AMMONIA PIPE AND EQUIPMENT LABELING – PART I

By Bill Lape, SCS Engineers

Recently, I was asked about Recognized and Generally Accepted Good Engineering Practices (RAGEGEP) for ammonia refrigeration piping and equipment labeling and the history of available standards and guidelines. This article is intended to educate the reader further on the concept of RAGAGEP, give them an overview of many of the standards and guidelines that are relevant to ammonia refrigeration system labeling, and to provide guidance on how to apply them. In Part II, we will examine the historical specifics of Bulletin 114, often considered to be THE RAGAGEP for ammonia refrigeration piping. In Part III, we will examine equipment labeling.

The first order of business is to further define RAGAGEP. The best place to do that is to look at OSHA's June 2015 enforcement memo on the topic, which defines RAGAGEP as *"the basis for engineering, operation, or maintenance activities and are themselves based on established codes, standards, published technical reports or recommended practices (RP) or similar documents. RAGAGEP details generally approved ways to perform specific engineering, inspection or mechanical integrity activities, such as fabricating a vessel, inspecting a storage tank, or servicing a relief valve."* The memo goes on to state that sources of RAGAGEP include published and widely adopted codes, such as NFPA 70, the National Electric Code, published consensus documents, such as IIAR2, the Standard for Safe Design of Closed Circuit Ammonia Refrigeration Systems, published non-consensus documents, such as pamphlets from the Chlorine Institute, or "appropriate internal standards."

One of the keys to the Process Safety Management (PSM) and Risk Management Program (RMP) regulations is that it is a performance based standard. Both regulations state that the employer, or owner/operator in the case of the EPA RMP rule, must follow RAGAGEP. However, nowhere in the regulations do either agency specify WHAT RAGAGEP to follow. A facility is able to choose what RAGAGEP they use, but they must ensure that all hazards have been addressed by the chosen RAGAGEP. If a hazard is not addressed by the chosen RAGAGEP, an additional one, not necessarily a replacement, must be chosen to address that hazard.

Now that we have defined RAGAGEP and have addressed what must be considered in choosing RAGAGEP to be applied at a facility, we can review some of the available options. In this article, we will focus solely on U.S. standards and guidelines and stay away from ISO standards.

First up is a standard from the Association of Mechanical Engineers (ASME). ASME first published a standard entitled "Scheme for the Identification of Piping Systems" in 1928. This document has been updated several times over the years, with the most recent edition being published in 2015. It includes requirements for the color-coding of piping based on its contents, size of marker labels, placement of marker labels, and basic requirements for information to be included on those labels, including name of contents and direction of flow. Regarding the labeling of the pipe, this standard requires that "Contents shall be identified by a legend with sufficient additional details such as temperature, pressure, etc., as are necessary to identify the hazard." One thing to note is that the current 2015 edition does reference the Global Harmonized Standard (GHS) pictograms for use on pipe legends. Note that the language says "may be included as part of the legend," so they are not required. The following is an example of a pipe label for an ammonia refrigeration system that would be compliant under ASME A13.1-2007 were a facility to choose it as their pipe labeling RAGAGEP.

Note that I have not included a physical state that is commonly found on ammonia refrigeration piping labels. Whether or not this is needed on the label would be based upon how the facility evaluated the relative hazards of ammonia during their process hazard analysis. It is possible, based on the facility's training and equipment, that, despite the physical differences between ammonia vapor and liquid, the relative hazards are substantially the same. With this documentation, the facility could argue that the label above is acceptable under their chosen RAGAGEP of ASME A13-1.-2007.

What about the color of the label? Under ASME A13.1-2007, the color orange is used for toxic or corrosive chemicals, while yellow is reserved for flammable chemicals. If the facility had chosen ASME A13.1-1996 as their RAGAGEP, yellow would have been acceptable for toxics and corrosives. We will discuss other color schemes later in this article.

For many years, ASME A13.1 was the only standard in existence for pipe identification. In fact, it is still the standard that would be applied for piping in a food processing or cold storage warehouse that is not part refrigerant piping in an ammonia refrigeration system.

In 1991, the International Institute of Ammonia Refrigeration (IIAR) published Bulletin 114 (B114), "Guidelines for Identification of Ammonia Refrigeration Piping and System Components." It was updated in 2014, 2017, and 2018. This document provided the ammonia refrigeration with guidance on how ammonia refrigeration piping and system components could be identified. It is important to note that these were intended to merely be recommendations, not requirements. We will cover the identification recommendations of this Bulletin, and how they have changed since 1991, in Part II of this article series.

In 2008, IIAR added a section on pipe marking to IIAR2, the "Standard for Equipment, Design, and Installation of Closed-Circuit Ammonia Mechanical Refrigerating Systems." It stated in Section 10.5:

> All piping mains, headers and branches shall be identified as to the physical state of the refrigerant (that is, vapor, liquid, etc.), the relative pressure level of the refrigerant, and the direction of flow. The identification system used shall either be one established as a standard by a recognized code or standards body or one described and documented by the facility owner.
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> **NOTE:** See IIAR Bulletin 114 [ref.4.2.2.2].

While specifying that the pipe labeling include physical state and relative pressure, along with direction of flow, IIAR made no mention of color coding, label size, label placement, or label text in the standard. Rather, they left this up to the facility to decide how to define that, but they did include a note that pointed to B114. The following is an example of a label that would be compliant with IIAR2-2008.

Note that the physical state has been added due to its explicit requirement in IIAR2-2008 Section 10.5. Bear in mind, that this could also be identified through color, providing that the color scheme is properly documented and affected personnel are trained to recognize it. In this instance, the color was chosen based on ASME A13.1, which would still need to be documented in the facility's program as chosen RAGAGEP. It should also be noted that there is no pipe service information included on this label. Much like the physical state omission under our A13.1 label example, whether or not to include the pipe service information would be dependent upon the relative hazards identified in the facility process hazard analysis for the ammonia refrigeration system.

In the 2014 edition of IIAR2, now titled "Standard for Safe Design of Closed-Circuit Ammonia Refrigeration Systems," IIAR added some additional requirements. Section 5.14.5 states:

> Ammonia piping mains, headers, and branches shall be identified with the following information:
>
> 1. "AMMONIA."
> 2. Physical state of the ammonia.
> 3. Relative pressure level of ammonia, being low or high as applicable.
> 4. Pipe service, which shall be permitted to be abbreviated.
> 5. Direction of flow.
>
> The marking system shall either be one established by a recognized model code or standard or one described and documented by the facility owner.

Note that once again, IIAR leaves the particulars (color, size, placement, text) of the marking system up to the facility. Here is an example of a label that would comply with IIAR2-2014 Section 5.14.5.

Bear in mind that the colors chosen must be documented in some form of standard. This may be ASME A13.1, or the facility may choose to create their own. The key is that the

facility must DOCUMENT this chosen standard, TRAIN affected personnel, including contractors, and DOCUMENT this training, including proof of understanding.

For instance, perhaps a facility, after considering the relative hazards of the ammonia refrigeration piping, and documenting those considerations in their PHA, develops a standard as follows:

Ammonia Refrigeration Pipe Labeling: Internal Standard – J&D Jammin' BBQ, LLC

The following standards shall apply to the ammonia refrigeration pipe labels at all J&D Jammin' BBQ, LLC, facilities.

1. Ammonia refrigeration pipe labeling shall comply with IIAR2-2008, and shall contain the following information:
    a. Physical state identified by the following background colors:
        i. Orange – liquid refrigerant
        ii. Yellow – refrigerant vapor
        iii. Purple – two phase (vapor/liquid) refrigerant
    b. The relative pressure denoted by:
        i. High: 70 psig and above
            1. Note that in addition to the pressure text, high pressure lines will be denoted by a red directional arrow
        ii. Low: below 70 psig
    c. Direction of flow arrow

2. In addition, the following will be included on the labeling
    a. Chemical identification denoted by NH3

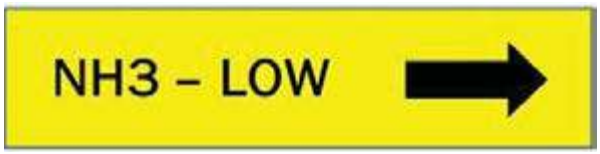
3. Pipe labeling must be placed 2 feet of any direction change or roof/wall penetration. Label spacing on horizontal or vertical runs must be such that a label is visible from any point along the pipe

4. The label must be viewable from the primary point of view, but additional labels may be added around the circumference of the pipe if it is deemed necessary through a process hazard analysis

5. Pipe labeling text must be sized so that the text is viewable from the primary viewpoint, or within 25 feet of the pipe, whichever is further

This internal standard not only describes an identification method that would be compliant with IIAR2-2008, but also includes parameters that cover the hazards addressed through ASME A13.1. The following are examples of compliant labels under this internal standard.

Wet Suction



Dry Suction

High Pressure Liquid / High Temperature Recirc. Liquid

Hot Gas Defrost

Selecting Recognized and Generally Accepted Good Engineering Practices for ammonia refrigeration piping is critical for a facility. Without pipe labeling standards, employees and contractors are at risk of injury or even death. The key to selecting your RAGAGEP for pipe labeling is three fold.

1. Make sure that ALL potential risks have been addressed through the selected RAGAGEP. If they have not, then additional RAGAGEP must be selected, or even developed.
2. Make sure that all affected personnel are trained on the identification schemes defined by the selected RAGAGEP.
3. Document this training and be sure to include proof of understanding.

Next month, we will review IIAR Bulletin 114 as a RAGAGEP, and describe some of the changes in it over the years.

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