BY ORDER OF THE
SECRETARY OF THE AIR FORCE

AIR FORCE OCCUPATIONAL SAFETY AND
HEALTH STANDARD 91-44

1 SEPTEMBER 1997

Safety

SAFETY COLOR CODING, LABELING, AND MARKING FOR PIPING SYSTEMS

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The criteria in this standard are the Air Force's minimum safety, fire prevention, and occupational health requirements for color coding of piping systems and equipment. Major commands (MAJCOM), direct reporting units (DRU), and field operating agencies (FOA) may supplement this standard when additional or more stringent safety, fire prevention, and health criteria are required. Refer to Air Force Instruction (AFI) 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH) Program*, for instructions on processing supplements or variances. For identification methods for bulk petroleum systems including hydrocarbon missile fuels, see Military Standard (Mil Std) 161F, *Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels.* Whenever this standard conflicts with Mil Std 161F, the Mil Std takes precedence. Report conflicts in guidance between this standard, federal standards, or other Air Force directives through MAJCOM, DRU, or FOA ground safety offices to Headquarters, Air Force Safety Center, Ground Safety Division, Safety Engineering and Standards Branch (HQ AFSC/SEGS), 9700 G Avenue, SE, Kirtland AFB NM 87117-5670.

This standard establishes minimum requirements for the positive identification of potentially hazardous materials conveyed in piping systems except those sections buried in the ground, concrete, and those pertaining to vehicles, etc. Supervisors within their areas of responsibility shall ensure that all piping systems are identified according to requirements in this standard. Employees maintaining piping systems shall become familiar with the material contained within the piping systems and the corresponding color codes designating the hazard potential. The standard applies to all US Air Force organizations, including US Air Force Reserve personnel and when Air National Guard personnel are on federal service.

This standard requires the application of a color code and a lettered legend identification system positioned in a distinctive manner as a visual aid for marking piping systems which indicates the materials conveyed. Color marking will not be accepted as a substitute for the elimination of hazards by safety engineering, but rather will be used to supplement other established mishap prevention practices.

SUMMARY OF REVISIONS

Administrative changes have been made to update this standard to electronic format. Paragraphs have been renumbered and references updated as required. A glossary of references, abbreviations, acronyms,

and terms is provided at **Attachment 1**. A | indicates revisions from the previous edition. ***NOTE:*** AFOSH 127-series standards are being converted to 91-series standards and the 161-series to 48-series standards. However, not all standards have been converted as of the effective date of this standard. To help you locate these documents, references to AFOSH standards are stated in the updated series and standard number, with the outgoing series and standard number stated as "formerly designated as" in the references section of **Attachment 1**.

1. Hazards and Human Factors.

1.1. Schemes for identification of the contents of piping systems have been developed in the past by a large number of industrial plants and organizations of various kinds. Generally, the standards at an individual location may have given satisfaction to those using them but they also may have suffered from a lack of uniformity. Numerous deaths, injuries to personnel, and damage to property have occurred because of mistakes made in turning valves on or disconnecting pipes at the wrong time or place, particularly when outside agencies were called in to assist. Furthermore, there has been considerable confusion in the minds of those who change employment from one base to another.

1.2. In order to promote greater safety, lessen the chances of error, confusion, or inaction, especially in times of emergency, a uniform system for the identification of piping contents has been established to warn personnel when the piping contents are inherently hazardous. Therefore, while this standard has been prepared to specify the identification of the contents of piping systems on the basis of legends, it also suggests the use of color as a supplementary means of identifying the type of hazards of the material contained in the system.

1.3. When employees learn to associate various levels of hazards with common colors and lettered legends in piping systems, they are alert to potential hazards. Often, this warning precedes any other warning that may come from the area of the hazard and allows the employee time to avoid the hazard.

2. General Requirements.

2.1. Regulatory Federal Requirements. Essential regulatory requirements are contained in Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910, Subpart J, *General Environment Controls*, Mil-Std 101B, *Color Code for Pipelines for Compressed Gas Cylinders*, American National Standards Institute (ANSI) A13.1, *Identification of Piping Systems*, and Z53.1, *Marking Physical Hazards*, and AFOSH standards. Requirements applicable to hazard identification using color coding and marking are included in this standard. These publications will be consulted for more detailed information.

2.2. Marking. The marking of physical hazards by standard warning colors shall not be accepted as a substitute for the elimination of the hazards.

2.3. Location. Each location will be carefully evaluated to keep the number of markings at a minimum, thereby providing emphasis for markings which are used and eliminating confusion which results when colors are indiscriminately applied. Locations where all piping contains the same materials (for example--a liquid fuels pump house) minimal marking is required.

2.4. Labeling and Color Coding. Piping systems shall be labeled and color coded if they contain any of the following materials:

- Flammable or easily ignited materials.
- Toxic or poisonous gases or materials.
- Corrosive materials.
- Fire protection materials.
- Compressed air at or above 30 pounds per square inch, gauge (psig).
- Potable water above 75 psig.
- Radioactive substances.
- Oxidizing materials.
- Steam.

2.5. Gloss and Fluorescent Warning Colors. Gloss and fluorescent warning colors shall meet the requirements of Federal Standard 595a, *Colors*. The Federal Standard identification numbers for colors used for warnings and the corresponding General Services Administration (GSA) stock numbers are listed in **Table 1.**

Table 1. Federal Standard Identification Numbers and Corresponding GSA Stock Numbers.

Color Gloss Federal		
Color	**Color Number**	**GSA Stock Number**
Black	17038	8010-894-4136
Blue	15102	8010-598-5929
Brown	10080	8010-598-5470
Gray	16187	8010-298-2300
Green	14260	8010-882-5703
Red	11105	8010-889-7345
White	17875	8010-298-2288
Yellow	13655	8010-161-7386
Fluorescent Colors, Lusterless*		
Green	38901	8010-958-8150
Red	38905	8010-958-8147
Yellow	38907	8010-958-8151
*Should have an application of clear acrylic top coat to extend durability		

2.6. Color Specifications. The following colors shall be used to distinguish the hazard potential of piping systems.

- **Black** (No 17038) — Non Potable (Raw) Water. Piping system containing water determined unsafe for human consumption.
- **Blue** (No 15102) — Anesthetics and Harmful Materials. All materials productive of anesthetic vapors and all liquid chemicals and compounds, such as acids and caustics, that are hazardous to life and property but not normally productive of dangerous quantities of fumes and vapors.

- **Brown** (No 10080) — Toxic and Poisonous Materials. Materials extremely hazardous to life or health under normal conditions.
- **Gray** (No 16187) — Physically Dangerous Materials. Physically dangerous materials not dangerous in themselves which are asphyxiating in confined spaces or which are generally handled in a dangerous physical state of pressure or temperature.
- **Green** (No 14260) — Oxidizing Materials. All materials which readily furnish oxygen for combustion and fire producers which react explosively or with the evolution of heat in contact with other materials.
- **Red** (No 11105) — Fire Protection. Piping systems which convey fire protection and like materials including sprinkler systems and all other fire fighting systems.
- **White** (No 17875) — Potable or Drinking Water. Piping systems containing water determined as safe for human consumption.
- **Yellow** (No 13655) — Flammable Materials. All material known ordinarily as flammable or combustible.

2.7. Method of Identification for Piping Systems:

2.7.1. Lettered Legend. Positive identification of a piping system's content will be by lettered legend giving the name of the content in full or abbreviated form in black or white. Where the view is unobstructed, legends will be lettered on the two lower quarters of the pipe or covering.

2.7.2. Location. Letter legends will be visible from operating positions. Identifications by title and color will be located immediately adjacent to all operating accessories such as valves, regulators, flow checks, strainers, cleanouts, and vents. In addition, primary color warnings will be painted throughout the system at convenient intervals. An arrow shape showing direction of flow should appear on piping systems in any installation that is color coded. A double-headed arrow should be placed on lines subject to reverse flow. The lettering sizes will conform to the requirements listed in **Table 2.** For pipes smaller than 3/4-inch in diameter, metal tags will be used and will be attached at the same location as color bands would be placed.

2.7.3. Color Band. Color bands should completely encircle the pipe or the entire piping system may be painted the designated color.

- The width of a color band may range from 8 to 32 inches according to the pipe diameter as specified in **Table 2.**
- Color bands may either be painted on the pipe or the pipe may be wrapped with self-adhesive colored tape.
- At each color band or identification tag (except for electrical conduit), the directions of the flow of the material within the pipe should be indicated by an arrow. The arrow should be the same color as the color used for the lettering.

2.7.4. Color Band Location:

- At some locations it may be desirable to code pipes only at junctions or distribution points, while on other systems more frequent markings will be required. In any case, the number and location of identification markings will be based on the particular needs of each system to ensure that the piping system is positively identified.

- Color bands used for pipe identification shall be located at frequent intervals on straight pipe runs, close to valves and changes in directions, and where pipes pass through walls and floors. Color coding bands will be used for fire protection piping sparingly when piping is exposed in areas designed to be suitably pleasing. If desired, the entire piping system may be color coded.

2.7.5. Use of Colors. Both primary and secondary warning colors applied to the piping system, either by paint or colored bands, will conform to the requirements listed in paragraph **2.8.** These colors will be used to identify the main classification of the piping content because the colors are readily distinguishable, one from another, under normal conditions.

2.7.6. Cryogenics. Labels and paint will flake off pipes carrying liquid oxygen and hydrogen. Metal signs with identification markings will be attached above or hung below cryogenics plumbing by metal bands.

2.8. Exact Identification for Piping Systems. Exact identification of materials in any piping system for hazardous materials and the classification for fire protection is mandatory and shall be made by means of titles lettered in black or white. These titles shall be prominently displayed adjacent to color warnings to prevent errors by personnel. It is recommended, where the view is unobstructed, that titles be lettered on the two lower quarters of the pipe or covering. Lettering in this position is unlikely to be obscured by dust collection or mechanical damage. However, titles should be clearly visible from operating positions, especially those adjacent to control valves. The use of stencils with standard size letters specified in **Table 2.** is recommended. For pipelines smaller than 3/4-inch in diameter, the use of securely fastened metal tags, with lettering etched or filled in with enamel, is suggested. It is recommended that titles be applied by use of upper case letters and Arabic numerals whenever applicable.

NOTE:

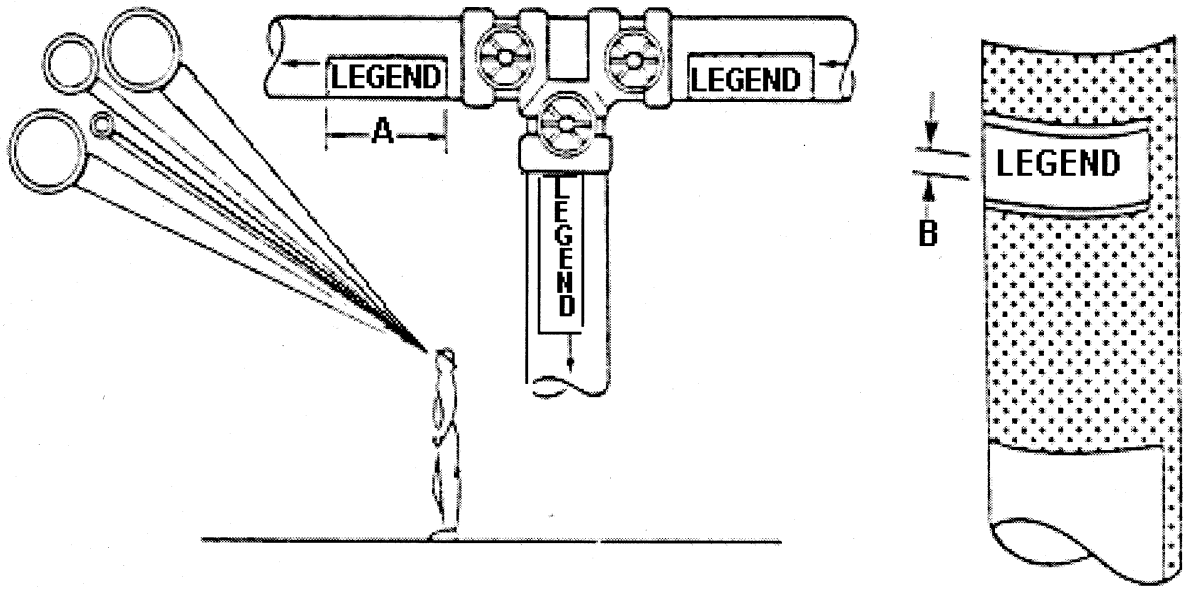
Labeling of containers and fixed systems containing materials not meeting the definition of hazardous or dangerous materials is not required. However, such containers may be labeled when the occupational environment dictates (hospitals, laboratories, etc.). AFOSH Standards 91-8, *Medical Facilities*, and 91-38, *Hydrocarbon Fuels Genera*l, will be consulted.

Table 2. Legend and Color Band Dimensions.

Outside Diameter of Pipe or Covering (Inches)	Length of Color Field A**	Size of Legend Letters and Numerals (Inches) B**
Less than 3/4		See reference paragraph **2.7.2.**
3/4 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/2 to 6	12	1-1/4
8 to 10	24	2-1/2
Over 10	32	3-1/2
Over 13	32	3-1/2
*Stencils or decals may be used.		
See **Figure 1.		

2.8.1. The appearance of any of the colors specified in paragraphs **2.5.** and **2.6.** on a piping system shall provide a warning of danger from the hazard involved in the system according to the definitions for warning colors specified in this standard. Piping systems which do not require warning colors may be painted to match surroundings (if not in conflict with other color designations of this standard) or such systems may be painted aluminum, black, or remain unpainted.

Figure 1. Exact Identification--Always by Name of the Material Contained.



2.8.2. A primary color warning shall appear on all dangerous piping systems and on all fire protection materials. Primary color warnings shall consist of a single color applied as a band or bands which completely encircle the piping system. Color bands shall be applied in conformance with dimensional information in **Table 2.** In lieu of color bands, all pipe and covering on an entire system may be painted with the primary color warning if that color is different from the background color. The use of color bands is preferred. In addition, primary color warnings shall be painted throughout the system, where the system passes underground or through walls, and at any other

conspicuous places where warnings are required by safety authorities. If desired, operating accessories may also be painted with the primary color warning.

2.9. Secondary Warning Color. Any piping system possessing a secondary hazard distinctively different from that indicated by its primary warning color will have a secondary warning color applied. The color of the band will be selected according to the definitions for warning colors specified in this standard. Location on piping systems will be immediately adjacent to all operating accessories such as valves, regulators, flowchecks, strainers, cleanouts, pumps, dispensing points, and vents.

2.10. Use of Arrows. Arrows should be used to indicate the normal directions of flow in the system. A double-headed arrow should be placed on lines subject to reverse flow. When used, arrows should appear adjacent to each primary color warning applied to other piping system. When the entire piping system is painted with the primary color warning, the arrow (if desired) should be black or white, whichever contrasts.

3. Employee Training. The administrative control established by this standard shall be specifically included in the job safety training required by AFI 91-301.

4. Classification of Material in Piping Systems. The classification of materials in a piping system shall be as specified in table 3. Examples of legends are found in **Table 4.** and color applications in **Table 5.**

Table 3. Classification of Hazards of Materials and Designation of Colors.

Classification	Color Field	Colors of Letters for Legend
Materials Inherently Hazardous:		
Flammable or Explosive	Yellow	Black
Chemically Active or Toxic	Yellow	Black
Extreme Temperatures or Pressures	Yellow	Black
Radioactive[1]	Magenta	Black
Materials of Inherently Low Hazard:		
Liquid or Liquid Admixture[2]	Green	White
Gas or Gaseous Admixture	Blue	White
Fire Quenching Materials:		
Water, Foam, $C0_2$, Halon, Etc.	Red	White

NOTES:

1. Previously specified radioactive markers using yellow and purple are acceptable if already installed and (or) until existing supplies are depleted, subject to pertinent Federal Regulations.

2. Markers with black letters on a green color field are acceptable if already installed and (or) until existing supplies are depleted.

Table 4. Examples of Legend.

"HOT WATER"	"HYDRAULIC OIL"
"SLURRY"	"FOAM"
"AIR 100 PSIG"	"CARBON TETRACHLORIDE"
"ARGON 500 PSIG"	"CAUSTIC"
"PROPANE"	"SULFURIC ACID"
"H.P. RETURN"	"STEAM 100 PSIG"

Table 5. Examples of Color Applications.

Black and White	**Brown**	**Green**	**Yellow**
Lettering on piping system and compressed gas cylinders.	Piping system containing toxic and poisonous materials.	Piping system containing oxidizing materials.	Piping system containing radioactive substances.
Black			
Piping system containing raw or nonpotable water.	Compressed gas cylinders containing toxic and poisonous materials.	Compressed gas cylinders containing oxidizing materials.	Piping system containing flammable materials.
White			
Piping system containing water safe (potable) for human consumption.			
Blue	**Gray**	**Magenta**	
Piping system containing anesthetics and harmful materials.	Piping system containing physically dangerous materials.	Radioactive sampling connections.	
Compressed gas cylinders containing anesthetics and harmful materials.	Compressed gas cylinders containing physically dangerous materials.	Lettering piping system containing radioactive substances.	

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Chief of Safety

Attachment 1

GLOSSARY OF REFERENCES, ABBREVIATIONS, ACRONYMS, AND TERMS

References

Air Force Instruction 91-301, *Air Force Occupational and Environmental Safety, Fire Protection, and Health (AFOSH) Program*

Air Force Occupational Safety and Health (AFOSH) Standard 91-8, *Medical Facilities* (formerly designated as AFOSH Standard 127-8)

AFOSH Standard 91-38, *Hydrocarbon Fuels General*

American National Standards Institute (ANSI) A13.1, *Identification of Piping Systems*

ANSI Z53.1, *Marking Physical Hazards*

Federal Standard 595a, *Colors*

Military Standard (Mil Std) 101B, *Color Code for Pipelines for Compressed Gas Cylinders*

Mil Std 161F, 1 *Identification Methods for Bulk Petroleum Products Systems Including Hydrocarbon Missile Fuels*

Occupational Safety and Health Administration (OSHA) 29 Code of Federal Regulations (CFR) 1910, Subpart J, *General Environment Controls*

Abbreviations and Acronyms

AFI—Air Force Instruction

AFOSH—Air Force Occupational Safety and Health

AFSC—Air Force Safety Center

ANSI—American National Standards Institute

CFR—Code of Federal Regulations

DRU—Direct Reporting Unit

FOA—Field Operating Agency

GSA—General Services Administration

HQ—Headquarters

MAJCOM—Major Commands

Mil Std—Military Standard

OSHA—Occupational Safety and Health Administration

PDO—Publishing Distribution Office

psig—Pounds Per Square Inch, Gauge

WWW—World-Wide Web

Terms

Shall—Indicates a mandatory requirement.

Will—Is also used to indicate a mandatory requirement and in addition is used to express a declaration of intent, probability, or determination.

Should—Indicates a preferred method of accomplishment.

May—Indicates an acceptable or satisfactory method of accomplishment.

Definitions

Dangerous Materials—Materials that are hazardous to life or property because they are toxic or easily ignited; corrosive at high temperatures or pressures; or produce poisonous gases or are in themselves poisonous.

Fire Protection Sprinkler—systems and other fire fighting or fire protection equipment/systems.

Legend—A legend is any lettered identification on a piping system. The legend will identify the contents by complete names or by generally recognized abbreviations, symbols, letters, numerals, or combinations thereof.

Physical Hazard and Obstruction—Specific hazards of such nature that failure to identify them may lead to accidental injury to workers and (or) property damage.

Piping Systems—Any pipes or conduit used for conveying gases, liquids, or semi-liquids, except those carrying solids in air or gas. Valves, buried piping fittings, and operating accessories are specifically excluded from application of warning colors.

Primary Warning Color—This color appears as a circular band on piping systems and identifies a material which is classified by its primary hazard.

Protective Materials—Materials used for the express purpose of preventing or minimizing the hazards of dangerous materials. This group includes protective materials for purposes other than for fire protection.

Safe Materials—Materials involving little or no hazard to life or property. They include materials at low pressure and temperatures; those that are not toxic or poisonous; and those that will not produce fires or explosions.

Secondary Warning Color—This color appears as arrows (or triangles) on piping systems and identifies a material with a second hazard distinctly different from that indicated by its primary color.

Attachment 2

CHECKLIST

This is not an all-inclusive checklist; it simply highlights some critical items in this standard. Other requirements exist that are not included in the checklist. Where appropriate, MAJCOMs, DRUs, FOAs, local safety personnel, and supervisors will add to this checklist to include command or individual shop-unique requirements or situations.

A2.1. Is each location evaluated and the number of markings kept at a minimum? (Reference paragraph **2.3.**).

A2.2. Are piping systems labeled and color coded if they contain: (Reference paragraph **2.4.**)

- Flammable or easily ignited materials?
- Toxic or poisonous gases or materials?
- Corrosive materials?
- Fire protection materials?
- Compressed air at or above 30 psig?
- Potable water above 75 psig?
- Radioactive substances?
- Oxidizing materials?
- Steam?

A2.3. Do the colors used to distinguish the hazard potential of piping systems conform to those in this standard? (Reference paragraphs **2.5.** and **2.6.**)

A2.4. Does the method of identification of piping systems conform to the requirements in paragraph **2.7.**?

A2.5. Are hazardous materials in piping systems identified per requirements in paragraph **2.8.**? Are these titles lettered in black or white only, in clearly visible locations, and in at least the sizes recommended? (Reference paragraph **2.8.**)

A2.6. Are secondary hazards identified as required in paragraph **2.9.**?

A2.7. Is the administrative control established by this standard included in job safety training required by AFI 91-301? (Reference paragraph **3.**)

A2.8. Is material in a piping system classified per the requirements in paragraph **4.**, using **Table 3.**, **Table 4.**, and **Table 5.**?