Continental
The Future in Motion

Oil + Gas
High Pressure Flexible User Guide

www.contitech.us

ContiTech

Introduction

ContiTech provides a complete line of quality, cost-effective solutions for Oil + Gas exploration around the world – from site preparation and drilling to cementing and fracturing. For over 50 years, we have been your complete Oil + Gas solution, and our products are specifically designed to work together for maximum efficiency, reliability and safety.

That's why we created this User Guide. It covers all aspects of safe use and the in-service design of our flexible lines in normal applications and production use. If you discover aspects or applications not covered in this guide, please contact your local ContiTech office listed on the back cover.

We also welcome and encourage your comments about this guide and our products. Your feedback helps us maintain the high quality of our products and develop new innovations.

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I. List of Abbreviations

API: American Petroleum Institute

BOP: Blow Out Preventer

FSL: Flexible Specification Levels

HNBR: Hydrogenated Nitrile Butadiene Rubber

ID: Internal Diameter

LMRP: Lower Marine Riser Package

MBR: Minimum Bend Radius

MPD: Managed Pressure Drilling

NACE: National Association of Corrosion Engineers

NBR: Nitrile Butadiene Rubber

OEM: Original Equipment Manufacturer

PA: Polyamide

PRV: Pressure Release Valve

UV: Ultra Violet

II. Description of ContiTech Flexible Lines

ContiTech flexible lines are made up of three primary components, the flexible line, the end fittings or couplings, and the bend stiffener/transition section as shown in Figure 1.

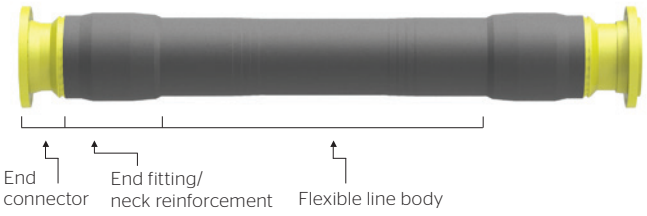


Fig. 1 Flexible Line Cross-Section

Flexible Line Body

The flexible line body is the largest component of the flexible line assembly and consists of a number of layers as shown in Fig. 2.

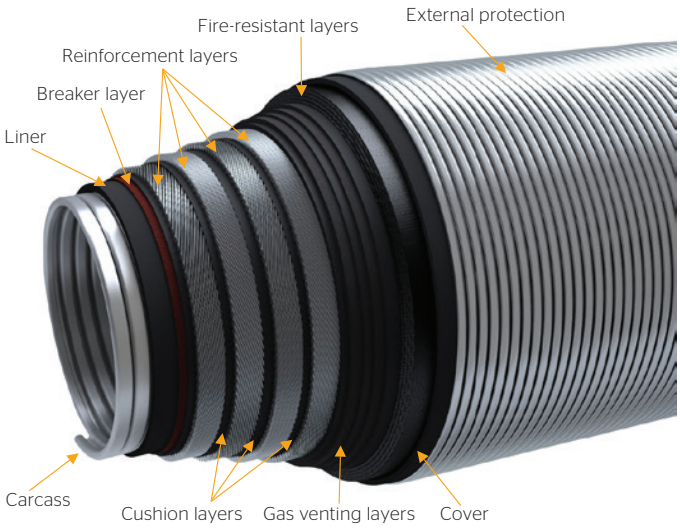


Fig. 2 Flexible Line Cross-Section

Carcass: Stainless steel stripwound tube to provide collapse and rapid gas decompression resistance

Liner: Provides a physical barrier to conveyed fluids/gasses

Breaker Layer: Rubberized textile for foundation of reinforcement layers

Reinforcement Layers: High-strength steel cables, either brass or zinc coated

Cushion Layers: Rubber compound to prevent cable-on-cable wear

Gas Venting Layers: Rubberized textile allows diffused gas to escape

Fire-Resistant Layers: Optional fire resistant layer

Cover: Heavy-duty UV-resistant rubber compound seals exterior of the flexible line from environment

External Protection: Optional additional protection for more severe service conditions (316 L Stainless Steel Stripwound shown, other options available)

Bonded End Fittings

ContiTech designed bonded end fittings so that they are the strongest part of the flexible line assembly. This ensures reliable service throughout the lifetime of our products. A cross section of a typical bonded end fitting is shown in Fig. 3.

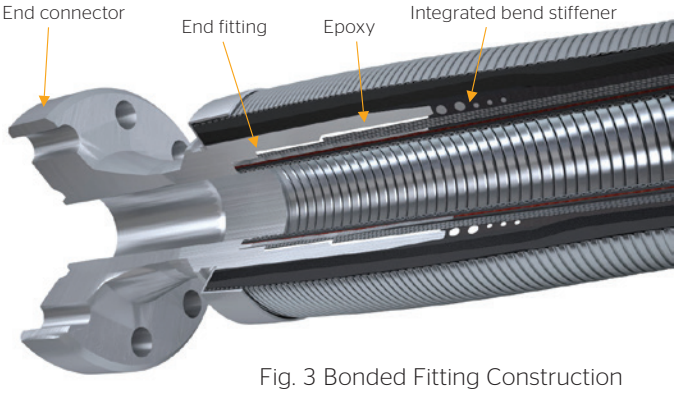


Fig. 3 Bonded Fitting Construction

Protection Against Corrosion

All ContiTech end fittings are coated in a number of different methods depending on the application. Although the coating system can be matched to customer requirements, a general breakdown of standard coatings is as follows:

- API Spec. 7K onshore – All-weather coating to ContiTech standards
- API Spec. 7K offshore - Seawater resistant coating to ContiTech Standards
- API Spec. 16C - Seawater resistant coating to ContiTech Standards
- API Spec. 17K topside – Coated according to Norsok M501
- API Spec. 17K subsea – Coated according to Norsok M501, System No. 7-24

Connectors

ContiTech flexible lines can be supplied with most any type of end connection, with the most common being hammer unions, ANSI flanges, API flanges and API hubs. ContiTech also offers their own hub, branded as Taurus, which is tested for compatibility with Grayloc and other similar clamp-style hubs. The end connections can be either machined as part of the end termination assembly, or butt welded to an end termination prior to flexible line assembly.

Bonded Coupling

The bonded coupling provides a mechanical attachment point to the flexible line body to take the tension, torsion, bending, and pressure loads exerted on and by the flexible line body. It also provides for a location to seal the flexible line body from internal fluids, as well as the external environment. A key feature of the bonded coupling is that the ID of the coupling is the same as the ID of the flexible line body eliminating flow restrictions.

Marking

The end connectors are marked with the type of connection, pressure rating, and seal size if applicable. In addition, the flexible line body is marked with the design pressure, rated working pressure, serial number, date of manufacture, fire rating (if applicable) and API monograms as needed. In the event that the flexible line has external stainless steel armor, the identical information is engraved on a stainless ring on each end of the flexible line assembly.

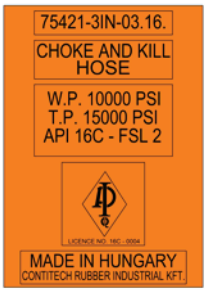


Fig. 4 Flexible Markings

Lifting Collar

Lifting collars are provided with ContiTech flexible lines as required. The collars are stamped with the maximum safe working load. See Section 5.1 for further information on line handling.

Swaged End Fittings

Swaged end fittings are offered for applications where bonded construction is not practical.

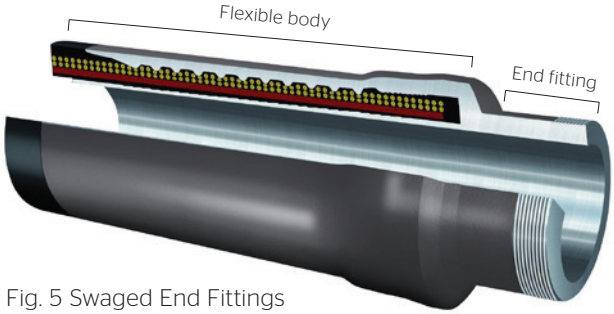


Fig. 5 Swaged End Fittings

Protection Against Corrosion

Swaged end fittings are protected with an all-weather coating to ContiTech standards.

Connectors

Similar to the bonded end fittings, almost any end connection can be offered, however the typical end fittings are hammer unions.

Marking

Swaged flexible lines are marked in a similar manner to the bonded end fitting flexible lines.

Ancillary Components

There are several ancillary components that ContiTech can provide to complement the flexible line assembly for particular service applications.

Swivels

Swivels are devices that allow for rotation between flexible line and hard piping. The use of swivels is highly recommended in situations where the torsional limit of 1deg/m is expected to be exceeded. This is usually in highly dynamic applications such as in vessel Moon Pools. Swivels can be supplied with ABS and/or DNVGL approval as needed by the user.

Bumpers

Bumpers are external devices that are clamped or otherwise affixed to the exterior of the flexible line body. Bumpers are usually made of rubber or plastic depending on the needs of a given application. Upon request, bumpers can be manufactured as an integral part of the flexible line for certain applications.

Shim Rings / Shim Plates

In situations where very precise lengths are required, the use of shim rings or shim plates may be necessary. Shim rings or plates are machined to exact dimensions after the manufacture of the flexible line in order to make up for tolerances that are a natural part of the manufacturing process.

Cross-overs

Cross-overs can be supplied in situations where a user may want to use a flexible line on multiple pieces of equipment, or if the interfaces have been modified or are non-standard.

External Bend-stiffener

External bend stiffeners can be provided for situations such as dynamic risers where the built-in bend stiffener may not meet the user's requirements. This is usually in situations where the flexible line passes through a bulkhead, or it is a requirement for the bend stiffener to be attached to a piece of equipment.

Bend Restrictor

Bend restrictors are different than bend stiffeners. They are comprised of interlocking segments that will lock into place and prevent further bending when a pre-determined bend radius has been achieved. Bend restrictors can be supplied that either attach to a supporting structure, or to the end fitting of the flexible line assembly.

Flotation Elements

Flotation elements can be provided as required to reduce hang off loads, to reduce the submerged weight of a flexible line, or to set a particular configuration of a flexible line in the water column. The elements are available in a variety of configurations for surface or subsea applications.

Optional Components

The following items are optional, and when specified by the user, are built into the flexible line during the manufacturing process.

Fire Rating

Fire-resistant layers can be applied to any flexible line as required by the user or by standards. The fire resistance of the flexible line is designed to meet API Spec. 16C and Lloyds Register OD 1000/499 requirements, and are tested to the same.

Integral Heating Cables

For extremely cold environments, or if the conveyed fluid might freeze in the flexible line, a self-regulating electric heating cable can be incorporated into the line body to maintain the temperature within the service requirements.

Fig. 6 Spiral Guard

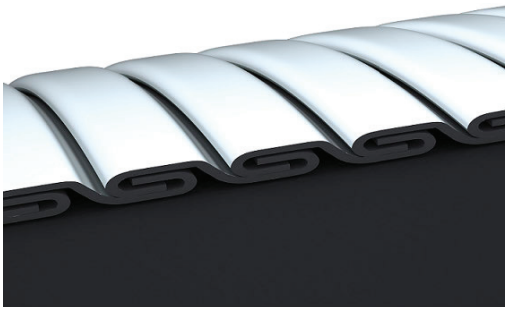


Fig. 7 Stainless Steel Stripwound

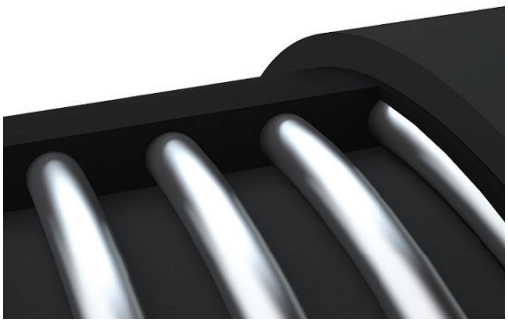


Fig. 8 Heavy Duty Moon Pool

Outer Protection

There are 3 options for additional outer protection: Plastic Spiral Guard, Stainless Steel Stripwound cover, and Heavy Duty Moon Pool Protection.

The Plastic Spiral Guard is designed to provide resistance against light impact loads and abrasion (e.g., light impact loads and scuffing in derrick applications).

The Stainless Steel Stripwound cover provides abrasion resistance, moderate impact resistance, and additional UV protection.

The Heavy Duty Moon Pool is for severe impact loads as would be experienced in the highly dynamic environment of a vessel Moon Pool. Renderings of each style are shown in Fig. 6, 7 and 8.

Contact your local ContiTech office for further information regarding the application of outer protection.

Mechanical Properties

The flexible lines are designed and manufactured to withstand various loads such as:

- Internal pressure (the design pressure or rated working pressure with safety factor as required in the relevant standard)
- Bending (the MBR measured on the centerline of the flexible line)
- External pressure (such as in subsea application)
- Axial loading as required by application
- Crushing and impact loads

Failure Modes

ContiTech flexible lines are extremely reliable due to:

- Inherent strength of design
- Use of the highest quality materials
- Strict adherence to the highest industry standards
- Stringent quality control program

Although ContiTech flexible lines are very robust, misuse of the product may lead to damage of the product. As such, it is important that the user is aware of the most common causes of line failure as follows:

- **Overbending –** If the flexible line is bent beyond the MBR it is possible to damage the inner structure of the flexible line. This may result in irreparable damage of the flexible line. Overbending is typically caused by mishandling during installation or incorrect flexible line configuration.
- **Corrosion of the cables –** Damage to the outer covering of the flexible line that exposes the steel reinforcement cables will allow corrosion to occur on the cables. This reduces their strength, thereby reducing the capacity of the flexible line to the point that the line may leak.
- **Premature aging of the inner liner –** The properties of the inner liner can be affected by the use of the flexible line in service conditions that are beyond the design consideration. Such conditions may include:
  - Extended operations at temperatures above the stated maximum
  - Use of incompatible chemicals or concentrations of chemicals

  Both of these conditions may result in the inner liner becoming brittle and breaking when bent, with or without internal pressure.

  This failure will most likely lead to a high pressure leak.
- **Inner liner collapse –** The inner liner of a flexible line may collapse if a flexible line that is not designed for gas is used in gas service. Diffused gas in the flexible line body may be trapped during a rapid decompression of the line and collapse the inner liner. This may result in the line leaking.

  In order to help prevent user-induced failure, ContiTech can provide Hose Management Services and training to help.

III. Operating Conditions

The following section is a general overview of the limitations for flexible line operability based on the transported mediums. This is not an exhaustive list of factors and is in no way meant to override documentation that is provided with the flexible line at the time of delivery. If there are any doubts as to the suitability of a line for service, contact your local ContiTech office for clarification.

Transported Mediums

Chemical Compatibility of Liners

Compatibility of various liners is given in Table 1. For further details, contact your local ContiTech office.

Table 1 - Compatibility of hose liner with selected chemicals

Medium	Product Liner									
	Tauro™Cool		NBR		HNBR		PA		TauroFlon™
Crude oil	82°C		100°C		100°C		100°C		130°C
Diesel oil	82°C		100°C		121°C		130°C		130°C
Water-based mud	82°C		90°C		90°C		50°C	90°C	130°C
Oil-based mud	82°C		100°C		121°C		130°C		130°C
Ester-based mud	82°C		90°C		N/A		N/A		130°C
Xylene	N/A		N/A		66°C		66°C	100°C	130°C
Methanol	NR		25°C	40°C	25°C		50°C	90°C	130°C
Glycol	70°C		70°C		70°C		70°C		130°C
Hydrogen sulphide (<20%)	N/A		N/A		60°C	90°C	130°C		130°C
Zinc bromide (40%)	30°C	82°C	30°C	90°C	30°C	50°C	25°C	50°C	130°C
Zinc bromide (saturated)	30°C		30°C		30°C	50°C	25°C	50°C	130°C
Calcium bromide (25%)	30°C	50°C	30°C	50°C	90°C		50°C	90°C	130°C
Calcium bromide (saturated)	30°C	50°C	30°C	50°C	90°C		50°C	90°C	130°C
Cesium formate (saturated)	82°C		100°C		100°C	121°C	50°C	100°C	130°C
Potassium formate (75%)	82°C		100°C		100°C	121°C	50°C	100°C	130°C
Acetic acid (20%)	82°C		90°C		90°C		50°C	90°C	100°C
Acetic acid (96%)	50°C		50°C	90°C	50°C	90°C	25°C	50°C	100°C
Formic acid	50°C	82°C	30°C	50°C	50°C	90°C	25°C	50°C	130°C
Hydrochloric acid (15%)	60°C	82°C	60°C	90°C	30°C	60°C	25°C	50°C	130°C
Hydrochloric acid (37%)	30°C		30°C		30°C		NR		130°C
Hydrofluoric acid (3%)	30°C		NR		30°C		25°C	60°C	130°C
Hydrofluoric acid (10%)	NR		NR		30°C		25°C	60°C	130°C
Sodium hydroxide (20%)	N/A		N/A		N/A		50°C		66°C
Produced Water	82°C		100°C		121°C		50°C	90°C	130°C

Max. Operating Temperature for Unlimited Application

Max. Operating Temperature for Limited Application

NR - Not Recommended

Table continued on the next page

Table 1 - Continued

Medium										**Product Liner**
	Tauro™Cool		**NBR**		**HNBR**		**PA**			**TauroFlon™**
Crude oil	180°F		212°F		212°F		212°F			266°F
Diesel oil	180°F		212°F		250°F		266°F			266°F
Water-based mud	180°F		200°F		200°F		122°F	200°F		266°F
Oil-based mud	180°F		212°F		250°F		266°F			266°F
Ester-based mud	180°F		200°F		N/A		N/A			266°F
Xylene	N/A		N/A		150°F		150°F	212°F		266°F
Methanol	NR		75°F	100°F	75°F		122°F	200°F		266°F
Glycol	160°F		160°F		160°F		160°F			266°F
Hydrogen sulphide (<20%)	N/A		N/A		140°F	200°F	226°F			266°F
Zinc bromide (40%)	90°F	180°F	90°F	200°F	90°F	122°F	75°F	122°F		266°F
Zinc bromide (saturated)	90°F		90°F		90°F	122°F	125°F	122°F		266°F
Calcium bromide (25%)	90°F	122°F	90°F	122°F	200°F		122°F	200°F		266°F
Calcium bromide (saturated)	90°F	122°F	90°F	122°F	200°F		122°F	200°F		266°F
Cesium formate (saturated)	180°F		212°F		212°F	250°F	122°F	212°F		266°F
Potassium formate (75%)	180°F		212°F		212°F	250°F	122°F	212°F		266°F
Acetic acid (20%)	180°F		200°F		200°F		122°F	200°F		212°F
Acetic acid (96%)	122°F		122°F	200°F	122°F	200°F	75°F	122°F		212°F
Formic acid	122°F	180°F	90°F	122°F	122°F	200°F	75°F	122°F		266°F
Hydrochloric acid (15%)	140°F	180°F	140°F	200°F	90°F	140°F	75°F	122°F		266°F
Hydrochloric acid (37%)	90°F		90°F		90°F		NR			266°F
Hydrofluoric acid (3%)	90°F		NR		90°F		75°F	140°F		266°F
Hydrofluoric acid (10%)	NR		NR		90°F		75°F	140°F		266°F
Sodium hydroxide (20%)	N/A		N/A		N/A		122°F			150°F
Produced Water	180°F		N/A		250°F		122°F	200°F		266°F

Max. Operating Temperature for Unlimited Application

Max. Operating Temperature for Limited Application

NR - Not Recommended

Hydrolysis Lifetime of PA Liner

PA liners suffer slow hydrolysis at elevated temperatures especially in low pH (acidic) conditions. Details of the process are reported in API 17 TR2 1st Ed. Generally, the duration of exposure to water is not long enough to cause significant property change, but based on API 17 TR2, a calculation methodology is given to check the possible lifetime effect of hydrolysis of PA. Please note, that due to the nature of the bonded (rubber) flexible line construction, even in the case of PA liner damage, only a slow leakage is expected, not a line burst.

A reference point is made at 65°C and pH=7. At these conditions, the calculated lifetime is 200,000 hours.
The cumulated damage can be calculated using Miner's rule in a similar way as shown in Appendix H of API 17 TR2.

Symbols:

t_i: Operating hours in a given temperature range and given pH value

N_{ipH}: Normalizing factor for a given temperature range and given pH value, summarized in Table 2

R_u: Percentage of remaining useful hydrolysis lifetime of the line

The percentage of remaining useful lifetime can be calculated by using the following equation:

$$R_u = 100-[\sum (N_{ipH}\, t_i)/200\,000]x100$$

Table 2 Matrix of N_{ipH} values for the calculation

i	Temp Range	pH 7	pH 6	pH 5	pH4	pH3
1	90-100	29.4882	39.5142	52.9490	70.9516	95.0752
2	80-90	10.1656	13.6219	18.2534	24.4595	32.7757
3	70-80	3.2964	4.4171	5.9190	7.9314	10.6281
4	60-70	1.0000	1.3400	1.7956	2.4061	3.2242
5	50-60	0.2821	0.3780	0.5065	0.6787	0.9095
6	up to 50	0.0735	0.0985	0.1319	0.1768	0.2369

In case **$\sum$ (NipH ti) >** at 200,000 hours, it is recommended to replace the PA lined hose.

Gas Service

Only flexible lines that have been specified for gas service should be used in a service where gas is present. If there is any question on a flexible line's suitability for gas service, please contact your local ContiTech office for clarification.

Sour Service

If sour service is specified for the flexible line then all components of the end-fittings are produced according to the standard NACE MR 0175 / ISO 15156 current editions. In addition, the high-strength steel cables used as reinforcement layers are zinc-coated and are fully embedded in special rubber compound to provide exceptional corrosion resistance.

Depending on the choice of lining, ContiTech bonded flexible lines can tolerate temporary or even permanent sour service with some limitations.

If sour service is not indicated in the flexible line documentation or you need further information on sour service applications, please contact your local ContiTech office given in Section 10.

TauroFlon® Liner

For flexible lines that will see extremely aggressive chemicals and temperatures, it is recommended to use ContiTech's TauroFlon™ liner material. The use of TauroFlon™ is typically recommended for harsh duty Choke and Kill lines and for well acidizing or stimulation lines where aggressive chemicals may be encountered.

Flow Rates

In order to maximize the service life of ContiTech flexible lines and reduce the damaging effects of high-velocity flow; the recommended maximum continuous flow-rate for bonded flexible lines is 15 m/sec for liquid, 20 m/sec for gas service and 8m/sec in the case of gaseous liquid medium. If higher flow velocity is required, please consult your local ContiTech office for available options.

If the fluid has solid content (erosion) or there is a corrosion effect, a detailed calculation should be carried out based on the abrasive properties to determine the anticipated service life of the flexible line.

Temperature Ratings

All ContiTech flexible lines are marked with their temperature rating, either on the flexible line body, or on a stainless band in the case of Stainless Steel Stripwound protection. If there is any doubt as to the temperature rating of a flexible line, please contact your local ContiTech office for assistance.

Standard Temperature Choke and Kill Lines

Standard temperature Choke and Kill lines are designed to be operated between -4°F and 212°F (-20°C to 100°C). If the flexible line is operated above the rated temperature, but below 266°F (130°C), please contact your local ContiTech office with details of the event (temperature, duration of exposure, pH, etc.) to determine the possible effect on the lifetime of the flexible line.

If the flexible line was exposed to temperatures greater than 266°F (130°C), the flexible line should be removed from service and marked as not reusable and replaced with a new flexible line.

High Temperature Choke and Kill Lines

High temperature Choke and Kill lines are designed to be operated between -4°F and 266°F (-20°C to 130°C). If the line is operated above the rated temperature, please contact your local ContiTech office with details of the event (temperature, duration of exposure, pH, etc.) to determine possible effect on the lifetime of the flexible line.

Temperature Excursions

ContiTech flexible lines should not be operated outside of their specified temperature range. However, bonded flexible lines are very tolerant against short term high temperature excursions above their design temperature.

All ContiTech FSL 2 and FSL 3 API Spec.16C Choke and Kill flexible lines are designed and tested to exceed 1 hour of exposure at 350°F (177°C) internal temperature. Copies of the qualification test report are available upon request.

ContiTech flexible lines built to API Spec. 7K, 17K, or fit for purpose in all other applications should be operated within the design temperature range marked on the flexible line. If the operating temperature is beyond the bounds of the design temperature, then it is required to contact your local ContiTech office in order ascertain the effect of the temperature excursion.

Low Temperature Use

Flexible line assemblies may be stored below their minimum design temperature, but they shall not be bent, straightened or uncoiled while below their minimum operating temperature. This can cause cracking of the liner and unexpected failure.

IV. General Procedures

General Handling

Procedure for Handling and Unpacking.

Wooden Crate

1. Transporting the Crate

- Using a forklift truck: lift up the crate under the horizontal stiffeners in the center of the crate. The forklift's forks must be longer than the width of crate (L > W), see Fig. 9.

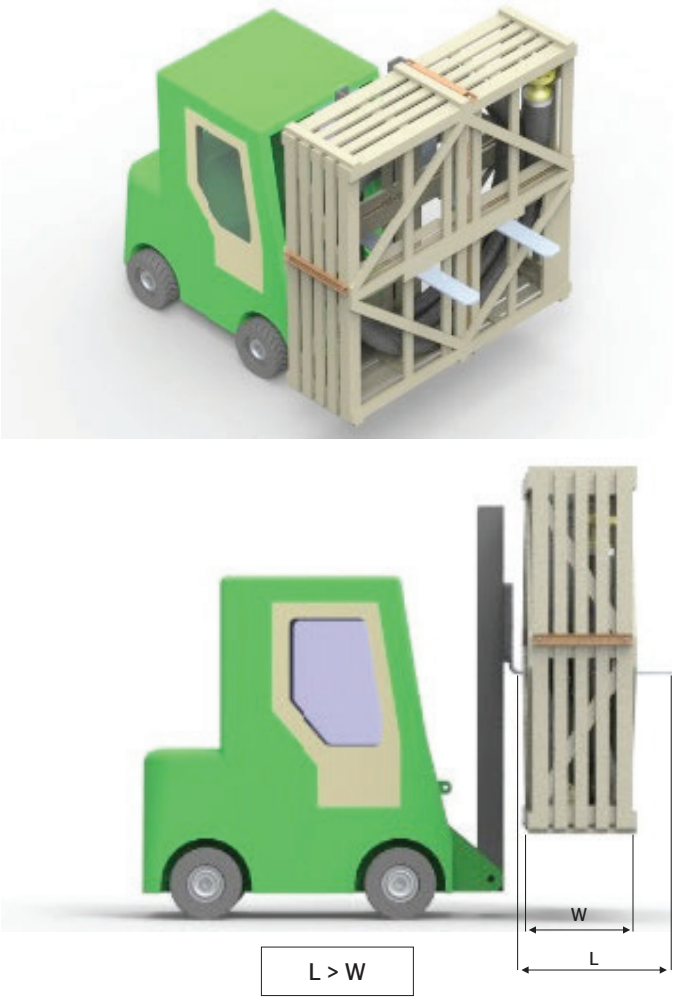


Fig. 9 Lifting wooden crate by forklift

- Using a crane: Lifting slings must be threaded through the middle of the crate, under the flexible line body and around the crate for lifting, see Fig. 10. Use of wire-ropes or chains is forbidden.

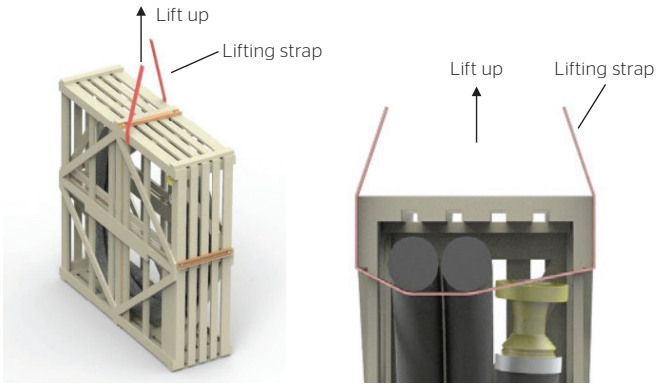
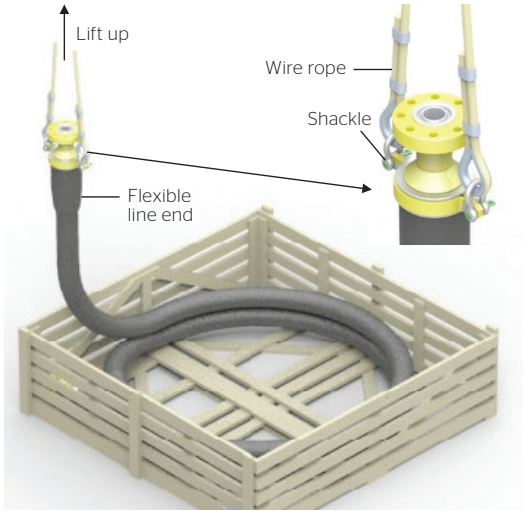


Fig. 10 Lifting by crane

2. Unpacking

- The crate must be laid flat on the ground.
- If the crate contains tie bars (threaded studs located across the middle of the crate), they must be unscrewed and removed. This applies to crate sizes of 2370 x 2300, 2870 x 2800 and 3270 x 3200 mm.
- The side of the crate must be removed as shown in Fig. 11.
- The lifting collar should be attached using the element "C" at the coupling end, lifting slings should be attached to the swivel-crane hook to prevent the flexible line from twisting during lifting, see Fig. 11 showing the use of the double-eyed lifting collar.
- Installation procedures for end connections are shown on Fig. 11.
- Alternatively, if the diameter of the end connector coupling is considerably larger than the coupling's neck, the flexible line can be lifted by choking/tightening with a lifting strap as shown in Fig. 12. The lifting strap has to be wrapped around the neck of the coupling at least two full turns. The sling of the lifting strap has to be fixed to the crane's swivel hook to prevent twisting the flexible line.



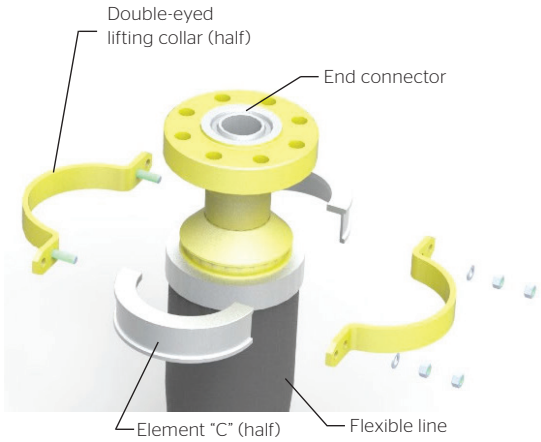


Fig. 11 Unpacking by using lifting collar

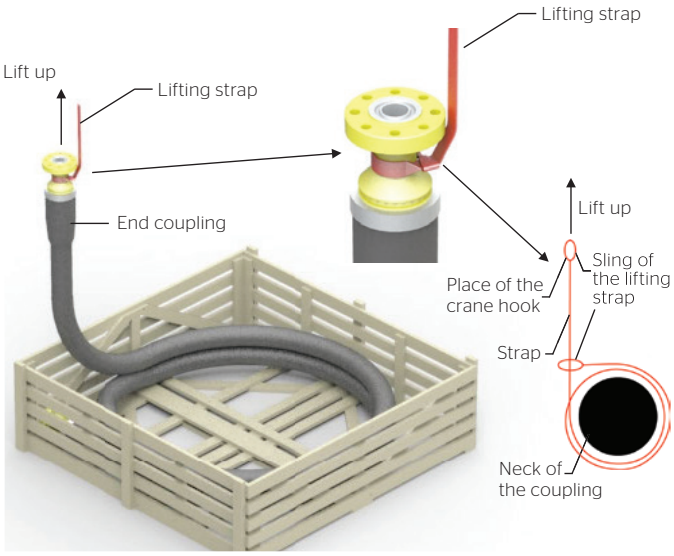


Fig. 12 Unpacking by using sling on the neck of the flexible line assembly

Steel Crate

1. Lifting and Transporting the Crate

- Using a forklift truck: Lift up the crate under the horizontal stiffener in the middle of the crate, see Fig. 13. The forklift truck's forks must be longer than the width of the crate (L > W).

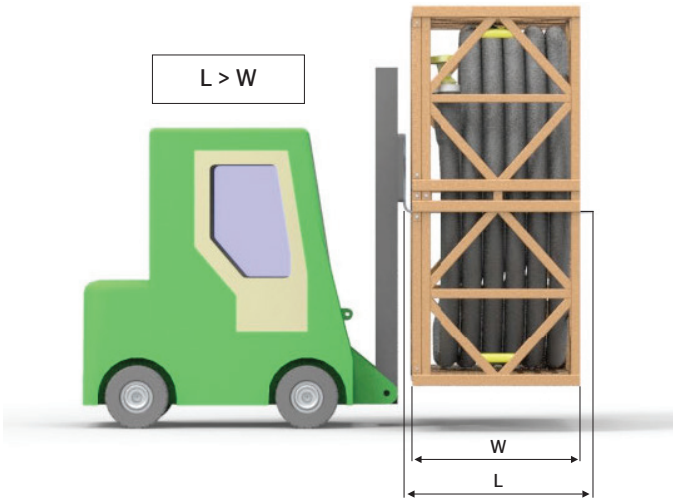


Fig. 13 Lifting steel crate by forklift

- Using a crane: The steel crate can be lifted both in horizontal or vertical position by crane:
  - Lifting in vertical position: Lifting can be on two hoisting points on the cover with minimum 60° rope angle.
  - Lifting in horizontal position: Lifting can be on four hoisting points on the upper side of the laid flat crate with a minimum 60° rope angle.

  The proper orientation and angles of the lifting ropes are shown in Fig. 14.

Caution!
Single point lifting not allowed

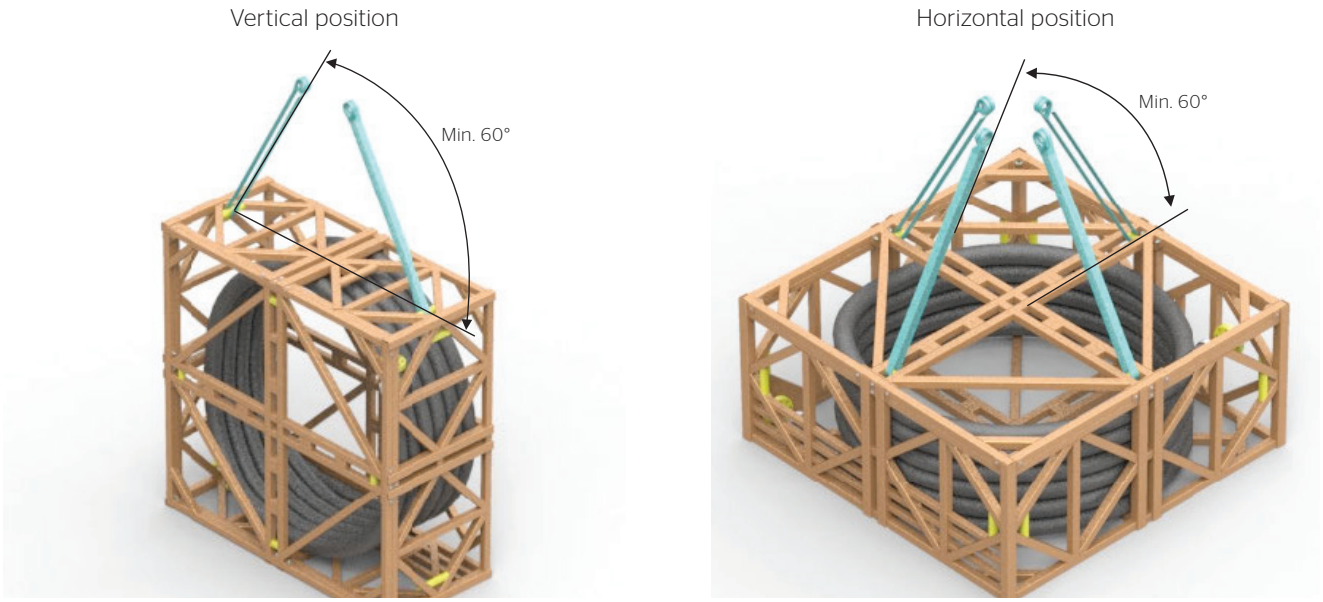


Fig. 14 Lifting steel crate by crane

2. **Storing the Crate:**

The crate can be stored both in horizontal and vertical position (Fig. 15a and Fig. 15b).

Fig. 15a Storing the lines in a vertical steel crate

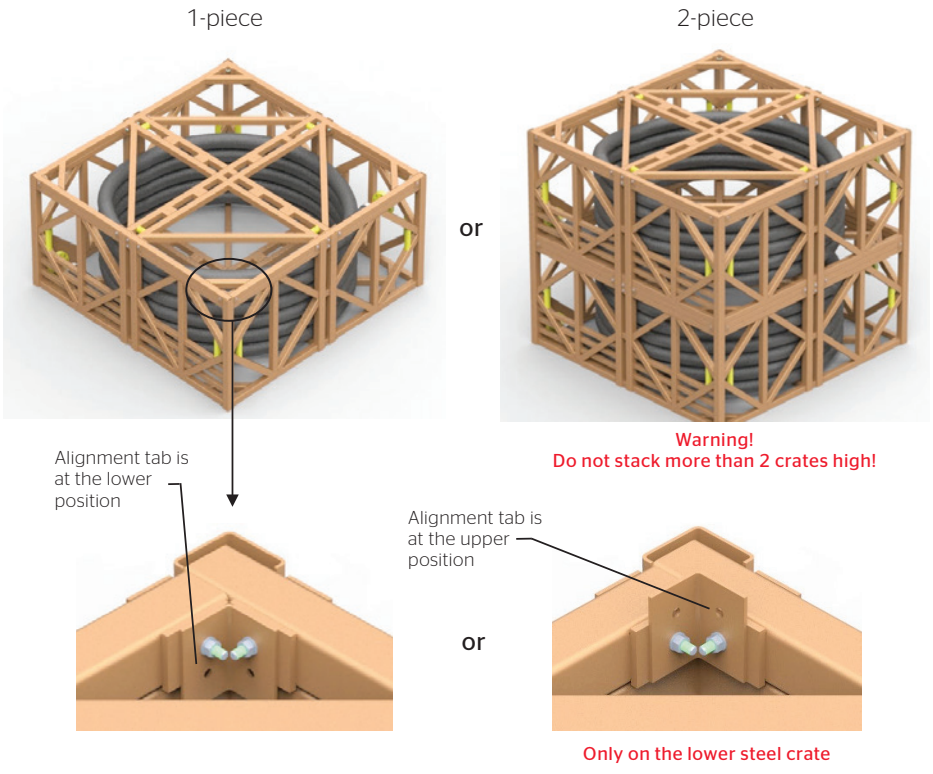


Fig. 15b Storing the lines in a horizontal steel crate

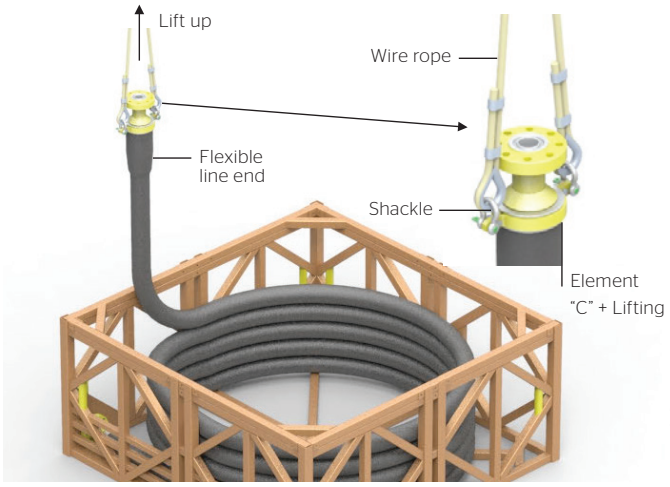
A maximum of 2 crates can be stacked in the horizontal position. If two steel crates are stacked, the lower steel crate's four limiting stops have to be mounted at the upper position in the corners.

Warning! Stacking different type of steel crates is prohibited!

Put nothing on the steel crate!

3. **Unpacking**

- The crate must be laid flat on the ground.
- The top cover plate fixed with bolts and nuts must be removed.
- The fastening bands on the flexible line must be cut.
- The lifting collar should be attached using the element "C" at the coupling end. Lifting slings should be attached to the swivel-crane hook to prevent the line from twisting during lifting. See Fig. 16.
- Alternatively, if the diameter of end connector of a coupling is considerably bigger than the coupling's neck, the flexible line can be lifted with a lifting strap. See Fig. 17. The lifting strap has to be placed on the neck of the coupling on the finishing end in at least two full turns. The sling of the lifting strap has to be fixed to the crane's swivel hook.



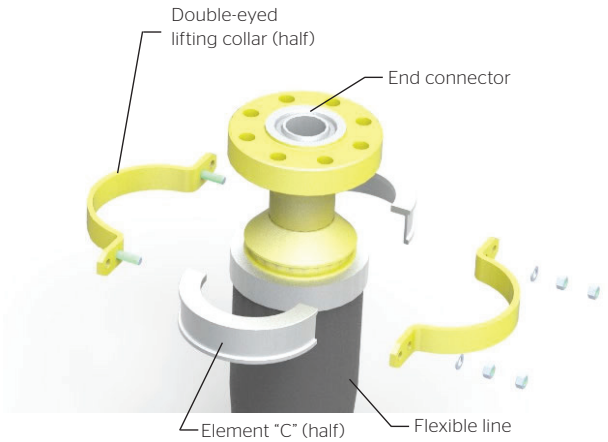


Fig. 16 Lifting the line from the crate using the lifting collar

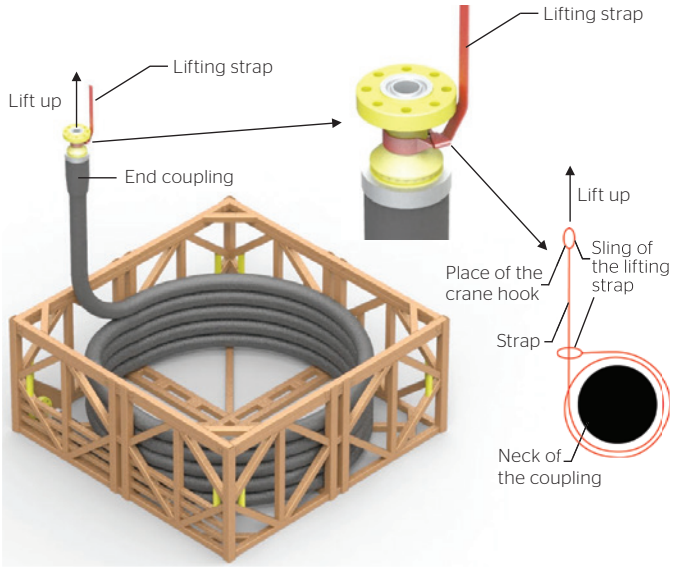


Fig. 17 Alternative method of lifting the flexible line from the crate

Lying Flat Pallet

The lying flat pallet must be transported and stored in a horizontal position.

The flat pallet must not be turned on its side.

Transport the flat pallet using a crane or forklift truck.

1. Transporting the Lying Flat Pallet

- Using a forklift truck: Lift up the flat pallet under the main beam of the pallet. The forklift truck's forks must be longer than the width of pallet.

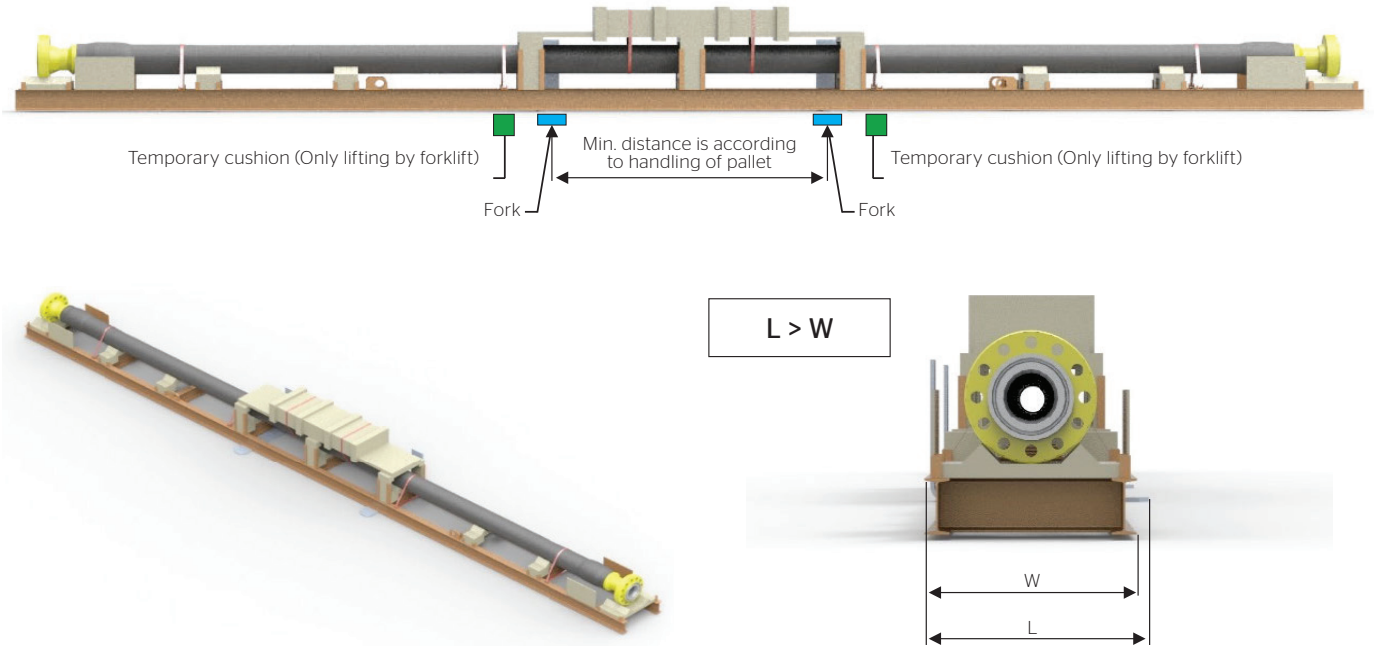
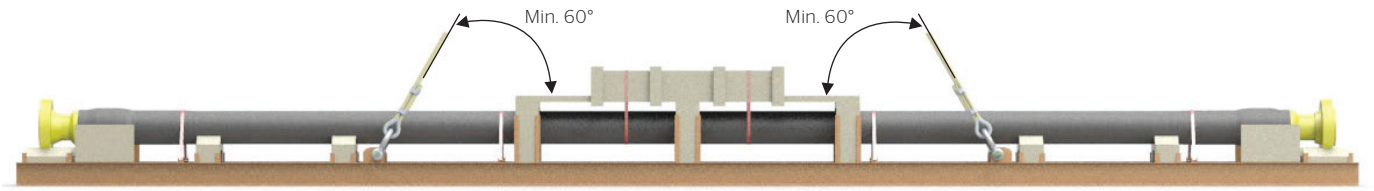


Fig. 18 Lifting laying flat pallet by forklift

- Using a crane: Lifting can be on the four hoisting points with a minimum 60° rope-angle.



Min. length of the lifting rope: according to the handling of pallet.
Load bearing capacity of the lifting rope: according to the handling of pallet.

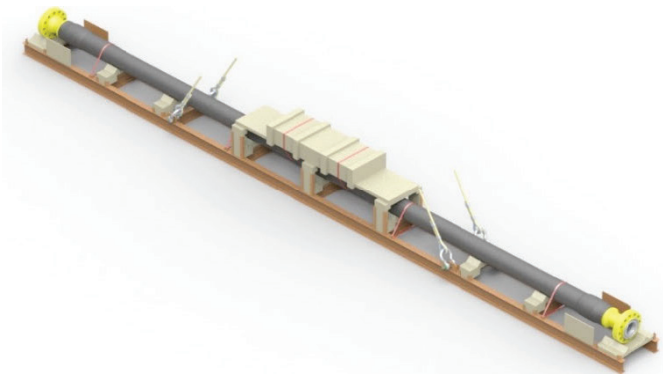


Fig. 19 Lifting laying flat pallet by crane

2. Unpacking

- The fastening bands on the flexible line must be cut.
- If the flexible line is shorter than 35 feet, lift the line using the lifting beam. Alternatively, when a lifting beam is not available, use wire ropes with lifting straps. The lifting straps should be a minimum 6 inches wide. Do not lift the line with wire ropes!

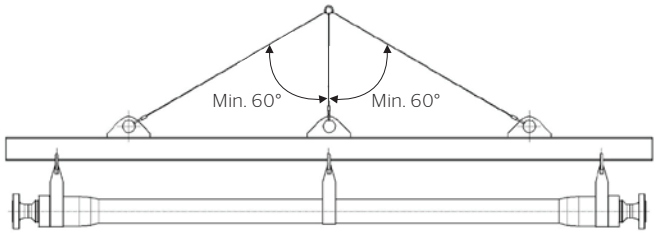


Fig. 20 Lifting lines by lifting beam

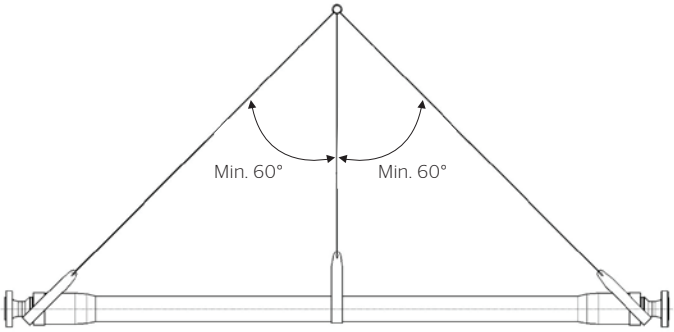


Fig. 21 Lifting short lines (max. 35 ft.) with slings

If the flexible line is longer than 35 feet, a lifting beam must be used with a maximum of 3 meters between lifting points. Use lifting straps at a minimum of 6 inches wide. Do not lift the line with wire ropes!

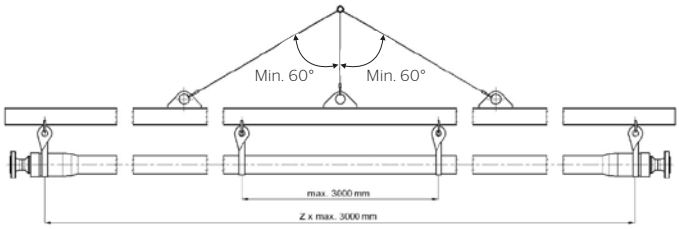
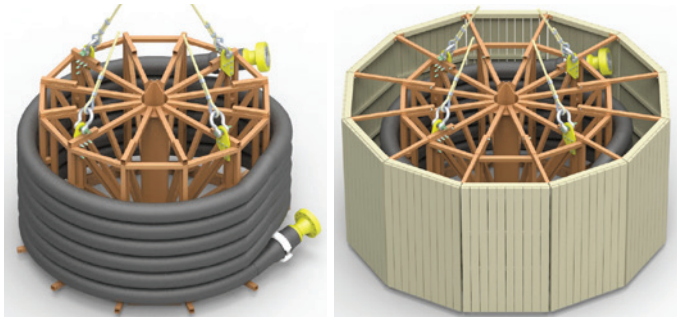


Fig. 22 Lifting of lines longer than 35 ft. by lifting beam

Other Packing Types (e.g.: Lying Drum, Steel Pallet (Frame), etc.)

Although less common, for long lengths, lying drums are used for the transport and storage of ContiTech flexible lines. Specifications of the drums, including design drawings, are part of the manufacturing record book as they are designed to the weight and lifting requirements of the transported flexible assembly.

In general, the drums are supplied with 4 lift points on the top of the drum. All 4 lifting points should be used for lifting the drum, with a minimum rope angle of 60°. A general arrangement drawing of a typical drum is shown in Fig. 23.



Without External Protection | With External Protection

Fig. 23 Typical transportation drum

Transport drums are typically not set up to be drum fork-liftable due to the normally high weight of such flexible lines. If it is desired to have the drum fork-liftable, please discuss this with your local ContiTech office during the quotation period.

Steel pallet frames are used in situations where the flexible properties are such that reeling is not an option. In such cases, the flexible should be lifted as shown in Fig. 17 & 18 unless specific instructions to the contrary are provided in the documentation package provided with the flexible lines. A general arrangement drawing of a steel pallet frame is shown in Fig. 24.

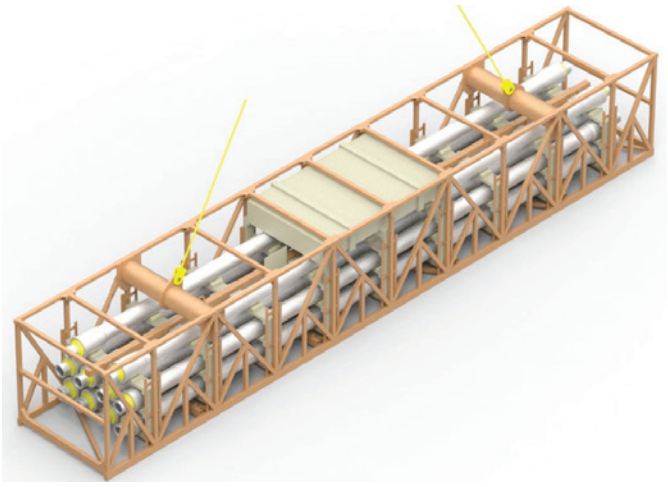


Fig. 24 Typical transportation steel pallet

Preservation

Short-Term Preservation (up to 6 months)

All flexible lines provided by ContiTech have short-term preservation measures taken to ensure that they arrive to the customer in perfect condition. Short-term preservation includes:

- Depending on end connection, plastic covers or caps.
- Wrapping of end connection with protective fabric.
- Loose items (e.g., safety chains) are wrapped and crated.

Long-Term Preservation in the Factory (over 6 months)

The long-term preservation contains:

1. **Inside of our flexible lines:**
   - Water flushing and subsequent hot air jetting.
   - Aquavap® coating on the unpainted carbon steel surfaces.
   - Nitrogen purging and capping.
2. **Outside of our flexible lines:**
   - General protection (end couplings closed with plastic caps or rubber plates and the surfaces above the whole length of couplings wrapped with protective fabric).
   - Protection of flexible line body with UV-resistant plastic foil and technical fabric.

Long-Term Preservation and Storage of the Flexible Lines by the Customer

In case of long-term (over 6 months) storage, the following steps are recommended:

- Water flushing.
- Hot air jetting between 75°C and 85°C to remove residual moisture.
- Protect the uncoated steel surfaces with grease.
- Close the ends of the flexible line with caps or plastic wrapping.
- Protect the surfaces above the whole length of the couplings.
- It is preferable to store the flexible line in its original crating, but it is not required as long as the storage method does not bend the flexible line beyond design MBR.
- Store the flexible lines indoor if possible, and/or protect the outer surfaces of the flexible line from environmental effects by UV-resistant plastic film or textile.
- Store the flexible line above the lowest design temperature.

Storage

In case of long-term storage (over 6 months) indoor storage is recommended.

> If the flexible line has been stored below its minimum design temperature, it does not need to be uncoiled or otherwise moved from the box, crate or pallet until the temperature of the flexible line body is above the minimum design temperature. Bending or uncoiling the flexible line below its minimum design temperature may lead to non-repairable liner damage, resulting in loss of warranty.

General Installation Procedure

Prior to installation, check the flexible lines integrity, ensuring end couplings are free from any damage and that the coupling seals are fitted correctly.

- If the flexible line has been in storage greater than 5 years, a major inspection of the line is recommended.
- Do not exceed the flexible line MBR.
- On request, ContiTech can perform a flexible line length analysis using Orcaflex® modeling software to ensure the proper configuration of the flexible line.

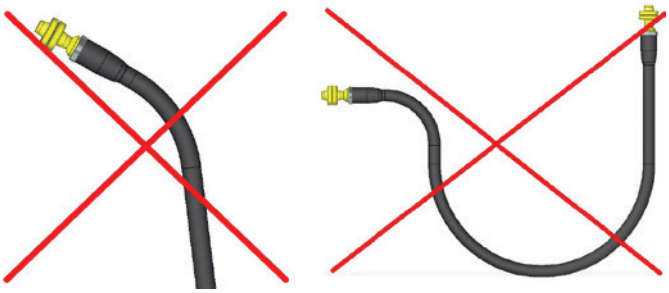


Fig. 25 Configurations to avoid

Fig. 26 Example of recommended configuration

After installation, the use of safety clamps is recommended for all applications. A guide to the installation of such clamps is shown in Fig. 27.

Note: Lifting by safety clamps is not permitted, as it may overbend the line.

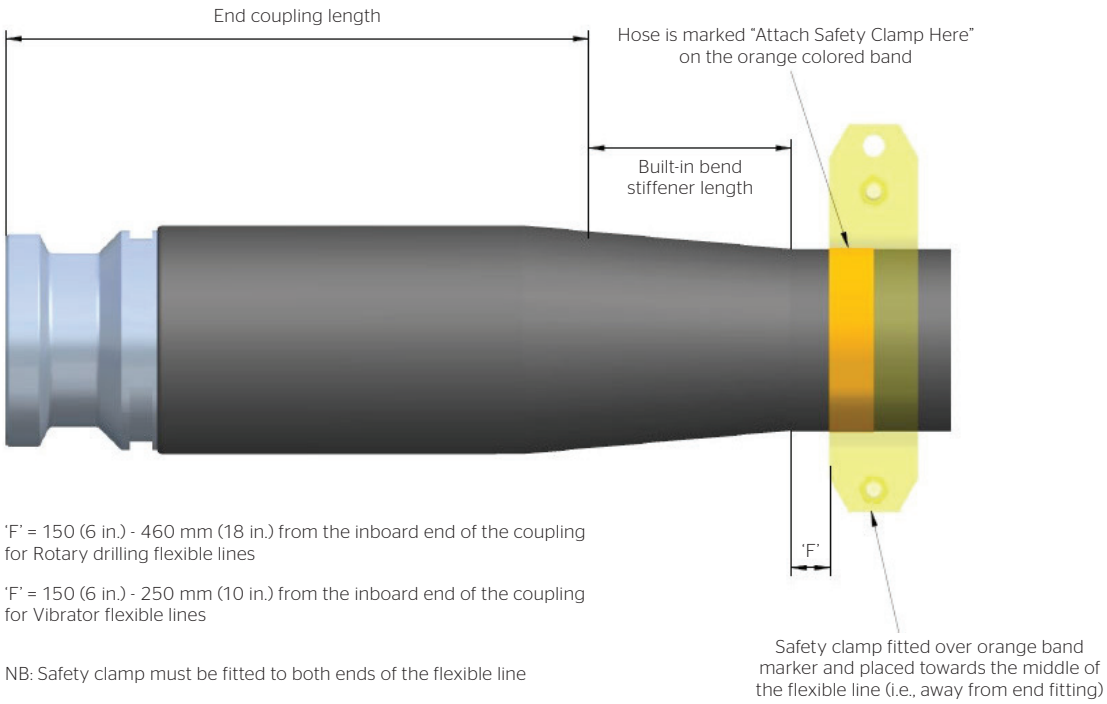


Fig. 27 Installation of safety clamp

V. Service Life

ContiTech flexible lines for drilling applications are designed to provide a long service life under typical conditions. This service life is based on the assumption that the flexible lines are not subject to temperature, chemicals, handling or installation that is not in line with the design specification for the flexible line.

The actual service life of a ContiTech flexible line depends greatly on service conditions and design requirements. In drilling applications, it is typically unrepaired external damage that limits the lifetime of the flexible line, therefore quickly repairing cover damage is essential to maximizing its lifetime.

Fatigue of the reinforcement cable may be a lifetime limiting factor. At a customer's request, lifetime calculations can be performed by ContiTech. Estimation of the service life is based on analysis, and it is required that the input data for the analysis is provided by the user. Changes in operating conditions could have significant effect on flexible line lifetime.

VI. Inspection Guidelines

This section is a general guideline for inspection. In case of any request, please contact the your local ContiTech office.

General

It is essential to care for and pay attention to the flexible line once installed and in service to maintain its integrity throughout its working life. By embracing the following guidelines and operating the flexible line within its design parameters, the user can maximize the service life of the flexible line.

The frequency and degree of inspection is dependent upon the possible failure modes of the flexible line, its criticality and severity of service. It is recommended that the user records all inspection data throughout the lifetime of the line. This will be used by the manufacturer in evaluating the condition of the flexible line during the inspection schedules.

In general, the flexible line should be inspected on a regular on-going basis. The frequency and degree of the inspection should as a minimum follow these guidelines:

- **Every 3 to 6 months:** Visual inspections – page 19 (Or during installation/removal)
- **Annually:** In-situ pressure test – page 19 (In addition to the 3-to-6 month inspections)
- **After initial 5 years of service:** Major inspection – page 20
- **Subsequent 3-year life cycle:** Major inspections – page 20

3-to-6 Month Visual Inspection

The flexible line is visually inspected externally by a competent person (preferably from the manufacturer) while installed and operating in line with Energy Institute Guidelines for the Management of Flexible Line Assemblies. All observations should be noted and logged. This is a critical early inspection technique where potential damage can be identified early, allowing remedial action to be taken before major line damage is induced.

The outer cover of the flexible line body is visually inspected for signs of abrasion, looseness, kinks, bulges, soft spots, cuts or gouges. The back of the bend stiffener area behind the coupling should be checked for such signs and any possibility of over-bending. Dimensional checks of this area taken at approximately 12 in. (300 mm) and 51 in. (1300 mm) from the ends should be considered to show changes in line diameter, from possible breakdown of the lining to coupling bonding, allowing pressure/medium to penetrate the line carcass.

Particular attention shall be paid to potential contact points between the flexible line and neighboring steelwork or equipment. Where possible, the line should be suitably guarded from potential abrasion or impacting.

Annual Field Pressure Test

A pressure test to verify the integrity of the flexible line body and its connections should be performed in accordance with this guideline or local testing procedures. The test is performed as installed and configured. For information on test pressures and hold durations see Table 3.

Table 3 - Annual In-Situ Test Pressure and Hold Requirements

Flexible Line Type	Test Pressure*	Hold Duration
API 7K Rotary & Cement	1.25 x Line-rated working pressure. If this pressure cannot be achieved, the test should be performed at the maximum allowable working pressure of the system.	10 Minutes
API 16C Choke and Kill	1.1 x Line-rated working pressure. If this pressure cannot be achieved, the test should be performed at the maximum allowable working pressure of the system.	1 Hour
API RP17B Production & Gas	1.1 x Line-rated working pressure. If this pressure cannot be achieved, the test should be performed at the maximum allowable working pressure of the system.	1 Hour
API 17K Production, Gas & Liquid Service	1.1 x Line-rated working pressure. If this pressure cannot be achieved, the test should be performed at the maximum allowable working pressure of the system.	1 Hour

In some cases, local system operating conditions will dictate pressure test parameters (e.g., PRV/Bursting disc ratings). The user may stipulate pressure limitations based on operational conditions. Discussions will take place to ascertain that these pressures will fulfill the requirements of this procedure.

During the pressure test, the flexible line should be examined for any leaks, especially in the area of the end couplings, any bulging of the flexible body, undue twisting or abnormal distortion. Any pressure drop during the test should be recorded and should not exceed 2% of the test pressure. (Please note that temperature variations can have an impact upon pressure drop. In such circumstances, please contact your local ContiTech office).

5-Year Service Guidelines

A flexible line should be considered for a major inspection after it has been in service or storage for a period of 5 years, thereafter, on a 3-year cycle (i.e., next major inspection at 8, 11, and 14 years, etc.). If it is not practical, carry out inspection within +/- 0.5-year, then consult the manufacturer. It is recommended that the major inspection be performed by the OEMs qualified and trained personnel. The following are the recommended minimum requirements for a major inspection:

1. External Inspection of the Flexible Line

Reference the 3- to 6-Month Visual Inspection procedure on page 19.

2. Internal Borescope/Camera Inspection

Video recording equipment is required to inspect the flexible bore and inside surface of end couplings. The flexible bore must be cleaned internally to remove oily traces ensuring clear viewing as follows:

- The flexible bores should be flushed with water in accordance with local flushing procedures. If possible, the last flush should be sampled to check for process residue. This sampling and purging may be followed by a “Foam Pigging” operation if necessary.
- Observations will be made of the rubber liner for bulges, bubbles, cuts or abrasion. Where a metallic liner is evident, the surface is observed for cracks, deformations or abrasion.
- When this internal inspection is not performed by the manufacturer, it is recommended that the inspection is recorded and made available to the manufacturer for evaluation/comment.
- Where the flexible bore has a metallic inner carcass, the operational data should be reviewed by the manufacturer.

3. Pressure Test

A pressure test shall be performed on the flexible bore using water to verify the integrity of the flexible body and its connections as per Table 4:

- The flexible pressure is to be monitored via a pressure gauge and charted during the entire duration of the hydrostatic pressure test.
- Access will be strictly controlled during the test. Nominated test personnel will only be allowed to investigate test anomalies (which become evident when the flexible bore is at the test pressure) with the pressure taken back to zero.
- Upon test completion, reduce pressure to atmospheric levels in a controlled manner, and the results and recorded data should be reviewed for the report.

4. Drag Chain In-situ Inspection and Pressure Test

Due to the difficulty of removing the high pressure flexible bores from the drag chain structure for inspection, ContiTech can offer inspection, pressure testing and recertification in operational positions.

Table 4 - Major Test Pressure and Hold Requirements

Flexible Type	Test Pressure*	Hold Duration
API 7K Rotary & Cement	1.5 x Line-rated working pressure	1 Hour
API 16C Choke and Kill	1.5 x Line-rated working pressure	1 Hour
API RP17B Production & Gas	1.5 x Line-rated working pressure	4 Hours
API 17K Production, Gas & Liquid Service	1.5 x Line-rated working pressure	4 Hours

*All high pressure flexible line types, no matter what API rating, will be tested at 1.5 x rated working pressure and test duration as per OEM recommendations

Client's Responsibilities

The following are the responsibilities of the client if ContiTech is contacted to conduct the inspection/recertification:

- Suitable flexible line end restraint should be provided to prevent movement of the flexible body during testing.
- Permits and isolations must be in place before work scope commences.
- Flexible body must be internally cleaned and flushed prior to breaking containment.
- Scaffolding as required must be in place for safe working platforms.
- Certified rigging equipment must be installed to allow access to flexible line end couplings.
- Disconnection of flexible lines from pipework and raising of flexible couplings to a suitable height for internal inspection.
- Reconnect flexible lines after inspection and testing.
- Provide authorized manpower for bolt torque settings.

VII. Flexible Line Repair

Cuts or gouges in the outer covering of the flexible line should be addressed immediately. Damage to the outer cover that is not too deep and does not expose the steel cables can be repaired by the manufacturer's qualified technicians using recommended repair materials. However, if this damage exposes the pressure retaining steel cables, then the integrity of the assembly has been compromised and the flexible line should be condemned. If there are any questions about the extent of external damage to a flexible line, please contact your local ContiTech office.

VIII. Application Specific Procedures

Rotary & Vibrator Flexible Lines

The products built to the API 7K latest edition standard are:

- Rotary drilling flexible lines, which are used as the flexible connector between the top of the standpipe and the swivel that allows for vertical travel. These hoses are usually 13.5 m (45 ft.) or longer depending on the hose configuration.
- Vibrator flexible lines, which are used as flexible connectors between the mud pump manifold and the standpipe manifold, to accommodate alignment and to isolate vibration. These hoses are usually 9.1 m (30 ft.) or less in length.

The typical fluid of a Rotary & Vibrator flexible line is gasless oil or drilling mud (water- and synthetic-based), but in some special cases the flexible lines are suitable to handle hydraulic fluid, cement slurry, water (industrial or seawater), etc.

All labelled API 7K flexible lines manufactured by ContiTech are subjected to and have successfully completed all relevant prototype tests including pulsation tests (if applicable) according to what is shown on the line markings.

The definition of API 7K FSL levels are as follows:

- FSL 0: Without pulsation test. Use this flexible line only for cementing.
- FSL 1: Low frequency pulsation test (these flexible lines are not designed for directional drilling application).
- FSL 2: High frequency pulsation test (these flexible lines are designed for directional drilling application).

In order to avoid the kinking of flexible lines, the length of line and height of standpipe should be such that while raising or lowering the traveling equipment, the bending radius of the line will not be less than the value of the MBR. This usually occurs at the swivel when the traveling equipment is in its lowest drilling position, and at the standpipe when the traveling equipment is in its highest drilling position. The recommended length of the line is given by the following equation see Fig. 26:

$$LH = LT/2+\neq R+2C+S$$

Where:

LH: Length of hose, m (ft.)

LT: Length of hose travel, m (ft.)

R: Minimum radius of bending of hose (see API Spec 7K, Table 7 and C.1 for MBR value). Note: The MBR for certain hoses may be less than the value provided in this table, m (ft.)

C: Coupling length, m (ft.)

S: 0.3 m (1 ft.) allowance for hose length tolerance and contraction when internal pressure is applied

* Please contact your local ContiTech office if there are any uncertainties on the configuration of the flexible line.

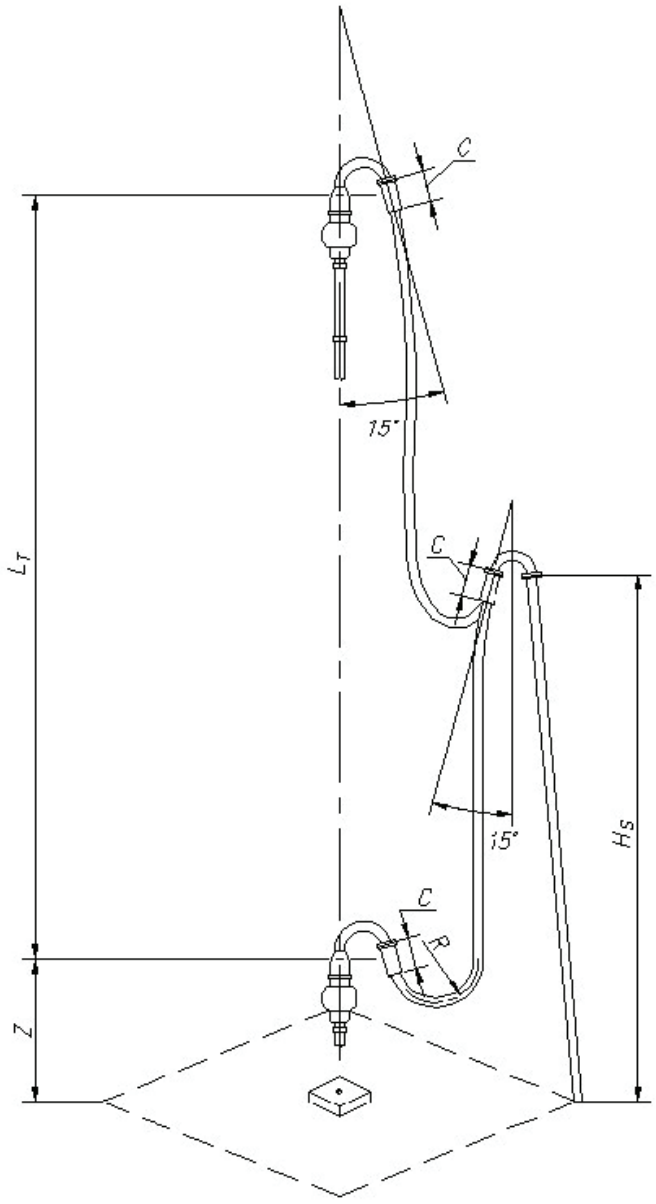


Fig. 28 Sketch to determine rotary flexible line length

There are some products, which are not defined in the Standard API 7K specification, but users are purchasing them with special requirements (e.g., to a special liquid, temperature or pressure).

Such flexible lines can be:

- Large bore hydraulic flexible lines (at top drive drilling rigs).
- Compensator flexible lines at floating platforms.
- Decoking flexible lines for coke producing towers.
- Drag chain flexible lines for drilling platforms.
- Kelly, mud flexible lines.
- Booster flexible lines, etc.

Rotary & Vibrator Flexible Lines with Bonded Coupling

Rotary & Vibrator flexible lines with the factory-bonded coupling always have integral bend stiffeners as part of the assembly. Upon request, specialized bend stiffeners can be designed to give maximum protection against over-bending the flexible line near the coupling.

The bonded coupling allows the use of swivel-lifting collars for the easier handling of flexible line assembly.

The typical inner diameter of these flexible lines are 2", 2.5", 3", 3.5", 4", and 5" and the usual rated working pressures are 5000 psi and 7500 psi with a test pressure 1.5 times rated working pressure per API Spec. 7K standard. The basic operating temperature range is -13°F to 212°F (-25°C to 100°C).

For chemical compatibility, please look for page 7. For other temperature ranges e.g. extreme high or cold temperatures see page 7.

Rotary & Vibrator Flexible Lines with Swaged Coupling

Swaged couplings are mechanically fixed on line bodies using a hydraulic swaging machine. Since they do not contain integral bend stiffener, special care should be taken to avoid over-bending near the coupling.

Usual sizes are 2", 3", 3.5", and 4" with a working pressure rating of 5000 psi. The test pressure per API 7K is 1.5 times rated working pressure.

Rotary & Vibrator Flexible Lines for High Temperature Drilling and Sour Service

Rotary & Vibrator flexible lines for high temperature and sour service are manufactured with factory-bonded couplings. The main difference between the basic Rotary & Vibrator flexible lines with bonded coupling and the high temperature drilling and sour service line is in the flexible line body. This construction has a special HNBR lining and special cushion layers which withstand the more aggressive conveyed fluids and increased temperatures.

Typical inner diameter of these flexible lines are 2", 2.5", 3", 3.5", 4" and 5", and the rated working pressures are 5000 psi and 7500 psi, with test pressures 1.5 times rated working test pressure, according to API Spec. 7K standard. The basic operating temperature range is -22°F to 250°F (-30°C to 121°C). For chemical compatibility, please look for page 7.

Tauro™ Cool Rotary & Vibrator Flexible Lines for Arctic Drilling

All of the flexible lines ContiTech makes for Arctic drilling are manufactured with factory built-in couplings. The main difference between the basic Rotary & Vibrator flexible lines with built-in coupling and the Tauro™ Cool Rotary & Vibrator flexible lines is in the line body. This line construction has a special oil- and low-temperature resistant liner, as well as special cushion and cover layers that withstand both the conveyed fluid and the extreme low temperature.

The typical inner diameter of these flexible lines are 2″, 2.5″, 3″, 3.5″ and 4″, and the rated working pressures are 5000 psi and 7500 psi, with test pressure 1.5 times rated working test pressure, according to API Spec. 7K standard. The basic operating temperature range is -40°F to 180°F (-40°C to 82°C).

For chemical compatibility, please see Table 1 on page 7.

This type of flexible line is recommended for Arctic areas only.

Underbalanced Drilling Line

Underbalanced drilling lines are manufactured with factory built-in couplings. Lines designed for underbalanced drilling operations are constructed with a gas decompression resistant PA liner. More frequent borescope inspection of the innermost layer is recommended as in air foam and mist drilling this layer is exposed to severe loads due to the carried gasses and blisters and other damages might occur under the combination of special circumstances.

The typical inner diameters of these flexible lines are 2", 2.5", 3", 3.5" and 4", and the usual rated working pressures are 5000 psi and 7500 psi, with test pressure 1.5 times rated working test pressure according to API Spec. 7K standard. The basic operating temperature range is -4°F to 180°F (-30°C to 82°C). For chemical compatibility, refer to pages 7-9. It should be noted that these flexible lines are not rated for well effluents and as such are not suitable for MPD applications.

Managed Pressure Drilling Mud Return Lines

MPD mud return lines are usually the largest diameter and longest flexible line hanging in the Moon Pool area of offshore drilling units. These flexible lines are carrying drilling mud and cuttings back from the wellbore to the MPD manifold. Sometimes (based on the drilling contractor's and operator's procedure) these lines might see well effluents (gasses) or sacrificial fluids injected into the wellbore. The liner compatibility to wellbore effluents, axial pulling capacity due to the long lengths, and external collapse resistance should be taken into account during design based on the API 17K standard.

In harsh conditions and certain configurations, these flexible lines can be exposed to a high level of wear due to clashing with the Moon Pool and the drilling riser. After each job, the external cover of the flexible line should be inspected for damage and repaired as needed.

ContiTech's standard external protection for MPD applications is a Heavy Duty Moon Pool Protection as described on page 5. As the helix is not a load bearing element, even if the cover is damaged exposing the helix, the flexible line is still functional.

It is further recommended that in applications where the flexible line will be in the Moon Pool of a vessel that bumpers be used to provide protection from the most severe clashing. More frequent borescope inspection of the innermost layer is recommended due to the potential for erosion caused by the conveyed mud and cuttings.

The typical inner diameters of these flexible lines are 5", 5.5", and 6", and the usual rated working pressures are 2,000 psi, 3,000 psi and 5,000 psi, with test pressure 1.5 times rated working test pressure, according to API Spec. 17K standard.

Managed Pressure Drilling Bleed-Off Line

MPD bleed-off lines are usually similar in length to the mud return lines, but smaller in diameter than the mud return lines. These are used for pressure equalization purposes in certain MPD techniques. In some circumstances, these lines might see well effluents (gasses) in addition to drilling mud.

In harsh conditions and certain configurations, these flexible lines can be exposed to a high level of wear due to clashing with the Moon Pool and the drilling riser. After each job, the external cover of the flexible line should be inspected for damage and repaired as needed.

ContiTech's standard external protection for MPD applications is a Heavy Duty Moon Pool Protection as described on page 5. As the helix is not a load bearing element, even if the cover is damaged exposing the helix, the flexible line is still functional.

It is further recommended that in applications where the flexible line will be in the Moon Pool of a vessel that bumpers be used to provide protection from the most severe clashing. More frequent borescope inspection of the innermost layer is recommended due to the potential for erosion caused by the conveyed mud and cuttings.

The typical inner diameter of these flexible lines are 2" and the usual rated working pressures are 2000 psi, 3000 psi and 5000 psi.

Cementing Line

Cementing lines are manufactured with factory-bonded couplings.

The typical inner diameter of these lines are 2", 2.5" and 3", and the rated working pressures are 10,000, 15,000 and 20,000 psi, with test pressure 1.5 times rated working test pressure, according to API Spec. 7K standard. The basic operating temperature range is -13°F to 212°F (-25°C to 100°C), but ContiTech has cement flexible lines available with a maximum temperature of 250°F (121°C). For some information for the chemical compatibility, please see Table 1 on page 7.

Note: Cement flexible lines need to be flushed with water after service. Solidified cement slurry will damage the flexible line.

Choke and Kill Flexible Lines

All Choke and Kill flexible lines made by ContiTech are manufactured with bonded couplings. The function of flexible Choke and Kill lines is defined in API Spec 16C 10.8 as follows: Flexible Choke and Kill lines are an integral part of the surface and subsea blowout prevention equipment required for drilling well control. The flexible Kill line provides a means of pumping fluid into the wellbore, when normal circulation through the drill string cannot be employed. The Choke and Kill line and manifold provide a means of applying back pressure on the formation, while circulation of formation fluid influxes into the wellbore following a "kick".

The flexible Choke and Kill (C&K) lines made by ContiTech are designed and produced for land based drilling and offshore topside applications. For subsea application, the user must specify the water depth requirements at the time they place an order.

In cases where an extremely small bend radius is required, such as on the LMRP, preformed Tauro™ Fit Choke and Kill lines can be used.

All labelled API Spec. 16C flexible lines manufactured by ContiTech have successfully completed all relevant prototype tests, including pulsation tests (if applicable) what is shown on the line labeling plate.

Flexible Specification levels for API Spec. 16C Flexible Line:

- FSL0 includes all design, material and design validation test requirements in 16C 10.8, B.12.1, B 12.2 (Hydrostatic internal pressure test, Bending flexibility, Burst test), and B12.3 (Exposure test).
- FSL1 includes FSL0 and the requirements of B12.4 (Flexible line fire test).
- FSL2 includes FSL0 and the requirements of B12.5 (Flexible line high temperature exposure test).
- FSL3 includes FSL0 and the requirements of B12.4 (Flexible line fire test) and B12.5 (Flexible line high temperature exposure test).
- Typical inner diameter flexible lines are 2", 2.5", 3", and 4". The rated working pressures are 5,000, 10,000, and 15,000 psi, with test pressure 1.5 times rated working test pressure, according to API Spec. 16C standard. The operating temperature range is -4°F to 212°F (-20°C to +100°C) or 0°F to 250°F (-18°C to 121°C) up to 266°F (130°C).

For chemical compatibility see Table 1 on page 7.

Note: It is mandatory to replace Choke and Kill lines from the system if:

- Fire in the system.
- Maximum rated operating temperature or pressure was exceeded during a kick situation.
- External or internal damage revealed by inspection.

Mud Booster Flexible Lines

This flexible line is part of the mud booster line, carrying mud and drill cuttings. The mud booster line is an auxiliary line which provides supplementary fluid supply from the surface to the drilling riser booster lines.

For chemical compatibility, see Table 1 on page 7.

Since it is in the Moon Pool area, external protection and frequent external inspection is recommended. In case of damage to the cover, repair should be carried out as soon as possible.

External bumpers are recommended to mitigate risk of cover damage.

Hydraulic Conduit

The main purpose of this flexible line is to provide hydraulic pressure supply to the BOP functions and operations. Hydraulic conduit flexible line is used, as they can accommodate the relative motion and/or vibration encountered on the drilling facility.

If in the Moon Pool, extra protection and more frequent visual inspection is recommended.

For chemical compatibility, see Table 1 on page 7.

Blowout Preventer Control Flexible Lines with Fireshield™

BOP control lines are fire rated according to API Spec. 16D. They are supplied with or without external armoring. For offshore topside application, frequent visual inspection is recommended.

Well Test

During well testing, usually two high pressure flexible lines are used: a Well Test Production Line conveying hydrocarbons from the well to the surface and a Well Test Kill Line used for killing the well if necessary.

These flexible line may have different diameters, pressure ratings and liner materials depending on the service company requirements. Hereinafter, no distinction is made between these two types, and both will be addressed as Well Test Hoses.

Well Test Hose manufactured by ContiTech are suitable for a both a drill stem test (DST), conducted right after drilling, and for production test on a completed well.

There is no recognized industry standard for Well Test Hose, however, in view of the typical operating conditions ContiTech supplies Well Test Hoses according to API Spec. 17K and API Spec. 16C.

The API specifications for Flexible Choke and Kill Lines (API Spec. 16C) requires the lines to withstand short-term high pressure and high temperature operation. However, the rough bore types supplied for well testing are designed for a high number of operating hours and to withstand a large number of decompressions (this is usual in well testing).

ContiTech's bonded flexible pipes built according to API Spec. 17K are designed for long-term production service of several years, and are capable of multiple decompressions, thus also suitable for well testing.

Well Stimulation (Acidizing) Flexible Lines

Acidizing flexible lines are supplied with the TauroFlon™ liner by ContiTech due to the nature of the chemicals usually employed in acidizing operations. The TauroFlon™ lining is the most chemical resistant liner offered by ContiTech and is in the top of the class within the industry. The ContiTech manufactured well stimulation line is suitable for both matrix acidizing and fracture acidizing. Acidizing flexible lines typically have a 3" or 4" ID and the usual rated working pressures are 10,000 psi and 15,000 psi.

For chemical compatibility of TauroFlon™, see Table 1 on page 7.

Burner/Flare Boom Flexible Lines

Burner/flare boom line is built to the API Spec. 17K and features fire-rated coverings as the flexible lines are subject to produced gas and fluids as well as high heat. Typically, ContiTech flexible lines in this application are designed and built to be fit for purpose for each individual application as the requirements vary depending on the flare boom arrangement. Frequent inspection of the external cover is recommended due to the heat radiation of the burner.

Riser Tensioner and Drill String Compensator

Riser tensioner and drill string compensator lines are usually built to API Spec. 17K standards, however, under certain circumstances and customer request, a fit-for-purpose design can be supplied.

Drill string compensator lines are usually supplied in 2" to 6" IDs and pressures of up to 5,000 psi. Riser tensioner flexible lines are usually supplied in 6" or 8" IDs and pressures up to 7,500 psi. Due to the nature of hydro-pneumatic systems, both the drill string compensator and riser tensioner flexible lines require gas decompression resistant designs.

More frequent borescope inspection of the innermost layer is recommended as this layer is exposed to severe loads due to the entrained gases carried by the hydraulic fluid. Blisters and other damage might occur under the combination of special circumstances.

Special attention should be paid after each job to inspect the external cover of the flexible line.

Bonded Flexible Pipes as Jumpers in Production Line

ContiTech flexible lines for production applications are generally specified to have a long service life (20+ years), therefore special attention should be made to carefully evaluate the installation location, and to design the flexible line accordingly to minimize any risks.

Configuration analysis is highly recommended. In case of longer flexible lines, analysis of the installation procedure may be necessary.

If the flexible line configuration is dynamic and the flexible line can clash with its surroundings, using bumpers at the expected clashing locations should be considered.

Topside Jumpers for Liquid Service

Liquid service includes water injection, gas free (treated) oil export, transport and injection of various chemicals, (e.g. methanol glycol, etc.) The typical inner diameter of these flexible lines are 2" to 12" and the rated working pressures are up to 10,000 psi, (depending on line size and construction), with test pressure 1.5 times rated working test pressure according to API Spec. 17K standard. The usual operating temperature range is -22°F to 195°F (-30°C to +90°C), but higher temperature rated flexible lines are also available.

For chemical compatibility see Table 1 on page 7.

Topside Jumpers for Gas Service

Gas service includes oil and/or gas production, gas lift, gas export, CNG transport, LNG regasification, etc. Typical inner diameter of these flexible lines are 2" to 14" and the rated working pressures are up to 7,500 psi (depending on line size and construction), with test pressure 1.5 times rated working test pressure, according to the API Spec. 17K standard. The typical temperature range for these flexible lines is -22°F to 195°F (-30°C to +90°C), but higher temperature rated flexible lines are also available.

For chemical compatibility see Table 1 on page 7.

Tauro™ Fit Preformed Production Lines

In case of tight installation space, preformed Tauro™ Fit production lines offer the advantage of lower MBR, decreased load on the end connector and the adjacent rigid piping, as well as up to an 80% savings in installation time. In all cases, static analysis of preformed Tauro™ Fit lines is required in order to manufacture the flexible line to the optimum shape for the given application.

Subsea Jumpers, Flowlines, Tie-ins for Gas and Liquid Service

Subsea flexible lines are usually specified to have a long service life (20+ years), and due to the subsea application, periodic inspections are not cost effective or practical. Therefore, special attention should be made to carefully evaluate the installation location, map the requirements and design the flexible line accordingly as to minimize the risks.

If the flexible line is lying on a rough seabed, the line should be laid on a mattress to protect the cover. If strong currents are likely on the seabed, covering some sections of the flexible line with a mattress should be considered.

If the flexible line is in a dynamic application and subject to clashing, it is recommended to install bumpers to maximize the lifetime of the flexible line.

Risers

Flexible lines for riser service are usually specified to have a long service life (10+ years), and due to the subsea application the periodic inspections can be difficult. The flexible lines manufactured by ContiTech are produced in limited length, max 30 or 60 m depending on inner diameter. This means that long-length lines will contain intermediate couplings.

The rigid section of the intermediate coupling requires special attention in analysis and during reeling the flexible line. In order to obtain reliable analysis results, typical models of unbonded flexible pipes should be modified to take into account the mass of couplings and local bending stiffness in the coupling region.

Dynamic analysis and fatigue life calculation is an absolute must in this application. Based on the hydrodynamic analysis, either a built-in bend stiffener, or in severe cases, an external bend stiffener, is recommended at the hang-off point of the riser.

Analysis of the installation procedure is highly recommended, with special attention on intermediate coupling locations. Installation can be carried out by reel or chute. For further details, contact your local ContiTech office.

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Oil and Gas

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ContiTech. Smart Solutions Beyond Rubber

The ContiTech division of the Continental Corporation is one of the world's leading industry specialists. As a technology partner, our name is synonymous with expertise in development and materials for components made of natural rubber and plastics and also in combination with other materials such as metal, fabrics or silicone. By integrating electronic components, we are also generating solutions for the future.

Beyond products, systems and services we also provide holistic solutions and have a formative influence on the industrial infrastructure. We see digitalization and current trends as an opportunity to work with our customers to add sustainable value – for both sides and for good.

Continental
The Future in Motion