APPENDIX C-2. MANUFACTURER COST DATA FOR RESIDENTIAL ELECTRIC AND GAS-FIRED WATER HEATERS

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APPENDIX C-2. MANUFACTURER COST DATA FOR RESIDENTIAL ELECTRIC AND GAS-FIRED WATER HEATERS

This Appendix contains the manufacturer cost data for residential electric and gas-fired water heaters provided to the U.S. Department of Energy by the Gas Appliance Manufacturer Association (GAMA) on October 20, 1998, for use in the rulemaking process to amend the federal efficiency standards for such products.

C-2.1 INTRODUCTION

The cost data supplied by GAMA were a primary source for the data used in the Engineering and the Life-Cycle Cost analyses. GAMA collected cost data directly from the major manufacturers of electric and gas-fired water heaters. (No data were supplied for oil-fired or LPG water heaters, which are also covered in this analysis.) The GAMA data provided estimates of the manufacturer cost for the existing typical baseline models and the design options. Before providing the data to DOE, they were aggregated to protect the confidentiality of the individual manufacturers. Note that cost was provided for typical size 50-gal electric and 40-gal gas-fired water heaters only.

C.2.2 DATA FORMAT

The data were provided in a format developed by the Arthur D. Little Company to reflect the ordering of the design options used in the analysis. GAMA used the term "level" to indicate the ordering sequence of the design options. The following table shows the GAMA "levels" as they were provided with the data.

GAMA Level	Electric Water Heaters	Gas-Fired Water Heaters
1	Baseline	Baseline
2	Heat Traps	Heat Traps
3	2" Improved Insulation	2" Improved Insulation
4	2.5" Improved Insulation*	Flue Damper (electro-mechanical)
5	Plastic Tank*	Improved Flue Baffle
6	Insulated Bottom Tank	Electric Ignition (IID)
7		Side Arm Heater*
8		Improved Combustion Chamber

*Note that because of insufficient data, GAMA did not provide data for three of the design options being considered: 2.5" Improved Insulation, Plastic Tank, and Side Arm Heater.

Separate data were provided for variable, fixed, and total manufacturing cost of baseline electric and gas-fired water heaters and of design options. The variable cost represents materials, labor, overhead, and transportation; the fixed cost is the capital and product design cost on a per unit basis; and the total cost is the sum of the variable and the fixed manufacturing costs.

C-2.2 DATA TABLES

The GAMA data are presented in Tables C-2.1 through C-2.6. The following is a list of the tables containing the cumulative frequency distribution of manufacturing costs provided by GAMA. The values reflect the results of 10,000 random samples from the aggregate distributions of manufacturing cost provided to GAMA by the water heater manufacturers.

Table C-2.1 - Electric Water Heaters Cumulative Variable Cost
Table C-2.2 - Electric Water Heaters Cumulative Fixed Cost
Table C-2.3 - Electric Water Heaters Cumulative Total Cost
Table C-2.4 - Gas-Fired Water Heaters Cumulative Variable Cost
Table C-2.5 - Gas-Fired Water Heaters Cumulative Fixed Cost
Table C-2.6 - Gas-Fired Water Heaters Cumulative Total Cost

In addition, GAMA provided average values for the design option components of the variable and the fixed costs. These data are shown in Tables C-2.7 and C-2.8.

Table C-2.1 GAMA Manufacturing Cost: Cumulative Variable Cost – Electric Water Heaters (50-gal)

Lvl	Design Options	Variable Costs Percentiles										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
		$	$	$	$	$	$	$	$	$	$	$
1	Baseline	87.49	96.18	100.76	110.97	114.26	121.04	129.36	130.62	147.50	152.68	163.50
2	Heat Traps	91.08	100.15	104.74	117.12	120.36	127.99	131.26	132.56	150.02	155.37	166.54
3	2" Improved Insulation	105.20	115.30	120.83	130.19	133.91	140.23	147.99	151.70	154.77	158.97	169.24
4	2.5" Improved Insulation	0. 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Plastic Tank	0. 00	0. 00	0. 00	0. 00	0. 00	0. 00	0. 00	0. 00	0. 00	0. 00	0. 00
8	Insulated Bottom Tank	131.90	134.81	136.63	138.68	141.44	147.28	155.54	158.18	160.93	164.43	172.93

Table C-2.2 GAMA Manufacturing Cost: Cumulative Fixed Cost – Electric Water Heaters (50-gal)

Lvl	Design Options	Fixed Cost Percentiles										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
		$	$	$	$	$	$	$	$	$	$	$
1	Baseline	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.01
2	Heat Traps	0.12	0.12	0.12	0.23	0.24	0.27	0.47	0.50	0.70	0.71	0.72
3	2" Improved Insulation	0.24	0.24	0.24	0.44	0.49	0.60	0.64	0.68	16.14	17.18	19.55
4	2.5" Improved Insulation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Plastic Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Insulated Bottom Tank	2.53	2.66	2.73	2.81	2.93	3.17	3.90	3.95	4.01	4.09	4.27

Table C-2.3 GAMA Manufacturing Cost: Cumulative Total Cost – Electric Water Heaters (50-gal)

Lvl	Design Options	Total Cost Percentiles										
		0% $	10% $	20% $	30% $	40% $	50% $	60% $	70% $	80% $	90% $	100% $
1	Baseline	88.49	97.19	101.76	111.98	115.26	122.04	130.36	131.62	148.50	153.68	164.49
2	Heat Traps	91.57	100.64	105.22	117.37	120.60	128.23	131.97	133.27	150.14	155.49	166.66
3	2" Improved Insulation	105.63	115.78	121.32	130.84	134.56	142.34	153.80	158.83	163.61	169.59	187.41
4	2.5" Improved Insulation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	Plastic Tank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Insulated Bottom Tank	134.54	137.59	139.44	141.48	144.21	150.10	159.56	162.14	164.92	168.41	176.95

Table C-2.4 GAMA Manufacturing Cost: Cumulative Variable Cost – Gas-Fired Water Heaters (40-gal)

Lvl	Design Options	Variable Costs Percentiles										
		0% $	10% $	20% $	30% $	40% $	50% $	60% $	70% $	80% $	90% $	100% $
1	Baseline	106.24	116.60	122.27	128.52	131.02	133.43	136.03	140.08	147.93	154.92	168.39
2	Heat Traps	109.83	120.22	125.64	131.51	133.95	136.38	139.07	142.75	151.01	158.36	171.92
3	2" Improved Insulation	113.61	124.39	130.70	141.66	148.41	152.13	154.87	158.22	162.83	169.31	184.15
4	Flue Damper (electro-mechanical)	193.57	200.39	207.18	224.28	232.66	238.32	243.50	251.05	282.22	296.77	321.98
5	Improved Flue Baffle	114.44	125.24	129.48	131.63	133.73	136.10	139.17	144.52	155.58	163.28	176.31
6	Electric Ignition (IID)	147.94	162.11	168.41	171.42	175.36	182.19	193.48	202.44	231.75	242.90	263.57
7	Side Arm Heater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Improved Combustion Chamber	173.59	195.64	202.66	208.11	213.43	220.87	241.99	278.95	284.13	290.92	307.37

Table C-2.5 GAMA Manufacturing Cost: Cumulative Fixed Cost – Gas-Fired Water Heaters (40-gal)

Lvl	Design Options	Fixed Cost Percentiles										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
		$	$	$	$	$	$	$	$	$	$	$
1	Baseline	0.99	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.01	1.01
2	Heat Traps	0.01	0.01	0.01	0.12	0.13	0.14	0.28	0.29	0.36	0.38	0.42
3	2" Improved Insulation	0.01	0.01	0.01	0.26	0.29	0.32	0.34	0.36	4.98	5.23	5.68
4	Flue Damper (electro-mechanical)	0.19	0.21	0.22	0.51	0.54	0.61	5.54	5.80	14.96	15.73	17.10
5	Improved Flue Baffle	0.15	0.21	0.22	0.24	0.29	0.40	0.95	1.00	9.72	10.21	11.08
6	Electric Ignition (IID)	0.12	0.13	0.13	0.16	0.16	0.76	0.81	0.87	12.58	13.24	14.38
7	Side Arm Heater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Improved Combustion Chamber	1.40	1.49	1.56	1.65	2.04	2.11	2.19	3.40	4.62	5.43	7.29

Table C-2.6 GAMA Manufacturing Cost: Cumulative Total Cost – Gas-Fired Water Heaters (40-gal)

Lvl	Design Options	Total Cost Percentiles										
		0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
		$	$	$	$	$	$	$	$	$	$	$
1	Baseline	107.25	117.60	123.27	129.52	132.03	134.43	137.03	141.08	148.93	155.92	169.39
2	Heat Traps	110.12	120.51	125.94	131.72	134.14	136.60	139.31	142.93	151.02	158.37	171.93
3	2" Improved Insulation	113.87	124.67	130.96	146.78	151.53	153.91	156.45	159.40	163.28	169.32	184.16
4	Flue Damper (electro-mechanical)	193.76	200.59	207.39	226.89	235.75	241.23	246.94	254.54	297.98	312.38	337.75
5	Improved Flue Baffle	114.66	125.53	130.01	132.44	135.32	139.94	147.91	152.84	158.19	164.24	177.27
6	Electric Ignition (IID)	148.10	162.27	168.97	172.04	176.01	182.81	193.60	202.57	244.81	256.05	277.17
7	Side Arm Heater	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Improved Combustion Chamber	178.69	198.93	205.60	210.78	216.35	224.25	247.09	280.57	285.73	292.44	309.00

Table C-2.7 Average Design Option Component Costs – Electric Water Heaters

		Variable Costs					Fixed Costs	
		Material	Labor	Transportation	Overhead	Total	Capital	Product Design
		$	$	$	$	$	$	$
	DOE Design Options	$/Unit	$/Unit	$/Unit	$/Unit	$/Unit	$/Million	$/Million
1	Baseline	62.16	10.57	10.11	38.89	121.73	–	–
2	Heat Traps	64.75	10.76	10.11	39.71	125.33	0.15	0.24
3	2" Improved Insulation	70.39	11.07	11.55	41.15	134.16	3.56	1.47
4	2.5" Improved Insulation	–	–	–	–	–	–	–
5	Plastic Tank	–	–	–	–	–	–	–
6	Insulated Tank Bottom	–	–	–	–	–	–	–

Table C-2.8 Average Design Option Component Costs – Gas-Fired Water Heaters

		Variable Costs					Fixed Costs	
		Material	Labor	Transportation	Overhead	Total	Capital	Product Design
		$	$	$	$	$	$	$
	DOE Design Options	$/Unit	$/Unit	$/Unit	$/Unit	$/Unit	$/Million	$/Million
1	Baseline	75.02	10.74	9.67	38.35	133.78	–	–
2	Heat Traps	77.77	10.9	9.67	38.54	136.88	0.07	0.13
3	2" Improved Insulation	83.53	11.33	12.23	40.75	147.84	0.85	0.59
4	2.5" Improved Insulation							
5	Plastic Tank							
6	Improved Flue Baffle	75.99	11.99	9.67	39.73	137.38	1.17	1.72
7	Multiple Flues	–	–	–	–	–		
8	Improved Combustion Chamber	134.24	21.68	10.82	61.88	228.62	1.42	1.4
9	Submerged Combustion Chamber							
10	Flue Damper (electro-mechanical)	160.07	14.03	16.84	47.84	238.78	3.45	2.03
11	Side Arm Heater							
12	Two-Phase Thermosiphon							
13	IID	118.8	13.34	14.51	45.9	192.55	2.09	1.47