DUCTING GUIDE

NAHAD

THE ASSOCIATION FOR HOSE AND ACCESSORIES DISTRIBUTION

NAHAD 520

2009

IMPORTANT NOTE TO READER:

NAHAD – The Association for Hose and Accessories Distribution – is pleased to provide this comprehensive set of basic guidelines for Ducting, a companion to the *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 Hose Assembly Specification Guidelines, addressing Composite Hose, Corrugated Metal Hose, Hydraulic Hose, Industrial Hose, and Fluoropolymer Hose, as well as a Guide for Custom Made 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.

Ducting, ducting end fittings and finishings, as well as accessories, 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.

© Copyright 2009 by The Association For Hose & Accessories Distribution, Inc. (NAHAD).
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transcribed, in any form or by any means, electronic, mechanical, photocopying or otherwise, without the prior written permission of NAHAD.

Published by The Association For Hose & Accessories Distribution, Inc.
105 Eastern Avenue, Suite 104
Annapolis, Maryland 21403
www.nahad.org

Ducting Guide

Table of Contents

Section 1 – Scope

Ducting refers to the transport of air or air-borne media and typically involves low pressure and/or negative pressure applications involving either air, fume, dust, and/or some light weight material handling.

The NAHAD Hose Assembly Guidelines Standards Committee rationale for separating the “Ducting” guide from the “Industrial hose” manual was to assure that the industry recognized the distinct differences between ducting and industrial hose. Although “light material handling” terminology is used when referencing some ducting products; it is in no way intended to be compared equally with the more substantial construction (heavier weight/ more compact) used with industrial material handling hoses. The construction of most “Ducting” products is significantly different and is generally relegated to lighter duty purposes.

This NAHAD Ducting Guideline is intended to complement existing industry standards and federal regulations. This document aids Distributors and the end user in the selection of and recommended practices for safe installation and use of suitable ducting.

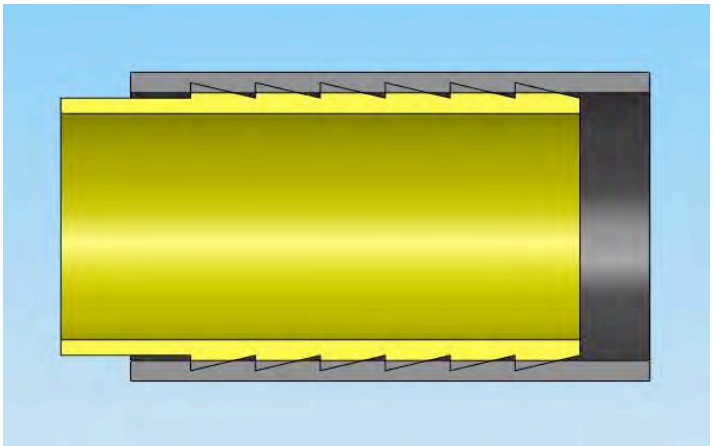
This document is not intended to prohibit either supplier or customer from attaching additional requirements for ducting to satisfy the application. It is the responsibility of the fabricator and user to separately qualify these applications and their unique requirements necessary to ensure performance capability.

Section 2 – Glossary

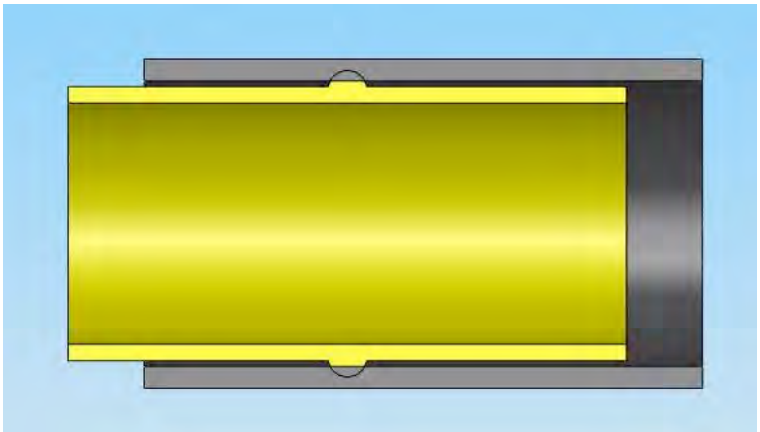
Abrasion: internal and/or external damage to a duct caused by prolonged contact with a foreign object or media; a wearing away by friction
ABS: Acrylonitrile butadiene styrene, a common rigid plastic used for injection molding for components such as fittings
Accelerated life test: life test where the conditions have been altered to speed the test procedure; the correlation between the life test and accelerated life test is critical.
Adhesion: A temporary or permanent bond between two surfaces through the use of an additional bonding material
Adhesive: a material which, when applied, will cause two surfaces to adhere. A material that bonds two items together
Adhesive failure: A failure of bonded items at the surface interface where the adhesive was applied (i.e. the adhesive interface was weaker than the bonded items or the adhesive itself). An example of a purposely-designed adhesive failure would be Post-It Note removal from another object. Often adhesive failures are due to poor surface preparation or poor adhesive selection for the specific application.
air flow: the volume of air that can flow through a duct in a given time period. (see

CFM)
air velocity: the speed at which air passes through a duct
ambient temperature: the temperature of the environment to which the ducting will be exposed
ambient/atmospheric conditions: The surrounding conditions, such as temperature, humidity, gases, pressure, and corrosion, to which ducting is exposed.
American Society of Heating, Refrigerating and Air-Conditioning Engineers (also known as AHR SOCIETY)
annular: refers to the convolutions on a flexible duct that are a series of complete circles or rings located at right angles to the longitudinal axis of the duct (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: product designed to reduce the build-up of static electricity in the application; not measurable with a standard ohm meter (10 *8 or higher ohms)
application working pressure: unique to customer’s application. See pressure, working; should never exceed the manufacturer’s recommended working pressure.
application: the service conditions that determine how a duct will be used.
assembly: a general term referring to any duct coupled with end fittings of any style attached to one or both ends.
ASTM: American Society for Testing and Materials.
ASTM E162/E662: refers to the spread of the flame/smoke if the product ignites
ASTM E162-06 Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source (Flame Spread)
ASTM E662-06 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials (Smoke Generation)
ASTM E84-08a Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E84: refers to smoke…
attachment: the method of securing an end fitting to a duct (e.g., banding, crimping, swaging, or screw-together-2 piece or 3 piece-style-reusable fittings, ground wire attachments, etc.).
autoclave: an apparatus using superheated high pressure steam for sterilization, vulcanization and other processes.

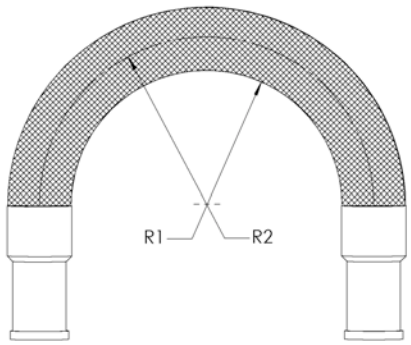
band: (1) a metal ring that is welded, shrunk, or cast on the outer surface of a coupling; (2) a thin strip of metal used as a non-bolted clamp. See hose clamp, or bridge clamp.
Barb: A mechanical feature designed to facilitate a leak-free interface between a hose or duct cuff and resist removal; the sealing features “bite” into the hose wall to prevent inadvertent removal and improved sealing at higher pressures



Bead: Another mechanical feature designed to facilitate a leak-free interface between a hose or duct cuff; unlike a barb, they provide significantly lower resistance to removal and are easier to re-use. Not for high-pressure applications without a secondary clamp.



bend radius: the radius of a bent section of duct measured to the innermost surface of the curved portion. (R1); bend radius centerline (R2)



bend radius, minimum: the smallest radius at which a duct can be used without deforming the cross section.
bloom: a discoloration or change in appearance of the surface of a ducting 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 molding: process of making corrugated duct using positive pressure in a continuous fashion
body wire: normally a round or flat wire helix embedded in the duct wall to increase strength or to resist collapse; also wire helix
bore: (1) an internal cylindrical passageway, as of a duct; (2) the internal diameter of a duct. (see ID)
brand: a mark or symbol identifying or describing a product and/or manufacturer, that is embossed, inlaid or printed.
Bridge clamp: a worm gear clamp capable of bridging over the wire helix in order to create a tight seal; must define whether helix is left or right handed.
Burst pressure: the pressure at which the duct self-destructs; do not attempt at home – stick with working pressure.

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.
cam & groove: see fitting/coupling - Cam & Groove.
capped end: a duct end covered to protect its internal elements.
CFM: cubic feet per minute
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.
clamp: see hose clamp.
Coefficiency of flow: When calculating the measure of the loss of air flow through a duct due to length, bends or any restriction, the coefficiency of flow pertains to the resistance of the duct to pass the volume of air flowing through it. Generally measured in a per foot basis.
coefficient of friction: a measure of the surface of the duct's resistance to slide
Cohesion: A measure of the innate strength of a single material in a composite construction
cohesive failure: A failure of bonded items or the adhesive near (but not at) the surface interface where the adhesive was applied (i.e. the adhesive interface was stronger than the bonded items or the adhesive itself). An example of cohesive failure would be office tape to paper where the adhesive tears off the outermost layer of paper upon removal. Cohesive failures are often a sign of exceeding the capabilities of the materials in practice, particularly when the failure occurs in one of the bonded items rather than the adhesive itself.
cold flex: see low temperature flexibility.
cold flexibility: relative ease of bending while being exposed to specified low temperature.

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 set: the radial deformation which remains in the duct after it has been subjected to and released from a specific compressive stress for a definite period of time at a prescribed temperature (can include packaging effects)
Compression ratio: a measurement shown in percentages reflecting axial compressibility of a duct
conditioning: the exposure of a specimen under specified conditions, e.g., temperature, humidity, for a specified period of time before testing.
conductive: provides a low impedance path for the flow of electricity (lower than 10 *8) ; measurable by a standard ohm meter.
convolution description of a duct having spiral or helical ridges formed to enhance flexibility.
convolution count: the number of ridges or corrugations per inch of a duct. See pitch
copolymer: A polymer comprised of two or more unique monomers in a polymerized chain (e.g. ABS, EVA, nitrile)
core: the inner portion of a duct, usually referring to the material in contact with the medium.
Corrugation: description of a duct having annular ridges formed to enhance flexibility.
corrosion: the process of material degradation by chemical or electrochemical means.
corrosion resistance: ability of metal components to resist oxidation or chemical reactions.
coupling: a frequently used alternative term for fitting.
cover wear: the loss of material during use due to abrasion, cutting or gouging.
cracking: a sharp break or fissure in the surface, generally caused by strain and environmental conditions.
crimped style: a mechanical lock hose construction whereby the external metal helix acts as a filler and securely crimps the overlapping folds of fabric. No adhesives or glues are required and the style is engineered for higher temperatures and acoustic applications
Crush proof: the ability to rebound to 75% of its original ID when crushed all the way closing off the ID; no structural damage such as cracking the helix should be encountered
Crush resistance: the force required to crush a hose to 50% of its original diameter; this typically refers to wire supported hose which will not regain its original diameter.
Cuff: soft wall, wireless, injection molded, or built-in end configurations
cure: the act of vulcanization. See vulcanization.

date code: any combination of numbers, letters, symbols or other methods used by a manufacturer to identify the time of manufacture of a product.
dielectric strength: the relative measure of a material's ability to resist conducting an electrical charge.
Dry-rot: loss of plasticizer (flexibility) over time, often resulting in cracks or splits in the material

Effective inside diameter: minimum inside diameter of a duct

effusion: the escape, usually of gases, through a material. See permeation.
elastomer: any one of a group of polymeric materials which are flexible at operating temperatures
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.
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 duct, in order to accommodate a larger fitting.
EPDM: Ethylene Propylene Diene Monomer; an elastomer.
EVA: Ethylene vinyl acetate
extrude/extruded/extrusion: forced through the shaping die of an extruder; extrusion may have a solid or hollow cross section.

fabricator: the producer of ducting 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, a fluorocarbon material commonly known as a Teflon derivative.
fitting/coupling: a device attached to the end of the duct to facilitate connection. The following is only a partial list of types of fittings available:

- *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 material.
- *Flange* - A flange is a circular connector with the cross section in the shape of an "L". A flange typically requires a hole pattern to be drilled to mate up with another flange or connector plate.
- *Flange Retainer Fittings* - a fitting flared to a 90° surface, designed to hold a circular rotating flange, such as a slip-on or lap joint style flange.
- *J-lock fitting or connector* – 2 pc connector using 3 pins on one half and 3 J shaped slots cut on an inner ring. When the pin ring is connected to one duct and the slot ring to another duct, the ducts can be easily attached without tools, making a quick and convenient way to connect 2 ducts.
- *Latch lock fitting* - 2 pc connector using latches on one half of the connector and tabs on the other half to make for a secure, quick and convenient way to connect 2 ducts without tools.
- *Pin lock* - 2 pc connector using spring pins on one half and holes on the other half to make a quick and convenient connection of 2 ducts without the use of tools.
- *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.
- *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.

Flame retardant: Material added to a compound to resist burning
Flame spread/propagation: rate at which a flame will proceed along a duct
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 duct product when subjected to dynamic bending stresses.
fluorocarbon: an organic compound containing fluorine directly bonded to carbon; characterized by extremely high temperature and chemical resistance
fluoropolymer: a high molecular weight (long chain) chemical containing fluorine as a major element; commonly known as PTFE or Teflon.
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.

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.
Heat sealed: see strip wound**.**
helical: used to describe a type of duct having one continuous spiral convolution resembling a screw thread.
helix: a shape formed by spiraling a wire or other reinforcement around the cylindrical body of a duct. Includes wire or rigid plastic.
Hg: mercury (inches of mercury measurement of vacuum)
Homopolymer: A polymer comprised of a single monomer in a polymerized chain (e.g. polypropylene, PVC)
hoop strength: the relative measure of a helix's resistance to collapse of the diameter perpendicular to the hose axis.
hose clamp: a device used to hold a duct onto a fitting.
HVAC: heating, ventilation, air conditioning
Hypalon®: a DuPont registered trademark.
Hytrel®: a DuPont registered trademark.

IAPMO: International Association of Plumbing and Mechanical Officials
I.D.: the abbreviation for inside diameter.

Inches of mercury (inHg): measure of air pressure or vacuum
Inches of water (inH_2O): measure of air pressure or vacuum
Inside diameter: measurement of the duct from interior wall to interior wall
ISO: International Organization for Standardization.

jacket: see sleeve

kinking: a temporary or permanent distortion of the duct 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.
layer: a single thickness of material between adjacent parts.
life test: a laboratory procedure used to determine the resistance of a duct to a specific set of destructive forces or conditions. See accelerated life test.
light resistance: the ability to retard the deleterious action of solar radiation; see UV
liner: material used to line the inside diameter of the duct

mandrel: 1) a form, generally of elongated round section used for size and to support ducting during fabrications and/or vulcanization. It may be rigid or flexible.
mandrel built: a duct fabricated and/or vulcanized on a mandrel.
Manufactured length: length of duct as produced prior to packing
media, medium: the substance(s) being conveyed through a system.
mender: a fitting or device used to join two sections of duct; also known as a splicer, or hose connector
Monomer: A basic structural molecule that can link with other monomers into a polymer chain to form unique materials with unique characteristics and properties (e.g. vinyl chloride, various base hydrocarbons).

NAHAD: the abbreviation for the Association for Hose and Accessories Distribution.
necking down: a localized decrease in the cross-sectional area of a duct resulting from tension.
Negative pressure: vacuum
Neoprene®: a registered trademark of DuPont, or polychloroprene;
NFPA: National Fire Protection Association
nitrile rubber (NB/Buna-N): a family of acrylonitrile elastomers used extensively for industrial hose.
nominal: the defined value
nomograph: a chart used to compare duct size to flow rate to recommended velocity.
non-conductive: the inability to transfer an electrical charge.
nylon: a family of polyamide materials known for good toughness and chemical resistance

OAL: see overall length
O.D.: the abbreviation for outside diameter.
OE/OEM: original equipment manufacturer.

oil resistance: the ability of the materials to withstand exposure to oil.
oil swell: the change in volume of a thermoplastic rubber article resulting from contact with oil.
operating conditions: the pressure, temperature, motion, and environment to which a duct or duct assembly is subjected.
Outgassing: the release of chemicals from the material of the duct over time
Outside diameter: measurement of the duct from exterior wall to exterior wall
Overall length: length of the duct as manufactured, includes any fittings or cuffs
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).

PC: Polycarbonate, a rigid plastic material with excellent impact strength and optically clarity
performance test (service test): a test in which the product is used under actual service conditions.
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.
PET: Polyethylene terephthalate, also commonly known as polyester
PFA: Perflouroalkoxy, a fluorocarbon material used for tubes
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.
Pitch count: typically measured in turns per inch (tpi)
ply: an individual layer in duct construction.
pneumatic testing: the use of compressed air to test a duct or duct assembly for leakage, twisting, and/or duct 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.
Polyurethane (PU): An organic polymer with a wide range of stiffness, hardness, viscosities and densities, ranging from flexible foams to rigid plastics to wood and floor finishes; see TPU
pre-production inspection or test: the examination of samples from a trial run of product to determine adherence to a given specification, for approval to produce.
pressure: force ÷ unit area. For purposes of this document, refers to PSI (pounds per square inch).
pressure drop: the measure of pressure reduction or loss over a specific length of duct.
pressure, operating: see pressure, working.
pressure, service: see pressure, working
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.

psi: pounds per square inch.
PTFE: Polytetraflouroethylene, a fluorocarbon material most commonly known as Teflon
pull off force: the force required to pull the duct 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. PVC can be obtained in a variety of formulations ranging from soft, flexible films to hard, rigid plastic.

PVDF: polyvinylidene fluoride.

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

reinforcement: the strengthening members, consisting of either fabric, cord, plastic and/or metal, of a duct. See ply.
Relaxed length: length of stretched out duct after compression packing
ROHS: Reduction of Hazardous Substances (standard) The RoHS acronym references the Restriction of Hazardous Substances Directive 2002/95/EC. It is a directive of the European Union which took effect on 1 July 2006. It prohibits the use of six banned substances: lead, mercury, cadmium, hexavalent chromium, poly-brominated biphenyls (PBB) or polybrominated diphenyl ethers (PBDE), in the manufacture of Electronics and Electrical Equipment. May be required for products shipped to Europe or otherwise specified by the customer.
Ref: www.rohs.eu.
SAE: Society of Automotive Engineers.
safety factor: setting a design standard above specifications to assure required standards are met
Santoprene®: A family of thermoplastic vulcanizate materials of varying hardnesses and flexibilities with very good thermal properties and chemical resistance
Self-extinguishing: property of material to extinguish a flame once started
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 duct.
shelf/storage life: the period of time prior to use during which a product retains its intended performance capability.
sleeve: a tubular braided or woven ply generally on the outside of a duct for the purpose of insulating or protecting the duct.
Smoke generation: a measure of the quantity and content of smoke when the material is burning
smooth bore: a term used to describe the interior surface of a duct.
soft cuff: a duct 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.
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: see conductive
static discharge: see electrostatic discharge.
Static dissipative: see anti-static
static wire: wire incorporated in a hose to conduct static electricity.
Stretch hose: duct that is self-retracting that can be stretched to a multiple of its original length
Stretch ratio: percentage of stretch allowed; rated for a certain load
Strip wound: also known as tape wound; heat welded, spiral wound product using pre-extruded tape. Also known as heat sealed.
swelling: an increase in volume or linear dimension of a specimen immersed in liquid or exposed to a vapor.

Taber: a type of abrasion tester, used to evaluate abrasion resistance of materials
tear resistance: the property of a ducting material to resist tearing forces.
Tensile strength: a measurement of a material's ability to resist tearing
Thermoplastic: A polymer that softens and becomes a liquid at elevated temperatures.
Thermoplastic polyurethane (TPU): Polyurethanes that are formulated to be processed via melt extrusion for profile extrusions and injection molding; typically considered highly abrasive resistant and flexible for ducting; can refer to both polyether based or polyester based material.
Thermoset: polymer that irreversibly cures at elevated temperatures (vulcanizes).
TPE: Thermoplastic elastomer, also commonly referred to a thermoplastic rubber (TPR). A class of materials that demonstrate both plastic and elastomeric properties than can be extruded and injection molded.
TPI: turns per inch of helix**;** see pitch count
TPR: Thermoplastic rubber
TPU: Thermoplastic polyurethane
TPV: Thermoplastic vulcanizate, a compound where a rubber component vulcanizes during the melt extrusion process, becoming partially thermoset to give rubber-like properties.
tube: the innermost continuous all-rubber or plastic element of a duct. See liner

UL: Underwriters Laboratories
UL181: Specifies requirements that apply to materials for the fabrication of air duct and air connector systems for use in accordance with the Standards of the National Fire Protection Association for the Installation of Air-Conditioning and Ventilating Systems, NFPA No. 90A, and the Installation of Warn Air Heating and Air-Conditioning Systems, NFPA No 90B. The 181 Standard for Factory-Made Air Ducts and Air Connector,

defines two categories of flexible “ducts”. The UL listed Air Duct must pass all of the tests in the UL 181 Standard. Air Ducts are labeled with a square or rectangular shaped label showing their respective listing. There is no limitation on the length of runs when using **UL Listed Air Ducts**. (Class 1 Air Ducts). The **UL Listed Air Connector** must pass only a limited number of the UL 181 tests, and is labeled with a round shaped label which states “for installation in lengths not over 14 feet”. Class 0 air ducts and air connectors have surface burning characteristics of zero. Class 1 air ducts have a flame spread index of not over 25 without evidence of continued progressive combustion and a smoke-developed index of not over 50.

UL94: The UL94 standard is a test specification for evaluating flammability of plastic materials used in devices and appliances All tests are performed on a uniform test specimen of the component material(s) of a specified thickness (usually 3.0mm when rated by the raw materials manufacturer). Application of these standards at the product level must consider application, wall thickness and component materials to determine acceptability at the finished product level. Note: contact your UL representative for further clarification.

UL94HB:HORIZONTAL BURN: Horizontal flammability (UL94 HB) – The material (or product) under test positioned in a horizontal orientation has a burning rate of:

- <75mm per minute for thicknesses less than 3.0mm or <40mm per minute for thicknesses between 3.0mm and 13mm
- Or it ceases to burn in less than 100mm regardless of wall thickness and burn rate

UL94V: Vertical flammability (UL94 V and VTM) – The material (or product) under test positioned in a vertical orientation must self-extinguish as follows:

- V-0 and VTM-0 – Must self-extinguish within 10 seconds after flame is removed with no flaming particles or smoldering drips
- V-1 and VTM-1 – Must self-extinguish within 30 seconds after flame is removed with no flaming particles or smoldering drips
- V-2 and VTM-2 – Must self-extinguish within 30 seconds after flame is removed; flaming particles and smoldering drips are acceptable; V and VTM (Very Thin Material) test procedures are similar except for the test sample preparation

UV: ultraviolet (most damaging component of solar radiation.) UV stabilizers are commercially available.

vacuum formed corrugated: process of making corrugated duct using die blocks, positive pressure and vacuum in a continuous fashion

vacuum resistance: the measure of a duct’s ability to resist negative pressure.

volume change: see swelling

volume swell: see swelling.

vulcanization: a process during which a rubber compound, through a change in its chemical structure, improves or extends elastic properties over a greater range of temperature.

Wear strip: added external material designed to increase the external resistance to abrasion

weathering: the surface deterioration of a duct during outdoor exposure, as shown by checking, cracking, crazing and chalking.
Web: unreinforced section of the duct between the helix (wall) typically found in plastic ducts.
WEEE: Waste Electrical and Electronic Equipment Directive (WEEE) 2002/96/EC is often used in conjunction with RoHS. It sets collection, recycling and recovery targets for electrical goods.
WG: water gauge, or inches of water measurement
Wire gauge: diameter of the helical wire
wire reinforced: a duct containing helical wires to give added strength, increased dimensional stability; crush resistance. See reinforcement.
working temperature: the temperature range of the application, may include the temperature of the media conveyed or the environmental conditions the assembly is exposed to in use; reflects maximum temperature.
WP: the abbreviation for working pressure.
wrapped cure: a vulcanizing process using a tensioned wrapper (usually of fabric) to apply external pressure.

The preceding Glossary of Terms, as utilized in the hose industry, includes some definitions from The Hose Handbook, published by the Rubber Manufacturers Association.

Section 3 – Application Requirements – STAMPED

3.1 Purpose

The purpose of this section is to provide a simple to use guide to assist in determining the correct hose, coupling and attachment method that will satisfy the customer's needs.

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., O.D. and length

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

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

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

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

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

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

3.3 Directions

Using the form:

1. Inform the customer you will be using an application format called STAMPED.
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. Provide the completed format to your assembly area or order entry as required.

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

1. Abrasion
2. Electrical conductivity
3. Environment
4. Flammability
5. Flow rate
6. Fluid velocity
7. Movement (type, distance, frequency)
8. Ozone
9. Permeation (vapor conveying hose)
10. Routing
11. Salt water
12. Static electricity
13. Ultraviolet light
14. Vibration (frequency rate – Hz, amplitude – "G" load)

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

Customer Information:

Company: _____ Fax: _____
Contact: _____ E-mail:_____
Address: _____ P.O.#:_____
Phone: _____ Terms: _____

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

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	Type:

Material/ **M**edia	Material Conveyed			
	Internal Media		External Environment	

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

Ends	End	Style/ Material	Size	Threads/Bolts Hole Alignment	Orientation	Attachment Methods	Capped
	1						Y N
	2						Y N

Delivery	Quantity Required:		Date Required:
	Package Type:		
	Pick Up Date:		Ship Via:
	Testing Required:	Y N	Type:
	Certification Required:	Y N	Type:

Special Requirements

Section 4 – Ducting Assemblies

4.0 Scope

The section pertaining to ducting assemblies has been compiled to provide authoritative information on ducting assemblies by applications: air, fume, dust and material handling.

This information is intended to help those that are responsible for selecting the relevant components.

The user of this document is cautioned that the information contained herein is for general guidance only. The document reflects the most commonly used equipment and procedures to make assemblies. It does not reflect new developments. The user is encouraged to contact a NAHAD Listed Distributor or Manufacturer in order to obtain the latest information.

Note:

Because there are many combinations of duct, coupling and attachment methods, the user should not assume that all combinations listed in the guide have been tested for acceptability. The reader is cautioned to contact the appropriate NAHAD Listed manufacturer when dealing with application extremes. Please see the disclaimer at the beginning of this document for additional information.

4.1 Duct Data Sheets

All types of ducts are classified into two general groups by Positive or Negative Pressure. Positive Air Ducts tend to have wider pitch while Negative pressure Air Ducts typically need a narrow pitch to handle vacuum.

General warning: these are general guidelines; please consult Section 3 (STAMPED) for more specific guidance. For application-specific uses, please check with the manufacturer.

4.1.1 Air Ducting

General Uses:

Air ducts tend to be lighter in weight as they are designed to transport air. Their pitch will be determined by either a negative or positive air application. The products tend to have lighter weight fabric and helix. Lay flat duct is also used for positive pressure air handling. Some typical applications are:
Heating and Cooling
Drying
Dehumidifiying
Cleaning
Dust Covers
Supply
Connectors
Air Filter Intake
General purpose

Limitations:

Not recommended for heavy particulate media.

4.1.2 Fume Ducting

General Uses:

Fume ducts are designed to carry gaseous or other types of non-particulate media so they tend to be lighter in weight. Material selection for fume ducts is important because chemical resistance of the media needs to be taken into consideration. Chemical resistant materials such as TPV, TPR, EPDM, Hypalon, Polyethylene, Polypropylene or Teflon are some typical material types. Some typical applications are:

Laboratory
Industrial
Automotive
Painting
Welding
Soldering
Plating

4.1.3 Dust Ducting

General Uses:

Dust ducts are generally medium weight as they are designed for light particulate media. Material selection for dust ducts is important so that abrasion resistant materials are used. Abrasion resistant materials such as Neoprene Coated Polyester, Neoprene Coated Nylon, TPU, TPV, EPDM, Polyethylene or Polypropylene are some typical material types. Dust ducts, as a negative air application, generally require a narrower pitch. Some typical applications are:
Filtering
Movement
Exhaust
Duct Cleaning
Textile Fiber Collection
Vacuum Cleaning
Lint collection
Loading (containment)
Cutting
Grinding

4.1.4 Material Handling Ducting

General Uses:

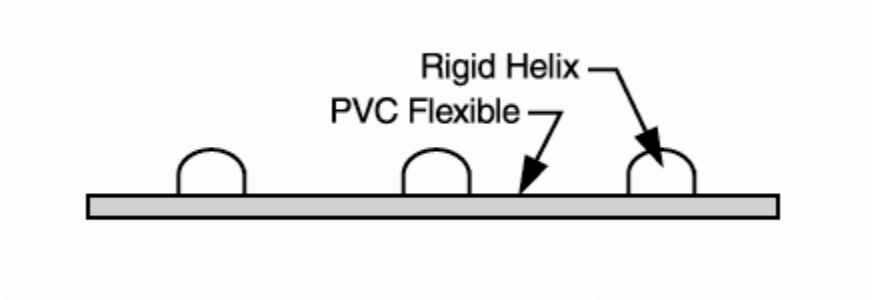
Material handling ducts are generally heavier in weight with thicker wall sections because they are designed to handle heavier particulate media. Material selection, wall thickness, pitch and wire gauge are critical components for the duct design. Abrasion resistant materials such as Neoprene Coated Polyester, Neoprene Coated Nylon, TPU, TPV, EPDM, Polyethylene or Polypropylene are some typical material types. Some typical applications are:
Shavings
Chips
Powders

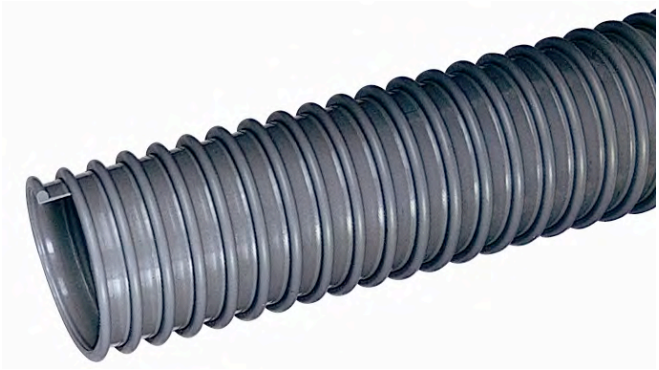
Debris
Leaf Collection
Street Sweeping
Lawn Vacuum
Slurries
Sawdust Collection
Drains
Packing Popcorn

4.1.5 Types of Duct Construction

4.1.5.1 Flexible PVC with Helix

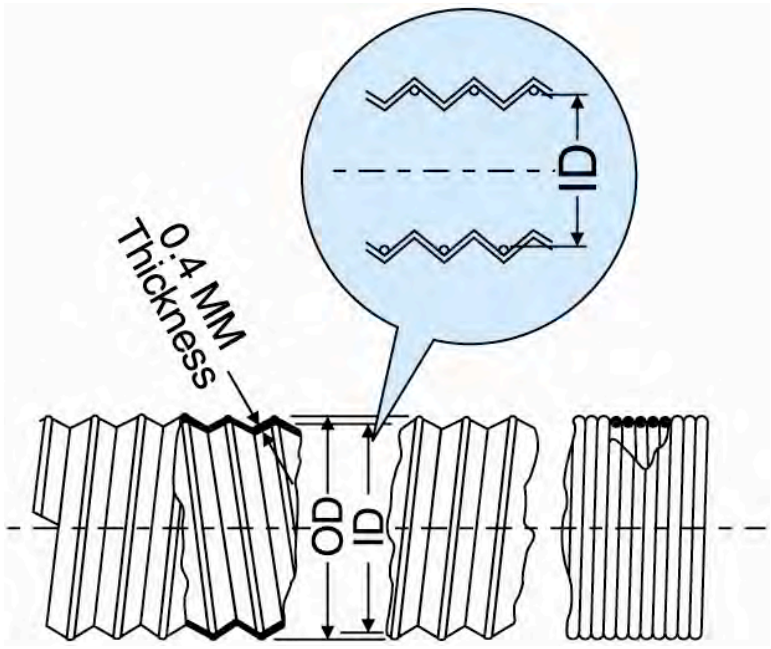
4.1.5.1.1 Flexible PVC with rigid PVC helix - for use in dust and fume ducting applications up to 150° F”





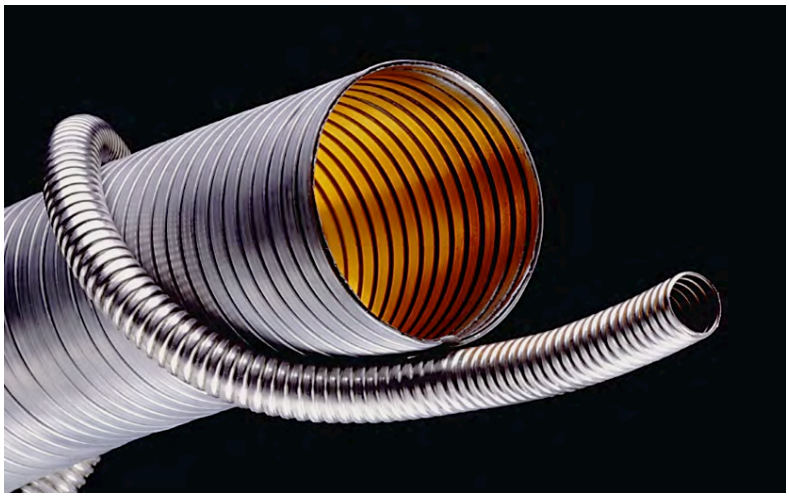
4.1.5.1.2 – Flexible PVC ducting with wire helix.

4.1.5.2 Unique wire reinforced/polypropylene construction; allows full contractibility with extendibility; for use in air, dust and fume ducting applications up to 175° F”



4.1.5.3 Metal Ducting

4.1.5.3.1 Metal Ducting: flexible interlocked metal duct A single metal strip is formed to create a duct that can be used for dust, fume and hot air ducting applications up to 750° F for Galvanized material and 1500° F for Stainless Steel.



This type of ducting can be used in packed or unpacked configurations.

4.1.5.3.2 Metal Ducting: flexible gas-tight metal duct A single metal strip is corrugated and helically-wound to form a duct that can be used for air supply and fume exhaust ducting applications up to 600° F for Aluminum material and 1500° F for Stainless Steel.

4.1.5.4 Crushproof type ducting

Crushproof-type ducting hoses are custom designed to handle vacuum, air intake and industrial bellows applications. They are made to accommodate applications requiring flexibility or stretching using Butyl, EPDM, Nitrile and Neoprene rubber materials.

4.1.5.5 - Wire Reinforced Neoprene Ducting

Neoprene wire reinforced ducting hoses offer flexibility combined with excellent crush resistance and tensile strength. Can be used for all air handling applications, dust and fume control and light material handling.

4.1.5.6 - Wire Reinforced Thermoplastic Rubber Ducting

Thermoplastic rubber wire reinforced ducting hoses provide flexibility with compressibility for demanding and difficult applications. They can be used for air transfer, venting systems, fume control, exhaust gases, dust collection and light abrasion transfer.

4.1.6 Custom Ducting

Certain applications may require ducting manufactured to custom specifications. Custom ducting may involve special shapes, raw materials, special sizes and configurations. Custom ducting can be used in all four application areas listed above. Contact manufacturers with specific requirements.

Below are examples of custom ducting.

4.2 End Fittings and Finishings Data Sheets

When working with duct assemblies, there are a number of end finishes that can be considered. Based on the application or use, the customer will determine what type of end finish is required. The following are a sampling of a variety of end finishings that are available and typically used. Typical end finishes are usually provided by the manufacturer; specialty end finishes can be provided by either the manufacturer or the distributor.

In general, the larger the duct size, the fewer end finish options available. Sewn or fabric type cuffs are typically used on larger diameter ducts. Molded cuffs would typically be used for smaller diameter vacuum hoses below six inches in diameter. See section 4.2.2 for specialty or custom end finishes. Consult the manufacturer for specific requirements.

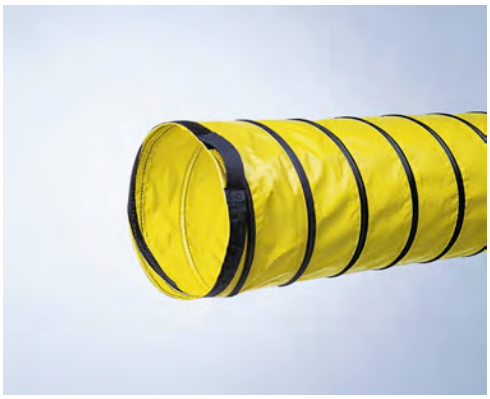
4.2.1. Standard end fittings and finishings:

4.2.1.1 Sewn Cuff – provides a smooth surface that can be used with banded clamps. If the customer needs to fit the cuff over piping or a round port and secure clamps this end configuration offers a soft cuff which can easily be clamped over. It is also known as a factory made “soft cuff.”

4.2.1.2 Standard/Enclosed Belted Cuff – creates an easy attachment method or quick connection capability. It includes a belt with a spring clamp that can be cinched around the connection.

4.2.1.3 Pull Tabs – Used to pull the duct onto the connector, or to pull through enclosed areas; good for applications where the ducting must be pulled through a man-hole (utility applications) these belt loops and pull tabs allow easy routing through a man-hole.

4.2.1.4 Flat Band/Nylon or Steel Ring/Wire Rope – Keeps the end open for easy air flow; also used for interlocked duct connections; gives the end of the hose form so it won't collapse and makes it easier to fit over pipe or ports.



4.2.1.5 Funnel Cuff (reducer) – Sewn transition piece to adapt to larger or smaller connection points; allows for a soft cuff that can slip easily over a pipe to transition from one ID up to a larger pipe OD.

4.2.1.6 Enlarged Cuff (belled end) – transition piece used when cuff ID is larger than hose or duct ID

4.2.1.7 Fabric Cuff - provides an integral smooth surface that can be used for use with banded clamps

4.2.1.8 Reduced Cuff – transition piece used when cuff ID is smaller than duct ID

4.2.1.9 Flange – can be made from steel, aluminum, or felt; also can have hole patterns drilled for custom connection purposes.

4.2.1.10 Screw on Cuff - Screw on cuffs are produced from a multitude of materials such as PVC, Urethane, Polypro or Polyeth and simply provide a means to plug into or slip or fittings in existing vacuum system or create a finished end for vacuum applications. These cuffs can also be sealed on to provide air tight/water tight seal with the appropriate adhesive or sealer.

4.2.2 Specialty End Finishings

At times, OEM customers will request custom made cuffs, made to print for their application. Custom made cuffs can be injection molded, or over molded from a variety of materials including TPE, PVC, and EVA. In this instance, careful consideration must be given to the pitch and diameter of the wire helix and the design of the particular duct cuff. Consult the manufacturer with specific application requirements.

Below is a duct with a custom specialty end: cuff is overmolded onto a custom hose; below that is another custom specialty end: Santoprene molded 90 degree elbow in a screw on cuff

4.3 Accessories Data Sheets

4.3.1 Screw Clamps – also called worm gear clamps; used to secure duct.

4.3.2 Bridge Clamps – typically used in applications without a cuff; used to secure duct and bridge the wire; available in both clockwise or counter clockwise configurations.

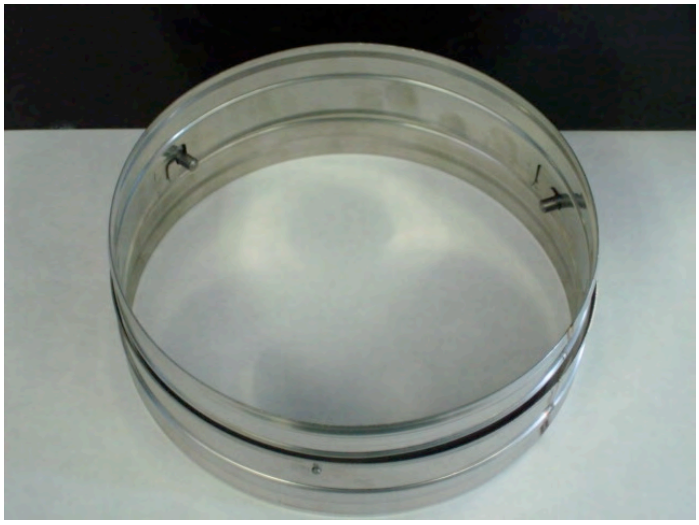
4.3.3 Spiral double bolt clamp - These clamps provide a means to secure heavy or light wall ducting with the wire on the clamp located on both sides of the duct outer helix; available in both clockwise and counter clockwise helix configurations.

4.3.4 Clamp, Preformed - To permanently secure ducting to barbed or beaded connectors

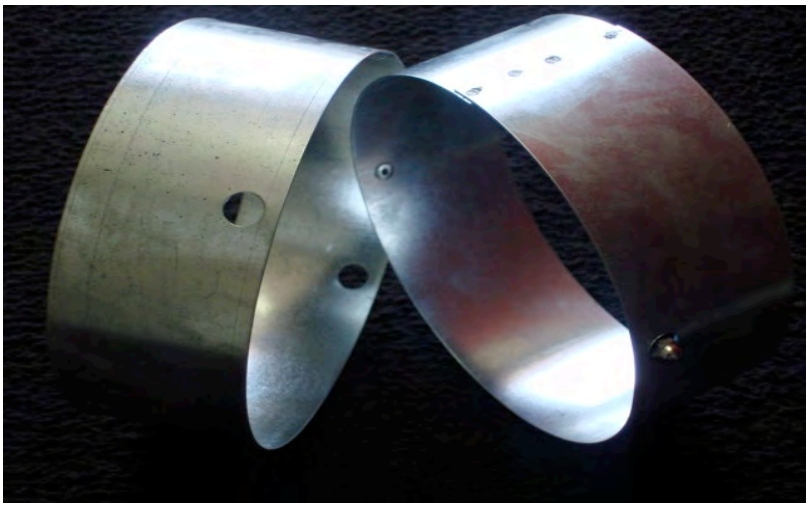
4.3.5 Aluminum or stainless steel sleeves Used to connect two ducts with band clamps; used to extend the length of the overall duct, or to repair existing duct.

Duct Coupler: Standard duct coupler to minimum on 24 gauge sheet metal construction with rolled containment bead in middle of coupling or on ends of coupling. The coupler slips into the ID of two duct lengths and are simply attached with worm drive clamps to create extended lengths.

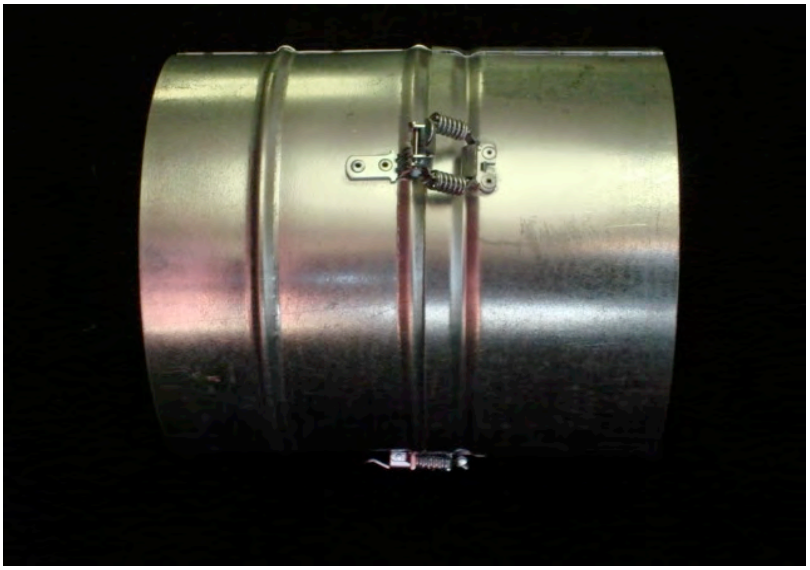
4.3.6 J Lock connector – used for quick connection of two ducts, or connecting a duct to equipment.



4.3.7 Pin lock connector - used for quick connection of two ducts, or connecting a duct to equipment.



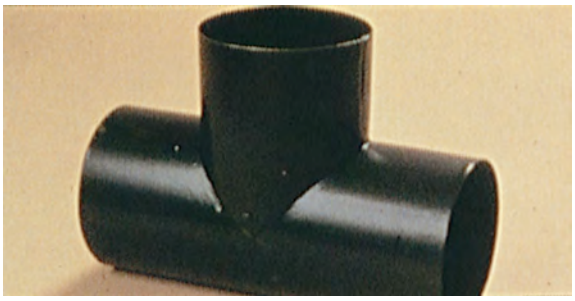
4.3.8 Latch lock connector - used for quick connection of two ducts, or connecting a duct to equipment.



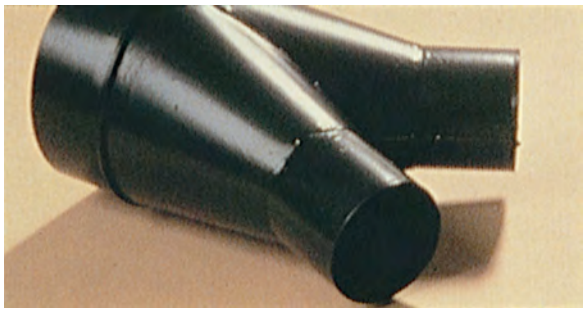
4.3.9 Reducer – molded or metal alternative to the sewn reducer; used to adapt to larger or smaller connection points.

4.3.10 Transition – used to adapt duct to square shaped connectors; molded or metal.

4.3.11 T – used to connect multiple ducts



4.3.12 Y – used to connect multiple ducts.



4.3.14 Sto-sack: A handy sewn on loop makes transporting the hose from location to location easy for the operator.

Section 5 Fabrication considerations

5.0 General Description

Ducting consists of two types: helically supported or lay flat. Both can be fabricated by a variety of different processes.

Helically supported ducting:

For helically supported ducting, the helix can come in the form of wire or rigid plastic, or can be integral into the construction. The web can be made from thermoplastic resins, various types of rubber, metals, or coated fabrics. The wire and web can be bonded thermally, with a solvent based adhesive system, or sewn. Optional wear strips over the helix are available from the manufacturer to protect the duct from external abrasion, and extend the life of the duct.

- All plastic profile ducting – single or multiple profile helically wound to form a flexible duct with a rigid support.
- Crimped - fabric strip which is crimped with metal in a continuous fashion creating an external helix.
- Mechanically interlocked – rigid plastic or metal duct which is interlocked in a continuous fashion creating a flexible duct.
- Thermally cured – materials in a semi cured state are wrapped into hose form with wire or plastic helix and then cured by a heat process.

Lay flat duct – is for positive pressure applications only, and is unsupported duct for air movement that is foldable for easy storage.

Note: It is important to work with the manufacturer to define which type manufacturing process or duct may be needed for a particular application given issues defined in the STAMPED process.

5.1 Cutting ducting to length

Ducting should be measured by stretched or extended length, rather than by relaxed length – check with manufacturer to determine which style is used. Note: when cutting, care should be taken to fully extend the duct to prevent shortages. Cut the duct WHILE EXTENDED. To cut, use sharp knife blades to cut the material; bolt cutters, or wire cutters should be used to cut the helix, depending on diameter of helix. Sharp edges or burrs can be created by the wire cutting process, so care should be taken to render the wire end safe after cutting by capping, grinding the wire back, bending the wire back, or cutting the wire shorter than the web.

Overall length may be affected by time in storage. Consult the manufacturer for length tolerances.

Note: the duct ID may change when the duct moves from an extended or lax state.

5.2 Attachment processes, clamping recommendations

Care in selection of attachment methods should be taken, based on requirements of the application. (See STAMPED.) Check the accessories section of this guide for common attachment options. For specific questions, call the manufacturer.

5.3 Grounding

Static electricity buildup can result in unsafe conditions, and lead to serious injury or death. If the application requires grounding, the duct assembly needs to be properly grounded by attaching the helix to a ground wire. The helix can be crimped to a ground wire, or can be attached to a steel fitting or ferrule. Check with an electrical continuity test using an ohmmeter. Consult the manufacturer and/or an electrical engineer for any special requirements.

If cutting the duct, the grounding wire needs to be reattached after cutting.

Section 6 – Testing Procedures

6.1 Purpose

The following testing methods may or may not be required. Refer to the customer requirements.

6.2 Leakage Tests

Customers may require specialized tests. When leak rates are critical, consult the manufacturer for recommendations. Tests may include but are not limited to the following: frictional loss, Pressure Decay, Vacuum Decay, air under water, etc.

6.3 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.

6.4 Tensile or Pull-off Test

Hang the assembly and attach a specified weight for a specific amount of time to determine assembly integrity, as determined by the customer. Other tests may be required by the customer.

6.5 Visual Inspection

All sample assemblies should be visually inspected for substandard quality conditions in the duct or couplings. Each assembly should be visually inspected for kinks, loose covers, bulges or ballooning, soft spots, cuts, broken wires, blooming, or any obvious defect in the duct. 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. Duct 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 -

- Exposed reinforcement. .
- General appearance of the assembly.
- Internal contaminants. .
- Restrictions in the tube.

6.6 Calibrations

Inspection and testing equipment used in the production or testing of assemblies should be calibrated at prescribed intervals according to written procedures. All gauging equipment shall be calibrated regularly by means traceable to NIST (National Institute of Standards and Technology). The tag giving date of last calibration, next calibration due date and signature of the inspector shall be attached to the gauge and a record filed for future reference.

6.7 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.

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. Duct Lot Number(s)
E. Duct details including length, type of duct and diameter
F. End fitting details
G. Test Date
H. Test Pressure
I. Electrical Continuity Conformance
J. Suppliers Authorization Signature

6.9 Other Documentation

Other types of documentation may be requested by the customer. All certificates and reports required should accompany the shipment, unless otherwise specified.

6.9.1 Certificate of Conformance

When required by the customer, a Certificate of Conformance (C of C) shall be supplied with the order, confirming in the form of a text, and without expressed mention of the test results, that the product being supplied meets the requirements of the customers purchase order, as agreed upon order acceptance. The C of C should have the following information, if applicable:

a.	Customer’s Name
b.	Customer’s Address
c.	Customer’s Purchase Order
d.	Customer’s Contract Number
e.	Customer’s Specification Number
f.	Customer’s Drawing Number
g.	Supplier’s Name
h.	Supplier’s Address
i.	Supplier’s Order Number
j.	Supplier’s Drawing Number
k.	Quantity
l.	Description
m.	Additional Information
n.	Supplier’s Authorized Signature
o.	Date

6.9.2 Test Report

A request for a C of C may require that actual test results be included.

6.9.3 Certified Material Test Reports

When required, a Certified Material Test Report (CMTR) shall be supplied showing the materials meet the requirements of the customer's purchase order. These may be supplied as copies of the raw material CMTR's provided by the materials supplier or on the manufacturer's form providing certified test results.

6.9.4 Third Party Certification

When required by the customer, an authorized inspection party shall inspect and certify that the product being supplied meets the requirements of the customer's purchase order as agreed upon order acceptance. Upon request, copies of these certifications shall be supplied.

Section 7 – Quality Plan

7.1 Purpose

The purpose of this section is to outline a quality plan for fabricating duct assemblies. The assurance of an acceptable duct assembly reaching the customer depends upon the quality of the components and the workmanship of the fabricator.

An effective quality control plan is based on statistical sampling principles. Responsibility for supervising the quality plan must be designated. Corrective action procedures must be formalized to deal with nonconformance.

7.2 Sampling Plan

An effective sampling plan is based on the statistical history of a design that demonstrates quality performance and sets confidence levels.

Sampling is performed in an effort to statistically evaluate a product or process against tolerances that are considered acceptable as determined by national standards, customer requirements, etc. This monitoring of product or process with an adequate sampling plan is done in an effort to provide 100% acceptable product to the customer. In an ideal world, if inspection capability is 100% effective, then the only way to assure 100% acceptable product is to inspect everything 100%. Due to practical considerations of time and resources (both manpower and financial), 100% inspection will probably not occur as a standard method of operation.

There are many areas or processes that may be sampled. These may vary from operation to operation, but there are some constants that should probably apply no matter what the operation.

A. Inspection of incoming material – You cannot guarantee the quality of the outgoing product, if the quality of incoming materials has not been verified.

B. In process inspection – This may be as simple as inspection of the first assembly produced. Or it may be quite complicated, such as doing a complete dimensional audit on so many pieces per production run and plotting these results on Statistical Process Control (SPC) charts in order to track trends and potential problems.

C. Final Inspection – This may be relatively simple, such as verifying piece counts before shipping to the customer, or as complicated as checking specific criteria to ensure compliance with the customer’s requirements. Regardless of what is being sampled, inspection characteristics, the corresponding documentation and the personnel responsible for carrying for inspecting these characteristics, must be defined.

D. When establishing the frequency of sampling, there are many factors that need to be considered. These include but are not limited to:

1. Cost
2. Complexity of process
3. Application
4. Liability
5. Stability of procedure

If a process is very stable as indicated by past performance, the frequency of sampling can be decreased or eliminated through historic receipt. There is no specific sampling plan that can be considered best suited to all applications.

7.3 Material Receiving Inspection

7.3.1 Cuffs and end configurations

1. Upon receipt of a shipment of cuffs, the assembly fabricator should perform, at minimum, the following inspection steps:

2. Compare the cuffs received with the purchase order by making sure part numbers agree between order and packing slip.

3. Check the count between packing slip and actual quantity received.

4. Check the product in the package to make sure it agrees with the part number on the package. Supplier catalogs are a good reference.

5. When possible, leave the cuffs in the original container with the original date code. If a coupling problem arises later, all the cuffs of that size and date code can be separated out for 100% inspection purposes.

6. At least one cuff from every box should be inspected for dimensions, defective plating, concentricity, knit lines, short shots, and any damage from shipping.

7.3.2 Ducting

Upon the receipt of a shipment of ducting, the assembly fabricator should perform, at a minimum, the following inspection steps:

1. Check product numbers on the packing list with numbers on the packages of the actual merchandise.

2. Check total footage against the packing slip, making sure they agree.

3. Check the product, making sure it agrees with the label on the packaging.

4. Check the ducting inside diameter, outside diameter and reinforcement, and verify against the manufacturer's product information.

5. All ducting should be visibly inspected for damage due to shipping, kinks, loose covers, bulges, ballooning, cuts, crush, and tears. A certificate of conformance may be requested with the ducting, cuffs, and attachments.

7.4 Storage (Labeling, Environment, Time)

Proper storage will maximize duct shelf life. All ducting 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 duct, as too much weight can crush duct at the bottom of the stack. The stack could also become unstable, creating a safety hazard.

Note:

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

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 8 – Assembly Identification, Packaging and Shipping

8.1 Purpose

This section is intended to establish methods and content of applying duct assembly identification markings and identify minimum packaging requirements.

8.2 Duct Assembly Markings

8.2.1 Method of Marking

The marking of duct assemblies may be achieved in two ways:

1. Information pre-stamped in legible characters on metal tag or band affixed to the assembly by approved durable method.
2. Information in legible characters stamped directly onto the cuff
3. Information included on a tag that is affixed to the assembly.

8.3 Packaging and Shipping

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

Ducts 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. If compressed to minimize shipping costs, care must be taken to protect the ends and/or prevent the end treatments from damaging the duct. Ducting may become compressed during shipping which can lead to shortening of the overall length.

Special consideration should be given to shipping costs when estimating ducting products. Due to ducting's inherent lighter weight and generally larger ID's; it tends to be more costly to ship than industrial or hydraulic hoses (heavier but more compact in construction.) When estimating ducting for quotation it is recommended to investigate packaging, box sizes and transportation to determine the most economical freight costs.

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

Section 9 – Installation and Handling

9.0 Purpose

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

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

9.1 Crush Proof / Crush Resistant

Adhere to manufacturer recommendations on handling of crush proof and crush resistant duct. Refer to glossary for specific definitions and constraints. Please note that these ducts are NOT indestructible.

9.2 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.

9.2.1 Media Permeation and Gaseous Applications

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

Chemical vapors and fine particulates should be checked with the manufacturer to determine suitability of duct selection.

9.2.2 Fire and Explosions

Media passing through ducting can generate static electricity, resulting in static-electric discharge. This may create sparks that can ignite gases in the surrounding atmosphere. Use ducting rated for static conductivity and/or a proper grounding device. Consult manufacturer and/or electrical engineer for proper ducting and end configuration selection.

Care should also be taken when considering sparks generated from welding or other environmental sources. These can cause catastrophic fires by igniting media, other gases, or sometimes the duct itself. Flame resistant duct, or duct made with UL rated material should be considered. If a UL or other regulation rating is required, contact the manufacturer. Note: UL rating for duct material does NOT equate to a UL rating for the duct itself.

9.2.3 Toxic Smoke Generation

Specific industry requirements may exist regulating the amount and type of smoke that can be generated by burning product. Work with the manufacturer to determine appropriate product for given applications and customer requirements.

9.3 Duct Installation

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

9.3.1 Pre-Installation Inspection

Before installing duct assemblies, the following shall be examined:

A. Duct length and routing for compliance with original design.
B. Correct style, size, length, and visible non-conformity of assembly.
C. Cuffs and/or end finishes for burrs or damage.
D. Kinked, crushed, flattened, or twisted duct.

9.3.2 Handling During Installation

Handle duct with care during installation; bending beyond the minimum bend radius will reduce duct life. Sharp bends at the duct to end fitting juncture should be avoided. Avoid bending the duct to the point of ovalization or kinking. Over-stretching the duct can result in tears or weak spots. Consult manufacturer if no minimum bend radius has been specified.

9.3.3 Torque

Duct assemblies shall not be installed or operated in a twisted or torqued condition. Swivel cuffs may be used to aid in torque-free installation; operators should take care not to twist the duct during installation.

9.3.4 Duct Routing

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

Routing at less than minimum bend radius, will reduce the service life of the duct. Sharp bends in the duct should be avoided. Weight per foot and any end finish weight should be considered for all suspended installations. Appropriate supports or elbow fittings should be included to ensure intended performance and increase duct life.

Care should be taken to minimize the movement of a duct where possible. Dynamic applications should be discussed with the manufacturer.

Avoid routing duct where extreme temperatures, sharp edges, UV light sources, and moisture (mold and mildew) can impact duct performance or life.

9.3.5 Securement and Protection

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

9.3.6 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)

Section 10 Inspection

10.1 Maintenance Inspection

A duct and assembly maintenance program can reduce equipment down time and maintain peak operating performance.

10.1.1 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 be conducted periodically. Frequency should be dependent on the application and circumstances.

10.1.2 Visual Inspections

The duct and assemblies shall be visually inspected for:

A. Leaks at the connections or holes/cuts in the duct.
B. Damaged helix.
C. Cracked, damaged, or badly corroded cuffs and end configurations.
D. Security of clamps or bands
E. Other signs of significant deterioration.
F. Level, type, contamination, condition, and air entrapment or blockage. If any of these conditions are found, appropriate action shall be taken.
G. Excessive dirt and debris (may indicate hole in duct)

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

Appendix A – Pressure Conversion Chart

psi	Atms	inches H_2O	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 – References

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: 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: 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: 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: www.astm.org

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

Government Printing Office
732 North Capitol St. NW
Washington, DC 20401
Phone: (202) 512-0000
Email: webteam@gpo.gov
Internet: 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: 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: 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: www.sae.org