GENERAL HOSE INFORMATION

The Thermoid® Brand Advantage!

HBD/Thermoid® produces durable, top-quality hose products with lots of value-added features. The CONCURE® continuous manufacturing process was invented, developed and patented by HBD Industries, Inc. and helps us produce the finest hose products possible. Our CONCURE process assures dimensional stability from end to end, provides a contamination-free and smooth hose tube in long, unbroken lengths. This process and our continuous product quality monitoring give us improved dimensional control and allow for closer tolerance control of the I.D. and O.D. of the hose from the tube extruder to the finished reel on all our Flex Strength® hose products. This attention to manufacturing saves our customers time and money. Here are just a few of the benefits you receive by selecting Flex Strength hose products:

- **Long Length Reels** — Over 90% of our reels contain one length of hose, absolutely no three-piece reels, giving you a 15-20% savings due to less scrap.
- **Product Flexibility/Kink Resistance** — Our spiral hose construction offers improved hose flexibility, easy handling on the job and provides increased resistance to kinking.
- **Uncontaminated Tube** — Flex Strength hose is cured with an air mandrel assuring a clean, smooth tube. No dirt or other contaminants to clog nozzles or damage air tools.
- **Brighter Colors/Pin-Pricked Covers** — The CONCURE process provides for more vivid colors for increased visibility and easier identification. Usually present only on critical applications, most Flex Strength hose products have a pin-pricked cover.
- **Wider Working Pressure Range/More Hose Grades** — Flex Strength hose is available with pressure ratings from 150 to 300 psi working pressure, assuring you have the right hose for the job. Our wide variety of products allows you to find the correct hose for every application.
- **Convenience Branding** — Our industrial hose products are branded with size, working pressure, type, Made In USA. Optional branding information is available for private branding as well.

HBD/Thermoid® Inc. – Leadership through Technology

HBD/Thermoid, Inc. has been and continues to be a leader in developing innovative hose product designs and manufacturing production techniques. This long-term commitment to hose manufacturing benefits all of our customers. Our production expertise provides customers with hose products that they can rely on to stand up to the roughest types of industrial and/or working environments. Outlined below are a few examples of the many hose products, design types and unique manufacturing techniques that assist customers with their daily hose product needs:

Handbuilt

With over 100 years of design experience, **HBD/Thermoid, Inc.** is the leader in handcrafted hose. The line is built by an experienced design team, using a computer-aided system that has received worldwide product approvals. This hose line is not your everyday water hose; it's one that encompasses products like submarine, rotary and the patented Hy-Flex™ dock hose.

Spiral

HBD/Thermoid's LX-200 production lines now produce a selection of Thermoid's most popular hoses in continuous lengths to 200 feet. The most notable example is the **Transporter**® line, which encompasses a wide variety of markets such as petroleum, material handling, chemical and food service.

Thermocure

With this process, **HBD/Thermoid** has become a potent force in the PED, Fuel Oil Delivery and LP Gas markets with such product lines like the Hi-Vac™ and Superlite® vapor recovery hoses, the Cobra™ FOD hose and the Type 75 LP Gas hose, just to name a few. The Thermocure process gives these first class products, a showroom quality look.

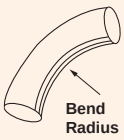
RMA OIL RESISTANCE DATA

The effects of oil on rubber depend on a number of factors that include the type of rubber compound, the composition of the oil, the temperature and the length of exposure. The RMA (Rubber Manufacturers Association) has developed a classification of hose performance based on sample immersions in ASTM No. 3 oil (High Swell) at 212°F for 70 hours. Oil resistance classifications for rubber stocks are shown in the table below.

Hose Physical Properties After Exposure to Oil		
Classification	**Volume Change Maximum**	**Tensile Strength Retained**
Class A (High Oil Resistance)	+25%	80%
Class B (Medium-High Oil Resistance)	+65%	50%
Class C (Medium Oil Resistance)	+100%	40%

RMA IP-8 (2002) Specification for Oil Suction and Discharge Hose definitions from section 8.3 for "ED" and "EC" hose as follows; Electrically Discontinuous (ED) hose assembly has a maximum allowable resistance of 100 ohms as ascertained by using a 9 volt ohmmeter. Electrically Continuous (EC) hose assembly has a minimum allowable resistance of 25,000 ohms as ascertained by using a 500 volt megger.

MINIMUM HOSE BEND RADIUS DATA (MBR)



The Bend Radius is the radius of the bent section of a hose measured to the innermost surface of the curved portion. It is important because the minimum bend radius is the maximum amount a hose can be bent without being kinked or damaged.

General formula to determine bend length:

$$\frac{\text{Angle of Bend}}{360°} \times 2\pi r$$ = minimum length of hose to make bend

r = given bend radius of hose

Example: to make a 90° bend with a hose with a 2" I.D.

Given r = 4.5 inches

$$\frac{90°}{360°}[2 \times 3.14 \times 4.5]$$

.25 x 2 x 3.14 x 4.5 = 7" (inches)

7 inches is the minimum length the hose can be bent without damaging it.

Remember that the bend should take place over the entire minimum length and not a portion of it. In addition, the formula does not mean that 7 inches will be long enough to meet application needs. It only means that if the 90° bend takes place in less than 7 inches, the hose could be damaged.

* Reprinted with permission from the Rubber Manufacturers Association (RMA) Hose Handbook, RMA/IP-2/2003.

FACTORS AFFECTING HOSE SERVICE LIFE

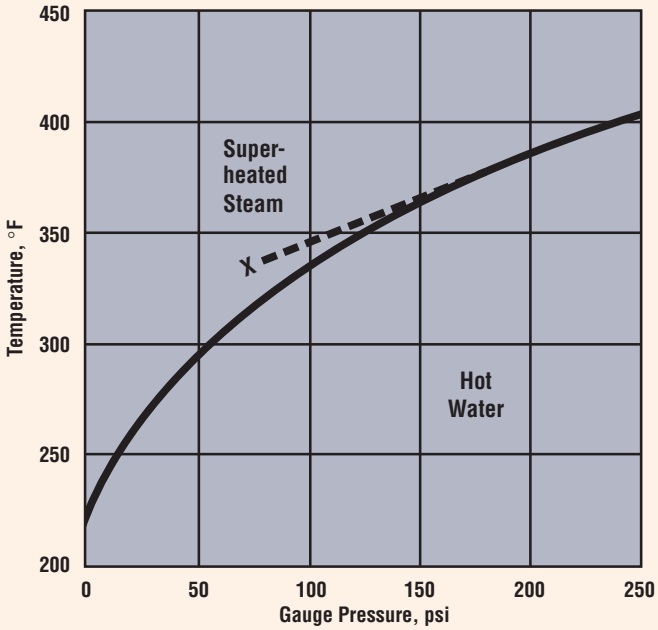
All hose has a limited life for a given application. This is true even if the proper hose has been selected for the application; it is used within rated pressures, temperatures and environmental conditions; and it is properly inspected and maintained. This is because the elastomers and reinforcement used to construct the hose will break down over time and with use. In addition, there are a number of factors that can adversely affect the service life of a hose. The major ones are:

1. **External Abuse** – Kinking, bending, high end pull, crushing, abrasion, exceeding the recommended minimum bend radius, exposure to chemicals and other abuse or damage will reduce the service life and performance of you hose. This may be the case even though the hose may appear to be undamaged from exterior appearance. Hoses should not be stretched, run over by equipment, or used to hoist, carry or pull objects. Hoses should not be bent beyond recommended minimum bend radius. This could result in kinks which could increase pressure and hose damage that could reduce pressure resistance. Large diameter hoses may require additional support to reduce stretching, kinking and external abuse.
2. **System Pressures** – **Never use hose at pressures that exceed its ratings**. A system (or device or application) can have varied pressures caused by source, operator action or mechanical components. It is the responsibility of the purchaser or user to accurately determine the maximum system pressure. Steady state pressure can be measured readily by gauges. Surge pressures are difficult to measure and may require the use of electronic pressure sensing devices. “Hammer effects” refers to sudden blockage or stoppage of the system that causes pressure spikes. This can damage or even cause catastrophic failure of the hose or system.
3. **High Temperatures** – Never use hose at temperatures that exceed its ratings. **High temperatures can degrade a hose very quickly**, resulting in shortened service life. The allowable temperature ranges for the Thermoid hoses are shown on the following pages. These are for **internal product temperatures** and assume external or ambient temperatures do not exceed the recommended working temperature of the fluid. Where external temperatures are higher than these ranges, contact your HBD/Thermoid Customer Service Representative for recommendations. **Fluid and environmental temperatures that are high, but within working temperature of hose, still shorten hose life.**
4. **Low Temperatures** – Never use hose at lower temperatures than recommended. Doing so could cause the hose to crack or break.
5. **Misapplication** – HBD/Thermoid designs and supplies a variety of hoses. **Always select the right hose for the application**. HBD/Thermoid disclaims liability for misapplication of its product. Contact your HBD/Thermoid Customer Service Representative for application assistance.
6. **Internal Abrasion** – Applications involving abrasive fluids, particularly where the hose makes one or more bends, will reduce the service life of the hose.
7. **Flexing and Vibration** – Flexing, twisting, vibration or other movement of the hose may shorten service life.
8. **Modifications to the Hose** – Repairing the hose, improperly coupling or re-coupling of the hose, or use of inappropriate fittings and other modifications to the hose will shorten service life and possibly cause immediate failure.
9. **Improper Installation** – Installing hose assemblies in a manner where the hose is subjected to a **torqued condition (twisted layline)**, will reduce the life of the hose significantly.

STEAM HOSE WARNING

Steam heat is hotter than boiling water (212°F, 100°C) and increases in temperature as pressure increases. The danger from steam in industrial applications is due to the great heat and pressures involved. Water changes to steam at higher temperatures when under pressure. If the steam escapes, massive quantities of heat are released. This, combined with high pressures, can prove to be dangerous for the operator. **Use only steam hoses designed for these applications. A steam hose should never be used to carry pressures or temperatures higher than it is rated to handle, in spite of any safety factor.**

STEAM CHART



The dotted line shows the process of saturated steam being transformed into superheated steam. If a steam line is at a pressure of 150 psi, and a temperature of 366°F, it contains saturated steam. If the pressure is substantially reduced by the expansion of the steam (such as the sudden opening of a valve or the steam passing into a larger pipe or hose), the condition of the steam follows the dotted line to some point X in the superheated steam area. This condition may not last very long, but the superheated steam tends to deteriorate the tube stock in ordinary steam hose intended for use with saturated steam. This usually results in hose failure.

Properties of Saturated Steam

(Abridged from Handbook of Chemistry and Physics – 39th Edition.)

Gauge Pressure (psi)	*Temperature of Saturated Steam (°F)
10	239
25	267
30	274
35	281
40	287
45	292
50	298
55	303
60	307
65	312
70	316
75	320
80	324
85	328
90	331
95	335
100	338
105	341
110	344
115	347
120	350
125	353
130	356
135	358
140	361
145	363
150	366

Gauge Pressure (psi)	*Temperature of Saturated Steam (°F)
155	368
160	371
165	373
170	375
175	377
180	380
185	382
190	384
195	386
200	388
205	390
210	392
215	394
220	395
225	397
230	399
235	401
240	403
245	404
250	406
255	408
260	409
265	411
270	413
275	414

* Based on an atmosphere pressure of 14.7 psi.

When making a selection for this type of application, keep safety in mind. Be sure to **select a hose identified as steam hose**. There should be a permanent form of branding on the hose and not just on the package. The manufacturer's name, hose type and operating pressure should be readable. If not, don't use the hose. Also, be sure to identify the type of service the steam hose will be required to accomplish. What will the temperature of the steam be? Will the steam be superheated (dry) or saturated (wet)? What environment will this hose be used in? Be sure that you can recognize that spillage or accumulations of corrosive materials can have a detrimental effect on the hose cover.

Make sure the hose is installed properly by using hose couplings designed for steam service. Check the tightness with each use. Installing and using a shut-off valve between the steam source and the hose will maximize service life and operator safety.

Provide operators with adequate clothing which would include rubber boots, gloves, eye protection and full length protective clothing. **Do not** allow the hose to remain under pressure when not in service. Failure to depressurize and drain the hose when not in service can reduce the usable life of the hose. Continue to monitor hose to ensure it has not deteriorated to the point to where it can no longer provide safe service. Most, if not all steam hoses are date-coded by the manufacturer. It is recommended that assemblies be tagged with a date that it went into service. This information will be helpful in identifying those hoses that should be replaced due to age.

Couplings: Hose couplings are extremely important when steam is being handled. High temperatures and pressures inside steam hose act like a pressure cooker and cause the inside and outside diameters to shrink during use. Couplings must be specifically designed to combat this effect. **Only couplings designed for steam hose should be used**.

CHEMICAL HOSE WARNING

Do not use chemical hose at pressures or temperatures above those recommended by HBD/Thermoid. All operators must be thoroughly trained in the care and use of these hoses, and must, at all times, wear protective clothing and other appropriate safety equipment. A hose or system failure could cause the release of corrosive, flammable or poisonous material. Never allow chemicals to drip on the exterior of the hose or allow the hose to lie in a pool of chemicals since the hose cover may not have the same chemical resistance as the inner tube. If kinking or crushing occurs, immediately subject the assembly to the Hydrostatic Pressure Test and Examination. If the Hydrostatic Test is not an option, immediately replace the assembly. If the reduction of the I.D. is greater than 20%, replace the assembly.

Extreme care must be taken when flushing out a chemical hose with water or removing clogs. Some chemicals, such as concentrated acids may react with the water. Spattering may occur which could result in serious injury to the eyes or other areas of the body. When flushing the hose, care must be taken so that all chemicals or flushing fluids are disposed of according to EPA recommended guidelines.

STATIC ELECTRICITY WARNING

Serious bodily injury, death, property damage or other loss, can result from the use of hose in hazardous or explosive atmospheres due to the buildup of static electricity from the movement of conveyed materials through the hose as well as movement or vibration of the hose against the other surfaces. Hose, as well as the entire system or application, used in such atmospheres must be properly grounded or bonded. For this reason, HBD/Thermoid recommends only hose with static wire be used.

Static electricity, as a source of ignition for flammable vapors, gases and dusts, is a hazard common to a wide variety of industries. A static spark can occur when an electrical charge accumulates on the surfaces of two materials that have been brought together and then separated (between two solids, between a solid and a liquid, or between two immiscible liquids, i.e., incapable of mixing). One surface becomes charged positively and the other surface becomes charged negatively. If the materials are not bonded or grounded, they will eventually accumulate a sufficient electrical charge capable of producing a static spark that could ignite flammable vapors, gases and dusts. Some common processes capable of producing a static ignition are as follows:

- The flow of liquids (for example, petroleum or mixtures of petroleum and water as well as any flammable fluids) through hose, pipes or fine filters.
- The settling of a solid or an immiscible liquid through a liquid (e.g. rust or water through petroleum).
- The ejection of particles or droplets from a nozzle (e.g. water washing operations or the initial stages of filling a tank with oil).
- The vigorous rubbing together and subsequent separation of certain synthetic polymers (e.g. the sliding of a polypropylene rope through PVC gloved hands).

Preventing and/or dissipating static electricity as an ignition source can be accomplished through bonding, grounding or possibly selecting a different non-static conducting material. Bonding is the process of connecting two or more conductive objects together by means of a conductor. Grounding, or earthing, is the process of connecting one or more conductive objects to the ground.**

Certain Thermoid hose incorporates a static wire, which if properly coupled can be used to ground the hose assembly. Other parts of the application or equipment may have to be grounded as well. Hose that does not contain a ground wire will nevertheless have to be grounded if used in an explosive or hazardous atmosphere. In all applications, it is the user's responsibility to ensure the hose assembly and equipment it is used on, is properly grounded to earth.

** Excerpts from Process Safety Handling Hazardous Chemicals, 1/97: Standards & Guidelines – Occupational Safety and Health Administration.

CARE, MAINTENANCE AND STORAGE

Hose has a limited life and the user must be alert to signs of impending failure, particularly when the conditions of service include high working pressures and/or the conveyance or containment of hazardous materials. The periodic inspection and testing procedures described here provide a schedule of specific measures which constitute a minimum level of user action to detect signs indicating hose deterioration or loss of performance before conditions leading to malfunction or failure are reached.

SAFETY WARNING: Failure to properly follow the manufacturer's recommended procedures for the care, maintenance and storage of a particular hose might result in its failure to perform in the manner intended and might result in possible damage to property and serious bodily injury.

General instructions are also described for the proper storage of hose to minimize deterioration from exposure to elements or environments which are known to be deleterious to rubber products. Proper storage conditions can enhance and extend substantially the ultimate life of hose products.

GENERAL CARE AND MAINTENANCE OF HOSE

Hose should not be subjected to any form of abuse in service. It should be handled with reasonable care. Hose should not be dragged over sharp or abrasive surfaces unless specifically designed for such service. Care should be taken to protect hose from severe end loads for which the hose or hose assembly were not designed. Hose should be used at or below its rated working pressure; any changes in pressure should be made gradually so as to not subject the hose to excessive surge pressures. Hose should not be kinked or be run over by equipment. In handling large size hose, dollies should be used whenever possible; slings or handling rigs, properly placed, should be used to support heavy hose used in oil suction and discharge service.

GENERAL TEST AND INSPECTION PROCEDURES FOR HOSE

An inspection and hydrostatic test should be made at periodic intervals to determine if a hose is suitable for continued service.

A visual inspection of the hose should be made for loose covers, kinks, bulges, or soft spots which might indicate broken or displaced reinforcement.

The couplings or fittings should be closely examined and, if there is any sign of movement of the hose from the couplings, the hose should be removed from service.

The periodic inspection should include a hydrostatic test for one minute at 150% of the recommended working pressure of the hose. An exception to this would be woven jacketed fire hose.* During the hydrostatic test, the hose should be straight, not coiled or in a kinked position.

Water is the usual test medium and, following the test, the hose may be flushed with alcohol to remove traces of moisture. A regular schedule for testing should be followed and inspection records maintained.

SAFETY WARNING: Before conducting any pressure tests on hose, provision must be made to ensure the safety of the personnel performing the tests and to prevent any possible damage to property. Only trained personnel using proper tools and procedures should conduct any pressure tests.

1. Air or any other compressible gas must never be used as the test media because of the explosive action of the gas should a failure occur. Such a failure might result in possible damage to property and serious bodily injury.

2. Air should be removed from the hose by bleeding it through an outlet valve while the hose is being filled with the test medium.

3. Hose to be pressure tested must be restrained by placing steel rods or straps close to each end and at approximate 10 foot (3 m) intervals along its length to keep the hose from "whipping" if failure occurs; the steel rods or straps are to be anchored firmly to the test structure but in such a manner that they do not contact the hose which must be free to move.

4. The outlet end of hose is to be bulwarked so that a blown-out fitting will be stopped.

5. Provisions must be made to protect testing personnel from the forces of the pressure media if a failure occurs.

6. Testing personnel must never stand in front of or in back of the ends of a hose being pressure tested.

7. If liquids such as gasoline, oil, solvent, or other hazardous fluids are used as the test fluid, precautions must be taken to protect against fire or other damage should a hose assembly fail and the test liquid be sprayed over the surrounding area.

STORAGE

Rubber hose products in storage can be affected adversely by temperature, humidity, ozone, sunlight, oils, solvents, corrosive liquids and fumes, insects, rodents and radioactive materials.

The appropriate method for storing hose depends to a great extent on its size (diameter and length), the quantity to be stored, and the way in which it is packaged. Hose should not be piled or stacked to such an extent that the weight of the stack creates distortions on the lengths stored at the bottom.

Since hose products vary considerably in size, weight, and length, it is not practical to establish definite recommendations on this point. Hose having a very light wall will not support as much load as could a hose having a heavier wall or hose having a wire reinforcement. Hose which is shipped in coils or bales should be stored so that the coils are in a horizontal plane.

Whenever feasible, rubber hose products should be stored in their original shipping containers, especially when such containers are wooden crates or cardboard cartons which provide some protection against the deteriorating effects of oils, solvents, and corrosive liquids; shipping containers also afford some protection against ozone and sunlight.

Certain rodents and insects will damage rubber hose products, and adequate protection from them should be provided.

Cotton jacketed hose should be protected against fungal growths if the hose is to be stored for prolonged periods in humidity conditions in excess of 70%.

The ideal temperature for the storage of rubber products ranges from 50° to 70°F (10-21°C) with a maximum limit of 100°F (38°C). If stored below 32°F (0°C), some rubber products become stiff and would require warming before being placed in service. Rubber products should not be stored near sources of heat, such as radiators, base heaters, etc., nor should they be stored under conditions of high or low humidity.

To avoid the adverse effects of high ozone concentration, rubber hose products should not be stored near electrical equipment that may generate ozone or be stored for any lengthy period in geographical areas of known high ozone concentration.

Hose should not be stored in locations where the ozone level exceeds the National Institute of Occupational Safety and Health's upper limit of 0.10 ppm. Exposure to direct or reflected sunlight – even through windows – should also be avoided. Uncovered hose should not be stored under fluorescent or mercury lamps which generate light waves harmful to rubber.

Storage areas should be relatively cool and dark, and free of dampness and mildew. Items should be stored on a first-in, first-out basis, since even under the best of conditions, an unusually long shelf life could deteriorate certain rubber products.

**Woven jacket fire hose should be tested in accordance with the service test provisions contained in the current edition of National Fire Protection Association Bulletin No. 1962 – Standard for the Care, Use and Service Testing of Fire Hose.*

* Reprinted with permission from the Rubber Manufacturers Association (RMA) Hose Handbook, RMA/IP-2/2003.

HOSE TESTING

SAFETY WARNING: Testing can be dangerous and should be done only by trained personnel using proper tools and procedures. Failure to follow such procedures might result in damage to property and/or serious bodily injury.

The Rubber Manufacturers Association (RMA) recognizes, accepts and recommends the testing methods of the American Society for Testing and Materials (ASTM).

Unless otherwise specified, all hose tests are to be conducted in accordance with ASTM Method No. D-380 (latest version). Where an ASTM D-380 test is not available, another test method should be selected and described in detail.

RMA participates with ASTM under the auspices of the American National Standards Institute (ANSI) in Technical Committee 45 (TC45) of The International Organization for Standardization (ISO) in developing both hose product and hose test method standards. Many of the hose test method standards published by ISO duplicate or closely parallel those shown in ASTM D-380. Many are unique and, in those cases, the RMA may be able to provide the necessary test standard references which may be purchased from the American National Standards Institute (ANSI).

HYDROSTATIC PRESSURE TESTS

Hydrostatic pressure tests are classified as follows:

1. DESTRUCTIVE TYPE
   a. Burst test
   b. Hold test
2. NON-DESTRUCTIVE TYPE
   a. Proof pressure test
   b. Change in length test (elongation or contraction)
   c. Change in outside diameter or circumference test
   d. Warp test
   e. Rise test
   f. Twist test
   g. Kink test
   h. Volumetric expansion test

Destructive Tests

Destructive tests are conducted on short specimens of hose, normally 18 inches (460 mm) to 36 inches (915 mm) in length and, as the name implies, the hose is destroyed in the performance of the test.

a. Burst pressure is recorded as the pressure at which actual rupture of a hose occurs.

b. A hold test, when required, is a means of determining whether weakness will develop under a given pressure for a specified period of time.

Non-Destructive Tests

Non-destructive tests are conducted on a full length of a hose or hose assembly. These tests are for the purpose of eliminating hose with defects which cannot be seen by visual examination or in order to determine certain characteristics of the hose while it is under internal pressure.

a. A proof pressure test is normally applied to hose for a specified period of time. On new hose, the proof pressure is usually 50% of the minimum specified burst except for woven jacket fire hose where the proof pressure is twice the service test pressure marked on the hose (67% of specified minimum burst). Hydrostatic tests performed on fire hose in service should be no higher than the service test pressure referred to above. The regulation of these pressures is extremely important so that no deteriorating stresses will be applied, thus weakening a normal hose.

b. With some type of hose, it is useful to know how a hose will act under pressure. All change in length tests, except when performed on wire braid or wire spiralled hose, are made with original length measurements taken under a pressure of 10 psi (0.069 MPa). The specified pressure, which is normally the proof pressure, is applied and immediate measurement of the characteristics desired are taken and recorded.

   Percent length change (elongation or contraction) is the difference between the length at 10 psi (0.069 MPa) (except wire braided or wire spiralled) and that at the proof pressure times 100 divided by the length at 10 psi (0.069 MPa). Elongation occurs if the length of the hose under the proof pressure is greater than at a pressure of 10 psi (0.069 MPa). Contraction occurs if the length at the proof pressure is less than at 10 psi (0.069 MPa). In testing wire braided or spiralled hose, the proof pressure is applied and the length recorded. The pressure is then released and, at the end of 30 seconds, the length is measured; the measurement obtained is termed the “original length.”

c. Percent change in outside diameter or circumference is the difference between the outside diameter or circumference at 10 psi (0.069 MPa) and that obtained under the proof pressure times 100 divided by the outside diameter or circumference at 10 psi (0.069 MPa). Expansion occurs if the measurement at the proof pressure is greater than at 10 psi (0.069 MPa). Contraction occurs if the measurement at the proof pressure is less than at 10 psi (0.069 MPa).

d. Warp is the deviation from a straight line drawn from fitting to fitting; the maximum deviation from this line is warp. First, a measurement is taken at 10 psi (0.069 MPa) and then again at the proof pressure. The difference between the two, in inches, is the warp. Normally, this is a feature measured on woven jacket fire hose only.

e. Rise is a measure of the height a hose rises from the surface of the test table while under pressure. The difference between the rise at 10 psi (0.069 MPa) and at the proof pressure is reported to the nearest 0.25 inch (6.4 mm). Normally, this is a feature measured on woven jacket fire hose only.

f. Twist is a rotation of the free end of the hose while under pressure. A first reading is taken at 10 psi (0.069 MPa) and a second reading at proof pressure. The difference, in degrees, between the 10 psi (0.069 MPa) base and that at the proof pressure is the twist. Twist is reported as right twist (to tighten couplings) or left twist. Standing at the pressure inlet and looking toward the free end of a hose, a clockwise turning is right twist and counterclockwise is left twist.

g. Kink test is a measure of the ability of woven jacket hose to withstand a momentary pressure while the hose is bent back sharply on itself at a point approximately 18 inches (457 mm) from one end. Test is made at pressures ranging from 62% of the proof pressure on sizes 3 inches (76 mm) and 3.5 inches (89 mm) to 87% on sizes under 3 inches (76 mm). This is a test applied to woven jacket fire hose only.

h. Volumetric expansion test is applicable only to specific types of hose, such as hydraulic or power steering hose, and is a measure of its volumetric expansion under ranges of internal pressure.

DESIGN CONSIDERATIONS

In designing hose, it is customary to develop a design ratio, which is a ratio between the minimum burst and the maximum working pressure.

Burst test data is compiled and the minimum value is established by accepted statistical techniques. This is done as a check on theoretical calculations, based on the strength of reinforcing materials and on the characteristics of the method of fabrication.

Minimum burst values are used as one factor in the establishment of a reasonable and safe maximum working pressure.

MAXIMUM WORKING PRESSURE IS ONE OF THE ESSENTIAL OPERATING CHARACTERISTICS THAT A HOSE USER MUST KNOW AND RESPECT TO ASSURE SATISFACTORY SERVICE AND OPTIMUM LIFE.

It should be noted that design ratios are dependent on more than the minimum burst. The hose technologist must anticipate natural decay in strength of reinforcing materials, and the accelerated decay induced by the anticipated environments in which the hose will be used and the dynamic situations that a hose might likely encounter in service.

Including all considerations, the following recommended design ratios are given for newly manufactured hose:

1. Water Hose up to 150 psi WP: 3:1
2. Hose for all other liquids, solid materials suspended in liquids or air, and water hose over 150 psi WP: 4:1
3. Hose for compressed air and other gases: 4:1
4. Hose for liquid media that immediately changes into gas under standard atmospheric conditions: 5:1
5. Steam Hose: 10:1

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HOSE AND COUPLING SELECTION GUIDE

GENERAL

A number of hose specifications have been developed for specific applications in industrial, agricultural or public service. These specifications are based on successful performance of the hose in the field as reported by consumers, manufacturers and governmental agencies.

These may be used as procurement specifications or performance standards when the application agrees with the scope of the hose specification. The RMA has published a number of hose specifications which are recommended for use.

Often, additional or new requirements may be imposed on hose because of the severity of service conditions, a change in service conditions, a change in the materials handled or in the method of handling, or the development of new uses or procedures. Hose specifications must then be prepared with the supplier and be based on all conditions affecting the expected service and performance of the hose. Generally, a hose manufacturer may have types of hose or can devise new ones which may meet other requirements than those covered by published standards.

For best performance, a hose should be selected to meet the service conditions under which it is to be used. Before deciding on size, type, and quality of hose, complete information on the actual service requirements should be examined.

SERVICE CONSIDERATIONS FOR HOSE IN CRITICAL APPLICATIONS

Hose is often used in locations and/or to convey materials where property damage or human injury could occur if the hose and/or associate fittings failed while in service.

The user must insure that the service conditions are known to himself and to the hose supplier. The improper use of hose or the use of a hose for service applications for which it was not designed may result in serious consequences.

Some examples of improper uses of hoses include the following: water hose should not be used for chemicals or solvents; low pressure hose should not be used for high pressure service; only steam hose should be used for steam service; hose for conveying mild chemicals should not be used for strong or concentrated acids which require special types of hose. Temperatures in or around the hose should be known so as not to exceed supplier's recommendations, etc.

INFORMATION NEEDED

Hose Dimensions

(a) I.D.
(b) O.D.
(c) Length (state whether overall length or length excluding couplings)
(d) Tolerance limitations (if normal RMA tolerances cannot be used)

Types of Service

(a) Material to be conveyed through hose
   1. Chemical name
   2. Concentration
   3. Temperature extremes (low and high)
   4. Solids, description and size

(b) Working pressure (including surge)
(c) Suction or vacuum requirements
(d) Velocity
(e) Flow Rate

Operating Conditions

(a) Intermittent or continuous service
(b) Indoor and outdoor use
(c) Movement and geometry of use
(d) Flexibility – Minimum bend radius
(e) External conditions
   1. Abrasion
   2. Oil (Specify type)
   3. Solvents (Specify type)
   4. Acid (Specify type and concentration)
   5. Temperature Range
      Normal
      Highest
      Lowest
   6. Ozone

Uncoupled Hose
- (a) Bulk or cut to length
- (b) Ends
  1. Straight or enlarged
  2. Capped or raw (uncapped)
  3. Soft ends or wire to end

Coupled Hose, Fittings
- (a) Factory applied
- (b) Field applied
- (c) Type of Fitting
  1. Type of thread
  2. Male or female
  3. Reusable/field attachable
  4. Non-reusable
- (d) Material for Fittings
  1. ANSI (or SAE or ASTM) metal composition specifications

Hose with Built-in Fittings
- (a) Ends
  1. Threaded (type of thread)
  2. Grooved
  3. Beveled for welding
  4. Integral flange
- (b) Flanges
  1. Type (threaded, slip-on, welding neck, lap joint)
  2. Pressure rating
  3. Drilling
- (c) Materials and Dimensions
  1. ANSI (or SAE or ASTM) composition and specifications
  2. Treatment for specific services

Hose Now in Use
- (a) Type of hose
- (b) Service life being obtained and description of failure
- (c) Service life desired

Special Requirements or Properties
- (a) Electrical and static conductive
- (b) Flame resistant
- (c) Sub-zero exposure
- (d) Non-contaminating to material

ORGANIZATIONS HAVING REGULATIONS OR SPECIFICATIONS FOR HOSE

U.S. Government Agencies

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

Canadian Agencies and Organizations

CGA	Canadian Gas Association
CGSB	Canadian Government Specifications Board
RAC	Rubber Association of Canada

Other Organizations

ABS	American Bureau of Shipping
ANSI	American National Standards Institute
API	American Petroleum Institute
ASTM	American Society for Testing and Materials
BIA	Boating Industry Association
BSI	British Standards Institute
CGA	Compressed Gas Association
DIN	Deutches Institut for Normung – German Standards
DNV	Det Norske Veritas
EN	European Norms
FM	Factory Mutual Research
FPS	Fluid Power Society
ISO	International Organization for Standardization
JIC	Joint Industrial Council (defunct)
JIS	Japanese Industrial Standards
NAHAD	National Association of Hose and Accessories Distributors
NFPA	National Fire Protection Association
	National Fluid Power Association
RMA	Rubber Manufacturers Association
SAE	Society of Automotive Engineers
TFI	The Fertilizer Institute
UL	Underwriters Laboratories

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COMMONLY USED RUBBER COMPOUNDS

ASTM Designation D1418	Common Name	Composition
CM	CPE	Chloronated Polyethylene
CR	Neoprene**	Chloroprene
CSM	Hypalon	Chloro-sulfonyl-polyethylene
ECO	Hydrin	Ethylene oxide and Chloromethyl oxirane
EPDM	Ethylene Propoylene Rubber	Ethylene-propylene-diene-terpolymer
FKM	Fluoroelastomer Viton	Hexafluoropropylene vinylidene fluoride
IIR	Butyl	Isobutylene-isoprene
IR	Polyisoprene	Isoprene, synthetic
NBR	Buna N, Nitrile	Nitrile-butadiene
NR	Natural Rubber	Isoprene, natural
SBR	SBR	Styrene-butadiene
UHMWPE	Ultra-High Molecular Weight Polyethylene	Polyethylene
XLPE	Cross-Linked Polyethylene	Polyethylene and cross-linking agent

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