This Guidance Document is not new law but is an agency interpretation of existing law. For more information or to provide input on the document, please contact the Water Rights Section Manager at 208-287-4800. (Feb.2020)

ADMINISTRATOR'S MEMORANDUM

TO: Regional Offices and Water Allocation Section

FROM: Norman C. Young *NCY*

DATE: September 28, 1992 (Replaces version dated May 9, 1984)

RE: Rate of Flow for Heating Use

Application Processing No. 23 (Amended)

The attached guidelines entitled "Method for Estimating Residential Space Heating Load", and "Method for Estimating Rates of Flow for Geothermal Heating Systems" are intended to assist with computation of reasonable rates of flow of geothermal water for heating purposes. The methods are designed to provide straightforward initial estimates for evaluation of applications for permit and are not to be used for final engineering design.

METHOD FOR ESTIMATING RATES OF FLOW FOR GEOTHERMAL HEATING SYSTEMS

The flow needed from a geothermal heat source depends on the maximum anticipated heat load (design heat load) and the temperature drop across the system (ΔT_s).

Design Heat Load

The design heat load must first be estimated. This can be done several ways. Some examples are:

1) Take name plate ratings from equipment
2) Take meter readings from existing processes.
3) Estimate by heat transfer and/or thermodynamic calculations.

If space heating is required, see attached method for estimation.

Temperature Drop Across System

To determine this, some information about the temperature requirements of the system is required. For instance, for residential space heating a temperature of 70°F is commonly assumed, for drying purposes a temperature of 120°-160° is adequate and to make steam at atmospheric pressure a temperature higher than 212°F is required. Once the system temperature requirement is established, the system temperature drop can be estimated from the formula -

$$\Delta T_s = (0.3)(S-t) \quad \text{where}$$

ΔT_s = Temperature drop across system °F

S = Geothermal source temperature °F

t = Temperature required by system °F

Note that the source temperature must always be higher than the system temperature unless a heat pump is to be used. If a heat pump is used, the temperature required at the evaporator becomes the system temperature.

Flow Rate Required

Once the heat load and temperature drop are estimated, the flow rate can be estimated from the equation -

$$W = \frac{Q}{(500)\ (\Delta T_s)} \quad \text{where}$$

W = Flow rate in gallons per minute

Q = System heat load in BTU/Hr

ΔT_s = Temperature drop across system °F

These calculations should not be used to design a geothermal heating system, but will give an indication of the approximate flow needed from a geothermal resource when applying for a water right from this Department. An engineer who is knowledgeable about the design of heating systems should be consulted for the actual design.

Example

The following is an example to estimate the flow required to heat a house with a design heat load of 50,000 BTU/hr from a geothermal well with 200°F water.

The heat load is given - 50,000 BTU/hr.

Since the heat load is space heating for comfort, the system temperature is assumed to be 70°F.

The temperature drop across the system is determined from the equation -

$$\Delta T_s = (0.3)(S\text{-}t)$$

for this case:

$$\Delta T_s = (0.3)(200° - 70°)$$

$$\Delta T_s = 39°F$$

The flow rate is determined from

$$W = \frac{Q}{(500)(\Delta T_s)}$$

for this case:

$$W = \frac{50{,}000\ \text{BTU/Hr}}{500\ (39°F)}$$

$$W = \underline{2.56\ \text{GPM}}$$

Therefore, 3 GPM would be a reasonable estimate.

METHOD FOR ESTIMATING
RESIDENTIAL SPACE HEATING LOAD

The following is a method to estimate a residential design heat load for sizing heating systems for typical residential buildings.

Design Heat Load

This varies for Idaho from a low of 25 BTU/hr-sq.ft. for a well insulated home in Boise to a high of 75 BTU/hr-sq.ft. for an average insulated home in Soda Springs. These values are appropriate for a single story house. If the house is two stories, then multiply the BTU/hr-sq.ft. ($e \cdot \Delta T$) value by 0.8.

A more precise determination of the BTU's required for a given house can be determined from the formula:

$E = [e \cdot \Delta T]\ A$ where

E = BTU/hr required

e = House efficiency factor BTU/hr-sq.ft.-°F

ΔT = Design temperature difference ($t_i - t_o$) in degrees Fahrenheit for residence

A = Area of livable floor space in the house in sq. ft.

For a two story house the formula becomes $E = [e \cdot \Delta T]\ 0.8 \times A$.

And,

t_i = the inside design temperatures (approximately 70°F)

t_o = the outside design temperature

Suggested Outside Design Temperatures *

Boise	4°F
Lewiston	6°F
Pocatello	-8°F

----

* From (American Society of Heating, Refrigeration & Air Conditioning Engineers), Handbook of Fundamentals, 1972.

Values for (e) are as follows:

.28 = Best energy efficiency -

Insulation in addition to that found in the average house, walls are now R19 (5 inches of blanket insulation in a 6 inch wall space), ceilings are R33 (approximately 9 inches of blanket insulation), all windows and doors are caulked and weather stripped.

.44 = Better energy efficiency -

All windows and doors caulked and weather stripped, no additional insulation above the average residence.

.67 = Average residence -

Modern home with no weatherproofing and the following insulation: walls R13 (3-1/2 inches of blanket insulation), ceiling R25 (6 inches of blanket insulation), double pane windows, or single pane with storm windows, concrete floor or concrete block basement wall.

1.11 = Poor energy efficiency -

Older home with the following insulation: walls are approximately R6 (typical frame construction with no insulation between the stud), ceiling R10 (3 inches of loose fill insulation), single pane windows with no storm windows and no weather stripping of the doors and windows.

Table 1 shows some typical BTU's/sq.ft.-hr for the four types of house efficiencies at a variety of design temperatures.

TABLE 1

$e \cdot \Delta T$ = BTU's/sq.ft.-hr for Different House Efficiencies

House Efficiency	Best $e = .28$	Better $e = .44$	Average $e = .67$	Poor $e = 1.11$
Design Temperature Difference $T = (t_i - t_o)$				
50°	14	22	33	56
60°	17	26	40	67
70°	20	31	47	78
80°	22	35	54	89
90°	25	40	60	100
100°	28	44	67	111

Example:

The following is an example problem to determine the design heat load for a hypothetical house. The house is a single story house with 1,250 ft.^{2} of floor with average insulation located in Boise.

The design heat load is estimated from the equation:

$$E = [e \cdot \Delta T]\ A$$

Where for this case:

e = .67 BTU/hr-ft.^{2}-°F (average insulation)

ΔT = (70-4)°F (assume a 4°F design temperature for Boise)

A = 1,250 ft.^{2}

Putting these numbers in the equation gives:

$$E = [.67 \times (66)]1250 = 55{,}275 \text{ BTU/hr}$$