Ashrae 90.1 pdf pipe insulation requirements

American Society of Heating, Cooling and Air Conditioning Engineers (ASHRAE) Standard 90.1: The Energy Standard for Buildings, excluding Low-Rise Residential Buildings and the International Energy Saving Code (IECC) are the main energy design standards for new buildings in the United States. Most states or local jurisdictions have adopted some versions of either Standard 90.1 or IECC as the minimum design standard for all new commercial and high-rise residential buildings. The template was for ASHRAE to update the standard 90.1 every few years and more recently to update it every three years. Its revision is therefore of particular interest to those working with energy efficiency technologies, including mechanical insulation. Many of the products and services of NIA member companies are used in insulation pipes and ducts in commercial and high-rise residential buildings. The energy efficiency of these buildings depends in part on limiting the flow of heat into or out of pipes, canals and equipment, whether they are above or below ambient temperature. When used to serve below the environment, insulation systems help prevent moisture condensation on these pipes and ducts, further saving energy. The last published version of Standard 90.1 was adopted in 2007, after versions of 2004 and 2001. The newest version, 2010, will take effect later this year, probably by the end of October 2010. Overall, Standard 90.1-2010 will result in buildings designed to use 30 percent less energy than those designed under the 90.1-2007 standard. How does this revised energy standard require building designers and mechanical system designers to reduce a building's energy consumption by 30 percent? There are many ways to achieve this, including: increasing the R-cost system (or reducing U-cost) of isolated exterior walls and roofs; Limiting solar heat to get through windows, while designing them to allow more visible light in buildings for passive daylight; Improving the thermal efficiency of heating and cooling systems; Expanding the use of automatic lighting control; Expanding the use of air barriers to limit infiltration; Targeting buildings for minimal energy consumption Expanding the use of energy-saving and energy-efficient to build ventilation; Tightening ducts to reduce leakage; Improving the efficiency of the electric motor; Improving the efficiency of the fan and pump; and increasing the thickness of insulation of pipes and ducts. There are building design technologies that use 30 percent less energy. In most cases, however, greater coordination between the architect and the architect is required and the designer of the mechanical system than it usually does. The old approach was for the architect to design the building without any input from mechanical designers and then pass the drawings of the building to a mechanical designer (or multiple designers, designers, work will usually be a competitive bet) to develop a mechanical system within both a tight energy budget and a tight spending budget. The new approach requires the architect to understand how his or her decisions affect the mechanical design of the system and involve a mechanical designer every step of the way to produce a truly energy efficient building. There is usually no room in this new process for engineering costs, leading to the inability of many buildings to meet basic criteria such as energy efficiency standards, maintenance budgets, and durability goals. New thickness of pipe insulation What are the new requirements for the thickness of the pipe and duct in the standard 90.1-2010? The thickness of the insulation of the pipes is greater or equal to those in the 2007 standard, but the thickness of the insulation of the ducts has not changed. Overall, this is good news, giving mechanical insulation the ability to contribute to improving the energy efficiency of the building. Standard 90.1-2010 contains two tables of minimum thickness of pipe insulation: one for systems over the environment and one for systems below the environment. In each table, the minimum insulation thicknesses refer to both the size of the pipe and the operating temperature. The minimum thickness of pipe insulation is given in two tables, 6.8.3A and 6.8.3B, in standard; values are on drawings 1 and 2, complete with footnotes. In the new standard, these tables are also reproduced in metric units. For the above ambient service, the thickness of the pipe insulation in Figure 1 is significantly larger than those normally installed (as they were in previous versions of Standard 90.1, but more so in the 2010 version). For many steam pipes distributing heat in buildings with an operating temperature of more than 350 degrees Fahrenheit, 5 inches of insulation (e.g. mineral wool, fiberglass, or calcium silicate) will be needed on all pipes except those with a size less than 1 inch. Nps. This will probably require double layering and therefore more manpower to install. Mechanical designers will need to allow clearance pipes larger than 10 inches, which is often neglected. Even hot water pipes used for hydronal heating will require 2 inches of insulation on all tube sizes equal to or more than 1-1/2 inches. Nps. For serving below the environment, on the contrary, the thickness of the new pipe insulation is not particularly remarkable. For example, 1 inch is thick enough for all sizes on chilled water lines (with a estimated operating temperature ranging from 40 to 60 degrees Fahrenheit). This is because these thicknesses have been identified for energy conservation rather than for condensation control, which often requires thickness greater than 1 inch, especially on pipes that pass through substandard spaces. It is also worth noting the equation for materials with thermal conductivity values outside the stated range. For example, cell glass has conductivity, with an average of 55 degrees Fahrenheit, is about 0.32 Btu-in./hr-ft2-F, which is larger than this range. If the material is a fiberglass comparison, with thermal conduction value of about 0.23 Btu-in./hr-ft22-F at 55 F average, and 1 in fiberglass required on the table for 4 inches. NPS pipes, and then using the equation given in the footnote for both tables, we would need about 1-1/2 inches of thick cell glass for the same cooled water pipe. However, since 1-1/2 inches thick the cell glass is likely to be used by 4 inches. NPS chilled water pipe anyway, this is not a serious problem. It's hard to imagine 5-in-thick removable/reusable insulation blankets mounted on valves, pressure regulators, a strainer, and other hard-to-isolate fittings. The main problem for the mechanical insulation industry is that these components often remain either unsalted or partially insulated in steam and hot heat distribution systems. Removable/reusable blankets 1 to 2 thick are often removed by service personnel and not reinstalled. Removable/reusable blankets 5 inches thick will be even less likely to be reinstalled as they are likely to be heavy and not very flexible. The solution may be for the designer to show that the overall heat loss of the system is equivalent to 5 inches of insulation in general and use thinner, more practical thicknesses for removable/reusable blankets. Summary When ASHRAE Standard 90.1-2010 takes effect later this year, compliance will require greater thickness of pipe insulation. On steam distribution pipes in buildings, these thicknesses will increase from 4 inches to 5 inches on most tube sizes when using materials such as mineral wool, fiberglass, and calcium silicate. Lower temperature, higher-ambient pipes will also require a greater thickness than those required in the previous standard 90.1-2007. On the lower ambient tube, the minimum insulation thickness will be only 1 inch for most insulating materials. The new buildings, designed and built in accordance with the 90.1-2010 standard, will be designed to use 30 percent less energy than under the 90.1-2007 standard. These new minimum design requirements, if followed, will result in significant energy savings in new buildings. States, however, will need time to adopt this revised standard. Figure 1 Figure 2 Buildings account for approximately 40 percent of energy consumption and 40 percent of carbon dioxide emissions in the United States.1 As a result, energy consumption in buildings (both residential and commercial) receives considerable attention from federal, state and local governments. American Society of Heating Engineers, and Air Conditioning (ASHRAE) Standard 90.1 Energy Standard for buildings, with the exception of low-rise residential buildings, provides minimum requirements for energy efficient design design commercial and high-rise residential buildings. Isolation specialists interested in building energy efficiency should be familiar with ASHRAE 90.1. What is ASHRAE 90.1? ASHRAE 90.12 is a consensus standard that provides minimum requirements for the design of energy efficient buildings. The scope of the standard includes new buildings and their systems, new parts of buildings and their systems, as well as new systems and equipment in existing buildings. The scope of the standard specifically excludes single-family houses, apartment buildings of three floors or less, manufactured houses, buildings that use no electricity, no fossil fuels, and equipment or parts of construction systems that use energy mainly for industrial, industrial or commercial processes. The standard was developed and maintained by a committee within ASHRAE, a technical organization of approximately 51,000 individual members worldwide. ASHRAE's stated mission is to promote the arts and sciences of heating, ventilation, air conditioning and cooling to serve humanity and promote sustainable peace. 3 ASHRAE dates back to 1894 (when it was originally organized as the American Society of Heating and Ventilation Engineers) and is working to achieve its mission through research, standards writing, publication and continuing education. Like many other technical organizations, ASHRAE publishes a technical journal, a series of guides, compilations of peer-reviewed technical papers, and various special publications. A unique portfolio of technical research projects for ASHRAE (funded by the ASHRAE Research Foundation). ASHRAE is considered to be a leading technical organization active in the development of building energy standards. The development of energy standards for buildings began in response to the lack of energy in the early 1970s. The original version of the standard was published in August 1975 as ASHRAE Standard 90-75 Energy saving in the new building design. Over the next decade, ASHRAE 90-75 was adopted (in one form or another) by most model code organizations, and then by most states. Changes to the ASHRAE 90 standard occurred regularly. In the mid-1980s, the standard was reorganized into two separate standards: 90.1 covering commercial and high-rise residential buildings, and 90.2 covering low-rise apartment buildings. The latest version of the commercial standard is officially called ANSI/ASHRAE/IESNA Standard 90.1-2007 Energy Standard for buildings, with the exception of low-rise residential buildings. The designation of the American National Standards Institute (ANSI) means that the standard was developed using ANSI-accredited procedures and is considered an American national standard. ANSI's requirements ensure that the procedures developments reflect openness, balance, consensus and time. Teh Teh The Engineering Society of North America (IESNA) designation indicates that the standard is one of the sponsors of IESNA. The 2007 designation indicates the date of approval by the ASHRAE Board of Directors. Why is ASHRAE 90.1 important? ASHRAE 90.1 is important because it forms the basis or at least affects most of the requirements of the energy code in the United States. The International Energy Saving Code (IECC) includes ASHRAE 90.1 as a reference. In addition, under the 1992 Federal Energy Policy Act (EPAct), ASHRAE 90.1 was sanctioned as the basis for all state building energy codes. In fact, EPAct requires all states to certify to the federal government that their energy codes are at least as stringent as ASHRAE 90.1-2004. Most federal agencies have adopted ASHRAE Standard 90.1 in one form or another as a minimum requirement for new federal buildings. The topic of building codes and standards is complex. In the United States, most construction and renovations are regulated by local building codes. Building codes are adopted by local jurisdictions and have the force of law. Local building codes are enforced by the departments of the building code through a combination of a review of the plan and inspections. Most jurisdictions of the code do not have the personnel or technical expertise to develop and maintain building codes within the country. Therefore, they rely on different code organizations to develop type codes. Local code jurisdictions accept model codes in full or in part, depending on local needs. The model building code is not enforceable until it is adopted by the State or local jurisdiction and becomes law. In the United States, the International Code Council (ICC) is a leading organization for model codes. The ICC was established in 1994 as a non-profit organization dedicated to the development of a single set of comprehensive and coordinated national type-shaped building codes. The ICC has developed I-codes, a number of model codes available for adoption in local jurisdictions. The I-Code, which covers energy consumption in buildings, is called the International Energy Saving Code (IECC), and its purpose is to regulate the design and construction of buildings for energy efficiency. I-codes are updated for a 3-year cycle; 2009 I-codes of the current version. Chapter 5 2009 IECC covers commercial buildings. The chapter provides two ways to ensure compliance: ASHRAE 90.1 or the requirements contained in Chapter 5. Chapter 5 requirements are a simplified approach that generally meets the ASHRAE 90.1 standard. Building designers can choose any path to meet the requirements, but must adhere to the chosen Designers are not allowed to choose portions from both paths. What's in ASHRAE 90.1? ASHRAE Standard 90.1 organized into sections: Determining the area of destination, reduction, and administration and execution execution Envelope heating, ventilation, and air conditioning service Water Heating Lighting Other Equipment Energy Budget Method Regulatory reference requirements are mainly contained in Section 5 (Building Envelope) and Section 6 (heating, ventilation, and air conditioning). The Envelope Requirements envelope requirements (section 5) cover the thermal characteristics of the building's shell. The requirements for opaque areas (roofs, walls, floors and doors) and phenestation (windows and lanterns) are included. Requirements for envelopes are imposed on each of the three categories of premises (non-residential space, living air conditioning and semi-heated space) and for each of the eight different climatic zones (Figure 1). For opaque walls and roofs, thermal requirements are either in terms of the maximum allowable U-factor4, or in terms of minimum R-value5 insulation for different classes of construction. As an example, Figure 2 cites roof requirements in climate zone 5. This example was extracted from the 5.5-5 table of the ASHRAE 90.1-2007 standard. The same table contains similar requirements for walls above class, walls below class, floors, slab-on-class floors, and opaque doors. The table also includes fentration requirements (vertical glazing and windows) as a function of the percentage of the wall or roof area. Given that Figure 2 is only part of one of eight tables (one for each climate zone) dealing with shell requirements, it's easy to see why some find the standard complex. However, keep in mind that a typical official code deals with only one table envelope for his or her climate zone. If designers have difficulty meeting the requirements in the tables, an alternative path is provided in the Building Envelope Trade-Off Option. This approach allows compromises between different elements (such as more wall insulation to compensate for lower window performance) according to the envelope part of the standard. Similarly, if the requirements for envelopes cannot be met (either by tabulated requirements or by compromise with the building envelope), designers can use the Energy Expenditure Budget Method (described in section 11). This method allows computer modeling of the proposed building to establish a match. The simulation should document that the total project cost of the energy of the proposed design will not exceed the energy budget for the building, calculated by approved computer energy modeling programs (such as DOE-2, BLAST or EnergyPlus). Mechanical insulation requirements for pipe and duct insulation are included in Section 6, called Heating, Ventilation and Air Conditioning (HVAC). part of this section of the standard focuses on HVAC design requirements and the minimum efficiency of HVAC HVAC equipment air conditioners, heat pumps, coolers, furnaces, boilers and heat-rejection equipment). Subdivision 6.4.4.1 is an isolation address. Requirements for duct insulation (as minimum R) in tables 6.8.2A (Cooling and heating only ducts) and table 6.8.2B (Combined heating and cooling ducts). The requirements for pipe insulation are presented in table 6.8.3 as a minimum thickness. To isolate ducts, requirements are made for the climate zone (Figure 1) and the location of the duct. Figure 3 is extracted from the combined heating and cooling requirements table (table 6.8.2B) from the standard. Taking into account two tables and seven listed ducts, there are a total of 161 individual cells in the duct tables. Again, this may seem too complicated, but let's remind you that a typical official code deals only with requirements for his or her climate zone. Tube insulation requirements are set out in Table 6.8.3 of the standard and summarized in Figure 4. Note that the requirements for pipe insulation do not depend on the climate zone. The thickness requirement is determined by the operating temperature and size of the pipe. It should also be noted that the requirements for pipe insulation are based on the supposed thermal conductivity curve of the insulating material. For insulating materials that differ from the intended conductivity, there is an adjustment equation to change the required thickness, taking into account the difference in conductivity. How is the standard designed and maintained? The ASHRAE 90.1 standard has been developed and maintained by the ASHRAE 90.1 Permanent Standards Project (SSPC 90.1). This committee is appointed specifically to write and maintain the standard and usually has about 50 voting members. The chairman and vice-chairman should be the members of ASHRAE (other members of the committee are not required to be members of ASHRAE); all members must be technically qualified in the subject area of the standard. The SSPC is organized into several subcommittees responsible for different sections of the standard. For example, the Subcommittee on Envelopes is responsible for Section 5 (Building Envelope), while the Mechanical Subcommittee is responsible for Section 6 (heating, ventilation and air conditioning) and Section 7 (Water Heating). The standard is under continuous service, which means that it is constantly reviewed through a number of addenda. The SSPC subcommittees, which meet face-to-face four times a year, spend most of their time addressing these issues. The addition may come from individuals within the SSPC, or they may come from a Continuous Service Offer (CMPs) from stakeholders. Anyone can initiate CMP (instructions and form of submission are available www.ashrae.org/technology/page/97). All proposed changes are analyzed, evaluated, discussed, and may eventually be draft additions to the public review. The public review project is available for public review and comment for a limited period of time (30 to 45 days). Comments received during the public review period are evaluated and discussed with commentators in order to resolve comments (either by accepting, adopting, adopting, or rejecting). In the event of a change, the draft goes to further public consideration until all comments are either resolved or rescinded by a committee vote. After all, the supplement is approved by SSPC and then by the boards of ashrae directors. Additional approval is required from IESNA and ANSI before the add-on becomes official and printed. Various add-ons are periodically published and then integrated into the full standard and reprinted over a 3-year cycle (due to a 3-year model code cycle). The next full publication will take place in 2010 and will be called ANSI/ASHRAE/IESNA Standard 90.1-2010 Energy Standard for buildings, with the exception of low-rise residential buildings. The goal of SSPC 90.1 is to increase the rigour of the 2010 standard by 30 percent compared to the 2004 standard. However, the increase should still be seen as cost-effective based on the financial guidelines adopted by the committee. These financial guidelines are generally based on average national conditions. For example, fuel economy analysis currently uses an average national fuel cost of $1.22 per thermal. Electricity savings are currently estimated on the condition that the cost is $0.0939/kWh. Similarly, the estimated cost of energy-saving opportunities is usually based on the national average cost information. How to use ASHRAE 90.1? Insulation manufacturers, distributors, laminators, and contractors are generally not members of the project team responsible for ensuring compliance with the ASHRAE 90.1 standard. However, they often have access to bargaining packages for various construction projects in their markets. Getting to know the isolation requirements in Standard 90.1 can help them identify opportunities for isolation overlooked by the project team. Project teams make thousands of decisions when designing the design and specifications of the project. Time and cost constraints often make it impossible to analyze each solution in detail. In some cases, insulation specifications are simply a marked version of the project company's main specification. Perhaps unsurprisingly, the levels of insulation required by the code are sometimes inadvertently omitted from the draft's drawings and specifications. In projects that consider insulation levels, the minimum thickness required by the code is usually the level. As mentioned earlier, these minimum levels based on average conditions. Often, it makes financial sense to set more than minimum levels of isolation. As an example, consider a hypothetical hypothetical with a natural gas hot water system using a pipeline recycling system. The system works year-round at 140 degrees Fahrenheit. The size of the pipe is 1 inch. NPS, and there are a total of 1,000 linear feet of pipelines. ASHRAE Standard 90.1 requires 1/2 inch of insulation for this application. Does it make sense to go beyond the minimum and install additional insulation on this pipeline loop? Using the 3E Plus® program6, you can easily calculate the savings that would result if 1 inch of insulation was installed instead. The results of these calculations are summarized in Figure 5 (which assumes elastometric insulation and an average ambient air temperature of 75 degrees Fahrenheit). In this example, doubling the thickness of insulation to 1 inch results in a 32 percent reduction in heat loss from the system. Annual energy savings will be approximately $610 per year, and CO_2 emissions will be reduced by about 6,100 pounds per year. Estimates of the set cost of additional insulation will obviously vary depending on the specifics of the project. For the purposes of illustration, the following estimates, taken from a public assessment guide.7 For a 1,000-person linear foot project, the additional costs will be estimated at approximately $2,100. The simple payback period for these investments will be about 3.5 years. Given that the lifespan of this insulation project will be 20 years or more, going beyond ASHRAE 90.1 lows seems to have excellent economic sense. The return on investment for this opportunity over a 20-year life will be about 29 percent. This example illustrates the possibility that going beyond the minimums can provide an attractive financial return to the owner while reducing greenhouse gas emissions. Isolation specialists who know ASHRAE 90.1 may also find it useful for projects that are not strictly covered by the standard. As an example, let's look at the existing application for an industrial process with 4 inches. The average pressure NPS steam line, operating at 300 degrees Fahrenheit, is initially isolated from 1st C. of insulation. This system goes beyond ASHRAE 90.1 because it involves an industrial process. Depending on the cost of energy and the efficiency of the boiler, the economic thickness of the insulation is probably significantly higher than the 1 inch originally indicated. Getting to know the requirements of ASHRAE 90.1 can help upgrade the line to 3 inches of insulation (minimum 90.1 for this line) with minimal time and effort spent on analysis and documentation. The ASHRAE Standard 90.1-2007 summary forms the basis, or at least affects, most commercial building energy codes in the United States. Knowledgeable insulation professionals should be familiar with the minimum insulation requirements in standard 90.1. They should also be aware that these requirements minimal, and in many cases outside the lows. Moving beyond the minimums saves energy, reduces energy costs, reduces greenhouse gas emissions and increases employment opportunities in the insulation industry. Notes from the U.S. Department of Energy, the Office of Energy Efficiency and Renewable Energy. Efficiency trends in residential and commercial buildings, October 2008. Available by www.ashrae.org/bookstore. www.ashrae.org. U-factor is the common heat transfer factor for construction, Btu/(h'ft2'F). The R-value is the thermality of the insulation material, h'ft2'F/Btu. Developed by the North American Association of Insulation Manufacturers (NAIMA) and available on www.pipeinsulation.org. Mechanical cost data 2008, RSMeans. Figure 1 Figure 2 Figure 3 Figure 4 Figure 5 Figure 6 6 ashrae 90.1 pdf pipe insulation requirements