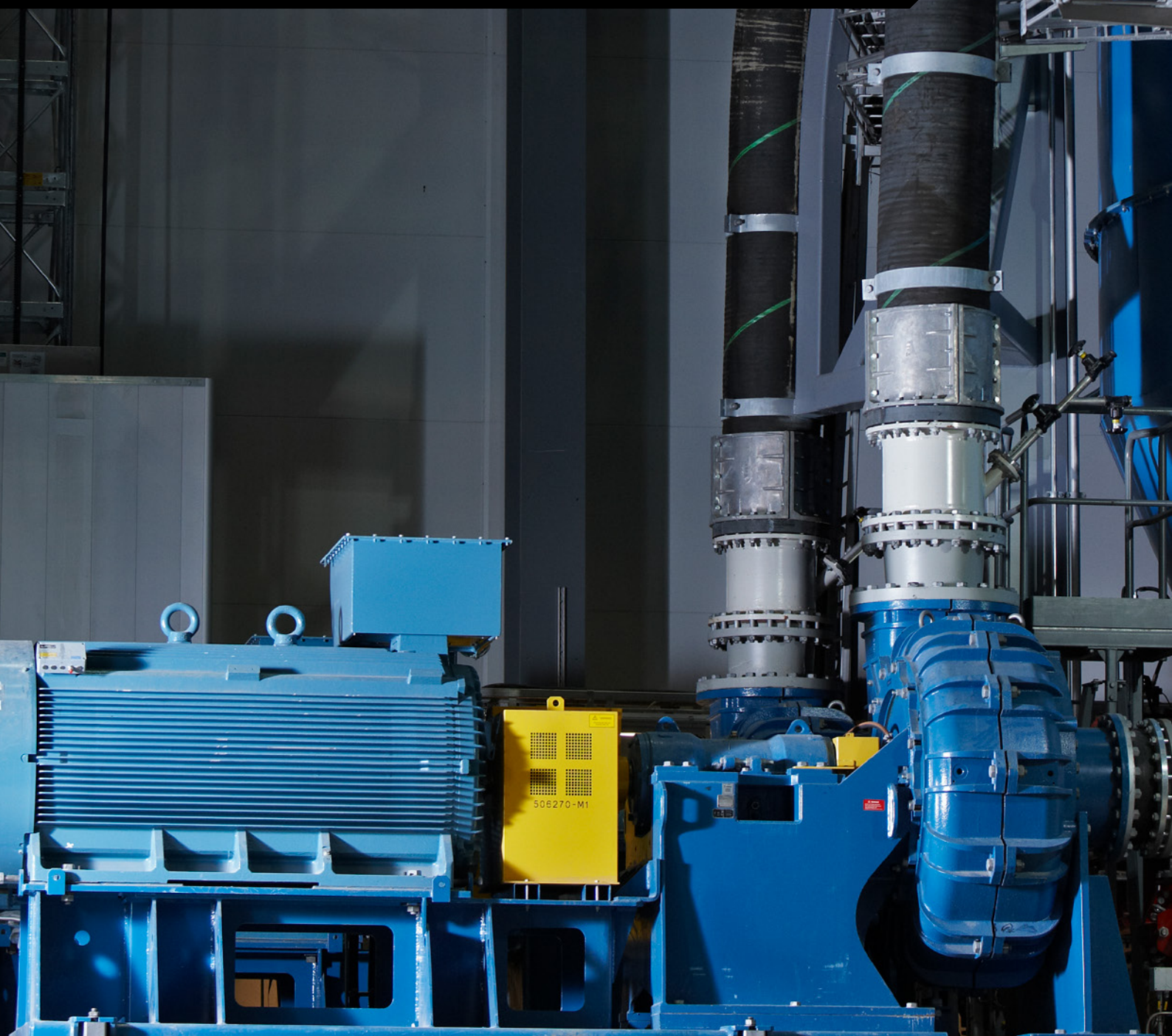
Metso

Slurry handling solutions

Swivel hose and pipe systems

Design manual

August 2025



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Introduction

Metso® Slurry Handling Solutions are designed and manufactured to meet strict quality and safety standards. This manual is intended to provide advice and instructions regarding the installation of Slurry Handling Systems, in order to secure safety during installation work and operation.

Since the late 1950's we have manufactured and installed our slurry hoses in the global mining industry. This has given us unique experience and knowledge, plus a world leading position in the field of slurry handling solutions.

Metso Slurry Handling Solutions are designed on the basis of firsthand experience of transporting highly abrasive iron, copper and other metallic or non-metallic ores in the mineral processing plants.

Rubber offers superior wear resistance when handling abrasive slurry material.

Metso Slurry Handling Solutions are mainly used in concentration plants, but also in sand, lime, and glass plants, in quarries, in coal preparation and power plants, as well as in the steel and cement works.

Our certified quality management system is an assurance for You as our customers. You can trust that our products and service always fulfil the most demanding quality and environmental standards in place today. Metso Slurry Handling Solutions' quality assurance system meets the demands and instructions specified in ISO 9001 and ISO 14001.

Metso Slurry Handling Solutions is a global company in every sense. Research, development, manufacturing, sales and service are organized to provide You as our customers with maximum return on Your investments, no matter where in the world these are located.

Preface

Liability for defects

The Supplier guarantees that the product will be free from defects in materials and workmanship when used properly and in accordance with the directions on the product. The Supplier´s liability shall not apply to nor include any products, which have been subjected to accidents, alterations, abuse or misuse.

Area of use

Metso Slurry Handling Solutions are suited for transporting abrasive material. All other use of the product is considered unintended use.

For information regarding the valid pressure class for Your specific Slurry Hose System, please refer to the design specifications.

Prohibited use

Metso Slurry Handling Solutions must not be used for transporting oils or acids since these substances shorten the service life of natural rubber and gaskets.

Spare parts

Spare parts and accessories can be ordered from Your local retailer or manufacturer.

Local regulations

Every country (state) has its own safety regulations. It is the responsibility of the work management and installation engineer to know and follow these. If the recommendations in this manual are different from those in Your country, then the local safety regulations shall be followed.

The system

Metso Slurry Handling Solutions are based on easily exchangeable standard components: hoses, couplings and gaskets of varying diameters.

The figure below shows the principle for Metso Slurry Handling Solutions with support beam. The beam is used as a support for hoses, bends and couplings and is fixed to a steel frame, which in turn is screwed to the floor. The hose is fixed to the beam using clamps, sized in relation to the hose dimensions.

Rubber Hoses

Rubber slurry hoses are used for sections of slurry hose systems containing bends, differences in levels and unevenness. The flexible rubber hose can be easily adjusted to different lengths, or, to a certain degree, bent to requirements. For the recommended bend radius, see System Design.

The rubber hoses require support in the form of a support beam along the whole installation.

Rubber Lined Steel Pipes

The rubber lined steel pipe is an alternative to the rubber hose for the straighter sections of the slurry hose system. The rubber lined steel pipe is available in 3 m, 6 m and 10 m lengths. The rubber lined steel pipe does not need an support beam, only supports at each end.

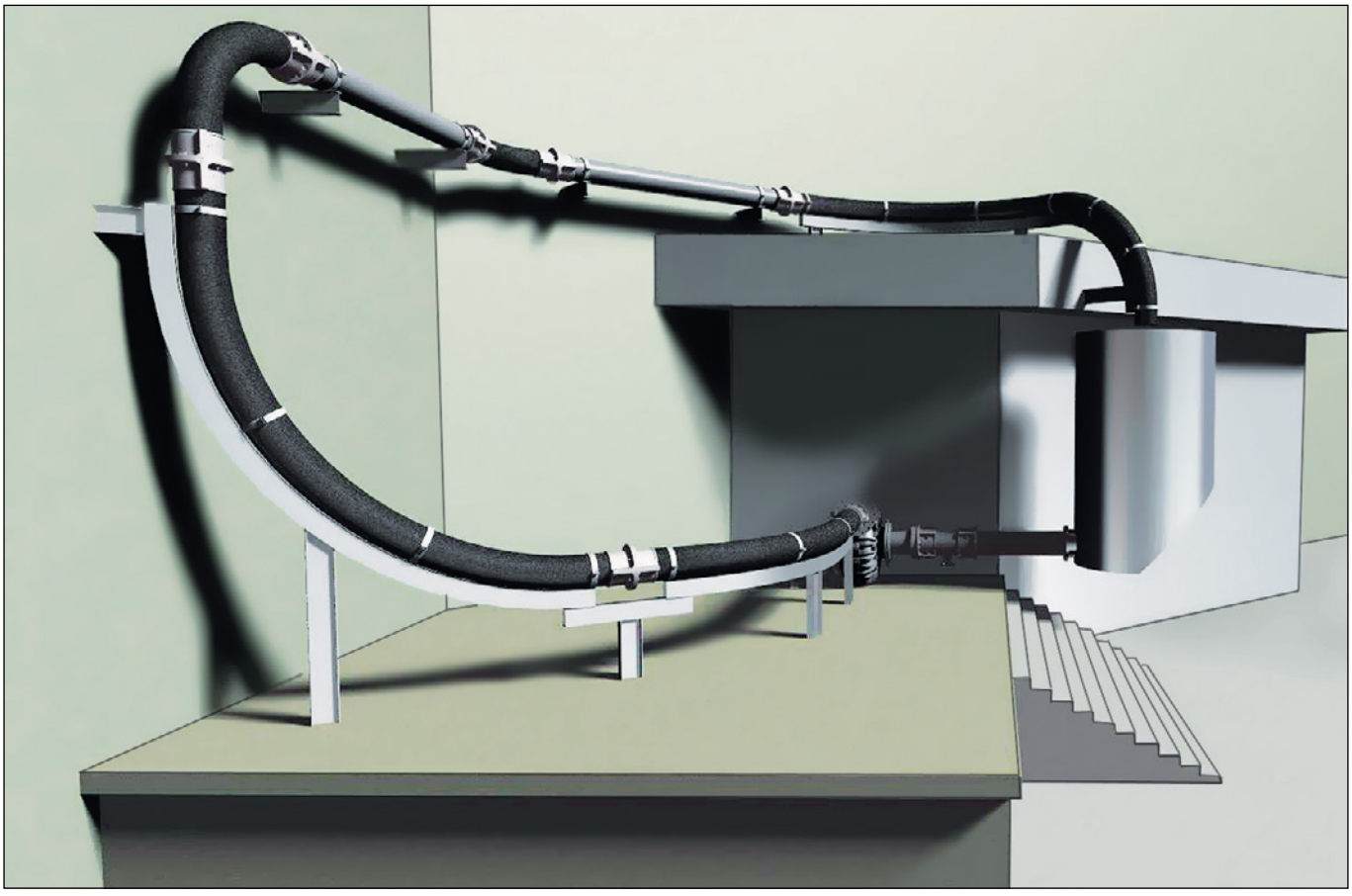
3xD Bends

Bends are used in tight spaces, where the smallest bend radius of the hose is not enough.

Couplings and Gaskets

Aluminium couplings are placed between the hose lengths, which give fully tight joints when combined with the steel tube reinforced rubber seals. The flexible rubber seals help compensate for the unevenness in the joints, while also protecting the couplings from direct contact with the slurry.

The same type of couplings and seals are used for both rubber hoses and rubber lined steel pipes.



Principle figure showing Metso® Slurry Handling Solutions with support beam.

Hoses, Couplings and Gaskets

Slurry Hoses

Product description

The slurry handling hose for hydraulic applications has a wear tube of rubber quality T-40.

Characteristics

Thick long-life wear tubes with smooth walls and low flow resistance. Together with Metso couplings and sealings, these hoses form an extremely reliable system which retains the free flow area without turbulence at the couplings.

Technical description

The hoses are reinforced with cord and have embedded galvanized steel wire spirals for managing dynamic pressure and underpressure. The safety factor against bursting is 1.5 times the working pressure.

Fitting the Couplings

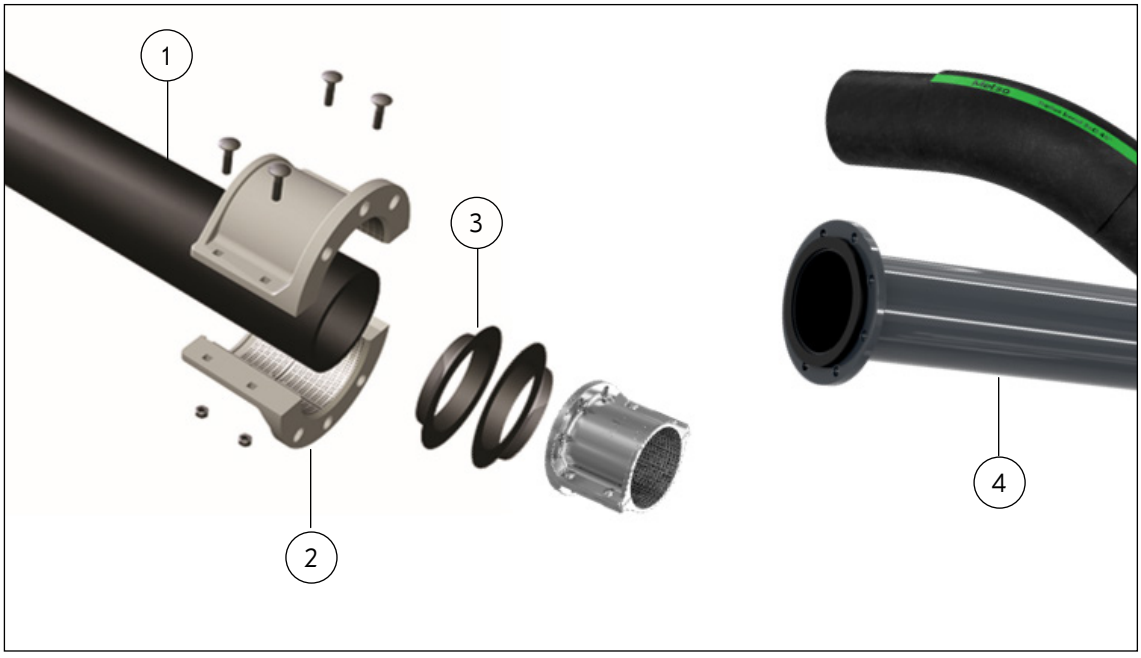
The coupling is fixed mechanically around the hose. The hose retains its full-flow cross-section, even at the point where the coupling is fitted.

The coupling does not have to match any particular pattern on the hose. It can easily be turned around the hose, until it is accurately aligned with the flange to which it is to be connected.

Easy assembly

The assembly can be carried out both quickly and easily, without requiring any special adapter devices, nor a trained crew.

Metso Slurry Handling Solutions can be connected to all flanges drilled to conform with all major international flange standards.

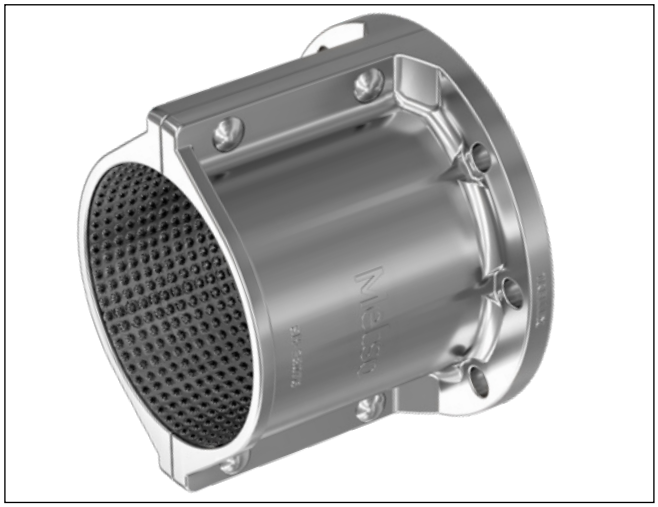


Overview:

1. Slurry Handling Hose
2. Coupling
3. Gasket
4. Rubber Lined Steel Pipe

Connections

Couplings



Product description

Metso Split Flange Couplings are made of high strength aluminium alloys. The couplings consist of two or four identical segments which are mechanically mounted on the smooth hose.

The coupling segments are identical, if one segment is lost or damaged it can be replaced with any other segment of the same size. Elongated holes in the front flange allow the coupling to be connected to all major flange drilling standards.

The couplings are supplied with bolts for the side flanges. To prevent them from turning, these bolts are square head type, and are also provided with stop rings to prevent them from falling out during assembly.

Characteristics

The couplings can be reused when replacing hoses, since they do not come into contact with the transported materials.

Technical description

Metso Couplings comply with most flange standards.

Gaskets



Product description

The conical Metso Gasket is designed for use together with Metso Hoses, Metso 3xD Bends and also Metso Rubber Lined Steel Pipes. Together with the Metso Coupling, the gasket ensures completely sealed couplings while retaining full inner diameter.

Characteristics

Metso Gaskets are steel reinforced to retain the same inner diameter as the hose when pressed into it. The gaskets allow turbulence free passage and are the same size as the inner diameter of the hose. The conical shape compensates for irregularities in the hose ends. Grooves at the front eliminate the risk of leaks.

Two couplings and two gaskets are required to form a complete link between two hoses.

Accessories

Metso Rubber Lined Steel Pipes, Metso 3xD Rubber Bends, Metso Reducers and Metso Branch Pipes are available as accessories for existing systems.

Rubber Lined Steel Pipes

Product description

Metso Material Handling Pipes for hydraulic applications are lined with a natural rubber of quality T-50.

Characteristics

Rigid steel pipes lined with long life wear rubber with smooth walls and low flow resistance. Together with Metso Couplings and Gaskets, these pipes form an extremely reliable system which retains the free flow area without turbulence at the couplings.

Technical description

High strength steel pipes rubber lined with naturalrubber. Steel surfaces are painted with RAL 7011. The safety factor is 1.5 times the working pressure.

3xD Rubber Bends

Product description

Metso 3xD Rubber Bends are made completely of rubber, cord reinforced and with a fully embedded galvanized steel wire spiral. For optimum wear economy, the outer bend has a >30 % thicker wear tube than the inner bend. It comes in 90° and 45° versions.

Areas of use

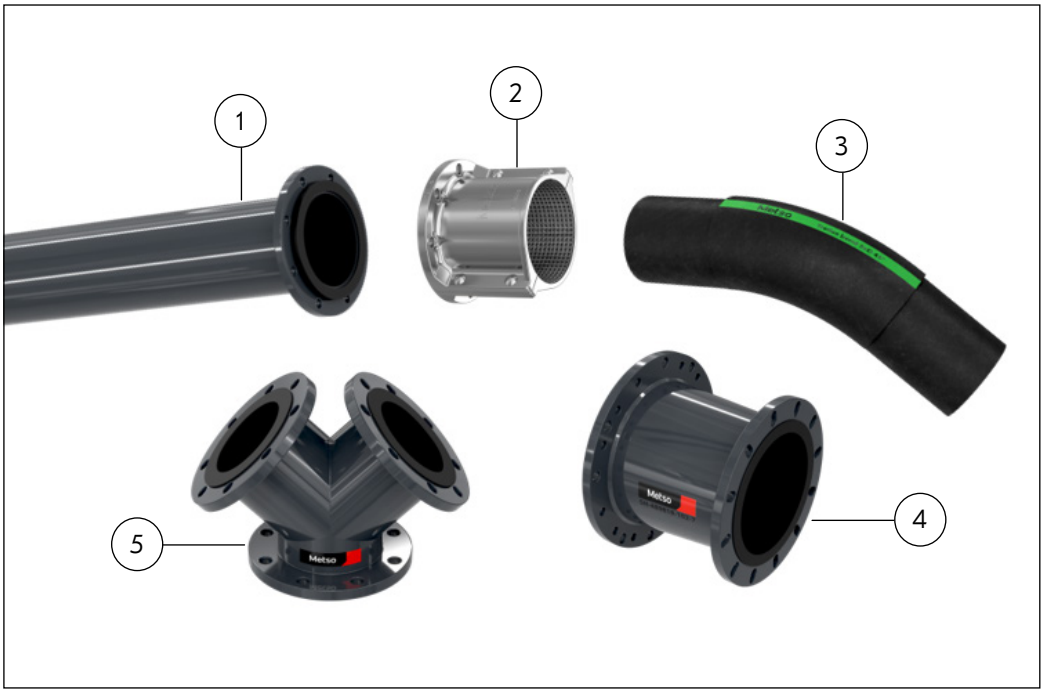
Metso 3xD Bends are intended for use in tight spaces where ordinary Metso Slurry Handling Hoses cannot be bent enough.

Characteristics

Thick exceptionally long-life wear tubes with smooth walls and low flow resistance.

Technical description

Straight sections outside the 3xD Bend allow connection with aluminium couplings.



Accessories:

1. Rubber Lined Steel Pipe
2. Coupling
3. 3xD Rubber Bend
4. Rubber Lined Steel Reducer
5. Branch Pipe

Rubber Lined Steel Reducers

Reducers provide a transition between different diameter pipes or hoses to compensate for changes in flow speed.

Product description

Metso Rubber Lined Steel Reducers are used when the compensators or rubber hoses form part of the slurry hose system.

Characteristics

Steel reducers lined with 10 mm long life wear rubber with smooth walls and low flow resistance.

DIN or ANSI flanges fit Metso Couplings.



Compensators

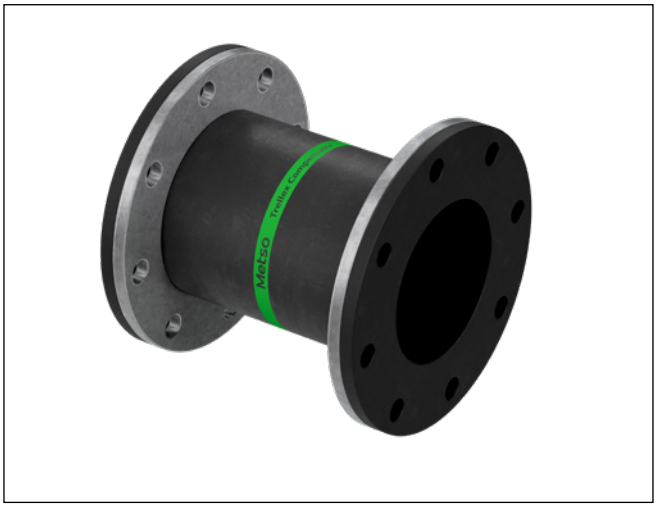
Product description

Metso Rubber Compensators are used to eliminate vibrations and noise as well as to compensate for misalignments and length deviations when rubber hoses or rubber reducers are not used e.g. between the sump and pump.

Areas of use

Typically used for flexibility when the pump flange calls for rubber lined steel reducers and the space from the sump is too short to fit a piece of hose.

DIN PN10 and ANSI lbs flanges fit aluminium couplings.



Clamps

Product description

Metso Steel Clamps are used to fix the hose and pipes to the so-called supporting beam. It is particularly important for the hose to be fixed to the supporting beam at bends and wherever long lengths of hose are used.

Characteristics

Clamping should be done every 1000 to 1500 mm on straight lines. In curved sections, tighter clamping is recommended.

Technical description

For recommended clamp sizes for each hose dimension, see Technical Specifications.



Branch Pipes

Y45 and Y60

Product description

Metso Y45 and Y60 Branch Pipes are fabricated from rolled and welded steel sheets, lined with 10 mm thick, hot vulcanized T-50 rubber. The lining is drawn over the flange faces. The cover surface is corrosion painted.

Characteristics

Y45 and Y60 Branch Pipes are lined with long life wear rubber with smooth walls and low flow resistance.

Technical description

Steel surfaces are painted with RAL 7011. DIN flanges fit aluminium couplings. Type Y45 goes with 45 degree branches and Y60 with 60°. Other sizes, shapes, branch types, hole drilling etc. are available upon request.



T90

Product description

Metso T90 Branch Pipes are lined with a natural rubber of quality T-50. The pipes are prepared to fit split steel flanges.

Characteristics

Rigid steel pipes lined with long life wear rubber with smooth walls and low flow resistance. The special components are based on Metso pipes, these pipes form an extremely reliable system which retains the free flow area without turbulence at the couplings.

Technical description

High strength steel pipes rubber lined with natural rubber. Steel surfaces are painted with RAL 7011. Rubber is vulcanized on the pipe end to eliminate leakage.



K45

Product description

Metso K45 Branch Pipes are lined with a natural rubber of quality T-50. The pipes are prepared to fit aluminium couplings.

Characteristics

Rigid steel pipes lined with long life wear rubber with smooth walls and low flow resistance. The special components are based on Metso pipes and together with Metso couplings and sealings, these pipes form an extremely reliable system which retains the free flow area without turbulence at the couplings.

Technical description

High strength steel pipes rubber lined with natural rubber. Steel surfaces are painted with RAL 7011.



Fields of application

Due to its wide flexibility, combined with fast and simple assembly, Metso Slurry Handling Solutions are suitable for both permanent and temporary installations. The Slurry Handling System is used in the mining industry for carrying crushed and ground ore, waste products, etc.

In the quarrying industry, it is used for carrying both sand and natural stone, as well as crushed and ground stone. It is used in the cement industry for the transport of lime, stone and slurry and also in a number of other industries and applications where wear-resistant pipes are needed.

Covering areas

The list of covering areas where hydraulic transports might be utilized can be very long.

Some examples of in-plant applications:

- Mining Industry
- Stone and Gravel Industry
- Cement Industry
- Steel Works
- Chemical Industry
- Coal Industry
- Food Industry

Mining Industry

Transportation of:

- crushed and ground ore
- waste products

Found e.g. between:

- mills and magnetic separators
- magnetic separators and classifiers
- classifiers and mills
- mills and cyclones
- magnetic separators and cyclones
- cyclones and thickeners
- cyclones and flotation cells
- flotation cells
- primary and secondary mills
- mills and thickeners
- thickeners and filters
- thickeners and spiral concentrators
- spiral concentrators and shakingtables
- thickeners and waste ponds

Stone and Gravel Industry

Transportation of:

- sand
- gravel
- crushed and ground rock

Found e.g. between:

- pumps and washing barrels
- washing barrels and classifiers
- classifiers and cyclones
- cyclones and store bins
- screens
- screens and sorting towers

Cement Industry

Transportation of e.g.:

- lime slurry
- chalk

Found e.g. between:

- screens and slurry milis
- slurry milis and slurry basins
- slurry basins and rotary kilns
- silos and bulk carriers (dry chalk)

Chemical Industry

Transportation of e.g.:

- leached uranium ore in diluted sulphuric acid
- granular gypsum in phosphoric acid
- phosphate slurry
- china clay
- calcium fluoride (fluorspar)
- salt (NaC1, KC1)

Steel Works

Transportation of e.g.:

- oxide scales (in water) between the pump and settling basin

Coal Industry

Washing plant:

- suction line to pump dirt slurry from thickener to waste pond
- effluent/separator pump line handling dilute magnetite

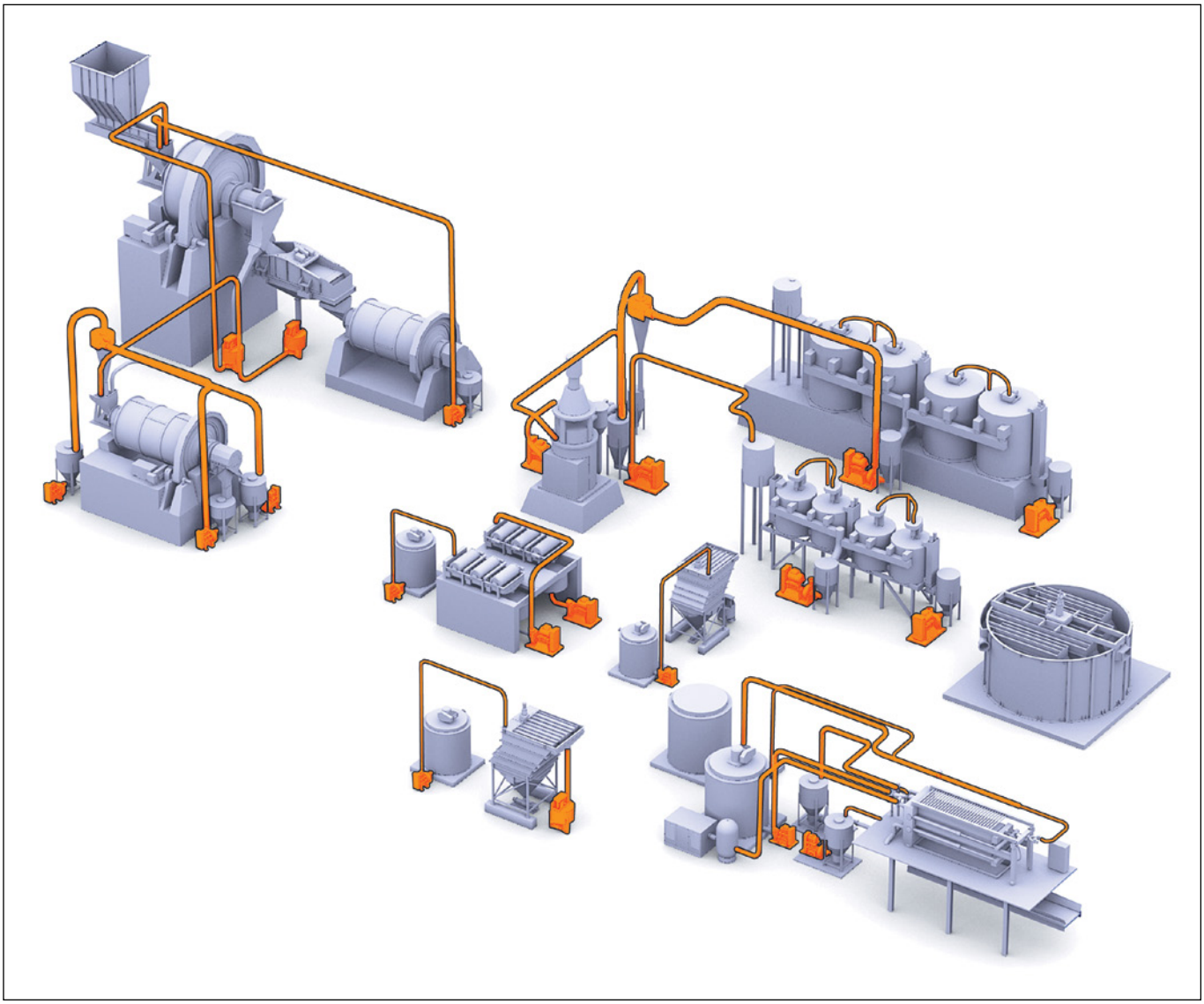
Preparation plant:

- between screens and sieve bends
- sieve bends and dryers
- screens and flotation cells
- flotation cells and filters
- flotation cells and thickeners
- thickeners and filters
- cyclones

Food industry

Sugar mills:

- transportation of digested sludge from settling basin



Flow sheet for a mine. The marked parts show transportation of slurry by pipes or

Different pipeline materials

A breakdown in a pipeline often causes problems for the whole plant. The selection of pipeline material is therefore of considerable importance. Problems may not only be practical and economical. A breakdown can also cause dramatic environmental damage.

Pipes can be divided into:

Steel pipelines

- Carbon steel
- Cast iron
- Special steel materials

Lined pipelines

- Rubber lined steel
- Rubber lined GRP
- Polyurethane lined steel
- Basalt lined steel

Non-metallic pipelines

- Wood
- Concrete
- Asbestoscement
- Plastic materials
- Rubber materials

Steel pipelines

Steel pipelines are used for high pressures and when the slurry is relatively fine and not corrosive. Both welded and flanged pipes are used as well as systems like the Victaulic. One of the limitations in the Victaulic system is that fittings such as bends usually have a short radius, which together with the gap for each coupling can lead to turbulent flow and encourage erosion at these locations.

Advantages:

1. Flanged pipes are easy to replace and to turn in order to prolong the service life.
2. Steel pipes are often made very thick to withstand both wear and corrosion.

Disadvantages:

1. Carbon steel pipes are comparatively cheap but have relatively bad wear characteristics while pipes made of special hardened steel materials are considerably more expensive without having any significant improvement in wear characteristics.

Lined pipelines

To increase the wear resistance, the pipes are often lined inside with different kinds of materials.

Advantages:

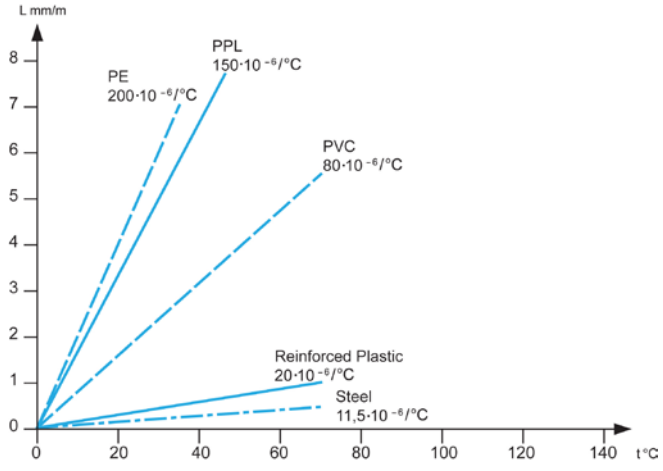
1. Steel pipes lined with natural rubber are generally used for transportation of wearing materials under higher pressures than permitted by plastic pipes and rubber hoses.
2. Thanks to the rubber lining, the servicelife of the pipeline is prolonged considerably. It is a well established product often used for tailing lines.

Rubber lined pipes are jointed together with flanges or couplings as welding will damage the rubber.

Complex fittings of tees, bends, etc. can be produced in steel and then lined with rubber, allowing the piping designer great flexibility in arranging interconnecting piping.

Disadvantages:

1. Once set in position in the plant, a rubber lined pipe is difficult to modify which may well give maintenance and modification problems during plant operation. Metso Slurry Handling Solutions therefore recommend the use of rubber lined steel pipes in combination with rubber hoses when installing the slurry handling system.



Thermal elongation of some different pipe materials.

Non-metallic pipelines

Wooden pipes

Wooden pipes were previously widely used for tailing lines. Today plastic pipes have taken over their role.

Concrete pipes

Concrete pipes offer slightly better wear resistance than wood. However, the wear resistance can be improved by reinforcing with or adding steel or plastic particles. The high friction coefficient means a large pressure drop.

Plastic pipes

Plastic pipes can be used for transporting fine and not very abrasive material under low velocities and pressures.

Advantages:

1. Superior corrosion resistance to steel pipe.
2. Low weight.
3. Lower heat conductivity than metals.
4. Less risk of slurry freezing. (However, if the slurry freezes into plastic pipes they cannot be heated like steel pipes. Very often the plastic pipes have to be replaced).
5. Does not cause galvanic corrosion.

Disadvantages:

1. Limited wear resistance
2. High coefficient of extension (if steel = 1, the coefficient for glass-fibre reinforced plastic is 1.5, for polyvinyl chloride 8 and for polyethylene 15).

It should also be noted that the wear resistance of most plastic materials is highly dependent on temperature.

PVC and PP are used under moderate wear conditions, sometimes for short-term use in temporary pipelines. They are not often used for long pipelines.

PB and HPE offer better wear characteristics and can be used if the slurry does not contain large, sharp, wearing particles. The low friction coefficient (the same as for rubber) is beneficial in terms of the pressure drop.

Different rubber hoses

Natural rubber is the most frequently used material in difficult wear situations in slurry lines. A natural rubber material of good quality and appropriate hardness of approximately 40 degrees IRH, e.g. T-40, provides extremely good resistance to the wear caused by most slurries.

It can be used for finely ground materials as well as relatively coarse particles, and normally has a service life that is 10-15 times longer than that of an equivalent pipe made of carbon steel, and 5-10 times longer than that of a pipe made of plastic such as HPE.

Synthetic rubber materials are used under special circumstances e.g. when resistance to oil is required. They are more expensive than natural rubber and the wear characteristics are not as good.

A rubber material that has attracted a great deal of attention in the last few years is polyurethane, PU. Among other things it is used for screen cloths and components in flotation equipment, but not often as wear protection in pipes.



Metso Slurry Handling Hoses

Advantages and operating costs

The rubber Slurry Handling Hoses were developed to provide great wear resistance together with flexibility in slurry piping arrangements. Mineral processing plants have adopted them for many purposes.

As pipelines are exposed to abrasive wear, with an angle of incidence at almost 0 degrees, this is an ideal application for rubber.

Transport economy

The advantages of transporting solid materials through pipelines are many:

The transport economy often proves to be profitable. A pipe transport system is normally distinguished by comparably high investment costs and low operating and maintenance costs. A correctly designed system also gives a very reliable method of transport.

Further advantages to note are the good environmental benefits of the transport method, the possibility of continuous transport and the small risk of accidents.

Possible disadvantages

One disadvantage could be the demand for considerable quantities of water. Any dewatering and water purifying might be expensive.

There are also other examples of applications where the transport technique is directly unsuitable, depending on whether the particles are too big or whether the solid material will be moisture saturated. Other disadvantages could be limited flexibility concerning changes in the production or heavy wear in pumps and piping in some applications.

Advantages – a summary

- Approximately 5-10 times longer lifespan than steel pipes or PVC tubing.
- Thicker layer of wear-resistant rubber and, conse-quently, a longer lifespan than most rubber coated steel pipes.
- Easy to fit due to its great flexibility.
- Can be installed by plant personnel, without special training, using simple tools such as an adjustable wrench, knife and hacksaw.
- Can be cut to exact length on site.
- Low assembly costs due to short fitting time.
- Reusable couplings keep spare parts costs down.
- Low stocking costs since no special lengths have to be kept in stock.
- Low maintenance costs since corrosion protection does not have to be renewed.
- Lowers vibration from pumps and machines and reduces the noise level.
- Can be curved to follow the hose installation.
- Can be turned. When the wear-resistant rubber layer in the outer radius is worn, the hose can be turned 180°, thereby doubling its lifespan. This also applies to curved hoses.
- Elongated holes in the coupling flanges allow the aluminium coupling to be connected to the majority of flanges drilled to conform with international flange standards, such as ANSI, BS, DIN.
- Supplied in 66 ft (20 m) lengths up to ID 5 in. (127 mm) and in 33 ft (10 m) lengths from ID 6 in. (152 mm), as against the 20 ft (6 m) lengths commonly available for steel pipes.



Efficiency and operating economy

Wear costs money, often large sums of money. How much it will cost depends partly on the abrasiveness of the actual process and the processed media and partly on the design of the production plant. The last variable, of course, is the material used to make the parts exposed to wear.

Wear is a factor that has particular major economic significance in branches of industry where highly abrasive materials are used, like the mining and quarrying industries.

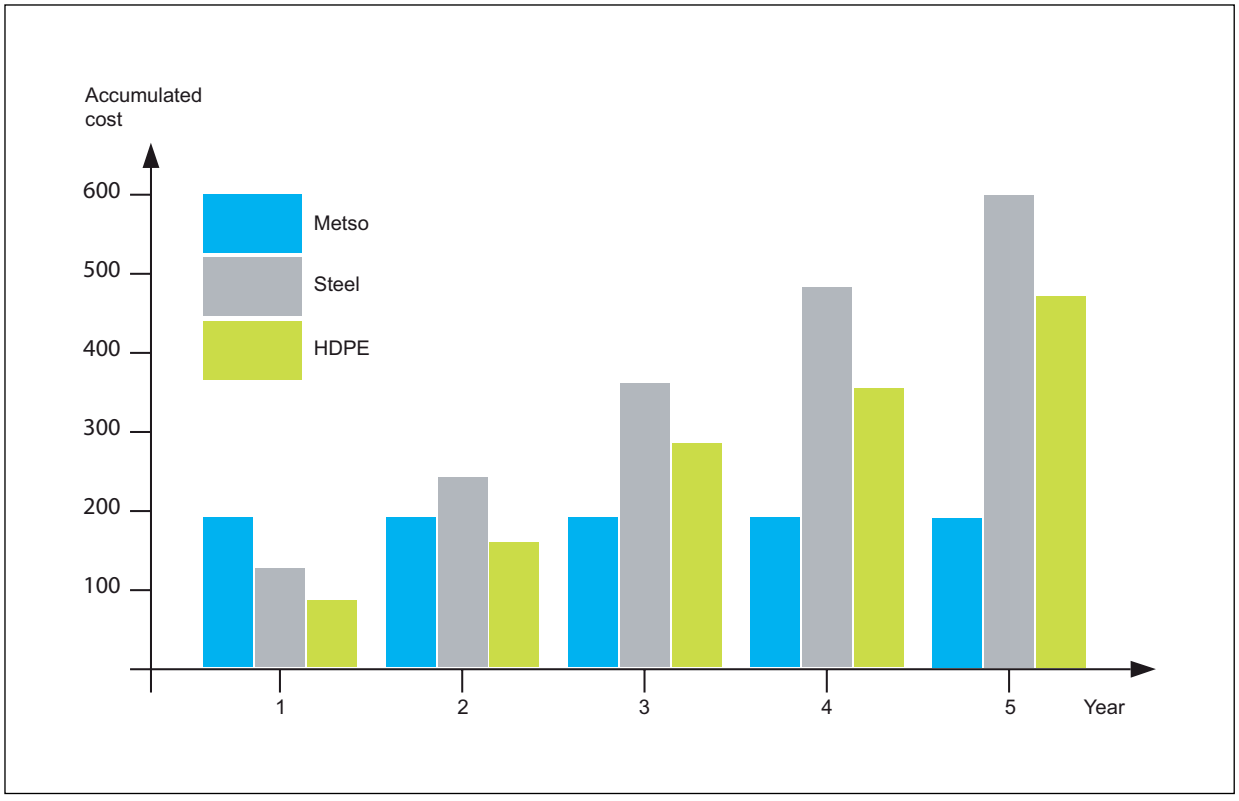
As the efficiency of production processes improves, and increasingly larger amounts of materials are processed at an unchanged or even lower labour cost, closer attention is paid to the costs of both continuous and preventive maintenance. In spite of a higher output and consequently greater stress on production machinery, stoppages due to malfunction or excessively frequent replacement of worn parts must be avoided.

Long service life

Owing to its long service life, Metso Slurry Handling Solutions does not require replacement as often as wear parts made of other materials. Stoppages are less frequent and production downtime is thus reduced.

The figure below shows a cost comparison between steel pipes and the Metso Slurry Handling Solutions. Wear in Metso Slurry Handling Solutions, which have been in operation for 3½ years, is scarcely noticeable. The steel pipes previously used had a lifespan of 6-8 months. Metso Slurry Handling Solutions, which are expected to have a service life of at least 5 years, have already lasted more than six times as long as the steel pipes.

The figure below, which is based solely on a direct comparison between costs of materials, shows that Metso Slurry Handling Solutions will already be economically advantageous after a period of just over 1½ years. If the savings in assembly costs and the consequent reduction in production fall-off are also taken into account, Metso Slurry Handling Solutions show a potential for even greater advantage in this comparison.



A cost comparison between Metso® Slurry Handling Solutions, conventional steel pipes and HDPE, based on the following operational data: 2 lines with a total length of approx. 1000 ft (300 m) having an inside diameter of 6 in. (152 mm) for carrying slurry (35 % solid material of diabase and gneiss with a particle size up to 3/16 in. (5 mm). Working pressure 75 psi (5 kp/cm²). Flow rate 11 ft/sec (3.3 m/s). Capacity 140 000 tons of solid material per year.

Product design

- The rubber Metso Slurry Handling Hose is available from ID 2.0 in. to 24.0 in. (51 mm to 610 mm).
- Working pressure is 50 to 100 kPa, safety factor against bursting is 1.5 times working pressure.
- Suction is 50% to 90% vacuum.

The structure of rubber hoses

The hose consists of:

- INNERTUBE made of thick black natural gum rubber which provides tightness and resistance to the media transported.
- REINFORCEMENT made of polyester cord and a fully embedded spiral wound galvanized steel wire which is primarily intended to absorb the inner pressure while also giving stability in diameter and length and preventing twisting.
- COVER made of SBR Rubber which protects the reinforcement from external damages such as abrasion, corrosion, sunlight and ozone.

These three components are vulcanized together in the production process. To improve the adhesion between the layers of reinforcement, interlays of rubber are used in some constructions.

Rubber materials

When choosing rubber for the inner tube, the hardness is important for the wear resistance.

- Hardness 40 shore A (T-40) is recommended for transporting slurry with particles smaller than
  10 mm
- Hardness 60 shore A (T-60) is recommended for transporting slurry with particles larger than 10 mm

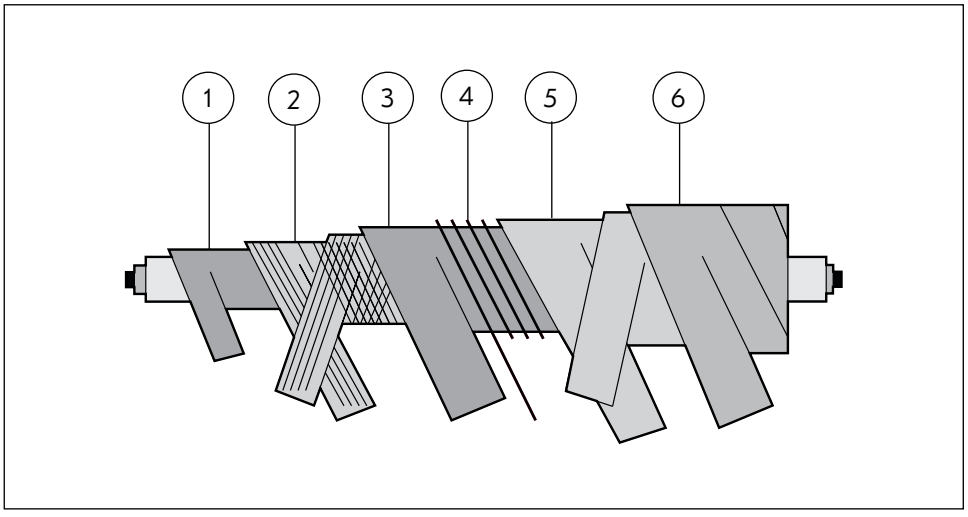
Reinforcement

Reinforcement is required to enable a rubber hose to withstand internal pressure.

Internal pressure to which a hose is subjected causes forces in both circumferential and axial directions. A reinforcement thread can only withstand tensile forces in the direction of the thread. In order to obtain optimum utilization of the reinforcement and minimum twisting of the hose, it is necessary for the reinforcement to be placed at a special predetermined angle. This angle between the reinforcement threads and the hose axis is called "the neutral angle". At this angle the sum of the circumferential and axial forces is directed along the reinforcement threads.

Design of the hose:

1. Wear tube, T-40, T-60
2. Polyester cord, 2 plies
3. "Sandwich" rubber
4. Steel spiral
5. Polyester cord, 2 plies
6. SBR Cover rubber



Handling the hose

The working conditions at a new plant site under construction are both rough and tough. Metso Slurry Handling Hoses should be handled with care, and not manhandled like ordinary steel pipes. The hose is delivered to the site in wooden boxes, or full container loads, and on arrival should not be dragged out and left on the ground for any vehicle to run over and flatten.

Metso Slurry Handling Hoses with an inside diameter (ID) of 5 in. (127 mm) or less are supplied in 66 ft. (20 m) reels while Metso Slurry Handling Hoses with an ID of 6 in. (152 mm) or more are supplied in straight 33 ft. (10 m) lengths.

Care must be exercised when handling the hose to avoid kink damage.

IMPORTANT: A hose with steel wire reinforcement will not return to its original shape if it is compressed. The result will be a permanent deformation.

Lifting the hose

Hoses should not be lifted with a single strap or wire round the middle of the hose. Such a method of lifting will often cause a kink to occur in the centre of the hose. Instead, lifting tackle such as a U-beam and at least four fabric straps should be used. The hose should be fitted in the lifting beam as shown in the figure below.

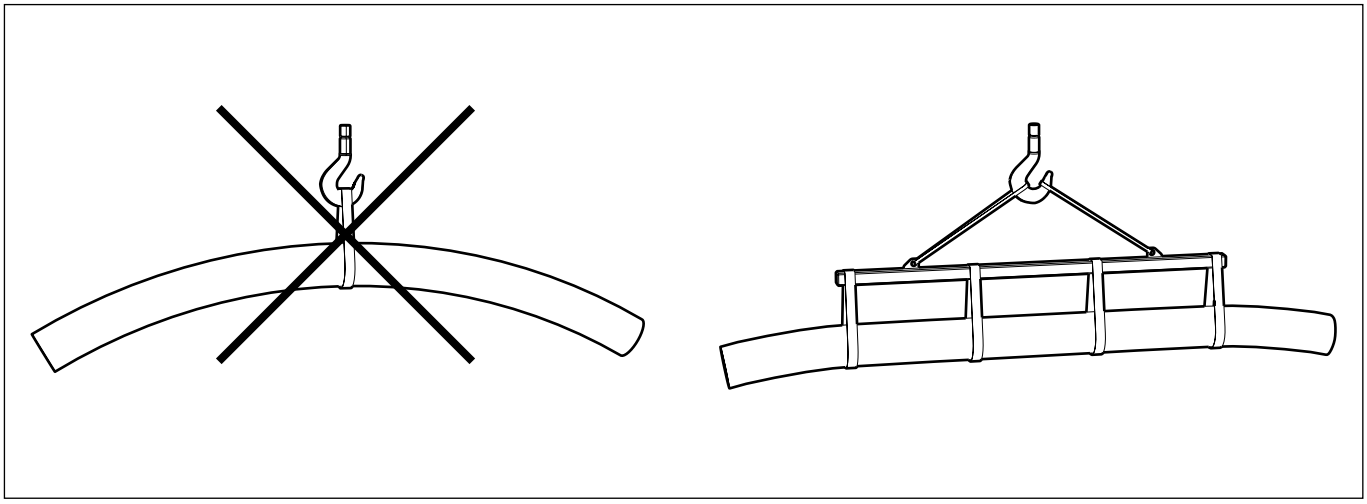
Lifting is also possible using special slings to allow transfer with travelling cranes inside the plant. Where space limitations only allow vertical lifting of a hose, a coupling should be fitted to the hose, and only the coupling should be placed in a sling, never the hose itself.

Storing the hose

Where Metso Slurry Handling Hoses are to be stored for a long period of time, the inner tube of the hose should be protected from direct sunlight, i.e. the ends of the hose should be covered.

The hose should be stored such that minimum possible stress occurs in the rubber. The surface on which it is stored should be able to support the entire hose.

Hoses should not be stored near electric motors or similar machinery because of the harmful effects of ozone. Store the hose so that it will not be run over by vehicles and protect it from falling objects and other mechanical damage.



Hoses should not be lifted with a single strap or wire round the middle of the hose. Instead, lifting tackle such as a U-beam and at least four fabric straps should be used.

Mounting installation

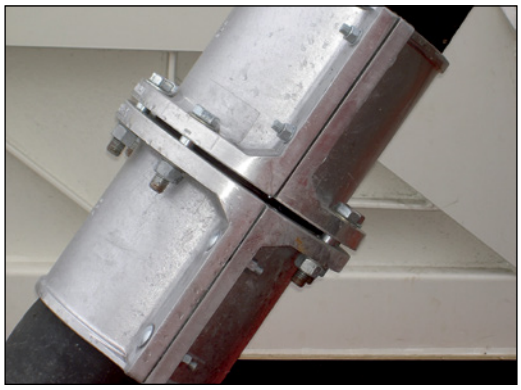
When wearing materials are being transported it is very important that the hose is installed as evenly as possible. The hose should be supported along its full length. Bends and loops should be mounted as uniformly as possible. Every irregularity will result in increased wear at the exposed points and increase the flow resistance in the system.

Metso Slurry Handling Solutions can be installed by the customer's regular personnel using simple tools. Metso Slurry Hose Cutting Kit can be used to adjust the length of the hoses (item no. SH-489351)

Just follow to the letter the instructions given in the "Installation Manual, 2660-09-11-SBL/Ersmark".

However, to ensure a perfect coupling of two hoses or a hose and a bend, be sure that you do not:

- tighten the coupling around the hose so hard as to distort the roundness of the hose, nor
- forget to let the hose protude some 5 mm beyond the flange of the coupling, nor
- tighten the flange bolts so hard that the faces of the connecting flanges meet.





Wear

Wear costs money, often big money. The actual wear costs depend partly on the rate of wear in the process and on the material itself, and partly on the construction of the production machinery and the type of material which is used for the parts subject to wear.

Wear theory

Wear can be defined as "the undesirable mechanical removal of material in fine particle form from a surface". There are different types of wear and the usual ones associated with rubber are:

- sliding wear
- cutting wear
- crushing

In pipes, the most important is sliding wear and to a smaller extent, cutting wear. Crushing wear is almost non-existent since the particles are usually small.

It should be noted that the angle of incidence is of great importance in the wear process. When the angle of incidence is <5° or >50° rubber has superior wear resistance compared with other wear resistant materials. In pipes and hoses, sliding wear with an angle of incidence close to 0° is common, thus favouring the use of rubber.

The amount of wear for particle-liquid mixtures (slurries) varies greatly, and depends mostly on the following factors:

Particle characteristics

- size
- size distribution
- profile characteristics
- hardness
- density – concentration
- temperature

Liquid characteristics

- density
- viscosity
- temperature
- pH-value

Type of flow

- laminar or turbulent
- heterogeneous or homogeneous
- flow velocity

Pipe conditions

- pipe material or pipe lining material
- formation (unevennesses, bends, slopes etc.)
- diameter



Installation of Slurry Hose System.

Metso best in British test

At the request of the British Ministry of Transport and Environment, the Transport and Road Research Laboratory has carried out detailed tests of wear in slurry pipelines. From the first of two programmes of wear tests, the following conclusions were reached:

- Over the range investigated (2 to 6 m/s) wear varied according to a power between the square and cube of the velocity.
- Over the range investigated (5 to 15 % by volume) wear varied more or less linearly with concentration.
- Over the range investigated (0.015 to 1.5 mm) wear varied more or less linearly with particle size.
- Emery (Mohs Hardness 8 to 9) produced a wear rate several times greater than that for silica sand (Mohs hardness 6 to 7).

These conclusions are all in accordance with our own experiences.

In the second programme the operating conditions were kept constant (velocity 4 m/s, 10 % slurry) while 18 different pipe materials were compared.

Among them, three were rubber - rubber "a" (T-40), rubber "b" (T-60) and rubber "c" (a British make). As shown in the following table, T-40 proved to be the most wear resistant material.

Material	Wear rate (mm/year)	Life expectancy of a 5 mm thick tube (years)
Rubber "a" (T-40)	0.13	38
Zirconia/alumina ceramic	0.15	33
Ni-hard steel	0.19	26
Polyurethane "a"	0.20	25
Polyurethane "b"	0.22	22
Rubber "b" (T-60)	0.35	14
Sintered alumina	0.40	12
Rubber "c" (not T-40 or T-60))	0.61	8
High density polyethylene "b"	0.67	7
High density polyethylene "a"	0.87	5
Unplasticised polyvinyl chloride	1.27	4
Stainless steel	1.29	4
Mild steel "a"	1.57	3
Polypropylene	1.59	3
Mild steel "b"	1.69	3
ABS	2.52	2
Asbestos/cement	94.68	-

For Moh´s scale, see page 28.



Flow

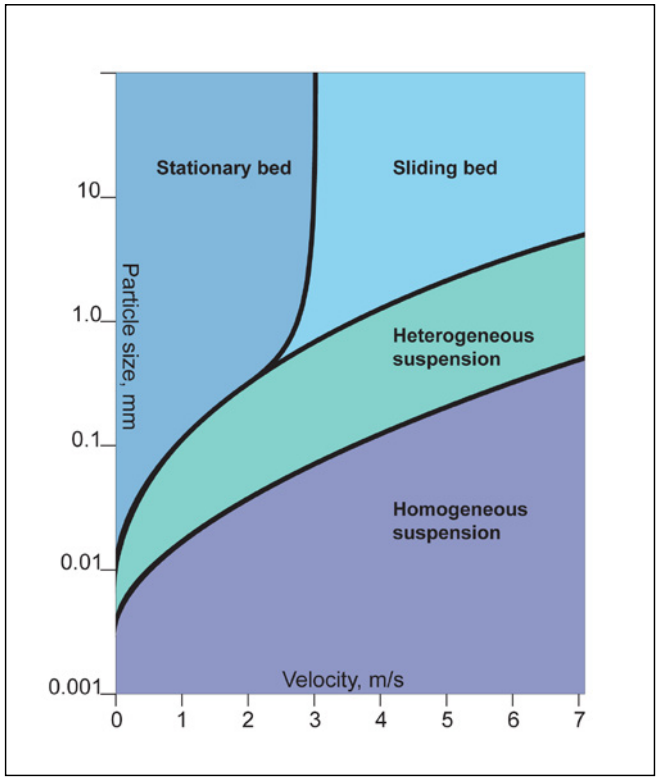
Basic conceptions and relationships

In a horizontal pipe flow, different grades of asymmetrical particle distribution may occur. Big particles are, as already known, more difficult to keep in suspension than small ones. Moreover, low distribution velocities entail a greater trend for particle transport along the bottom.

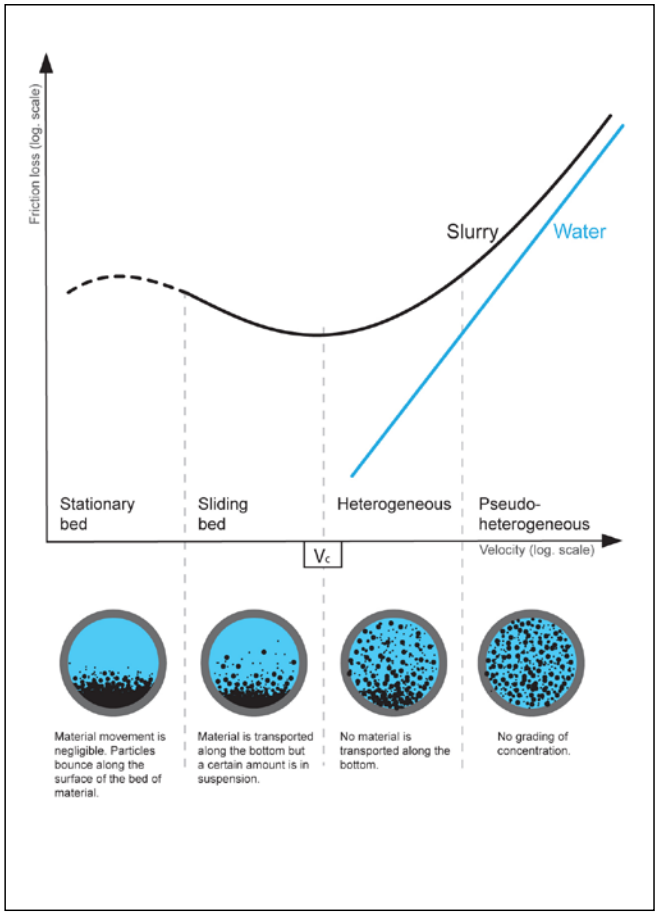
The figure below shows the principle connection between different types of flow and friction losses.

"Stationary bed" and "sliding bed"

There is a great risk of production problems if particles settle on the bottom during operation. The "stationary bed" flow condition can consequently not be used in practice. In some applications with shorter pipeline distances, the "sliding bed" flow condition can be used.



Example of flow configurations (sand density = 2700 kg/m^3, pipe diameter 160 mm.



Relationship between different flow conditions and friction losses.

Heterogeneous and pseudohomogeneous

When it comes to longer pipeline distances with remarkable low points, the pipeline system should be designed so that no appreciable material will be transported along the bottom, in other words the flow condition should be heterogeneous or so called pseudohomogeneous.

From the figure above you can see how the different flow conditions vary in relation to particle size and velocity for sand with homogeneous particle distribution.

To decide on a suitable velocity is consequently a levelling which has to be done. Low velocities can cause blockages while high velocities give higher wear and increased friction losses.

Effected factors

From a hydraulic point of view pumping slurries is more complicated than pumping liquids. Below you will find the main factors which affect the flow in a pipeline.

Particles charact.	Liquids charact.	Suspensions charact.	Pipes charact.
particle size	density	cone of solid particles	diameter
particle distribution	viscosity	rheology[1]	inclination
density shape hardness		velocity	roughness

[1] Intends in principle to decide how the viscosity varies under separate conditions.

Hydraulic parameters

Some possible ways to decide the hydraulic parameters are:

- investigate the experiences from similar applications
- make calculations with those formulas which have turned out to be usable for the actual application
- compare with the test results shown in the literature
- make laboratory tests for decision of the particles' density, size, hardness and speed of vertical descent as well as characteristics of the suspension such as viscosity at different concentrations etc.
- undertake test pumpings

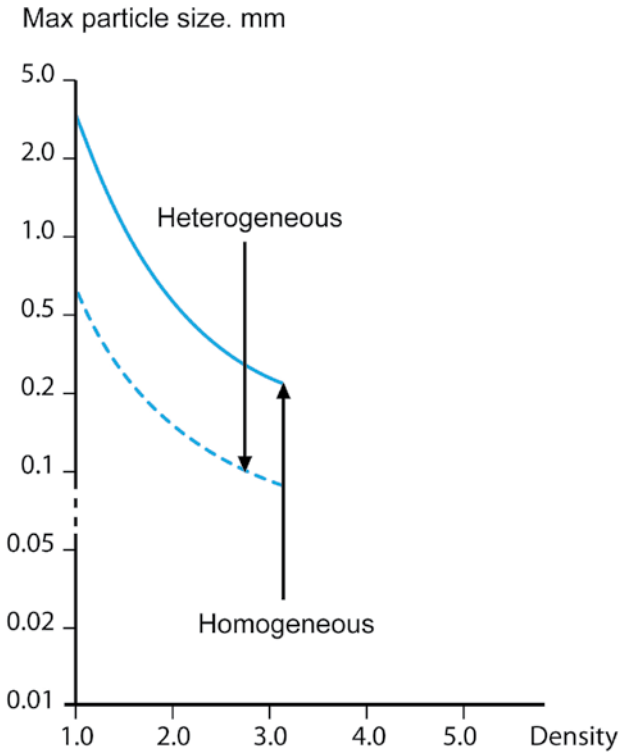
The extent of these investigations will of course vary from case to case.

Homogeneous suspension

A separation in so called homogeneous and heterogeneous suspensions is often well adapted to describe the characteristics of a suspension.

When the solid particles are distributed smoothly over the pipe cross section, this is a homogeneous suspension. If the particle size is smaller than 50µ (0.05 mm) the suspension is said to be homogeneous. The figure on this page also gives an estimation of when the suspension is considered to be a homogeneous or a heterogeneous one.

For a homogeneous suspension there is no risk of a sedimentation along the bottom during operation. During a hydraulic analysis of a homogeneous suspension, the suspension will normally be treated as a liquid.



Change from homogeneous to heterogeneous suspension (velocity 1.2-2.1 m/s).

The main point is to decide the rheological characteristics of the suspension which means how the viscosity varies under different circumstances. This will normally be made with a viscosimeter or by measuring the pressure fall in a testline.

Homogeneous suspensions, of slurried grain-shaped material in water with concentrations up to 10-15 volume-percent are normally designated Newtonian.

Heterogeneous suspension

For heterogeneous suspensions — suspensions with more coarse particles — the risk of sedimentation is a primary problem. The particles are suspended by the turbulence in the liquid. The liquid and the particles keep their identities.

The viscosity of the suspension is not as interesting as for homogeneous suspensions.

The empirical method of calculating the friction loss of a heterogeneous suspension is basically the same as the one used for the liquid itself.

An additional factor should be added to this because of the presence of the solid particles.

Critical velocity

There is a great risk of operating problems where irregular flow conditions are present as well as a risk of accumulation and plugging if the flow velocity is too low. The velocity (speed) at which the transition occurs from a sliding bed of material to a heterogeneous rate of flow is known as the critical velocity and is very interesting for the technique of hydro-
transport. At velocities below critical, the danger of clogging is great.

Increased particle size, particle density and pipe diameter give increased critical velocity. Empirical calculation terms are available for an estimated decision on the critical velocity.

The critical velocity V_C is calculated according to Durand-Condolio´s equation:

$$V_C = F_L \sqrt{2 \times g \times D \times \frac{S_S - S_1}{S_1}}$$

F_L = velocity parameter according to the particle size and the volumetric concentration of solid material

g = gravitational acceleration, (9.81 m/s²)

D = inside diameter of the hose (m)

S_S = density of the solid material (kg/m³)

S_1 = density of the liquid

Durand-Condolio´s equation shows that the critical velocity increases with the square root of the hose diameter for any given concentration and particle size. The velocity parameter F_L generally does not exceed 1.5, even with a volumetric concentration over 15 percent.



Different flow conditions. The third (lowest) variant in the figure represents the preferred flow condition.

Slurry

Particle size

Suspensions frequently contain both small particles — smaller than 0.05 mm — as well as coarse particles. This dispersion of the particle size is often positive. The risk of sedimentation is smaller, which means that the velocity might be lowered. It also reduces the wear and sometimes even the friction losses, including at unchanged velocities.

The liquid together with the small particles establishes a homogeneous suspension which represents the bearing media. The density and the viscosity are usually larger than for the liquid only. The bigger particles together with the bearing media establish a heterogeneous suspension.

The increased density of the bearing media, caused by the small particles, has a smaller difference of density for this heterogeneous suspension.

In bigger pipeline-projects it is beneficial to find a favourable dispersion of the particle size.

Particles hardness

The particle hardness can be expressed according to different scales, of which the most common are Mohs' and Brinnell's. The wear-tendency "abrasivity" of a material is expressed as a Miller number which is determined by a special test procedure.

The Miller number also gives another value "attribution" for how the wearing effect changes during transportation due to particle breakdown. This may be a negative if there is a loss of abrasion and a positive if there is a gain. The phenomenon of abrasion increasing over time is comparatively rare but it can occur under certain conditions if the solids tend to split with brittle fractures, exposing fresh sharp edges.

Examples of material hardness according to Moh's scale:	
Talc	1
Feldspar	6
Gypsum	2
Quartz	7
Calcite	3
Topaz	8
Fluorite	4
Corundum	9
Apatite	5
Diamond	10

Examples of the wear-tendency of different material, expressed as Miller numbers:	
Water	0 — 0
Limestone	14 — 12
Coal	21 — 7
Magnetite	67 — 4
Copper concentrate	128 — 0
Phosphate	133 — 12
Sulphur pyrites	194 — 4
Copper pyrites	436 — 22
Carborundum	1,000 — 12



Concentration, size, density and profile of the particles

The amount of wear increases with the concentration of solid material. Practical tests have shown that if the concentration increases over 20-25% in weight, the increase in wear tendency is less. This is thought to be due to the fact that particles collide with each other to a greater extent instead of against the walls of the pipe. With increasing size and density of the particles, the wear has been found to increase proportionately. This is a consequence of the increase in kinetic energy. The role of the particles' profile has not been precisely determined, but observations show that irregular sharp edged particles cause greater wear than regular almost spherical-shaped particles.



Flow velocity

Wear is greatly affected by the rate of flow. Practical tests have shown that wear in slurry applications increases exponentially with the flow velocity and by an exponent between 2 and 3.

Heterogeneous and turbulent flow

Slurries in the mining industry are often heterogeneous. The flow is kept turbulent to avoid sedimentation and a sliding bed of material.

In spite of this, most of the material is usually concentrated in the lower part of the pipe (in a horizontal flow) and therefore the wear is heavier here than in the upper portion.

To compensate for this heavier wear, it is usual, where possible, to rotate the hose or pipe 90-120 degrees at regular intervals.

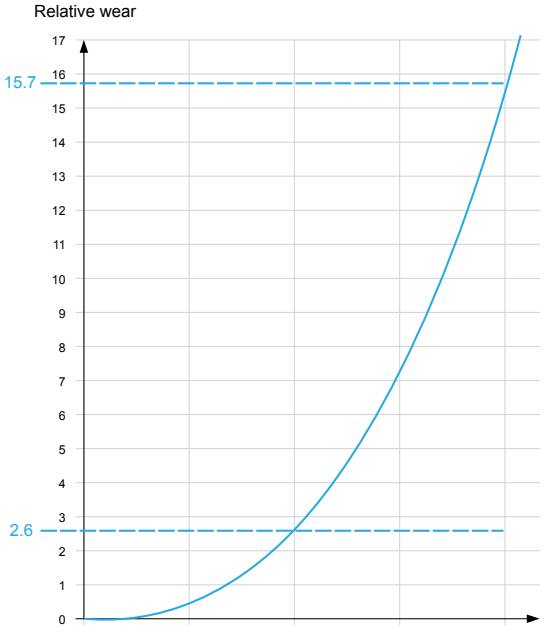


Diagram showing relative wear at different speeds.

Even installation

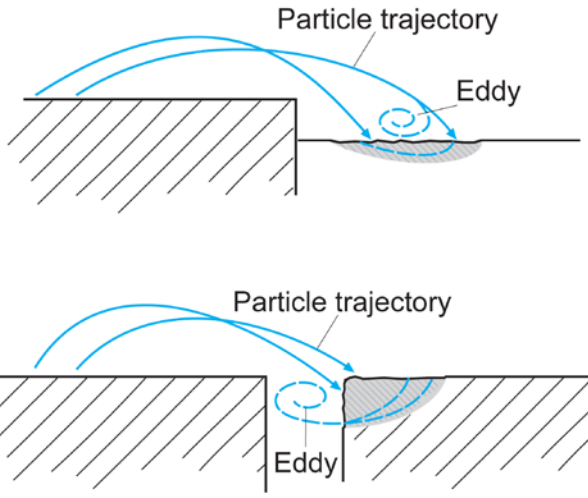
When transporting abrasive materials it is important that the slurry line is installed as evenly as possible and with the fewest possible irregularities. Each irregularity will increase wear at the exposed point and also increase the flow resistance in the system.

In the installation of bends and loops,the largest possible radius should be used. An often used rule of thumb is that the radius of the bends have to be made at least 10 x ID.

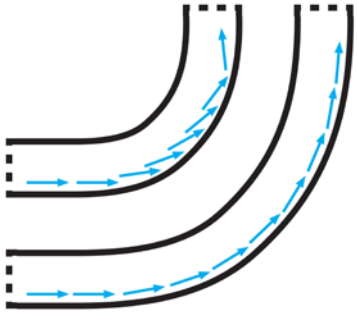
Internal welding ridges, and carelessly installed flanges can also cause unnecessary wear, see figure.

With changes in pipe dimensions, conical adaptors should be used.

To minimise wear it is important to give the bends as big a radius as possible.



If discontinuities occur, a process such as that shown in this figure can take place. Local turbulence sets in, causing eddies to form which tends to scour a depression at the discontinuity.



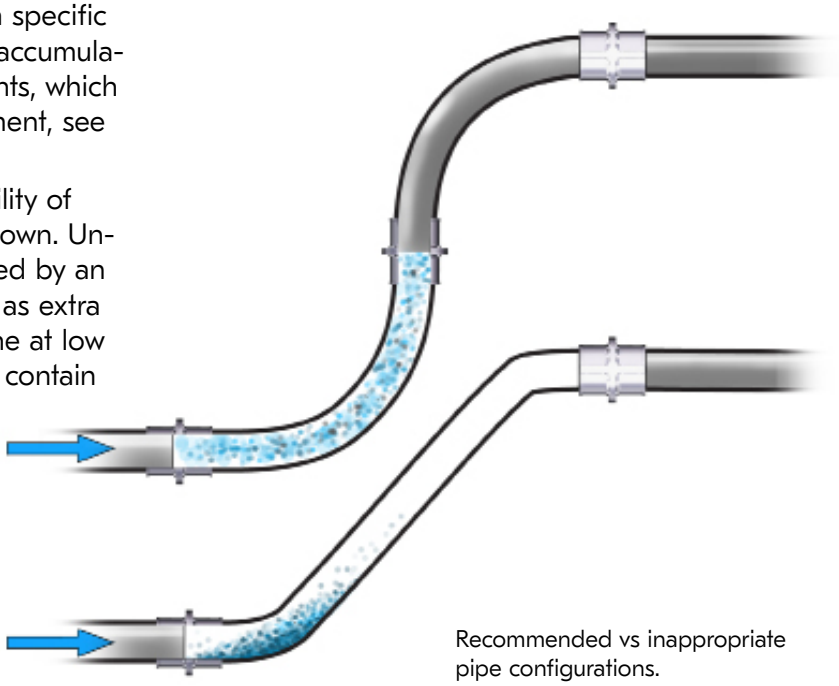
Radius of bends affects wear.

Inclination

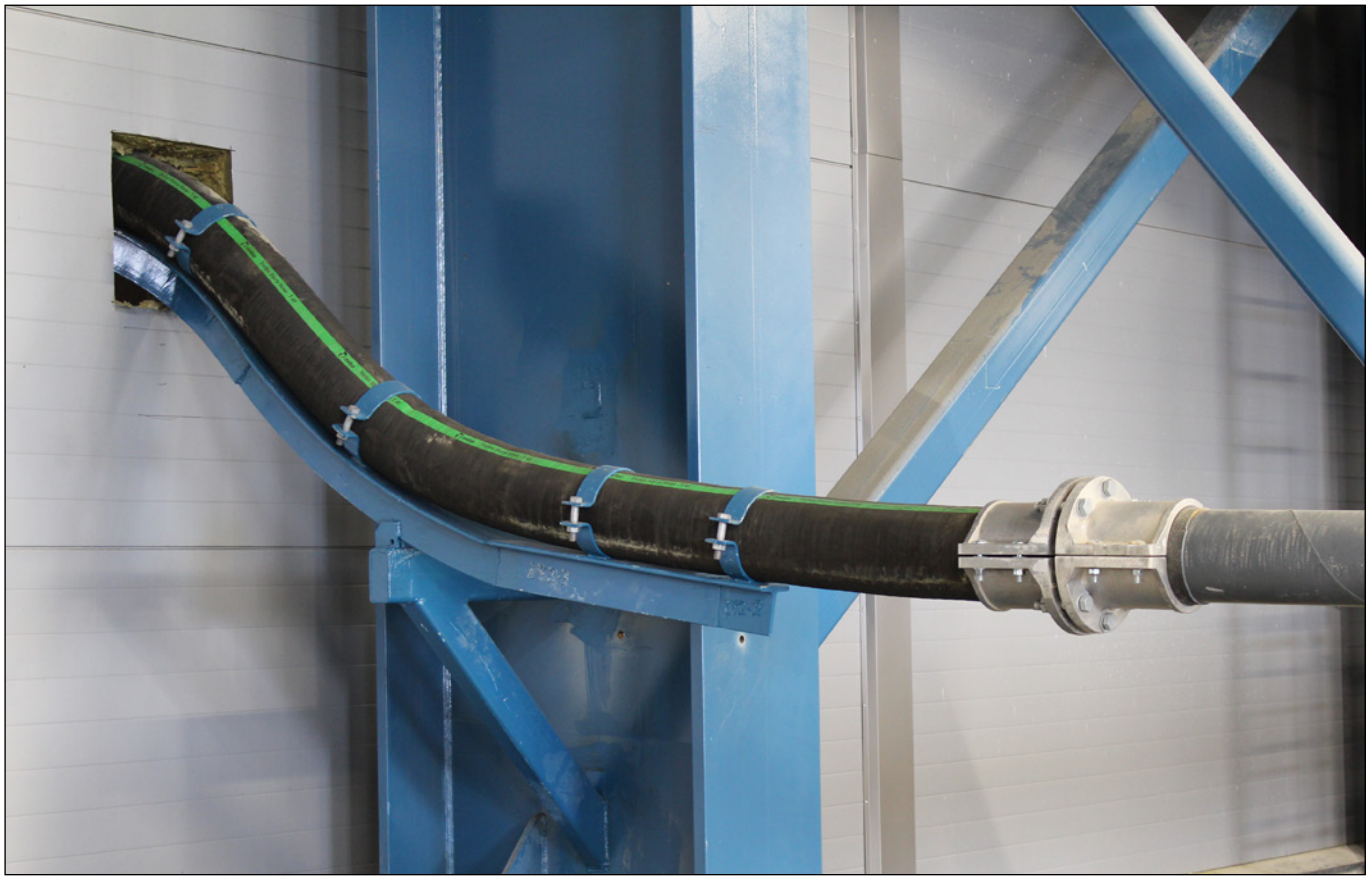
Production stops or close downs cause a specific problem. If the inclination is too big, an accumulation of the particles will occur at low points, which might give problems at the starting moment, see figure beside.

In smaller pipe systems there is a possibility of pumping clean water in before closing down. Unexpected production stops may be helped by an extra facility for supplying power as well as extra pumps. Another option is to open the line at low points. These smaller pipe systems often contain vertical distances.

Another way to eliminate the risk of accumulation during production stops is to limit the inclination of the lining. This normally will be done with long-distance transportation of solid particles.



Recommended vs inappropriate pipe configurations.



Chemical resistance

Since there are sometimes aggressive chemicals present "internally" in the system, the chemical resistance of the Slurry Hose System is extremely important.

The degree of resistance to a certain chemical depends on such factors as temperature, concentration, pressure, flow rate, exposure time, stability of the liquid, etc.

For further information and specific details applicable to chemical resistance, see Technical Specifications.



Rules and regulations

Local regulations

Every country (state) has its own safety regulations. It is the responsibility of the work management and installation engineer to know and follow these. If the recommendations in this manual are different from those in Your country, then the local safety regulations shall be followed.

Working pressure

Working pressure is 500–1000 kPa. Hoses between 51 and 204 mm are designed for 10 bar and hoses between 254 and 610 mm are designed for 5 bar.

Safety factor against bursting is 1.5 times working pressure.

Standards

According to PED EN 13480.

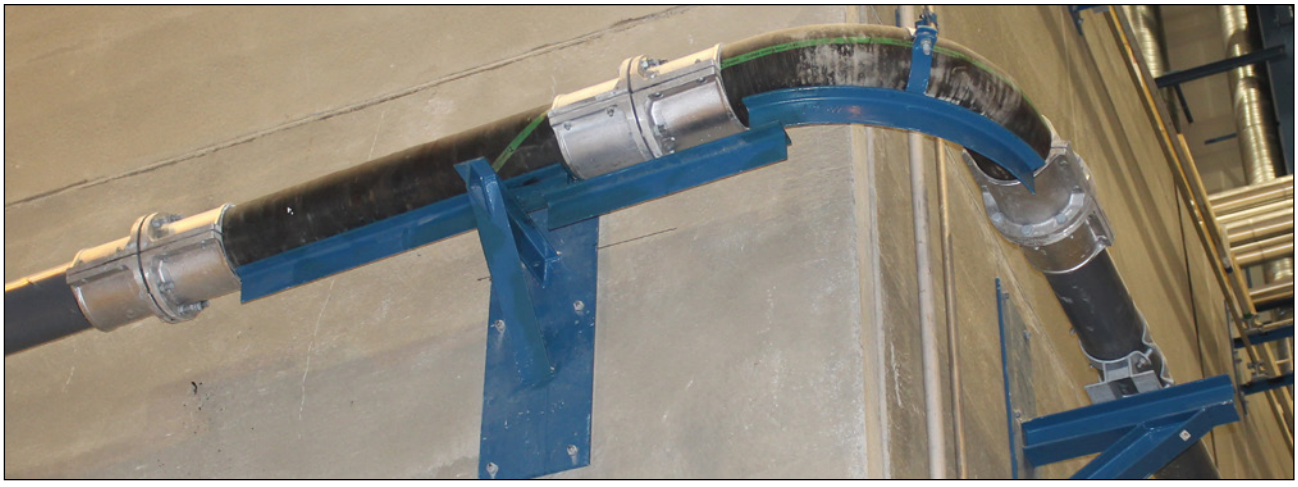
According to EN 287 and EN 15609.

Flanges according to DIN 2501 and ANSI B16.5.

Painting and surface treatment according to EN ISO 12944-4, ISO 8501-1 and EN ISO 12944-5.

Specifications:	
Surface preparation grade	Sa 2.5
Primary Coat	EP (Zn (R)) 60/1
Top Coat	Pur 120/2
Painting system	EP (Zn (R)) PUR 180/3
Colour	RAL 7011 Grey





Support System

It is recommended that the slurry line should be supported along its entire length and fixed to the support with clamps. Bends and loops should be mounted as uniformly as possible.

Metso provides a wide range of designs for, and methods of, mounting and installing Metso Slurry Handling Systems. Supporting systems using standard components have been designed for the majority of applications.

Bends and loops

Bends and loops should be uniform, with as large a radius as the available space allows. The radii stated in Metso manuals and catalogues are the minimum radii at which the hoses can be curved without kinking, and the use of larger radii is always recommended. When fitting the hose in a curve, be careful to trim the length with a plus-tolerance, otherwise even the minimum radius might be exceeded. For recommended bend radius, please see **System Design**.

To avoid chaffing of the hose against clamps when subjected to pulsating pressures, and to give the hose maximum support, the support in a curve should be inverted to the outer radius of the hose. Otherwise, only the clamps and not the support will be holding the hose in position.

Clamps

For recommended clamp sizes for each hose dimension, please see **Technical Specifications**.

Clamping

Clamping should be done every 1000 to 1500 mm on straight lines. The following spacing between each clamp is recommended:

Hose / Pipe ID (mm/inch)	Spacing Hose (mm/ft)	Distance to pipe end (mm/ft)
51-127 / 2-5"	1000 / 3	300 / 1
152-355 / 6-14"	1250 / 4	500 / 1.5
405-610 / 16-24	1500 / 5	1000 / 3

Hoses: In curved sections, tighter clamping is recommended.

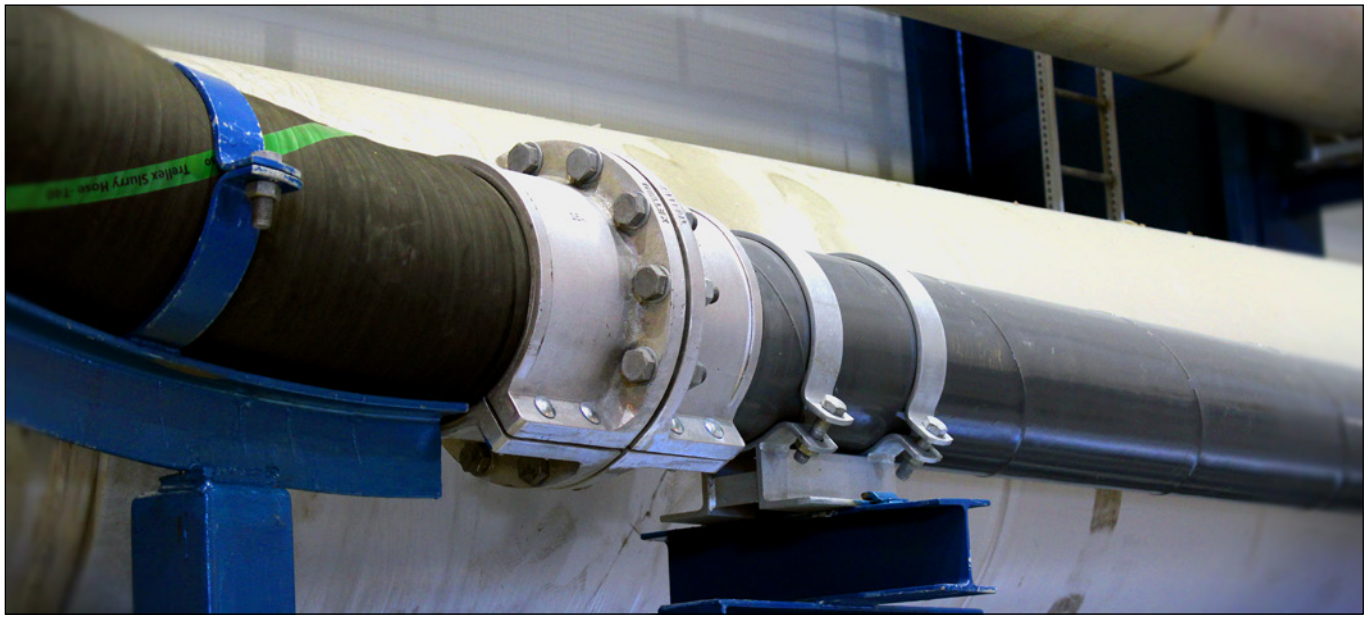
Pipes: For 3 and 6 meter pipes min. 2 clamps is recommended, for 10 meter pipes min. 3 clamps is recommended.

Clamps are available at Metso.

Accessories

Rubber Lined Steel Pipes

In contrast to the rubber hoses, the rubber lined steel pipe does not need any support in the form of supporting beams along the full length of the hose installation. This reduces the total installation costs for rubber lined steel pipes in comparison to rubber hoses. The rubber lined steel pipe, however, lacks the flexibility of the slurry hose and does not give the same options for bending and adjusting in small spaces and difficult passages which may occur in an installation. We therefore recommend a combination of both alternatives.



Support Beams

As a support for the slurry hose system we used so-called support beams which are selected according to the internal diameters of the hose and the distance between the supports. The basic principle is that the support beam is positioned along the underside of the hose. The hose is fixed to the support beam using clamps that are fixed around the hose and beam. The figures on the right show the most common types of beam used as a support for Metso Slurry Handling Systems.

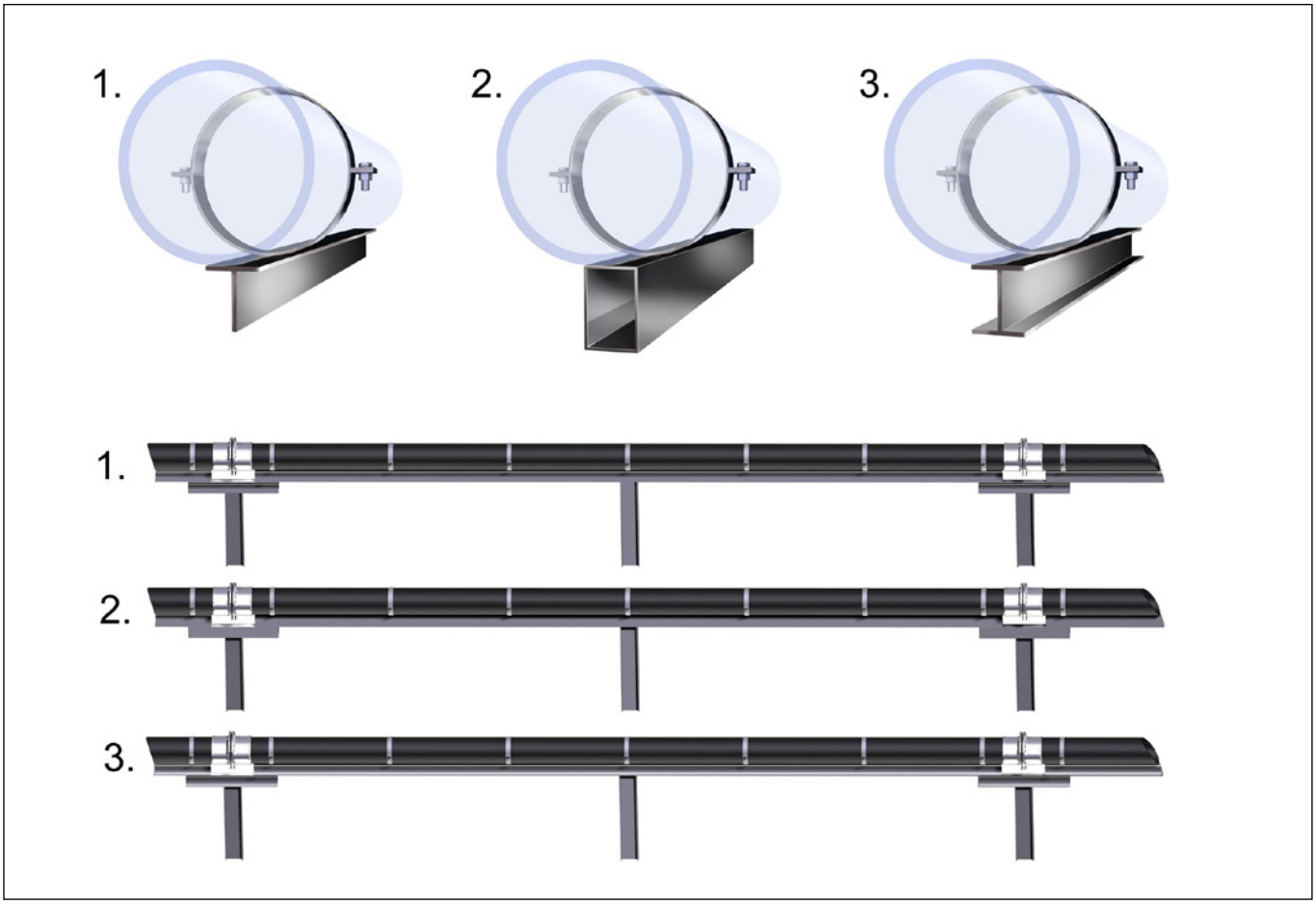
- T-beam
- VKR-beam
- HEA-beam

For further recommendations in relation to types of beam and installing support beams see the **Support beam selection** table on the next page.

Note: Support beams are not currently included in Metso's product range, but can be ordered locally.



1. T-balk with clamps
2. VKR-balk with clamps
3. HEA-balk with clamps



Selection of Support Beams

The support beams are dimensioned according to the following:

Allowed stress level: 100 MPa

Distributed load:

- Load per meter for each hose size corresponding to a pulp density of 2 or 3 ton/m3
- Load applied by the weight of different sizes of hose.
- Load of clamps distributed per meter.

Note: The calculation is based on a distance between clamps of 1 meter for hose sizes up to ID 102, 1.25 meters for hose sizes with ID between 127-204 and 1.5 meters for larger sizes.

Point load:

The point load is applied on the beam in the middle between supports (worst case) and corresponds to the weight of two couplings. An additional load of 5 kg for hose sizes up to ID102 and 65 kg for larger sizes is also applied.

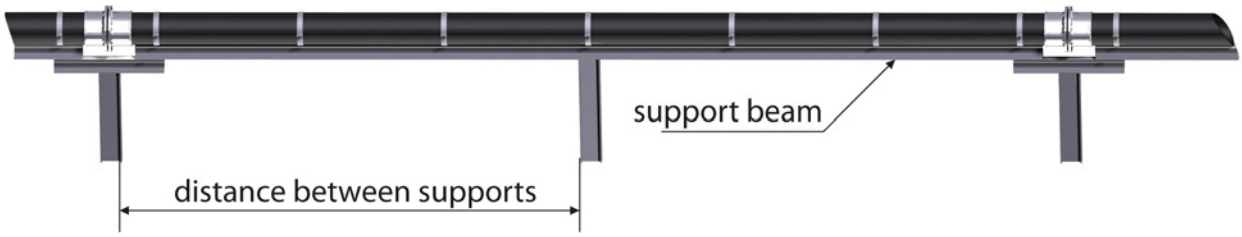
Selection of support beam:

The support beam is calculated depending on distance between supports and slurry density.

Support beam selection - Pulp density 2 ton/m^3

DIMENSIONING LOADS													
INNER DIAMETER													
mm	51	76	102	127	152	204	254	305	355	405	457	508	610
inch	2	3	4	5	6	8	10	12	14	16	18	20	24
Distributed load (kg/m)	8,0	16,9	26,7	39,4	53,9	97,1	143,4	202,7	281,7	359,6	452,9	561,6	797,1
Point load (kg)	8,6	9,8	12	14,6	77,4	86,2	87,2	107,8	119	155,8	167,6	188,4	224

Distance between support (m)	REQUIRED SECTION MODULUS, W (x10^3 mm^3)												
INNER DIAMETER													
mm	51	76	102	127	152	204	254	305	355	405	457	508	610
inch	2	3	4	5	6	8	10	12	14	16	18	20	24
1	0	0	1	1	3	3	4	5	6	8	10	12	16
2	1	1	2	3	7	9	12	16	20	26	31	37	51
3	2	3	4	6	12	17	23	31	41	52	64	77	106
4	2	4	7	9	19	28	37	51	68	88	107	131	182
5	4	6	10	14	27	41	56	77	103	132	162	199	277
6	5	9	14	20	36	57	78	107	145	185	229	281	392
7	6	12	18	27	47	75	103	143	193	248	307	377	527
8	6	12	18	27	47	75	103	143	193	248	307	377	527
9	10	19	30	43	72	118	165	230	312	399	496	611	857
10	12	24	36	53	87	143	201	280	382	488	608	749	1052



Recommended distance between supports.

Support beam selection - Pulp density 3 ton/m³

DIMENSIONING LOADS													
INNER DIAMETER													
mm	51	76	102	127	152	204	254	305	355	405	457	508	610
inch	2	3	4	5	6	8	10	12	14	16	18	20	24
Distributed load (kg/m)	10	22	36	54	75	135	202	287	396	508	641	795	1133
Point load (kg)	8,6	9,8	12	14,6	77,4	86,2	87,2	107,8	119	155,8	167,6	188,4	224

Distance between support (m)	REQUIRED SECTION MODULUS, W (x10^3 mm^3)												
INNER DIAMETER													
mm	51	76	102	127	152	204	254	305	355	405	457	508	610
inch	2	3	4	5	6	8	10	12	14	16	18	20	24
1	0	1	1	1	3	4	5	6	8	10	12	15	20
2	1	2	2	3	8	11	14	20	26	33	40	49	68
3	2	3	5	7	14	22	29	40	53	69	85	104	144
4	3	5	8	12	23	36	49	68	91	117	145	178	249
5	4	8	13	19	33	53	74	103	138	178	221	272	382
6	6	11	18	26	45	74	104	145	196	252	314	386	544
7	8	15	24	36	59	98	139	194	263	338	422	520	733
8	10	20	31	46	75	125	179	251	340	437	547	673	951
9	12	25	39	58	93	156	224	315	427	549	687	847	1198
10	15	30	48	71	113	190	274	385	524	674	844	1040	1473

Support beam selection - Pulp density 2 ton/m³

Distance between support (m)	RECOMMENDED SUPPORT BEAM												
INNER DIAMETER													
mm	51	76	102	127	152	204	254	305	355	405	457	508	610
inch	2	3	4	5	6	8	10	12	14	16	18	20	24
1	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-80x80x9	T-80x80x9	T-80x80x9	T-80x80x9	T-100x100x11
2	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-80x80x9	T-80x80x9	T-80x80x9	T-100x100x11	T-100x100x11	100x50x4	120x60x5	120x60x5	150x100x5
3	T-60x60x7	T-60x60x7	T-60x60x7	T-80x80x9	T-80x80x9	T-100x100x11	T-100x100x11	120x60x5	120x60x5	150x100x5	150x100x5	150x100x5	180x100x5,6
4	T-60x60x7	T-60x60x7	T-80x80x9	T-80x80x9	T-100x100x11	100x50x4	120x60x5	150x100x5	150x100x5	150x100x5	180x100x5,6	180x100x5,6	200x100x6,3
5	T-60x60x7	T-80x80x9	T-80x80x9	T-100x100x11	100x50x4	120x60x5	150x100x5	150x100x5	180x100x5,6	180x100x5,6	200x100x6,3	220x120x6,3	250x150x6,3
6	T-60x60x7	T-80x80x9	T-100x100x11	T-100x100x11	120x60x5	150x100x5	150x100x5	180x100x5,6	200x100x6,3	220x120x6,3	220x120x6,3	250x150x6,3	300x200x6,3
7	T-80x80x9	T-80x80x9	T-100x100x11	100x50x4	150x100x5	150x100x5	180x100x5,6	200x100x6,3	220x120x6,3	250x150x6,3	250x150x6,3	300x200x6,3	HE240A
8	T-80x80x9	T-100x100x11	T-100x100x11	120x60x5	150x100x5	150x100x5	180x100x5,6	200x100x6,3	250x150x6,3	250x150x6,3	300x200x6,3	300x200x6,3	HE260A
9	T-80x80x9	T-100x100x11	120x60x5	150x100x5	150x100x5	180x100x5,6	200x100x6,3	220x120x6,3	250x150x6,3	300x200x6,3	300x200x6,3	HE240A	HE280A
10	T-80x80x9	T-100x100x11	120x60x5	150x100x5	150x100x5	200x100x6,3	220x120x6,3	250x150x6,3	300x200x6,3	300x200x6,3	HE240A	HE260A	HE300A

Support beam selection - Pulp density 3 ton/m³

Distance between support (m)	RECOMMENDED SUPPORT BEAM												
INNER DIAMETER													
mm	51	76	102	127	152	204	254	305	355	405	457	508	610
inch	2	3	4	5	6	8	10	12	14	16	18	20	24
1	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-80x80x9	T-80x80x9	T-80x80x9	T-80x80x9	T-100x100x11	T-100x100x11
2	T-60x60x7	T-60x60x7	T-60x60x7	T-60x60x7	T-80x80x9	T-80x80x9	T-100x100x11	T-100x100x11	100x50x4	120x60x5	120x60x5	150x100x5	150x100x5
3	T-60x60x7	T-60x60x7	T-60x60x7	T-80x80x9	T-100x100x11	T-100x100x11	120x60x5	120x60x5	150x100x5	150x100x5	150x100x5	180x100x5,6	200x100x6,3
4	T-60x60x7	T-60x60x7	T-80x80x9	T-80x80x9	T-100x100x11	120x60x5	150x100x5	150x100x5	150x100x5	180x100x5,6		200x100x6,3	250x150x6,3
5	T-60x60x7	T-80x80x9	T-80x80x9	T-100x100x11	120x60x5	150x100x5	150x100x5	180x100x5,6	200x100x6,3	200x100x6,3	220x120x6,3	250x150x6,3	300x200x6,3
6	T-80x80x9	T-80x80x9	T-100x100x11	100x50x4	150x100x5	150x100x5	180x100x5,6	200x100x6,3	220x120x6,3	250x150x6,3	250x150x6,3	300x200x6,3	HE240A
7	T-80x80x9	T-100x100x11	T-100x100x11	120x60x5	150x100x5	150x100x5	200x100x6,3	220x120x6,3	250x150x6,3			300x200x6,3	HE260A
8	T-80x80x9	T-100x100x11	120x60x5	150x100x5	150x100x5	180x100x5,6	200x100x6,3	250x150x6,3			HE240A	HE240A	HE280A
9	T-80x80x9	T-100x100x11	120x60x5	150x100x5	150x100x5	200x100x6,3	220x120x6,3	250x150x6,3		HE240A	HE260A	HE280A	HE300A
10	T-100x100x11	120x60x5	150x100x5	150x100x5	180x100x5,6	220x120x6,3	250x150x6,3	300x200x6,3		HE240A	HE280A	HE300A	HE320A

Placing the Support Beams

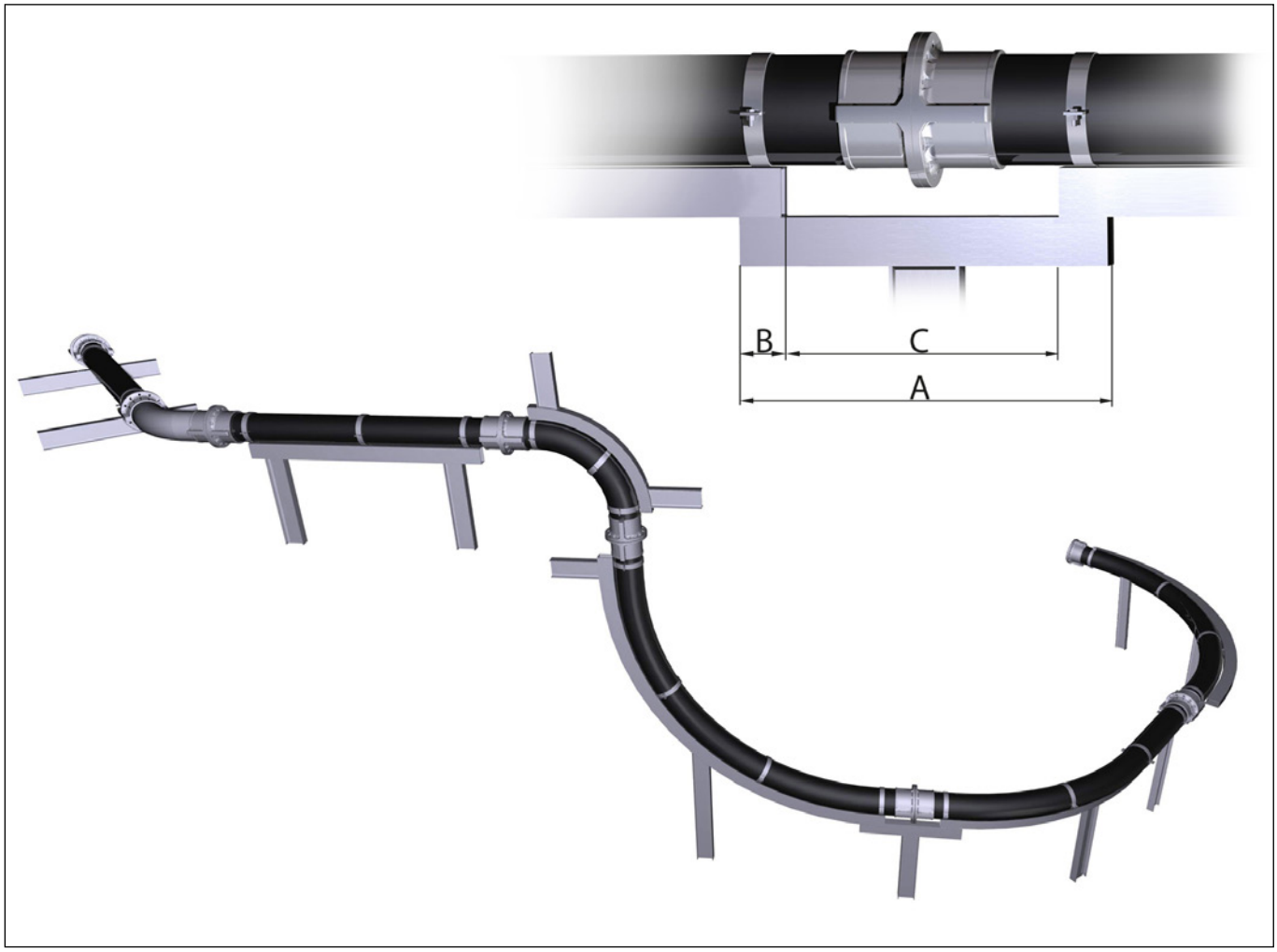
When installing support beams on bends, there are three placing options: inside beam, underneath beam and outside beam. When bending straight lengths of hose, the support beam needs to follow the full length of the hose.

For straight lengths of hose, the support beam needs to be placed underneath the hose as much as possible. For bends, we recommend that the beam is placed along the outside of the hose. Fixed obstacles in the installation, for example in the form of pillars or other parts of the slurry hose system, will sometimes require you to deviate from this principle. The support beam can be placed along the underneath or inside the hose instead, also in bends. See the example in the figure below.

The table on the right and the figure below show how the support beams should be placed in relation to the couplings. So that transitions are as straight as possible and to avoid wear and flow resistance, it is important that the couplings do **not** rest on the support beam, so that the hose is lifted there.

Hose size	A	B	C
51	470	120	230
76	590	150	290
102	780	180	420
127	910	200	510
152	1010	200	610
204	1190	200	790
254	1010	200	610
305	1330	300	730
355	1450	300	850
405	1820	300	1220
457	1970	300	1370
508	2120	300	1520
610	2420	300	1820

Support beam at couplings according to table.



Overview of support beam placement.

Clamping Hose in Curved Sections

Hose / Pipe ID (mm/inch)	Spacing Hose (mm/ft)	Distance to pipe end (mm/ft)
51-127 / 2-5"	1000 / 3	300 / 1
152-355 / 6-14"	1250 / 4	500 / 1.5
405-610 / 16-24	1500 / 5	1000 / 3

IMPORTANT: Accessories like fabricated 3xD Bends, Reducers, Branch Pipes, etc., need not be supported.

Clamping Hose 90 degree

When bending straight hose lengths, the instructions relating to bending radius and clamp location in the figures should be followed. The figures also gives the recommended support system for 90° curves and for 45° curves.

Recommended number of clamps

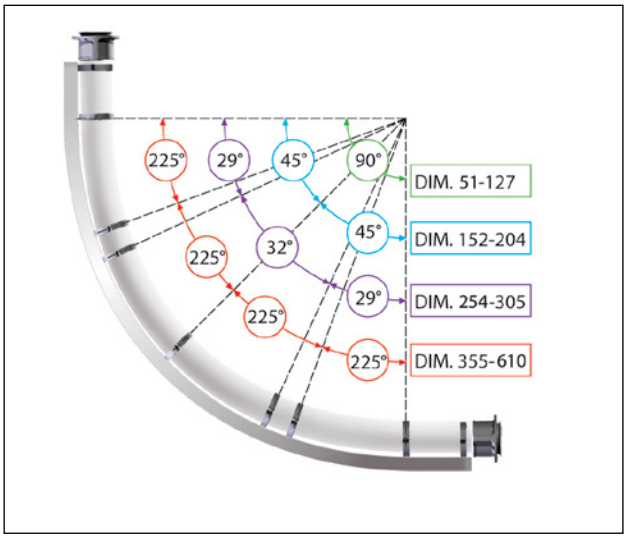
Refer to the tables below for information about the recommended number of clamps.

Clamp item no.	Hose dim.	Screw dim.	No. of clamps
SH-596551	51	M6S 8x35 h fzb	2
SH-596577	76	M6S 8x35 h fzb	2
SH-575043	102	M6S 8x35 h fzb	2
SH-575050	127	M6S 12x45 h fzb	2

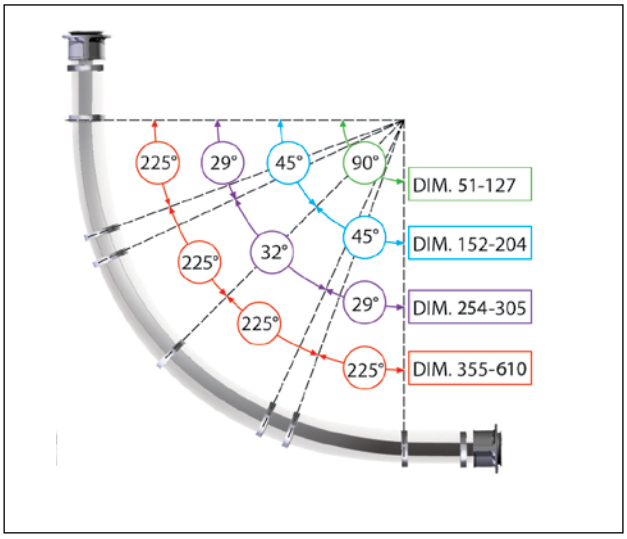
Clamp item no.	Hose dim.	Screw dim.	No.of clamps
SH-575068	152	M6S 12x45 h fzb	3
SH-575076	204	M6S 12x45 h fzb	3

Clamp item no.	Hose dim.	Screw dim.	No .of clamps
SH-575084	254	M6S 12x45 h fzb	4
SH-575092	305	M6S 16x50 h fzb	4

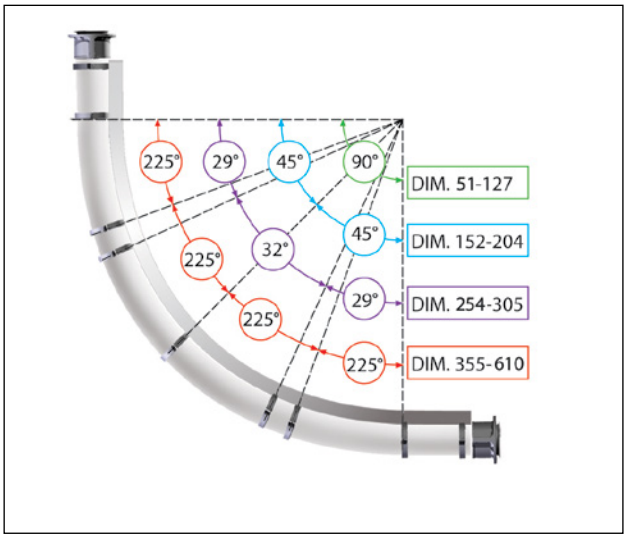
Clamp item no.	Hose dim.	Screw dim.	No. of clamps
SH-602904	355	M6S 16x50 h fzb	5
SH-602896	405	M6S 16x50 h fzb	5
SH-602888	457	M6S 16x50 h fzb	5
SH-602870	508	M6S 16x50 h fzb	5
SH-602862	610	M6S 16x50 h fzb	5



OUTSIDE - Recommended number of clamps, support beams placed on the outside of the hose bend.



UNDERNEATH - Recommended number of clamps, support beams placed underneath the hose bend.



INSIDE - Recommended number of clamps, support beams placed on the inside of the hose bend.

Clamping Hose 45 degree

The principle is the same for hoses that need to be bent at a 45 degree angle as for hoses that need to be bent at a 90 degree angle.

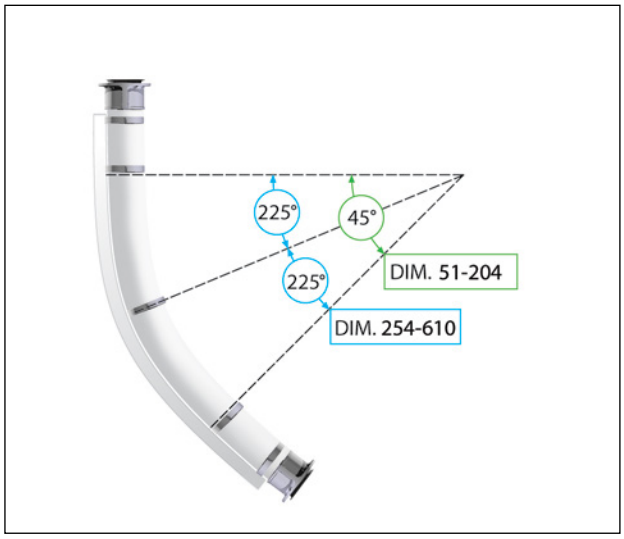
Recommended number of clamps

Refer to the tables below for information about the recommended number of clamps.

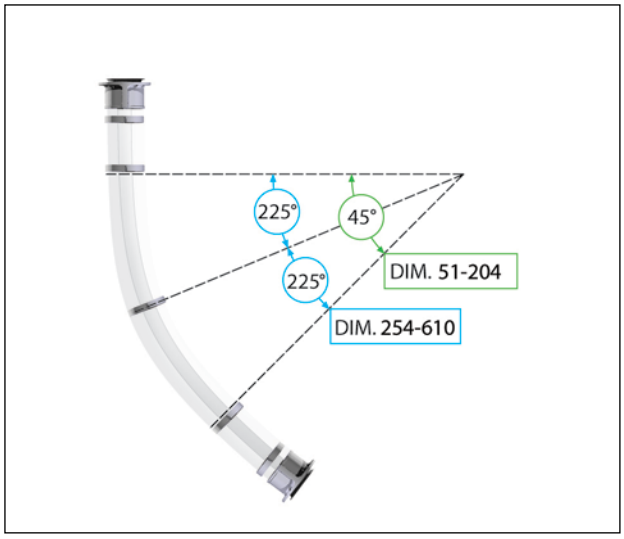
Clamp item no.	Hose dim.	Screw dim.	No. of clamps
SH-596551	51	M6S 8x35 h fzb	2
SH-596577	76	M6S 8x35 h fzb	2
SH-575043	102	M6S 8x35 h fzb	2
SH-575050	127	M6S 12x45 h fzb	2
SH-575068	152	M6S 12x45 h fzb	2
SH-575076	204	M6S 12x45 h fzb	2

Clamp item no.	Hose dim.	Screw dim.	No. of clamps
SH-575084	254	M6S 12x45 h fzb	3
SH-575092	305	M6S 16x50 h fzb	3
SH-602904	355	M6S 16x50 h fzb	3
SH-602896	405	M6S 16x50 h fzb	3
SH-602888	457	M6S 16x50 h fzb	3
SH-602870	508	M6S 16x50 h fzb	3
SH-602862	610	M6S 16x50 h fzb	3

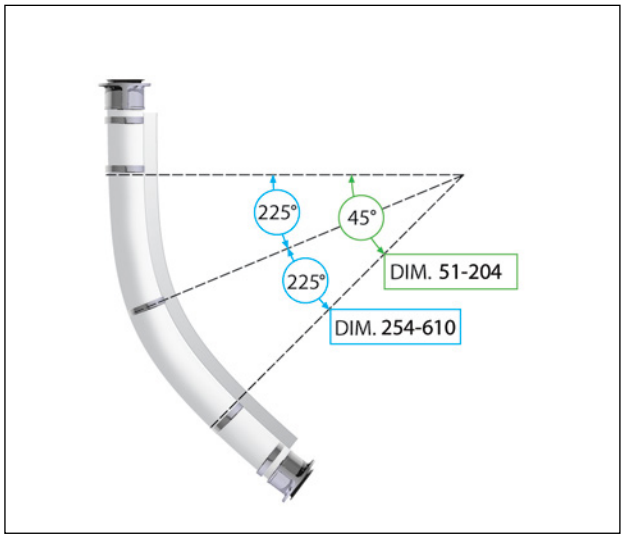
IMPORTANT: Clamps should always be placed on each side of the coupling, 20 mm from the support beam end. See Placing the Support Beams.



OUTSIDE - Recommended number of clamps, support beams placed on the outside of the hose bend.

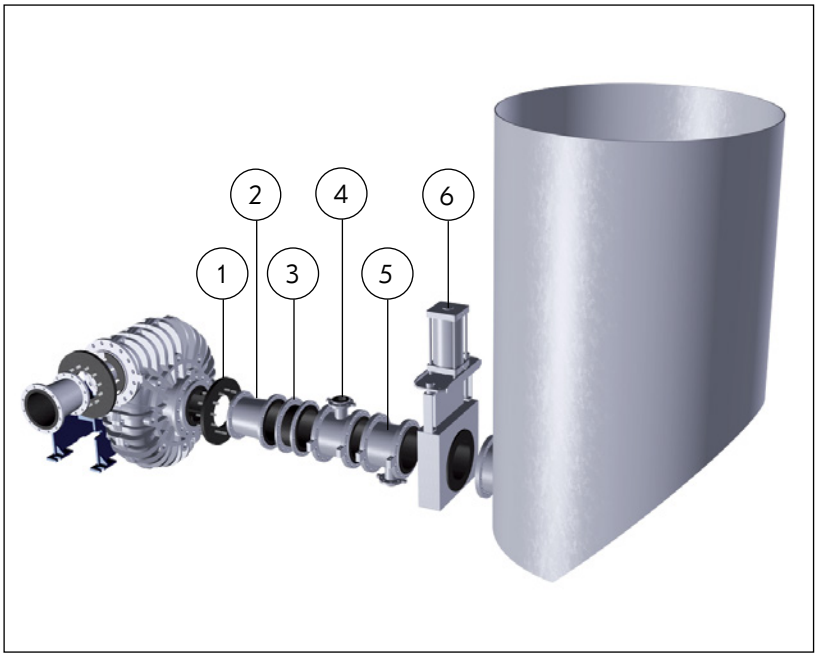


UNDERNEATH - Recommended number of clamps, support beams placed underneath the hose bend.



INSIDE - Recommended number of clamps, support beams placed on the inside of the hose bend.

Suction Pump Connections



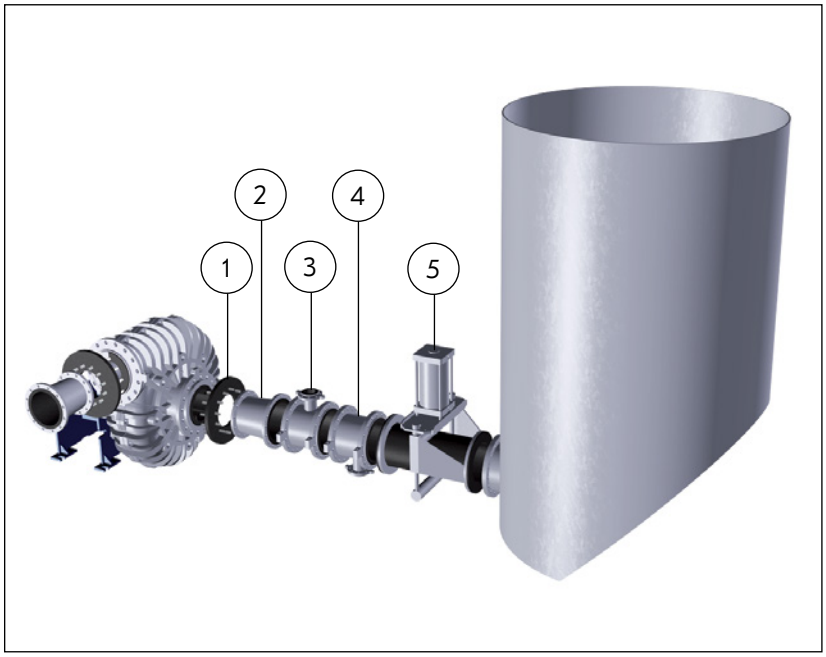
Overview

1. Flange adapter
2. Rubber Lined Steel Reducer
3. Rubber Compensator
4. Branch pipe T90 for inlet water
5. Branch pipe T90 for drainage
6. Knife Gate Valve

The piping system between the sump and the pump can vary depending on space available, valve type, and maintenance requirements. The Metso Slurry Hose System includes components that allow for a variety of setup solutions. Here are some examples of how to build a piping system using the components.

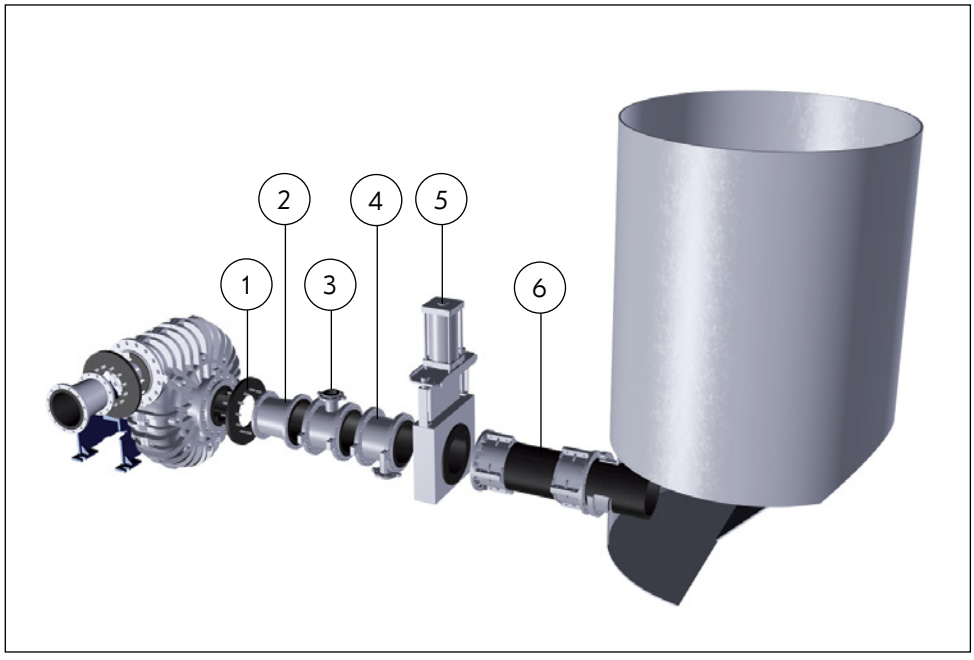
Above: The Flange adapter is required when the pump has a different flange drilling pattern than the corresponding Slurry Hose System component. The Rubber Lined Steel Reducer decreases the pipe diameter next to the pump. The Rubber Compensator is used here to give the necessary flexibility to the suction side to ease disassembly and maintenance. The Branch Pipe T90 is used for both inlet water and drainage. The Knife Gate Valve is used for the shut off application.

Below: When using Open Body Pinch Valves instead of Knife Gate Valves, the Rubber Compensator is not needed. The Open Body Pinch Valve can shut off the sump and act as the Rubber Compensator.



Overview

1. Flange adapter
2. Rubber Lined Steel Reducer
3. Branch pipe T90 for inlet water
4. Branch pipe T90 for drainage
5. Open Body Pinch Valve



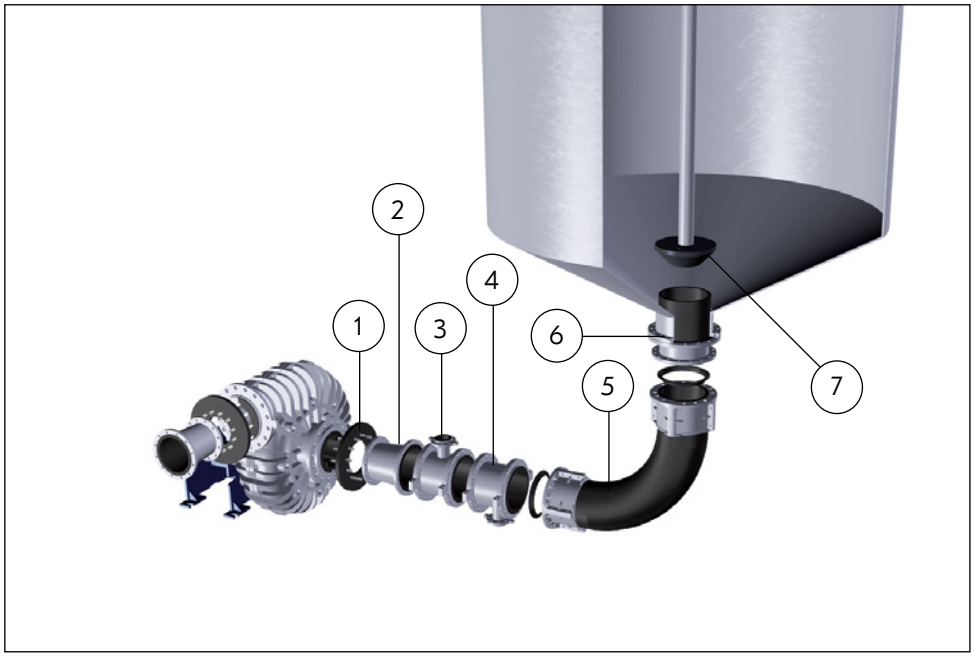
Overview

1. Flange adapter
2. Rubber Lined Steel Reducer
3. Branch pipe T90 for inlet water
4. Branch pipe T90 for drainage
5. Knife Gate Valve
6. Metso Material Handling Hose

Above: Another method of increasing flexibility in the piping system is to use the Metso Material Handling Hose next to the sump. Together with the Metso Split Flange Couplings it is possible to let the hose go into the tank.

Below: When vertical outlet sump tanks are used, another type of valve is more suitable. The Metso Dart Valves are a way to shut off the sump. The Dart Valve, Dart Valve Seat and the Metso 3xD Bend allow for the usage of a vertical sump tank.

For more information regarding each component, see Technical Specifications.



Overview

1. Flange adapter
2. Rubber Lined Steel Reducer
3. Branch pipe T90 for inlet water
4. Branch pipe T90 for drainage
5. Metso 3xD Bend
6. Metso Dart Valve Seat
7. Metso Dart Valve

Chemical resistance

This table should be used only as a guide since the degree of resistance to a certain chemical depends on such factors as temperature, concentration, pressure, flow rate, exposure time, stability of the liquid, etc. The values apply to chemical temperatures of up to 105 °F (+40 °C).

Consult Metso in any doubt.

Since aggressive chemicals are usually present "internally" in the system, the need for resistance in the coupling is generally not so acute. However, if couplings with greater resistance are required, they can be supplied to order. When inquiring, always state the chemical, temperature, concentration and whether the coupling is constantly exposed to the chemical or is exposed through splashing or flooding.

A = Very good

B = Good

C = Limited application

D = Unsuitable

— = No details available

CHEMICAL	HOSE T40/T60	GASKET	COUPLING
A			
Acetic acid, dilute (10 %)	B	D	C
Acetone	A	D	A
Acetylene	A	A	A=dry C=moist
Aluminum sulphate	A	D	C
Ammonia gas	A	B	A=dry D=moist
Ammonium phosphate	A		C
Ammonium hydroxide	A	B	D
Ammonium chloride	A	D	C
Ammonium nitrate	A	D	C
Ammonium sulphate	A	D	C
Asphalt	D	D	A
B			
Beet-sugar liquors	A	A	A
Benzene	D	D	A
Borax	A	A	A
Boric acid	A	D	C
Brine	A	C	C
Bromine	D	D	A=dry C=moist
Butane	D	D	A
C			
Cane-sugar solution	A	A	A
Carbon dioxide (dry)	A	A	A
Carbon dioxide (wet and water solution)	A	B	C
Carbon disulphide	B	D	A
Carbon tetrachloride	D	D	A
Chlorine (dry)	D	C	A
Chlorine (wet)	D	D	D
Chromic acid	D	D	D
Citric acid	A	D	C
Coke oven gas (town gas, coal gas)	A	C	A
Copper sulphate	A	D	D
E			
Ether	C	C	A
Ethylene glycol	A	A	A
F			
Ferrous sulphate	A	D	C
Formaldehyde	A	D	A
Formic acid	A	D	C
Freon	D	D	A=(dry)
Furfural	D	C	A
G			
Gelatine	A		A
Glycerine	A	A	A
Glycos	A	A	A
H			
Hydrochloric acid			
0-0.2 %	A	D	D
0.2-0.3 %	A	D	D
0.3-0.4 %	A	D	D
37 %	B	D	D
Hydrogen	A	B	A
Hydrogen fluoride	A	D	D
Hydrogen peroxide			
(30 % 20° C)	A	D	C
Hydrogen sulphide	C	C	A
Hydrosulphuric acid	C	C	A=dry C=moist
Iron chloride	D	D	C

CHEMICAL	HOSE T40/T60	GASKET	COUPLING
Magnesium chloride	A	D	C
Magnesium hydroxide	B	B	D
Magnesium sulphate	A	D	C
Mercury	A	A	A=dry D=moist
Mercury chloride	A	C	D
N			
Natural gas	D	C	A
Nickel chloride	A		D
Nickel sulphate	A	D	D
Nitric acid	D	D	D
O			
Oleic acid	C		A
Oxalic acid	C	C	C
Oxygen	A	C	A
P			
Palmitic acid	C	B	A
Petroleum	D	D	A
Phosphoric acid			
0 –25 %	A	C	D
25-50 %	A	D	D
50-85 %	A	D	D
Potassium chloride	A	C	C
Potassium hydroxide	A	B	D
Potassium sulphate	A	C	C
Propane	D	D	A
S			
Sodium bicarbonate	A	D	A
Sodium bisulphite	A	D	C
Sodium chloride	A	C	D
Sodium cyanide	A	A	D
Sodium hydroxide	A	B	D
Sodium hypochlorite	C	D	D
Sodium metaphosphate	A	–	D
Sodium nitrate	A	D	C
Sodium perborate	C	D	C
Sodium peroxide	C	C	D
Sodium silicate	A	A	C
Sodium sulphate	A	C	A
Sodium sulphide	A	D	D
Sodium thiosulphate	A	D	C
Stearic acid	D	D	A
Sulphur	B	B	A

CHEMICAL	HOSE T40/T60	GASKET	COUPLING
Sulphur chloride	D	D	D
Sulphur dioxide (dry)	A	D	A
Sulphuric acid			
0-10 %	A	D	D
10-75 %	B	D	D
75 – 95 %	C	D	D
Sulphurous acid	C	C	C
T			
Tannic acid	A	–	A
Turpentine	D	D	A
Toluene	D	D	A
Trichlorethylene	D	D	A=dry D=aqua-ous
V			
Vegetable oil	D	D	A
Vinegar	B	C	C
X			
Xylene	D	D	A
Z			
Zinc chloride	A	C	C
Zinc sulphate	A	C	C

Conversion factors

Length		
1 inch =	25.4 mm	
1 foot =	0.305 m	

Area		
1 square inch =	645 mm^2 =	16.4 cm^2
1 square foot =	0.0929 m^2 =	929 cm^2

Volume	
1 cubic inch =	16.4 cm^3
1 cubic foot =	28.3 dm^3
1 UK gallon =	4.55 l
1 US gallon =	3.79 l

Mass	
1 pound (lb) =	0.454 kg
1 ounce (oz) =	28.3 g
1 troy ounce =	31,7 g
1 short ton =	907 kg

Spec. gr.		
1 lb/in^3 =	27.7 t/m^3 =	27.7 g/cm^3
1 lb/ft^3 =	16.0 kg/m^3	

Force	
1 kp (kgf) =	9.81 N
1 lbf =	4.45 N

Energy	
1 kWh =	3.60 MJ
1 kcal =	4.19 kJ
1 Btu =	1.06 kJ

Power	
1 kcal/h =	1.16 W
1 hp =	746 W (US)
1 hp =	736 W (metric)

Pressure		
1 bar =	14.5 psi =	100 kPa
1 bar =	100 kPa	
1 kp/cm^2 =	98.1 kPa	
1 atm =	760 dry =	101 kPa
1 lbf/$1n^2$ (psi) =	6.89 kPa =	0.07031 kp/cm^2
1 torr (mm Hg) =	133 Pa	

Torque	
1 ft.lb =	1.356 Nm

Unit Area	
1 sq.ft/t/24h =	2.23 m^2/(t h)

Filtration capacity	
1 lb/min/sq.ft =	293 kg/(m^2 h)
1 lb/h/sq.ft =	4.882 kg/(m^2 h)

Surface load	
1 usgpd/sq.ft =	1.698 x 10^{-3} m^3/(m^2 h)
1 usgph/sq.ft =	0.041 m^3/ (m^2 h)
1 usgpm/sq.ft =	2.44 m^3/(m^2 h)
1 cfm/sq.ft =	0.3048 m^3/(m^2 min)

Velocity		
1 fpm =	18.288 m/h	
ppm =	parts per million =	mg/l
ppb =	parts per billion =	mg/m^3
SS =	suspended solids	
TS =	total solids (incl. dissolved solids)	

Flow	
1 usgpm	0.23 m^3/h

Conversion tables

Pressure

	Lbf/in²	Kgf/cm²	Bar	Atmos-pheres	mm/hg	in/hg	Feet head of water	Metres head of water
Lbf/in2	1	0.0703	0.069	0.068	51.71	2.036	2.307	0.7031
Kgf/c in 2	14.223	1	0.961	0.968	735.56	28.959	32.81	10.00
Bar	14.504	1.020	1	0.97	750	29.53	33.4	10.2
Atmosphere	14.696	1.033	1.01	1	760	29.92	33.9	10.33
mm/hg	0.0193	0.0014	0.0013	0.0013	1	0.0394	0.0446	0.0136
in/hg	0.4912	0.0345	0.034	0.0334	25.49	1	1.133	0.3443
ft head of water	0.4335	0.0305	0.03	0.0295	22.42	0.8827	1	0.3048
m head of water	1.422	0.1000	0.0978	0.0968	73.56	2.896	3281	1

	Lbf/in²	Kgf/cm²	Bar	NM^{-2} = Pa	Kpa (Kilopascals)	Mpa (Megapascals)
Lbf/in2	1	0.0703	0.069	6894.76	6.8948	0.0069
Kgf/cm2	4.223	1	0.981	98066.5	98.07	0.098
Bar	14.504	1.020	1	105	100	10
NIPt4-2 = Pa	0.000145	1.02x10-5	1x10-6	1	10	106
Kpa	0.145	0.0102	0.01	103	1	10-3
Mpa		145.04	10.197	10	106	103

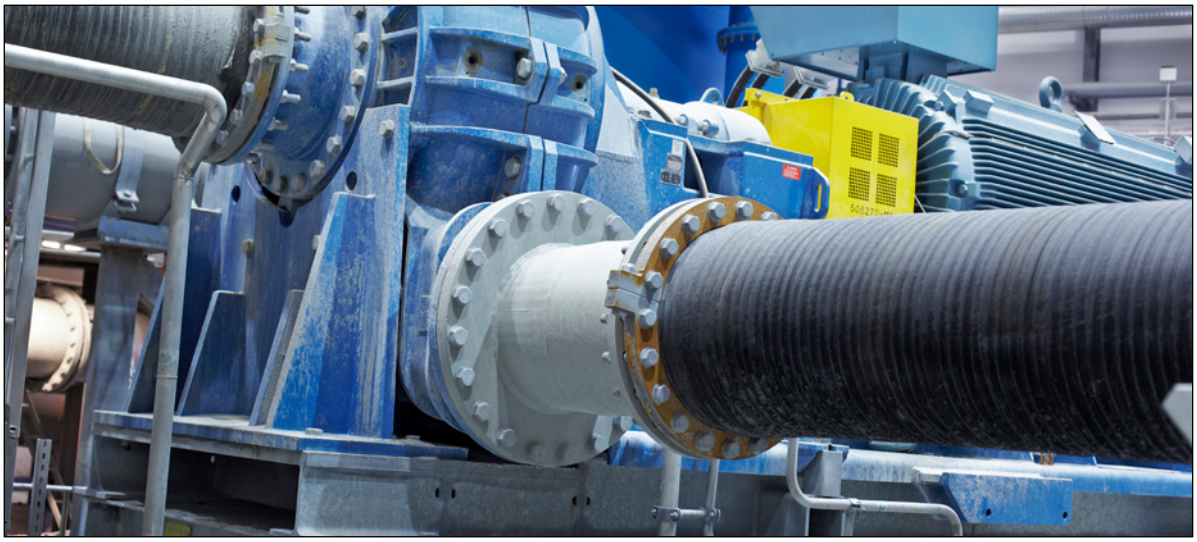


Table of water heads and equivalent pressures

Elevation mt.	Pressure kPa	Elevation mt.	Pressure kPa	Elevation mt.	Pressure kPa
1	9.804	110	1078.48	240	2353.05
5	49.02	120	1176.52	250	2451.10
10	98.04	130	1274.57	260	2549.14
15	147.06	140	1372.61	270	2647.19
20	196.08	150	1470.66	280	2745.23
30	294.13	160	1568.70	290	2843.27
40	392.17	170	1666.74	300	2941.32
50	490.22	180	1764.79	310	303936
60	588.26	190	1862.83	320	3137.41
70	686.30	200	1960.88	330	3235.45
80	784.35	210	2058.92	340	3333.49
90	882.39	220	2156.96	350	3431.54
100	980.40	230	2255.01	360	3529.58

Equivalent Fluid Volume and Velocity

USA Gallons/ minute	UK Gallons/ minute	Barrels/hour	Ft^3/ second	Mt^3/ second
14000	11662	20000	31.2	0.883
21000	18543	30000	46.8	1.324
28000	24724	40000	62.5	1.768
35000	30905	50000	78.0	2.207
42000	37086	60000	93.6	2.648
49000	43267	70000	109.5	3.098



FAQ

1. Installation & Maintenance?

Installation:

When abrasive materials are handled, it is extremely important to install the hose as evenly as possible. It should be supported along its entire length, while bends and loops should be mounted as uniformly as possible. Every irregularity will cause greater wear at the exposed point and increase the flow resistance in the system. Metso provides a wide range of designs for, and methods of, mounting and installing Metso Slurry Handling Solutions. Supporting systems using standard components have been designed for the majority of applications. The components of the supporting system consist of simple welded structures of flat-bars and angle irons. Fixing clamps 11105 or other types of clamps recommended by Metso should be welded at suitable distance apart on the support. When bending straight hose lengths, the instructions relating to bending radius and clamp location in Metso manuals should be followed.

Our system is based on easily exchangeable standard units: hose, couplings and gaskets. The coupling is mounted mechanically around the smooth hose. Due to the design of the coupling, the hose retains its full flow-through area even at the point where the coupling is fitted. Since the coupling does not come into contact with the material handled and is exposed to no wear, it can be reused when the hose is replaced. Since the coupling does not have to match any particular pattern on the hose, it can easily be turned around the hose until it is accurately lined up with the flange to which it is to be connected.

Maintenance:

With its corrosion-resistant couplings and hoses that are resistant to weather and wear, Metso Slurry Handling Solutions are practically maintenance-free. However, the system should be inspected at regular intervals so that any worn parts will be detected and replaced.

In order to achieve a maximum service life, the hose must be rotated through 90° at regular intervals. The space of time elapsing between each rotation of the hose varies individually between different applications, depending on such factors as the type of material, flow rate, quantity of material handled, etc.

By measuring the wear in the hose on a number of occasions at identical intervals, wear intensity can be determined and suitable times for rotation can be planned.

2. Lifetime for Slurry Hoses?

It's very hard or even impossible to determine the lifetime of a Slurry Hose System, due to a lot of factors that vary constantly. The estimated lifetime for a Metso hose is 5-10 times longer than the lifespan for steel pipes or PVC tubing.

In order to achieve a maximum service life, the hose must be rotated through 90 degrees at regular intervals. The space of time elapsing between each rotation of the hose varies individually between different applications, depending on such factors as the type of material, flow rate, quantity of material handled, etc. By measuring the wear in the hose on a number of occasions at identical intervals, wear intensity can be determined and suitable times for rotation can be planned.

3. Bending radius?

The required bending radius increase for bigger hoses. When bending straight hose lengths, the instructions relating to bending radius and clamp location in Metso manuals should be followed. Hose bends and loops should be mounted as uniformly as possible and a bigger radius means a longer lifetime.

3xD Rubber Bends:

- 90 degree Bends can be bent between 60-100°
- 45 degree Bends can be bent between 30-55°

4. Transported material?

Metso Slurry Handling Solutions are designed for pressure and suction operations specialised in slurries and abrasive material. T-40 for material size up to 10 mm and T-60 for size lager then 10 mm. The wear resistance tube gives a low flow resistance and long life.

FAQs continue on the next page.

1. Cutting?

Use a sharp knife dipped in water or soap solution when cutting the hose. Be sure that the hose with steel wire is completely exposed. Bend the steel wire out and cut it with a hacksaw or bolt clipper. If the end of the wire protrudes, use a pair of pliers to bend it into the rubber. Use Metso Cutting kit (SH-489351).

2. Working pressure?

There is difference in working pressure for smaller hoses and bigger dimensions. Hoses between 44 and 204 mm are designed for 10 bar and hoses between 240 and 610 mm are designed for 5 bar.

The couplings are designed the same way. Since we cannot change the thickness of the hose to withstand higher pressure, due to change of outer diameter and by that means interfering in the fitting between hose and coupling, we are forced to supply hoses with vulcanised flanges for applications with higher pressure.

3. Safety factor?

Metso Slurry Handling Solutions should always be on the safe side.

We guarantee a bursting safety margin of at least 1.5 times working pressure, and 90 % vacuum for suction between 44-204 mm hoses and couplings, and 50 % vacuum for bigger sizes.

4. Coupling standards?

Metso Couplings for Slurry Handling Hoses are made of corrosion-resistant cast aluminium. Elongated holes in the front flange allow the same coupling to be connected to the majority of flanges drilled to conformity with the major international flange standards. We have only three sizes (305, 355 and 457 mm) double set to fit all major standards. For all other sizes fit flanges that conform with SMS, DIN, ANSI, BS and NF.

5. Working temperature?

Metso Slurry Hoses with natural rubber T-40 wear tube can be used in working temperatures of up to 60-70 °C, and our T-60 wear tube hose with SBR up to 70-80 °C.

6. Gasket design?

Metso Slurry Handling Solutions are made of T-60 wear resistant rubber for Metso Couplings. Designed for mounting coupling to coupling, coupling to pump and coupling to pipe — both with and without rubber coating.

The gaskets are tapered on the rear to compensate for irregularities and indentations that may occur in the end of the hose when it is cut. Since less accuracy is required when cutting the hose, valuable time is saved and mounting is made easier. The front of the gasket is fluted, making it many times more leak-proof than other flat gaskets.

7. Optimum flow?

To avoid sedimentation it is necessary to keep the flow turbulent. Deposits on the bottom reduce efficiency and can give rise to clogging with stoppages as a result. Depending on the proportion of materials and liquids, as well as the flow rate, the material in turbulent flow may be carried along at uniformed flow of heterogeneous mixture, non-uniform flow where the larger particles bounce along the bottom of the pipe or non-uniform flow with a sliding or stationary bed of material.

When calculating the flow you have to consider a lot of different factors, such as transported material, density, friction losses, hose dimension, etc. Therefore please use the calculation data in the Metso Slurry Handling Solutions manuals or contact us for assistance if you have a long hose system and the flow is important.

8. Chemicals?

Since our hoses have a wear tube made of NR or SBR for resistance against abrasion, we have a very moderate and poor resistance against chemicals. Depending on the type of chemical, concentration, temperatures, pressure, and exposure time the result varies.

9. Wear tube?

Our slurry hoses are made with our well-known NR T-40 inner tube, optimised for transporting slurry with fine particles up to 10 mm.

T-60 hoses are made with SBR T-60 tube developed and optimized for transporting slurry with particles larger than 10 mm, or pneumatic bulk service.

Metso is a frontrunner in sustainable technologies, end-to-end solutions and services for the aggregates, minerals processing and metals refining industries globally. We improve our customers' energy and water efficiency, increase their productivity, and reduce environmental risks with our product and service expertise. We are the **partner for positive change**.

Metso

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