

Design Conditions

Location: Anchorage, Alaska

Design Temp: 70° F

Building Size: 300'L x 100'W x 25'H

Garage Door: 8'W x 13'H

Walls: Metal with 1-inch blanket insulation

Windows: None

Doors: Metal- single sheet

Roof: 1" Blanket Insulation under deck

Floor: Non-Insulated

Air Changes: 2 per hour

Design for 99.0% Heating Data



State/Province:
 City:

Elevation (Ft above Sea Level):

Heating Data

	DB(F)	Coldest Month WS (MPH)
99.6%	-11	27
99.0%	-6	23

DB = Dry Bulb
 WB = Wet Bulb
 WS = Wind Speed
 MCDB = Mean Coincident Dry Bulb
 MCWB = Mean Coincident Wet Bulb

Default Settings

Heating Data

- 99.6%
 99.0%

Cooling Data

- 0.4%
 1.0%
 2.0%

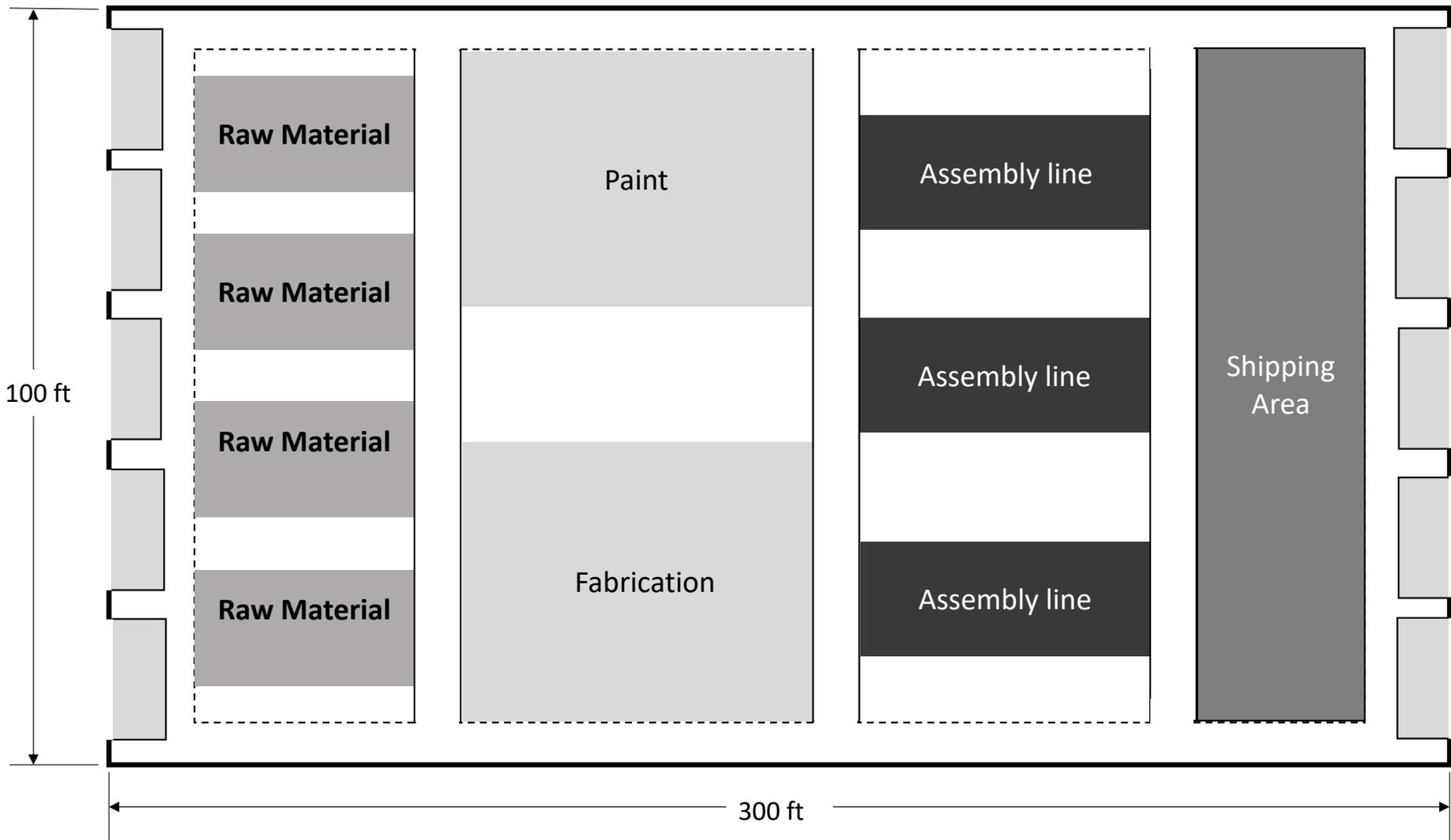
Cooling Data

Use for units up to 30% outside air

	DB(F)	MCWB(F)	Enthalpy BTU/lb	Dew Point DegF	Humidity Pct.
0.4%	71	58	25	50	48
1.0%	68	57	24	49	52
2.0%	65	56	24	49	55

Use for units above 30% outside air

	WB(F)	MCDB(F)	Enthalpy BTU/lb	Dew Point DegF	Humidity Pct.
0.4%	60	68	26	55	63
1.0%	59	66	25	54	67
2.0%	57	63	25	53	70



HEAT LOSS CALCULATION

unit heaters

BUILDING _____ ADDRESS _____

CONSTRUCTION _____ DESIGN TEMPERATURE DIFFERENCE _____

CUSTOMER _____ AIR CHANGES _____

Type Selection

When selecting unit heaters consider the following: 1) type of heating medium available; gas, electricity, fuel oil, steam or hot water; 2) type of unit (Vertical, Horizontal or Power- Throw); 3) mounting height; 4) sound level; and 5) size. For some applications mounting height may narrow possible selection down to one or two models of particular type. However, the wide selection of Modine unit heaters makes it possible to meet most requirements.

Size Selection

Following "type" selection for each space, heater size must be chosen to offset the heat loss of the space . . . taking into account heat-throw or spread (in the case of verticals) and piping arrangement. To select size:

- A. Determine inside temperature to be maintained and design outside temperature for your locality. The difference between these two figures is the design temperature difference.
- B. Calculate net areas in square feet of glass, wall, floor and roof exposed to outside temperature or to unheated spaces. Calculate doors as all glass.
- C. Select heat transfer coefficients from table on next page (or the ASHRAE Handbook) and compute heat transmission loss for each type of area in BTU per hour by multiplying each area by its coefficient times the temperature difference. The overall coefficient of heat transfer is the U-factor. The steady state thermal resistance of something is known as its' R-value. Heat loss calculations use the U-factor, however, the U-factor can be calculated if the R-value is known.
- D. Calculate room volume in cubic feet and multiply by the estimated number of air changes per hour due to infiltration (usually one or two). Determine cubic feet per hour of air exhausted by ventilating fans or industrial processes. Substitute the larger of these two figures in the formula to determine the heat required to raise the air from outside to room temperature.

$$\text{BTU/hr.} = \frac{(\text{Cu. ft. per hour}) (\text{temp. difference})}{55}$$

- E. Totals of BTU losses from C and D will give total heat to be supplied by unit heaters. Note—if processes performed in the room give-off considerable heat, this may be determined as accurately as possible as heat gain and subtracted from the total.
- F. Add 10% to heat loss figures for areas exposed to prevailing winds.
- G. Match total BTU per hour heat loss to output of catalog model number(s) of unit type(s) selected.



steam/hot water horizontal delivery unit heaters

A propeller fan moves room air through a condenser which is heated by steam or hot water. Adjustable louvers positioned horizontally in the air discharge opening permit heated air to be directed down, up, or straight out. Vertical louvers (optional) permit complete directional control of heated air. Steam and hot water unit heaters are also available in vertical air delivery models.



gas-fired propeller or blower fan unit heaters

A propeller or blower fan is the air mover pushing room air through the heat exchanger. Horizontally positioned adjustable air deflectors permit heated air to be directed up, down, or straight out. Vertically positioned deflector blades (optional) may be added for complete directional control of heated air.



oil-fired unit heaters

A motor-driven propeller fan directs room air over the exterior surfaces of the heat exchanger. When the burner is ignited a combination fan and limit control prevents fan operation until the heat exchanger has warmed up and after the burner is shut down; allows the fan to run until the heat exchanger has cooled. Horizontal and optional vertical louvers provide complete directional control of heated air.



electric unit heaters

Vertical delivery unit heaters (illustrated) and horizontal delivery units are available. Finned tube heating elements located in the air stream heat the room air or drawn into the unit by the propeller fans. Horizontal delivery units are equipped with adjustable louver-type air deflectors. Vertical delivery models may be used with or without air deflector devices (optional). Three air deflector assemblies are offered, each with its own distinctive air distribution pattern. Heavy-duty, long heat throw, horizontal delivery models are also available.

Common Heat Transfer Coefficients

Building Material	U = 1/R R = 1/U	"U" Factors
WALLS		
• Poured concrete, 80#/cu. ft.		
8-inch		0.25
12-inch		0.18
• Concrete block, hollow cinder aggregate		
8-inch		0.39
12-inch		0.36
• Gravel aggregate		
8-inch		0.52
12-inch		0.47
• Concrete block, w/4-inch facebrick		
Gravel, 8-inch		0.41
Cinder, 8-inch		0.33
• Metal		
(un-insulated)		1.17
w/1-inch blanket insulation		0.22
w/3-inch blanket insulation		0.08
• Frame		
2 X 4 w/1/2" asphalt sheathing and wood siding, 1/2" gypsum wall board (un-insulated)		0.23
w/3" insulation		0.07
ROOFING		
• Corrugated metal (un-insulated)		1.50
w/1" bolt or blanket		0.23
w/1-1/2" bolt or blanket		0.16
w/3" bolt or blanket		0.08
• Flat metal		
w/3/8" built-up roofing		0.90
w/1" blanket insulation under deck		0.21
w/2" blanket insulation under deck		0.12
• Wood/1"		
(un-insulated) w/3/8" built-up roofing		0.48
w/1" blanket insulation		0.17

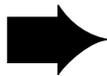
• Wood/2"		
(un-insulated) w/3/8" built-up roofing		0.32
w/1" blanket insulation		0.15
• Concrete slab/2"		
(un-insulated) w/3/8" built-up roofing		0.30
w/1" insulation board		0.16
• Concrete slab/3"		
(un-insulated) w/3/8" built-up roofing		0.23
w/1" insulation board		0.14
• Gypsum slab/2"		
(un-insulated) w/1/2" gypsum board		0.36
w/1" insulation board		0.20
• Gypsum slab/3"		
(un-insulated) w/1/2" gypsum board		0.30
w/1" insulation board		0.18
WINDOWS		
• Vertical, single-glass		1.13
• Vertical, double-glass, 3/16" air space		0.69
• Horizontal, single-glass (sky light)		1.40
DOORS		
• Metal-single sheet		1.20
• Wood, 1"		0.64
• Wood, 2"		0.43

"F" Factors for Floor Heat Loss	"F" Factor
FLOOR	
Design Temps (i.e. Montreal - 16, Milwaukee -6, St. Louis 7, Chattanooga 15)	
-15F to -19F, no insulation	50.00
-15F to -19F, 24" thick, R=3.75 insulation	43.00
-5F to -9F, no insulation	50.00
-5F to -9F, 24" thick, R=3.75 insulation	38.00
6F to 10F, no insulation	50.00
6F to 10F, 18" thick, R=3.75 insulation	31.00
11F to 15F, no insulation	50.00
11F to 15F, 12" thick, R=3.75 insulation	31.00

Final Calculations

NET SQ. FT.	X	DESIGN TEMP. DIFF. °F	X	"U" FACTOR COEFFICIENT	=	HEAT LOSS BTU/HR.
1. WALLS	_____	X	_____	X	_____	= 1. _____ Btu/hr.
2. WINDOWS	_____	X	_____	X	_____	= 2. _____ Btu/hr.
3. DOORS	_____	X	_____	X	_____	= 3. _____ Btu/hr.
4. ROOF	_____	X	_____	X	_____	= 4. _____ Btu/hr.
5. EXPOSED FLOOR PERIMETER	(EXPOSED LENGTH) _____	X	_____	("F" FACTOR)	_____	= 5. _____ Btu/hr.
6. (VOLUME (CU. FT.)	X	(DESIGN TEMP. DIFF.)	X	(AIR CHANGES/HR.)	_____	= 6. _____ Btu/hr.
	X		X		_____	
			55			
7. Add 10% to heat loss figures for areas exposed to prevailing winds.						= 7. _____ Btu/hr.

TOTAL HEAT LOSS Btu/hr. _____



Preliminary Calculations

See Page 1 for Instructions. Refer to Catalog for capacities, heat throw, and mounting heights.

1. **WALLS:** LENGTH X HEIGHT = TOTAL SQ. FT.

NORTH _____ X _____ = _____

SOUTH _____ X _____ = _____

EAST _____ X _____ = _____

WEST _____ X _____ = _____

TOTAL GROSS SQ. FT. = _____

2. **WINDOWS:** NUMBER X HEIGHT X WIDTH = SQ. FT.

NORTH _____ X _____ = _____ = _____

SOUTH _____ X _____ = _____ = _____

EAST _____ X _____ = _____ = _____

WEST _____ X _____ = _____ = _____

TOTAL SQ. FT. = _____

3. **DOORS:** NUMBER X HEIGHT X WIDTH = SQ. FT.

NORTH _____ X _____ = _____ = _____

SOUTH _____ X _____ = _____ = _____

EAST _____ X _____ = _____ = _____

WEST _____ X _____ = _____ = _____

TOTAL SQ. FT. = _____

4. **ROOF:** LENGTH X WIDTH =

_____ X _____ = _____ **TOTAL SQ. FT.**

5. **FLOOR:** NORTH SOUTH EAST WEST TOTAL

EXPOSED EXPOSED EXPOSED EXPOSED EXPOSED EXPOSED

FLOOR LENGTH + LENGTH + LENGTH + LENGTH LENGTH

PERIMETER: _____ + _____ + _____ + _____ = _____

6. **VOLUME:** LENGTH X WIDTH X HEIGHT

_____ X _____ X _____ **VOLUME (CU. FT.)**

TOTAL GROSS WALL AREA = _____ SQ. FT.

(MINUS) NET GLASS AREA = _____ SQ. FT.

(MINUS) NET DOOR AREA = _____ SQ. FT.

NET WALL AREA = _____ SQ. FT.

↓

1. NET WALL _____ SQ. FT.

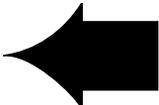
2. WINDOWS _____ SQ. FT.

3. DOORS _____ SQ. FT.

4. ROOF _____ SQ. FT.

5. FLOOR EXPOSED PERIMETER _____ EXPOSED LENGTH (FT.) _____

6. VOLUME _____ CU. FT.



(Now to Final Calculations)

Locating Unit Heaters

1. Use as few unit heaters as possible to give proper heat coverage of the area to be heated. The number of units selected will depend on the heat throw or heat spread of the individual heaters.
2. More than any other single factor, improper mounting height is responsible for most heater installations. When unit heaters are installed at heights higher than those recommended, improper heat distribution is the result and comfort conditions are either difficult or impossible to maintain. And just the opposite, when installed too low, excessive air movement may cause discomfort.
3. Horizontal delivery type unit heaters should be located so that the air streams of the individual units wipe the exposed walls of the building with either parallel or angular flow without blowing directly against the walls. Heaters should be spaced so that each supports the air stream from another heater. This sets up a circulatory air movement around the area to produce a blanket of warm air along the cold walls.
4. It is advisable to locate unit heaters so that their air streams be subjected to a minimum of interference from columns, machinery, partitions, and other obstacles.
5. Unit heaters installed in a building exposed to a prevailing wind should be located so as to direct a large portion of the heated air along the windward walls of the building.
6. Large expanses of glass, or large doors that are frequently opened, should be covered by long-throw unit heaters such as large horizontal delivery unit heaters or door heaters.
7. In buildings having high ceilings, vertical delivery unit heaters equipped with the correct air-distribution devices are recommended to produce comfort in central areas of the space to be heated. Horizontal delivery units are generally used to heat the peripheral areas of the same building.
8. Horizontal delivery type units should be arranged so they do not blow directly at occupants. Their air streams should be directed down aisles, into open spaces on the floor, or along exterior walls of the building.
9. When only vertical delivery units are used, they should be located so that exposed walls are blanketed by their warm air streams.
10. Several unit heaters may be operated by a single thermostat. In large open spaces where similar activities are carried on, zone heating will improve comfort and generally reduce fuel costs. Unit heaters may also be controlled individually, either manually or by a thermostat.

Location Precautions

1. Do not install gas or oil-fired units in potentially explosive or flammable atmospheres laden with grain dust, sawdust, or similar air-borne materials. In such applications a blower type heater is recommended in a separate room with ducting to the dust-laden room.
2. Consult piping, electrical, and venting instructions in unit installation manual before installation.
3. Do not locate ANY gas or oil-fired unit in areas where chlorinated, halogenated or acid vapors are present in the atmosphere.
4. Unit heaters installed in an occupied zone (less than 7 feet above the floor level) must have fingerproof guards for all moving parts (fans, belts, sheaves, etc.). High temperature surfaces, such as flue pipes, must be installed or protected by guards to prevent body contact.
5. Installation of unit heaters in high humidity or salt water atmospheres will cause accelerated corrosion resulting in a reduction of the normal life span of the units.



75-202

Table 7.1 - Propeller Unit Model HD and PDP General Performance Data

	Model HD Sizes						Model PDP Sizes							
	30	45	60	75	100	125	150	175	200	250	300	350	400	
Btu/Hr Input ①	30,000	45,000	60,000	75,000	100,000	125,000	150,000	175,000	200,000	250,000	300,000	350,000	400,000	
Btu/Hr Output ①	24,900	36,900	49,200	62,250	83,000	102,500	124,500	145,250	166,000	207,500	249,000	290,500	332,000	
Entering Airflow (CFM) @ 70°F	505	720	990	1160	1490	1980	2180	2550	2870	3700	4460	4870	5440	
Outlet Velocity (FPM)	523	725	653	769	565	747	931	959	819	1053	1123	1068	1016	
Air Temp. Rise (°F)	44	46	45	48	50	47	51	51	52	50	50	53	54	
Max. Mounting Height (Ft.) ②	10	10	12	14	12	16	16	17	15	19	21	20	19	
Heat Throw (Ft.) @ Max Mtg Ht ②	25	27	36	38	42	56	55	59	51	67	74	70	69	
Motor Type ③	SP	SP	PSC	PSC	PSC	PSC	PSC	PSC	PSC	PSC	PSC	PSC	PSC	
Motor HP	1/15	1/15	1/12	1/12	1/6	1/8	1/8	1/6	1/6	1/3	1/2	3/4	3/4	
Motor RPM	1550	1550	1625	1625	1050	1625	1625	1075	1075	1075	1075	1125	1125	

Table 20.1 - Downtown Hood General Performance Data for HD/PDP/PTP (feet)

		Model HD Sizes				Model PDP Sizes						Model PTP Sizes							
		60	75	100	125	150	175	200	250	300	350	400	150	175	200	250	300	350	400
Max. Mtg. Height (ft.)		9	11	11	12	18	18	18	22	24	24	24	16	16	15	20	22	21	23
30° Hood	X	4	5	5	6	6	9	6	8	8	8	8	6	6	7	7	8	7	11
	Y	11	14	14	16	20	26	18	24	26	24	24	20	17	20	22	25	23	31
	Z	16	21	20	23	29	37	26	35	38	36	35	29	26	29	32	37	34	44
60° Hood	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Y	8	12	12	14	13	23	12	16	19	16	16	17	14	17	18	21	18	26
	Z	12	17	17	19	19	32	17	23	28	24	23	24	21	24	26	30	26	37
90° Hood	S	10	14	13	15	23	25	22	29	32	20	29	17	16	16	20	22	21	24

Figure 20.2 - 30° and 60° Throw/Floor Coverage

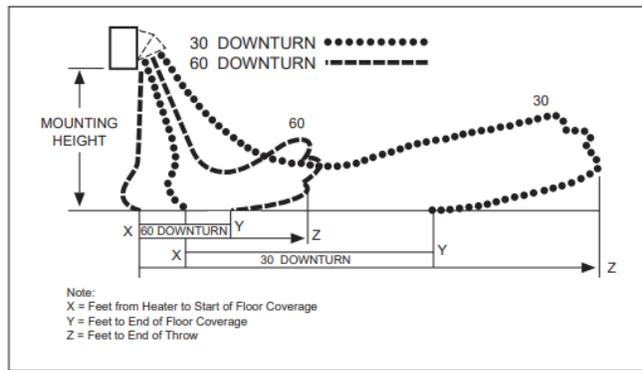
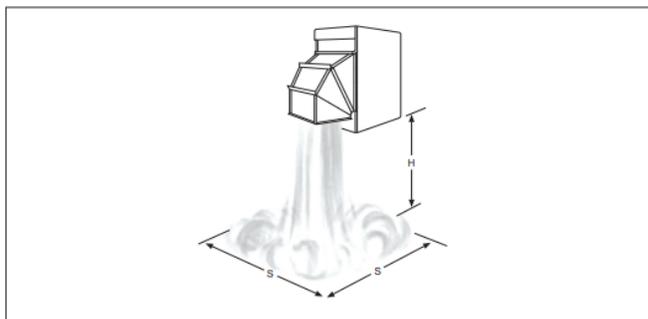


Figure 20.3 - 90° Hood Throw/Floor Coverage



Infrared

Table 7.1 - Performance and Dimensional Data

Model	Gas Controls ③ ④	Input Rating (Btu/hr)		Recommended Mounting Height (ft.) ①		Dimensions (in) ②		Ship Wt. (lbs)	Radiating Area (sq. in.)
				Standard Reflector	Parabolic Reflector	A	B		
		Natural	Propane	30° Angle	30° Angle				
IHR 30	Single Stage or Millivolt	30,000		12 - 14	12 - 15	12 3/4	14 1/4	44	85
IHR 60	Single Stage or Millivolt	60,000		14 - 16	18 - 21	19 1/8	15 1/4	60	170
IHR 90	Single Stage or Millivolt	90,000		16 - 18	21 - 25	26 5/8	15 1/4	81	255
IHR 130	Single Stage or Millivolt	130,000		21 - 24	26 - 32	32	15 1/4	55	340
IHR 160	Single Stage or Millivolt	160,000		24 - 28	29 - 35	38 1/2	15 1/4	65	425

Table 8.1 - Allowable Mounting Angle Range

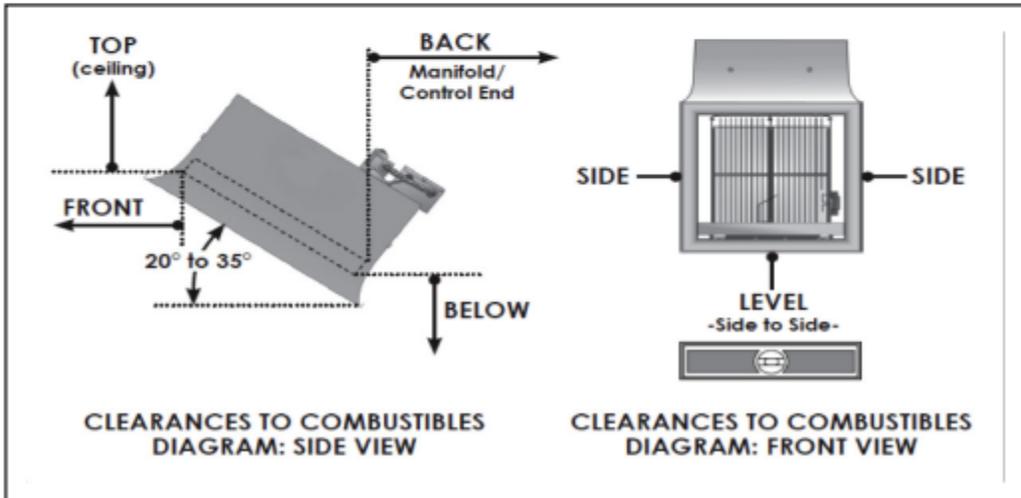
Model Size	Allowable Mounting Angle Range
30 - 160	20° - 35°

Table 8.2 - Clearances to Combustible Materials (See Figure 8.3)

Model Sizes	30	60	90	130	160
Side of Heater	30	32	48	48	50
Back of Heater	18	18	30	30	32
Top of Heater	28	40	42	52	60
Below Front	72	72 ^①	98	120	132

① Clearance is 80 in. when heater is fitted with a parabolic reflector.

Figure 8.3 - Clearances to Combustibles (See Table 8.2)



Infrared Tube Heaters

Table 10.1 - Performance

Input MBH	50	60	75	100	125	150	175	200
Certified Tube Lengths (ft.)	20, 30	20, 30, 40	20, 30, 40	30, 40, 50 ②	40, 50, 60	50, 60	50, 60, 70 ③	50, 60, 70 ③
Recommended Mounting Height (ft.) ①	10 - 12	10 - 12	12 - 14	12 - 14	15 - 22	15 - 22	18 - 28	20 - 30
Recommended Tube System Application ①	Spot or Area Heating	U-Tube						
	Total Building Heating	Straight Tube						

① Recommended Mounting Height and Tube System Applications are meant as a general guide and are adjusted to meet the requirements of the actual application. The applications are as follows:

- Spot or Area Heating is an application where occupant comfort is the goal and occupant(s) are either relatively stationary (Spot - Example: small work cell or dispersed over a slightly wider range than with Spot Heating (Area - Example: assembly line). Mounting height is typically at the low end of the range shown above.
- Total Building Heating is an application where average space temperature is to be maintained, however due to the significant temperature gradient differences on long straight tube systems, areas may exist where direct occupant comfort is not achieved.

② IPT 100 not available for Propane Gas operation at 50 ft. tube system length.

③ IPT 75 not available for Propane Gas operation at 40 ft. tube section length.

Table 10.3 - Combustible Material Clearances ① ② ③

IPT			
Combustible Material Clearances (inches)			
Input MBH	"A" ①	"B" ②	"C" ③
50/60	9	54	20
75/100/125	9	76	24
150/175/200	12	106	38

① Clearance to each end and above the U-Tube is 12 inches.

② In unvented applications, clearance from radiant tube end is 36" in all directions.

③ Refer to Figures 8.1 through 8.3.

Figure 10.2 - Stacking Height

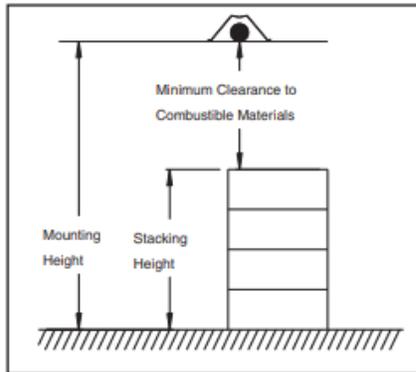


Figure 10.1 - Combustible Material Clearances - Straight Tube

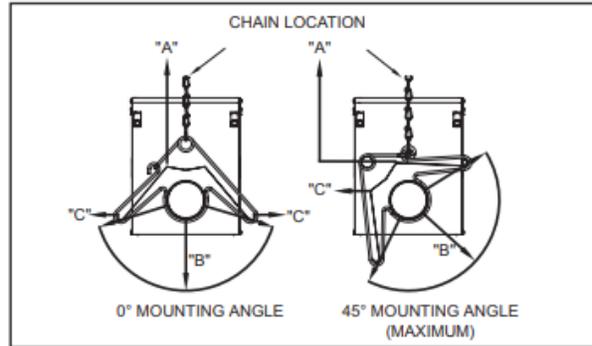


Figure 8.3 - Combustible Material Clearances - U-Tube

