

TECH TIP # 49



One of a series of dealer contractor technical advisories prepared by HARDI wholesalers as a customer service.

Working With the New Hydronic Heat Loss Short Form

The HARDI course Modern Hydronic Heating explains two methods of estimating heat loss — the Detailed and Modern methods developed by the Hydronics Institute (HI). HI has recently introduced a third simplified form for estimating heat loss for bidding and other need-to-know-fast situations.

The forms are available from HI applicable to specific states for convenient city-by-city design temperature information. A sample of the form for the state of Ohio is attached.

For example: the “U” value for an insulated frame wall is about .08 -- assuming 3.5 inches of insulation. Multiplied by 70 would yield a factor of 5.6. Then this combined factor is simply multiplied by the appropriate surface area in question to arrive at the heat loss rate in Btu/hr at 70° temperature difference. Corrections for other temperature differences are provided.

The form is particularly useful in determining the total house load (block load) or separate forms can be used for individual room estimates.

Using the example house from Unit 2 exam in HARDI’s course, a block load has been estimated following the short form. (See attached worksheet.)

In this instance, the total window and door area was separated into two components -- area for single glass and area for double glazed windows and exterior doors with storm doors. This was considered an important refinement since the heat loss factor for single glass is nearly twice the value for double glass or storm sash. Obviously, in many instances this split is not necessary since windows are usually all one way or the other in a particular house.

Using the detailed method (for the first floor rooms only) the estimated load is 33,360 Btu/hr. Using the new short form, the estimated load is 35,612. If we had made the split for the single and double glass, an additional 2,311 Btu/hr would have been included in the estimate — bringing the total to 37,923 Btu/hr (vs. 33,360 for the detailed method).

When using any type of short form, additional judgment may be required to maintain reliability and to preserve a reasonable level of accuracy. For actual system design, the detailed or modern procedures should be followed.

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ESTIMATE OF RESIDENTIAL HEAT LOSS

Job Name _____	Date _____
	Room _____
Address _____	Inside Temperature (IDT) _____
	Outside Temperature (ODT) _____
	Temperature Difference _____
Estimator _____	

Instructions for use of the Residential Btu Estimate form

To determine the amount of heat required to provide comfort in a room or a house, it is necessary to calculate the amount of heat being lost (in Btu's per hour) when winter conditions outdoors are at the outside design temperature, which is the normal coldest temperature for that area.

Heat is transmitted through all surfaces that will be warm on the inside and cold on the outside. This includes walls, ceilings, floors, windows and doors. If a room on the other side of a wall or ceiling is to have normal heating, then that wall is not considered "cold."

In addition to the outward transmission losses, the infiltration of cold air must be added. Transmission + infiltration equal the total heat loss, which must be replaced by the heating equipment.

This form is suitable for either an individual room or for an entire house. If several rooms are to be calculated, use an individual sheet for each room.

DESIGN TEMPERATURE

The amount of heat lost is directly related to the temperature difference (TD) between the desired indoor design temperature (IDT) and the outside design temperature (ODT). It is usually desirable to maintain 70° F inside the room when the outside temperature is at its normal low point. The ODT for each major city is determined by long-range weather readings, and is fixed by the engineering profession. Subtracting ODT from the usual 70° gives the temperature difference for that locality. (Do not calculate TD when using this form, UNLESS the desired inside design temperature is other than 70° F.

The heat loss factors listed opposite the calculation sheet are based on 70° F IDT and 0° F ODT. In localities where the ODT is not 0° F, the temperature difference will be either greater or smaller than 70° F, and so will the calculated heat loss. Conversion numbers for other ODT's are shown at the bottom of page 3.

Following are the Outside Design Temperatures (ODT) for cities in the state of Ohio.

(Temperatures can be rounded off to the next lower 5 or 10.)

Akron	6°	Dayton	4°	Middleton	5°
Ashtabula	9°	Defiance	4°	Norwalk	1°
Bowling Green	2°	Findley	3°	Portsmouth	10°
Cambridge	7°	Fremont	1°	Sandusky	6°
Chillicothe	6°	Hamilton	5°	Springfield	3°
Cincinnati	6°	Lima	4°	Toledo	1°
Cleveland	5°	Mansfield	5°	Youngstown	4°
Columbus	5°				

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APPROXIMATE ESTIMATE OF Btu's per hour RESIDENTIAL HEAT LOSS*

For locations with zero degrees (0°F) ODT

(For other ODT's, use conversion numbers from bottom of opposite page.)**

Step 1: To determine transmission losses, measure all surfaces which will be warm and cold outside.

Step 2: To determine infiltration, calculate total volume of heated space.

Step 3: Select factors for each category of heat loss --- A,B,C,D,E.

Step 4: Multiply each total below by the appropriate factor, and add all totals for the TOTAL Btu/hr.

GROSS COLD WALL (Including windows and doors)				WINDOWS and OUTSIDE DOORS								
	Height	x	Length	=	Sq. Feet	Height	x	Width	x	Quan.	=	Sq. Ft.
Front												
L. Side												
R. Side												
Rear												
Gross Wall: _____					Total: _____ (A)							
→					(Gross Wall: _____)							
(COLD CEILING (attic or roof above))					(Subtract (A) _____ Windows & Doors)							
Length x Width = Square Feet					NET WALL: _____ (B)							
Total Cold Ceiling: _____ (C)					(COLD FLOOR (over cold bsmt. or crawl space))							
Length x Width = Square Feet					Length x Width = Square Feet							
Total Volume: _____ (E)					Total Cold Floor: _____ (D)							
Length x Width x Height = Cubic Feet					OR — Floor on concrete slab (cold edge only)							
Total Volume: _____ (E)					Length + Width + Length + Width = Lin. Feet							
Total Volume: _____ (E)					Linear Ft. Total Cold Floor: _____ (D)							

* For accurate calculations use the I=B=R method.

CALCULATIONS (Select factors from opposite page.)

MULTIPLY x **FACTOR** = **Btu per hour**

- A). Windows & Doors: _____ Sq. Ft. x _____ = _____
- B). Net Wall: _____ Sq. Ft. x _____ = _____
- C). Cold Ceiling: _____ Sq. Ft. x _____ = _____
- D). Cold Floor: _____ Sq. Ft. x _____ = _____
- and/or Cold Floor: _____ Lin. Ft. x _____ = _____
- E). Infiltration: _____ Cub. Ft. x _____ = _____

Btu per hour heat loss at 0° F outside design temperature Total _____ Btu/hr.

** Conversion number for other outside design temperature: x _____

Adjusted Btu/Hr. _____

APPROXIMATE ESTIMATE OF Btu's per hour RESIDENTIAL HEAT LOSS*

For locations with Zero degrees (0°) ODT

(For other ODT's, use Conversion Numbers from bottom of opposite page.)**

Step 1: To determine transmission losses, measure all surfaces which will be warm inside and cold outside.

Step 3: Select factors for each category of heat loss — A,B,C,D,E.

Step 2: To determine infiltration, calculate total volume of heated space.

Step 4: Multiply each total below by the appropriate factor, and add all totals for the TOTAL Btu./Hr.

GROSS COLD WALL (Including windows and doors)			
	Height	x Length	= Sq. Feet
Front	8	(38+4)	336
L. Side	8	11.5	92
R. Side	8	29.	232
Rear	8	35.5	284
Gross Wall:			944

WINDOWS and OUTSIDE DOORS			
	Height	x Width	x Quan. = Sq. Ft.
A	4.17	3.67	2 = 30
B	6.	4.17	1 = 25
C	3.83	2.5	11 = 110
E	2.83	2.5	2 = 14
F	2.83	3.17	2 = 18
Door	7.	3.	2 Total: = 42
(Gross Wall: 944)			→ 239 (A)
(Subtract (A) 239 Windows & Doors)			
NET WALL:			705 (B)

COLD CEILING (attic or roof above)			
Length	x	Width	= Square Feet
38		29	1102
4		19	minus 76
2.5		11.5	minus 29
Total Cold Ceiling:			997 (C)

INFILTRATION (volume)			
Length	x	Width	x Height = Cubic Feet
		997	x 8 = 7976
Total Volume:			7976 (E)

COLD FLOOR (over cold bsmt. or crawl space)			
Length	x	Width	= Square Feet
Total Cold Floor:			0 (D)

OR — Floor on concrete slab (cold edge only)			
Length	+ Width	+ Length	+ Width = Lin. Feet
Linear Ft. Total Cold Floor:			0 (D)

CALCULATIONS

(Select Factors from opposite page.)

	MULTIPLY	x	FACTOR	=	Btu per hour
(A) Window & Doors:	239	$\frac{172}{67}$	80	=	13,760
(B) Net Wall:	705		45.5	=	3,049
(C) Cold Ceiling:	997		5.6	=	3,948
(D) Cold Floor:	—		4.9	=	4,885
(D) Cold Floor:	—		0	=	
and/or (D) Cold Floor:	—		0	=	
(E) Infiltration:	7976		1.25	=	9,970

Btu per hour heat loss at 0° Outside Design Temperature **TOTAL** 35,612 Btu./Hr.

**Conversion Number for other Outside Design Temperature: x _____
Adjusted Btu./Hr: _____

* For accurate calculations use the I=B=R Method.

Approximate Heat Loss FACTORS For Residential Construction*
Factors per Square Foot for 70° Temperature Difference

(A) Glass & Outside Doors

Single	—	80.0
Double Glass	—	45.5
Storm Windows	—	39.2

(B) Walls, Not Insulated

Wood Frame	—	17.5
Brick	—	22.0

OR

(B) Walls, Insulated

2" batts (R-7)	—	7.0
3½" batts (R-11)	—	5.6
6" batts (R-19)	—	4.2

(C) Cold Ceiling

Uninsulated	—	21.0
2" batts (R-7)	—	7.7
3½" batts (R-11)	—	4.9
6" batts (R-19)	—	3.5
8" batts (R-28)	—	2.1
12" batts (R-40)	—	1.4

(D) Floor Over Unheated Basement

Uninsulated	—	10.5
2" batts	—	3.5
3½" batts	—	2.8

OR Floor Over Cold Vented Crawl Space

Uninsulated	—	25.0
2" batts	—	6.2
3½" batts	—	4.2

OR Slab floor on grade (x Lin. Ft. Perimeter)

No Edge Insulation	—	60.0
1" Edge Insulation	—	48.3
2" Edge Insulation	—	37.1

Heated (finished) Basement Room Factors

Floor (square feet)	—	2.8
Foundation Wall, uninsulated		
Above Grade	—	37.0
Below Grade	—	4.2
Foundation Wall, 2" insulation		
Above Grade	—	9.0
Below Grade	—	3.0

(E) AIR INFILTRATION FACTORS x cubic feet (For individual room or total house)

<u>Fully Detached House</u>	<u>Assumed Air Changes</u>	<u>FACTOR</u>	<u>Attached House</u>
Very Tight House, heavy insulation	¾ per hr.	1.00	Front & back exposed; Insul.
Standard Modern House, some insul.	1 per hr.	1.25	Front & back & 1 side exp.; Insul.
Older House, good condition	1½ per hr.	1.90	Front & back & 1 side exp., No. Insul.
Loose Construction, air leaks	2 per hr.	2.50	

For other types of construction, see additional factors in I=B=R Guide H-21.

**For other Outside Design Temperature, MULTIPLY Total Btu/Hr. by Conversion Number.

Outside Temperature	-20°	-15°	-10°	-5°	0°	+5°	+10°	+15°	+20°
Conversion Number	1.29	1.21	1.14	1.07	1.00	.93	.86	.79	.71

To get the Conversion Number for Outdoor Design Temperatures not listed above, calculate the Temperature Difference (IDT minus ODT) and divide by 70.

Examples: 70 IDT -(+30) = 40 ÷ 70 = .57 70 IDT -(-30) = 100 ÷ 70 = 1.43

HEATING TIPS

Boiler Selection: If installing a water boiler, its Net I=B=R Rating (in Btu's per hour) should be equal to, or slightly more than the calculated Btu/hr heat loss. If the house will be used intermittently during winter, add 20% to the heat loss total for quick pick-up.

If a companion water heater is to be connected to the boiler for domestic hot water, there is sufficient output between the net rating and the gross heating capacity to satisfy normal needs. However, if heavy use of hot water is expected, 10,000 Btu/hr can be added to the calculated heat loss.

If a replacement boiler is being installed for a steam system, the system must be sized to match the capacity of the existing radiation. (See I=B=R Guide #200, pp. 16-19.)

Radiation Replacement: If modernizing an existing radiation system, certain cautions must be observed. Cast-iron radiation and copper-tube radiation have different response times, so they should not be mixed on the same circuit. Where both types exist in the house, they should be kept on separate zones.

When adding radiation on a circuit or zone where existing radiation is excessively oversized, the new radiation should also be approximately oversized, to maintain a reasonable balance of heating output.

Garages: if the garage will be unheated, walls of adjoining rooms and the floor above the garage should be considered "cold". By installing finned radiation about 50% of normal requirements, the adjoining room, the room above, and the cars in the garage will all benefit.

Bathrooms: For bathrooms with tub or shower, add 20% to the calculated heat loss.

Notes & Sketches