



Energy
Efficiency
Program

Emerging Technology Program

#1139: Pipe Insulation Online Calculator

Final Public Memo Report

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The results within this report relate only to the items tested.

Background

As a part of the Nicor Gas Energy Efficiency Program, the Emerging Technology Program (ETP) assesses new technologies that have the potential to realize natural gas savings for the 2.3 million

Nicor Gas customers in northern Illinois. Gas Technology Institute (GTI) provides program implementation for the Nicor Gas ETP. The team has created a comprehensive Pipe Insulation Web-based Energy Savings Calculator, which is publicly available on the Nicor Gas website at nicorgas.com/emerging. This report summarizes the need for this web-based calculator and other findings regarding the pipe insulation measure in the Illinois Technical Resource Manual (TRM).

Description

The genesis of this project was an investigation of the existing commercial pipe insulation measure (measure ID # 4.4.14) in the Illinois TRM. This initial study aimed to determine if the length of elbows, tees, flanges, and valves accurately accounted for the deemed energy savings. While these equivalent lengths were being calculated per appropriate ANSI/ASME/ASTM standards, there were other significant limitations in how the savings are calculated and tiered. The existing measure for pipe insulation offers deemed rebates based on a limited set of energy savings calculations. The natural gas therm savings are restricted to a 2-inch nominal pipe diameter with either a 1- or 2-inch thick insulation, among other preset values for pipe material, boiler efficiency, and fluid temperatures. The lack of variability for these parameters in these calculations dramatically limits the accuracy and applicability of the deemed savings when real-world install conditions are simulated. A sample of the difference in savings is shown below in the “% change” column, where a positive value means the savings were missed based on existing calculation methodology.

Table 1 – Sample of Algorithm Inputs for Pipe Insulation Measure of Existing Illinois TRM

Pipe Material	Location	Application	Building Type	Climate Zone	Pipe Size (inches)	Insulation thickness (in.)	Calculator Savings (therms/ft/yr)	TRM Savings (therms/ft/yr)	% Change
Steel	Indoor	5 psi Steam - Non recirculation	Grocery	Zone 1	2	2	4.21	3.83	10%
Steel	Indoor	5 psi Steam - Recirculation year round	Grocery	Zone 1	2	2	22.95	20.84	10%
Steel	Indoor	150 psi Steam - Non recirculation	Grocery	Zone 1	2	2	10.74	7.22	49%
Steel	Indoor	65 psi Steam - Non recirculation	Grocery	Zone 1	2	2	7.97	7.22	10%
Copper	Indoor	Hot Water space heating with outdoor reset - Non recirculation	High School	Zone 1	2	1	1.43	1.37	4%
Copper	Indoor	Hot Water space heating without outdoor reset - Recirculation heating season only	High School	Zone 1	2	1	5.79	5.51	5%
Copper	Indoor	Domestic Hot Water	High School	Zone 1	2	1	5.29	5.02	5%
Copper	Indoor	Hot Water space heating with outdoor reset - Recirculation heating season only	Hospital - VAV econ	Zone 1	2	1	3.90	3.73	5%
Copper	Indoor	Hot Water space heating without outdoor reset - Recirculation year round	Hospital - VAV econ	Zone 1	2	1	10.07	9.58	5%
Stainless Steel	Indoor	15 psi Steam - Non recirculation	Hospital - VAV econ	Zone 1	2	2	1.52	1.74	-13%
Stainless Steel	Indoor	40 psi Steam - Non recirculation	Hospital - VAV econ	Zone 1	2	2	1.97	1.74	13%
Stainless Steel	Indoor	100 psi Steam - Non recirculation	Hospital - VAV econ	Zone 1	2	2	2.64	3.28	-19%
Stainless Steel	Indoor	150 psi Steam - Non recirculation	Hospital - VAV econ	Zone 1	2	2	3.03	3.28	-8%
Steel	Indoor	5 psi Steam - Non recirculation	Hospital - VAV econ	Zone 1	2	2	1.92	1.74	10%
Steel	Indoor	40 psi Steam - Non recirculation	Hospital - VAV econ	Zone 1	2	2	3.09	1.74	77%
Steel	Indoor	150 psi Steam - Non recirculation	Hospital - VAV econ	Zone 1	2	2	4.88	3.28	49%

The web-based calculator considers over two million permutations between pipe sizes, pipe materials, boiler efficiencies, fluid temperatures, pipe thickness, insulation thickness, climate zones, and install locations. The heat loss calculations and corresponding energy savings were adopted from the latest version of 3E Plus v4.1, which is a heat loss calculation software provided by the North American Insulation Manufacturer Association (NAIMA). Due to the large number data points and the variability in different combinations, an online web-based calculator was developed to compute savings.

The calculator accurately captures savings for real-world scenarios. The following variations in parameters are currently considered in the web-based calculator:

- Pipe Material: Copper, Steel, Stainless Steel
- Pipe Location: Indoor (Heated, Semi-Heated, Unheated, Unspecified) or Outdoor

- Application: Hot Water Space Heating with/without an outdoor reset, Steam systems
- Thermal Regain Factor (based on pipe location) and Service Hot Water
- Building Type—37 different types
- Nominal Pipe Size (inches): 1, 1.25, 1.5, 2, 2.5, 3, 3.5, or 4
- Insulation Thickness (inches): ½, 1, 1.5, 2, 2.5, 3, 3.5, or 4
- Service Hot Water/ Heating Hot Water/Steam Boiler Efficiency (%): 75, 77.5, 80, 82.5, 85, 87.5, or 90
- Climate Zone: Rockford, Chicago, Springfield, Belleville, Marion
- Length of Installed Pipe (feet)
- Number of Elbows, Tees, Flanges, and/or Valves

The new web-based calculator is incorporated in the Illinois Statewide Technical Reference Manual Version 9.0. The calculator is updated in September 2021 to accommodate changes to the pipe insulation measure methodology in the Illinois Statewide Technical Reference Manual Version 10.0.

Web calculator URL: nicorgas.com/emerging