

The coil should be of the return-bend type (square or slightly rectangular in form), and should have the pipes running east and west, with the coil on the south side of the building where it can receive the full sun effect all day long without shadows from the building itself, or from the adjacent obstructions such as trees or other structures. The coil should be placed as low as possible in relation to the storage tank level, such as on a porch roof, the roof of a one-story extension or, if necessary, even on the ground. Both the coil and the circulation lines should be designed to facilitate the circulation flow as much as possible, using long-radius copper fittings or recessed galvanized-iron fittings to match the materials of the coil, circulation lines, and tank. The coil should be inclined, as shown in Fig. 14, so that the north end is raised above the south end to secure an angle with the horizontal of about 53 deg. This will result in the inlet end of the coil being on the south side (or bottom), and the outlet end being on the north side (or top). This will satisfy conditions along the 30-deg N latitude, which includes the portions of Florida and Southern California where these heaters are most frequently used.

The hot box is usually constructed of wood on the four sides and bottom, and is insulated. Glass sash are placed over the top of the box which should be airtight. The interior surfaces should be painted white to reflect the heat, while the coil should be painted black to absorb the heat. The box need not be deeper than necessary to house the coil and to protect it from the weather.

The addition, on the bottom of the box, of a light gage copper plate to which the pipe of the coil is soldered for good metallic contact, will add to the amount of heat received by the coil, due to the fact that this plate will receive all of the sun's rays which fail to directly strike the coil. The heat from this source is transmitted to the coil through the plate rather than from the heated air surrounding the coil. Otherwise, only part of the heat enters the coil, the balance being transmitted through the glass.

Design data given in Table 13 may be used with judgment in selecting the size of solar heater coil and box for a particular application. These data are based on consumptions of 30 and 40 gal of hot water per (day) (person).

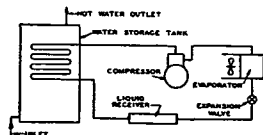


Fig. 15 Heat Pump Arrangement for Hot Water Supply

DOMESTIC HOT WATER BY HEAT PUMP

Hot water may suitably be obtained by using a heat-pump installation. The hot water heater may be either a heat exchanger installed just ahead of the compressor of a heat-pump installation, or may be a self-contained domestic-water heat pump.

Various designs of self-contained domestic water heat pumps are available, and one particular arrangement is shown in Fig. 15.

Hot water heating by means of a heat pump is not yet advisable where high water temperatures are desired. This is due to the fact that higher water outlet temperatures result in lower coefficients of performance.

For coefficients of performance of 4 or higher, the heat-pump water heater may be more economical to operate than a conventional water heater.

Although the first cost of domestic hot water heat pumps is somewhat high, they have the advantages of operating without products of combustion, odors, soot, or chimney. A further advantage is that they may be used for cooling purposes. With a coefficient of performance of $2\frac{1}{2}$ to 3, water temperatures of 140 to 150 F may be obtained.¹

REFERENCES

- ¹R. B. Hunter: *Water Distributing Systems for Buildings* (National Bureau of Standards Report BMS79, p. 6). (Chart extended to flow of 0.30 gpm.)
- ²Private communication from H. E. Degler.
- ³J. S. Setchell: *Enough Hot Water—Hot Enough* (American Gas Association, 1950).
- ⁴Svend Plum: *Plumbing Practice and Design* (John Wiley and Sons, New York, 1943).
- ⁵P. Sporn and E. R. Ambrose: Progress report on a heat pump water heater (*Heating and Ventilating*, Vol. 46, February 1949, p. 78).

BIBLIOGRAPHY

- H. C. Russell: Laundry, kitchen and hospital equipment (*ASHVE TRANSACTIONS*, Vol. 35, 1929, p. 45).
- G. C. St. Laurent: Water consumption, cost and savings (*Hotel Engineering*, Vol. 1, American Hotel Association, 1940).
- F. M. Dawson and A. A. Kalinske: *Water-Supply Piping for the Plumbing System* (National Association of Master Plumbers Technical Bulletin No. 3).
- F. A. Brooks: *Use of Solar Energy for Heating Water* (Smithsonian Institution, Washington, D.C.).
- R. B. Hunter: *Methods of Estimating Loads in Plumbing Systems* (National Bureau of Standards Report BMS65, 1940).
- Plumbing Manual, Report of the Subcommittee on Plumbing, Central Housing Committee on Research, Design and Construction* (National Bureau of Standards Report BMS66, 1940).
- R. B. Hunter: *Water-Distributing Systems for Buildings* (National Bureau of Standards Report BMS79, 1941).
- M. B. Mackay: Hot water requirements (*Modern Sanitation*, Vol. 1, August 1949, p. 30).
- M. A. Pond: Urban domestic water consumption (*Journal of the American Water Works Association*, Vol. 31, No. 12, 1939, p. 2003).
- R. Murray: How to size and install gas water heaters correctly (*Air Conditioning, Heating and Ventilating*, February 1955, p. 88).
- J. C. Church: Water supply for tall buildings (*Air Conditioning, Heating and Ventilating*, February 1955, p. 99).
- F. M. Reiter: Service hot water design for multi-story buildings (*Air Conditioning, Heating and Ventilating*, December 1955, p. 79).
- F. M. Reiter: Service hot water for commercial and industrial use (*Air Conditioning, Heating and Ventilating*, February 1956, p. 89).
- F. M. Reiter: Design data for service hot water (*Air Conditioning, Heating and Ventilating*, April 1956, p. 81).
- G. R. Jerns: Design of swimming pools (*Air Conditioning, Heating and Ventilating*, February 1957, p. 113).
- J. Nachbar: Water supply for industrial plants (*Air Conditioning, Heating and Ventilating*, December 1957, p. 53).

CODES AND STANDARDS

THE Codes and Standards listed in Table 1 represent accepted practice, methods, or standards prepared and accepted by the organizations indicated. They are valuable guides for the practicing engineer in determining test methods, ratings, performance requirements, and limits applying to equipment used in heating, ventilating, and air conditioning. Copies can usually be obtained from the organization listed in the reference column.

Table 1 Codes and Standards Prepared and Accepted by Various Societies and Associations

Subject	Title	Sponsor	Reference
Acoustics (Terminology)	American Standard Acoustical Terminology (1951).	AS of A	ASA Z24.1
Air Conditioners	ASRE Standard Methods of Rating and Testing Air Conditioners (1956).	ASRE	ASRE Standard 16-56
Air Conditioners (Room)	Standards for Room Air-Conditioners.	ARI	ARI Standard 110-58
Air Conditioning	Code of Minimum Requirements for Comfort Air Conditioning (1938).	ASHVE ASRE	ASHAE
Air Conditioning (120,000 Btu/hr or less)	Code and Manual for the Design and Installation of Warm Air Winter Air Conditioning Systems (1953).	NWAH & ACA	NWAH & ACA Manual No. 7 4th Edition
Air Conditioning (Above 120,000 Btu/hr)	Code and Manual for the Design and Installation of Mechanical Warm Air Heating Systems (1950).	NWAH & ACA	NWAH & ACA Manual No. 9 5th Edition
Air Conditioning	Standards for the Installation of Air Conditioning and Ventilating Systems of Other Than Residence Type (1955).	NFPA	NBFU or NFPA No. 90A
Air Conditioning	Standards for the Installation of Residence Type Warm Air Heating and Air Conditioning Systems (1956).	NFPA	NBFU or NFPA No. 90B
Air Conditioning (Residential)	Design and Installation of Summer Air Conditioning for New and Existing Residences, Tentative (1955).	NWAH & ACA	NWAH & ACA Manual No. 11
Air Conditioning (Unitary Equipment)	Standard for Unitary Air Conditioning Equipment.	ARI	ARI Standard 210-57
Air Conditioning (Year-Round Residential)	Standard for Year-Round Residential Air-Conditioning.	ARI	ARI Standard 230-57
Airplane	Air Conditioning Equipment, Airplane—General Requirements for (1948).	SAE	SAE ARP 85B
Airplane	Heaters, Airplane, Internal Combustion Heat Exchanger Type (1949).	SAE	SAE ARP 143B
Airplane	Heaters, Airplane, Steam Type.	SAE	SAE ARP 87
Attic Ventilation	Residence Ventilation Guide (1950).	PFMA	PFMA
Boilers	1-B-R Testing and Rating Code for Low Pressure Cast Iron Heating Boilers, 6th Edition, 1958.	IBR	IBR
Boilers	Net Load Recommendations for Heating Boilers. Publ. semi-annually.	HP & ACCNA	MCAA
Boilers	Net Square Feet Radiation Loads in 70 Deg Fahr, Recommended for Low Pressure Heating Boilers (1948).	HP & ACCNA	MCAA
Boilers	ASME Boiler and Pressure Vessel Code (1956, 8 Sections).	ASME	ASME
Boilers	ASME Boiler and Pressure Vessel Code, Section IV, Low Pressure Heating Boilers (1956 with 1957 and 1958 addenda).	ASME	ASME
Boilers (Gas)	American Standard Approval Requirements for Central Heating Gas Appliances Vol. 1, Steam and Hot Water Boilers (1956).	A.G.A.	ASA Z21.13.1-1956
Boilers (Miniature)	ASME Boiler and Pressure Vessel Code, Section V, Miniature Boilers (1952).	ASME	ASME
Boilers (Power)	ASME Boiler and Pressure Vessel Code, Section I, Power Boilers (1956).	ASME	ASME
Boilers (Power)	ASME Boiler and Pressure Vessel Code, Section VII, Suggested Rules for Care of Power Boilers (1954).	ASME	ASME
Boilers (Steel)	Steel Boiler Institute Rating Code for Steel Boilers (1958).	SBI	SBI 7th Edition CSD R157-50
Boilers (Steel)	Simplified Practice Recommendation for Steel Firebox Boilers and Steel Heating Boilers (Commercial and Residential Types) (1950).	BS SBI	