Řetězárna a.s.®	**Chain slings, Grade 10, "EN" type**	**according to PN 45-04 (ČSN EN 818-4)**

MANUFACTURER Řetězárna a.s.
Polská 48
790 81 Česká Ves

EDITION 3/2017
REPLACES 12/2016

PHONE 584 488 111
FAX 584 428194
E-mail: info@retezarna.cz
www.retezarna.cz

CE

OPERATING AND MAINTENANCE

1. INTRODUCTION

"EN" type chain slings, grade 10, are noted for their high quality, high utility value and long life. They are manufactured with utmost care and concern for operational safety. All their components correspond to Safety Factor 4. The design of grade 10 chain slings is in accordance with PN 45-04 (ČSN EN 818-4).

Their use is subject to the standard ČSN EN 818 - Part 6: "Chain slings – Specification for information for use and maintenance to be provided by the manufacturer". These operating and maintenance instructions contain the most important information for users of our chain slings. Safe operation and long life of the chain slings are subject to compliance with these instructions. All operating personnel as well as personnel responsible for inspections and storage of the chains must be familiar with the instructions. When a chain sling is used intensively (e.g. in continuous operation) and in a harsh conditions (abrasive environment, impacts, etc.), its life decreases dramatically and it can be even shorter than 6 months. It is therefore necessary to minimize such the adverse conditions (for example by selecting appropriate lubrication).

2. CHAIN SLING SELECTION

The selection of a suitable chain sling requires particular attention. If a chain sling fails and the load is released, it can lead to direct or indirect danger to life and health of persons in the given area or to serious damage to property.

When selecting a chain sling, it is necessary to take into account the weight of the loads to be lifted, the way the load will be gripped, and the environment in which the chain sling is used. The factors causing the reduction of the load-bearing capacity usually add up. It is therefore necessary to select an appropriate slinging method and to select an appropriate chain sling with a load-bearing capacity corresponding to or higher than the weight of the load to be lifted.

2.1. LOAD-BEARING CAPACITY

The maximum load-bearing capacity for which a chain sling can be used is specified on the identification tag (see Table 1). These load-bearing capacity values apply when the chain sling is loaded symmetrically. This means that as the load is lifted, individual chains of the chain sling are arranged symmetrically, at the same angle to the vertical axis. This situation is referred to as "normal lifting conditions." Chain slings can be used in many alternatives in terms of design, types of loads and slinging methods. These variations must be taken into account when determining the load-bearing capacity of a specific chain sling. The use of shortening elements (with a lock preventing the chain from slipping out) does not decrease the load-bearing capacity of the chain sling and it can also be used to equalize any asymmetrical loading of the chain sling.

2.1.1. Adverse operating conditions

Use in adverse conditions (e.g. abrasive environment, high temperature) must be consulted with the manufacturer.

The chain slings of Grade 10 must not be used in chemically aggressive environment. For the same reason, chain slings must never be zinc-plated or galvanized in any way, and they must not be subjected to surface treatment processes involving pickling in acids.

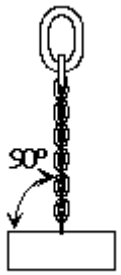
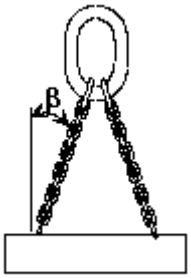
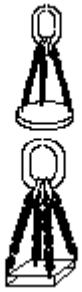
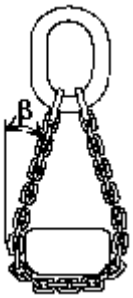
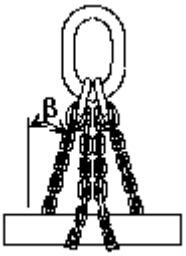
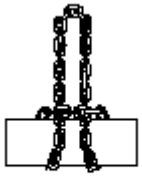
Chain rated thickness mm	Permitted load-bearing capacity (t) for:									
	Loads suspended on hooks and eyes					Loads fixed by under-running				Loads fixed by looping
										
	1-chain sling	2-chain sling		3 and 4-chain sling		2-chain sling		4-chain sling		continuous
Inclination angle β	0°	0° - 45°	45° - 60°	0° - 45°	45° - 60°	0° - 45°	45° - 60°	0° - 45°	45° - 60°	-
Coefficient	1	1.4	1	2.1	1.5	1.1	0.8	1.7	1.2	1.6
6	1.4	2	1.4	3	2.12	1.6	1.12	2.36	1.7	2.24
8	2.5	3.55	2.5	5.3	3.75	2.8	2	4.25	3	4
10	4	5.6	4	8.4	6	4.25	3.2	6.7	4.75	6.3
13	6.7	9.5	6.7	14	10	7.5	5.3	11.2	8	10.6
16	10	14	10	21.2	15	11.2	8	17	11.8	16

Table 1 - Load-bearing capacity of chain slings in tons (safety 1:4)

2.1.2. Use at various temperatures

The chain slings may only be used within the temperature range specified in Table 2.

Ambient temperature °C	from -20° to +200°C	over 200°C
The load-bearing capacity is reduced to:	100%	use inadmissible

Table 2 - Decrease of the load-bearing capacity depending on temperature

If the chain sling is used within the permissible temperature range specified in Table 2, its load-bearing capacity is not reduced permanently when it returns to normal temperature. However, should the temperature of 200°C be exceeded, the chain slings must be put out of operation.

2.1.3. Chain slings with multiple chains, where not all the chains are used

The chain sling should be used in accordance with its original design. However, in practice it may happen that not all the chains of a chain sling are loaded when lifting a load. In such cases, the load-bearing capacity specified on the chain sling must be reduced to the value specified in Table 3.

Chains that are not loaded should be fixed in such a way that they do not swing about or get caught on anything as the load moves.

Type of chain sling	Number of chains used	The load-bearing capacity is reduced to:
2-chain	1	1/2
3-chain and 4-chain	2	2/3
3-chain and 4-chain	1	1/3

Table 3 - Coefficient of load-bearing capacity (WLL)

2.1.4. Use under exceptionally hazardous conditions

Exceptionally hazardous conditions include the lifting of persons or the lifting of potentially dangerous loads, such as molten metals or radioactive substances. Such cases are not described in this manual. Taking this risk level into consideration, the competent person must select an appropriate chain sling with an adequate load-bearing capacity, temperature affecting the chain and the most suitable method of gripping the load.

2.2. TEST CERTIFICATE

A test certificate has been issued for each chain sling in accordance with the standard (ČSN EN 10 204-3.1). The certificate contains the following information: manufacturer information, identification number, product description (nominal chain size, design, length), loads for which the chain sling can be used, test forces to which the individual parts of the chain sling were subjected, and the Grade 10 designation.

Mechanical properties are guaranteed only in the condition in which the chain was supplied to the customer.

2.3. DESIGNATION

Each chain sling is marked with a metal tag. The tag shows the following basic information: manufacturer's mark, "CE" mark, nominal chain thickness, number of chains, load-bearing capacity for angles of inclination (with respect to the vertical axis) according to Table 1, and an identification number identical to the number on the test certificate. If this tag is lost, it is necessary to put the chain sling out of operation (unless its identity can be documented otherwise) and to test its function thoroughly.

2.4. STORAGE AND RECORDS

When chain slings are not used, they should be stored in a suitable rack or on a shelf, protected from weather effects. It is inappropriate to leave them lying freely on the ground, as they could be damaged.

When chain slings are left on the crane hook, they should be hooked into the suspension eye, as to reduce their free swinging and to prevent them from getting caught on anything.

If it is assumed that the chain slings will not be used for a period of time, they should be cleaned, dried and treated against corrosion (for example lightly oiled).

3. INSPECTION OF THE CHAIN SLING

3.1. INSPECTION OF THE CHAIN SLING BEFORE PUTTING IT INTO OPERATION

Before you put the chain sling into operation, you must check the following:

- you have a certificate from the manufacturer and the chain sling matches the description in the certificate
- marking and load-bearing capacity values on the tag are consistent with the data in the certificate
- all the information about the chain sling is recorded in the operating documentation

3.2. BEFORE EACH USE

Before each use, it is necessary to check the chain sling for any visual damage (notches, elongation, deformation, etc.) and to determine whether its condition has deteriorated. If any faults are discovered during this inspection, please proceed in accordance with chapter 5 of these instructions.

4. HANDLING A LOAD

4.1. PREPARATION

Plan well how the load will be tied, lifted, transferred and laid down. It is always necessary to take into account the specific conditions when attaching and handling the load (such as adverse weather conditions, strong wind, rain, frost, snow, low visibility, handling loads near other persons, etc.). Before you start lifting the load, you must always check that the load is attached properly to the chain sling, that it is free to move up and that it is not blocked in any way (buried, fixed, frozen to ground, stuck, etc.).

4.2. LOAD WEIGHT

It is necessary to know the weight of the load. The weight of the load can be determined: from information written on the load, from enclosed documentation, from a drawing of the load, by weighing the load, or by calculating the weight using engineering tables.

4.3. CENTRE OF GRAVITY

The location of the centre of gravity of the load must be determined in relation to the possible points of attachment of the chain sling.
Observe the following principles to lift the load without tilting and swaying:

- For single-chain and endless chain slings, the attachment point must be on the vertical axis above the centre of gravity
- For double-chain slings, the attachment points must be on both sides and above the centre of gravity
- For three-chain and four-chain slings, the attachment points must be located in-plane around the centre of gravity.
  Uniform distribution is preferable, and these attachment points must be above the centre of gravity.

When using two-, three- and four-chain slings, it is necessary to select such attachment points and such a slinging method, that the angles between the chains of the chain sling and the vertical axis are within the permissible range, which is indicated on the chain sling. It is preferable if all the angles in relation to the vertical axis (inclination angle β) are the same. If possible, avoid angles smaller than 15°, because they present a higher risk of load imbalance.

All multi-chain slings are stressed by horizontal components of force, which become stronger with the increasing angle of inclination of the chains. Where the chains are threaded through hooks or other components (e.g. chain slings for crates, barrels), the horizontal (clamping) components of force are much stronger, and therefore the angle of inclination of these chains should not exceed 30° from the vertical axis. You must ensure that the transported load withstands the horizontal (clamping) component of force without any damage.

The vertical axis of the hook to which the chain sling is attached must be directly above the centre of gravity.

Figure 1 shows the load change in one chain of a chain sling, depending on the angle between the chain and the vertical axis, for a load of 10 tons. It shows why the chain sling must never be used for angles exceeding $\beta = 60°$.

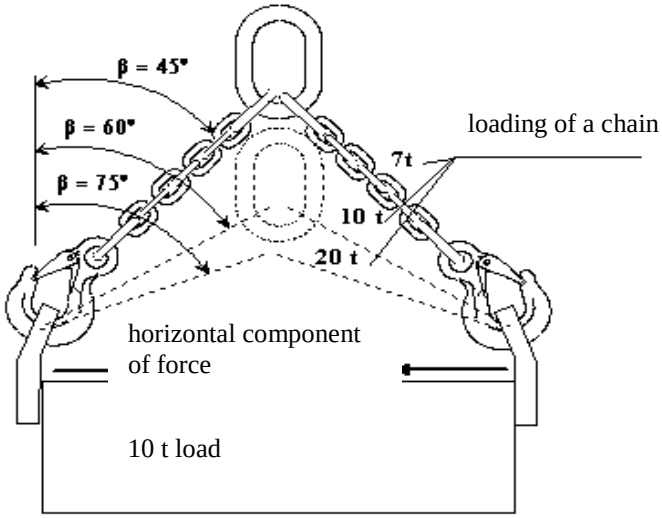


Figure 1: Changing the load at one chain of a chain sling, depending on the angle between the chain and the vertical axis, for a load of 10 t

4.4. LOAD FIXING METHODS

The chain sling is usually attached to the load and the hoist by means of end pieces such as hooks and eyes. It is necessary to select a chain sling with such a lifting eye that would allow it to be hanged with sufficient play onto the hoist's hook, so that there is no excessive wear and no deformation.

Chains must not be twisted and there must be no knots. The load shall be applied at the bottom of the hook, never at the tip or at the opening. It must be possible to move the hook freely in all directions, in order to prevent it from bending.

The chain can be threaded under or over the load in such a way as to fix the load by looping or by under-running. If it is necessary to use more than one chain of the chain sling to prevent the load from tilting when using the under-running method, it is more suitable to connect it to the transverse beam. If you use the looping method, leave the angle as it is formed and do not change it by force.

If shortening elements are used, they must be fitted with safety locks preventing the chain from slipping out.

4.4.1. Direct suspension

The chain sling is connected to the load at attachment points - see Figure 1. The contact between the hooks and the attachment points must be such that the weight of the load is applied at the bottom of the hook and not on the tip. With multi-chain slings, tips of hooks must face outward, with the exception of those that have been designed for another use.

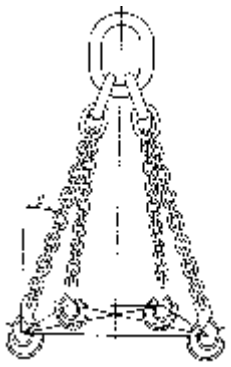


Figure 2: Direct suspension

4.4.2. Loads fixed by looping

The chains of the chain sling are threaded through or under the load, and the lashing part is hooked back or threaded into the chain sling - see Figure 3. This method can be used where there are no attachment points, and it has the additional advantage that the chains of the chain sling bind up the load.

When looping is used, the load-bearing capacity of the chain sling is reduced to 80% of the nominal load-bearing capacity specified on the nameplate.

This does not apply to endless chain slings - their reduced load-bearing capacity is already specified on the nameplate.

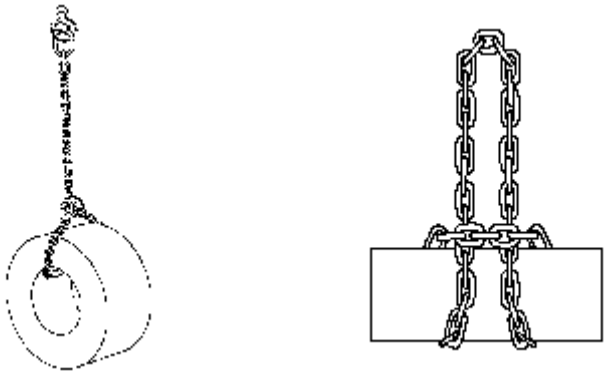


Figure 3: Loads fixed by looping

4.4.3. Loads fixed by under-running

The chain sling is threaded through or under the load. Then the lashing part is attached directly to the hoist's lifting eye or hook - see Figure 4. In general, this method requires a two-chain or multi-chain sling. It is not suitable for loads which should be bound up by the chain sling.

If the shape of the load allows it, it is possible to use a single-chain sling, on condition that the chain sling passes through the load directly above its centre of gravity.

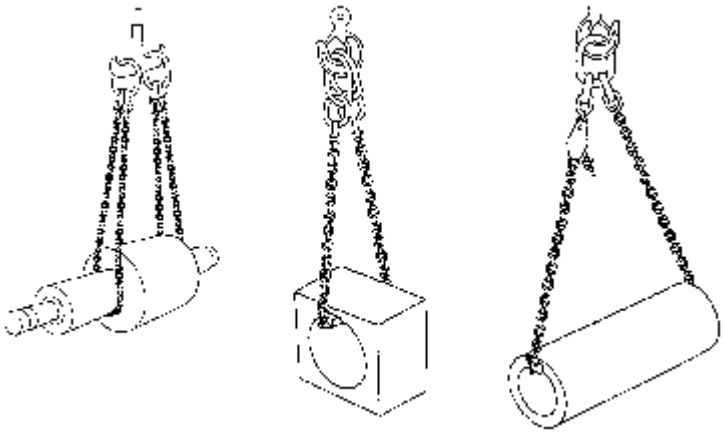


Figure 4: Loads fixed by under-running

4.4.4. Wrapping and looping or wrapping and under-running

These methods are derived from the binding procedures described in 4.4.2. and 4.4.3. above. They allow for a higher safety when lifting loose loads - as the chain is additionally wrapped around the load.

If looping or wrapping is used with two-chain or multiple-chain slings (see Figure 5), it is necessary to observe the following:

- if no torque is supposed to be applied on the load, the wrapping must be done in one direction;
- if the goal is to prevent the load from rotating or moving about when it is first lifted, then (at least) one chain must be wrapped in the opposite direction.

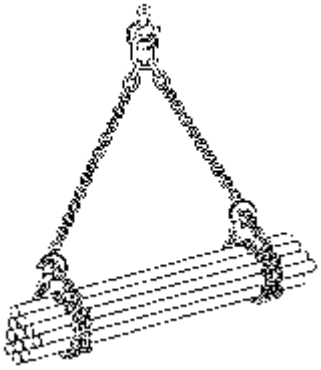


Figure 5: Wrapping and looping or wrapping and under-running

4.4.5. Loads fixed using shortening elements

When using shortening elements, it is necessary to shorten only the chain which is connected to the same connecting element (coupling), as the shortening element.

Failure to follow this rule would overload one of the parts (connecting element or coupling) and it could lead to the failure of the whole chain sling. The right and wrong ways of using the shortening elements are shown in Figure 6.

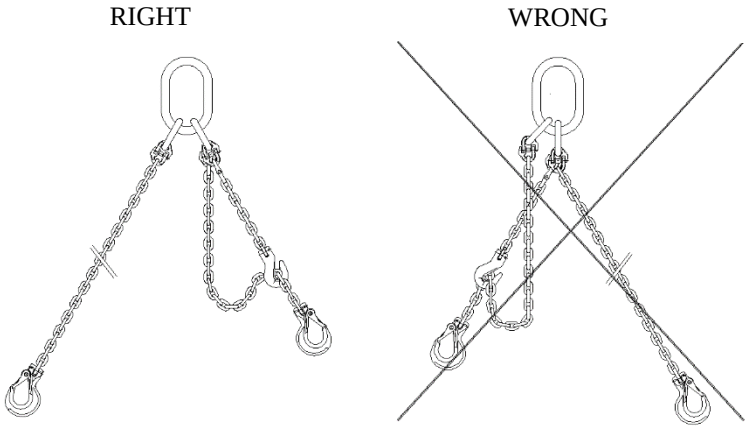


Figure 6: Loads fixed using shortening elements

4.5. SHARP EDGES

Where the chain comes into contact with the load, we recommend the use of protective pads to protect the chain or the load, or both. Sharp edges of hard materials can bend or damage the chain links, or, by contrast, the chain may damage the load by applying too much pressure at the place of contact. Sharp edges of the load must be appropriately protected, for example by means of wooden blocks.

A sharp edge is any edge with the radius “r smaller than the diameter “d” of the chain link - see Figure 7. When in doubt, use a chain sling with larger links or use the pads.

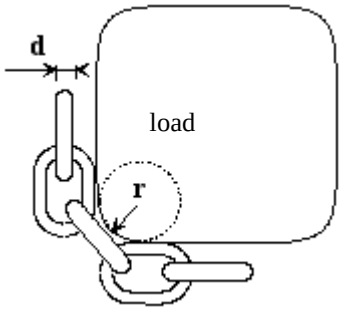


Figure 7: Chain sling in contact with the load

4.6. LIFTING SAFETY

Before you start lifting, it is necessary to check that the load cannot move freely and cannot slip out of the chain sling, and that there is nothing to prevent it from lifting. The load must be lifted by gentle pulling without shocks. Also prevent any shocks and jerks during transportation and unloading. Shocks produce very strong dynamic forces which increase the tension in the chain. Consequently, this may cause damage or even breakage of the chain sling which would result in the fall of the load. When everything is ready for lift off, stretch the chain sling completely. The load should be lifted easily. Check that it is fixed securely and that it is in the right position. This is particularly important when the load is fixed by under-running or by another method which relies on the friction of the load's surface for a safe grip.

If shortening elements are used, they must be fitted with safety locks preventing the chain from slipping out.

A location must be prepared where to set the load down and it must be accessible freely. Keep hands and other body parts away from the stretched chain in order to prevent injury. Operating personnel must always be outside the danger zone. Suspended load should never be left unattended! When planning and performing lifting operations, always observe the standard ČSN ISO 12480-1 and other applicable guidelines. If there is a risk that the chain sling might have been damaged during the handling of a load, it is necessary to stop the operation immediately, set the load down and inspect the whole chain sling thoroughly (see Chapter 5.1).

4.7. LOADING SYMMETRY

Load-bearing capacities for Grade 10 chain slings are determined for various sizes and configurations. These load-bearing capacity values apply when the chain sling is loaded symmetrically. This means that as the load is lifted, individual chains of the chain sling are arranged symmetrically, at the same angle to the vertical axis - see Figure 8.

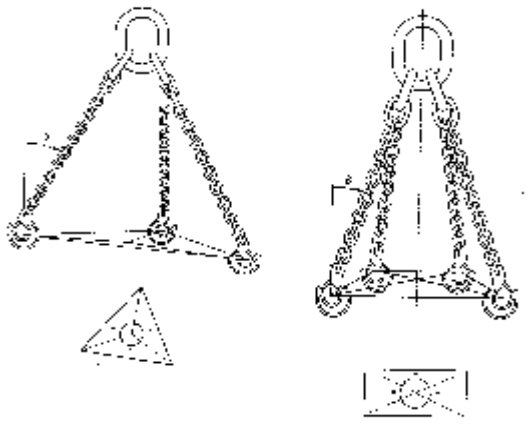


Figure 8: Multi-chain slings - load distribution

In case of unbalanced load distribution in individual chains of a three-chain sling, the highest stress will be applied on the chain for which the sum of all angles (in relation to the adjacent chains) is the largest.

The same applies to four-chain slings, where it is also necessary to take into account the stability of the load - when the load is rigid, a larger proportion of its weight is carried by three or sometimes even two chains and the remaining chain(s) only provide for the load's balance - see Figure 9.

In case of two-chain, three-chain and four-chain slings with uneven angles of individual chains (in relation to the vertical axis), the largest stress will be applied on the chain with the greatest angle (in relation to the vertical axis). In extreme cases, when one of the chains is vertical, this one chain carries the whole load - see Figure 9.

If asymmetrical distribution of loads combines with asymmetrical angles (in relation to the vertical axis), these two effects may add up or counterbalance each other - see Figure 9.

Load can be considered symmetrical, when all of the following conditions apply:

- the load has a weight smaller than 80% of the specified load-bearing capacity;
- the angles of all the chains of the chain sling in relation to the vertical axis are smaller than 15°;
- the angles of all the chains of the chain sling in relation to the vertical axis do not differ from one another by more than 15°;
- in case of three-chain and four-chain slings, angles in the plane of the attachment points do not differ from one another by more than 15°;

If one of the conditions above is not met, the load must be regarded as asymmetrical, and the determination of the load-bearing capacity must be done by a competent person in order to guarantee that the use of the chain sling is safe.

Alternatively, for asymmetrical loads it is possible to reduce the load-bearing capacity of the chain sling to one half of the nominal load-bearing capacity specified on the nameplate - see Figure 9.

If the load tends to lean, you should put it down and change the way it is fixed by rearranging the attachment points or by using a chain sling with a shortening element at one or more of its chains. The chain must be threaded through the shortening element with great care, in order to prevent it from slipping out.

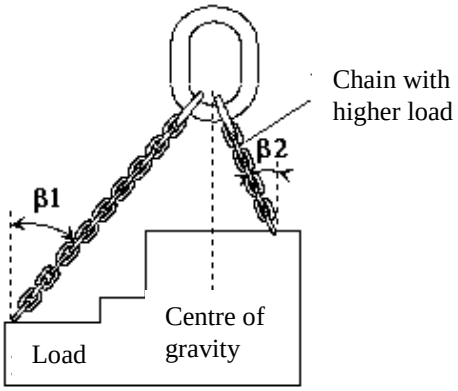


Figure 9: Asymmetrical loading

4.8. SETTING THE LOAD DOWN

A location must be prepared where to set the load down. The subbase must have adequate strength, there must be no sewage conduits, unevenness or pipes which could be damaged. The location must be readily accessible, it must be sufficiently spacious, without any obstacles and persons. If necessary, place pads on the surface (wood or similar material) to prevent the chain sling from getting stuck under the load, and/or to protect the surface or the load from damage, and/or to ensure the stability of the load as it is set down.

Set the load down very carefully. If there is a risk that the load may start swaying, it is recommended to use a stabilizing rope as the load is set down. Prevent the chain sling from getting stuck under the load, otherwise it could be damaged. Before you unfasten the chain sling, check that the load has been set down properly and that it is stable. This is particularly important if the load consists of multiple loose objects which were only bound together by the chain. After the load is set down, remove the chain sling by hand.

The chain sling must not be pulled off using the lifting hoist, because it could get stuck on the load and topple it over. The load must not be pushed over the chain sling, as the chain sling could be damaged.

5. MAINTENANCE

5.1. INSPECTION

During operation, the chain slings are exposed to conditions that may affect their reliability and safety and, consequently, the safety of lifting. It is therefore necessary to check their technical condition on a regular basis. The inspection is a visual check of the condition of the chain sling, intended to find any apparent damage that could affect its suitability for use.

5.1.1. Putting chain slings out of operation

Chain slings must be put out of operation and submitted to a competent person for testing, if some of the following faults occur:

- Marking of the chain sling (identification data, load-bearing capacity) is illegible, or the identification tag is missing completely
- Deformation of couplings
- Chain elongation - the chain sling is elongated if the length of the chain links changes or if there is insufficient play between the chain links or if there is non-negligible difference between the length of chains in multi-chain slings
- Wear - wear caused by contact with other objects usually occurs on the outer flat surface of the links, where it is clearly visible and can be measured easily. The wear between adjacent links remains hidden. The chain must be loosened and the adjacent links rotated in such a way as to expose the inner surface of each link. Permissible wear between links is up to 90% of the link thickness (d_n), which is expressed as a mean value from two perpendicular measurements of diameters (d_1) and (d_2) - see Figure 10.
- Notches, dents, cracks, deep corrosion, change of colour due to high temperature, bent or twisted links or any other defects
- Indications of hook “opening” - i.e. any non-negligible increase in the opening at the tip of the hook, or any other types of deformations in the bottom contact part. The opening at the tip of the hook must not exceed 10% of the nominal value, or it must be such that when the safety lock is engaged it cannot unlock spontaneously.
- When the hook lock is pressed toward the body of the hook, it does not exert resistance, and when released it does not return automatically to the original position in the groove at the tip of the hook. The spring must keep the lock closed in any hook position. It is not allowed to use a hook if the lock requires great strength to open (due to deformed latch or pin, overstrained spring, etc.)

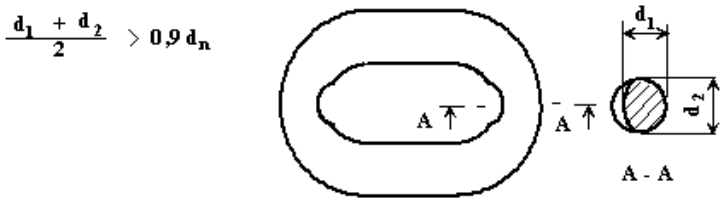


Figure 10: Wear between links

5.2. TESTING

Testing is a visual inspection performed by a competent person accompanied with other measures (if necessary), such as non-destructive crack detection.

Testing should be performed by a competent person at intervals shorter than 12 months. This interval shall be shorter, if necessary, with regard to actual operating conditions.

With every three-year inspection, a non-destructive crack detection test will be performed. If the chain is not used in ideal conditions, the test interval must be shortened according to the assessment of the operating conditions. This check may also be ordered from the manufacturer. The results of the testing must be recorded in the chain sling operating documentation.

Before the testing, the chain sling must be thoroughly cleaned of oil, dirt and rust. Any cleaning method is permissible as long as it does not damage the original material. It is forbidden to burn the chain with open flame, dip it in acid or use a method which could cover any cracks or surface defects. Then the whole length of the chain sling is tested in adequate light for wear, deformations or external damage.

5.3. CHAIN SLING REPAIR

Minor defects, such as notches and scratches, can be removed by careful grinding or filing.
After the repair, the surface must be smooth, without sharp protrusions. The removal of defects must not reduce the thickness of the material in the given location by more than 10%. Cracks and similar defects must not be repaired by welding. Do not connect chain links using screws or wire.

5.3.1. Repair of assembled chain slings

Chain slings may only be repaired by the manufacturer or by a competent person possessing the necessary skills and capabilities to assess whether repair is possible with respect to the safety of the chain sling. If a chain link is defective, it is necessary to replace the whole chain segment in the given chain of the chain sling. Cracked, twisted or strongly corroded chain sling components must be replaced. Any component of a chain sling may only be replaced with a corresponding original spare part supplied by Řetězárna a.s. Česká Ves together with a manufacturer's certificate. Pins of assembled parts may not always be secured against falling out by means of spring pins - see Figure 11. By using original spare parts, you make sure that the load-bearing capacity of the parts is not different.

Figure 11: Clevis hook

5.3.2. Repairs of welded chain slings

Welded chain slings may only be repaired by the manufacturer by resistance butt-welding or flash-welding. Links which have been newly inserted during a repair must be heat treated. Then these and other parts of the chain sling which were subject to heat treatment must be tested by applying test force(s) MPF_1 to MPF_4, and subsequently examined by a competent person.

6. TRANSPORT

The chain slings must be transported and stored in such a way as to exclude any negative weather effects and the presence of corrosive substances. Corrosive environment significantly reduces the life of a new chain sling.

The buyer shall check the chain sling after its takeover without undue delay and report immediately any apparent defects to the chain supplier. Later claims raised on the basis of apparent defects of the chain will not be accepted by the supplier.

7. CHAIN SLING DISPOSAL

Worn and discarded chains are to be disposed of as normal metal waste at a waste collection facility (in accordance with Act no. 185/2001 Coll. on waste as "O" - Other).