Scientific Equipment & Furniture Association
Recommended Practices

SEFA 7-2021 - Laboratory Fixtures

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SEFA SPELLS SAFE

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Foreword

SEFA Profile

The Scientific Equipment and Furniture Association (SEFA) is an international trade association comprised of manufacturers of laboratory furniture, casework, fume hoods and members of the design and installation professions. The Association was founded to promote this rapidly expanding industry and improve the quality, safety and timely completion of laboratory facilities in accordance with customer requirements.

SEFA Recommended Practices

SEFA and its committees are active in the development and promotion of Recommended Practices having domestic and international applications. Recommended Practices are developed by the association taking into account the work of other standard-writing organizations. Liaison is also maintained with government agencies in the development of their specifications.

SEFA's Recommended Practices are developed in and for the public interest. These practices are designed to promote a better understanding between designers, architects, manufacturers, purchasers, and end-users and to assist the purchaser in selecting and specifying the proper product to meet the user's particular needs. SEFA's Recommended Practices are periodically updated. The Recommended Practices are numbered to include an annual suffix which reflects the year that they were updated. SEFA encourages architects to specify these Recommended Practices as follows: "SEFA 7-2021".

SEFA Glossary of Terms

SEFA has developed a Glossary of Terms (SEFA 4-2021) for the purpose of promoting a greater understanding between designers, architects, manufacturers, purchasers and end users. The terms defined by SEFA are frequently used in contracts and other documents, which attempt to define the products to be furnished or the work involved. The Association has approved this Glossary in an effort to provide uniformity among those who use these terms. Where a specific Recommended Practice contains definitions which differ from those in the Glossary of Terms, then the definitions in the specific Recommended Practice should be used.

SEFA encourages all interested parties to submit additional terms or to suggest any changes to those terms already defined by the Association. The definitions should be used to help resolve any disputes that may arise or to incorporate the applicable terms in any contract or related documents.

SEFA Disclaimer

SEFA uses its best effort to promulgate Recommended Practices for the benefit of the public in light of available information and accepted industry practices. SEFA does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with SEFA Recommended Practices or that any tests conducted under its Recommended Practices will be non-hazardous or free from risk. SEFA encourages the use of third party independent testing where appropriate.

Note : Testing as described in this document must be performed and documented by a SEFA-approved third party testing facility. See Page 36 of the SEFA Desk Reference or visit us at SEFALABS.COM for the most current list of SEFA-approved test labs.

1.0 Scope

These Recommended Practices apply to (i) laboratory service fittings and fixtures, including faucets, valves and related products, and (ii) safety equipment, consisting of emergency eye washes, emergency showers and related products.

2.0 Purpose

SEFA has developed and made available these Recommended Practices as a guide for regulatory agencies, architects, engineers, consultants, specification writers, contractors, manufacturers and dealers of laboratory furniture, installers, facilities managers and users who specify, recommend for purchase, install and/or use laboratory service fittings and safety equipment. It is intended to provide the laboratory community with the most suitable products for dependable performance and safe sanitary installations. Specific construction features of the products covered by these Recommended Practices have not been considered.

3.0 References

"Plumbing Fixture Fittings", ASME A112.18.1-2005

"Standard Specification for Copper Alloys in Ingot Form", ASTM B30-04

"Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes", ASTM B124 / B124M-04

"Standard Specification for Seamless Brass Tube", ASTM B135-02

"Standard Specification for Seamless Red Brass Pipe, Standard Sizes", ASTM B43-98 (2004)

"Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines", ASTM B16 / B16M-05

"Standard Specification for Seamless Copper Water Tube", ASTM B88-03

"Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire", ASTM B211-03

"Standard Specification for Aluminum-Alloy Sand Castings", ASTM B26 / B26M-03

"Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium", ASTM B456-03

"Standard Specification for Qualitative Adhesion Testing of Metallic Coatings", ASTM B571-97 (2003)

"Standard Test Method for Chipping Resistance of Coatings", ASTM D3170-03

"Standard Test Method for Mandrel Bend Test of Attached Organic Coatings", ASTM D522-93a (2001)

"Standard Test Methods for Measuring Adhesion by Tape Test", ASTM D3359-02

"Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes", ASTM D1308-02

"Standard Guide for Testing Coating Powders and Powder Coatings", ASTM D3451-01

"Standard Specification for Polypropylene

Injection and Extrusion Materials", ASTM D4101

"Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves", ANSI Z21.15-1997 / CGA 9.1-M97

"Performance Requirements for Atmospheric Type Vacuum Breakers", ASSE 1001-2002

"Performance Requirements for Laboratory Faucet Backflow Preventers", ASSE 1035-2002

Powder Coating – The Complete Finisher's Handbook, The Powder Coating Institute – 1999

"Uniform Plumbing Code", **IAPMO/ANSI UPC 1-2003**

4. 0 Definitions

Accessory - A component that can, at the discretion of the user, be readily added, removed, or replaced, and that, when removed, will not prevent the fitting from fulfilling its primary function. Includes outlet fittings such as serrated hose ends, aerators and aspirators.

Air Gap - The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture or other device and the mounting surface of the fitting.

Aerator - A type of outlet fitting that is designed to deliver a mixture of air and water. An aerator may incorporate an internal flow control to deliver water at a specific rate (usually specified in gallons or liters per minute).

Angle Pattern Valve - A valve that has its inlet port and outlet port at 90° to each other, with the operating stem at 180° to the inlet port.

Aspirator - A type of outlet fitting that, when water is passed through it, develops a vacuum through a side port. Also referred to as a "filter pump".

Atmospheric Vacuum Breaker - A device containing a float check, a check seat and an air inlet port. The flow of water into the body causes the float to close against the air inlet port. When the flow of water stops, the float falls and forms a check valve against back siphonage and at the same time opens the air inlet port to allow air to enter and relieve the vacuum.

Ball Valve - A type of valve used for controlling water or gases. The valve operates by means of a spherical "ball" that is positioned between two seals that are within a body housing and press against the ball to form a watertight or gastight seal. Rotation of the ball 90 degrees opens and closes the valve.

Celcon®- An acetyl copolymer.

Check Valve - A valve that permits flow in one direction only. The valve is designed to close automatically to retard or obstruct the flow in a reverse direction.

Cold Water - For test purposes, water at a temperature of 40°F to 70°F (5°C to 21°C).

Combination Fitting or Faucet - A supply fitting with more than one supply inlet delivering a mixture of hot and cold water through a single spout. May also be referred to as a "mixing faucet."

Critical Level - The level at which polluted water, entering through an outlet of the supply fitting, will flow back to the supply lines by gravity and/or any pressure below atmospheric in the supply line when the water control valve is wide or fully open.

Dead Leg - A sump, or area of entrapment, in a vessel or a piping system where contamination can occur.

Deck Mounted Fitting - A fitting that mounts on a horizontal surface.

Diaphragm or Bellows Valve - A type of valve used for controlling water or gases that utilizes a diaphragm or bellows to separate the operating components of the valve (such as the valve stem and bonnet) from the areas through which the gas flows through the valve. These valves are used to prevent permeation of atmospheric impurities into a gas flowing through the valve, as well as to control gas or vapor flow in vacuum networks. These valves are sometimes also referred to as "packless" valves.

ETFE - Ethylene Tetrafluoroethylene, a fluoropolymer with excellent chemical resistance and thermal properties.

Effective Waterway - (Opening) The minimum cross-sectional area at the point of water supply discharge, measured or expressed in terms of (i) the diameter of a circle, or (ii) if the opening is not circular, the diameter of a circle of equivalent cross-section area.

Fine vacuum - Vacuum (see definition) in the range between 1 Torr and 0.001 Torr.

FFKM - a perfluoroelastomer with excellent flexibility and better heat and chemical resistance

than neoprene or nitrile rubber. May be used in gaskets or seals in valves exposed to corrosive chemicals.

FKM - A fluoroelastomer with excellent heat and chemical resistance. Also known as FPM under ISO standards.

Fitting - A device designed to control and/or guide the flow of water, gases, vacuum or steam. Also referred to as a "service fitting".

Faucet - A device designed to control and/or guide the flow of water. A faucet generally incorporates some type of gooseneck or spout.

Fixture - In the plumbing industry, a fixture refers to a sink or receptacle that receives water or water-borne wastes and discharges into a drainage system. However, in the laboratory field, the term "fixture" has been used to describe a fitting or service fitting. Also referred to as a "laboratory fixture", "service fixture" or "laboratory service fixture."

Flange - A type of mounting fitting generally used to hold a valve perpendicular to a wall or other vertical surface. May also be referred to as a "panel flange." Alternately, the term is used to describe a type of surface-to-surface connection between piping used in sanitary systems or vacuum devices.

Flood Level Rim - The top edge of a receptor over which water would overflow.

Foot Operated Valve - A valve for water service that is operated by the user's foot. The valve may be either single or mixing and may be mounted on the floor, a ledge or a wall. Also referred to as a "pedal valve."

FPM - A fluoroelastomer with excellent heat and chemical resistance. FPM is the material's designation under ISO standards. Known as FKM in North America.

Front Loaded Remote Control Valve - A valve for use on a fume hood that is installed on the front face or post of the fume hood. The valve is usually designed so that the working components of the valve are accessible from the front exterior face of the hood. Also referred to as a "panel mounted remote control valve."

Fuel Gas - A gas that can be burned to supply heat. In laboratory applications, fuel gas generally refers to natural gas.

Gas - In laboratory applications, may refer to either fuel gas or to other substances in a gaseous state, such as nitrogen, helium, argon and oxygen. These latter gases may also be referred to as "special gases" or "cylinder gases."

Gas Purity - The purity of a gas is a function of the quantity of impurities present in a sample of the gas. A gas that is 99.999% pure has .001% impurities in it. A gas that is 99.998% pure has .002% impurities in it.

Gas purity may also be designated by a two digit code. The first digit of the code represents the "number of nines" in the percentage value designating the purity of the gas and the second digit indicates the last decimal digit, if it is smaller than "nine". For example, a gas that is 99.999% pure is referred to as being a "5.0" gas. A gas that is 99.998% pure is referred to as being a "4.8" gas.

Ground Key Cock - A type of valve used for controlling low pressure gases. The valve operates by means of a tapered cylindrical plug that fits into a matching tapered bore in the valve body. The tapered plug is ground and lapped and held in the valve body under continuous pressure to form a gastight seal in the valve body. Rotation of the tapered plug 90 degrees opens and closes the valve.

Gooseneck - A component of a faucet, usually fabricated of pipe or tubing and usually in the shape of the letter U, whose function is to direct the flow of water into a sink or receptor. Goosenecks may be of the rigid, swing or convertible rigid/swing type and may incorporate a vacuum breaker.

High Purity Gases - Any gas that has a level of purity or chemical composition that is certified as high purity by the gas manufacturer. For purposes of these Recommended Practices, high purity gases are gases with a certified purity level up to 5.0; ultra high purity gases have a certified purity

level greater than 5.0 (see definition of "gas purity" above).

Index Button - An indicator fitted into the top surface of the handle of a fitting that serves to identify the media or service being supplied by the fitting. For standards for color coding and symbols of services, refer to Section 6.

Manifold - A pipe or tube on which multiple fittings or outlets are mounted in parallel, relatively close together. On a typical manifold, one end is connected to a supply and the other end is plugged.

Manual Control - A type of valve mechanism wherein, once the valve is opened, the valve remains open until it is manually closed. Also referred to as "compression control."

May - When used, indicates an alternate requirement or option**.**

Mixing Valve, Faucet or Fitting - A valve or faucet designed to mix hot and cold water by means of automatic or manual regulation.

Mixing Valve, Single Control - A fitting with a single handle or control that shall serve to turn water on and off, and to change volume and temperature by means of a single handle.

Monel - An alloy of approximately 67% nickel, 28% copper and 5% other elements that is made by direct reduction from ore in which the constituent metals occur in these proportions**.**

Mounting Fitting - A fitting used to install or mount a valve on a horizontal or vertical surface. Examples of mounting fittings include turret bases, panel flanges and wye fittings.

Mounting Shank - A threaded length of pipe used for securing a fitting to a horizontal or vertical surface and to supply water, gas or other media to the fitting. The pipe should be machined with a taper pipe thread to connect to the fitting, a straight pipe thread for a locknut and either a straight or taper pipe thread to connect to the supply line. The mounting shank should be supplied by the manufacturer with a locknut and lockwasher. Also referred to as a "supply nipple" or "tank nipple."

Needle Valve - A type of valve in which an orifice is opened or closed by means of a needle or cone that is moved into or withdrawn from it.

Nipple - A short piece of pipe that is threaded at both ends.

Outlet Fitting - An accessory that is installed in the outlet end of a fitting.

Pedestal - See Turret Base.

Polyethylene (PE) - A plastic polymer of ethylene.

Polypropylene (PP) - Any of various thermoplastic plastics that are polymers of propylene.

PPS Polyphenylene Sulfide - A chemical and heat resistant organic polymer.

PTFE Polytetrafluoroethylene - A synthetic fluoropolymer with excellent thermal and chemical resistance. Most familiar as DuPont's Teflon®

Polyvinyl Chloride (PVC) - A water insoluble, thermoplastic material derived by the polymerization of vinyl chloride.

Polyvinylidene Flouride (PVDF) - A fluoropolymer that is chemically resistant to most acids, bases and organic solvents.

Potable Water - Water that is satisfactory for drinking, culinary, and domestic purposes, and meets the requirements of the health authority having jurisdiction.

Pressure Gauge - An instrument that measures and indicates the pressure of a liquid or gas.

Pressure Regulator - A device that regulates the pressure of a liquid or gas that is delivered through it.

Push/Turn Valve - A type of valve that has a handle that locks in the closed position and must be pushed down to permit the handle to rotate to open the valve. The internal construction of the valve shall incorporate rotating ceramic discs

or other type of valve mechanism suitable for the intended use. Push/turn valves are generally used for natural and other burning gases.

Quick Connect - A fitting consisting of a body and a plug that interlock together to form a watertight or gastight connection. The body and plug may each have an internal valve to shut off the supply line when the two components are disconnected. The body and plug may also be keyed to form a matched set. Also referred to as a "quick disconnect."

Remote Control Valve - A type of valve for use in a fume hood, where the handle of the valve is located on the outside of the hood (generally on the front face or post of the hood or underneath the hood). A remote control valve is usually connected to an outlet fitting that is installed within the interior of the fume hood. A remote control valve can be either a rod-type valve or a front loaded valve (see definitions).

Renewable Unit - A cartridge or unit that contains all of the working components of a valve and can be removed from the fitting body and replaced without disturbing the fitting body. Also referred to as a "replaceable unit."

Rod-Type Remote Control Valve - A type of remote control valve where the valve is mounted within the side wall or underneath the fume hood. The valve is fitted with an extension rod that projects from the valve through the face of the hood or through the apron underneath the hood and a handle is mounted on the end of the rod**.**

Rough vacuum or low vacuum - Vacuum (see definition) in the range between atmospheric pressure and 1 Torr. This pressure level is suitable for most laboratory suction and evaporative applications.

Seat - The surface around or within an orifice in a faucet or valve through which water or gas flows and against which a closing member, such as a disc or washer, is pressed or seated to terminate the flow. Also referred to as a "valve seat." A "renewable seat" is a seat that is separate from the valve body and can be removed and replaced, either with or without a tool.

Seat Disc - A disc or washer that, when compressed against a seat, provides a watertight or gastight seal. Also referred to as a "valve disc" or "bib washer".

Self-Closing Control - A type of valve mechanism that closes automatically when the handle is released.

Serrated Hose End - A fitting that has graduated serrations that will accommodate hose or tubing at the point of connection. Also referred to as a "serrated nozzle" or "serrated tip."

Service - The supplying of utilities such as water, air, gas, vacuum and steam as required in a laboratory. "Service" or "media" also refers to the specific liquid or gas that is delivered by a particular fitting.

Service Fitting - Any device that controls and/or guides the flow of a service in a laboratory.

Shall - Where used, indicates a mandatory requirement.

Single Valve, Faucet or Fitting - When used with reference to a water fitting, a fitting that delivers either cold, hot or tempered water only, without the capability of mixing the water.

Significant Surface - An exposed surface that, if marred, would detract from the appearance of the fitting.

Standard Tools - Tools, such as a screwdriver, key wrench, flat jawed wrench, strap wrench and pliers, which are normally carried by plumbers for the installation and maintenance of plumbing.

Straight Pattern Valve - A valve that has its inlet port and outlet port at 180° to each other, with the operating stem at 90° to the inlet port.

Torr - A unit of vacuum measurement for absolute pressure (that is, not relative to local atmospheric pressure) in which theoretical absolute vacuum is zero, and all other vacuum levels (including, for example, sea level atmospheric pressure of about 760 Torr) are on the same continuous scale.

Turret or Turret Base - A type of mounting fitting, usually cylindrical in shape, used to install one or more fittings on a horizontal or vertical surface. The fittings are held parallel to the surface on which the turret base is installed.

Vacuum - Pressures below atmospheric pressure used in labs variously for suction applications (e.g., filtration, aspiration), evaporative applications (e.g., concentration, distillation, drying) or to create conditions for analysis or fabrication. Vacuum may be measured as a gauge unit (relative to local atmospheric pressure) or on an absolute scale in which theoretical perfect vacuum is set at zero.

Vacuum Breaker - A device to prevent the creation or formation of a vacuum in a piping system by admitting air at atmospheric pressure. A vacuum breaker is used to prevent back siphonage. A vacuum breaker used on a laboratory faucet may be either an atmospheric vacuum breaker (as defined above) or a laboratory faucet vacuum breaker having two independent acting check valves.

Valve - A device or fitting by which flow may be started, stopped or regulated by a movable part that opens or obstructs one or more passages.

Water - The liquid that descends from the clouds as rain, forms streams, lakes and seas, and is a major constituent of all living matter and that is an odorless, tasteless, very slightly compressible liquid oxide of hydrogen which appears bluish in thick layers, freezes at 0 C and boils at 100 C, has a maximum density at 4 C and a high specific heat, is feebly ionized to hydrogen and hydroxyl ions, and is a poor conductor of electricity and a good solvent.

Wrist Blade Handle - A handle that permits the control of a faucet with the wrist or forearm.

Wye Fitting - A type of mounting fitting that is similar to a panel flange except with two outlets.

5.0 Materials and Finishes

5.1 Materials Used in Laboratory Fittings

All materials used in laboratory service fittings shall be of the highest quality, shall be suitable for the intended use and shall meet or exceed the applicable standards listed below:

Brass Castings. Red brass castings shall be made of commercial red brass alloy conforming to ASTM Specification B30-04, C/Metal alloy, having a nominal composition of 81% copper.

Brass Forgings. Brass forgings shall conform to ASTM Specification B124-74, Alloy No. 377, having a nominal composition of 59% copper.

Seamless Brass Tube. Seamless brass tubing shall conform to ASTM Specification B135-74, Alloy No. 280, having a nominal composition of 60% copper.

Seamless Red Brass Pipe. Seamless red brass pipe in standard sizes shall conform to ASTM Specification B43-74, having a nominal composition of 84 to 86% copper.

Free-Cutting Brass Rod, Bar & Shapes for Use in Screw Machines. Components fabricated of free-cutting brass rod, bar and shapes for use in screw machines shall conform to ASTM Specification B16-74, having a nominal composition of 60 to 63% copper.

Aluminum Castings. Aluminum castings shall conform to ASTM Specification B26-74, Alloy No. SG70A, having a chemical composition of 0.25% maximum copper, 0.6% maximum iron, 6.5% to 7.5% range silicon, 0.35% maximum manganese, 0.20% to 0.40% range magnesium, 0.35% maximum zinc, 0.25% maximum titanium, 0.15% maximum total other, and balance aluminum.

Aluminum Rod, Bar, Tube and Shapes. All components fabricated of aluminum rod, bar, tube, and shapes shall conform to ASTM Specification B211-74, Alloy No. 6061-T6, having a nominal composition of 1.0% magnesium, 0.6% silicon, 0.25% chromium, 0.25% copper, and balance aluminum.

Polypropylene. All components fabricated of polypropylene shall be non-pigmented and conform to ASTM Specification D4104**.**

5.2 Finishes for Laboratory Service Fixtures and Safety Equipment

5.2.1 Finish Types

The finish on laboratory service fittings and safety equipment shall be categorized as either a (i) chrome plated finish, or (ii) a corrosion resistant coated finish. Other types of finishes are not recommended for use in a laboratory environment.
If the materials of construction for laboratory service fittings and safety equipment are inherently suitable for the intended use - for example, including but not limited to corrosion resistant to common laboratory chemicals - then these materials shall conform to the requirements of Section 5.2.3 Corrosion Resistant Finishes. If the materials of construction for laboratory service fittings and safety equipment are not inherently suitable for the intended use - for example, not resistant to corrosion by common laboratory chemicals - then the finish on laboratory service fittings and safety equipment shall be categorized as either a (i) chrome plated finish, or (ii) a corrosion resistant coated finish. Other types of finishes are not recommended for use in a laboratory environment.

5.2.2 Chrome Plated Finishes

5.2.2.1 Description of Chrome Plated Finishes

Chrome plated finishes shall consist of either (i) a layer of chromium applied over a layer of nickel applied over a layer of copper that is applied over all exposed surfaces of the components of the fitting itself, or (ii) a layer of chromium applied over a layer of nickel that is applied over all exposed surfaces of the components of the fitting itself. Chrome plated finishes shall be applied in conformance with "Standard Specifications for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium asefaland Nickel Plus Chromium", ASTM B456-03. Finishes shall meet the requirements for Service Condition No. SC 4 (Very Severe Service) for nickel plus chromium coatings on copper or copper alloys.

5.2.2.2 Performance Tests for Chrome Plated Finishes

Chrome plated finishes shall meet the requirements for adhesion as specified in "Standard Practice for Qualitative Adhesion Testing of Metallic Coatings", ASTM B571-97. The applicable tests shall be the (i) burnishing test, (ii) chisel-knife test, (iii) file test, and (iv) peel test.

5.2.3 Corrosion Resistant Finishes

5.2.3.1 Description of Corrosion Resistant Finishes

Corrosion resistant finishes shall be an organic coated finish applied to all exposed surfaces of the fitting. The finish may be either colored or clear. Coating material shall be either epoxy, epoxy/polyester hybrid, or polyester. Corrosion resistant finish can be applied as either a wet finish or a dry, powder coated finish. In either case, following application of the coating material, the fitting shall be baked to cure the coating material.

5.2.3.2 Performance Tests for Corrosion Resistant Finishes

Corrosion resistant finishes shall meet the following tests:

a. Fume Test.

Prepare samples of fittings having the corrosion resistant finish to be tested. Suspend samples in a container at least 6 cubic feet capacity, approximately 12" above open beakers, each containing 100 cc of 70% nitric acid, 94% sulfuric acid and 35% hydrochloric acid, respectively. After exposure to the fumes from these reagents for 150 hours, the finish shall show no discoloration, disintegration or other effects.

b. Direct Application Test

Prepare samples of flat brass panels with the corrosion resistant finish to be tested. The test shall consist of direct application of the reagents listed below.

Test Method A — For volatile chemicals, chemical spot tests shall be made by placing a cotton ball saturated with the reagent on the surface to be tested and covering with an inverted two-ounce wide mouth bottle to retard evaporation.

Test Method B — For nonvolatile chemicals, chemical spot tests shall be made by applying five (5) drops of each reagent to the surface to be tested and covering with a 1 1/4" diameter watch glass (concave side down) to confine the reagent.

All spot tests shall be conducted in such a manner that the test surface is kept wet throughout the entire test period and at a temperature of 77° F ±3° F. For both methods, leave the reagents on the panel for a period of one hour. At the end of the test period, (i) the reagents shall be flushed from the surface with water, (ii) the surface shall be scrubbed with a soft bristle brush under running water, and (iii) the surface shall be rinsed and dried. **Immediately prior to evaluation, 16 to 24 hours after the reagents are removed, the test surface shall be scrubbed with a damp towel and dried.**

Note: Where concentrations are indicated, percentages are by weight

Test Evaluation: Evaluation of test results shall be based on the following rating system:

Test No.	Chemical Reagent	Test Method
1.	Acetate, Amyl	A
2.	Acetate, Ethyl	A
3.	Acetic Acid, 98%	B
4.	Acetone	A
5.	Acid Dichromate, 5%	B
6.	Alcohol, Butyl	A
7.	Alcohol, Ethyl	A
8.	Alcohol, Methyl	A
9.	Ammonium Hydroxide, 28%	B
10.	Benzene*	A
11.	Carbon Tetrachloride	A
12.	Chloroform	A
13.	Chromic Acid, 60%	B
14.	Cresol	A
15.	Dichloroacetic Acid	A
16.	Dimethylformamide	A
17.	Dioxane	A
18.	Ethyl Ether	A
19.	Formaldehyde, 37%	A
20.	Formic Acid, 90%	B
21.	Furfural	A
22.	Gasoline	A
23.	Hydrochloric Acid, 37%	B
24.	Hydrofluoric Acid, 48%	B
25.	Hydrogen Peroxide, 30%	B
26.	Iodine, Tincture of	B
27.	Methyl Ethyl Ketone	A
28.	Methylene Chloride	A
29.	Mono Chlorobenzene*	A
30.	Naphthalene	A
31.	Nitric Acid, 20%	B
32.	Nitric Acid, 30%	B
33.	Nitric Acid, 70%	B
34.	Phenol, 90%	A
35.	Phosphoric Acid, 85%	B
36.	Silver Nitrate Saturated	B
37.	Sodium Hydroxide 10%	B
38.	Sodium Hydroxide 20%	B
39.	Sodium Hydroxide 40%	B
40.	Sodium Hydroxide Flake	B
41.	Sodium Sulfide Saturated	B
42.	Sulfuric Acid, 33%	B
43.	Sulfuric Acid, 77%	B
44.	Sulfuric Acid 96%	B
45.	Sulfuric Acid 77% & Nitric Acid 70% equal parts	B
46.	Toluene	A
47.	Trichloroethylene	A
48.	Xylene	A
49.	Zinc Chloride, Saturated	B

If the use of this chemical is permitted by law, in the country where this testing is being performed.

Level 0 – No detectable change.
Level 1 – Slight change in color or gloss.
Level 2 – Slight surface etching or severe staining.
Level 3 – Pitting, cratering, swelling, or erosion of coating. Obvious and significant deterioration.

Acceptance Level: Results will vary from manufacturer to manufacturer. Corrosion resistant finishes should result in no more than four Level 3 conditions. Suitability for a given

application is dependent upon the chemicals used in a given laboratory.

c. Adhesion Test

Corrosion resistant finishes shall meet the standards set forth in "Standard Test Methods for Measuring Adhesion by Tape Test", ASTM D3359-02, "Standard Test Method for Mandrel Bend Test of Attached Organic Coatings", ASTM D522-93a and "Standard Test Method for Chipping Resistance of Coatings", ASTM D3170-03.

5.2.4 Inherently corrosion-resistant materials

5.2.4.1 Description of inherently corrosion-resistant materials

Certain plastic materials are inherently resistant to chemicals commonly used in laboratories. These materials may be molded, cast or machined directly into components of laboratory fixtures without need for a protective finish.

5.2.4.2 Performance tests for inherently corrosion resistant materials

Inherently corrosion-resistant materials shall be able to meet the standards prescribed in Section 5.2.3.2 for evaluation of corrosion-resistant finishes, with the following modifications:

a. The fume test is directly applicable.

b. For the direct application test, solid plastic parts can be tested directly without preparation of flat panel plastic samples. Covering glasses as small as possible but of suitable size to cover the sample completely shall be used.

6.0 Color Coding

The handle of each laboratory fitting (except pressure regulators) shall be marked to indicate the particular liquid or gas or other service that is delivered by or through such fitting. The handle or index button fastened to the handle shall be color coded, and the handle or index button shall be marked with a symbol to designate the service. Letters or symbols used to designate the service shall be legible and easy to read. Coding shall be in accordance with the prevailing standard for the location of the installation. Refer to Appendices 1 & 2.

7.0 General Requirements for Laboratory Service Fittings

7.1 Workmanship

Laboratory service fixtures shall be of superior workmanship. Working parts shall be uniform and shall have smooth, even machining free of burrs, rough edges and ragged threads.

7.2 Handling

Fittings and components shall withstand normal handling and installation without damage or distortion of any part. Where special handling of a fitting is required, appropriate instructions shall either be attached to the fitting or packaged therewith.

7.3 Installation

7.3.1 Fitting Design

Fittings shall be designed to readily facilitate field installation, as follows:

a. All fittings shall be provided with suitable means to connect to a type of supply line in common use in laboratories.

b. The fitting manufacturer shall design its fittings or shall otherwise provide that fittings may be installed and connected without marring the finish or otherwise damaging the fitting or the surface on which it is to be mounted.

c. Deck mounted fittings shall be designed to be mounted on counter tops up to 1.5 inches (38mm) thick. The diameter of the base of the fitting, flange, or cover plate shall not be less than 1.5 inches (38mm).

d. Panel mounted combination hot and cold water faucets shall be furnished with union type inlets for ease of installation. The diameter of the flange or cover plate shall not be less than 1 1/2 inches.

e. Means shall be provided to securely mount the fitting to withstand loading normally encountered in service.

7.3.2 Field Installation

The installer responsible for the installation of laboratory service fittings shall follow good plumbing practice. Installers shall, in particular:

a. Thoroughly clean and flush supply lines prior to installing fittings, as pipe shavings, scale and other debris can be carried through a pipe and into a faucet or valve when the plumbing system is activated. Such foreign matter can damage valve components and interfere with the proper operation of the fitting.

b. Observe the manufacturer's recommended test and working pressures for fittings. Testing or using a fitting with materials or at pressures for which it is not designed can result in leakage, contamination or failure.

c. Clean fittings using a soft cloth and soapy water. Use of abrasives, detergents or other cleaners can damage the finish on a fitting. Solvents shall not be used in or near water or gas supply fittings, as solvents can dissolve lubricants used in the valve mechanism of a fitting.

7.4 Threads and Other Connections

7.4.1 Pipe Threads / Inlet Connections

a. Straight pipe threads on inlets and field assembled joints shall conform to ISO 228/1.

b. Taper pipe threads on inlets and field assembled joints shall conform to ASME B1.20.1 or ISO 7/1

7.4.2 Inlets for Sink Fittings

Shank lengths of deck mounted fittings shall be at least 1 ¾ inches (45 mm).

7.4.3 Solder Connections

The dimensions of solder joint end for connection to copper tube or copper tube fittings, except factory assembled parts, shall conform with respect to length and diameter of the joint section to the dimensions given in ASME B16.18 or ASME B16.22.

7.4.4 Compression Connections

Connections used on thin wall tubing which rely on an outer compression nut and an inner compression ring or ferrule to create reversible, leak-tight fittings. Fittings may be designed for positive pressure or negative pressure (vacuum) applications, and the appropriate fitting chosen for the application according to manufacturer instructions.

7.5 Marking

7.5.1 Product Marking

a. Each fitting shall bear permanent legible markings to identify the manufacturer. This marking shall be the trade name, trademark, or other mark known to identify the manufacturer or in the case of private labeling, the name of the customer or trademark for whom the fitting was manufactured. Such marking shall be located where it can be seen after installation. This marking shall be by means of either a permanent mark or a permanent label on the product.

b. Permanent labels shall comply with the performance requirements of UL 969 or ISO 61010, the standard prevailing for the geographic location of installation. Labels shall comply with the requirements for indoor use where exposed to high humidity or occasional exposure to water, and shall have a temperature rating of at least 176 F (80 C).

7.5.2 Packaging

The package shall be marked with the manufacturer's name and model number, or in the case of private labeling, the name of the customer or trademark for whom the fitting was manufactured.

8.0 Water Faucets and Fittings

8.1 General Requirements

8.1.1 Working Pressures

All faucets and fittings for water service shall be designed to function at water working gauge pressures between 20 PSI (140 kPa) and 125 PSI (860 kPa), and for intermittent shock gauge pressures up to 180 PSI (1,240 kPa).

8.1.2 Working Temperatures

All faucets and fittings for water service shall be designed to function at supply temperatures from 40 F (4C) to 150 F (66 C) and shall withstand 180 F (82 C) for 0.5 hours without failure of the pressure envelope.

8.2 Valve Construction

a. All faucets and fittings for water service shall be designed to have either (i) a renewable unit or cartridge containing all working components subject to wear, or (ii) renewable working components, including seat, seat disc and seals. After installation of the faucet or fitting, all wearing parts shall be capable of being replaced and such replacement shall be able to be accomplished without removing the body from the piping or disconnecting the fitting from the supply pipe or surface on which it is installed.

b. Joints which may have to be taken apart to replace worn parts after the fitting is installed shall be designed so that they may be disassembled and reassembled without damaging or marring a significant surface of the fitting or a significant surface on which the fitting is installed.

c. The seat disc arrangement shall be made so that it will neither vibrate nor loosen in service and so that it can be replaced.

d. Packings shall be of such design and quality as to ensure leak-proof joints and be capable of providing satisfactory field service.

8.3 Goosenecks, Spouts and Outlet Fittings

8.3.1 General Construction

Goosenecks and spouts shall be one of the following types:

a. Rigid Construction. Goosenecks and spouts may be rigid (i.e. non-moveable) type. Rigid goosenecks shall thread directly into the faucet body and shall be constructed so as to be immobile in ordinary use. Rigid goosenecks are typically used at cup sink locations.

b. Swing Construction. Goosenecks and spouts may be swing or swivel type. Swing goosenecks and spouts shall be able to swivel around the faucet body. Swing goosenecks are typically used at laboratory sinks.

c. Rigid/Swing or Convertible Construction. Goosenecks and spouts may be rigid/swing or convertible construction. Goosenecks shall be capable of being either rigid or swing, and may be converted in the field from rigid to swing and vice versa.

8.3.2 Packings

Packings shall be of such design and quality as to ensure leak-proof joints and be capable of providing satisfactory field service.

Swing goosenecks and spouts designed to use an adjustable packing in the joint between the spout and the body shall be constructed so that the adjustments can be made without removing the gooseneck or spout.

8.3.3 Outlets

a. The outlet of all goosenecks and spouts shall have a 3/8 inch NPS or NPT female thread or be so designed as to accommodate an adapter with a 3/8 inch NPS or NPT female thread.

b. All outlet fittings and accessories, such as serrated hose ends, aerators and aspirators, shall have a 3/8 inch NPS or NPT male thread or be so designed as to accommodate an adapter with a 3/8 inch NPS or NPT male thread.

8.4 Testing

8.4.1 Strength Tests

8.4.1.1 Burst Strength Test

Fittings shall withstand a hydrostatic gauge pressure of 500 PSI (3,445 kPa) for two (2) minutes. The pressure shall be applied (i) for one (1) minute to the inlet with the valve(s) closed, and (ii) for one (1) minute to the inlet with the outlet blocked and the valve open. The fitting shall not show any permanent distortion or failure of the pressure envelope.

8.4.1.2 Bending Loads on Fittings

No cross section of a rigid waterway on the pressure side of a faucet or fitting shall be damaged when tested in accordance with the following test. A force shall be applied not closer to the cross-section being tested than twice the major diameter of that section. The bending moment shall be as specified below. This requirement shall not apply to waterways through a solder joint or equivalent.

Bending Loads on Fittings:

Nominal Size (In)	Bending Moment, Ft-Lb (N-m)
3/8	30 (40)
½	44 (60)
¾	60 (80)
1	74 (100)

8.4.1.3 Spout Strength Test

Goosenecks and spouts shall withstand a minimum bending moment of 175 in.-lbf (19.7 N-m) at the centerline of the joint between the gooseneck or spout and the body.

The faucet shall be mounted in accordance with the manufacturer's instructions. The angle of the gooseneck or spout outlet shall be measured from the vertical. Sufficient weight shall be applied to the centerline of the spout outlet to generate a 175 in.-lbf (19.7 N-m) bending moment at the centerline of the spout/body joint for three (3) minutes. One-half (.5) hours after the weight has been removed, the spout outlet angle shall be measured. The faucet shall have failed the test if the angle shall have changed from the angle measured prior to loading.

8.4.2 Handle Security Test

a. The faucet or fitting handle shall be designed so that it fits securely to the valve stem of the fitting, with no lateral movement or play, and it will not be damaged by normal use of the fitting to which it is attached. Except for faucets or fittings that are intended to be vandal-resistant (see below), the faucet or fitting handle shall be secured in such a manner that it can be removed in service using standard tools.

b. The handle shall be tested by loading an applied torque or force in the same manner required to close the valve to an amount of (i) 45 in.-lb (5.1 N-m) for rotary motion (torque), and (ii) 45 lbs (200.25 N) for linear normal motion (force). Failure shall be consist of damage or fracture of the handle or valve stem (including damage or stripping of the splines or broach in the handle).

c. The handle shall not fracture or pull off under an axial static load of 150 lbf (667 N).

8.4.3 Valve Operating Test

When closed, valves shall not leak at any test gauge pressure between 20 PSI (140 kPa) and 200 PSI (1,400 kPa) applied to the inlet for 5 minutes. The torque or force required to open or close a manually activated valve shall not exceed (i) 15 in-lb (1.7 N-m) for rotary motion (torque), or (ii) 15 lb (66.75 N) for linear normal motion (force). The force shall be applied at the extreme end of the handle. This test shall not apply to self-closing valves or nonmetallic fittings intended for use with purified water (see below).

8.4.4 Life Tests

8.4.4.1 Life Test for Valves

a. Valves shall be subjected to a life test for 500,000 cycles of operation. After completion of the life test, the valve shall control the flow of water at test pressure with an application of force or torque to the lever or handle not to exceed 50%

more than the valve force or torque specified in Section 8.4.3 above.

b. The test procedure for valves shall be as follows:

1. The cold water supply shall be at ambient temperature and the hot water supply at 140 F +/- 10 F (60 C +/- 5 C). Both supplies shall be at the same flowing gauge pressure of 50 +/- 5 PSI (350 +/- 35 kPa). Manually operated fittings shall be operated from full off to three-eighths of a turn open, but not to exceed three- fourths of the maximum amount of turning from fully closed to fully open, and back to full off (one cycle) at the rate of 1,500 cycles per hour (minimum). The test apparatus shall apply sufficient load to close the valve throughout the test, but shall in no case exceed 50% greater than the load specified in Section 8.2.3 above.

2. Single control mixing valves shall be cycled alternately from off to full hot and back for 30 cycles, and from off to full cold and back for 30 cycles.

8.4.4.2 Life Test for Goosenecks and Spouts

a. Swing goosenecks and spouts shall be subjected to a life test for 50,000 cycles of operation. The swing gooseneck or spout shall (i) hold a hydrostatic gauge pressure of 125 PSI (860 kPa) for 1 minute after 25,000 cycles with the original seal in place; and (ii) hold a hydrostatic gauge pressure of 125 PSI (860 kPa) for 1 minute after 50,000 cycles. The seal may be replaced to pass once during this test.

b. The test procedure for swing goosenecks and spouts shall be as follows. The fitting shall be mounted on the life test apparatus with the axis about which the spout turns in line with the axis of the drive spindle. The forked end of the drive adapter shall be fitted loosely over the spout; the drive adapter shall be free to move vertically and shall be so weighed that a bending torque of 5 in.-lbf (0.6 N-m) shall be applied at the base of the spout; the apparatus shall be adjusted to turn the spout through a 90 degree arc, 45 degrees to each side of center. The turning mechanism shall be loaded to apply a static torque of 24 in.-lbf (2.7 N-m) to the centerline of the base of the spout. Cycle speed shall be 1,500 cycles per hour, and hot and cold water alternated every 6,000 cycles. Hot and cold water temperatures and pressures are to be as in the valve test.

8.4.5 High Temperature Extreme Test

Faucets and fittings designed for water service shall withstand a water temperature of 180 F (82 C) for 1 hour without failure of the pressure envelope. The fitting shall be connected to a hot water supply of 180 F (82 C). The cold water inlet shall be blocked. A shutoff valve shall be connected to the outlet and the hot water bled through it to maintain 180 F +/- 5F (82 C +/-3 C) within the fitting for 1 hour at a gauge pressure of 125 PSI (860 kPa). The fitting shall be considered to have failed if it leaks after the test when a gauge pressure of 125 PSI (860 kPa) is applied with the valve in a closed position.

8.4.6 Intermittent Shock Test

a. Faucets and fittings designed for water service shall withstand an intermittent shock gauge pressure to 180 PSI (1,240 kPa) from a simulated apparatus connected to the spout outlet as described below.

b. Water supply to the hot side of the fitting shall be at 140 F +/- 10 F (60 C +/- 5 C) such that the flow gauge pressure is 125 PSI at 2.0+/-.

c. .24 GPM (860 kPa at 7.6 +/- .95 L/min) with the fitting in the full hot position. The cold side inlet shall be at a gauge pressure of 125 PSI (860 kPa) static and at ambient cold water temperature. A simulated apparatus such as rapid closing solenoid valve shall be connected downstream of the spout so as to create a shock gauge pressure of 180 PSI (1,240 kPa). The solenoid valve shall be cycled at a rate of two seconds open, two seconds closed for a duration of 30,000 cycles.

d. Any leakage shall be cause for rejection under the following conditions: (i) at the end of the test, examine the pressure envelope while still at test pressure; (ii) turn off the valve(s), disconnect the simulated appliance from the spout outlet, and examine with pressure still applied to the inlet.

9.0 Fittings for Natural Gas, Air, Vacuum, Special Gases and Steam Services

9.1 Valve Types, Applications, etc.

9.1.1 Ground Key Cock Valves

Due to the widespread use and acceptance of laboratory ball valves, ground key cock valves are no longer recommended for use in science laboratories.

9.1.2 Laboratory Ball Valves

a. Laboratory ball valves may be used for natural gas, air, vacuum and special gas services. In addition, laboratory ball valves may be used for water service. Where used for oxygen or high purity gases, valves shall be specially cleaned, lubricated and packed. Ball valves provide on/off control of the service, with a limited degree of metering or control of the service.

b. Ball valves operate by means of a spherical "ball" that is positioned between two seals that are within a body housing and press against the ball to form a watertight or gastight seal. Rotation of the ball 90 degrees opens and closes the valve. Valves have either a lever-type handle or a handle that locks in the closed position and must be lifted to open the valve. In either case, the valve handle shall visually indicate whether the valve is open or closed.

c. Ball valves for pressure service (water, steam or gas delivery) shall be designed for a working pressure of at least 75 PSI. Ball valves for "rough vacuum" service (see definition) shall be designed for a working pressure of 1 Torr. Ball valves designed for "fine vacuum" service (see definition) shall be designed for a working pressure of 0.001 Torr.

9.1.3 Needle Valves

Needle valves may be used for control of all laboratory gases. Where used for oxygen and high purity gases, valves shall be specially cleaned, lubricated and packed. Needle valves shall not be used for water or steam services. Needle valves provide good metering of the service.

a. Needle valves shall have needle point internal construction and shall have a replaceable seat.

b. Needle valves shall have a rated working pressure of at least 145 PSI.

9.1.4 Steam Valves

a. Valves for steam service shall be similar in construction to needle valves, except that valves shall have a renewable valve disc and replaceable seat.

b. Steam valves shall have a rated working pressure of at least 15 PSI steam pressure at 260° F maximum.

9.1.5 Diaphragm Valves

See definitions. Diaphragm valves may contain wetted materials that are chemical resistant. This design feature, and the absence of lubricants, can make them well suited to corrosive applications such as vacuum duty, in which the nature and concentration of gas or vapor exposure varies over the life of the laboratory. Valves for "rough vacuum" service (see definition) shall be designed for a working pressure of 1 Torr. Those designed for "fine vacuum" service (see definition) shall be designed for a working pressure of 0.001 Torr.

9.2 Valves for Burning Gases

9.2.1 Valve Construction

Valves for use with burning gases shall be ground key cock valves, ball valves, needle valves, push/turn valves or other valve type specifically designed for use with burning gas.

9.2.2 Certification

Valves for burning gas shall be certified to comply with ANSI Z21.15/Canadian Gas Association Standard CSA 9.1 or DIN 12918 Part 2 as required the prevailing standard for the geographic location of the installation

9.3 Mounting Fittings

Valves for laboratory gases shall be pipe mounted or installed on a horizontal or vertical surface

using a mounting fitting. Such fitting may be a turret base, panel flange, wye fitting, etc. Where required, the manufacturer shall furnish a mounting shank with a locknut and lock washer for installation. Unless field installation conditions or fitting design dictate otherwise, the fitting manufacturer shall install the valve into the mounting fitting and the mounting shank into the mounting fitting, and shall test the assembly as a single, complete unit prior to shipment.

9.4 Valves and Pressure Regulators for High Purity & Ultra High Purity Gases

9.4.1 General

a. Valves and pressure regulators for use on high purity gas distribution systems shall be specially designed and manufactured for such use.

b. Valves and pressure regulators shall not contain any components manufactured from materials that will off-gas contaminants into the high purity gas stream.

c. Where a pressure regulator is installed, there shall be an internal filter, located either inside the pressure regulator or upstream of the pressure regulator, to prevent particles from contacting the seat.

d. All interior surfaces of the valve or pressure regulator that will be in contact with the high purity gas stream shall be ultrasonically cleaned using cleaning agents that will not negatively affect the purity or the gas.

e. Valves and pressure regulators shall be protected during transport and storage against damage and against contamination from particles, moisture, solvents and other foreign matter that could negatively affect the purity of the gas.

9.4.2 Valves and Pressure Regulators for 5.0 Gases

a. Pressure regulators for use with 5.0 gases shall have a metal diaphragm or bellows internal construction.

b. Valves and pressure regulators shall have a maximum leak rate through the valve or regulator of (i) less than 1 x 10-5 standard cubic centimetres per second (SCCS) or 1 mbar l/S of helium with an outboard leakage test, and (ii) less than 1 x 10-5 SCCS or 1mbar l/S of helium with an inboard leakage test. The manufacturer of the valve and pressure regulator shall certify the above leak rates.

9.4.3 Valves and Pressure Regulators for 6.0 Gases

a. Valves and pressure regulators for use with 6.0 gases shall have a metal diaphragm or bellows internal construction. Ball valves, gate valves and other types of valves that have valve stem packings are not suitable for use with 6.0 gases.

b. Valves and pressure regulators shall have a maximum leak rate through the valve or regulator of (i) less than 1 x 10-6 standard cubic centimetres per second (SCCS) or 1mbar l/S of helium with an outboard leakage test, and (ii) less than 1 x 10-7 SCCS or 1mbar l/S of helium to the atmosphere with an inboard leakage test. The manufacturer of the valve and pressure regulator shall certify the above leak rates.

9.5 Valves for Vacuum Service

a Valves for vacuum service may be of ball valve, diaphragm valve or needle valve construction. All wetted parts of any of these valve options shall be resistant to prolonged exposure to vapors of corrosive solvents and reagents.

b. Valves for "rough vacuum" service (see definition) shall be designed for a working pressure of 1 Torr. Those designed for "fine vacuum" service (see definition) shall be designed for a working pressure of 0.001 Torr.

c. Valves for vacuum service shall never be tested with compressed air or pressurized water. These valves are designed to be tight under vacuum conditions; pressure testing may give false positives or false negatives in testing.

10.0 Valves and Outlets for Use in Fume Hoods

Fittings for use in fume hoods consist of two primary components: (i) a remote control valve installed outside of the interior fume hood working area or chamber, and (ii) an outlet/inlet fitting installed within the fume hood chamber. The valve is controlled by a handle located outside of the fume hood chamber. The outlet fitting is connected to the valve (either directly or by a supply line from the valve), and the service or media is delivered through the outlet fitting within the fume hood chamber.

10.1 Valve Types

Remote control valves for use in fume hoods may be either rod-type or panel mounted, as follows:

10.1.1 Rod-Type Valves

Rod-type valves are installed either within the side wall or underneath the horizontal work surface of the fume hood. Valves may be either straight or angle pattern. Valves are fitted with an extension rod connected to the valve stem that projects through the front face or apron of the fume hood, and a handle is installed on the exposed end of the rod.

10.1.2 Panel Mounted Valves

Panel mounted valves are installed on either the side wall or front apron of the hood. The valve body is mounted on the panel using a locking ring or other locking mechanism. The valve is mounted so that all of the working components of the valve are accessible from the front exterior face of the hood, without accessing the internal side wall of the hood or disturbing the plumbing connections to the valve. Panel mounted valves offer two advantages over rod-type valves:

(i) All of the working components of a panel mounted valve are accessible from the front exterior face of the fume hood. Maintenance of the valve is facilitated, since the fume hood does not have to be entered or disassembled to gain access to the working components of the valve.

10.2 Valve Construction

Valves for fume hood use shall have the construction set forth below:

a. Valves for water shall be similar in construction and performance to those described in Section 8 above.

b. Valves for non-burning laboratory gases shall be either ball, needle, diaphragm-type or a suitable equivalent and shall have the construction and performance described in Section 9 above.

c. Valves for burning gases shall be either ball type, needle type or push/turn type and shall have the construction and performance described in Section 9 above.

d. Valves for steam shall have the construction and performance described in Section 9 above.

e. Valves for vacuum service shall have the construction described in Section 9 above.

10.3 Outlet/Inlet Fittings

10.3.1 General Construction

Outlet fittings convey the media from the remote control valve to the interior of the fume hood chamber (or the reverse, in the case of vacuum). They are generally mounted to the side wall or work surface of the fume hood utilizing a mounting shank with locknut and washer or other mounting mechanism. Outlet fittings are available in a variety of configurations including turrets, flanges and goosenecks.

10.3.2 Corrosion Resistance

The outlet fitting installed inside the fume hood chamber will be exposed to the fumes that are generated within the hood. Accordingly, these fittings should be resistant to corrosion, either by (i) utilizing a corrosion resistant material for the outlet fitting that is suitable for the intended application, or (ii) supplying the fitting with a corrosion resistant finish in accordance with Section 5.2.3 above.

10.3.3 Color Coding

The outlet fitting should be color-coded to designate the service or media delivered through the fitting. Identification can be accomplished a (i) color coding the corrosion resistant fitting material or coating to match the service index color, or (ii) providing a color-coded index ring or plate. The color-coding shall match the corresponding remote control valve handle or index.

10.4 Vacuum Breakers for Use on Fume Hoods

Valves and outlet fittings for potable water service shall be equipped with vacuum breakers to prevent backflow or back-siphonage into the potable water system. Vacuum breakers shall meet the provisions of Section 12 below. Vacuum breakers shall be installed (i) in accordance with the manufacturer's instructions and applicable plumbing codes, and (ii) in a location where they are accessible for maintenance.

10.5 Installation

Unless field conditions otherwise require, remote control valves and outlet fittings shall be installed, plumbed and pressure tested prior to shipment of the fume hood from the manufacturer's factory.

11.0 Faucets for Purified Water

11.1 General

Many laboratory processes and procedures require the availability and use of purified water. Purified water is domestic water that has been treated to reduce the concentration of impurities in it. Impurities may take the form of organic or inorganic substances, live bacteria, cell fragments and/or dissolved gases. Purity requirements vary depending upon the final use of the water. However, purified water may be categorized as follows:

Laboratory Grade: water from which one or more categories of contaminants have been removed.

Reagent Grade: water from which all categories of contaminants have been removed, with sub-classifications Type IV through Type I indicating increasing quality.

Water purity is further measured in terms of resistance to electrical current. A value of 18.3 megohms-centimeter at 25 degrees C is the maximum achievable value of electrical resistivity.

Several processes to purify water are commonly used, including distillation, reverse osmosis (RO) and deionization (DI). The choice of process depends on a wide variety of factors, including the type of experimentation or research to be done in the laboratory, the type of purified water required, whether the purified water system is centralized or decentralized, and cost.

11.2 Fitting Materials and Construction

It is generally accepted that the system for treating and distributing purified water is more important to the purity of the delivered water than are the faucets or other fittings installed at the termination points of the system. However, in determining the most suitable type of fitting for dispensing purified water, care should be taken in the selection of the material and construction of the fitting. The materials and construction of fittings for purified water vary widely in the marketplace but, in general, may be divided into three categories:

a. Metallic Fittings. Faucets and fittings may have metallic construction. As such, all metal components that have contact with the purified water (such as the fitting body, gooseneck or spout and internal operating components) shall be (i) brass with an interior lining of an inert metal (such as tin), or (ii) stainless steel. All nonmetallic components (such as valve discs, seals, etc.) shall be compatible with the purified water delivered by the fitting. Metallic fittings shall have the construction and performance set forth in Section 8 above.

b. Nonmetallic Fittings. Faucets and fittings may have nonmetallic construction. As such, all nonmetallic components that have contact with the purified water (such as the

fitting body, gooseneck or spout and internal operating components) shall be constructed of an inert plastic, such as PVC, non-pigmented polypropylene, polyvinylidene fluoride (PVDF) or polyethylene. All other components shall be compatible with the purified water delivered by the fitting.

c. Fittings with a Metallic Exterior and Nonmetallic Interior. Faucets and fittings may have an exterior metallic casing with an interior lining of inert plastic. All components that have contact with the purified water shall be nonmetallic and shall be compatible with the purified water delivered by the fitting.

Fittings and faucets may be supplied with manual (compression) control, self-closing control or combination manual/self-closing control. Faucets may be supplied incorporating a method of recirculating the pure water through the interior of the faucet. The recirculation shall permit the water to circulate completely to the valve mechanism, thus effectively removing any "dead leg."

12.0 Backflow Prevention

12.1 General

All laboratory fittings that deliver potable water shall be equipped with a backflow prevention device. Such device shall be either (i) an atmospheric vacuum breaker, or (ii) a laboratory faucet vacuum breaker. Atmospheric vacuum breakers shall be certified to comply with ANSI/ ASSE Standard 1001, "Pipe Applied Atmospheric Type Vacuum Breakers." Laboratory faucet vacuum breakers shall be certified to comply with ANSI/ ASSE Standard 1035, "Laboratory Faucet Vacuum Breakers."

13.0 Fittings for ADA Compliance

Pursuant to the requirements of Section 309.4 of ANSI/ICC A117.1, where a faucet or fitting will be used in an application that is intended to be ADA compliant, the maximum force required to open or close a manually activated fitting shall not exceed 5 lb. (22 N) at 80 PSI (550 kPa) static pressure.

14.0 Vandal-Resistant Fittings

Laboratory fittings are frequently installed in facilities such as high schools, junior colleges and other public facilities where they might be subject to vandalism and physical abuse. In such facilities, consideration should be given to installing service fixtures and fittings that are vandal-resistant or comprised of easily replaced components or both.

14.1 Resistance to Physical Abuse

Vandal-resistant service fixtures shall be designed to meet the following criteria:

Each fitting shall, so far as possible, resist turning, bending, breakage and unintended disassembly through acts of vandalism or physical abuse. Construction features shall include:

a. All threaded connections that will not require field service (including the connection between a valve and mounting fitting, and between a mounting fitting and mounting shank) shall be secured with a suitable adhesive so as to be non-removable.

b. Goosenecks and spouts shall be constructed of heavy duty pipe or tubing that is sufficient to resist bending and breakage.

c. Faucet bodies, turret bases and other mounting fittings shall be provided with locking pins or other means to prevent the fixture from being turned on the work surface, panel or wall surface.

d. Outlet fittings (such as serrated hose ends and aerators) shall either be of vandal-resistant design or shall be secured in place with an adhesive.

e. Index buttons shall be tamper proof.

14.2 Protection of Supply Lines

Each fitting shall be designed to protect against contaminants from entering the service lines by means of backflow, back-siphonage, or acts of vandalism. Accordingly, water and gas supply fittings shall be furnished with vacuum breakers to prevent contamination of the potable water system through backflow or back-siphonage. Valves for laboratory gases shall be furnished with internal check valves to prevent backflow through the valve.

14.3 Maintenance

Vandal-resistant fixtures shall be designed to provide maintenance personnel with access to internal components for service requirements. Construction features shall include, but are not limited to:

Valve packing nuts shall be secured with set screws.

Vacuum breaker covers shall be secured with vandal-resistant screws that may be removed only by maintenance personnel.

15.0 User-replaceable Fixtures

Fittings designed to be user-replaceable address risk of vandalism or abuse by offering the lab the ability to replace all or part of a damaged fixture with compatible components that will restore original function. Such fixtures shall only be used for services, such as vacuum supply, in which damage to the replaceable fixture will not result in the release of water, gases or vapors that pose a risk to building occupants. Features shall include:

a. Design and materials that are sufficiently rugged to resist damage in routine use.

b. Modular components that may be assembled without tools, or with only simple tools, requiring no specialized skill or training for assembly.

16.0 Electrical Fittings

Electrical pedestal boxes may be provided on laboratory work surfaces for the installation of power and data devices and outlets. Electric pedestal boxes shall have a cast aluminum housing and shall be supplied with a mounting shank and locknut for installation on the countertop or work surface. Pedestal boxes shall have a satin (brushed) finish, polished finish or shall have a corrosion resistant coating in conformance with Section 5.2.3 above. Pedestal boxes shall be certified to comply with the provisions of ANSI/UL 514A, "Standard for Metallic Outlet Boxes."

17.0 Emergency Eye Wash and Shower Equipment

17.1 General Requirements

Emergency eye wash and shower equipment installed in laboratory facilities shall comply with the provisions of ANSI Z358.1, "Emergency Eye Wash and shower Equipment."

17.2 Materials and Finishes

Where emergency eye wash and shower equipment is installed within the workspace of a laboratory room, the metal components used in the equipment shall be (i) brass, with either a chrome plated or corrosion resistant finish, (ii) stainless steel, or (iii) galvanized steel with a corrosion resistant finish. Where emergency equipment is installed on or immediately adjacent to a laboratory work surface or countertop, the metal components used in the equipment shall be (i) brass, with either a chrome plated or corrosion resistant finish, or (ii) stainless steel. Chrome plated and corrosion resistant finishes shall conform to the provisions of Section 5 above.

Appendix 1

North American Colour Coding / Indexing

Service	Color	Symbol
Acetylene	Violet	ACET
Air	Orange	AIR
Ammonia	Light Green	NH3
Argon	Violet	AR
Butane	Light Blue	BUT
Carbon Dioxide	Pink	CO2
Carbon Monoxide	Silver	CO
Chilled Water Supply	Green	CHWS
Chilled Water Return	Green	CHWR
Cold Water	Green	CW
Compressed Air	Orange	CA
Deionized Water	White	DI
Distilled Water	White	DW
Gas	Blue	GAS
Helium	Black	HE
High Vacuum	Yellow	HVAC
Hot Water	Red	HW
Hydrogen	Pink	HYD
Industrial Cold Water	Green	ICW
Industrial Hot Water	Red	IHW
Low Vacuum	Yellow	LVAC
Nitrogen	Brown	NIT
Oxygen	Light Green	OXY
Pure Water	White	PW
Reverse Osmosis Water	White	RO
Special Gas	Light Blue	SG
Steam	Black	STM
Vacuum	Yellow	VAC

Appendix 2

European Color Coding / Indexing (EN 13792)*

Service	Zone 1 Outer Color	Zone 2 Middle Color	Zone 3 Inner Color	Symbol
Acetylene	Yellow	White	Green	C2H2
Ammonia	Black	Green	Red	NH3
Argon	Blue	Grey	Grey	AR
Butane	Yellow	Blue	Blue	C4H10
Carbon Dioxide	Blue	Blue	Black	CO2
Carbon Monoxide	Black	Blue	Black	CO
Compressed Air	Blue	Blue	Yellow	CA
Coolant Water Feed	Green	Blue	Blue	WCF
Coolant Water Return	Green	Blue	Red	WCR
Deionized Water, Cold	Green	Grey	Blue	WDC
Deionized Water, Hot	Green	Grey	Red	WDH
Distilled Water	Green	White	White	WDI
Fine Vacuum	Grey	Grey	Grey	VF
Helium	Blue	Grey	White	HE
High Vacuum	Grey	Grey	White	VH
Hydrogen	Red	Red	Red	H2
Low Vacuum	Grey	Grey	Black	V
Methane	Yellow	Blue	Yellow	CH4
Natural Gas	Yellow	Yellow	Yellow	G
Nitrogen	Blue	Green	Green	N2
Non-Potable Water, Cold	Green	Yellow	Blue	WNC
Non-Potable Water, Hot	Green	Yellow	Red	WNH
Oxygen	Blue	Blue	Blue	O2
Potable Water, Cold	Green	Green	Blue	WPC
Potable Water, Hot	Green	Green	Red	WPH
Propane	Yellow	Blue	Red	C3H8
Regulated Air	Blue	Blue	Green	RA
Steam	Green	Red	Red	WST

***EN 13792 refers to more than color codes. It should be noted that SEFA 7 is referencing this standard solely in connection with the color coding described therein.**

Appendix 3

Protection of Potable Water Systems
Federal Safe Drinking Water Act

In recent years, there has been a great deal of concern and discussion regarding the effects of contamination of drinking water on human health. As a result of these concerns, the American National Standards Institute (ANSI) and NSF International have adopted ANSI/NSF International Standard 61, Section 9, "Drinking Water System Components – Health Effects." This standard was promulgated to establish minimum requirements for the control of potential adverse human health effects from products which contact drinking water. This standard covers mechanical plumbing devices, components and materials that are typically installed at the endpoint of a water distribution system and are intended by the manufacturer to dispense water for human ingestion. In order to comply with this standard, many manufacturers of plumbing products have changed the materials used in their products, including reducing or removing lead from the brass alloys used for their products.

As noted above, ANSI/NSF 61, Section 9 applies only to products that are intended to dispense water for human consumption. The standard specifically exempts "all commercial, industrial, and institutional devices that are not (otherwise) included, including …laboratory fittings." (emphasis added) This standard thus specifically exempts laboratory faucets and fittings.

It is the position of SEFA that laboratory fittings are not designed, manufactured, sold or installed for the purpose of delivering water for human ingestion. SEFA endorses the position of ANSI and NSF International that the provisions of ANSI/NSF 61 do not apply to laboratory faucets and fittings. Moreover, ingesting water in a laboratory raises serious safety issues beyond exposure to the contaminants that might be found in drinking water, regardless of their origin. Safe laboratory work practices should always prohibit laboratory users from eating or drinking in a laboratory work environment.