

or propeller fan units will have a larger reduction in capacity than housed fan units for a given added resistance, and a given heater will have a larger reduction in capacity as the fan speed is lowered. When confronted with this problem the ratings under the conditions expected should be secured from the manufacturer.

When steam supplied to the heaters contains superheat, the capacity of the heater will be but slightly less than with saturated steam at the same pressure. Recent tests conducted at the University of Kentucky indicate that the reduction of capacity from this cause is negligible for

TABLE 1.—CONSTANTS FOR DETERMINING THE CAPACITY OF UNIT HEATERS FOR VARIOUS STEAM PRESSURES AND TEMPERATURES OF ENTERING AIR

(Accurate within 5 per cent)

STEAM PRESSURE LB.	TEMPERATURE OF AIR ENTERING HEATER													
	-10°	0°	10°	20°	30°	40°	45°	50°	55°	60°	65°	70°	75°	
0	0.975	0.93	0.89	0.84	0.80	0.76	0.73	0.71	0.69	0.67	0.64	0.62	0.60	
2	1.01	0.96	0.92	0.87	0.83	0.79	0.76	0.74	0.72	0.70	0.68	0.65	0.63	
5	1.04	1.00	0.96	0.91	0.87	0.82	0.80	0.78	0.76	0.74	0.71	0.69	0.67	
10	1.06	1.05	1.01	0.97	0.92	0.88	0.85	0.83	0.81	0.79	0.76	0.74	0.72	
15	1.15	1.10	1.05	1.01	0.97	0.92	0.90	0.88	0.86	0.83	0.81	0.79	0.76	
20	1.18	1.14	1.09	1.05	1.00	0.96	0.94	0.92	0.89	0.87	0.85	0.83	0.81	
30	1.25	1.21	1.16	1.12	1.08	1.03	1.01	0.98	0.96	0.94	0.92	0.90	0.88	
40	1.30	1.26	1.22	1.17	1.12	1.08	1.06	1.04	1.02	1.00	0.97	0.95	0.93	
50	1.35	1.31	1.27	1.22	1.18	1.13	1.11	1.09	1.07	1.04	1.02	1.00	0.98	
60	1.39	1.35	1.31	1.26	1.22	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.03	
80	1.49	1.43	1.38	1.34	1.29	1.25	1.23	1.20	1.18	1.16	1.14	1.12	1.10	
100	1.53	1.49	1.44	1.40	1.35	1.31	1.29	1.26	1.24	1.22	1.20	1.18	1.16	
125	1.59	1.56	1.51	1.46	1.42	1.37	1.36	1.33	1.31	1.29	1.27	1.24	1.22	
135	1.61	1.57	1.53	1.48	1.44	1.39	1.37	1.35	1.33	1.30	1.28	1.26	1.24	
140	1.62	1.58	1.54	1.49	1.45	1.41	1.38	1.36	1.34	1.32	1.29	1.27	1.25	
150	1.64	1.60	1.55	1.51	1.46	1.42	1.40	1.38	1.35	1.33	1.31	1.28	1.26	

Note.—To determine capacity at any steam pressure and entering temperature, multiply constant from table by rated capacity at 0 deg. entering and 5 lb. pressure.

superheat up to 50 deg. and will not exceed $3\frac{1}{2}$ per cent for any degree of superheat.

Arrangement of Heaters

Heaters may be distributed through the central portions of a room discharging toward exposed surfaces, or may be spaced around the walls, discharging along the walls and inward as well, when there are considerable roof losses.

In general, it is better to direct the discharge from the unit heaters in such fashion that rotational circulation of the entire room content is set up by the system rather than to have the heaters discharge in random and in counter-directions.

Direction and Location of Discharge

Various types and makes of unit heaters are illustrated in the Catalog Section of THE GUIDE. Usually hot blasts of air in working zones are objectionable, so heaters mounted on the floor should have their discharge outlets above the head line and suspended heaters should be placed in

such manner and turned in such direction that the heated air stream will not be objectionable in the working zone. In the interest of economy, however, the elevation of the heater outlet and the direction of discharge should be so arranged that the heated air shall be brought as close to the head line as possible, yet not into the working zone.

Boiler Capacity for Unit Heaters

The capacity of the boiler should be based on the rated capacity of the heaters at the lowest entering air temperature that will occur, plus an allowance for line losses. Ordinarily for recirculating heaters the lowest entering temperature will occur at the beginning of the heating period and is usually taken as 40 deg., while for heaters taking air from outdoors the lowest entering temperature will be the extreme outdoor temperature expected in the district. No greater allowance in boiler capacity beyond the calculated heat demand need be added in order to supply unit heaters than for any other type of system.

It is unwise to install a single unit heater as the sole load on any boiler, particularly if the unit heater motor is started and stopped by thermostatic control. The wide and sudden fluctuations of load that occur under such conditions would require closer attendance to the boiler than is usually possible in a small installation. Where oil or gas is used to fire the boiler, it is possible by means of a pressurestat to control the boiler, in response to this rapid fluctuation. In most cases, however, and particularly where the boiler is coal-fired, it is advisable to use two or more smaller heating units instead of one large unit.

Steam pressures below 5 lb. can be used with safety for recirculating unit heaters when their coils are designed for the purpose and when proper provision is made for returning the condensate. If heaters are to take in air that may be at a temperature below freezing, however, a steam pressure of not less than 5 lb. should be maintained on the heater coils.

Automatic Control

There are two general methods of automatic control that may be applied to a unit heater installation. One is to start and stop the unit heater motors individually or in a group by means of a room thermostat. The other is to control the steam supply either to individual units or a group of units by means of a graduated-acting valve, operated from a room thermostat. Where steam valve control is used, the return system must be equipped with a vacuum pump, as a considerable pressure difference between supply and return pipes necessarily exists in all unit heaters.

A combination of these two methods is sometimes used, wherein the steam supplied to the units is cut off completely before the unit heater motor is stopped and is turned on just after the motor is again started. The function of this control is to cool off the heater and prevent possible discomfort to persons close to the heater from the increased radiant effect of the heater if steam is left on the coils when the motor is stopped. This is accomplished by two thermostats, one controlling the motor and the other controlling the steam valve. The latter is set for a wider operating range than the former. With this combination control there is some possibility of draft-complaint if the fan delivers cool air.