

ISO

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION R 1834

SHORT LINK CHAIN FOR LIFTING PURPOSES

GENERAL CONDITIONS OF ACCEPTANCE

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 1834, *Short link chain for lifting purposes – General conditions of acceptance*, was drawn up by Technical Committee ISO/TC 111, *Round steel link chains, chain wheels, lifting hooks and accessories*, the Secretariat of which is held by the British Standards Institution (BSI).

Work on this question led to the adoption of Draft ISO Recommendation No. 1834, which was circulated to all the ISO Member Bodies for enquiry in April 1969. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Australia	Italy	Sweden
Austria	Japan	Thailand
Chile	Netherlands	Turkey
France	New Zealand	U.A.R.
Greece	Norway	United Kingdom
India	Peru	
Israel	South Africa, Rep. of	

The following Member Bodies opposed the approval of the Draft :

Belgium
Germany
U.S.A.

This Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided to accept it as an ISO RECOMMENDATION.

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SHORT LINK CHAIN FOR LIFTING PURPOSES

GENERAL CONDITIONS OF ACCEPTANCE

1. GENERAL

1.1 Scope

This ISO Recommendation covers general requirements for lifting chains. These are electrically welded round-steel short-link chains, heat treated and fully tested, for use on cranes, in chain slings and for general lifting purposes (non-calibrated) or in pulley blocks (calibrated).

This ISO Recommendation does not cover surface-hardened chain.

Special requirements appertaining to chains of particular types (calibrated, non-calibrated) or of particular materials (carbon steel, alloy steel, etc.) will be covered by separate ISO Recommendations.

1.2 Definitions

For the purpose of this ISO Recommendation, the following definitions apply :

Term	Definition	Symbol
<i>Size of chain</i>	The nominal diameter of the steel wire or bar from which the chain is made.	d_n
<i>Material diameter</i>	The diameter of the material in the chain link as measured.	d
<i>Pitch of chain</i>	The internal length of a link, or the distance between the bearing points of a length of chain under tension divided by the number of links	p
<i>Proof load</i>	The load to which after processing (see definition below) the whole of the chain is subjected as specified in clause 3.6.	F_e
<i>Breaking load</i>	The maximum load which the chain withstands during the course of a tensile test to destruction.	F_m
<i>Elongation at fracture</i>	Permanent elongation after a chain has broken, expressed as a proportion of the gauge length (see clause 4.3.2).	A
<i>Energy absorption factor</i>	The product of the elongation at fracture and the breaking load.	$A \times F_m$
<i>Lifting capacity; Working load limit</i>	The maximum mass which the chain hanging vertically is authorised to support in general service.	
<i>Working load (Safe working load)</i>	The maximum mass which the chain hanging vertically should support in a particular stated service.	SWL
<i>Processing</i>	Any treatment of the chain subsequent to welding, for example, heat treatment, polishing, galvanizing or other surface treatment.	—
<i>Lot</i>	A specified length of chain from which a test sample is selected.	—

2. DIMENSIONS

2.1 Material diameter

The material diameter of any section of the finished link which is to accord with the size within stated tolerances is the mean of two diameters measured in the same plane at right angles.

NOTE. — It may be convenient to measure the mean diameter by a single measurement with an instrument of the type described in Appendix Y.

2.2 Other link dimensions

The length, the pitch and the width of a chain link, and the length of a number of links of calibrated chain, are given in separate ISO Recommendations for particular chains.

3. MATERIAL AND MANUFACTURE

3.1 Quality of material

The steel shall comply with the requirements of the ISO Recommendation for that particular type of chain, these requirements being designed to ensure reliable welding quality and freedom from strain age embrittlement (see Appendix Z).

Within these limitations it is the responsibility of the chain manufacturer to select a steel such that the finished chain, suitably heat treated, possesses the specified mechanical properties.

When so required by the purchaser, the manufacturer shall supply a copy of the steelmaker's cast analysis. When a check analysis of the steel in the chain is required by the purchaser, such analysis shall be made from cuttings taken from a complete transverse section of a link selected from a length tested to destruction. The cost of such analysis should be borne by the purchaser.

NOTE. — When comparing an analysis of the steel in the chain (check analysis) with the steelmaker's cast analysis, allowance must be made for the heterogeneity of the steel.

3.2 Heat treatment

Before proof loading, all chain shall be subjected to the appropriate heat treatment.

3.3 Workmanship

The weld shall be appropriately finished (see ISO Recommendation for particular chains).

3.4 Surface condition

Unless otherwise agreed between the manufacturer and the purchaser, the finished chain shall be free from coating of any description.

3.5 Quality marking

At least each twentieth link, or links at intervals of 1 m, whichever is the lesser distance, shall be legibly stamped or embossed with the appropriate quality mark described in Annex C. The marking shall not coincide with a weld, or be situated where material is displaced by the weld, nor shall it be on the extrados. If agreed between the supplier and the purchaser, for calibrated chain the quality mark may alternatively be applied in the same manner and position as the identification marking specified in clause 5.2.1.

The marks shall be of the sizes shown in Table 1.

TABLE 1 — Sizes of quality mark

Size of chain	Diameter of mark
mm	mm
Up to and including 12.5	3
Over 12.5 up to and including 26	4.5
Over 26	6

Stamps, if used, shall have a concave surface and the indentation shall be neither too sharp nor of excessive depth.

3.6 Proof loading

After heat treatment and complete processing, the chain shall be subjected to the recommended proof load. The testing machine shall comply with the requirements of Annex A. Care shall be taken that the chain is placed in the testing machine without twist. After removal of the load and adjustment for pitch, the chain shall be carefully examined by a competent person and any faulty links replaced (see clause 3.7). The chain shall articulate freely when manipulated by the examiner.

3.7 Links inserted in the course of manufacture

Any links which have been inserted shall be processed similarly to the chain in such a way as to ensure that every link in the finished chain is in a uniform condition. Where links have been inserted after proof loading (see clause 3.6), that portion of the chain affected by such processing shall then be subjected to the proof load and re-examined.

4. TEST REQUIREMENTS

4.1 Condition of chain tested

Chain shall be subjected to test in the finished condition.

4.2 Selection of samples

At least one test sample sufficient to provide a gauge length as defined in clause 4.3.2 shall be selected by the inspector from each lot or part lot. The length of the lot is stated in the ISO Recommendation for each particular chain.

Where the chain length is required to be in one continuous piece so that the severance for a test sample will necessitate the insertion of a joining link, the samples shall be selected and cut from the chain before heat treatment. After the joining links have been inserted, the samples shall be wired to the lengths which they represent and shall undergo the same processing up to the application of the proof load. The samples for any or all of the lengths may, at the request of the manufacturer, be selected in triplicate in order to provide additional test samples if required (see clause 4.4).

Where the chain length is not required to be in one continuous piece, the samples shall be selected from the chain in its finished condition.

NOTE. – The purchaser is required to state in his enquiry and order when the chain length may be in more than one piece.

4.3 Static tensile test

4.3.1 *Testing machine.* The testing machine shall comply with the requirements of Annex A.

4.3.2 *Tensile test.* Test samples shall consist of at least the number of links stated in Table 2, constituting the gauge length. Two additional links will be required to engage the jaws of the testing machine unless this is done by half-links or some other method.

TABLE 2 - Gauge lengths

Size of chain	Minimum number of links in gauge length actually tested
mm	<i>N</i>
6 or less	9
Greater than 6, less than 16	7
16 or greater	5

The test sample is placed in the testing machine, loaded to one-tenth of the proof load, and the gauge length L (which does not include the links engaging the jaws of the testing machine) and the diameter of the wire d are measured (see Fig. 1).

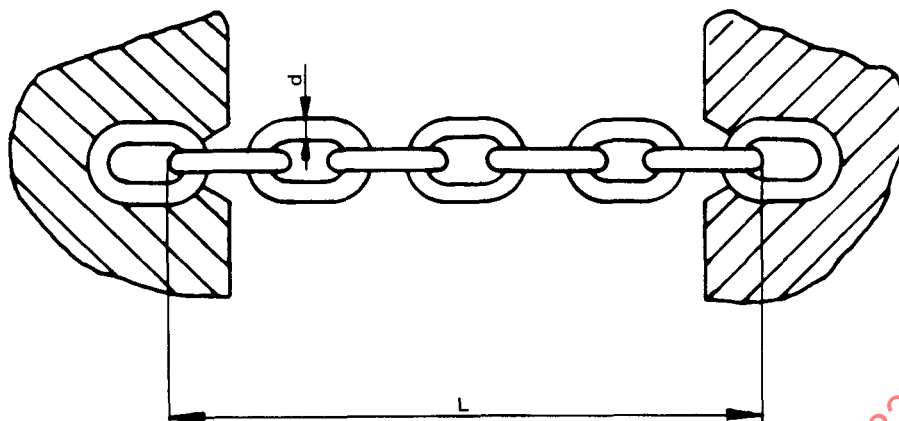


FIG. 1

The load is then gradually and smoothly increased until fracture occurs, and the breaking load and elongation at fracture are determined (see clause 4.3.3).

This may be done with an autographic recorder, or alternatively by measuring the two unbroken lengths on either side of the broken link as shown in Figure 2.

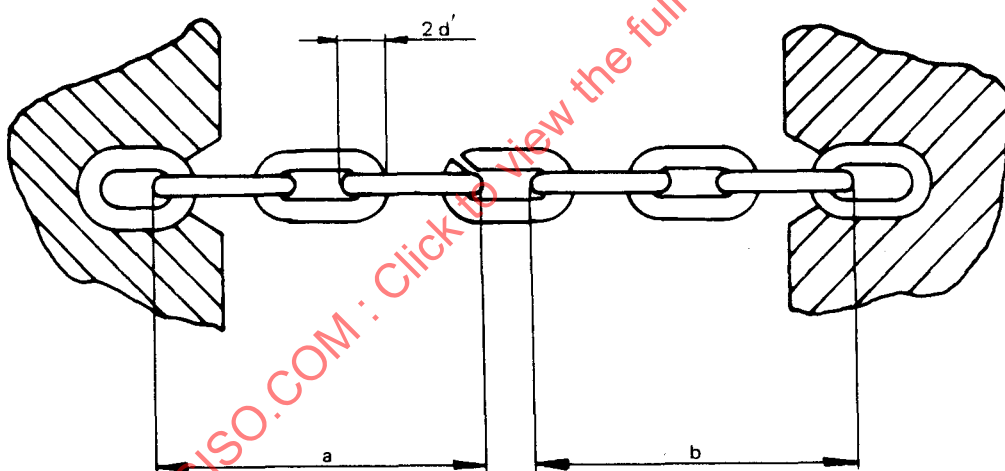


FIG. 2

Mean pitch p at one-tenth proof load is

$$\frac{L - 2d}{N}$$

Mean pitch p' of unbroken links after fracture is

$$\frac{(a - 2d') + (b - 2d')}{N - 1}$$

where $2d'$ is the mean of all the measurements made at the junctions between adjacent links, but not including junctions with the broken link and the fixing links.

- 4.3.3 *Elongation at fracture.* The permanent elongation at fracture shall be related to the basis of a 1 m gauge length and expressed in centimetres per metre or as a percentage. If calculated from the mean pitch of the unbroken links it is

$$\frac{p' - p}{p} \times 100$$

Autographic measurements shall be so interpreted that the elastic part of the extension and any further extension of the broken link after fracture cannot contribute to the value stated. The energy absorption factor is based solely on permanent elongation.

In cases of dispute, direct (non-autographic) measurement shall be made.

- 4.3.4 *Energy absorption factor.* The product obtained by multiplying the permanent elongation at fracture by the measured breaking load in kilonewtons is known as the energy absorption factor, expressed in kilojoules per metre of unstretched length. (See Annex B.)

4.4 Retests

Should any sample fail to fulfil the test requirements, two further samples may be selected at the request of the manufacturer from the same lot of chain for retesting. The lot complies only if both the additional tests are satisfactory.

5. INSPECTION

5.1 Provision for inspection

The inspector shall have access to the works of the manufacturer at all reasonable times for the purpose of witnessing the specified tests and inspecting the testing machine and method of examination. The manufacturer shall provide the inspector, at the time of inspection, with copies of the test sheets giving the results of all the tests made in his presence.

The manufacturer shall supply the samples required for testing free of charge, and at his own cost supply labour and appliances for such testing as may be carried out on his premises in accordance with this ISO Recommendation. In the absence of facilities (see clause 4.3.1) at his own works for making the specified tests, the manufacturer should bear the cost of carrying out such tests elsewhere.

The purchaser, if he so wishes, may delegate the chain manufacturer to inspect the chain for him.

5.2 Marking

- 5.2.1 *Identification marking.* Marks shall be legibly stamped or embossed upon all end links of the chain(s), or upon idle links or upon substantial metal tabs, tallies or links permanently attached to the end links, or at the same intervals as used for quality marking (see clause 3.5), giving
- the name of the manufacturer of the chain;
 - a reference mark to indicate the order to which the chain has been supplied.

- 5.2.2 *Inspection marking.* Provided that the foregoing tests are satisfactory, the inspector may stamp, with a distinguishing mark, all end links of the chain(s) from which the samples were taken, in a position not immediately coinciding with a weld.

5.3 Test certificate

The manufacturer shall supply a certificate of test and examination, in the appropriate statutory form, with every supply of chain. The certificate shall give the results of all the tests. A typical form is shown in Appendix W.

ANNEX A

REQUIREMENTS FOR CHAIN TESTING MACHINES

- A.1 The machine shall not be used for proof loading or for testing more than 30 m in one test.
- A.2 The stroke of the straining mechanism in relation to the length of chain tested shall suffice for the full load to be applied without the need for taking a fresh hold.
- A.3 The machine shall be calibrated in accordance with ISO Recommendation R 147, *Load calibration of testing machines for tensile testing of steel*, and shall comply with grade 1.0 conditions of accuracy, or the calibration and accuracy shall be in accordance with a relevant national standard.
- In no case shall the tolerance of the machine exceed $\pm 1.5 \%$ of the load applied.
- A.4 Machines shall be verified and adjusted as necessary by a competent independent person at intervals of not greater than one year.
- A.5 A signed certificate of the last examination shall be prominently displayed adjacent to the machine.
- A.6 Adequate facilities shall be provided, with suitable lighting, for the purpose of examining the chains after they have been proof loaded.
- A.7 The machine used for the static tensile test described in clause 4.3 may advantageously be provided with an autographic recorder enabling a load-extension diagram to be taken during the test. (See clause 4.3.2.)

ANNEX B

ENERGY ABSORPTION FACTOR

A lifting chain used under normal conditions must support by a safe margin not only the static working load but also certain limited dynamic overloads and minor shock loads which often result from the raising and lowering of the working load. It must be so designed that it is capable of resisting the stresses thus resulting from normal use with a minimum of deformation.

However, owing to abuse or accident, a lifting chain might become subjected to an extreme shock load. For safety reasons it is important, therefore, that it should be able just once to absorb large impact energies even though it will thereby suffer excessive stretch and hence be rendered unfit for further service.

This important property of the chain – always assuming freedom from gross defects – is related to the energy absorbed by the chain in the course of a static tensile test to destruction as measured by the area under the load-extension curve (see Fig. 3).

That value can be approximated by the product :

$$\text{breaking load} \times \text{elongation at fracture} (F_m \times A \text{ in Fig. 3})$$

which has been termed the “energy absorption factor”.

In assessing and comparing the properties of chains of different tensile levels, particularly as between one quality grade and another, the energy absorption factor is more important than elongation at fracture taken by itself. The latter, though, is still measured and recorded and is not allowed to fall below a stated figure.

The test requirements are intended to ensure that the chain possesses the greatest amount of shock absorption compatible with high resistance to deformation at normal safe stress levels.

NOTE. – In assessing energy absorption the elongation is the permanent elongation and does not include elastic extension.

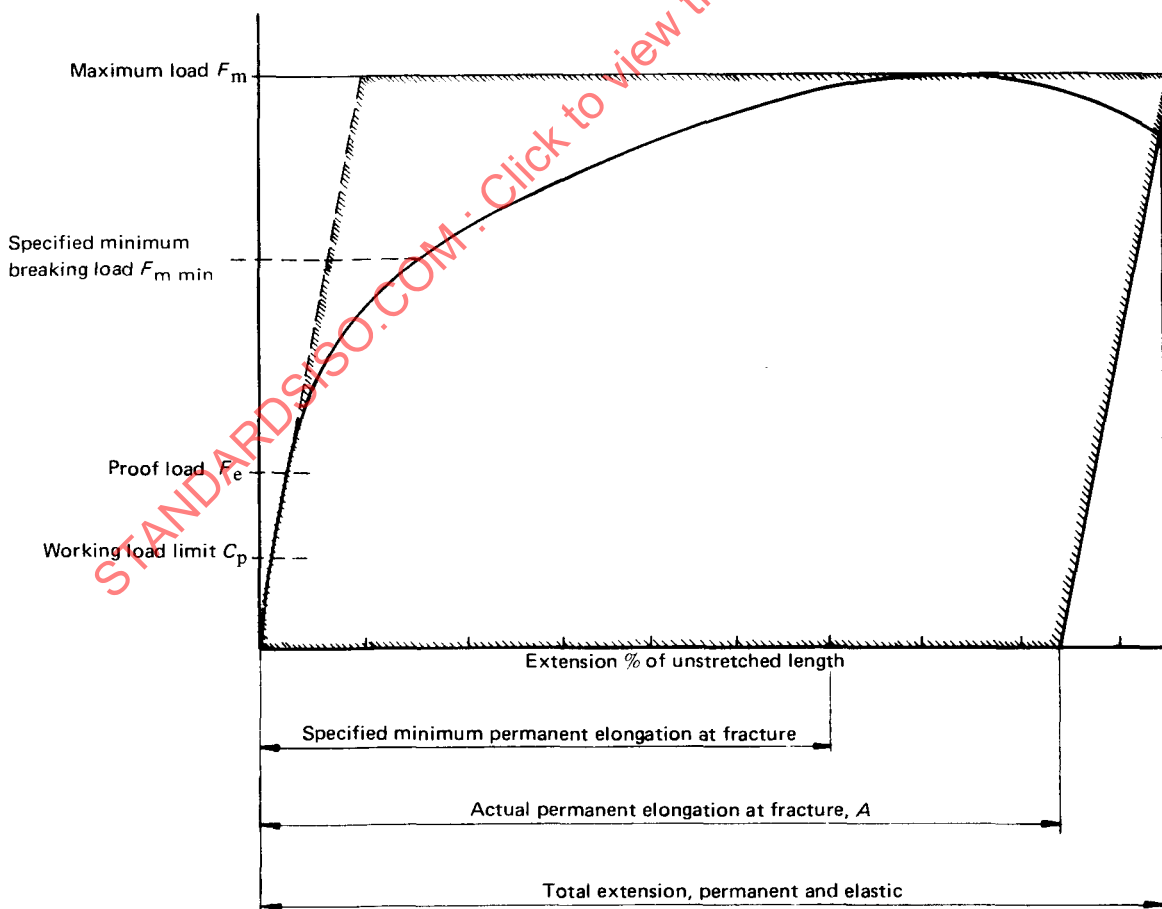


FIG. 3 – Load-extension curve

ANNEX C

QUALITY GRADING AND QUALITY GRADE IDENTIFICATION

Lifting chains are divided into quality grades, each to be covered by its own specification.

Each grade is known by a number such as 40, 75, etc.*

Each number signifies the mean stress (in hectobars) at the guaranteed minimum breaking load specified for the grade so indicated.*

For identifying the quality grade of a chain by means of stamping, embossing, tallying, etc., abbreviated code numbers are used where possible. For example,

④ denotes "Quality Grade 40".

The mean stress (for example 40 hbar for grade 40) is exceeded in many parts of a chain link because the stress distribution is far from homogeneous.

The tensile strength of the steel from which, for example, a grade 40 chain is made must, therefore, always be considerably higher than 40 hbar.

* An alternative system of grading has been considered by Technical Committee ISO/TC 111 and it has been agreed to adopt a letter based system. It is therefore possible that an amendment to this Annex may be proposed.

APPENDIX W

EXAMPLE OF CERTIFICATE OF TEST AND EXAMINATION

We hereby warrant that all the chain supplied as described hereunder conforms in all respects to National Standard and ISO Recommendation R for Steel Chain.

Quantity:

Description:

.....

Samples truly representing all the chain of which this consignment forms part were selected and tested in accordance with the specified requirements.

The actual results are tabulated below.

Identification	Nominal size of chain	Proof load	Breaking load of sample	Elongation at fracture	Energy absorption factor
	mm	kN	kN	cm/m	kJ/m

The chain was subjected in manufacture to the following heat treatment :

.....
.....

We hereby certify that the whole of the above chain has been subjected to the specified proof load and was subsequently examined by a competent person.

Signatures
and/or
stamps

{ Manufacturer
Manufacturer's inspector
and/or purchaser's inspector

APPENDIX X

SAFETY RECOMMENDATIONS FOR THE USE, CARE AND MAINTENANCE OF CHAINS

- X.1 Never overload a chain.
- X.2 Never use a chain in which the links are locked, stretched, or without free movement.
- X.3 Never hammer a chain to straighten a link or to force a link into position.
- X.4 Never use an excessively pitted, corroded or worn chain.
- X.5 Special precautions should be taken and a stronger chain or sling should be used
 - (a) when the exact load is in doubt;
 - (b) when there is liability to shock;
 - (c) when the conditions are abnormal or severe;
 - (d) when there is exceptional hazard to life and limb.
- X.6 The following precautions should always be strictly observed:
 - (a) do not cross, twist, kink or knot any chain, or shorten it with a pin;
 - (b) do not drag a chain from under a load;
 - (c) do not drop a chain from a height;
 - (d) do not roll loads over with a chain, or let running loads pass over chains lying on the ground;
 - (e) do not use a chain over sharp corners without protective padding;
 - (f) do not form a loop by inserting the point of a hook into a link.
- X.7 Special care should be taken to avoid snatch or sudden loads in cold weather.
- X.8 Chain life is increased by reasonable lubrication.
- X.9 Chains should be stored in dry and sheltered places.
- X.10 Careful periodic inspection reduces hazard and increases safety.
- X.11 Chains should always be repaired by a fully qualified repairer capable of providing the necessary heat treatment, proof loading and inspection.

APPENDIX Y

INSTRUMENTS FOR MEASURING THE TRUE MEAN DIAMETER OF CHAIN LINKS

In forming a chain link from round bar, the section of the bar may become slightly flattened where it is pressed in contact with the mandrel. However, the material from the flattened region is displaced mainly tangentially across the section and neither the area of the section nor the section modulus is appreciably altered. By measurement of links deformed in this manner it has been shown that the true mean diameter corresponding to the area of the section may be determined by a single measurement using calipers or a micrometer having one flat measuring face, the other being a narrow blade shaped in a V-groove of 135° angle.

A form of caliper gauge suitable for use in the field is illustrated in Figure 4. This type of gauge can be adapted for use on several chain sizes by provision of a series of interchangeable flat anvils.

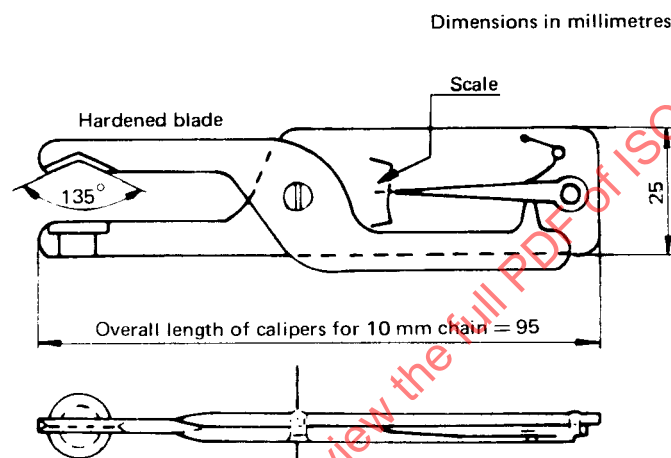


FIG. 4 — Caliper gauge

For more accurate measurements an ordinary micrometer may be adapted by replacing its fixed flat anvil by a narrow blade shaped in a V-groove of 135° angle; but in order to afford this blade access to the inside of the link the outer end of the micrometer bow may need to be reduced in thickness as shown in Figure 5.

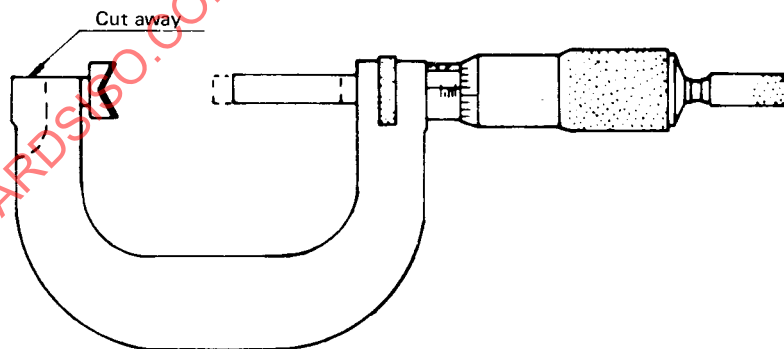


FIG. 5 — Micrometer gauge

With either form of instrument the blade is fitted to the inside of the link and the flat face is brought into contact with the outside. Variation of the direction of measurement over the range $\pm 20^\circ$ from the plane of the link makes no appreciable difference.

There is no risk of either type of instrument being used the wrong way round because it is not possible to insert the flat face inside the link.

Either type of instrument needs to be calibrated by use of round bars of known diameters covering the range of nominal diameter of chain plus 10% to minus 10%.