TECHNICAL REPORT

ISO/TR 17165-2

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2006-09-15

Hydraulic fluid power — Hose assemblies —

Part 2: Recommended practices for hydraulic hose assemblies

Transmissions hydrauliques — Flexibles de raccordement —

Partie 2: Pratiques recommandées pour les flexibles de raccordement hydrauliques

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 17165-2 was prepared by Technical Committee ISO/TC 131, *Fluid power systems*, Subcommittee SC 4, *Connectors and similar products and components*.

ISO/TR 17165 consists of the following parts, under the general title *Hydraulic fluid power — Hose assemblies*:

— *Part 1: Dimensions and requirements*

— *Part 2: Recommended practices for hydraulic hose assemblies* (Technical Report)

Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit.

To allow fluid flow between components, they are interconnected by piping, both rigid (tubes and tube connectors) and flexible (hose assemblies, which consist of hose and hose fittings).

Hydraulic fluid power — Hose assemblies —

Part 2:
Recommended practices for hydraulic hose assemblies

1 Scope

This part of ISO 17165 provides guidelines for selection, routing, fabrication, installation, replacement, maintenance and storage of hose and hose assemblies for hydraulic fluid power systems, which are manufactured from hoses conforming to ISO 1436-1, ISO 1436-2, ISO 3862-1, ISO 3862-2, ISO 3949, ISO 4079-1, ISO 4079-2, ISO 11237-1 and ISO 11237–2, and hose connectors conforming to ISO 12151-1 through ISO 12151-6.

NOTE 1 Many of these recommended practices can also be suitable for use with other types of hoses and systems.

NOTE 2 Annex A (informative) lists examples of actual failure resulting from improper use of hydraulic hose and hose assemblies.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1436-1, *Rubber hoses and hose assemblies — Wire-braid-reinforced hydraulic types — Specification — Part 1: Oil-based fluid applications*

ISO 1436-2, *Rubber hoses and hose assemblies — Wire-braid-reinforced hydraulic types — Specification — Part 2: Water-based fluid applications*

ISO 2230, *Rubber products — Guidelines for storage*

ISO 3457, *Earth-moving machinery — Guards — Definitions and requirements*

ISO 3862-1, *Rubber hoses and hose assemblies — Rubber-covered spiral-wire-reinforced hydraulic types — Specification — Part 1: Oil-based fluid applications*

ISO 3862-2, *Rubber hoses and hose assemblies — Rubber-covered spiral-wire-reinforced hydraulic types — Specification — Part 2: Water-based fluid applications*

ISO 3949, *Plastics hoses and hose assemblies — Textile-reinforced types for hydraulic applications — Specification*

ISO 4079-1, *Rubber hoses and hose assemblies — Textile-reinforced hydraulic types — Specification — Part 1: Oil-based fluid applications*

ISO 4079-2, *Rubber hoses and hose assemblies — Textile-reinforced hydraulic types — Specification — Part 2: Water-based fluid applications*

ISO 5598, *Fluid power systems and components — Vocabulary*

ISO 8330, *Rubber and plastics hoses and hose assemblies — Vocabulary*

ISO 8331[1)], *Rubber and plastics hoses and hose assemblies — Guidelines for selection, storage, use and maintenance*

ISO 11237-1, *Rubber hoses and hose assemblies — Wire-braid-reinforced compact types for hydraulic applications — Specification — Part 1: Oil-based fluid applications*

ISO 11237-2 *Rubber hoses and hose assemblies — Wire-braid-reinforced compact types for hydraulic applications — Specification — Part 2: Water-based fluid applications*

ISO 12151-1, *Connections for hydraulic fluid power and general use — Hose fittings — Part 1: Hose fittings with ISO 8434-3 O-ring face seal ends*

ISO 12151-2, *Connections for hydraulic fluid power and general use — Hose fittings — Part 2: Hose fittings with ISO 8434-1 and ISO 8434-4 24 cone connector ends with O-rings*

ISO 12151-3, *Connections for hydraulic fluid power and general use — Hose fittings — Part 3: Hose fittings with ISO 6162 flange ends*

ISO 12151-4[2)], *Connections for hydraulic fluid power and general use — Hose fittings — Part 4: Hose fittings with ISO 6149 metric stud ends*

ISO 12151-5[2)], *Connections for hydraulic fluid power and general use — Hose fittings — Part 5: Hose fittings with ISO 8434-2 37° flared ends*

ISO 12151-6[2)], *Connections for hydraulic fluid power and general use — Hose fittings — Part 6: Hose fittings with ISO 8434-6 60° cone ends*

ISO 17165-1[2)], *Hydraulic fluid power — Hose assemblies — Part 1: Dimensions and requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 5598 and ISO 8330 and the following apply.

3.1
manufacturing date of the hose assembly
date when the hose and connectors were assembled into a hose assembly

4 Safety considerations

4.1 General

The list of potential conditions and situations that can lead to personal injury and/or property damage described in 4.2 through 4.8 is not necessarily all-inclusive. Reasonable and feasible means, including those described in this clause, shall be taken into consideration, to reduce the risk of injuries and/or property damage. Training, including the information in this document, for operators, maintenance personnel, and other individuals working with hose assemblies under pressure is encouraged.

1) To be published. (Revision of ISO 8331:1991)

2) To be published.

4.2 Fluid injections

Fine streams of escaping pressurized fluid can penetrate skin and enter a human body. These fluid injections can cause severe tissue damage and loss of limb. Various means shall be taken into consideration to reduce the risk of fluid injections, particularly in areas normally occupied by operators. Such means include: careful routing of hose, adjacent components, warnings, guards, shields and training programs.

Pressure shall be relieved before disconnecting hydraulic or other lines. All connections shall be tightened before applying pressure. Contact with escaping fluids shall be avoided. All leaks shall be treated as if they were pressurized and hot enough to burn skin. No part of the human body shall be used to check a hose for leaks. If a fluid-injection accident occurs, medical treatment by a doctor shall be sought immediately.

WARNING — Fluid-injection injuries shall be treated without delay and shall not be treated as a simple cut.

Any fluid injected into the skin shall be surgically removed within a few hours, or gangrene can result. Doctors unfamiliar with this type of injury should consult a knowledgeable medical source.

4.3 Whipping hoses

If a pressurized hose assembly blows apart, the hose fittings can be thrown off at high speed, and the loose hose can flail or whip with great force. This is particularly true in systems that use compressible fluids. When this risk exists, consider guards and restraints to protect against injury.

4.4 Burns from conveyed fluids

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

4.5 Fire and explosions from conveyed fluids

Most fluid-power media (hydraulic fluid), including fire-resistant hydraulic fluids, burn under certain conditions. Fluids that escape from pressurized systems can form a mist or fine spray that can flash or explode upon contact with an ignition source. Consider selecting, guarding and routing hose to minimize the risk of combustion (see Clause 5 and ISO 3457).

4.6 Fire and explosions from static-electric discharge

Fluid passing through hose can generate static electricity, resulting in static-electric discharge. This can create sparks that can ignite fluids in the systems or gases in the surrounding atmosphere. When this potential exists, hose specifically designed to carry the static-electric charge to ground shall be selected.

4.7 Electrical shock

Electrocution can occur if hose conducts electricity through a person. Most hoses are conductive. Many contain metal or have metal hose fittings attached. Even nonconductive hoses can be conduits for electricity if they carry conductive fluids. This shall be kept in mind when routing or using hose near electrical sources. When this cannot be avoided, appropriate hose shall be selected and nonconductive hoses should be considered. Hoses that comply with ISO 3949 with orange covers marked “Nonconductive” are available for applications requiring nonconductive hose.

4.8 Mechanisms controlled by fluid power

Mechanisms controlled by fluids in hoses can become hazardous when a hose fails. For example, when a hose bursts, objects supported by fluid pressure can fall, or vehicles or machines can lose their brakes or

steering. If mechanisms are controlled by fluid power, safe modes of failure that minimize risks of injury or damage shall be considered.

5 Hose selection and routing

5.1 General

A wide variety of interacting factors influence hose service life and the ability of each hydraulic fluid power system to operate satisfactorily, and the combined effects of these factors on service life are often unpredictable. Therefore, hydraulic-hose specification documents should not be construed as design standards. For applications outside the specifications in ISO 1436-1, ISO 1436-2, ISO 3862, ISO 4079, ISO 11237, ISO 3949 and ISO 12151-1 through ISO 12151-6, or other relevant design standards, performance of hose assemblies should be determined by appropriate testing. Each system shall be carefully analyzed, and then routings shall be designed and hose and related components shall be selected to meet the system performance and hose-service-life requirements and to minimize the risks of personal injury and/or property damage. The factors covered in 5.2 through 5.25 shall be considered.

5.2 System pressures

Excessive pressure can accelerate hose assembly failure. Steady-state pressures and the frequency and amplitude of pressure surges, such as pulses and spikes, shall be analyzed. These are rapid and transient rises in pressure which might not be indicated on many common pressure gauges and can be identified best on high-frequency-response electronic measuring instruments. For maximum hose service life, selection of the hose and hose fittings should be based on a system pressure, including surges, that is less than the maximum working pressures of the hose and hose fitting.

5.3 Suction

For suction applications, such as inlet flow to pumps, select hose to withstand both the negative and positive pressures the system imposes on the hose.

5.4 External pressure

In certain applications, such as in autoclaves or under water, the external environmental pressures can exceed the fluid pressure inside the hose. In these applications, consider the external pressures and, if necessary, consult the hose manufacturer.

5.5 Temperature

Temperature outside of the hose's ratings can significantly reduce hose life. Select hose so the fluid and ambient temperatures, both static and transient, fall within the hose's ratings. The effects of external heat sources should not raise the temperature of the hose above its maximum operating temperature. Select hose, heat shields, sleeving and other methods to meet these requirements and route or shield hose to avoid hose damage from external heat sources.

5.6 Permeation

Permeation, or effusion, is seepage of fluid through the hose. Certain materials in hose construction are more permeable than others. Consider the effects of permeation, especially of gaseous fluids, when selecting hose. Consult the hose and fluid manufacturers for permeability information.

5.7 Compatibility between hose materials and system fluids

Variables that can affect compatibility of system fluids with hose materials include, but are not limited to

a) chemical properties,

b) fluid pressure,

c) temperature,

d) concentration,

e) duration of exposure.

Because of permeation (see 5.6), compatibility of system fluids with the hose, tube, cover, reinforcement, and hose fittings shall be considered. Consult the fluid and hose manufacturers for compatibility information.

Rubber hoses should not be painted without consulting the hose manufacturer.

Many fluid/elastomer compatibility tables in manufacturers' catalogues show ratings based on fluids at 21 °C (i.e., room temperature). These ratings can be different at other temperatures. The notes on the compatibility tables should be read carefully and the manufacturer consulted if there is any doubt.

5.8 Environment

Environmental conditions can cause hose and fitting degradation. Conditions that shall be evaluated include, but are not limited to

a) ultraviolet light,

b) salt water,

c) air pollutants,

d) temperature,

e) ozone,

f) chemicals,

g) electricity,

h) abrasion,

i) paint.

If necessary, the hose manufacturer shall be consulted for more information about the effect of these and other environmental conditions.

5.9 Static-electric discharge

Fluid passing through hose can generate static electricity, resulting in static electric discharge. This can create sparks that can puncture hose. If this potential exists, hose with sufficient conductivity to carry the static-electric charge to ground shall be selected.

5.10 Sizing

The power transmitted by pressurized fluid varies with pressure and flow rate. Hose with adequate size to minimize pressure loss and to avoid hose damage from heat generation or excessive flow rates shall be selected. Conduct calculations or consult the hose manufacturer for sizing at relevant flow rates.

5.11 Unintended uses

Hose assemblies are designed for the internal forces of fluids conducted. Hose assemblies shall not be pulled or used for purposes that can apply external forces for which the hose or hose fittings were not designed.

5.12 Specifications and standards

When selecting hose and hose fittings for specific applications, applicable government, industry and manufacturer's specifications and standards shall be referred to.

5.13 Unusual applications

Applications that are not addressed by the manufacturer or by industry standards can require special testing before hose selection.

5.14 Hose assembly cleanliness

The cleanliness requirements of system components other than hose assemblies determine the cleanliness requirements of the application. Consult the component manufacturers' cleanliness information for all components in the system. Hose assemblies vary in cleanliness levels; therefore, specify hose assemblies with adequate cleanliness for the system.

5.15 Hose fittings

Selection of the proper hose fittings for the hose and application is essential for proper operation and safe use of hose and related assembly equipment. Hose fittings are qualified with the hose. Therefore, only hose fittings compatible with the hose for the applications shall be selected. Improper selection of hose fittings or related assembly equipment for the application can result in injury or damage from leaks or from hose assemblies blowing apart (see 4.3, 6.3, 6.4 and 6.5).

5.16 Vibration

Vibration can reduce hose service life. If required, tests shall be conducted to evaluate the effects of frequency and amplitude of system vibration on a hose assembly. Clamps or other means can be used to reduce the effects of vibration. Consider the vibration requirements when selecting hose and predicting service life.

5.17 Hose cover protection

The hose cover shall be protected from abrasion, erosion, snagging, and cutting. Special abrasion-resistant hoses and hose guards are available for additional protection. Hose shall be routed to reduce abrasion from hose rubbing other hose or objects that can abrade it.

5.18 External physical abuse

Hose shall be routed to avoid

a) tensile loads,

b) side loads,

c) flattening of the hose,

d) damage to threads,

e) kinking,

f) damage to sealing surfaces,

g) abrasion,

h) twisting.

5.19 Swivel-type hose fittings and adapters

Swivel-type hose fittings and adapters do not transfer torque to hose while they are being tightened. These types of hose fittings and adapters shall be used as needed to prevent twisting of the hose during installation.

5.20 Live swivel connectors

If two components in the system are rotating in relation to each other, live swivel connectors can be necessary. These connectors reduce the torque transmitted to the hose.

5.21 Slings and clamps

Slings and clamps shall be used to support heavy or long hose and to keep it away from moving parts. Clamps shall be used to prevent hose movement that causes abrasion. Care shall be taken to prevent the sling or clamp from abrading the hose. Overtightening of slings or clamps shall be avoided.

5.22 Minimum bend radius

The minimum bend radius (R) of a hose is defined in the relevant hose standards and hose manufacturer's product literature. Routing during assembly and use at less than minimum bend radius can reduce hose life. Sharp bending at the juncture between the hose and hose fitting can result in leakage, hose rupture or the hose assembly blowing apart (see 4.3 and Figure 1). A minimum straight length of 1,5 times the hose's outside diameter (D) shall be allowed between the hose fitting and the point at which the bend starts.

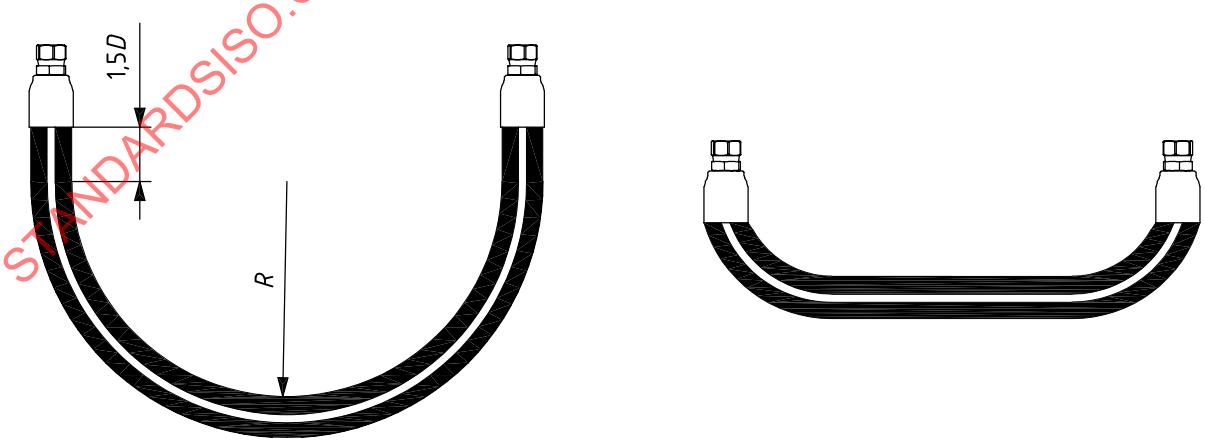

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Figure 1 — Minimum bend radius

5.23 Elbows and adapters

In special cases, elbows or adapters shall be used to relieve hose strain (see Figure 2).

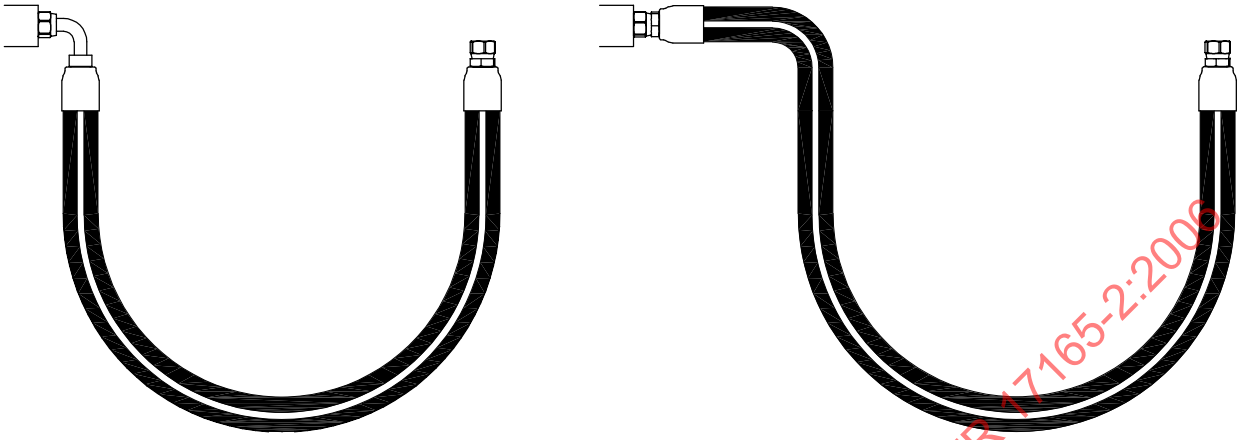

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Figure 2 — Elbows and adapters

5.24 Lengths

Unnecessarily long hose can increase pressure drop and affect system performance. When pressurized, hose that is too short can pull loose from its hose fittings or stress the hose fitting connections, causing premature metallic or seal failures. When establishing hose and hose assembly length, as defined in ISO 17165-1 for the different hose fitting types, Figures 3, 4, and 5 and the practices in 5.24.1 through 5.24.3 shall be taken into consideration.

5.24.1 Motion absorption

The hose assembly shall be of such length to distribute movement and prevent bends smaller than the minimum bend radius.

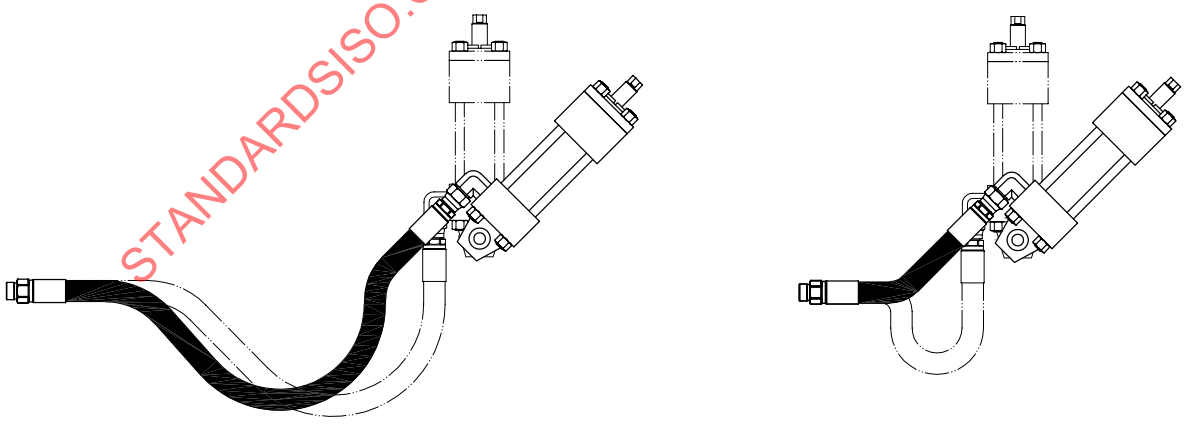

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Figure 3 — Motion absorption

5.24.2 Tolerances and machine motion

The hose assembly shall be of such length to allow for tolerances and machine motion.

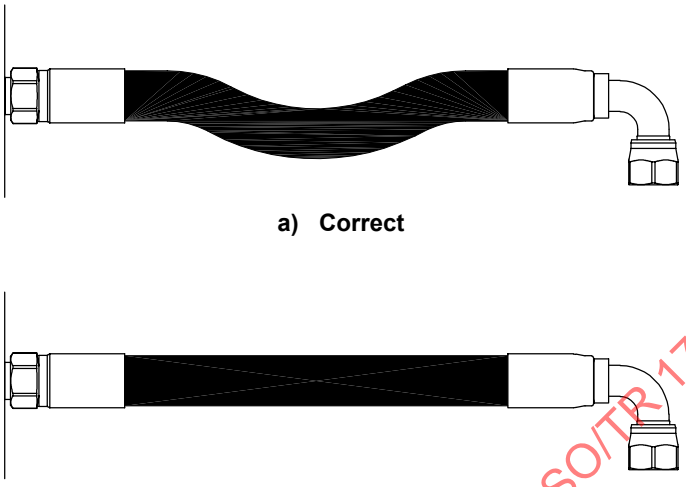

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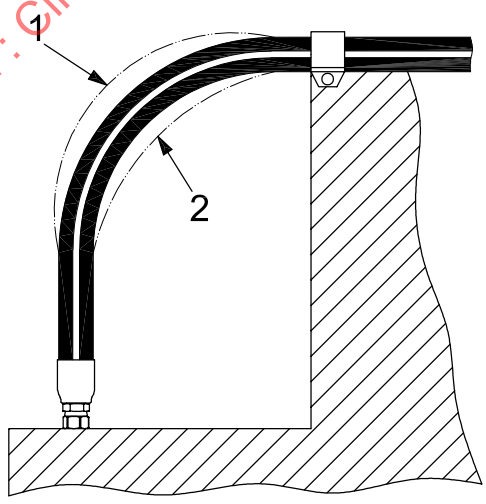
Figure 4 — Hose and machine tolerances

5.24.3 Change in hose length due to changes in pressure

The hose assembly shall be of such length to accommodate changes in length resulting from changes in pressures. Hoses for high- and low-pressure lines shall not be crossed or clamped together, as the difference in changes in length could wear the hose covers.



Key

1 no pressure

2 high pressure

Figure 5 — Change in hose length due to change in pressure

5.25 Hose movement and bending

5.25.1 Hose allows for relative motion between system components. This motion shall be analyzed when hose systems are designed. The frequency of motion (i.e., the number of cycles per day) can significantly affect hose life. Movement in multiple planes and twisting shall be avoided. The motion of the hose shall be considered when selecting hose and predicting service life. In applications that require that hose moves or bends, Figures 6 and 7 and the practices specified below shall be considered.

5.25.2 Hose should be bent in only one plane to avoid twisting.

5.25.3 Hose should not be bent in more than one plane. If hose follows a compound bend, it shall be coupled into separate segments or clamped into segments that each flex in only one plane.

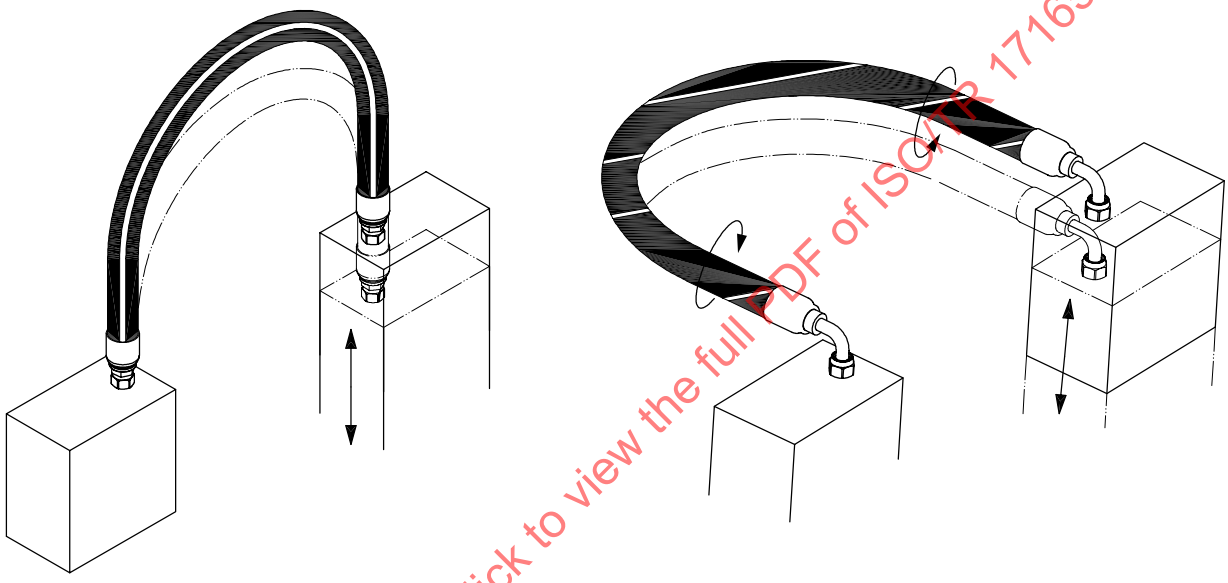


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Figure 6 — Illustration of bending in only one plane to avoid twisting

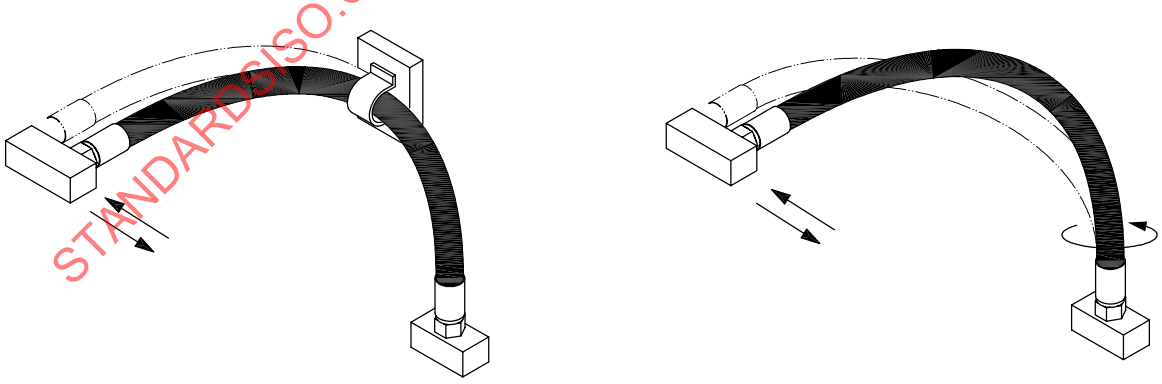

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Figure 7 — Illustration of how to prevent hose bending in more than one plane

6 Hose assembly fabrication

6.1 General

Persons fabricating hose assemblies should be trained in the proper use of equipment and materials. The manufacturers' instructions and the practices listed in 6.2 through 6.11 shall be followed. Properly assembled hose fittings are vital to the integrity of a hose assembly. Improperly assembled hose fittings can separate from the hose and can cause serious injury or property damage from whipping hose or from fire or explosion of vapour expelled from the hose.

6.2 Component inspection

Prior to assembly, components shall be inspected for

a) style or type,

b) cleanliness,

c) loose covers,

d) corrosion,

e) nicks, dents, scores, burrs or sharp edges,

f) size,

g) inside obstructions,

h) visible defects,

i) damage,

j) length,

k) blisters,

l) burrs.

6.3 Hose fittings

Hose-fitting components from one manufacturer are not usually compatible with hose-fitting components supplied by another manufacturer. For example, a hose fitting nipple from one manufacturer shall not be used with a hose socket from another manufacturer. It is the responsibility of the hose-assembly fabricator to consult the manufacturer's written instructions, or the manufacturer directly, for information on proper hose-fitting components.

6.4 Compatibility between hose and hose fittings

Care shall be taken to determine proper compatibility between the hose and hose fitting. Selection shall be based on the manufacturers' recommendations substantiated by testing to relevant standards for hose and hose fittings. Hose from one manufacturer is not usually compatible with hose fittings from another. Hose from one manufacturer and hose fittings from another manufacturer shall not be intermixed without approval from both manufacturers.

6.5 Hose-assembly equipment

Equipment for fabricating hose assemblies from one manufacturer is usually not interchangeable with that from another manufacturer. Hoses and hose fittings from one manufacturer should not generally be assembled with the hose assembly equipment of another manufacturer.

6.6 Safety equipment

During fabrication, proper safety equipment, including eye protection, respiratory protection and adequate ventilation, shall be used.

6.7 Use and reuse of hose and hose fittings

Damaged hoses or hose fittings shall not be used.

When fabricating hose assemblies,

a) field-attachable fittings that have blown or pulled off hose shall not be reused,

b) any part of hose fittings that were permanently crimped or swaged to hose shall not be reused,

c) hose that has been in service after system checkout (see 7.8) shall not be reused.

6.8 Cleanliness of hoses and/or hose assemblies

Hose assemblies can be contaminated during fabrication. Hoses and/or hose assemblies shall be cleaned to specified cleanliness levels (see 5.14).

6.9 Temperature

The fabrication of hose assemblies should be performed at an ambient temperature over 0 °C unless otherwise recommended by the manufacturer.

6.10 Assembly inspection

After assembly, examine hose assembly for visible defects and interior obstructions, such as tube bulges, etc.

6.11 Marking

Hose assemblies shall be marked in accordance with ISO 17165-1. Marking shall remain legible.

7 Hose installation and replacement

7.1 General

The practices specified in 7.2 through 7.8 shall be used when installing hose assemblies in new systems or replacing hose assemblies in existing systems. The manufacturer should make available additional instructions on mounting, storage and operating conditions.

7.2 Pre-installation inspection

Before installing hose assemblies, the following should be examined:

a) hose length and routing, for compliance with original design;

b) hose assemblies, for correct style, size, length and visible nonconformities;

c) hose fitting sealing surfaces, for burrs, nicks or other damage.

When replacing hose assemblies in existing systems, verify that the replacement hose assembly is of equal quality to the original assembly.

7.3 Handling during installation

Hose shall be handled with care during installation. Kinking the hose, or bending it at less than its minimum bend radius, can reduce hose life. Sharp bending at the hose/fitting juncture shall be avoided (see 5.23). Before and during installation, hose assemblies should be at a temperature above 0 °C.

7.4 Twist angle and orientation

Pressure applied within a twisted hose can shorten the life of the hose or loosen the connections. To avoid twisting, the hose lay line or marking can be used as a reference if the lay line or marking is parallel to the axis of the hose (see Figure 8). Twisting can also be avoided through the use of two wrenches during the installation of swivel connectors.

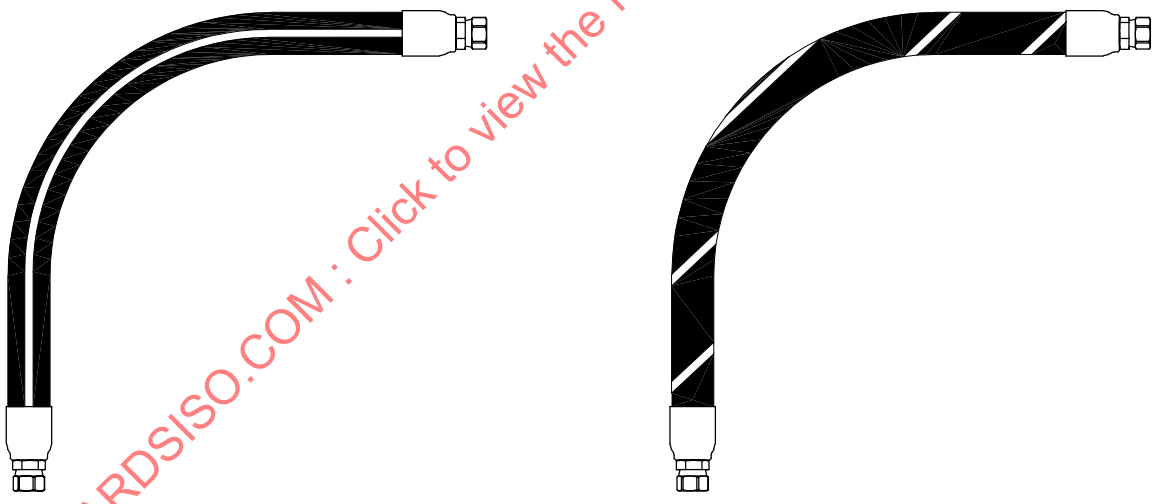

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Figure 8 — Twist angle and orientation

7.5 Securing and protection

Necessary restraints and protective devices shall be installed. It shall be determined that such devices do not create additional stress or wear points.

7.6 Routing

Review proper routing practices provided in Clause 5 and make appropriate corrections to obtain optimum performance.

7.7 Assembly torque

The connection end of a hose fitting is normally threaded to obtain a tight pressure seal when attached to a port, an adapter or another fitting. Sometimes bolts or screws provide the threaded connection. Each size and type of connection requires different torque values, and these can vary due to type of material, exterior coating and/or lubrication. Follow appropriate torquing instructions to obtain proper pressure sealing without overtorquing. A properly calibrated torque wrench should be used to tighten each connection, except when the hose-fitting manufacturer specifies tightening a specified number of hex-flat turns beyond finger tight to obtain a seal.

7.8 System checkouts

In hydraulic or other liquid systems, all entrapped air shall be eliminated after installation is complete. The manufacturers' instructions shall be followed to test the system for possible malfunctions and leaks. To avoid injury during system checkout,

a) do not touch any part of the system when checking for leaks (see 4.2);

b) stay out of potentially hazardous areas while testing hose systems (see Clause 4);

c) relieve system pressure before tightening connections.

8 Maintenance inspection

8.1 General

A hose and hose-fitting maintenance program can reduce equipment downtime, maintain peak operating performance and reduce the risk of personal injury and/or property damage. The user should design and implement a maintenance program that suits the specific application and each specific hose in that application. For additional information on inspection, see Table 1.

8.2 Inspection frequency

Factors such as the nature and severity of the application, past history and manufacturers' information shall be evaluated to establish the frequency of visual inspections and functional tests.

8.3 Visual inspection (hose and hose fittings)

Hose and hose fittings shall be inspected for the items listed in Table 1, which also gives information as to the main causes and corrective actions to be taken for each item.

8.4 Visual inspection (all other components in the system)

When visually inspecting hose and hose fittings, inspect for related items including:

a) leaking ports;

b) damaged or missing hose clamps, guards, or shields;

c) excessive dirt and debris around hose;

d) system fluid: level, type, contamination, condition, and air entrainment.

If any of these are found, they shall be addressed appropriately.

8.5 Functional tests

Functional tests determine if systems with hose assemblies are leak-free and operating properly. Function tests shall be carried out in accordance with the equipment manufacturer's instructions.

Table 1 — Items related to visual inspection of hose and hose fittings

Item		Main cause	Corrective actions to be taken
Leakage from threaded connector		Defective connector seat due to presence of flaw, dirt or other foreign objects	Clean connector seat
		Loose connector or O-ring wear	Tighten the connector or replace O-ring
		Mismatching of seat surface	Replace the connector as necessary
Leakage from flange connection		Loose fixture bolt or deterioration of O-rings/seals	Tighten the bolt or replace O-rings/seals
Leakage from hose/connection assembly, hose fitting slippage on hose		Deterioration of hose (due to heat, oil, long use, etc.)	Replace the hose
		Improper piping	Avoid sharp bending at the assembly part
Deformation	(depression)	External shocks	Shock prevention (protection)
	(inflation)	Oil spillage (leak)	Replace the defective hose if necessary
Visible defect (damaged, cut or abraded cover; exposed reinforcement; kinked, crushed, flattened, or twisted hose; blistered, soft, degraded or loose cover; cracked, damaged, or badly corroded hose fittings; wear flaws; scratch etc.)		Component interference External shocks	Shock prevention (protection) Replacement
Visible external cracks		Ozone, radiation, paint, oil	Exterior protection Replacement
Unusual hose movement at starting of operation		Improper hose length	Replace the hose
		Improper piping	Correct piping or use of adaptive devices
Hardening/softening, heat cracked or charred hose		Deterioration due to oil or temperature mismatch	Replacement as necessary
Unusual noise, smell, heat		Improper circuitry	Check the circuit
Rusting of joints		Sand dust, water, air salinity	Use of protective paint (but not on the exterior surface of the hose)
Product lifetime (useful service life has been reached)		Deterioration and wear	Replace hose and/or hose assembly based on criteria defined in Clause 8

9 Hose storage

9.1 General

Age control and the manner of storage can affect hose life. The practices for storing hose specified in 9.2 and 9.3 shall be followed.

9.2 Age control

9.2.1 A system of age control shall be maintained to ensure that hose is used before its shelf life has expired. Shelf life is the period of time when it is reasonable to expect the hose to retain full capabilities for rendering the intended service. Hose shall be stored in a manner that facilitates age control and first-in, first-out usage based on the manufacturing date on the hose or hose assembly.

9.2.2 The shelf life of rubber hose in bulk form or hose made from two or more materials is 40 quarters (10 years) from the date of manufacture, if stored in accordance with ISO 2230. The shelf life of thermoplastic and polytetrafluoroethylene hose is considered to be unlimited. Hose assemblies that pass visual inspection and proof test shall not be stored for longer than 2 years.

9.3 Storage

9.3.1 Hose and hose assemblies shall be stored in accordance with the storage conditions defined in ISO 8331. When storing hose, care shall be taken to avoid damage that can reduce hose life and the manufacturers' information for storage and shelf life followed. Examples of factors that can adversely affect hose and hose assemblies in storage are the following:

a) temperature;

b) ozone;

c) oils, petrol, kerosene or their vapours;

d) corrosive liquids and fumes;

e) rodents;

f) humidity;

g) ultraviolet light;

h) solvents;

i) insects;

j) radioactive materials;

k) direct sun or heat rays;

l) acids, alkalis;

m) sharp edges and abrasive surfaces;

n) electric or strong magnetic fields;

o) mould and fungi.