to be handled from direct radiation, direct-indirect radiation and indirect or fan blast radiation may be estimated as follows:

For direct radiation $W = 0.3\ R$
For direct-indirect radiation $W = 0.6\ R$
For indirect radiation $W = \frac{Q \times 60 \times T}{55.6 \times H}$

where

W = lbs. of condensate per hour, R = sq. ft. of radiation, Q = cu. ft. of air per min., T = temperature rise of air in deg. fahr. and H = the latent heat of steam in the system in B.t.u. per pound.

The normal capacity of pumps to be based on condensate at a temperature of not over 180 deg. fahr. For temperature of condensate above 180 deg. fahr. capacity should be increased above that estimated for 180 deg. fahr. condensate as per the following Table 63.

TABLE 63. TEMPERATURE OF CONDENSATE AT PUMP SUCTION

Deg. fahr.	Factor
190	1.15
200	1.56
204	2.00

To use Table 63, multiply the quantity of condensate to be handled by the factor corresponding to the temperature of the condensate at the pump suction and select a pump suitable for the quantity thus found.

The above increase in pump capacity may be reduced by providing a static head above the pump suction and when this static head is made equivalent to 15 ft. minus the absolute boiling pressure of the condensate (measured in feet of water) no increase is necessary.

Allow sufficient head in addition to the total head necessary to overcome static head, velocity head, pipe friction and boiler pressure, wherever condensate is to be returned direct to a boiler from the pump.

BOILER FEED PUMPS

Types.—Boiler Feed Pumps may be of the following types:

1. Direct acting steam driven reciprocating pumps.
2. Power driven reciprocating pumps.
3. Centrifugal pumps.
4. Screw pumps.

Capacities.—The capacity of a boiler feed pump should be based on 34.5 lb. of water per hour per maximum boiler horsepower served, with a slippage allowance of 10 per cent in the water cylinders and a factor of safety allowance of 2 for intermittently operating pumps and a factor of safety allowance of 1½ for continuous operating pumps, to provide for unusual demands when the water in boilers becomes low or excessive loads are carried.

Piston Speeds in Feet per Minute.—For reciprocating boiler feed pump

not to exceed 10 times the square root of the number of inches in the length of stroke of the water pistons.

Direct acting reciprocating steam driven or power driven boiler feed pumps are generally found to be more efficient for smaller installations especially with widely fluctuating loads as the efficiencies of centrifugal

TABLE 64. DIRECT ACTING STEAM DRIVEN DUPLEX RECIPROCATING BOILER FEED PUMPS

Dia. of Steam Cyl. in Inches	Dia. of Water Cyl. in Inches	Length of Stroke in Inches	No. of Strokes per Min.	Discharge in Gallons		Equivalent Dia. of Single Cyl. Pump	Boiler H. P. Served Without Factor of Safety	Size Pipe, Inches			
				Per Stroke	Per Min.			Steam	Exhaust	Suction	Discharge
3	2	3	70	0.04	5.6	2⅞	80	½	¾	1¼	1
4½	2¾	4	60	0.10	12.0	4	180	½	¾	1½	1¼
5¼	3½	5	50	0.20	20.0	5	300	¾	1¼	2	1½
6	4	6	50	0.33	33.0	5⅝	480	1	1½	2½	2
7½	4½	6	50	0.42	42.0	6⅜	600	1½	2	3	2½
7½	5	10	40	0.85	68.0	7	1000	1½	2	3	2½
10	6	10	40	1.22	97.6	8½	1400	2	2½	4	3
12	7	12	35	2.00	140.0	9⅞	2000	2½	3	5	4

TABLE 65. HORIZONTAL DUPLEX PISTON PACKED POWER DRIVEN BOILER FEED PUMPS FOR 100 LB. WORKING PRESSURE

Size of Pump Cylinders in Inches		No. of Revolutions per Min.	Displacement Gallons		Boiler H. P. Served Without Factor of Safety	H. P. Required to Drive Pump	Pipe Sizes Inches	
Dia.	Stroke		Per Rev.	Per Min.			Suction	Discharge
2½	4	30	0.34	10.2	148	1.5	1½	1¼
3	4	30	0.49	14.7	213	4.0	2	1½
3½	5	30	0.83	24.9	361	3.5	2½	2
4	6	25	1.30	32.5	471	4.0	3	2½
8	10	20	8.69	173.8	2520	18.0	5	4

TABLE 66. RECIPROCATING SINGLE ACTING POWER DRIVEN TRIPLEX BOILER FEED PUMPS FOR 150 LB. WORKING PRESSURE

Size of Pump Cylinders in Inches		No. of Revolutions per Min.	Displacement Gallons		Boiler H. P. Served Without Factor of Safety	H. P. Required to Drive Pump	Pipe Sizes Inches	
Dia.	Stroke		Per Rev.	Per Min.			Suction	Discharge
1½	2	50	0.045	2.25	33	0.40	¾	¾
1¾	2½	50	0.078	3.90	57	0.65	1	1
2	3	40	0.122	4.88	70	0.80	1¼	1
2½	4	30	0.255	7.65	110	1.15	1½	1¼
3	4	30	0.367	11.01	160	1.40	1½	1¼
4	4	30	0.652	19.56	280	4.60	2	1½
4	6	25	0.978	24.45	355	3.10	2½	2
5	8	20	2.041	40.82	592	5.00	3	2½
6	8	20	2.938	58.76	852	6.00	3½	3
8	10	20	6.520	130.40	1891	14.00	4	3