
CONTENTS

Warnings and Cautionary Statements	2
Comparisons of Fuel Prices and Operating Costs	3
Estimated Annual Cost of Operation; Oil-Fired Units	4
Estimated Annual Cost of Operation; Gas Units and Electrical Units	5
General Information	6
Oil-Fired Water Heater Installation, Pipe Sizes, Alternatives	7
Piping Fuel Lines for Bock Oil-fired Water Heaters	9
Gas-Fired Water Heater Installation	11
Indirect Water Heater Installation	12
Sizing:	
Boiler and Circulator Sizing	12
General Sizing Formula, Sizing for BTUH Input	14
Indirect Water Heater Applications	14
Multiple Dwelling Buildings	15
Expansion Tank Sizing	16
Hair Salons, Barber Shops, Car Washes, Places of Worship, Schools	17
Industrial Plants, Dairy Barns, Care Centers, Dorms, Office Buildings, Clubs	19
Hot Water Requirements for Fixtures and Machines	20
Shower Head Availability	21
Food Service Establishments	22
Machine Dishwasher Requirements	23
Self-Service and Commercial Laundries, Swimming Pools, Hot Tubs, Baptistries	26
Venting:	
Venting the Water Heater, Types of Venting, Individual Vents	28
The Common Vent	29
Combustion/Ventilation Air, Balanced Combustion System, Insufficient or Excessive Draft	30
Barometric Draft Controls, Power Vent Selection – Tjernlund Products	31
Power Vent Selection – Field Controls, Draft Inducer	32
Installation and Hookups:	
Specialized Installation Hookups	33
Indirect Installation	34
System Plus Installation	36
Radiant Heating	37
Combined Appliance Sizing	38
Multiple Hookups: Parallel, Series, Isolating, Reverse Storage Tank.....	38
Isolating Series, Reverse Storage Tank System Hookups.....	40
Weights, Measures, Metric Conversions	42
Tables:	
Vent Tables.....	43
Indirect, Oil, Gas Performance Tables	55
Measuring Combustion Efficiency Using Oxygen (O^2).....	74
Glossary of Terms	75

WARNINGS AND CAUTIONARY STATEMENTS

Warning!

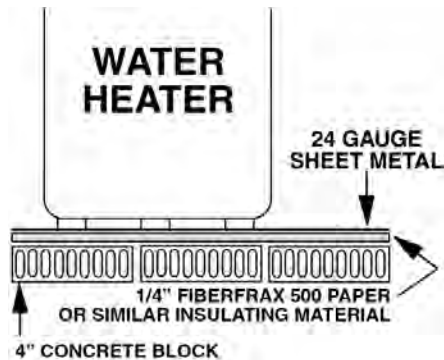
Improper installation, adjustment, alteration, service or maintenance can cause severe property damage and personal injury or death. Refer to instruction manuals for recommended procedures. For assistance or additional information, consult a qualified installer, service agency or the water heater supplier.

For your information

A program of regular maintenance should be established to keep the heater operating at peak efficiency with maximum safety and to extend the life of the unit. Refer to the instruction manual supplied with the heater and consult the supplier or a qualified service agency for a recommended maintenance program.

Warning!

Do not install the heater on combustible flooring. Fire may result, causing severe property damage and personal injury or death. Install in accordance with all local codes. In the absence of local codes, refer to National Fuel Gas Code ANSI Z223.1-1999 or to NFPA 31: "Installation of Oil Burning Equipment."



In Canada, installation must be in accordance with Standard CAN 1-B149.1 or .2: "Installation Codes for Gas Burning Appliances and Equipment," and/or local codes.

Code compliance is the sole responsibility of the installing contractor.

Important: All flooring must have adequate support.

Warning!

Do not store or use gasoline or other flammable liquids and vapors near this heater or any other appliance. Fire or explosion can result, causing severe property damage and personal injury or death. Chlorine may produce a poisonous gas and may ignite other combustible materials. As a vapor, it may cause the steel heater jacket to become compromised (as a liquid, chlorine has no effect on the interior of the Bock *Coglass*-lined tanks).

Warning!

Do not install or operate a water heater if any part has been under water. Electrical shock or short circuit can

result, causing severe property damage and personal injury or death. Immediately contact a qualified service technician to inspect the entire unit and to replace any part of the control system that has been under water.

Caution:

When a water heater is installed in a closed system, such as with a backflow preventer installed on the cold water inlet, excessive pressure can build up, resulting in a tank rupture causing severe property damage and personal injury or death. An expansion tank must be installed to relieve excessive pressure buildup in the heater tank. Contact a local water supplier or plumbing inspector to correct the situation.

Warning!

Natural gas leaks can result in an explosion causing severe property damage and personal injury or death. If the smell of gas is noticeable do the following:

- ✓ Do not try to light any appliance.
- ✓ Do not touch any electrical switch. Do not plug in or unplug any electrical appliance.
- ✓ Do not use the telephone in the building.
- ✓ Immediately contact the gas supplier from a neighbor's telephone and follow the supplier's instructions.
- ✓ If the supplier cannot be reached, call the fire department!

Caution:

The highest recommended temperature setting for normal residential use is 120°F. The dial on the aquastat does not always reflect the outgoing water temperature and it could occasionally exceed 120°F. Variation in outgoing temperature could be based on factors including but not limited to usage patterns and type of installation. Test the water at the tap nearest the water heater.

Danger!

Hotter water increases the risk of severe scald injury or death. Before changing temperature settings, refer to the instruction manual. Temperatures at which injury occurs vary with the person's age and length of exposure. The slower reaction time of children, the elderly or physically or mentally challenged persons increases the scalding hazard to them. It is recommended that lower water temperatures be used where these exposure hazards exist. To produce less than 120°F, use point-of-use temperature limiting devices.

Warning!

Water heater blankets may restrict air flow to the heater and cause fire, asphyxiation, personal injury or death and should not be used on Bock products.

TABLE 1

COMPARISONS OF FUEL PRICES AND OPERATING COSTS

COST PER THERM	FUEL OIL PER GAL.	ELECT. PER KWH	LP PER GAL.	LP PER LB.	NAT. GAS PER THERM	Operating cost for 2000 gal. hot water per month (normal residential use – 90°F rise)			
						FUEL OIL	ELECT.	LP	NAT. GAS
0.600	0.832	0.020	0.548	0.129	0.600	\$13.84	\$10.34	\$15.78	\$13.84
0.650	0.902	0.022	0.594	0.140	0.650	\$14.99	\$11.20	\$17.10	\$14.99
0.700	0.971	0.024	0.639	0.150	0.700	\$16.15	\$12.06	\$18.41	\$16.15
0.750	1.040	0.026	0.685	0.161	0.750	\$17.30	\$12.93	\$19.73	\$17.30
0.800	1.110	0.027	0.731	0.172	0.800	\$18.45	\$13.79	\$21.04	\$18.45
0.850	1.179	0.029	0.776	0.182	0.850	\$19.61	\$14.65	\$22.36	\$19.61
0.900	1.248	0.031	0.822	0.193	0.900	\$20.76	\$15.51	\$23.67	\$20.76
0.950	1.318	0.032	0.868	0.204	0.950	\$21.91	\$16.37	\$24.99	\$21.91
1.000	1.387	0.034	0.913	0.215	1.000	\$23.07	\$17.23	\$26.31	\$23.07
1.050	1.456	0.036	0.959	0.225	1.050	\$24.22	\$18.10	\$27.62	\$24.22
1.100	1.526	0.038	1.005	0.236	1.100	\$25.37	\$18.96	\$28.94	\$25.37
1.150	1.595	0.039	1.050	0.247	1.150	\$26.53	\$19.82	\$30.25	\$26.53
1.200	1.664	0.041	1.096	0.258	1.200	\$27.68	\$20.68	\$31.57	\$27.68
1.250	1.734	0.043	1.142	0.268	1.250	\$28.83	\$21.54	\$32.88	\$28.83
1.300	1.803	0.044	1.187	0.279	1.300	\$29.99	\$22.40	\$34.20	\$29.99
1.350	1.872	0.046	1.233	0.290	1.350	\$31.14	\$23.27	\$35.51	\$31.14
1.400	1.942	0.048	1.279	0.300	1.400	\$32.29	\$24.13	\$36.83	\$32.29
1.450	2.011	0.049	1.324	0.311	1.450	\$33.45	\$24.99	\$38.14	\$33.45
1.500	2.081	0.051	1.370	0.322	1.500	\$34.60	\$25.85	\$39.46	\$34.60
1.550	2.150	0.053	1.416	0.333	1.550	\$35.75	\$26.71	\$40.77	\$35.75
1.600	2.219	0.055	1.461	0.343	1.600	\$36.91	\$27.58	\$42.09	\$36.91
1.650	2.289	0.056	1.507	0.354	1.650	\$38.06	\$28.44	\$43.40	\$38.06
1.700	2.358	0.058	1.553	0.365	1.700	\$39.22	\$29.30	\$44.72	\$39.22
1.750	2.427	0.060	1.598	0.376	1.750	\$40.37	\$30.16	\$46.03	\$40.37
1.800	2.497	0.061	1.644	0.386	1.800	\$41.52	\$31.02	\$47.35	\$41.52
1.850	2.566	0.063	1.690	0.397	1.850	\$42.68	\$31.88	\$48.66	\$42.68
1.900	2.635	0.065	1.735	0.408	1.900	\$43.83	\$32.75	\$49.98	\$43.83
1.950	2.705	0.067	1.781	0.419	1.950	\$44.98	\$33.61	\$51.30	\$44.98
2.000	2.774	0.068	1.827	0.429	2.000	\$46.14	\$34.47	\$52.61	\$46.14
2.050	2.843	0.070	1.872	0.440	2.050	\$47.29	\$35.33	\$53.93	\$47.29
2.100	2.913	0.072	1.918	0.451	2.100	\$48.44	\$36.19	\$55.24	\$48.44
2.150	2.982	0.073	1.964	0.461	2.150	\$49.60	\$37.05	\$56.56	\$49.60
2.200	3.051	0.075	2.009	0.472	2.200	\$50.75	\$37.92	\$57.87	\$50.75
2.250	3.121	0.077	2.055	0.483	2.250	\$51.90	\$38.78	\$59.19	\$51.90
2.300	3.190	0.078	2.101	0.494	2.300	\$53.06	\$39.64	\$60.50	\$53.06
2.350	3.259	0.080	2.146	0.504	2.350	\$54.21	\$40.50	\$61.82	\$54.21
2.400	3.329	0.082	2.192	0.515	2.400	\$55.36	\$41.36	\$63.13	\$55.36
2.450	3.398	0.084	2.238	0.526	2.450	\$56.52	\$42.22	\$64.45	\$56.52
2.500	3.467	0.085	2.283	0.537	2.500	\$57.67	\$43.09	\$65.76	\$57.67
2.550	3.537	0.087	2.329	0.547	2.550	\$58.82	\$43.95	\$67.08	\$58.82
2.600	3.606	0.089	2.375	0.558	2.600	\$59.98	\$44.81	\$68.39	\$59.98
2.650	3.676	0.090	2.420	0.569	2.650	\$61.13	\$45.67	\$69.71	\$61.13
2.700	3.745	0.092	2.466	0.580	2.700	\$62.28	\$46.53	\$71.02	\$62.28
2.750	3.814	0.094	2.512	0.590	2.750	\$63.44	\$47.39	\$72.34	\$63.44
2.800	3.884	0.096	2.557	0.601	2.800	\$64.59	\$48.26	\$73.65	\$64.59
2.850	3.953	0.097	2.603	0.612	2.850	\$65.74	\$49.12	\$74.97	\$65.74
2.900	4.022	0.099	2.649	0.622	2.900	\$66.90	\$49.98	\$76.29	\$66.90
2.950	4.092	0.101	2.694	0.633	2.950	\$68.05	\$50.84	\$77.60	\$68.05
3.000	4.161	0.102	2.740	0.644	3.000	\$69.20	\$51.70	\$78.92	\$69.20
3.050	4.230	0.104	2.786	0.655	3.050	\$70.36	\$52.57	\$80.23	\$70.36
3.100	4.300	0.106	2.831	0.665	3.100	\$71.51	\$53.43	\$81.55	\$71.51
3.150	4.369	0.107	2.877	0.676	3.150	\$72.66	\$54.29	\$82.86	\$72.66
3.200	4.438	0.109	2.923	0.687	3.200	\$73.82	\$55.15	\$84.18	\$73.82
3.250	4.508	0.111	2.968	0.698	3.250	\$74.97	\$56.01	\$85.49	\$74.97
3.300	4.577	0.113	3.014	0.708	3.300	\$76.12	\$56.87	\$86.81	\$76.12
3.350	4.646	0.114	3.060	0.719	3.350	\$77.28	\$57.74	\$88.12	\$77.28

TABLE 1 continued on next page ...

... **TABLE 1** continued

COMPARISONS OF FUEL PRICES AND OPERATING COSTS

FUEL	BTU content	Unit of measure	Thermal efficiency	Service efficiency
Nat Gas	1,025	Cubic Feet	78%	57%
Fuel Oil	138,700	Gallon	80%	65%
Electricity	3,412	K. W. H.	96%	87%
Propane	91,333	Gallon	78%	57%

Monthly Cost Equation

$$\text{Cost \$} = \$ / \text{therm} * 1 \text{ therm} / 100,000 \text{ BTU} * 8.33 \text{ Btu} / (\text{gal} * \text{deg}) * 90 \text{ deg.} * 2000 \text{ gal} / \text{Service Efficiency}$$

TABLE 2

ESTIMATED ANNUAL COST OF OPERATION, OIL-FIRED UNITS

FUEL COST PER GALLON (\$)	ENERGY FACTOR (EF)										
	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.74	
1.50	\$337	\$325	\$314	\$304	\$295	\$286	\$277	\$269	\$262	\$255	
1.55	\$348	\$336	\$325	\$314	\$304	\$295	\$286	\$278	\$271	\$263	
1.60	\$359	\$347	\$335	\$324	\$314	\$305	\$296	\$287	\$279	\$272	
1.65	\$370	\$357	\$346	\$334	\$324	\$314	\$305	\$296	\$288	\$280	
1.70	\$381	\$368	\$356	\$345	\$334	\$324	\$314	\$305	\$297	\$289	
1.75	\$393	\$379	\$366	\$355	\$344	\$333	\$323	\$314	\$305	\$297	
1.80	\$404	\$390	\$377	\$365	\$353	\$343	\$333	\$323	\$314	\$306	
1.85	\$415	\$401	\$387	\$375	\$363	\$352	\$342	\$332	\$323	\$314	
1.90	\$426	\$412	\$398	\$385	\$373	\$362	\$351	\$341	\$332	\$323	
1.95	\$438	\$422	\$408	\$395	\$383	\$371	\$360	\$350	\$340	\$331	
2.00	\$449	\$433	\$419	\$405	\$393	\$381	\$370	\$359	\$349	\$340	
2.05	\$460	\$444	\$429	\$415	\$402	\$390	\$379	\$368	\$358	\$348	
2.10	\$471	\$455	\$440	\$426	\$412	\$400	\$388	\$377	\$366	\$357	
2.15	\$482	\$466	\$450	\$436	\$422	\$409	\$397	\$386	\$375	\$365	
2.20	\$494	\$477	\$461	\$446	\$432	\$419	\$407	\$395	\$384	\$374	
2.25	\$505	\$487	\$471	\$456	\$442	\$428	\$416	\$404	\$393	\$382	
2.30	\$516	\$498	\$482	\$466	\$452	\$438	\$425	\$413	\$401	\$391	
2.35	\$527	\$509	\$492	\$476	\$461	\$447	\$434	\$422	\$410	\$399	
2.40	\$539	\$520	\$503	\$486	\$471	\$457	\$443	\$431	\$419	\$408	
2.45	\$550	\$531	\$513	\$497	\$481	\$466	\$453	\$440	\$428	\$416	
2.50	\$561	\$542	\$524	\$507	\$491	\$476	\$462	\$449	\$436	\$425	
2.55	\$572	\$552	\$534	\$517	\$501	\$485	\$471	\$458	\$445	\$433	
2.60	\$583	\$563	\$544	\$527	\$510	\$495	\$480	\$467	\$454	\$441	
2.65	\$595	\$574	\$555	\$537	\$520	\$505	\$490	\$476	\$462	\$450	
2.70	\$606	\$585	\$565	\$547	\$530	\$514	\$499	\$485	\$471	\$458	
2.75	\$617	\$596	\$576	\$557	\$540	\$524	\$508	\$494	\$480	\$467	
2.80	\$628	\$607	\$586	\$567	\$550	\$533	\$517	\$503	\$489	\$475	
2.85	\$639	\$617	\$597	\$578	\$560	\$543	\$527	\$512	\$497	\$484	
2.90	\$651	\$628	\$607	\$588	\$569	\$552	\$536	\$521	\$506	\$492	
2.95	\$662	\$639	\$618	\$598	\$579	\$562	\$545	\$530	\$515	\$501	
3.00	\$673	\$650	\$628	\$608	\$589	\$571	\$554	\$539	\$524	\$509	
3.05	\$684	\$661	\$639	\$618	\$599	\$581	\$564	\$547	\$532	\$518	
3.10	\$696	\$672	\$649	\$628	\$609	\$590	\$573	\$556	\$541	\$526	

Formula to determine yearly cost of operation:

Oil: $\left(\frac{47,743 \text{ BTU}}{\text{EF}} \right) \left(\frac{\text{fuel cost / gallon}}{138,700 \text{ BTU / gal}} \right) \left(365 \frac{\text{days}}{\text{year}} \right) = \frac{\$}{\text{year}}$

Nat Gas: $\left(\frac{47,743 \text{ BTU}}{\text{EF}} \right) \left(\frac{\$}{\text{therm}} * \frac{1 \text{ therm}}{100,000 \text{ BTU}} \right) \left(365 \frac{\text{days}}{\text{year}} \right) = \frac{\$}{\text{year}}$

Elec: $\left(\frac{47,743 \text{ BTU}}{\text{EF}} \right) \left(\frac{\$}{\text{kWh}} * \frac{1 \text{ kWh}}{3,412 \text{ BTU}} \right) \left(365 \frac{\text{days}}{\text{year}} \right) = \frac{\$}{\text{year}}$

47,743 BTU = Nominal amount of energy needed to heat 64.3* gallons of water at a 90°F rise.

* 64.3 gallons is the U.S. Department of Energy daily average usage.

TABLE 3

ESTIMATED ANNUAL COST OF OPERATION, GAS-FIRED UNITS

COST PER THERM (\$)	ENERGY FACTOR									
	0.56	0.58	0.60	0.62	0.64	0.66	0.68	0.70	0.72	0.74
0.55	\$171	\$165	\$160	\$155	\$150	\$145	\$141	\$137	\$133	\$130
0.56	\$174	\$168	\$163	\$157	\$153	\$148	\$144	\$139	\$136	\$132
0.57	\$177	\$171	\$166	\$160	\$155	\$151	\$146	\$142	\$138	\$134
0.58	\$181	\$174	\$169	\$163	\$158	\$153	\$149	\$144	\$140	\$137
0.59	\$184	\$177	\$171	\$166	\$161	\$156	\$151	\$147	\$143	\$139
0.60	\$187	\$180	\$174	\$169	\$163	\$158	\$154	\$149	\$145	\$141
0.61	\$190	\$183	\$177	\$172	\$166	\$161	\$156	\$152	\$148	\$144
0.62	\$193	\$186	\$180	\$174	\$169	\$164	\$159	\$154	\$150	\$146
0.63	\$196	\$189	\$183	\$177	\$172	\$166	\$161	\$157	\$153	\$148
0.64	\$199	\$192	\$186	\$180	\$174	\$169	\$164	\$159	\$155	\$151
0.65	\$202	\$195	\$189	\$183	\$177	\$172	\$167	\$162	\$157	\$153
0.66	\$205	\$198	\$192	\$186	\$180	\$174	\$169	\$164	\$160	\$155
0.67	\$209	\$201	\$195	\$188	\$182	\$177	\$172	\$167	\$162	\$158
0.68	\$212	\$204	\$198	\$191	\$185	\$180	\$174	\$169	\$165	\$160
0.69	\$215	\$207	\$200	\$194	\$188	\$182	\$177	\$172	\$167	\$163
0.70	\$218	\$210	\$203	\$197	\$191	\$185	\$179	\$174	\$169	\$165
0.71	\$221	\$213	\$206	\$200	\$193	\$188	\$182	\$177	\$172	\$167
0.72	\$224	\$216	\$209	\$202	\$196	\$190	\$185	\$179	\$174	\$170
0.73	\$227	\$219	\$212	\$205	\$199	\$193	\$187	\$182	\$177	\$172
0.74	\$230	\$222	\$215	\$208	\$202	\$195	\$190	\$184	\$179	\$174
0.75	\$233	\$225	\$218	\$211	\$204	\$198	\$192	\$187	\$182	\$177
0.76	\$237	\$228	\$221	\$214	\$207	\$201	\$195	\$189	\$184	\$179
0.77	\$240	\$231	\$224	\$216	\$210	\$203	\$197	\$192	\$186	\$181
0.78	\$243	\$234	\$227	\$219	\$212	\$206	\$200	\$194	\$189	\$184
0.79	\$246	\$237	\$229	\$222	\$215	\$209	\$203	\$197	\$191	\$186
0.80	\$249	\$240	\$232	\$225	\$218	\$211	\$205	\$199	\$194	\$188
0.81	\$252	\$243	\$235	\$228	\$221	\$214	\$208	\$202	\$196	\$191
0.82	\$255	\$246	\$238	\$231	\$223	\$217	\$210	\$204	\$199	\$193
0.83	\$258	\$249	\$241	\$233	\$226	\$219	\$213	\$207	\$201	\$196
0.84	\$261	\$252	\$244	\$236	\$229	\$222	\$215	\$209	\$203	\$198
0.85	\$265	\$255	\$247	\$239	\$231	\$224	\$218	\$212	\$206	\$200

TABLE 4

ESTIMATED ANNUAL COST OF OPERATION, ELECTRIC UNITS

COST PER kWh (\$)	ENERGY FACTOR															
	0.80	0.81	0.82	0.83	0.84	0.85	0.86	0.87	0.88	0.89	0.90	0.91	0.92	0.93	0.94	0.95
0.035	\$223	\$221	\$218	\$215	\$213	\$210	\$208	\$206	\$203	\$201	\$199	\$196	\$194	\$192	\$190	\$188
0.040	\$255	\$252	\$249	\$246	\$243	\$240	\$238	\$235	\$232	\$230	\$227	\$225	\$222	\$220	\$217	\$215
0.045	\$287	\$284	\$280	\$277	\$274	\$270	\$267	\$264	\$261	\$258	\$255	\$253	\$250	\$247	\$245	\$242
0.050	\$319	\$315	\$311	\$308	\$304	\$300	\$297	\$294	\$290	\$287	\$284	\$281	\$278	\$275	\$272	\$269
0.055	\$351	\$347	\$343	\$338	\$334	\$331	\$327	\$323	\$319	\$316	\$312	\$309	\$305	\$302	\$299	\$296
0.060	\$383	\$378	\$374	\$369	\$365	\$361	\$356	\$352	\$348	\$344	\$341	\$337	\$333	\$330	\$326	\$323
0.065	\$415	\$410	\$405	\$400	\$395	\$391	\$386	\$382	\$377	\$373	\$369	\$365	\$361	\$357	\$353	\$349
0.070	\$447	\$441	\$436	\$431	\$426	\$421	\$416	\$411	\$406	\$402	\$397	\$393	\$389	\$384	\$380	\$376
0.075	\$479	\$473	\$467	\$462	\$456	\$451	\$445	\$440	\$435	\$430	\$426	\$421	\$416	\$412	\$408	\$403
0.080	\$511	\$504	\$498	\$492	\$486	\$481	\$475	\$470	\$464	\$459	\$454	\$449	\$444	\$439	\$435	\$430
0.085	\$543	\$536	\$529	\$523	\$517	\$511	\$505	\$499	\$493	\$488	\$482	\$477	\$472	\$467	\$462	\$457
0.090	\$575	\$568	\$561	\$554	\$547	\$541	\$535	\$528	\$522	\$517	\$511	\$505	\$500	\$494	\$489	\$484
0.095	\$607	\$599	\$592	\$585	\$578	\$571	\$564	\$558	\$551	\$545	\$539	\$533	\$527	\$522	\$516	\$511
0.100	\$638	\$631	\$623	\$615	\$608	\$601	\$594	\$587	\$580	\$574	\$568	\$561	\$555	\$549	\$543	\$538
0.105	\$670	\$662	\$654	\$646	\$638	\$631	\$624	\$616	\$609	\$603	\$596	\$589	\$583	\$577	\$571	\$565
0.110	\$702	\$694	\$685	\$677	\$669	\$661	\$653	\$646	\$638	\$631	\$624	\$617	\$611	\$604	\$598	\$591
0.115	\$734	\$725	\$716	\$708	\$699	\$691	\$683	\$675	\$667	\$660	\$653	\$645	\$638	\$632	\$625	\$618
0.120	\$766	\$757	\$747	\$738	\$730	\$721	\$713	\$705	\$697	\$689	\$681	\$674	\$666	\$659	\$652	\$645
0.125	\$798	\$788	\$779	\$769	\$760	\$751	\$742	\$734	\$726	\$717	\$709	\$702	\$694	\$687	\$679	\$672
0.130	\$830	\$820	\$810	\$800	\$790	\$781	\$772	\$763	\$755	\$746	\$738	\$730	\$722	\$714	\$706	\$699

GENERAL INFORMATION

The Bock line of residential, commercial and industrial water heaters is constructed for lasting peak performance and high efficiency. TURBOFLUE® is the principal component, whether used as a single center flue or in multiflue heaters. It is the combination of all innovative Bock components that makes our name synonymous with quality. Proper selection and installation of one or more Bock units will meet virtually any hot water requirement. This manual will assist in determining which model or models are required and how, when and where accessory items should be used to make the installation safe, efficient and easily maintained.

Fuel Oils

Most oil-fired water heaters use No. 2 grade fuel oil. Bock oil-fired water heaters will efficiently burn No.'s 1 and 2 grade fuel oils as well as kerosene and diesel fuel. Special burners for larger units are available from Bock to fire on No. 4 grade fuel oil.

IMPORTANT: Oil filters should be installed on inlet lines to the burners to prevent foreign particles from clogging the nozzles.

Fuel Gases

Fuel gases used for heating water throughout the United States fall into two classifications: natural gas and liquid petroleum (butane and propane). Bock gas-fired water heaters are shipped to burn one of these two standard gases (see Table 5).

TABLE 5

Heat Content & Specific Gravity

Type of Gas	Heat content of Gas BTU/CU.FT.	Specific Gravity of Gas
Natural Gas	1050	0.65
Liquified Petroleum:		
Butane	3200	2.00
Propane	2550	1.53

Water heaters using gasses other than the standard types may be ordered directly from Bock, but requirements must be carefully specified. The following information must be given when ordering:

1. Type of gas to be used.
2. Heat content of specified gas in BTU/Cu. Ft.
3. Specific gravity of the gas.
4. Service pressure of the gas at the meter.

Local gas companies and suppliers can usually supply the above information.

TABLE 6

Recommended Gas Pressures*

Type of Gas	Before Gas Control	After Gas Control
Natural Gas	5" w.c.	3.5" w.c.
Liquified Petroleum	11" w.c.	10" w.c.

* Check burner & valve specifications

Downrating for Altitude

Heaters that are installed above 2,000 feet above sea level must be downrated to function properly. Heaters are downrated according to the following:

Oil-fired:

Rule of thumb: Downrate input 5% for every 1,000 ft above 2,000 ft above sea level.

Therefore, if elevation > 2,000 ft, then,

$$\text{Downrated input} = (\text{rated input}) - (0.05) \left(\frac{\text{Elevation} - 2,000 \text{ ft}}{1,000 \text{ ft}} \right) * \\ *(\text{rated input})$$

Gas-fired:

Rule of thumb: Downrate input 4% for every 1,000 ft above 2,000 ft above sea level.

Therefore, if elevation > 2,000 ft, then,

$$\text{Downrated input} = (\text{rated input}) - (0.04) \left(\frac{\text{Elevation} - 2,000 \text{ ft}}{1,000 \text{ ft}} \right) * \\ *(\text{rated input})$$

Combustion and Ventilation Air

Care must be taken to ensure an adequate air supply for combustion equipment is installed in every type of structure. If the water heater will be installed in closely confined areas such as closets or small utility rooms, the air supply must provide ventilation as well as combustion air. These areas must be vented at the floor for combustion air and at the ceiling for ventilation. Eleven cubic feet of air is required for every 100,000 BTUs.

Buildings with concrete slab foundations and interior equipment rooms require the combustion air to be brought in from the attic space to within six inches of the floor. Consult local codes and ordinances or NFPA 31 and NFPA 54.

Electric

Electric water heaters for use with 208, 220, 240 and 440 to 480 volts AC can be furnished. Specify use for single phase or three-phase operation. The highest recovery rate provided is 222 GPH for a single unit. When large volumes of hot water are needed, the use of multiple units is an excellent way to meet requirements.

GENERAL INFORMATION (cont.)

Anode Rods

The anode rod is used as a sacrificial element within the volume of the storage tank. The purpose of the magnesium anode rod is to protect the inside of the tank against corrosion. Anode rods should be inspected twice in the first year and at least yearly once a time interval for inspection has been developed. Water conditions can influence the



Figure 9

consumption rate of the anode rods.

Anode rods should be replaced when the rod diameter has eroded to two-thirds or less of its original diameter (Figure 9). If the steel wire core is visible (Figure 10), the rod has lost its effectiveness.



Figure 10

OIL-FIRED WATER HEATER INSTALLATION

Bock oil-fired water heaters are equipped with single stage pumps and 3450 RPM burners. Two-stage pumps are optional.

Use caution in the final connection of tubing to the burner, particularly on long runs. Do not connect the burner to the pipe. Use copper tubing between the pipe and the burner. If possible, form a coil in the tubing before attaching to the burner to minimize any vibration or joint problems.

When designing a new installation, follow the pump manufacturer's recommendations for pipe sizes and configuration. Burners are normally shipped with data for the fuel pump they are equipped with.

TABLE 7 *

Maximum Lift & Horizontal Run for Oil Units

One-pipe System		
LIFT	HORIZONTAL RUN	
	3/8" O.D. TUBE	1/2" O.D. TUBE
0'	65'	100'
4'	45'	100'
7'	31'	100'
8'	16'	64'

Inlet vacuum must not exceed 6 inHg on a one-pipe system.

TABLE 8 *

Two-pipe System with Single Stage pump				
LIFT	3450 RPM			
	3/8" O.D. TUBE 3 GPH	7 GPH	1/2" O.D. TUBE 3 GPH	7 GPH
0'	84'	71'	100'	100'
1'	78'	66'	100'	100'
2'	73'	62'	100'	100'
3'	68'	57'	100'	100'
4'	63'	53'	100'	100'
5'	57'	48'	100'	100'
6'	52'	44'	100'	100'
7'	47'	39'	100'	100'
8'	42'	35'	100'	100'
9'	36'	31'	100'	100'
10'	31'	27'	100'	100'
11'	26'	22'	100'	87'
12'	21'	18'	83'	70'
13'	—	—	62'	52'
14'	—	—	41'	35'

TABLE 8A *

Two-pipe System with Two-Stage pump				
LIFT	3450 RPM			
	3/8" O.D. TUBE 3 GPH	7 GPH	1/2" O.D. TUBE 3 GPH	7 GPH
0'	93'	80'	100'	100'
1'	85'	73'	100'	100'
2'	77'	66'	100'	100'
3'	69'	59'	100'	100'
4'	60'	52'	100'	100'
5'	52'	45'	100'	100'
6'	44'	38'	100'	100'
7'	36'	31'	100'	100'
8'	27'	24'	100'	93'
9'	18'	—	76'	65'

Inlet vacuum must not exceed 6 inHg on a one-pipe system. On a two-pipe system, inlet vacuum must be less than 12 inHg for "A" model pumps and 17 inHg for "B" model pumps.

* Suntec A & B Series pumps
Heaters 361E and larger use 7 gph pumps.

✓ On all Bock oil-fired water heaters up through 1.5 GPH (Models 32E through 72E, equipped with single stage pumps), use minimum 3/8" O.D. soft copper tubing and a one-pipe system. Refer to Table 7 (One Pipe System) for the maximum lift and horizontal run. If the lengths exceed the table, use a two-stage, two-pipe system or check the "Alternatives" section following.

✓ Important: On water heaters fired at a rate greater than 1.5 GPH, use a two-pipe system. Use 1/2" O.D. or larger copper tubing.

For multiple heater installations, we recommend separate lines to each water heater.

If the required lift exceeds recommendations or horizontal run exceeds 100 feet, check the "Alternatives" section following.

- ✓ Return lines must be the same diameter as suction line.
- ✓ Both the suction and return lines must extend close to the bottom of the oil storage tank.
- ✓ Use a minimum number of fittings; preferably, make bends in the tubing with as large a radius as possible. Use flared fittings, not compression fittings.

Alternatives

Installing a new water heater where there is an existing oil supply tank and oil lines:

A booster pump must be used for any lift or horizontal run exceeding Tables 7, 8, and 8A specifications. Booster pumps must be installed as close as possible to the oil supply tank. The booster pressure should not exceed 10 lbs. at the burner. (See NFPA 31 Std.) An OSV valve shall be installed on all pressurized lines.

Booster pumps may be obtained from Suntec Hydraulics, Rockford, Illinois.

1. Inspect existing equipment.
2. Determine whether a separate one-pipe system can be installed to furnish oil to the water heater. A separate system is ideal.
3. If a separate one-pipe system is not possible and the heater that is to be replaced is supplied with a one-pipe system, tee into that one-pipe system to furnish oil to the new heater burner.
4. If the heater that is to be replaced is supplied with a two-pipe system, check to see if the return line extends to the bottom of the oil supply tank. Consider changing the existing setup to a one-pipe system and changing the return line to the suction line for the new installation.

5. If Step 4 is not feasible, tee into the existing suction line and the existing return line to supply oil to the new burner. This hookup can be satisfactory if the return line extends to the bottom of the oil supply tank. But if the tubing is too small and there is a two-stage pump on the existing heater the additional heater pump may be starved for fuel oil.

6. Where return lines do not extend to the bottom of the oil supply tank, use check valves on each suction line located as close as possible to each burner. This will prevent air from being drawn through the line.

7. Before teeing into any existing oil line, check the vacuum on the existing burner by installing a vacuum gauge in the 1/4" inlet port or the vent opening. On a two-pipe system, a single stage pump should not exceed 8" Hg. vacuum and a two-stage pump should not exceed 15" Hg. vacuum. If the vacuum readings do not exceed these limits, the new water heater can be connected to the existing lines. If the heater performs poorly, recheck the vacuum reading with all units in the system operating. A high vacuum reading indicates too much resistance to proper fuel oil flow, possibly caused by a clogged filter, restricted shut-off valve, kinked tubing, obstructed oil line, excessive lift, too long a horizontal run or an undersized oil line (see Tables 8 and 8A).

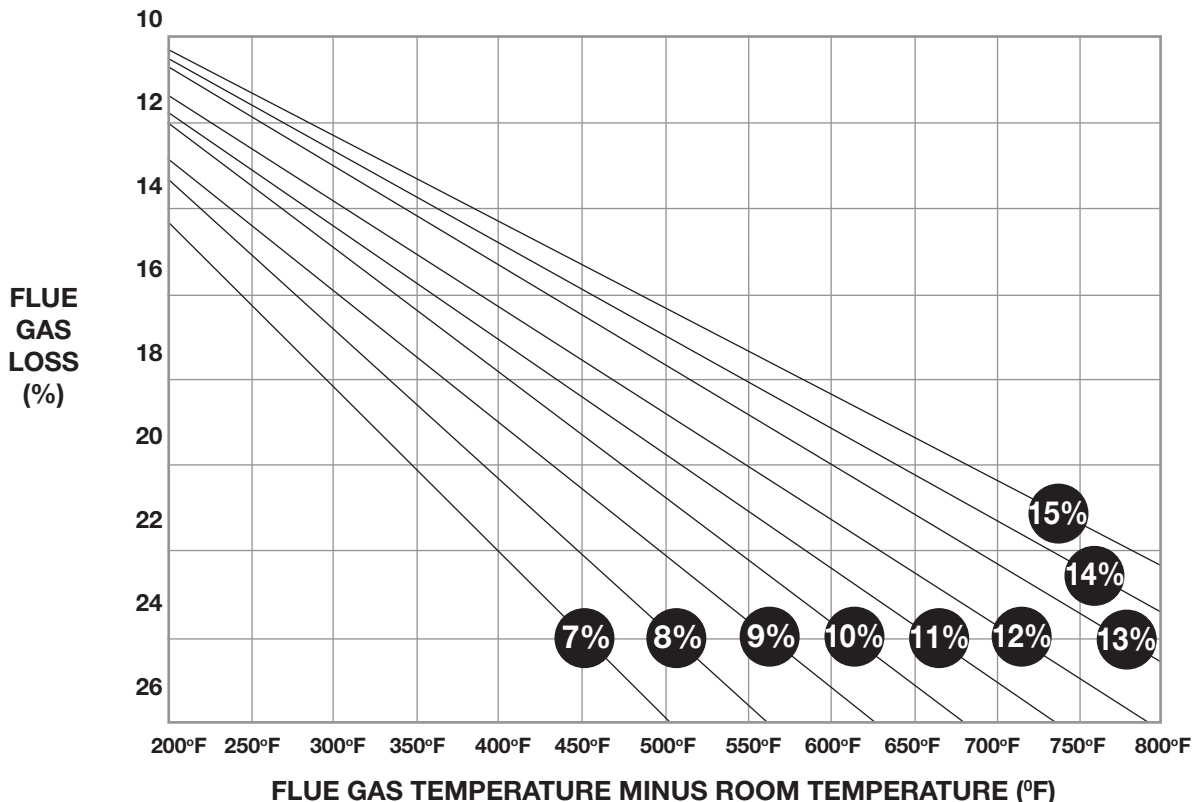
Bleed the pumps until the oil loses the milky or opaque appearance and becomes clear or transparent.

If none of the preceding installation variables are suitable, Bock recommends installing an oil booster pump as close to the oil supply tank as possible using the existing supply and return line. Change the existing unit to a one-pump system and tee off the one pipe that supplies fuel oil to the water heater.

Figure 11

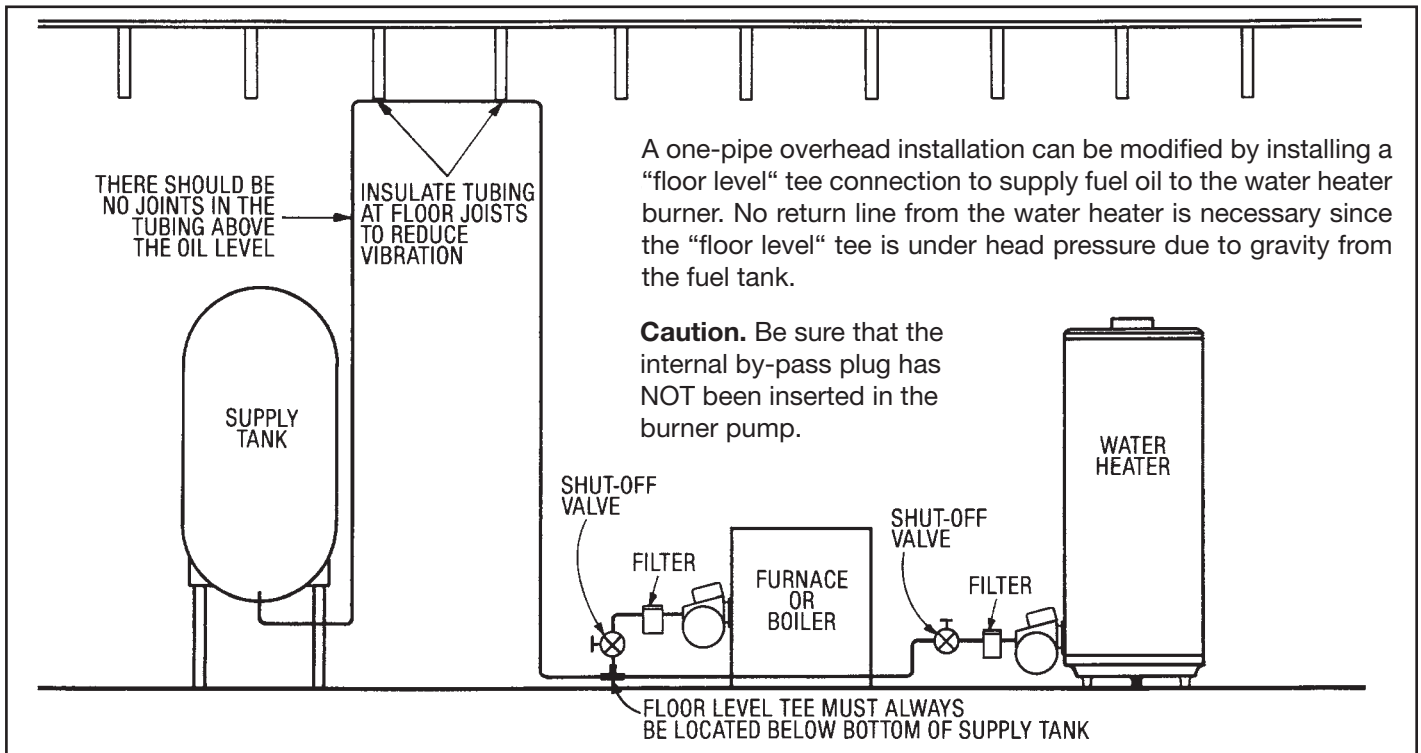
Percent of Flue Loss for Fuel Oil

Figure 11 can be used to approximate combustion efficiency or an AFUE number. Using the CO₂ reading and net stack temperature, find the % of flue gas loss. Approximate AFUE = 100 - (% x 100). Example: CO₂ = 8% Net Stack = 450°F. Approximate AFUE = 100 - (.22 x 100) = 78.



PIPING FUEL LINES FOR BOCK OIL-FIRED WATER HEATERS

Figure 12: Inside tank, one-pipe overhead installation



On a conventional single-pipe installation where the inlet line is located below the tank and no life is required for either fuel unit, the inlet line for the water heater burner can

be teed to the supply line at any point. It may be convenient to connect to the unused inlet port of the other fuel line.

Figure 13: Outside tank, two-pipe installation (burner below tank)

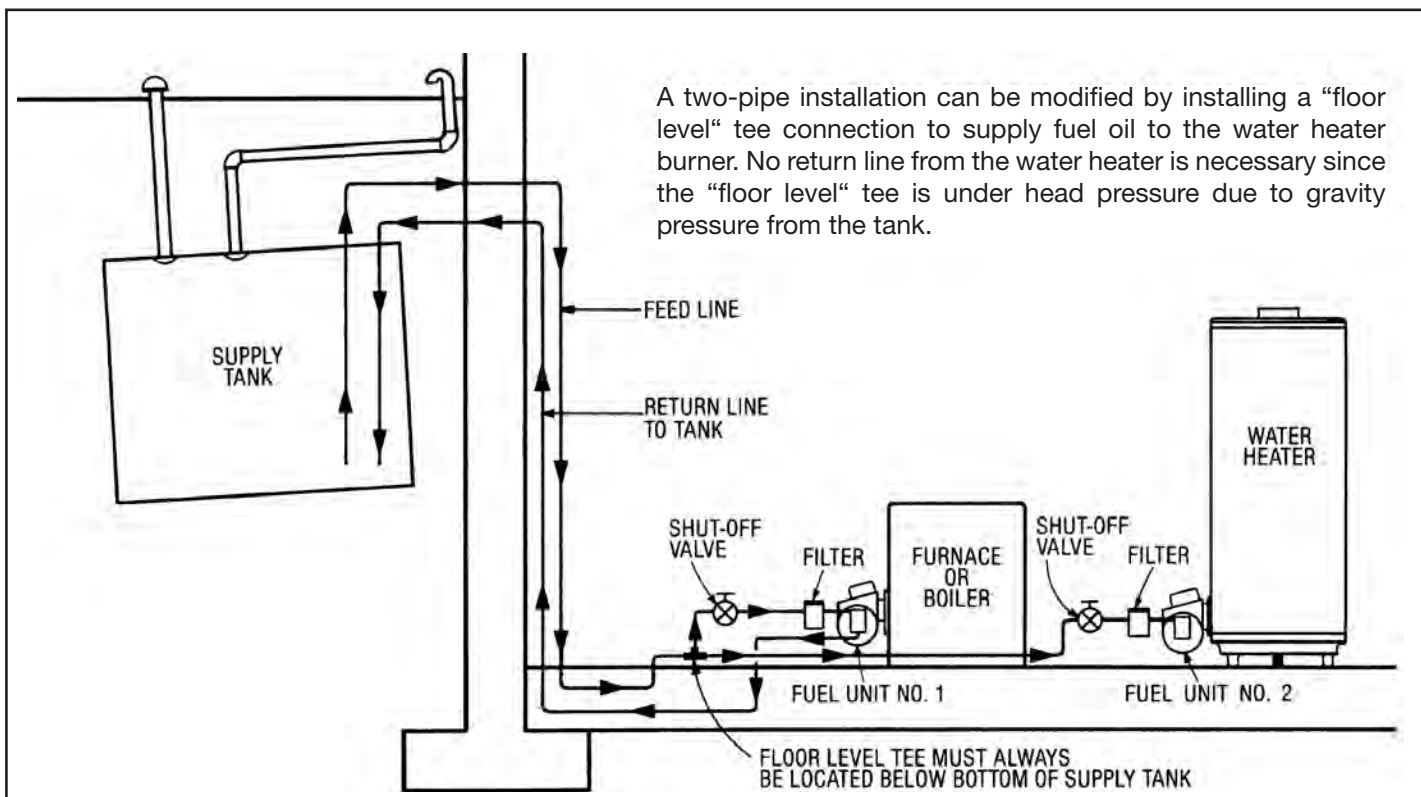


Figure 14: Installation using existing outside tank lift; two burners

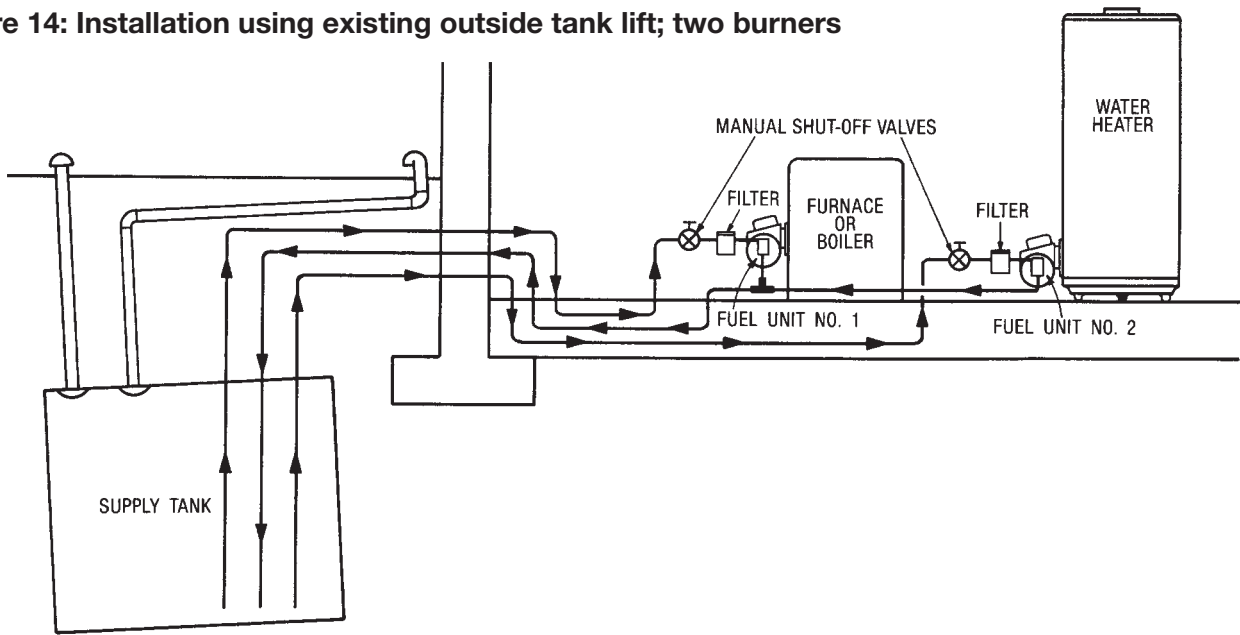
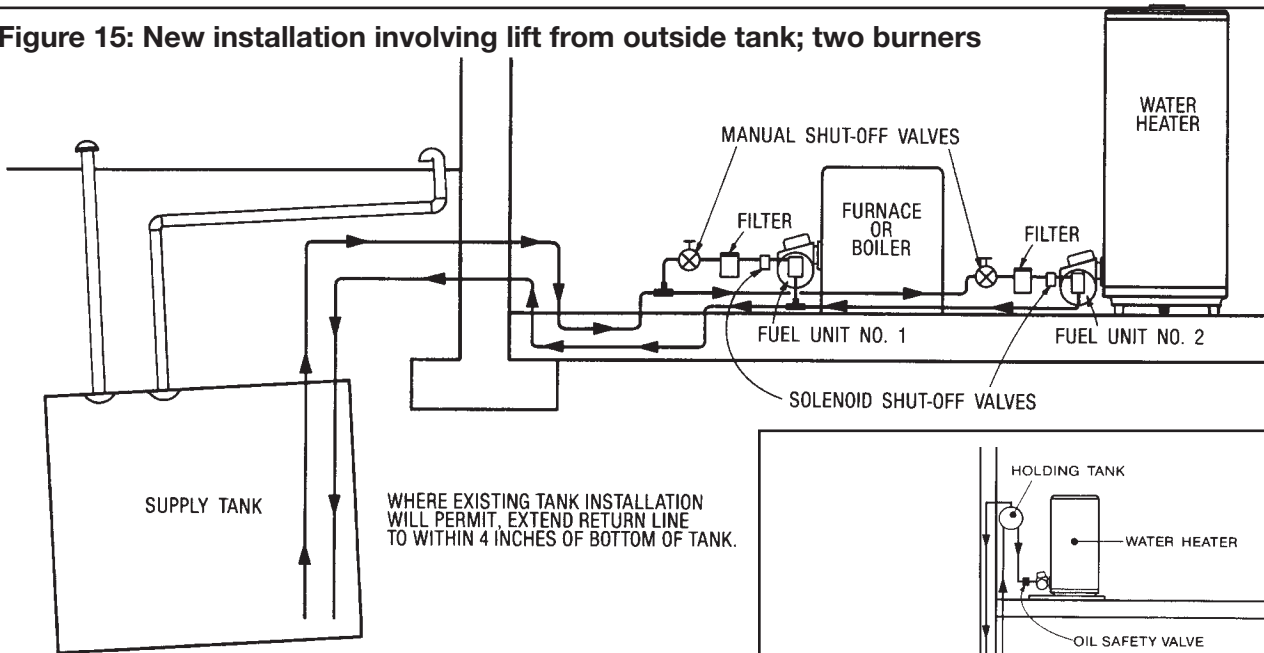


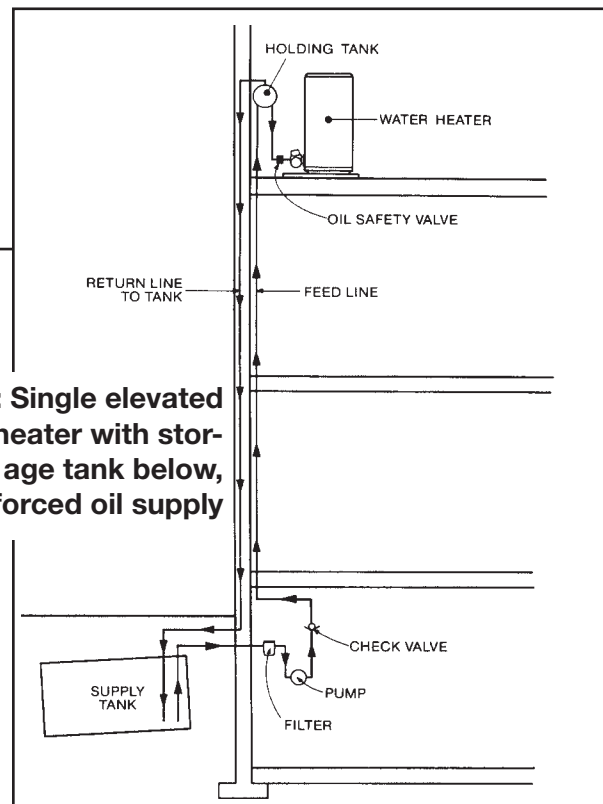
Figure 15: New installation involving lift from outside tank; two burners



For the addition of an oil-fired water heater to an existing outside fuel tank installation, it may not be possible to install a separate suction line. The suction line for the water heater burner can be teed to the existing suction line if solenoid shut-off valves or check valves are installed in the inlet side of each fuel unit.

Individual suction lines should be used to supply fuel to the burners. Individual return lines are also recommended, but may be tied together as shown and should run to within 4" of the fuel tank bottom.

Figure 16: Single elevated heater with storage tank below, forced oil supply



GAS-FIRED WATER HEATER INSTALLATION

When installing a Bock gas water heater, care must be taken in sizing and installing the gas pipe system. Gas pipe size and length of run should follow the guidelines listed in the water heater / gas burner installation manual. In the absence of this data refer to the most recent edition of the National Fuel Gas Code, NFPA 54/ANSI Z223.1. Table 10 lists data presented in the code for iron pipe. National Fuel Gas Code contains more detailed information for other types of pipe and various gas pressures.

Always measure manifold gas pressure after installing the appliance with other appliances in the system operating. Correct pressure values are listed on the water heater rating plate. If this pressure cannot be maintained, the gas piping or main may be undersized.

Select a location for the water heater that guarantees adequate combustion air. Atmospheric water heaters such as the Bock EZ100-199 must have free air flow to the bottom of the heater. Failure to supply adequate air will result in unsafe heater operation. CO levels in the flue gases exiting the heater should be checked during operation.

Properly sized and installed venting is also vital to the safe and efficient operation of gas appliances. National Fuel Gas Code, NFPA 54/ANSI Z223.1 has extensive guidelines on the proper installation of venting systems. Tables 23-35 in this manual are reprinted from the code for your convenience.

When connecting gas water heaters to a venting system with other large vent hood equipped appliances such as the boiler in an apartment building, the vent system should produce -0.02 in w.c. draft when only the water heater is operating.

Large vent hood equipped appliances can prevent the vent system from developing draft when only the water heater is operating. This results in unsafe combustion and nuisance lock outs. The solution to this problem is to install automatic vent dampers in the vent connectors of large appliances to stop any air flow through the vent hoods of appliances that are not operating. Alternately, the water heater may need a draft inducer or its own venting system.

TABLE 10

Maximum capacity of gas pipe in cubic feet per hour

Based on gas pressure of 0.5 PSI, pressure drop of 0.3" W.C. and 0.6 specific gravity

LENGTH (ft)	Nominal iron pipe size (in)								
	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"	4"
10	132	278	520	1,050	1,600	3,050	4,800	8,500	17,500
20	92	190	350	730	1,100	2,100	3,300	5,900	12,000
30	73	152	285	590	890	1,650	2,700	4,700	9,700
40	63	130	245	500	760	1,450	2,300	4,100	8,300
50	56	115	215	440	670	1,270	2,000	3,600	7,400
60	50	105	195	400	610	1,150	1,850	3,250	6,800
70	46	96	180	370	560	1,050	1,700	3,000	6,200
80	43	90	170	350	530	990	1,600	2,800	5,800
90	40	84	160	320	490	930	1,500	2,600	5,400
100	38	79	150	305	460	870	1,400	2,500	5,100
125	34	72	130	275	410	780	1,250	2,200	4,500
150	31	64	120	250	380	710	1,130	2,000	4,100
175	28	59	110	225	350	650	1,050	1,850	3,800
200	26	55	100	210	320	610	980	1,700	3,500

Source: 2001 ASHRAE Fundamentals Handbook

INDIRECT WATER HEATER INSTALLATION

Bock indirect, or SideKick, water heaters offer a cost effective water heating alternative. These units utilize circulating boiler - fed hot water through a coil inside the water tank. Indirects are ideal for applications that use boilers for space heating.

All piping between the boiler and the indirect heater should be new copper with a minimum size of 3/4" ID for models 30SK, 40SK, and 50SK. Use 1" minimum copper for models 80SK and 119SK. Elbows should be minimized. A flow check valve must be installed on the return line.

Piping to the inlet (cold) and outlet (hot) domestic water connections should be new copper with a minimum size of 1/2" ID for models 30SK, 40SK, and 50SK. Use 3/4" ID minimum for models 80SK and 119SK.

Installations should conform to local codes and ordinances. At a minimum, refer to IHLR 84 code if local codes are not in place. It is recommended that all piping be adequately insulated with approved material to ensure minimum heat loss. If a re-circulation line is used for domestic water, be certain that all lines are well insulated and the circulator is temperature controlled. Install isolation valves to permit proper servicing. It is also recommended to install a union on the domestic outlet to facilitate replacement of the hot outlet / anode nipple on models 30SK, 40SK, and 50SK.

Note: Indirect may be connected to a steam boiler provided that all piping to and from the boiler are below the water line of the boiler. Boiler must also be protected by a low water cut off safety device.

BOILER AND CIRCULATOR SIZING

The ratings published in this manual (Tables 31 and 32) for your Bock Indirect Coil Tank Water Heater can be obtained through proper selection of boiler output and circulator capacity. As noted, the ratings in Table 31 are based on a 77°F rise with 58°F potable water inlet temperature at a circulator pump flow rate of 8 GPM. The boiler was set at 180°F. See Table 32 for additional first hour ratings at pump flow rates of 6, 8, 10 and 12 GPM with 180°F and 200°F boiler water.

To determine the appropriate circulator for your system, follow these three steps:

1) Calculate the pressure drop of all straight pipe and fittings on the supply and return at the desired flow rate.

2) Add the pressure drop from Step 1 to the pressure drop through the indirect coil tank water heater coil (see Table 31 for friction loss) to obtain a total pressure drop.

3) Select a circulator pump that will provide adequate flow at the total pressure drop.

A pump performance curve should accompany every circulator pump. Figures 17-19 contain performance curves for Taco and Grundfos circulator pumps, recommended by Bock.

Note: Zone valves on the heat source supply to the indirect heater are not recommended and will drastically reduce performance.

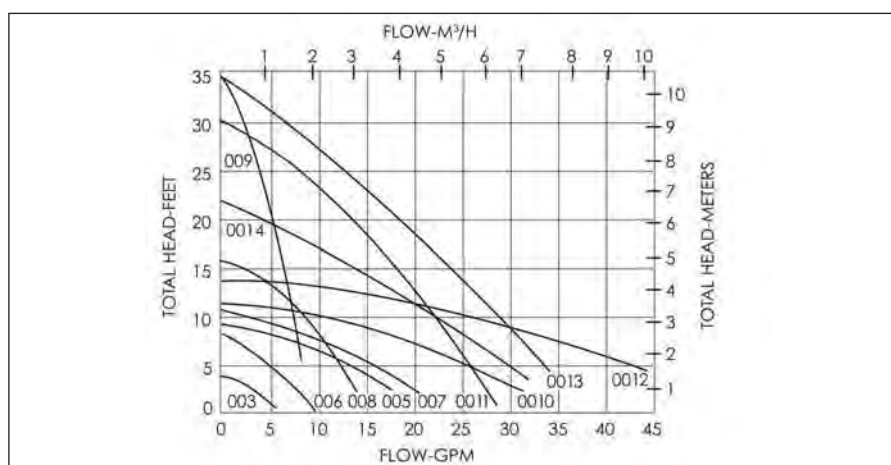


Figure 17: Taco 00 Series performance curves

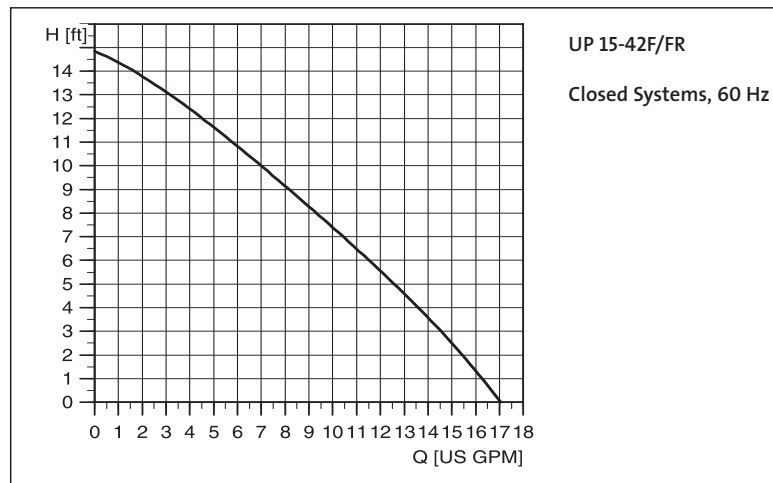


Figure 18: GRUNDFOS UP 15-42F performance curve

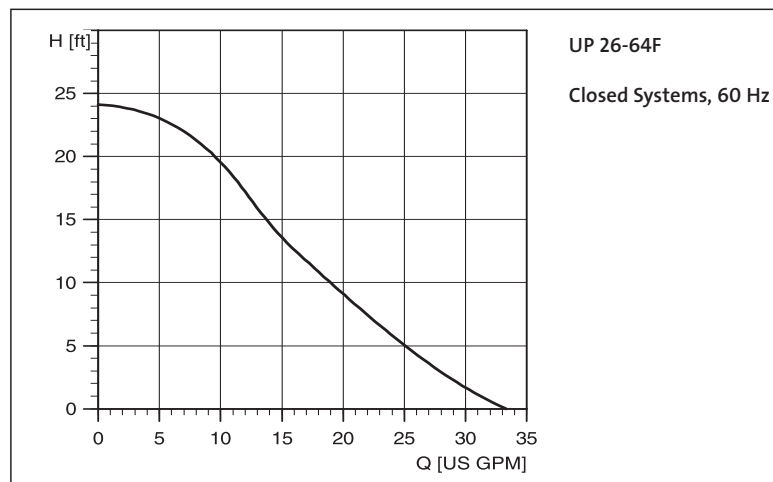


Figure 19: GRUNDFOS UP 26-64F performance curve

System performance can also vary based on the heating capacity of the boiler. If the minimum coil output (assume coil output = boiler output) listed in Tables 31 and 32 is not met, the output (first hour rating) of the water heater will not be met at the selected flow rate. To approximate the reduction in first hour rating as a result of low boiler capacity, use the following formula:

$$\text{New first hour rating} = (\text{First hour rating}) * (\text{Actual boiler output}) / (\text{Minimum coil output})$$

For example, the first hour rating of a 50SK at a 77°F rise with an 8 GPM heat source flow rate using a boiler having a DOE heating capacity (output) of 60,000 BTU/Hr would be:

$$\text{New first hour rating} = (160 \text{ gal}) * (60,000 \text{ BTU/Hr}) / (77,000 \text{ BTU/Hr}) = 125 \text{ gal}$$

GENERAL SIZING FORMULA

All requirements for hot water should be totaled to obtain the maximum amount of hot water required per hour. Use multiple water heaters when the requirements exceed the capacity of a single heater. If too many heaters in multiples will be required, use a storage tank sized to the gallons of hot water required per peak hour and heat the water in the tank with heaters having a recovery of one-third the capacity of the storage tank. Except in the case of self-service laundries, this total use could be factored by judgement – assuming that not all fixtures will be on at the same time – 75% to 80%, for example.

Sizing Formula for BTUH Input

Desired temperature.....140°F
Inlet water temperature50°F
1. Temperature difference.....90°F
2. Expected flow rate 5 GPM x 60 minutes = 300 GPH
3. BTU/gallon °F (water) 8.25
Total expected BTUH output is:
90°F x 300 gallons x 8.25 BTUs = 222,750 BTUH
To find the input required to produce 222,750 BTUH output, divide by .80

$$\frac{222,750}{.80} = 278,438 \text{ BTUH input}$$

* The Bock recommended Recovery / Efficiency

INDIRECT WATER HEATER APPLICATIONS

The Bock indirect water heaters are designed as a long life water heater for use in domestic and light commercial applications in buildings using boilers for space heating. The concept behind using an indirect is that the boiler heats water when it is not heating the home. This causes the boiler to run more frequently, reducing the boiler stand-by times and associate losses. Installing a dedicated boiler to power an indirect water heater is not an efficient way to heat water.

When selecting an indirect water heater, choose a tank size that can easily meet the immediate hot water demands of the customer. Do not count on recovery to help meet the load of a single draw. The reason for this is that the typical boiler will take two

or more minutes to get to operating temperature before it can begin to heat the water in the tank. This means that most or all hot water stored in the tank could be gone by the time the boiler can begin to recover the tank.

Example:

The customer uses 40 gallons to fill a bathtub. What size indirect should be used? The minimum tank size for this application would be a 50SK. A 40SK will deliver 33 gallons of usable hot water in a single draw and would not be able to fill the tub, resulting in customer complaints.

MULTIPLE DWELLING BUILDINGS

Tables 11A, 11B and 11C are based on ASHRAE Chapter 32: "Service Water Heater Tables," use 3 GPM shower heads and figure two to 2.5 people per unit. These tables may not be applicable to FHA sizing for some apartment building categories due to different diversity factors than those applied in the ASHRAE Guide.

If larger shower heads or extra-heavy use is predicted, sizing should be based on Table 11.

TABLE 11

Apartment, Hotels & Motels

INPUT BTUH	APARTMENTS			MOTELS/ HOTELS	GAS	OIL/PG	ELECTRIC	INDIRECTS
	LIGHT	AVG	HEAVY					
95,000	3	2	1	3	1-EZ75-135	1-32E/PG	1-27KW	1-80SK
110,000	4	3	2	4	1-EZ75-135	1-51E/PG	1-36KW	1-80SK
140,000	5	4	3	5	1-EZ75-135	1-51E/PG	1-40KW	1-119SK
175,000	6	5	4	6	1-EZ80-156	1-71E/PG	1-54KW	1-119SK
200,000	8	7	6	8	1-EZ80-199	1-72E/PG	2-30KW	2-50SK
230,000	12	10	9	12	1-EZ100-199	1-73E/PG	2-36KW	2-50SK
280,000	20	17	14	20	2-EZ75-135	1-241E/PG	2-45KW	2-80SK
360,000	31	23	18	31	2-EZ80-156	2-71E/PG	3-36KW	2-119SK
460,000	37	28	22	37	2-EZ100-199	1-361E/PG	3-45KW	N/R
500,000	52	40	32	52	3-EZ80-156	2-241E/PG	3-54KW	N/R
600,000	72	55	44	72	3-EZ80-156	1-541E/PG	4-45KW	N/R
1,500,000	221	166	132	221	1-150/250G	1-150/250E/PG	N/R	N/R

N/R = Not Recommended

LIGHT LOAD: Two people per unit; 3 GPM shower or less. Central laundry facilities (for individual laundries add 10% more input).

AVERAGE LOAD: Three to five people per unit; 4 to 6 GPM shower. Central laundry facilities (for individual laundries add 10% more input).

HEAVY LOAD: More than six people per unit; two baths. Individual laundry facilities.

Chart assumes recirculating line. If none, add 20% to required input.

All sizing based on 100°F rise in water temperature.

Hot water for food service units in motels/hotels should be sized separately.

For 90°F temperature rise, decrease required input by 10%. For 80°F temperature rise, decrease required input by 20%.

Federal regulations require all shower heads to be a maximum of 2.5 GPM. In older homes and buildings, larger GPM shower heads may be found and should be factored into sizing (see Table 15).

Note: U.S. Department of Housing and Urban Development Minimum Property Standards; 4910.1 - 1973, paragraph 615-5 states: "Hot water requirements for multiple dwellings should be based on design criteria shown in the ASHRAE Guide."

TABLE 11A

Apartment Sizing, 4 to 25 units

	TYPE OF FUEL	50°F RISE MODEL	70°F RISE MODEL	90°F RISE MODEL	100°F RISE* MODEL
4 UNITS	OIL P/GAS GAS ELEC. INDIRECT	32E 32PG EZ75-135 50F-15 50SK	32E 32PG EZ75-135 50F-15 50SK	32E 32PG EZ75-135 50F-15 50SK	51E 51PG EZ75-135 80F2C-15 80SK
	OIL P/GAS GAS ELEC INDIRECT	32E 32PG EZ75- 13550F-18 50SK	51E 51PG EZ75-135 50F-18 50SK	51E 51PG EZ75-135 50F-18 80SK	71E 71PG EZ75-135 80F-18 80SK
6 UNITS	OIL P/GAS GAS ELEC INDIRECT	51E 51PG EZ75-135 80F-15 80SK	51E 51PG EZ75-135 80F-15 80SK	51E 51PG EZ75-135 80F-15 80SK	71E 71PG EZ75-135 80F-18 80SK
	OIL P/GAS GAS ELEC INDIRECT	51E 51PG EZ75-135 80F-18 80SK	51E 51PG EZ75-135 80F-24 119SK	51E 51PG EZ75-135 N/R 119SK	72E 72PG EZ75-135 80F-30 119SK
8 UNITS	OIL P/GAS GAS ELEC INDIRECT	51E 51PG EZ75-135 80F-24	51E 51PG EZ75-135 120F-27 80F-30 119SK	51E 51PG EZ75-135 120F-27	241E 241PG EZ100-199 120F-30
	OIL P/GAS GAS ELEC INDIRECT	51E 51PG EZ75-135 80F-30 119SK	51E 51PG EZ75-135 80F-30 119SK	71E 71PG EZ80-156 120F-30 119SK	241E 241PG EZ100-199 120F-36 80SK(2)
10 UNITS	OIL P/GAS GAS ELEC INDIRECT	71E 71PG EZ75-135 120F-30 119SK	71E 71PG EZ75-135 80F-36 119SK	72E 72PG EZ80-156 80F-45 80SK(2)	241E 241PG EZ100-199 120F-45 80SK(2)
	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
12 UNITS	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
15 UNITS	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
20 UNITS	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
25 UNITS	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R
	OIL P/GAS GAS ELEC INDIRECT	72E 72PG EZ80-156 120F-36 80SK(2)	73E 73PG EZ100-199 120F-45 119SK(2)	241E 241PG N/R 120F-45 119SK(2)	N/R N/R N/R N/R N/R

N/R = Not Recommended

* **Note:** Indirects are not recommended for use at outlet temperatures of more than 140°F.

TABLE 11B

Apartment Sizing, 30 to 72 units

	TYPE OF FUEL	50°F RISE MODEL	70°F RISE MODEL	90°F RISE MODEL
30 UNITS	OIL	72E (2) 51E	241E (2) 71E	361E (2) 71E
	P/GAS	72PG (2) 51PG	241PG (2) 71PG	361PG (2) 71PG
	GAS	EZ80-156 (2) EZ75-135	— (2) EZ75-135	— (2) EZ80-156
	ELEC.	120C-45 (2) 52C-24	120C-54 (2) 82C-27	(2) 82C-30 —
36 UNITS	OIL	72E (2) 32PP	241E (2) 51E	361E (2) 71E
	P/GAS	72PG (2) 32PG	241PG (2) 51PG	361PG (2) 72PG
	GAS	EZ80-156	(2) EZ75-135 —	(2) EZ80-156 —
	ELEC.	82C-45 (2) 52C-24	120C-54 + 90-Gal. (2) 82C-30	(2) 82C-36 —
48 UNITS	OIL	241E (2) 51E	361E (2) 71E	(2) 73E
	P/GAS	241PG (2) 51PG	241PG (2) 71PG	(2) 73PG —
	GAS	(2) EZ80-156	(2) EZ100-199	—
	ELEC.	(2) 82C-30 —	120C-54 + 90-Gal. (2) 82C-36	(2) 120C-45
60 UNITS	OIL	361E (2) 51E	(2) 73E	200E-600 541E (2) 241E
	P/GAS	361PG (2) 71PG	(2) 73PG	541PG
	GAS	(2) EZ80-156	—	—
	ELEC.	(2) 120C-30	(2) 82C-45	(2) 120C-54
72 UNITS	OIL	361E (2) 72E	(2) 241E	250E-800 (2) 361E
	P/GAS	361PG 72PG	541PG (2) 241PG	(2) 361PG
	GAS	(2) EZ80-156	—	150G-800
	ELEC.	52C-36	(2) 82C-54	(3) 120C-36

TABLE 11C

Apartment Sizing, 100 to 150 units

	TYPE OF FUEL	50°F RISE MODEL	70°F RISE MODEL	90°F RISE MODEL
100 UNITS	OIL	150E-800 (2) 241E (3) 71E	250E-800 (2) 361E (3) 73E	250E-1000 (2) 541E (3) 361E
	P/GAS	(3) 241PG (2) 361PG	(3) 361PG (3) 73PG	(2) 361PG —
	GAS	— (3) EZ80-156 —	— 150G-800 —	— 150G-800
	ELEC.	(2) 82C-45 (3) 52C-27 (4) 82C-30	(2) 82C-54 (3) 52C-36 (4) 82C-36	(3) 120C-36
150 UNITS	OIL	250E-800 (2) 361E (3) 241E (4) 72E	250E-1000 (3) 361E (4) 241E	250E-1250 (3) 541E (4) 361E
	P/GAS	(2) 361PG (3) 241PG (4) 72PG	(2) 541PG (3) 361PG (4) 241PG	(3) 541PG (4) 361PG
	GAS	250G-800 (4) EZ80-156	250G-1000	250G-1500
	ELEC.	(3) 82C-45 (4) 52C-30	(3) 82C-54 (4) 82C-45	(6) 82C-54

EXPANSION TANK SIZING

The cold water supply to the water heater may contain a check valve, pressure reducing valve and/or a back flow preventer, creating a "closed system." As the heated water expands, it creates a pressure buildup in the closed system. This may cause the T&P (temperature and pressure) relief valve to weep and/or discharge water. To prevent this, an expansion tank must be installed in the cold water supply line.

Size the expansion tank to 10% of the water heater's capacity.

Example: Heater capacity = 30 gallons / 10% requires a minimum three-gallon tank.

Note: For commercial and farm applications, consideration should be given to piping size and capacity.

Always check with the manufacturer of the expansion tank for sizing.

HAIR SALONS

The size of water heating equipment for a hair salon is based on the number of basins used. Because most hot water is used for washing hair, assume each station or chair uses 12 gallons of hot water per hour based on each shampoo lasting five to six minutes with a maximum of four shampoos per hour per basin. If in doubt, refer to Table 12 below.

TABLE 12

Hair Salon Sizing

CHAIRS	GAS	OIL & PG	ELECTRIC
1-6	1 - EZ75-135	1 - 51E/PG	1 - 15KW
7-8	1 - EZ75-135	1 - 71E/PG	1 - 40KW
9-14	1 - EZ100-199	1 - 72E/PG	2 - 30KW
15-27	2 - EZ75-135	1 - 361E/PG	2 - 54KW
28-35	2 - EZ100-199	1 - 541E/PG	3 - 54KW
36-49	3 - EZ100-199	2 - 361E/PG	4 - 54KW
50-70	4 - EZ100-199	2 - 541E/PG	6 - 54KW

Heater size is based on the number of stations/chairs, with incoming water at 40°F and delivered temperature at 140°F.

Sizing is based on a 100°F rise in water temperature. For a lower rise, multiply the number of stations/chairs by the appropriate factor before determining the water heater requirement.

Example: For a 90°F rise in water temperature, multiply the number of stations by .90. For an 80°F rise, multiply the number of stations by .80.

Washing machines for laundry should be sized according to the self-service laundry section on page 25.

Important:

Corrosive products such as hair spray must be kept away from water heating equipment. When mixed with combustion products, such products can become very aggressive and may actually corrode the heater from the outside in.

Make sure that ample fresh outside air is supplied to the heater and that the boiler room door is always closed off from aromatic sprays.

BARBER SHOPS

Although less hot water is used to wash men's hair than women's, more high temperature water is used for hot towel applications during a shave. Use the same calculations and table as for hair salons.

CAR WASHES

Most car washes use 110°F water to protect auto finishes, although slightly hotter water may be used to clean tires. A storage tank is recommended and should be set to the highest temperature required for the system. If wheels and tires are washed with water power, storage temperatures can range from 160°F to 180°F and mixed with cold water.

Caution: In cold climates, higher temperature water delivered under pressure will vaporize and turn to steam before reaching the vehicle. In northern climate winter, ice removal can be accelerated by pre-rinsing the vehicle with 120°F water.

Important:

The water heater must be supplied with fresh, outside air and the boiler room door must be kept closed to protect the heater from detergent fumes and aromatic car "freshener" fumes. When mixed with combustion products these fumes will inhibit good combustion and can corrode a heater from the outside in.

PLACES OF WORSHIP

Hot water requirements for places of worship will be determined by the largest use, usually food preparation and/or dish washing. If the building is equipped with a machine dishwasher, the hot water requirement will be found in Table 17, pages 25 - 27. If the building does not have a machine dishwasher, base the requirement on two gallons of hot water per person per meal served.

Example: The building has five showers, each rated at 4 GPH flow, 10-minute use; six sinks; and a 2-E Blakeslee dishwasher.

General Purpose Water:

Showers: 5 x 4 x 10 =200 gallons

Sinks: 6 x 5 =30 gallons

TOTAL REQUIREMENT230 gallons

(may be accomplished using storage)

Food Service (from Table 17,

2-E Blakeslee dishwasher, 140°F general purpose; 180°F rinse water, 288 gallons (pre-rinse: 180 gallons)

Food service (the largest requirement) will also be adequate for shower and sink use, as use normally occurs at other times.

Use two Bock Model EZ100-199 as preheaters and a Model EZ75-135 as a 180°F booster, **or** two Model 241E or 241PG with a 71E or 71PG as a booster.

Without a machine dishwasher, the requirements are:

Showers, 5 x 4 x 10 = 200 gallons

Sinks, 6 x 5 = 30 gallons

Food service, 250 x 1/2 = 125 gallons
(1/2 gallon per person per meal)

Showers (the largest requirement) will also be adequate for food service use, as use normally occurs at other times.

Use one Bock Model 75W-300SD, one 361E, one 361PG or one 118C-54 electric.

The application for a baptistry tank is similar to a swimming pool except the warm-up period is shorter, there is no filter or pump and the tank is drained between baptismal services. The desired temperature is usually 80°F to 100°F but may vary. Refer to the Swimming Pool section of this manual on page ___ for sizing information.

SCHOOLS

Because water heating requirements may use between 5% and 15% of the total energy consumed in a school, proper sizing with efficient systems is very important. Normally, efficient systems follow these principles:

1. Schools may have several hot water requirements such as the gymnasium, cafeteria, clean-up and general purpose use. Separate water systems should be used for each application, with the system located as closely as possible to the end use to avoid long pipe runs of hot water lines.
2. Insulate all hot water lines and storage vessels.
3. The thermostat settings should be lowered to 120°F on water heaters used for general purposes and clean-up.
4. Use booster heaters for cafeteria applications requiring 180°F water for machine dishwashers, but heat only the water used for the sanitizing rinse.

Method of Sizing

There are two methods of sizing the hot water requirements of schools. The first is more exacting and will provide a more energy-efficient system by using a separate system for each requirement. The second is if a single system is used for all requirements and there are not extraordinary hot water demands such as after-school athletic use.

Sizing by individual hot water requirements is recommended, rather than sizing by the number of students. It classifies hot water requirements into three categories:

1. General purpose use
2. Cafeteria use
Use the food service section of this manual for school cafeteria sizing.
3. Gymnasium shower use
 - A. Schools with showers used only for gym class have relatively stable hot water requirements and are used about 10 minutes per hour with a 50-minute recovery time between shower intervals. Sink hot water requirements are typically low. Size these applications by the number of shower heads to be serviced and their flow rates.
 - B. Schools with moderate after-school use, such as basketball practice and wrestling require longer shower periods. Size for 20 minutes of continuous shower flow.
 - C. Schools with heavy after-school use, such as football practice and larger athletic events should be sized for a 30-minute shower period and long recovery time. A water heating system with a large external storage tank can be used.

Gymnasium Unit Method Sizing

To determine the sizing for school gymnasium use, use the following factors:

1. Number of shower heads.
2. Flow rate of the shower heads. New facilities will have shower heads at 2 1/2 GPM; older buildings may have much larger shower heads.
3. Temperature rise – the required temperature of hot water less the temperature of incoming cold water.
4. Type of use: light, moderate or heavy.

Example:

20 shower heads, 3 GPM flow rate, 20-minute usage per shower head.

$20 \times 3 \times 20 = 1,200$ gallons per 20-minute shower requirement

Five sinks: 5 GPM usage.

$5 \times 5 = 25$ GPH sink requirement

Bradley Washfountain: One 36-inch full-size 4 GPM flow rate, 10 minute usage per hour.

$4 \times 10 = 40$ gallons per 10-minute washfountain requirement

TOTAL REQUIREMENTS:

$1,200 + 25 + 40 = 1,265$ gallons per 20-minute demand period

For this requirement, use one Bock Model 250-800 heater with a 1,000-gallon storage tank. A single 250 will provide 527 gallons of hot water in 20 minutes at 90°F rise. The additional 738 gallons are obtained from the 75% usable storage in the 1,000-gallon storage tank.

Caution: For peak demands beyond normal use go to larger storage.

For schools with swimming pools see the Swimming Pool sizing section of this manual, page 27.

INDUSTRIAL PLANTS

In small industrial plants all hot water needs can be supplied from a central installation.

For better economy and service in larger plants, hot water should be provided from individual installations at each use location.

To determine industrial hot water requirements, group the outlets first. If a central location is advisable, the hot water load for all uses should be totaled and equipment sized accordingly.

If individual locations at points of use is more advisable, size each area's requirements separately.

General purpose hot water for showers and Bradley Washfountains should be based on 100% flow for 10 minutes (see Table 13, page 21).

Hot water for sinks and slop sinks is based on gallons per hour (see Table 12, page 18).

For special applications such as washing, cleaning or product processing, rate of flow times length of use should be determined to give the total requirement. Using this total, Tables 33 - 50, pages 58 - 75 can be used to size the water heater(s).

Example, Small Plant

A small industrial plant has one 54-inch Bradley Wash-fountain, four sinks and one slop sink.

Washfountain: 7 GPM flow rate for 10 minutes usage.
 $7 \times 10 = 70$ gallons

Sink: 5 GPH usage.

$$4 \times 5 = 20 \text{ gallons}$$

Slop sink: 20 GPH usage.

$$1 \times 20 = 20 \text{ gallons}$$

TOTAL USAGE:

$$70 + 20 + 20 = 110 \text{ gallons for 10-minute demand}$$

For this requirement use one Bock Model 241E or 241PG. Refer to Tables 33 - 50, pages 58 - 75.

Example, Large Plant

A large industrial plant has two 54-inch Bradley Wash-fountains and eight shower heads.

Shower heads: eight, each with 2.5 GPM flow rate, 10-minute usage.

$$8 \times 2.5 \times 10 = 200 \text{ gallons per 10-minute usage}$$

Bradley Washfountains: Two 54-inch washfountains, 7 GPM flow rate, 10-minute usage each.

$$2 \times 7 \times 10 = 140 \text{ gallons per 10-minute usage.}$$

TOTAL USAGE:

$$200 + 140 = 340 \text{ gallons in 10 minutes.}$$

Use two 541PG or 541E water heaters manifolded.

DAIRY BARNS

Most dairy barn applications require 180°F water for sterilizing procedures. A large volume of water may be required in a short time span so a storage tank should be used. Where a Bock is replacing an existing electric water heater, if the tank is in good condition it can be used for storage.

Note: The standard operating controls on models 51E/PG and 71E/PG are not designed for this application and must be ordered from the factory equipped to provide 180°F water. Bock 30- and 40-gallon units cannot be used in this application.

CARE CENTERS, DORMS, OFFICE BUILDINGS, CLUBS

When referring to relevant tables, remember that there are additional considerations in determining the hot water needs for each of the following installations:

Assisted Living Facilities

Water heater sizing in this section addresses the hot water necessary for baths, showers, sinks, laundry, general cleaning and kitchen use. 180°F water for machine dish-washing should be provided by a separate booster heater. The ASHRAE Guide indicates the need for 4.5 gallons of hot water per bed per maximum hour and 30 gallons per bed per day. Use caution in determining requirements.

Bock highly recommends the installation of anti-scald or mixing valves to maintain 120°F water – water temperatures in excess of 120°F can cause scalding, serious injury or death.

Office Buildings

Sizing is based on hot water requirements for cleaning and lavatory use of occupants and visitors. Food service should be sized separately according to the Food Service section of this manual on page 23. Reasonable fuel economy can be achieved through the use of a time clock (a Paragon or the equivalent) that shuts off the water heater on weekends.

Dormitories

Food service is not included in dormitory sizing and must be considered separately. The hot water consumption at a dorm is based on a one-hour peak demand.

Country Clubs and Health Clubs

Country club use is similar to school gymnasiums, except that such clubs have their heaviest demand during weekends and summer months. To size for clubs, refer to the school gymnasium format, page 19.

Restaurants at clubs should be sized using Tables 16 and 17. Size for swimming pools using the Swimming Pool guide on page 27.

TABLE 13

Sizing for Dormitories

100% RECOVERY AND NO EXTRA STORAGE AT 70°F

NO. OF MEN	NO. OF WOMEN	PEAK LOADS	OIL MODEL	POWER GAS MODEL	ATMO. GAS MODEL	ELECT. MODEL
15	10	50 GPH	32E	32PG	EZ75-135	82C-15
	15	75 GPH	32E	32PG	EZ75-135	82C-18
25	20	100 GPH	32E	32PG	EZ75-135	82C-24
30	25	125 GPH	32E	32PG	EZ75-135	82C-36
40	30	150 GPH	51E	51PG	EZ75-135	82C-36
	30	160 GPH	51E	51PG	EZ75-135	82C-45

Table 13 continued in next column ...

... **TABLE 13** continued

Sizing for Dormitories

100% RECOVERY AND NO EXTRA STORAGE AT 70°F

NO. OF MEN	NO. OF WOMEN	PEAK LOADS	OIL MODEL	POWER GAS MODEL	ATMO. GAS MODEL	ELECT. MODEL
40	35	175 GPH	51E	51PG	EZ75-135	82C-45
45	35	180 GPH	51E	51PG	EZ75-135	82C-45
50	40	200 GPH	51E	51PG	EZ75-135	82C-45
55	45	225 GPH	71E	71PG	80W-180SD	82C-54
	50	250 GPH	72E	72PG	80W-180SD	82C-54
65	55	275 GPH	72E	72PG	EZ80-156	---
	60	300 GPH	72E	72PG	EZ100-199	---
80	65	325 GPH	241E	241PG	80W-250SD	---
	70	350 GPH	241E	241PG	100W-250SD	---
94	75	375 GPH	241E	241PG	75W-300SD	---
100	80	400 GPH	241E	241PG	75W-300SD	---
	85	425 GPH	241E	241PG	75W-300SD	---
112	90	450 GPH	361E	361PG	75W-300SD or 66W-370SD	---
125	100	500 GPH	361E	361PG	80W-399SD	---

TABLE 14

Hot Water Requirements for Fixtures and Machines

TYPE OF FIXTURE OR MACHINE	FLOW RATE	DEMAND	TEMPERATURE
BATHTUB	4 GPM	20 GPH	120°F to 110°F
SINK	3 GPM	5 GPH	120°F to 110°F
CIRCULAR WASH FOUNTAIN, 54" DIAMETER	7 GPM	70 GPH	120°F to 110°F
SEMICIRCULAR WASH FOUNTAIN, 54" DIAMETER	3.5 GPM	35 GPH	120°F to 110°F
5-IN-A-GROUP SHOWER	12.5 GPM	125 GPH	120°F to 110°F
3-IN-A-GROUP SHOWER	7.5 GPM	75 GPH	120°F to 110°F
CORNER SHOWER	5 GPM	50 GPH	120°F to 110°F
CIRCULAR COLUMN SHOWER	12.5 GPM	125 GPH	120°F to 110°F
SEMI-CIRCULAR COLUMN SHOWER	7.5 GPM	75 GPH	120°F to 110°F
HAIR SALON FIXTURE/STATION	3 GPM	12 GPH	120°F to 110°F
BARBER SHOP LAVATORY	3 GPM	5 GPH	120°F to 110°F
RESTAURANT AUTOMATIC DISHWASHER	4 GPM	7 GPH	140°F
MOP SINK	3 GPM	15 GPH	140°F
BAR SINK	3 GPM	25 GPH	140°F
SINGLE POT SINK	4 GPM	25 GPH	140°F
DOUBLE POT SINK	4 GPM	50 GPH	140°F
TRIPLE POT SINK	4 GPM	75 GPH	140°F
VEGETABLE SINK	4 GPM	40 GPH	140°F
HANDSPRAY DISH PRE-RINSE	4 GPM	45 GPH	140°F
BRUSH-TYPE DISH PRE-RINSE	3 GPM	180 GPH	140°F
CONVEYOR DISH PRE-RINSE *	4 GPM	240 GPH	140°F
AUTOMATIC 9 LB. TO 12 LB. CLOTHES WASHER	5 GPM	36 GPH	160°F
STATIONARY RACK DISHWASHING MACHINE	SEE FOOD SERVICE SECTION		140°F TO 180°F
CONVEYOR DISHWASHING MACHINE	SEE FOOD SERVICE SECTION		140°F TO 180°F

* May be built into dishwasher; frequently used as separate appliance

CAUTION: 180°F water generated by the heating system should be connected only to the rinse inlet of the dishwasher and possibly to the wash tank fill. The pre-wash or scrapping section of the dishwashing operation and the general purpose sinks throughout the kitchen should not receive any water hotter than 140°F unless local health regulations require one pot sink to be serviced by 180°F water. If so, the faucet should be clearly marked.

WARNING! 180°F water can cause scalding, serious burns and death!

TABLE 15

Shower Head by Manufacturer's Model

NOTE: Federal law limits all new shower heads to 2.5 gallons per minute

MANUFACTURER	MODEL	GPM (105°F) NORMAL FLOW
ALSONS	44PB	2.0
	110DPB	2.0
	605	2.75
AMERICAN STANDARD	BOYD	9.5
	CADET SPS 1411	2.5
	HERITAGE N 1301-03	9.3
	VICTOR R 1311-13	5.5
BRIGGS	17T-8610	5.5
	T-8612	5.5
CENTRAL BRASS	3033	3.0
CHASE BRASS	188.355	10.0
CHICAGO FAUCET	620 FC	2.75
	Brown 620-B	8.0
CITADEL	C2209	2.75
CRANE	9-221	3.0
	9-238	5.5
	9-250	8.0
	9-251	8.0
	ECONOMY 8-2564	3.5
	ECONOMY 9-221	3.0
	RAINBEAU 9-238	5.5
	RAINBEAU 8-2556	5.5
	CAPRI 8-2550	8.0
DEARBORN BRASS	DEARBORN	7.5
DELTA	ALL	2.75
DOLE VALVE	2 S	2.0
	3 S	3.0
	4 S	4.0
	2-1S	2.0
	3-1S	2.0
	1	NOT RATED
	3	NOT RATED
DUURMEER	NO. 19	5.6
	NO. 60	9.1
ELJER	E-9115	6.0
FEDERAL HUBER	FEDERAL HUBER	NOT RATED
GYRO BRASS	GYRO-MANY STREAM	NOT RATED
HARVEY MACHINE	HARCRAFT B-2	8.0
INDIANA BRASS	INDIANA BRASS	7.5
KOHLER	K-7325	NOT RATED
	K-7332	NOT RATED
	K-7350	7.0
	K-7370	7.5
LEONARD	HO1	3.0
	HO2	2.0
LOGAN	C-10-2S	2.0
	500 SERIES	2.0
	WIZARD STD. HEAD	2.4 to 3.5
	WIZARD LOW PRES. HEAD	3.5 to 6.0

MANUFACTURER	MODEL	GPM (105°F) NORMAL FLOW
MAGIC FOUNTAIN	DIAPHRAGM	2.8
	MAGIC FOUNTAIN	3.0
MILWAUKEE FAUCET	K-3682 A	3.5
	CATALINA	3.5
	PREMIER	3.5
MOEN	3905	2.75
	3900 A	2.75
NOLAND	CITATION NO. 1 DELRIN	4.0
ONDINE	28446	2.75
REPCAL BRASS	B-1447	4.0
	B-1427	5.0
	HYDRO JET	4.2
	PRESTO	5.0
SCOVILLE	1466	7.0
SEARS	HOMART 2055	10.5
	HOMART 2080	5.5
	HOMART 2091	NOT RATED
SLOAN VALVE	NO. 1 STANDARD ACT-O-MATIC	4.5
	NO. 2 FINE SPRAY ACT-O-MATIC	3.6
	NO. 3 NEEDLE SPRAY ACT-O-MATIC	3.0
	ACT-O-MATIC AC-10	5.5
SPEAKMAN	1-S-2240	4.5
	2-S-2240	4.5
	3-S-2240	2.5
	S-2250	9.0
	ANY STREAM NO. 1 S-2250	7.0
	ANY STREAM NO. 2 S-2250	6.0
	ANY STREAM NO. 3 SS-2250	8.0
	ANY STREAM MODEL 1 SS-2250	6.0
	ANY STREAM MODEL 2 SS-2250	4.0
	ANY STREAM MODEL 3	
	S-2245	4.5
	S-194	6.0
	15-031	6.0
STERLING FAUCET		
SURE FLOW BRASS	NO. 35	3.0
	NO. 36	4.5
SYMMONS INDUSTRIES	CLEAR-FLO	3.5 to 7.0
	SUPER-FLO	4.0 to 9.0
UNIVERSAL RUNDLE	8-1245	4.0
WRIGHTWAY	BUBBLE STREAM	4.0

FOOD SERVICE ESTABLISHMENTS

When supplying hot water for food service establishments the water heating system must be adequate to meet the maximum probable demand, regardless of whether the peak period exists for just one hour or much longer. The system must be capable of supplying hot water at two temperatures: 140°F for general purpose water and 180°F for sanitizing water.

Sanitizing water must be maintained at 180°F or higher for the sanitizing rinse of all tableware in restaurants and other food service establishments to insure satisfactory bacteria reduction and to promote rapid air drying. Most health department codes specify a 180°F rinse of tableware. The amount of hot water to be supplied will be governed by meal-serving capacity and the dishwashing equipment being used.

As food service establishments vary considerably in size and dish washing methods range from individual hand washing to the largest continuous-feed automatic dishwashing machines, hot water requirements range from a residential water heater to the largest commercial units.

Additionally, peak demands of dishwashing machines also vary widely and are not generally a consistent factor of the number of meals served during any given period. Table 17 has been formulated to help the architect, engineer, builder or installer to quickly determine the appropriate Bock water heater according to the type of dishwashing being used.

Machine Dishwashing

To make the selection of water heating equipment as simple as possible, Table 17, pages 25-27, lists various models of dishwashing machines and the recommended Bock water heaters needed to meet requirements. Similar requirements of makes not listed in the table can be compared to like requirements that are listed.

Installation Issues

1. A flow pressure of 20 PSI is ideal for a satisfactory rinse. A flow pressure above 20 PSI would cause atomization of the rinse spray and unsatisfactory flushing of washing solution residue from the dishes and tableware. Temperature of the dishes would not be maintained at a level capable of destroying harmful bacteria. An uncontrolled rate of flow would also waste hot water and the heating system would probably be incapable of meeting the unanticipated demand for hot water or maintaining proper temperature. The installation of pressure regulators is strongly advised when the line pressure (flowing) exceeds 20 PSI.
2. The booster providing 180°F water should be located as close to the dishwasher as possible to minimize heat loss in the pipe run, thereby assuring 180°F water at the dishwasher. All hot water piping should be insulated to a 3/4" minimum.

Example: A restaurant serving 200 to 400 meals daily. A Blakeslee Model I-ER dishwasher is specified.

Refer to Table 17 to find the manufacturer of this specified machine and the Bock water heating equipment required to furnish 180°F water. Bock models required to boost the water temperature from 140°F to 180°F are found in Table 17, Section A (if 140°F water is available).

To determine the amount of 140°F general purpose water necessary for the restaurant, refer to Table 17 and size the additional load for the pre-scrapper, pot sinks, etc. If possible, use one water heater to supply all the 140°F general purpose water, plus the 140°F water to be furnished to the dishwasher. Water temperature will be boosted to 180°F by a second water heater. To size, total the general purpose water (for sinks, pot washers, cleaning, etc.) from Table 17 and add this to the total amount of 180°F water required for the specific dishwasher shown in Table 17, Section A.

Example: Small installations

It may be desirable to select one water heater for all 180°F requirements and install a mixing valve to supply 140°F water. (Recirculating, holds temperature more steady, could be on a manual switch.)

Tray-type dishwasher

Tray-type dishwasher sizing can be estimated assuming that the average 60-tray single tank will require 90 GPH of 180°F water. Fifty trays will require 75 GPH of 180°F water, 40 trays 60 GPH. Approximately 1 1/2 times the number of trays per hour determines the gallons of 180°F water needed per hour.

TABLE 16

Water Mixing Valves

Temp. of mixed water	Percentage of hot water automatically mixed with cold water to obtain the desired outlet temperature.						
	COLD WATER SUPPLY						
	40°F	50°F	60°F	70°F	80°F	90°F	100°F
180°F	—	—	—	—	—	—	—
170°F	92.8	92.3	91.7	90.9	90	88.8	87.5
160°F	86	85	83.3	82	80	78	75
150°F	78.5	76	75	73	70	67	62.5
140°F	71	69	67	64	60	55.5	50
130°F	65	61.5	58	54.5	50	44	37.5
120°F	57	54	50	45	40	33	25
110°F	50	46	41.5	35	30	21	12
100°F	43	38	33	27	20	11	11

TABLE 17

MACHINE DISHWASHING REQUIREMENTS

MAKE & MODEL NUMBER	180°F WATER REQUIRED GPH	A BOCK WATER HEATER MODEL TO BOOST EXISTING 140°F WATER TO 180°F				B BOCK WATER HEATER MODEL TO SUPPLY 180°F AT 140°F RISE			
		OIL	ELEC.	GAS	POWER GAS	OIL	ELEC.	GAS	POWER GAS
ADAMATION									
10-20	234	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-100W-199SD	1-361PG
CA-4 SUPER WASH	288	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-100W-300SD	2-73PG
SL-1390	294	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-65W-370SD	2-73PG
CSL-1390	294	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-65W-370SD	2-73PG
CA,CA-1	417	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-80W-505SD	2-361PG
CA-2, CA-4	417	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-80W-505SD	2-361PG
SL-3, CA2M	420	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-80W-505SD	2-361PG
AMERICAN DISH SERVICE									
AHC, L90-3DW, WC, ET-AH	44	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
AC, ETA	51	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
AH, L72-3DW, WC	55	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
HT-25	61	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
A, AFC, AFC-3D, AF-3D (10SEC), L60-3DW, WC, AF, AFC-3D, AF-3D (90 SEC)	68	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
AF-B	88	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-EZ75-135	2-73PG
5AH	101	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	1-40KW	1-EZ80-156	1-72PG
ADC-44	120	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	2-40KW	1-EZ80-156	1-72PG
5	126	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	2-40KW	1-EZ80-156	1-72PG
5AG	168	1-51E	1-24KW	1-EZ80-156	1-51PG	1-72E	2-40KW	1-EZ80-156	1-72PG
BLAKESLEE									
UC-21, D-9	35	1-51E	1-15KW	1-EZ75-135	1-51PG	1-32E	1-24KW	1-EZ75-135	1-51PG
D-8, D8-LT	72	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-27KW	1-EZ75-135	1-51PG
A-7, B-7, BC7, D7, DC7	117	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	2-40KW	1-EZ80-156	1-72PG
DOUBLE D-8, DOUBLE D8-LT, R-L, R-M, R-PL, R-PM, FA-L, FA-M, FA-PL, FA-PM	144							1-EZ75-135	
RA-L, RA-M, RA-PL, RA-PM	282	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-100W-300SD	2-73PG
F-L, F-M, F-PL, F-PM, R-CC, R-EE, R-LL, R-MM	282	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-100W-300SD	2-73PG
FA-EE, FA-LL, FA-MM, RA-EE, RA-LL, RA-MM, R-PCC, R-PEE, R-PLL, R-PM, FA-PEE, RA-PLL, RA-PMM, RA-PEE, RA-PLL, RA-PMM, R-EEE, R-LLL, R-MMM, FA-333, FA-LLL, FA-MMM, RA-EEE, RA-LLL, RA-MMM, F-EE, F-LL, F-MM, F-PEE, F-PLL, F-PMM, F-EEE, F-LLL, F-MMM, XF-EE, XF-LL, XF-MM, XF-PEE, XF-PLL, XF-PMM	288	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73PG	2-54KW	1-100W-300SD	2-73PG
2-E, 2-ER, 2-L, 2-LR, 2-M, 2-MR, 3-E, 3-L, 3-M, F2-E, F2-ER, F2-L, FA2-L, F2-LR, FA2-LR, F2-M, FA2-M, F2-MR, FA2-MR, F3-E, FA3-E, F3-L, FA3-L, F3-M, FA3-M	288	1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-100W-300SD	2-73PG
XF-LLL, XF-XMM	360	1-72E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-40KW	1-80W-450SD	—
1-E, 1-ER, 1-L, L-LR, 1-M, 1-MR, F1-E, F1-ER, F1-L, F1-R, F1-M, F1-MR, XFA2-E, XF2-ER, XFA2-ER, XF2-L, XFA2-L, XF2-LR, FA2-LR, XF2-M, XFA2-M, XF2-MR, XFA2-MR, XF3-E, XFA3-E, XF3-L, XFA3-L, XF3-M, XFA3-M	420	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-150G-400	3-361PG
XF1-E, XFA1-E, XF1-ER, XFA1-ER, XF1-L, XFA1-L, XF1-LR, XFA1-LR, XF1-M, XFA1-M, XF1-MR, XFA1-MR	720	1-361E	2-36KW	2-EZ75-135	1-361PG	3-361E	5-54KW	1-200G-850	3-361PG
XF-MMM, XF-L, XF-M, XF-PL, XF-PM	720	1-361E	2-36KW	2-EZ75-135	1-361PG	3-361E	5-54KW	1-200G-850	3-361PG
CHAMPION									
U-HB, UH1	33	151E	1-15KW	1-EZ75-135	1-51PG	1-32E	1-24KW	1-EZ75-135	1-51PG
TUW	37	151E	1-15KW	1-EZ75-135	1-51PG	1-32E	1-24KW	1-EZ75-135	1-51PG
U-LD	44	151E	1-15KW	1-EZ75-135	1-51PG	1-32E	1-24KW	1-EZ75-135	1-51PG
D-HB, D-H1, D-LF	66	151E	1-15KW	1-EZ75-135	1-51PG	1-32E	1-24KW	1-EZ75-135	1-51PG
T-6A, T-7A, T-7AC	74	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-27KW	1-EZ75-135	1-51PG
1-KAB, 1-KACB	107	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	1-40KW	1-EZ80-156	1-72PG
44WS, 66WS, 64KB, 64-KPRB	130	151E	1-15KW	1-EZ75-135	1-51PG	1-51E	—	1-EZ75-135	1-51PG
40K Series, 60K Series, PR-96, PR-120	282	1-51E	1-30KW	1-EZ75-135	1-51PG	1-73E	2-54KW	1-100W-300SD	2-73PG
64K Series	348	1-71E	1-36KW	1-EZ80-156	1-71PG	1-361E	3-40KW	1-80W-425SD	—
20K Series, 30K Series	416	1-72E	1-40KW	1-EZ80-156	1-72PG	1-150-400E	3-54KW	1-150G-400	—
UC Series	426	1-72E	1-45KW	1-EZ80-156	1-72PG	3-361E	3-54KW	1-80W-505SD	2-361PG

TABLE 17

MACHINE DISHWASHING REQUIREMENTS

MAKE & MODEL NUMBER	180°F WATER REQUIRED GPH	A BOCK WATER HEATER MODEL TO BOOST EXISTING 140°F WATER TO 180°F				B BOCK WATER HEATER MODEL TO SUPPLY 180°F AT 140°F RISE			
		OIL	ELEC.	GAS	POWER GAS	OIL	ELEC.	GAS	POWER GAS
CHAMPION, cont.									
40KB, 4-PKRB, 44KB, 44-KPRB, KL-44, KL-66	300	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-65W-370SD	——
54-KB, 54-KBRP	325	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-65W-370SD	——
UC-C	336	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-65W-370SD	——
UC-CW	425	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-65W-625SD	2-361PG
W-6	852	2-71E	——	1-65W-625SD	——	2-150E-400	——	1-250G-1000	——
FOOD EQUIPMENT DIVISION- McGRAW-EDISON									
TKM-20	60	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
TKM-27, TKMC-27	116	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	1-40KW	1-EZ80-156	2-72PG
TKM-215 thru TKM-324	414	1-72E	1-40KW	1-EZ80-156	72PG	2-361E	3-54KW	1-80W-505SD	2-361PG
TKM-44, TKM-66R	420	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-80W-505SD	2-361PG
TKM-64 thru TKM-115	624	1-241E	2-30KW	2-EZ75-135	1-241PG	1-200E-650	4-54KW	1-150G-800	——
GENERAL ELECTRIC FOOD SVC. EQPT.									
3T-30B, SK-10B, SK-30B	77	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-27KW	1-EZ75-135	1-51PG
50-20, SK Series, 50SMT	103	1-51E	1-15KW	1-EZ75-135	1-51PG	1-71E	1-36KW	1-EZ80-156	1-71PG
115-20, 165-20, 225-20, 275-20	282	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-100W-300SD	2-361PG
SS64B, SS80B, SS86B, SS102B, SS100B, SS116B	300	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-165W-370SD	1-361PG
SS40B, SS48B, SS62B, SS70B, SS76B, SS84B	426	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-200G-450	2-361PG
HOBART									
WM Series	68	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
UM Series	70	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
AM Series, LM-3T3	122	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	1-45KW	1-EZ80-156	1-72PG
C-64, CRS-86, FR-64, FRC-64, CPW-100, C-81, CRS-103, FR-81, FRC-81, CWS-103, CPW-117, CS-100, CS-117	282	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-100W-300SD	1-361PG
FT-200, 300 and 500 Series	348	1-71E	1-36KW	1-EZ80-156	1-71PG	1-361E	3-40KW	1-80W-450SD	——
C-44, CRS-66, CWS-66, CPW-80, C-54CRS-76, FR-54, FRC-54, CWS-76, CPW-90, FT-400 Series	450	1-72E	1-45KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-200G-450	2-361PG
INSINGER									
45SA5-F1, 45SA5-F2	36	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
Ensign 40-2, 45SA	61	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
Ensign 40-2, Ensign 60-2oM-NSU, 85- 20M, 135-20M-NSU, 185-20M-NSU	61	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
Commander 18-4, Commander 18-4C, Commander 18-4H	65	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
CA-3	70	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
Commodore 15, commander 18, 50SA	120	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	1-45KW	1-EZ80-135	7-72PG
Admiral 44, Admiral 66-3	210	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-200G-180	1-361PG
250-20M-NSU	220	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-EZ100-199	1-361PG
Speeder 65, Speeder 86-3	222	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-200G-180	1-361PG
Clipper (all)	222	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-100G-180SD	1-361PG
Century 14	228	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-100W-250SD	1-361PG
Speeder 5, Speeder 86-1, Clipper 9, Clipper 96-1, Super 8, Super 106-1, Super F-106-1, Master 165-DA-3, 60-DA, 85-DA, 85-DA7, 116DA, 135DA, 165-DA, 185-DA, 225-DA, 250-DA, 275-DA	300	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-65W-370SD	——
Super 106-2	300	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-65W-370SD	——
Defender (all)	306	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-65W-370SD	——
Clipper RC-16 FPW thru RC-21 FPW, Clipper RC16 RPW thru RC-21 RPW, Master RC-18 thru RC-33, Master RC-18 FPW thru RC33 FPW, Master RC-18 RPW thru Master RC-33 RPW	312	1-51E	1-36KW	1-EZ75-135	1-51PG	1-361E	2-54KW	1-65W-370SD	——
Master (all)	360	1-72E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-40KW	1-80W-425SD	——
Admiral 120-5, Admiral 120-7, Admiral 60-2, Admiral 66-2	416	1-72E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-80W-505SD	2-361PG
MiniFlite S-9 thru S-12, Admiral RC-12 FPW thru RC-20 RPW	480	1-73E	1-54KW	1-EZ100-199	1-73PG	2-361E	3-54KW	1-200G-450	2-361PG

TABLE 17

MACHINE DISHWASHING REQUIREMENTS

MAKE & MODEL NUMBER	180°F WATER REQUIRED GPH	A BOCK WATER HEATER MODEL TO BOOST EXISTING 140°F WATER TO 180°F				B BOCK WATER HEATER MODEL TO SUPPLY 180°F AT 140°F RISE			
		OIL	ELEC.	GAS	POWER GAS	OIL	ELEC.	GAS	POWER GAS
Clipper RC-16-EW-2 thru RC-31 RPW-EW-2, Clipper RC-16 RPW-EW-3 thru RC-31 PRW-EW-3, Master RC-18 RPW-EW-3 thru RC-33 RPW-EW-3, Master HRC-	480	1-73E	1-54KW	1-EZ100-199	1-73PG	2-361E	3-54KW	1-65W-625SD	2-361PG
JACKSON									
10A, 10AB, 10APRB, 10APRB-H, 50APR, 50APRB, JV-24A, JV-24AF, JB-24B, JV-24BF		1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
JL-100A, JL100G, JL-100, JL100PRB, JL-100PR		1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-72E	1-EZ80-156	1-72PG
J-44, SJF-44, 39C, 44-C		1-72E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-80W-505SD	2-361PG
4-A, DJF-48, 4-ARD, 6-A, DJF-60, 6-ARD, ROTO DR JR, DJF-64, 1323 thru 2673 (Suffix "B" models have integral booster)		1-51E	1-30KW	1-EZ75-135	1-51PG	2-73E	2-54KW	1-EZ75-135	2-73PG
JP-24 Series	26	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
24LT Series	29	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
200 Series	52	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
Temp Star, SDS	52	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
Conservor II	60	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
Conservor I	111	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	2-40KW	1-EZ80-156	1-72PG
10 Series	234	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-100W-250SD	1-361PG
AJ-44, AJ-66, AJ-80 Vision Series	234	1-51E	1-24KW	1-EZ75-135	1-51PG	1-361E	2-40KW	1-100W-250SD	1-361PG
MOYER DIEBEL									
501LT, 501HT									
MD-18 Series									
MH6-L, MH60									
501HTN	37	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
MH6N	66	1-51E	1-15KW	1-EZ75-135	1-51PG	1-51E	1-24KW	1-EZ75-135	1-51PG
STERO									
SF-1RA, SF-2RA, SF-2DRA, SDRA, SD-2RA	103	1-51E	1-15KW	1-EZ75-135	1-51PG	1-71E	1-36KW	1-EZ80-156	1-51PG
SCT-44, SCT44-10, SCT-76S, SCT-76SC, SC-1-SCT-44, SC-1-SCT-44-10, SC-1-SCT-54, SC-2-4, SC-6-4, SC-1-2-4, SC-1-6-4, SC-5-6-4	417	1-51E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-80W-505SD	1-51PG
SCT-64, SCT-76, SCT-80, SCT-94, SCT-94S, SCT-95SC, SCT-108S, SCT-108SC, SCT-108, SCT-120, SCT-120SM, SCT-120S, SCT-120SC, SCT-05SM, SC-1-SCT-64, SC-1, SC-76, SCT-80, SCT-94, SCT-108, SCT-120, SC-5, SCT-64	277	1-51E	1-27KW	1-EZ75-135	1-51PG	1-241E	3-40KW	1-100W-300SD	2-51PG
SC-2-3-4, SC-6-3-4, SC-2-7-4, SCT-44, SC-3-4, SCT-44-10SC-3-4, SCT-54SC-3-4, SC-1-2-7-4, SC-1-6-3-4, SC-5-2-3-4, SC1-6-7-4, SC5-6-3-4, SC-5-2-7-4, SCT-76S-SC-3-4, SCT-44SC-1-3-4, SCT-44-10SC-1-3-4, SCT-54SC1-3-4	295	1-51E	1-30KW	1-EZ75-135	1-51PG	1-361E	3-54KW	1-65W370SD	1-361PG
SCT-76SM, STPC-15, STPEC-18, STPEC-19, STPEC-19PS, STPEC-20, STPC-22, STPEC-24, STPEC-24D, STPEC-26, STPEC-26D	330	1-72E	1-36KW	1-EZ75-135	1-71PG	1-361E	2-54KW	1-65W-399SD	1-361PG
STPCW-15 thru STPCW-26	390	1-72E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-40KW	1-80W-505SD	—
STPC-10, STPC-12HS, STPC-12PS	465	1-73E	1-54KW	1-EZ100-199	1-73PG	1-200E-450	4-54KW	1-200G-450	—
STPCW-10, STPCW-12HS, STPCW-12PS, STPCW-15HS, STPCW-15PS	576	1-241E	2-30KW	—	1-241PG	1-150E-600	4-54KW	1-200G-600	—
VULCAN-HART									
CU-16BTA, R-16BTA, 3D20T, CD20T	120	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	1-45KW	1-EZ80-156	—
A-44 thru A-54	480	1-73E	1-54KW	1-EZ100-199	1-73PG	2-361E	3-54KW	1-65W-625SD	—
A-64 thru A-98	390	1-72E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-40LW	1-80W-505SD	—
CP-3 Series, HP-3 Series, CP-2 Series	420	1-72E	1-40KW	1-EZ80-156	1-72PG	2-361E	3-54KW	1-EZ100-199	—
WELLS									
AD-20 Series	102	1-51E	1-15KW	1-EZ75-135	1-51PG	1-72E	1-36KW	1-EZ80-156	—
AD-64, AD-80, PC-19, PC-26	300	1-51E	1-30KW	1-EZ75-156	1-51PG	2-51E	2-45KW	1-65W-370SD	—
AD-44, PC-12	480	1-73E	1-54KW	1-EZ100-199	1-73PG	2-361E	3-54KW	1-65W-625SD	—

SELF-SERVICE AND COMMERCIAL LAUNDRIES

Self-Service Laundries

Self-service laundries typically require 2 1/2 gallons of water per pound of laundry, which should be adequate for hot water storage plus a recovery capacity equal to the hourly demand of automatic washing machines. Although hot water demands will not be uniform, there may be times when all machines would be in operation simultaneously – most likely to occur on weekdays or at night.

This possible one-hour peak demand should always be given serious consideration when sizing for self-service laundry hot water requirements.

Bock uses a calculation of two cycles per hour. This number – multiplied by the number of machines by the gallons of hot water used by each machine – gives the amount of hot water used per hour. This known GPH, along with temperature of water required, will determine the capacity needed.

Consult manufacturers for sizes of machines. Hot water requirements for a self-service laundry are determined through the following steps:

1. From the rating plate on the machine or from the manufacturer's literature, find hot water usage in GPH for each automatic washer.
 - A. Few self-service laundries use the pre-wash soak cycle. This factor should be ascertained, however, and the gallonage used in the soak cycle subtracted from the unit rating.
 - B. If the rating for each washer cannot be found, use 25 GPH for each unit (if one cycle per hour).
2. Add together all the individual washer requirements for the maximum hourly demand.
3. From Tables 33-50, pages 58 - 75, determine the num-

ber of high volume water heaters required to supply the laundry's probably hourly demand.

Example: Laundry with 30 washers

Each washer has a capacity of 26 GPH of 140° F water. Laundry operates on one-hour peak demand.

Total Hourly Usage: $30 \times 26 = 780$ gallons @ 140° F

Using Tables 43-44, pages 68 - 69, Bock models EZ80-156, 190PG, and 72E would satisfy demand. At a 90°F rise, the following sizing recommendations can be made:

1) **(3)-EZ80-156** units can provide:

Recovery: 3×212 GPH = 636 GPH

Usable Storage: 3×80 gal. $\times 0.8 = 192$ gal.

Total 1-hr delivery = 636 GPH + 192 gal. = **828 gallons**

2) **(3)-190PG** units can provide:

Recovery: 3×191 GPH = 573 GPH

Usable Storage: 3×113 gal. $\times 0.8 = 271$ gal.

Total 1-hr delivery = 573 GPH + 271 gal. = **844 gallons**

3) **(3)-72E** units can provide:

Recovery: 3×212 GPH = 636 GPH

Usable Storage: 3×67 gal. $\times 0.8 = 161$ gal.

Total 1-hr delivery = 636 GPH + 161 gal. = **797 gallons**

Note : This formula is for average conditions which include an occasional peak demand. When all machines are used constantly, the preceding formula must be doubled (as - suming a half-hour cycle per machine).

Commercial Laundries

The best way to determine the cycle of hot water needs of a commercial laundry is to contact the equipment manufacturer. If this cannot be done, assumed three gallons of hot water per one pound of laundry with half the required water being hot. Bock recommends 160°F for this water.

SWIMMING POOLS, HOT TUBS AND BAPTISTRIES

Size a hot tub based on its gallon capacity. Obtain this quantity from either the manufacturer or by using steps 1 and 2 of the Swimming Pool instruction section on page 28. Determine how long it will take to fill the tub.

With these known factors, size the water heater using Deliverability Tables 33-50, pages 58 - 75. These tables show the capability of different types of Bock water heaters for a given length of time at a desired temperature.

To use these tables, find the temperature rise, which depends on water temperature norms for the geographical region:

Northern Tier States – 45°F to 55 °F

Central Tier States – 55 °F to 60 °F

Southern Tier States – 65°F to 75 °F

To determine the temperature rise, subtract the desired temperature from the norm for the area.

Example: 125°F water in a South Tier state. Result: 125°F minus 60 °F to 65 °F temperature rise.

Refer to Table 37-38, pages 62-63 to find the maximum delivery in gallons (Use Tables 39-40, pages 64-65 for a 65 °F rise).

Example: To fill a 120-gallon hot tub in 15 minutes, look down the 15 MINUTE column to 120 gallons or higher. Then move left across that space to find the correct Bock model water heater. This example requires a 72PG, EZ80-156, or 72E. Use this same method to size a baptistry.

Note: Aerated hot tubs have approximately 50% greater heat loss than standard tubs. To maintain temperature, Bock recommends adding half of the total heat loss to the sizing and increasing the input by 50%.

The first criterion is the maximum temperature rise in degrees Fahrenheit (°F), for initial heat-up (Delta T) to establish the desired pool temperature. The temperature rise is determined by the known desired pool temperature and then by the ambient air conditions at the time the pool water is initially heated.

The second criterion is the time allowed for the initial heating of the pool or spa water (for example; 24 or 48 hours).

The third criterion is the size of the swimming pool or spa. The water heater must be sized large enough for initial heat-up within the desired time frame.

From these criteria, calculate the hourly BTU input. BTUH input is the basis used to find the correct Bock water heater model. After the BTUH calculation has been determined, refer to Tables 33-50, pages 58 - 75 to find the exact Bock water heater to fit the requirements.

Steps to finding the BTU hourly input:

1. Cubic feet - length X width X average depth.
2. Gallons - cubic feet X 7.5.
3. Hourly BTU input = gallons X factor.

A. Factor is found in Table 18, this page, by noting the hours desired for heating the swimming pool or spa water, plus the temperature rise.

B. To find the temperature rise, first decide the ideal water temperature for the pool or spa, then subtract the yearly average outdoor temperature for the month pool heating will begin. Call the local weather station to find the yearly average temperature for the area.

Example: Swimming pool is 40' x 18' x 5' = 3600 cubic feet. 3600 X 7.5 = 27,000 gallon capacity. Need 48 hours to heat swimming pool. Average water temperature at initial heat-up is 60°F. Desire 80°F water temperature in pool. 80 - (minus) 60 = 20°F rise. Factor = 5 (with 48 hours heating time and 20°F rise) refer to Table 18. BTUH = 27,000 gallons X 5 = 135,000 BTUH input. A Bock Model 5IPG or a 5IE would be appropriate for this example. Refer to Tables 33-50, pages 58 - 75.

In a swimming pool or spa installation, the major consideration when using a storage-type water heater is the prevention of condensation inside the unit.

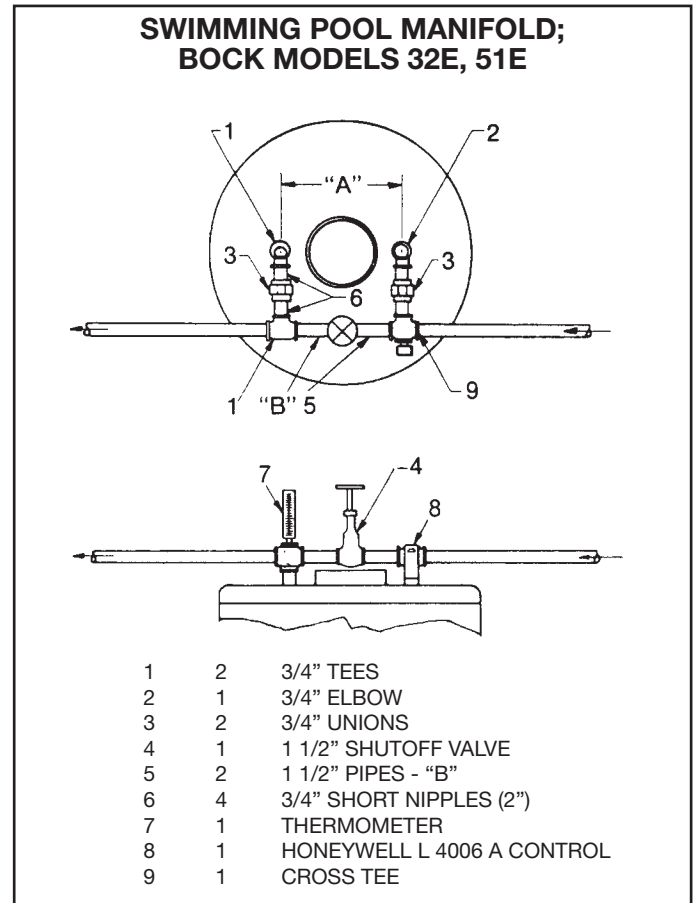
Condensation is held to a minimum when the temperature in the water heater is maintained above 120°F. To do this, use a bypass, which will increase the life of the water heater tank and combustion chamber appreciably (water temperature higher than 120°F has no other function).

Only one-fourth of the water goes through the water heater. The remaining three-fourths is bypassed around the water heater. The desired water temperature is maintained by adjusting one valve. The bypass valve should be left open far enough to maintain water temperature in the tank at 120°F or higher.

The temperature of the water after the bypass is increased only 2°F to 5°F, and is ideal for reintroducing back into the pool. See Figure 20, page 29. Also see Figure 27, page 35, for hookup drawing.

NOTE: Install only on non-combustible flooring.

FIGURE 20: Piping Diagram



Note: If chlorinated water is used, the dip tube must be removed from the heater and the drain valve must be used as the inlet.

TABLE 18

Sizing swimming pools, hot tubs, baptistries

HEATING TIME IN HOURS	Factors					
	20°F RISE	25°F RISE	30°F RISE	40°F RISE	50°F RISE	60°F RISE
1	250	300	375	500	625	720
2	120	150	180	250	300	360
3	80	100	120	160	200	240
4	60	75	90	120	150	180
5	48	60	72	96	120	144
6	40	50	60	80	100	120
7	34	42	52	68	85	102
8	30	37	45	60	75	90
9	26	32	39	52	65	78
10	24	30	36	48	60	72
12	20	25	30	40	50	60
24	10	12.5	15	20	25	30
48	*5	*6.3	*7.5	10	12.5	15
72	3.4	4.25	5.1	6.8	8.5	10.2
96	2.5	3.0	3.75	5.0	6.25	7.5

* Most commonly used

Note: For swimming pools, heating periods of 48 to 72 hours are usually acceptable. For baptistries, the heating period is typically five to 12 hours.

VENTING THE WATER HEATER

The purpose of venting a gas or oil-fired water heater is to completely remove all products of combustion and to vent gasses to the outside air without condensation in the vent or spillage at the draft hood (except in cases of downdraft or poor stack conditions).

To assure correct venting, use a strong, gas-tight insulated pipe with a cross section equal to that of the flue collar or draft hood outlet and of sufficient vertical height.

During vent installation, avoid sharp turns, long horizontal runs and improper pitches. Maintain proper support of vent connectors and joints, observe clearances from all combustibles, and top the vent outlet with an approved cap.

Type "L" vent is double walled vent. Type "L" is stainless lined and used for oil and Power Gas heaters. Type "B", due to its temperature rating, can only be used with atmospheric gas water heaters.

All venting installations must conform with local codes. In the absence of local codes, refer to "National Fuel Gas Code" NFPA 54 and "Standard for the Installation of Oil-burning Equipment" NFPA 31 (Tables 21-33 are based on NFPA 54).

Note: Fan min. and max. applies to oil and power gas heaters; nat. max. refers to vent hood-equipped appliance.

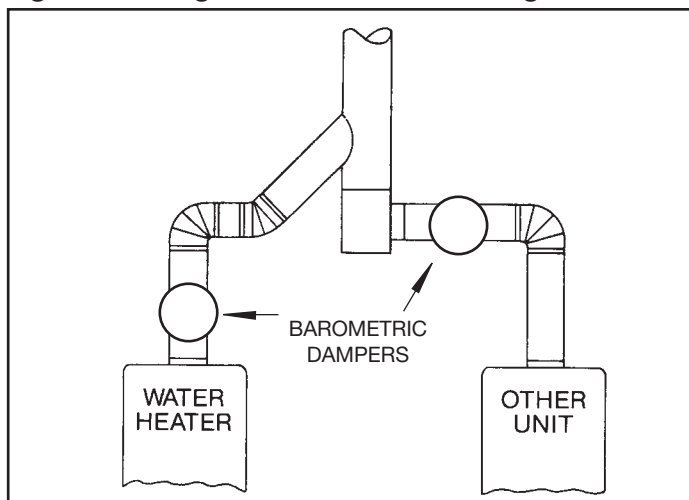
TYPES OF VENTING

Natural Draft: The venting of combustion products through a venting system (vent piping) and chimney by natural means.

Induced Draft: A power operated fan, blower or other mechanical device installed in the chimney connector (vent piping) between the appliance and chimney to increase natural draft (rarely used since the advent of high speed flame retention burners).

Power / Sidewall Venting: A combination of a mechanical fan (power venter), air pressure switch, post-purge control (timed or temperature), barometric damper and flue connectors designed to exhaust combustion gases through the side wall of a structure to the outside atmosphere in lieu of a chimney.

Figure 21: Single Water Heater Venting

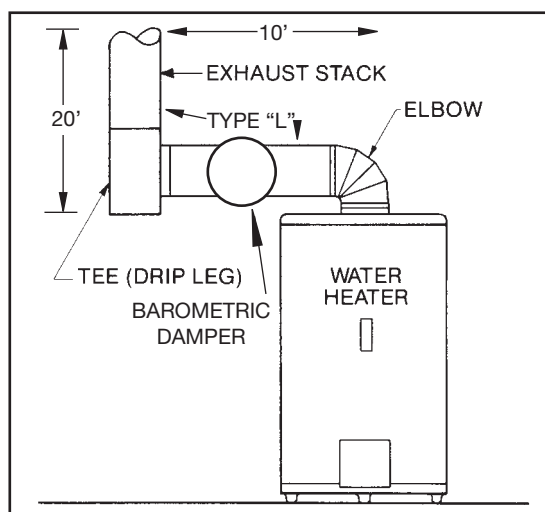


Sealed Combustion / Balanced Flue: A system consisting of an appliance specifically designed, constructed and installed so all air for combustion is derived from the outside atmosphere and all flue gases are discharged to the outside atmosphere.

INDIVIDUAL VENTS

An "individual" vent is defined as a single independent vent for one appliance. "Total Vent Height" is the measured vertical distance between the flue outlet and the vent top. The position or rise of a connector – or the location of an offset – has no effect on the "Total Vertical Height." "Length of Lateral" is the horizontal distance or offset between the flue outlet and the final vertical portion of the vent. See Figure 21.

Figure 22: Typical Individual Venting



Using the Individual Vent Tables

To determine the proper vent size for an individual vent, use Tables 21-25, pages 44-49 (depending on vent type).

Example: A typical individual venting project is shown in Figure 22. The Power Gas water heater has a 200,000 BTUH capacity, and a 6" flue.

To determine the size of the vent, go down the Total Vent Height column (Table 21, page 44) to the 20' height, then across to the right on the line for 10' lateral. 62,00 BTUH min. and 351,000 BTUH max. capacity is shown in the 6" fan min/max column. This system should work fine.

Vent Reductions

The vent size determined by Tables 21-33, pages 44-56 may be used as long as the vent is at least 10' high. When a vent is shorter than 10', the vent should be at least as large as the flue. Vents for draft hoods 12" in diameter or less should not be reduced more than one pipe size. A six-to-five inch, or a twelve-to-ten inch reduction is a one pipe size reduction. For larger gas-fired equipment, such as boilers having draft hood sizes from 14" to 24" diameters, reduction of more than two pipe sizes is not recommended (24-to-20 inches is a two-size reduction).

THE COMMON VENT

A “combined” vent is a venting system for two or more appliances at one level that are attached to a common vent.

Least Total Height is the vertical distance from the highest appliance flue outlet in the system to the top of the vent (see Figure 23). This is one fixed dimension for any one system, regardless of the number or placement of appliances in the system.

Connector Rise for any appliance is the vertical distance from its flue outlet to the point where the next connector joins the system.

A **Common Vent** is the portion of the venting system above the lowest interconnection. L-venting is typically used for gas and oil. B-venting may be used for gas only where permitted by local codes. Both are double wall vents. “L” vent uses a stainless steel liner; “B” vent uses an aluminum liner.

Using the Common Vent Tables

DETERMINING EACH VENT CONNECTOR SIZE:

1. Determine the Least Total Height for the system.
2. Determine the Connector Rise for each appliance.
3. Enter the Vent Connector Tables (Tables 27-30) at the appropriate Least Total Height. Continue across to the right on a line for the first appliance Connector Rise to the name plate BTUH rating (or the next higher rating) for that appliance. Read the connector vent size for that appliance at the top of the column.
4. At the Least Total Height, repeat the procedure for the Connector Rise and BTUH rating for each appliance.

Caution: Never use a connector smaller than draft hood outlet size.

DETERMINING THE SIZE OF A COMMON VENT:

1. Add together all appliance BTUH input ratings to determine the total BTUH rating.
2. Enter the Common Vent Tables (Tables 27-30) at the Least Total Height.
3. Continue across to the right; stop at the first value which is equal to or greater than the total BTUH rating.
4. Read the size of the common vent at the top of the column.

Caution: Regardless of the table results, the common vent must always be at least as large as the largest connector. If both connectors are the same size, the common vent must be one size larger.

Example: Figure 24 shows a typical two-appliance combined vent and relative individual connector sizes. Use the following procedure:

- A. Enter the Vent Connector Table (Table 27) at the Least Total Height of 15 feet, and a Connector Rise of one foot. Read across to the BTUH rating for natural gas heaters next higher than the water heater rating. This is the column showing 53,000 BTUH. At the top of this column, a four inch connector size is designated for the water heater. See Figure 22, Drawing 1.
- B. Enter the Vent Connector Table again, this time at the same Least Total Height of 15 feet, but for the furnace Connector Rise of three feet. Read across to 111,000 BTUH or the next higher rating above 105,000 BTUH. At the top of this column a vent connector size of five inches is designated for the furnace connector. See Figure 19, Drawing 2.
- C. The sum of the two ratings is 140,000 BTUH. Enter the Common Vent Table at the same Least Total Height of 15 feet and look in the natural gas column. For a total capacity of 144,000 BTUH, the column heading directs the use of a five inch common vent for this system. See Figure 24, Drawing 3.

Figure 23: Dual Water Heater Venting

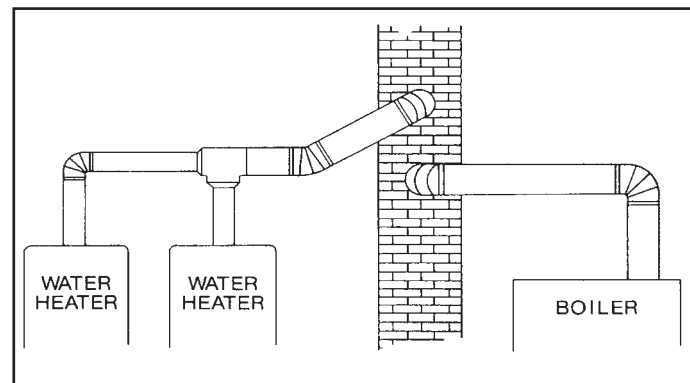
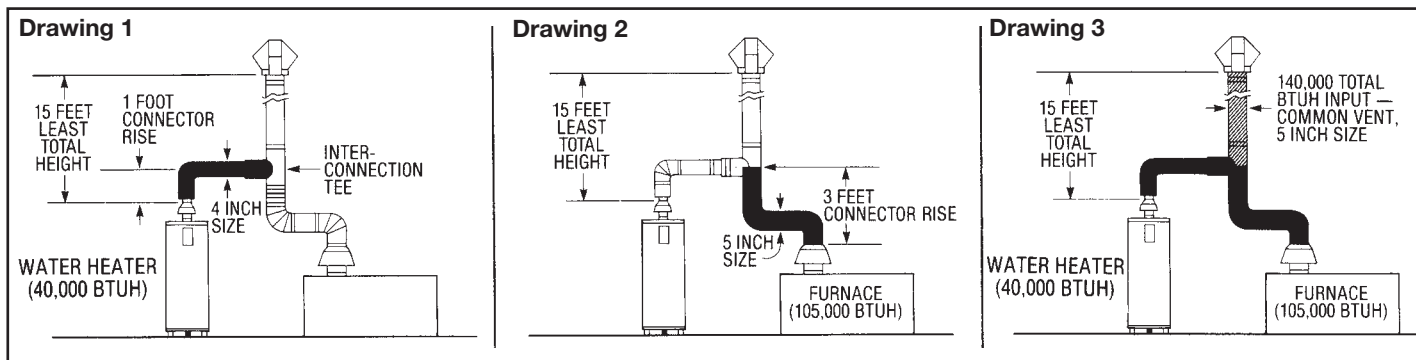


Figure 24: Determining the use of a 5" common gas vent



COMBUSTION AND VENTILATION AIR

Properly sized vents are vital for the safe and efficient operation of a Bock water heater installed in a confined space. When combustion and ventilation air are supplied from inside the building, each opening must have an area of one square inch for every 1,000 BTUH input. When combustion air is supplied from the outside, each opening must have an area of one square inch for every 2,000 BTUH for horizontal ducts and one square inch for every 4,000 BTUH for vertical ducts (refer to NFPA 31, 54).

The Bock BCS is exempt from these requirements because all combustion air is supplied from outside the heated space (however, some air for ventilation is desirable),

Most oil burners and some Power Gas burners can also be equipped with outside air kits (available from the burner

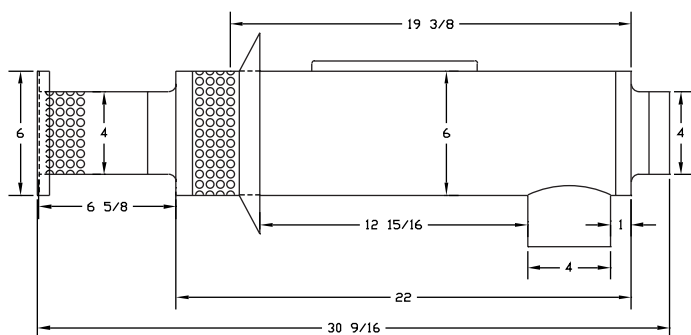
manufacturer) that draw combustion air from the outside through a duct system. This eliminates the need the supply combustion air through louvered ducts as described previously (ventilation air is still required). Air may also be required for draft hood or barometric damper operation.

As an alternative, combustion air may be supplied by a powered blower system such as a Field "Fan in a Can" or Tjernlund "In-forcer." These systems are powered on a call for heat, and force outside combustion air into the room through their own duct system. These systems, when properly sized, eliminate the need for any other combustion air ducting to the outside or other parts of the building. Consult the manufacturer of these systems for installation information and sizing.

BALANCED COMBUSTION SYSTEM (BCS)

Flue outlet placement is of utmost importance for maximizing the performance of the Bock Balanced Combustion System (US patent # 5,924,390).

BALANCED FLUE™



The east or south wall (or wall opposite of prevailing winds) is the preferred wall for installation if prevailing winter winds are typically out of the north or west. This reduces the likelihood that the Balanced Flue™ application will be operating against high winds and severe cold when it is cycling the most often.

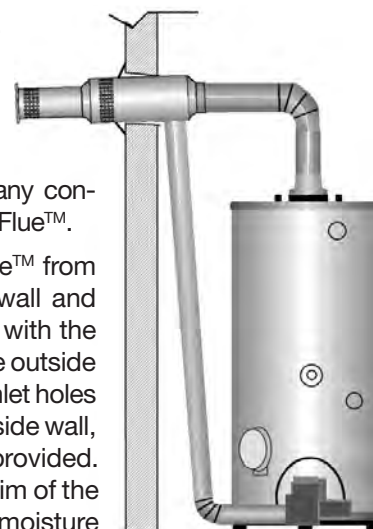
The flue outlet must be placed at least one (1) foot above the highest anticipated snow load to prevent flue blockage.

Use a flat wall for the flue outlet and stay a minimum of four feet from corners or any structure to reduce eddy currents.

To reduce frosting effects, place the outlet **as far as possible** from windows and doors – four feet is a minimum (per NFPA 31 A-1-12.3).

A minimum distance of three feet from the outlet to plants and shrubs is suggested; a greater distance is preferred, as the moisture and frost effects can result in damage or loss.

1. Cut a 7" O.D. opening in the preferred wall and provide a minimum of 1/2" clearance of non-combustible space around the Balanced Flue™. The opening should allow for a 1/2" downward pitch to the outside for drainage of any condensate in the Balanced Flue™.
2. Insert the Balanced Flue™ from the inside through the wall and fasten to the inside wall with the tabs provided. Check the outside extension to be sure air inlet holes are exposed. On the outside wall, install the flashing ring provided. Caulk around the outer rim of the flashing ring to prevent moisture from entering through the wall.



* INSUFFICIENT OR EXCESSIVE DRAFT (NATURAL & POWER VENT)

Excessive or insufficient draft can cause poor burner performance, excessive combustion noise and improper combustion or sooting. On Bock products, stack draft should be a minimum of -0.02" W.C. and a maximum of -0.05" W.C. where there is insufficient draft, install the properly sized draft inducer. Where excessive draft is encountered, install

the properly sized barometric draft regulator. **Note:** All Power Gas heaters must use a barometric damper.

For sizing and technical information on draft inducers and diverters, please contact the manufacturer of the equipment: Field Controls Co., 252/522-3031 or Tjernlund Products, Inc., 800/255-4208.

* Does not apply to BCS applications.

* BAROMETRIC DRAFT CONTROLS (NATURAL & POWER VENT)

Barometric draft controls and draft inducers can be used to correct draft problems found in some applications. A barometric draft control will bring room air into the vent to decrease the draft and a draft inducer will help force air away from the appliances.

Barometrics should be installed on all Bock power gas and dual fuel heaters to fine tune the equipment for optimal efficiency. A barometric is not used on Bock atmospheric gas heaters equipped with draft hoods.

* Does not apply to BCS applications.

TABLE 19A

POWER VENT SELECTION – TJERNLUND PRODUCTS

GPAK/HS-SERIES (Residential/light commercial)

MODEL #	VENT PIPE DIA.	BUT/HR INPUT	MAXIMUM PIPE LENGTH (FT) AT STACK TEMP			CFM @ 70°F				
			GAS FIRED 300°F		OIL FIRED 500°F	0" SP	.50" SP	.75" SP	1.0" SP	1.4" SP
			400°F							
HSUL-J	4"	50,000	100'	100'	100'	110	85	67	10	-
HST-J **		75,000	100'	100'	100'					
HS115-J		100,000	100'	100'	100'					
GPAK-J		125,000	35'	23'	-					
GPAK-JT										
HSUL-1	4"	150,000	100'	60'	35'					
HST-1		200,000	87'	57'	27'					
HS115-1		250,000	40'	12'	-					
GPAK-1 *		300,000	4'	-	-					
GPAK-17*										
HSUL-2	6"	150,000	100'	100'	100'	158	115	95	12	-
HST-2 **		200,000	100'	100'	100'					
HS115-2		250,000	100'	92'	-					
		300,000	30'	-	-					
HSUL-2	6"	350,000	100'	100'	100'					
HST-2 **		400,000	100'	100'	100'					
HS115-2		450,000	100'	100'	67'					
		500,000	100'	72'	-					
		550,000	94'	-	-					
		600,000	15'	-	-					
HSUL-2	8"	350,000	100'	100'	100'	286	235	215	196	158
HST-2 **		400,000	100'	100'	100'					
HS115-2		450,000	100'	100'	100'					
		500,000	100'	100'	-					
		550,000	100'	-	-					
		600,000	67'	-	-					

HS-3, 4, 5 SERIES (Commercial)

MODEL #	VENT PIPE DIA.	BUT/HR INPUT	MAXIMUM PIPE LENGTH (FT) AT STACK TEMP		CFM @ 70°F				
			100% Dilution 300°F	25% Dilution 400°F	0" SP	.50" SP	.75" SP	1.0" SP	1.4" SP
			GAS FIRED Atmospheric w/Draft Hood or Draft Diverter	GAS FIRED Power Burner w/Barometric					
HS-3	8"	450,000	100'	100'					
		500,000	100'	100'					
		600,000	100'	100'					
		700,000	7'	100'					
					500	425	380	325	110
HS-3	10"	450,000	100'	100'					
		500,000	100'	100'					
		600,000	100'	100'					
		700,000	21'	100'					
HS-4	8"	700,000	100'	100'					
		800,000	100'	100'					
		900,000	100'	100'					
		1,000,000	70'	100'					
		1,100,000	32'	100'					
		1,200,000	5'	100'					
	10"	700,000	100'	100'					
		800,000	100'	100'					
		900,000	100'	100'					
		1,000,000	100'	100'	925	800	730	620	425
HS-4	12"	1,000,000	100'	100'					
		1,100,000	97'	100'					
		1,200,000	14'	100'					
	12"	700,000	100'	100'					
		800,000	100'	100'					
		900,000	100'	100'					
		1,000,000	100'	100'					
		1,100,000	100'	100'					
		1,200,000	34'	100'					
HS-5	10"	1,200,000	100'	100'					
		1,400,000	100'	100'					
		1,600,000	100'	100'					
		1,825,000	29'	100'					
	12"	1,200,000	100'	100'					
		1,400,000	100'	100'					
		1,600,000	100'	100'					
		1,825,000	72'	100'					
	14"	1,200,000	100'	100'					
		1,400,000	100'	100'					
		1,600,000	100'	100'					
		1,825,000	100'	100'					

VH1 SERIES VENT HOODS

MODEL	DIMENSIONS							ROUGH-IN DIMENSIONS
	A DIA.	B	C	D	E	F	G	
VH1-3"	3"	6 1/4" SQ.	8 1/2"	10"	10"	5 1/4"	7 3/4"	6 3/4" SQ.
VH1-4"	4"	7 1/2" SQ.	7 1/8"	13"	8 5/8"	7 3/8"	11"	8" SQ.
VH1-6"	6 1/2"	8 1/2" DIA.	7 7/8"	12"	9 1/2"	10 1/2"	10"	9" DIA.

MODEL	DIMENSIONS					ROUGH-IN DIMENSIONS
	A DIA.	B	C	D	E	
VH1-8"	8"	15 1/4"	9"	18 3/8"	20"	8 1/2" DIA.
VH1-10"	10"	15 1/4"	9"	18 3/8"	20"	10 1/2" DIA.

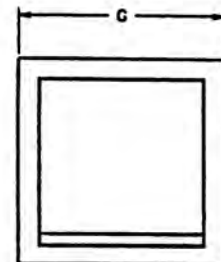
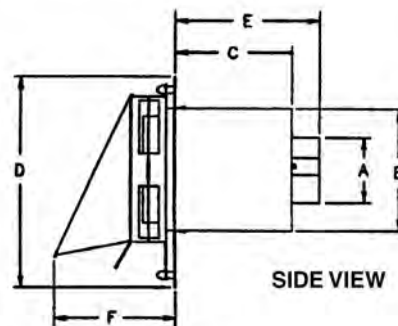
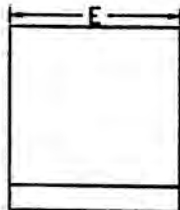
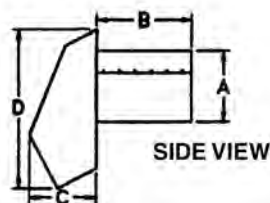


TABLE 19B

POWER VENT SELECTION – FIELD CONTROLS

MODEL	MAX. OIL GPH INPUT	MAX. BTUH INPUT	Max. Equivalent Feet of Vent Pipe		VENT PIPE SIZE
			at MAX. BTUH INPUT	60% of MAX. BTUH INPUT	
SWG-3	N/A	70,000	21	80	3"
			50	100	4"
SWG-4 HD	1.10	170,000	—	23	3"
			35	100	4"
SWG-5	1.85	290,000	65	100	5"
			16	44	4"
SWG-6	2.65	416,000	51	100	5"
			95	100	6"
SWG-7	3.60	566,000	28	78	5"
			68	100	6"
SWG-8	4.75	740,000	100	100	7"
			28	78	6"
			61	100	7"
			90	100	8"
			26	72	7"
			51	100	8"
			70	100	9"

MODEL	DIA.	Max. Equivalent Feet of Vent Pipe GAS BTUH Input			
		25,000	55,000	70,000	100,000
PVG-100	3"	270	100	—	—
PVGPAK-100*	4"	455	169	144	100
PVG-300	DIA.	100,000	145,000	220,000	310,000
	4"	305	145	64	—
	5"	—	247	100	54
	6"	—	334	147	74
PVG-600	DIA.	145,000	220,000	310,000	400,000
	5"	413	181	91	54
	DIA.	310,000	400,000	520,000	610,000
	6"	146	87	52	—
	8"	216	134	86	66

* PVG PAKs include a Power Venter, 4" MG-1 Draft Control and 4" vent hood.

MODEL	DIA.	Max. Equivalent Feet of Vent Pipe OIL GPH Input			
		0.75	1.00	1.50	2.25
PVO-300	4"	287	150	75	—
	5"	—	257	120	51
	6"	—	346	172	70
PVO-600	DIA.	1.00	1.50	2.25	3.00
	5"	428	212	86	46
	DIA.	2.25	3.00	3.75	4.00
	6"	143	74	51	—
	8"	211	116	84	77

THE DRAFT INDUCER

To adjust air flow on *Tjernlund Products, Inc.** draft inducers, manually bend the draft adjustment plate until desired draft is obtained. For all models, loosen the nut and adjust the position of the draft adjustment plate until desired draft is obtained.

A *Field Controls Company*** barometric draft control should be installed on Bock Power Gas water heaters to fine tune the desired draft at the water heater. A barometric draft damper is not recommended on Bock oil-fired water heaters unless excessive draft is encountered; $-.07$ W. C., or greater.

Seal all pipe joints and seams on the pressure side of the inducer with a high temperature silicone adhesive sealant or equivalent. **Note:** A barometric draft control is not normally required on Bock gas-fired water heaters equipped with draft hoods. Before operating, run draft inducer through two or three cycles to insure proper installation.

* *Tjernlund Products, Inc.*, 1601 9th St., White Bear Lake, MN 55110, 651/426-2993 or 800/255-4208.

** *Field Controls Company*, 2630 Airport Road, Kinston, NC 28504, 252/522-3031.

Installation

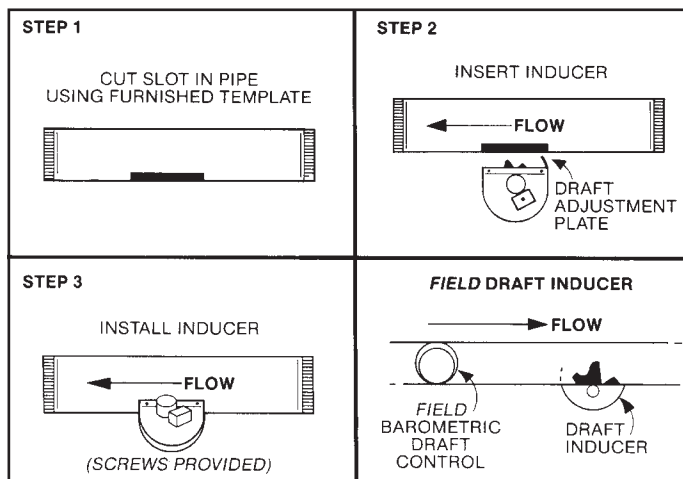
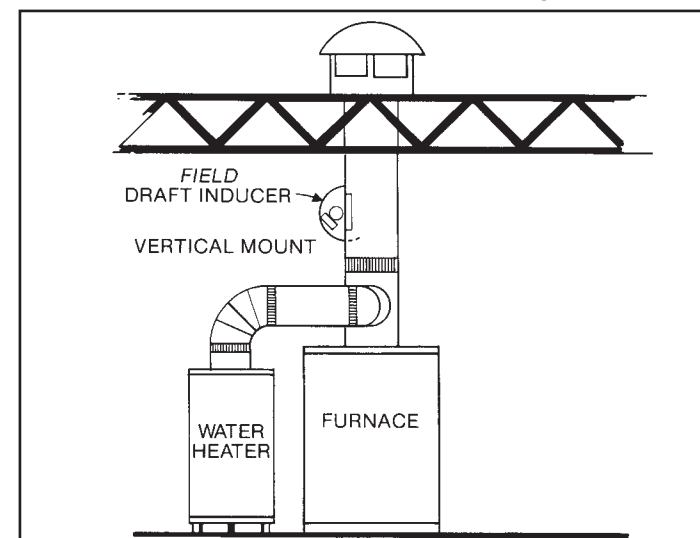


FIGURE 25: Inducer mounted vertically



SPECIALIZED INSTALLATION HOOKUPS

Figure 26: Dual temperature water for food service application

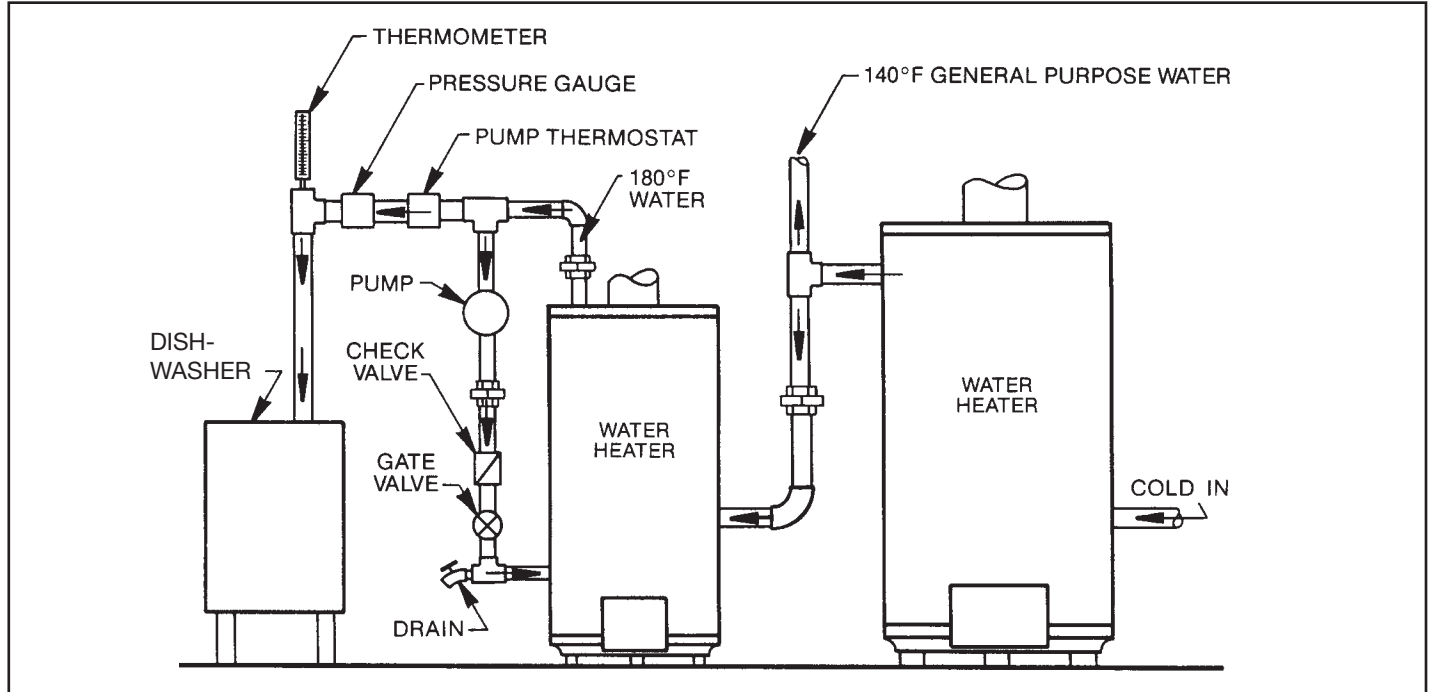
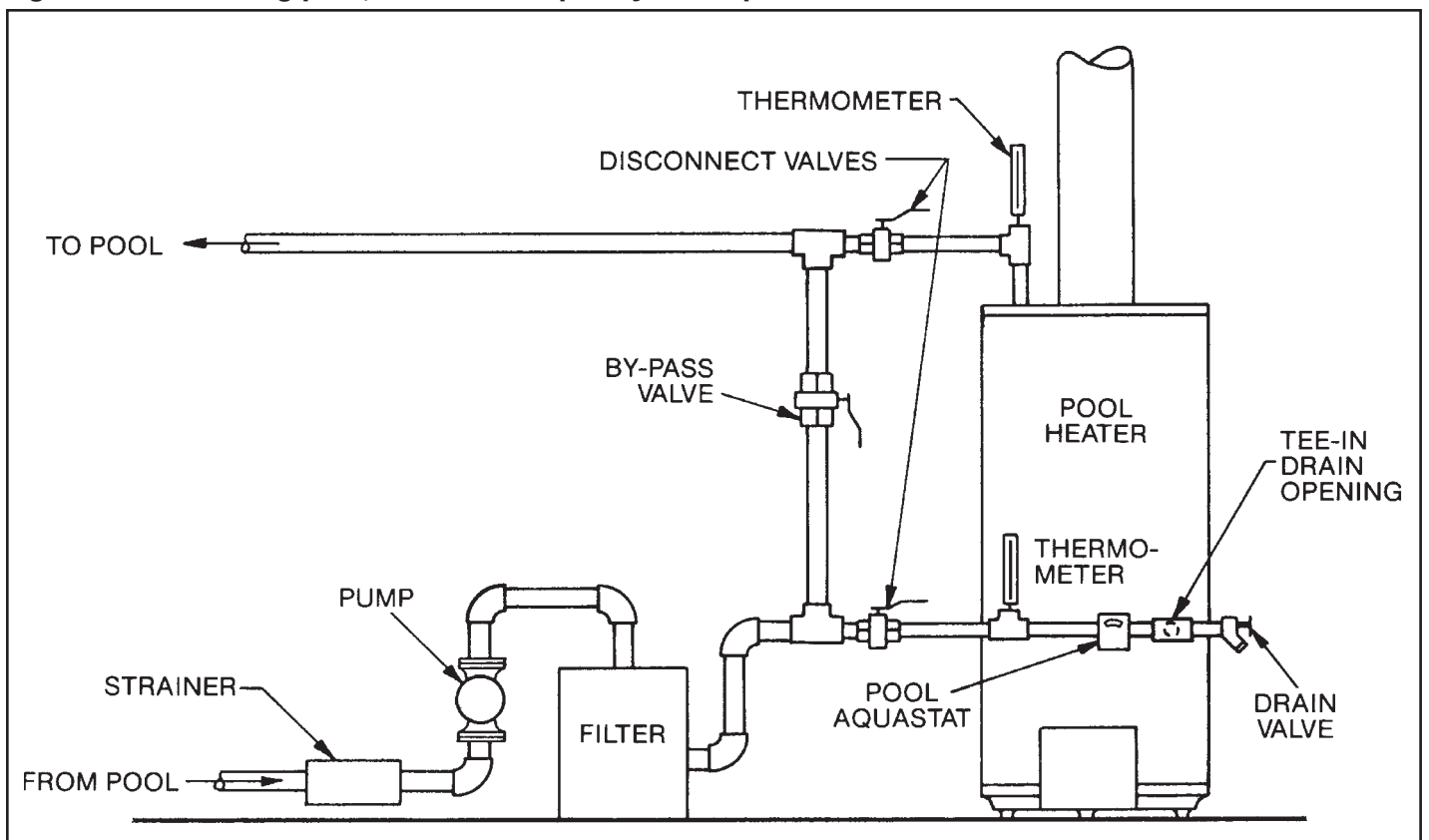


Figure 27: Swimming pool, hot tub or baptistry hookup



INDIRECT WATER HEATER INSTALLATION

Figure 28: 30SK, 40SK & 50SK installed with boiler

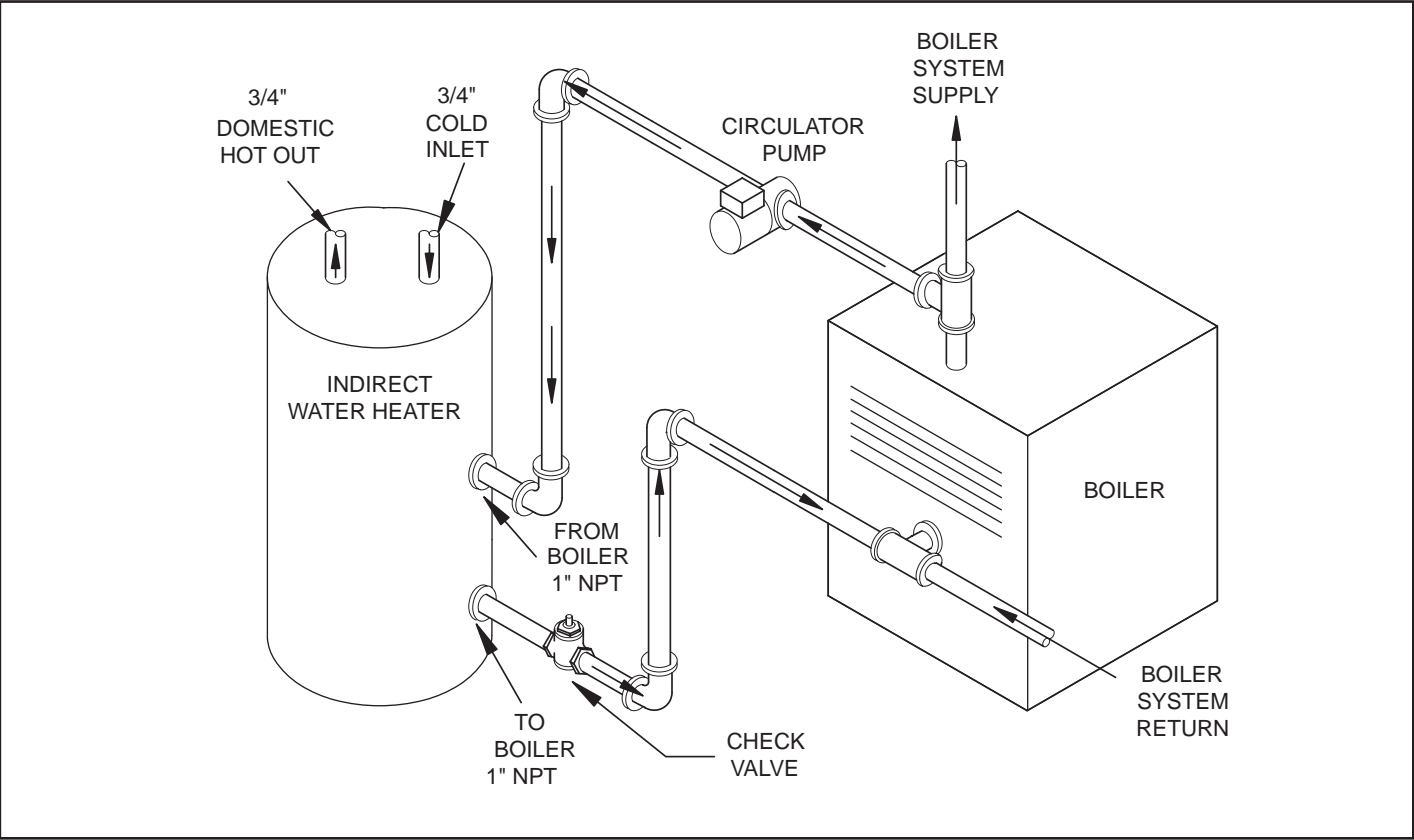
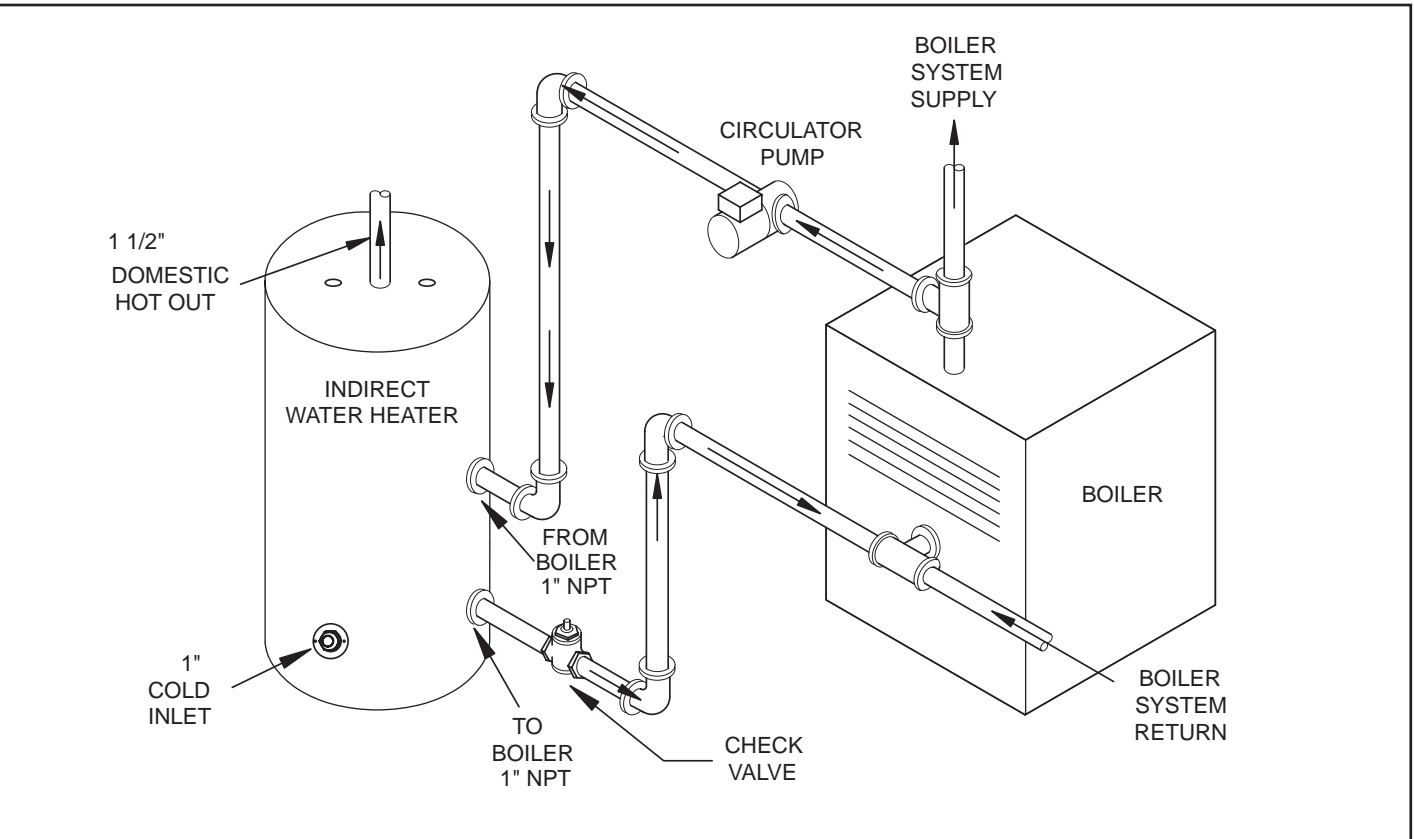


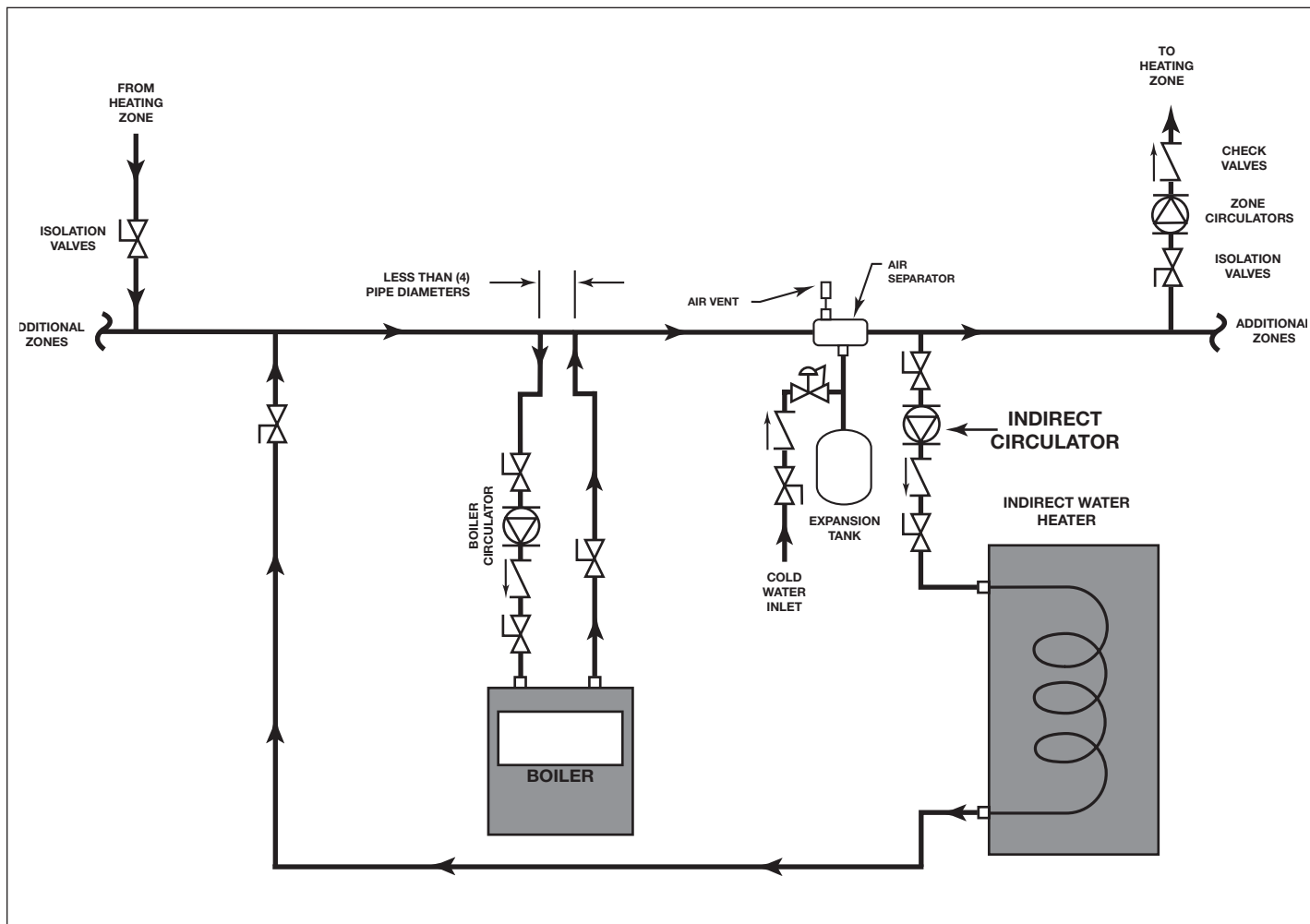
Figure 29: 80SK & 119SK installed with boiler



INDIRECT WATER HEATER INSTALLATION

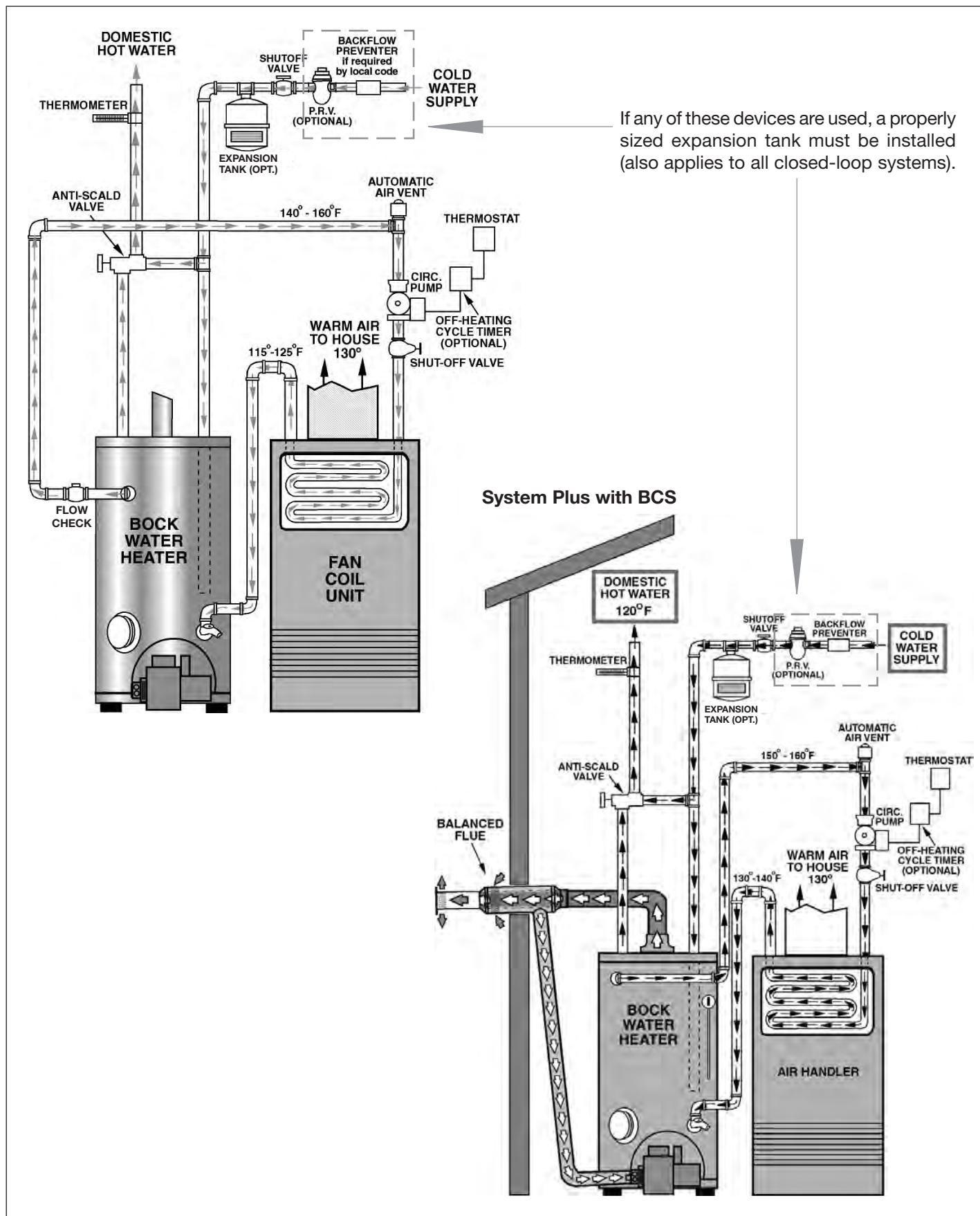
See Figure 30 for piping your Bock Indirect Coil Tank Water Heater to a low-mass boiler (diagram recommended by boiler manufacturer).

Figure 30: Bock Indirect with Low-Mass Boiler



SYSTEM PLUS INSTALLATION FOR HYDRONIC HEATING

Figure 31



RADIANT HEATING

Where permitted by code jurisdictions, a domestic water heater may be used as a heat source for hydronic radiant heating in a closed system, provided all generally accepted plumbing practices for closed-loop hydronic heating are used.

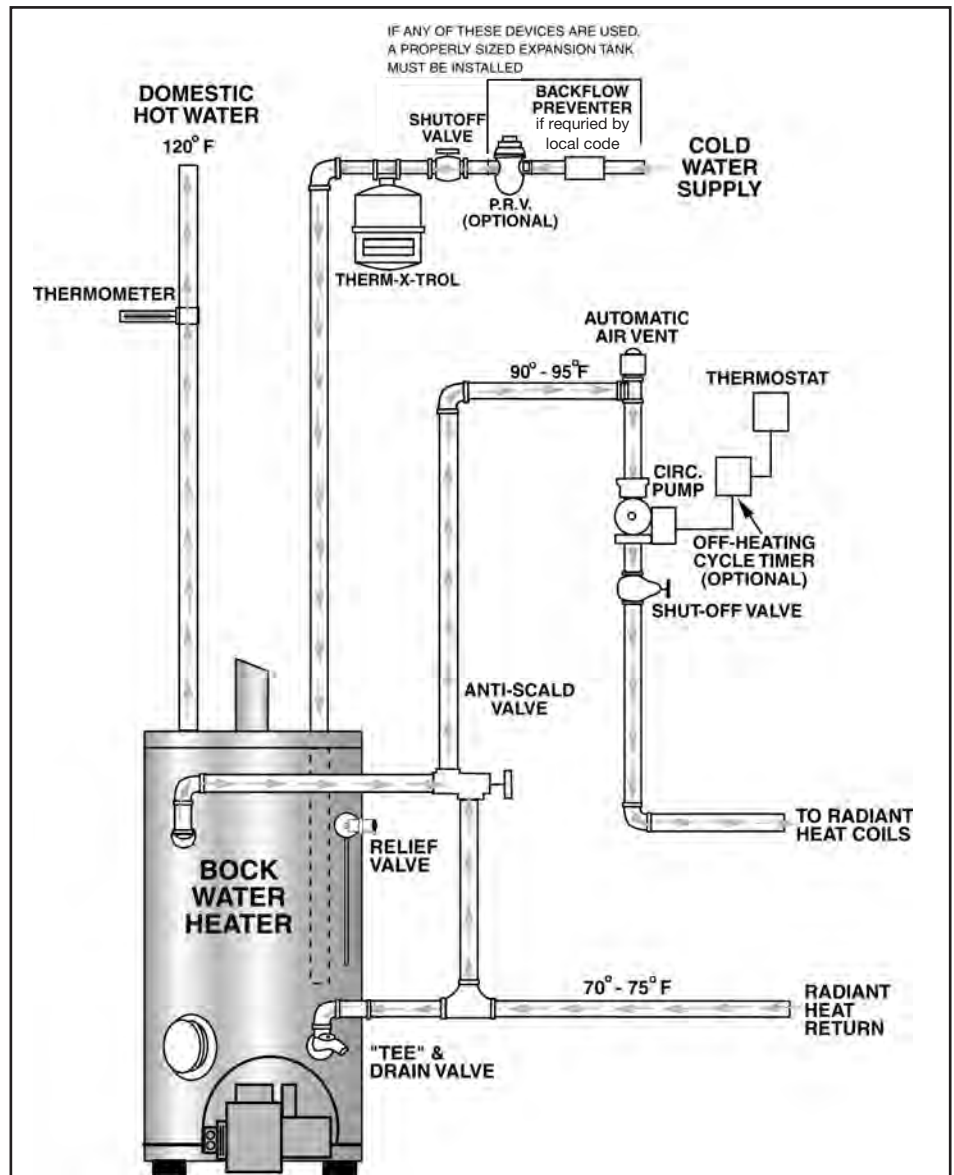
Sizing: The water heater net output should be within the range of 100% to 120% of the calculated heat loss unless design factors, piping losses or water heater ratings require that the selection exceed this range.

Additional output capacity should be allowed when other heating demands such as domestic water, priority systems, hot tubs, swimming pools, snow-melting equipment, etc. are serviced from the water heater.

Note: Proper sizing of the water heater can be obtained from the radiant equipment manufacturer using their design criteria.

- ✓ Bock water heaters operate at lower temperatures than boilers, using less fuel to heat potable and radiant water
- ✓ Bock water heaters' high BTU output makes them far more efficient for radiant heating than boilers
- ✓ One unit heats both water and the home for greater economy
- ✓ A well-designed hydronic radiant system can reduce fuel use by as much as 40%
- ✓ Hydronic radiant supply heat is between 90°F to 140°F; conventional heat supply heat is between 160°F to 200°F
- ✓ Hydronic radiant heat works with conventional heating systems and is ideal for hard-to-heat areas
- ✓ Hydronic radiant heat can be used in new construction and retrofitting or remodeling.
- ✓ Hydronic radiant heat uses hot water to warm the home, avoiding the dry "scorched" air produced by conventional heating systems.

Figure 32: Water heater installation for radiant and domestic water heating



COMBINED APPLIANCE SIZING

Water Heater Sizing

Three factors must be considered:

1. Heat loss of structure
2. Hot water consumption
3. Required storage (hot tubs, whirlpools, multiple or larger shower heads)

Method 1:

Calculate heat loss of the structure and add 10% for an average family of four to obtain the minimum output of the required water heater.

75,000 BTU (heat loss) + 7,500 BTU (10% allowance for a family of four) = 82,500 BTU (required minimum output)

With this information, the required input can be calculated as follows:

Output - recovery efficiency ** = minimum input required

Example: 82,500 (BTU output) divided by 80% (.80) = 103,125 (minimum BTU input)

** recovery efficiency per GAMA directory

Method 2

Multiply the heat loss of the structure by a factor of 1.51* to obtain the input requirements of the water heater. (In northern tier states, a factor of 1.58 is suggested.)

75,000 BTU (heat loss) X 1.51 = 113,250 minimum BTU input

* This is a quick estimate calculation and should only be used to estimate heater sizing.

Air Handler / Coil Unit Sizing

Determine the heat loss of the area to be heated. Select an air handler / coil unit with a heating output that exceeds the space heat loss. The heating output of the air handler / coil (BTUH) must not exceed the output (BTUH) of the water heater. Consult with the air handler / coil manufacturer for specifications.

MULTIPLE HOOKUPS

There are four types of hookups, each with their own advantages and disadvantages.

The Parallel System

The parallel system permits water heaters to be operated at the same temperature if they are perfectly balanced in the piping. Perfect balance is easy to accomplish with a new installation but almost impossible when either heater is replaced or the piping is altered. Any piping imbalance results in one heater working more than the other and reduces recovery and usable storage. The parallel system allows for isolating either water heater at any time and is recommended when high volume peak loads occur in short periods of time and the gallons-per-hour flow is a prime factor in sizing.

The Series System

The series system solves the imbalance problem by forcing all the water through both heaters to maintain full recovery rates. The first heater is usually set at a lower temperature (i.e. 120°F) than the second heater (i.e. 140°F). While the first heater must raise the water temperature by about 65 degrees and the second by only 20 degrees, they work equally hard because maintaining the higher water temperature of the second heater is as hard on a water heater as the longer firing time of the first heater. The series system also has the advantage of being a simpler, less costly installation, a better hookup for drawing off hot water in the tanks

and a means of prolonging the life of the heaters. However, pressure drop through the system is greater and less flow per minute is available.

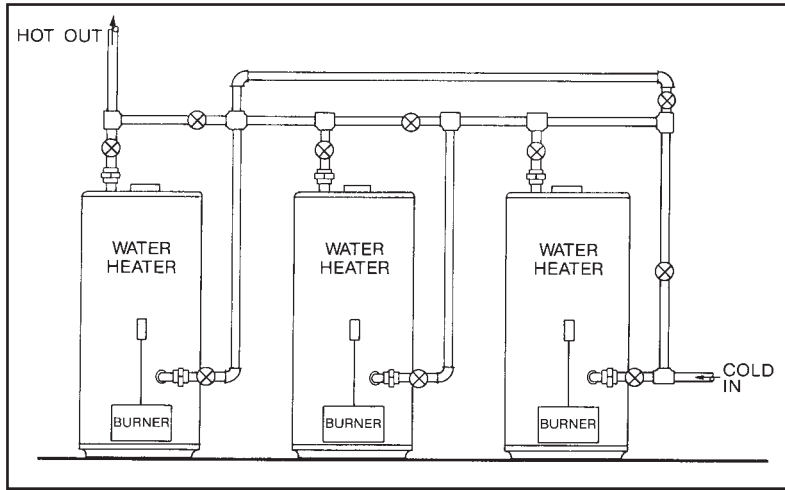
The Isolating Series

The isolating series is a variation of the series system resulting in full recovery rates, equal life expectancy and easy isolation of either unit. This system provides a backup in case of heater failure, can be a cost savings versus one large unit and can provide dual temperature water without mixing valves.

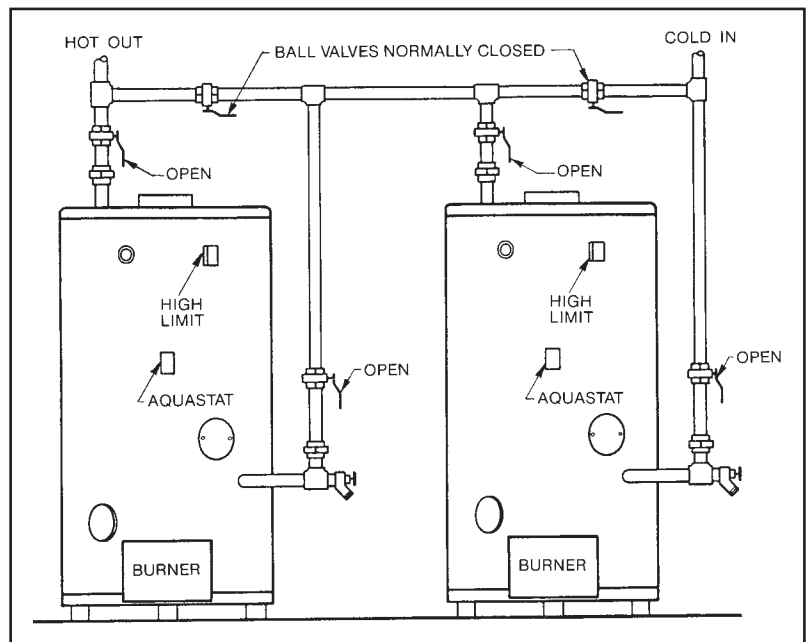
The Reverse Storage Tank System

The reverse storage tank system draws hot water off the heater and uses the storage tank as backup. It is ideal for applications such as schools or country clubs having high water demands for nine months of the year and minimal requirements for the remaining three months. When the extra capacity is not required, the circulating pump can be turned off. This system allows a smaller water heater to maintain high peak loads by running off-peak to maintain extremely large reserves for peak periods. This system will maintain uniform temperatures for long periods of time, until both the heater and storage tank have exhausted their storage capacity. If necessary, the tank can be maintained with its own thermostat at a lower temperature than the water heater. This is also a good application for two-temperature water without a mixing valve.

Figure 33: Three water heaters in series



**Figure 34:
Series hookup
with bypass**



Figures 35 and 36: Two water heaters with mixing valve

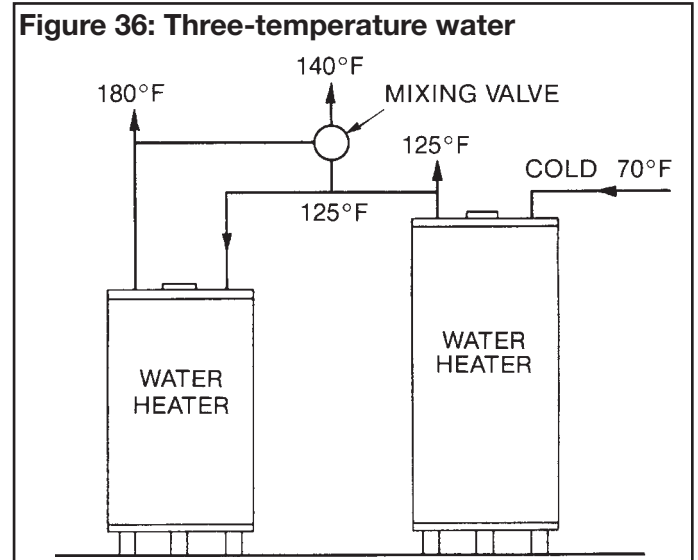
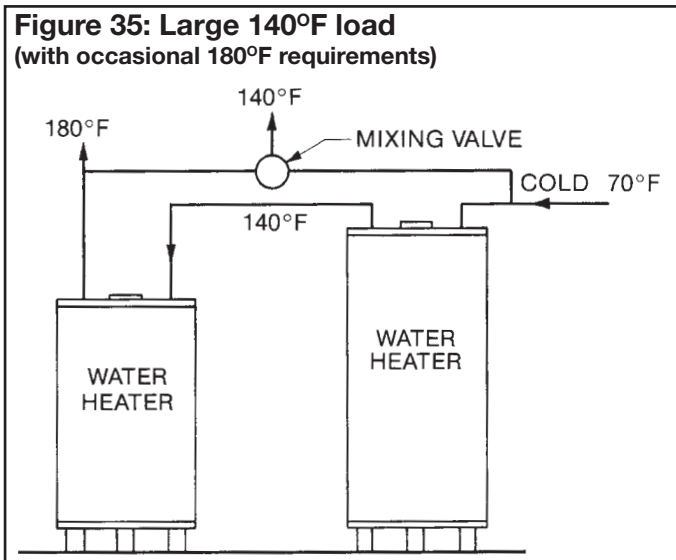
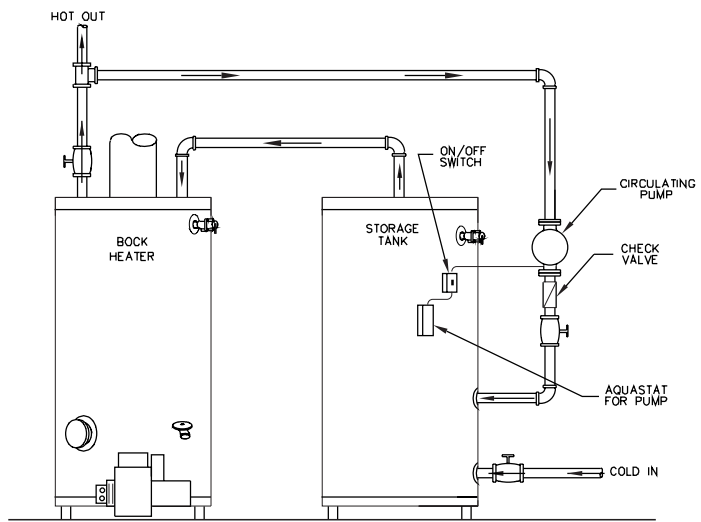


Figure 37: REVERSE STORAGE TANK SYSTEM HOOKUPS

Using a reverse storage tank system hookup can reduce energy consumption when compared to a conventional hookup if the pump is turned off whenever the extra storage capacity is not needed. Such applications are recommended for use in schools using hot water only nine months each year, churches that use large amounts of hot water primarily on weekends, milk houses, dorms, weekend residential housing and homes with large whirlpools or hot tubs. The reverse storage tank system reduces standby losses and allows a small heater to provide as much hot water as a larger unit.



WATER HEATER WITH STORAGE TANK

Figure 38

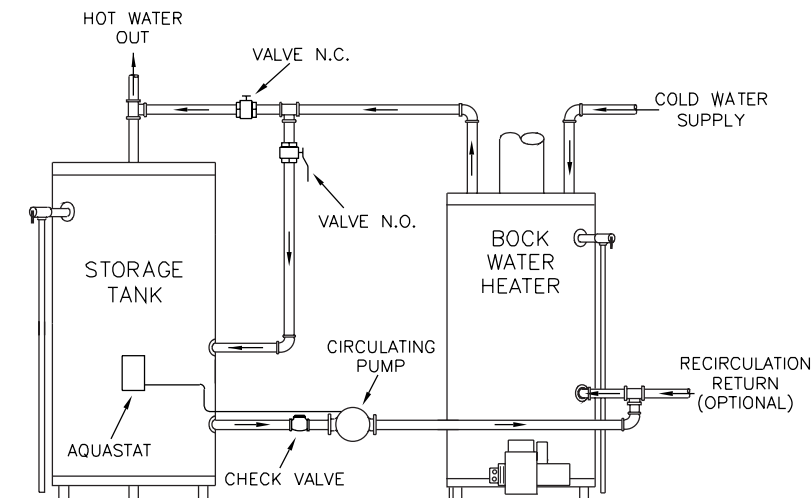
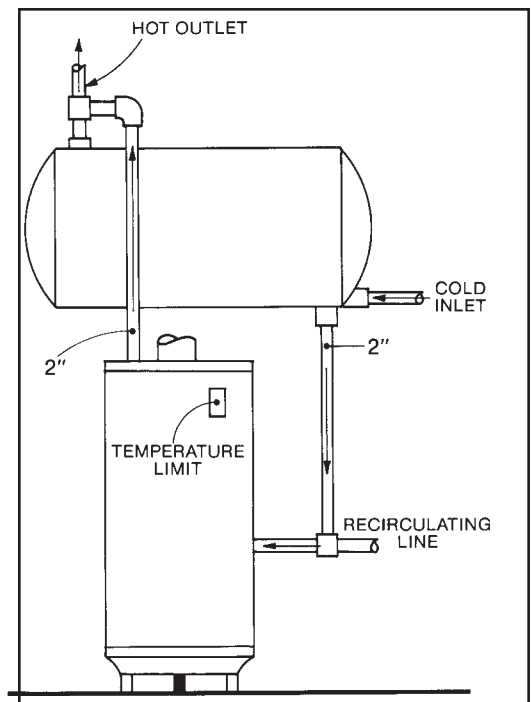
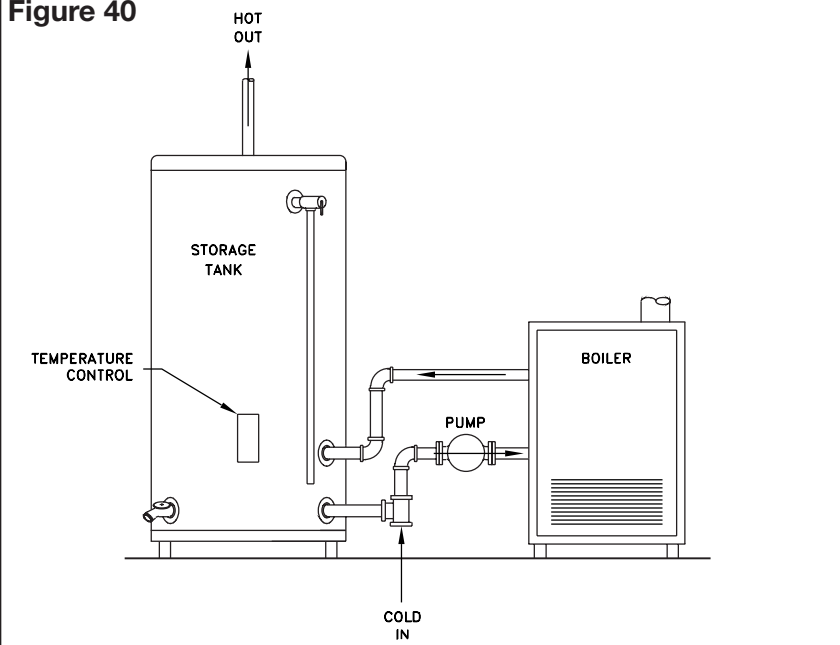


Figure 39: Single heater and large storage tank, gravity flow



STORAGE TANK AND BOILER INSTALLATION

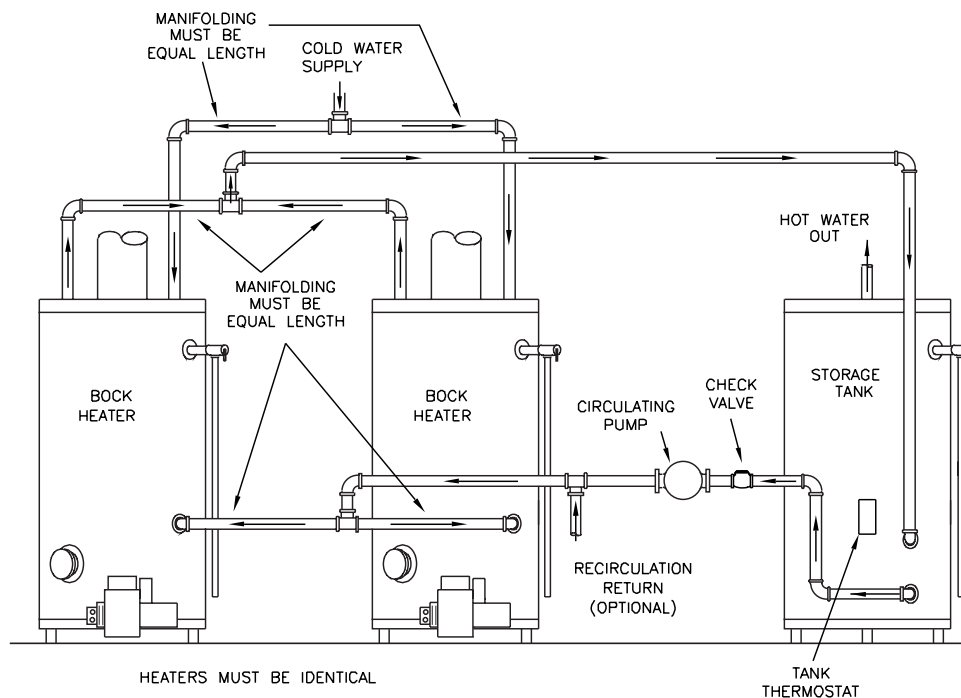
Figure 40



TWO HEATERS AND STORAGE TANK – PARALLEL PIPING

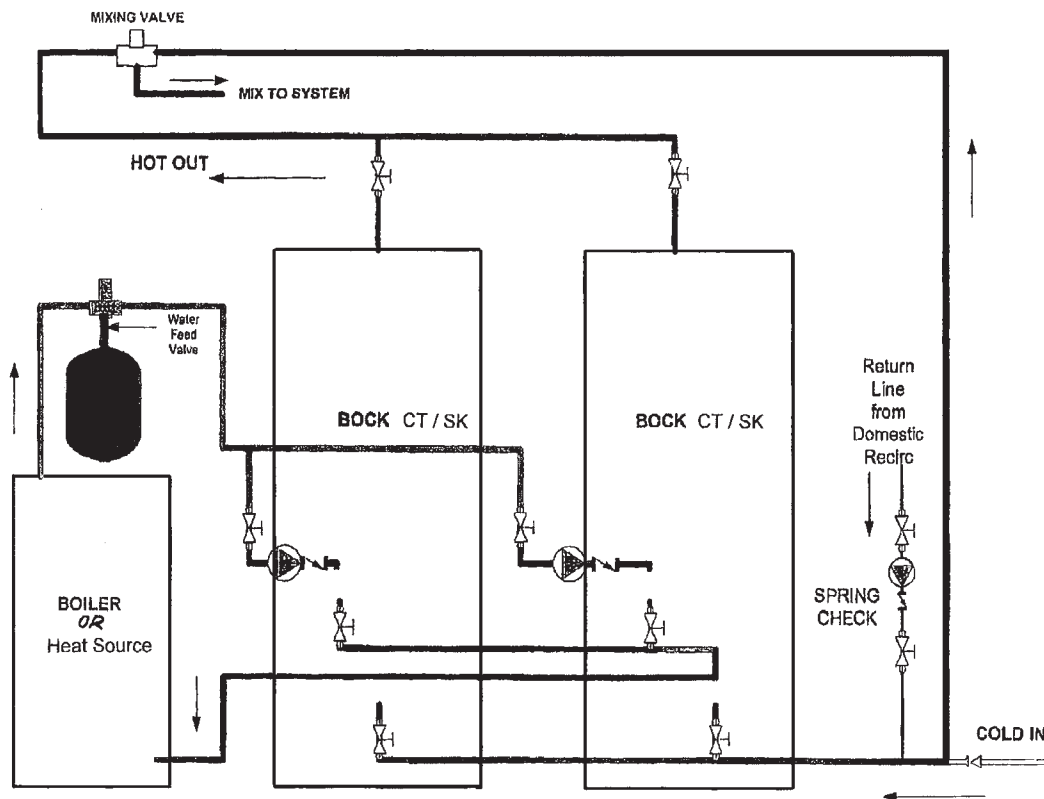
Figure 41

NOTE– SET HEATER THERMOSTATS 5° HIGHER THAN STORAGE TANK THERMOSTAT



TWO INDIRECT WATER HEATERS WITH HEAT SOURCE

Figure 42



Typical Reverse System / Sample Drawing - Not to Scale
 **Anti-scald / tempering valve and domestic recirc must be used.

WEIGHTS, MEASURES, METRIC CONVERSIONS – Table 20

METRIC SYSTEM			U.S. SYSTEM		
LINEAR MEASURE			LINEAR MEASURE		
10 Millimeters	=	1 Centimeter	12 inches	=	1 foot
10 Centimeters	=	1 Decimeter	3 feet	=	1 yard
10 Decimeters	=	1 Meter	5 1/2 yards	=	1 rod
10 Meters	=	1 Dekameter	40 rods	=	1 furlong
10 Dekameters	=	1 Hectometer	8 furlongs (5,280 feet)	=	1 mile
10 Hectometers	=	1 Kilometer	3 land miles	=	1 league
			6,086 feet	=	1 intl. nautical mile
AREA MEASURE			AREA MEASURE		
100 sq. Millimeters	=	1 sq. Centimeter	144 sq. inches	=	1 sq. foot
10,000 sq. Centimeters	=	1 sq. Meter	9 sq. feet	=	1 sq. yard
1,000,000 sq. Millimeters	=	1 sq. Meter	30 1/4 sq. yards	=	1 sq. rod
100 sq. Meters	=	1 Are (a)	160 sq. rods	=	1 acre
100 Ares	=	1 Hectare (ha)	640 acres	=	1 sq. mile
100 Hectares	=	1 sq. Kilometer	1 sq. mile	=	1 section
1,000,000 sq. Meters	=	1 sq. Kilometer	36 sections	=	1 township
VOLUME MEASURE			LIQUID MEASURE		
1 liter	=	0.001 cubic meter	4 gills (2 cups)	=	1 pint
10 millimeters	=	1 centiliter	2 pints	=	1 quart
10 centiliters	=	1 deciliter	4 quarts	=	1 gallon
10 deciliters	=	1 liter			
10 liters	=	1 dekaliter	DRY MEASURE		
10 dekaliters	=	1 hectoliter	2 pints	=	1 quart
10 hectoliters	=	1 kiloliter	8 quarts	=	1 peck
			4 pecks	=	1 bushel
WEIGHT			WEIGHT		
10 milligrams	=	1 centigram	27 11/32 grams	=	1 dram
10 centigrams	=	1 decigram	16 drams	=	1 ounce
10 decigrams	=	1 gram	16 ounces	=	1 pound
10 grams	=	1 dekagram	100 pounds	=	1 hundredweight
10 dekagrams	=	1 hectogram	20 hundredweight	=	1 ton
10 hectograms	=	1 kilogram			
1,000 kilograms	=	1 metric ton			

GENERAL WEATHER GUIDELINES IN CELCIUS & FAHRENHEIT

0°C .....Freezing point of water (32°F)	40°C .....Heat wave conditions (104°F)
10°C .....Warm winter day (50°F)	100°C .....Boiling point of water (212°F)
20°C .....Mild spring day (68°F)	
30°C .....Warm day (86°F)	°C = (°F - 32) * 5/9
37°C .....Normal body temperature (98.6°F)	°F = (°C * 9/5) + 32

MEASUREMENT CONVERSIONS

FROM	MULTIPLY BY	.TO FIND	FROM	MULTIPLY BY	.TO FIND	FROM	MULTIPLY BY	.TO FIND
Centimeters	.394	.....Inches	Kilograms	1,000.0	.....Grams	Miles	5,280.0	..... Feet
	.0328	..... Feet		35.274	..... Ounces		1,770.0	..... Yards
Feet	30.48	.....Centimeters		2.205	..... Pounds		1,609.0	..... Kilometers
	.3048	..... Meters	Kilometers	3281	..... Feet	Ounces	28.35	.....Grams
	.0001894	.....Miles		1,000.0	..... Meters		.0625	..... Pounds
	.3333	..... Yards		.621	..... Miles		.028	..... Kilograms
Gallons	8.0	..... Pints		1093.0	..... Yards	Pints	.473	..... Liters
	3.785	..... Liters	Liters	2.113	..... Pints		.50	..... Quarts
	4.0	..... Quarts		.264	..... Gallons		.0125	..... Gallons
Grams	.035	..... Ounces		1,000.0	..... Milliliters	Pounds	453.59	.....Grams
	.002	..... Pounds	Meters	3.281	..... Feet		16.0	..... Ounces
	.001	..... Kilograms		39.37	.....Inches		.454	..... Kilograms
Inches	2.54	.....Centimeters		.001	..... Kilometers	Quarts	2.0	..... Pints
	.0833	..... Feet		.0006214	.....Miles		.946	..... Liters
	.0254	..... Meters		1.093	..... Yards		.25	..... Gallons
	.0278	..... Yards				Yards	.914	..... Meters
							.0005682	.....Miles

BOCK ENGINEERING MANUAL TABLES

VENT TABLES • pages 46-56

National Fuel Gas Code, 2006 Edition, ANSI Z223.1 • NFPA 31, 2006 Edition

INDIRECT COIL TANK PERFORMANCE TABLES • page 57

OIL & GAS PERFORMANCE TABLES • pages 58-75

COMBUSTION EFFICIENCY TABLES • page 76

Using the Individual Vent Tables

To determine the proper vent size for an individual vent:

1. Determine Total Vent Height and Length of Lateral based on water heater and vent location, plus height to top, or to chimney-styled roof assembly.
2. Read down the Total Vent Height column (first column) to a height equal to or less than the total vent height.
3. Select the horizontal row of the table for the appropriate Length of Lateral (use zero for straight vertical vents).
4. Read across to the first column which shows a capacity equal to or greater than the water heater name plate heat input. Be certain to view the correct column for your burner/heater type.
5. If the vent size shown at the top of the column containing the correct capacity is equal to or larger than the water heater vent connector, use the vent determined.

STANDBY LOSS FORMULA

1. Gallons in tank X 8.25 X 90°F = Stored Heat
2. Stored Heat X % Standby Loss X Hours on standby = Standby BTU
3. $\frac{\text{Standby BTU} \times \$ \text{ per gallon}}{138,500 \text{ BTU}}$ = Standby Cost Per Day

Example:

$$(32 \times 8.25 \times 90^\circ\text{F}) \times (.03) \times 23.2 = 16,537 \text{ BTUs}$$
$$\frac{22,049.28 \times 1.10}{138,500} = \$1.75 \text{ per day} \times 365 = \$63.91 \text{ per yr}$$

To reduce standby loss by 1%:

$$23760 \times .03 \times 23.2 = \frac{16,375}{38,500} \times 1.10 = \$1.131 \text{ per day}$$
$$\times 365 = \$47.94$$

Add \$30 to \$40 for piping losses
for an accurate prediction of water heating costs.

Equivalencies

1 gal. fuel oil	=	140,000 BTU's
1 gal. propane	=	90,000 BTU's
1 lb. propane	=	21,500 BTU's
1 gal. butane	=	100,000 BTU's
1 lb. butane	=	21,000 BTU's
1 kWh	=	3,413 BTU's
1 gal. water	=	8.34 lbs
1 cubic ft. water	=	7.5 gal.

ENERGY / POWER CONVERSIONS

1 btu	=	1.055 kJ
1 kJ	=	0.9478 BTU
1 BTU/hr	=	0.2931 kW
1 W	=	3.412 BTU/hr
1 hp (550 ft/lbs)	=	0.7457 kW
1 kW	=	1.341 hp
1 hp	=	2545 BTU/hr
1 BTU/hr	=	0.000393 hp
1 BTU	=	252 cal

Raising one gallon of water:	Requires a BTUH input of:
140°F	1,666
120°F	1,428
100°F	1,190
90°F	1,071
80°F	852
70°F	833
60°F	714
50°F	595
40°F	476

TABLE 21

Capacity of Type B Double-Wall Gas Vents (when connected directly to a single Category 1 appliance)

Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of BTU per Hour																				
		3"			4"			5"			6"			7"			8"			9"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	78	46	0	152	86	0	251	141	0	375	205	0	524	285	0	698	370	0	897	470
	2	13	51	36	18	97	67	27	157	105	32	232	157	44	321	217	53	425	285	63	543	370
	4	21	49	34	30	94	64	39	153	103	50	227	153	66	316	211	79	419	279	93	536	362
	6	25	46	32	36	91	61	47	149	100	59	223	149	78	310	205	93	413	273	110	530	354
8	0	0	84	50	0	165	94	0	276	155	0	415	235	0	583	320	0	780	415	0	1,006	537
	2	12	57	40	16	109	75	25	178	120	28	263	180	42	365	247	50	483	322	60	619	418
	5	23	53	38	32	103	71	42	171	115	53	255	173	70	356	237	83	473	313	99	607	407
	8	28	49	35	39	98	66	51	164	109	64	247	165	84	347	227	99	463	303	117	596	396
10	0	0	88	53	0	175	100	0	295	166	0	447	255	0	631	345	0	847	450	0	1,096	585
	2	12	61	42	17	118	81	23	194	129	26	289	195	40	402	273	48	533	355	57	684	457
	5	23	57	40	32	113	77	41	187	124	52	280	188	68	392	263	81	522	346	95	671	446
	10	30	51	36	41	104	70	54	176	115	67	267	175	88	376	245	104	504	330	122	651	427
15	0	0	94	58	0	191	112	0	327	187	0	502	285	0	716	390	0	970	525	0	1,263	682
	2	11	69	48	15	136	93	20	226	150	22	339	225	38	475	316	45	633	414	53	815	544
	5	22	65	45	30	130	87	39	219	142	49	330	217	64	463	300	76	620	403	90	800	529
	10	29	59	41	40	121	82	51	206	135	64	315	208	84	445	288	99	600	386	116	777	507
	15	35	53	37	48	112	76	61	195	128	76	301	198	98	429	275	115	580	373	134	755	491
20	0	0	97	61	0	202	119	0	349	202	0	540	307	0	776	430	0	1,057	575	0	1,384	752
	2	10	75	51	14	149	100	18	250	166	20	377	249	33	531	346	41	711	470	50	917	612
	5	21	71	48	29	143	96	38	242	160	47	367	241	62	519	337	73	697	460	86	902	599
	10	28	64	44	38	133	89	50	229	150	62	351	228	81	499	321	95	675	443	112	877	576
	15	34	58	40	46	124	84	59	217	142	73	337	217	94	481	308	111	654	427	129	853	557
	20	48	52	35	55	116	78	69	206	134	84	322	206	107	464	295	125	634	410	145	830	537
30	0	0	100	64	0	213	128	0	374	220	0	587	336	0	853	475	0	1,173	650	0	1,548	855
	2	9	81	56	13	166	112	14	283	185	18	432	280	27	613	394	33	826	535	42	1,072	700
	5	21	77	54	28	160	108	36	275	176	45	421	273	58	600	385	69	811	524	82	1,055	688
	10	27	70	50	37	150	102	48	262	171	59	405	261	77	580	371	91	788	507	107	1,028	668
	15	33	64	NA	44	141	96	57	249	163	70	389	249	90	560	357	105	765	490	124	1,002	648
	20	56	58	NA	53	132	90	66	237	154	80	374	237	102	542	343	119	743	473	139	977	628
	30	NA	NA	NA	73	113	NA	88	214	NA	104	346	219	131	507	321	149	702	444	171	929	594
50	0	0	101	67	0	216	134	0	397	232	0	633	363	0	932	518	0	1,297	708	0	1,730	952
	2	8	86	61	11	183	122	14	320	206	15	497	314	22	715	445	26	975	615	33	1,276	813
	5	20	82	NA	27	177	119	35	312	200	43	487	308	55	702	438	65	960	605	77	1,259	798
	10	26	76	NA	35	168	114	45	299	190	56	471	298	73	681	426	86	935	589	101	1,230	773
	15	59	70	NA	42	158	NA	54	287	180	66	455	288	85	662	413	100	911	572	117	1,203	747
	20	NA	NA	NA	50	149	NA	63	275	169	76	440	278	97	642	401	113	888	556	131	1,176	722
	30	NA	NA	NA	69	131	NA	84	250	NA	99	410	259	123	605	376	141	844	522	161	1,125	670
100	0	NA	NA	NA	0	218	NA	0	407	NA	0	665	400	0	997	560	0	1,411	770	0	1,908	1,040
	2	NA	NA	NA	10	194	NA	12	354	NA	13	566	375	18	831	510	21	1,155	700	25	1,536	935
	5	NA	NA	NA	26	189	NA	33	347	NA	40	557	369	52	820	504	60	1,141	692	71	1,519	926
	10	NA	NA	NA	33	182	NA	43	335	NA	53	542	361	68	801	493	80	1,118	679	94	1,492	910
	15	NA	NA	NA	40	174	NA	50	312	NA	62	528	353	80	782	482	93	1,095	666	109	1,465	895
	20	NA	NA	NA	47	166	NA	59	311	NA	71	513	344	90	763	471	105	1,073	653	122	1,438	880
	30	NA	NA	NA	NA	NA	NA	78	290	NA	92	483	NA	115	726	449	131	1,029	627	149	1,387	849
	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	147	428	NA	180	651	405	197	944	575	217	1,288	787

TABLE 21 ...continued

Capacity of Type B Double-Wall Gas Vents (when connected directly to a single Catagory 1 appliance)

Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of BTU per Hour																							
		10"			12"			14"			16"			18"			20"			22"			24"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	0	1,121	570	0	1,645	850	0	2,267	1,170	0	2,983	1,530	0	3,802	1,960	0	4,721	2,430	0	5,737	2,950	0	6,853	3,520
	2	75	675	455	103	982	650	138	1,346	890	178	1,769	1,170	225	2,250	1,480	296	2,782	1,850	360	3,377	2,220	426	4,030	2,670
	4	110	668	445	147	975	640	191	1,338	880	242	1,761	1,160	300	2,242	1,475	390	2,774	1,835	469	3,370	2,215	555	4,023	2,660
	6	128	661	435	171	967	630	219	1,330	870	276	1,753	1,150	341	2,235	1,470	437	2,767	1,820	523	3,363	2,210	618	4,017	2,650
8	0	0	1,261	660	0	1,858	970	0	2,571	1,320	0	3,399	1,740	0	4,333	2,220	0	5,387	2,750	0	6,555	3,360	0	7,838	4,010
	2	71	770	515	98	1,124	745	130	1,543	1,020	168	2,030	1,340	212	2,584	1,700	278	3,196	2,110	336	3,882	2,560	401	4,634	3,050
	5	115	758	503	154	1,110	733	199	1,528	1,010	251	2,013	1,330	311	2,563	1,685	398	3,180	2,090	476	3,863	2,545	562	4,612	3,040
	8	137	746	490	180	1,097	720	231	1,514	1,000	289	2,000	1,320	354	2,552	1,670	450	3,163	2,070	537	3,850	2,530	630	4,602	3,030
10	0	0	1,377	720	0	2,036	1,060	0	2,825	1,450	0	3,742	1,925	0	4,782	2,450	0	5,955	3,050	0	7,254	3,710	0	8,682	4,450
	2	68	852	560	93	1,244	850	124	1,713	1,130	161	2,256	1,480	202	2,868	1,890	264	3,556	2,340	319	4,322	2,840	378	5,153	3,390
	5	112	839	547	149	1,229	829	192	1,696	1,105	243	2,238	1,461	300	2,849	1,871	382	3,536	2,318	458	4,301	2,818	540	5,132	3,371
	10	142	817	525	187	1,204	795	238	1,669	1,080	298	2,209	1,430	364	2,818	1,840	459	3,504	2,280	546	4,268	2,780	641	5,099	3,340
15	0	0	1,596	840	0	2,380	1,240	0	3,323	1,720	0	4,423	2,270	0	5,678	2,900	0	7,099	3,620	0	8,665	4,410	0	10,393	5,300
	2	63	1,019	675	86	1,495	985	114	2,062	1,350	147	2,719	1,770	186	3,467	2,260	239	4,304	2,800	290	5,232	3,410	346	6,251	4,080
	5	105	1,003	600	140	1,476	967	182	2,041	1,327	229	2,696	1,748	283	3,442	2,235	355	4,278	2,777	426	5,204	3,385	501	6,222	4,057
	10	135	977	635	177	1,446	936	227	2,009	1,289	283	2,659	1,712	346	3,402	2,193	432	4,234	2,739	510	5,159	3,343	599	6,175	4,019
	15	155	953	610	202	1,418	905	257	1,976	1,250	318	2,632	1,675	385	3,363	2,150	479	4,192	2,700	564	5,115	3,300	554	6,129	3,980
20	0	0	1,756	930	0	2,637	1,350	0	3,701	1,900	0	4,948	2,520	0	6,376	3,250	0	7,988	4,060	0	9,785	4,980	0	11,753	6,000
	2	59	1,150	755	81	1,694	1,100	107	2,343	1,520	139	3,097	2,000	175	3,955	2,570	220	4,916	3,200	269	5,983	3,910	321	7,154	4,700
	5	101	1,133	738	135	1,674	1,079	174	2,320	1,489	219	3,071	1,978	270	3,926	2,544	337	4,885	3,174	403	5,950	3,880	475	7,119	4,662
	10	130	1,105	710	172	1,641	1,045	220	2,282	1,460	273	3,029	1,940	334	3,880	2,500	413	4,835	3,130	489	5,896	3,830	573	7,063	4,600
	15	150	1,078	688	195	1,609	1,018	248	2,245	1,425	306	2,988	1,910	372	3,835	2,465	459	4,786	3,090	541	5,844	3,795	631	7,007	4,575
	20	167	1,052	665	217	1,578	990	273	2,210	1,390	335	2,948	1,880	404	3,791	2,430	495	4,737	3,050	585	5,792	3,760	689	6,953	4,550
30	0	0	1,977	1,060	0	3,004	1,550	0	4,252	2,170	0	5,725	2,920	0	7,420	3,770	0	9,341	4,750	0	11,483	5,850	0	13,848	7,060
	2	54	1,351	865	74	2,004	1,310	98	2,786	1,800	127	3,696	2,380	159	4,734	3,050	199	5,900	3,810	241	7,194	4,650	285	8,617	5,600
	5	96	1,332	851	127	1,981	1,289	164	2,759	1,775	206	3,666	2,350	252	4,701	3,020	312	5,863	3,783	373	7,155	4,622	439	8,574	5,552
	10	125	1,301	829	164	1,944	1,254	209	2,716	1,733	259	3,617	2,300	316	4,647	2,970	386	5,803	3,739	456	7,090	4,574	535	8,505	5,471
	15	143	1,272	807	187	1,908	1,220	237	2,674	1,692	292	3,570	2,250	354	4,594	2,920	431	5,744	3,695	507	7,026	4,527	590	8,437	5,391
	20	160	1,243	784	207	1,873	1,185	260	2,633	1,650	319	3,523	2,200	384	4,542	2,870	467	5,686	3,650	548	6,964	4,480	639	8,370	5,310
	30	195	1,189	745	246	1,807	1,130	305	2,555	1,585	369	3,433	2,130	440	4,442	2,785	540	5,574	3,565	635	6,842	4,375	739	8,239	5,225
50	0	0	2,231	1,195	0	3,441	1,825	0	4,934	2,550	0	6,711	3,440	0	8,774	4,460	0	11,129	5,635	0	13,767	6,940	0	16,694	8,430
	2	41	1,620	1,010	66	2,431	1,513	86	3,409	2,185	113	4,554	2,840	141	5,864	3,670	171	7,339	4,630	209	8,980	5,695	251	10,788	6,860
	5	90	1,600	996	118	2,406	1,495	151	3,380	2,102	191	4,520	2,813	234	5,826	3,639	283	7,295	4,597	336	8,933	5,654	394	10,737	6,818
	10	118	1,567	972	154	2,366	1,466	196	3,332	2,064	243	4,464	2,767	295	5,763	3,585	355	7,224	4,542	419	8,855	5,585	491	10,652	6,749
	15	136	1,536	948	177	2,327	1,437	222	3,285	2,026	274	4,409	2,721	330	5,701	3,534	396	7,155	4,511	465	8,779	5,546	542	10,570	6,710
	20	151	1,505	924	195	2,288	1,408	244	3,239	1,987	300	4,356	2,675	361	5,641	3,481	433	7,086	4,479	506	8,704	5,506	586	10,488	6,670
	0	183	1,446	876	232	2,214	1,349	287	3,150	1,910	347	4,253	2,631	412	5,523	3,431	494	6,953	4,421	577	8,557	5,444	672	10,328	6,603
100	0	0	2,491	1,310	0	3,925	2,050	0	5,729	2,950	0	7,914	4,050	0	10,485	5,300	0	13,454	6,700	0	16,817	8,600	0	20,578	10,300
	2	30	1,975	1,170	44	3,027	1,830	72	4,313	2,550	95	5,834	3,500	120	7,591	4,600	138	9,577	5,800	169	11,803	7,200	204	14,264	8,800
	5	82	1,955	1,159	107	3,002	1,803	136	4,282	2,531	172	5,797	3,475	208	7,548	4,566	245	9,528	5,769	293	11,748	7,162	341	14,204	8,756
	10	108	1,923	1,142	142	2,961	1,775	180	4,231	2,500	223	5,737	3,434	268	7,478	4,509	318	9,447	5,717	374	11,658	7,100	436	14,105	8,683
	15	126	1,892	1,124	163	2,920	1,747	206	4,182	2,469	252	5,678	3,392	304	7,409	4,451	358	9,367	5,665	418	11,569	7,037	487	14,007	8,610
	20	141	1,861	1,107	181	2,880	1,719	226	4,133	2,438	277	5,619	3,351	330	7,341	4,394	387	9,289	5,613	452	11,482	6,975	523	13,910	8,537
	30	170	1,802	1,071	215	2,803	1,663	265	4,037	2,375	319	5,505	3,267	378	7,209	4,279	446	9,136	5,509	514	11,310	6,850	592	13,720	8,391
	50	241	1,688	1,000	292	2,657	1,550	350	3,856	2,250	415	5,289	3,100	486	6,956	4,050	572	8,841	5,300	659	10,979	6,600	752	13,354	8,100

TABLE 22

Capacity of Type B Double-Wall Gas Vents

(with single-wall metal connectors serving
a single Category 1 appliance)

Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of BTU per Hour																										
		3"			4"			5"			6"			7"			8"			9"			10"			12"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	0	38	77	45	59	151	85	85	249	140	126	373	204	165	522	284	211	695	369	267	894	469	371	1,118	569	537	1,639	849
	2	39	51	36	60	96	66	85	156	104	123	231	156	159	320	213	201	423	284	251	541	368	347	673	453	498	979	648
	4	NA	NA	33	74	92	63	102	152	102	146	225	152	187	313	208	237	416	277	295	533	360	409	664	443	584	971	638
	6	NA	NA	31	83	89	60	114	147	99	163	220	148	207	307	203	263	409	271	327	526	352	449	656	433	638	962	627
8	0	37	83	50	58	164	93	83	273	154	123	412	234	161	580	319	206	777	414	258	1,002	536	360	1,257	658	521	1,852	967
	2	39	56	39	59	108	75	83	176	119	121	261	179	155	363	246	197	482	321	246	617	417	339	768	513	486	1,120	743
	5	NA	NA	37	77	102	69	107	168	114	151	252	171	193	352	235	245	470	311	305	604	404	418	754	500	598	1,104	730
	8	NA	NA	33	90	95	64	122	161	107	175	243	163	223	342	225	280	458	300	344	591	392	470	740	486	665	1,089	715
10	0	37	87	53	57	174	99	82	293	165	120	444	254	158	628	344	202	844	449	253	1,093	584	351	1,373	718	507	2,031	1,057
	2	39	61	41	59	117	80	82	193	128	119	287	194	153	400	272	193	531	354	242	681	456	332	849	559	475	1,242	848
	5	52	56	39	76	111	76	105	185	122	148	277	186	190	388	261	241	518	344	299	667	443	409	834	544	584	1,224	825
	10	NA	NA	34	97	100	68	132	171	112	188	261	171	237	369	241	296	497	325	363	643	423	492	808	520	688	1,194	788
15	0	36	93	57	56	190	111	80	325	186	116	499	283	153	713	388	195	966	523	244	1,259	681	336	1,591	838	488	2,374	1,237
	2	38	69	47	57	136	93	80	225	149	115	337	224	148	473	314	187	631	413	232	812	543	319	1,015	673	457	1,491	983
	5	51	63	44	75	128	86	102	216	140	144	326	217	182	459	298	231	616	400	287	795	526	392	997	657	562	1,469	963
	10	NA	NA	39	95	116	79	128	201	131	182	308	203	228	438	284	284	592	381	349	768	501	470	966	628	664	1,433	928
20	15	NA	NA	NA	NA	NA	72	158	186	124	220	290	192	272	418	269	334	568	367	404	742	484	540	937	601	750	1,399	894
	0	35	96	60	54	200	118	78	346	201	114	537	306	149	772	428	190	1,053	573	238	1,379	750	326	1,751	927	473	2,631	1,346
	2	37	74	50	56	148	99	78	248	165	113	375	248	144	528	344	182	708	468	227	914	611	309	1,146	754	443	1,689	1,098
	5	50	68	47	73	140	94	100	239	158	141	363	239	178	514	334	224	692	457	279	896	596	381	1,126	734	547	1,665	1,074
30	10	NA	NA	41	93	129	86	125	223	146	177	344	224	222	491	316	277	666	437	339	866	570	457	1,092	702	646	1,626	1,037
	15	NA	NA	NA	NA	NA	80	155	208	136	216	325	210	264	469	301	325	640	419	393	838	549	526	1,060	677	730	1,587	1,005
	20	NA	NA	NA	NA	NA	NA	186	192	126	254	306	196	309	448	285	374	616	400	448	810	526	592	1,028	651	808	1,550	973
	0	34	99	63	53	211	127	76	372	219	110	584	334	144	849	472	184	1,168	647	229	1,542	852	312	1,971	1,056	454	2,996	1,545
50	2	37	80	56	55	164	111	76	281	183	109	429	279	139	610	392	175	823	533	219	1,069	698	296	1,346	863	424	1,999	1,308
	5	49	74	52	72	157	106	98	271	173	136	417	271	171	595	382	215	806	521	269	1,049	684	366	1,324	846	524	1,971	1,283
	10	NA	NA	NA	91	144	98	122	255	168	171	397	257	213	570	367	265	777	501	327	1,017	662	440	1,287	821	620	1,927	1,243
	15	NA	NA	NA	115	131	NA	151	239	157	208	377	242	255	547	349	312	750	481	379	985	638	507	1,251	794	702	1,884	1,205
100	20	NA	NA	NA	NA	NA	NA	181	223	NA	246	357	228	298	524	333	360	723	461	433	955	615	570	1,216	768	780	1,841	1,166
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	389	477	305	461	670	426	541	895	574	704	1,147	720	937	1,759	1,101
	0	33	99	66	51	213	133	73	394	230	105	629	361	138	928	515	176	1,292	704	220	1,724	948	295	2,223	1,189	428	3,432	1,818
	2	36	84	61	53	181	121	73	318	205	104	495	312	133	712	443	168	971	613	209	1,273	811	280	1,615	1,007	401	2,426	1,509
100	5	48	80	NA	70	174	117	94	308	198	131	482	305	164	696	435	204	953	602	257	1,252	795	347	1,591	991	496	2,396	1,490
	10	NA	NA	NA	89	160	NA	118	292	186	162	461	292	203	671	420	253	923	583	313	1,217	765	418	1,551	963	589	2,347	1,455
	15	NA	NA	NA	112	148	NA	145	275	174	199	441	280	244	646	405	299	894	562	363	1,183	736	481	1,512	934	668	2,299	1,421
	20	NA	NA	NA	NA	NA	NA	176	257	NA	236	420	267	285	622	389	345	866	543	415	1,150	708	544	1,473	906	741	2,251	1,387
100	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	315	376	NA	373	573	NA	442	809	502	521	1,086	649	674	1,399	848	892	2,159	1,318
	0	NA	NA	NA	49	214	NA	69	403	NA	100	659	395	131	991	555	166	1,404	765	207	1,900	1,033	273	2,479	1,300	395	3,912	2,042
	2	NA	NA	NA	51	192	NA	70	351	NA	98	563	373	125	828	508	158	1,152	698	196	1,532	933	259	1,970	1,168	571	3,021	1,817
	5	NA	NA	NA	67	186	NA	90	342	NA	125	551	366	156	813	501	194	1,134	688	240	1,511	921	322	1,945	1,153	460	2,990	1,796
100	10	NA	NA	NA	85	175	NA	113	324	NA	153	532	354	191	789	486	238	1,104	672	293	1,477	902	389	1,905	1,133	547	2,938	1,763
	15	NA	NA	NA	132	162	NA	138	310	NA	188	511	343	230	764	473	281	1,075	656	342	1,443	884	447	1,865	1,110	618	2,888	1,730
	20	NA	NA	NA	NA	NA	NA	168	295	NA	224	487	NA	270	739	458	325	1,046	639	391	1,410	864	507	1,825	1,087	690	2,838	1,696
	30	NA	NA	NA	NA	NA	NA	231	264	NA	301	448	NA	355	685	NA	418	988	NA	491	1,343	824	631	1,747	1,041	834	2,739	1,627
100	50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	540	584	NA	617	866	NA	711	1,205	NA	895	1,591	NA	1,138	2,547	1,489

Capacity of Masonry Chimney Flue with Type B Double-Wall Vent Connectors (serving a single Category 1 appliance)

Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of BTU per Hour																										
		3"			4"			5"			6"			7"			8"			9"			10"			12"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	180	NA	NA	247	NA	NA	320	NA	NA	401	NA	NA	581
	5	NA	NA	25	NA	NA	49	NA	NA	82	NA	NA	117	NA	NA	165	NA	NA	231	NA	NA	298	NA	NA	376	NA	NA	561
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	198	NA	NA	266	84	590	350	100	728	446	139	1,024	651
	5	NA	NA	26	NA	NA	52	NA	NA	88	NA	NA	134	NA	NA	183	NA	NA	247	NA	NA	328	149	711	423	201	1,007	640
	8	NA	NA	24	NA	NA	48	NA	NA	83	NA	NA	127	NA	NA	175	NA	NA	239	NA	NA	318	173	695	410	231	990	623
10	2	NA	NA	31	NA	NA	61	NA	NA	103	NA	NA	162	NA	NA	221	68	519	298	82	655	388	98	810	491	136	1,144	724
	5	NA	NA	28	NA	NA	57	NA	NA	96	NA	NA	148	NA	NA	204	NA	NA	277	124	638	365	146	791	466	196	1,124	712
	10	NA	NA	25	NA	NA	50	NA	NA	87	NA	NA	139	NA	NA	191	NA	NA	263	155	610	347	182	762	444	240	1,093	668
15	2	NA	NA	35	NA	NA	67	NA	NA	114	NA	NA	179	53	475	250	64	613	336	77	779	441	92	968	562	127	1,376	841
	5	NA	NA	35	NA	NA	62	NA	NA	107	NA	NA	164	NA	NA	231	99	594	313	118	759	416	139	946	533	186	1,352	828
	10	NA	NA	28	NA	NA	55	NA	NA	97	NA	NA	153	NA	NA	216	126	565	296	148	727	394	173	912	567	229	1,315	777
	15	NA	NA	NA	NA	NA	48	NA	NA	89	NA	NA	141	NA	NA	201	NA	NA	281	171	698	375	198	880	485	259	1,280	742
20	2	NA	NA	38	NA	NA	74	NA	NA	124	NA	NA	201	51	522	274	61	678	375	73	867	491	87	1,083	627	121	1,548	953
	5	NA	NA	36	NA	NA	68	NA	NA	116	NA	NA	184	80	503	254	95	658	350	113	845	463	133	1,059	597	179	1,523	933
	10	NA	NA	NA	NA	NA	60	NA	NA	107	NA	NA	172	NA	NA	237	122	627	332	143	811	440	167	1,022	566	221	1,482	879
	15	NA	NA	NA	NA	NA	NA	NA	NA	97	NA	NA	159	NA	NA	220	NA	NA	314	165	780	418	191	987	541	251	1,443	840
	20	NA	NA	NA	NA	NA	NA	NA	NA	83	NA	NA	148	NA	NA	206	NA	NA	296	186	750	397	214	955	513	277	1,406	807
30	2	NA	NA	41	NA	NA	82	NA	NA	137	NA	NA	216	47	581	303	57	762	421	68	985	558	81					

TABLE 24

Capacity of Masonry Chimney Flue with Single-Wall Vent Connectors

(serving a single Category 1 appliance)

Single-Wall Metal Connector Diameter – D
(to be used with chimney areas within the size limits at bottom)

Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of BTU per Hour																												
		3"			4"			5"			6"			7"			8"			9"			10"			12"				
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT		
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max		
6	2	NA	NA	28	NA	NA	52	NA	NA	86	NA	NA	130	NA	NA	180	NA	NA	247	NA	NA	319	NA	NA	400	NA	NA	580		
	5	NA	NA	25	NA	NA	48	NA	NA	81	NA	NA	116	NA	NA	164	NA	NA	230	NA	NA	297	NA	NA	375	NA	NA	560		
8	2	NA	NA	29	NA	NA	55	NA	NA	93	NA	NA	145	NA	NA	197	NA	NA	265	NA	NA	349	382	725	445	549	1,021	650		
	5	NA	NA	26	NA	NA	51	NA	NA	87	NA	NA	133	NA	NA	182	NA	NA	246	NA	NA	327	NA	NA	422	673	1,003	638		
	8	NA	NA	23	NA	NA	47	NA	NA	82	NA	NA	126	NA	NA	174	NA	NA	237	NA	NA	317	NA	NA	408	747	985	621		
10	2	NA	NA	31	NA	NA	61	NA	NA	102	NA	NA	161	NA	NA	220	216	518	297	271	654	387	373	808	490	536	1,142	722		
	5	NA	NA	28	NA	NA	56	NA	NA	95	NA	NA	147	NA	NA	203	NA	NA	276	334	635	364	459	789	465	657	1,121	710		
	10	NA	NA	24	NA	NA	49	NA	NA	86	NA	NA	137	NA	NA	189	NA	NA	261	NA	NA	345	547	758	441	771	1,088	665		
15	2	NA	NA	35	NA	NA	67	NA	NA	113	NA	NA	178	166	473	249	211	611	335	264	776	440	362	965	560	520	1,373	840		
	5	NA	NA	32	NA	NA	61	NA	NA	106	NA	NA	163	NA	NA	230	261	591	312	325	755	414	444	942	531	637	1,348	825		
	10	NA	NA	27	NA	NA	54	NA	NA	96	NA	NA	151	NA	NA	214	NA	NA	294	392	722	392	531	907	504	749	1,309	774		
	15	NA	NA	NA	NA	NA	46	NA	NA	87	NA	NA	138	NA	NA	198	NA	NA	278	452	692	372	606	873	481	841	1,272	738		
20	2	NA	NA	38	NA	NA	73	NA	NA	123	NA	NA	200	163	520	273	206	675	374	258	864	490	252	1,079	625	508	1,544	950		
	5	NA	NA	35	NA	NA	67	NA	NA	115	NA	NA	183	NA	NA	252	255	655	348	317	842	461	433	1,055	594	623	1,518	930		
	10	NA	NA	NA	NA	NA	59	NA	NA	105	NA	NA	170	NA	NA	235	312	622	330	382	806	437	517	1,016	562	733	1,475	875		
	15	NA	NA	NA	NA	NA	NA	NA	NA	95	NA	NA	156	NA	NA	217	NA	NA	311	442	773	414	591	979	539	823	1,435	835		
	20	NA	NA	NA	NA	NA	NA	NA	NA	80	NA	NA	144	NA	NA	202	NA	NA	292	NA	NA	392	663	944	510	911	1,394	800		
30	2	NA	NA	41	NA	NA	81	NA	NA	136	NA	NA	215	158	578	302	200	759	420	249	982	556	340	1,237	715	489	1,789	1,110		
	5	NA	NA	NA	NA	NA	75	NA	NA	127	NA	NA	196	NA	NA	279	245	737	391	306	958	524	417	1,210	680	600	1,760	1,090		
	10	NA	NA	NA	NA	NA	66	NA	NA	113	NA	NA	182	NA	NA	260	300	703	370	370	920	496	500	1,168	644	708	1,713	1,020		
	15	NA	NA	NA	NA	NA	NA	NA	NA	105	NA	NA	168	NA	NA	240	NA	NA	349	428	884	471	572	1,128	615	798	1,668	975		
	20	NA	NA	NA	NA	NA	NA	NA	NA	88	NA	NA	155	NA	NA	223	NA	NA	327	NA	NA	445	643	1,089	585	883	1,624	932		
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	182	NA	NA	281	NA	NA	408	NA	NA	544	1,055	1,539	865		
50	2	NA	NA	NA	NA	NA	91	NA	NA	160	NA	NA	250	NA	NA	350	191	837	475	238	1,103	631	323	1,408	810	463	2,076	1,240		
	5	NA	NA	NA	NA	NA	NA	NA	NA	149	NA	NA	228	NA	NA	321	NA	NA	442	293	1,078	593	398	1,381	770	571	2,044	1,220		
	10	NA	NA	NA	NA	NA	NA	NA	NA	136	NA	NA	212	NA	NA	301	NA	NA	420	355	1,038	562	447	1,337	728	674	1,994	1,140		
	15	NA	NA	NA	NA	NA	NA	NA	NA	124	NA	NA	195	NA	NA	278	NA	NA	395	NA	NA	533	546	1,294	695	761	1,945	1,090		
	20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	180	NA	NA	258	NA	NA	370	NA	NA	504	616	1,251	660	844	1,898	1,040		
	30	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	318	NA	NA	458	NA	NA	610	1,009	1,805	970		
Minimum internal area of chimney in sq. inches				12			19			28			38			50			63			78			95			132		
Maximum internal area of chimney in sq. inches				49			88			137			198			269			352			445			550			792		

TABLE 25

Capacity of Single-Wall Metal Pipe or Type B Cement Vents (serving a single draft hood-equipped appliance)

Height H (ft)	Lateral L (ft)	Appliance Input Rating in Thousands of BTU per Hour Maximum Appliance Input Rating in Thousands of Btu per Hour							
		3"	4"	5"	6"	7"	8"	10"	12"
6	0	39	70	116	170	232	312	500	750
	2	31	55	94	141	194	260	415	620
	5	28	51	88	128	177	242	390	600
8	0	42	76	126	185	252	340	542	815
	2	32	61	102	154	210	284	451	680
	5	29	56	95	141	194	264	430	648
	10	24	49	86	131	180	250	406	625
10	0	45	84	138	202	279	372	606	912
	2	35	67	111	168	233	311	505	760
	5	32	61	104	153	215	289	480	724
	10	27	54	94	143	200	274	455	700
	15	NA	46	84	130	186	258	432	666
15	0	49	91	151	223	312	420	684	1,040
	2	39	72	122	186	260	350	570	865
	5	35	67	110	170	240	325	540	825
	10	30	58	103	158	223	308	514	795
	15	NA	50	93	144	207	291	488	760
	20	NA	NA	82	132	195	273	466	726
	30	NA	NA	NA	NA	NA	NA	NA	NA
20	0	53	101	163	252	342	470	770	1,190
	2	42	80	136	210	286	392	641	990
	5	38	74	123	192	264	364	610	945
	10	32	65	115	178	246	345	571	910
	15	NA	55	104	163	228	326	550	870
	20	NA	NA	91	149	214	306	525	832
30	0	56	108	183	276	384	529	878	1,370
	2	44	84	148	230	320	441	730	1,140
	5	NA	78	137	210	296	410	694	1,080
	10	NA	68	125	196	274	388	656	1,050
	15	NA	NA	113	177	258	366	625	1,000
	20	NA	NA	99	163	240	344	596	960
	30	NA	NA	NA	NA	192	295	540	890
50	0	NA	120	210	310	443	590	980	1,550
	2	NA	95	171	260	370	492	820	1,290
	5	NA	NA	159	234	342	474	780	1,230
	10	NA	NA	146	221	318	456	730	1,190
	15	NA	NA	NA	200	292	407	705	1,130
	20	NA	NA	NA	185	276	384	670	1,080
	30	NA	NA	NA	NA	222	330	605	1,010

TABLE 26

Capacity of Single-Wall Metal Pipe or Type B Cement Vents (serving a two or more draft hood-equipped appliances)

Total Vent Height (ft)	Conn. Rise (ft)	Maximum Appliance Rating in Thousands of Btu per Hour					
		3"	4"	5"	6"	7"	8"
6-8	1	21	40	68	102	146	205
	2	28	53	86	124	178	235
	3	34	61	98	147	204	275
15	1	23	44	77	117	179	240
	2	30	56	92	134	194	265
	3	35	64	102	155	216	298
30 & UP	1	25	49	84	129	190	270
	2	31	58	97	145	211	295
	3	36	68	107	164	232	321

COMMON VENT CAPACITY

Total Vent Height (ft)	Combined appliance input rating in thousands of Btu per hour						
	4"	5"	6"	7"	8"	10"	12"
6	48	78	111	155	205	320	NA
8	55	89	128	175	234	365	505
10	59	95	136	190	250	395	560
15	71	115	168	228	305	480	690
20	80	129	186	260	340	550	790
30	NA	147	215	300	400	650	940
50	NA	NA	NA	360	490	810	1,190

TABLE 27

Capacity of Type B Double-Wall Vents with Type B Double-Wall Connectors

(serving two or more Category 1 Appliances)

Vent Height H (ft)	Conn. Rise R (ft)	Appliance Input Rating Limit in Thousands of Btu per Hour																							
		3"			4"			5"			6"			7"			8"			9"			10"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	22	37	26	35	66	46	46	106	72	58	164	104	77	225	142	92	296	185	109	376	237	128	466	289
	2	23	41	31	37	75	55	48	121	86	60	183	124	79	253	168	95	333	220	112	424	282	131	526	345
	3	24	44	35	38	81	62	49	132	96	62	199	139	82	275	189	97	363	248	114	463	317	134	575	386
8	1	22	40	27	35	72	48	49	114	76	64	176	109	84	243	148	100	320	194	118	408	248	138	507	303
	2	23	44	32	36	80	57	51	128	90	66	195	129	86	269	175	103	356	230	121	454	294	141	564	358
	3	24	47	36	37	87	64	53	139	101	67	210	145	88	290	198	105	384	258	123	492	330	143	612	402
10	1	22	43	28	34	78	50	49	123	78	65	189	113	89	257	154	106	341	200	125	436	257	146	542	314
	2	23	47	33	36	86	59	51	136	93	67	206	134	91	282	182	109	374	238	128	479	305	149	596	372
	3	24	50	37	37	92	67	52	146	104	69	220	150	94	303	205	111	402	268	131	515	342	152	642	417
15	1	21	50	30	33	89	53	47	142	83	64	220	120	88	298	163	110	389	214	134	493	273	162	609	333
	2	22	53	35	35	96	63	49	153	99	66	235	142	91	320	193	112	419	263	137	532	323	165	658	394
	3	24	55	40	36	102	71	51	163	111	68	248	160	93	339	218	115	445	286	140	565	365	167	700	444
20	1	21	54	31	33	99	56	46	157	87	62	246	125	86	334	171	107	436	224	131	552	285	158	681	347
	2	22	57	37	34	105	66	48	167	104	64	259	149	89	354	202	110	463	265	134	587	339	161	725	414
	3	23	60	42	35	110	74	50	176	116	66	271	168	91	371	228	113	486	300	137	618	383	164	764	466
30	1	20	62	33	31	113	59	45	181	93	60	288	134	83	391	182	103	512	238	125	649	305	151	802	372
	2	21	64	39	33	118	70	47	190	110	62	299	158	85	408	215	105	535	282	129	679	360	155	840	439
	3	22	66	44	34	123	79	48	198	124	64	309	178	88	423	242	108	555	317	132	706	405	158	874	494
50	1	19	71	36	30	133	64	43	216	101	57	349	145	78	477	197	97	627	257	120	797	330	144	984	403
	2	21	73	43	32	137	76	45	223	119	59	358	172	81	490	234	100	645	306	123	820	392	148	1,014	478
	3	22	75	48	33	141	86	46	229	134	61	366	194	83	502	263	103	661	343	126	842	441	151	1,043	538
100	1	18	82	37	28	158	66	40	262	104	53	442	150	73	611	204	91	810	266	112	1,038	341	135	1,285	417
	2	19	83	44	30	161	79	42	267	123	55	447	178	75	619	242	94	822	316	115	1,054	405	139	1,306	494
	3	20	84	50	31	163	89	44	272	138	57	452	200	78	627	272	97	834	355	118	1,069	455	142	1,327	555

Common Vent Capacity

Vent Height H (ft)	Appliance Input Rating Limit in Thousands of Btu per Hour																				
	4"			5"			6"			7"			8"			9"			10"		
	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT
6	92	81	65	140	116	103	204	161	147	309	248	200	404	314	260	547	434	335	672	520	410
8	101	90	73	155	129	114	224	178	163	339	275	223	444	348	290	602	480	378	740	577	465
10	110	97	79	169	141	124	243	194	178	367	299	242	477	377	315	649	522	405	800	627	495
15	125	112	91	195	164	144	283	228	206	427	352	280	556	444	365	753	612	465	924	733	565
20	136	123	102	215	183	160	314	255	229	475	394	310	621	499	405	842	688	523	1,035	826	640
30	152	138	118	244	210	185	361	297	266	547	459	360	720	585	470	979	808	605	1,209	975	740
50	167	153	134	279	244	214	421	353	310	641	547	423	854	706	550	1,164	977	705	1,451	1,188	860
100	175	163	NA	311	277	NA	489	421	NA	751	658	479	1,025	873	625	1,408	1,215	800	1,784	1,502	975

TABLE 27 ... continued

Vent Connector Capacity

Type B Double-Wall Vent and Connector Diameter – D

Vent Height H (ft)	Conn. Rise R (ft)	Appliance Input Rating Limit in Thousands of Btu per Hour																				
		12"			14"			16"			18"			20"			22"			24"		
		FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	174	764	496	223	1,046	653	281	1,371	853	346	1,772	1,080	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	180	897	616	230	1,231	827	287	1,617	1,081	352	2,069	1,370	NA	NA	NA	NA	NA	NA	NA	NA	NA
	3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	1	186	822	516	238	1,126	696	298	1,478	910	365	1,920	1,150	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	192	952	644	244	1,307	884	305	1,719	1,150	372	2,211	1,460	471	2,737	1,800	560	3,319	2,180	662	3,957	2,590
	3	198	1,050	772	252	1,445	1,072	313	1,902	1,390	380	2,434	1,770	478	3,018	2,180	568	3,665	2,640	669	4,373	3,130
10	1	196	870	536	249	1,195	730	311	1,570	955	379	2,049	1,205	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	201	997	664	256	1,371	924	318	1,804	1,205	387	2,332	1,535	486	2,887	1,890	581	3,502	2,280	686	4,175	2,710
	3	207	1,095	792	263	1,509	1,118	325	1,989	1,455	395	2,556	1,865	494	3,169	2,290	589	3,849	2,760	694	4,593	3,270
15	1	214	967	568	272	1,334	790	336	1,760	1,030	408	2,317	1,305	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	221	1,085	712	279	1,499	1,006	344	1,978	1,320	416	2,579	1,665	523	3,197	2,060	624	3,881	2,490	734	4,631	2,960
	3	228	1,181	856	286	1,632	1,222	351	2,157	1,610	424	2,796	2,025	533	3,470	2,510	634	4,216	3,030	743	5,035	3,600
20	1	223	1,051	596	291	1,443	840	357	1,911	1,095	430	2,533	1,385	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	230	1,162	748	298	1,597	1,064	365	2,116	1,395	438	2,778	1,765	554	3,447	2,180	661	4,190	2,630	772	5,005	3,130
	3	237	1,253	900	307	1,726	1,288	373	2,287	1,695	450	2,984	2,145	567	3,708	2,650	671	4,511	3,190	785	5,392	3,790
30	1	216	1,217	632	286	1,664	910	367	2,183	1,190	461	2,891	1,540	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	223	1,316	792	294	1,802	1,160	376	2,366	1,510	474	3,110	1,920	619	3,840	2,365	728	4,861	2,860	847	5,606	3,410
	3	231	1,400	592	303	1,920	1,410	384	2,524	1,830	485	3,299	2,340	632	4,080	2,875	741	4,976	3,480	860	5,961	4,150
50	1	206	1,479	689	273	2,023	1,007	350	2,659	1,315	435	3,548	1,665	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	213	1,561	860	281	2,139	1,291	359	2,814	1,685	447	3,730	2,135	581	4,601	2,633	709	5,569	3,185	851	6,633	3,790
	3	221	1,631	1,031	290	2,242	1,575	369	2,951	2,055	461	3,893	2,605	594	4,808	3,208	724	5,826	3,885	867	6,943	4,620
100	1	192	1,923	712	254	2,644	1,050	326	3,490	1,370	402	4,707	1,740	NA	NA	NA	NA	NA	NA	NA	NA	NA
	2	200	1,984	888	263	2,731	1,346	336	3,606	1,760	414	4,842	2,220	523	5,982	2,750	639	7,254	3,330	769	8,650	3,950
	3	208	2,035	1,064	272	2,811	1,642	346	3,714	2,150	426	4,968	2,700	539	6,143	3,350	654	7,453	4,070	786	8,892	4,810

Common Vent Capacity

Vent Height H (ft)	Combined Appliance Input Rating Limit in Thousands of Btu per Hour																				
	12"			14"			16"			18"			20"			22"			24"		
	FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat	FAN		Nat
	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT
6	900	696	588	1,284	990	815	1,735	1,336	1,065	2,253	1,732	1,345	2,838	2,180	1,660	3,488	2,677	1,970	4,206	3,226	2,390
8	994	773	652	1,423	1,103	912	1,927	1,491	1,190	2,507	1,936	1,510	3,162	2,439	1,860	3,890	2,998	2,220	4,695	3,616	2,680
10	1,076	841	712	1,342	1,200	995	2,093	1,625	1,300	2,727	2,113	1,645	3,444	2,665	2,030	4,241	3,278	2,400	5,123	3,957	2,920
15	1,247	986	825	1,794	1,410	1,158	2,440	1,910	1,510	3,184	2,484	1,910	4,026	3,133	2,360	4,971	3,862	2,790	6,016	4,670	3,400
20	1,405	1,116	916	2,006	1,588	1,290	2,722	2,147	1,690	3,561	2,798	2,140	4,548	3,552	2,640	5,573	4,352	3,120	6,749	5,261	3,800
30	1,658	1,327	1,025	2,373	1,892	1,525	3,220	2,558	1,990	4,197	3,326	2,520	5,303	4,193	3,110	6,539	5,157	3,680	7,940	6,247	4,480
50	2,024	1,640	1,280	2,911	2,347	1,863	3,964	3,183	2,430	5,184	4,149	3,075	6,567	5,240	3,800	8,116	6,458	4,500	9,837	7,813	5,475
100	2,569	2,131	1,670	3,732	3,076	2,450	5,125	4,202	3,200	6,749	5,509	4,050	8,597	6,986	5,000	10,681	8,648	5,920	13,004	10,499	7,200

TABLE 28

Capacity of Type B Double-Wall Vent with Single-Wall Connectors

(serving two or more Category 1 Appliances)

Vent Height H (ft)	Conn. Rise R (ft)	Appliance Input Rating Limit in Thousands of Btu per Hour																							
		3"			4"			5"			6"			7"			8"			9"			10"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	NA	NA	26	NA	NA	46	NA	NA	71	NA	NA	102	207	223	140	262	293	183	325	373	234	447	463	286
	2	NA	NA	31	NA	NA	55	NA	NA	85	168	182	123	215	251	167	271	331	219	334	422	281	458	524	344
	3	NA	NA	34	NA	NA	62	121	131	95	175	198	138	222	273	188	279	361	247	344	462	316	468	574	385
8	1	NA	NA	27	NA	NA	48	NA	NA	75	NA	NA	106	226	240	145	285	316	191	352	403	244	481	502	299
	2	NA	NA	32	NA	NA	57	125	126	89	184	193	127	234	266	173	293	353	228	360	450	292	492	560	355
	3	NA	NA	35	NA	NA	64	130	138	100	191	208	144	241	287	197	302	381	256	370	489	328	501	609	400
10	1	NA	NA	28	NA	NA	50	119	121	77	182	186	110	240	253	150	302	335	196	372	429	252	506	534	308
	2	NA	NA	33	84	85	59	124	134	91	189	203	132	248	278	183	311	369	235	381	473	302	517	589	368
	3	NA	NA	36	89	91	67	129	144	102	197	217	148	257	299	203	320	398	265	391	511	339	528	637	413
15	1	NA	NA	29	79	87	52	116	138	81	177	214	116	238	291	158	312	380	208	397	482	266	556	596	324
	2	NA	NA	34	83	94	62	121	150	97	185	230	138	246	314	189	321	411	248	407	522	317	568	646	387
	3	NA	NA	39	87	100	70	127	160	109	193	243	157	255	333	215	331	438	281	418	557	360	579	690	437
20	1	49	56	30	78	97	54	115	152	84	175	238	120	233	325	165	306	425	217	390	538	276	546	664	336
	2	52	59	36	82	103	64	120	163	101	182	252	144	243	346	197	317	453	259	400	574	331	558	709	403
	3	55	62	40	87	107	72	125	172	113	190	264	164	252	363	223	326	476	294	412	607	375	570	750	457
30	1	47	60	31	77	110	57	112	175	89	169	278	129	226	380	175	296	497	230	378	630	294	528	779	358
	2	51	62	37	81	115	67	117	185	106	177	290	152	236	397	208	307	521	274	389	662	349	541	819	425
	3	54	64	42	85	119	76	122	193	120	185	300	172	244	412	235	316	542	309	400	690	394	555	855	482
50	1	46	69	34	75	128	60	109	207	96	162	336	137	217	460	188	284	604	245	364	768	314	507	951	384
	2	49	71	40	79	132	72	114	215	113	170	345	164	226	473	223	294	623	293	376	793	375	520	983	458
	3	52	72	45	83	136	82	119	221	123	178	353	186	235	486	252	304	640	331	387	816	423	535	1,013	518
100	1	45	79	34	71	150	61	104	249	98	153	424	140	205	585	192	269	774	249	345	993	321	476	1,236	393
	2	48	80	41	75	153	73	110	255	115	160	428	167	212	593	228	279	788	299	358	1,011	383	490	1,259	469
	3	51	81	46	79	157	85	114	260	129	168	433	190	222	603	256	289	801	339	368	1,027	431	506	1,280	527

Common Vent Capacity

Vent Height H (ft)	Combined Appliance Input Rating Limit in Thousands of Btu per Hour																				
	4"			5"			6"			7"			8"			9"			10"		
	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT
6	NA	78	64	NA	113	99	200	158	144	304	244	196	398	310	257	541	429	332	665	515	407
8	NA	87	71	NA	126	111	218	173	159	331	269	218	436	342	285	592	473	373	730	569	460
10	NA	94	76	163	137	120	237	189	174	357	292	236	467	369	309	638	512	398	787	617	487
15	121	108	88	189	159	140	275	221	200	416	343	274	544	434	357	738	599	456	905	718	553
20	131	118	98	208	177	156	305	247	223	463	383	302	606	487	395	824	673	512	1,013	808	626
30	145	132	113	236	202	180	350	286	257	533	446	349	703	570	459	958	790	593	1,183	952	723
50	159	145	128	268	233	208	406	337	296	622	529	410	833	686	535	1,139	954	689	1,418	1,157	838
100	166	153	NA	297	263	NA	469	398	NA	726	633	464	999	846	606	1,378	1,185	780	1,741	1,459	948

TABLE 29

Capacity of Masonry Chimney with Type B Double-Wall Connectors

(serving two or more Category 1 Appliances)

Vent Height H (ft)	Conn. Rise R (ft)	Appliance Input Rating Limit in Thousands of Btu per Hour																							
		3"			4"			5"			6"			7"			8"			9"			10"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	24	33	21	39	62	40	52	106	67	65	194	101	87	274	141	104	370	201	124	479	253	145	599	319
	2	26	43	28	41	79	52	53	133	85	67	230	124	89	324	173	107	436	232	127	562	300	148	694	378
	3	27	49	34	42	92	61	55	155	97	69	262	143	91	369	203	109	491	270	129	633	349	151	795	439
8	1	24	39	22	39	72	41	55	117	69	71	213	105	94	304	148	113	414	210	134	539	267	156	682	335
	2	26	47	29	40	87	53	57	140	86	73	246	127	97	350	179	116	473	240	137	615	311	160	776	394
	3	27	52	34	42	97	62	59	159	98	75	269	145	99	383	206	119	517	276	139	672	358	163	848	452
10	1	24	42	22	38	80	42	55	130	71	74	232	108	101	324	153	120	444	216	142	582	277	165	739	348
	2	26	50	29	40	93	54	57	153	87	76	261	129	103	366	184	123	498	247	145	652	321	168	825	407
	3	27	55	35	41	105	63	58	170	100	78	284	148	106	397	209	126	540	281	147	705	366	171	893	463
15	1	24	48	23	38	93	44	54	154	74	72	277	114	100	384	164	125	511	229	153	658	297	184	824	375
	2	25	55	31	39	105	55	56	174	89	74	299	134	103	419	192	128	558	260	156	718	339	187	900	432
	3	26	59	35	41	115	64	57	189	102	76	319	153	105	448	215	131	597	292	159	760	382	190	960	486
20	1	24	52	24	37	102	46	53	172	77	71	313	119	98	437	173	123	584	239	130	752	312	180	943	397
	2	25	58	31	39	114	56	55	190	91	73	335	138	101	467	199	126	625	270	153	805	354	184	1,011	452
	3	26	63	35	40	123	65	57	204	104	75	353	157	104	493	222	129	661	301	156	851	396	187	1,067	505
30	1	24	54	25	37	111	48	52	192	82	69	357	127	96	504	187	119	680	255	145	883	337	175	1,115	432
	2	25	60	32	38	122	58	54	208	95	72	376	145	99	531	209	122	715	287	149	928	378	179	1,171	484
	3	26	64	36	40	131	66	56	221	107	74	392	163	101	554	233	125	746	317	152	968	418	182	1,220	535
50	1	23	51	25	36	116	51	51	209	89	67	405	143	92	582	213	113	798	294	140	1,049	392	168	1,334	506
	2	24	59	32	37	127	61	53	225	102	70	421	161	95	604	235	118	827	326	143	1,085	433	172	1,379	558
	3	26	64	36	39	135	69	55	237	115	72	435	180	98	624	260	121	854	357	147	1,118	474	176	1,421	611
100	1	23	46	24	35	108	50	49	208	92	65	428	155	88	640	237	109	907	334	134	1,222	454	161	1,589	596
	2	24	53	31	37	120	60	51	224	105	67	444	174	92	660	260	113	933	368	138	1,253	497	165	1,626	651
	3	25	59	35	38	130	68	53	237	118	69	458	193	94	679	285	116	956	399	141	1,282	540	169	1,661	705

Common Vent Capacity

Minimum Internal Area of Masonry Chimney Flue (in²)

Vent Height H (ft)	Combined Appliance Input Rating Limit in Thousands of Btu per Hour																							
	12"			19"			28"			38"			50"			63"			78"			113"		
	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT
6	NA	74	25	NA	119	46	NA	178	71	NA	257	103	NA	351	143	NA	458	188	NA	582	246	1,041	853	NA
8	NA	80	28	NA	130	53	NA	193	82	NA	279	119	NA	384	163	NA	501	218	724	636	278	1,144	937	408
10	NA	84	31	NA	138	56	NA	207	90	NA	299	131	NA	409	177	606	538	236	776	686	302	1,226	1,010	454
15	NA	NA	36	NA	152	67	NA	233	106	NA	334	152	523	467	212	682	611	283	874	781	365	1,374	1,156	546
20	NA	NA	41	NA	NA	75	NA	250	122	NA	368	172	565	508	243	742	668	325	955	858	419	1,513	1,286	648
30	NA	NA	NA	NA	NA	NA	NA	270	137	NA	404	198	615	564	278	816	747	381	1,062	969	496	1,702	1,473	749
50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	620	328	879	831	461	1,165	1,089	606	1,905	1,692	922
100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	348	NA	NA	499	NA	NA	669	2,053	1,921	1,058

TABLE 30

Capacity of Masonry Chimney with Single-Wall Connectors

(serving two or more Category 1 Appliances)

Single-Wall Metal Vent Connector Diameter – D

Vent Height H (ft)	Conn. Rise R (ft)	Appliance Input Rating Limit in Thousands of Btu per Hour																							
		3"			4"			5"			6"			7"			8"			9"			10"		
		FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT
		Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max	Min	Max	Max
6	1	NA	NA	21	NA	NA	39	NA	NA	66	179	191	100	231	271	140	292	366	200	362	474	252	499	594	316
	2	NA	NA	28	NA	NA	52	NA	NA	84	186	227	123	239	321	172	301	432	231	373	557	299	509	696	376
	3	NA	NA	34	NA	NA	61	134	153	97	193	258	142	247	365	202	309	491	269	381	634	348	519	793	437
8	1	NA	NA	21	NA	NA	40	NA	NA	68	195	208	103	250	298	146	313	407	207	387	530	263	529	672	331
	2	NA	NA	28	NA	NA	52	137	139	85	202	240	125	258	343	177	323	465	238	397	607	309	540	766	391
	3	NA	NA	34	NA	NA	62	143	156	98	210	264	145	266	376	205	332	509	274	407	663	356	551	838	450
10	1	NA	NA	22	NA	NA	41	130	151	70	202	225	106	267	316	151	333	434	213	410	571	273	558	727	343
	2	NA	NA	29	NA	NA	53	136	150	86	210	255	128	276	358	181	343	489	244	420	640	317	569	813	403
	3	NA	NA	34	97	102	62	143	166	99	217	277	147	284	389	207	352	530	279	430	694	363	580	880	459
15	1	NA	NA	23	NA	NA	43	129	151	73	199	271	112	268	376	161	349	502	225	445	646	291	623	808	366
	2	NA	NA	30	92	103	54	135	170	88	207	295	132	277	411	189	359	548	256	456	706	334	634	884	424
	3	NA	NA	34	96	112	63	141	185	101	215	315	151	286	439	213	368	586	289	466	755	378	646	945	479
20	1	NA	NA	23	87	99	45	128	167	76	197	303	117	265	425	169	345	569	235	439	734	306	614	921	387
	2	NA	NA	30	91	111	55	134	185	90	205	325	136	274	455	195	355	610	266	450	717	348	627	986	443
	3	NA	NA	35	96	119	64	140	199	103	213	343	154	282	481	219	365	644	298	461	831	391	639	1,042	496
30	1	NA	NA	24	86	108	47	126	187	80	193	347	124	259	492	183	338	665	250	430	864	330	600	1,089	421
	2	NA	NA	31	91	119	57	132	203	93	201	366	142	269	518	205	348	699	282	442	908	372	613	1,145	473
	3	NA	NA	35	95	127	65	138	216	105	209	381	160	277	540	229	358	729	312	452	946	412	626	1,193	524
50	1	NA	NA	24	85	113	50	124	204	87	188	392	139	252	567	208	328	778	287	417	1,022	383	582	1,302	492
	2	NA	NA	31	89	123	60	130	218	100	196	408	158	262	588	230	339	806	320	429	1,058	425	596	1,346	545
	3	NA	NA	35	94	131	68	136	231	112	205	422	176	271	607	255	349	831	351	440	1,090	466	610	1,386	597
100	1	NA	NA	23	84	104	49	122	200	89	182	410	151	243	617	232	315	875	328	402	1,181	444	560	1,537	580
	2	NA	NA	30	88	115	59	127	215	102	190	425	169	253	636	254	326	899	361	415	1,210	488	575	1,570	634
	3	NA	NA	34	93	124	67	133	228	115	199	438	188	262	654	279	337	921	392	427	1,238	529	589	1,604	687

Common Vent Capacity

Minimum internal area of masonry chimney flue (in²)

Vent Height H (ft)	Combined Appliance Input Rating Limit in Thousands of Btu per Hour																							
	12"			19"			28"			38"			50"			63"			78"			113"		
	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT	FAN		NAT			
	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT	+FAN	+FAN	+NAT			
6	NA	NA	25	NA	118	45	NA	176	71	NA	255	102	NA	348	142	NA	455	187	NA	579	245	NA	846	NA
8	NA	NA	28	NA	128	52	NA	190	81	NA	276	118	NA	380	162	NA	497	217	NA	633	277	1,136	928	405
10	NA	NA	31	NA	136	56	NA	205	89	NA	295	129	NA	405	175	NA	532	234	771	680	300	1,216	1,000	450
15	NA	NA	36	NA	NA	66	NA	230	105	NA	335	150	NA	400	210	677	602	280	866	772	360	1,359	1,139	540
20	NA	NA	NA	NA	NA	74	NA	247	120	NA	362	170	NA	503	240	765	661	321	947	849	415	1,495	1,264	640
30	NA	NA	NA	NA	NA	NA	NA	NA	135	NA	398	195	NA	558	275	808	739	377	1,052	957	490	1,682	1,447	740
50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	612	325	NA	821	456	1,152	1,076	600	1,879	1,672	910
100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	494	NA	NA	663	2,006	1,885	1,046

INDIRECT WATER HEATER PERFORMANCE

TABLE 31

Model	Capacities		P e r f o r m a n c e					
	Actual Tank Volume (gal)	Coil Volume (gal)	First Hour Rating (gal)*	Continuous Draw Rating (GPH)*	First Draw Rating (gal)*	Minimum Coil Output (BTU/Hr)**	Standby Loss Rating (°F/hr)	Heat Source Friction Loss (ft. w.c.)
30SK	30	1.4	119	92	27	59,000	1.5	2.3
40SK	38	2.3	198	165	33	105,000	1.5	3.4
50SK	45	2.3	205	165	40	105,000	1.1	3.4
80SK	75	2.8	259	189	70	120,000	0.8	3.5
119SK	110	2.8	291	189	102	120,000	1.2	3.5

NOTES:

* Based on 77°F rise with 58°F potable water inlet temperature at 14 GPM heat source flow rate. Heat source temperature was 180°F.

** Minimum Coil output based on continuous boiler operation over 30 minutes. See Section III for additional considerations.

All data obtained through testing in accordance with GAMA INDIRECT-FIRED WATER HEATER TESTING STANDARD IWH-TS-1_MARCH 2003

TABLE 32

Model	FIRST HOUR RATING (gal) @ Coil Output (Btu/hr)						
	180°F 8 GPM*	180°F 10 GPM*	180°F 12 GPM*	200°F 8 GPM*	200°F 10 GPM*	200°F 12 GPM*	200°F 14 GPM*
30SK	115 @ 56,000	117 @ 57,000	118 @ 58,000	138 @ 71,000	144 @ 75,000	149 @ 78,000	154 @ 81,000
40SK	173 @ 89,000	183 @ 96,000	191 @ 101,000	214 @ 115,000	226 @ 123,000	235 @ 129,000	243 @ 134,000
50SK	180 @ 89,000	190 @ 96,000	198 @ 101,000	221 @ 115,000	233 @ 123,000	242 @ 129,000	250 @ 134,000
80SK	233 @ 104,000	245 @ 111,000	254 @ 117,000	277 @ 132,000	292 @ 141,000	304 @ 149,000	314 @ 155,000
119SK	265 @ 104,000	277 @ 111,000	286 @ 117,000	309 @ 132,000	324 @ 141,000	336 @ 149,000	346 @ 155,000

NOTES:

First Hour Rating = First Draw + Continuous Draw

* Coil Input (temperature, flow rate). Ratings based on 77°F rise with 58°F inlet potable water.

All data obtained through testing in accordance with GAMA INDIRECT-FIRED WATER HEATER TESTING STANDARD IWH-TS-1_MARCH 2003

TABLE 33

DELIVERY AT 40°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	159	230	301	373	515	729	943	1,798	2,654	14.26	855	9
OT400N-A	125	400,000	182	276	370	464	652	934	1,216	2,344	3,473	18.81	1,128	7
OT500N-A	125	500,000	204	320	436	553	785	1,134	1,483	2,879	4,274	23.26	1,396	5
60HEC-125	60	125,000	88	118	148	178	238	328	418	778	1,138	6.00	360	10
60HEC-150	60	150,000	91	126	160	195	265	370	474	893	1,312	6.98	419	9
60HEC-199	60	199,000	101	147	193	238	330	467	605	1,154	1,704	9.16	549	7
100HEC-150	100	150,000	136	173	211	248	322	434	545	991	1,437	7.44	446	13
100HEC-199	100	199,000	148	197	246	295	393	540	687	1,275	1,863	9.80	588	10
100HEC-250	100	250,000	158	218	279	340	461	643	825	1,553	2,280	12.13	728	8
150G-400	175	400,000	225	307	389	470	634	880	1,125	2,107	3,089	16.37	982	11
150G-600	166	600,000	259	381	504	627	872	1,241	1,609	3,082	4,555	24.55	1,473	7
150G-800	157	800,000	292	456	619	783	1,110	1,601	2,092	4,056	6,020	32.73	1,964	5
200G-450	245	450,000	293	385	477	569	753	1,029	1,305	2,410	3,515	18.42	1,105	13
200G-650	212	650,000	306	439	572	705	971	1,370	1,768	3,363	4,958	26.58	1,595	8
200G-850	204	850,000	341	514	688	862	1,210	1,731	2,253	4,339	6,425	34.77	2,086	6
200G-1150	191	1,150,000	391	627	862	1,097	1,568	2,273	2,979	5,802	8,625	47.05	2,823	4
250G-800	271	800,000	385	549	713	876	1,204	1,695	2,186	4,150	6,114	32.73	1,964	8
250G-1000	257	1,000,000	415	619	824	1,029	1,438	2,051	2,665	5,120	7,575	40.92	2,455	6
250G-1250	247	1,250,000	458	713	969	1,225	1,736	2,503	3,270	6,338	9,406	51.13	3,068	5
250G-1500	247	1,500,000	509	816	1,123	1,429	2,043	2,964	3,884	7,566	11,248	61.37	3,682	4
75-76SKG	73	76,000	75	90	105	121	152	198	244	429	613	3.08	185	24
100-76SKG	98	76,000	95	110	126	141	172	218	264	449	634	3.08	185	32
EZ 75-76	75	76,000	75	90	106	121	151	197	242	425	607	3.04	182	25
EZ 76-76PDV	75	76,000	76	92	107	122	153	199	246	430	615	3.08	185	24
EZ 100-76	100	76,000	95	110	126	141	171	217	262	445	627	3.04	182	33
EZ 100-76PDV	100	76,000	96	112	127	143	173	220	266	451	635	3.08	185	32
EZ 75-135	67	135,000	81	108	135	162	216	297	378	702	1,026	5.40	324	12
EZ 80-156	80	156,000	95	126	158	189	251	345	439	813	1,188	6.24	375	13
EZ 80-199	80	199,000	104	144	183	223	303	422	542	1,020	1,497	7.96	478	10
EZ 90-199	90	199,000	112	152	191	231	311	430	550	1,028	1,505	7.96	478	11
EZ 100-199	100	199,000	120	160	199	239	319	438	558	1,036	1,513	7.96	478	13
80W-250SD	80	250,000	115	165	216	266	367	519	670	1,276	1,882	10.10	606	8
100W-250SD	98	250,000	129	179	230	280	381	533	684	1,291	1,897	10.10	606	10
100W-270SD	100	270,000	135	189	244	298	407	571	735	1,389	2,044	10.91	655	9
75W-300SD	75	300,000	121	181	242	302	424	605	787	1,515	2,242	12.12	727	6
100W-300SD	100	300,000	141	201	262	322	444	625	807	1,535	2,262	12.12	727	8
66W-370SD	65	370,000	127	201	276	351	500	725	949	1,846	2,743	14.95	897	4
66W-399SD	65	399,999	133	214	294	375	537	779	1,022	1,991	2,961	16.16	970	4
80W-425SD	80	425,000	150	236	322	407	579	837	1,094	2,125	3,155	17.17	1,030	5
80W-450SD	80	450,000	155	246	337	428	609	882	1,155	2,246	3,337	18.18	1,091	4
80W-505SD	80	505,000	166	268	370	472	676	982	1,288	2,512	3,737	20.40	1,224	4
66W-625SD	65	625,000	178	305	431	557	810	1,188	1,567	3,082	4,597	25.25	1,515	3
80W-725SD	80	725,000	210	357	503	650	943	1,382	1,822	3,579	5,337	29.29	1,758	3
71PG	68	173,000	82	114	145	177	241	336	432	813	1,195	6.36	382	11
72PG	67	199,000	90	128	167	205	282	396	511	971	1,431	7.66	460	9
73PG	67	242,000	98	144	190	236	329	468	607	1,162	1,718	9.26	556	7
120PG	113	155,000	118	148	178	208	268	358	448	809	1,169	6.01	361	19
190PG	113	190,000	121	157	193	229	301	408	516	946	1,377	7.18	431	16
241PG	109	277,000	136	189	242	295	401	560	719	1,355	1,991	10.60	636	10
361PG	91	385,000	147	223	298	374	525	752	978	1,886	2,793	15.12	907	6
541PG	83	623,000	180	298	416	533	768	1,121	1,474	2,886	4,298	23.53	1,412	4

TABLE 34

DELIVERY AT 40°F RISE – OIL

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	29	42	54	66	91	129	166	316	465	2.49	149	8
32E	32	104,000	48	69	90	112	154	218	282	538	794	4.27	256	8
32PP	32	104,000	48	70	92	114	158	224	290	555	820	4.41	265	7
33E	33	104,000	47	68	89	110	151	214	276	526	775	4.16	250	8
40E	40	126,000	58	83	109	135	186	262	339	645	951	5.11	306	8
50ES	50	140,000	69	97	126	154	211	296	381	721	1,062	5.67	340	9
51E	50	152,000	70	100	130	161	221	312	402	765	1,128	6.04	363	8
51PP	50	152,000	73	105	138	171	236	334	432	824	1,216	6.53	392	8
71E	68	173,000	85	118	151	184	251	350	449	846	1,244	6.62	397	10
72E	67	199,000	93	133	173	213	292	412	531	1,009	1,487	7.96	478	8
73E	67	242,000	102	150	199	247	344	489	635	1,216	1,797	9.68	581	7
120E	113	155,000	120	151	181	212	273	365	457	824	1,192	6.12	367	18
190E	113	190,000	126	163	201	238	313	424	536	984	1,432	7.46	448	15
241E	109	277,000	138	192	246	299	407	568	729	1,373	2,017	10.74	644	10
361E	91	415,000	156	239	322	405	571	820	1,069	2,066	3,062	16.61	996	5
541E	83	623,000	186	308	429	551	794	1,159	1,523	2,982	4,440	24.31	1,458	3
150E-400	175	400,000	230	314	398	482	650	901	1,153	2,159	3,165	16.77	1,006	10
150E-600	166	600,000	265	391	516	642	894	1,271	1,648	3,157	4,666	25.15	1,509	7
150E-800	157	800,000	299	467	635	802	1,138	1,641	2,144	4,156	6,168	33.53	2,012	5
200E-450	245	450,000	300	394	488	583	771	1,054	1,337	2,469	3,601	18.87	1,132	13
200E-650	212	650,000	314	450	586	723	995	1,404	1,813	3,448	5,083	27.25	1,635	8
200E-850	204	850,000	349	527	705	884	1,240	1,774	2,309	4,447	6,585	35.63	2,138	6
200E-1150	191	1,150,000	401	642	883	1,124	1,606	2,329	3,052	5,944	8,836	48.20	2,892	4
250E-800	271	800,000	396	564	733	901	1,237	1,742	2,247	4,266	6,285	33.65	2,019	8
250E-1000	257	1,000,000	430	641	853	1,065	1,489	2,124	2,760	5,302	7,844	42.37	2,542	6
250E-1250	247	1,250,000	467	728	990	1,251	1,773	2,556	3,339	6,472	9,605	52.22	3,133	5
250E-1500	247	1,500,000	528	846	1,164	1,482	2,118	3,073	4,027	7,845	11,663	63.63	3,818	4

TABLE 35

DELIVERY AT 50°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	145	202	259	316	430	601	772	1,456	2,140	11.40	684	11
OT400N-A	125	400,000	163	238	313	388	539	765	990	1,893	2,796	15.05	903	8
OT500N-A	125	500,000	181	274	367	460	646	925	1,204	2,320	3,437	18.61	1,116	7
60HEC-125	60	125,000	82	106	130	154	202	274	346	634	922	4.80	288	12
60HEC-150	60	150,000	84	112	140	167	223	307	391	726	1,061	5.58	335	11
60HEC-199	60	199,000	92	128	165	202	275	385	495	934	1,374	7.33	440	8
100HEC-150	100	150,000	129	159	188	218	278	367	456	813	1,170	5.95	357	17
100HEC-199	100	199,000	138	177	216	255	334	451	569	1,040	1,510	7.84	471	13
100HEC-250	100	250,000	146	194	243	291	388	534	679	1,261	1,844	9.70	582	10
150G-400	175	400,000	208	274	339	405	536	732	928	1,713	2,498	13.08	785	13
150G-600	166	600,000	234	332	430	528	725	1,019	1,314	2,492	3,670	19.63	1,178	8
150G-800	157	800,000	259	390	521	652	914	1,307	1,699	3,270	4,841	26.18	1,571	6
200G-450	245	450,000	274	348	421	495	642	863	1,084	1,968	2,852	14.73	884	17
200G-650	212	650,000	280	386	492	599	811	1,130	1,449	2,725	4,001	21.27	1,276	10
200G-850	204	850,000	306	445	584	723	1,001	1,419	1,836	3,505	5,174	27.82	1,669	7
200G-1150	191	1,150,000	344	533	721	909	1,285	1,850	2,414	4,672	6,930	37.63	2,258	5
250G-800	271	800,000	353	483	614	745	1,007	1,400	1,793	3,364	4,935	26.18	1,571	10
250G-1000	257	1,000,000	374	538	701	865	1,192	1,683	2,174	4,138	6,102	32.73	1,964	8
250G-1250	247	1,250,000	407	611	816	1,020	1,430	2,043	2,657	5,112	7,567	40.92	2,455	6
250G-1500	247	1,500,000	447	693	938	1,184	1,674	2,411	3,147	6,092	9,037	49.08	2,945	5
75-76SKG	73	76,000	71	84	96	108	133	170	207	355	503	2.46	148	30
100-76SKG	98	76,000	92	104	116	129	153	190	227	375	523	2.46	148	40
EZ 75-76	75	76,000	72	84	96	109	133	169	206	352	498	2.43	146	31
EZ 76-76PDV	75	76,000	73	85	98	110	135	172	209	356	504	2.46	148	30
EZ 100-76	100	76,000	92	104	116	129	153	189	226	372	518	2.43	146	41
EZ 100-76PDV	100	76,000	93	106	118	130	155	192	229	377	524	2.46	148	41
EZ 75-135	67	135,000	75	97	118	140	183	248	313	572	832	4.32	259	16
EZ 80-156	80	156,000	89	114	139	164	214	289	364	663	963	4.99	300	16
EZ 80-199	80	199,000	96	128	160	191	255	351	446	828	1,211	6.37	382	13
EZ 90-199	90	199,000	104	136	168	199	263	359	454	836	1,219	6.37	382	14
EZ 100-199	100	199,000	112	144	176	207	271	367	462	844	1,227	6.37	382	16
80W-250SD	80	250,000	104	145	185	226	306	428	549	1,034	1,519	8.08	485	10
100W-250SD	98	250,000	119	159	200	240	321	442	563	1,048	1,533	8.08	485	12
100W-270SD	100	270,000	124	167	211	255	342	473	604	1,127	1,651	8.73	524	11
75W-300SD	75	300,000	108	157	205	254	351	496	642	1,224	1,805	9.70	582	8
100W-300SD	100	300,000	128	177	225	274	371	516	662	1,244	1,825	9.70	582	10
66W-370SD	65	370,000	112	172	231	291	411	590	770	1,487	2,205	11.96	718	5
66W-399SD	65	399,999	117	181	246	311	440	634	828	1,604	2,379	12.93	776	5
80W-425SD	80	425,000	133	201	270	339	476	682	888	1,712	2,537	13.74	824	6
80W-450SD	80	450,000	137	209	282	355	500	719	937	1,809	2,682	14.55	873	6
80W-505SD	80	505,000	146	227	309	390	554	799	1,043	2,023	3,002	16.32	979	5
66W-625SD	65	625,000	153	254	355	456	658	961	1,264	2,476	3,688	20.20	1,212	3
80W-725SD	80	725,000	181	298	416	533	767	1,119	1,470	2,876	4,282	23.43	1,406	3
71PG	68	173,000	75	101	126	152	203	279	355	661	966	5.09	305	13
72PG	67	199,000	82	113	144	174	236	328	419	787	1,155	6.13	368	11
73PG	67	242,000	88	125	162	199	273	385	496	940	1,385	7.41	444	9
120PG	113	155,000	112	136	160	184	232	304	376	664	953	4.81	288	24
190PG	113	190,000	114	143	171	200	258	344	430	774	1,119	5.74	344	20
241PG	109	277,000	126	168	211	253	338	465	592	1,101	1,610	8.48	509	13
361PG	91	385,000	132	192	253	313	434	616	797	1,523	2,248	12.09	726	8
541PG	83	623,000	157	251	345	439	627	910	1,192	2,321	3,451	18.82	1,129	4

TABLE 36

DELIVERY AT 50°F RISE – OIL

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	27	37	46	56	76	106	136	256	375	1.99	120	10
32E	32	104,000	43	60	77	94	129	180	231	436	641	3.41	205	9
32PP	32	104,000	43	61	79	96	131	184	237	449	661	3.53	212	9
33E	33	104,000	43	60	76	93	126	176	226	426	626	3.33	200	10
40E	40	126,000	53	73	94	114	155	216	277	522	768	4.08	245	10
50ES	50	140,000	63	86	109	131	177	245	313	585	857	4.54	272	11
51E	50	152,000	64	88	112	136	185	257	330	620	910	4.84	290	10
51PP	50	152,000	66	92	118	145	197	275	354	667	981	5.23	314	10
71E	68	173,000	78	105	131	158	211	290	370	688	1,005	5.30	318	13
72E	67	199,000	85	117	149	181	245	340	436	818	1,200	6.37	382	11
73E	67	242,000	92	131	170	209	286	402	518	983	1,448	7.75	465	9
120E	113	155,000	114	138	163	187	236	310	383	677	971	4.90	294	23
190E	113	190,000	119	148	178	208	268	357	447	805	1,163	5.97	358	19
241E	109	277,000	127	170	213	256	342	471	600	1,115	1,631	8.59	515	13
361E	91	415,000	139	206	272	339	471	671	870	1,667	2,464	13.29	797	7
541E	83	623,000	162	259	356	454	648	940	1,231	2,398	3,565	19.45	1,167	4
150E-400	175	400,000	214	281	348	415	549	750	952	1,757	2,562	13.42	805	13
150E-600	166	600,000	240	340	441	541	743	1,044	1,346	2,553	3,760	20.12	1,207	8
150E-800	157	800,000	266	400	534	668	937	1,339	1,742	3,352	4,962	26.83	1,610	6
200E-450	245	450,000	281	356	431	507	658	884	1,110	2,015	2,920	15.08	905	16
200E-650	212	650,000	287	396	505	614	832	1,159	1,486	2,794	4,102	21.80	1,308	10
200E-850	204	850,000	313	456	598	741	1,026	1,453	1,881	3,591	5,301	28.50	1,710	7
200E-1150	191	1,150,000	353	546	739	931	1,317	1,896	2,474	4,788	7,102	38.57	2,314	5
250E-800	271	800,000	363	497	632	767	1,036	1,440	1,844	3,460	5,076	26.93	1,616	10
250E-1000	257	1,000,000	387	557	726	896	1,235	1,743	2,252	4,286	6,320	33.90	2,034	8
250E-1250	247	1,250,000	415	624	833	1,042	1,459	2,086	2,712	5,218	7,724	41.77	2,506	6
250E-1500	247	1,500,000	464	719	973	1,228	1,737	2,501	3,265	6,320	9,375	50.92	3,055	5

TABLE 37

DELIVERY AT 60°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	135	183	230	278	373	515	658	1,228	1,798	9.50	570	13
OT400N-A	125	400,000	150	213	276	338	464	652	840	1,592	2,344	12.54	752	10
OT500N-A	125	500,000	165	243	320	398	553	785	1,018	1,948	2,879	15.51	930	8
60HEC-125	60	125,000	78	98	118	138	178	238	298	538	778	4.00	240	15
60HEC-150	60	150,000	79	102	126	149	195	265	335	614	893	4.65	279	13
60HEC-199	60	199,000	86	116	147	177	238	330	422	788	1,154	6.11	366	10
100HEC-150	100	150,000	124	149	173	198	248	322	397	694	991	4.96	297	20
100HEC-199	100	199,000	131	164	197	229	295	393	491	883	1,275	6.54	392	15
100HEC-250	100	250,000	137	178	218	259	340	461	582	1,067	1,553	8.09	485	12
150G-400	175	400,000	198	252	307	362	471	634	798	1,453	2,108	10.92	655	16
150G-600	166	600,000	218	299	381	463	627	872	1,118	2,100	3,082	16.37	982	10
150G-800	157	800,000	237	347	456	565	783	1,110	1,437	2,746	4,055	21.82	1,309	7
200G-450	245	450,000	262	323	384	446	568	752	936	1,672	2,408	12.27	736	20
200G-650	212	650,000	262	351	439	528	705	971	1,237	2,301	3,365	17.73	1,064	12
200G-850	204	850,000	283	399	515	631	862	1,210	1,558	2,949	4,340	23.18	1,391	9
200G-1150	191	1,150,000	313	470	627	784	1,097	1,568	2,038	3,920	5,802	31.37	1,882	6
250G-800	271	800,000	331	440	549	658	876	1,203	1,531	2,840	4,149	21.82	1,309	12
250G-1000	257	1,000,000	346	483	619	755	1,028	1,437	1,846	3,482	5,118	27.27	1,636	9
250G-1250	247	1,250,000	372	543	713	884	1,224	1,736	2,247	4,292	6,337	34.08	2,045	7
250G-1500	247	1,500,000	407	611	816	1,020	1,430	2,043	2,657	5,112	7,567	40.92	2,455	6
75-76SKG	73	76,000	69	80	90	100	121	152	182	305	429	2.05	123	36
100-76SKG	98	76,000	90	100	110	120	141	172	203	326	449	2.05	123	48
EZ 75-76	75	76,000	70	80	90	101	121	151	182	303	425	2.03	122	37
EZ 76-76PDV	75	76,000	71	81	92	102	122	153	184	307	430	2.05	123	37
EZ 100-76	100	76,000	90	100	110	121	141	171	202	323	445	2.03	122	49
EZ 100-76PDV	100	76,000	91	102	112	122	143	173	204	327	451	2.05	123	49
EZ 75-135	67	135,000	72	90	108	126	162	216	270	486	702	3.60	216	19
EZ 80-156	80	156,000	85	106	126	147	189	251	314	563	813	4.16	250	19
EZ 80-199	80	199,000	91	117	144	170	223	303	383	701	1,020	5.31	319	15
EZ 90-199	90	199,000	99	125	152	178	231	311	391	709	1,028	5.31	319	17
EZ 100-199	100	199,000	107	133	160	186	239	319	399	717	1,036	5.31	319	19
80W-250SD	80	250,000	98	131	165	199	266	367	468	872	1,276	6.73	404	12
100W-250SD	98	250,000	112	146	179	213	280	381	482	886	1,291	6.73	404	15
100W-270SD	100	270,000	116	153	189	225	298	407	516	953	1,389	7.27	436	14
75W-300SD	75	300,000	100	141	181	222	302	424	545	1,030	1,515	8.08	485	9
100W-300SD	100	300,000	120	161	201	242	322	444	565	1,050	1,535	8.08	485	12
66W-370SD	65	370,000	102	152	201	251	351	500	650	1,248	1,846	9.97	598	7
66W-399SD	65	399,999	106	160	214	267	375	537	698	1,345	1,991	10.77	646	6
80W-425SD	80	425,000	121	178	236	293	407	579	751	1,438	2,125	11.45	687	7
80W-450SD	80	450,000	125	185	246	306	428	609	791	1,519	2,246	12.12	727	7
80W-505SD	80	505,000	132	200	268	336	472	676	880	1,696	2,512	13.60	816	6
66W-625SD	65	625,000	136	220	305	389	557	810	1,062	2,072	3,082	16.84	1,010	4
80W-725SD	80	725,000	162	259	357	455	650	943	1,236	2,407	3,579	19.53	1,172	4
71PG	68	173,000	71	92	114	135	177	241	304	559	813	4.24	254	16
72PG	67	199,000	77	103	128	154	205	282	358	665	971	5.11	307	13
73PG	67	242,000	82	113	144	175	236	329	422	792	1,162	6.17	370	11
120PG	113	155,000	108	128	148	168	208	268	328	568	809	4.01	240	28
190PG	113	190,000	109	133	157	181	229	301	372	659	946	4.78	287	24
241PG	109	277,000	119	154	189	225	295	401	507	931	1,355	7.07	424	15
361PG	91	385,000	122	172	223	273	374	525	676	1,281	1,886	10.08	605	9
541PG	83	623,000	141	220	298	376	533	768	1,004	1,945	2,886	15.69	941	5

TABLE 38**DELIVERY AT 60°F RISE – OIL**

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	25	33	42	50	66	91	116	216	316	1.66	100	12
32E	32	104,000	40	55	69	83	112	154	197	367	538	2.84	171	11
32PP	32	104,000	40	55	70	84	114	158	202	379	555	2.94	176	11
33E	33	104,000	40	54	68	82	110	151	193	359	526	2.77	166	12
40E	40	126,000	49	66	83	100	135	186	237	441	645	3.40	204	12
50ES	50	140,000	59	78	97	116	154	211	267	494	721	3.78	227	13
51E	50	152,000	60	80	100	120	161	221	282	523	765	4.03	242	12
51PP	50	152,000	62	84	105	127	171	236	301	563	824	4.36	261	11
71E	68	173,000	74	96	118	140	184	251	317	582	846	4.41	265	15
72E	67	199,000	80	107	133	160	213	292	372	691	1,009	5.31	319	13
73E	67	242,000	86	118	150	183	247	344	441	828	1,216	6.46	387	10
120E	113	155,000	110	130	151	171	212	273	334	579	824	4.08	245	28
190E	113	190,000	114	138	163	188	238	313	387	686	984	4.97	298	23
241E	109	277,000	120	156	192	228	299	407	514	944	1,373	7.16	430	15
361E	91	415,000	128	184	239	294	405	571	737	1,401	2,066	11.07	664	8
541E	83	623,000	146	227	308	389	551	794	1,037	2,009	2,982	16.20	972	5
150E-400	175	400,000	203	259	314	370	482	650	818	1,489	2,160	11.18	671	16
150E-600	166	600,000	223	307	391	474	642	894	1,145	2,151	3,157	16.77	1,006	10
150E-800	157	800,000	243	355	467	579	802	1,137	1,473	2,814	4,155	22.35	1,341	7
200E-450	245	450,000	268	331	394	457	583	772	960	1,715	2,470	12.58	755	19
200E-650	212	650,000	269	359	450	541	723	995	1,268	2,358	3,448	18.17	1,090	12
200E-850	204	850,000	290	408	527	646	883	1,240	1,596	3,021	4,446	23.75	1,425	9
200E-1150	191	1,150,000	321	481	642	803	1,124	1,606	2,088	4,016	5,944	32.13	1,928	6
250E-800	271	800,000	340	452	564	677	901	1,237	1,574	2,920	4,266	22.43	1,346	12
250E-1000	257	1,000,000	359	500	641	783	1,065	1,489	1,913	3,608	5,303	28.25	1,695	9
250E-1250	247	1,250,000	380	554	728	902	1,250	1,772	2,294	4,382	6,470	34.80	2,088	7
250E-1500	247	1,500,000	422	634	846	1,058	1,482	2,118	2,754	5,299	7,844	42.42	2,545	6

TABLE 39

DELIVERY AT 70°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	128	169	210	250	332	454	576	1,065	1,554	8.15	489	15
OT400N-A	125	400,000	141	195	249	302	410	571	732	1,377	2,022	10.75	645	12
OT500N-A	125	500,000	154	220	287	353	486	686	885	1,682	2,480	13.29	797	9
60HEC-125	60	125,000	75	92	109	126	160	212	263	469	675	3.43	206	17
60HEC-150	60	150,000	76	96	116	136	175	235	295	534	774	3.99	239	15
60HEC-199	60	199,000	81	108	134	160	212	291	369	683	997	5.23	314	11
100HEC-150	100	150,000	120	142	163	184	227	290	354	609	864	4.25	255	24
100HEC-199	100	199,000	127	155	183	211	267	351	435	771	1,107	5.60	336	18
100HEC-250	100	250,000	132	166	201	236	305	409	513	929	1,345	6.93	416	14
150G-400	175	400,000	190	237	283	330	424	564	704	1,265	1,826	9.35	561	19
150G-600	166	600,000	206	276	346	417	557	767	978	1,820	2,662	14.03	842	12
150G-800	157	800,000	222	315	409	502	689	970	1,250	2,372	3,494	18.70	1,122	8
200G-450	245	450,000	253	305	358	411	516	674	831	1,462	2,093	10.52	631	23
200G-650	212	650,000	249	325	401	477	629	857	1,085	1,997	2,909	15.20	912	14
200G-850	204	850,000	266	365	465	564	763	1,061	1,359	2,551	3,743	19.87	1,192	10
200G-1150	191	1,150,000	291	425	559	694	963	1,366	1,769	3,382	4,995	26.88	1,613	7
250G-800	271	800,000	315	409	502	596	783	1,063	1,344	2,466	3,588	18.70	1,122	14
250G-1000	257	1,000,000	327	444	561	678	912	1,262	1,613	3,016	4,419	23.38	1,403	11
250G-1250	247	1,250,000	348	494	640	786	1,078	1,517	1,955	3,708	5,461	29.22	1,753	8
250G-1500	247	1,500,000	377	553	728	903	1,254	1,780	2,306	4,410	6,514	35.07	2,104	7
75-76SKG	73	76,000	68	77	86	94	112	138	165	270	376	1.76	106	41
100-76SKG	98	76,000	88	97	106	115	132	159	185	291	396	1.76	106	56
EZ 75-76	75	76,000	69	77	86	95	112	138	164	269	373	1.74	104	43
EZ 76-76PDV	75	76,000	70	78	87	96	114	140	166	272	377	1.76	106	43
EZ 100-76	100	76,000	89	97	106	115	132	158	184	289	393	1.74	104	58
EZ 100-76PDV	100	76,000	90	99	107	116	134	160	187	292	398	1.76	106	57
EZ 75-135	67	135,000	69	84	100	115	146	193	239	424	609	3.09	185	22
EZ 80-156	80	156,000	82	100	118	135	171	225	278	492	706	3.57	214	22
EZ 80-199	80	199,000	87	110	132	155	201	269	337	610	883	4.55	273	18
EZ 90-199	90	199,000	95	118	140	163	209	277	345	618	891	4.55	273	20
EZ 100-199	100	199,000	103	126	148	171	217	285	353	626	899	4.55	273	22
80W-250SD	80	250,000	93	122	151	179	237	324	410	757	1,103	5.77	346	14
100W-250SD	98	250,000	107	136	165	194	252	338	425	771	1,117	5.77	346	17
100W-270SD	100	270,000	111	142	174	205	267	361	454	828	1,202	6.23	374	16
75W-300SD	75	300,000	95	129	164	199	268	372	476	891	1,307	6.93	416	11
100W-300SD	100	300,000	115	149	184	219	288	392	496	911	1,327	6.93	416	14
66W-370SD	65	370,000	95	137	180	223	308	436	565	1,077	1,590	8.54	513	8
66W-399SD	65	399,999	98	144	191	237	329	468	606	1,160	1,714	9.24	554	7
80W-425SD	80	425,000	113	162	211	260	358	506	653	1,241	1,830	9.81	589	8
80W-450SD	80	450,000	116	168	220	272	376	532	687	1,311	1,934	10.39	623	8
80W-505SD	80	505,000	122	181	239	297	414	589	764	1,463	2,163	11.66	700	7
66W-625SD	65	625,000	124	196	268	341	485	701	918	1,784	2,649	14.43	866	5
80W-725SD	80	725,000	148	231	315	399	566	817	1,068	2,073	3,077	16.74	1,044	5
71PG	68	173,000	68	86	104	123	159	214	268	486	704	3.63	218	19
72PG	67	199,000	73	95	117	139	183	249	314	577	840	4.38	263	15
73PG	67	242,000	78	104	131	157	210	289	369	686	1,004	5.29	317	13
120PG	113	155,000	105	122	139	156	191	242	294	500	706	3.43	206	33
190PG	113	190,000	106	126	147	167	208	270	331	577	823	4.10	246	28
241PG	109	277,000	114	144	174	205	265	356	447	810	1,174	6.06	363	18
361PG	91	385,000	115	158	201	244	331	460	590	1,108	1,626	8.64	518	11
541PG	83	623,000	130	197	264	332	466	668	869	1,676	2,483	13.44	807	6

TABLE 40
DELIVERY AT 70°F RISE – OIL

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	24	31	38	45	59	81	102	187	273	1.42	85	14
32E	32	104,000	38	51	63	75	99	136	172	319	465	2.44	146	13
32PP	32	104,000	38	51	63	76	101	139	177	328	479	2.52	151	13
33E	33	104,000	38	50	62	74	98	133	169	312	454	2.38	143	14
40E	40	126,000	47	62	76	91	120	164	207	382	557	2.92	175	14
50ES	50	140,000	57	73	89	105	138	186	235	429	624	3.24	194	15
51E	50	152,000	57	74	92	109	143	195	247	454	661	3.45	207	14
51PP	50	152,000	59	77	96	115	152	208	264	488	712	3.73	224	13
71E	68	173,000	71	90	109	128	166	222	279	506	733	3.78	227	18
72E	67	199,000	76	99	122	145	190	258	327	600	873	4.55	273	15
73E	67	242,000	81	109	137	164	220	303	386	718	1,050	5.53	332	12
120E	113	155,000	107	124	142	159	194	247	299	509	719	3.50	210	32
190E	113	190,000	110	131	153	174	217	281	344	600	856	4.26	256	27
241E	109	277,000	115	146	177	207	269	361	453	821	1,189	6.14	368	18
361E	91	415,000	120	168	215	263	357	500	642	1,212	1,781	9.49	569	10
541E	83	623,000	134	204	273	343	481	690	898	1,731	2,565	13.89	833	6
150E-400	175	400,000	195	243	290	338	434	578	722	1,297	1,872	9.58	575	18
150E-600	166	600,000	211	283	355	426	570	786	1,001	1,863	2,725	14.37	862	12
150E-800	157	800,000	227	323	419	515	707	994	1,282	2,432	3,582	19.17	1,150	8
200E-450	245	450,000	259	313	367	421	529	691	852	1,499	2,146	10.78	647	23
200E-650	212	650,000	255	333	411	489	645	878	1,112	2,046	2,980	15.57	934	14
200E-850	204	850,000	273	375	477	578	782	1,088	1,393	2,615	3,837	20.37	1,222	10
200E-1150	191	1,150,000	298	436	573	711	987	1,400	1,813	3,466	5,119	27.55	1,653	7
250E-800	271	800,000	324	420	516	613	805	1,093	1,382	2,536	3,690	19.23	1,154	14
250E-1000	257	1,000,000	339	460	581	702	944	1,307	1,671	3,124	4,577	24.22	1,453	11
250E-1250	247	1,250,000	355	505	654	803	1,101	1,549	1,996	3,786	5,576	29.83	1,790	8
250E-1500	247	1,500,000	391	573	755	937	1,301	1,846	2,392	4,574	6,756	36.37	2,182	7

TABLE 41

DELIVERY AT 80°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	123	159	194	230	301	408	515	943	1,371	7.13	428	18
OT400N-A	125	400,000	135	182	229	276	370	511	652	1,216	1,780	9.40	564	13
OT500N-A	125	500,000	146	204	262	320	436	611	785	1,483	2,181	11.63	698	11
60HEC-125	60	125,000	73	88	103	118	148	193	238	418	598	3.00	180	20
60HEC-150	60	150,000	73	91	108	126	160	213	265	474	684	3.49	209	17
60HEC-199	60	199,000	78	101	124	147	193	261	330	605	879	4.58	275	13
100HEC-150	100	150,000	118	136	155	173	211	266	322	545	768	3.72	223	27
100HEC-199	100	199,000	123	148	172	197	246	319	393	687	981	4.90	294	20
100HEC-250	100	250,000	127	158	188	218	279	370	461	825	1,189	6.06	364	16
150G-400	175	400,000	184	225	266	307	389	511	634	1,125	1,616	8.18	491	21
150G-600	166	600,000	197	258	320	381	504	688	872	1,608	2,344	12.27	736	14
150G-800	157	800,000	210	292	374	456	619	865	1,110	2,092	3,074	16.37	982	10
200G-450	245	450,000	246	292	338	384	476	614	752	1,304	1,856	9.20	552	27
200G-650	212	650,000	240	306	373	439	572	772	971	1,769	2,567	13.30	798	16
200G-850	204	850,000	254	341	428	514	688	949	1,210	2,253	3,296	17.38	1,043	12
200G-1150	191	1,150,000	274	391	509	627	862	1,214	1,567	2,978	4,389	23.52	1,411	8
250G-800	271	800,000	304	385	467	549	713	958	1,204	2,186	3,168	16.37	982	17
250G-1000	257	1,000,000	312	415	517	619	824	1,130	1,437	2,664	3,891	20.45	1,227	13
250G-1250	247	1,250,000	330	458	585	713	969	1,352	1,736	3,270	4,804	25.57	1,534	10
250G-1500	247	1,500,000	355	509	662	816	1,123	1,583	2,043	3,884	5,725	30.68	1,841	8
75-76SKG	73	76,000	67	75	82	90	105	128	152	244	336	1.54	92	47
100-76SKG	98	76,000	87	95	102	110	126	149	172	264	357	1.54	92	64
EZ 75-76	75	76,000	68	75	83	90	106	128	151	242	334	1.52	91	49
EZ 76-76PDV	75	76,000	68	76	84	92	107	130	153	246	338	1.54	92	49
EZ 100-76	100	76,000	88	95	103	110	126	148	171	262	354	1.52	91	66
EZ 100-76PDV	100	76,000	89	96	104	112	127	150	173	266	358	1.54	92	65
EZ 75-135	67	135,000	67	81	94	108	135	175	216	378	540	2.70	162	25
EZ 80-156	80	156,000	80	95	111	126	158	204	251	439	626	3.12	187	26
EZ 80-199	80	199,000	84	104	124	144	183	243	303	542	781	3.98	239	20
EZ 90-199	90	199,000	92	112	132	152	191	251	311	550	789	3.98	239	23
EZ 100-199	100	199,000	100	120	140	160	199	259	319	558	797	3.98	239	25
80W-250SD	80	250,000	89	115	140	165	216	291	367	670	973	5.05	303	16
100W-250SD	98	250,000	104	129	154	179	230	306	381	684	987	5.05	303	19
100W-270SD	100	270,000	107	135	162	189	244	325	407	735	1,062	5.45	327	18
75W-300SD	75	300,000	90	121	151	181	242	333	424	787	1,151	6.06	364	12
100W-300SD	100	300,000	110	141	171	201	262	353	444	807	1,171	6.06	364	17
66W-370SD	65	370,000	89	127	164	201	276	388	500	949	1,397	7.47	448	9
66W-399SD	65	399,999	92	133	173	214	294	416	537	1,022	1,507	8.08	485	8
80W-425SD	80	425,000	107	150	193	236	322	450	579	1,094	1,609	8.59	515	9
80W-450SD	80	450,000	109	155	200	246	337	473	609	1,155	1,700	9.09	545	9
80W-505SD	80	505,000	115	166	217	268	370	523	676	1,288	1,900	10.20	612	8
66W-625SD	65	625,000	115	178	241	305	431	620	810	1,567	2,325	12.63	758	5
80W-725SD	80	725,000	137	210	284	357	503	723	943	1,822	2,700	14.65	879	5
71PG	68	173,000	66	82	98	114	145	193	241	432	622	3.18	191	21
72PG	67	199,000	71	90	109	128	167	224	282	511	741	3.83	230	17
73PG	67	242,000	74	98	121	144	190	260	329	607	885	4.63	278	14
120PG	113	155,000	103	118	133	148	178	223	268	448	628	3.00	180	38
190PG	113	190,000	103	121	139	157	193	247	301	516	731	3.59	215	31
241PG	109	277,000	110	136	163	189	242	322	401	719	1,037	5.30	318	21
361PG	91	385,000	109	147	185	223	298	412	525	978	1,432	7.56	454	12
541PG	83	623,000	121	180	239	298	416	592	768	1,474	2,180	11.76	706	7

TABLE 42

DELIVERY AT 80°F RISE – OIL

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	23	29	35	42	54	73	91	166	241	1.25	75	16
32E	32	104,000	37	48	58	69	90	122	154	282	410	2.13	128	15
32PP	32	104,000	37	48	59	70	92	125	158	290	423	2.21	132	15
33E	33	104,000	37	47	58	68	89	120	151	276	401	2.08	125	16
40E	40	126,000	45	58	71	83	109	147	186	339	492	2.55	153	16
50ES	50	140,000	55	69	83	97	126	168	211	381	551	2.84	170	18
51E	50	152,000	55	70	85	100	130	176	221	402	584	3.02	181	17
51PP	50	152,000	56	72	87	103	135	182	229	418	607	3.15	189	15
71E	68	173,000	69	85	102	118	151	201	251	449	648	3.31	199	21
72E	67	199,000	74	93	113	133	173	233	292	531	770	3.98	239	17
73E	67	242,000	78	102	126	150	199	271	344	635	925	4.84	291	14
120E	113	155,000	105	120	135	151	181	227	273	457	641	3.06	184	37
190E	113	190,000	107	126	145	163	201	257	313	536	760	3.73	224	30
241E	109	277,000	111	138	165	192	246	326	407	729	1,051	5.37	322	20
361E	91	415,000	114	156	197	239	322	446	571	1,069	1,567	8.30	498	11
541E	83	623,000	126	186	247	308	429	612	794	1,523	2,252	12.15	729	7
150E-400	175	400,000	189	230	272	314	398	524	650	1,153	1,656	8.38	503	21
150E-600	166	600,000	202	265	328	391	517	705	894	1,649	2,404	12.58	755	13
150E-800	157	800,000	215	299	383	467	635	886	1,138	2,144	3,150	16.77	1,006	9
200E-450	245	450,000	253	300	347	394	488	630	771	1,337	1,903	9.43	566	26
200E-650	212	650,000	246	314	382	450	586	790	995	1,812	2,629	13.62	817	16
200E-850	204	850,000	260	349	438	527	705	973	1,240	2,309	3,378	17.82	1,069	11
200E-1150	191	1,150,000	281	401	522	642	883	1,245	1,606	3,052	4,498	24.10	1,446	8
250E-800	271	800,000	312	396	481	565	733	986	1,238	2,248	3,258	16.83	1,010	16
250E-1000	257	1,000,000	324	430	535	641	853	1,171	1,489	2,760	4,031	21.18	1,271	12
250E-1250	247	1,250,000	337	467	598	728	989	1,381	1,772	3,338	4,904	26.10	1,566	9
250E-1500	247	1,500,000	369	528	687	846	1,164	1,641	2,118	4,027	5,936	31.82	1,909	8

TABLE 43

DELIVERY AT 90°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	119	151	183	214	278	373	468	848	1,228	6.34	380	20
OT400N-A	125	400,000	129	171	213	255	338	464	589	1,091	1,592	8.36	502	15
OT500N-A	125	500,000	139	191	243	294	398	553	708	1,328	1,948	10.34	620	12
60HEC-125	60	125,000	71	84	98	111	138	178	218	378	538	2.67	160	22
60HEC-150	60	150,000	71	87	102	118	149	195	242	428	614	3.10	186	19
60HEC-199	60	199,000	76	96	116	137	177	238	299	544	788	4.07	244	15
100HEC-150	100	150,000	116	132	149	165	198	248	297	496	694	3.30	198	30
100HEC-199	100	199,000	120	142	164	186	229	295	360	621	883	4.36	261	23
100HEC-250	100	250,000	124	151	178	205	259	340	420	744	1,067	5.39	323	19
150G-400	175	400,000	179	216	252	288	361	470	579	1,015	1,451	7.27	436	24
150G-600	166	600,000	190	245	300	354	463	627	791	1,446	2,101	10.92	655	15
150G-800	157	800,000	201	274	347	419	565	783	1,001	1,874	2,747	14.55	873	11
200G-450	245	450,000	241	282	323	364	446	569	691	1,182	1,673	8.18	491	30
200G-650	212	650,000	232	292	351	410	528	705	882	1,591	2,300	11.82	709	18
200G-850	204	850,000	244	321	399	476	630	862	1,094	2,021	2,948	15.45	927	13
200G-1150	191	1,150,000	261	365	470	575	784	1,098	1,411	2,666	3,921	20.92	1,255	9
250G-800	271	800,000	294	367	440	513	658	876	1,095	1,968	2,841	14.55	873	19
250G-1000	257	1,000,000	301	392	483	574	756	1,028	1,301	2,392	3,483	18.18	1,091	14
250G-1250	247	1,250,000	316	429	543	657	884	1,225	1,566	2,930	4,294	22.73	1,364	11
250G-1500	247	1,500,000	338	475	611	747	1,020	1,429	1,838	3,474	5,110	27.27	1,636	9
75-76SKG	73	76,000	66	73	80	87	100	121	141	223	305	1.37	82	53
100-76SKG	98	76,000	86	93	100	107	120	141	161	244	326	1.37	82	72
EZ 75-76	75	76,000	67	74	80	87	101	121	141	222	303	1.35	81	55
EZ 76-76PDV	75	76,000	68	74	81	88	102	122	143	225	307	1.37	82	55
EZ 100-76	100	76,000	87	94	100	107	121	141	161	242	323	1.35	81	74
EZ 100-76PDV	100	76,000	88	95	102	108	122	143	163	245	327	1.37	82	73
EZ 75-135	67	135,000	66	78	90	102	126	162	198	342	486	2.40	144	28
EZ 80-156	80	156,000	78	92	106	119	147	189	230	397	563	2.77	166	29
EZ 80-199	80	199,000	82	99	117	135	170	223	276	489	701	3.54	212	23
EZ 90-199	90	199,000	90	107	125	143	178	231	284	497	709	3.54	212	25
EZ 100-199	100	199,000	98	115	133	151	186	239	292	505	717	3.54	212	28
80W-250SD	80	250,000	86	109	131	154	199	266	333	603	872	4.49	269	18
100W-250SD	98	250,000	101	123	146	168	213	280	348	617	886	4.49	269	22
100W-270SD	100	270,000	104	128	153	177	225	298	371	662	953	4.85	291	21
75W-300SD	75	300,000	87	114	141	168	222	302	383	706	1,030	5.39	323	14
100W-300SD	100	300,000	107	134	161	188	242	322	403	726	1,050	5.39	323	19
66W-370SD	65	370,000	85	118	152	185	251	351	451	849	1,248	6.64	399	10
66W-399SD	65	399,999	88	124	160	196	267	375	483	914	1,345	7.18	431	9
80W-425SD	80	425,000	102	140	178	217	293	407	522	980	1,438	7.63	458	10
80W-450SD	80	450,000	104	145	185	226	306	428	549	1,034	1,519	8.08	485	10
80W-505SD	80	505,000	109	155	200	245	336	472	608	1,152	1,696	9.07	544	9
66W-625SD	65	625,000	108	164	220	276	389	557	725	1,399	2,072	11.22	673	6
80W-725SD	80	725,000	129	194	259	324	455	650	845	1,626	2,407	13.02	781	6
71PG	68	173,000	64	78	92	107	135	177	220	389	559	2.83	170	24
72PG	67	199,000	69	86	103	120	154	205	256	460	665	3.41	204	20
73PG	67	242,000	72	92	113	134	175	236	298	545	792	4.12	247	16
120PG	113	155,000	101	114	128	141	168	208	248	408	568	2.67	160	42
190PG	113	190,000	101	117	133	149	181	229	277	468	659	3.19	191	35
241PG	109	277,000	107	130	154	178	225	295	366	649	931	4.71	283	23
361PG	91	385,000	105	139	172	206	273	374	475	878	1,281	6.72	403	14
541PG	83	623,000	115	167	220	272	376	533	690	1,317	1,945	10.46	627	8

TABLE 44**DELIVERY AT 90°F RISE – OIL**

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	22	28	33	39	50	66	83	149	216	1.11	66	18
32E	32	104,000	36	45	55	64	83	112	140	254	367	1.90	114	17
32PP	32	104,000	35	45	55	65	84	114	143	261	379	1.96	118	16
33E	33	104,000	36	45	54	63	82	110	137	248	359	1.85	111	18
40E	40	126,000	44	55	66	78	100	135	169	305	441	2.27	136	18
50ES	50	140,000	53	66	78	91	116	154	192	343	494	2.52	151	20
51E	50	152,000	53	67	80	93	120	161	201	362	523	2.69	161	19
51PP	50	152,000	54	68	82	96	124	166	208	376	544	2.80	168	18
71E	68	173,000	67	81	96	111	140	184	229	405	582	2.94	177	23
72E	67	199,000	71	89	107	124	160	213	266	478	691	3.54	212	19
73E	67	242,000	75	97	118	140	183	247	312	570	828	4.30	258	16
120E	113	155,000	103	116	130	144	171	212	253	416	579	2.72	163	42
190E	113	190,000	105	122	138	155	188	238	288	487	686	3.32	199	34
241E	109	277,000	108	132	156	180	228	299	371	657	944	4.77	286	23
361E	91	415,000	110	147	184	220	294	405	516	958	1,401	7.38	443	12
541E	83	623,000	119	173	227	281	389	551	713	1,361	2,009	10.80	648	8
150E-400	175	400,000	184	221	258	296	370	482	594	1,041	1,488	7.45	447	23
150E-600	166	600,000	195	251	307	363	475	642	810	1,481	2,152	11.18	671	15
150E-800	157	800,000	206	281	355	430	579	802	1,026	1,920	2,814	14.90	894	11
200E-450	245	450,000	247	289	331	373	457	583	708	1,211	1,714	8.38	503	29
200E-650	212	650,000	238	299	360	420	541	723	905	1,632	2,359	12.12	727	17
200E-850	204	850,000	250	329	408	488	646	883	1,121	2,071	3,021	15.83	950	13
200E-1150	191	1,150,000	267	374	482	589	803	1,125	1,446	2,732	4,018	21.43	1,286	9
250E-800	271	800,000	303	378	453	527	677	902	1,126	2,024	2,922	14.97	898	18
250E-1000	257	1,000,000	312	406	500	594	783	1,065	1,348	2,478	3,608	18.83	1,130	14
250E-1250	247	1,250,000	322	438	554	670	902	1,250	1,598	2,990	4,382	23.20	1,392	11
250E-1500	247	1,500,000	351	492	634	775	1,058	1,482	1,906	3,603	5,300	28.28	1,697	9

TABLE 45

DELIVERY AT 100°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	116	145	173	202	259	344	430	772	1,114	5.70	342	22
OT400N-A	125	400,000	125	163	200	238	313	426	539	990	1,442	7.52	451	17
OT500N-A	125	500,000	134	181	227	274	367	506	646	1,204	1,762	9.30	558	13
60HEC-125	60	125,000	70	82	94	106	130	166	202	346	490	2.40	144	25
60HEC-150	60	150,000	70	84	98	112	140	181	223	391	558	2.79	167	21
60HEC-199	60	199,000	74	92	110	128	165	220	275	495	715	3.66	220	16
100HEC-150	100	150,000	114	129	144	159	188	233	278	456	634	2.97	178	34
100HEC-199	100	199,000	118	138	157	177	216	275	334	569	804	3.92	235	25
100HEC-250	100	250,000	121	146	170	194	243	315	388	679	970	4.85	291	21
150G-400	175	400,000	176	209	241	274	340	438	536	929	1,322	6.55	393	27
150G-600	166	600,000	185	234	283	332	430	577	725	1,314	1,903	9.82	589	17
150G-800	157	800,000	194	259	325	390	521	717	913	1,698	2,483	13.08	785	12
200G-450	245	450,000	237	274	311	348	421	532	642	1,084	1,526	7.37	442	33
200G-650	212	650,000	227	280	333	386	492	652	811	1,449	2,087	10.63	638	20
200G-850	204	850,000	237	306	376	445	584	793	1,002	1,837	2,672	13.92	835	15
200G-1150	191	1,150,000	250	344	438	533	721	1,003	1,285	2,414	3,543	18.82	1,129	10
250G-800	271	800,000	287	352	418	483	614	810	1,007	1,792	2,577	13.08	785	21
250G-1000	257	1,000,000	292	374	456	538	701	947	1,192	2,174	3,156	16.37	982	16
250G-1250	247	1,250,000	304	406	509	611	815	1,122	1,429	2,656	3,883	20.45	1,227	12
250G-1500	247	1,500,000	325	448	570	693	939	1,307	1,675	3,148	4,621	24.55	1,473	10
75-76SKG	73	76,000	65	71	78	84	96	115	133	207	281	1.23	74	59
100-76SKG	98	76,000	86	92	98	104	116	135	153	227	301	1.23	74	80
EZ 75-76	75	76,000	66	72	78	84	96	115	133	206	279	1.22	73	62
EZ 76-76PDV	75	76,000	67	73	79	85	98	116	135	209	282	1.23	74	61
EZ 100-76	100	76,000	86	92	98	104	116	135	153	226	299	1.22	73	82
EZ 100-76PDV	100	76,000	87	93	99	106	118	136	155	229	303	1.23	74	81
EZ 75-135	67	135,000	64	75	86	97	118	151	183	313	443	2.16	130	31
EZ 80-156	80	156,000	76	89	101	114	139	176	214	364	513	2.50	150	32
EZ 80-199	80	199,000	80	96	112	128	160	207	255	446	637	3.19	191	25
EZ 90-199	90	199,000	88	104	120	136	168	215	263	454	645	3.19	191	28
EZ 100-199	100	199,000	96	112	128	144	176	223	271	462	653	3.19	191	31
80W-250SD	80	250,000	84	104	125	145	185	246	306	549	791	4.04	242	20
100W-250SD	98	250,000	99	119	139	159	200	260	321	563	806	4.04	242	24
100W-270SD	100	270,000	102	124	145	167	211	276	342	604	865	4.36	262	23
75W-300SD	75	300,000	84	108	133	157	205	278	351	642	933	4.85	291	15
100W-300SD	100	300,000	104	128	153	177	225	298	371	662	953	4.85	291	21
66W-370SD	65	370,000	82	112	142	172	231	321	411	770	1,128	5.98	359	11
66W-399SD	65	399,999	84	117	149	181	246	343	440	828	1,216	6.46	388	10
80W-425SD	80	425,000	98	133	167	201	270	373	476	888	1,300	6.87	412	12
80W-450SD	80	450,000	100	137	173	209	282	391	500	937	1,373	7.27	436	11
80W-505SD	80	505,000	105	146	186	227	309	431	554	1,043	1,533	8.16	490	10
66W-625SD	65	625,000	103	153	204	254	355	507	658	1,264	1,870	10.10	606	6
80W-725SD	80	725,000	123	181	240	298	416	591	767	1,470	2,173	11.72	703	7
71PG	68	173,000	63	75	88	101	126	164	203	355	508	2.54	153	27
72PG	67	199,000	67	82	98	113	144	190	236	419	603	3.07	184	22
73PG	67	242,000	70	88	107	125	162	218	273	496	718	3.70	222	18
120PG	113	155,000	100	112	124	136	160	196	232	376	520	2.40	144	47
190PG	113	190,000	100	114	128	143	171	214	258	430	602	2.87	172	39
241PG	109	277,000	105	126	147	168	211	274	338	592	847	4.24	254	26
361PG	91	385,000	102	132	162	192	253	344	434	797	1,160	6.05	363	15
541PG	83	623,000	110	157	204	251	345	486	627	1,192	1,757	9.41	565	9

TABLE 46

DELIVERY AT 100°F RISE – OIL

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	22	27	32	37	46	61	76	136	196	1.00	60	20
32E	32	104,000	35	43	52	60	77	103	129	231	333	1.71	102	19
32PP	32	104,000	34	43	52	61	79	105	131	237	343	1.76	106	18
33E	33	104,000	35	43	51	60	76	101	126	226	326	1.66	100	20
40E	40	126,000	43	53	63	73	94	124	155	277	400	2.04	123	20
50ES	50	140,000	52	63	75	86	109	143	177	313	449	2.27	136	22
51E	50	152,000	52	64	76	88	112	149	185	330	475	2.42	145	21
51PP	50	152,000	53	65	78	90	116	153	191	342	494	2.52	151	20
71E	68	173,000	65	78	92	105	131	171	211	370	529	2.65	159	26
72E	67	199,000	70	85	101	117	149	197	245	436	627	3.19	191	21
73E	67	242,000	73	92	112	131	170	228	286	518	751	3.87	232	17
120E	113	155,000	102	114	126	138	163	200	236	383	530	2.45	147	46
190E	113	190,000	104	119	133	148	178	223	268	447	626	2.98	179	38
241E	109	277,000	106	127	149	170	213	278	342	600	858	4.30	258	25
361E	91	415,000	106	139	172	206	272	372	471	870	1,268	6.64	399	14
541E	83	623,000	113	162	211	259	356	502	648	1,231	1,815	9.72	583	9
150E-400	175	400,000	180	214	247	281	348	448	549	951	1,353	6.70	402	26
150E-600	166	600,000	190	240	290	341	441	592	743	1,347	1,951	10.07	604	16
150E-800	157	800,000	199	266	333	400	534	735	937	1,742	2,547	13.42	805	12
200E-450	245	450,000	243	281	319	356	432	545	658	1,111	1,564	7.55	453	32
200E-650	212	650,000	232	287	341	396	505	668	832	1,486	2,140	10.90	654	19
200E-850	204	850,000	242	313	385	456	598	812	1,026	1,881	2,736	14.25	855	14
200E-1150	191	1,150,000	256	353	449	546	739	1,028	1,317	2,474	3,631	19.28	1,157	10
250E-800	271	800,000	295	363	430	497	632	834	1,036	1,844	2,652	13.47	808	20
250E-1000	257	1,000,000	302	387	472	557	726	980	1,235	2,252	3,269	16.95	1,017	15
250E-1250	247	1,250,000	311	415	519	624	833	1,146	1,459	2,712	3,965	20.88	1,253	12
250E-1500	247	1,500,000	337	464	591	718	973	1,355	1,736	3,263	4,790	25.45	1,527	10

TABLE 47

DELIVERY AT 120°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	111	135	159	183	230	301	373	658	943	4.75	285	26
OT400N-A	125	400,000	119	150	182	213	276	370	464	840	1,216	6.27	376	20
OT500N-A	125	500,000	126	165	204	243	320	436	553	1,018	1,483	7.75	465	16
60HEC-125	60	125,000	68	78	88	98	118	148	178	298	418	2.00	120	30
60HEC-150	60	150,000	67	79	91	102	126	160	195	335	474	2.33	140	26
60HEC-199	60	199,000	70	86	101	116	147	193	238	422	605	3.05	183	20
100HEC-150	100	150,000	111	124	136	149	173	211	248	397	545	2.48	149	40
100HEC-199	100	199,000	115	131	148	164	197	246	295	491	687	3.27	196	31
100HEC-250	100	250,000	117	137	158	178	218	279	340	582	825	4.04	243	25
150G-400	175	400,000	170	198	225	252	307	388	470	797	1,124	5.45	327	32
150G-600	166	600,000	177	218	259	299	381	504	627	1,118	1,609	8.18	491	20
150G-800	157	800,000	183	238	292	347	456	620	783	1,438	2,093	10.92	655	14
200G-450	245	450,000	231	262	292	323	384	476	568	936	1,304	6.13	368	40
200G-650	212	650,000	218	262	306	351	439	572	705	1,237	1,769	8.87	532	24
200G-850	204	850,000	225	283	340	398	514	688	862	1,557	2,252	11.58	695	18
200G-1150	191	1,150,000	235	313	391	470	627	862	1,097	2,038	2,979	15.68	941	12
250G-800	271	800,000	276	331	386	440	549	713	877	1,532	2,187	10.92	655	25
250G-1000	257	1,000,000	278	346	415	483	619	824	1,028	1,846	2,664	13.63	818	19
250G-1250	247	1,250,000	287	373	458	543	714	969	1,225	2,248	3,271	17.05	1,023	14
250G-1500	247	1,500,000	304	406	509	611	815	1,122	1,429	2,656	3,883	20.45	1,227	12
75-76SKG	73	76,000	64	69	75	80	90	105	121	182	244	1.03	62	71
100-76SKG	98	76,000	85	90	95	100	110	126	141	203	264	1.03	62	95
EZ 75-76	75	76,000	65	70	75	80	90	106	121	182	242	1.01	61	74
EZ 76-76PDV	75	76,000	66	71	76	81	92	107	122	184	246	1.03	62	73
EZ 100-76	100	76,000	85	90	95	100	110	126	141	202	262	1.01	61	99
EZ 100-76PDV	100	76,000	86	91	96	102	112	127	143	204	266	1.03	62	97
EZ 75-135	67	135,000	63	72	81	90	108	135	162	270	378	1.80	108	37
EZ 80-156	80	156,000	74	85	95	106	126	158	189	314	439	2.08	125	38
EZ 80-199	80	199,000	77	91	104	117	144	183	223	383	542	2.65	159	30
EZ 90-199	90	199,000	85	99	112	125	152	191	231	391	550	2.65	159	34
EZ 100-199	100	199,000	93	107	120	133	160	199	239	399	558	2.65	159	38
80W-250SD	80	250,000	81	98	115	131	165	216	266	468	670	3.37	202	24
100W-250SD	98	250,000	95	112	129	146	179	230	280	482	684	3.37	202	29
100W-270SD	100	270,000	98	116	135	153	189	244	298	516	735	3.64	218	28
75W-300SD	75	300,000	80	100	121	141	181	242	302	545	787	4.04	242	19
100W-300SD	100	300,000	100	120	141	161	201	262	322	565	807	4.04	242	25
66W-370SD	65	370,000	77	102	127	152	201	276	351	650	949	4.98	299	13
66W-399SD	65	399,999	79	106	133	160	214	294	375	698	1,022	5.39	323	12
80W-425SD	80	425,000	93	121	150	178	236	322	407	751	1,094	5.72	343	14
80W-450SD	80	450,000	94	125	155	185	246	337	428	791	1,155	6.06	364	13
80W-505SD	80	505,000	98	132	166	200	268	370	472	880	1,288	6.80	408	12
66W-625SD	65	625,000	94	136	178	220	305	431	557	1,062	1,567	8.42	505	8
80W-725SD	80	725,000	113	162	210	259	357	503	650	1,236	1,822	9.76	586	8
71PG	68	173,000	61	71	82	92	114	145	177	304	432	2.12	127	32
72PG	67	199,000	64	77	90	103	128	167	205	358	511	2.55	153	26
73PG	67	242,000	67	82	98	113	144	190	236	422	607	3.09	185	22
120PG	113	155,000	98	108	118	128	148	178	208	328	448	2.00	120	56
190PG	113	190,000	97	109	121	133	157	193	229	372	516	2.39	144	47
241PG	109	277,000	101	119	136	154	189	242	295	507	719	3.53	212	31
361PG	91	385,000	97	122	147	172	223	298	374	676	978	5.04	302	18
541PG	83	623,000	102	141	180	220	298	416	533	1,004	1,474	7.84	471	11

TABLE48

DELIVERY AT 120°F RISE – OIL

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	21	25	29	33	42	54	66	116	166	0.83	50	24
32E	32	104,000	33	40	48	55	69	90	112	197	282	1.42	85	23
32PP	32	104,000	33	40	48	55	70	92	114	202	290	1.47	88	22
33E	33	104,000	33	40	47	54	68	89	110	193	276	1.39	83	24
40E	40	126,000	41	49	58	66	83	109	135	237	339	1.70	102	24
50ES	50	140,000	50	59	69	78	97	126	154	267	381	1.89	113	26
51E	50	152,000	50	60	70	80	100	130	161	282	402	2.01	121	25
51PP	50	152,000	51	61	72	82	103	135	166	292	418	2.10	126	24
71E	68	173,000	63	74	85	96	118	151	184	317	449	2.21	132	31
72E	67	199,000	67	80	93	107	133	173	213	372	531	2.65	159	25
73E	67	242,000	70	86	102	118	150	199	247	441	635	3.23	194	21
120E	113	155,000	99	110	120	130	151	181	212	334	457	2.04	122	55
190E	113	190,000	101	114	126	138	163	201	238	387	536	2.49	149	45
241E	109	277,000	102	120	138	156	192	246	299	514	729	3.58	215	30
361E	91	415,000	100	128	156	184	239	322	405	737	1,069	5.54	332	16
541E	83	623,000	105	146	186	227	308	429	551	1,037	1,523	8.10	486	10
150E-400	175	400,000	174	202	230	258	314	398	482	817	1,152	5.58	335	31
150E-600	166	600,000	181	223	265	307	391	516	642	1,145	1,648	8.38	503	20
150E-800	157	800,000	188	243	299	355	467	635	803	1,474	2,145	11.18	671	14
200E-450	245	450,000	237	268	299	331	394	488	582	959	1,336	6.28	377	39
200E-650	212	650,000	223	269	314	359	450	586	723	1,268	1,813	9.08	545	23
200E-850	204	850,000	230	290	349	409	528	706	884	1,597	2,310	11.88	713	17
200E-1150	191	1,150,000	240	321	401	481	642	883	1,124	2,088	3,052	16.07	964	12
250E-800	271	800,000	284	340	396	452	564	733	901	1,574	2,247	11.22	673	24
250E-1000	257	1,000,000	288	359	429	500	641	853	1,065	1,912	2,759	14.12	847	18
250E-1250	247	1,250,000	293	380	467	554	728	989	1,250	2,294	3,338	17.40	1,044	14
250E-1500	247	1,500,000	316	422	528	634	846	1,164	1,483	2,756	4,029	21.22	1,273	12

TABLE 49

DELIVERY AT 140°F RISE – POWER GAS, ATMOSPHERIC GAS, ENERGY SAVERS

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
OT300N-A	125	300,000	108	128	149	169	210	271	332	576	821	4.07	244	31
OT400N-A	125	400,000	114	141	168	195	249	329	410	732	1,055	5.37	322	23
OT500N-A	125	500,000	121	154	187	220	287	387	486	885	1,284	6.65	399	19
60HEC-125	60	125,000	66	75	83	92	109	135	160	263	366	1.71	103	35
60HEC-150	60	150,000	66	76	86	96	116	146	175	295	415	1.99	120	30
60HEC-199	60	199,000	68	81	94	108	134	173	212	369	526	2.62	157	23
100HEC-150	100	150,000	110	120	131	142	163	195	227	354	481	2.12	127	47
100HEC-199	100	199,000	113	127	141	155	183	225	267	435	603	2.80	168	36
100HEC-250	100	250,000	114	132	149	166	201	253	305	513	721	3.47	208	29
150G-400	175	400,000	167	190	214	237	284	354	424	705	986	4.68	281	37
150G-600	166	600,000	171	206	241	276	346	452	557	978	1,399	7.02	421	24
150G-800	157	800,000	175	222	269	315	409	549	689	1,250	1,811	9.35	561	17
200G-450	245	450,000	227	253	280	306	359	438	517	833	1,149	5.27	316	47
200G-650	212	650,000	211	249	287	325	401	515	629	1,085	1,541	7.60	456	28
200G-850	204	850,000	216	266	316	365	465	614	763	1,359	1,955	9.93	596	21
200G-1150	191	1,150,000	223	290	358	425	559	761	962	1,768	2,574	13.43	806	14
250G-800	271	800,000	268	315	362	409	502	642	783	1,344	1,905	9.35	561	29
250G-1000	257	1,000,000	269	327	385	444	561	736	911	1,612	2,313	11.68	701	22
250G-1250	247	1,250,000	275	348	421	494	641	860	1,079	1,956	2,833	14.62	877	17
250G-1500	247	1,500,000	290	377	465	553	728	991	1,254	2,306	3,358	17.53	1,052	14
75-76SKG	73	76,000	64	68	72	77	86	99	112	165	217	0.88	53	83
100-76SKG	98	76,000	84	88	93	97	106	119	132	185	238	0.88	53	111
EZ 75-76	75	76,000	64	69	73	77	86	99	112	164	216	0.87	52	86
EZ 76-76PDV	75	76,000	65	70	74	78	87	100	114	166	219	0.88	53	85
EZ 100-76	100	76,000	84	89	93	97	106	119	132	184	236	0.87	52	115
EZ 100-76PDV	100	76,000	85	90	94	99	107	121	134	187	239	0.88	53	114
EZ 75-135	67	135,000	61	69	77	84	100	123	146	239	331	1.54	93	43
EZ 80-156	80	156,000	73	82	91	100	118	144	171	278	385	1.78	107	45
EZ 80-199	80	199,000	75	87	98	110	132	166	201	337	474	2.28	137	35
EZ 90-199	90	199,000	83	95	106	118	140	174	209	345	482	2.28	137	40
EZ 100-199	100	199,000	91	103	114	126	148	182	217	353	490	2.28	137	44
80W-250SD	80	250,000	78	93	107	122	151	194	237	410	583	2.89	173	28
100W-250SD	98	250,000	93	107	122	136	165	208	252	425	598	2.89	173	34
100W-270SD	100	270,000	96	111	127	142	174	220	267	454	641	3.12	187	32
75W-300SD	75	300,000	77	95	112	129	164	216	268	476	683	3.46	208	22
100W-300SD	100	300,000	97	115	132	149	184	236	288	496	703	3.46	208	29
66W-370SD	65	370,000	73	95	116	137	180	244	308	565	821	4.27	256	15
66W-399SD	65	399,999	75	98	121	144	191	260	329	606	883	4.62	277	14
80W-425SD	80	425,000	89	113	138	162	211	285	358	653	947	4.91	294	16
80W-450SD	80	450,000	90	116	142	168	220	298	376	687	999	5.19	312	15
80W-505SD	80	505,000	93	122	151	181	239	326	414	764	1,113	5.83	350	14
66W-625SD	65	625,000	88	124	160	196	268	377	485	918	1,351	7.22	433	9
80W-725SD	80	725,000	106	148	190	231	315	441	566	1,068	1,570	8.37	502	10
71PG	68	173,000	59	68	77	86	104	132	159	268	377	1.82	109	37
72PG	67	199,000	63	73	84	95	117	150	183	314	446	2.19	131	31
73PG	67	242,000	64	78	91	104	131	170	210	369	527	2.65	159	25
120PG	113	155,000	96	105	113	122	139	165	191	294	397	1.72	103	66
190PG	113	190,000	96	106	116	126	147	178	208	331	454	2.05	123	55
241PG	109	277,000	99	114	129	144	174	220	265	447	629	3.03	182	36
361PG	91	385,000	93	115	136	158	201	266	331	590	849	4.32	259	21
541PG	83	623,000	96	130	163	197	264	365	466	869	1,273	6.72	403	12

TABLE 50
DELIVERY AT 140°F RISE – OIL

Model	Volume	Input	DELIVERY (GAL)									Recovery (GPM)	Recovery (GPH)	Mins. to recover contents
			5 min.	10 min.	15 min.	20 min.	30 min.	45 min.	1 hr.	2 hr.	3 hr.			
20E	20	60,000	Not recommended for 180°F water											
32E	32	104,000	Not recommended for 180°F water											
32PP	32	104,000	Not recommended for 180°F water											
33E	33	104,000	Not recommended for 180°F water											
40E	40	126,000	Not recommended for 180°F water											
50ES	50	140,000	49	57	65	73	89	113	138	235	332	1.62	97	31
51E	50	152,000	48	57	66	74	92	117	143	247	351	1.73	104	29
51PP	50	152,000	49	58	67	76	94	121	148	256	364	1.80	108	28
71E	68	173,000	61	71	80	90	109	137	166	279	392	1.89	113	36
72E	67	199,000	65	76	88	99	122	156	190	327	463	2.28	137	29
73E	67	242,000	67	81	95	109	137	178	220	386	552	2.77	166	24
120E	113	155,000	98	107	116	124	142	168	194	299	404	1.75	105	65
190E	113	190,000	99	110	121	131	153	185	217	344	472	2.13	128	53
241E	109	277,000	100	115	130	146	177	223	269	453	637	3.07	184	36
361E	91	415,000	97	120	144	168	215	286	357	642	927	4.74	285	19
541E	83	623,000	99	134	169	204	273	377	481	898	1,315	6.94	417	12
150E-400	175	400,000	170	194	218	242	290	362	433	720	1,007	4.78	287	37
150E-600	166	600,000	175	211	247	283	355	462	570	1,001	1,432	7.18	431	23
150E-800	157	800,000	180	227	275	323	419	563	707	1,282	1,857	9.58	575	16
200E-450	245	450,000	232	259	286	313	367	447	528	851	1,174	5.38	323	46
200E-650	212	650,000	217	255	294	333	411	528	645	1,112	1,579	7.78	467	27
200E-850	204	850,000	222	273	324	375	477	629	782	1,393	2,004	10.18	611	20
200E-1150	191	1,150,000	229	298	366	435	573	779	986	1,812	2,638	13.77	826	14
250E-800	271	800,000	276	324	372	420	516	661	805	1,382	1,959	9.62	577	28
250E-1000	257	1,000,000	278	339	399	460	581	762	944	1,670	2,396	12.10	726	21
250E-1250	247	1,250,000	281	355	430	505	654	877	1,101	1,996	2,891	14.92	895	17
250E-1500	247	1,500,000	300	391	482	573	755	1,028	1,301	2,392	3,483	18.18	1,091	14

TABLE 51

Measuring Combustion Efficiency Using Oxygen (O₂)

		NET STACK TEMPERATURE IN DEGREES FAHRENHEIT (°F)																
FUEL	%O ₂	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900
NATURAL GAS	1	87.9	86.8	85.7	84.6	83.6	82.5	81.4	80.3	79.2	78.2	77.1	76.0	74.9	73.9	72.8	71.7	70.6
	2	87.8	86.7	85.5	84.4	83.3	82.2	81.0	79.9	78.8	77.7	76.5	75.4	74.3	73.2	72.1	70.9	69.8
	3	87.7	86.5	85.3	84.2	83.0	81.8	80.6	79.5	78.3	77.1	75.9	74.8	73.6	72.4	71.2	70.1	68.9
	4	87.6	86.3	85.1	83.9	82.7	81.4	80.2	79.0	77.7	76.5	75.3	74.0	72.8	71.6	70.4	69.1	67.9
	5	87.5	86.2	84.9	83.6	82.3	81.0	79.7	78.4	77.1	75.8	74.5	73.2	71.9	70.6	69.3	68.0	66.8
	6	87.3	85.9	84.6	83.2	81.8	80.5	79.1	77.8	76.4	75.0	73.7	72.3	70.9	69.6	68.2	66.8	65.5
	7	87.1	85.7	84.3	82.8	81.4	79.9	78.5	77.0	75.6	74.1	72.7	71.2	69.8	68.3	66.9	65.4	64.0
	8	87.0	85.4	83.9	82.3	80.8	79.2	77.7	76.2	74.6	73.1	71.5	70.0	68.5	66.9	65.4	63.8	62.3
	9	86.7	85.1	83.4	81.8	80.1	78.5	76.8	75.2	73.5	71.9	70.2	68.6	66.9	65.3	63.6	62.0	60.3
	10	86.5	84.7	82.9	81.1	79.3	77.1	75.8	74.0	72.2	70.4	68.6	66.9	65.1	63.3	61.5	59.7	58.0
	11	86.2	84.2	82.3	80.3	78.4	76.5	74.5	72.6	70.6	68.7	66.8	64.8	62.9	60.9	59.0	57.1	55.1
	12	85.8	83.6	81.5	79.4	77.2	75.1	73.0	70.9	68.7	66.6	64.5	62.3	60.2	58.1	55.9	53.8	51.7
	13	85.3	82.9	80.5	78.2	75.8	73.4	71.1	68.7	66.3	63.9	61.6	59.2	56.8	54.0	52.1	49.7	47.3
	14	84.7	82.0	79.3	76.6	73.9	71.3	68.6	65.9	63.2	60.5	57.8	55.1	52.5	49.8	47.1	44.4	41.7
NO. 2 GRADE FUEL OIL	1	91.8	90.7	89.6	88.4	87.3	86.2	85.1	84.0	82.9	81.7	80.6	79.5	78.4	77.3	76.2	75.0	73.9
	2	91.7	90.5	89.4	88.2	87.0	85.9	84.7	83.6	82.4	81.2	80.1	78.9	77.7	76.6	75.4	74.2	73.1
	3	91.6	90.4	89.2	87.9	86.7	85.5	84.3	83.1	81.9	80.7	79.4	78.2	77.0	75.8	74.6	73.4	72.1
	4	91.5	90.2	88.9	87.7	86.4	85.1	83.8	82.6	81.3	80.0	78.7	77.5	76.2	74.9	73.6	72.4	71.1
	5	91.3	90.0	88.7	87.3	86.0	84.6	83.3	82.0	80.6	79.3	77.9	76.6	75.3	73.9	72.6	71.2	69.9
	6	91.2	89.8	88.4	87.0	85.5	84.1	82.7	81.3	79.9	78.5	77.0	75.6	74.2	72.8	71.4	70.0	68.6
	7	91.0	89.5	88.0	86.5	85.0	83.5	82.0	80.5	79.0	77.5	76.0	74.5	73.0	71.5	70.0	68.5	67.0
	8	90.8	89.2	87.6	86.0	84.4	82.8	81.2	79.6	78.0	76.4	74.8	73.2	71.6	70.0	68.4	66.8	65.2
	9	90.6	88.9	87.2	85.5	83.7	82.0	80.3	78.6	76.9	75.2	73.5	71.7	70.0	68.3	66.6	64.9	63.2
	10	90.3	88.5	86.6	84.8	82.9	81.1	79.2	77.4	75.5	73.7	71.8	70.0	68.1	66.3	64.4	62.6	60.7
	11	90.0	88.0	86.0	84.0	81.9	79.9	77.9	75.9	73.9	71.9	69.8	67.8	65.8	63.8	61.8	59.8	57.8
	12	89.6	87.4	85.2	82.9	80.7	78.5	76.3	74.1	71.9	69.7	67.4	65.2	63.0	60.8	58.6	56.4	54.1
	13	89.1	86.6	84.2	81.7	79.2	76.8	74.3	71.8	69.3	66.9	64.4	61.9	59.5	57.0	54.5	52.1	49.6
	14	88.4	85.7	82.9	80.1	77.3	74.5	71.7	68.9	66.1	63.3	60.5	57.7	54.9	52.1	49.3	46.6	43.8

GLOSSARY OF TERMS

A.F.U.E. - Annual Fuel Usage Efficiency. Ratio of annual output of useful energy or heat to annual energy input to heater. Only heat leaving as hot water deemed usable and calculated as part of space heating efficiency.

A.S.M.E. - American Society of Mechanical Engineers.

BAROMETER - Device for measuring atmospheric pressure.

BAFFLE - Object placed in appliance to change direction of or retard flow of air, gas or mixtures of flue gases.

BTU (British Thermal Unit) - Energy required to raise the temperature of 1 lb of water from 60°F to 61°F at 1 atmosphere pressure.

CALORIE - Energy required to raise the temperature of 1 gram of water by 1°C at 1 atmosphere pressure.

CENTRAL SYSTEM HEATING - Unit that produces heat from a centralized location and distributes it throughout a structure.

CIRCULATING WATER HEATER -

1. **Automatic** - Furnishes hot water to be stored in separate vessel. Storage tank temperatures controlled by thermostat installed on heater. Circulation either natural or forced.

2. **Non-automatic** - Same as automatic except thermostat installed in storage vessel.

CIRCULATING TANK SYSTEM - Water heater is connected to separate storage tank, allowing large amounts of hot water to be built up for use during short periods of peak demand. Recovery to storage ratio: 1 GPH recovery to 1 gallon stored.

COIL CIRCULATION - Water heater with heat transfer surface composed primarily of water tubes less than 1 1/2" in internal diameter and requiring circulation.

COLD INLET TEMPERATURE - Temperature of water coming into water heating system.

COMBUSTION EFFICIENCY - Measurement of how well the heating equipment is converting a specific fuel into usable heat energy at a specific period of time in the operation of a heating system.

COMMERCIAL WATER HEATER - Water heater with input rate of more than 75,000 BTU/HR (gas) and 105,000 BTU/HR (oil).

CONDENSATE - A liquid obtained by condensation (usually initiated by a reduction in temperature of a vapor).

CONDUCTION - Heat transfer through a material from more energetic particles to less energetic particles.

CONVECTION - Heat transfer occurring between a fluid in motion and a bounding surface when the two are at different temperatures.

DELIVERY - Amount of hot water a heater can supply, most commonly over the period of one hour. Delivery = Recovery + 80% of storage.

DIRECT VENT - System with indoor water heater, combustion air connections between heater and outside atmosphere, flue gas connections between heater and vent cap, vent cap for outdoors so all air for combustion is obtained from outside atmosphere and all flue gases are discharged to outside.

DUCT - A channel, typically made from sheet metal, through which a substance, such as air, may flow.

ELECTRODE - Conductor that transfers electric charges into or out of another conducting medium, or that influences the flow of current in another conducting medium.

ENERGY FACTOR - Measure of overall efficiency of heater based on model's recovery efficiency, standby loss and energy inputs.

FORCED AIR - Air that is mechanically moved using fans or blowers.

FUEL OIL - Petroleum products used as fuels.

#1 - distillate oil for vaporizing-type burners

#2 - distillate oil for general purpose burners

#4 - blended oil for use without preheating

#5 - blended oil for use with preheating

#6 - residual oil for use in burners with preheaters using high viscosity fuel

FLOW CONTROL VALVE - Devices installed between supply pipe and plumbing fixture (shower head, faucet, etc.) to regulate water flow. Recommended for large shower installations; can reduce water flow in half without disturbing spray pattern for water resulting in energy savings.

FLOW RATE - Amount of water in gallons flowing in plumbing fixture or pipe during period of time. Typically, measured in GPM (gallons per minute).

GLOSSARY OF TERMS (continued)

GPH/GPM - (Gallons Per Hour/Gallons Per Minute)- Amount of water flowing through plumbing fixture or pipe per hour/per minute.

HEAT EXCHANGER - Device specifically designed to transfer heat between two physically separate fluids.

HYDRONICS - Systems of heating or cooling involving heat transfer by a circulating fluid in a closed system of pipes.

INSTANTANEOUS WATER HEATER - Produces hot water on demand. Heater with rated minimum recovery of 3.5 GPH (at 100°F rise) and 4000 BTUs per hour per gallon of self-stored water.

NATURAL GAS - Combustible mixture of methane and higher hydrocarbons used chiefly as a fuel or raw material.

N.P.T. INLETS - National pipe thread standard.

PROPANE - Component of raw natural gas.

RADIATION - The combined processes of emission, transmission, and absorption of energy traveling as electromagnetic waves.

REAR OUTLET UNIT - Exhaust stack located at rear of unit (as opposed to the top).

RECOVERY - Amount of water per hour (GPH) heater will deliver not including storage.

ROUGHING IN - Sizes for space left around heater.

SEMI-INSTANTANEOUS - Heater has steam in tubes and water in shell (Instantaneous: steam in shell, water in tubes).

SIZING - Procedure to estimate the total demand on a heating unit. A properly sized heating unit will account for peak demand times where maximum delivery will occur.

STANDBY LOSS - Amount of heat lost per hour (measured in %) while heater is in standby mode (no water being drawn). Loss can occur through jacket or piping.

TEMPERATURE RISE - Number of degrees (F) that water temperature is raised to achieve the desired outlet temperature.

THERM - Measurement of heat. One (1) therm = 100,000 BTUs.

VENTING -

Type A: Three (3) walls of stainless steel, used for oil-fired water heaters. Withstands higher temperatures.

Type B: Single wall of aluminum, used for atmospheric gas water heaters only.

Type L: Two (2) walls, inner of stainless, outer of aluminum. For oil-fired and power gas heaters.

THERMAL EFFICIENCY - Ratio of output energy (in water) to input energy (fuel). Output only includes what is delivered from heater as hot water.

VACUUM (psi) - Any pressure less than 0 psi (gage) or 14.7 psi (absolute).

VALVE -

1. **Automatic** - Valve and operator controlling gas supply to burner(s) during normal operation of appliance. Operator may be actuated by gas pressure on flexible diaphragm, electrical or mechanical means or any other means.

2. **Semiautomatic** - Valve opens manually and closes automatically, or vice versa.

3. **Burner** - Manually or mechanically operated valve permitting control of gas flow.

4. **Diaphragm-type Automatic** - Device consisting of automatic valve actuated by application of gas pressure on flexible diaphragm.

5. **Electric-type Automatic** - Device actuated by electricity for controlling gas supply.

6. **Manual Main Shutoff** - Manually operated valve in gas line for completely turning on or shutting off gas supply to appliance (pilots may have independent shutoff valves).

7. **Safety Shutoff** - Valve automatically closed by safety control system or by emergency device. May be automatic or manual type.

VENT-AIR TERMINAL - Used with direct vent water heater, located on outside of tank. Takes in combustion air from outside atmosphere and discharges combustion products.

1. **Vent Terminal** - Fitting at end of vent pipe that directs flue products into outside atmosphere.

2. **Air Intake Terminal** - Fitting at inlet of air intake pipe allowing outside atmosphere into air intake pipe.

VENT LIMITER - Limits flow of air or gas from atmospheric diaphragm chamber of gas pressure regulator to atmosphere. May be device or orifice.

VENTING SYSTEM - Gas vent, chimney or single-wall pipe (and vent connector, if used) assembled to form continuous open passageway from gas appliance to outdoor atmosphere to remove vent gasses.

ZONED HEATING - Living areas separated into different spaces, with each space's heat controlled independently.

GLOSSARY OF TERMS

A.F.U.E. - Annual Fuel Usage Efficiency. Ratio of annual output of useful energy or heat to annual energy input to heater. Only heat leaving as hot water deemed usable and calculated as part of space heating efficiency.

A.S.M.E. - American Society of Mechanical Engineers.

BAROMETER - Device for measuring atmospheric pressure.

BAFFLE - Object placed in appliance to change direction of or retard flow of air, gas or mixtures of flue gases.

BTU (British Thermal Unit) - Energy required to raise the temperature of 1 lb of water from 60°F to 61°F at 1 atmosphere pressure.

CALORIE - Energy required to raise the temperature of 1 gram of water by 1°C at 1 atmosphere pressure.

CENTRAL SYSTEM HEATING - Unit that produces heat from a centralized location and distributes it throughout a structure.

CIRCULATING WATER HEATER -

1. **Automatic** - Furnishes hot water to be stored in separate vessel. Storage tank temperatures controlled by thermostat installed on heater. Circulation either natural or forced.

2. **Non-automatic** - Same as automatic except thermostat installed in storage vessel.

CIRCULATING TANK SYSTEM - Water heater is connected to separate storage tank, allowing large amounts of hot water to be built up for use during short periods of peak demand. Recovery to storage ratio: 1 GPH recovery to 1 gallon stored.

COIL CIRCULATION - Water heater with heat transfer surface composed primarily of water tubes less than 1 1/2" in internal diameter and requiring circulation.

COLD INLET TEMPERATURE - Temperature of water coming into water heating system.

COMBUSTION EFFICIENCY - Measurement of how well the heating equipment is converting a specific fuel into usable heat energy at a specific period of time in the operation of a heating system.

COMMERCIAL WATER HEATER - Water heater with input rate of more than 75,000 BTU/HR (gas) and 105,000 BTU/HR (oil).

CONDENSATE - A liquid obtained by condensation (usually initiated by a reduction in temperature of a vapor).

CONDUCTION - Heat transfer through a material from more energetic particles to less energetic particles.

CONVECTION - Heat transfer occurring between a fluid in motion and a bounding surface when the two are at different temperatures.

DELIVERY - Amount of hot water a heater can supply, most commonly over the period of one hour. Delivery = Recovery + 80% of storage.

DIRECT VENT - System with indoor water heater, combustion air connections between heater and outside atmosphere, flue gas connections between heater and vent cap, vent cap for outdoors so all air for combustion is obtained from outside atmosphere and all flue gases are discharged to outside.

DUCT - A channel, typically made from sheet metal, through which a substance, such as air, may flow.

ELECTRODE - Conductor that transfers electric charges into or out of another conducting medium, or that influences the flow of current in another conducting medium.

ENERGY FACTOR - Measure of overall efficiency of heater based on model's recovery efficiency, standby loss and energy inputs.

FORCED AIR - Air that is mechanically moved using fans or blowers.

FUEL OIL - Petroleum products used as fuels.

#1 - distillate oil for vaporizing-type burners

#2 - distillate oil for general purpose burners

#4 - blended oil for use without preheating

#5 - blended oil for use with preheating

#6 - residual oil for use in burners with preheaters using high viscosity fuel

FLOW CONTROL VALVE - Devices installed between supply pipe and plumbing fixture (shower head, faucet, etc.) to regulate water flow. Recommended for large shower installations; can reduce water flow in half without disturbing spray pattern for water resulting in energy savings.

FLOW RATE - Amount of water in gallons flowing in plumbing fixture or pipe during period of time. Typically, measured in GPM (gallons per minute).

GLOSSARY OF TERMS (continued)

GPH/GPM - (Gallons Per Hour/Gallons Per Minute)- Amount of water flowing through plumbing fixture or pipe per hour/per minute.

HEAT EXCHANGER - Device specifically designed to transfer heat between two physically separate fluids.

HYDRONICS - Systems of heating or cooling involving heat transfer by a circulating fluid in a closed system of pipes.

INSTANTANEOUS WATER HEATER - Produces hot water on demand. Heater with rated minimum recovery of 3.5 GPH (at 100°F rise) and 4000 BTUs per hour per gallon of self-stored water.

NATURAL GAS - Combustible mixture of methane and higher hydrocarbons used chiefly as a fuel or raw material.

N.P.T. INLETS - National pipe thread standard.

PROPANE - Component of raw natural gas.

RADIATION - The combined processes of emission, transmission, and absorption of energy traveling as electromagnetic waves.

REAR OUTLET UNIT - Exhaust stack located at rear of unit (as opposed to the top).

RECOVERY - Amount of water per hour (GPH) heater will deliver not including storage.

ROUGHING IN - Sizes for space left around heater.

SEMI-INSTANTANEOUS - Heater has steam in tubes and water in shell (Instantaneous: steam in shell, water in tubes).

SIZING - Procedure to estimate the total demand on a heating unit. A properly sized heating unit will account for peak demand times where maximum delivery will occur.

STANDBY LOSS - Amount of heat lost per hour (measured in %) while heater is in standby mode (no water being drawn). Loss can occur through jacket or piping.

TEMPERATURE RISE - Number of degrees (F) that water temperature is raised to achieve the desired outlet temperature.

THERM - Measurement of heat. One (1) therm = 100,000 BTUs.

VENTING -

Type A: Three (3) walls of stainless steel, used for oil-fired water heaters. Withstands higher temperatures.

Type B: Single wall of aluminum, used for atmospheric gas water heaters only.

Type L: Two (2) walls, inner of stainless, outer of aluminum. For oil-fired and power gas heaters.

THERMAL EFFICIENCY - Ratio of output energy (in water) to input energy (fuel). Output only includes what is delivered from heater as hot water.

VACUUM (psi) - Any pressure less than 0 psi (gage) or 14.7 psi (absolute).

VALVE -

1. **Automatic** - Valve and operator controlling gas supply to burner(s) during normal operation of appliance. Operator may be actuated by gas pressure on flexible diaphragm, electrical or mechanical means or any other means.

2. **Semiautomatic** - Valve opens manually and closes automatically, or vice versa.

3. **Burner** - Manually or mechanically operated valve permitting control of gas flow.

4. **Diaphragm-type Automatic** - Device consisting of automatic valve actuated by application of gas pressure on flexible diaphragm.

5. **Electric-type Automatic** - Device actuated by electricity for controlling gas supply.

6. **Manual Main Shutoff** - Manually operated valve in gas line for completely turning on or shutting off gas supply to appliance (pilots may have independent shutoff valves).

7. **Safety Shutoff** - Valve automatically closed by safety control system or by emergency device. May be automatic or manual type.

VENT-AIR TERMINAL - Used with direct vent water heater, located on outside of tank. Takes in combustion air from outside atmosphere and discharges combustion products.

1. **Vent Terminal** - Fitting at end of vent pipe that directs flue products into outside atmosphere.

2. **Air Intake Terminal** - Fitting at inlet of air intake pipe allowing outside atmosphere into air intake pipe.

VENT LIMITER - Limits flow of air or gas from atmospheric diaphragm chamber of gas pressure regulator to atmosphere. May be device or orifice.

VENTING SYSTEM - Gas vent, chimney or single-wall pipe (and vent connector, if used) assembled to form continuous open passageway from gas appliance to outdoor atmosphere to remove vent gasses.

ZONED HEATING - Living areas separated into different spaces, with each space's heat controlled independently.

