

# Mech 275 – Environmental Engineering

## Heat Gains from People, Equipment and Lighting (Partial Tables from Your Textbook, Chapter 7)

**Table 7-14 SI Rates of Heat Gain from Occupants<sup>a,b,c</sup>**  
(Table 1, Chapter 18, 2013 ASHRAE Handbook—Fundamentals)

Degree of Activity		Total Heat, W		Sensible Heat, W	Latent Heat, W	% Sensible Heat that is Radiant <sup>b</sup>	
		Adult Male	Adjusted, M/F <sup>a</sup>			Low V	High V
		Seated at theater	Theater, matinee	115	95	65	30
Seated at theater, night	Theater, night	115	105	70	35	60	27
Seated, very light work	Offices, hotels, apartments	130	115	70	45		
Moderately active office work	Offices, hotels, apartments	140	130	75	55		
Standing, light work; walking	Department store; retail store	160	130	75	55	58	38
Walking, standing	Drug store, bank	160	145	75	70		
Sedentary work	Restaurant <sup>c</sup>	145	160	80	80		
Light bench work	Factory	235	220	80	140		
Moderate dancing	Dance hall	265	250	90	160	49	35
Walking 4.8 km/h; light machine work	Factory	295	295	110	185		
Bowling <sup>d</sup>	Bowling alley	440	425	170	255		
Heavy work	Factory	440	425	170	255	54	19
Heavy machine work; lifting	Factory	470	470	185	285		
Athletics	Gymnasium	585	525	210	315		

**Notes:**

1. Tabulated values are based on 24°C room dry-bulb temperature. For 27°C room dry bulb, the total heat remains the same, but the sensible heat values should be decreased by approximately 20%, and the latent heat values increased accordingly.
2. Also refer to Table 4, Chapter 8, for additional rates of metabolic heat generation.
3. All values are rounded to nearest 5 W.
- <sup>a</sup>Adjusted heat gain is based on normal percentage of men, women, and children for the application listed, with the postulate that the gain from an adult female is 85%

of that for an adult male, and that the gain from a child is 75% of that for an adult male.

<sup>b</sup>Values approximated from data in Table 6, Chapter 8, where is air velocity with limits shown in that table.

<sup>c</sup>Adjusted heat gain includes 18 W for food per individual (9 W sensible and 9 W latent).

<sup>d</sup>Figure one person per alley actually bowling, and all others as sitting (117 W) or standing or walking slowly (231 W).

**Table 7-21A SI Recommended Rates of Radiant and Convective Heat Gain from Unhooded Electric Appliances During Idle (Ready-to-Cook) Conditions**

(Table 5A, Chapter 18, 2013 ASHRAE Handbook—Fundamentals)

Appliance	Energy Rate, W		Rate of Heat Gain, W				Usage Factor $F_U$	Radiation Factor $F_R$
	Rated	Standby	Sensible Radiant	Sensible Convective	Latent	Total		
Cabinet: hot serving (large), insulated*	1993	352	117	234	0	352	0.18	0.33
hot serving (large), uninsulated	1993	1026	205	821	0	1026	0.51	0.20
proofing (large)*	5099	410	352	0	59	410	0.08	0.86
proofing (small 15-shelf)	4191	1143	0	264	879	1143	0.27	0.00
Coffee brewing urn	3810	352	59	88	205	352	0.08	0.17
Drawer warmers, 2-drawer (moist holding)*	1202	147	0	0	59	59	0.12	0.00
Egg cooker	3194	205	88	117	0	205	0.06	0.43
Espresso machine*	2403	352	117	234	0	352	0.15	0.33
Food warmer: steam table (2-well-type)	1495	1026	88	176	762	1026	0.69	0.08
Freezer (small)	791	322	147	176	0	322	0.41	0.45
Hot dog roller*	996	703	264	440	0	703	0.71	0.38
Hot plate: single burner, high speed	1114	879	264	615	0	879	0.79	0.30
Hot-food case (dry holding)*	9115	733	264	469	0	733	0.08	0.36
Hot-food case (moist holding)*	9115	967	264	528	176	967	0.11	0.27
Microwave oven: commercial (heavy duty)	3194	0	0	0	0	0	0	0.00
Oven: countertop conveyORIZED bake/finishing*	6008	3693	645	3048	0	3693	0.61	0.17
Panini*	1700	938	352	586	0	938	0.55	0.38
Popcorn popper*	586	59	29	29	0	59	0.1	0.50
Rapid-cook oven (quartz-halogen)*	12 016	0	0	0	0	0	0	0.00
Rapid-cook oven (microwave/convection)*	7297	1202	293	909	0	293	0.16	0.24
Reach-in refrigerator*	1407	352	88	264	0	352	0.25	0.25
Refrigerated prep table*	586	264	176	88	0	264	0.45	0.67
Steamer (bun)	1495	205	176	29	0	205	0.14	0.86
Toaster: 4-slice pop up (large): cooking	1788	879	59	410	293	762	0.49	0.07
contact (vertical)	3312	1553	791	762	0	1553	0.47	0.51
conveyor (large)	9613	3019	879	2139	0	3019	0.31	0.29
small conveyor	1700	1084	117	967	0	1084	0.64	0.11
Waffle iron	909	352	234	117	0	352	0.39	0.67

\*Items with an asterisk appear only in Swierczyna et al. (2009); all others appear in both Swierczyna et al. (2008) and (2009).

**Table 7-21E SI Recommended Rates of Radiant and Convective Heat Gain from Warewashing Equipment During Idle (Standby) or Washing Conditions**

(Table 5E, Chapter 18, 2013 ASHRAE Handbook—Fundamentals)

Appliance	Energy Rate, W		Rate of Heat Gain, W						Usage Factor $F_U$	Radiation Factor $F_R$
			Unhooded				Hooded			
	Rated	Standby/Washing	Sensible Radiant	Sensible Convective	Latent	Total	Sensible Radiant			
Dishwasher (conveyor type, chemical sanitizing)	13 716	1671/12 778	0	1304	3954	5258	0	0.36	0	
Dishwasher (conveyor type, hot-water sanitizing) standby	13 716	1671/N/A	0	1392	4973	6366	0	N/A	0	
Dishwasher (door-type, chemical sanitizing) washing	5393	352/3898	0	580	818	1398	0	0.26	0	
Dishwasher (door-type, hot-water sanitizing) washing	5393	352/3898	0	580	818	1398	0	0.26	0	
Dishwasher* (under-counter type, chemical sanitizing) standby	7796	352/5480	0	668	1222	1890	0	0.35	0.00	
Dishwasher* (under-counter type, hot-water sanitizing) standby	7796	498/5774	234	305	882	1421	234	0.27	0.34	
Booster heater*	38 099	0	147	0	0	0	147	0	N/A	

\*Items with an asterisk appear only in Swierczyna et al. (2009); all others appear in both Swierczyna et al. (2008) and (2009).

Note: Heat load values are prorated for 30% washing and 70% standby.

**Table 7-15 Typical Nonincandescent Light Fixtures**

Description	Ballast	Watts/Lamp	Lamps/Fixture	Lamp Watts	Fixture Watts	Special Allowance Factor	Description	Ballast	Watts/Lamp	Lamps/Fixture	Lamp Watts	Fixture Watts	Special Allowance Factor
<b>Compact Fluorescent Fixtures</b>													
Twin, (1) 5 W lamp	Mag-Std	5	1	5	9	1.80	Twin, (2) 40 W lamp	Mag-Std	40	2	80	85	1.06
Twin, (1) 7 W lamp	Mag-Std	7	1	7	10	1.43	Quad, (1) 13 W lamp	Electronic	13	1	13	15	1.15
Twin, (1) 9 W lamp	Mag-Std	9	1	9	11	1.22	Quad, (1) 26 W lamp	Electronic	26	1	26	27	1.04
Quad, (1) 13 W lamp	Mag-Std	13	1	13	17	1.31	Quad, (2) 18 W lamp	Electronic	18	2	36	38	1.06
Quad, (2) 18 W lamp	Mag-Std	18	2	36	45	1.25	Quad, (2) 26 W lamp	Electronic	26	2	52	50	0.96
Quad, (2) 22 W lamp	Mag-Std	22	2	44	48	1.09	Twin or multi, (2) 32 W lamp	Electronic	32	2	64	62	0.97
Quad, (2) 26 W lamp	Mag-Std	26	2	52	66	1.27							
<b>Fluorescent Fixtures</b>													
(1) 18 in., T8 lamp	Mag-Std	15	1	15	19	1.27	(4) 48 in., T8 lamp	Electronic	32	4	128	120	0.94
(1) 18 in., T12 lamp	Mag-Std	15	1	15	19	1.27	(1) 60 in., T12 lamp	Mag-Std	50	1	50	63	1.26
(2) 18 in., T8 lamp	Mag-Std	15	2	30	36	1.20	(2) 60 in., T12 lamp	Mag-Std	50	2	100	128	1.28
(2) 18 in., T12 lamp	Mag-Std	15	2	30	36	1.20	(1) 60 in., T12 HO lamp	Mag-Std	75	1	75	92	1.23
(1) 24 in., T8 lamp	Mag-Std	17	1	17	24	1.41	(2) 60 in., T12 HO lamp	Mag-Std	75	2	150	168	1.12
(1) 24 in., T12 lamp	Mag-Std	20	1	20	28	1.40	(1) 60 in., T12 ES VHO lamp	Mag-Std	135	1	135	165	1.22
(2) 24 in., T12 lamp	Mag-Std	20	2	40	56	1.40	(2) 60 in., T12 ES VHO lamp	Mag-Std	135	2	270	310	1.15
(1) 24 in., T12 HO lamp	Mag-Std	35	1	35	62	1.77	(1) 60 in., T12 HO lamp	Mag-ES	75	1	75	88	1.17
(2) 24 in., T12 HO lamp	Mag-Std	35	2	70	90	1.29	(2) 60 in., T12 HO lamp	Mag-ES	75	2	150	176	1.17
(1) 24 in., T8 lamp	Electronic	17	1	17	16	0.94	(1) 60 in., T12 lamp	Electronic	50	1	50	44	0.88
(2) 24 in., T8 lamp	Electronic	17	2	34	31	0.91	(2) 60 in., T12 lamp	Electronic	50	2	100	88	0.88
(1) 36 in., T12 lamp	Mag-Std	30	1	30	46	1.53	(1) 60 in., T12 HO lamp	Electronic	75	1	75	69	0.92
(2) 36 in., T12 lamp	Mag-Std	30	2	60	81	1.35	(2) 60 in., T12 HO lamp	Electronic	75	2	150	138	0.92
(1) 36 in., T12 ES lamp	Mag-Std	25	1	25	42	1.68	(1) 60 in., T8 lamp	Electronic	40	1	40	36	0.90
(2) 36 in., T12 ES lamp	Mag-Std	25	2	50	73	1.46	(2) 60 in., T8 lamp	Electronic	40	2	80	72	0.90
(1) 36 in., T12 HO lamp	Mag-Std	50	1	50	70	1.40	(3) 60 in., T8 lamp	Electronic	40	3	120	106	0.88
(2) 36 in., T12 HO lamp	Mag-Std	50	2	100	114	1.14	(4) 60 in., T8 lamp	Electronic	40	4	160	124	0.84