I. INTRODUCTION

A. Purpose: To provide Los Angeles County Fire Department (Department) fire series personnel with the information on the construction and care of the various type of fire hose used by the Department

B. Scope: This instruction applies to all Department fire series personnel.

C. Administrator: The deputy fire chiefs of the regional Emergency Operations Bureaus are responsible for the content, revision, and periodic review of this instruction.

II. RESPONSIBILITY

A. All fire series personnel are responsible for the information contained in this instruction.

B. Company officers and training captains are responsible for training Department personnel and ensuring proficiency in the information contained in this instruction.

III. POLICY

A. History

The fire hose we use today is the culmination of an evolution that began with leather buckets. Members of the fire service and manufacturers have continuously sought better ways to transport water from one location to another. In the early 1800's, the finest form of hose to evolve from this need to provide a better method of transporting water was the leather hose. This hose was made by stitching leather hides into the form of a tube and fastening it together with copper rivets. Much difficulty was experienced with this type of hose, as it was stiff, extremely heavy when wet, and leaked badly. Additional problems were also encountered when trying to couple it together and, when used in low or freezing temperatures.

In 1871, the B.F. Goodrich Company designed and manufactured a type of hose consisting of both canvas and rubber. It was made in a manner best described as the plying of alternate layers of rubber and heavy cotton duct over a rubber tube, with a final layer of rubber covering the hose. While this was a great improvement over leather hose, and greatly received by

firefighters, it soon became apparent that many improvements were still needed in manufacturing techniques before a quality hose could be produced.

In the early 1900's, the circular seamless cotton woven jacket was adapted. This new method created a more flexible hose allowing for easier storage, increased hose loads on apparatus, and better maneuvering on the fireground. As time has gone on, the main areas of improvement have been in the development of better materials used in this type of construction.

Since the 1970's, synthetic woven jackets with rubber lining and nitrile three (3)-ply rubber hose have been the most widely utilized hose types. Recently, a blend of these two construction types were developed and introduced. Currently, the Department is purchasing and outfitting apparatus with these types.

B. Construction of Fire Hose

Fire hose is classified in size by its inside diameter and by the material of which it is constructed. Hose is manufactured by two specific construction methods: (1) woven, and (2) extruded. Hose jackets are made of low stretch, "warp" (lengthwise) and "filler" (circular) yarns using cotton, nylon, rayon, vinyl, and polyester. Hose linings are made of thermoplastic, polypropylene, ethylene propylene diene monomer (EDPM) or styrene-butadiene rubber (SBR), which is extruded free of pits or imperfections.

Fire hose is either single jacket, or double jacket; consisting of an inner lining covered by one layer (jacket) of protective material, or an inner lining covered by two layers (jackets) of protective material.

The inner lining is then attached to the inner jacket using steam and pressure, called vulcanizing. This process uses glue; however, stronger versions are vulcanized using a calendarized bonding process. Jacketed hose is then sprayed with a protective latex compound to increase abrasion resistance.

All rubber hose types use a thin mesh jacket completely encapsulated by an extruded rubber liner, called "through the weave" construction.

Hose is then cut into lengths of 50 feet for convenience of handling, but varied lengths can be ordered from the manufacturer. These lengths are commonly referred to as sections. Sections of fire hose are coupled together to form a continuous hose line.

C. Construction of Fire Hose Used by the Department

1. Synthetic jacketed hose/dacron blended

   a. Jacket: 100 percent synthetic warp yarns, six (6) by six (6) continuous nylon filament or better. Yellow in color.

   b. Lining: Lining shall be a single ply extruded tube of EDPM rubber, compounded to eliminate deterioration by ozone. The lining shall be vulcanized to the inner jacket by a calendarized process, eliminating lining delamination.

   c. Couplings: Pyrolite, extruded aluminum alloy, hard coat anodized, rocker lug, threaded, and attached to hose with a brass expansion ring. All couplings shall be National Standard Thread (NH).

2. Jacketed “through the weave” lined

   a. Jacket: A single jacket consisting of 100 percent polyester filament warp yarns, or better. Orange (highrise) or yellow (supply) in color.

   b. Lining: Lining shall be high tenacity clear polypropylene extruded “through the weave” of polyamide woven mesh.

   c. Couplings: Pyrolite, extruded aluminum alloy, hard coat anodized, rocker lug, threaded, and attached to hose with a brass expansion ring. All couplings shall be NH.

3. Nitrile three-ply rubber hose

   Nitrile hose combines the outer, center, and inner plies using a simultaneous “though the weave” extrusion process resulting in a one-piece construction.

   a. Outer ply: Ribbed nitrile rubber compound, yellow in color.

   b. Center ply: 100 percent continuous synthetic high tenacity polyamide fibers, woven into thin mesh.

   c. Inner ply: Smooth nitrile rubber compound.

   d. Couplings: Pyrolite, extruded aluminum alloy, hard coat anodized, rocker lug, threaded, and attached to hose with a brass expansion ring. All couplings shall be NH.

4. Polyester jacketed hose

   a. Jacket: 100 percent polyester double jacket. White in color.

   b. Lining: Rubber lining constructed with a combination of natural and synthetic rubbers. The lining shall be vulcanized to the inner jacket by a calendarized process, eliminating lining delamination.

   c. Couplings: May either be forged or extruded, constructed of brass or pyrolite, equipped with rocker lugs. Threads shall be NH.

5. Single jacket wildland hose

   a. Jacket: 100 percent polyester filament warp yarns. Yellow in color with red striping to identify manufacturer.

   b. Lining: High strength rubber compound, can be either EDPM or desmopan. Lining shall be permanently bonded without the use of glue, eliminating lining delamination.

   c. Couplings: Pyrolite, extruded aluminum alloy, hard coat anodized, rocker lug, threaded, and attached to hose with a brass expansion ring. 1½ inch (") hose shall be NH, and 1" hose shall be National Pipe Straight Thread (NPSH), commonly referred to as Forest Service Thread.

D. Types and Sizes of Fire Hose Used by the Department

1. Reel line:

   a. ¾" or 1" rubber covered, rubber lined with synthetic cord reinforcement, equipped with 1" couplings. Can be either 50- or 100-foot lengths, and is sometimes referred to as "booster" or "chemical" hose. Red in color.

   b. 1" polyester double jacket hose, 1" couplings, with NH threads. 50-foot lengths. White in color.

2. Wildland:

   a. 1” single woven jacket, rubber lined, 1” couplings with NPSH. Jacket shall be yellow with red stripe. Can be either 50- or 100-foot lengths.

   b. 1½” single woven jacket, rubber lined, 1½” couplings with NH. Jacket shall be yellow with red stripe. Can be either 50- or 100-foot lengths.

   c. Wildland hose that is either white all polyester or “Forest Service Spec 186/187” shall not be accepted due to low quality and high failure rate.

   d. Our Department only uses wildland hose consisting of 100 percent polyester filament warp yarns with linings that are permanently bonded without the use of glue. Since the 1990’s, Niedner Hotline (Wajax) and more recently Mercedes Textiles FireBoss.

3. Attack lines:

   a. 1¾” double jacket, synthetic woven jackets impregnated with latex compound, EDPM rubber lined, 1½” couplings with NH. Yellow in color. 50-foot lengths.

   b. 2½” double jacket, synthetic woven jackets impregnated with latex compound, EDPM rubber lined, 2½” couplings with NH. Yellow in color. 50-foot lengths.

   c. High rise hose: 1¾” polyester woven outer jacket impregnated with latex compound with an inner liner consisting of high tenacity clear polypropylene extruded “through the weave” of polyamide woven mesh, 1½” couplings with NH. Highly kink resistant and 1.92” inside diameter to reduce friction loss at low pressures. Orange in color. 50-foot lengths.

4. Supply line:

   a. Jacketed “through the weave” lined: 4” polyester woven outer jacket impregnated with latex compound with an inner liner consisting of high tenacity clear polypropylene extruded “through the weave” of polyamide woven mesh, 4” couplings with NH. Used for supply in 50-foot lengths.

b. Rubber: 4” hose with 4” couplings with NH. Three (3) ply hose: Outer ply: made of ribbed rubber nitrile compound. Center ply: 100 percent continuous synthetic polyamide fibers. Inner ply: smooth rubber nitrile compound. 4” couplings with NH. Hose yellow in color. Used for supply in 50-foot length, or soft suctions in 20-foot length.

c. Synthetic jacketed: 4” hose with 4” couplings with NH. Double jacketed woven impregnated with latex compound, EDPM rubber lined. Hose yellow in color. Used for bypass hose in 20-foot length.

d. Rubber hard suction: 4” inside diameter hose with 4” couplings with NH. Three ply hose: outer and inner plies made of SBR rubber compound. Center ply: mesh of synthetic tire cord plus a spiral wire helix for full suction and collapse resistance. Non-corrugated for minimal friction loss. Black in color. 10-foot lengths.

e. Polyvinyl chloride (PVC) hard suction: 4” inside diameter hose with 4” field serviceable couplings with NH. High pressure PVC corrugated hose used only for drafting. Couplings will separate with any pressure above 30 pounds per square inch (PSI). Clear in color with black ribbing on corrugations. 7- and 8-foot lengths.

   NOTE: Supply on Type III engines use 3” hose with 2½” couplings, synthetic jacket. Yellow or OES tan in color. 50-foot lengths.

f. Soft suctions: One 4” “female” long handle and one 4” “male” rocker lug coupling.

g. Hard suctions: For patrols or other wildland applications, hard suctions are 1½” couplings and may be corrugated. For water tenders, hard suctions are 2½” couplings. Varying lengths and colors.

h. Aerial supply line: 3” hose with 2½” couplings with NH. Three (3) ply hose: Outer ply: made of ribbed rubber Nitrile compound. Center ply: 100 percent continuous synthetic polyamide fibers. Inner ply: smooth rubber nitrile compound. Hose red in color. Used for supply ladder pipe operations on truck/quint companies without hard plumbing in 50- or 100-foot lengths.

5. Couplings

There are several types of couplings used in the fire service, made with a variety of materials, including brass, aluminum alloy, and aluminum alloy with a hard coating (Pyrolite).

For the purpose of standardization, NH is required by law in the State of California. Beginning thread on couplings is referred to as a "blunt cut," previously known as the "higbee cut," and is designed to provide connection between opposing threads, which helps to eliminate cross threading. Forest Service Thread 1" hose is to have NPSH. Iron pipe thread is a tapered thread and is used for natural gas piping where no gaskets are utilized. Iron pipe thread is not used in fire hose.

Other types of couplings are the Kam-lock coupling which has spring-loaded clips or lugs on a "female" coupling which clamp over a ring on the "male" coupling and the "Storz" or quick connect which uses a quarter turn to couple and lock. Both of these couplings are rated to 200 PSI.

Lugs are provided on couplings to aid in tightening with spanner wrenches. Types of lugs used on couplings are rocker, recessed, pin, and long handle lugs which provide a handle for attaching and tightening of intake hose.

E. Care of Fire Hose and Couplings

1. Hose: There are four (4) general ways in which hose can be injured/damaged and must be protected against.

a. Mechanical injury/damage:

1) Cuts from dragging through debris.

2) Dragging over concrete or being run over by vehicles.

3) Rubbing against curbs and walls.

4) Chafing due to vibrations caused by engine and pump impulse transmitted to hose.

5) Improperly positioned hose clamps.

b. Heat: Fire hose will burn if it comes in direct contact, or indirect contact with flame, or hot debris. Care should be taken to avoid hot spots when advancing hose line as it may be damaged.

c. Chemicals: Exposure to sea water and contamination by most chemical substances, hydrocarbons, oils, alkalis, acids, and grease have had no effect on the short- or long-term performance of hose. Although the properties of hose resist chemical injury/damage, care should still be exercised to keep contact to a minimum. For example, avoid placing hose in the gutter where liquids and chemicals can flow and accumulate.

d. Neglect: This covers a multitude of areas that range from the fireground to the fire station. On the fireground, care should be taken in rinsing and reloading hose to make sure the hose receives the best care.

2. Couplings:

a. Avoid dropping or dragging.

b. Wash dirty couplings to remove all dirt, grease, and tar.

c. Inspect gaskets and replace if missing, cracked, or creased.

d. Use dry graphite or “Breakfree” on swivel couplings to lubricate.

e. Hose that becomes unserviceable due to bent, or damaged couplings shall be taken out of service, and sent in for repair.

F. Hose Maintenance Procedures

The following maintenance procedures shall be conducted at the time indicated:

1. Hose gaskets shall be inspected after each use, and before reloading for proper fit and any deterioration. Missing or faulty gaskets shall be replaced immediately. Never over tighten couplings, as this damages the gasket and causes the coupling to leak.

2. Water shall be run through all hose once every three months unless the hose has been otherwise wet in service. Water shall be run through all suction hose once every 30 days.

3. All rubber hose must be reloaded following the annual hose test and then quarterly thereafter. This is due to the fact rubber hose will crack in the fold if left in the same position for long periods of time.

4. Use clear water only for cleaning. The use of soap, detergents, or petroleum products is prohibited.

   Exception: Rubber hose may be cleaned with a mild solution of soap and water if heavily soiled.

5. All cotton hose shall be thoroughly cleaned and dried before being rolled for storage, placed in packs, or reloaded on apparatus. This is due to damage from molds, which on cotton hose will cause a breakdown in the fibers of the hose and adhesion of the lining. Other types of hose do not require drying before loading on apparatus.

6. Where possible, hose should be carried covered, out of the direct sun to prevent damage due to long sun exposure.

7. Where possible, hose shall be carried and not dragged to prevent excessive wear to the jacket from mechanical damage.

8. Cotton hose in damp or dirty condition shall not be allowed to remain on apparatus more than 24 hours, unless emergency conditions make hose change impossible.

9. Wildland hose rolls shall be secured with large rubber bands only. Parachute cord or other rope shall not be used.