Bulletin No. 114 March 2014

Guidelines for:

Identification of Ammonia Refrigeration Piping and System Components

International Institute of Ammonia Refrigeration

NOTICE

The information contained in this Bulletin has been obtained from sources believed to be reliable. However, it should not be assumed that all acceptable methods or procedures are contained in this document, or that additional measures may not be required under certain circumstances or conditions. The IIAR makes no warranty or representation and assumes no liability or responsibility in connection with the use of any information contained in this document. Use of and reference to this document by private industry, government agencies and others is intended to be voluntary and not binding unless and until its use is mandated by authorities having jurisdiction.

The IIAR does not “approve” or “endorse” any products, services or methods. This document should not be used or referenced in any way which would imply such approval or endorsement.

Note that the various codes and regulations which might be referenced in this document may be amended from time to time and it should be assumed that the versions referenced herein are the versions of such codes and regulations in effect at the time of the publication of this Bulletin.

The IIAR uses its best efforts to promulgate Bulletins for the benefit of the public in light of available information and accepted industry practices. However, the IIAR does not guarantee, certify, or assume the safety or performance of any products, components or systems tested, installed, or operated in accordance with IIAR’s Bulletins or that any tests conducted under its Bulletins will be nonhazardous or free from risk.

This Bulletin is subject to periodic review. Up-to-date information about the status of the Bulletin may be received by contacting IIAR.

COPYRIGHT

Table of Contents

International Institute of Ammonia Refrigeration

Guidelines for Identification of Ammonia Refrigeration Piping and System Components

INTRODUCTION

Uniform guidelines for identifying ammonia refrigeration piping and system components will promote safety, facilitate maintenance and provide vital information to emergency service personnel.

Bulletin 114 was developed and published in 1991 as a means to establish uniformity among ammonia refrigeration users and practitioners in identifying refrigerant piping. Since its original publication, the industry has widely adopted the recommended practices for pipe marking, which is a code requirement. The basis for the development of the guidelines was ANSI Standard A13.1–1981 “Scheme for Identification of Piping Systems.” ANSI A13.1 was revised in 2007. The revised standard indicates that orange backgrounds, rather than yellow backgrounds, should be used for toxic and corrosive fluids. Bulletin 114 has been updated to reflect this standard and provide better consistency with general industry standards.

The use of color to identify fluid characteristics is also suggested by ANSI A13.1. Users and practitioners in the ammonia refrigeration industry have used varying color schemes, or no color schemes, to identify ammonia refrigeration piping systems. In an effort to bring consistency to the industry and aid in training and safety efforts, Bulletin 114 was revised to also include a suggested color scheme for ammonia refrigeration piping. The suggested color scheme outlined in this document is not intended to replace existing color schemes that have been established by facilities.

2.0 SCOPE

The scope of this bulletin is to establish uniform guidelines for identifying piping in a closed-circuit ammonia refrigeration system and the related refrigeration system components. It is not intended for any other use.

All piping mains, headers and branches should be identified as to the physical state of the refrigerant, i.e. vapor, liquid, etc., the relative pressure level of the refrigerant and the direction of flow. All components of the refrigeration system, e.g. receivers, heat exchangers, accumulators, etc., should also be uniformly identified.

The identifying designations given to the piping and components that comprise the refrigeration system, as shown on system drawings, should be consistent with the nomenclature used for pipe and components in these guidelines.

3.0 DEFINITIONS

For purposes of these guidelines, the following terms shall have the definitions provided.

3.1 Piping System

A piping system includes all ammonia refrigerant piping and fittings, hand valves, control valves and other devices that are inclusive to the refrigeration lines. Pipe insulation is also considered part of the piping system. Pipe supports, hangers, brackets or other piping accessories are not considered part of the piping system.

3.2 System Components

System components include compressors and compressor units, condensers, receivers, thermosyphon vessels, recirculators, intercoolers, accumulators, transfer vessels, oil pots, evaporators, heat exchangers and any other component of the refrigeration system containing refrigerant that is not inclusive to the refrigeration lines comprising the piping system.

4.0 IDENTIFICATION SYSTEM

4.1 Piping Markers

Piping markers in accordance with this guideline, are designed to identify the refrigerant contained within that piping segment (i.e., ammonia) including the physical state of the refrigerant, relative pressure level of the refrigerant and direction of flow.

The piping marker will be considered to have (5) sections:

a. marker body
b. physical state section
c. pressure level section
d. abbreviation section
e. directional arrow

A list of approved abbreviations, which may be used to further identify piping, is provided in paragraph 4.1.4.

4.1.1 Marker Body

The marker body shall be *SAFETY ORANGE* in color. The word *AMMONIA* shall be printed in *BLACK* letters on the orange body.

The size of the marker body and lettering shall be in accordance with paragraph 4.1.8.

The material requirements for the marker body shall be in accordance with paragraph 4.3.

Colors for pipe markers are described by the ANSI Z535 Safety Color Chart.

4.1.2 Physical State

If the refrigerant is in the liquid state, *LIQ* shall be printed in *BLACK* letters on a *YELLOW* band and applied in a circumferential arc on the marker body. The band shall be applied to the left of and adjacent to the word *AMMONIA* on the marker body.

If the refrigerant is in the vapor state, *VAP* shall be printed in *BLACK* letters on a *SKY BLUE* band, and applied in a circumferential arc on the marker body. The band shall be applied to the left of and adjacent to the word *AMMONIA* on the marker body.

If the refrigerant is normally present in both the vapor and liquid state, *VAP*, printed in *BLACK* letters on a *SKY BLUE* band, shall be applied in a circumferential arc on the marker body to the left of and adjacent to the word *AMMONIA*. *LIQ*, printed in *BLACK* letters on a *YELLOW* band, shall be applied in a circumferential arc on the marker body to the left of and adjacent to the vapor band.

The size of the lettering shall be accordance with paragraph 4.1.8.

The material used to denote the physical state of the refrigerant shall be in accordance with paragraph 4.3.

4.1.3 Pressure Level

The pressure of the refrigerant in the system piping shall be labeled either *HIGH* or *LOW*.

Pressure in excess of 70 psig, under normal operating conditions, will be considered to be high pressure. *HIGH PRESSURE* will be denoted by the word *HIGH* printed in *BLACK* letters on a *RED* band and applied in a circumferential arc on the marker body to the right of and adjacent to the word *AMMONIA*.

Pressure equal to or less than 70 psig, under normal operating conditions, will be considered to be low pressure. *LOW PRESSURE* will be denoted by the word *LOW* printed in *BLACK* letters on a *GREEN* band and applied in a circumferential arc on the marker body to the right of and adjacent to the word *AMMONIA*.

The size of the lettering shall be accordance with paragraph 4.1.8.

The material used to denote the pressure level on the pipe marker shall be in accordance with paragraph 4.3.

4.1.4 Ammonia Piping Abbreviations

Applying abbreviations of the names commonly given to piping in an ammonia refrigeration system will assist the operator in identifying and tracing system piping. In addition to the abbreviation, the use of a temperature or a pressure commonly associated with a particular line may further assist the operator.

For example, the addition of “-10°F” to a particular recirculated suction line and “0°F” to another, would serve to differentiate between two low temperature recirculated suction (LTRS) lines. The same can be done using pressures commonly associated with the service of a particular line.

COMMON AMMONIA PIPING ABBREVIATIONS

Piping Description	Abbreviation
Booster Discharge	BD
Booster Suction	BS
Condenser Drain	CD
Economizer Suction	ES
High Pressure Liquid	HPL
High Stage Discharge	HSD
High Stage Suction	HSS
High Temperature Recirculated Liquid	HTRL
High Temperature Recirculated Suction	HTRS
High Temperature Suction	HTS
Hot Gas Defrost	HGD
Intermediate Pressure Liquid	IPL
Liquid Injection Cooling	LIC
Low Stage Suction	LSS
Low Temperature Liquid	LTL
Low Temperature Recirculated Liquid	LTRL
Low Temperature Recirculated Suction	LTRS
Low Temperature Suction	LTS
Medium Temperature Recirculated Liquid	MTRL
Medium Temperature Recirculated Suction	MTRS
Medium Temperature Suction	MTS
Oil Drain	OD
Pump Out	PO
Relief Vent	RV
Sub-Cooled Liquid	SCL
Thermosyphon Return	TSR
Thermosyphon Supply	TSS
Thermosyphon Vent	TSV

Notes on abbreviations:

1. The designations of Low Temperature Suction, Medium Temperature Suction, and High Temperature suction are typically used to indicate suction piping that contains “dry” or “nearly dry” vapor, which returns from a refrigeration load.
2. The designations of Low Stage Suction, Booster Suction, and High Stage Suction are typically used to indicate suction piping that is connected from a vessel to the suction side of a compressor.
3. Low Stage Suction and Booster Suction are often interchangeable terms, but should be consistently used at a facility.

The abbreviation lettering will be in *BLACK* letters on a *SAFETY ORANGE* field. The abbreviation may be an integral part of the pipe marker or it may be applied separately. The abbreviation shall be located to the left of and adjacent to the physical state band if the abbreviation is an integral part of the marker or to the left of the pipe marker if the abbreviation is applied separately.

The size of the lettering shall be in accordance with paragraph 4.1.8.

The material used for the abbreviation section shall be in accordance with paragraph 4.3.

4.1.5 Directional Arrows

Directional arrows may be printed on the marker body. In the case of the vinyl “snap-on” type of pipe marker, the arrows and legend will be printed universally, meaning that regardless of the position of the marker (either vertically or horizontally) the arrows will point in the correct flow direction. The “self-adhesive” type of marker can be printed with two directional arrows (one at each end of the marker); the arrow not required for indicating the direction of flow can be manually cut off before application.

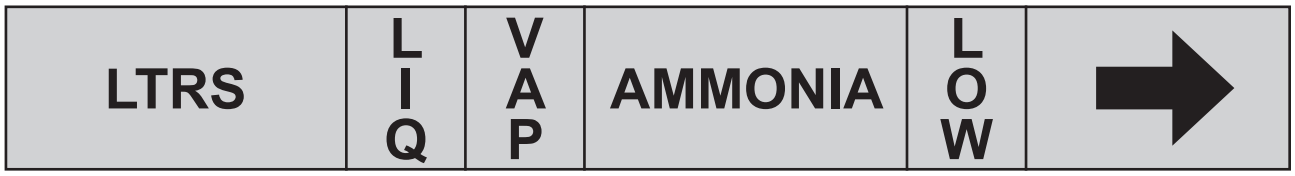
In either case, the directional arrow or arrowhead shall be *BLACK* in color and proportionate in size to the marker.

Directional arrows may be applied around the full circumference of the pipe.

The material used for directional arrows shall be in accordance with paragraph 4.3.

4.1.6. Pictorial View of a Pipe Marker

A typical pipe marker for a saturated Low Temperature Recirculated Suction (LTRS) line, where both liquid and vapor are present, is pictured below:



ABBREVIATION SECTION

PHYSICAL STATE

(LIQ) = Yellow
(VAP) - Blue

PRESSURE LEVEL

DIRECTIONAL ARROW

Low (70 psig or less) = Green
High (More than 70 psig) = Red

Marker Body (Black on Safety Orange)

4.1.7. Identifying Small or Hidden Pipe

In those instances where one pipe is hidden behind another, or where the pipe outside diameter (O.D.) is too small for a pipe marker to provide proper visibility, an alternate method of marking can be used.

If the pipe is ½" or less, or if a pipe is hidden, a properly sized marker should be applied to a durable piece of material, such as Plexiglas or sheet metal, cut to the dimensions of the marker and suspended from the pipe so that the marker is clearly visible. The marker should be suspended using durable, corrosion resistant wire or chain.

4.1.8 Pipe Marker Dimensions and Lettering Size

The size of the pipe marker and the lettering thereon is determined by two factors:

a. the outside diameter of the pipe, including insulation on insulated pipe.

b. the distance between the viewer and the pipe.

Considering these factors, the size of the pipe marker and lettering should be selected to provide quick and positive identification. Pipe location, from a viewer's standpoint, will be different on every installation. Therefore, on-site decisions will be necessary to provide the optimum pipe marking system.

Table 1 provides guidance for the selection of pipe markers and lettering:

TABLE 1

Diameter (O.D.) Range	Marker Width	Marker Length	Letter Size	Physical State	Pressure Level
Up to 1-1/4”	1”	8”	1/2”	1/2”	1/2”
Greater than 1-1/4” – 2”	1-1/2”	8”	3/4”	3/4”	3/4”
Greater than 2” – 7”	2-1/2”	12”	1-1/4”	1”	1”
Greater than 7” – 10”	3-1/2”	24”	2-1/2”	1-1/2”	1-1/2”
Over 10”	4-1/2”	32”	3-1/2”	2”	2”

Note: Diameter includes insulation, if applied

4.2 Component Markers

Component markers will bear the name of the equipment they identify, e.g., RECEIVER, ACCUMULATOR, RECIRCULATOR, etc. In addition, component markers will be provided with a pressure level designation. Additionally, other information can be provided.

Component markers will have *BLACK* letters on a *SAFETY ORANGE* field.

Pressure Level will be indicated by the word HIGH in *RED* letters or the word LOW in *GREEN* letters printed or applied flush with the right edge of the marker.

The material used for component markers shall be in accordance with paragraph 4.3.

Colors for component markers are described by the ANSI Z535 Safety Color Chart.

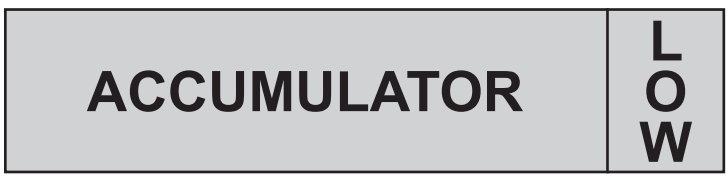
4.2.1 Component Marker Dimensions and Lettering Size

Component markers will be approximately 3-1/2” wide and long enough to accommodate the name of the component leaving a 2-1/2” margin at either end of the name to allow room for the pressure level designation.

Lettering on component markers will be 2-1/2” high.

4.2.2 Pictorial View of a Component Marker

A typical component marker for an Accumulator is pictured below:



Component (Black on Safety Orange) PRESSURE LEVEL

Low (70 psig or less) = Green
High (More than 70 psig) = Red

4.2.3 Ammonia System Component Abbreviations

Applying abbreviations of the names commonly given to components or equipment in an ammonia refrigeration system will assist the operator in identifying components and tracing system piping. In addition to the abbreviation, the use of a temperature or a pressure commonly associated with a particular line may further assist the operator.

For example, the addition of “-10°F” to a particular vessel and “0°F” to another, would serve to differentiate between two low temperature vessels. The same can be done using pressures commonly associated with the service of a particular line.

COMMON AMMONIA SYSTEM COMPONENT/EQUIPMENT ABBREVIATIONS

Component/Equipment	Abbreviation
Accumulator (with/without int. coil)	ACC
Air Cooled Condenser	AC
Air Handling Unit	AHU
Air Unit	AU
Booster Compressor	BC
Controlled Pressure Receiver	CPR
Evaporative Condenser	EC
Heat Exchanger	HEX
High Pressure Receiver	HPR
High Stage Compressor	HSC
High Temperature Recirculator	HTR
Intercooler (with/without int. coil)	IC
Liquid Transfer Unit	LTU
Low Temperature Compressor	LTC
Low Temperature Recirculator	LTR
Low Low Temp Recirculator	LLTR
Oil Pot	OP
Oil Separator	OS
Pilot Receiver	PR
Purger Unit	PRG
Refrigerant Pump	RP
Refrigerated Make-Up Air Unit	RMAU
Rooftop Air Unit	RTU
Surge Drum	SD
Swing Compressor	SWC
Thermosyphon Receiver	TSR
Water Cooled Condenser	WC

4.3 Marker Material Requirements

Pipe markers may be of the “self-adhesive,” “wrap-around” or “strap-on” type. The identifying information may also be stenciled directly onto the piping, provided that the stenciling is done in a professional manner and is in accordance with the general requirements of this guideline.

Note: Moisture trapped under self-adhesive markers on uninsulated carbon steel pipe or surfaces can cause corrosion if surfaces are not dry when the marker is applied or if surfaces are not properly prepared.

All pipe markers will be made of a material suitable for the area of use.

Markers should resist fading in the presence of indoor lighting or if subjected to infra-red or ultraviolet radiation. The markers must be suitable for application to insulated or non-insulated piping. In the case of self-adhesive markers, the adhesive backing shall be such that it adheres in all temperature ranges served by the refrigeration system and also retains its adhesive qualities when applied to piping located outdoors.

5.0 MARKER LOCATION

Piping markers shall be located as follows:

a. before and after a change in piping direction; when piping terminates at equipment and is within 24” of a marker or when piping changes direction more than once and is within 24” of a marker, it is not necessary to place an additional marker between the directional changing elbows or the termination point at equipment.

b. before and after piping penetrations of walls, ceilings and floors,

c. on extended horizontal or vertical runs of pipe, with a maximum spacing of 40 feet between markers, in order to provide positive identification, and

d. at least once on the piping in every area through which the refrigeration piping passes.

6.0 VISIBILITY

Care should be taken in placing identification labels on piping, vessels, and refrigeration equipment to provide good visibility. Where piping is located above or below the normal line of vision the lettering shall be placed above or below the center line of the pipe, respectively.

7.0 PIPING COLOR SCHEME

7.1 Piping Color Scheme Scope

The scope of this section is to provide a suggested, non-mandatory color scheme beyond a simple ‘one color’ or ‘two color’ scheme for ammonia refrigeration piping systems in machinery rooms. The color schemes may also be applied to portions of the refrigeration system beyond machinery rooms.

Existing schemes for identification are considered acceptable. These color schemes should be posted according to Section 8.

In those areas where state codes and government regulations are not conflicted, ammonia refrigerated facilities have the option to implement a company documented piping color scheme.

7.2 Piping Color Scheme Purpose

The machinery room of a typical industrial ammonia refrigeration system is often the most piping intense part of a system. An expanded piping multi-color scheme helps to identify the various piping duties. A multi-color scheme aids in a quicker identification of the fluid state, pressure range, and temperature range. By being able to quickly identify, and follow piping in a machinery room, the response to an emergency situation may be expedited. This may aid in the location of valves that need to be manipulated to abate an emergency condition. Further, the color scheme of the machinery room piping system can assist in providing a training tool for current and new employees. By providing an accompanying drawing that maps the piping and corresponding colors, the piping in the machinery room can be more easily followed, and its function determined. See Section 8.0 for additional information.

Piping color scheming is recommended for uninsulated lines using finish paint in the recommended color and for insulated lines using insulation jacketing or intermittent markers in the recommended color. Intermittent markers should be applied every ten feet; on either side at changes of direction; on either side of a wall, roof or floor penetration. Intermittent displays of color should match the color scheme recommendations included in this bulletin or a scheme developed and documented by the facility.

Note that the PANTONE® colors (from the PANTONE MATCHING SYSTEM®) listed below are “targets” for shade, tone, and color.[1] Slight variations are expected because of variance in manufacturing, UV deterioration, interior lighting, dust and other unforeseen factors that may alter the appearance. Further, facilities may select an alternate color scheme. But in any case, the color scheme should be consistent throughout a facility.

[1] Pantone LLC is a private company that specializes in the identification of color for a broad range of industries.

Regardless of the color scheme selected, a legend or key for the piping colors should be posted in a conspicuous area.

The colors referenced below have not been evaluated by PANTONE for accuracy or applicability and may not match current PANTONE Color Standards. Consult current PANTONE Publications for accurate color.

7.3 Ammonia Piping Color Scheme Recommendations

The following color scheme for ammonia piping is recommended:

Ammonia High Pressure Liquid piping should be Ammonia Refrigeration Orange (or PANTONE 152 C) for services > 70 psig as follows:

- High Pressure Liquid (HPL)
- Sub Cooled Liquid (SCL)
- Thermosyphon Supply (TSS)
- Thermosyphon Return (TSR)
- Condenser Drain (CD)
- Liquid Injection Cooling (LIC)
- Intermediate Pressure Liquid (IPL)

Ammonia High Pressure Vapor piping should be Ammonia Refrigeration Yellow (or PANTONE 109 C) for services > 70 psig as follows:

- Booster Discharge (BD)
- High Stage Discharge (HSD)
- Hot Gas Defrost (HGD)
- Foul Gas (FG)

Low Pressure/ High Temperature Liquid and Vapor piping should be Ammonia Refrigeration Light Blue (or PANTONE 298 C) for the services within the 0°F to +47.3°F temperature range or within the pressure range 70 psig>P≥15.7 psig. If more than one temperature/ pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the Low Pressure/High Temperature range are as follows:

- High Temperature Recirculated Liquid (HTRL)
- Booster Suction (BS)
- Economizer Suction (ES)
- High Stage Suction (HSS)
- Medium Temperature Suction (MTS)
- Medium Temperature Recirculated Suction (MTRS)
- Medium Temperature Recirculated Liquid (MTRL)
- High Temperature Suction (HTS)
- High Temperature Recirculated Suction (HTRS)
- Defrost Relief (DR)

Low Pressure/ Low Temperature Liquid and Vapor piping should be Ammonia Refrigeration Dark Blue (or PANTONE 3015 C) for the services within the -1°F to -20°F temperature range or within the pressure range 15.7 psig>P≥3.6 psig. If more than one temperature/ pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the Low Pressure/Low Temperature range are as follows: Low Temperature Recirculated Suction (LTRS)

- Low Temperature Suction (LTS)
- Low Temperature Recirculated Liquid (LTRL)
- Low Temperature Liquid (LTL)

Low Pressure/ Low-Low Temperature Liquid and Vapor piping should be Ammonia Refrigeration Purple (or PANTONE 2617 C) for the services at or below -21°F or at pressure P< 3.6 psig. If more than one temperature/pressure level exists within this range, additional colors can be selected to further distinguish these subsystems. Note that any alternate colors can be selected if they are easily distinguishable, do not duplicate defined uses within this guideline and are identified in an accessible legend. The services for the Low Pressure/Low Temperature range are as follows: Low Low Temperature Recirculated Suction (LLTRS)

- Low Low Temperature Suction (LLTS)
- Low Low Temperature Recirculated Liquid (LLTRL)
- Low Low Temperature Liquid (LLTL)

7.4 Pressure Relief Valve Vent Piping Color Scheme Recommendations:

The following color scheme for pressure relief vent piping is recommended:

Pressure Relief Vent Grey (or PANTONE 430 C) for:

- Pressure Relief Vent Piping (RV)

7.5 Non-pressurized Refrigeration Piping and Related Process Piping Color Scheme Recommendations:

The following color scheme for related process piping is recommended:

Water Green (or PANTONE 3415 C) for:

- Water Piping, Water and Glycol mixtures, other nonvolatile brines that do not require special labeling

Note that Red is commonly used for Fire Sprinkler Piping

8.0 REFERENCE CHART

A reference chart that fully explains the ammonia refrigeration piping and component identification markers, including the approved abbreviations, should be placed in areas that are conspicuous to operating personnel. Regardless of the piping color scheme selected, a legend or key to the meaning of the colors should be posted in a conspicuous area. The reference chart, legend, or key should be made of durable material that will remain legible.

9.0 EXPANDING THE IDENTIFICATION GUIDELINES

The above are recommended guidelines for uniform identification of ammonia refrigeration piping and system components. Additional information, pertinent to a particular application, e.g. operating temperature or pressure levels that would be of value to the operator, may be incorporated into the identification guidelines.

Any augmentation of the identification guidelines should not circumvent the intent or quality of the guidelines. The addition of other useful information to the identification system is encouraged, as long as the addition is done in the spirit of this publication.

REFERENCES

ANSI A13.1 – 2007, “Scheme for Identification of Piping Systems”.

ANSI Z535 Color Chart – 2011, “Safety Color Chart for Use with the ANSI Z535 Standards Series”.

DIN 2403 (March 1984), “Identification of Pipelines According to the Fluid Conveyed”.

DIN 2405 (July 1965), “Pipelines in Refrigeration Plants – Characterization (mark,sign)”.

Pantone LLC, “PANTONE MATCHING SYSTEM®”

International Institute of Ammonia Refrigeration
1001 N. Fairfax Street, Suite 503
Alexandria, VA 22314
Phone: (703) 312-4200 Fax: (703) 312-0065
Website: www.iiar.org