WARNINGS AND CAUTIONARY STATEMENTS

Warning!

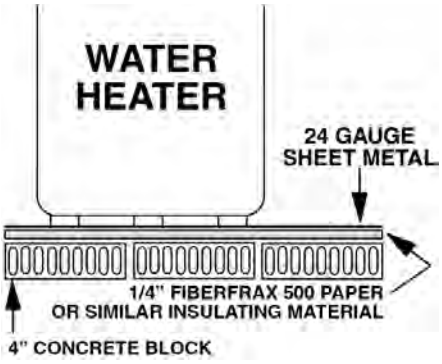
Improper installation, adjustment, alteration, service or maintenance can cause severe property damage and personal injury or death. Refer to instruction manuals for recommended procedures. For assistance or additional information, consult a qualified installer, service agency or the water heater supplier.

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 *Cerglass*®-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 outcoming water temperature and it could occasionally exceed 120°F. Variation in outcoming 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

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

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

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

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

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,

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

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,

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

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 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 9

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		1/2" O.D.TUBE	
	3 GPH	7 GPH	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		1/2" O.D.TUBE	
	3 GPH	7 GPH	3 GPH	7 GPH
0'	93'	80'	100'	100'
2'	85'	73'	100'	100'
4'	77'	66'	100'	100'
6'	69'	59'	100'	100'
8'	60'	52'	100'	100'
10'	52'	45'	100'	100'
12'	44'	38'	100'	100'
14'	36'	31'	100'	100'
16'	27'	24'	100'	93'
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).

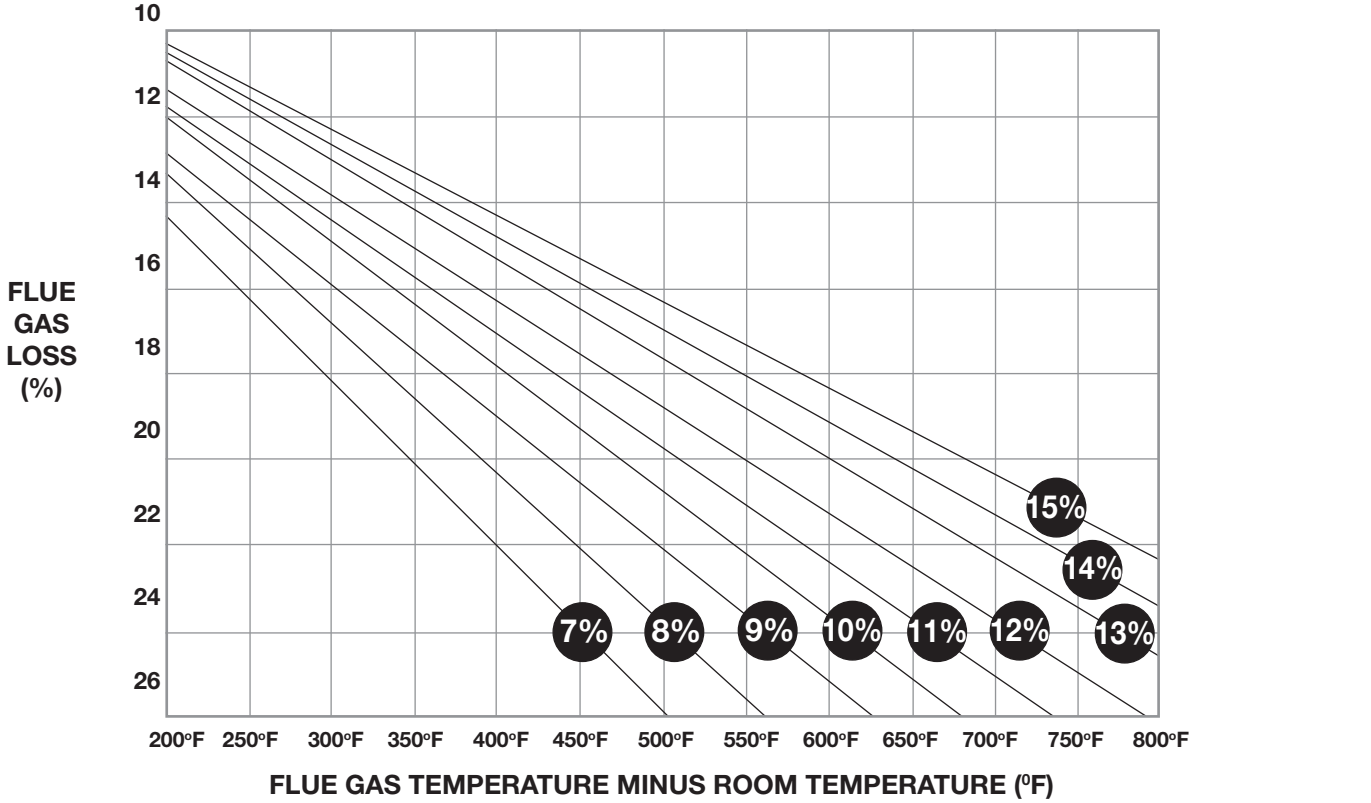
   Bleed the pumps until the oil loses the milky or opaque appearance and becomes clear or transparent.

   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

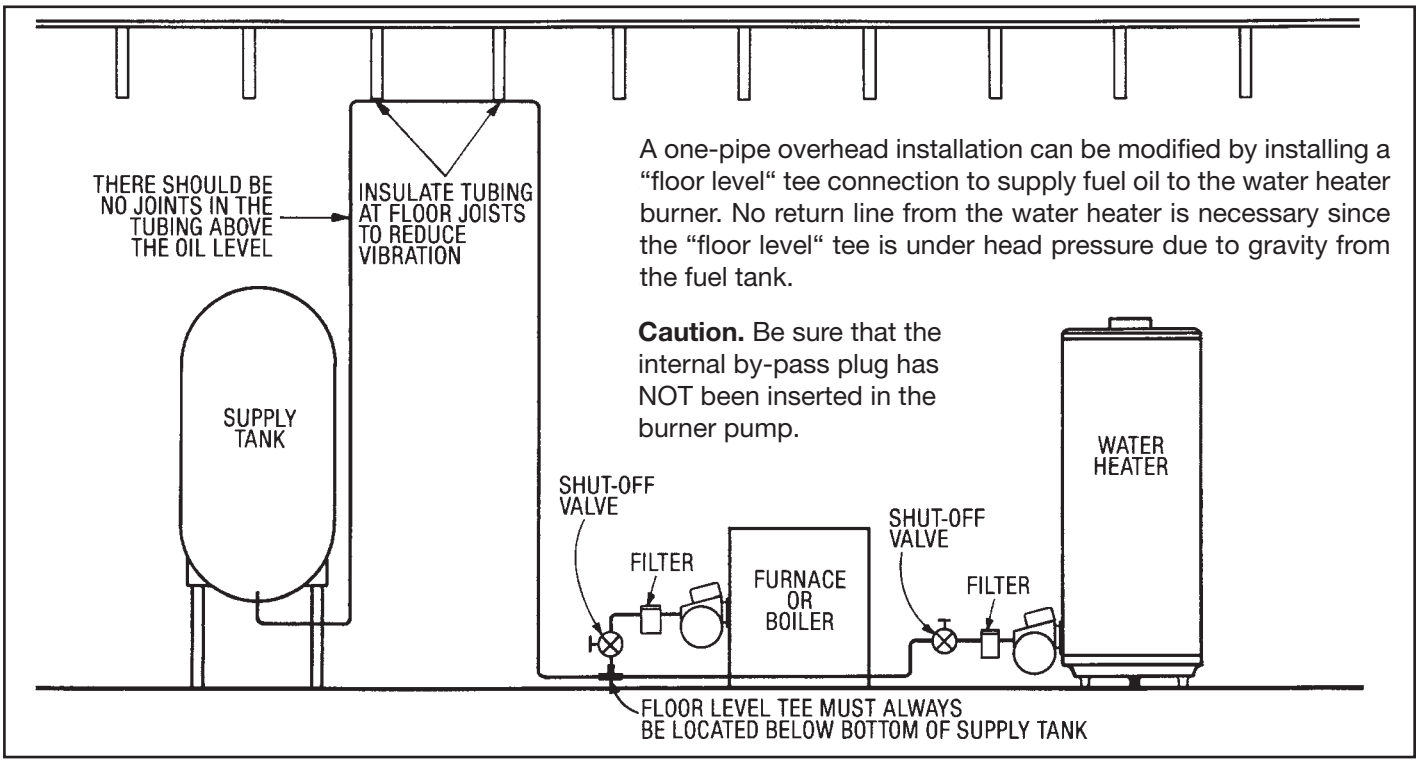
Percent of Flue Loss for Fuel Oil

Figure 11 can be used to approximate combustion efficiency or an AFUE number. Using the CO_2 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)

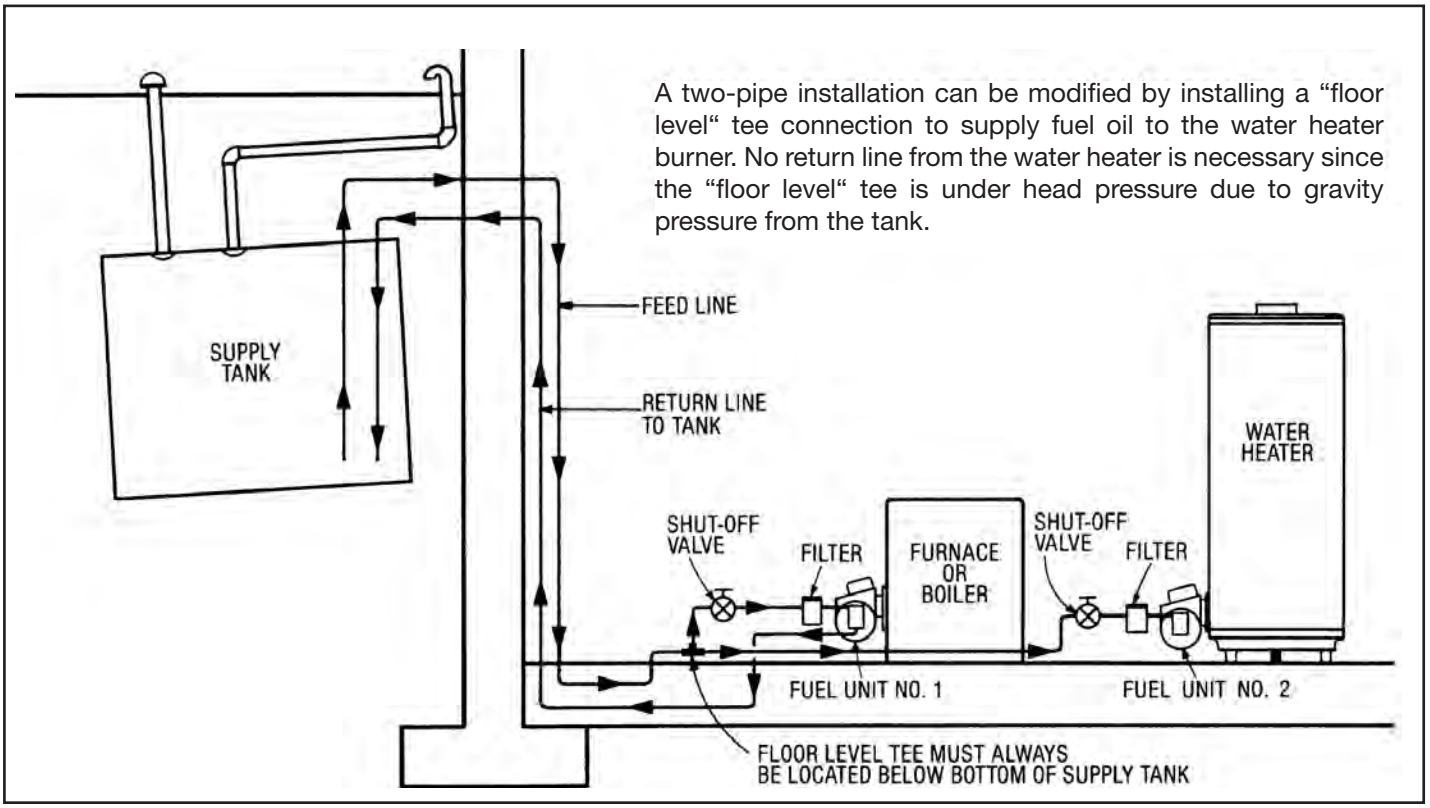


Figure 14: Installation using existing outside tank lift; two burners

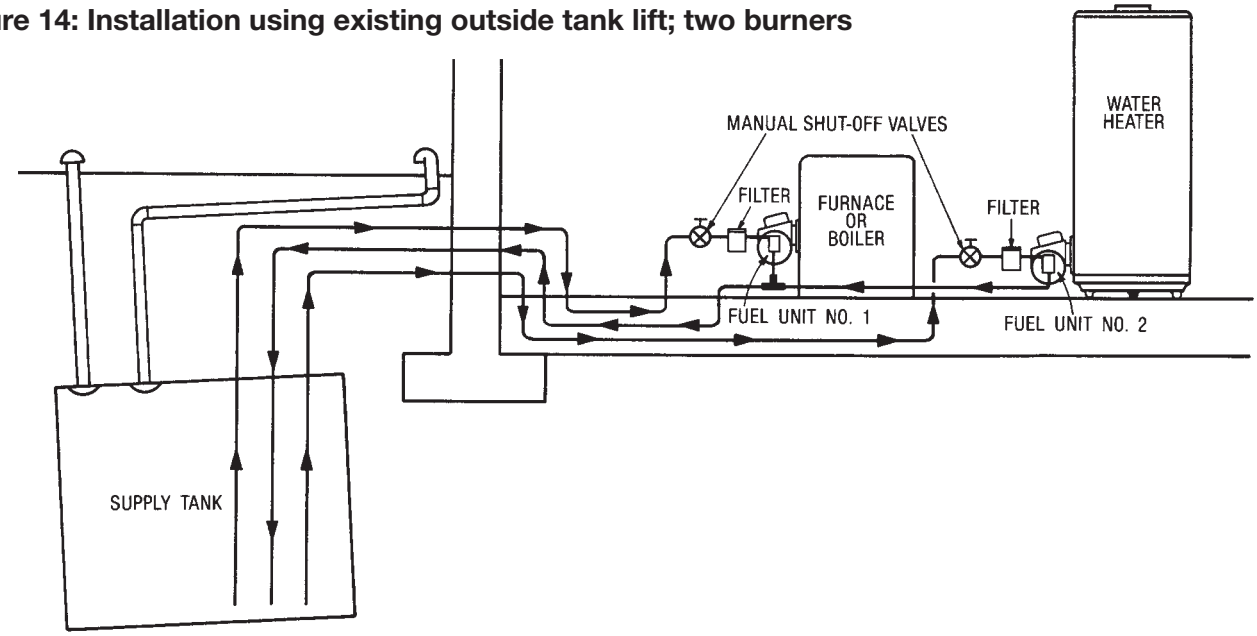
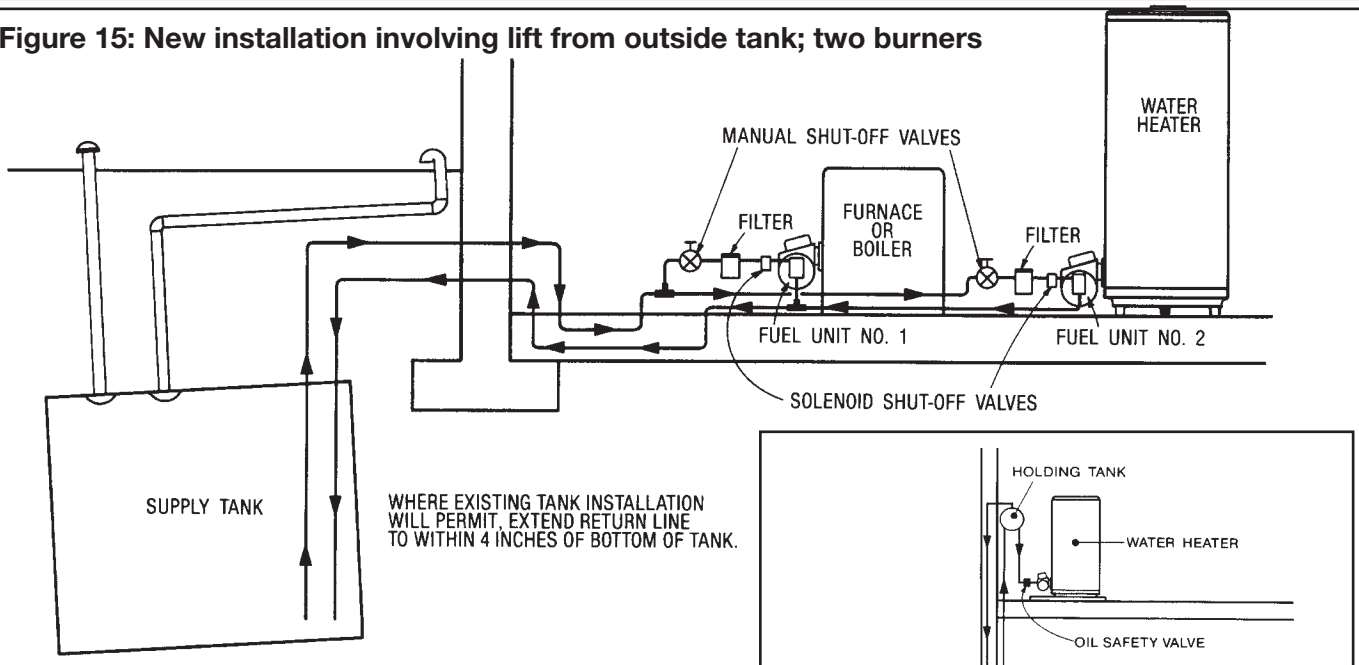


Figure 15: New installation involving lift from outside tank; two burners



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.

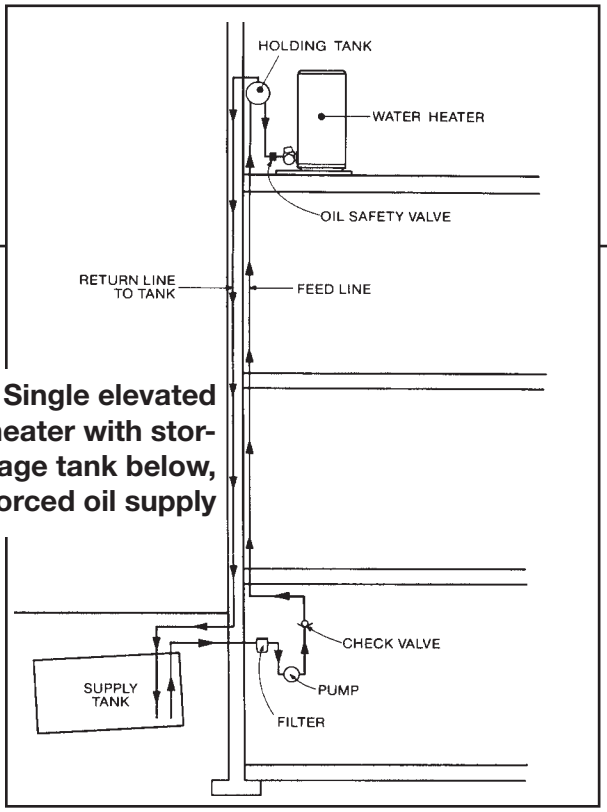


Figure 16: Single elevated heater with storage tank below, forced oil supply

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

	Nominal iron pipe size (in)								
LENGTH (ft)	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.

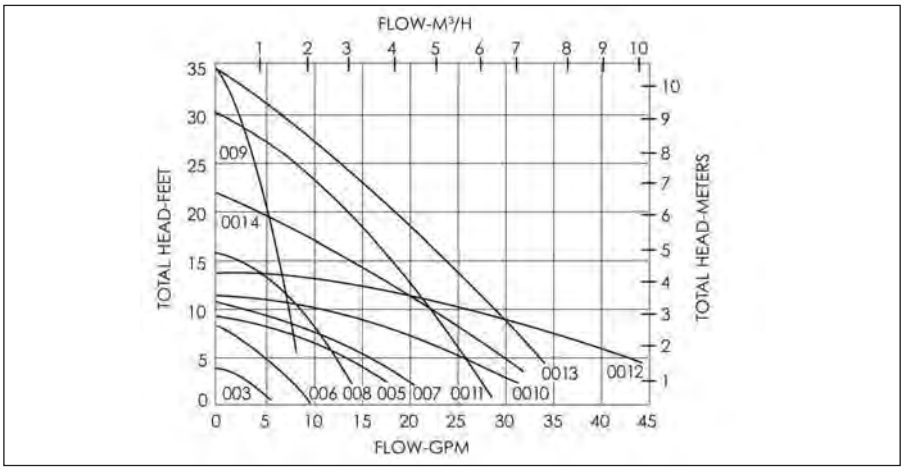


Figure 17: Taco 00 Series performance curves

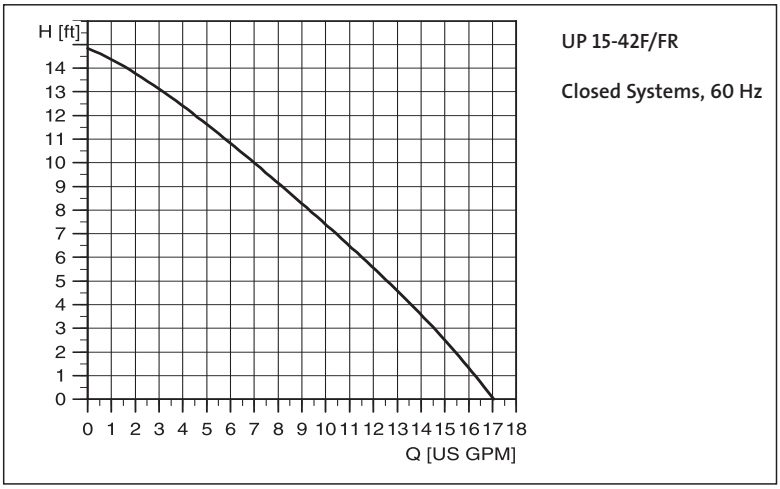


Figure 18: GRUNDFOS UP 15-42F performance curve

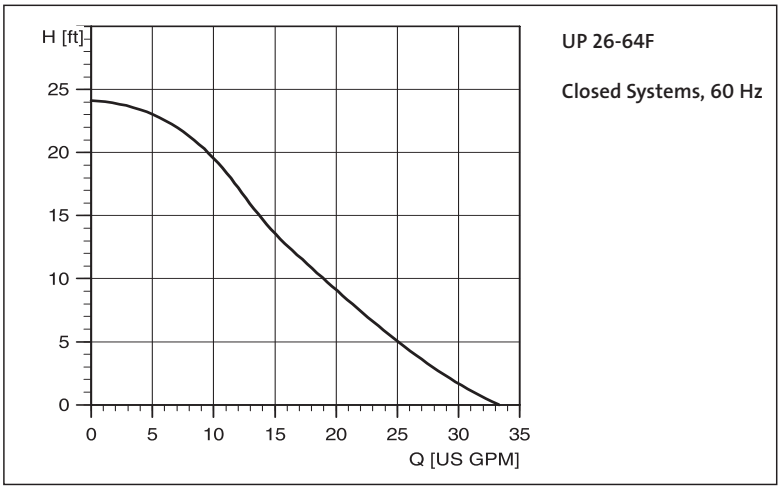


Figure 19: GRUNDFOS UP 26-64F performance curve

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:

*New first hour rating = (First hour rating) * (Actual boiler output)/(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:

*New first hour rating = (160 gal) * (60,000 BTU/Hr)/ (77,000 BTU/Hr) = 125 gal*