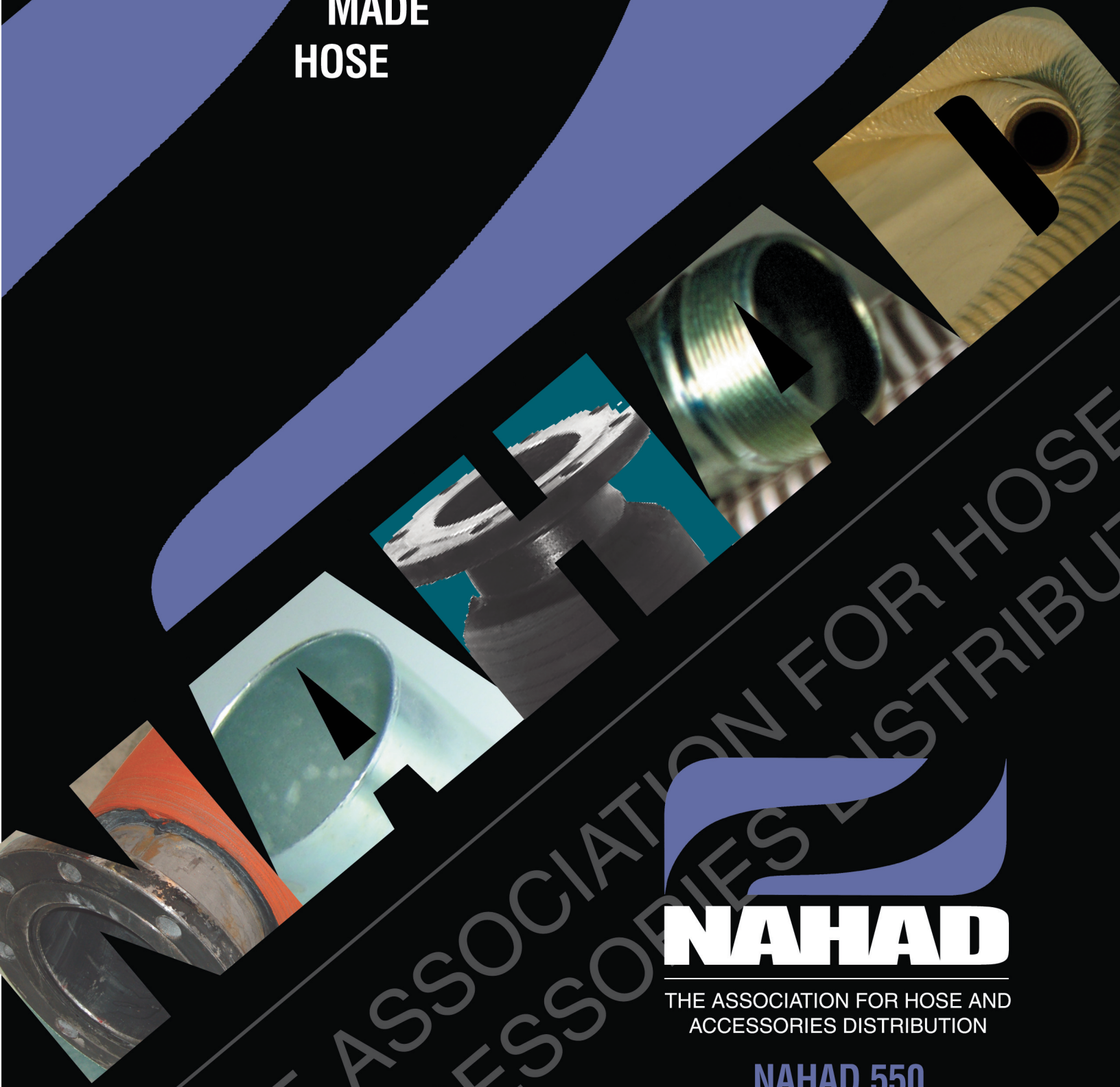
GUIDE FOR CUSTOM MADE HOSE



THE ASSOCIATION FOR HOSE AND ACCESSORIES DISTRIBUTION

NAHAD

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NAHAD 550

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IMPORTANT NOTE TO READER:

NAHAD – The Association for Hose and Accessories Distribution – is pleased to provide this comprehensive set of basic Hose Guidelines for the custom hose business, a companion to NAHAD 500 Industrial Hose Assembly Specification Guidelines. The information contained within this document has been developed through the concerted efforts of numerous member volunteers, association staff and industry leaders, with the common goal of helping to clarify and improve the safety, quality, and reliability of custom hose assemblies.

In addition to this document, NAHAD has published five other Hose Assembly Specification Guidelines, addressing; Composite Hose, Corrugated Metal Hose, Hydraulic Hose, Industrial Hose, and Fluoropolymer Hose. These six publications are intended to complement existing industry and federal regulations. Aerospace and hydraulic brake hose assemblies are specifically excluded from this and our other five documents.

Hose, hose fittings, and hose couplings come in various sizes and designs. Although there are standards published by manufacturers and independent testing organizations, such as ANSI, ASME, ASTM, ASQ, UL, ISO, SAE, RMA, and others which relate to hoses and hose fittings, there are no generally recognized standards for hose assemblies. This publication is indebted to these organizations and, in specific cases, refers the reader to designated existing standards and recommendations provided by these other sources in an attempt to encourage the fabrication of safer, higher quality, and more reliable hose assemblies.

In compiling standards and recommendations published by others and in developing these Guidelines, NAHAD has not and will not engage in independent testing or verification of the information provided to it. Users of these Guidelines, should not, and cannot, rely on these Guidelines as a standard, certification or approval of the data published herein. NAHAD, and the member company volunteers, association staff, and industry leaders who participated in the creation of these Guidelines do not assume, and expressly decline and deny, any and all liability for any product failures, damages, or injuries that may result in any way from utilization of these Guidelines or products based on these Guidelines.

The NAHAD Hose Assembly Guidelines incorporate various technical recommendations published by other sources. NAHAD has not independently verified these recommendations and specifically disclaims any and all liability, direct or indirect, for any failures, damages or injuries resulting in whole or in part from the failure of any product, including hoses, fittings, and assemblies described in this publication or in the Guidelines.

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This document, a companion to NAHAD 500 Industrial Hose Assembly Specification Guidelines, describes the unique nature of the custom hose business in order to:

- assist end-users (customers) to more effectively leverage those capabilities within their own businesses;
- provide guidance to distributors for working with manufacturers more effectively and productively; and
- provide basic instruction regarding the business in general for manufacturing personnel new to the business.

No document can anticipate the parameters of every application, and this guide is only intended to address basic concepts that should be considered when working with custom made hose.

NAHAD would like to thank the Rubber Manufacturers Association for their support and assistance in creating this document; substantial portions of the RMA Hose Handbook (RMA /IP-2/2003) were used in the preparation of this document and provided tremendous added value. www.rma.org

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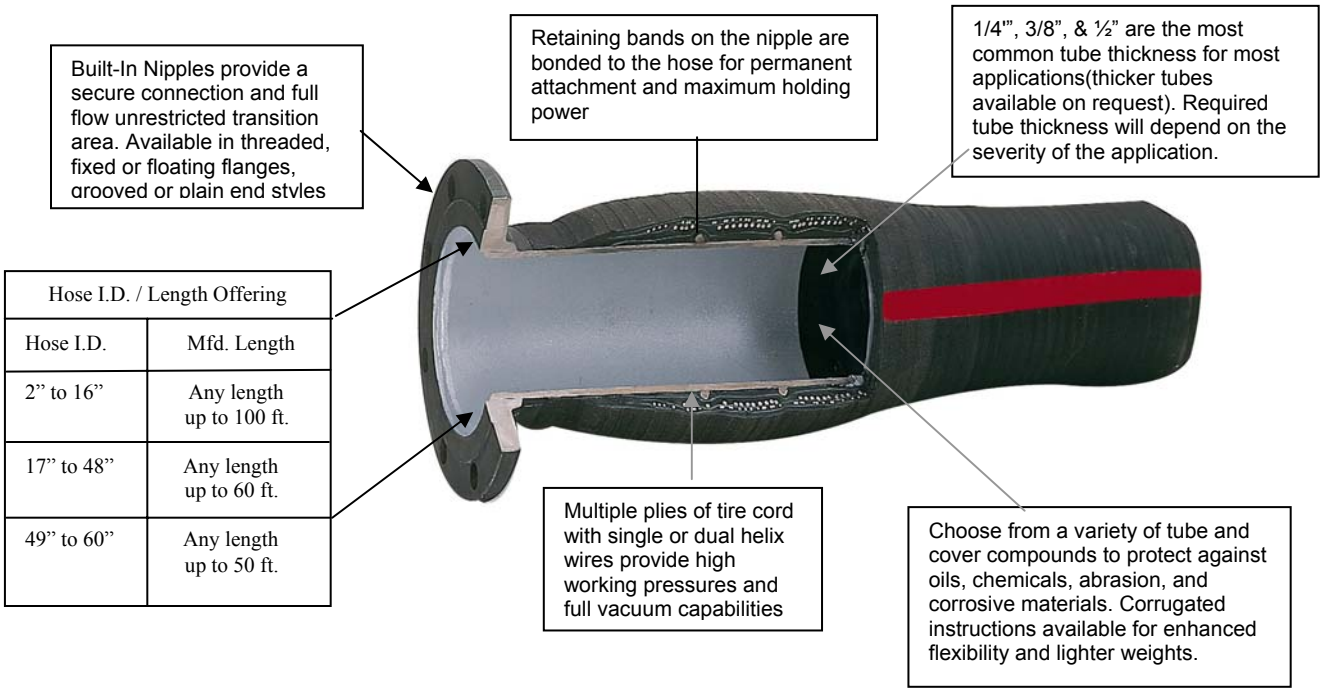
Custom Made Hose

Section 1 – Introduction and Background

1.1 Introduction

Custom Made hose is generally hose that is manufactured to meet the requirements of a specific application. Application of hose components (tube reinforcement/cover etc.) is typically by hand. Applications requiring hose attributes that are not typically available with standard hose assembly components are usually considered custom. Application considerations requiring non-standard solutions include: required bend radius, chemical, heat or abrasion resistance (both interior and external), end fittings, working pressure/vacuum, bore size, made to order length, and built on ends.

Many people refer to these applications as hand built hose. For the purposes of this document, the terms “hand built hose” and “custom made hose” can be used interchangeably.

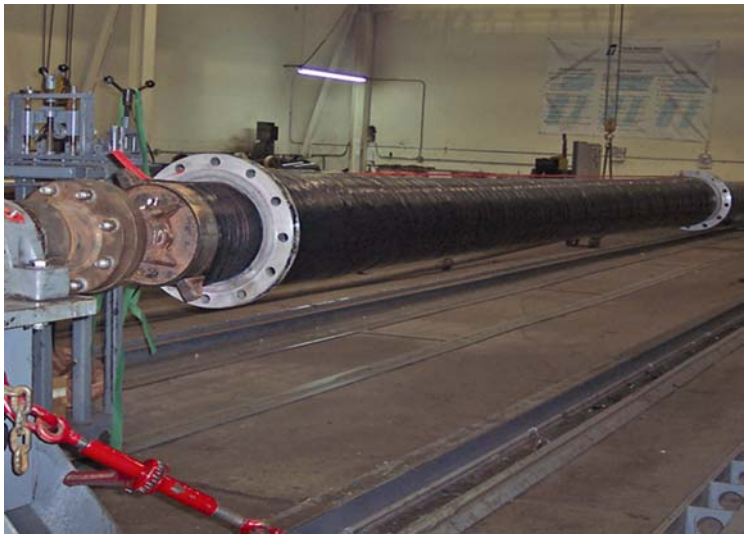


Hose I.D. / Length Offering	
Hose I.D.	Mfd. Length
2” to 16”	Any length up to 100 ft.
17” to 48”	Any length up to 60 ft.
49” to 60”	Any length up to 50 ft.

1.2 Background

(Taken from the Hose Handbook, published by the Rubber Manufacturers Association, Inc.)

The term “hand built hose” applies to two general types of hose, I.e., non-wire reinforced and wire reinforced, which are made by hand on a steel mandrel.
The mandrel is mounted on a series of double roller stands and one end of the mandrel is held in the jaws of a power driven chuck in order to rotate the mandrel during the making operations.



Non-Wire Reinforced Hose is made of the same components as machine wrapped ply hose, namely, a rubber tube, plies of fabric reinforcement wrapped around the tube and a rubber cover. The hose is made by hand when it is too large in diameter, too long to fit in the three roll Making Machine, or when the hose is made with special ends. The hand method is also used frequently when the fabric reinforcement must be applied one ply at a time.

The tube for hose up to 8” internal diameter is either extruded or spiraled and mounted on a mandrel. The tube for hose larger than 8” diameter is formed by wrapping calendered tube stock around the mandrel with an overlapping seam running the length of the tube. The frictioned and cut fabric is applied to the tube by hand and rolled down progressively as the mandrel is turned.

Tire cord fabric when cut and spliced in bias lengths only has strength in the cord direction of the bias. In order to compensate for the unidirectional strength and to have a balanced hose construction, the tire cord fabric is applied one ply at a time and the direction of the cord lay is reversed with each succeeding ply. Cord hose is always made with two or more plies. Tire cord fabric can also be cut into strips

and applied as a spiral from end to end.

A calendered sheet of cover stock is applied to the carcass to complete the construction of the hose. The hose is cross wrapped with one or more layers of nylon or cotton tape in a power chuck before vulcanization. The wrapping tape is removed after vulcanization and the mandrel withdrawn from the hose.

Wire Reinforced Hand-Built Hose, as the name indicates, has wire added to the reinforcement component of the construction. The wire may be present to prevent the hose from collapsing in suction service, to prevent kinking of pressure hose which must be curved in a small radius loop, or to obtain the strength necessary for high pressure service.

The wire in suction hose is located underneath the main plies of fabric reinforcement to provide rib support against the external pressure. In fact, rough bore suction hose is made with one helix of flat wire forming the bore of the hose and thus is located underneath the tube member of the construction.

Combination pressure and suction is made with the wire placed approximately midway in the plies of the fabric. In pressure hose, the wire is positioned over the main plies of fabric to provide hoop strength against high internal pressure. Flat wire is used for the inner wire of rough bore hose and round or flat wire may be used in the body of pressure or suction hose. The wire is present in most wire reinforced hose in the form of a close spaced helix or spring which opposes inward or outward radial stresses but does not add any significant strength to the hose in the axial direction. When high strength is needed in both axial and radial directions, the hose is built with two or more even numbers of layers of wire. Each layer is composed of many strands of solid round wire or wire cable applied over the fabric reinforcement. The wire lays on the hose in a spiral forming an angle greater than 45 degrees with the axis of the hose. The direction of the wire spiral is reversed with each layer of wire for balanced strength.

Hand-built hose is produced with various types of ends, depending upon use, as follows:

- Straight ends – hose has same inside diameter at ends as body
- Enlarged ends – to provide full-flow characteristics, an end can be manufactured with a larger I.D. than the bore of the hose. This special end is generally restricted to hand-made hose where the special mandrels can be handled in a practical manner.
- Soft ends – generally restricted to suction-type hoses that contain a close-spaced helical wire throughout the hose. To facilitate coupling, the helix is terminated before the end of the hose and the end is completed with suitable fabric reinforcement to provide adequate strength and wall thickness. Available on either straight or enlarged end hose.
- Flanged ends – many installations are best suited for hose with flanged

connections. Certain styles of hose can be made wit rubber flanges molded as an integral part of the hose. These flanges can be drilled to match standard ratings. Metal inserts are sometimes used to provide the necessary rigidity and bolting strength. Another style of flanged end utilizes a partial flange molded as an integral part of the hose which is used in conjunction with metal back-up rings for bolting purposes. This permits alignment of bolt holes without rotating the hose.

- Built-in nipples – these nipples are used for high pressure service or for hose handling hazardous liquids.

Section 2 - Applications and Markets

2.1 General

Applications and markets for Custom Made hose are extensive. These include but are certainly not limited to:

Chemical
- Acid discharge hose
- Acid suction hose
- Chemical transfer hose

Dock/ O.S. & D.
- Flex barge dock hose
- Hot tar and asphalt hose
- Molten sulphur dock hose
- Oil suction and discharge hose
- Rough bore dock hose
- Vapor recovery hose
- Viton dock hose

Dredge
- Dredge sleeve
- Sand suction hose

Petroleum
- Mud pump suction hose
- Petroleum transfer hose
- Sewage digester hose
- Tank truck hose

Water
- Fire engine suction hose
- Furnace door hose
- Water discharge hose
- Water suction hose
- Water jetting hose

Material Handling
- Clam jetting hose
- Concrete hose
- Debris handling hose
- Dry material discharge hose
- Elephant trunk hose
- Fish suction hose
- Furnace intake and discharge
- Hot air blower hose
- Industrial vacuum hose
- Slurry handling hose

Marine
- Hardwall marine industrial hose
- Softwall marine industrial hose

Dredging Application:

2.2 Application Considerations

2.2.1 Material handling hose

Typical abrasive materials include dry cement, crushed rock, screenings, limestone, grain etc. in dry, slurry (wet) or air suspension.

Typical large bore material handling hoses are Sand Suction, Suction &Discharge (S&D), Dredge, Discharge Material Handling, etc. Such applications are found in Mine, Mills, Quarries, Sea Ports, etc.

There are many parameters which will affect the hose life: the material type and size, flow rated velocity, % solid, turbulence, temperature of the product and ambient environment, bend radius, angle of impact of material transferred, chemical attack, static electricity and others.

Reasons to use rubber hoses over rigid piping are flexibility, ability to reduce vibration and mostly that rubber often outperforms steel in abrasion resistance. Abrasion is mainly the result of the change in momentum of the product (Mass x Velocity) in bends, thus inducing high localized wear. So to maximize hose longevity we recommend the end user install the hose with the largest possible bend radius; this will spread the wear over a large section of the hose.

2.2.2 Non-Conductive, static dissipating, electrically continuous and electrically discontinuous assemblies

There has always been much confusion involved with the terms applied to industrial hoses regarding the capabilities of being non-conductive, static dissipating, and electrically continuous or discontinuous. This confusion primarily originates because we do not properly relate these terms to the HOSE APPLICATIONS and WHAT THE HOSE IS EXPECTED TO DO IN APPLICATION. To determine the proper hose to use when the possibility of any

electrical build-up is involved, it is most important to know and understand the application and what is expected of the hose performance in the application.

2.2.2.1 Non-conductive hose

Non-conductive hoses normally are recommended in applications where the electrical charge is transferred from the OUTSIDE ENVIRONMENT to the hose. Air hoses used around electrical furnaces and multipurpose hoses used in proximity to high voltage poiwer lines should have non-conductive ratings as prescribed by the respective industry. In essence, the hose acts as an insulator protecting the user from EXTERNAL electrical sources. Non-conductive hoses generally are manufactured WITHOUT a metal helix or "bonding" wire. An industry standard for "non-conductive" hose follows the Alcoa specification for potroom air hose which requires a resistance of ONE MEGAOHM PER INCH PER LENGTH OF HOSE.

2.2.2.2 Static dissipating hose (also referred to as semi-conductive hose)

Static dissipating hose refers to the electrical properties of the rubber materials making up the hose, usually the tube and/or cover material; it is measured in M-Ohms (million Ohms). It is used in applications where the conveyed material can generate static electricity build-up. Such hoses will dissipate static electricity through the rubber material to the hose ends, provided the correct coupling type is used.

> Note: Non-black and many black rubber compounds will not dissipate static electricity. Only black compounds formulated with high carbon black content will dissipate static electricity.

2.2.2.3 Electrically continuous assembly

Electrically continuous refers to the electrical conductivity between coupling ends. To get an "electrically continuous" assembly you need to have the helix or static wires terminated to the couplings; it is measured in Ohms (typically less than 100 ohms).

Note: an electrically continuous hose is not necessary a static dissipating hose

2.2.2.4 Electrically discontinuous assembly

Electrically discontinuous refers to the electrical conductivity between coupling ends. To get an "electrically discontinuous" assembly, the wire helix or static wire MUST NOT be terminated to the couplings and the rubber component should have a high electrical resistance; it is measured in thousand of Ohms (electrical resistance typically > 25,000 Ohms)

2.2.3 Hose & Hose Assembly Working Pressure/Temperature - Guidelines

Hose working pressure ratings are recommended in accordance with RMA design safety factors at **ambient temperatures**. Do not operate outside of hose temperature limits specified by the hose manufacturer. Even within hose temperature limits, end fittings and hose size can impact performance at higher temperatures. For your safety, it is recommended that the following working pressure reductions for the following temperatures ranges be considered and complied with when selecting a hose (S.T.A.M.P.) and in when the hose assembly is in service.

- **80° to 150°F – Reduce working pressure by 15%**
- **150° to 225°F – Reduce working pressure by 30%**
- **Over 225°F – Reduce working pressure by 50%**

Note: Hose and hose assemblies should also not be subjected to storage conditions or used in service applications at temperatures below the minimum specified temperature rating (Example: -40˚F (-40˚C)) of the hose manufacturer. Hose may be stored at lower temperatures, but must be warmed before working with it.

Section 3 – Application Requirements – STAMPED

3.1 Purpose

The purpose of this section is to provide a concise guide to assist in determining the correct hose, coupling and attachment method that will satisfy the customer's needs. This should be used as the basis for collecting ALL information critical to the proper design of the hose for the desired application.

3.2 General

The guide uses the STAMPED process. STAMPED is an acronym and stands for the 7 major information areas required to provide a quality hose assembly for the customer, as follows:

S stands for **SIZE**; I.D. and length; any O.D. constraints

- overall length should be specified to include fittings
- tolerances need to be specified if special requirements exist

T stands for **TEMPERATURE** of the material conveyed and environmental

- Are there factors such as heat sources in the environment in which the hose will be used
- Continuous (average) and minimum and maximum temperatures have to be specified for both the environment and material conveyed
- Note if flame resistance or flammability will be an issue

- Sub-zero exposure

A stands for the **APPLICATION**, the conditions of use

- Configuration/routing (add a sketch or drawing if applicable)
  - is the hose hanging, laying horizontally, supported, unsupported (orientation and aspect of the hose)
  - what else is attached to the hose, any external load on the hose
  - bend radius requirements, flexibility
  - elongation considerations with working pressure
- Quantify anticipated movement and geometry of use requirements
- Intermittent or continuous service
- Indoor and outdoor use
- External conditions – abrasion, oil (specify type), solvents (specify type), acid (specify type and concentration), ozone, salt water
- Hose now in use
  - Type of hose
  - Service life being obtained and description of failure or source of customer dissatisfaction

M stands for the **MATERIAL** being conveyed, type and concentration

- Are there special requirements for this hose tube
  - Any special specifications (or agency requirements) that need to be considered (e.g., FDA, API)
  - Will the material be continuously flowing, or sit in the hose for long periods of time (specify)
- Media velocity, flow rate
- Chemical name/concentration (MSDS)
- Salt water
- Solids, description and size

P stands for the **PRESSURE** to which the assembly will be exposed

- Temperature implications
- Vacuum considerations

E stands for **ENDS**; style, type, orientation, attachment methods, etc.

- Uncoupled or coupled hose; hose with built-in fittings
- Specify end style (see chart)
- Materials and dimensions (steel, stainless, etc.)
- Conductivity requirements

D stands for **DELIVERY**; testing, packaging, and delivery requirements

- Testing requirements
  - certification requirements (e.g., Coast Guard)
- any special packaging requirements
- any special shipping requirements

3.3 Directions

Using the form:

1. Inform the customer you will be using an application form titled STAMPED Information Required for Custom Made Hose.

2. Ask your customer the pertinent questions outlined on the form, in sequence.

3. After completing the form, ask your customer to confirm their answers as you repeat them, in sequence.

4. The following list of special considerations may help to clarify application parameters:

    1. Abrasion – tube, cover, thickness, internal/external
    2. Electrical conductivity requirements
    3. Environment
    4. Flammability
    5. Flow rate
    6. Fluid velocity
    7. Movement (type, distance, frequency)
    8. Ozone
    9. Permeation (vapor conveying hose)
    10. Routing/configuration
    11. Salt water
    12. Static electricity
    13. Ultraviolet light
    14. Vibration considerations
    15. Special marking or branding requirements

5. Provide the completed form to a qualified NAHAD manufacturer.

(See **STAMPED** Form on next page)

STAMPED Information Required for Custom Made Hose

Customer Information:
Company: _____
Contact: _____
Address: _____
Phone: _____
Quantity Required: _____

Quote needed by: _____
Fax: _____
E-mail:_____
P.O.#:_____
Terms: _____
Date Required: _____

Size	I.D.	O.D.*	Overall Length	Tolerance

* *if applicable*

Temperature	Materials Conveyed		Environmental Temperature	
	Min.	Max	Min	Max
	^{o}F/^{o}C	^{o}F/^{o}C	^{o}F/^{o}C	^{o}F/^{o}C

Application	

Material/media	Internal media
	Special requirements for tube

Pressure	Max Working Pressure PSI/kPa	Spikes PSI/kPa	Vacuum Inches of Hg

Ends	End 1	
	End 2	

Delivery	Packaging/packing requirements:		
	Any special shipping requirements:		Ship Via:
	Testing Required:	Y N	Type:
	Certification Required:	Y N	Type:

Application considerations: Abrasion – tube, cover, thickness, internal/external; Electrical conductivity requirements; Environment; Flammability; Flow rate; Fluid velocity; Movement (type, distance, frequency); Ozone; Permeation (vapor conveying hose); Routing/configuration; Salt water; Static electricity; Ultraviolet light; Vibration considerations; Special marking or branding requirements
Special Requirements: (tube, cover, etc.)

Section 4 - Components

4.1 General

In the custom made hose business, the distributor works directly with the end-user to understand the application and environment, and will typically specify all aspects of the STAMPED process (Size, Temperature, Application, Material, Pressure, Ends, and Delivery). The distributor works with the customer to define and qualify the opportunity, oversee delivery, help with problem resolution, and is instrumental in assisting with final installation. The distributor is the primary point of contact for the customer, the first line of resources for the customer, and is backed by the manufacturer. The distributor also can provide packaging and handling support in their work with end-users. They should recognize any risk in leaving the customer to install the hose, and educate the customer on proper care and handling of the hose. Finally, the distributor should assess any post-installation issues or problems, and answer any questions.

The manufacturer typically specifies and/or recommends the materials used for actual hose construction based on information provided from the STAMPED process and fabricates an appropriate hose. Hose material information is included below for informational purposes.

4.2 Hose Construction – overview

A hose is a reinforced, flexible conduit used to move materials from one point to another or to transmit energy. It is flexible to accommodate motion, alignment, vibration, thermal expansion and contraction, portability, ease of routing, and ease of installation.

Most hoses are made up of three elements: (1) a tube, (2) reinforcement, and (3) an outer cover. Each of these components is usually adhered to the adjacent components by bonding agents or thin layers of specially compounded rubber.

4.2.1 Tube

The tube is the innermost rubber or plastic element of the hose. The tube may be placed over reinforcing elements. For suitable service, the tube must be resistant to the materials it is intended to convey. The characteristics of the rubber or plastic compound from which the tube is made and the thickness of the tube are based on the service for which the hose is designed.

4.2.2 Reinforcement

Reinforcement can be textile, plastic, or metal, alone of in combination, built into the body of the hose to withstand internal pressures, external forces, or a combination of both. The type and amount of reinforcing material used depends

on the method of manufacture and on the service requirements. For example, a residential garden hose does not need the same level of reinforcement as required for high pressure air hose used in construction and mining applications.

4.2.3 Cover

The cover is the outer element and can be made of various materials; its prime function is to protect the reinforcement from damage and the environment in which the hose will be used. Covers are designed for specific applications and can be made to be resistant to oils, acids, abrasion, flexing, sunlight, ozone, etc.

4.3 Hose Materials

The basic materials in the manufacture of hose are rubber, plastics, textile yarns, textile fabrics, and metal in the form of wires and cables. The term “rubber” will be used in its broadest sense, and will include all elastomeric materials that are compounds of natural or synthetic elastomers, or combinations of these materials.

4.3.1 Rubber

To provide a wide range of physical properties for specific service needs, elastomers are mixed with various chemicals. There are many compounding ingredients and compounding methods available to the hose manufacturer, and many types can be blended in almost unlimited combinations to obtain the most desirable properties for the application.

The reader is cautioned that the “General Properties” described are just that, properties which have been found to be generally applicable in the experience of persons familiar with rubber chemistry. However, the reader should always follow the manufacturer’s recommendation as to the use of any particular rubber composition, especially with respect to the resistance of the rubber composition to the materials it is intended to carry or protect against. Failure to do so may result in possible damage to property and/or serious bodily injury.

4.3.1.1 Rubbers Used In Hose

ASTM Designation D1418	Common Name	Composition	General Properties
ABR	Acrylics	Acrylate-butadiene	Excellent for high temperature oil and air resistance. Poor cold flow and low temperature resistance. Not recommended for water service.

AEM	Ethylene acrylic	Ethylene methyl acryl- ate copolymer	Excellent high temperature, ozone, and oil resistance
AU	Urethane	Polyester	Excellent abrasion, tear and solvent resistance, good aging. Poor high temperature properties.
BIIR	Bromobutyl	Brominated isobutylene-isoprene	Same general properties as Butyl (see IIR below)
BR	Polybutadiene	Butadiene	Excellent low temperature and abrasion properties. High resilience.
CIIR	Chlorobutyl	Chlorinated isobutylene-isoprene	Same general properties as Butyl (see IIR below)
CM	Chlorinated polyethylene	Chlorinated polyethylene	Good long term resistance to UV and weathering. Good oil and chemical resistance. Excellent flame resistance. Good low temperature impact resistance.
CO	Epichlorohydrin Rubber	Polychloromethyl oxirane	Excellent oil and ozone resistance. Good flame resistance and low permeability to gases. Fair low temperature properties.
CR	Neoprene	Polychloroprene	Good weathering resistance, flame retarding. Moderate resistance to petroleum based fluids. Good physical properties.
CSM	Hypalon	Chlorosulfonyl-Polyethylene	Excellent ozone, weathering and acid resistance. Good abrasion and heat resistance. Good resistance to petroleum based fluids.
EAM	Ethylene vinyl acetate	Ethylene vinyl acetate copolymer	Excellent high temperature and ozone

			resistance. Good resistance to petroleum based fluids as vinyl acetate content increases.
ECO	Epichlorohydrin copolymer	Ethylene oxide and chloromethyloxirane	Excellent oil and ozone resistance. Fair flame and low permeability to gases. Good low temperature properties.
EPDM	Ethylene Propylene Rubber	Ethylene-propylene diene-terpolymer	Excellent ozone, chemical and aging characteristics. Good heat resistance. Poor resistance to petroleum based fluids.
EPM	Ethylene Propylene Rubber	Ethylene-propylene copolymer	Excellent ozone, chemical and aging characteristics. Good heat resistance. Poor resistance to petroleum based fluids.
EU	Urethane	Polyether	Excellent abrasion, tear, and solvent resistance. Good aging. Poor high temperature properties.
FKM	Fluoroelastomer	Fluorocarbon rubber	Excellent high temperature resistance, particularly in air or oil. Very good chemical resistance.
HNBR	Hydrogenated nitrile	Hydrogenated acrylonitrile-butadiene	Excellent high temperature and oil resistance.
IIR	Butyl	Isobutylene-isoprene	Very good weathering resistance. Low permeability to air. Good physical properties. Poor resistance to petroleum based fluids.
IR	Polyisoprene	Polyisoprene-synthetic	Same properties as natural rubber (see NR below)
MQ	Silicone	Dimethylpolysiloxane	Excellent high and low temperature resistance. Fair physical properties.

NBR	Nitrile	Acrylonitrile-butadiene	Excellent resistance to petroleum based fluids. Moderate resistance to aromatics. Good physical properties.
NR	Natural Rubber	Polyisoprene, natural	Excellent physical properties including abrasion and low temperature resistance. Poor resistance to petroleum based fluids.
SBR	SBR	Styrene-butadiene	Good physical properties, including abrasion resistance. Poor resistance to petroleum based fluids.
T	Thiokol	Organic polysulfide	Outstanding solvent resistance and weathering resistance. Other properties are poor.
XLPE	Cross-linked polyethylene	Polyethylene and cross linking agent	Excellent chemical resistance with good heat and electric properties
XNBR	Carboxylated nitrile	Carboxylated acrylonitrile-butadiene	Excellent oil and abrasion resistance.

4.3.1.2 Plastics Used in Hose

ASTM Designation D1600	Common Name	Composition	General Properties
PA	Nylon	Polyamide	Good abrasion, chemical and fatigue resistance. Good long term resistance to high temperature. Low gas permeation and low coefficient of friction
PE	Polyethylene	Polyethylene	Excellent dielectric properties. Excellent resistance to water, acids, alkalis, and solvents. Good abrasion and weathering

			resistance.
	UHMWPE	Ultra high molecular weight polyethylene	Excellent resistance to a broad range of chemicals, excellent abrasion resistance.
PVC	PVC	Polyvinyl chloride	Good weathering, moisture and flame resistance. General resistance to alkalis and weak acids. Good abrasion resistance.
	Polyester	Thermoplastic polyester resin	Good flex fatigue and low temperature properties. High resistance to deformation. Good resistance to abrasion, chemicals, hydraulic fluids and aromatic fuels.
	Thermoplastic Rubber	Thermoplastic polyolefins and block copolymers of styrene and butadiene	Good weather and aging resistance. Good for water and dilute acids and bases.
PTFE	Fluoropolymer	Fluorocarbon resin	Excellent high temperature properties and chemical resistance.

4.3.2 Fabrics

4.3.2.1 Overview: Textile fabrics used as reinforcement in hose construction provide the strength to achieve the desired resistance to internal pressure or to provide resistance to collapse, or both.

The properties of a fabric depend on the construction and the material from which the yarn is made and on the type of weave used.

One common hose fabric is woven from warp yarns, which run lengthwise, and fill yarns, which run cross-wise. Usually they are woven at right angles to each other. The most common weave is known as “plain weave” where the warp and fill yarns cross each other alternatively. Other weaves used, though to a lesser degree, are twill, basket weave, and leno. Leno weave is used mainly where the fabric must be distorted in the hose as in certain types of curved hose. Leno also provides a means for better adhesion than other patterns. Woven Cord is a special type of hose reinforcement. The warp cords are strong while the fill yarn is very fine and merely holds the cords in position. This is often called “tire cord” because this type of construction is commonly used in reinforcing tires. Woven

cord provides strength in one direction only. When woven cord is used, a minimum of two layers are applied in alternate directions.

To adhere to the tube and cover of the hose, the fabric must be rubberized. The fabric is either frictioned or coated with a thin layer of rubber. Before rubberizing, some fabrics are treated with liquid adhesive.

4.3.2.2 Fibers Used in Hose

Common Name	Composition	General Properties
Aramid	Meta-Aramid	Exceptional heat resistance with low shrinkage.
Aramid	Para-Aramid	Exceptional strength with low elongation. High heat resistance.
Cotton	Natural cellulose	Natural vegetable fiber used in hose. Gains strength with increased moisture content. Requires protection against chemical and fungal activity.
Glass	Glass	Very high strength compared to other fibers. Low elongation; mainly used in high temperature applications.
Nylon	Polyamide	High strength and elongation with good resistance to abrasion, fatigue, and impact. Low moisture absorption and excellent moisture stability. High resistance to fungal activity.
Polyester	Polyester	High strength, good resistance to abrasion, fatigue, and impact. Low moisture absorption and excellent moisture stability. High resistance to fungal activity.
PVA	Polyvinyl alcohol	High strength, low shrinkage, and good chemical resistance.
Rayon	Regenerated cellulose	Similar to cotton in chemical and fungal resistance. Moisture absorption higher than cotton. Dry strength is substantially greater than cotton. Strength is reduced with increased moisture content but retains a wet strength level above cotton.

4.3.3 Yarns

Yarns are used in hose for reinforcement of the tube material to provide the strength to achieve the desired resistance to internal pressure or to provide resistance to collapse, or both. The basic yarn properties required for hose reinforcement are: adequate strength, acceptable heat resistance, dynamic

fatigue resistance, and satisfactory processability for the various methods of reinforcing hose. Other special properties such as stiffness, adhesion, conductivity, etc., may be developed depending upon the specific hose application. Yarn is available in two basic forms: staple (sometimes referred to as spun yarn) and filament.

4.3.3.1 Staple: Staple yarn is made by twisting bundles of short fibers to form a continuous yarn. The staple obtains its strength from the binding effect of the twist imparted to the individual fibers. The base staple yarn is called “singles”. It is made from fiber bundles twisted together in one direction to form a singles strand. If two or more single yarns are twisted together, usually in a direction opposite that of the singles yarn, the result is a plied yarn. Two or more plied yarns may be twisted to form a cable cord. The strength, elongation, and thickness of yarn are a function of the twist level and the number of fibers in the bundle. Staple yarns may be made from natural or synthetic fibers or a blend of the two. The cotton count system is normally used to designate staple yarn size. The number of “hanks” in one pound is the yarn number. A cotton hank is 840 yards. Therefore, a 2’s staple yarn contains approximately 1680 yards in one pound. The cotton count system is an inverse measure of the linear density of the yarn, i.e., as the yarn number increases the yarn size is decreased.

4.3.3.2 Filament Yarns: Filament yarn is produced by extruding synthetic material through a spinnerette containing hundreds of orifices. The mono-filaments from each of the orifices are brought together to form a multifilament yarn.

Filament yarns have higher tenacity (strength per unit of weight – grams per denier), in the range of 2 to 3 times that of staple yarn on the same material type and size. Yarn size is normally designated using the *denier* system (weight in grams of 9000 meters of yarn.) The *TEX* system (the weight in grams of 1000 meters of yarn) is also widely used. Both are direct yarn measurements, i.e., as the number increases, the yarn size increases.

4.3.4 Wires

Reinforcing wire is used in a wide variety of hydraulic and industrial hose, primarily where textiles alone do not satisfy the special engineering requirements or the service conditions for which the hose is designed.

4.3.4.1 Steel wire: Steel wire has strength, high modulus for dimensional stability, fatigue resistance, and low cost, and is the major reinforcement used in high pressure hose and in most suction hose.

4.3.4.2 Steel wire (High Tensile Low Carbon): Small diameter high tensile steel wire is most commonly used for reinforcement in braided or spiral-wound hose

for high pressure and high temperature applications. The wire normally used ranges in size from 0.008 inch to 0.037 inch (0.20 mm to 0.94 mm) in diameter.

4.3.4.3 Flat Wire Braid: This consists of an odd number of steel wires interwoven to produce a flexible reinforcement. It is used in specialized types of hose, either by itself, or in combinations with other shapes of steel wire. Flat braids of standard sizes are composed of 9, 13, 17, or 21 strands of wire in an "over two, under two" plain braid pattern.

4.3.4.4 Wire Cable: Wire cable consists of multiple strands of round wire. It provides high bursting strength without undue loss of flexibility or crush resistance. Sizes range from 0.047 inch to 0.25 inch (1.19 mm to 6.4 mm) in diameter and are made from high tensile carbon steel wire.

4.3.4.5 Round Wire: Round is the most commonly used wire shape in hose fabrication. It ranges in size from 0.013 inch to 0.875 inch (0.79 mm to 22.2 mm) in diameter. Round wire is generally made of high tensile carbon steel.

4.3.4.6 Rectangular Wire: Rectangular wire is most commonly used as a helical reinforcement on the interior of rough bore suction hoses to prevent collapse. It is sometimes used in the body of the hose. Occasionally this type of wire is also used as an external helix embedded in and flush with the rubber cover to provide protection against cutting and abrasion and to increase crush resistance. Rectangular wire is generally steel, although aluminum may also be used.

4.3.4.7 Half-round Wire: Half-round steel wire is used mainly as a protective spiral armor on the exterior of a hose. It is wound with the flat side against the hose cover to provide maximum surface contact. It is available in stainless steel or steel with tin-coated or galvanized finishes.

4.3.4.8 Wire finishes: Wire finishes for steel wire can be either one of two types, (1) brass drawn finish, or (2) coated finish. The most commonly used finish in the hose industry is brass (drawn finish), or galvanized (coated finish.) Other finishes include bronze, liquor, and tin. Helical round wires used as helical wound in the body of a hose may have a drawn copper finish, or may be unfinished (bright). Rectangular steel wires used in the bore of a hose usually have a galvanized finish.

4.3.4.9 Alloy and Non-Ferrous Wires: Under certain service conditions, carbon steel wire is **not** suitable. An alloy wire is used instead. One of the most commonly used is stainless steel which offers exceptional resistance to corrosion and heat. Where light weight is essential, alloys of aluminum are used.

4.3.4.10 Static Wires: Static wires and other conductive materials are used in hose to prevent static electricity buildup. Wires can be made from many metals

including copper, steel, Monel, aluminum and tin-coated copper. Static wires may be solid, stranded, or braided.

4.4 Physical Characteristics of Hose

4.4.1 Flexibility and Bend Radius

Flexibility and minimum bend radius are important factors in hose design and selection if it is known that the hose will be subjected to sharp curvatures in normal use. When bent at too sharp an angle, hose may kink or flatten in the cross-section. The reinforcement may also be unduly stressed or distorted and the hose life compromised.

The hose should be able to conform to the smallest anticipated bend radius without overstress. The minimum bend radius is generally specified by the manufacturer and is the radius to which the hose can be bent in service without damage or appreciably shortening its life. The radius is measured to the inside of the curvature. If the application entails dynamic bending, the minimum bend radius may need to be larger – consult with the manufacturer.

Textile reinforced hoses have a tendency to kink as the bend radius is reduced. Generally, a helix of wire is used when a hose must withstand severe bends without flattening or kinking.

Some indication of relative hose flexibility can be determined from the manufacturer's minimum bend radius recommendations. The bend radius does not necessarily reflect the force required to bend the hose to this radius, which is a major factor in flexibility. Different hose constructions may require significantly different forces to attain the same minimum bend radius.

Generally, the preferred hose is the more flexible hose, provided all other properties are essentially equivalent. There are exceptions to this as in sand blast hose where minimizing the bending in service increases hose life.

4.4.2 Suction and Vacuum

Most hose is used for pressure service; however, some applications require the host to resist collapse in suction and vacuum service. Such hose is subjected to crushing forces because the atmospheric pressure outside the hose is greater than the internal pressure. The hose can collapse and restrict the flow unless the hose is constructed to resist these pressure differentials.

The most common method of preventing hose collapse is to build a helical wire reinforcement into the hose body. The size and spacing of the wire reinforcement depends on the size of the hose and the expected pressure differential for the application. In suction applications approaching a perfect

vacuum, most of the carcass plies are applied over the wire reinforcement. The hose is constructed with high adhesion between the tube and the carcass to prevent tube separation. Suction hose must be specifically designed for the service for which it is used. Each element – tube, textile reinforcement, size, spacing, and location of the wire reinforcement – must be carefully planned.

While suction hose is generally used to convey liquids, vacuum hose carries air under a partial vacuum. Vacuum hose is reinforced to resist collapse and maintain its shape under rough handling and/or mechanical abuse. It does not require the heavy construction of suction hose because the dry materials generally conveyed are much lighter in weight than liquids and the vacuum is usually less than for normal suction service.

4.5 Electrical Characteristics of Hose

4.5.1 Conductive Hose

Static wires and conductive rubber components are used in hose to help prevent static electricity build-up and subsequent discharge as a spark. Electrical engineers differ in opinion on the effects of static electricity and the means of dissipating it.

In handling gasoline and other petroleum-based liquids, recognized national associations and companies have conflicting opinions on the need for conductive hoses.

Until a consensus is reached among all associations, laboratories, and users and a standard practice is established, it is essential that the user determine the need for static bonded hose based on: (a) the intended use of the hose; (b) instructions from the company's Safety Division; (c) the insurer; and, (d) the laws of the States in which the hose will be used.

Some types of hose include a body reinforcing wire. This wire can be used for electrical continuity provided that proper contact is made between it and the hose coupling. This can be done by extending the body wire to the ends of the hose, or by attaching a light static wire to the outermost coils of the body wire. This lighter wire is led through the ends of the hose and attached to the couplings. In non-wire reinforced hose, a static wire can be included in the hose body.

The tendency has been toward a grounding connection completely separate from the hose or to have the tube or cover of the hose conducting. Examples would be sand blast hose with conducting tube or aircraft fueling hose with a conducting cover. An internal static wire could break or lose contact with the couplings and not be detected visually. This could occur from an unusual stress imposed on the hose.

4.5.2 Non-Conductive Hose

In some specific applications, especially around high voltage electrical lines, it is imperative for safety that the hose be non-conductive. Unless the hose is designed particularly to be non-conductive and is so branded, one dare not conclude that it is non-conductive. Many black rubber compounds are inherently and inadvertently conductive. Non-conductive hose is usually made to a qualifying standard that requires it to be tested to verify the desired electrical properties. The hose is usually non-black in color and clearly branded to indicate it is designed for non-conductive applications.

WARNING: unless a hose is described specifically and clearly branded to be conducting or non-conducting, it must be assumed that the electrical properties are uncontrolled.

4.6 Fittings/Couplings

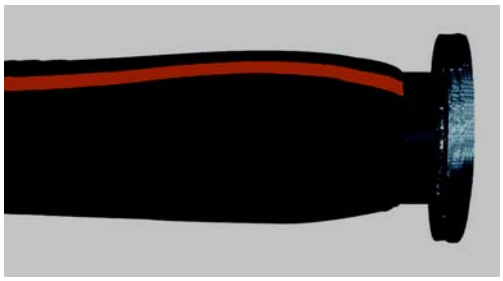
The ends of hose can be provided in a variety of ways. The selection of the end configurations is dependent on the application and the input/desire of the end user. Not all end options are appropriate for all applications - this will be determined by the manufacturer. Each manufacturer has their own end configuration availability. The end options may vary between manufacturers depending on their process and/or design parameters. It is not uncommon for a hose to have different end styles on each end.

Fittings/Couplings	
Built-In Nipple (See Illustration Below)	Steel nipple is built into the hose during fabrication providing maximum holding power and a full flow unrestricted transition area. Available in threaded, fixed flange, floating flange, beveled for weld, or grooved end styles. Recommended for heavy duty, high pressure applications.
Built-In Nipple/Rubber Lined	Hose tube extends through the nipple and up the face of the flange providing a full flow unrestricted transition area. Extends service life by protecting the steel nipple from contact with conveyed material. Recommended for heavy duty, high pressure abrasive applications. (Provides added abrasion resistance and extended service life. Recommended for highly abrasive or corrosive applications.)
Built-In Rubber Flange (B.I.R.F.) (See Illustration Below)	Fabric plies and hose tube turn up the face of the flange. Steel back-up flange and rubber flange are molded together. Recommended for light to medium duty, low pressure, abrasive applications.

	Sometimes known as Duck & Rubber Flange or integral rubber flange.
Enlarged	Hose end is enlarged to accommodate the outside diameter of pipe. Used in typically lower pressure rated applications with soft cuffs. Consideration must be given to enlarged i.d. and length.
Split Bolted Flange	Two piece reusable coupling system is attached externally with compression bolts and allows the user to fabricate assemblies in the field. Designed for large bore material transfer hose.
Beaded End (B.E.) (See Illustration Below)	Hose tube and reinforcement extends through the steel ring and up the face of the stub end providing a full flow. Either full floating or split ring flanges are used to ensure proper bolt hole alignment. Recommended for abrasive applications.
Soft Cuff	Internal wire reinforcement is eliminated from the end of the hose providing a soft and flexible section for ease of attaching. Consideration must be given to cuff length and cuff o.d.
Capped ends	Hose end covered to protect its internal elements
End Styles	
Custom ends	Hose couplings designed specifically to engineered specifications; sanitary fittings; tapered ends
Straight or plain ends	End of hose is square and cut straight with no end fittings or cuffs.
Built-in Nipple Attachments	
Fixed / floating flanges	150# and 300# drilling ANSI forged steel flanges. Metric sizes also available. Also available in stainless steel. Can also be reducing.
Beveled for weld	Plain end nipple ready for welding.

Other styles of built-in fittings available on request

Built-In Rubber Flange (BIRF)



Built-In Nipple Flange (BINF)

Beaded End

Section 5 - Proper Handling and Packaging

5.1 General

Proper handling and packaging are critical in the Custom Made hose environment. In order to insure the hose arrives undamaged at the final destination, NAHAD strongly recommends proper packaging and handling practices are followed. Several options and considerations are listed below; the customer, the distributor and the manufacturer should all understand and agree on the appropriate options.

Take pictures to maintain a paper trail!! Be clear about FOB specifications. Only use shippers you trust. And watch those fork-lift guys and gals – any handling other than by specified methods can result in expensive hose damage. (This concept critical – add picture of fork-lift)

Hose assemblies shall be packaged in such a manner to insure that external abuse during shipping and handling does not damage the hose or fittings.

Hose shall be packed in a clean and dry state.

Containers, boxes, banding and pallets shall be of sufficient size and strength to

withstand handling and transit without failure.

When packaged, hose assemblies should not be coiled tighter than the specified minimum bend radius. Check customer information for any specific labeling or packaging requirements.

The length of the hose typically determines whether hose is shipped coiled or straight. End caps can be used as required.

5.2 Packaging Options (check with the manufacturer for recommendations)

5.2.1 Coiled

- Protective wrap; palletized
- in crates
- on reels
- poly-bagged in bales

5.2.2 Straight

- Slat packing
- Plastic tubes
- Metal rack (dedicated truck)
- Poly-bagged
- Skids

Slat Packing

5.3 Packaging and Handling Considerations

Handling in transit and during installation needs to be considered in order to reduce or eliminate potential damage. Care should be taken not to kink the hose, damage the hose cover, or stress it in ways it wasn't designed to handle. (Any questions should be referred to the manufacturer.) Some considerations include:

- Do not drag the hose over docks or decks, or sharp, abrasive surfaces
- Never lift long length or large bore hose from the middle of its length with the ends hanging down
- Support the hose with wide slings or saddles to limit the curvature of the hose. *In order to increase the service life of the hose, NAHAD recommends that proper support be given to the hose during lifting; the use of chains, rope or cable should be avoided.*
- Do not kink hose or run over it with equipment
- For additional information, see the RMA manuals for hose maintenance, testing and inspection. (list specifics)

5.4 Storage (Labeling, Environment, Time)

Proper storage will maximize hose shelf life. All hose should be stored in such a manner to protect them from degrading factors such as humidity, temperature extremes, ozone, sunlight, direct light from fluorescent or mercury lamps, oils, solvents, corrosive liquids, insects, rodents, and any other degrading atmosphere.

Care should be taken when stacking hose, as its weight can crush hose at the bottom of the stack. The stack could also become unstable, creating a safety hazard.

Note:

The ideal storage temperature for rubber hose is +50°F to +70°F with the maximum of +100°F. Care should be taken to keep rubber hoses from being stored next to heat sources. Rubber hose should not be stored near electrical equipment that generates ozone. Exposure to high concentrations of ozone will cause damage to the hose.

Store components in a cool, dry area. If stored below freezing, pre-warming may be required prior to handling, testing and placing into service.

Components should be stored in original date-coded containers. Steps should be made to rotate inventory on a first-in, first-out basis, to insure that the products are exposed to the shortest shelf time possible.

Section 6 – Installation Considerations

6.1 Purpose

The purpose of this section is to increase awareness of the proper installation and handling of hose assemblies, and to alert fabricators, installers and end-users to the safety hazards in the field.

Hoses and hose assemblies are used interchangeably in this document. Hoses are used to convey fluids, gases, dry materials and other media. Hose constructions are available in a variety of materials and styles depending on the intended application.

Because proper handling of Custom Hose has such a huge impact on hose life and viability, please refer back to Section 5 (Proper Handling and Packaging) when considering installation issues as well.

6.2 General

All hose has a finite life and there are a number of factors, which will reduce its life. The design and use of systems, which contain hoses, require consideration of factors related to specific application requirements.

6.3 Safety Considerations

Below are some potential conditions that can lead to personal injury and property damage. This list is not inclusive. Consider reasonable and feasible means, including those described in this section to reduce the risk of injuries or property damage.

Employers with hose assemblies in fluid systems are encouraged to provide training, including the information in this document, for maintenance personnel and other employees working with and around hoses under pressure.

6.3.1 Media Permeation

Hoses should always be used in well-ventilated areas. Certain media will permeate through hoses that can displace breathable air in confined spaces. Consult the manufacturer if in question.

6.3.2 Fluid Injections

Fine streams of pressurized fluid can penetrate skin and enter a human body. Fluid injection wounds may cause severe tissue damage and loss of limb. Consider the use of guards and shields to reduce the risk of fluid injections.

If a fluid injection occurs, contact a doctor or medical facility at once. Do not delay or treat as a simple cut. Fluid injections are serious injuries and prompt medical treatment is essential. Be sure the doctor knows how to treat this type of injury.

Avoid all contact with escaping fluids. Treat all leaks as though they are pressurized and hot or caustic enough to burn skin.

6.3.3 Whipping Hose

If a pressurized hose or hose fitting comes apart, the loose hose end can flail or whip with great force, and fittings can be thrown off a high speed. This is particularly true in compressible gas or fluid systems. If the risk of hose whipping exists, consider the use of guards and restraints.

6.3.4 Fire and Explosions from Conveyed Fluids

All hydraulic fluids, including many designated as “Fire Resistant”, are flammable (will burn) when exposed to the proper conditions.

Fluids under pressure which escape from system containment, may develop a mist or fine spray that can explode upon contact with a source of ignition (e.g.; open flames, sparks, hot manifolds.) These explosions can be very severe and could cause extensive property damage, serious injury or death. Care should be taken to eliminate all possible ignition sources from contact with escaping fluids, fluid spray or mist, resulting from hydraulic system failures. Select and route hoses to minimize the risk of combustion.

6.3.5 Fire and Explosions from Static-Electric Discharge

Fluid passing through hose can generate static electricity, resulting in static-electric discharge. This may create sparks that can ignite system fluids or gases in the surrounding atmosphere. Use hose rated for static conductivity or a proper grounding device. Consult manufacturer for proper hose and coupling selection.

6.3.6 Burns from Conveyed Fluids

Fluid media conveyed in certain applications may reach temperatures that can burn human skin. If there is risk of burns from escaping fluid, consider guards and shields to prevent injury, particularly in areas normally occupied by operators.

6.3.7 Electrical Shock

Electrocution could occur when a hose assembly conducts electricity to a person. Most hoses are conductive. Many have metal fittings. Even nonconductive hoses can be

conduits for electricity if they carry conductive fluids.
Certain applications require hose to be nonconductive to prevent electrical current flow. Other applications require the hose to be sufficiently conductive to drain off static electricity. Hose and fittings must be chosen with these needs in mind. Consult manufacturer with any questions.

6.3.8 Fluid Controlled Mechanisms

Mechanisms controlled by fluids in hoses can become hazardous if a hose fails. For example, when a hose bursts, objects supported by the fluid pressure may fall. If mechanisms are controlled by fluid power, use hose with design characteristics sufficient to minimize the potential risks of property damage or injury.

6.3.9 Air and Gaseous Applications

Consult manufacturer for proper hose and coupling selection. The covers of hose assemblies that are to be used to convey air and other gaseous materials must be pin perforated.

CAUTION: Exercise care not to perforate beyond the cover. These perforations allow gas that has permeated through the inner tube of the hose to escape into the atmosphere. This prevents gases from accumulating and blistering the hose.

6.3.10 Hand-held Hydraulic Operated Tools

Extreme care is necessary when connecting hand-held or portable hydraulic powered tools to a hydraulic power source with a hose assembly.

A. Always use a strain reliever at both ends of the hose assembly to prevent excessive bending, kinking and stress at the coupling to hose interface.

B. Never use the hose assembly as a means to carry, pull, lift or transport the hydraulic tool or power unit.

C. Exposed hose near the operator should be covered with a fluid deflection apparatus such as nylon sleeving, for protection against injection injuries should a hose rupture occur.

D. Operators should be protected with the proper safety equipment such as face masks, leather gloves and safety clothing as dictated by the job, fluid and tools being used.
E. If the connecting hose assembly could be subjected to external forces that may inflict damage, an appropriate guard should be used.

6.4 Hose Installation and Replacement

The following practices shall be used when installing hose assemblies in new systems or replacing hose assemblies in existing systems.

6.4.1 Pre-Installation Inspection

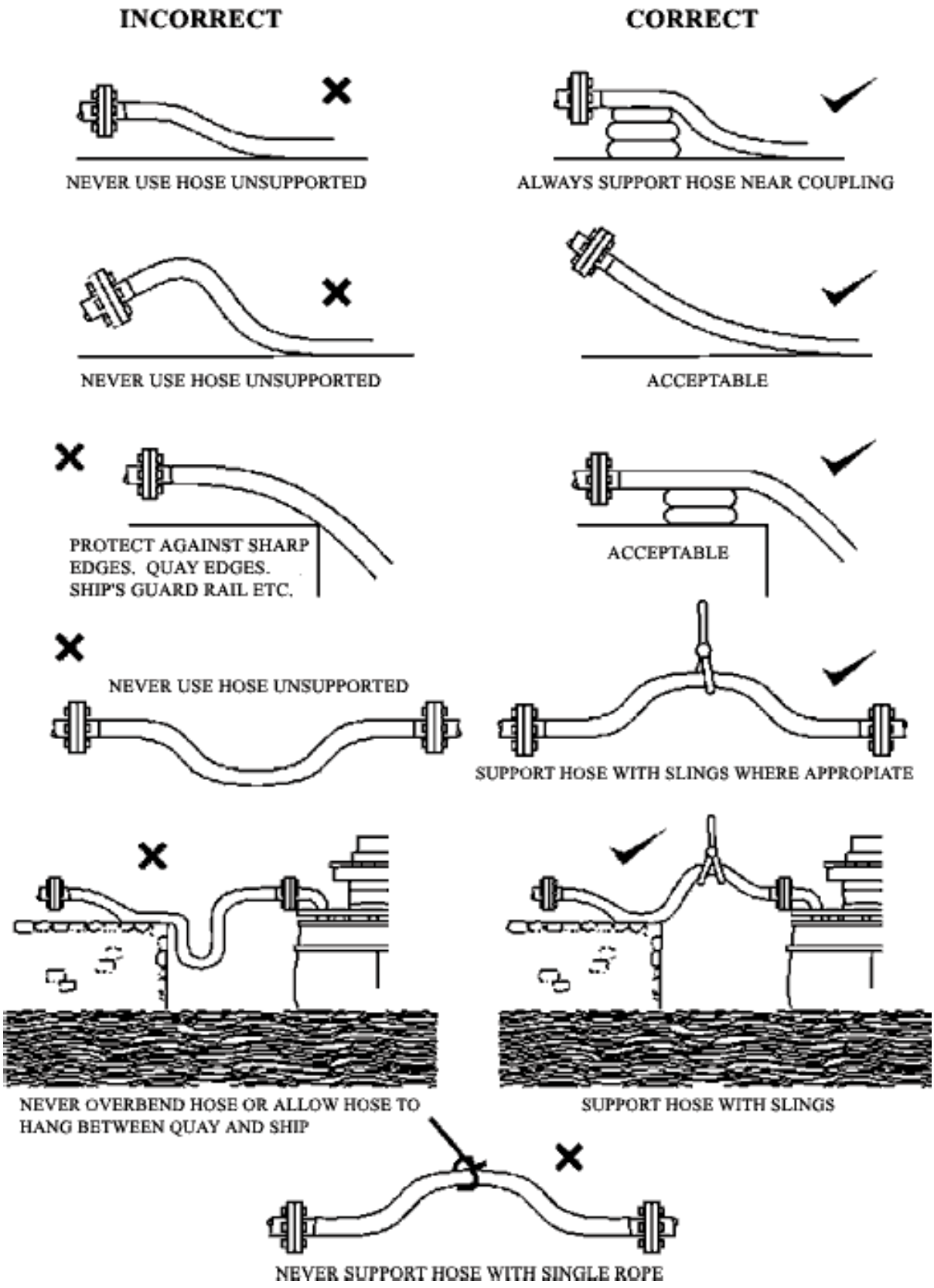
Before installing hose assemblies, the following shall be examined:

A. Hose length and routing for compliance with original design.
B. Correct style, size, length, and visible non-conformity of assembly.
C. Fitting seats for burrs, nicks or other damage.
D. Kinked, crushed, flattened, or abraded hose. Note: do not install if any of these conditions apply impacting hose functionality.

6.4.2 Handling During Installation

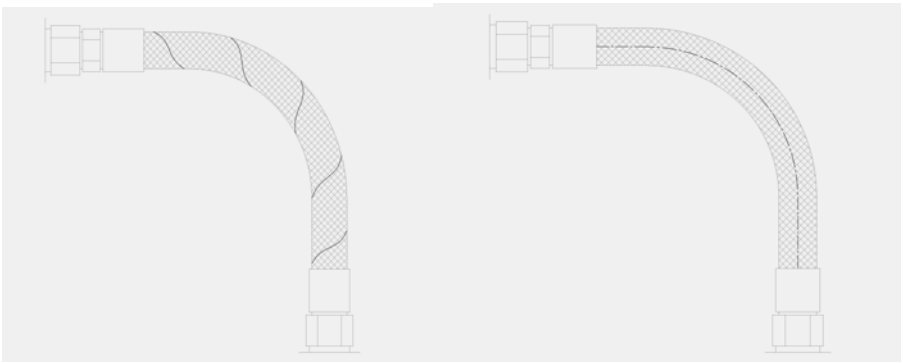
Handle hose with care during installation; bending beyond the minimum bend radius will reduce hose life. Sharp bends at the hose to fitting juncture should be avoided. Selecting the proper handling equipment (slings, cradles, hose saddles, and spreader bars) is critical. Chains or wire ropes should never be used during installation to support the hose Slings, cradles, spreader bars or other equipment can be used. Hoses of large enough girth may require cranes or other appropriate material handling equipment, but forklift forks should never be inserted inside the hose. The hose should never be lifted, moved or maneuvered from the inside.

Please see the following page for additional handling Do’s and Don’t’s.


INCORRECT
CORRECT
NEVER USE HOSE UNSUPPORTED
ALWAYS SUPPORT HOSE NEAR COUPLING
NEVER USE HOSE UNSUPPORTED
ACCEPTABLE
PROTECT AGAINST SHARP EDGES. QUAY EDGES. SHIP'S GUARD RAIL ETC.
ACCEPTABLE
NEVER USE HOSE UNSUPPORTED
SUPPORT HOSE WITH SLINGS WHERE APPROPIATE
NEVER OVERBEND HOSE OR ALLOW HOSE TO HANG BETWEEN QUAY AND SHIP
SUPPORT HOSE WITH SLINGS
NEVER SUPPORT HOSE WITH SINGLE ROPE

6.4.3 Torque

Hose assemblies shall not be installed or operated in a twisted or torqued condition. Swivel fittings or a lay line may be used to aid in torque-free installation. Flange to flange bolt hole alignment is critical for proper installation.



INCORRECT **CORRECT**

6.4.4 Hose Routing

When planning the hose routing use the following practices for optimum performance and more consistent and predictable service life.

Routing at less than minimum bend radius, will reduce the service life of the hose. Use the static or dynamic minimum bend radius according to service conditions. Sharp bends at the hose to fitting juncture should be avoided

Hose assemblies subject to movement while operating should be installed in such a way that flexing occurs in the same plane.

6.4.5 Securement and Protection

Necessary restraints and protective devices shall be installed. Such devices shall not create additional stress or wear points.

6.4.6 System Checkouts

In some liquid systems, it may be necessary to eliminate all entrapped air after completing the installation. Follow manufactures' instructions to test the system for possible malfunctions and leaks.

To avoid injury during system checkouts, do not touch any part of the hose assembly when checking for leaks and stay out of potentially hazardous areas while testing hose systems. (See Safety Considerations)

6.5 Maintenance Inspection

A hose and fitting maintenance program can reduce equipment down time and maintain peak operating performance. For custom hose, these inspections are most likely to be performed by the end user (rather than the distributor).

6.5.1 Inspection Frequency

The nature and severity of the application, past history and manufacturer's recommendations shall be evaluated to determine the frequency of the visual inspections and functional tests. However, in the absence of this information, we recommend a visual inspection on a frequent basis.

To avoid injury during system checkouts, do not touch any part of the hose assembly when checking for leaks and stay out of potentially hazardous areas while testing hose systems. (See Safety Considerations)

6.5.2 Visual Inspections

The hose and fittings shall be visually inspected for:

A. Leaks at the hose fittings or in the hose.
B. Damaged, abraded, or deteriorated components.
C. Cracked, damaged, or badly corroded fittings.
D. Other signs of significant deterioration such as blisters.

If any of these conditions exist, the hose assemblies shall be evaluated for replacement.

6.5.4 Functional Tests

Custom hose is designed, and when required, tested and certified by the manufacturer prior to shipment. Any additional testing in the field is dependent on any relevant governing regulations such as RMA, Coast Guard, etc. The responsibility for in service testing lies with the end user, not the distributor. Any branding requirements are handled by the fabricator as part of the certification.

Section 7 – Assembly Identification

7.1 Purpose

This section is intended to establish methods and content of applying hose assembly identification markings and identify minimum cleaning requirements. Some branding may be required by the various regulatory organizations listed in Appendix B; distributors should work with the manufacturer to ensure appropriate markings that meet those requirements. Customers may also specify custom marking requirements.

7.2 Hose Assembly Markings

7.2.1 Method of Marking

The marking of hose assemblies may be achieved in various ways:

1. Branding may be achieved with colored stripes on the hose, embossed brands, stenciling, printing, labels, etc.
2. Information pre-stamped in legible characters on metal tag or band affixed to the assembly by approved durable method.
3. Information in legible characters stamped or welded directly onto the ferrule, flange or fitting.

Section 8 – Testing Procedures

8.1 Purpose

The following testing methods may or may not be required. For custom hose, testing is normally the responsibility of the fabricator. Refer to the customer requirements for recommended testing and documentation needed.

8.2 Hydrostatic Proof Pressure Tests

A proof test is usually one and a half times the working pressure of the hose assembly (the rating of the component with the lowest rated working pressure). The test is usually conducted for a minimum of 5 minutes under pressure. Tests should be conducted only with liquids. **Testing with gaseous materials such as nitrogen or air is absolutely prohibited and can cause injury or death.**

Recommended Procedure

For Industrial hose assemblies, it is strongly recommended to use hydrostatic pressure test methods instead of pneumatic proof testing!

A hydrostatic pressure test requires either a hand pump, a power driven hydraulic pump, or an accumulator system. Connect the hose assembly to the test pump in a straight fashion, assuring a leak tight connection. It is extremely important that fittings, adapters, and any other mating components are rated for the pressure value of the test. It is recommended that the hose assembly be secured in an encapsulated tank that will withstand the pressure, and secure it with steel rods or straps close to each end and at ten-foot intervals along the length of the hose. This will prevent it from “whipping" if a failure occurs. The securing rods or straps must be anchored firmly to the test structure, but should not contact the hose. The hose must be free to move slightly when pressure is applied.

An outlet valve should be applied to the hose end of the assembly that opposes the test pump end of the assembly. Unless otherwise specified by the customer, the test media should be water. Fill the hose with water while the outlet end is raised and the valve slightly opened to bleed all of the air from the system. Use the outlet valve to bleed all air remaining in the hose. When all the air has been expelled, close the outlet valve and lower the raised end.

****This is very important as a safety measure because expansion of air compressed in the hose, when suddenly released by bursting or other failure, might result in a serious accident. ****

Next for reference, mark a line behind the couplings which is at the end of the ferrule, clamp, band, etc. Then gradually raise the pressure to the desired pressure rating. Hold the pressure at for time dictated by hose type and conduct a visual inspection. As the pressure is raised, watch for visual indications of permanent deformation, leakage, and coupling slippage. If any of these are noted it is cause for rejection. After the test is complete, relieve the test pressure before disconnecting the hose assembly from the test equipment and drain the water from the hose. The hose may be flushed with alcohol if all of the water must be removed.

WARNINGWARNING**WARNING**WARNING**WARNING**

Wherever particular skills are required, only specially trained persons should engage in those applications or testing procedures. Failure to do so may result in damage to the hose assembly or to other personal property and, more importantly, may also result in serious bodily injury.

Hoses must be properly cleaned prior to inspection and testing. This will prevent unexpected reactions between conveyants and the test media. Always wear safety glasses, gloves, and protective clothing to protect from leaks or high pressure spray. Also, use shields to protect people in the work area in the event of a hose burst, spray, or coupling blow-off.

It is recommended to never stand in front of, over, or behind the ends of a hose assembly during pressure testing. Also make sure that the hose is sufficiently shielded during pressure testing to stop a coupling in case of a coupling blow-off.

Any failure during testing is likely to be of an explosive nature!

8.3 Other Leakage Tests

When leak rates are critical, consult the manufacturer for more sensitive testing methods. These may include but are not limited to the following: Mass Spectrometer Leak Testing, Pressure Decay, Vacuum Decay, Mass Flow, and Halogen Leak Test.

8.4 Electrical Continuity Test

There are two types of electrical grounding paths for hoses: metallic and non-metallic. Hoses should be tested with a calibrated multi-meter from end fitting to end fitting to determine if the assembly is electrically continuous.

An Electrically Continuous (EC) hose assembly shall have an electrical bond between the hose end fittings. Electrical continuity shall be maintained between the hose assembly fittings in service, as well as during and after subjection to hydrostatic and/or suction testing, if such tests are required by the end user. The electrical continuity shall be ascertained by using a 9 volt ohmmeter and low resistance wire connected in series to both end fittings of the hose assembly. The maximum allowable electrical resistance measured over the entire length of an EC hose assembly shall be 100 ohms.An Electrically Discontinuous (ED) hose assembly shall not have an electrical bond between the hose end fittings. The electrical discontinuity shall be ascertained by using a 500 volt megger and low resistance wire connected in series to both end fittings of the hose assembly. The minimum allowable electrical resistance measured over the entire length of an ED hose assembly shall be 25,000 ohms.

8.5 Visual Inspection

All sample assemblies should be visually inspected for substandard quality conditions in the hose or couplings. Each assembly should be visually inspected for kinks, loose covers, bulges or ballooning, soft spots, cuts, broken wires, or any obvious defect in the hose. The fittings and attachments should be inspected for any type of visible defects that may affect the performance of the assembly.

A. Visual inspection checkpoints should include but are not limited to the following:

B. Hose Identification - Size and type must correspond to the fabrication order (work order).

C. Coupling Identification - Coupling size, type, and product number must correspond to information on the fabrication order (work order) and specifications. Identified with date code, part number, etc. when required.

D. Inspection Items -

- Bulge behind the coupling.
- Cocked couplings.
- Cracked couplings .
- Exposed reinforcement.
- Freedom of swivels.
- General appearance of the assembly.
- Hose cover pricked if required.
- Internal contaminants.
- Protective caps or plugs.
- Restrictions in the tube.
- Rusted Couplings.

8.6 Test Documentation

If required by the customer, a test certificate may be issued to provide written confirmation that the assembly has been tested, and conforms to certain performance criteria. If a test certificate is not supplied, test results should be maintained and kept on file for a minimum of five years.

Each test certificate should bear a unique number for traceability. Test certificates should include the following information as a minimum:

A. Test Certificate Number
B. Customers Name and Purchase Order Number
C. Suppliers Name and Job Number
D. Hose Serial Number(s)
E. Hose details including length, type of hose and diameter
F. End fitting details with types of ferrules and seals used
G. Test Date
H. Test Pressure
I. Electrical Continuity Conformance
J. Suppliers Authorization Signature

Appendix A – Pressure Conversion Chart

psi	Atms	inches H2O	inches Hg	mm Hg (Torr)	mbar	Bar	Pa (N/m^2)	kPa	MPa
1	0.0681	27.71	2.036	51.715	68.95	0.0689	6895	6.895	0.0069
14.7	1	407.2	29.92	760	1013	1.013	101,325	101.3	0.1013
0.0361	0.00246	1	0.0735	1.866	2.488	0.00249	248.8	0.249	0.00025
0.4912	0.03342	13.61	1	25.4	33.86	0.0339	3386	3.386	0.00339
0.01934	0.001316	0.536	0.0394	1	1.333	0.001333	133.3	0.1333	0.000133
0.0145	0.000987	0.4012	0.0295	0.75	1	0.001	100	0.1	0.0001
14.504	0.987	401.9	29.53	750	1000	1	100,000	100	0.1
0.000145	0.00001	0.00402	0.000295	0.0075	0.01	0.00001	1	0.001	0.000001
0.14504	0.00987	401.9	0.295	7.50	10	0.01	1000	1	0.001
145.04	9.869	401.9	295.3	7500	10,000	10	1,000,000	1000	1

To use this chart:

1. Locate the column with the units you want to convert from.
2. Move DOWN that column until you locate the “1”.
3. Move HORIZONTALLY to the column with the units you want to convert to.
4. MULITIPLY the number in the box by the amount you are changing from to get the converted value.

Length

1 cm = 0.3937 in = 10 mm = 0.01 m
1 m = 3.2808 ft = 1000 m = 100 cm
1 in = 2.540 cm = 25.40 mm
1 ft = 30.48 cm = 0.3048 m

Volume

1 L = 0.0353 ft^3
1 L = 0.2642 gal
1 L = 61.025 in^3
1 L = 0.001 m^3
1 ft^3 = 28.3286 L
1 Gal = 0.1336 ft^3

Pressure

1 psi = 0.0681 atm
1 psi = 27.71 in H_2O
1 psi = 703.8 mm H_2O
1 psi = 2.036 in Hg
1 psi = 51.715 mm Hg (torr)
1 psi = 68.95 mbar
1 psi = 0.0689 bar
1 psi = 6895 Pa (n/m2)
1psi = 6.895 kPa
1 psi = 0.0069 MPa

Appendix B - Regulatory and Standards Considerations

Applications may require adherence to certain standards or regulatory requirements. There are several regulatory bodies publishing these requirements; the following is a brief listing of the most common ones:

Coast Guard
FDA
RMA
ISO
NSF
MSHA

Requirements of the Code of Federal Regulations, Title 33 Navigation and Navigable Waters, (latest edition) Chapter 1 Coast Guard, Department of Transportation, Parts 154.500 Hose Assemblies, 156.120 requirements for Oil Transfer, and 156.170 Equipment Tests and Inspections, as presently constituted (at the time of publication of this document).

ANSI
American National Standards Institute
Attn: Customer Service
25 West 43rd Street
New York, NY 10036
Phone: (212) 642-4900
Fax: (212) 398-0023
E-mail: info@ansi.org
Internet: http://www.ansi.org

ASME
American Society for Mechanical Engineers
22 Law Drive
Box 2900
Fairfield, NJ 07007-2900
Phone: (800) 843-2763; (973) 882-1167
Fax: (973) 882-1717; (973) 882-5155
E-mail: infocentral@asme.org
Internet: http://www.asme.org

ASQ
American Society for Quality
600 North Plankinton Avenue
Milwaukee, WI 53203
Phone: (800) 248-1946
Fax: (414) 272-1734
E-mail: help@asq.org
Internet: http://www.asq.org

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Phone: (610) 832-9585
Fax: (610) 832-9555
E-mail: service@astm.org
Internet: http://www.astm.org

Document Center, Inc.
111 Industrial Road, Suite 9
Belmont, CA 94002
Phone: (650) 591-7600
Fax: (650) 591-7617
E-mail: mailto:info@document-center.com
Internet: http://www.document-center.com/

Global Engineering Documents
15 Inverness Way East
Englewood, CO 80112
Phone: (800) 854-7179; (303) 397-7956
Fax: (303) 397-2740
Email: global@ihs.com
Internet: http://www.ihs.com

Government Printing Office
732 North Capitol St. NW
Washington, DC 20401

Phone: (202) 512-0000
Email: webteam@gpo.gov
Internet: http://www.gpo.gov

NAHAD
The Association for Hose and
Accessories Distribution
105 Eastern Ave. Suite 104
Annapolis, MD 21403-3300
Phone: (410) 263-1014
Fax: (410) 263-1659
E-mail: nahad@nahad.org
Internet: http://www.nahad.org

RMA
Rubber Manufacturers Association c/o
The Mail Room
P.O. Box 3147
Medina, OH 44258-3147
Phone: (800) 325-5095; (330) 723-2978
Fax: (330) 725-0576
E-mail: info@rma.org
Internet: http://www.rma.org

SAE
Society of Automotive Engineers
400 Commonwealth Drive
Warrendale, PA 15096-0001
Phone: (877) 606-7323;
Fax: (724) 776-0790
Email: customerservice@sae.org
Internet: http://www.sae.org

Appendix C - Glossary

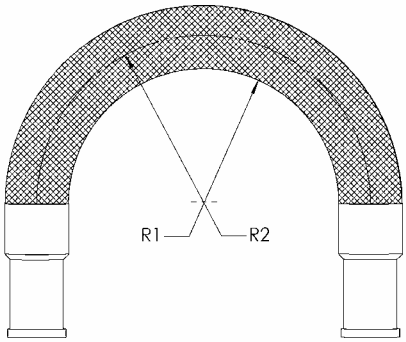
The following are terms generally used in the custom hose business.

abrasion: external damage to a hose assembly caused by its being rubbed on a foreign object; a wearing away by friction; internal wear on the tube of the hose caused by media passing through the hose.
abrasion resistance: the ability of the hose to withstand abrasion**. Internal**: the ability of the hose assembly to withstand failure caused by media passing through the hose. **External**: the ability of the hose assembly to withstand abrasion caused by foreign objects rubbing against the cover.
abrasion tester: a machine for determining the quantity of material worn away by friction under specified conditions.
absorption: regarding hose, the process of taking in fluid. Hose materials are often compared with regard to relative rates and total amounts of absorption as they pertain to specific fluids.
accelerated life test: a method designed to approximate in a short time the deteriorating effects obtained under normal service conditions.
acid resistant: having the ability to withstand the action of identified acids within specified limits of concentration and temperature.
adapter, adaptor: 1) fittings of various sizes and materials used to change an end fitting from one type to another type or one size to another. (i.e., a male JIC to male pipe adapter is often attached to a female JIC to create a male end union fitting); 2) the grooved portion of a cam & groove coupling.
adhesion: the strength of bond between cured rubber surfaces or between a cured rubber surface and a non-rubber surface.
adhesion failure: (1) the separation of two bonded surfaces at an interface by a force less than specified in a test method; (2) the separation of two adjoining surfaces due to service conditions.
adhesive: a material which, when applied, will cause two surfaces to adhere.
aerostatic testing: see pneumatic testing.
afterglow: in fire resistance testing, the red glow persisting after extinction of the flame.
air oven aging: a means of accelerating a change in the physical properties of rubber compounds by exposing them to the action of air at an elevated temperature at atmospheric pressure.
air under water testing: see pneumatic testing.
ambient temperature: the temperature of the atmosphere or medium surrounding an object under consideration.
ambient/atmospheric conditions: The surrounding conditions, such as temperature, pressure, and corrosion, to which a hose assembly is exposed.
amplitude of vibrations and/or lateral movement: the distance a hose assembly deflects laterally to one side from its normal position, when this deflection occurs on both sides of the normal hose centerline.
anchor: a restraint applied to eliminate motion and restrain forces.
angular displacement: displacement of two parts defined by an angle.
annular: refers to the convolutions on a hose that are a series of complete circles or rings located at right angles to the longitudinal axis of the hose (sometimes referred to as “bellows”).
anodize, anodized: an electrolytic process used to deposit protective or cosmetic coatings in a variety of colors on metal, primarily used with aluminum.
ANSI: American National Standards Institute.

anti-static: see static conductive.
application working pressure: unique to customer's application. See pressure, working.
application: the service conditions that determine how a hose assembly will be used.
armor: (external) a protective cover slid over and affixed to a hose assembly; used to prevent over bending or for the purpose of protecting hose from severe external environmental conditions such as hot materials, abrasion or traffic**.** **Internal armor**: steel materials mounted in the bore of the hose; generally used to reduce the effect of abrasive wear on the hose tube; can be annular rings, plates, or wire helix
assembly: a general term referring to any hose coupled with end fittings of any style attached to one or both ends.
ASTM: American Society for Testing and Materials.
attachment: the method of securing an end fitting to a hose (e.g., banding, crimping, swaging, or screw-together-2 piece or 3 piece-style-reusable fittings).
autoclave: an apparatus using superheated high pressure steam for sterilization, vulcanization and other processes.
axial movement: compression or elongation along the longitudinal axis.

backing: a soft rubber layer between a hose tube and/or cover and carcass to provide adhesion.
band: (1) a metal ring that is welded, shrunk, or cast on the outer surface of a hose nipple or fitting; (2) a thin strip of metal used as a non-bolted clamp. See hose clamp.
barb: the portion of a fitting (coupling) that is inserted into the hose, usually comprised of two or more radial serrations or ridges designed to form a redundant seal between the hose and fitting.
barbed and ferrule fitting: a two-piece hose fitting comprised of a barbed insert (nipple), normally with peripheral ridges or backward-slanted barbs, for inserting into a hose and a ferrule, usually crimped or swaged.
basket weave: a braid pattern in which the plaits of wire alternately cross over and under two strands (two over-two under).
bench marks: marks of known separation applied to a specimen used to measure strain (elongation of specimen).
bench test: a modified service test in which the service conditions are approximated in the laboratory.

bend radius: the radius of a bent section of hose measured to the innermost surface of the curved portion.



bend radius, minimum: the smallest radius at which a hose can be used.
bend radius, dynamic: the radius at which constant or continuous flexing occurs.
bend radius, static: the smallest fixed radius at which a hose can be subjected.
bending force: an amount of stress required to induce bending around a specified radius and hence, a measure of stiffness.
bevel seat fitting: see fitting, Bevel Seat.
bias angle: the angle at which the reinforcement, either fabric or cord, is applied to the hose relative to the horizontal axis.
bias lap: the area where plies of bias cut reinforcement overlap.
billet: a solid piece of material from which a fitting is manufactured.
bleeding: surface exudation. See bloom.
blister: a raised area on the surface or a separation between layers usually creating a void or air-filled space in a vulcanized article.
bloom: a discoloration or change in appearance of the surface of a rubber product caused by the migration of a liquid or solid to the surface, (e.g. sulfur bloom, wax bloom). Not to be confused with dust on the surface from external sources.
blow out force: the force generated from the internal pressure attempting to push the fitting from the hose.
body wire: normally a round or flat wire helix embedded in the hose wall to increase strength or to resist collapse.
bolt hole circle: a circle on the flange face around which the center of the bolt holes are distributed.
bore: (1) an internal cylindrical passageway, as of a tube, hose or pipe; (2) the internal diameter of a tube, hose, or pipe.
bowl: (1) the exterior shell of an expansion ring type coupling; (2) the larger internal diameter of the internal portion of a ferrule.
braid: the woven portion of a hose used as reinforcement to increase pressure rating and add hoop strength. Various materials such as polyester, cotton or metal wire are used. A hose may have one or more braids, outside or between layers of hose material.
braid angle: the angle developed at the intersection of a braid strand and a line parallel to the axis of a hose.
braid coverage: the relative amount of braid material covering a hose expressed as a percent.
braid sleeve/ring/ferrule: a ring made from tube or metal strip placed over the ends of a braided hose to contain the braid wires for attachment of fitting and ferrule, and to immobilize heat affected corrugations.
braid wear: motion between the braid and corrugated hose, which normally causes wear on the outside diameter of the corrugation and the inside diameter of the braid.
braided braid: a braid where the strands of wire on each carrier of the braiding machine

are braided together, and then braided in normal fashion.
braided ply: a layer of braided reinforcement.
braid-over-braid: multiple plies of braid having no separating layers.
brand: a mark or symbol identifying or describing a product and/or manufacturer, that is embossed, inlaid or printed.
brass: a family of copper/zinc alloys.
brazing: a process of joining metals using a non-ferrous filler metal having a melting point that is lower than the "parent metals" to be joined, typically over +800ºF.
bronze: an alloy of copper, tin and zinc.
buffing (sizing): grinding a surface to obtain dimensional conformance or surface uniformity.
bunch braid: braid applied to hose in bundles rather than flat strands (plaits), usually done to achieve high pressure versus hose weight.

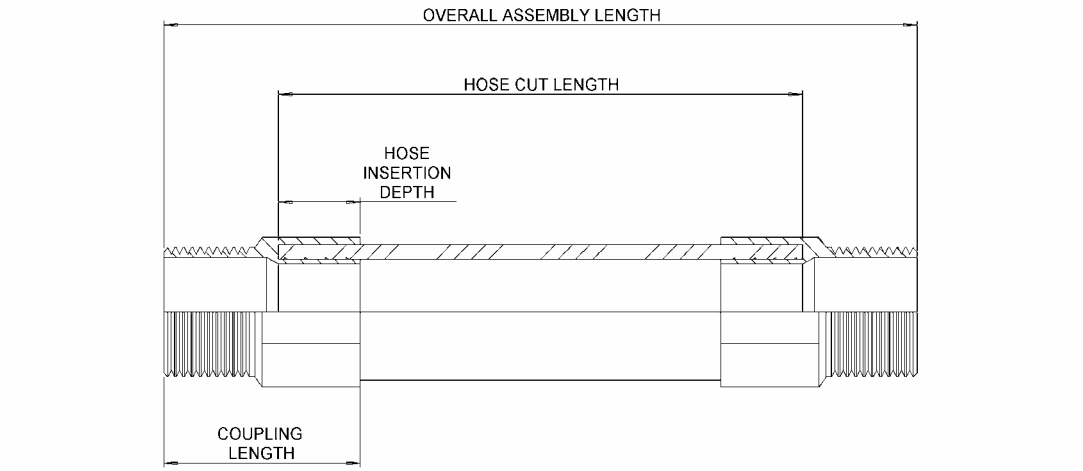
C of C: certificate of conformance or certificate of compliance; a document, typically signed and dated pertaining to a particular lot or purchase order of item(s), which describes any standards, specifications, tests, materials and/or performance attributes to which the referenced item(s) have met or will meet.
calender: a three-roll or four-roll piece of equipment used to produce elastomer plies for a hose at the thickness and width required; also used to skim elastomer onto reinforcing cord or fabric; also used to friction coat (flood) reinforcing fabrics with elastomer.
cam & groove: see fitting/coupling - Cam & Groove.
capped end: a hose end covered to protect its internal elements.
carcass: the fabric, cord and/or metal reinforcing section of a hose as distinguished from the hose tube or cover.
casing: see external armor.
cement: unvulcanized raw or compounded rubber in a suitable solvent used as an adhesive or sealant.
cemented end: a hose end sealed with the application of a liquid coating.
chafe sleeve: an outer sleeve providing resistance to chafing and external resistance to damage to braided hoses, available in wide variety of materials to meet the application requirements (e.g., chafe sleeves include slip-on, heat shrinkable, integrally extruded).
chalking: the formation of a powdery surface condition due to disintegration of surface binder or elastomer by weathering or other destructive environments.
checking: the short, shallow cracks on the surface of a rubber product resulting from damaging action of environmental conditions.
chemical compatibility: the relative degree to which a material may contact another without corrosion, degradation or adverse change of properties.
chemical resistance: the ability of a particular polymer, rubber compound, or metal to exhibit minimal physical and/or chemical property changes when in contact with one or more chemicals for a specified length of time, at specified concentrations, pressure, and temperature.
clamp: see hose clamp.
cloth impression: see fabric impression.
coefficient of friction: a relative measure of the surface lubricity.
cold flex: see low temperature flexibility.
cold flexibility: relative ease of bending while being exposed to specified low temperature.
cold flow: continued deformation under stress. See creep.
collar: 1) the portion of a fitting that is compressed by swaging or crimping to seal the hose onto the fitting barbs and create a permanent attachment; also called a ferrule.

(With reusable fittings, the lock and seal are accomplished mechanically by the collar without swaging or crimping); 2) a raised portion on the hose shank which functions as a connection for a ferrule or other locking device or functions as a hose stop.
combustible liquid: a combustible liquid is one having a flash point at or above +100°F (37.8°C).
composite hose: non-vulcanized hose that consists of the following:

- An internal wire helix;
- A multi-ply wall of thermoplastic films and reinforcing fabrics in proportions that give the required physical properties and provide a complete seal. (Note: The film content may be built of tubular films.)
- A cover consisting of fabric with an abrasion resistant polymeric coating;
- An external helix wire.

compound: the mixture of rubber or plastic and other materials, which are combined to give the desired properties when, used in the manufacture of a product.
compression fitting: see fitting/coupling - Compression
compression set: the deformation which remains in rubber after it has been subjected to and released from a specific compressive stress for a definite period of time at a prescribed temperature. (Compression set measurements are for evaluating creep and stress relaxation properties of rubber.)
concentricity: the uniformity of hose wall thickness as measured in a plane normal to the axis of the hose.
conditioning: the exposure of a specimen under specified conditions, e.g., temperature, humidity, for a specified period of time before testing.
conductive: the ability to transfer electrical potential.
configuration: the combination of fittings on a particular assembly.
control: a product of known characteristics, which is included in a series of tests to provide a basis for evaluation of other products.
controlled flexing: occurs when the hose is being flexed regularly, as in the case of connections to moving components (e.g., platen presses, thermal growth in pipe work).
convoluted: description of hose or innercore having annular or helical ridges formed to enhance flexibility.
convolution/corrugation: the annular or helical flexing member in corrugated or strip wound hose/corrugation.
convolution count: the number of ridges or corrugations per inch of a hose.
copolymer: a blend of two polymers.
core: the inner portion of a hose, usually referring to the material in contact with the medium.
corrosion: the process of material degradation by chemical or electrochemical means.
corrosion resistance: ability of metal components to resist oxidation.
corrugated cover: a ribbed or grooved exterior.
corrugated hose: hose with a carcass fluted, radially or helically, to enhance its flexibility or reduce its weight.
coupler: the female portion of the cam & groove connection with the cam arms.
coupling: a frequently used alternative term for fitting.
cover wear: the loss of material during use due to abrasion, cutting or gouging.

cover: the outer component usually intended to protect the carcass of a product.
CPE: chlorinated polyethylene; a rubber elastomer.
CR: Polychloroprene rubber
cracking: a sharp break or fissure in the surface, generally caused by strain and environmental conditions.
creep: the deformation, in material under stress, which occurs with lapse of time after the immediate deformation.
crimp diameter: the distance across opposite flats after crimping.
crimp/crimping: a fitting attachment method utilizing a number of fingers or dies mounted in a radial configuration. The dies close perpendicular to the hose and fitting axis, compressing the collar, ferrule, or sleeve around the hose.
CSM: chlorosulfonated polyethylene.
cure: the act of vulcanization. See vulcanization.
cut off factor: the hose length to be subtracted from the overall assembly length that allows for the hose coupling end connection extension beyond the end of the hose.



cut resistant: having that characteristic of withstanding the cutting action of sharp object.
cycle-motion: movement from normal to extreme position and return.

date code: any combination of numbers, letters, symbols or other methods used by a manufacturer to identify the time of manufacture of a product.
deduct length: the amount of fitting length deducted from a hose to result in the desired finished assembly length.
design factor: a ratio used to establish the working pressure of the hose, based on the burst strength of the hose.
design pressure: see application working pressure and pressure, working.
developed length: see overall length.
diamond weave: braid pattern in which the strands alternately cross over one and under one of the strands
(one over-one under); also known as “plain weave.”
die: a tool used to swage or crimp a fitting onto a hose. Swage dies usually consist of two halves machined to a predetermined diameter, designed for a specific hose type and size. A crimp die set is typically six to eight “fingers” designed for infinite diameter settings within a range or preset to a specific diameter for a given hose type and size.
dielectric strength: the relative measure of a material’s ability to resist conducting an electrical charge.
displacement: the amount of motion applied to a hose defined as inches for parallel

offset and degrees for angular misalignment.
dog-leg assembly: two hose assemblies joined by a common elbow.
DOT: Department of Transportation.
duplex assembly: an assembly consisting of two hose assemblies-one inside the other, and connected at the ends; also known as “jacketed assemblies.”
durometer: an instrument for measuring the hardness of rubber and plastic compounds.
durometer hardness: a numerical value, which indicates the resistance to indentation of the blunt indentor of the durometer.
dye penetrant inspection/test: non-destructive inspection method for detecting surface defects.
dynamic bend radius: see bend radius, dynamic.

eccentric wall: a wall of varying thickness.
eccentricity: the condition resulting from the inside and outside diameters not having a common center. See eccentric wall.
effusion: the escape, usually of gases, through a material. See permeation.
elastomer: any one of a group of polymeric materials, usually designated thermoset, such as natural rubber, or thermoplastic, which will soften with application of heat.
electrostatic discharge: the sudden discharge of static electricity from an area of buildup to a grounding point.
elongation: the increase in length expressed numerically as a percentage of the initial length.
encapsulated fitting: see fitting/coupling-Encapsulated fittings.
endurance test: a service or laboratory test, conducted to product failure, usually under normal use conditions.
enlarged end: an end having a bore diameter greater than that of the main body of the hose, in order to accommodate a larger fitting.
EPDM: Ethylene Propylene Diene Monomer; an elastomer.
exothermic: releasing heat.
extrude/extruded/extrusion: forced through the shaping die of an extruder; extrusion may have a solid or hollow cross section.

fabric impression: impression formed on the rubber surface during vulcanization by contact with fabric jacket or wrapper.
fabricator: the producer of hose assemblies.
fatigue: the weakening or deterioration of a material occurring when a repetitious or continuous application of stress causes strain, which could lead to failure.
FDA: United States Food and Drug Administration.
FEP: fluorinated ethylene propylene.
ferrule: a metal cylinder placed over a hose end to affix the fitting to the hose. See braid sleeve, interlocking ferrule, and sleeve.
fire sleeve: slip-on or integrally extruded sleeve used to retard the effects of fire in certain applications; most often made with silicone and/or ceramic fiber.
fitting/coupling: a device attached to the end of the hose to facilitate connection. The following is only a partial list of types of fittings available:

- *Banjo Fitting* - a through bolted designed featuring a hollow circle or “donut” attached to one end of the fitting barb so that the inner diameter is along the hose axis.

- *Butt Weld Fittings* - a hose fitting designed to be permanently welded to a

connecting member such as another pipe or a butt weld flange.

- *Cam & Groove Fittings* - a type of fitting that allows connection and disconnection by means of arm(s) or cam(s) on the female fitting. The seal is accomplished by means of a gasket, available in various materials. These fittings are frequently used on product transfer hose assemblies.
- *Compression Fitting* - a fitting style that seals on a mating tube by compressing an internal ferrule against the tube O.D..

- *Field Attachable Fitting* - a fitting designed to be attached to hose without crimping or swaging. This fitting is not always a Reusable type fitting.

- *Flange Retainer Fittings* - a hose fitting flared to a 90° surface, designed to hold a circular rotating flange, such as a slip-on or lap joint style flange.

- *Flange Style Fittings* - pipe flanges and flanged fitting standards are listed under ANSI B16.5. Flanges are rated for pressure and listed as “American Class 150, 300, 400, 600, 900, 1,500 or 2,500”. Pressure-Temperature ratings can be obtained by consulting the ANSI specification or ASME B16.5 (American Society of Mechanical Engineers). Designs vary by neck and face style, or other dimensional changes based on use. Various finishes or grooves may be applied to the face for sealing on a gasket or o-ring. Bolt holes and other dimensions are per the ANSI standard.

- *Slip-on Flange* - a flange designed to slip over a flange retainer and float freely in place for bolt alignment. Similar to a lap joint flange except with a very small radius on the face side of the inside diameter to mate with a machined flange retainer. May have a flat or raised face.

- *Lap Joint Flange* - a flange designed to float freely on the flange retainer for bolt alignment. Made with a flat face and having a large radius on the I.D. to mate with a flared pipe style flange retainer.

- *Threaded Flange* - a flange, the inside diameter of which is threaded to attach to a male pipe fitting. A leak proof seal, made with thread sealant, usually does not allow for bolt hole alignment. Inverted Flare Fitting - a fitting consisting of a male or female nut, trapped on a tube by flaring the end of the tube material to either 37° or 45°.

- *JIC Fittings* - joint Industrial Council (no longer in existence). An engineering group that established an industry standard fitting design incorporating a 37° mating surface, male and female styles. These standards now governed by SAE.

- *Lined Fitting* - any fitting of which the wetted surface or entire fitting is covered with a protective material. The covering process may be by spray coating, molding or by inserting hose liner through the I.D. of fitting and anchoring.
- *O-ring Fittings* - a fitting that seals by means of an elastomeric ring of a specified material.

- *Reusable Fitting* - a fitting designed to be attached and unattached to a hose, allowing all or most of the fitting to be reused.

- *Sanitary Fittings* - a fitting whose seal is accomplished by means of a round gasket in a groove on the face of the fitting. The design eliminates the need for a male and female, since the fitting mates to itself. A re-attachable clamp is also used for coupling.

- *Bevel Seat* - a type of sanitary fitting incorporating a 45° beveled sealing surface. Used in the food and pharmaceutical industries.

- *Split Flange Fitting* - a fitting consisting of a flange retainer and a flange of two halves. This design allows the flanges to be installed after the retainer has been attached to the hose, making the flange reusable. SAE Code 61 and 62.

- *Tube Fitting* - a hose fitting of which the mating end conforms to a tube diameter. The mate or male end of a compression fitting.

- *2-Bolt Flange Fitting* - an elliptical flange with two bolt holes. Typically used in steam applications such as laundry and tire presses.

flammable gases/liquid/media: a flammable gas, including liquefied gas, is one having a closed cup flash point below +100ºF (+37.8ºC) and a vapor pressure greater than 25 psi. (174.2 KPa)
flat spots: flat areas on the surface of cured hose caused by deformation during vulcanization.
flex cracking: a surface cracking induced by repeated bending and straightening.
flex life: the relative ability of an article to withstand bending stresses.
flex life test: a laboratory method used to determine the life of a rubber product when subjected to dynamic bending stresses.
flow rate: a volume of media being conveyed in a given time period.
fluid: a gas or liquid medium.
fluid velocity: the speed of fluid through a cross section expressed in length divided by time.
fluorocarbon: an organic compound containing fluorine directly bonded to carbon. The ability of the carbon atom to form a large variety of structural chains gives rise to many fluorocarbons and fluorocarbon derivatives.
fluoropolymer: a high molecular weight (long chain) chemical containing fluorine as a major element.
free length: the lineal measurement of hose between fittings or couplings.
frequency: the rate of vibration or flexure in a given time period.

galvanic corrosion: corrosion that occurs on the less noble of two dissimilar metals in direct contact with each other in an electrolyte, such as water, sodium chloride in solution, sulfuric acid, etc.
GPM: gallons per minute.
guide (for piping): a device that supports a pipe radially in all directions, but directs movement.

hand built hose: a hose made by hand on a mandrel, reinforced by textile or wire or

combination of both.
hardness: resistance to indentation. See durometer hardness.
heat resistance: the property or ability to resist the deteriorating effects of elevated temperatures.
helical wire armor/spring guard: an abrasion resistance device.
helical: used to describe a type of corrugated hose having one continuous convolution resembling a screw thread.
helix: a shape formed by spiraling a wire or other reinforcement around the cylindrical body of a hose; typically used in suction hose.
hoop strength: the relative measure of a hose's resistance to collapse of the diameter perpendicular to the hose axis.
hose: a flexible conduit consisting of a tube, reinforcement, and usually an outer cover.
hose assembly: see assembly.
hose clamp: a device used to hold a hose onto a fitting.
hydrostatic testing: the use of liquid pressure to test a hose or hose assembly for leakage, twisting, and/or hose change-in-length.
Hypalon®: a DuPont registered trademark. See CSM.
Hytrel®: a DuPont registered trademark.

I.D.: the abbreviation for inside diameter.
identification yarn: a yarn of single or multiple colors, usually embedded in the hose wall, used to identify the manufacturer.
impression: a design formed during vulcanization in the surface of a hose by a method of transfer, such as fabric impression or molded impression.
impulse service: an application parameter characterized by continuous cyclical pressure changes from low to high.
impulse: an application of force in a manner to produce sudden strain or motion, such as hydraulic pressure applied in a hose.
indentation: 1) the extent of deformation by the indentor point of any one of a number of standard hardness testing instruments; 2) a recess in the surface of a hose.
innercore: the innermost layer of a hose; the hose material in contact with the medium.
insert: optional term for nipple. See nipple.
interlocked hose: formed from profiled strip and wound into flexible metal tubing with no subsequent welding, brazing, or soldering; may be made pressure-tight by winding in strands of packing.
interlocking clamp: a clamp which engages the fitting in a manner which prevents the clamp from sliding off the fitting, typically a bolt or U-bolt style with interlocking fingers which engage an interlock ring on the fitting.
interlocking ferrule: a ferrule, which physically attaches to the fitting preventing the ferrule from sliding off the fitting.
interstice: a small opening, such as between fibers in a cord or threads in a woven or braided fabric.
IPT: iron pipe threads; a reference to NPT or NPTF.
ISO: International Organization for Standardization.

jacket: a seamless tubular braided or woven ply generally on the outside of a hose.
JIC: see fitting/coupling-JIC.

kinking: a temporary or permanent distortion of the hose induced by bending beyond the minimum bend radius.

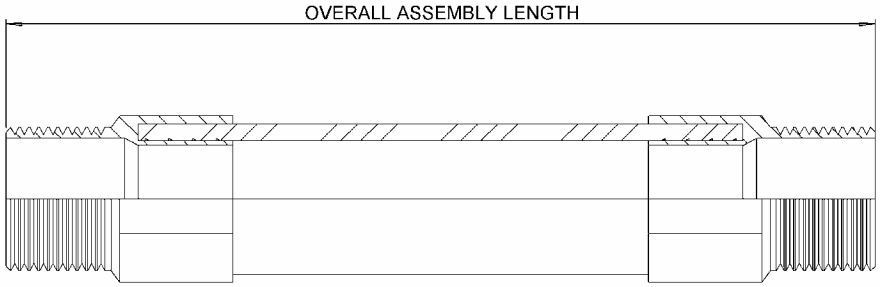
lap seam: a seam made by placing the edge of one piece of material extending flat over the edge of the second piece of material.
lay: 1) the direction of advance of any point in a strand for one complete turn; (2) the amount of advance of any point in a strand for one complete turn. See pitch.
layer: a single thickness of rubber or fabric between adjacent parts.
leaker: 1) a crack or hole in the tube which allows fluids to escape; 2) a hose assembly which allows fluids to escape at the fittings or couplings.
life test: a laboratory procedure used to determine the resistance of a hose to a specific set of destructive forces or conditions. See accelerated life test.
light resistance: the ability to retard the deleterious action of light.
lined bolt holes: the bolt holes, which have been given a protective coating to cover the internal structure.
liner: flexible sleeve used to line the inside diameter of hose when conveying a high velocity media, also prevents erosion.
live length: see free length.
LJF (lap joint flange): see fitting/coupling - Lap Joint Flange.
long shank: a shank length greater than the nominal diameter, typically two diameters in length, which allows more than a single clamp.
loop installation: the assembly is installed in a loop or “U” shape, and is most often used when frequent and/or large amounts of motion are involved.
low temperature flexibility: the ability of a hose to be flexed, bent or bowed at low temperatures without loss of serviceability.
LPG, LP Gas: the abbreviation for liquefied petroleum gas.

MAWP: see pressure, maximum allowable working, including any momentary surge in the hose.
mandrel: 1) a form, generally of elongated round section used for size and to support hose during fabrications and/or vulcanization. It may be rigid or flexible; 2) a tapered expanding device, fixed in diameter, which is pulled through a shank of a fitting thus expanding the diameter to exert force on the hose between the shank and ferrule.
mandrel built: a hose fabricated and/or vulcanized on a mandrel.
mandrel, flexible: a long, round, smooth rod capable of being coiled in a small diameter. It is used for support during the manufacture of certain types of hose. (The mandrel is made of rubber or plastic material and may have a core of flexible wire to prevent stretching.)
mandrel, rigid: a non-flexible cylindrical form on which a hose may be manufactured.
manufacturer’s identification: a code symbol used on or in some hose to indicate the manufacturer.
mass flow rate: the mass of fluid per unit of time passing through a given cross-section of a flow passage in a given direction.
mean diameter: the midpoint between the inside diameter and the outside diameter of a corrugated/convoluted hose.
mechanical fitting/reusable fitting: a fitting attached to a hose, which can be disassembled and used again.
media, medium: the substance(s) being conveyed through a system.
mender: a fitting or device used to join two sections of hose.
metal hose: thin wall metal tubing formed into flexible hose with helical or annular ridges and grooves, often braided with stainless steel to increase the operating pressure capability. With fittings welded on, assemblies are used in applications outside temperature range of rubber, thermoplastic and fluoroplastic.
misalignment: a condition where two parts do not meet true.

NAHAD: the abbreviation for the Association for Hose and Accessories Distribution.
necking down: a localized decrease in the cross-sectional area of a hose resulting from tension.
Neoprene®: a registered trademark of DuPont. See CR.
nipple: the internal member or portion of a hose fitting.
nitrile rubber (NB/Buna-N): a family of acrylonitrile elastomers used extensively for industrial hose.
nominal: a size indicator for reference only.
nomograph: a chart used to compare hose size to flow rate to recommended velocity.
non-conductive: the inability to transfer an electrical charge.
non-interlocking ferrule: see sleeve.
nozzle end: an end of hose in which both the inside and outside diameters are reduced.
NPT/NPTF: abbreviation for national pipe threads. See fitting/coupling - Pipe Thread Fittings.
nylon: a family of polyamide materials.

OAL: see overall length
O.D.: the abbreviation for outside diameter.
OE/OEM: original equipment manufacturer.
off-center: see eccentricity.
offset-lateral, parallel: the distance that the ends of a hose assembly are displaced in relation to each other as the result of connecting two misaligned terminations in a system, or intermittent flexure required in a hose application.
oil resistance: the ability of the materials to withstand exposure to oil.
oil swell: the change in volume of a rubber article resulting from contact with oil.
open steam cure: a method of vulcanizing in which steam comes in direct contact with the product being cured.
operating conditions: the pressure, temperature, motion, and environment to which a hose assembly is subjected.
Optimum cure: the state of vulcanization at which a desired rubber compound combination is attained
o-ring fitting: see fitting/coupling, O-Ring.
OS & D hose: the abbreviation for oil suction and discharge hose.

overall length (OAL): the total length of a hose assembly, which consists of the free hose length plus the length of the coupling(s).



oxidation: the reaction of oxygen on a material, usually evidenced by a change in the appearance or feel of the surface or by a change in physical properties.

ozone cracking: the surface cracks, checks or crazing caused by exposure to an atmosphere containing ozone.
ozone resistance: the ability to withstand the deteriorating effects of ozone (generally cracking).

penetration (weld): the percentage of wall thickness of the two parts to be joined that is fused into the weld pool in making a joint.
performance test (service test): a test in which the product is used under actual service conditions.
permanent fitting: the type of fitting which, once installed, may not be removed for re-use.
permeation: the process of migration of a substance into and through another, usually the movement of a gas into and through a hose material; the rate of permeation is specific to the substance, temperature, pressure and the material being permeated.
Pharmacopeia Class VI: a standard for sanitary fittings, designating the form, fit, function and finish.
pick: the distance across a group of braid wires from a single carrier, measured along the axis of the hose.
pig: a mechanical projectile used for cleaning hose.
pin pricked: perforations through the cover of a hose to vent permeating gases.
pitch: 1) the distance from one point on a helix to the corresponding point on the next turn of the helix, measured parallel to the axis; 2) the distance between the two peaks of adjacent corrugation or convolution.
pitted tube: surface depressions on the inner tube of a hose.
plain ends: the uncapped or otherwise unprotected, straight ends of a hose**;** or, fitting ends without threads, groove, or a bevel typically used for welding, as in a flange.
plaits: an individual group of reinforcing braid wires/strands.
plating: a material, usually metal, applied to another metal by electroplating, for the purpose of reducing corrosion; typically a more noble metal such a zinc is applied to steel.
ply: an individual layer in hose construction.
pneumatic testing: the use of compressed air to test a hose or hose assembly for leakage, twisting, and/or hose change-in-length. NOTE: Use of high pressure air is extremely hazardous.
polymer: a macromolecular material formed by the chemical combination of monomers, having either the same or different chemical compositions.
pre-production inspection or test: the examination of samples from a trial run of hose to determine adherence to a given specification, for approval to produce.
preset: the process of pressurizing a hose to set the braid and minimize length change in final product.
pressure: force ÷ unit area. For purposes of this document, refers to PSIG (pounds per square inch gauge).
pressure drop: the measure of pressure reduction or loss over a specific length of hose.
pressure, burst: the pressure at which rupture occurs.

pressure, deformation: the pressure at which the convolutions of a metal hose become permanently deformed.
pressure, gauge: relative pressure between inside and outside of an assembly.
pressure, maximum allowable working: the maximum pressure at which a hose or hose assembly is designed to be used.
pressure, operating: see pressure, working.

pressure, proof test: a non-destructive pressure test applied to hose assemblies.
pressure, pulsating: a rapid change in pressure above and below the normal base pressure, usually associated with reciprocating type pumps.
pressure, rated working: see pressure, maximum allowable working.
pressure, service: see working pressure.
pressure, shock/spike: the peak value of a sudden increase of pressure in a hydraulic or pneumatic system producing a shock wave.
pressure, working: the maximum pressure to which a hose will be subjected, including the momentary surges in pressure, which can occur during service. Abbreviated as WP.
printed brand: see brand.
profile: used in reference to the contour rolled into strip during the process of manufacturing strip wound hose, or the finished shape of a corrugation/convolution.
propane: see LPG, LP Gas.
psi: pounds per square inch.
pulled-down tube: see loose tube, delamination or tube separation.
pull off force: the force required to pull the hose from its attachment not generated by the internal pressure.
PVC: polyvinyl chloride. A low cost thermoplastic material typically used in the manufacture of industrial hoses.
PVDF: polyvinylidene fluoride.

quality conformance inspection or test: the examination of samples from a production run of hose to determine adherence to given specifications, for acceptance of that production.

RAC: Rubber Association of Canada.
random motion: the uncontrolled motion of a metal hose, such as occurs in manual handling.
reinforcement: the strengthening members, consisting of either fabric, cord, and/or metal, of a hose. See ply.
reusable fitting/coupling: see fitting/coupling, reusable.
RMA: The Rubber Manufacturers Association, Inc.

SAE: Society of Automotive Engineers.
safety factor: see design factor.
sampling: a process of selecting a portion of a quantity for testing or inspection, selected without regard to quality.
Santoprene®: a registered trademark of Monsanto.
scale: the oxide in a hose assembly brought about by surface conditions or welding.
serrations: bumps, barbs, corrugations, or other features that increase the holding power of the device.
service temperature: see working temperature.
shank: that portion of a fitting, which is inserted into the bore of a hose.
shelf/storage life: the period of time prior to use during which a product retains its intended performance capability.
shell: see ferrule.
shock load: a stress created by a sudden force.
short shank: shank length, approximately equal to the nominal diameter, but long enough to allow a single clamp at minimum.
simulated service test: see bench test.
skive: the removal of a short length of cover and/or tube to permit the attachment of a

fitting directly over the hose reinforcement.
sleeve: a metal cylinder, which is not physically attached to the fitting, for the purpose of forcing the hose into the serrations of the fitting.
smooth bore: a term used to describe the type of innercore in a hose.
socket: the external member or portion of a hose fitting, commonly used in describing screw-together reusable fittings.
soft end: a hose end in which the rigid reinforcement of the body, usually wire, is omitted.
specification: a document setting forth pertinent details of a product.
spiral: a method of applying reinforcement in which there is not interlacing between individual strands of the reinforcement.
spiral angle: the angle developed by the intersection of the helical strand and a line parallel to the axis of a hose. See braid angle.
splice: a method of joining two sections of hose.
splicer: a fitting or device used to join two sections of hose.
spring guard: a helically wound component applied internally or externally to a hose assembly, used for strain relief, abrasion resistance, collapse resistance.
squirm: a form of failure where the hose is deformed into an “S” or “U” bend, as the result of excessive internal pressure being applied to unbraided corrugated hose while its ends are restrained or in a braided corrugated hose which has been axially compressed.
standard: a document, or an object for physical comparison, for defining product characteristics, products, or processes, prepared by a consensus of a properly constituted group of those substantially affected and having the qualifications to prepare the standard for use.
static bonding: use of a grounded conductive material between fittings to eliminate static electrical charges.
static conductive: having the capability of furnishing a path for a flow of static electricity.
static discharge: see electrostatic discharge.
static wire: wire incorporated in a hose to conduct static electricity.
stem: see nipple.
stress corrosion: a form of corrosion in metal.
strip wound: see interlocked hose.
surge (spike): a rapid and transient rise in pressure.
swage: the method of fitting attachment that incorporates a set of die halves designed to progressively reduce the collar or ferrule diameter to the required finish dimension by mechanically forcing the fitting into the mating die.
swelling: an increase in volume or linear dimension of a specimen immersed in liquid or exposed to a vapor.

tape wrapped convoluted: a type of flexible hose incorporating layers of tape to form helical ridges and grooves.
tear resistance: the property of a rubber tube or cover of a hose to resist tearing forces.
tube: the innermost continuous all-rubber or plastic element of a hose.
tube fitting: see fitting/coupling-Tube.
tubing: a non-reinforced, homogeneous conduit, generally of circular cross-section.
twist: (1) the turns about the axis, per unit of length, of a fiber, roving yarn, cord, etc. Twist is usually expressed as turns per inch; (2) the turn about the axis of a hose subjected to internal pressure.

U. L.: Underwriters Laboratory
U.S.C.G.: United States Coast Guard

USDA: United States Department of Agriculture
U.S. Government Agencies:

DOD – Department of Defense, DOT – Department of Transportation, FDA – Food and Drug Administration, MSHA – Mine Safety and Health Administration, OSHA – Occupational Safety and Health Administration, PHA – Public Health Administration, USCG – U.S. Coast Guard, USDA, U.S. Department of Agriculture.

vacuum resistance: the measure of a hoses ability to resist negative gauge pressure - suction
velocity: the speed (e.g., feet/second) at which the medium flows through the hose
velocity resonance: vibration due to the buffeting of a high velocity gas or liquid flow.
vibration: amplitude motion occurring at a given frequency.
viscosity: the resistance of a material to flow while under stress.
volume change: a change in dimensions of a specimen due to exposure to a liquid or vapor.
volume swell: see swelling.
volumetric expansion: the volume increase of a hose when subjected to internal pressure.
vulcanization: a process during which a rubber compound, through a change in its chemical structure (e.g., cross-linking), becomes less plastic and more resistant to swelling by organic liquids, and which confers, improves or extends elastic properties over a greater range of temperature.

WARP: (1) the lengthwise yarns in a woven fabric or in a woven hose jacket, (2) the deviation from a straight line of a hose while subjected to internal pressure.
water resistant: having the ability to withstand the deteriorating effect of water.
weathering: the surface deterioration of a hose cover during outdoor exposure, as shown by checking, cracking, crazing and chalking.
WEFT: a term used for filling in a fabric. See filling.
welding: the process of localized joining of two or more metallic components by means of heating their surfaces to a state of fusion, or by fusion with the use of additional filler material.
wire reinforced: a hose containing wires to give added strength, increased dimensional stability; crush resistance. See reinforcement.
working pressure (WP): the maximum pressure to which a hose will be subjected, including the momentary surges in pressure which can occur during service. Abbreviated as “W.P.” or “MAWP” (Maximum Allowable Working Pressure).
working temperature: the temperature range of the application, may include the temperature of the medium conveyed or the environmental conditions the assembly is exposed to in use.
WP: the abbreviation for working pressure.
wrapped cure: a vulcanizing process using a tensioned wrapper (usually of nylon fabric) to apply external pressure to the hose.
The preceding Glossary of Terms, as utilized in the hose industry, includes some definitions from The Hose Handbook, published by the Rubber Manufacturers Association.

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