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Rubber and plastics hoses and hose assemblies — Guidelines for selection, storage, use and maintenance

Tuyaux et flexibles en caoutchouc et en plastique — Lignes directrices pour la sélection, le stockage, l'utilisation et la maintenance

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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.

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 8331 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*, Subcommittee SC 1, *Hoses (rubber and plastics)*.

This second edition cancels and replaces the first edition (ISO 8331:1991), which has been technically revised.

Rubber and plastics hoses and hose assemblies — Guidelines for selection, storage, use and maintenance

1 Scope

This International Standard sets out recommendations designed to maintain rubber and plastics hoses and hose assemblies, prior to use, in a condition as close as possible to the condition they were in when they were received and to obtain the expected service life.

NOTE It is intended that this International Standard be used in conjunction with any applicable national statutory regulations.

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 1402, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 2230, *Rubber products — Guidelines for storage*

ISO 8031, *Rubber and plastics hoses and hose assemblies — Determination of electrical properties*

ISO/TR 17165-2, *Hydraulic fluid power — Hose assemblies — Part 2: Recommended practices for hydraulic hose assemblies*

3 General recommendations

3.1 Selection criteria

It is in the best interests of the user to select hoses or hose assemblies complying with national or international standards whenever such standards exist for the intended application. For applications outside the scope of such standards, needing special requirements or for which the necessary information is not available, the hose manufacturer or trade association should be consulted.

The following points should be taken into consideration when selecting a hose or hose assembly for a specific application:

a) Operational environment:

- ambient temperature;
- atmospheric conditions;
- contact with chemically aggressive liquids;
- contact with other deleterious media.

b) Media conveyed:
   — liquid;
   — gaseous;
   — solids;
   — combinations of the above.
c) Method of conveyance:
   — pressure (including rate of flow);
   — suction (including rate of flow);
   — gravity (including rate of flow);
   — assisted (mixture of solid/fluid, solid/air).
d) Operating conditions:
   — pressure and temperature of product conveyed;
   — frequency of use.
e) Installation:
   — degree of curvature (minimum bend radius);
   — vibration of system;
   — risk of damage by impact and abrasion;
   — use of correct type of connection;
   — type of movement and frequency.

3.2 Storage conditions

3.2.1 General

During storage, especially for long periods, and when hoses and hose assemblies are exposed to certain adverse influences, the physical properties of hoses and hose assemblies can undergo changes that may result in them no longer having the optimum characteristics corresponding to their application when they are put into service. The storage conditions should be such as will offer maximum protection and minimize deterioration of the articles during storage.

3.2.2 Storage period

The storage period should be kept to a minimum. Rotation of stock is therefore essential and the “first-in first-out” rule applied. For long-term storage, refer to ISO 2230 for storage time and conditions. Items 3.2.3 to 3.2.8 are covered in ISO 2230 and are shown here for convenience only.

3.2.3 Temperature

The storage temperature should be below 25 °C and articles stored away from direct heat sources. Storage above 25 °C may shorten the life of the hose. Articles should not be subjected to temperatures over 50 °C or below − 30 °C or to abnormal fluctuations in temperature during the storage period. See ISO 2230 for information on the effect of higher and lower temperatures on the storage time.

3.2.4 Humidity

The relative humidity should not exceed 70 % (see ISO 2230 for details).

3.2.5 Light

The articles should be stored in a dark place away from sunlight and strong artificial light. If the storage area has windows or glazed openings, they should be obscured with red, orange or white coverings.

3.2.6 Ozone

Due to the harmful effect of ozone on rubber-based articles, storage areas should not contain equipment capable of generating ozone, for example mercury vapour lamps or tubes, high-voltage electrical equipment, electric motors or other equipment likely to cause sparks or electrical discharges.

3.2.7 Environment

Articles should not be placed in contact with certain products or exposed to their vapours, particularly solvents, oils, greases, acids, disinfectants, etc. Some metals, such as copper, iron and manganese, have a harmful effect on certain rubber compounds.

3.2.8 Sources of heat

Articles should not be stored in close proximity to heat sources. The distance between the articles and the heat sources should be sufficient to ensure compliance with the recommendations of 3.2.3.

3.2.9 Electric and magnetic fields

Storage areas should not be in the vicinity of equipment that may generate electric or magnetic fields, as variations/fluctuations in such fields could induce currents in metallic joints, which in turn generate heat.

3.2.10 Method of storing

Articles should be stored in such a way that they are not subjected to excessive stress, elongation or deformation. Contact with sharp, pointed or abrasive objects or surfaces should be avoided, and storage racks should be provided whenever possible.

Coiled hose or hose assemblies should be stored flat and preferably not stacked. When stacking is unavoidable, the height of the stack should be restricted so that the articles at the bottom do not suffer permanent deformation. The hanging of coils on pegs is not recommended. Hoses and hose assemblies supplied in straight lengths should be stored flat and unbent. End caps should be kept on hoses supplied with them.

3.2.11 Rodents

Articles should be secure from attack by rodents, and adequate protection should be provided if there are any risks.

3.2.12 Issue from storage

Care should be taken to ensure that articles issued from stock are in their correct condition and correspond to their intended application. Identification of the different types in stock is essential. Hose assemblies which do not have permanent end fittings, i.e. those with clipping/clamping arrangements that can be adjusted, should be checked to ensure that the end fittings are secure.

3.2.13 Return to storage

Before being returned to storage, articles which have been withdrawn from service should be drained of the substance they have been used to convey. Special care should be exercised with hoses that have been used to transport chemical, explosive, flammable or corrosive products. After cleaning and before return to storage, the articles should be examined to establish their suitability for continued use.

3.3 Use and maintenance

3.3.1 Handling

Hoses and hose assemblies should always be handled with care. They should not be dragged over sharp or abrasive surfaces. They should not be subjected to kinking or flattening, for example by being run over by vehicles.

3.3.2 Pressure

Articles should not be subjected to pressures, including surge pressures, in excess of the specified maximum working pressure.

3.3.3 Temperature

Articles are not be used at temperatures, either conveyed-product temperatures or environmental temperatures, outside the range specified or recommended by the manufacturer.

3.3.4 Products conveyed

Hoses and hose assemblies should only be used for conveying the products for which they are designed. If there is doubt regarding the suitability, the hose manufacturer should be consulted. When potentially dangerous (for example toxic, corrosive, explosive or flammable) products are being conveyed, precautions to minimize the effects of spillage due to leakage should be taken and it is recommended that, when not in use, hoses and hose assemblies should not remain filled.

3.3.5 Environment

Hoses and hose assemblies should not be used in environments other than those for which they were designed. If there is doubt regarding the suitability of the environment, or if unusual or variable conditions are experienced, the manufacturer should be consulted.

3.3.6 Bending radii

Hoses and hose assemblies should not be used with bends less than the minimum bend radius specified or recommended by the manufacturer as this may restrict the passage of the product being conveyed or damage the hose assembly. Bends or kinking adjacent to end fittings should be avoided as continued bending in the same area may fatigue the reinforcement and lead to premature failure.

3.3.7 Torsional stress

Hoses and hose assemblies are not designed to operate in torsion. Installation should be performed so that the relative motions of machine components produce bending of the hose and eliminate twisting.

3.3.8 Tensile stress

Only when hoses and hose assemblies are specially designed to do so may they be subjected to tensile stress. If the hose standard does not address suitability, then the hose manufacturer should be consulted.

3.3.9 Vibration

Vibration subjects hoses and hose assemblies to fatigue and heating, particularly around the connections, which can lead to premature failure. It is important to ascertain from the hose standard or manufacturer whether a hose assembly is designed to withstand vibration.

3.3.10 Assembly of end fittings

Before proceeding with the assembly, determine the compatibility of the fitting, the hose and the method of installation. In case of doubt, the hose manufacturer should be consulted.

Fittings should be free from sharp edges, and the dimensions of hose inserts, ferrules, etc., should be such as to ensure an effective seal when correctly fitted. Swaging dimensions and clip torque loads should be controlled, as insufficient or excessive swage dimensions will lead to premature failure of the assembly. To facilitate insertion of the fitting into the hose, the use of plain or soapy water is recommended. Do not use products containing oil, grease or solvents unless specified by the hose manufacturer in the assembly instructions. Care should be taken not to twist or kink the hose when inserting the fitting.

3.3.11 Leakage

After the attachment of the end fittings, it is recommended that the assembly undergo a hydrostatic proof test, to the specified proof pressure of the hose, to verify the hose fitting installation, i.e. freedom from leaks and no evidence of slipping between the fitting and the hose. In the absence of statutory regulations or other standards, carry out testing in accordance with ISO 1402.

3.3.12 Electrical properties

When there are requirements regarding electrical properties of the hose or hose assembly, it is recommended that they be ascertained in accordance with ISO 8031. Continued compliance should be established by testing at regular intervals in use.

3.3.13 Fixed installations

Hoses and hose assemblies used in fixed installations should, whenever possible, be supported by adequate clamping. Care should be taken to ensure that the clamps do not create excessive hose distortion during pressure/suction, i.e. dilation, change in length or expansion.

3.3.14 Moving parts

When the hose or hose assembly is used to convey fluid between moving parts or components, the installation needs to ensure that the length is adequate, without being excessive, and that any movement does not result in the hose being subjected to shock loading, pinching, abrasion, bending smaller than the minimum bend radius or tensile/twisting stress.

3.3.15 Marking/identification

If marking additional to that specified in the hose standard, such as further identification, is required, it is recommended that this be done by the application of adhesive tape bearing the required marking. Marking directly on the hose is also possible provided the hose cover compound is compatible with the printing inks used to produce the marking.

3.3.16 Maintenance

Hose and hose assemblies, excluding those for which there are regulations, standards or contractual requirements, should be subjected to periodic testing/inspection to establish their suitability for continued use. Particularly attention should be paid to the condition of the connections and adjacent areas and to the appearance of defects indicative of deterioration of the hose due either to normal ageing or to damage attributable to abnormal service conditions, maltreatment or accidents during use.

The following defects are sufficient justification for the withdrawal of hose from service:

— punctures, splits, tears, exposure of reinforcement;

— ozone cracking;

— localized deformation, blisters, swelling under pressure;

— soft or sticky patches.

When “use-by” or expiry dates are included in the hose marking, they should be observed even if the hose shows no apparent signs of deterioration.

3.3.17 Repairing of hoses

Hose repair is not allowed, unless specifically addressed by the hose manufacturer.

4 Additional recommendations for specific applications

4.1 General

The following recommendations supplement the general recommendations given in Clause 3.

4.2 Welding and gas-cutting hoses

The gases used for these applications are oxygen, acetylene, liquefied petroleum gas (LPG) and inert, non-combustible gases, for example argon and nitrogen, and the linings of the hoses are formulated to avoid reaction with the particular gas they convey. To avoid confusion and to ensure that the correct welding hose is used, some countries' national gas standards require coloured covers as follows:

a) blue or green: for oxygen;

b) red: for acetylene;

c) orange: for LPG;

d) black: for inert, non-combustible gases.

Under no circumstances should these hoses be used for other purposes or for the conveyance of a gas other than that for which they are identified.

NOTE Hoses for welding and gas-cutting applications intended to convey LPG, i.e. with an orange cover, are not suitable for connecting household appliances to a propane/butane supply.

Coloured hoses should maintain their original colour during the storage period prior to sale or use.

4.3 Steam hoses

Unless otherwise stipulated or specified, steam hoses are designed to convey saturated steam for which there is a direct relationship between temperature and pressure. Hoses required to convey superheated steam, for which there is no direct relationship between temperature and pressure, are subject to different stresses. Unless the hose marking specifies use with superheated steam, the hose manufacturer should be consulted before using a hose with superheated steam.

When steam hose is not in continuous use or if there are cooling phases in the service cycle, the hose will be subjected to thermal shock which can result in liner ruptures (popcorning). Rapid depressurization can also cause liner ruptures, and gradual relief of the pressure in the system is therefore recommended. The hose liner should be examined at relatively short intervals to establish its suitability for further use.

In view of the serious consequences of failure, i.e. injury by scalding, adequate precautions should be taken to protect personnel and to minimize the effects of bursting of the hose or hose assembly.

4.4 Hoses for the conveyance of foodstuffs and drinking water

Hoses and hose assemblies for these applications are generally subject to statutory health regulations. Consequently, hoses are manufactured with linings compounded to avoid reaction with the products to be conveyed which could result in contamination. Hoses and hose assemblies should therefore only be used to convey the product for which they were designed, and regulations regarding cleaning materials, procedures and frequency should be strictly adhered to.

4.5 Hoses for the conveyance of abrasive products

In order to obtain maximum service life, hoses and hose assemblies used for the conveyance of abrasive products should be used, wherever possible, in a straight position. When the inclusion of bends cannot be avoided, bend radii as large as possible should be used. Installations incorporating small bends or coiled hose will inevitably result in rapid localized wear of the lining, caused by turbulence, resulting in premature failure.

To minimize wear of sandblast hose lining by abrasion, it is recommended that couplings be by external fittings as the absence of nipples/tail-pieces inserted into the hose reduces the turbulence.

The electrical continuity required for this type of hose assembly should be periodically checked to ensure the effective discharge of static electricity generated by the abrasive particles moving against the wall of the hose. If the static electricity is not discharged, the hose may fail prematurely due to perforations caused by electric arcs.

4.6 Hoses for the conveyance of corrosive or aggressive products

Agricultural chemicals, acids and some chemical products are designated corrosive or aggressive. Hoses or hose assemblies are designed to carry a particular product or range of products. If the product to be conveyed is not referred to in the scope of the standard or in the hose manufacturer's literature, or if the concentration, temperature or pressure limits are not within the quoted ranges, the hose manufacturer should be consulted. Care should be taken to avoid stagnation of products, particularly solutions and emulsions, within the hose, as separation can give concentrations exceeding the permissible limits, leading to deterioration of the hose lining. To avoid this, it is recommended that, whenever possible, the hose or hose assembly be drained and rinsed after use.

In view of the serious consequences of hose or hose assembly failure, precautions should be taken to minimize the effects of failure on the operator or the environment.

4.7 Hoses for the conveyance of flammable products

In most countries, there are regulations pertaining to the storage and transport of flammable products, including liquid hydrocarbons (petrol, kerosene and diesel oil) and liquefied hydrocarbons (LPG). Where the regulations apply to hoses used in the charging or discharging operation, they should be strictly adhered to.

Hoses and hose assemblies should be subjected to regular examinations to establish suitability for use, particularly with regard to their electrical properties. It is recommended that, when not in use, the hose be drained.

When using hoses or hose assemblies to convey liquid hydrocarbons, it is essential that the aromatic hydrocarbon content is within the limits given in the hose specification.

4.8 Automotive hoses

Hoses and hose assemblies used on automobiles are exposed to, and should be made resistant to or protected from, hostile environments, such as:

a) the conditions of their location, for example under the bonnet (hood), where they can come into contact with fuel oils, lubricating oils, battery acid, etc., be exposed to heat from the engine or be exposed to an ozone-enriched atmosphere;

b) the conditions in which the vehicle may be required to operate, such as extremes of temperature and humidity or splashing with sand, mud, gravel, snow, ice, etc.;

c) movements between parts of the vehicle to which the hoses or hose assemblies are connected, and vibration.

In the conditions given in a) and b) above, it is recommended that the hoses and hose assemblies be protected by shields wherever possible. Where the installation involves severe bends or where the fixing points are in different planes, the use or formed (shaped) hose should be considered. Hoses installed at bend radii less than that specified in the hose standard are liable to early failure. Care should be exercised to ensure that the hose is not under tension or twisted and that there is sufficient clearance between the hose and adjacent components. Where clearance exists under static conditions, it should be established that the dynamic operating conditions of the vehicle do not subject the hose to vibrations or other movements causing contact with hot spots or rubbing against other components. The length of the hose or hose assembly should be the correct length required to satisfy these conditions and, when needed, the hose should be supported using correctly positioned clamps.

The following special points should also be considered:

Coolant hoses should be sufficiently flexible to ensure that the radiator connection is not subjected to excessive stress. Brake hoses and hose assemblies should be of sufficient length to allow them to function satisfactorily without undue stress under extremes of operating conditions, taking into consideration

a) clearance from other components, especially at extremes of movement, such as full lock of the wheel;

b) movement in relation to the fixing points, taking into consideration the high and low positions due to wheel bounce and the rotational movement during changes in direction.

4.9 Hydraulic hoses

Use ISO/TR 17165-2 for hydraulic hoses and hose assemblies.

4.10 Fire-fighting hoses

4.10.1 General

The hoses and hose assemblies referred to in this subclause are those lay-flat and conventional flexible hoses employed in fire-fighting applications using water or foam solutions. Hoses are manufactured for the differing environments they may be required to operate in, and care should be taken to ensure that the correct type is used, i.e. domestic, industrial, land based, ship-borne, etc.

Consideration should also be given to the working pressure of the system and the possibility of contact with aggressive substances and burning embers/hot surfaces. Failure to establish the end-use conditions could lead to premature failure of the hose.

Where there are requirements to comply with, laid down in statutory regulations or contractual standards or specifications, they should be strictly followed.

4.10.2 Special points to be observed

4.10.2.1 Storage

Prior to use, hoses and hose assemblies should be stored in a dry, well-ventilated place (for specific information, see ISO 2230).

4.10.2.2 Installation

When installed either in a fixed position or on a vehicle, a hose or hose assembly should be positioned to ensure the circulation of air and prevent contact with other components that could result in abrasion, e.g. sides of lockers if carried on a fire-fighting vehicle.

To minimize the risk of permanent deformation when a hose is coiled around a drum, it should be periodically unwound and rewound in the opposite direction.

Lay-flat hoses may be stored in a flaked condition to prevent damage and permanent deformation. They should be periodically unfolded and refolded in such a way that the folds occur in different positions.

NOTE The above two paragraphs do not apply to hoses vulcanized in the coiled state or pre-folded hoses.

4.10.2.3 Use

When hoses and hose assemblies are in use, precautions should be taken to avoid damage by crushing caused by being run over by vehicles, as this may result in a restriction in the flow rate or pressure. When hoses are uncoiled or unfolded along the ground, they should not be dragged over rough surfaces or sharp objects nor should they be pulled with excessive force to remove kinks or loops. Protective coverings (sleeves) should be used where hoses may come into contact with abrasive surfaces, particularly close to the pumping point. For temporary installation (i.e. a length of hose supported by a sling during pumping), the supports shown in Figure 1 are recommended.

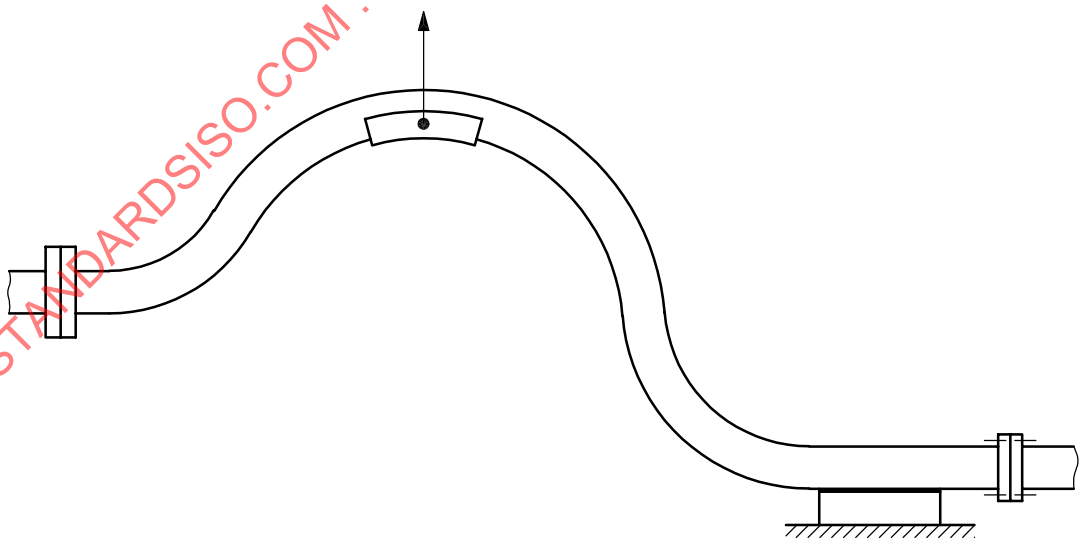

Figure 1 — Supports for hose during temporary installation

4.10.2.4 Application of pressure

Before pressure is applied, hoses and hose assemblies should be as straight as possible and free from kinks/loops. Nozzles and valves should be opened and closed slowly to prevent surges and water hammer.

4.10.2.5 Maintenance

After use, the hoses and hose assemblies should be drained, cleaned (both internally and externally) and dried, after which they should be examined for defects. If the hose has been used in a situation where it may have been in contact with chemical products or if it may have been subjected to severe stresses, it is recommended that it undergo hydrostatic testing to ensure suitability for further use. Unless there are statutory requirements or regulations, it is recommended that the test be carried out in accordance with ISO 1402.

Irrespective of whether or not they have been used, hoses and hose assemblies should be inspected and tested at least once a year.

4.11 Oil-industry hoses and hose assemblies

4.11.1 General

The hoses and hose assemblies referred to in this subclause are those used in the oil industry for the bulk transfer of liquid petroleum products.

They may be used for ship-to-ship or ship-to-shore transfer where they may be submerged, floating or suspended. Hoses and hose assemblies used for bulk delivery on land by either road or rail tanker are covered by the general recommendations in Clause 3 with the additional recommendations of 4.7.

Generally, the hoses are of bore sizes greater than those used in general industrial applications. Whilst the general recommendations of Clause 3 apply, because of their bulk and the situations in which they are used, there are special needs in respect of storage, handling and repair.

Reference should also be made to the following documents:

a) OCIMF guide to hoses for offshore moorings [1];

b) OCIMF guidelines for hoses in the field [2];

c) relevant national, international, manufacturers' and oil companies' specifications.

4.11.2 Special points to be observed

4.11.2.1 Storage

When storage under the recommended conditions as given in ISO 2230 is not possible, e.g. when hoses or hose assemblies are stored outside, care should be taken to protect hoses and hose assemblies from exposure to atmospheric attack.

Large-bore hoses supplied in straight lengths, particularly those with built-in couplings, should be adequately supported at all times with the end caps in place at all times (see Figure 2).

4.11.2.2 Handling

Large-bore hoses and hose assemblies supplied in straight lengths should be adequately supported in transit, especially when they are lifted (see Figure 3).

4.11.2.3 Repairs

Whilst the repair of hoses, particularly of the carcass is not recommended (see 3.3.17) because of the size and the high initial cost, minor repairs may be undertaken. When this is permissible (i.e. when statutory regulations and insurers' requirements allow it), the hose manufacturer's instructions should be adhered to. After repair, the hose or hose assembly should be tested, including electrical testing if applicable.