bituminous Coal	Pulv., dry btm	33.3	32.2	MJ/kg	1.0%	81.6%	5.0%	6.1%	10.5 tons	319	204	110	.1	8.5
	Pulv., wet btm	33.3	32.2	MJ/kg	1.0%	81.6%	5.0%	6.1%	10.5 tons	224	204	178	3.1	8.5
	Spreader St	33.3	32.2	MJ/kg	1.0%	81.6%	5.0%	6.1%	10.5 tons	314	204	73	26	8.5
	Overfeed St	33.3	32.2	MJ/kg	1.0%	81.6%	5.0%	6.1%	10.5 tons	84	204	39	31	8.5
Sub-Bituminous Coal	Pulv., dry btm	24.8	23.5	MJ/kg	1.4%	60.4%	6.0%	3.6%	14.4 tons	259	352	151	4.3	8.7
	Pulv., wet btm	24.8	23.5	MJ/kg	1.4%	60.4%	6.0%	3.6%	14.4 tons	181	352	244	4.3	8.7
	Spreader St	24.8	23.5	MJlkg	1.4%	60.4%	6.0%	3.6%	14.4 tons	431	352	101	36	8.7
	Overfeed St	24.8	23.5	MJ/kg	1.4%	60.4%	6.0%	3.6%	14.4 tons	115	352	54	3	8.7
	Hand fired	24.8	23.5	MJ/kg	1.4%	60.4%	6.0%	3.6%	14.4 tons	108	312	22	646	8.7
Distillate #2 Oil	Industrial or Comm. Boiler	45.2	42.5	MJ/kg	1.0%	87.2%	12.9%	–	7,926 kg	2.22	158	22	5.6	6.9
Residual #5 Oil	Industrial or Comm. Boiler	43.1	40.8	MJ/kg	3.0%	87.9%	11.3%	–	8,268 kg	10.5	493	58	5.2	7.3
Natural Gas**	Indust. Boiler	–	39.1	MJ/m³	–	0.540 Kg/m3		–	8612m³	0.41	† 0.08	19.3	4.8	4.6
	Comm. Boiler	–	39.1	MJ/m³	–	0.540 Kg/m3		–	8612m³	0.41	† 0.08	13.8	2.8	4.6

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 hundred cubic feet. Specification limits, and SOx emissions, could be several orders of magnitude larger.

**Energy of natural gas shown is equivalent to 10.87 KW-hr/m³

Steam Comparison For Various Operating Conditions and Orifice Sizes

Drip & Tracer Traps					Process Traps			
Press bar	Orifice size in.	Steam Loss kg/hr	Steam Loss Ratio		Press bar	Orifice size, in.	Steam Loss kg/hr	Steam Loss Ratio
10	**5/64**	**11.8**	**1.0**	(Base)	2	l/8	5.3	0.5
10	No.38	20	1.7		2	l/4	21	1.8
10	l/8	30	2.6		2	l/2	85	7.2
20	5/64	23	1.9		8	l/8	16	1.3
20	No. 38	38	3.2		8	l/4	64	5.4
20	l/8	58	4.9		8	l/2	255	21.5

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 losses 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

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

			Steam Loss	Bituminous Coal						Sub-bituminous Coal					
				Fuel Used	*Pollutants Generated					Fuel Used	*Pollutants Generated				
	Press bar	Orifice size, in.	kg/hr	tons/yr	P.M., kg/yr	SOx, kg/yr	NOx, kg/yr	CO, kg/yr	Total C, ton/yr	tons/yr	P.M., kg/yr	SOx, kg/yr	NOx, kg/yr	CO, kg/yr	Total C, ton/yr
Process Traps	2	1/8	5	5	144	92	50	1.4	3.9	6.3	190	155	44	15.8	3.8
	2	1/4	21	19	577	369	199	5.7	15.4	25	760	621	177	63	15.3
	2	1/2	85	76	2309	1476	795	23	62	101	3041	2483	709	253	61
	8	1/8	16	14	440	281	151	4.3	11.8	19	579	473	135	48	11.7
	8	1/4	64	58	1759	1125	606	17	47	77	2317	1892	541	193	47
	8	1/2	255	231	7035	4498	2422	69	188	309	9269	7570	2163	772	187
Drip & Tracer Traps	10	5/64	12	10	319	204	110	3.1	8.5	14.4	431	352	101	36	8.7
	10	No. 38	20	18	539	345	186	5.3	14.4	24	728	594	170	61	14.6
	10	1/8	30	27	818	523	282	8.0	22	37	1103	901	257	92	22
	20	5/64	23	20	614	393	211	6.0	16.4	28	829	677	193	69	17
	20	No. 38	38	34	1036	663	357	10.2	28	47	1398	1142	326	117	28
	20	1/8	58	52	1572	1005	541	15.5	42	71	2121	1732	495	177	43

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

			Steam Loss	Distillate Oil						Residual Oil						Natural Gas					
				Fuel Used	* Pollutants Generated					Fuel Used	* Pollutants Generated					Fuel Used	*† Pollutants Generated				
	Press bar	Orifice size, in.	kg/hr	ton/yr	P.M., kg/yr	SOx, kg/yr	NOx, kg/yr	CO, kg/yr	Total C, ton,yr	ton/yr	P.M., kg/yr	SOx, kg/yr	NOx, kg/yr	CO, kg/yr	Total C, ton,yr	m^3/yr	P.M., kg/yr	SOx, kg/yr	NOx, kg/yr	CO, kg/yr	Total C, ton,yr
Process Traps	2	1/8	5.3	3.5	1.0	70	10	2.5	3.0	3.6	15.2	218	25	2.3	3.2	3799	0.2	0.04	9	2.1	2.1
	2	1/4	21	14	3.9	278	39	9.8	12.2	14.6	61	871	102	9.2	12.8	15195	0.7	0.15	34	8.5	8.2
	2	1/2	85	56	15.7	1114	157	39	49	58	244	3482	407	37	51	60780	2.9	0.58	136	34	33
	8	1/8	16	10.7	3.0	212	30	7.5	9.3	11.1	46	663	77	7.0	9.8	11580	0.6	0.11	26	6.5	6.3
	8	1/4	64	43	12.0	849	120	30	37	44	186	2654	310	28	39	46321	2.2	0.45	104	26	25
	8	1/2	255	170	48	3395	478	120	149	178	744	10615	1240	113	156	185284	8.9	1.78	415	104	100
Drip & Tracer Traps	10	5/64	11.8	7.9	2.2	158	22	5.6	6.9	8.3	10.5	493	58	5.2	7.3	8616	0.4	0.08	19	4.8	4.7
	10	No.38	20	13	3.8	266	38	9.4	11.7	14.0	58	833	97	8.8	12.3	14542	0.7	0.14	33	8.2	7.8
	10	1/8	30	20	5.7	404	57	14.2	17.7	21	89	1264	148	13.4	19	22056	1.1	0.21	49	12.4	11.9
	20	5/64	23	15	4.3	303	43	10.7	13.3	16	66	949	111	10.1	14.0	16561	0.8	0.16	37	9.3	8.9
	20	No.38	38	26	7.2	512	72	18	22	27	112	1602	187	17	24	27954	1.3	0.27	63	15.7	15.1
	20	1/8	58	39	10.9	777	109	27	34	41	170	2429	284	26	36	42397	2.0	0.41	95	24	23

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

† Note: SOx emissions are based on "average" sulfur content of 0.2 grains per hundred cubic feet. Specification limits, and SOx emissions, could be several orders of magnitude larger,

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